

# **The Construction of Liveness in Rock Recordings**

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## **Table of Contents**

|    |                                                              |    |
|----|--------------------------------------------------------------|----|
| 1. | Introduction                                                 | 1  |
| 2. | What is Live?                                                | 12 |
| 3. | The Virtual Performance Space                                | 22 |
| 4. | Performance Live and In-Studio                               | 34 |
| 5. | Constructing Liveness in Asynchronously Performed Recordings | 44 |
| 6. | Conclusion                                                   | 59 |
|    | References                                                   | 66 |
|    | Appendices                                                   | 71 |

## Summary

*The Construction of Liveness in Rock Recording* explores the concept of liveness from the perspective of record production. What does it mean for a recording to ‘sound live,’ and how can artists and producers use the technologies and techniques of record production to create this sense of liveness? The thesis uses critical analysis of academic literature, industry sources, and recordings alongside experimentation with record production to deepen understanding of liveness in rock recordings at a conceptual level and in practice.

Building on existing scholarly discussion, the thesis considers liveness as a potential property of recordings which manifests as an affective experience for listeners. The thesis proposes a taxonomy of common recording and performance situations in rock, considering them in terms of co-presence and co-temporality between performers and audience, as well as degrees and types of mediation. In some cases, such as recordings of concert performances, a sense of liveness may be present by default. Significant production qualities which are present in live recordings but absent from typical non-live studio recordings are identified in the thesis. It is hypothesised that these qualities are important drivers in imbuing recordings with the property of liveness.

The thesis argues that there is a genre-specific link between liveness and authenticity in rock music, and that authenticity is highly valued by rock fans. Therefore, in the context of rock, there is value in exploring music production practices which can create or enhance a sense of liveness in recordings which do not feature this property as a matter of course. Practical experimentation with production techniques both facilitated the discovery of insights not available from the analysis of finished recordings and tested interventions intended to increase the sense of liveness of non-live recordings.

## Statement of Originality

*This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.*

Signed:

Date: 7/11/2020

(Dylan Cassidy Wheeler)

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I acknowledge the Wangal clan of the Eora nation and the Wattamattagal clan of the Darug nation, the Traditional Custodians of the lands on which this project was carried out. I pay my respects to Elders past, present, and future. These lands were stolen, and sovereignty was never ceded.

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# 1. Introduction

## 1.1. Aims

This thesis explores record production characteristics which contribute to a ‘live sound’<sup>1</sup> in the context of rock music. It aims to address two main research questions:

1. What are the production characteristics of rock recordings which cause them to ‘sound live’?
2. How might these characteristics be achieved in recordings which are not recorded live?

The first aim is to more precisely understand the statement that a recording ‘sounds live’. Producers, musicians, and fans sometimes describe recordings in this way, but it is not obvious specifically what it is about certain recordings that creates this impression. This thesis attempts to address this ambiguity in discourse by asking what the specific sonic characteristics that result in a recording creating an affective experience of ‘liveness’ for the listener are.

Second, the thesis explores production practices that might be used to create this sense of liveness in recordings which were not recorded live. The focus is especially on techniques that can be used in cases where recordings are assembled from asynchronous performances, as opposed to situations where several performers are recorded playing together at the same time. The reason for this focus on asynchronously performed recordings is that this seems to be the furthest extreme away from live performance. As such, we would not expect these recordings to feature many characteristics which contribute to signalling liveness as a matter of course. This brings post-production practices to the foreground. As will be discussed shortly, there are several common recording situations (including home recording) in which characteristics of live recording are not inherently present but may be desirable.

In addressing these questions, the thesis aims to contribute to knowledge in three ways. First, to the understanding of record production technologies and practices and how these are used to create specific affective experiences for listeners. Second, by providing a

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<sup>1</sup> The term ‘live’ is conceptually dense in the context of scholarly writing and by extension this thesis. Terms like ‘live sound’ and ‘live recording’ are therefore also problematised. The first chapter of this thesis is dedicated to reviewing existing academic discussion related to liveness and explicating the conceptual model for liveness deployed herein.

fresh perspective on scholarly discussions surrounding the concept of liveness and applying these discourses to the area of record production. And third, practically, by suggesting approaches to record production that might be deployed by practitioners attempting to create live sounding recordings.

## **1.2. Methods**

The central questions of the thesis are addressed through critical analysis of academic, industry, and fan sources, critical analysis of recordings, and practical experimentation. This approach is informed primarily by Simon Zagorski-Thomas' discussion of methodology in *The Musicology of Record Production* (2014, 32-45). As he points out, the study of record production is an interdisciplinary area with no single methodological approach. Depending on the specific project, methodology could be informed by musicology, cultural studies, anthropology, sociology and/or psychology. The approach taken by this thesis is primarily rooted in musicology.

Analysis of written sources serves several functions. Existing scholarly work on record production is used to establish the basic methodological and theoretical approach of the research project, and in some cases offers insight which is directly relevant to the primary research questions. Discussions on the concept of 'liveness' (largely situated in the discipline of performance studies) also assist in building the project's background. Examination of sources from the record industry, such as interviews with producers or musicians, provide further insights into record production practices which are not available in the academic literature.

Analysis of recordings is used to identify and generalise differences between live and non-live recordings. Because the thesis is directly concerned with the properties of recordings, their analysis is a natural part of the project's methodology. This analysis is qualitative in nature and reflects the observations of an expert listener who is experienced in record production.

Practical experimentation with recording assisted in investigating the research questions. Having identified differences between live and non-live recordings, test recordings were made to explore methods for creating a live sound in non-live recordings. These practical experiments significantly contributed to the process of investigation, yielding insights not available when analysing finished recordings from third parties. Furthermore, this experimentation is potentially valuable to practitioners, as it demonstrates the effects of novel production techniques which could be reproduced by

others.

### 1.3. Scope

The project's scope is limited by the time and length restrictions inherent to a master's thesis. A notable but necessary methodological omission is a study into the perceptions of non-expert listeners. The thesis hypothesises about the ways certain production qualities are likely to be perceived by general audiences without surveying such an audience directly. The thesis instead provides insights from an expert production viewpoint. These could later become the subject of a study of the perceptions from non-expert listeners. It was necessary to complete this production-side conceptual work before such a study could be designed, as no solid framework for considering liveness in the context of record production was yet available. Exploring the research questions from the production side *and* conducting blind listening experiments with sample audiences was not considered feasible given the project's timeline.

The thesis focuses on two specific areas of production: staging<sup>2</sup> and performance. These areas were identified as likely to be important in fostering liveness in recordings after an initial review of both literature and recordings. Other aspects of record production which seem to be important are mentioned opportunistically throughout the thesis, but in order to achieve the desired level of depth it was necessary to limit the scope of the thesis to a few primary areas of investigation.

The thesis is focused on rock recordings, excluding other genre spaces. Given the project's timeline and the considerable differences in production practices between genres, limiting investigation to a single genre was necessary. As will become clear throughout Section 1.6 and Chapter 2, the issue of liveness is of particular importance in the context of rock. Defining 'rock' is not entirely straightforward. Simon Frith's entry on rock in *Encyclopædia Britannica* features a discussion of the difficulty of defining the term immediately after its introduction, and suggests that short definitions are either too vague to be useful or have too many counterexamples (Frith 2019). This thesis deploys the term in a broad sense, incorporating a large number of rock's subgenres and descendent styles. Rather than attempting to give a concrete definition of rock, where examples of specific artists, albums, songs, performances, etc. are used, an effort has been made to make

selections that would be generally uncontroversial under this broad use of the term.

Although rock emerged as a style in the 1950s, this thesis is specifically concerned with recordings from the mid-late-1970s onwards, excluding earlier recordings. By the end of the 70s, rock recordings had adopted various normative production practices which continue in some form to the present day.<sup>3</sup> The thesis relies on identifying general differences between live and non-live recordings. This requires the existence of these norms in the production of rock recordings. Considering earlier recordings would make it difficult to draw comparisons or conclusions that are relevant to contemporary recording practice.

The test recordings created as part of the investigation into the research questions were limited to what is possible with a fairly typical home recording setup, and what can be executed by a single person. This limitation was partially to allow easy access to all required resources. The focus on the possibilities of solo home recording does serve the project in other ways, however. It is the recording context which is perhaps the furthest away from what would generally be considered live. Minimisation of the presence of 'liveness by default' should make it easier to isolate and discuss the impacts of the particular production practices being considered. Furthermore, as will be discussed in Section 1.6, home recording is a context in which production interventions designed to increase liveness may be particularly valuable. Although practical experimentation was limited to solo home recording, the thesis also considers the possibilities of large studio recording practice at some points.

## **1.4. Thesis Structure**

Following this introduction, the thesis begins with a discussion of the concept of liveness, examining existing scholarly discussion on the concept. Liveness is clarified as a potential characteristic of recordings which may be present to a lesser or greater extent, manifesting as an affective experience for listeners.

The next two chapters are each concerned with one of the facets of recordings which seem to be important in creating this quality of liveness – staging/spatial aspects, and performance aspects.

The final chapter builds on these discussions, suggesting strategies for creating a

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3      The particulars of these normative practices will be discussed in more detail later in the thesis, as they become relevant.

live sound in non-live recordings and discusses the test recordings included as appendices to the thesis.

The conclusion sums up the findings of the project and suggests directions for future research.

## **1.5. Academic Context**

The primary academic context for this thesis is the musicological sub-discipline referred to by Zagorski-Thomas as the musicology of record production. The thesis is principally concerned with practical and technical aspects of record production, such as the affective results of specific production choices, how the production of live recordings differs from studio recordings, and how we might adapt studio practices to achieve a sound that is more live. Academic literature addressing music production techniques and processes directly is currently limited, the body of work is expanding. The recent emergence of more scholarly work of this nature has served as the catalyst for scholars like Zagorski-Thomas seeking to establish the musicology of record production as a distinct field.

*The Art of Record Production...* (Zagorski-Thomas and Frith 2012) and *The Musicology of Record Production* (Zagorski-Thomas 2014) both serve as introductory texts in this emerging field. *The Art of Record Production* (Zagorski-Thomas and Frith 2012) is a collection of essays sorted into three categories; historical studies, which examine the way recording has changed over time, theoretical studies, which are concerned mainly with theoretical understandings of recordings and recording practices, and case studies, which examine in detail particular recordings or recording artists. *The Musicology of Record Production* (Zagorski-Thomas 2014) takes a different approach to introducing the field, attempting more directly to explicate the theoretical and methodological approaches which underpin the discipline as a whole. Both texts have heavily informed the approach taken by this research project.

More specifically, we are interested in scholarly literature on record production which addresses how the production process operates as a mediating force and the affective results of various recording techniques, especially with regards to perceptions of liveness or authenticity.

There have been a range of efforts to examine the affective results of recording practices in various musical contexts. Crooks (2012) examines how recording techniques alter the sound of jazz rhythm sections. Crigny et al. (2013) investigate how differences in

drum tuning affect the reaction of performers and producers in both live settings and in recording. Austin Moore (2012) discusses why a specific compressor is widely used in music production and attempts to define the sonic signature of that particular piece of equipment. Whilst these studies look at the affective results of recording practices, no work has yet been done in the musicology of record production to directly explore the question of 'live sound' or 'liveness' in the specific context of rock recording.

Scholarly works focused on genres outside of rock bear some mention. Gould (1966) discusses the apparently adversarial relationship between live and recorded performance at the level of cultural economy later identified by Auslander (2008). Gould (1966) also discusses the potential for the editing of performance to go far beyond correcting errors, and into the realm of creating perfected or idealised version of performances beyond what can be achieved in a concert setting, a topic that will be discussed in detail in Chapter 4. Similarly, Crooks (2012) parallels this thesis in some respects by examining in detail the effects of the recording process on jazz performance and timbre. In particular his discussion of 'participatory discrepancies' could be related to the discussion of the importance of real-time intra-ensemble communication in Chapter 4.

However, the utility of works which are firmly situated in non-rock genre spaces is somewhat limited. This thesis argues that perceptions of liveness are deeply entangled with audience's expectations regarding authenticity, and with the specific ways recordings labelled as live differ from typical studio recording practices. These expectations and practices can vary significantly between genre spaces. For example, Gould's (1966) work discusses the idea of assembling perfected performances in a way which is similar to discussion in this thesis, but what it means for a performance to be 'perfect' is not necessarily the same in a rock context as it is in a classical one, nor are audience's evaluations regarding to what extent such a performance can be considered 'authentic'.

This is not to say that there is no existing scholarly work on record production that bears relevance to the thesis. Zagorski-Thomas (2010) has written about how record production choices related to staging can affect the perceived authenticity of recordings. This work connects to the thesis as a result of a conceptual link between liveness and authenticity in rock music, the nature of which is explicated in Chapter 2. Gwilliam (2009) surveyed differences in audience reaction to quantized and non-quantized versions of the same recording. This work was of considerable value in understanding how audiences perceive subtle differences in performances such as those that exist between live and non-

live recordings. And a model for conceptualising spatial properties of recordings developed by William Moylan (2012) is discussed in detail in Chapter 3. Still, none of these sources are specifically concerned with the concept of liveness or live sound. Because the body of writing which can be directly related to the thesis is currently thin, this research project has been designed as an initial exploration into the topic area.

Outside of this primary disciplinary context, the thesis also engages with scholarly work from a number of other fields, most notably texts concerning the concepts of liveness, rock authenticity, and mediation. This subject area is explored in detail in Chapter 2. Chapter 4, which discusses performance, references a number of studies from psychology and the cognitive sciences which investigated musical performance/performers. These sources will be discussed in detail as they become relevant.

## **1.6. Cultural Context**

One way of conceptualising recordings is as representations of performances. Zagorski-Thomas describes this position as follows:

[R]ecorded music is as different from live performance as photography, film and even painting are from the objects they seek to represent . . . what is produced is a schematic representation of some real or constructed performance. The representation may be relatively realistic, like a photograph or an unedited section of a film, but the 'two-dimensional' nature of recorded music will ensure that we can tell the difference between the representation and the 'real thing'. Of course, the representation need not be realistic, like an edited film where close-ups tell us where to focus our attention. We may, for example, mix a whispering voice to be louder than a drum kit in a recorded song. (Zagorski-Thomas 2014, 6-7)

Recording technology and typical studio practice have both changed dramatically in recent decades. Many of the effects of these changes might be understood as facilitating representations that resemble perfect or idealised performances. Parts are assembled from many different takes, sometimes at the level of individual notes, to ensure that the best performance possible is presented at each moment. Remaining timing and rhythmic discrepancies can be corrected in software. The number of different tracks or layers in a recording is effectively unlimited, allowing a sonic density that few rock ensembles could achieve live without the use of pre-recorded materials. The careful use of equalisation, compression, and automation can ensure that every part can be heard with clarity, with the listening ear carefully guided towards focusing on the elements of a mix that are most important at any given moment. Having the possibility of achieving this level of perfection

is desirable, and in many contexts (especially but not exclusively in pop music) helps to achieve the goals of artists and meet audience expectations of how recordings should sound.

In rock it is less clear that constructing such idealised representations of performances is desirable. As will be discussed in detail in the following chapter, fans of rock often place a high value on authenticity, and there exists a somewhat adversarial relationship between authenticity and the high degree of mediation present in such recordings. Some types of mediation, such as pitch correction (commonly known as auto-tune),<sup>4</sup> may compromise the authenticity of a recording in the eyes of fans. Authenticity might also be compromised by overuse of mediating production techniques which are generally acceptable, resulting in recordings which fans or critics regard as ‘over-produced’.

This context-specific value in creating a live sound is demonstrated by critical reviews which discuss albums sounding live with positive connotations. A review of the album *War Music* (Refused 2019) refers to achieving “an album that bristles with live energy” (Travers 2019). Another reviewer wrote that Clutch’s *Book of Bad Decisions* (2018) was “the band’s most live-sounding album to date. Rarely has their stage rawness and charisma been so appropriately captured in the studio,” (Altaf 2018). Reviewer Dan Caffery wrote that dance punk band The Rapture “has managed to stand out from their peers with a sound that relies on ramshackle idiosyncrasies and live-sounding instrumentation” (2011). These are just a few examples; large numbers of reviews discussing liveness in similar ways exist. Such reviews demonstrate both that listeners are able to identify liveness as a property of some recordings and not others, and that this property is often valued.

This valuation is not limited exclusively to fans. Producers and artists sometimes discuss the desire for capturing a sense of liveness in recordings or suggest a preference for recording practices which might themselves be understood as live in some way. For example, in a 2012 interview, studio designer Wes Lachot and producer Dave Trumfio

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4 Auto-Tune was a specific piece of software for pitch correction first released in 1997. In current studio practice, a variety of plugins are available to perform pitch correction, the most popular probably being Celemony’s Melodyne. However, the term auto-tune has stuck in popular discourse as a generic term for pitch correction software. The terms are used interchangeably in this thesis.

describe sound bleed<sup>5</sup> as a positive factor in recordings specifically because it contributes to a live sound (Brown 2012, 25). Erlend Hjelvik, frontman of metal band Kvelertak said of the band's 2016 album *Nattesferd*:

Before, we recorded with Kurt Ballou in the States, and we'd just do one instrument at a time. This time, we wanted to use all the live experience we've got from all the years of touring, so the whole band is playing together, live in the same room, and it sounds more dynamic and more organic. (Hjelvik and Landa 2016)

This quote shows both a preference for live recording as a practice and a belief that it has positive production outcomes. In some cases, producers may also seek to minimise the overall amount of mediation present in recordings not just because they believe it improves the final result, but also for reasons that are essentially ideological (a desire for 'realness'). Steve Albini is a well-known example of an engineer whose approach focuses on capturing the natural sound of a band, keeping interference or mediation from post-production practices to a minimum.<sup>6</sup>

The importance of authenticity is seen to varying extents across all sub-genres of rock but can perhaps be seen most clearly in discourses surrounding punk and DIY (Do It Yourself) recording. In punk, DIY recording and more broadly a "DIY ethic" are associated with the authenticity of the music. Rather than technical quality, what is most valued in a recording is that it captures the energy and emotion of the performers in as unmediated a form as possible. As such, punk has been linked to home recording or the use of small, independent studios from its inception, and remains so in the present day (Cuffman 2015; Dunn 2012). Until relatively recently, due the limitations of recording equipment that was accessible on a low budget this DIY approach resulted in recordings that were principally produced by recording an entire band playing together with minimal editing.

The solo recording artist working with these genres finds themselves in a somewhat difficult position. Although undeniably their practice is DIY, modern digital recording technology makes it (perhaps counter-intuitively) easier than not to produce a recording

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5 When multiple performers are recorded at the same time in the same space, the sound produced by one musician 'bleeds' into the microphone(s) set up to record other performers. For example, if a singer and an acoustic guitarist record their parts in the same space at the same time, the singer's microphone will pick up some of the sound of the acoustic guitar, and the microphone(s) recording the guitar will pick up some of the sound of the singer's voice. This phenomenon is also referred to as sound or microphone 'spill' throughout the thesis.

6 For a more detailed discussion both of the changes to recording practice that resulted from the adoption of digital recording technologies and of Albini's attitude towards recording, see Bennett (2009)

that lacks the kinds of technical imperfections or qualities that make a recording sound live or (in the sense described above) unmediated/authentic. Recording instruments asynchronously eliminates sound bleed. Working with a virtual drummer reduces or eliminates rhythmic discrepancies in performances. Recording a dozen takes and assembling a near-perfect performance by splicing them together is fast and easy. In many musical contexts, this is desirable. In punk and other genres that fit broadly under the label of “alternative music,” recordings may suffer because, as outlined above, to some extent these imperfections contribute positively to the texture and aesthetic associated with these genres. Importantly, these innovations or improvements are now available in the home studio as well as in professional environments. Cheap home recording is no longer a 4-track tape recorder, but rather a digital audio interface and workstation – albeit in a smaller space and with less mic inputs and outboard gear than you would see in a professional studio. This tension in the particular context of home rock recording further justifies limiting the scope of practical experimentation during this project to what is possible in a home recording setting.

Home recording is not the only context in which it may be desirable to attempt to imbue recordings that were principally recorded asynchronously with more of a live sound. Capturing well-isolated performances during recording benefits productions in many ways. Even in a large studio space where it is possible to record an entire band playing together at the same time, this may not be desirable. In this context, knowledge of post-production techniques which can create a greater sense of liveness in recordings allows producers to take advantage of the positive aspects of high isolation recording strategies without losing the possibility of creating a live aesthetic if one is desired.

## **1.7. Significance**

This thesis aims to contribute to knowledge in three primary ways. As discussed in Section 1.5, the topic of ‘live sound’ or liveness in recordings has hitherto not been explored directly from the perspective of the musicology of record production. This thesis aims to address this gap in knowledge, contributing to an improved understanding of record production. Second, this thesis engages with existing discourses surrounding liveness, authenticity, and mediation from a novel perspective, expanding understanding in this area as it relates to record production. Thirdly, as discussed in Section 1.6, there is context-specific value in using record production practices to achieve aspects of a live sound in recordings which do not feature these characteristics as a matter of course. This thesis will suggest and

experiment with production techniques that may achieve this aim, providing value to practitioners.

## 2. What is Live?

### 2.1. Liveness, Authenticity, and Mediation

In order to identify specific properties of recordings which contribute to a live sound, we must define 'live'. This is not as simple as it might seem. The most widely cited source on this topic is *Liveness: Performance in a Mediatized Culture* (Auslander 2008). In it, Auslander writes that the "default definition of live performance is that it is the kind of performance in which the performers and audience are both physically and temporally co-present to one another," (ibid, 60). This definition is overly restrictive. As Auslander points out, the comfort with which we use terms such as 'live broadcast' and 'live recording' to refer to situations where the audience is not necessarily co-present in either of these ways shows that the meaning of the term has expanded considerably beyond this definition. This is not to say that co-presence is entirely irrelevant, but it is clear that it is not the sole determining factor in whether or not a performance or recording is considered to be live.

Auslander wrote in a later paper that one of the core premises of his model for liveness is that "[it] is not an ontologically defined condition but a historically variable effect of mediatization," (Auslander 2012, 3). The term mediatization here bears some discussion, both to clarify Auslander's position and because the terms 'mediatization' and 'mediation' are important throughout this thesis. Auslander writes:

Several important premises are implied by my use of the word "mediatized," which I have borrowed from Jean Baudrillard. I often employ this word, admittedly somewhat loosely, to indicate that a particular cultural object is a product of mass media or of media technology. "Mediatized performance" is performance that is circulated on television, as audio or video recordings, and in other forms based in technologies of reproduction. (Auslander 2008, 4)

He later explains that to some extent, all contemporary performance must be understood as mediatized, at the very least through the use of electrical amplification, which he interprets as a technology of reproduction. Auslander positions 'mediatized' and 'live' performances as oppositional or competing at the level of cultural economy, and yet also in state where the boundary between them has been eroded in many important ways. This erosion of boundaries manifests, perhaps most relevantly, through the way mass media representations of performances have come to influence live performances. For example, in many cases rock bands attempt to create a concert sound that is as close to the sound of

their albums as possible.<sup>7</sup> We can understand this fact as an effect of mediatization as it is understood more broadly in scholarly discourses.<sup>8</sup>

This thesis is less concerned with the concept of mediatization than the broader idea of mediation. Mediation, like mediatization, is a complex concept as it relates to music.<sup>9</sup> This thesis is concerned specifically with the forms of mediation that occur between persons involved in the creation of recordings (for example, the influence of a producer on an artist during recording), the technologies (both hard and soft) that they deploy, and the impact of other assemblages (social, cultural, economic, and others) on the process itself. Put more simply, this thesis is concerned with the specifics of how recordings are made, understands the record production process as a process of mediation, and therefore thinks of the technologies and practices involved as specific forms of mediation. All recordings are mediated, but they can be mediated in different ways and to different extents depending on how and to what degree various mediating forces shape the recording process.

Returning to Auslander's description of liveness as "not an ontologically defined condition but a historically variable effect of mediatization," (Auslander 2012, 3), what this means is that liveness cannot be defined in static terms. What is considered live or not changes over time as the general media landscape and the forms of mediatization present in society change. Auslander supports this view largely through a historical analysis of discourses surrounding what is and is not "live," showing that usage of the term has considerably changed over time. Often, these changes have been caused by changes in the available technologies for producing or circulating mediatized performances (including music recordings) or changes in attitudes towards these technologies. Both the social pressure exerted on the construction of performances and the technologies used in their creation are forms of mediation. As such, we can understand that whether or not something is considered to be "live" is (at least in part) determined by the specific degrees or types of mediation used in its construction, and how audiences perceive those types of mediation as

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7 The relationship between studio performance and concert performance is an increasingly complicated exchange of practices, with a confluence in practice seemingly emerging as more of what is possible in the studio becomes possible on stage. Knowles and Hewitt (2012) discuss this changing relationship in more detail and suggest an initial taxonomy for studio techniques which are now used in concert performance.

8 See Michelsen and Krogh (2017, 522-523) for a recent discussion of how the term mediatization is defined and used by various scholars. In general, it refers to the way the media, as an institution, shapes other areas of society.

9 See Born (2005) for a more extensive discussion on mediation in music.

“live” or “non-live”.

Auslander devotes a considerable portion of his book to the discussion of how the concept of liveness has evolved in the discourses of rock critics and fans. He asserts that the primary object in rock is the recording, not the live performance. This position draws upon the work of Gracyk (1996), who argues that the role of visual artefacts in rock music (especially live performance) is to establish the authenticity of the music for fans (Auslander 2008, 74-97).

Moore (2002) provides a useful overview of some of the discourse surrounding the term authenticity, and how the term is applied to music both within and outside scholarly writing. He writes that in rock music, authenticity and honesty as validating criteria of musical value are reinterpreted as ‘unmediated expression’. That is to say, listeners are able to establish recordings as authentic (and therefore valuable) by verifying that they represent the genuine artistic expression or intention of their creators, rather than an expression which has been heavily mediated by outside technological or social forces. Among the ways in which recording artists demonstrate that their expression is unmediated, Moore mentions the “practice of recording ‘live’ in the studio, i.e. with an absolute minimum of overdubs, multi-tracking and other devices which ‘cheat’ the listening ear,” (ibid, 212).

Considering Moore and Auslander’s positions together, we can establish a conceptual link between liveness and authenticity in the context of rock music. I propose that whether or not a performance (be it constructed as a concert performance or as a studio recording) is judged to possess the qualities of liveness or authenticity both depend on the degree and types of mediation present. This is not to say that there is a functional equivalence between the concepts of liveness and authenticity. Forms of mediation which render a recording ‘not live’ do not necessarily also render it ‘inauthentic’. It seems very likely however that forms of mediation which are heard as ‘live’ and those which are heard as ‘authentic’ have some overlap. The terms ‘authentic’ and ‘live’ are therefore linked by their shared relationship with degrees and types of mediation. This link between authenticity and liveness is part of what makes the investigation conducted in this thesis valuable. As discussed in the introduction, authenticity is extremely important to rock fans, especially in the cultures surrounding less mainstream sub-genres such as punk. Creating a live sound in a recording may help to signal that a recording is authentic, or to better meet

the aesthetic expectations of fans in those genre spaces.

With this background in mind, in what ways can we say that live recordings manifest a sense of liveness? Auslander has discussed live recordings, but this discussion has some limits. He writes:

The liveness of the experience of listening to or watching the recording is primarily affective: live recordings allow the listener a sense of participating in a specific performance and a vicarious relationship to the audience for that performance not accessible through studio productions. (Auslander 2008, 60)

Whilst this may be the case, Auslander does not attempt to unpack what it is about these recordings that creates the sense of participation in a specific performance for the listener. I contend that it is not sufficient that recordings are labelled as 'live' or that audience sound can be heard in live recordings. The presence of crowd sound in a recording would be an obvious signal that a recording was made at a concert (notwithstanding the possibility of this sound having been added later in the production process).<sup>10</sup> In this case, it is easy to see how a listener might feel a vicarious relationship with that audience.

The potential significance of crowd noise in signalling liveness is discussed by Reed (2005). Reed examines the ways in which the sound of the audience is consciously used by producers as a textual element signalling liveness or even 'realness' to listeners. Ironically given these aims, the deliberate and mediated use of crowd noise in production serves, on closer inspection, to highlight the constructed nature of recordings.

Reed's assertion that the presence of crowd noise is a "textual universal ... in effectively all recordings whose paratext declare them to be 'live,'" (ibid.) is somewhat inaccurate. The term live is also widely applied to recordings made for radio broadcast or online streaming, or simply those which have been recorded 'live in studio'. In these situations, there is no audience present at the time of recording, no audience sound present

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<sup>10</sup> An example of this can be heard on *The White Room* (The KLF 1991). The original UK release of this electronic album heavily features samples of crowd noise. Combined with ample use of a large, slap-back style reverb and the first five tracks on the album segueing smoothly which each other, this creates the impression of a stadium concert. However, the intention here is not to trick the listener – the tracks are not labelled as live, except for the third track, "3 A.M. Eternal (Live At The S.S.L.)". S.S.L. here is not a reference to a concert venue, but to the Solid State Logic mixing desk used in recording. If anything, the effect of creating the illusion of a stadium serves to reinforce the idea that recordings are manufactured artefacts, carefully constructed to provide certain experiences for the listener.

in recordings, and no audience co-present to the performers with which a person listening to the recording might feel a vicarious relationship. What such recordings do offer, however, is the sense of participation in a *specific* full band performance, rather than a performance assembled from various overdubs.<sup>11</sup> Identifying properties of recordings that contribute to creating this affective experience of participating in a specific performance, especially when no visual cues or extramusical cues such as crowd noise are present, is one of the aims of this thesis.

Other texts on liveness in the context of music have, like Auslander, focused more on performance to a co-present audience, and not on recordings. Instead, discussion focuses on the ways concert performance has changed over the years in response to technological development and on the changing role of live performance in music and fan cultures. Examples include Bown, Bell, and Parkinson (2014), who discuss audience perceptions of liveness in concert performances of electronic music. Croft (2007), is similarly interested in performativity and electronic music with a particular focus on the relationship between performer, instrument, and sound in the context of electronic live performances. Morris (2008) writes about a creative project which incorporated recording, concerned with the relationship between live performance and recording. Interestingly, he writes that “[l]iveness itself can be used and manipulated as a distinct musical element,” (ibid, 59) which hints at the way this thesis considers liveness as a potential property of recordings that can be intentionally emphasised if desired. That said, Morris’ work is still primarily concerned with venue-based performance. Considering liveness as it manifests or is communicated through recordings has not hitherto been the focus of investigation.

Before attempting to explicate some of the specific properties of recordings which communicate liveness to listeners, it is necessary to discuss how recordings are constructed in various recording situations.

## **2.2. The Construction of Recordings**

Nearly all performances are mediated to some extent, but recordings especially must be thought of as being *constructed*. Even a recording that produced by capturing a concert performance is constructed and mediated in various ways, for example by the choice of

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<sup>11</sup> ‘Overdubbing’ is a ubiquitous studio recording practice where additional audio material recorded at a later time replaces or is played alongside audio from a performance recorded earlier.

microphones used to capture and amplify the sound of the band. Most recordings we hear are far more constructed than this. Even concert recordings often receive corrections or overdubs if they are to be commercially released.<sup>12</sup>

In contemporary studio practice, a recording for a rock album might begin by capturing the band or part of the band playing together at the same time, but a large amount of additional material is generally layered on top. Performances from the original full or partial band capture will likely be replaced with better takes, either in whole or, more commonly, in a piecemeal manner – if a bassist makes an error in one section of an otherwise good performance, often they will simply re-record a few bars of material around the error and splice this with the existing performance, for example. It is also common for no group performances to be recorded at all, rather recording each part individually from the outset. This is especially common in home-recording or small studios, where limitations on space, number of microphones, or number of simultaneous inputs may make it impractical to record a full band performance at a high quality. Typical studio recordings are perhaps best thought of as collages of performances. Fragments of audio are stuck together and layered to create the final impression of a cohesive band performance. This differs significantly from concert performances, which may incorporate pre-recorded materials, but are principally performed cohesively in the moment.<sup>13</sup>

Another dimension along which concert performances and studio performance differ is in the types of mediation available. Concert performances will typically be subject to audio processing such as equalisation and compression, as well as the use of additional effects such as reverb. However, they are strictly limited to processing and effects than can be achieved in real-time. Studio recordings, on the other hand, (as well as the recorded versions of concert performances) have access to additional post-processing techniques such as quantization of audio.<sup>14</sup> As technology has advanced, the palette of effects that are

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12 For example, in a 2011 interview Peter Frampton stated that “I’m not going to go into the studio and overdub. If you want to say that, say that about ‘Kiss Alive,’ because they borrowed my guitars and my amps to do those overdubs.” In the same interview, Frampton later states that the album *Frampton Comes Alive!* (Peter Frampton 1976) does indeed contain a small number of overdubs which were necessary due to technical problems with the recordings (Frampton 2011).

13 At least, it is the expectation of a rock audience that this is the case. Musicians miming a performance to pre-recorded materials is an accepted practice in many performance contexts. A rock audience attending a concert, however, would not generally accept such an approach as authentic or live.

14 A process by which performances are aligned perfectly to a tempo grid. For example, human drummers will generally have small variations in timing when playing, rather than always hitting perfectly ‘on beat’. Quantization removes these variations by shifting audio material to line up perfectly with a defined tempo map.

available in real-time has considerably increased. Pitch correction (auto-tune) for example was once only possible in studio productions but can now be achieved in a concert setting, albeit with some limitations. In fact, quantization of MIDI data can also be achieved in concert, although, again, it has some limitations compared to studio recording.

The preceding paragraphs have referred exclusively to studio recordings and concert performances/recordings. These are not the only typical performance/recording situations in rock. Before continuing, it is necessary to propose a taxonomy of modes of performance/recording, classifying them primarily in terms of levels/types of 'presence'. The following table illustrates these modes, considering them in terms of co-presence and co-temporality, as well as whether 'post-mediation' is available. Post-mediation refers to any form of mediation - be it social, technological, or practical - which takes place after a performance, rather than synchronously as the performance.

Studio recording refers to typical studio situations in which most commercial albums are recorded. Live in studio refers to situations where the entire band is recorded playing together in studio at once, but this material is not intended for broadcast over radio, television, or livestream. An example of this is "AudioTree Live"<sup>15</sup>, which records bands 'live' and then releases these recordings on Spotify and as YouTube videos. Live for broadcast refers to situations where an entire band is recorded playing together and this performance is then broadcast over radio, TV, or livestream at a later time. This is how most radio shows featuring 'live' segments are produced. Straight to air refers to situations where a band performance is broadcast over radio, TV, or livestream as it happens. Concert performance refers to situations where audience and performers are co-present in a venue at the time of the performance.

*Table 1: Common performance situations in rock.*

|                        | Audience/Performer<br>Co-presence | Audience/Performer<br>Co-temporality | Performer/Performer<br>Co-presence | Performer/Performer<br>Co-temporality | Audience/Audience<br>Co-presence | Audience/Audience<br>Co-temporality | Post-<br>mediation<br>available |
|------------------------|-----------------------------------|--------------------------------------|------------------------------------|---------------------------------------|----------------------------------|-------------------------------------|---------------------------------|
| Studio<br>Recording    | No                                | No                                   | Limited                            | Limited                               | No                               | No                                  | Yes                             |
| Live in Studio         | No                                | No                                   | Yes                                | Yes                                   | No                               | No                                  | Yes                             |
| Live for<br>Broadcast  | No                                | No                                   | Yes                                | Yes                                   | No                               | Yes                                 | Yes                             |
| Straight to<br>Air     | No                                | Yes                                  | Yes                                | Yes                                   | No                               | Yes                                 | No*                             |
| Concert<br>Performance | Yes                               | Yes                                  | Yes                                | Yes                                   | Yes                              | Yes                                 | No*                             |

*\*Post-mediation available in recordings of events.*

Considering Table 1, it is clear that the basic criterion for considering a performance/recording ‘live’ is not physical and temporal co-presence between audience and performers. As soon as audiences have a reasonable expectation that the performers were co-present with one another during recording, the term ‘live recording’ can be used. That said, audiences would likely still consider a concert performance ‘more live’ than a straight-to-air broadcast, and this broadcast ‘more live’ than a ‘live in studio recording’ in some meaningful way. Table 1 also explicates the fact that co-temporality between the audience and performers excludes the possibility of audio processing that cannot be done in real-time, as well as the kinds of layering/overdubbing/corrective re-recording that can be done in-studio.

The contention of this thesis is that, in terms of recordings possessing ‘liveness by default’, there is a continuum of recording situations which are generally understood as more or less live, with the important criteria being degrees of co-presence and whether or not forms of mediation that are not possible in real-time have been used.

What about studio recordings that ‘sound live’? As discussed above, liveness in recordings manifests as an affective experience for the listener of participating in a specific performance.

Given these two statements, we can now propose the following: Recordings possess the quality of liveness when they sound to the listener as if they were created by recording a physically and temporally co-present band without the extensive use of mediating practices which are not possible in real-time. Production characteristics that communicate this impression may be present as a matter of course if this is in fact how a recording was made. However, there is no reason to think that we cannot use the mediating process of record production to create this affective quality intentionally, even in cases where the

recording is highly constructed.

### **2.3. Liveness and Realism**

As discussed in the introduction, one way of conceptualising recordings is as representations of performances which, like other representative art forms, may be more or less realistic. This concept is perhaps more familiar in the context of film. Films can use special effects and CGI to portray extremely fantastical versions of reality. At the other end of the spectrum, some filmmakers might choose to minimise interference as much as possible, presenting their films as raw captures of events (although such films are still mediated by decisions about framing, what to film and what not to film, and so on). Most films lie somewhere in-between.<sup>16</sup>

When thought of as representations of performances, recordings can be seen to operate in much the same way. A raw recording of a concert performance is an extremely realistic representation, although still mediated and still distinguishable to the listener from the concert itself. A studio production may be extremely unrealistic, featuring far more simultaneous layers than could actually be performed by the band in real-time, corrected to an inhuman level of rhythmic accuracy, and subject to all kinds of other processing.

Most forms of mediation that heavily contribute to the unreality of recordings are not available in live settings. This can be understood intuitively – a recording is a representation of a performance that is more or less realistic. Any performance that takes place at a concert must be thought of as ‘realistic’ by virtue of it happening in reality.

Consider auto-tuned vocals. Although widely accepted in some genre contexts, the use of pitch correction on vocals is controversial in the context of rock. Auto-tune is considered inauthentic or ‘fake.’ This is because auto-tuned recordings are believed to represent performances that the vocalist cannot execute ‘for real.’ Again, we see a confluence (in the context of rock) between perceptions of authenticity, liveness, and realism.

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16 I borrow the idea of thinking of recordings as representations of performances, as well as the analogy to film, from Zagorski-Thomas (2014).

## 2.4. What is Live?

Taking these various perspectives into consideration, this thesis hypothesises that the following three criteria are important when attempting to construct recordings that will be heard as live:

1. Recreation of acoustic and performance qualities present in a physically and temporally cohesive full band performance.
2. Avoidance of forms of mediation that cannot be executed in real-time.
3. A focus on realism of representation in the construction of the recording.

These criteria likely operate as three distinct spectra. For example, although constructing a single guitar part in a song from multiple takes is not possible in real-time, the use of this mediating practice does not necessarily prevent a recording from being heard as live. If listeners hear the recording as a somewhat realistic representation of a band playing in the same space at the same time absent heavy mediation, they may perceive it as 'sounding live'. Put another way, such a recording possesses the quality of liveness *to some extent*. Recordings which sound as if they would not be possible under those conditions cease to be interpreted as live.

The following chapters are concerned with exploring how this impression of liveness might be cultivated at various levels throughout the production process.

## 3. The Virtual Performance Space

### 3.1. Introduction

As discussed in the previous chapter, it seems likely that an important facet of cultivating a sense of liveness in a recording is creating the impression that performers were co-present to one another at the time of recording. This follows from the fact that audiences seem to be content to refer to situations where a band plays together at the same time in a studio as live recordings (live in studio). If video material is present, audiences can authenticate that a recording resulted from this kind of performance visually.<sup>17</sup> However, if only an audio recording is available, how do audiences authenticate and experience that recording as 'live'? It is possible that one important aspect may be a recording's sense of acoustic space or 'staging'.

Staging refers to elements of a recording which give listeners the impression of the overall space in which the performance represented by the recording is taking place, and where in that space specific sound sources (such as a guitar amplifier or a snare drum) are located in relation to the listener.

This chapter explores the staging of recordings, in particular how producers might create the impression of performer co-presence in a realistic performance space.

### 3.2. How We Hear Space

The ability for humans to perceive the location of a sound source via hearing is a well-understood phenomenon in psychoacoustics.<sup>18</sup> In the case of recordings, the actual sound source is always the playback device (most commonly near-field speakers or headphones), however, by altering the sound in various ways it is possible to give the listener the impression of the various sounds in a mix coming from different locations. We can discern

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17 It is entirely possible for a video of a band playing together (or miming playing together) to be matched with audio from a different performance of the same piece without it being obvious that this has been done. However, when told that a video is of a band playing 'live,' for example in the case of Audiotree Live, audiences seem content to accept that this has not been done. Because of this, even if the audio is from a different performance, the liveness of the recording is still authenticated from the perspective of the audience.

18 Moylan (2012) whose conceptual model for the staging of recordings will be discussed shortly, primarily references Blauert (1983) with regards to psychoacoustics. The discussion of psychoacoustics in this chapter is based primarily on Rumsey (2001). The basic mechanisms described in each source are the same.

the lateral angle to a sound source, its approximate depth, and some information about the environment it is located in from various audio cues. These can be manipulated during production. The discussion of these mechanisms herein is simplified for the sake of brevity.

Lateral location is discerned primarily by:

- Interaural Time Difference (ITD). Which ear does the sound arrive at first and how much time passes before the sound reaches the other ear? The sound source is heard as closer to the ear which sound reaches first.
- Interaural Phase Difference (IPD). How out-of-phase is the sound as it is heard between the two ears? This is closely related to ITD, as changes in time difference also result in changes in phase relationship.
- Interaural Intensity Difference (IID). How much louder is the signal in one ear compared to the other? The sound source is heard as closer to the ear where the signal is louder.

In music production, the primary mechanism used to move sounds laterally is the IID. It is this balance of intensity between speakers which is being altered when a standard pan control is used.<sup>19</sup>

We can also perceive a sense of the width of sound sources. Apparent width is largely determined by early reflected sound<sup>20</sup> up to about 80ms behind the sound source and “interaural cross correlation, which (put crudely) measures the degree of similarity between the signals at the two ears,” (Rumsey 2001, 37).

The distance to a sound source is discerned primarily by:

- The relative volume between sound sources. Softer sounds are heard as further

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19 The specific algorithm used to determine how much to reduce the signal in the speaker being panned ‘away from’ and how much (if at all) to increase the signal in the speaker being panned ‘towards’ varies, but they all operate on this general principle.

20 Reflected sound refers to sound which reflects off one or more surfaces before reaching a listener’s ear or (in the case of recording) a microphone. In music recordings, this may be present either from the real space in which a recording was made, or it may be added later using reverb/delay effects to simulate reflected sound.

away.

- Ratio of direct to reflected sound. Sources with a higher ratio of reflected to direct sound are heard as further away.
- The ratio of high-frequency to low-frequency content in the sound. High-frequency content is lost over distance at a faster rate than low-frequency content. As such, sound sources with reduced high-frequency content sound further away.

It should be noted that attributes within these categories can be traded against each other. For example, a snare drum in a rock mix may have a large amount of reverb applied to it, suggesting distance, but still sound close to the listener if it is loud in the mix. ITD/IPD can also be traded against IID in this way with regards to lateral placement.

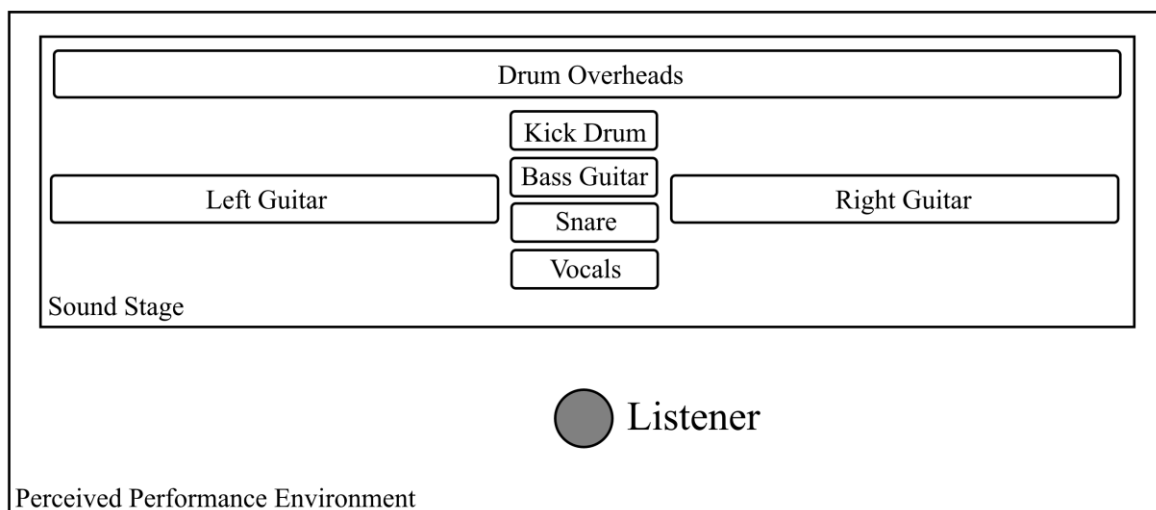
Finally, we can discern some characteristics of the environment a sound is located in (such as the size of the environment and how reflective it is) based on the duration, density, and frequency characteristics of reflected sound, as well as the balance between early and late reflections, and the delay between direct sound and the onset of reflected sound. Large, highly reflective spaces such as concert halls produce denser, longer-lasting reverberation with more pronounced late reflections compared to smaller or less reflective spaces.

### **3.3. Conceptualizing Space in Recordings**

Given this background on how we perceive space from auditory information, we can now discuss methods of conceptualising spatial characteristics heard in music recordings. This thesis makes use of a framework for staging based primarily on the work of William Moylan (2012). The main components of this framework are summarised below.

Recordings are heard as taking place in a Perceived Performance Environment (PPE). This is the broader environment or space in which the performance represented by the recording is heard as taking place. The PPE exists as a virtual space heard in the recording, distinct from the actual performance space(s) used when the recording was created. The listener takes a position inside the PPE. Put another way, because of the auditory mechanisms described in the preceding section, listeners build some (often unconscious) perception of the space in which the performance a recording is representing is taking place based on cues present in the recording. This is the PPE.

Within the PPE is the sound stage. The sound stage is the area of the PPE occupied by the various sound sources in a mix. A listener perceives the width of the sound stage as being defined by the elements of a mix which are heard as furthest left and furthest right. Individual sound sources are placed laterally within this stereo field,<sup>21</sup> and also have their own sense of width. The depth of the sound stage is delimited by the element of the mix which sounds closest to the listener and the element of the mix which sounds most distant (Moylan 2012, 163-167). These perceptions of angle and depth are effects of the mechanisms discussed in the previous section, and can be controlled by producers with a combination of level, pan, delay, reverb, and EQ.



*Figure 1: PPE and sound stage of a basic rock recording.*

The maximum limits of the sound stage and the listener's perception of the PPE are influenced by the playback device being used. When listening through speakers, the limits of the sound stage are determined by the position of the speakers relative to the listener. Sound sources will not be heard closer to the listener than the speakers themselves, nor as further left or right<sup>22</sup> – essentially, the position of the stereo speakers relative to the listener defines the front edge of the sound stage. When speakers are used the PPE is defined not just by qualities present in the recording itself, but also the qualities of the playback environment. Reflections from the room the speakers are in combine with the spatial information present in the recording itself to create the PPE.

<sup>21</sup> Moylan also discusses surround sound mixes, which offer an expanded set of possibilities compared to stereo mixes. In rock, surround sound mixes are uncommon. This thesis therefore focuses on stereo mixing.

<sup>22</sup> In certain conditions extremely out of phase material can appear to emanate from outside the width of the speakers, but this is generally avoided in rock mixing to reduce phase cancellation in mono playback.

When listening on well-isolated headphones, the sound stage instead wraps around the listener's head in a 180-degree arc, from direct left to direct right.<sup>23</sup> A sound source panned hard left will only be heard by the listener's left ear.<sup>24</sup> The PPE in this case is not affected by listening environment.

Moylan's model of staging is not the only one. Another prominent model is Moore's concept of the soundbox (2008). Like Moylan's model, Moore's soundbox considers the dimensions of laterality and depth. The soundbox also incorporates a vertical aspect showing pitch, placing higher pitched sound sources above lower pitched ones. There is general agreement that "[s]ome conceptualization of perceived elevation related to pitch/frequency level does exist" (Moylan 2012, 167). Whether or not this translates to a sense of spatial location which is comparable to perceptions of lateral/depth placement remains a subject of debate. Moylan, citing Brian Moore (2004), writes that pitch "is not an element of the actual spatial locations and relationships of sounds, but rather a conceptualization of vertical placement of pitch (representing register), much aligned with the concepts of 'pitch density' and 'timbral balance;'" (2012, 167) whereas Moore and Dockwray (2008), citing Rusconi et al. (2006) take the position that pitch/frequency does in fact map onto a mental representation of space.

The discussion of space in this chapter adapts Moylan's model rather than Moore's soundbox because regardless of whether or not, or to what extent, pitch is perceived spatially, consideration of pitch is not a relevant aspect of the current discussion. In both live and non-live recordings of a given song, the same instruments playing in the same pitch registers will usually be present. Pitch is therefore unlikely to be an important criterion in distinguishing between the two, or in establishing a sense of liveness in recordings. Moylan's model offers several useful conceptual tools for thinking about staging and omits elements that are not relevant to the current discussion.

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23 It is possible to some extent to signal that sounds are coming from behind, above, or below a listener using headphones, positioning them in the middle of a bubble, surrounded by the sound stage. However, the auditory mechanisms used to tell where sound sources are located vertically and whether they are in front of or behind us seem to be much more strongly dependent on factors unique to each individual compared to perceptions of lateral placement and depth (Rumsey 2001, 24-25). Because of this, these perceptions are difficult to reliably reproduce or trigger with music production techniques.

24 In fact, this is 'further left' in some sense than would be heard in nature – usually, sources to our direct left are also heard by the right ear at a slight delay/lower intensity.

### 3.4. Typical Staging of Rock Recordings

The staging of recordings can be more or less realistic. Rock recordings often present a highly stylised sense of space. For example, it is common in rock to pan the various elements of a drum kit very wide across the sound stage. There may be a much greater perceived distance between the furthest right and furthest left elements of a kit than would be possible in physical space. Furthermore, different elements of the drum kit may have wildly different volume and reverb levels, resulting in an image of the drum kit with a great deal of depth compared to reality, or even with signals that might indicate that elements of the drum kit were recorded in entirely different spaces if reverbs of different colours/intensities are used.

Zagorski-Thomas (2010) argues that the staging of rock recordings most typically “[takes] on some aspects of the acoustic characteristics of the arena/stadium experience in order to create the sensation of scale without the negative musical impact,” (ibid., 256). The primary negative musical impact being referred to is masking.<sup>25</sup> Stadiums typically create long natural reverberation, accentuate low frequencies, and often produce discrete echoes from the walls of the venue, all of which can mask other sounds in the mix and contribute to a muddier, less clear sound. Rock recordings typically also feature these characteristics to some extent, but reverbs are carefully tuned to reduce their masking effects, the low end is strategically processed at all levels (individual instruments, mixing and mastering) to ensure that it sounds full and powerful without becoming too muddy, and discrete echoes are carefully timed to reinforce the beat of the music rather than interfere with it. This artificial construction of a more ideal performance space was made possible in part by developments in studio design and recording practice which increasingly emphasised capturing well-isolated sound sources from the mid-60s into the mid-late-70s (ibid., 255-257).

In contemporary studio rock recordings considerable care is taken to reduce the amount of spatial information present on unprocessed tracks. Rooms are treated to minimise sound reflection and microphones are placed very close to sound sources.<sup>26</sup> The

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25 Masking refers to cases where one element of a mix makes it difficult or impossible to clearly hear some other element. Most commonly it occurs when multiple sounds occupy the same primary pitch register and share the same lateral placement.

26 The only common exception in rock music is drum kits, which are often recorded using a mix of close and distant microphones, and sometimes in rooms with more natural echo than the rest of the studio.

result is that the ratio of sound directly from the desired source to sound reflected from the room is very high. This enables the highly idealised construction of space discussed above without interference from actual room sound.

Perhaps not coincidentally, greater focus on the isolation of sound sources during the recording process was emerging during roughly the same period in which Moore and Dockwray (2008) identified the establishment of the current normative trend in how rock recordings are staged. Most typically, the lead vocals, bass guitar, bass drum and snare drum are placed in or near the centre of the stereo space, with drum overheads, additional percussion, and instruments such as guitars or keyboards panned wide around them, as shown above in Figure 1. Depth placement is somewhat more varied. In heavier or more aggressive subgenres, for example, guitars are typically placed at the ‘front’ of the mix, very close to the listener, with the bass guitar further back. In other styles of rock, such as those more influenced by funk, this relationship may be inverted.

In contemporary rock recordings staging is rarely static over the course of a song. At a minimum, elements of a mix are likely to be added or removed at different points. Furthermore, changes in volume, lateral placement, reverb level, and timbral characteristics can also be present in sound sources over the course of a recording. For the purposes of simplicity, the discussion here will focus on the main or typical placement sound sources occupy over the duration of the recordings under discussion.

Given this discussion of the normative staging of studio rock recordings, we will now attempt to identify some common ways live recordings differ from typical studio staging, using Moylan’s concepts of the PPE and sound stage as a basis for this analysis.

### **3.5. Hearing the Room: Qualitative Comparison of Live and Studio Recordings**

In order to determine common differences between studio and live recordings, qualitative comparisons have been performed on a number of songs where both non-live studio recordings and live recordings (either venue-based performance or live-in-studio) are available. These recordings were selected from a period spanning the late 70s to the late 2010s and spread across various rock subgenres. For the purposes of clarity and brevity, rather than including detailed breakdowns of many recordings, this section will lay out the commonly observed differences in staging between studio and live recordings with

reference to a handful of clearer or more relevant examples.

In general, the lateral placement of sound sources in live rock recordings matches one of three models:

1. Two guitarists, one panned wide left and one panned wide right. Vocals, bass guitar, bass drum and snare drum panned on or near the centre. Additional drums panned across the stereo space.
2. One guitarist panned on or near the centre. Other instruments as in case 1.
3. One guitarist panned wide left or right with the bass either centred, or in some cases, panned opposite the guitar.

The only one of these approaches which is somewhat common in studio production is the first, although even in that case studio productions often feature additional parts to fill out the mix. It is uncommon in contemporary studio practice to place a single guitar in the centre of the sound stage. Bands with a single guitarist usually either add additional guitar tracks as overdubs in studio recording, or fill out the mix in other ways. For example, much of the first Van Halen record (1978) features only a single guitar panned hard into one speaker, but reverb panned in the opposite speaker is added to balance the mix somewhat.

Where possible there seems to be a preference for using as similar of an approach as possible in live recordings as in studio recordings of the same piece. For example, the studio version of NOFX's 'The Longest Line' (2010) and a live recording (NOFX 2007) both feature two guitars, panned wide against each other. The album version of Van Halen's 'Runnin' with the Devil' (1978) features a single guitar panned hard to one side with the bass guitar centred for most of its duration. A recent live recording (Van Halen 2015) keeps the guitar panned wide, but differs from the studio recording in that the bass guitar is panned fairly far off-centre in the other speaker. This is less similar than the NOFX example, but still shares some commonality between the live and studio recordings.

When live recordings differ considerably from studio recordings in terms of lateral placement, it is usually because the arrangement on the album cannot be performed by the band live for one reason or another. For example, the album versions of 'Drain You' (Nirvana 1991) and 'Accident Prone' (Jawbreaker 1995) both feature densely layered guitars with several simultaneous tracks panned around the mix. However, since each band in fact only features a single guitarist, an approach with guitars panned wide against each other is not possible live. Live versions of both songs (Nirvana 1996; Jawbreaker 1999) pan

the guitar slightly off-centre with the bass guitar similarly near centre stage.

Many bands with two guitarists utilise more than two guitar tracks in studio recordings. One example is the intro solo in 'Welcome Home (Sanitarium)' (Metallica 1986). Here, the lead guitar is placed near the centre of the sound stage, with a wide double-tracked rhythm part in the background – a common practice in rock production. In these cases, live recordings tend to employ the approach of panning the two guitars (one playing the solo, the other playing the rhythm part) wide against each other, even though this results in features like solos being placed very far to one side of the sound stage. This can be heard in the live version of 'Welcome Home (Sanitarium)' (Metallica 1993), and in the solo during the live version of 'The Longest Line' (NOFX 2007). These practices, as well as those discussed in the preceding paragraph, illustrate a relationship between arrangement and staging. Live arrangements are limited by the number of parts the actual members of a band can perform simultaneously, which also has effects on the staging of recordings.

In addition to these differences in lateral placement, a number of differences in staging are present as a result of performers being physically and temporally co-present, and in the case of venue based performance, as a result of recording in an environment which is much more highly reflective than a studio. As mentioned in the preceding section, rock recordings typically feature very little spatial information from the actual performance space (excepting drums) and sound sources are usually well isolated from one another. In live recordings, this is not the case.

Microphones intended to capture one sound source, such as a snare drum, will pick up the sound from other instruments played in the same space at the same time, such as a guitar amplifier. This is known as spill or bleed. The direct sound from the guitar amplifier is picked up by the snare mic, but it is captured off-axis and at a distance, meaning that, relative to the microphone in front of the amplifier, the guitar sound present on the snare mic is quieter, has less presence (upper mid and high frequencies), and may also have a less pronounced bottom end due to the lack of any proximity effect.<sup>27</sup> If the performance is taking place in a reflective environment, there will also be a high ratio of room reflection to direct sound. There will always be a higher ratio of reflected sound in the more distant

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27      The proximity effect is a quality of directional microphones which results in bass frequencies being boosted when the microphone is placed close to a sound source.

microphone than the direct microphone.

As discussed earlier, sound source width is an effect of the presence of early reflections and of differences in how a sound source is heard by each ear. Spill between microphones means that a sound source such as an electric guitar amplifier operating at high volume is heard not just where that source's microphone is panned, but also around the rest of the mix at lower levels, slightly out of phase, and altered in terms of frequency content as discussed earlier. Furthermore, in concert recordings, more reflected sound is likely to be present even in close microphone captures because the overall environment is considerably more reflective than a sound-treated studio. We should expect these factors to result in sound sources generally appearing to be wider in live recordings than in studio recordings.

This does seem to be the case, and works to alleviate some of the potential negative effects of the lack of availability of double-tracking. For example, in the Metallica recordings discussed earlier, hearing a guitar solo panned hard to one side against its backing accompaniment is less jarring than it might otherwise be because the sound source is perceived as wider. Another example of this can be heard when comparing the album version of 'Back in Black' (AC/DC 1980) with a 1991 live recording (AC/DC 1992). The album version of this track features heavy use of reverb to give tracks more width and a greater sense of space.<sup>28</sup> The live version has much less added reverb, with width coming from the presence of spill and room reflections from the actual venue, which are clearly audible in the recording.

The degree to which these effects are present depends on the specific recording space and varies between instruments. For example, in the live recording of *Accident Prone* (Jawbreaker 1999) we can hear the effects of microphone spill on most instruments, but in contrast the vocal sounds very dry. Because vocals are quite low volume compared to a drum kit being played hard or a cranked guitar amplifier, they will not generally generate very much spill from direct sound in the context of rock. However, because they are typically quite high in the mix to the PA, they may create a great deal of reflected sound picked up either by the vocal microphone or microphones set up to capture other sound sources, especially any microphones which have been set up specifically to capture sound

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28 This recording is an excellent example of Zagorski-Thomas' observation that rock albums are often produced to sound like idealised versions of stadium shows (Zagorski-Thomas 2010).

from the audience or room.<sup>29</sup> The very dry sounding vocal in the live recording of *Accident Prone* (Jawbreaker 1999) might therefore be attributed to the recording being made in a relatively small or non-reflective venue,<sup>30</sup> or to audience or room mics either not being used or being placed in the mix at a very low level. As a contrasting example, ‘God Am -Live at the Kiel Center, St. Louis, MO – July 1996’ (Alice in Chains 1999), which was recorded at a large indoor arena,<sup>31</sup> features vocals that are heavily tonally shaped by the room, with long room reflections clearly audible.

The result of this additional presence of room sound is a greater awareness of the PPE in live recordings. Furthermore, unlike studio recordings, the PPE in live recordings is strongly influenced by the actual performance environment in which a recording was made. The PPE is still shaped by the production process, however, the presence of more information about the actual performance space results in a PPE which is more realistic than what is typically present in the highly stylised representations of space given by studio recordings. The more extreme spatial distortions possible in well-isolated recordings, such as placing elements of a drum kit at wildly different depths, are limited somewhat by the fact that spatial cues related to an instrument’s actual location in the real performance environment are present in the recording.

In addition to these spatial effects, the presence of spill in recordings also manifests as a timbral difference between live and non-live recordings. These timbral differences are often most noticeable in guitar parts. In general, guitar parts sound more ‘washed out’ or less ‘present’ in live recordings compared to studio recordings. Alongside the increased presence of reflected sound as a result of spill, this contributes to an overall spatial image where guitars seem to be more distant from the listener than in studio recordings. This timbral difference likely results from a combination of two factors. As Moylan writes, “[e]nvironments have sound qualities that fuse with the timbre of the instrument/voice to create a new sound. This new timbre may be subtly different from the source without the environment, or substantially transformed” (2012, 178), meaning that reflected sound

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29 The use of audience or room microphones is not uncommon when recording venue-based performances, and these may be mixed into live recordings of those performances.

30 In fact, the venue was The Warfield in San Francisco (<https://www.setlist.fm/setlist/jawbreaker/1996/the-warfield-san-francisco-ca-73c6a69d.html>), a theatre with a capacity of around 2000 patrons (<https://www.thewarfieldtheatre.com/venue-info>).

31 The Kiel Center has since been renamed as Enterprise Center (<http://www.enterprisecenter.com/about-us>), and has a capacity of around 22,000 for music concerts (<http://www.enterprisecenter.com/events/seat-locator>).

always shapes the perceived timbre of sound sources to some extent. Given the increased presence of reflected sound in live recordings, we would expect this timbral shaping to be taking place. These timbral differences are likely also partially a result of mild phase cancellation between the direct capture of each sound source and its spill. Because spill arrives at other microphones in the performance environment with a slight delay, it may be somewhat out of phase with the direct capture. When a signal is combined with somewhat out of phase material, the timbre of the signal is affected.

This effect seems to be endemic, present at least to some degree in all pairs of studio/live recordings which have been subject to critical listening. One fairly clear example is a comparison of the first few seconds of “One Armed Scissor” (At The Drive In 2000a) and “One Armed Scissor – triple j Live At The Wireless ” (At The Drive In 2000b), which is a live in-studio recording.

Techniques for attempting to replicate these spatial and timbral effects by simulating spill in asynchronously performed recordings will be discussed in Chapter 5.

## 4. Performance Live and In-Studio

### 4.1. Introduction

Musician's performances are affected by their environment. Musicians and scholars alike have discussed the fear of the red light<sup>32</sup> that signifies a recording in progress. A nervousness that comes from knowing that a musical performance, usually something immaterial and ephemeral, will be reified and made permanent. In concert performance, musicians often speak of being influenced by the energy of their audience, who are notably absent from the recording studio. Musicians playing together communicate in real-time in several ways; musically, somatically, and verbally.<sup>33</sup> On stage, these lines of communication are open. In the studio, they are often mediated, either by the space itself or by the recording practices being deployed. The former might block sightlines or limit the ability for musicians to speak to one another. The latter might erase real-time communication during performance entirely if parts are recorded asynchronously.

Perhaps the most significant difference between the stage and the studio in terms of the performance heard by the audience are the abilities to re-record and to edit. In recording, mistakes can be erased by a new performance. But the power of the edit goes far beyond the removal of errors. If a singer gives an engineer five takes of a chorus that are devoid of obvious issues, a skilled editor can construct a performance that is greater than any of those individual takes by selecting at each moment, sometimes down to the syllable, the version which is best intonated, or sung with the most suitable expression, or best compliments the surrounding material. Going a step further, pitch correction software might be used either to improve pitch accuracy beyond the capability of the human singer, or even to alter the melody by changing pitches entirely. Improvements to timing are also possible. Either through automated quantisation or manually by an engineer, the attacks of notes can be perfectly aligned to an even tempo or shifted to coincide more precisely with some other piece of musical material.

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32 The phrase 'red light fear' is used by Zagorski-Thomas (2014, 183) to describe this phenomenon. He cites a radio documentary called "Performing to the Red Light", which interviewed classical performers about the psychological experience of recording music (Curran 2009).

33 Kawase (2014b) identifies ten different types of communication cues which can be used between performers, between performers and an audience, and between audience members. These will be discussed in more detail later in the chapter.

We can think of these various factors as falling into three broad categories which affect performances experienced by listeners:

1. The performance environment.
2. Intra-ensemble communication.
3. Editing of performances.

It seems very likely that differences in these areas between live and non-live situations result in categorical differences in the resultant performances. This chapter is concerned with how these differences manifest in recordings and how they might contribute to the liveness of live recordings.

It is worth noting at the outset of this chapter that the majority of the studies referenced herein were not focused on rock performers, and most commonly were conducted with classical musicians. Furthermore, at least one study has found that rock musicians and classical musicians have somewhat differing emotional experiences of performance (Perdomo-Guevara 2014). Another has found that performance setting (which differs considerably between typical classical and rock performance) also has a notable impact on anxiety levels in performance (Cox and Kenardy 1993). Although these differences bear noting, they are not so great as to make the studies in question irrelevant. A lack of focus on the experiences of rock musicians is simply a fact of the available literature.

## **4.2. The Performance Environment**

Musicians and producers alike evince a belief that environment has important effects on the quality of a performance. Zagorski-Thomas offers a number of examples, ranging from a producer using a performer's own fabrics to cover vocal screens in order to create a more familiar and comfortable environment, to George Martin's Associated Independent Recording studios being located on the island of Montserrat to provide a beautiful and relaxing recording environment, to Daniel Lanois recording U2 in various non-studio environments including a castle and a sea-side home in order to affect the performances produced by the members of the band (Zagorski-Thomas 2014, 183-185). In other cases, producers sometimes put more pressure (through either negative or positive feedback) on musicians in an effort to elicit more energised or excited performances. In these cases, the goal is to overcome the sometimes tedious or workmanlike process of studio recording, or

the relatively sterile and uninspiring performance environment of the studio compared to other environments such as concerts (Zagorski-Thomas 2014, 185-186).

Although a considerable body of literature exists on the topic of performance anxiety in musicians (some of which will be discussed momentarily), the potential impacts of studio design or recording location does not seem to have been explored in depth. That musicians and producers believe recording environment has a considerable impact on performance is significant and warrants further investigation, however performing such a study is beyond the scope of this thesis.

The presence of an audience is associated with increased performance anxiety in musicians (Conklin 2011; Cox and Kenardy 1993; Leblanc et al. 1997). Some studies have also shown that in experienced musicians, higher levels of anxiety can be correlated with better performances (Hamann 1982; Hamann and Sobaje 1983). This reinforces the belief of certain producers that creating a higher-pressure situation in the studio can sometimes lead to improved performances. More importantly with regards to liveness, because performance in front of an audience is associated with higher anxiety and higher anxiety is associated with improved performances, it follows that performances in live situations are noticeably different than non-live performances as a result of this difference in the performer's mental state.

A study on the impact of an audience on the performances of musicians was performed by Schaerlaeken, Grandjean, and Glowinski (2017). In this study, musicians performed inside an immersive virtual environment (virtual reality) both with no audience in the environment, and with the presence of a virtual audience. Their study found that the presence of an audience (even a virtual one) had a considerable impact on the way musicians performed. Performers were asked to play with one of three different levels of emotional projection – deadpan, projected, or exaggerated. When no audience was present, these three performances showed very significant differences both in terms of musician body motion and in terms of musical features such as tempo and timing variation. When the virtual audience was present, it seemed to have a moderating effect – regardless of level of emotional projection the performer was attempting, the performances were quite similar. The authors of the study suggest that this is most likely because in the higher-pressure situation created by the presence of an audience, musicians tend to rely on a more habitual mode of expression (ibid, 12-13).

One might think that the 'red light fear' mentioned earlier contributes to performer anxiety in recording situations, offsetting the lack of an audience. Interestingly however, at least one study has shown that the level of anxiety experienced by performers during a recorded performance is not substantially higher than in rehearsal (Conklin 2011, 145). The results of this study were conflicting, however. Participants did not experience significantly higher physiological symptoms of anxiety while recording compared to a rehearsal setting, but nonetheless subjectively rated the experience of performing while being recorded as significantly more stressful than the rehearsal, and in interviews specifically cited the presence of a microphone and the belief that at some point in the future the recording would be heard by a broader audience (ibid, 185-186). It seems that although being recorded may create some degree of anxiety in performers, this anxiety is not experienced in the same way or to the same degree as performance in front of an audience.

Environmental factors (including the presence of an audience and other details about the recording location) on recorded performances are likely to be impossible to detect from analysis of the recordings themselves – one cannot reliably tell from a recording how nervous a performer is, or how immersed they feel in their physical environment, or isolate the effects of these emotional states on the recorded performance without the aid of other data such as that collected in the studies discussed above. However, we can clearly see from the existing scholarly literature that such factors are important.

The facts of the performance environment in a typical recording studio also frequently mediate the communication of musicians. Zagorski-Thomas (2014, 175-185) describes the relationship between performers and studio personnel in this area as somewhat adversarial. As discussed previously, typical recording practice in rock (and many other genres) aims to capture well-isolated sounds. This generally means either placing physical barriers between musicians or recording them at different times. However, musicians often express a preference for clear lines of sight to other members of their ensemble and for recording simultaneously to allow reactive, two-way musical communication. The result is usually either some form of compromise which partially obstructs communication to provide reasonably good isolation of sound sources, or total isolation via asynchronous recording. The effects of this obstruction of communication will be discussed in the next section.

### **4.3. Intra-Ensemble Communication**

Musicians communicate with each other during a performance in numerous ways, including verbally, somatically (body language/movement), and through the music itself. In musical styles which feature a high degree of improvisation, musicians respond to the melodic, harmonics and rhythmic ideas of other performers. Rock is generally not improvised (although of course there are exceptions), however, musicians still respond to the dynamics and expression of the rest of the ensemble and exert their own influence on these factors in turn.

In the case of music played without the assistance of a metronome or click track a key aspect of intra-ensemble communication is the negotiation of tempo. A study performed by Holger Hennig (2014) found that when two performers attempt to synchronise rhythmically, the interbeat interval of any two notes performed by one player is affected by the entire history of their partner's interbeat intervals on a scale as long as several minutes, not just the most recent bar or two as one might expect. Hennig refers to this phenomenon as musical coupling. Surprisingly, when examining what he terms sequential recordings (where musicians are recorded asynchronously, one after the other), Hennig found some (inconclusive) evidence that musical coupling between individual tracks may still be present as a matter of course (*ibid*, 12976). A strategy intended to maximise the presence of coupling in asynchronous performances including virtual instruments will be considered in Chapter 5.

Rhythm is not the only way communication between musicians influences performances. Chang et al. (2017) measured the magnitude and direction of information flow between members of a string quartet during performance where one player was assigned as the leader of the ensemble without the knowledge of the other performers. Followers were significantly more accurate than chance at identifying the secretly assigned leader (*ibid*, E4135, E4137), and the assigned leader was observed to exert significant influence on the motion of others. This effect was present regardless of whether performers could see each other or not, but was enhanced by visual information, indicating that both audio and visual cues are important in communication between performers.

Kawase (2014b) examined the importance of communication cues between performers and their co-performers, and between performers and an audience. The study found that performers regarded sound as the most important communication cue between

performers. However, gaze, body movement, and facial expression were all also regarded as important, corroborating other studies which showed that visual information improves ensemble coordination (ibid, 57), including Chang et al. (2017). The importance of visual cues is further corroborated by Kawase (2014a), which found that mutual gaze improved rhythmic synchronisation, particularly during changes in tempo (ibid, 534). Considering these studies together, we can conclude that real-time visual communication between musicians being mediated either by studio design or by performances being recorded asynchronously may result in important performance differences compared to live performance situations. However, as in the case of environmental factors, it seems unlikely that it will be possible to detect or attribute differences caused by this factor from an analysis of recordings alone. Further study is needed in this area.

#### **4.4. Editing of Performances**

The most obvious way the availability of editing alters the performances heard in studio recordings compared to live performance or live recordings is in the presence of errors. In general, commercially released studio recordings will not contain obvious errors. Even in genres such as punk, where a certain degree of sloppiness is tolerated (even expected), studio recordings rarely feature mistakes which are obvious in casual listening. Live recordings, on the other hand, sometimes feature quite obvious errors. For example, “Leaning on a Wheel – Audiotree Live Version” (Pile 2017) contains a very noticeable error in the guitar part at around 50 seconds. Another example can be heard in a live recording of “You Drink, You Drive, You Spill” on the album *I Heard They Suck Live* (NOFX 1995). Guitarist Aaron “El Hefe” Abeyta makes several errors during the verse from around 1:10 to 1:20. At the end of the recording, we hear a conversation between El Hefe and frontman Michael “Fat Mike” Burkett discussing the mistake and whether or not the performance would appear on the album. Including this conversation actively draws the listener’s attention to the error. The inclusion of this performance and conversation may serve to reinforce the liveness of the recording by emphasising its unedited, perhaps even uncurated<sup>34</sup> nature. In a similar vein, Peter Frampton showed a clear awareness that the

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34 It is worth noting that the live recordings released by bands *are* curated, at least to some extent. In 2009 I attended a live performance of the band Megadeth. During the bridge which appears at around 2:14 in the studio recording of “Holy Wars... The Punishment Due” (Megadeth 1990) guitarist Chris Broderick played a series of wrong notes that was egregious enough to draw a collective gasp from the audience. Occurrences like this will happen occasionally with any touring band, but would rarely (if ever) be selected for release as official live recordings.

inclusion of errors contributes to signalling liveness, stating in an interview regarding the album *Frampton Comes Alive!* (Peter Frampton 1976) that:

...we tried other overdubs, but we didn't use them because it sounded bad. It didn't sound live. We let the mistakes in. If I wanted to have my voice be perfect and in tune, I would have re-sung the whole album. But I didn't. Because it wouldn't be live. And there are some really bad notes that I sing. There's some out of tune guitar notes that I play, as well. But when you have the audience mics as loud as I had them in the mix on that album, there's no way you can replace anything, lead-wise or vocal-wise because it won't match the audience. Therefore the proof is in listening to the album, and you can hear if anything is overdubbed and it's not. (Frampton 2011)

As stated in the introduction to this chapter, the editing of performances can go far beyond re-recording sections to fix errors. Performances can also be subject to pitch correction or rhythmic adjustments. These corrections may be small tweaks – such as an editor moving a note a few milliseconds by hand to better align with the beat – or they may be more extensive. Modern Digital Audio Workstations (DAWs) offer the possibility of strictly aligning every note to a perfect tempo grid, a technique known as quantisation.<sup>35</sup>

Gwilliam (2009) describes an initial study on how listeners perceive a strictly quantised recording compared to one which contains timing variations typical of human performance. An experienced rock band was recorded playing with free tempo (a click was played to establish an initial tempo, but dropped out as the performance began), and this performance was then quantised to a strict tempo grid. Listeners were played both the quantised and unquantised recordings and completed a questionnaire. Participant preferences varied across age groups and musical experience. In Gwilliam's sample, the unquantised recording was preferred among younger listeners and musicians, and the quantised version preferred among older listeners and non-musicians. Importantly, the majority (76%) of respondents expressed some preference for one recording over the other. Only around a quarter of respondents expressed no preference. This suggests that, although preference varies, most listeners are sensitive at some level to the effects of quantisation. Interestingly, the differences most commonly noticed by participants in this study were related to the mix or timbral quality, despite these factors being identical<sup>36</sup> between the two tracks, indicating a misattribution of rhythmic differences to other aspects

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35 Quantisation need not be entirely strict. Most methods for performing quantisation allow users to control the strength of the effect – non-strict or weak quantisation moves audio material closer to a set tempo grid rather than aligning all notes perfectly.

36 Spectrographs of the two files showed only very minor differences, likely due to slight differences in phase alignment as a result of quantisation.

of the production. However, among participants who preferred the free time recording, the most cited reason for this preference was “better feel”.

This sensitivity towards rhythmic discrepancies is corroborated by Chapin et al. (2010). In this study, participant’s brain activity was measured while they were played two different versions of the same solo piano piece. One version was performed with the use of expression pedals, dynamics, and expressive rhythmic variation. A mechanical version of the same piece was created which was perfectly quantised to a fixed tempo, fixed note velocities, and eliminated pedal information. This mechanical performance was set to the mean tempo of the human performance, so the two versions had the same length, and the RMS amplitude<sup>37</sup> between the two versions was also matched to control for volume-related preference. Both versions were reproduced using the same synthesiser, eliminating timbral discrepancies.

Their results found that both timing and intensity dynamics resulted in increased brain activation, and that “temporal dynamics of expressive rhythmic performance increase emotion-related neural activations,” (Chapin et al. 2010, 8).

Going even further, research conducted by Hennig et al. (2011) showed that not only are listeners sensitive to differences between quantised and unquantised performances, they are in fact sensitive at some level to the difference between small random timing deviations and small timing deviations that reflect a human performance. Human performers do not play perfectly on-beat. The offset of a skilled performer from a fixed tempo beat is on the scale of milliseconds, but is always present. Hennig et al. (2011) found that these offsets are not random, but rather exhibit Long-Range Correlations (LRCs). For example, a drummer may tend to be a little ahead of the beat in one section of music, and tend to be a little behind the beat in another. A small rhythmic fluctuation, once performed, appears to influence following fluctuations on the scale of tens of seconds (ibid, 4).

The researchers played participants two recordings. One was humanised using white noise deviation<sup>38</sup> and the other using a method developed by the researchers to approximate the LRCs present in human performance. 79% of their participants reported that the recording with non-random deviation sounded ‘more precise’ and 64% said that

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37 Root-mean-square amplitude, a common measurement for average volume.

38 White noise deviation is essentially random. This is how most humanising algorithms for virtual instruments operate.

they preferred that recording. This further corroborates the studies discussed above in showing that listeners are sensitive to very small-scale timing differences, and in particular suggests that listeners are able to differentiate human fluctuations in timing from random ones. An approach for humanising material in a way that should create these non-random fluctuations will be discussed in Chapter 5.

From the mid-2000's on, there has been a trend in rock music (particularly releases from major record labels) to heavily quantise performances to a tempo that remains static over the entire song. Several examples can be seen in producer Rick Beato's video "How Computers Ruined Rock Music" (2019). There are numerous advantages to this approach in terms of editing, and, although the study performed by Chapin et al. (2010) suggests that this static and 'perfected' approach to rhythm may lead to reduced emotional engagement from listeners, Gwilliam's (2009) study showed that, nonetheless, a significant portion of listeners prefer the sound of quantised performances. The point is not that locking recordings to a fixed grid is 'bad,' however, it would immediately destroy the human rhythmic effects described above.

Furthermore, LRCs (be they between members of an ensemble as discussed in Section 4.3 or in the rhythmic performance of a single individual as discussed above) are likely to be damaged by the editing of performances. Because these correlations operate over fairly long timescales, piecemeal edits and overdubs should be expected to erode them to some extent, although perhaps not as destructively as quantisation. A performance of only a few bars, or a loop constructed from a segment of a performance on that scale would not be expected to contain these rhythmic relationships because the duration is too short for them to fully manifest. Although these relationships are very subtle (perhaps too subtle to be clearly identified through critical listening alone) the various scholarly sources discussed about show that listeners are sensitive to them on some level, even if it is unconscious.

In live performance settings, strict quantisation of audio material is generally not possible. Electronic instruments such as synthesisers and samplers can be quantised live, but typical rock orchestration – acoustic drum kits, guitars, bass guitar, and vocals – are not able to be quantised in real-time. Editing and overdubbing are wholly unavailable. Recordings of live performances may make use of quantisation or editing, and do on some occasions, but in general are not quantised and feature considerably less editing than typical studio recordings. Therefore, this may be an important area in which live recordings

generally differ from typical contemporary studio practice, which sometimes makes use of quantisation of audio and almost always makes use of overdubbing or other kinds of performance editing. The practical production implications of these findings are discussed in the following chapter.

## 5. Constructing Liveness in Asynchronously Performed Recordings

### 5.1. Introduction

This chapter examines techniques which might be useful in imbuing non-live recordings with a greater sense of liveness. The focus is on strategies which can be used in totally asynchronously performed recordings incorporating sequenced drum samples. This approach to recording was selected because it represents a situation at the furthest extreme away from live recording, and we would not expect such a recording to possess 'liveness by default' as a result of the method of recording. Furthermore, as discussed in the introduction of the thesis, practical experiments were limited to what is possible with a fairly typical home recording setup, in which the recording of live drums is rarely possible.

The examination of scholarly and industry resources and of recordings conducted in the preceding chapters and my perspective as an experienced recordist made it possible to hypothesise several production interventions which may contribute to creating an increased sense of liveness in recordings. These interventions have been investigated through the creation of test recordings over the course of the project. Examples of these recordings are included as appendices to the thesis. These recordings will be discussed and analysed throughout this chapter.

The test recordings were created as a means to explore and demonstrate the effects of production techniques and as such are not intended as fully finished productions suitable for commercial release. They are used as test sites to hear and analyse the effects of various interventions. At the end of the chapter, the effectiveness of these interventions is discussed and evaluated. The goal is to determine whether or not the recordings resulting from these strategies exhibit characteristics that are typical of live recordings but are not typical of studio productions. We would expect such recordings to be interpreted as sounding live/possessing the quality of liveness to some degree.

### 5.2. General Production Concerns

In Chapter 3, we identified that the staging of live recordings was affected by the arrangement restrictions present in live performance. In general, live performances of rock music are limited to one or two simultaneous guitar performances, one bass guitar

performance, and one drum performance.<sup>39</sup> The maximum number of simultaneous vocal performances is limited by the number of members in a band. Importantly, the maximum number of simultaneous vocal performances in the same voice is one. We can reflect this in the production of studio recordings by avoiding dense, heavily layered textures common in modern recording. Contemporary studio recordings of rock bands often feature many more simultaneous guitar performances than could be produced live, either via the multi-tracking of parts or the addition of extra parts on top of the band's typical live arrangement. Similarly, lead vocals are very commonly double- or triple-tracked. Finally, additional sounds or instruments not present in a band's live configuration are often used in recordings in order to add additional interest or textural complexity. Limiting the use of these techniques in recordings may help those recordings to be perceived as more live.

In Chapter 4 we discussed the ways in which editing and quantisation alter the types of performances heard when a recording is played back. Recordings allow for a level of perfection in performance that is not attainable in a live setting. Alterations go beyond merely polishing performances. For example, it is not uncommon in modern production for performances to be copied and pasted. This allows repeated parts (for example, the bass groove in a chorus) to be exactly the same each time they are heard. There may be aesthetic, technical, or workflow related benefits to this approach,<sup>40</sup> but it differs significantly from live performance. Human performers will always produce slight differences in each performance of the same material. Again, limiting the use of these studio techniques which alter performances may assist in creating a sense of liveness in recordings.

Both of these points relate to the general criteria for liveness in rock recordings that were identified at the end of Chapter 2. These were:

1. Recreation of acoustic and performance qualities present in a physically and temporally cohesive full band performance.
2. Avoidance of forms of mediation that cannot be executed in real-time.

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39 There are of course exceptions to these limits. Keyboards are relatively common in rock as well, for instance. There are also numerous examples of rock bands which tour with more than two guitarists, or in some cases even multiple drummers. However, a configuration featuring one or two guitarists, one bassist, one drummer, and a vocalist (often also playing one of the other instruments) is the most common or 'basic' live rock configuration.

40 The video "How Computers Ruined Rock Music" (Beato 2019) demonstrates the ease with which parts can be copied and pasted or even altered – changing drum grooves etc. via editing – when recordings are fully quantised to a fixed tempo.

### 3. A focus on realism of representation in the construction of the recording.

It is now clear that these three criteria are entangled. Avoiding the use of quantisation (for example) serves all three. They are not, however, functionally equivalent. Post-mediation might be used to increase the sense of co-presence, for example, and a lack of these qualities will not necessarily be heard as ‘unrealistic’.

There are other basic considerations which may result in recordings that sound closer to live recordings. For example, microphone selection and placement are heavily influenced by performance situation. This is most clearly exemplified with regards to vocals. In live situations vocals are usually captured with a dynamic microphone which the vocalist remains very close to.<sup>41</sup> This gives live vocals more of a ‘closed in’ sound than most studio recordings, where it is more typical to record using a large diaphragm condenser microphone and to have slightly more distance between the microphone and the singer to achieve a clearer, more open sounding vocal. Limitations on microphone placement and selection also affect other instruments to some extent.<sup>42</sup> These factors have a large impact on the sound of recordings. Using the kinds of microphones and microphone positions that are more typical in live situations when recording in a studio should result in recordings that sound closer to live recordings.

In addition to these broad ideas about altering or restricting the recording process to match live recording situations more closely, each chapter also suggested a handful of more specific interventions which may assist in creating a sense of liveness in non-live recordings. Practical experimentation has been undertaken with two of these ideas. The first was simulating the spill between captured sound sources which occurs in live recordings due to performer co-presence. As discussed in Chapter 3, this appears to shape the sound of recordings in various ways. Importantly, if listeners are sensitive (even unconsciously) to the effects of spill, accurately recreating its effects may communicate to listeners that performers were co-present (even if they were not), thereby increasing the sense of liveness in a recording.

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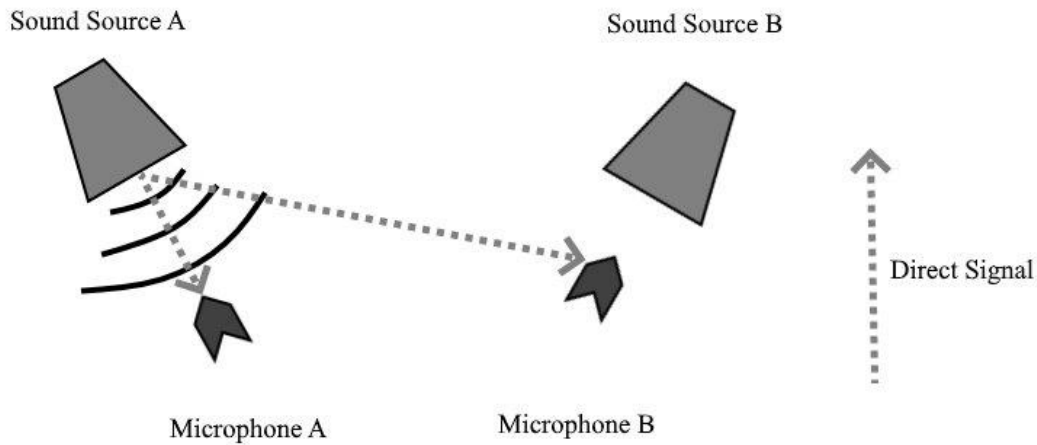
41 There are exceptions. Particularly on very large stages, it is sometimes possible to position a vocal microphone in such a way that an approach that is closer to studio practice is possible. Similarly, there are many examples of studio recordings where the vocals were captured in a similar manner to most live performances. Both of these situations are atypical in contemporary practice, however.

42 For example, one approach used in studio production is to use a ribbon microphone blended with a dynamic microphone to capture electric guitar. Due to their bi-directional nature, ribbon microphones are not desirable in live settings, so this particular technique would not be used.

The second relates to performance - specifically, an iterative approach to recording intended to maximise the presence of the phenomenon Hennig (2014) refers to as 'coupling' in performances which were recorded asynchronously. Furthermore, this approach should humanise hand-sequenced VIs more effectively than randomisation alone by imbuing them with the long-range correlations identified by Hennig et al. (2011). These rhythmic effects will almost always be present in live recordings due to their nature as single synchronous band performances, generally presented with minimal editing. This preserves subtle temporal relationships between parts/performers. In non-live studio recording, although performers interact with temporal materials in existing tracks, they do so asynchronously, meaning that communication is one-way as opposed to the multi-directional communication present in live performance. The iterative approach to recording described below is hypothesised to more closely approximate the temporal relationship between parts present in recordings of live performances. The rest of this chapter discusses these two techniques and the results of applying them to recording practice.

### **5.3. Simulating Spill**

In Chapter 3, the presence of spill between captured sound sources was identified as influencing the staging of live recordings. Spill seems to increase the apparent width of sound sources, alter their timbre, and result in recordings which contain a higher ratio of reflected sound. The last factor is significant because we would expect it to result in a more realistic Perceived Performance Environment (PPE) and greater listener awareness of the PPE. This may contribute to a listener's impression that a recording is a capture of a co-present full band performance and therefore live. This section discusses strategies for simulating spill in asynchronously captured recordings.



*Figure 2: Multiple sound sources and microphones in a performance environment.*

As shown in Figure 2, when multiple sound sources are set up for recording in the same space, sound from one sound source (Source A) will reach the microphone set up to capture audio from the other source (Source B). The sound from Source A will sound different when picked up by Microphone A and B. Specifically, relative to Microphone A, the capture in Microphone B will be:

1. Delayed slightly. The further away Microphone B is from Microphone A, the longer the delay.
2. The prevalence of different frequencies (EQ) will be affected both by distance and by the fact that Microphone B is off-axis to Source A. This effect is complicated, but the most significant difference is that higher frequencies are attenuated by distance and off-axis rejection.
3. There will be a greater ratio of reflected to direct sound in Microphone B as opposed to Microphone A both as a result of Microphone B being off-axis and at a greater distance from Source A.

In a fully synchronous and co-present band performance, spill with these properties will be present between all parts in a mix. It is possible to re-create this condition in asynchronous recordings via the method described below:

1. Record sound sources onto tracks which will serve as passthroughs. No processing or mixing should be done on these tracks. This assists in project organisation – all tracks in this layer can be hidden after recording and initial setup is completed.
2. Route the main outputs of these tracks to tracks which will serve as the main mix layer of the recording. This is where all processing should be done.
3. Select a method for creating spill tracks from the list below. Create spill tracks in the

passthrough layer. In the more complex/realistic methods, each sound source may be associated with multiple spill tracks.

4. Use sends to route the spill tracks to the main mix tracks of every other sound source in the mix. That is, a spill track associated with a guitar part should be sent to the main mix tracks associated with every sound source *except* for that guitar.

The basic signal flow for a simplified mix with only two sound sources is shown below.

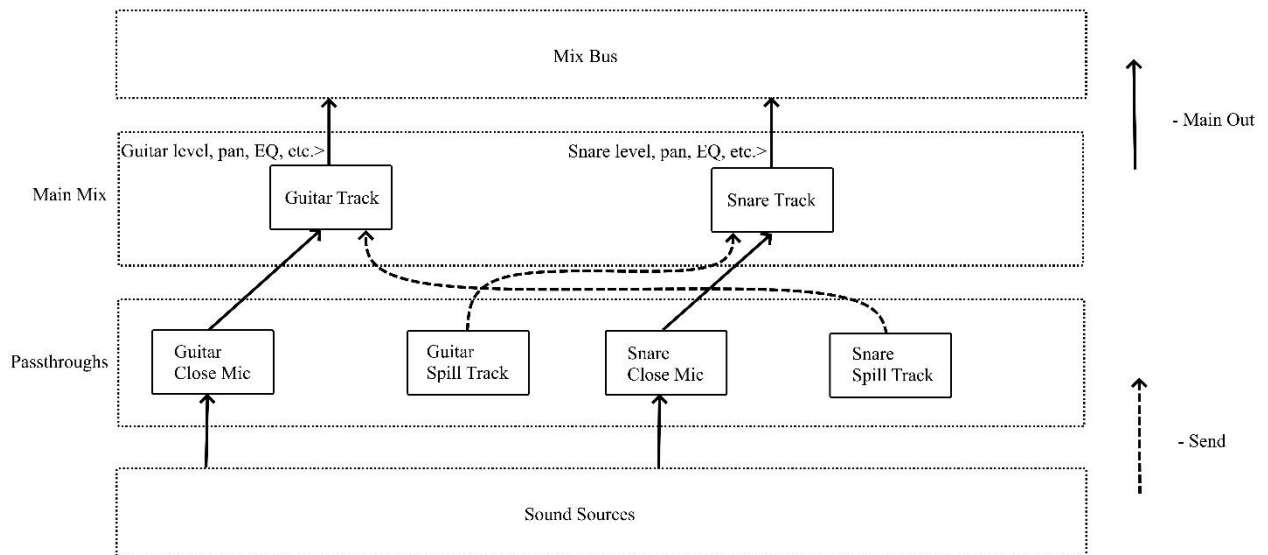


Figure 3: Basic signal flow for spill simulation.

Methods for creating spill tracks:

**Method 1:** Microphones positioned to record other sound sources. In Figure 2, such a situation is represented for only two sound sources. While playing Sound Source A, the audio captured by Microphone A and B are both recorded to separate tracks. The track containing the recording from Microphone B is the spill track. In the most realistic case, every sound source present in the mix would be set up to record at once. Suppose a basic rock mix with drums, vocals, two guitars and bass guitar recorded using eight microphones (stereo drum overheads, snare and kick close mics, and one mic each for the vocals, guitars, and bass). All eight microphones are set up in the same space at the same time. While the bass guitar part is being recorded, all eight microphones are recorded onto separate tracks. The recording from the snare microphone will later be sent to the snare's track in the mix, the recording from the vocal mic to the vocal track, and so on.

**Method 2:** The recording from a single room microphone off-axis to the sound source being captured.

**Method 3:** A copy of the capture from the close microphone (Microphone A in Figure 2) which has been processed to replicate the three effects described above – delay, EQ differences due to distance and off-axis rejection, and an increased ratio of reflected to direct sound.

Method 1 should provide the greatest level of realism by including spill recordings with subtly different characteristics and time delays depending on the positioning of microphones and sound sources in the recording space. However, it requires the same amount of space and the same number of microphones/microphone inputs as tracking a full band live, making it difficult to achieve in smaller recording setups. It also results in an extremely large number of tracks on the passthrough layer and very complex signal flow. Methods 2 and 3 are presented as more practical alternatives which are hypothesised to create the overall character of mixes containing spill with only a single spill pathway per sound source as opposed to several. Both Method 2 and 3 have been tested in the materials which accompany this thesis, as well as an approach that is a hybrid between Methods 1 and 2, in which individual spill mics were used for some parts and the remainder of the simulation accomplished with a room microphone. A discussion of the results of this experimentation appears later in this Chapter.

In normal studio recording practice, delays and reverbs are often used to give tracks an increased sense of space. These effects can also have the result of increasing the apparent width of sound sources and altering their timbre. At first glance it may not be obvious how substantially the result of this spill simulation method differs from more typical reverb and delay usage. The key difference results from the signal flow illustrated above.

Consider the example scenario in Figure 2. Because all audio processing is done on the level of the main mix, any processing applied to the snare drum is also applied to the simulated spill present in the snare mix track. This contributes to the overall perceived timbre and spatial positioning of the guitar sound in a manner that is substantially different from simply adding reverb to the guitar close mic because of the incorporation of this additional processing from the snare channel. The effect on the overall sound of the guitar is fairly minor in this simplified example with only two sound sources – if we are aiming for realism, the level of the spill should be significantly lower than that of the direct sound in

any individual track. However, over an entire mix the effect builds up, ultimately having a considerable influence on the sonic character of a recording. Comparing Appendix 3A, which features spill simulated using the above signal flow,<sup>43</sup> with Appendix 3C (the same mix with the spill tracks muted) illustrates how significant of a factor this becomes in a full mix.

Even more realistic approaches than Method 1 are possible, for example, if Direct Input (DI) signals are captured for electric guitars and bass, these instruments could all be re-amped<sup>44</sup> simultaneously in the same space. Or a more complex simulated approach where, rather than one simulated spill track per instrument, there are many with slightly different levels of delay, reverb, and EQ applied to simulate different distances between microphones. These approaches would be considerably more complex and time-consuming to execute, however, and seem unlikely to offer substantially better results than the simpler approaches. The goal is not to perfectly mimic the reality of a co-present recording, but to create a simulation with sufficient realism to reproduce the audible effects of spill in such a recording

These strategies will be most useful in recording situations where actually tracking a band live is not an option, but not exclusively. Working from well-isolated takes and using this strategy to simulate a co-present performance gives control *in the mixing phase* of factors such as the degree of room sound present and the character of that room at the cost of some realism. A producer could push the bleed sends to high levels to achieve a very exaggerated, roomy sound. Or they could be set at or below realistic levels for a more subtle effect. This level of flexibility is not available when actually tracking a band live.

## 5.4. Performance Concerns

Chapter 4 discussed several ways in which we would expect live performances to differ from those captured in studio recordings. Beyond those considerations discussed in the introduction of this chapter, one factor discussed in Chapter 4 was the influence of performance environment on performers. An interesting observation gleaned from

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43 Specifically, Appendix 3A used the second method described for creating spill tracks – a single room microphone.

44 Re-amping refers to the practice of recording a Direct Input (DI) signal of an instrument and then later sending this signal out to an amplifier (e.g. an electric guitar amplifier). The sound from the amplifier is then recorded using microphones. Capturing a DI signal when recording has become a typical practice in studio recording because of the possibilities afforded by re-amping. Re-amping makes it possible to re-record the same performance through different amplifiers in order to capture different tones.

Schaerlaeken, Grandjean, and Glowinski (2017) was that the presence of even a virtual audience created significant changes in musical performances. The idea of having musicians in the studio record while performing to a virtual audience presents itself. This is not practical in most current studios or home recording spaces, however as virtual and augmented reality technologies become more affordable, this may become an interesting avenue of exploration. For the purposes of this thesis, testing was not deemed feasible due to the required space and technology.

Intra-ensemble communication was another area of difference identified between live situations and typical studio recording. Co-present musicians utilise real-time two-way communication through a number of channels, including body language, gaze, speech or vocalisations, and the music itself. These lines of communication are usually at least partially obstructed in non-live studio recording, and are necessarily obstructed (and made one-way only) when recording asynchronously. One option for approximating elements of live performance communication would be to record videos of musicians during recording and play these back as a visual reference for performers recording later. Studies referenced in Chapter 4 showed that the presence of visual cues helps musicians synchronise with one another rhythmically.

Unfortunately, executing this presents greater technical challenges than may be immediately obvious. Any minor synchronisation discrepancies between audio playback, video playback, or audio recording would make this technique essentially useless. Although many DAWs support sample-accurate audio and video synchronisation, they are generally not able to handle multiple video tracks or record video. It is possible to record using video editing software and then move the audio to a DAW for editing/processing, but the workflow of such an approach is fairly torturous and has the potential to introduce synchronisation issues as a result of the transfer from one piece of software to the other. Due to these technical issues, experimentation with this idea has not been carried out. Even if these difficulties were overcome, this approach still only offers one-way communication between pre-recorded materials and later performances rather than the multidirectional communication present in a live performance. Nonetheless, given the importance of visual cues to intra-ensemble communication established in Chapter 4, it may be worth further investigating the potential benefits of this approach in future research.

## **5.5. Iterative Recording**

So what *can* we do? An iterative approach to recording which is intended to bring

asynchronously recorded performances closer to those captured in live settings has been subject to experimentation. Primarily, this approach is intended to increase the presence of the phenomenon Hennig terms ‘coupling’. More generally, the goal is to come closer to a sense of two-way communication between asynchronously recorded parts rather than the exclusively one-way communication which is generally present.

The basic method is described below, followed by further explanation of each step including their intended effects.

1. Record a guide performance. This could be to a click track, but free tempo should be preferred given the discussion of listener sensitivity to timing variations discussed in Chapter 4.
2. If working with one or more Virtual Instruments (VIs) which are sequenced by hand (as is the case in the test recordings),<sup>45</sup> build the project tempo map from a human performance. In the test recordings this was done by tapping on a microphone in time with the guide performance and then using a plugin (Celemony’s Melodyne) to detect the tempo of these taps and apply them to the project.
3. Record performances of all parts of the song. Ideally the entire piece should be captured from one continuous performance, rather than in a piecemeal manner.
4. Iterate over these performances. That is, re-record parts that were previously recorded while listening back to all the other parts. This can include rebuilding the tempo map from a new performance.

Step 1 is done for the same reasons guide performances are typically used: to provide an outline of the song as a guide for recording other parts.

The main purpose of Step 2 is to humanise hand-programmed VIs more effectively than randomisation. As discussed in Chapter 4, Hennig et al. (2011) showed that human rhythmic variation is non-random, instead featuring Long-Range Correlations (LRC). This method for humanising the rhythm of virtual instruments should result in the presence of LRC by virtue of the process being based on human rhythmic performance. Given that listeners were also shown to be sensitive to these LRC, we might expect this process to increase the sense of liveness in a recording by creating a rhythmic feel that is closer to

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45 The decision was made to create drum parts by manual step sequencing rather than by performing the parts on a MIDI instrument or using groove templates created from human performances because hand sequencing parts in this way represents the furthest extreme from live performance. Unquantised performances of a MIDI instrument may not exactly replicate the performance of an acoustic drum kit but, with regard to timing, the effects being examined here would most likely be present by default to some extent.

what one would hear in a live performance by a human musician. In the test recordings, additional offsets to drum hits were added using a randomisation algorithm. This additional randomisation was done so that hits landing on the same beat subdivision did not strike at the exact same instant but were instead very slightly offset from one another. This is an aspect of human drum performance that having a shifting project tempo alone does not simulate. These randomisations were very small – only a couple of milliseconds – so as not to introduce enough noise to destroy the LRCs, which operate on a timescale of approximately 15-20ms.

The importance of recording continuous performances rather than recording piecemeal is primarily to attempt to preserve the degree of inter-performance coupling present in synchronous performances. Hennig (2014) showed that the rhythm of a performer is influenced by other's performances on a timescale as long as several minutes. To accurately capture the same degree of influence as would be present in a live performance it is therefore necessary to avoid (or at least minimise) cuts, edits, and so on. A secondary effect of capturing full performances is that it reduces the overall degree of editing which is not possible in real-time.

The iteration described in Step 4 is done to attempt to emulate to some degree the two-way nature of intra-ensemble communication in live performances. In typical asynchronous recording, parts which are recorded first are not influenced by the parts of the piece that will be recorded later. Re-recording these earlier parts after the entire arrangement has been recorded allows them to be influenced by those parts which were not yet available during the first recording. This process can be extended/repeated, leading to a situation where parts recorded later are influenced by performances that were themselves influenced by an earlier iteration of that part. This is not the same thing as true two-way communication. The hypothesis is that it may result in relationships between parts that are closer in some ways to the relationships present in synchronously performed recordings. The process could be repeated indefinitely – a stopping point has to be selected by subjective evaluation of the quality of a set of performances and how they sound when combined.

Appendix 2B was created using the approach described above, whereas Appendix 2A is a recording of the same song using a more typical studio/asynchronous recording approach – parts are performed to a fixed tempo, were recorded in a piecemeal manner, and in some cases copied and pasted to create perfect repetition. The efficacy of this iterative approach to recording with regards to cultivating liveness is discussed below.

## **5.6. Discussion of Recordings**

This section will discuss the results of the experimental production techniques described above with reference to test recordings linked as appendices at the end of this thesis. Each appendix is comprised of an audio file and a brief text description of the recording in question. Discussion in this chapter does not touch on every recording included in the appendices – additional recordings and short clips which may be of interest are also included. The reader is encouraged to briefly familiarise themselves with the content of the appendices at this point.

Test recordings were made in consideration of the discussion in Section 5.2. Arrangements were limited to what would typically be possible for a live rock band, editing of performances minimised, and so on. The hope is that these recordings will manifest some of the characteristics identified throughout the thesis which distinguish live recordings from typical studio practice – the spatial aspects discussed in Chapter 3 and the performance aspects identified in Chapter 4. If these characteristics are present in the sample recordings, it suggests that the practices used to create them do result in recordings that more closely resemble live recordings, and are therefore more likely to be interpreted as sounding live by listeners.

### **5.6.1. Simulating Spill**

In Chapter 3, a number of differences between live and studio recordings were identified that were hypothesised to be related to the presence of spill. Two key factors were an increase in the apparent width of sound sources and a somewhat ‘washed out’ or ‘less present’ timbral quality of loud sound sources (especially noticeable in guitars), likely attributable to a combination of the greater presence of reflected sound and the presence of out of phase sound captured by distant microphones.

The strategy for spill simulation discussed above does appear to manifest these properties. Compare Appendix 1A, which features no spill and Appendix 1B which features spill simulated according to the method described in Section 5.3. The increase in the apparent width of sound sources is perhaps most evident in the guitars during the end of the intro and the first verse (~22 seconds onwards). In Appendix 1A, the left and right guitars are very distinct and remain out of the centre of the mix. In Appendix 1B the guitars are subtly present in the centre of the sound stage, an effect which must be a result of the spill simulation as no other changes were made to the mix.

Timbral differences similar to those found between studio and live recordings are also present, although subtle. These must also be attributed to the addition of spill. The hypothesis that these two properties of live recordings are attributable at least in part to spill would seem to be confirmed by these experiments. Spill simulation may operate to make recordings sound more live by virtue of making them more similar to actual live recordings in this manner.

Appendices 1B, 1C, and 1D sound different to one another as a result of using three different methods to simulate spill, however, all three demonstrate the above properties. This confirms that all three of the methods for creating the spill tracks described in Section 5.3 are sufficient for this purpose. This is not to say that the additional realism of Method 1 compared to Methods 2 and 3 is not significant. It may assist in contributing to a live sound in ways that have not yet been discovered. But all methods explored via test recordings were able to reproduce the particular spill-related characteristics of live recordings identified by this project.

Chapter 3 also suggested that perhaps the greater awareness of the PPE, the more realistic nature of the PPE, or simply the presence of spill itself might signal to listeners that a recording is a capture of a fully co-present performance and therefore live. The fact that the approach to simulating spill discussed in this Chapter is sufficiently realistic to reproduce the characteristics described above allows for the hypothesis that if these other factors are important to perceptions of liveness, they might also be produced by this simulation. Further research involving non-expert listeners would be needed to test this hypothesis.

### **5.6.2. Iterative Recording**

It is more difficult to say how the iterative approach to recording described in Section 5.4 might affect perceptions of liveness. Scholarly work on performance discussed in Chapter 4 suggests that these interventions may increase perceptions of liveness by incorporating greater rhythmic variation, by inducing more realistically human rhythmic feel in synthesised instrument tracks, and by preserving delicate long-range rhythmic relationships between parts via the minimisation of editing. Studies discussed in Chapter 4 showed that listeners do have a level of sensitivity towards these phenomena which are present in live recordings as a matter of course but may be destroyed or suppressed in studio recordings. Due to the subtlety of these effects however it is difficult to clearly identify them via critical listening. Appendix 2B, which was produced using the iterative

approach to recording described in Section 5.5 and with minimal use of editing or overdubs features more rhythmic variation than Appendix 2A, with its fixed tempo and use of copied and pasted repeats. It also features more inconsistencies and variation in performance in a more general sense. These kinds of inconsistencies were identified in Chapter 4 as being more prevalent in live recordings than in heavily edited studio productions and we might therefore expect Appendix 2B to be heard as more live as a result of their presence.

There are moments where my assessment is that the additional variation contributes positively to the overall ‘feel’ of the recording, such as the slight slowing of the tempo into the repeat of the final chorus (around 3:33-3:40 in Appendix 2B). But whether or not iterating over recordings meaningfully increases the presence of the ‘coupling’ phenomenon between performers described by Hennig (2014), and whether the presence of the long-range correlations identified in other research (Hennig et al. 2011) has direct impacts on perceptions of liveness specifically is difficult to say given the methodology deployed by this project. Again, further research involving would need to be conducted on these points.

## **5.7. Knock-on/Combination Effects**

The various approaches and interventions discussed above have effects on production beyond the immediate. Limiting the size of arrangements and the use of multi-tracking (for example) has a large impact on the mixing phase of production. Because the mix isn’t being ‘filled in’ by a large number of layered parts, each individual performance can be given considerably more space before the mix becomes too crowded or muddy.

The presence of spill, either real or simulated, has a timbral impact which informs later EQ decisions. It also effects the use of compression, since compressing tracks containing spill reduces the ratio of the loudness of the intended source to the spill present in the track. Gating could be used to filter out spill on tracks when their primary sound source is not being played, but gating is an imperfect solution, and if an effort is also being made to minimise editing that can’t be done in real time, manually cutting audio material in these instances should also be avoided. These issues manifest at some level in all recording – there will always be some degree of unintended noise on tracks. But it is generally very low in contemporary studio recording compared to a live rock performance, where several loud sound sources are co-present.

Limiting arrangements to only one or two guitar tracks and using a single lead vocal track as opposed to multi-tracking gives recordings a somewhat sparser feel than most

contemporary studio rock recordings, but which is common across live recordings. The addition of spill fills in some of this space by increasing the width of sound sources. In studio recordings, this might be done using reverb panned away from the instrument's direct sound.<sup>46</sup> In synchronous co-present band recordings, spill which is present as a matter of course fulfills this function. This was hypothesised in Chapter 3 with reference to a live recording of Metallica and seems to be confirmed by practical experimentation. This is an example of a case where one characteristic of live recordings (restricted arrangements) combines with another (the presence of spill) in an important way.

The significance of these knock-on effects can be seen through a comparison of Appendices 1A (a basic rock mix with no spill present), 1B (the same mix with spill simulation added but no further adjustments) and 1E (1B, but further work has been done on the mix taking the presence of spill into account). The differences here are subtle, perhaps most noticeable in the chorus at the end of the recordings. Changes were motivated primarily by a desire to bring back some of the clarity that was lost as a result of the presence of simulated spill.

As we can see, beyond the immediate effects of an intervention such as simulating spill, which aims to recreate a specific aspect of live recordings, such an intervention also results in later production decisions perhaps being more like the handling of live recordings. The closer in nature the basic materials of a mix are to live recordings, the stronger this influence towards mimicking live production practices.

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46 For example, see "Runnin' with the Devil" (Van Halen 1978). Much of the track features only a single guitar panned hard left, but a large amount of reverb has been applied, particularly in the right speaker. This technique is widely used throughout the album *Van Halen* (1978).

## 6. Conclusion

### 6.1. Overview of Findings

The thesis succeeded in partially answering the two research questions:

1. What are the production characteristics of rock recordings which cause them to ‘sound live’?
2. How might these characteristics be achieved in recordings which are not recorded live?

A number of production characteristics which appear to contribute to emphasising liveness in recordings (that is, to making recordings ‘sound live’) were identified. These are discussed in brief below in Section 6.2 and in more detail throughout the body of the thesis. Most likely, other factors not considered by this project also contribute to the construction of liveness. The initial exploration into this area conducted by the thesis is not comprehensive, but has offered numerous new insights in the specific areas of production considered which will be discussed in the following section.

Several methods for achieving these characteristics in asynchronous (non-live) recordings have been hypothesised throughout the thesis and are summarised in Section 6.3. Some of these were subject to practical experimentation. The results of this experimentation are somewhat inconclusive. Although the interventions tested and discussed in Chapter 5 did result in recordings which resemble live recordings in some ways, it is currently unknown how non-expert listeners would perceive these interventions. It seems likely from these initial tests that convincingly constructing liveness in recordings requires consideration of a wide range of factors, only some of which were able to be considered/tested in the scope of this thesis.

The significance of this project is primarily as an initial investigation into the topic of liveness as it relates to record production conceptually and in practice. The project’s synthesis of scholarly texts on liveness, authenticity, and mediation with the practical study of record production techniques lead to several contributions to knowledge discussed in more detail below. In particular, this thesis considered the question of liveness in recordings from a practitioner’s perspective and incorporated practical experimentation with production techniques, yielding insights not available from the audience/listener or purely theoretical perspectives explored in previous scholarly work.

Industry and fan sources discussed in the thesis suggest that there is genre-specific value in creating live sounding recordings, an idea which was reinforced by scholarly work linking the concepts of liveness and authenticity in the context of rock discussed in Chapter 2. The thesis further proposed a shared link with degrees and types of mediation present in the record production process as argued in Section 2.1. The thesis has made some initial strides towards a more formal understanding of what liveness means in the context of record production, and how liveness in recordings can be achieved in practice. These insights may be useful in genre-contexts where achieving a live sounding recording is valued.

## **6.2. Increasing Understanding of Liveness as a Property of Recordings**

A survey of scholarly discussions around liveness and in the area of the study of record production found that although some works briefly considered ways liveness might manifest in recorded music, it had not yet been the focus of sustained investigation. Chapter 2 focused on building a framework for thinking about liveness in the context of record production. The thesis has posited that liveness can be thought of as a conceptual property which may be present in recordings to a greater or lesser extent. Auslander (2008) put forth the idea that liveness in recordings would manifest as an affective experience for listeners of participating in a specific musical performance in a way or to an extent generally not present in studio recordings (ibid, 60). This thesis has built on this view by identifying specific properties of recordings or production practices which contribute to creating this affective experience for listeners in the context of rock recording.

Chapter 2 proposed a taxonomy of performance/recording situations in rock categorised by degrees and types of co-presence. Live recordings were defined under this model as recordings which are produced principally via recording a performance in which members of a band are both physically and temporally co-present to one another. Such live recordings should be expected to possess the property of liveness to by default. It follows that non-live recordings would be heard to possess liveness if they sound more like recordings of co-present performances. Forms of mediation which would disqualify a performance from being considered live by fans should also be avoided. In the context of rock, live recording contrasts in numerous ways with a contemporary normative studio recording and production practice which solidified by the late-70s. Creating and emphasising these areas of contrast is the primary strategy this thesis has considered in

order to create live sounding recordings.

With these ideas in mind, Chapter 2 suggested three general criteria that seem to contribute to creating liveness in recordings:

1. Recreation of acoustic and performance qualities present in a physically and temporally cohesive full band performance.
2. Avoidance of forms of mediation that cannot be executed in real-time.
3. A focus on realism of representation in the construction of the recording.

Two particular areas of record production (staging and performance) were then examined from a perspective informed by this broader conceptual understanding of liveness. An effort was made to identify specific ways in which live recordings tended to differ from studio recordings in these two areas, and to relate these differences to the three criteria listed above.

Chapters 3 and 4 identified several sites of difference between studio and live recordings which seemed to be significant:

1. Live recordings typically feature sparser arrangements than contemporary studio productions due to the limitations of live performance.
2. Live recordings feature spill between sound sources as a result of co-presence and co-temporality between performers. Various spatial and timbral effects were hypothesised to be the result of this spill.
3. The effects of performance environment on performers.
4. The degree/type of communication available between performers.
5. The effects of extensive editing of performances on studio recordings in contrast to live recordings, which are generally presented with minimal editing.

The taxonomy of performance/recording situations and subsequent proposal of the three general criteria for liveness in rock recordings, as well as the identification of the five potentially significant sites of difference between live and non-live recordings all constitute novel contributions to scholarly discourses surrounding liveness and record production.

Some of the factors hypothesised to be important differences between live and non-live recordings – in particular the effects of spill, intra-ensemble communication, and minimisation of editing – were further investigated through practical experimentation. The

aim of this experimentation was to test possible methods for imbuing asynchronously performed non-live recordings with a greater sense of liveness.

### **6.3. Results of Practical Experimentation**

The practical experimentation carried out throughout the project with the goal of simulating or recreating characteristics of live recordings in asynchronously performed recordings yielded some interesting results. As discussed in Section 5.6.1, attempts at simulating spill between sound sources successfully recreated some features of live recordings that were hypothesised to result from the presence of spill - increased width of sound sources and timbral alterations to sound sources.

These effects are quite subtle. They are unlikely to be identified consciously by non-expert listeners, or attributed correctly as being the result of spill between sound sources. However, they may still contribute to creating a sense of liveness in recordings. Studies referenced regarding performance showed that audiences are able to differentiate between and express preferences regarding quite subtle differences in timing (Gwilliam 2009; Hennig et al. 2011). In the case of the Gwilliam (2009) study, several participants who expressed a preference for one recording over another misidentified the difference in the recordings as relating to the mix rather than to timing. This reinforces the idea that differences don't necessarily need to be clearly identifiable to non-expert listeners in order to be significant – when it comes to record production, the subtle things matter.

The effects of the iterative recording approach described in Section 5.5, which was intended to encourage the presence of subtle effects on performances, are even more difficult to precisely describe or quantify. The effects of cohesive/co-present ensemble performances that this recording approach is attempting to replicate are mostly not able to be detected via critical listening. A more thorough empirical analysis may have been useful here, although many of these effects may still have been impossible to clearly identify in finished recordings.

The extent to which some of the test recordings do resemble live recordings is also likely due in part to the other aspects of production identified as being relevant in Section 5.2. The sparse arrangements, lack of double-tracking, presence of errors or general looseness in performance, and the use of microphones and microphone placements typical in live recordings all seem to be significant factors.

A point of concern when analysing the test recordings is that rather than being heard as 'live' they may simply be heard as 'unprofessional'. Audiences are highly

conditioned by the ubiquity of standard rock recording practices. Significant deviations from these norms may well be interpreted as a lack of expertise rather than an intentional choice. This suggests a broader question regarding what kinds and levels of deviation from normative recording practice are acceptable to a general audience. In the case of liveness, it may be that merely presenting a single aspect of live recordings, such as inconsistent performances, would be heard as unprofessional. If performance inconsistencies or errors are present without other factors signalling liveness, listeners will likely just assume that the musicians are unskilled. If, however, a recording also features the presence of spill or other factors that suggest a live recording it may be more likely to be interpreted as live.

With this concern regarding listener reception in mind, there are likely few viable use cases for the specific production interventions experimented with as part of this project. Executing the simulation of spill requires considerably more complex set up and signal flow than is typical, especially in mixes containing a large number of parts. The iterative approach to recording described in Section 5.5 is considerably more time consuming to execute than standard piecemeal recording/overdubbing. These costs in terms of complexity and time are non-trivial in the context of record production. The results of these techniques likely do not warrant these costs in most production situations. They may be made more useful if used in combination with further (as yet undeveloped) interventions intended to increase a sense of liveness in recordings. For the time being, these test recordings were primarily valuable in that their creation lead to insights regarding liveness that may not have been available through other means.

#### **6.4. Limitations and Directions for Future Research**

A necessary limitation in scope precluded the evaluation of non-expert listener responses to the experimental recorded materials. Such a study could provide valuable insights into what facets of recordings are most important in causing recordings to be heard as live and test the efficacy of various production strategies in increasing recordings' sense of liveness. Before any such study could be performed, it was necessary to develop the theoretical ground covered in this thesis to generate suggestions as to what factors might be worth testing. The thesis' initial experimental work testing the effects of certain production interventions with an expert listener may subsequently be followed up with listening tests involving non-expert listeners as research participants in a standardised blind listening experiment. A project focused on such experimentation would be a natural continuation of this thesis.

It was also not possible to consider every aspect of production which may be important in creating a live sound in this thesis. The realms of staging and performance are only two aspects of production which may be significant, and there are almost certainly others. Exploring other dimensions of record production and relating these to liveness warrants further investigation.

Practical experimentation with recording was limited to what is possible in a typical home recording setup as outlined in Section 1.3 (Scope). The thesis has at various points hypothesised interventions which were not practical to test in this environment. These could be explored by a future research project with greater access to the required resources.

A point of concern raised in Section 6.2 was that recordings which differ significantly from typical contemporary studio production practices may be heard as unprofessional or low-quality even in cases where the decision to eschew typical practice was made intentionally to achieve a specific aesthetic end. An interesting avenue for future research that goes beyond addressing the limitations of this thesis would be to further examine listener conditioning in rock; What types and degrees of difference from typical practice are acceptable to audiences? How does this conditioning interact with other factors such as methods of distribution, listener demographics, or broader economic structures? And how might producers or artists interested in challenging these norms proceed? These issues are relevant far beyond the idea of creating live sounding records, applying to any effort to create aesthetic experiences in recorded music which differ significantly from established norms.

It became apparent over the course of the project that a more formalised evaluative framework for analysing the production characteristics of recordings would have been a useful methodological tool. Discussion of recordings throughout the thesis was based on wide-ranging listening and comparison of live and non-live recordings, but was limited to referencing specific examples of the differences identified. If a formalised evaluative framework had been used, it would have been possible to better present these differences by referencing the resulting body of written research data. It would have been necessary to first identify production characteristics hypothesised to be significant and then develop a formal framework for noting the degree of presence or absence of these characteristics in a body of recordings. Future studies investigating the production characteristics of recordings should consider deploying such an approach.

Due to a lack of available literature addressing the concept of liveness as it relates to

record production, this thesis was designed as an initial exploration into the topic area. In that context, it is unsurprising that the project was limited in the ways discussed above. Nonetheless, the thesis was able to present numerous new ideas and discoveries relevant both to scholarly discourses surrounding liveness and to the study of record production which may be built upon by future research.

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# Appendices

Each appendix entry refers to a recording by file name and offers a short text description of the recording. All of the recordings are available for download at the following link:

<https://drive.google.com/file/d/1Last19QZZfoz5KNlmLB5xeghdBS131cY/view?usp=sharing>

## Appendix 1

These recordings are a partial cover of “Jet Black” (Jawbreaker 1995), or smaller clips extracted from this cover. Guitars and bass were recorded with Shure SM57s, vocals were recorded with a Shure SM58. These microphones were selected because they are typical in live recording situations. Close mics were positioned against the grills of the amplifiers, on-axis, centre speaker. The room microphone which is featured on some of the recordings is an sE Electronics Voodoo VR1 which was placed roughly an equal distance between the guitar and bass amplifiers, off-axis to both. The guitar and bass amps as well as the vocal and room microphones were set up for recording in the same space at the same time, although each part was performed asynchronously. The recording space was a small room with no acoustic treatment, typical of home recording.

These recordings all feature a fixed tempo. There are two guitar tracks, one bass track, and one vocal track in addition to drums synthesised using XLN Audio’s Addictive Drums 2, replicating typical arrangement restrictions of live rock performances. Drums were sequenced by hand.

### Appendix 1A

File name: 1A - Jet Black No Spill.wav

Description: This recording features no spill or any other particular attempts to achieve a live sound beyond the microphone and arrangement restrictions mentioned above. This recording serves as a baseline.

### Appendix 1B

File name: 1B – Jet Black Spill Mics.wav

Description: This recording features spill simulated using the signal flow

described/pictured in Section 5.3. In particular, the simulation is a hybrid of methods 2 and 3 described in Section 5.3. Using the microphone setup described above, the spill sends were configured using the microphone that most closely resembled what would be present in a synchronous co-present performance. This recording uses almost the same mix as Appendix 1A. The only modification made was on the master limiter to maintain the same overall loudness as Appendix 1A.

For example, spill from guitar tracks to bass and vocals used recordings from the microphones set up to capture those sources. Spill from one guitar track to another or to close drum microphones used the bass microphone. Spill from guitars to drum overheads used the room microphone.

## **Appendix 1C**

File name: 1C – Jet Black Room Spill.wav

Description: As Appendix 1B, however, all spill sends used the room microphone.

## **Appendix 1D**

File name: 1D – Jet Black Digital Spill.wav

Description: As Appendix 1B, however, spill tracks were created by digitally processing close mic tracks as discussed in Section 5.3.

## **Appendix 1E**

File name: 1E – Jet Black Spill Mics Remix.wav

Description: As Appendix 1B, but the level of spill has been exaggerated somewhat and the mix has been altered extensively with accounting for the presence of spill in mind.

## **Appendix 1F**

File name: 1F – Guitar Close Mic.wav

Description: A brief clip of the close microphone placed in front of the guitar amplifier.

Appendices 1F – 1I are included to facilitate comparison between an electric guitar as it is captured by a close microphone compared to the various options for use as a spill track discussed in Section 5.3.

## **Appendix 1G**

File name: 1G – Guitar Spill Mic.wav

Description: This is the same performance as Appendix 1F, but captured by a microphone set up in front of a bass amplifier in the same room.

## **Appendix 1H**

File name: 1H – Guitar Room Mic.wav

Description: As 1G, but captured from a general room microphone.

## **Appendix 1I**

File name: 1I – Digital Spill Sim.wav

Description: This is the close mic recording from Appendix 1F but digitally processed to resemble a distant/off-axis microphone as discussed in Section 5.3. The simulation in this case is of a considerably larger/more reflective space than the actual recording space, more akin to what might be heard in a large venue.

## **Appendix 1J**

File name: 1J – Snare with Spill.wav

Description: This is clip from the isolated snare track as it appears in Appendix 1E.

Comparing this with Appendix 1K demonstrates the differences between a perfectly isolated track and one which has had spill simulation applied to it.

## **Appendix 1K**

File name: 1K – Snare No Spill.wav

Description: As 1J but with simulated spill from other sound sources has been muted.

## **Appendix 2**

These recordings are covers of “Here I Dreamt I Was an Architect” (The Decemberists 2003). Microphone selection, arrangement restriction and drum synthesiser/programming approach are the same as in Appendix 1.

## **Appendix 2A**

File name: 2A – HIDIWAA Fixed Tempo.wav

This recording features a fixed tempo and the use of looped and copy-pasted grooves in the guitars and bass. The vocal performance is assembled from several different takes.

## **Appendix 2B**

File name: 2B – HIDIWAA Iterated.wav

As Appendix 2A, however, the iterative approach to recording described in Section 5.5 has been applied. Minimal editing of takes has been used and the tempo varies throughout the recording based on a human rhythmic performance. Slight differences in timbre and mixing are present as a result of this recording being captured some time after Appendix 2A in a different recording space.

## **Appendix 3**

These recordings are a cover of “Careful” (Sebadoh 1994). Microphone selection is the same as in Appendices 2 and 3. Unlike the other Appendices, these recordings feature one additional instrument outside of a typical live recording set up – a third guitar (acoustic) which is present at a low level throughout the recording. These recordings used the same approach to performance as in Appendix 2B.

## **Appendix 3A**

File name: 3A – Careful Room Spill.mp3

Description: Features spill simulation using a room microphone as in Appendix 1C.

## **Appendix 3B**

File name: 3B – Careful Digital Bleed.mp3

Description: Features spill simulation via processing of the close microphone tracks. The specific set up of the EQ, reverb, and delay here is different than in Appendix 1D, demonstrating the potential for creating the impressions of different spaces post-recording.

## **Appendix 3C**

File name: 3C – Careful No Spill.mp3

Description: As Appendix 3A, but the room microphones have been muted. This demonstrates how significant of a factor spill can become as it builds up across a mix.