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Composing with Noise

utilising noise as a transformative and generative tool for creative sound practice

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August 2021

Thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy

City, University of London – School of Arts and Social Sciences – Department of Music

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Notes on the Portfolio

When approaching this portfolio and thesis, it is recommended that listening and reading is interleaved, with each piece of the portfolio being listened to when it appears in the text. The portfolio is split into three sections, each named after the chapter in which those pieces are discussed.

Portfolio Contents

Improvising with Playback Media

Glitch Turntablism (2020) – 29'26"

Live recording of a *Glitch Turntablism* performance using modified CD players.

Originally broadcast on the Noise Quest live stream.

Bootlegs (2019) – 19'04"

Four track EP, containing improvisations performed on modified CD players.

Originally released on CDr by the label Fractal Meat Cuts.

Sckt (2021) – 02'08"

Fixed media composition, composed with modified CD players.

Scores and Visual Noise

Music for Piano 21-36 & 37-52 (2020) - 05'00" – 15'00" (recording length – 07'25")

For Baritone voice, C Trumpet, Tenor Trombone and Bass Clarinet.

Recording performed by the Loadbang ensemble: Adrian Sandi (bass clarinet), Andy Kozar (trumpet), Jeffrey Gavett (baritone voice) and William Lang (trombone).

Please note that within the thesis this piece is referred to as *Music for Piano for Loadbang* to avoid confusion with the John Cage suite of pieces with the same title.

Man in Regent Street (2021) – 15'00" – 60'00" (recording length – 40'14")

For soprano voice, paper, and live electronics.

Recording performed by Mimi Doulton (soprano voice).

(Un)fixed Media

Wallpaper (2020) – 05'07"

Fixed media composition for playback both as a digital file and over a telephone line.

The telephone line is available on 0330 818 0351 (calls cost your standard landline rate).

Included in the portfolio are three recordings of the telephone line recorded on different phones from different locations and times.

Features performers: Patricia Auchterlonie, Mimi Doulton, Ella Taylor and Juliet Wallace.

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Figure 4.1 © Robert Rauschenberg Foundation

Figure 4.2, Figure 4.6 and Figure 4.7

John Cage: Music for Piano 21-36 & 37-52

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Abstract

Within the field of Sound Studies, discourse on noise has increasingly looked to define noise by examining its affective and transformative properties, reformulating the question 'What is noise?' to 'What does noise do?' (Thompson 2017: 49). Approaching noise in this way presents an alternative to the three commonly accepted definitions of noise frequently utilised in texts on composition. These define noise as unwanted sound, spectrally dense sound, or loud sound. Through practice-based research this thesis and portfolio explores how the question 'what does noise do?' can be applied to creative sound practice.

By repurposing Claude Shannon's (1948) *A Mathematical Theory of Communication* the thesis lays out an approach for employing the transformative and generative potential of noise within composition. This approach provides a simple framework for engaging with the near limitless applications of the transformative properties of noise within creative sound practice. By reframing the role of noise in this way, this approach offers an alternative to conventional methods for utilising noise within composition, which generally treat noise as a qualitative or quantitative property of a sound.

Creative applications of this approach are examined through discussions of both the accompanying portfolio and related work from other practitioners. The discussion is split between three different forms of creative sound practice: improvisation with playback media, score based instrumental composition and fixed media electroacoustic composition. Each of these areas of discussion relate to specific projects within the portfolio: an improvisatory performance practice using modified CD players, scores utilising visual noise, and a fixed media composition available as both a digital download and a telephone hotline. This discussion highlights how, as well as being a novel way of approaching composition, when used as a transformative and generative tool noise is uniquely adept at interrogating the flaws in commonly accepted notions in creative sound practice; instruments become performers, performers become composers, and what was once fixed becomes variable.

Chapter 1:

Introduction

Most practitioners working with noise can tell a variation on the same humorous anecdote. It goes something like this:

> 'I was playing a gig. Mid-way through my set the promoter came over to the stage. Shouting above the noise they asked if I was going to play some music.'

Everyone laughs, noise musicians in the room make a mental note to tell their version of that story first next time.

I am in a room above an arcade in east London having finished my sound check for the gig that night. While I tidy up, rearranging my CDs and patch cables, the promoter comes over:

> 'I thought you were a noise musician, are you going to play some noise?'

Although not something I realised at the time, in hindsight this proved to be a pivotal moment. Not only do I now have my own anecdote to rush to tell first, but it articulated the question at the centre of my practice; how is this use of noise different from those conventionally discussed?

1.1 Noise as compositional material

There has been little agreement between creative sound practitioners about what noise is. However, the varying understandings of noise used within creative sound practice generally align with one of three definitions: non-periodic sound, loud sound, and unwanted sound. Each of these three definitions treats noise as a material quality of sound that is either quantifiable (non-periodic or loud sound) or a qualitative judgement (unwanted sound). When it comes to composition, making noise a material has its benefits. To take a simplified view of composition, it allows sounds to be designated as noise or not and then be arranged according to this into a musical structure, in the same way that chords have been sorted and arranged by major or minor, or electronic sound as gesture or texture (Smalley 1986: 81–2).

In textbook style discussions of using noise in composition, the most prevalent definition of noise is sounds with non-periodic waveforms. As composer Daphne Oram (2016: 39) describes: 'if it is a "musical" sound [the waveform] will have some resemblance to a repetitive pattern; if it is a "noise" it will usually have little that is repetitive'. This spectral approach to defining noise is derived from acoustics and the concept of white noise, a signal with equal intensities across all bands of the frequency spectrum. This definition is particularly commonly used by composers working with electronics. Electroacoustic composers Denis Smalley (1986: 65–8) and Curtis Roads (2015: 208) have both utilised this definition to propose continuums with noise in opposition to pitch. Both place the periodic waveforms of sine tones at one end of the spectrum and the random, non-periodic waveforms of noise at the other. When utilising this continuum in electronic composition, the two poles can be moved between by changing the harmonic content of a sound through techniques such as filtering, distortion and additive synthesis (Oram 2016: 31–48). As composer Aaron Einbond (2013: 57) highlights through the widely utilised model of subtractive synthesis – where a spectrally dense waveform is shaped into something more periodic through filtering – 'noise lies beneath the surface of the history of electroacoustic musics', even in pieces of music which often are not considered to be about noise The use of this definition is not limited to electronic composition. Hermann Helmholtz's (1954: 9) foundational text *On The Sensations of Tone* laid out this definition in relation to acoustic instruments in 1863, and composer Henry Cowell's (2002) essay *The Joys of Noise* utilised this definition to examine noise in orchestration. Quantifying noise as non-periodic sound provides a useful tool for composition, as Cowell (2002: 252) notes, it has the potential to allow noise to be thought of and arranged in a similar method to notes and intervals.

An equally quantifiable, although less often discussed definition of noise, is that of noise as loudness. Like the spectral definitions of noise above, noise as loudness allows for noise to form part of a

continuum, framing noise in opposition to quiet or silence. As sound levels are relatively easy to measure, loudness is often used by governments when implementing restrictions on noise; for example, the UK Noise Act utilises loudness to determine legally what is or isn't noise (UK Government 1996). Despite its quantifiability, sound practitioners working with noise as loudness rarely utilise specific measurements to determine what is or is not noise in this context. Instead, practitioners commonly look to the effects of sound at extreme volumes as the determining factor of noise. As cultural studies theorist and sound artist Julian Henriques describes, at the extremes of loudness sound goes beyond the aural, becoming a visceral, physical experience:

> The volume of sound crashes down on you like an ocean wave, you feel the pressure of the weight of the air like diving deep underwater. […] Sound at this level cannot but touch you and connect you to your body. It is not just heard in the ears, but felt over the entire surface of the skin. The bass line beats on your chest, vibrating the flesh, playing on the bone (Henriques 2003: 452)

Utilisations of this visceral, enveloping potential of loud sound can be found in many styles of music, for example bands like My Bloody Valentine have become famous for the extreme loudness of their live shows, using this noise to create what they describe as 'an amazing physical experience, a real transcendent experience' (Shields in Petridis 2021). However, probably the most prominent example of noise as loudness originated in Japan where the extreme volumes used by musicians such as Merzbow and MSBR have become a defining feature of the Noise Music scene (Hegarty 2007: 142). As ethnomusicologist David Novak describes:

> The sheer loudness of Noise can produce sensations of interiority, and live shows are valued for this immersive experience, especially in the tiny "livehouses" of urban Japan, where audiences are suffused in an intense environment of overwhelming volume. (Novak 2013: 22–3)

Beyond these two quantifiable approaches to defining noise, the final way noise is commonly defined in creative sound practice is as unwanted sound. Cultural theorist Paul Hegarty (2007: 5) states: 'noise is negative: it is unwanted, other, not something ordered. [...] In other words, it does not exist independently, as it exists only in relation to what it is not'. What makes a sound 'unwanted' can vary quite considerably as this qualitative assessment can be incredibly personal. As sound arts theorist Salome Voegelin (2011: 48) describes 'when I am not there my neighbour's stereo is not noisy. […] Noise needs me'. For soundscape composers like R. Murray Schafer and Hildegarde Westerkamp, unwanted noise predominantly pertains to human made mechanical sounds such as cars and factories. Falling under the umbrella of 'Acoustic Ecology', these composers

blend artistic practice with semi-scientific aims and approaches to ‘study the relationship between people and their acoustic environment’ in order to find ways ‘to achieve ecologically balanced soundscapes and bring congruence to the relationship between the human community and its sonic environment’ (Hill 2014). For these artists noise informs their compositional approach not through use but through its avoidance.

In contrast, many other composers have sought out ‘unwanted sound' to be utilised within their music. However, unlike Acoustic Ecologists, who define noise based primarily on personal aesthetic and moral judgements of what is unwanted, these noises are rarely unwanted to the composer. Instead, they often look to sounds that may be considered unwanted in a specific situation or may be culturally unwanted. For example, practitioners working in the electronic music genre of Glitch, such as Oval, AGF and Ryoji Ikeda, seek to expose the usually unwanted sounds of digital audio and re-contextualise them as musical material. As Cascone (2000: 13) describes ‘it is from the "failure" of digital technology that this new work has emerged: glitches, bugs, application errors, system crashes, clipping, aliasing, distortion, quantization noise, and even the noise floor of computer sound cards are the raw materials composers seek to incorporate into their music'.

A broader example of what may be culturally considered unwanted sound can be found in the framing of a separation and opposition between noise and music. For example in his 1937 essay *The Future of Music: Credo* composer John Cage (1968: 4) suggested that ‘whereas, in the past, the point of disagreement has been between dissonance and consonance, it will be, in the immediate future, between noise and so-called musical sounds’. Similarly, in his 1913 essay *The Art of Noises*, futurist artist Luigi Russolo (2009: 27) criticises the limited sounds of the orchestra stating that ‘this limited circle of pure sounds must be broken, and the infinite variety of “noise sound” conquered’. Although still used today, the opposition of noise and music as a formal structuring tool for composition has not seen the widespread adoption predicted by Cage. This lack of adoption is perhaps, at least in part, a direct result of composers like Cage and Russolo’s calls to expand what sounds can be considered music. This is particularly true of Cage, who through his ‘silent’ piece *4’33’’*, is often credited with musicalizing all sound by making ‘the ability and willingness to listen […] the only requirements’ for a sound to be considered music (Kahn 2001: 158). Despite often being credited with this, to what extent Cage is solely responsible for this is a point of contention. However, it is undeniable that since the early 20th Century there has been an expansion of what is considered ‘musical sound’ that has in turn undermined the distinction Cage and Russolo made between music and noise.

Definitions that allow composers to treat noise as a composition material have been widely used since the increase of interest in noise from the early 20th century. However, within the field of sound studies, critiques of such definitions have developed, and alternative ways of defining noise have been proposed.

1.2 ~~What noise has been~~[1]

Sections exploring 'what noise has been' seem almost ubiquitous in contemporary discourse on noise. These sections usually offer criticism of the three conventional definitions of noise – unwanted sound, non-periodic sound, and loud sound – and explain why these definitions are ineffectual and should be disregarded. Media theorist Greg Hainge (2013: 9) argues that while these definitions of noise may seem 'commonsensical', they are problematic due to being 'mutually incompatible' and 'subject to high degrees of subjective variation'. Sound studies theorist Marie Thompson (2017: 17–40) provides a critical analysis of the limitations and overlaps of these definitions and highlights the biases and oppressive structures that these definitions can perpetuate and reinforce. Such criticisms are not unwarranted, despite the common usage of these three definitions each has limitations, and in combination they are often contradictory: the hum of a broken light fitting is often unwanted, but it is also pitched and quiet. Increasing confusion over the definition of noise has led to calls to reconsider the use of the term. Composer Michel Chion (2011) suggests that the term 'noise' is so broad as to be useless and should be replaced with more specific language, whereas composer Peter Ablinger (2013) suggests a distinction between 'noise' (white noise) and 'noises' (unwanted sound).

Thompson (2017: 2) highlights that defining 'noise' in a succinct and encompassing way is difficult as 'noise is a "noisy" concept: it is messy, complex, fleeting, fuzzy-edged and, at times, infuriating'. Contemporary attempts to define noise often attempt to clarify and 'de-noise' the concept, disregarding the mess of the older, conflicting, and less developed definitions. Thompson's (2017: 4) book *Beyond Unwanted Sound* is one particularly noteworthy example of this reconsideration of noise, which proposes an 'ethico-affective' approach to defining noise. In this approach, Thompson applies Spinozist concepts of affect[2] and draws upon a wide variety of often non-musical philosophies and theories involving noise, including Michel Serres' *Parasite* and Claude Shannon's *A Mathematical Theory of Communication*. Thompson (2017) argues that noise is an inherent part of

[1] The stylisation of the fonts used for various headers and chapter titles throughout this thesis has been done in order emphasise the content of the respective sections.

[2] When discussing Spinoza, Thompson highlights that '[t]here is not one but many "Spinozas", insofar as his work has been interpreted in different ways within different disciplines. Here, I refer to Spinoza's work as it is "appropriated" by Gilles Deleuze' (Thompson 2017: 11). For an outline of Deleuze's interpretation of Spinoza's affect see: (Deleuze 1978).

any medium that operates as an affective force, that is transformative and has the potential to be positive. The new perspectives on noise suggested by Thompson and others working in this area of sound studies offer considerable creative potential for composers and creative sound practitioners. This shift in focus away from what noise 'is', to what noise 'does', is the starting point of this thesis, as it suggests new ways noise can be used in composition. Rather than utilising noise as a material, it can instead be used to transform and to generate. This approach has applications across the broad spectrum of creative sound practice; this portfolio and thesis explore specific uses in improvisation, instrumental and fixed media composition. However, the potential applications are not limited to these particular cases. It does not seem unreasonable to suggest that most creative practitioners, even those not working with sound, may find uses within their practice for the transformative and generative potential of noise.

While contemporary discourse on noise provides new and clearer ways of understanding noise, to discount the commonly utilised, material definitions of noise on the basis that they are unclear presents an issue. As discussed in section 1.1, many practitioners have worked and continue to work with these definitions as the basis for their musical output. To invalidate these definitions has the potential of obscuring the original intention of this music and, as such, a total disregard of the old, as often proposed within the field of sound studies, may not necessarily be the best approach. Therefore, while this thesis presents a new way of utilising noise within composition it is not the intention to usurp existing approaches to composing with noise. Without doubt there is plenty of exciting music still to be made with unwanted, non-periodic or loud noise. Instead, the approach presented here should be viewed as something which can co-exist as an expansion and development to the existing approaches to composing with noise.

Chapter 2:

Composing with Noise

‘Composing with Noise’ in this context does not mean ‘Composing with Noisy Sounds’. Rather than looking to material definitions of noise (loud, non-periodic, or unwanted), the approach to composition outlined in this chapter looks to noise as a tool with the power to transform and generate. This way of understanding noise has been derived from mathematician and electrical engineer Claude Shannon’s *A Mathematical Theory of Communication* (1948). This theory positions noise as an inherent part of a communication system which acts upon a signal during transmission ‘to produce the received signal’ (Shannon & Weaver 1949: 34), or as Thompson (2017: 50) summarises, noise is something ‘which interferes with and subsequently modifies a signal’. This chapter begins by exploring the framing of noise within Shannon’s theory, the broad applications of Shannon’s theory and its main criticisms and limitations. It then outlines how this theory can be repurposed to inform composition. It is important to note that this is not a strict method for composition, it does not resemble *A Mathematical Theory of Composition*. Instead, it better resembles an approach or way of thinking about composition and the role noise can play within it, that both utilises and interrogates Shannon’s theory.

2.1 A Mathematical Theory of Communication

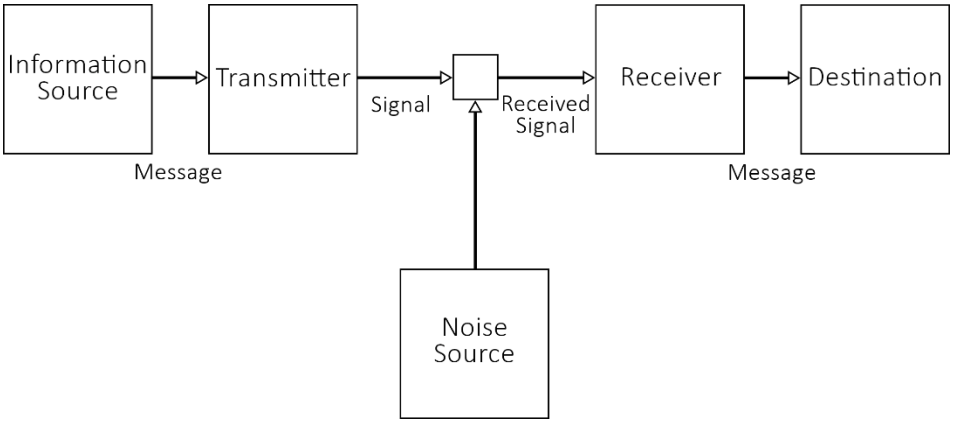

Figure 2.1 Shannon's 'Schematic diagram of a general communication system'
(Shannon 1948: 381)

Published in 1948 by the communications research centre Bell Laboratories, Claude Shannon's (1948) *A Mathematical Theory of Communication* built upon research by electrical engineers Ralph Hartley and Harry Nyquist, also of Bell Laboratories, in order to produce 'a general theory of communication' (Verdú 1998: 2057–8). Viewing the 'semantic aspects of communication [as] irrelevant to the engineering problem', Shannon (1948: 379) side-lined meaning in favour of the quantifiable aspects of communication. Within *A Mathematical Theory of Communication*, Shannon laid out a model for a communication system, seen in Figure 2.1 (above). Shannon highlights that this 'schematic diagram' for a communication system consists of five main parts:

> 1. An *information source* which produces a message or sequence of messages to be communicated to the receiving terminal […]
> 2. A *transmitter* which operates on the message in some way to produce a signal suitable for transmission over the channel […]
> 3. The *channel* is merely the medium used to transmit the signal from transmitter to receiver […]
> 4. The *receiver* ordinarily performs the inverse operation of that done by the transmitter, reconstructing the message from the signal […]
> 5. The *destination* is the person (or thing) for whom the message is intended […]
>
> (Shannon 1948: 380–1)

In addition to these five elements there is a sixth part in the system: a noise source. Contrary to Hartley's (1928: 535) assertion that as noise 'can never be entirely eliminated' we can 'arbitrarily assume it to be absent', Shannon 'considered noise as *part* of the communication system in order to

find ways to deal with it' (Sterne 2012: 87). Shannon's (1948: 379–80) theory outlined a shift in perspective on the role of noise in communication, as well as several other aspects of communication system design which have gone on to become ubiquitous in contemporary systems, such as utilising a base two logarithm, also known as binary. Following its publication, *A Mathematical Theory of Communication* had an immediate impact in the field of electrical engineering, becoming the foundational text in the field of Information Theory; some have gone as far as to call it 'the Magna Carta of the information age' (Verdú 1998: 2057). It received wider attention a year after it was originally published when it was republished as a book with a new introduction from mathematician Warren Weaver that 'helped readers see past the complex math' and a new title: *The Mathematical Theory of Communication* (Sterne 2012: 20).

2.1.1 *The* Mathematical Theory of Communication

The change of title in 1949 from *A Mathematical Theory of Communication* to *The Mathematical Theory of Communication* is subtle but significant, presenting it as the definitive theory of all communication. Coupled with the new commentary from Weaver that sought to emphasise the generality of Shannon's theory, highlighting the potential for its wider application beyond engineering and telecommunications. The implied generality of Shannon's theory has resulted in it being applied across a broad field of studies, ranging from analysis of the mating calls of king penguins to identifying cancer biomarkers (Berretta & Moscato 2010; Lengagne *et al.* 1999). Weaver (1949: 3–4) suggested that the theories in the book can be applied 'equally well to music of any sort, and to still or moving pictures as in television'. Of particular relevance to music composition is the recent increase in discussion and applications of Shannon's theory in the growing field of Sound Studies, in particular in discourse on noise. A notable example of this can be found in Marie Thompson's (2017) book *Beyond Unwanted Sound*. Discussing *The Mathematical Theory of Communication*, Thompson highlights the transformative role of noise within Shannon's theory, stating that:

> In Shannon's diagram noise is depicted not as a component but as a *relation*. The line that connects the noise source to the transmitted signal represents noise – and this relation that is noise *does* something. According to Shannon and Weaver, noise is that which interferes with and subsequently modifies a signal in its passage between emitter, transmitter and receiver. (Thompson 2017: 50)

Reading Shannon's theory through a Spinozist concept of affect, Thompson (2017: 51) goes on to argue that noise is an affective force, that once noise has acted upon a signal within a communication system 'what is received is an affection of the signal […] upon which a noise source

[…] leaves a trace'. The cross-disciplinary applications of Shannon's theory combined with its foundational role in the field of Information Theory, attest to its generality and give credence to its definitive second title. However, despite Shannon's theory being commonly accepted and widely utilised, in recent years researchers in a variety of fields have scrutinised the generality of Shannon's theory.

2.1.2 The Mathematical Theory of Communication?

Exploring the historical positioning of Shannon's theory, Sound Studies researcher Jonathan Sterne (2012: 80) draws attention to the capitalist motivations behind *A Mathematical Theory of Communication.* Sterne (2012: 80) notes that due to the American Telephone and Telegraph Company's ownership of Bell Laboratories, Shannon's theory 'descended directly' from AT&T's attempts to maximise profit, and that because of this 'the mosquito of corporate capitalism was embalmed in the amber of information theory'. Thompson (2017: 49) also highlights this issue, stating that 'despite the abstract language it employs, Shannon's model is by no means "neutral" […] it is reflective of the financial imperatives of the telephone and telegraph company'. The capitalist bias inherent in Shannon's theory raises questions of its definitiveness; if a communication system's purpose doesn't fit within the economic and political structures of capitalism, then perhaps Shannon's theory isn't *the* theory.

Shannon's (1948: 379) assertion that the 'semantic aspects of communication are irrelevant to the engineering problem' is also questioned. Communications researchers José María Díaz Nafría and Basil Al Hadithi argue that Shannon's approach is an over-simplification, stating that:

> One of the radical simplifications carried by this model is the assumption that information or the semantic content travels wrapped by the clothing of the message, and once it is received by the consignee, this is self-sufficient for retrieving the semantic content. (Díaz Nafría & Al Hadithi 2009: 302)

Díaz Nafría and Al Hadithi go on to highlight that in using Shannon's model, the meaning of a communication may not be correctly interpreted. They instead encourage the exploration of alternatives to Shannon's theory that place an emphasis on semantics. In his book *The Sonic Persona,* sound studies theorist Holger Schulze (2018: 93), perhaps the most ardent of Shannon's critics, argues that Shannon's disregard of semantics is evocative of the 'colonialist and imperialist imprint of nineteenth-century research cultures' as it seeks to 'overpower the findings and to have them processed following the orders of a master of one's own kind'.

Schulze (2018: 90) is also strongly critical of the implied generality of Shannon's theory, arguing that it fails to account for the 'highly complicated and amalgamated mingledness [of the everyday,] that

experientially exceeds any reduction to well-defined terms and atoms'. He argues it is not a general theory of communication but one only applicable to 'the field of militarily organized and applied information transfer' and that to apply the theory outside of that field is to enforce a militarisation in non-military fields (Schulze 2018: 90). Schulze (2018: 90) goes as far as to state that 'almost every single detail in the definition by Claude Shannon is wrong'. However, the examples provided by Schulze to highlight the flaws in Shannon's theory are primarily confined to the simplicity of Shannon's schematic diagram of a general communication system, rather than Shannon's main contributions to information theory – Schulze makes no mention of Shannon's conception of the role of noise in a communication system, for example. In a review of Schulze's book, interdisciplinary artist and theorist G Douglas Barrett notes that Shannon does attempt to address some of Schulze's concerns as he highlights that the elements in the model are 'suitably idealized from their physical counterparts' (Shannon in Barrett 2020: 472). However, Schulze's concerns are not unfounded – the simplicity of Shannon's theory does make for an uncomfortable fit when it is applied to everyday communication, which is often complex and multifaceted with an emphasis on meaning.

Given these shortcomings of Shannon's theory, it may seem counter-intuitive to present a new application of it however, in many ways, these weaknesses in Shannon's theory are strengths when applied to composition. As Schulze identifies, while the simplicity of Shannon's model makes it seem easy to apply and easy to use, the reality is that these applications can be an oversimplification of the multiple layers of complex communication taking place. For example, a piano recital could be visualised utilising Shannon's model with the score as the information source, the piano as the transmitter, the audience's ears as the receiver and the audience's brains as the destination (see Figure 2.2 below).

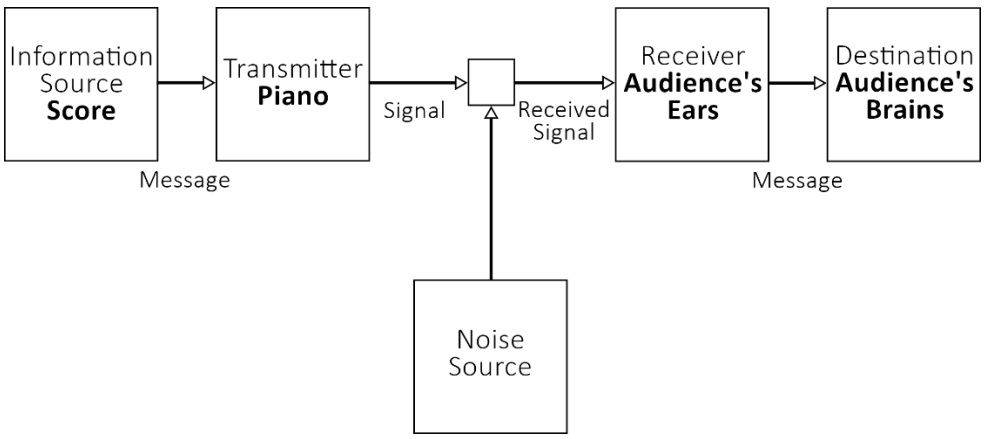

Figure 2.2 'Schematic diagram of a general communication system' applied to a piano recital

However, representing the recital in this way ignores multiple layers and aspects of communication taking place. The composer is communicating to the performer via the score, the audience's ears are communicating with their brains via the cochlear nerve, etc., and not only this, but communication can go back the other way simultaneously; the performer is likely trying to observe and read the audience's enjoyment of the performance, making subtle adjustments in response ('does that person hate this performance, or do they just have a cough?'). Rather than representing everything that is happening in a given scenario, an application of Shannon's model may only represent a tiny part of the communication taking place. However, while potentially problematic for the design of a communication system, this flaw simply broadens the creative potential when applied to composition. When applying Shannon's theory here, it is appropriated as a method for identifying potential noise sources and their creative effects. Given the complexity of communication and the ubiquity of noise there can be an overwhelming number of potentially useable noise sources affecting multiple layers of communication in different ways. The reductive nature of Shannon's theory provides a simple way of identifying and isolating individual noise sources. In addition, interrogating how applications of Shannon's model are ineffectual representations of the multiple layers of communication taking place can help in identifying sources of noise that may not initially seem obvious. As such, the model can often be applied multiple times, in multiple ways to the same scenario to identify different sources of noise with different creative applications.

Similarly, Díaz Nafría and Al Hadithi's concerns over Shannon's disregard for the semantics of the communication taking place, and the potential affect this could have on a communication, provides further potential creative applications. In his introduction to *The Mathematical Theory of Communication* Weaver (1949: 26) highlights this issue of meaning changing within a communication system and suggests the addition of a box on Shannon's diagram labelled 'semantic noise'. Again, while this may present problems for designing and analysing communication systems, in the context of utilising noise in composition, the more potential ways noise can transform a signal the more potential applications of noise to composition. Identifying how a communication system can diminish, transform, or generate meaning provides another avenue for creative exploration. Finally, it is worth highlighting that although not the primary driver of this application of Shannon's theory, appropriating Shannon's theory for use in composition has the potential to challenge the capitalist undercurrents of the theory. Utilising and encouraging noise within a communication system undermines the capitalist intentions of Shannon's theory which was primarily written in order to minimise and/or mitigate noise in order to maximise profits. Misusing Shannon's theory in this way could provide a potential for interrogating the failures and shortcomings of capitalist means of communication through sound.

2.2 Using noise

For Shannon and Weaver (1949: 19) the noise of a communication system was predominantly negative, as in their opinion it produces 'spurious and undesirable' results. However, the approach presented here seeks to move beyond a negative understanding, towards considerations of how noise can be utilised positively, to not just 'diminish and destroy, but also to enhance and create' (Thompson 2017: 8). At times, the sounds made working in this way align with conventional definitions of 'noise' (loud, non-periodic, or unwanted) however, this is not the specific aim of this approach. Instead, this approach looks to noise for its transformative properties, utilising it to manipulate information in order to produce a new result. Thus, this compositional approach diverges from the majority of conventional discourse on the utilisation of noise within composition, which predominantly understands noise as a material rather than as a transformative tool.[3] Thompson (2017: 8) states that 'noise is inescapable, unavoidable and necessary'. Noise is everywhere, permeating, affecting, and altering all communication. As such, while this approach to composing with noise may be a novel, it isn't really 'new'. Noise affects every composition, performance, improvisation, recording session, audio playback, etc., even if those involved are unaware of it and it is not foregrounded in the music. Despite the ever-presence of noise, its effects are usually mitigated or ignored. However, shifting the perspective on noise and actively engaging with it can result in wide variety of unique, exciting, and varied new music.

This approach to composing with noise can be summarised simply as: find a situation where information is or can be transmitted; identify, or introduce, a noise source; and explore what that does to the information. This approach can be applied to any situation where information is being transmitted. While Shannon's theory focuses on electronically mediated communication, this approach is not limited to this, noise is present in all forms of communication be it acoustic, visual, written, etc. Although sound is the most commonly associated form of information in music, there is no reason why this approach needs to be confined to the sonic; music making is built from a myriad of different approaches to communication. It is worth reiterating that this approach is a reframing of how noise can be utilised within the compositional process rather than a specific method for composition and utilising this approach does not necessarily impart any one aesthetic or specific musical characteristics – although these can often be derived from this approach.

While this is not intended as a step-by-step method for composition, the remainder of this chapter outlines some practical considerations for getting started with this approach to composing with

[3] Examples of discourse on composing with noise as a material include: (Cowell 2002; Roads 2015: 208–13; Russolo 2009; Smalley 1986: 65–8)

noise. These are not specific or exhaustive and are intended as a stimulus for creative exploration, as well as providing context for the discussion in subsequent chapters on the implications of using this approach. These chapters discuss the utilisation of this approach within different areas of creative sound practice considering the implications of working in this way. Each frames discussion around creative practice, examining related work from other practitioners as well as one or more pieces from the accompanying portfolio.[4] Chapter 3: Improvising with Playback Media discusses the performative use of playback media devices, such as turntables and CD players, within improvisation examining how by introducing noise to cause these devices to fail they can begin to take on the role of a performer. Chapter 4: Scores and Visual Noise looks beyond the sonic applications of this approach, exploring how transforming visual materials, in particular scores, through noise can be utilised to create complex evolving structures, highlighting how this can call in to question conventional understandings of the composer/performer dynamic. Chapter 5: (Un)fixed Media considers how the noise inherent in the process of playing back fixed media compositions transforms the piece, rendering the composition unfixed and how this unfixing can be utilised as a feature of the composition. The practice that underpins each of these chapters began with the same first step, identifying what I wanted to transform and what communication system I wanted to work with.

2.2.1 Choosing information and a communication system

To utilise this approach, both information and a corresponding communication system are needed. The term 'communication system' is used here in a broad sense: a medium in which information is being transmitted, and 'information' is whatever material is intended to be transformed by noise.[5] Either can be picked first, starting with a specific form of information and identifying means of communication that use it or, choosing a medium of communication that seems particularly interesting and exploring what kind of information it can transmit. The options for what information to transmit and transform are vast and ever expanding. Given that this is a method for composition and music is predominantly sound based, a logical starting point is transmitting sound in some form. In this case utilising systems intended for recording or playing back sound such as a record player or a loudspeaker may be a good choice for a corresponding communication system. However, as any information that can be transmitted can be manipulated with noise, this approach is not limited to

[4] Where related work by other practitioners is discussed, it is to consider the effects and implications of utilising noise in this way through work which is similar. It is not the intention of this thesis to argue that these practitioners are/were utilising the approach discussed here, or to use Shannon's theory as an analysis tool.
[5] While terms like 'information' and 'communication system' are most commonly used in electronically mediated systems this approach is not limited to this, low-tech and no-tech communication systems and information sources are equally ripe for exploration.

sound. Any information that could form part of a composition or influence the composition process can be used, for example words, diagrams, gestural movements, or scores. In addition, the corresponding communication system does not necessarily need to be a 'good choice'; trying to send a form of information through a system that is not designed for it can sometimes produce even more interesting results. Ultimately, the scope for what can be transformed and what can be used to transform it is almost limitless and as such, decisions on what information to manipulate and what communication system to use primarily come down to personal preference.

2.2.2 Finding and/or making noise

In almost all forms of communication noise is ever-present. Sometimes the effects of noise on a signal are obvious but they can also be subtle or almost imperceptible. The latter is often the case in electronically mediated communication systems which, are generally designed to minimise and mitigate the effects of noise. After all, mitigating the effects of noise was a considerable part of Shannon's original motivation when researching and writing *A Mathematical Theory of Communication* which has been used as a model for many of these technologies. Noise that is present, particularly in contemporary technology, can often go unnoticed. Greg Hainge (2005: 9) argues that recognising noise within contemporary technology is impossible as noise is 'only recognised after the fact', when new, less-noisy technology is introduced. This is perhaps a slightly hyperbolic and ahistorical argument. For example, when describing the sound of gramophone records in 1927, philosopher Theodor Adorno (1990: 48) highlighted their uneven frequency response, criticising their 'shrill tone'. Similarly, writing in 1982, the year the CD was commercially released, audio technology reviewer David Ranada (1982: 70) discussed glitches in the CD's audio playback describing '[b]ursts of low-level clicks' and 'audible jumps in the signal'. While it may not be the focus, the noise of a contemporary playback media doesn't always go entirely unnoticed.

This is arguably an overly literal reading of Hainge's argument which, primarily pertains to how the meaning we attach to the noise inherent in technology changes over time. However, this literal interpretation is not entirely incorrect. In the same essay where he refers to gramophone records as 'shrill', Adorno (1990: 48) also states that the 'incidental noises' present in earlier gramophone records, presumably referring to the pops and crackles of surface noise, had 'disappeared', although any record made in 1927 would likely have levels of surface noise that would be quite obvious by today's standards. Despite being present, the noise of contemporary technology is often significantly less apparent until a new technology without this noise highlights this. Whether due to the impossibility of looking back on the present retrospectively or, due to engineering designed to mitigate noise, when attempting to utilise the noise of a communication system in composition, the sources of noise and their effects upon a signal may not be obvious. If the effects of noise are

incredibly subtle or seemingly absent it may be necessary to explore how the communication system works, in order to identify how it can be used.

Researching and understanding how the communication system operates can offer insight into what source(s) of noise may be acting upon the system.[6] For some communication systems documentation may be available, for others a certain amount of reverse engineering, such as mapping a best fit of Shannon's model to the communication system, can provide useful insight. When attempting to identify noise sources utilising Shannon's model, it is worth noting that while the noise source in the schematic diagram appears to come from outside the communication system, 'there is no reason why it could not in fact originate also in the communications channel itself' (Hainge 2013: 10). Additionally, while Shannon's model only has one box signifying a noise source, often there is potential for a multitude of different noise sources to be acting upon a communication system at once each affecting the signal in differing ways. Additionally it is worth keeping in mind that as Schulze (2018: 90) highlights, for a non-engineered communication system, for example an in-person conversation, Shannon's model may not represent the entirety of the communication taking place. Fortunately, even if Shannon's model is not a perfect fit from an analysis perspective, the aspect of Shannon's model that is needed here, noise, is unavoidable and omnipresent and if desired, additional sources of noise can often be introduced. Once it is clearer how the system functions and where noise is or could be acting upon the system it is then a case of identifying how to make the effects of the noise more pronounced or how to introduce a new source of noise into the system.

How to use, emphasise or introduce noise varies with each communication system and the information used. Some techniques and specific examples are discussed throughout the following chapters however, again, these are not exhaustive. To cover every possible eventuality of this approach would be impossible. Noise permeates all communication, as such there is a universe of potential noise sources available to be used to transform and generate. Using the approach outlined in this chapter and the foundation of different examples below, I hope that creative sound practitioners continue to experiment with using (and misusing) communication systems for the creative potential of the noise found in them.

[6] It is worth noting that a methodical, research-based approach is not always necessary; impulsive experimentation and exploration can produce fruitful results. Finding out the answer to "I wonder what would happen if I just do this" by just doing that thing has often proven to be a valid approach. Or in other words, lick your finger and poke around in a CD player.

Chapter 3:

Improvising with Playback Media

Throughout the twentieth and twenty-first centuries playback media – such as vinyl and the compact disc – have been adopted by performers as a means of transforming and generating sound. This practice is widespread across a vast array of sound-based arts and has permeated popular culture. For example, performing with vinyl records – known as turntablism – reached near ubiquity in popular music towards the end of the twentieth century, spawning and defining genres from hip hop to house. Turntablists – from DJ Kool Herc and Grandmaster Flash to Shiva Feshareki – have developed a rich tapestry of complex and highly idiomatic techniques for performing with vinyl. Because of this, discourse on the utilisation of vinyl and other playback media often refers to these technologies as a 'musical instrument' that can be utilised 'in both […] creation and performance' (Smith 2007: 86).

As practices exploring the creative potential of playback media have developed, improvisers have looked to test the boundaries of what is possible with these technologies. Through doing this, practitioners have begun to actively engage with the sonic potential of pushing technology to the point of failure through the introduction of noise into the playback system. Improvisers often look to push playback technology 'to the edge of breaking', introducing noise to destabilise the technology, but stopping short of removing its ability to function entirely (Kelly 2009: 34). Many improvisers working in this way aim to maintain the technology in a state of failure, setting up systems where the playback media exists on the cusp of complete technological breakdown. Due to the effects of

noise in this system, the playback technology often behaves erratically and throughout performances improvisers engage and respond to this, altering the noise source to change the system, producing an evolving sense of form. When working in this way, the relationship between the improviser and the playback media becomes increasingly complex. The notion that the playback media is just an instrument that the improviser is performing with begins to feel unsatisfactory, with practitioners describing the process of working with these systems as feeling 'more like playing with another musician' (Dunning 2019: 8).

This chapter explores how introducing noise into a playback media system, in order to push the technology to the point of failure, can cause these devices to function as an improviser, exhibiting musical agency over the performance that mirrors that of human improvisers. Through a discussion of approaches to this practice from improvisers such as Yasunao Tone, Maria Chavez, Graham Dunning, Christian Marclay and Otomo Yoshihide, this chapter will first examine how failing playback media functions within a performance and the ways in which playback media can be understood to improvise. It then explores how the improvisatory nature of failing playback media informed the development of a performance practice utilising CDs, called *Glitch Turntablism,* that features in the accompanying portfolio. After establishing the reactive, collaborative nature of performing with this failing playback technology, the chapter will then consider the problem of recording and fixing these improvised performances and how the collaborative nature of improvising with the failing playback media translate to these recordings.

3.1 More than an instrument

Similar to 'noise' there is no singular definition for what constitutes an 'instrument'. However, here the need to define 'instrument' is perhaps a distraction. Regardless of whether there is an agreed definition, improvisers experimenting at the limits of technological boundaries continue to self-define what is or is not a musical instrument in their practice. As improviser and researcher Thor Magnusson (2019: 17) states: '[p]ut simply: anything can be a musical instrument if framed as such'. Rather than attempting to identify a satisfactory and all-encompassing definition here, it is perhaps more pertinent to examine what it is about these devices that leads practitioners to consider them as musical instruments and what this brings to the process of improvised performance.

Descriptions of playback media as an instrument can be traced back to the first half of the twentieth century. In 1930, Paul Hindemith and Ernst Toch premiered works for gramophone discs that contained pitch-shifted sound created by adjusting the speed of playback on a gramophone; Toch described this process as allowing him to create 'a kind of instrumental music' from the mechanical process (Toch in Katz 2001: 162–4). By 1948, Pierre Schaeffer had begun experimenting with

playback media as a means of manipulating sound to make music. Writing in April 1948 on one of his earliest experiments with record players, Schaeffer notes:

> By arranging the discs on record players, I can, using the controls, play these notes as I wish, one after the other or simultaneously. Of course, the manipulation is unwieldy, unsuited to any virtuosity; but I have a musical instrument. A new instrument? I am doubtful. I am wary of new instruments. (Schaeffer 2012: 7)

The level of control this technology afforded Schaeffer led him to immediately link this experience of manipulating playback technology to that of playing an instrument. The technique described by Schaeffer is still used by turntablists today, and despite Schaeffer's (2012: 7) initial doubts about the veracity of his 'musical instrument' claim, performers who continue to manipulate playback media in similar ways often consider the playback media to be a musical instrument.

The instrumentality of playback media is apparent in the language used to describe this practice by practitioners and theorists alike. Hip hop DJ Gregory Keltgen, known as DJ Abilities, describes turntables and turntablism as 'so complex, and rhythmically challenging. To me, the turntable is the last new instrument' (Keltgen in McLeod 2014: 86). On learning to perform with turntables, turntablist and researcher Sophy Smith (2007: 81) notes that '[a]s in many popular music genres, turntablists may begin by imitating favourite musicians and experimenting with techniques in order to learn to play their instrument'. What is interesting in these descriptions is not just the use of the word 'instrument' but also the way in which performers describe engaging with playback technology for music-making: a focus on technique and virtuosity of performance and the ability to learn and develop a nuanced practice. Performers using playback media as an instrument can learn how to control their instrument to produce repeatable results. Pioneer hip hop DJ Grandmaster Flash (1983) highlighted the importance of this repeatability in his seminal TV demonstration of turntablism on MTV's *The Cutting Edge* when he described his process of mixing between two different records on the beat as 'cutting them on time, all the time'. Performers utilising playback media as an instrument primarily view it as a tool for enabling their musical agency. Through study and practice, performers can learn how to control the playback media with a high degree of accuracy and repeatability.

It is, however, important to note that instruments, including playback media, are not passive objects within a performance. While performers may view instruments as just a tool for enabling their musical agency, all instruments exhibit some agency over a performance. As Magnusson describes:

> Against the logic that sees musical instruments as a direct channel for our musical thoughts, seamless media that materialise our imagination, the critical analytics of musical instruments reveals them as epistemic objects with agency; as technologies that are not

> supposed to merely channel but to also to converse, resist, challenge, surprise, and reject their performer. (Magnusson 2019: 68)

The agency exhibited by instruments is perhaps more commonly referred to as the limitations of the instrument or, for more positive connotations, idiomaticism. Like all instruments, playback media exhibit their own sets of limitations; for example, without specially cut records it is incredibly difficult to use a turntable to 'produce defined pitches […] and playing sustained tones is almost impossible' (Hansen 2015: 51). Conversely, playback media also have unique traits that enable them to produce music that would not be possible on many other instruments, the most notable of course being the ability to play back recorded sound. When performers are practising and learning an instrument, they are exploring and learning how the instrument exerts agency; by learning what an instrument can and cannot do, a performer is able to effectively utilise the instrument as a tool for expressing their musical agency.

Throughout much of the past century, performers have utilised playback media as an instrument, enabling them to express themselves musically in ways that would not be possible on other instruments. While playback media used in this way does exhibit some agency over the performance, the focus of the performance is primarily on the agency of the performer. However, as the practice of utilising playback media in performance has progressed, performers have looked to explore the limits of the technology. Through doing this, the distinction between the agency of the performer and the instrument becomes less clear.

3.1.1 Failing playback media

Improvisers exploring the limits of playback media often engage with what academic and sound art curator Caleb Kelly (2009: 4) refers to as a 'crack' in the technology: 'a point of rupture or a place of chance occurrence, where unique events take place that are ripe for exploitation toward new creative possibilities'. Read through Shannon's (1948) theory, Kelly's concept of a 'crack' can be understood as introducing a noise source into the playback media's system and/or exploring a noise source that is inherent in the medium (for more on inherent noise see Chapter 5: (Un)fixed Media). There are a multitude of approaches to introducing noise in order to create these 'cracks' in playback technology with varying levels of destructiveness.

> At the extreme end is a destructive approach in which the mediating device or recording is broken, perhaps beyond repair. Toward the center is the less finally destructive crack, where impermanent or nonfatal damage is caused to the player or the recording media. The least extreme approach uses the simple manipulation of playback technology—sometimes an extremely subtle intervention. (Kelly 2009: 32)

While the means of producing a 'crack' vary, the goal is usually the same: to exploit a point of failure in the technology through the introduction of noise, in order to transform the signal being played back producing sonic results that differ from the designer's original intention. While in day-to-day use the term 'failure' is predominantly used in a negative context, in improvisatory practice with playback media, the failure of the media is often explored deliberately for its positive potential. This positive reframing of failing technology can be found in the work of artist and experimental turntablist Christian Marclay who states that '[i]t's when the technology fails that something interesting happens' (Marclay in Kelly 2009: 177). When exploited in this way, the failure of the playback media to function as it was originally intended is utilised for the opportunity it offers for something new and unexpected to occur.

Failure is often thought of as part of a binary – something has passed or failed, it is working or has failed. However, rather than forming one side of a binary, failure within playback media can often manifest as a continuum between functioning correctly to complete technological breakdown. Improvisers exploring the cracks of playback media often seek to utilise or highlight this transitory state of failure. Rather than seeking to cause an instantaneous breakdown of the playback media into absolute failure, improvisers instead often look to set in motion systems of failure with drawn-out or extended gradual declines from functioning to not. Or they may look to create systems that suspend the playback media in a perpetual state of failure somewhere between functioning and complete breakdown. How these states of failure manifest varies substantially between practitioners, performances and playback media; however, the ways in which practitioners choose to utilise and engage with the continuum of failure are often very similar.

Auto-destructive sound

Once a playback media is in a state of failure the performer has two main options available: let the system run its course, leaving it to work independently until it reaches a natural endpoint, often complete breakdown, or interact with the system, altering the noise source(s) to change the rate and effects of this failure. The first approach shares many similarities with the practice of Auto-destructive Art developed by Gustav Metzger (2017) in the late 1950s. Auto-destructive Art is a performative, usually visual, artform that focuses on destruction as process for creation. However, unlike other Destructivist art forms – such as the work of Rafael Ortiz (2017: 75), which places an emphasis on the artist as the destroyer – Auto-destructive Art places an emphasis on the artwork destroying itself with minimal interaction from human agents; a system of failure is put in place and then left to run its natural course.

An example of Auto-destructive sound is William Basinski's *The Disintegration Loops*. *The Disintegration Loops* are a suite of pieces composed by Basinski utilising loops of magnetic tape that had been recorded 20 years prior to their use in this suite. Owing to the age and poor storage conditions of the tape loops, the substrate on the tape had begun to deteriorate, meaning that as the tape loops were played, they began to flake apart (Doran 2012). Each piece within the suite is a recording of a single tape loop running through a tape machine; on each loop the tape degrades slightly further as this physical source of noise causes the tape to fall apart. This transforms the audio on the loop resulting in gradual dropouts in the playback and distortions to the recorded sound. Each loop is left to run until almost all semblance of the original material is lost. While *The Disintegration Loops* were originally recorded live, they now exist as fixed media compositions documenting the Auto-destructive process. Owing to the lack of human intervention, Auto-destructive systems of failure are more commonly utilised in fixed compositions than improvisations. One example of Auto-destructive sound that is not fixed is Christian Marclay's *Record Without a Cover.* As the title suggests, *Record Without a Cover* is a vinyl record that was sold and intended to be stored without any protective packaging. The original audio content of the record is a fixed composition by Marclay; however, damage incurred to the record over time – exacerbated by its unconventional storage – results in the original material being gradually transformed in a way that is unique to each copy of the record. This Auto-destructive process is generally very slow and the developing effects of this noise between each playback of the record are usually incredibly subtle. While improvisers can and do utilise *Record Without a Cover* and other records kept without protective sleeves as part of performances, due to its gradual nature this Auto-destructive process may be imperceptible in an individual performance (Chavez 2012: 105). However, if the record is utilised across numerous performances the Auto-destructive process will likely be more apparent at this macro-scale.

Interacting with systems of failure

Rather than allowing the system of failure caused by the effects of noise on the playback media to run autonomously, improvisers working with failing playback media often choose to engage with the sources of noise, actively changing aspects of the system. Interacting with the system can have a myriad of results in different combinations; for example, when utilising a system of failure that is designed to end in full technological breakdown, altering the severity of the noise source may cause the rate of deterioration to speed up or slow down. Alternatively, by removing or changing the source of noise the performer may be able to reverse the rate of deterioration, pulling the media back from complete breakdown. If the system of failure is designed to suspend the playback media

in an ongoing state of failure, then manipulating how the source of noise affects the signal may change the sonic effect of the failure.

This engagement with and manipulation of systems of failure can be found in the work of improviser and composer Yasunao Tone. Tone has performed regularly with CD players since the 1990s, creating a system of failure in the CD players by introducing a source of noise between the CD and the laser built into the CD Player. Tone does this by modifying or 'wounding' the CDs with pieces of scotch tape, affecting the CD player's ability to read the CD and causing the CD player to skip, outputting a variety of snippets of manipulated audio, harsh clicks and pops. During performances, Tone 'knocks and jolts the CD tray […] gently nudging it to continue reading the prepared CD' (Kelly 2009: 238). By doing this, Tone acts as a noise source affecting the failing playback media further, using his interaction to prolong the state of failure in the CD player and to change what audio from the CD is being processed by the breakdown of the technology. Although Tone's interaction with the system appears similar to that of an instrumentalist performing with their instrument, unlike an instrumentalist, Tone is unable to learn how the playback media will respond to these sources of noise and his manipulations of the CD and CD player causes it to perform in unpredictable ways.

The Unpredictability of Failing Playback Media

Owing to how the effects of noise on playback media can manifest, failing playback media often functions erratically, producing unpredictable audio transformations, textural and structural changes. Performers working with failing playback media in this way often list this unpredictability as being a driving force behind their work. For example, Christian Marclay states:

> When something goes wrong [in a performance], like when the needle skips, something unpredictable happens […]. In that incident, something new and exciting happens. For me, it has creative potential. (Marclay in Gross 1998)

For Marclay, the unexpected moments in a performance caused by the failure of the playback media are generative opportunities, where the playback media can drive a change in the direction of the performance. Similarly, experimental turntablist and sound artist Maria Chavez describes:

> By experiencing chance situations during performance, this created the basis of developing my vocabulary with the turntable. The more that 'went wrong' the more I learned about new sound possibilities, i.e. when a needle broke a certain way it began making interesting sounds on different records. The more they broke, the more sounds began to emerge that wouldn't have without accidents and damage. (Chavez in Neumann 2013)

Here, Chavez highlights the creative potential of noise in failing playback media to transform the source material in new and interesting ways, creating sonic manipulations that she would not have

anticipated or sought out on her own. Both Marclay and Chavez view the unpredictability of failing playback media as an intrinsic part of their practice. The shifts and changes caused by the instability of the failing playback media result in an unpredictable improvisatory experience where the agency of the playback media begins to determine key aspects of the performance.

3.1.2 Playback media as an improviser

As discussed, instruments exhibit a sense of agency over performance through their unique set of features and limitations (Magnusson 2019: 68). However, playback media forced into a state of failure through noise, exhibits agency that far exceeds the level of influence commonly found in other instruments. When a system of failure is set into motion in the playback media, the instrument gains influence and control over broad decisions of form and structure, disrupting the conventional relationship between performer and instrument. As sound artist and turntable performer Graham Dunning (2019: 8) describes it, improvising with systems in this way can often 'feel more like playing with another musician, another entity'. Dunning's sentiment that failing playback media can feel like 'another musician' is mirrored in the language of a variety of other practitioners working in this way; Chavez personifies vinyl and turntables by describing the failures of the media as giving them 'a personality' and composer and hardware hacker Nicholas Collins describes his use of skipping CD players as giving a performance 'the tension and sense of uncertainty associated with improvised music' (Chavez in Uszerowicz 2017; Collins 2009: 3–4).

Playback media pushed into failure with noise begins to exhibit a sense of agency over an improvisation that can mirror that of human improvisers. Rather than functioning as an instrument, failing playback media can be better understood as operating as a non-human improviser. The ways in which the effects of noise on playback media manifest as a non-human improviser are many and ever evolving, varying between practitioners, playback media and performances. It is not the aim of this chapter to provide an all-encompassing study of the myriad ways failing playback media can function as an improviser or to suggest that the manifestations discussed are ubiquitous to all examples of improvisation using noise to cause failure in playback media, but instead to provide some examples that highlight this potential. However, before discussing how failing playback media feels 'like playing with another musician' it is first pertinent to briefly examine how developments in computer-based non-human improvisers can inform our understanding of what a non-human improviser is and does (Dunning 2019: 8).

Non-human improvisers

Developments in computational processing power and approaches to artificial intelligence have led to an ever-expanding field of research into the creation of computer-based non-human improvisers

(Herremans *et al.* 2017). To what extent these systems are considered improvisers is a point of some contention (particularly among human improvisers) and one that is perhaps marred by an anthropocentric view of what improvisation is, as George Lewis observed:

> … it seemed to many that there was just something wrong with the notion of computers as improvisers. There was something special about improvisation—something essential, fundamental to the human spirit—that one just couldn't, or shouldn't, approach with machines. (Lewis 2018: 127)

However, even within 'conventional' improvisation there are already a multitude of non-human elements influencing the process and result of improvisation. Marcel Cobussen's (2017) *Field of Musical Improvisation Theory* identifies and explores how a wide variety of human and non-human elements combine and influence each other during the process of improvisation; Cobussen (2017: 83) describes improvisation as a 'multiplicity made up of many heterogeneous actants of many different natures, a network of interconnected, human and non-human, nodes'.[7]

If an improvised performance is the product of both human and non-human elements, it is hard to see why improvisation should be considered a purely human activity. However, the boundary between influencing an improvisation and improvising is unclear. This is likely due in part to our conception of what it means to 'improvise' being derived directly from our human experience of creating music in this way. Computer-based non-human improvisers predominantly seek to imitate, or at least appear to imitate, the behaviours of human improvisers. For computer-based non-human improvisers to be considered successful by their researchers, they usually undergo some variation on the improvisatory equivalent to a Turing Test: the system plays with human improvisers and the researchers see if the human improvisers describe the non-human system as seeming to improvise. Researchers seek to ensure 'that contributions [from human and non-human improvisers] seem equally valuable' and that the results of improvisations utilising computer-based non-human improvisers are 'convincing [on their] own terms, with the same richness of sonic language, complexity of form, and effectiveness of expression that could be found in human-only music' (Young & Blackwell 2016: 508). While improvisers do not need to be human, our understanding of what it means to improvise is still deeply rooted in the human experience. For this reason, this discussion of the ways in which failing playback media can function as an improviser, will primarily relate this back to how it mirrors the behaviours of human improvisers. However, that is not to say

[7] An anthropocentric understanding of improvisation is perhaps a particularly western viewpoint. The understanding of improvisation outlined by Cobussen aligns with the Japanese concept of animism, a view derived from traditional Japanese beliefs routed in Shintoism and Buddhism which consider 'inanimate objects to have soul or spirit' (Sone 2021: 5) . When applied to technology this is often referred to as techno-animisim which as media theorist Yuji Sone (2021: 5) describes can enable technology to 'have an agentic existence'.

that these systems can only operate with human improvisers; if and how failing playback media can function as an improviser without interaction with human improvisers is an interesting and rich avenue for future exploration.

Communicating with Failing Playback Media

Within group improvisation, communication between human improvisers is often considered to be a vital aspect of the process of improvising; in order to effectively improvise, non-human performers 'must be able to react in a convincing way to stimuli, sonic or otherwise' (Young & Blackwell 2016: 509). Human improvisers communicate their intention for the performance in a wide variety of differing ways, encompassing 'verbal communication, non-verbal communication (e.g. eye contact, aural cues and body language) and musical communication' (Seddon 2005: 47). Through this communication performers seek to share their ideas for the content of the improvisation in order to negotiate a collaborative performance where 'the performance emerges out of the actions of everyone working together' (Seddon 2005: 49). To what extent the communication between improvisers is successful is of some debate; studies have shown that improvisers often misinterpret the intentions of other performers in the group, yet despite this the performance is able to continue (MacDonald & Wilson 2020: 104–5). It appears that what is more important is the perception of clear communication, as music psychologists and improvisers Raymond MacDonald and Graeme Wilson state:

> it did appear important to individuals that they *felt* they could make sense of what others were doing—that they could trust their own judgements, and could trust others to be making sense of them as well. Although improvisers may expect to share understanding, this may not be as important as believing that shared understanding exists. As long as each person *thinks* that they are working together, their interaction will show musical qualities. (MacDonald & Wilson 2020: 106)

For human improvisers, it is important that the performers they are working with appear to be able to interpret their communications, respond to it and communicate their own ideas. Therefore, for a non-human improviser to improvise, it is important that to other improvisers it feels as though it is communicating, irrespective of there being any intent behind the apparent communication taking place.

During a performance, it is most common for human improvisers to communicate both through aural interpretations of musical intent and visually, through eye contact and body language. Due to its physical nature, playback media can often appear to communicate visually to human improvisers, mitigating the issues surrounding physicality and embodiment that often arise with computer-based

non-human improvisers (Frisk 2020: 38–9). For example, improviser and turntablist Otomo Yoshihide (2007) often replaces the needle in a turntable's cartridge with a large spring and then overlaps and stacks various records in a pile on the platter, creating an uneven and unstable surface. As the turntable spins, the spring bounces over the records, lifting itself off the surface and causing the arm to swing in different directions and the records in the pile to shift and slide on top of each other. Visually the effects of this source of noise – the spring and the uneven surface – align with the sonic result, by watching and following the physical motion of the spring, the turntable's arm and the records beneath, Yoshihide can gain insight into what may happen next sonically. Just as an emphasised bowing motion on a violin may indicate to other improvisers an accent or downbeat, the physical motion of playback media can often offer some visual communication of the forthcoming sonic result. Similarly, just as human improvisers listen to and interpret the playing of other human improvisers in order to attempt to understand the intention and direction behind what they are playing, by listening to and interpreting the effects of noise on a playback media, human improvisers can gain insight into not just what is playing at that moment but also where it may be going in future. The gradual build of feedback from a record cartridge, the looping of audio from a stuck CD player or the increase in dropouts from a worn tape loop can all communicate to human improvisers the future musical direction of the failing playback media.

While failing playback media can give the impression of communicating both visually and aurally to human performers, there is no immediately apparent way for the human performer to communicate back. Computer-based non-human performers often utilise machine listening and vision to enable the system to engage with the aural and visual communication between human improvisers. It may seem as though failing playback media is incapable of communicating in dialogue with human improvisers, as it is generally not capable of listening and analysing. However, this is only true if we limit ourselves to a consideration of the specific ways in which human improvisers communicate.

There are means through which human improvisers can communicate their intention for the direction of the improvisation with the failing playback media. Due to its physical nature human improvisers are able physically to alter the sources of noise acting on the playback media through touching and manipulating the playback media. This method of communication between human and non-human performers is very similar to the mode of communication utilised in one of the earliest examples of computer-based non-human improvisation. Formed in the late 1970s, improvising ensemble the *League of Automatic Music Composers* consisted of a mix of human and non-human performers; during performances the human performers in the group 'took hands-on improvisative roles with their machines, [doing so] from a collaborative rather than an instrumental standpoint, negotiating with their machines rather than fully controlling them' (Lewis 2017: 96). This process of

physical communication and negotiation is one that is commonly found in improvisations utilising playback media that have been pushed into a state of failure through noise. Rather than producing a predictable outcome in the way that pressing a key on a piano would, communicating with and influencing a system of failure through touching the failing playback media can produce a wide variety of responses, ranging from the expected, to the unexpected, to no change at all. For example, when Tone knocks the failing CD player, he is doing so in order to communicate to the CD player how he intends to progress the improvisation, similar to how an instrumentalist may try to direct human improvisers by changing tempo, rhythm or dynamic. Just like when playing with human improvisers, Tone has no clear conception of what the end result of his communication will be; the CD player could skip forwards or backwards as Tone intended, remain playing what it was playing or shut down completely (Kelly 2009: 238). The option for the failing playback media to ignore the communication from the human improviser may at first seem like a flaw in its ability to communicate. However, this aligns very closely with the idea of 'musical rudeness' within improvisation; to 'choose to not listen' is for most improvisers considered a valid musical decision (Frisk 2020: 36).

While communication between human improvisors and failing playback media may not exactly mirror the modes of communication that are common in performances between human improvisers, the impression of communication between human improvisers and failing playback media nevertheless manifests in a manner that is familiar to human improvisers. Given the lack of intent or understanding behind the apparent communications from failing playback media it may seem counter-intuitive to frame interactions between human improvisors and failing playback media as communication. However, as MacDonald and Wilson (2020: 106) have shown, it is more important to human improvisers that clear communication appears to exist irrespective of the effectiveness, or in this case feasibility, of the apparent communication taking place. Familiarity for human improvisors with the means and outcome of communication between themselves and failing playback media gives the impression that communication is taking place and because of this, improvisations appear to emerge 'out of the actions of everyone working together' rather than the human improviser working as a leader (Seddon 2005: 49). As will be discussed in relation to my own practice in section 3.2.2 Learning to collaborate, thinking of improvising with the failing playback media as a communicative dialogue can be beneficial as it changes the approaches the human performer takes when performing with and responding to the unpredictable nature of the failing technology. Owing to the nature of noise acting on playback media, responses from the playback media may be unpredictable, creating the impression of a dialogue between the human and the non-human performers that has the potential to be surprising and engaging for musical exploration.

Unexpected Music

One of the most commonly discussed improvisatory traits of failing playback media is its potential to produce 'unexpected music' (Knížák in Kelly 2009: 142). While commonly mentioned by practitioners, the implications of the unpredictability of noise and failure are relatively underexplored: rather than being viewed as a single improvisatory trait, the potential for the unexpected underpins many of the ways in which failing playback media can function as an improviser.

Turntablist Graham Dunning performs what he has dubbed *Mechanical Techno*; by stacking multiple modified records on a single record platter separated by blocks of wood, Dunning utilises the spinning motion of the turntable to loop content from the records and to trigger, both electronically and mechanically, other percussive and synthesised sounds to create live dance music. The construction of Dunning's spinning tower of records is often complex and simultaneously precarious. This instability acts as a source of noise within the performance, transforming the playback through moments of error: 'a small accidental pull on a cable might physically move the tone arm, resulting in a completely different loop. Leaving the machine running for too long whilst preparing the setup might lead to the groove wearing down and becoming audibly more noisy' (Dunning 2015a). However, rather than trying to mitigate these unexpected elements, Dunning (2015b) embraces them, as these effects of noise on the playback media often force him to reconsider what he is playing: '[t]he chance elements and unpredictable aspects lead to [music] the artist would never think to deliberately make'.

Prolific improviser Mattin (2005) describes this process of reconsideration as being fundamental to the process of improvisation between human improvisers: 'improvised music forces situations into play where musicians push each other into bringing different perspectives to their playing'. As performers communicate, interpret and misinterpret the ideas of other performers, the improvisation can often move in directions that are unexpected to the members of the group; in order to incorporate and respond to these unexpected elements improvisers must often reconsider elements of their performance – for example, what they are currently playing, their intentions for the rest of the improvisation and their overall role within the performance. Just as human improvisers can influence failing playback media through touch during a performance, due to its ability to produce unexpected results noise introduced into playback media can function generatively within a performance, producing results that often cannot be fully anticipated by human performers. This noise gives the failing playback media agency over the performance as the unexpected outcomes of the system force the human improvisers to reconsider their intentions for the improvisation. The human improvisers and the failing playback media influence and shape each

other's performances, producing the musical output collaboratively. Rather than the playback media primarily enacting the agency of the human performer, the noise causes the playback media to work semi-autonomously with the human performer, each responding reactively to the other.

Failing playback media has the potential to produce unexpected results in a variety of different ways. For example, Chavez describes 'creating unstable situations' in order to structure her turntablism performances; by introducing noise to push playback media to failure, Chavez is able to utilise the unpredictable rate of breakdown as a structure for her improvisations (Chavez in Neumann 2013). One technique often utilised by Chavez to introduce noise and create 'unstable situations' is to layer fragments of snapped vinyl records on the platter of a turntable (Chavez 2012: 78). As the platter rotates, the needle drags across various shards of different records, creating a montage of different recordings, punctuated with percussive pops and scratches as the needle bumps up and down the edges of the fragments. As the needle bumps into the fragments, the tone arm of the turntable moves unpredictably, deciding for the human performer which sections of the record fragments are played. During this, the tone arm may bounce off the platter away from the records, or the cartridge may become detached from the tone arm, creating a period of silence or the end of the performance (Chavez 2012: 78). During a performance, Chavez nudges both the tone arm and the record fragments, influencing and altering the system of failure; by doing this Chavez influences the noise source acting on the playback media, working in collaboration with the failing playback media to create a structure for the improvisation.

Beyond creating structures for improvisation, using noise to cause failure in playback media can also transform the audio it is attempting to play back in unexpected ways. Tone's work with 'wounded' CDs utilises noise to create evolving and shifting manipulations of the source audio that are unique across performances. Owing to the unpredictable way the error correction built into the CD player attempts to interpret the noise of the 'wounded' CD, the 'sounds produced by the affected discs [are] never quite the same' (Stuart 2003: 48). Each time the disc is played, the error correction causes the audio on the CD to be distorted, warped and skipped in different and unexpected ways. Similarly, sound artist Lucas Abela's *High Powered Turntables* utilised industrial motors to spin records nearly a thousand times faster than intended, which he then played with amplified skewers instead of record needles. Owing to the difficulty of holding the skewer on the spinning record and the damage this does to the record, the myriad of noise sources Abela introduced to the playback media in this chaotic system manipulated the audio on the records unpredictably into imperceptible 'loud bursts of sound' punctuated by 'occasionally recognizable high-speed cartoon-like tunes' (Kelly 2009: 1).

While the effects of noise on playback media can produce unexpected results, they are not entirely random, as they are still working within a system constructed and set into motion by the human improviser, with the source sounds on the media pre-selected by the human improviser (Kelly 2009: 238). This means the musical results of the improvisation usually align with a fixed aesthetic, allowing the failing playback media to perform within the bounds of a specific style or improvisatory approach. In group improvisation settings, human improvisers will often share a 'common purpose, set of skills' and/or 'musical vocabulary' that can help them create music together with a sense of cohesion (Ashley 2008: 418). The ability for noise to transform sound, producing unexpected musical results that still adhere to a fixed aesthetic allows failing playback media to improvise in a manner that mirrors that of human improvisers while retaining a unique sense of identity as a non-human performer. This, combined with the communicative nature of introducing and influencing noise sources while performing with failing playback media, allows human improvisers to utilise failing playback media in a way that feels like performing with other human improvisers.

3.2 Glitch Turntablism

Inspired by the practice of turntablists Christian Marclay and Maria Chavez the starting point for this project was a desire to develop a personal approach to turntablism, focusing like Marclay and Chavez on using noise to transform and generate sound materials. Marclay has regularly attributed his decision to utilise vinyl to the shift in status and value of vinyl the 1970s and 80s from an 'object to be respected, collected and stored for posterity' to 'just a cheap commodity to be used and abused' (Marclay & Tone 2004: 345). However, the ongoing vinyl revival starting in the mid-2000s has shifted vinyl into a desirable and expensive product, moving attitudes and prices back in the opposite direction (Palm 2017: 2). While classical records can sometimes be picked up for cheap in a charity shop, purchasing turntables or records of other genres proved prohibitively expensive. Due to this high barrier to entry I looked to alternative playback media, settling on CDs which in recent years have become a 'cheap commodity to be used and abused' (Marclay & Tone 2004: 354).

Following their introduction in the mid-90s, DJ hardware that utilises CDs – known as CDJs – rapidly became ubiquitous in the commercial DJ industry (Rothlein 2013).[8] However, despite their widespread use, CDs have never really developed a performance practice unique to the medium. The sonic and performative characteristics that defined turntablism, most notably record scratching, are the result of the noise inherent in the medium. Rather than looking to the noise inherent in CDs,

[8] CDJs are still commonly used today although they are gradually being phased out in favour of XDJs which are functionally the same as a CDJ but read from a USB drive rather than a CD.

CDJs primarily sought to imitate vinyl. Their ability to imitate vinyl is a major selling point for CDJs and is something that manufacturers place significant emphasis on:

> Pioneer's CDJ-1000 revolutionises the way to play with CD's, just like vinyl you can stop the digital sound with your fingers and cue up in exactly the same way. Even bending the sound or scratching with no sound latency is possible. Never before has digital so successfully reproduced the sounds, feel and creativity of analogue. (Pioneer n.d.)

Because of this imitation, the widespread practice of performing with CDJs is primarily a simulation of vinyl turntablism, albeit with some extra conveniences such as easier track skipping and looping.

This is not to suggest that practitioners have not explored and utilised the noise inherent in CDs. As discussed throughout sections 3.1.1 and 3.1.2, Yasunao Tone has made extensive use of the 'wounded CD' technique, modifying CDs with scotch tape to introduce noise into the playback system, causing glitches within the CD player's error correction software (Kelly 2009: 238). Tone's technique was similarly utilised and popularised by artists including Oval and alvo noto, with skipping CDs becoming a mainstay rhythmic element in music released on glitch focused labels, such as Mille Plateaux and Raster-Norton, in the late 90s and early 2000s (Cascone 2000: 15). Others, most notably composer Nicholas Collins (2009: 2), have looked to the CD player itself, modifying the CD player to bypass its automatic muting function, releasing 'a flood of hitherto unheard sounds'. In recent years, likely due to their falling price, CD players have been frequently modified by members of the circuit bending community, who look to introduce noise into the circuits, causing them to behave in ways never intended by the manufacturer.[9] Probably the most common modification within the circuit bending community is known as the Anti-Skip RAM modification, where pins on the Random Access Memory (RAM) used to store the audio on a CD prior to playback are shorted together introducing a source of noise into the data stream inside the CD player. This modification process has been documented extensively by a circuit bender known as r20029 (2012). Sharing documentation on modifications is common in the circuit bending and hardware hacking communities, something composer and instrument builder John Richards (2013: 274) refers to as doing-it-together, or DIT (a play on DIY); the approaches and techniques in this chapter are intended as my contribution back.

[9] Circuit bending is an approach to electronics that promotes experimentation and chance over electrical engineering theory. It usually consists of the 'creation of new connections inside sound-generating electronic devices to provide sounds unintended by their original designers' (Smith 2016). For more on circuit bending see (Collins 2006; Ghazala 2005).

3.2.1 Building the instrument

Figure 3.1 Glitch Turntablism setup

The point of departure for this setup was questioning what the medium of CDs can bring to the practice of turntablism, looking to utilise the idiosyncrasies of CDs rather than imitating vinyl. This was done through an exploration of introducing noise into the CD player's circuit in a performance style that builds upon and fits within the broader practice of experimental turntablism. Utilising documentation from Collins and r20029 as a starting point, I modified three Sony Discman CD players, two with r20029's (2012) Anti-Skip RAM modification and one with Collins' (2009: 2) un-mute modification. These modifications allow new options for introducing noise into the CD player's system and when noise is introduced, it acts upon and transforms the audio that has been read from the CD. Understood through Shannon's theory, as outlined in section 2.2, these modifications allow the human performer to act as a noise source upon the CD players introducing noise into the circuits and mechanisms of the CD players. The two different approaches provide different methods of interaction for a performer and produce different sonic results.

The Anti-Skip RAM modification takes advantage of an intermediary step many portable CD players have between reading the information on the CD and playing the audio back, called Electronic Skip Protection (ESP).[10] In order to avoid the audio playback being affected by the CD player being knocked, the system stores several seconds of the next audio to be played in RAM. As such, if 'the unit receives a physical shock which prevents the laser pick-up from "reading" the CD, the sound stored [in RAM] is played back until the laser pick-up recovers' (Sony Corporation 1992: 4). ESP enables the CD player to hide the effects of noise from physical disruptions of the playback media. r20029's modification allows the performer to short circuit pins of the ESP RAM together, acting as a noise source on the signal as it reads the audio from the CD into the RAM and plays it back. The

[10] ESP is also commonly referred to as anti-skip or anti-jog

effects of this noise on the audio can result in a wide range of transformations, ranging from rhythmic skipping and ring modulated like sounds, to spectrally dense crackles and pops that no longer resemble the original audio.

Collins' un-mute modification stops the CD player muting its output when it is not playing back music. When a CD player is paused or moving between tracks 'the laser [does] not lift up from the surface like a turntable's tonearm' instead the internal circuitry silences 'the audio output during certain "unmusical" operations' (Collins 2009: 2). Modifying the CD player to leave these operations unmuted uncovers a palette of transformations of the contents of the CD, as Collins describes:

> starting and stopping the disc was accompanied by a brief, loud squawk; pressing "next track" (>>|), especially in "shuffle" mode, evoked a needle being dragged violently across an LP, or John Zorn's furious stylistic jump-cutting; "pause", by contrast, isolated short fragments of material from the CD in lilting loops. (Collins 2009: 2)

As well as uncovering these usually hidden sounds of the operation of a CD player, the un-mute modification makes audible the effects of physical interactions with the disc by a performer. When a CD player that does not have ESP detects a knock or jog that interrupts the laser reading information from the CD, the player mutes the output hiding the sonic effects of this noise. By removing the ability for the player to mute itself these interactions become audible, allowing the performer to act as a noise source upon the CD player, interrupting the flow of data and transforming the audio.

The two CD players either side of the mixer in Figure 3.1 (above) are both the same model CD player and have been modified with the anti-skip RAM modification described by r20029 (2012). Having experimented with numerous different makes and model of CD player, I identified that this modification produced different sonic results depending on the player. Opting to have two identical players gave increased consistency to both sound and performance style making the final setup easier to learn and the sound of the two CD players easier to mix between in a performance. However, this did come at the expense of a reduced palette of audio transformations and altering the setup to include different CD players is an avenue for potential future expansion. Each of the anti-skip modified CD players has ten 3.5mm jack patch points (see Figure 3.2 Anti-skip modified CD player, below). The jack sockets connect to different pins on the CD player's ESP RAM. When nothing is plugged into the patch points the CD player operates as originally intended. Patching two or more points together creates a short circuit, introducing noise into the signal, pushing the CD player into a state of failure, and transforming the audio signal that is being played back.

Figure 3.2 Anti-skip modified CD player

In addition to the patch points, the anti-skip modified CD players also have a customised user interface, replacing the very small buttons of the original CD player with large push buttons (above the patch points in Figure 3.2 Anti-skip modified CD player, above). The lid to the CD players was removed and the mechanism the CD player uses to detect if the lid is open or closed was replaced with a toggle switch making it possible to trick the CD player into thinking the lid is closed (top left on the front panel in Figure 3.2 Anti-skip modified CD player, above). This enables CDs to be swapped and changed much faster during a performance. These modifications to the user interface were made as initial testing proved that using the small built-in buttons and needing to open and close the lid to change CDs made making quick decisions during a performance difficult, an issue exacerbated by low lighting in a club setting, the intended destination for public performance.

The small CD player on the far left of Figure 3.1 (above) has been modified using Collins' unmute modification. As well as the modification to its circuitry, this CD player also has a hole cut into the lid (see Figure 3.3 Unmute modified CD player below). Unfortunately, the design of this CD player meant the lid could not be removed entirely, however the hole in the lid allows the disc to be touched. By touching the CD, noise is introduced, disrupting and altering the data stream from the CD. As this CD player is unable to mute itself when it detects this, the sonic transformations introduced by touching the disc and the CD player's attempts to rectify this issue are audible. This makes for a relatively expressive instrument, that can be played like percussion. Knocking the player

causes a flurry of glitched snippets of sound from the CD variable to how hard the CD player is hit. Gently applying friction to the disc as it spins introduces subtle distortions, clicks, and pops to the audio playback. When used in tandem with the now unmuted transport controls, such as pause or shuffle, more performative options are available; knocking the CD player while it is paused causes the loop created by being on pause to shift, jumping forwards or backwards through the CD.

Figure 3.3 Unmute modified CD player

The modified CD players are paired with a simple DJ mixer to create a setup that aligns with the format of a conventional turntablism setup (see Figure 3.1 above). The decision to utilise the format of a turntablism setup was a multifaceted one. Utilising the DJ mixer helps to sonically situate the hacked CD players within the practice of turntablism, through the commonality of performance techniques that utilise crossfading and blending using EQ. Additionally, having the setup laid out like a conventional turntablism setup creates a visual 'metaphor' for the audience of a performance style they are familiar with, 'increasing the transparency [of the process for] the audience' (Fels *et al.* 2002: 112). While it is likely that the majority of an audience would be unfamiliar with what the CD players are doing, given the ubiquity of turntablism and DJ culture, there is generally a culturally tacit understanding of what a turntablist is and does – a performer mixing between and manipulating pre-recorded sound. The intention is that this visual link to turntablism helps audiences to engage with what is happening on a macro level, even if they may be unfamiliar with the specifics of the setup.

Modifying the CD players in this way has intrumentalised the process of introducing noise into the playback of CDs. The practice of modifying playback media to utilise noise for performance has been prevalent throughout the history of turntablism, from pioneers like Grandmaster Flash (1983) and Grandwizard Theodore using paper and other materials as slipmats to reduce friction when scratching the record, to Otomo Yoshihide's (2007) spring record cartridge and Maria Chavez' (2012: 78) snapped records. It is possible to use the modified CD players to manipulate the pre-recorded contents of the CD in a way that can be learnt, practiced, and performed. For example, the effects of the noise introduced by specific combinations of patch points on the anti-skip modified CD players is somewhat repeatable. As such, different patching combinations can be learnt and recalled during a performance however, the reliability of this not guaranteed. Similar to the numerous practices discussed in sections 3.1.1 and 3.1.2, when the CD players are pushed to a point of failure through noise, they begin to behave unpredictably. The result of connecting patch points together is slightly different each time and is not stable after a connection has been made. Sometimes the result can be drastically different to expected, it is not uncommon for the CD player to suddenly turn off, or for the effect to completely change or suddenly become significantly louder.[11] Similarly, interacting physically with the un-mute modified CD player can also produce unpredictable results. Hit the player too hard or too often and it may switch off, lock up or jump to a completely different section of the CD. In this way, the CD players begin to exhibit agency over the performance. To echo Dunning (2019: 8), performing with the modified CD players feels 'more like playing with another musician'.

3.2.2 Learning to collaborate

After modifying the CD players and combining them with a mixer, I began experimenting with the setup, exploring how it worked and trying to learn how to perform with it; a practice I came to refer to as *Glitch Turntablism*. After becoming comfortable with some techniques for manipulating and combining different recordings, I began trying to plan performances, composing structures for semi-improvised performances, similar to how competition scratch turntablists plan and rehearse routines (Smith 2007: 80). However, performing with the CD players to a precomposed structure often felt like a desperate fight to get the CD players to do what I wanted and required avoiding certain patching combinations that were too unpredictable. When the CD players were cooperating, it was difficult to focus on the structure as I was primarily worrying about how long it would be before one turned off.

[11] The sudden very loud sounds resulted in a limiter being added as a final stage to the setup when playing live to avoid accidental damage to a PA or any audience member's hearing.

Abandoning precomposed structures fundamentally altered my approach to performing with the CD players. Moments where the CD players produce something unexpected are no longer a mistake in the performance. Instead, they are part of the performance, something to be embraced and responded to rather than avoided or corrected. Unpredictability and the practice of responding to it and developing from it is an intrinsic part of many group improvisations, as MacDonald and Wilson describe:

> This inherent unpredictability [of other performers] is what makes improvised music surprising and therefore creative, since it is bound to result in novel sounds and events. The creative quality is a property of the group rather than of any one member (MacDonald & Wilson 2020: 70)

In a performance with the CD players, the joint process of creation born from this unpredictability manifests in numerous ways, as the CD players exhibit different levels of agency over the performance. These moments of agency over the direction of the performance from the failing CD players are not entirely random, the sounds they produce are linked to the CD they are playing. As discussed in section 3.1.2, this helps maintain a sense of consistency in the performance, giving the impression of a shared language of improvisation between myself and the CD players. When communicating my intention for the direction of the performance to the CD player by introducing noise into the system in a specific way – for example by setting up a patch, hitting the CD player, or touching the CD – numerous different things can occur with varying amounts of predictability. The result of this may be the CD player does what was expected or, it may do something completely unexpected or something in between, that can be anticipated but not fully known. In this way the CD players and myself share control over the direction of the performance with each performer leading and collaborating in different ways at different points in the performance.

One of the most overt points of agency the CD players exhibit over the performance is when something entirely unexpected occurs. Due to the instability introduced through noise, the effects of noise on playback can change at almost any time, not just when physically interacting with the player. It is not uncommon for a patch that has otherwise been stable for several minutes to suddenly change in dynamic and timbre[12] or, for the loop of a paused CD to shift abruptly forwards or backwards in the track. Unlike vinyl, where the observable physical motion of the playback media is intrinsically linked to the sound, often giving human performers visual cues as to what is going to happen next, the failing CD players are often impossible to interpret visually. As such, it is not

[12] This occurs at numerous points in the *Glitch Turntablism* video included in the portfolio. One particularly clear example can be heard at 15:20 when the CD player on the right-hand side begins to emit a high pitched and crackly sound it had not previously been making.

possible to anticipate these changes and interrupt the CD player in order to stop or alter what is about to take place. This ensures a shared agency over the introduction of new directions into the performance. As Seddon describes, this is common in group improvisation between human improvisers:

> By listening and responding to other musicians a collaborative performance is produced. No one acts as a leader directing the performance; instead, the performance emerges out of the actions of everyone working together (Seddon 2005: 49)

As it is impossible for the human performer to fully take charge of the failing CD players and lead the performance, a democratisation of the creative process is instilled in the performance, where either performer can introduce a new development. An unexpected direction produced by the CD player needs to be responded to in some way and be incorporated as part of the performance, rather than ignored as a mistake, in order to maintain a sense of coherency. As a result, the improvisation is made through an act of collective creation with the playback media, where individual new developments to the structure are equally valued, responded to and incorporated as a feature of the performance.

Other effects of introducing noise can produce results which can be anticipated but not fully predicted, resulting in a development of the improvisation being produced in collaboration with the CD players rather than reactively. For example, some patching combinations and methods of interaction, such as repeatedly knocking the player or applying increasing friction to the disc, introduce a significant amount of noise into the system, pushing the CD players into states of failure that are unsustainable for long periods of time and often result in the CD player turning off.[13] Lasting from seconds to a few minutes, these ephemeral states of failure have proven to be particularly engaging to work with while improvising. Causing the CD player to fail in this way and allowing it to run to the point of complete technological break down allows the human performer to consciously step back from the performance, setting a system of failure in motion but giving the CD players control over the specifics of the system's development. Approaching improvisation by setting up 'unstable situations' using playback media, is utilised prominently by Chavez (2012: 13), who highlights that this can function as a means of structuring a performance. Unlike the fully unexpected changes discussed above, when utilising these unstable situations, it is known that introducing noise in this way is unsustainable for the CD player. However, exactly when the playback device completely fails, and the effects on the audio during this process can vary significantly. As

[13] Again, this occurs multiple times in the *Glitch Turntablism* video. One example can be found from 12:40-13:11 where an unstable patch is set up on the left-hand Anti-skip modified CD player and left to run until the CD player freezes and stops emitting any sound.

such, when pushed to this point of failure, the CD players and I are jointly responsible for when and how that section will progress and end. The resultant structure of the improvisation is created through cooperation, with both performers working together on a shared idea with neither fully in control of its development.

When noise is introduced into the CD player's system the effects of this do not have to be left to run independently. Elements of the noise source acting upon the system, such as the different RAM pins which are short circuited, can be altered.[14] This can influence the rate of failure towards complete technological breakdown in the CD player or the effect of the noise on the data from the CD, similar to Tone's nudging of the CD player to alter the playback of a wounded CD (Kelly 2009: 238). Performing with the modified CD players in this way can result in a dialogical passing and developing of ideas. As the state of failure and the noise in the CD player's circuit is altered, its effect on the sound changes; when I respond to this change by changing the source of noise again this alters the sonic result further in unexpected ways and this cycle can repeat. This process mirrors the musical exchanges commonly found in group improvisation, where improvisers can choose 'to vary or augment another contribution, for instance by harmonising' (MacDonald & Wilson 2020: 76). In this way, ideas can be developed throughout the performance dialogically, with both the CD players and me introducing unique developments on a theme which complement, augment or contrast with what is currently taking place.

These different manifestations of agency throughout a performance align with what MacDonald and Wilson (2020: 77) identify as the five 'key choices for group improvisers' during a performance. During group improvisation performers have a choice between 'maintaining' what is currently happening, 'initiating' a new idea, 'adopting' the direction another performer is taking the performance, or taking an idea that is currently occurring and developing it by 'augmenting' or 'contrasting' the musical material (MacDonald & Wilson 2020: 77). These choices may not always go as intended and a live performance is born out of a combination of these choices and the various successes and failures of this. As music cognition researcher Richard Ashley (2008: 413) describes, improvisation 'is a kind of tightrope act, where there is always the chance that something will go wrong'. The risk of something going wrong is particularly high in *Glitch Turntablism as* this system exists on the boundaries of complete technological breakdown. A performance is often only one accidental nudge of the table away from a premature ending. This combined with the requirement for constant active decision making throughout a performance in order to work with and respond to

[14] An example of this can be found in the *Glitch Turntablism* video from 20:00-22:00

the unpredictable nature of noise within the CD players, means that this performance practice lends itself particularly well to a live concert environment.

3.2.3 From live to the studio: *Bootlegs* and *Sckt*

Glitch Turntablism was primarily intended to be performed in front of an audience and I gigged with the setup regularly from 2018 to 2020.[15] Multiple elements of the setup and performance style lend themselves well to a live performance. The physicality of the performance – knocking the CD players, connecting patch points, mixing, and swapping CDs – generally correlates to the sound produced. As John Richards (2008: 29) describes the physical action of interacting with devices and connecting up patch points 'sets up an expectation of cause and effect [for the audience], with the potential to link a sound with an action or movement'. This helps to convey what is happening in the performance to the audience, even though the specifics of how the sound is produced in this setup may be unfamiliar. Where changes in sound do not correlate to my actions, this suggests to the audience that these changes may have been instigated by the system itself. This combined with the visual 'metaphor' of a conventional turntablism setup helps to provide insight for the audience into what is happening in the system (Fels *et al.* 2002: 112). In order to promote this, when possible, during a performance I encourage the audience to freely move around and to come close and stand or sit directly at the table I am performing at. As well as this, the increased risk of attempting to utilise and harness failing playback media live in a performance can also create a sense of tension and drama to a performance. While risk and the additional information provided by seeing a performance are common arguments for the positives of almost all live music performances, here they provide insight into intrinsic elements of the performance that are fundamental to its creation in a way that is relatively uncommon.

Bootlegs

At most *Glitch Turntablism* gigs I recorded the audio of the performance. Listening back to the recordings acousmatically they seemed to be missing something. Marclay has suggested that some improvised music should exist as 'live only' and that when these performances are recorded their primary value is as a document rather than as a composition (Marclay in Toop 2015: 13). While this is an arguably reductive view, it seemed to apply in some extent here. Without a clear conception of what was happening during the recording, these recordings, while a relatively good document of what was heard during the performance, failed to capture and convey the collaborative relationship that was explored throughout the performance. This presented a unique challenge, how could the practice of improvising with failing CD players that I had been developing in concerts be translated to

[15] Live performances were put on hold during the pandemic, I am planning to resume when possible.

a fixed media recording? In addition to finding ways to represent my live performance in a fixed media recording, I was also interested in interrogating the boundary between document and composition laid out by Marclay (Marclay in Toop 2015: 13). As such I attempted to situate the piece as something that could be viewed as both a document of live performance and a composition in its own right.

Rather than presenting a live recording, I aimed to create something representative of my live practice. The result is an EP titled *Bootlegs* containing four short, improvised tracks each recorded live in a single take. The source sounds used for these were from performances recorded at Liquid Sky, Berlin on the 1st May 2019 and at Hatch, Sheffield on the 20th July 2019. These two recordings were chosen as they were two stand-out gigs I had particularly enjoyed where collaboration with the CD players seemed most successful. However, the recordings were some of my least favourites to listen back to as this collaboration was often unclear and it was the dichotomy of this that led to the development of this project. The improvisation that became the first track on *Bootlegs* used selections from these two gig recordings which had been burnt onto CD. The subsequent three tracks were created using an iterative approach which was utilised in order to forefront and highlight the role of the CD players within the performance, to remedy the loss of context caused by acousmatic listening. When the first track was finished, it was burnt to CDs, these CDs were improvised with to create the second track, and so on. This created what composer Simon Emmerson refers to as 'time delayed' feedback. With each iteration, as the material was recycled through the CD players, the effects of the noise in the system became increasingly apparent, overwhelming the original audio (for more on feedback see section 5.1.3 Feedback). The result of this process is that each track functions like a vignette of a specific point in time in the feedback loop, with the tracks collectively creating an overarching form. By utilising repetition in this way, a point of reference is given to the listener that they can then follow throughout the EP to identify the role of the CD players in the realisation of the performance.

The improvisations that made each of the tracks were performed using the techniques and approaches to collaboration discussed in 3.2.1 and 3.2.2. The unpredictability of these techniques and the potential for complete technological breakdown when utilising noise to push the CD players into failure is usually a source of tension within a live performance. Composer and performer Kerry L. Hagan (2016: 139) argues that live recordings which capture 'spontaneity, risk, an acceptance of error and fault' retain some of this and are 'closer to a live concert than the studio recording' that has been edited. While it is true that hearing error and imperfections is evocative of a live performance, I found it difficult to convey the tension caused by the failing playback media in the recording. When listening to a recording that has been released, the assumption is that everything

worked out fine, else the recording wouldn't have been released. The ability to listen to the recording multiple times compounds this issue as the listener knows what to expect, even if the improvisation on the recording does result in the performance going wrong. This issue with recorded performances is not unique to utilising CD players in this way, looking beyond failing playback media, this is also a common point of contention with performers of free improvisation and can be applied to most recorded music (Bailey 1993: 103–4). However, it did present a significant issue when adapting my performance style to the studio, as the relationship between noise and failure is central to the collaborative performance practice. Given the documentary style of *Bootlegs* this drop in tension compared to a live performance was perhaps unavoidable. However, through *Bootlegs* it became apparent that, if the modified CD players were to be utilised in the studio beyond this semi-documentary approach, alternative ways of working with them should also be explored.

Sckt

When looking for alternative ways to work with the CD players to create a studio composition, it quickly became apparent that the seemingly obvious methods, such as sampling and arranging sounds from the CD players, lacked what made performing with them exciting. So, similarly as I came to approach the CD players as a collaborator within live performances, I looked to find ways to collaboratively compose with them in the studio. *Sckt* is the result of a collaborative compositional process where the CD players and I each had control over different aspects of the composition.

A basic drum loop was burnt to a CD and played back on one of the anti-skip modified CD players. The CD player had been patched to introduce noise creating an unstable state within the system. This noise transformed the drum loop from a simple straight pattern into shuffling, stuttering rhythms. The resultant transformation of the drum loop by the CD player was recorded until the CD player switched itself off and this recording was used unedited as the basis of the piece. However, none of the sounds from this recording are heard directly in the piece as the track is muted on the master bus. Instead, the altered rhythms generated by the CD player are used to control the dynamics of numerous layers of drone sounds, composed by me, through sidechain compression and gating.

This approach explored how the collaborative relationship with the CD players can be adapted and expanded beyond the limitations of a real-time performance. The autonomy of the CD player to transform and generate new material through noise was utilised as a collaborator taking primary control over the form and rhythmic content of the piece. This method of collaborating with the CD players in the studio is not necessarily better or worse than collaborating with them live in real-time.

Each are simply different ways of engaging with the effects of introducing noise into the CD player and exploring the resultant autonomy to produce a collaborative result.

3.2.4 Conclusion

This chapter has explored the effects of introducing noise into the systems of playback media and the implications of utilising this within improvisation. It identified how introducing noise into these systems can push playback media into a state of failure, resulting in the playback media behaving unpredictably. Improvisers working with failing playback media often personify the technology, describing it as feeling 'more like playing with another musician' (Dunning 2019: 8). Why performers may feel this way towards these technologies was considered through an examination of the relationship between human performers and the failing playback media, and the role failing playback media take in a performance. It was proposed that when noise is introduced, causing a state of failure in the playback media, that the playback media exhibits agency over the performance beyond that of an instrument, instead functioning as an improviser. Two ways in which failing playback media can be understood to be improvising have been identified: by exhibiting agency over the structure and musical content of the improvisation, and through the ability for the human improvisers and the failing playback media to communicate.

Understanding the potential for failing playback media to function as an improviser, offers a reframing of the role of the playback media in performance. How this agency can be used in performance was explored through a discussion of *Glitch Turntablism*, a newly developed improvisatory performance practice utilising modified CD players. Developed from the repurposing of Shannon's theory outlined in section 2.2, these modifications allow a human performer to act a noise source on the circuitry and mechanisms of the CD players, performatively introducing noise to transform the data being read from the CD. This chapter identified how the various different methods of introducing noise through interacting with the modified CD players allowed both the CD players and me to have control over the realisation of the improvisation. As such each performance is a result of a collaboration. In addition, the discussion expanded this further, considering the limitations of recording this practice due to its reliance of visual metaphor and tension created from the risk of complete technological break down. It outlined two different approaches utilised to attempt to overcome these shortcomings by engaging with and highlighting the collaborative potential of the failing CD players, which formed the compositional methods of *Bootlegs* and *Sckt* from the accompanying portfolio.

It is hoped that this shift of perspective of the role of noise in improvising with playback media will encourage other creative sound practitioners to further explore this through practice. I anticipate

that *Glitch Turntablism* will continue to grow and develop over time. Although I have spent over two and a half years developing, performing, and recording with these modified CD players they still continue to produce varied and surprising music. MacDonald and Wilson (2020: 140) describe, that when human improvisers perform together their 'collaborative practice is […]transformed the more they play with the same people, such that long-term improvising partners feel they are able to form working predictions of what each other might do'. Like long-term groups of human improvisers, I am looking forward to continuing to explore noise and CD players and developing an ongoing collaborative performance practice.

Chapter 4:

Scores and Visual Noise

Since music is generally sound-based, discourse on noise and its role in music tends to focus on the sonic. However, there are usually many other forms of information and modes of communication involved in the creation of a piece of music than just sound. Performers often communicate with each other via eye contact, conductors utilise gesture, audiences can feel the tactile rumbles of sub-bass and, of particular interest here, composers often produce visual representations of music by utilising music notation. Neither is noise confined to just the audible. Thompson (2017: 7) highlights that 'noise is also implicated in the visual; it can be seen as well as heard, infecting writing, photographs and digital screens' however, she predominantly focuses on sonic manifestations of noise. Given the prevalence of music notation it seems appropriate to explore beyond the sonic and examine how noise can be utilised within composition to transform and generate visual materials.

This chapter will first discuss the use of visual noise in the compositions of John Cage and in the photography of Thomas Ruff, exploring how these applications of visual noise challenge commonly accepted power dynamics such as composer and performer or photographer and viewer. It will then discuss how these approaches to utilising visual noise and the resultant destabilisation of the composer/performer dynamic, informed the composition process of two pieces in the accompanying portfolio: *Music for Piano 21-36 & 37-52* and *Man in Regent Street.* Finally, it will consider how deliberately utilising visual noise in an attempt to challenge the composer/performer dynamic can also reinforce and perpetuate aspects of this dynamic.

4.1 Drawing a blank

Figure 4.1 Robert Rauschenberg - *White Painting [three panel]* 1951

In an article by composer John Cage (1968: 98–108) exploring the art of his friend and collaborator Robert Rauschenberg, Cage frequently refers to Rauschenberg's *White Paintings* (see Figure 4.1 above); a series of seemingly blank canvases, containing nothing but an even layer of white paint. While these paintings may seem to be empty, Cage (1968: 102–103) is keen to highlight that this is not the case, describing the *White Paintings* as 'airports for the lights, shadows and particles' and reiterating a quote from Rauschenberg: 'a canvas is never empty'. Using Shannon's theory to interpret Cage's descriptions of the *White Paintings*, they can be seen as foregrounding the noise of the medium through a lack of signal; on a blank canvas, only the noise is left behind. This is similar to the concept underpinning Cage's seminal 'silent' work *4'33''* where, in lieu of the piano playing, the noise of the concert hall is brought to the fore. Cage (1968: 98) alludes to Rauschenberg's influence on *4'33''* in the foreword to this article, stating that '[t]he white paintings came first; my silent piece came later'. However, *4'33''* is not the only one of Cage's works where the influence of Rauschenberg's *White Paintings* can be felt.

From 1952 Cage began developing and exploring a system for utilising the noise inherent in a blank piece of paper as a generative tool for composition (Pritchett 1993: 94). Composer and musicologist Michael Nyman (1999: 62) describes that '[j]ust as Cage had found that "silence" is full of (unintentional) sounds which may be of use to the composer and listener, so a "blank" sheet is also already alive with prospective sounds'. While a blank piece of paper is conventionally seen as something on which to write information, Cage looked to the noise that was already there. Looking closely at the paper, Cage (1968: 60) found imperfections and intensified them with pencil so that they became note heads on a stave. This composition process was utilised many times by Cage, perhaps most famously in his *Music for Piano* series (1952-62) but also in his *Music for Carillon Nos. 2 and 3* (1954) as well as pieces from 'The Ten Thousand Things' project such as *27' 10.554'' for percussionist* (1956) (Pritchett 1993: 94–5). Unlike *4'33''*, Cage does not include the noise of the medium as part of the performance. Cage's use of visual noise is confined to the composition process, resulting in 'scores that are no less (and no more) fixed in their notation than are Cage's pre-1951 works' (Holzaepfel 2002: 175). Cage does leave some decisions open to the performer – such as tempo and dynamic – however, any imperfections which may be found on the paper of the *final* printed score are not considered part of the piece, and such additional noise in the score is to be ignored by the performer.

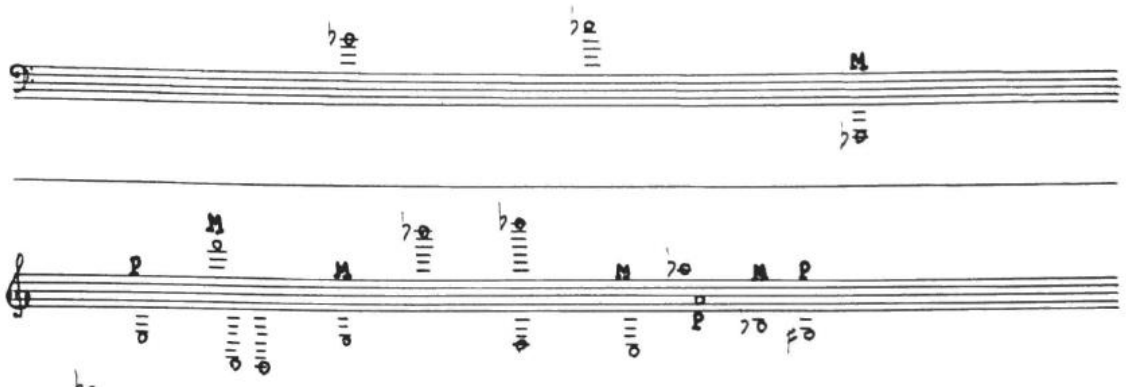

Figure 4.2 Excerpt from *Music for Piano 27* by John Cage

For Cage (1968: 10), this process was one of many chance based techniques he developed in an attempt to distance himself from the compositional process, to 'provide a music free from one's memory and imagination'. To what extent Cage's utilisation of noise is successful in creating a music separate from himself is perhaps debateable, after all even though the note selections themselves may be indeterminate, the system of sonification was designed by Cage and therefore he had some significant compositional input through the system design. Composer Steve Reich (2002: 35)

suggested that the process utilised by Cage 'could not be heard when the piece was performed' and that the 'compositional processes and the sounding music have no audible connection'. However, Cage's music composed from the noise of a blank page does produce music with distinctive features produced through this specific way of working. For example, in Cage's *Music for Piano 21-36 and 37-52* (1955) the relatively even distribution of imperfections across the entire surface of the page means that the notes are spread across the page rather than mostly falling on the stave and as such the score makes extensive use of ledger lines (for example see Figure 4.2 above). The result of this is music that utilises the polarised extremes of the piano's tessitura and is often highly disjunct. While this 'paper noise' process used by Cage may not be overtly clear to a listener in the same way the phase processes used by Reich or the feedback loops utilised by Alvin Lucier are, the process does have an audible connection to the resultant sound (see 5.1.3 Feedback for more).

As well as the sonic results of utilising visual noise in this way, Cage's compositional process also raises questions about the conventional relationship between composer and performer. Composer and musicologist William Brooks, suggests that Cage's use of visual noise presents interpretive issues for performers, stating that:

> The third note of Music for Piano 4 is A; but why play that note? It was, after all, selected randomly from the eighty-eight possibilities the keyboard offers. Any other note could just as well have been chosen. Were this a Mozart minuet, one would presume that a different note would be wrong, would detract from the beauty of the work, would violate the composer's intention and hinder a listener's opportunity to discern that intention. But this is not Mozart, and there is no intention. Why play A? (Brooks 2002: 224)

Brooks (2002: 224) argues that 'judgment, taste, interpretive insight are all irrelevant' in *Music for Piano* and that the decision to play the music as written is essentially an ethical one. Using Brooks' logic, the argument of 'Why play A?' could simply be rephrased as 'Why play any notated music as written?', after all Cage's utilisation of visual noise and other chance operations is not considerably more prescriptive than utilising the tonal system of harmony or the structure and conventions of a minuet. However, a showdown between Cage and Mozart is definitely beyond the scope of this thesis and almost certainly a futile exercise. What is interesting though, is perhaps why Brooks feels that Cage's music presents a dilemma of interpretation for the performer that isn't found in Mozart. It seems likely that this stems from how Cage (1968: 10) situated his role within the compositional process, that by utilising noise in this way he has created music removed from himself. Whether or not this music truly is removed from Cage is perhaps irrelevant. By making noise the forefront of the compositional process rather than himself, Cage exposed the fragility of the authoritarian role of the composer over performer that has permeated much of the western classical tradition: a relationship

where, to use the words of Beethoven (2014: 458), performers must use the score to 'follow the ideas of the unfettered genius'. Within this relationship the score is viewed as the literal manifestation of the piece, almost a window, direct into the 'genius' mind of the composer, through which the performer can reproduce the exact intentions of the composer. A challenge to this relationship by Cage's music is seemingly in spite of the fact that he was often vehemently opposed to alteration or improvisation during a performance of these pieces; just like many composers before him, Cage expected the performers to play the notes as written on the page (Brooks 2002: 224–5). However, simply suggesting that the score was not the authoritative voice of the composer is enough to raise questions of the role of a performer: if the score is not a window into the mind of the composer, what is it, what is it for and why should a performer play it at all?

4.2 Ruff around the edges

Parallels of this ontological dilemma can be found in many other artforms throughout the 20th and 21st centuries. Although not exclusively, noise is often a driving force in this destabilisation, something which is particularly apparent in the photography of Thomas Ruff. Ruff was a student of photographers Bernd and Hilla Becher in Düsseldorf, where the Becher's practice and teaching centred around the truthfulness and transparency of photography (Biro 2012: 354). Throughout its relatively short history, photography has often been described in terms of its truthfulness and transparency, something which has been utilised to set it apart from painting and other visual arts. Some, such as philosopher Kendall Walton (1984: 251), have gone as far as to argue that we look *through* photographs, and that by doing this 'we *see,* quite literally' the subject of the photograph. This documentary, seemingly transparent approach to photography can be found in Ruff's early work, for example his early series *Interieurs* (1979 - 1983), which documented empty rooms in his friend's and families' homes. Ruff's next major series, a selection of passport-like images titled *Portraits,* at first appear to continue with this approach to photography. However, as Ruff describes the presentation of these images in large 1-meter and later, 2-meter-high prints, sought to challenge the transparency of the image:

> People were pointing to the portraits and saying […] 'oh that's Heinz, that's Peter' and I always had to tell them 'no, that's not Heinz, that's not Peter, that's not Pierre, that's a photograph of them'. So, I had to realise that people looked through the photograph […] they ignored the medium thinking they were looking into reality. […] I decided to do the portraits in a very big size […] and that really helped a lot. Because now people [...] no more said 'ah, that's Peter', they said 'oh, this is a big photograph of Peter'. So, this was the first time they realised that they are looking at a photograph (Ruff 2012)

This exploration of the medium of photography and investigating and undermining its transparency is something that Ruff has continued to explore throughout much of his work, so much so that Ruff's practice is sometimes described as being 'art *about* photography' (Blazwick 2017: 9).

Figure 4.3 Thomas Ruff – *nudes ga08* 2001

Figure 4.4 Thomas Ruff – *nudes ry18* 2002

Seeking to further draw the viewer's attention to the materiality of the medium of photography, Ruff began deliberately degrading the quality of his photographs. Through this degradation Ruff utilised the transformative potential of visual noise to produce effects that are overtly apparent to a viewer, undermining the transparency of the image through the emphasis of the noise of the medium. Ruff's utilisation of visual noise is best known from his *nudes* (1999-2004 and 2011) and his *jpegs* (2004-2007) series which, both predominantly utilise found and appropriated imagery that were then degraded by Ruff. In *nudes*, Ruff utilised low resolution pornographic images he found online which he distorted using pixel shifting and blurring, partially obscuring the original image and smoothing out the edges of the pixel structure from the original low-resolution image creating a soft focus, painterly like effect (see Figure 4.3 and Figure 4.4 above) (Ruff in Goertz 2012: 29:45; Gunti 2020: 274). In *jpegs,* he juxtaposes a variety of images including human catastrophes, natural catastrophes, landscapes and nature reclaiming ruins (Ruff 1999, 2009). With these images Ruff explored and emphasised the effects of noise introduced into an image by the JPEG data compression algorithm which created grid structures across the images (see Figure 4.5 below) (Gunti

2020: 283). Like the *Portraits* series, the prints in both *nudes* and *jpegs* are very large to further highlight the medium itself, the *jpegs* range from 188cm x 188cm to 297cm x 364cm (Simpson 2009).

The large size of the images combined with the effects of visual noise, results in an interactive experience for a viewer. From a distance the original images are generally perceptible however, as the viewer approaches the image the blurring and distortions become more apparent. The noise varies the possible transparency of the image depending on the viewer's distance, as they approach the image, presumably in search of more detail, they are instead confronted with the medium itself. As well as questioning the transparency of the photographic medium, the introduction of noise into these images also encourages a shift of focus towards abstraction; presented with a lack of detail our attention is instead drawn towards the underlying geometry of the image. This again is an active process for the viewer, as curator and artist David Campany (2017: 196) describes when viewing an image 'through Ruff's crude but often beautiful grids of pixels, we switch from looking at figuration to abstraction and back again'. Similar to how Cage's use of noise raised questions about the relationship between composers and performers, Ruff's use of noise challenges the notion of the passive observer and highlights the active role of the viewer as a participant in the realisation of the image within the gallery space.

Figure 4.5 Thomas Ruff – *jpegs ny02* 2004

As well as engaging the viewer actively in how they look at the image, the effects of noise in Ruff's photographs also changes how a viewer may understand the image. Ruff's work is often relatively resistant to clear interpretations of meaning and Ruff himself is often fairly oblique in descriptions of his work. The titles of individual images follow an archival format using short letter codes and dates and are presented in the gallery without additional context. This style seems clearly derived from the seemingly neutral, documentary approach to photography taught to Ruff by the Bechers. However, Ruff's utilisation of noise combined with the high cultural and political significance of his chosen subjects means his photos often invite interpretations of meaning. For example, Hainge (2013: 214) argues that the abstraction of the image caused by the utilisation of noise is the focus of Ruff's *nudes* and *jpegs*, stating that the effects of noise 'emphasises not so much the *medium* through which photographs are distributed in the internet age […] but, rather, the way in which all images are necessarily at some level about the distribution of light and colour, about the process of composition'. Campany (2017: 196) suggests that the switching between abstraction and figuration is reflective of the 'character of contemporary life, with its great forces of bureaucratic rationality and irrationality'. The introduction to Ruff's *jpegs* monograph by curator Bennett Simpson (2009) offers several different and contrasting readings of the meaning behind the *jpegs* series. To what extent these analyses are 'correct' to Ruff's intention is something that could be debated extensively however, what is interesting from a compositional perspective is that through the transformative effects of noise, these images are able to evoke and suggest new meanings to a viewer. This stands in antithesis to Shannon's (1948: 379) assertion in *A Mathematical Theory of Communication* that the 'semantic aspects of communication are irrelevant to the engineering problem'. If this were the case, the images – no matter how noisy – would retain their original meaning. While this may be problematic for those using Shannon's theory to engineer communication systems, when used deliberately as a creative tool it offers the potential to transform not just the material itself but to alter, prompt and create new interpretations of meaning.

4.3 Distorted scores

Building upon the techniques utilised by Cage and Ruff, two compositions included in the portfolio explore how visual noise can be utilised further within composition, going beyond Cage's applications of noise as a generative tool and looking to the transformative potential of visual noise utilised by Ruff. The result of this exploration is two compositions: *Music for Piano 21-36 & 37-52* (hereinafter referred to as *Music for Piano for Loadbang* in order to distinguish it from Cage's suite) for baritone voice, c trumpet, tenor trombone and bass clarinet; and *Man in Regent Street* for soprano voice, paper and live electronics. Central to this exploration of visual noise are two main themes, firstly how noise can be utilised as a transformative tool and secondly, how noise can be

utilised to undermine the authoritarian position of the composer by highlighting the authorship a performer has over a piece of notated music in performance. In order to further explore the performer/composer relationship, during the composition process both pieces were composed with direct input from the performers, the Loadbang ensemble and Mimi Doulton respectively. This section will explore the compositional process of these pieces, examining applications of visual noise and its effect on the compositions. It will then reflect on the success and failure of these pieces to subvert the composer/performer relationship.

4.3.1 Music for Piano for Loadbang

Taking its name from the eponymous John Cage suite, *Music for Piano for Loadbang* was composed using visual noise at two different stages in the composition process. Using the application of Shannon's theory outlined in 2.2, I looked to sources of noise inherent in visual technologies to transform the visual materials of the score. Firstly, a short score was heavily degraded using the noise inherent in digital photocopiers before being sent to the Loadbang ensemble to interpret. The recordings of this were analysed to generate two different tone rows which were used as the harmonic basis of the composition. Using this, short cells were composed which form the content of the score. Several of these cells were degraded with noise inherent in digital image compression.

Pre-Composition

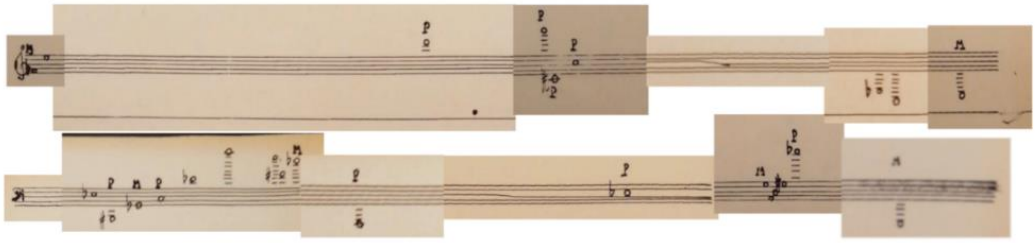

Figure 4.6 Collage of material from John Cage's *Music for Piano 21-36 & 37-52*

Drawing influence from Ruff's appropriation of imagery I was keen to explore how noise could be used to alter and create new music from existing material. For the starting material I chose to use the score for John Cage's *Music for Piano 21-36 & 37-52,* primarily for its thematic link. Going through the scan of the score, I noticed there was a significant amount of visual noise present throughout. This noise ranged from mistakes Cage had made while writing the score by hand, imperfections introduced when Cage's score was duplicated, and noise introduced by the low-quality digital scan I was viewing. Given that Cage's intention for this piece was that visual noise would only be part of the composition process rather than something that was to be engaged with by the performer, these effects of visual noise in the score stood out. I created a collage of some

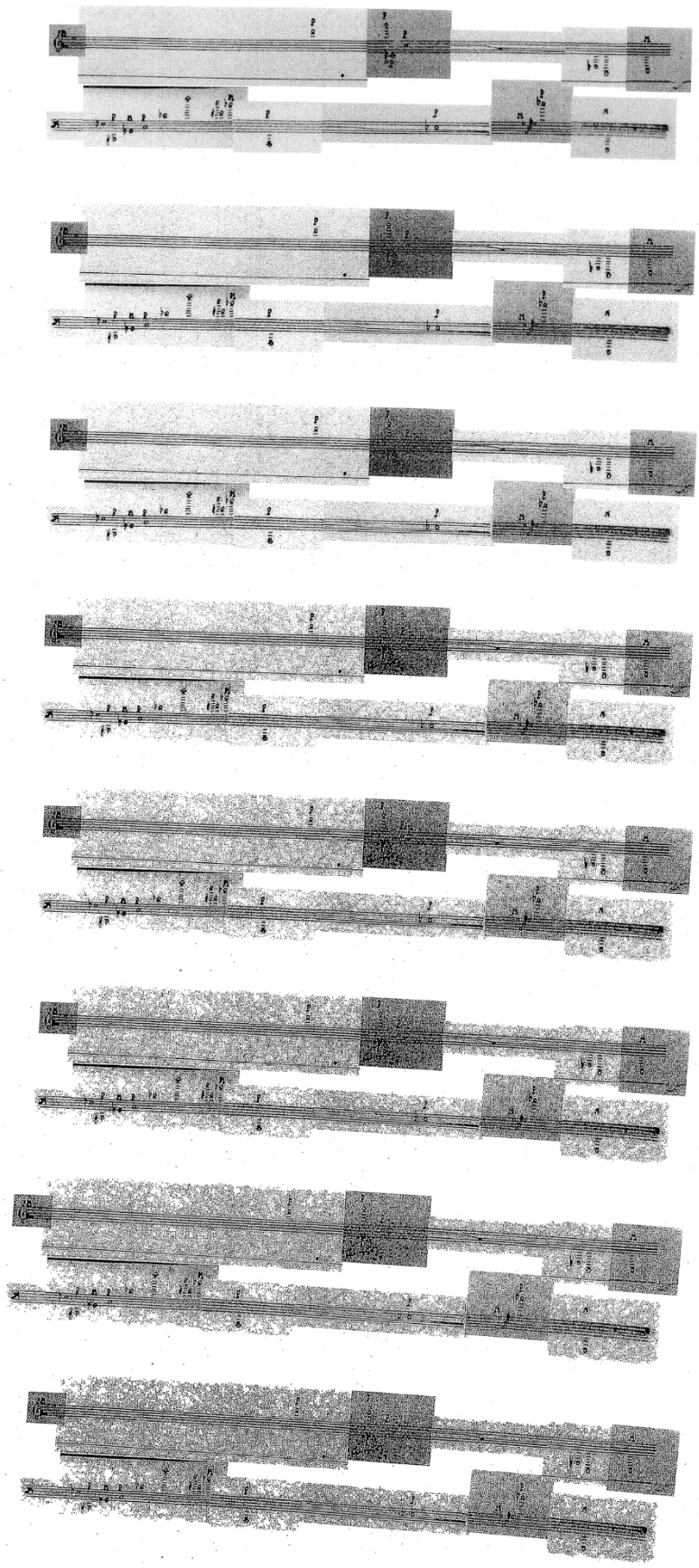

Figure 4.7 Photocopier feedback on collaged score

parts of the score that contained prominent transformations from visual noise (see Figure 4.6 above). This collage of material was then run through a photocopier cyclically, recycling the output of the photocopier back into its input. This process was inspired by the early days of score sharing website IMSLP. Often the scores on this website were scans of photocopies which were themselves several generations of photocopies and almost entirely unreadable. This feedback process emphasised the noise introduced to the material by the photocopier and with each cycle the original material was altered and effected by the noise imparted by the machine. As can be seen in Figure 4.7 (above) this process increased the contrast of the image, removing the middle greys of the background and making it significantly harder to distinguish the score from the now grainy black background, as well as twisting and stretching the score slightly – diagonally and to the left – due to misalignments within the photocopier.[16] After eight iterations this process began to stagnate with no clear differences between each subsequent iteration. The eighth iteration was scanned, the contrast and brightness adjusted digitally to taste and run through a pixel shifting process similar to that used by Ruff in *nudes* to subtly obscure the content further (see Figure 4.8 below).

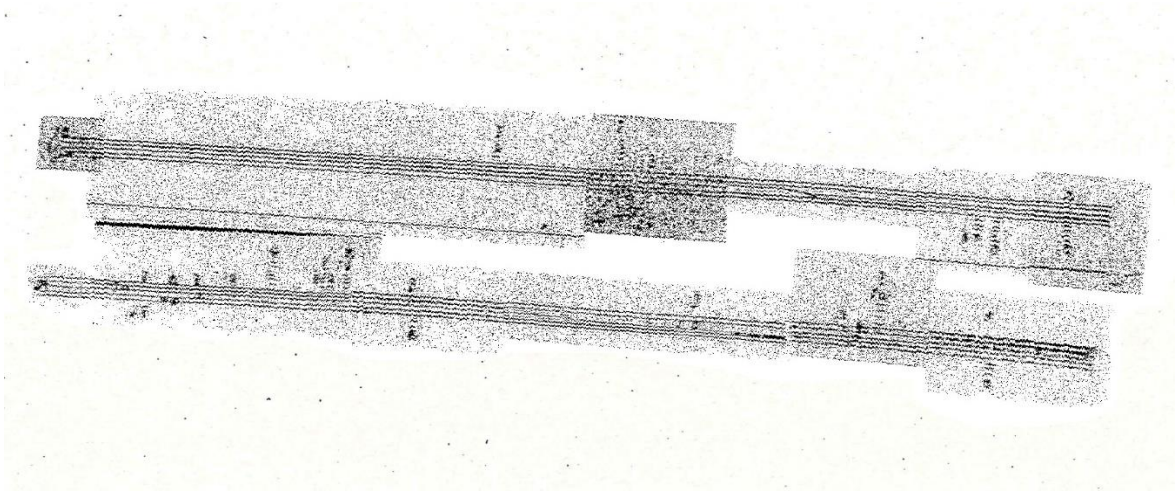

Figure 4.8 Final manipulation of collaged score

The final result of this process was then sent to the Loadbang ensemble, who were asked to play the score and return a recording of their interpretation. The ensemble was not informed of the origin of the score so that any prior knowledge they may have had of Cage's piece would not influence their interpretation. I received back two recordings of different interpretations, one sung and one played on trombone. As anticipated, the recordings were not an accurate recreation of the original Cage material, although some disjunct movement between notes at the extremes of the tessitura did

[16] It is also interesting to note is that the photocopier picked out imperfections in the paper and made these more prominent, similar to Cage's composition process. These are the small sparse specks seen around the main collage.

remain. Unexpectedly, both recordings contained substantially more unpitched and complex inharmonic material than pitched, after being transformed by noise the original meaning of the score to the performers had been transformed. The original intention was to transcribe the recordings and utilise the transcriptions as melodic material within the final piece. However, given the prevalence of inharmonic sound within the recordings, I instead opted to run a pitch detection algorithm on the recordings, taking the most prominent frequencies to utilise as the harmonic basis for the piece. Through analysing these interpretations of the Cage's score transformed by noise, I created two scales (see Figure 4.9 below), one from each recording.

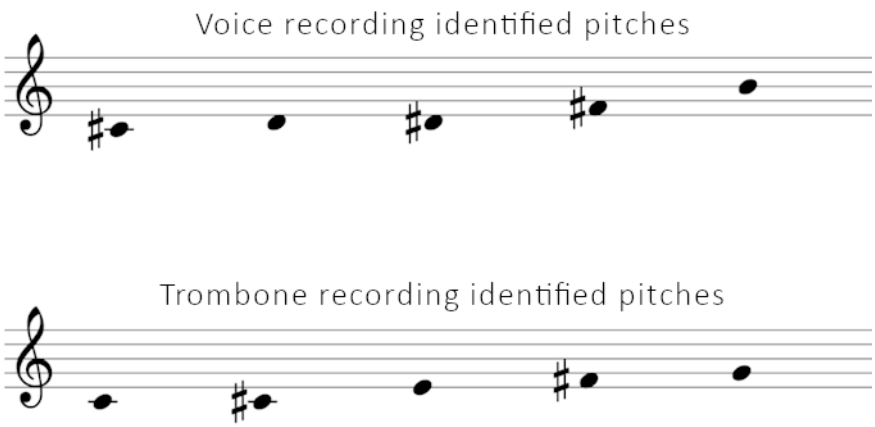

Figure 4.9 Pentatonic scales identified from Loadbang recordings

Utilising these two scales I composed multiple short musical cells for each instrument. These cells were then organised into a simple structure comprising of three main sections, using the voice recording scale for sections A and C and the trombone recording scale for section B. However, by incorporating visual transformations from noise into the score to blur the distinctions between each section it was possible to create a considerably more complex, indeterminate structure than the simple ternary-like organisation of material would initially suggest.

Structure through Noise

Music for Piano for Loadbang is in essence a game piece.[17] As well as the three main sections (labelled Section A, B and C in the score) there are also small transitional sections called shared cells (labelled Shared Cell 1-4). The two section types each have their own distinct rules about how a

[17] Albeit one that is seemingly less 'open' than can be found in other game pieces, such as the music of John Zorn.

performer should proceed through the piece. Within the main sections, each performer has three short musical cells that are unique to them. The performance instructions for the main sections are:

> Choose one of the three cells. Play it on repeat and on each repeat play one dynamic marking quieter. When you reach *ppp* start the process again.
>
> If you have completed this process at least once for all three cells you may move to the next Shared Cell.
>
> If you notice another performer playing the Shared Cell, finish the cell you are playing and move to the Shared Cell.

Shared cells are short, and identical for all performers. The specifics of the rules for the shared cells differ slightly depending on where they are in the piece. Essentially the main rule for the shared cell is that when all performers are playing the shared cell they may then progress to the next section. While the simple rules should result in a relatively straight forward and clearly defined structure, the shared cells have been transformed with noise in order to obscure the distinction between each section. The shared cells are all distorted with pixel shifting and JPEG compression to varying degrees (for example see Figure 4.10 Shared Cell 4 below). Different performers will likely interpret the meaning of the distorted score in different ways and performers are also encouraged to explore different interpretations of the shared cell on each repeat where they are unsure what the 'correct' notes are. The rest of the ensemble must try and consider not just how they would interpret the score but listen and compare what they are hearing to the distorted score in order to identify if that may be what is being played and to then progress to the next section. This, combined with the quiet dynamic the shared cells are played at, is designed to create an overlapping of the sections. A member of the ensemble may be quietly trying out different interpretations of the score for a significant period of time before anyone notices and joins in. Alternatively, a member may misinterpret what they have heard being played and jump to the shared cell before anyone else has moved to it.

Figure 4.10 Shared Cell 4

This instability introduced into the score through the effects of visual noise has the potential to create complex structures within the composition with variation between performances despite the relative simplicity of the score. How this structure evolves and manifests during the performance is predominantly dependent on the how the performers interpret the score after the effects of noise, and through this interpretation the performers take on a compositional role within the realisation of the piece. However, the noise utilised in *Music for Piano for Loadbang* is a fixed part of the score, while the interpretations of the score may change between performances, the effects of the JPEG compression remain fixed. Building from this idea, the next piece in the portfolio: *Man in Regent Street* looks to explore how the transformations of noise upon a score can be utilised as part of a performance.

4.3.2 Man in Regent Street

Scores printed on paper can often end up subjected to a myriad of physical sources of noise. For example, as a not so diligent undergraduate student, I kept most scores I used in a crumpled mess at the bottom of my backpack. Creases, tears, and dirt accumulated on the scores over time while individual pages got jumbled out of order or lost. Through this gradual ongoing process, the scores were transformed through noise, at times becoming almost unrecognisable from the original

Figure 4.11 An installation of *Man in Regent Street* prior to performance

material. *Man in Regent Street*[18] incorporates these physical sources of noise into the performance, exploring how the performer and audience can function as a source of noise to transform and generate musical material.

During a performance of *Man in Regent Street*, the performer is instructed to rip the score multiple times. After the performance, the audience is invited to rearrange the pieces of the score. This is an iterative process, after the score has been rearranged it is performed, torn, and reordered again. This system was developed using Shannon's theory, as outlined in section 2.2, as it enables the performer and audience to act as noise sources upon the score, altering and transforming it, affecting its ability to transmit the original information back to the performer. These physical sources of noise acting upon the score effect the sonic result in numerous ways, creating new musical phrases and an entirely new structure. In addition to this, just as Ruff's photography invited new interpretations through noise, the engagement with noise in this piece is intended not just to transform the musical material but, to bring new meaning with each iteration. As the score is damaged and rearranged, lyrics are reordered to uncover and create new meaning. Through these transformations, a version of the piece is created by the performer and audience that is unique to that staging of *Man in Regent Street.*

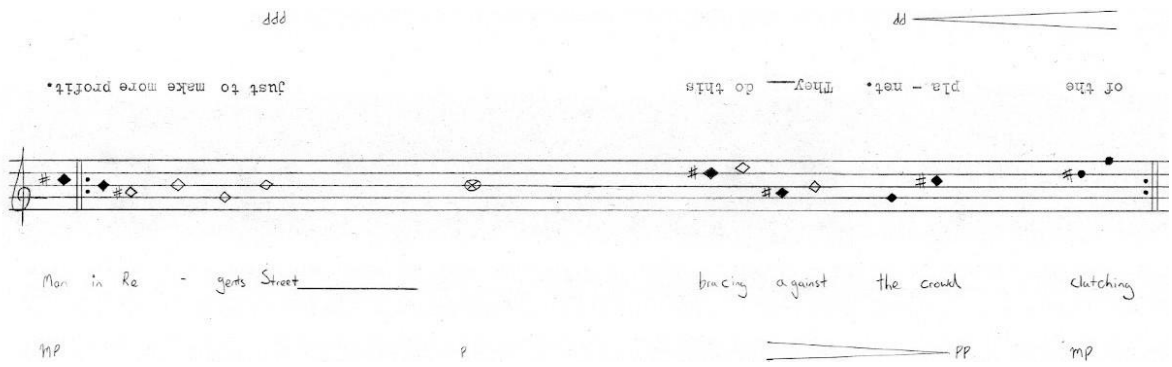

Figure 4.12 Excerpt from *Man in Regent Street* score

The score for *Man in Regent Street* has been designed in order to maximise the transformative and generative potential of the performer and audience as a noise source. Unlike *Music for Piano for Loadbang,* the score for *Man in Regent Street* has no deliberate effects of noise fixed within the score. The score does however have two notable unconventional elements. Firstly, the score is considerably longer than normal; rather than utilising multiple pieces of paper, the score is printed onto a continuous four-meter roll of paper (see Figure 4.11 above). Printing the score on a single continuous roll of paper allows the performer to rip the score at any point, uninfluenced and

[18] *Man in Regent Street* takes its title from the first line of Gustav Metzger's (2017: 87) second Manifesto of Auto-Destructive Art. For more on Auto-Destructivism see section 3.1.1 Failing playback media.

unimpeded by the length of individual pages. As such, the sections of score that are created by the performer do not correspond to anything predetermined, encouraging the development of a unique structure throughout the piece derived from the decisions of the performer and audience. Secondly, the score has two sets of lyrics and dynamics, one above and one below the stave (see Figure 4.12 above). The two sets of lyrics increase the possibility of new meanings and narratives emerging from the restructuring of the score. The performer always sings the lyrics and dynamics that are below the score. As such, during the first iteration of the piece, only one set of lyrics and dynamics will be heard. However, after the score has been torn and rearranged, sections of the score may have been rotated, incorporating some of the second set of lyrics into the next performance. This means that not only can the lyrics be rearranged but new lyrics can be uncovered and incorporated into the piece through the transformation of the score through noise. As the process progresses, the sonic effects of noise become increasingly apparent. The torn sections of score become shorter and more erratic; increasing amounts of the second set of lyrics are heard; and some lyrics end up separated from their accompanying notes.

Figure 4.13 An installation of *Man in Regent Street* after six iterations

The transformative effects of this noise are reinforced by both the staging of the piece and the electronic accompaniment. The large physical presence of the score in the space provides a clear visual representation of the process for the audience as the score moves from being one continuous piece of paper (see Figure 4.11 above) to torn fragments that have been rearranged and pieced together (see Figure 4.13 above). The iterative performances of the piece can be spread over

multiple days with different audiences and so the visual manifestation of the process provides a link to those who may not have previously engaged with the piece. The electronic accompaniment for *Man in Regent Street* also provides a sonic link to previous iterations, as well as providing a backing for the vocal. The different elements of the electronic accompaniment follow the performer triggered by either the performer singing specific pitches or the performer physically interacting with the score. This means that, as the effects of the performer and audience acting as a noise source alter and rearrange the score, the electronic accompaniment is also altered and rearranged. In addition to this, the electronics record each iteration of the vocal performance, which is incorporated into the electronic backing for subsequent iterations. Through this, the transformations of the score by the performer and audience from each iteration are embedded into the piece generating an electronic accompaniment that is unique to each staging of the piece.

By utilising the performer and audience as a noise source, this piece heightens the level of creative control both the performer and audience have over the mediation and delivery of the piece. As a result, the performer and the audience have control over the ultimate development of all aspects of the piece, collaborating to transform the original score into a new, unique version. Actively engaging with noise in this way brings the compositional control performers and audiences have over a piece to the fore, blurring supposedly clear boundaries between composer, performer, and audience.

4.3.3 Open scores?

Both *Music for Piano for Loadbang* and *Man in Regent Street* could be considered examples of open scores, as the performers are responsible for decisions which fundamentally alter the form and content of the pieces (Eco 2017: 241). However, a problem with using the term 'open score' here, as elsewhere, is that it suggests the possibility of an opposite 'closed score' in which the score is the authoritative voice of the composer, and where the performer has little or no input into the content of the piece. A theoretical 'closed score' fits well with the accepted hierarchical relationship between composer and performer that is prevalent throughout much of the western classical tradition. For example, Brooks (2002: 224) views the score as the manifestation of the composer's intention and that if a performer were to deviate from the score it would 'hinder a listener's opportunity to discern that intention'. Within this relationship, the performers' role is to accurately recreate the will of the composer and the score is the fixed manifestation of that will. However, as Cage's utilisation of noise highlighted, this commonly accepted relationship between composer and performer is relatively tenuous.

As scores are often thought of as being the fixed, definitive manifestation of the composer's intention, they can often become synonymous with being the musical work itself. However, as musicologist Christopher Small highlights:

> A score, of course, is not a musical work. It is not even the representation of it. It is a set of coded instructions that, when properly carried out, will enable performers not only to make sounds in a specific combination, called a musical work, but also to repeat that combination as many times as they desire. (Small 1998: 112)

The coded instructions of the score are a form of communication between the composer and performer. This communication indicates what the composer would like a performer to achieve. However, this is far from a perfect form of communication. Due to noise in the communication system, when using any score performers are continuously interpreting (and misinterpreting) the meaning of the communication. Often the compositional decisions made by performers during a performance are relatively small – a slight crescendo, an increase in vibrato or lengthening a phrase with rubato – and are done with the intention of better representing what the composer meant, augmenting the information on the page. Framing it in this way diminishes the creative input of the performer, reinforcing the authority of the composer; the performer is not making compositional decisions over the realisation of the piece if they are just playing what the composer really meant all along. But, to what extent these interpretations are correct to the composers' original intentions is often largely unknowable and as such through these interpretations the performer takes some control over the realisation of the piece. As composer Roger Smalley (1969: 84) highlights: 'musical creativity is not just the prerogative of the composer but of all musical people'. Even notation styles which may seem to leave no room for input from the performer can require interpretation. For example, although the score for *Cassandra's Dream Song* by composer Brian Ferneyhough is intricately scored to an extreme, flautist Ellen Waterman (1994) highlights, this information overload results in performances which are just as collaborative. Composers and performers are both responsible for the creation and realisation of a piece of music with the score providing a starting point for the performer's creative input.

The utilisation of noise in *Music for Piano for Loadbang* and *Man in Regent Street* aims to highlight the creative input of the performers directly by utilising noise to undermine the supposed authority of the score.[19] Both pieces utilise noise that already exists to some extent in conventional 'closed' scores, however these pieces push the transformations of this noise to an extreme in order to

[19] It is worth noting that noise is not the only way to challenge the conventional composer/performer relationship, for example Cage produced similar results by utilising random numbers.

emphasise its effects on the performance. This foregrounds the performer's contribution to the realisation of the composition, highlighting the collaborative relationship that always exists between composer and performer when utilising a score. Through this, both pieces are able to generate long, relatively complex and evolving structures despite using a relatively limited amount of musical material within the score. Embracing the transformative potential of noise and the subsequent creativity of the performer has considerable creative potential however, despite this, it does not come entirely problem free.

Resistance is futile

The issue with challenging the accepted composer/performer relationship is that despite its considerable flaws, plenty of performers are used to thinking in this way and are quite happy with it. While workshopping sketch pieces with various performers that tested this concept, I was often met at first with some resistance. This was not entirely unexpected, composer John Zorn (2017: 276) highlights that composers like John Cage and Earle Brown had similar experiences with performers, particularly those from the classical tradition. Similarly, Thor Magnusson (2019: 105–6) discusses how issues such as a lack of training, limitations on time and financial resources can impact the willingness of performers to engage with 'open' scores. In my experience, the resistance from performers came primarily from a discomfort with the unfamiliar. While the performers were used to making interpretive decisions, the reframing of their role in the composition of the piece added a new layer of pressure. The result has been like a cat and mouse game, performers have tried to find ways around the noise, and I have tried to increase the effects of noise so that it cannot be avoided. However, this in itself presents a dilemma: is enforcing collaboration any less authoritative than Beethoven's (2014: 458) view that performers must 'follow the ideas of the unfettered genius'? In practice I have found that while there is often some initial hesitancy from the performer, as long as there is adequate rehearsal time then much of this is mitigated. Overall, using the visual effects of noise in this way has encouraged and highlighted the agency of the performer and has had a positive effect on the music created resulting in exciting, variable new music that I would likely never have composed without the input of the performers.

4.4 Conclusion

Although discourse on noise within music is conventionally limited to the sonic, there is no reason why it needs to be. Music often uses visual forms of communication and noise is present within these. As explored through Cage and Ruff's applications of noise, noise can both generate and transform visual material. Utilising noise in this way can often highlight and challenge accepted relationships within artistic communication; Cage's applications of visual noise raises questions

about the conventional authoritarian composer/performer relationship and Ruff's work highlights the active role of the viewer. However, this destabilisation need not be viewed as a negative, instead these points of rupture provide significant creative potential.

The potential for visual noise to disrupt compositional norms was explored through two compositions, *Music for Piano for Loadbang* and *Man in Regent Street.* Both of these pieces sought to foreground the ownership performers have over a piece. By applying Shannon's *Mathematical Theory of Communication,* as outlined in 2.2, various sources of noise that can act upon visual media were identified. Each of the compositions engaged with different sources of noise with *Music for Piano for Loadbang* focusing on noise inherent in digital visual media and *Man in Regent Street* on noise inherent in printed visual media. In *Music for Piano for Loadbang* the noise inherent in JPEG compression was utilised and the effects of this noise on the notation are fixed in the score. In *Man in Regent Street* the ownership the performer has over the piece was pushed further with the performer functioning as a noise source altering and transforming the score. Utilising the visual effects of noise in this way resulted in music with complex and evolving structures despite the relative simplicity of the original musical material.

However, through this composition and rehearsal process it became apparent that challenging the conventional composer/performer relationship and foregrounding the role of the performer within the performance also raised further questions about the authority of the composer. Is telling performers they must take ownership of a piece any less of an authoritarian position? In reality, this question likely does not have a clear answer. However, it seems likely that examining this contradiction created by noise, has potential for exciting further exploration through creative practice.

Chapter 5:

(Un)fixed Media

> Painting is superior to music because it need not die as soon as it has received life, as is the case with poor music […]. Music, which vanishes the moment after it comes into being, is no match for painting, which with the use of varnish has become eternal (da Vinci in Benjamin 2009: 277)

The advent of sound recording in the late 19th century enabled sound to 'live' beyond the moment of production; like Leonardo da Vinci's use of varnish, recording has the potential to render sound 'eternal' (Benjamin 2009: 277). Parallels between recorded sound and the fixity of visual arts frequently occur in discourse on the metaphysics of electronic music. For example, philosopher Stanley Godlovitch (1998: 118) states that unlike instrumental music where performers may introduce 'uncontrollable indeterminacy in the form of third-party interpretation', electronic music is instead a perpetual, fixed form of sound, that '[l]ike bronze, […] is cast, and persists historically independent of and uninfluenced by any performance traditions'. The concept of the fixity of recorded sound is reflected in the language often used by composers to describe their music; the anachronistic term 'tape' has gradually been superseded with 'fixed media'. However, as discussed in Chapter 4: Scores and Visual Noise, visual media is not immune to the transformative properties of noise and as such the notion of fixity in visual arts is in itself a fallacy; the varnish that rendered da Vinci's paintings 'eternal' has cracked and darkened with age. Despite this, comparisons between recorded sound and visual arts are not unfounded; on the contrary, fixed media compositions are

equally unfixed. For example, composer Adam Stanović highlights how the presentation and performance practices in a broad range of electronic music styles, from multi-channel installations and sound diffusion to algorithmic compositions, introduce variability into the music (Stansbie 2018). Not to mention, if recorded sound truly was fixed, then most of the practice discussed in Chapter 3: Improvising with Playback Media, would not be possible. As well as performance practices introducing variation, noise inherent in the processes and technology used for playing back fixed media compositions also introduces variation (Stansbie 2018: 5–6). While the effects of this noise are sometimes viewed as negative or, unavoidable and therefore irrelevant, deliberately seeking out and utilising this noise can provide both novel ways of transforming sound and a way to increase the variability and interactivity of fixed media compositions.

An old computing adage is that any fault, known as a bug, in a piece of software can be spun into a positive by reframing its esoteric behaviour as a feature.

> FEATURE n.
>
> 1. A surprising property of a program. Occasionally documented. […] See BUG. "That's not a bug, that's a feature!" ('The Jargon File' 1988)

A similar attitude can be found in the approaches of numerous creative sound practitioners who embrace the creative potential of the noise inherent in fixed media composition. Chapter 3: Improvising with Playback Media explored the potential of introducing noise and pushing playback media into a state of failure. This chapter examines how even playback systems which are functioning as intended transform sound due to the noise inherent in these systems resulting in variability in fixed-media compositions. This examination is done through the lens of creative practice, focusing on a variety of different ways practitioners have embraced and emphasised the transformative, variable effects of this noise as a feature, rather than a bug of the medium. These include the performance practice of sound diffusion specifically using Acousmonium style loudspeaker orchestras as well applications of distortion in the music of Maryanne Amacher and the emphasis of inherent noise through feedback in the music of Alvin Lucier and Graham Dunning. It then explores how these utilisations of inherent noise and (un)fixed media informed the composition process of the portfolio composition *Wallpaper* as well as how the noise inherent in the global telephone network was used to unfix *Wallpaper* through its delivery over a telephone hotline.

5.1 Not bugs, features

5.1.1 The Acousmonium

Sound diffusion – 'the realtime (usually manual) control of the relative levels and spatial deployment during performance' – is a prevalent form of performance practice in fixed media electroacoustic

composition (Harrison 1998: 117). The origins of the practice can be traced back to the earliest performances of musique concrète by Pierre Schaeffer in 1950. Schaeffer (2012: 99) utilised a three channel speaker system to diffuse sounds around the audience, in order to provide the fixed 'sound objects of concrete music with a spatial development in keeping with their forms'. The origins of sound diffusion were 'primarily corrective, serving to present a sound field similar to that heard during the compositional process' when scaling up the playback environment to a large concert hall (Stansbie 2018: 12). The need for sound diffusion as a corrective tool is highlighted by composer and performer Jonty Harrison who notes:

> Even on a good domestic hi-fi system, with the listener in the 'sweet spot' (roughly in an equilateral triangle with the two speakers), the stability of the stereo image is notoriously fickle – moving to left or right by just a few centimetres, or turning or inclining the head can cause all kinds of involuntary shifts in the stereo image. So if a stereo piece is played over a stereo pair of loudspeakers (even large speakers) in a large hall, the image will be even less stable and controllable than in a domestic space, and will certainly not be the same for everyone in the audience (Harrison, 1998, p. 121)

A corrective approach to sound diffusion is intended to mitigate some of the variability from the playback of fixed media compositions and provide everyone in the audience with a more consistent listening experience. However, performers working with sound diffusion often look to the creative applications of these systems to introduce interpretive variation into a performance through the performative control of dynamics and spatial placement in order to 'further dramatise, enhance, enlarge, exaggerate, expand and/or spatialise what is on the fixed medium' (Stansbie 2018: 12).

Speaker systems used for sound diffusion vary significantly, as composers and designers of the BEAST diffusion system Scott Wilson and Jonty Harrison (2010: 240) note, there is 'little if any standardisation in terms of layout, hardware or software amongst most […] systems currently in use'. The reasoning behind these variations ranges from practical considerations, such as limitations on space or financial resources, to aesthetic decisions derived from the performance and compositional styles of those involved in its use and design. Within these variations there exists something of a continuum between non-homogenous systems where the 'various pairs and arrays of speakers are not all of the same size, type, or model' and homogenous systems where every loudspeaker in the system matches (Wilson & Harrison 2010: 240). Homogenous systems generally utilise a design of speaker with a full range and relatively flat frequency response selected with the goal of remaining 'true to the original [frequency spectrum] of the recording' (Deruty 2012). However, as Wilson and Harrison (2010: 240) note, 'loudspeakers cannot be treated as strictly neutral and transparent conveyors of fully and ideally realised sound'; when playing back sound over

a loudspeaker the noise inherent in the speaker acts upon and transforms the sound. While Wilson and Harrison (2010: 240) don't view this as ideal they acknowledge that when using multiple different loudspeakers such as in a non-homogenised system, 'this lack of neutrality is not a weakness but is again rather a potential tool waiting for an appropriate opportunity to be exploited'.

Non-homogenised diffusion system designs primarily stem from the 'Acousmonium' developed by composer François Bayle with technician Jean-Claude Lallemand at the GRM in 1974. When designing this system, Bayle and Lallemand looked to create an 'orchestra made up of loudspeakers of different calibres following the pattern of orchestral instruments, each with its own register' (Zanési & Gayou 2007: 278). As composer Cathy van Eck describes, the design of the Acousmonium comprises of numerous drastically different loudspeakers:

> The different loudspeakers comprising the Acousmonium all have their own individual characteristics, such as frequency range, amplitude range, sound dispersion pattern, and so on. There are for example special high range loudspeaker (tweeter) trees, which are often placed among the audience (Eck 2017: 133)

This system design allows performers to utilise a wide range of effects of noise inherent in the different loudspeakers. As composer and performer Annette Vande Gorne describes, utilising a system like the Acousmonium gives the performer 'the liberty in the interpretation of timbre that different loudspeakers provide' (Anderson & Vande Gorne 2012: 13). The unique timbre of each speaker is a product of the noise inherent in its design. Rather than attempt to minimise the effects of this, a non-homogenised speaker system embraces the transformative potential of the noise inherent in loudspeakers using it to shape the frequency spectrum of the sound being played back.

In addition to utilising the noise inherent in loudspeakers to transform sounds, when designing the Acousmonium, Bayle and Lallemand also positioned speakers pointing towards 'the wall or ceiling for a more indirect sound' (Eck 2017: 133). By pointing the loudspeakers away from the audience, the manipulations of the acoustic of the concert hall can also be utilised creatively. Wilson and Harrison (2010: 247) note that indirect speakers can be used both as a tool to help bridge gaps when fading between different sets of loudspeakers and as a creative effect that transforms the sound being played back. This approach also embraces the noise inherent in the performance space for its creative potential in manipulating a fixed media composition. When performing on an Acousmonium the fixed media composition can be sent to specific loudspeakers in order to deliberately manipulate the sound through the noise, either altering the frequency spectrum of the composition with specific loudspeakers or through the resonances of the performance space. Rather than attempting to minimise the manipulation caused by the noise inherent in the process of playing back fixed-media

compositions, Acousmoniums are designed with the intention of embracing this for its creative, transformative potential.

5.1.2 Distortion

Distortion[20] is a widely used effect within music production that can be found on recordings of many different genres of music from jazz, rock, pop and dance to industrial and harsh noise. Despite its prevalence as a production and live performance tool, it is rarely engaged with when playing back and performing fixed media compositions (at least not deliberately). This is perhaps in part due to its avoidability. While transformations of the frequency range of a sound caused by the design of a loudspeaker are ever present, distortion is usually only usually evident when the system is overloaded. When using a well-designed speaker system, with careful monitoring of volume levels, noticeable distortion can be avoided. However, just because distortion is not commonly used in the playback of fixed-media compositions, does not mean it cannot be.

A particularly novel use of distortion to transform a fixed media composition can be found in the work of Maryanne Amacher, most notably the release *Sound Characters (Making the Third Ear).* On this album Amacher looks to human hearing and distortion that can be imparted upon a sound by the noise inherent in the ear. These pieces are designed to stimulate the production of a phenomena called Otoacoustic Emissions. Otoacoustic Emissions, or Ear Tones as Amacher refers to them, are 'faint sounds [that are] emitted by the ear spontaneously or induced by sound stimuli' (Manley & van Dijk 2016: 53). These sounds are not illusory tricks of psychoacoustics, they are literal sounds generated by parts of the inner ear. Amacher (2017: 118) highlights that often Otoacoustic Emissions go unnoticed when they occur and that her music seeks to bring them 'to the surface'. *Sound Characters (Making the Third Ear)*, deliberately utilises sounds that can trigger Otoacoustic Emissions through overloading the ears ability to interpret sound. These emissions are not uniformly produced by all ears and variables such as the volume of playback and the position of the head relative to the loudspeakers can alter the ears' production of these sounds. As such, each person listening to *Sound Characters (Making the Third Ear)* will hear a unique version shaped by the noise inherent in their own ears. By deliberately overloading and distorting part of the system of playback, in this case the listener's ears, Amacher is able to transform the fixed media composition. As such, while the sound file may be fixed, the composition is not realised fully until it is transformed through noise in the ears of the listener.

[20] Within audio production, distortion is an umbrella term that is applied to a broad range of different audio processing tools. Here the term is used to refer to processes such as saturation and clipping which occur when the medium of communication is ineffectual for the amount or type of information being transmitted.

5.1.3 Feedback

Often the effects of noise upon fixed media compositions can be incredibly subtle and sometimes imperceptible. In order for practitioners to utilise the subtle, hidden effects of noise they must find and develop tools and systems for uncovering and emphasising it. While tools and methods emphasising the effects of noise are wide and varied, a mainstay among practitioners is the use of feedback. Feedback, as a term, is predominantly associated with the high-pitched squealing sound that interrupts a public speech. Acousticians Campbell and Greated describe that feedback occurs:

> when sound issuing from the loudspeakers is picked up by the microphone. If the amplifier gain is set high, then this sound is further amplified and comes out even louder from the speakers. An unstable loop is created in which even the tiniest of sounds quickly builds up beyond the overload point. (Campbell & Greated 1998: 498)

Despite the association of feedback with loud screeching sounds, it has a considerably broader range of sonic applications. Within conventional effects processing, feedback is an often-utilised tool found in a range of common effects including delays, compressors, and filters. As Campbell and Greated highlight, feedback is a recursive process where the signal that has been transmitted is literally fed back and re-transmitted again and again. While it can produce unwieldy sound, what feedback does is accentuate the effects of noise upon a transmission, as composer Simon Emmerson describes:

> each part of the feedback chain acts as a filter – having its own characteristic spectrum. The resonances of objects and spaces act in exactly this way, colouring the sound as it flows around the loop. Sound energy is focussed within the resonant frequency ranges (Emmerson 2007: 133)

By controlling how long and fast signals feedback, for instance by recording the signal into a buffer and/or managing dynamic levels, the noise inherent in any means of transmitting a signal can be used as a variable transformative effect.

I am sitting in a room

Alvin Lucier's *I am Sitting in a Room* is perhaps the best-known application of feedback to accentuate the transformations of noise. Composed in 1968-1969 for voice, one microphone, two tape recorders, amplifier and one loudspeaker, the piece was originally inspired by a lecture given by Amar Bose, founder of the Bose Corporation, at MIT that a collaborator of Lucier's had attended and spoken about. In this lecture Bose described a process for listening to the frequency response of loudspeakers by recycling sounds through them, highlighting the noise inherent in the loudspeakers' design (Lucier 2014: 88). Inspired by this idea, Lucier experimented with iteratively recording sounds in various rooms to observe the transformative effects of noise in each space and based on these

experiments Lucier composed *I am Sitting in a Room*. During the piece, a short speech is read aloud into a space, recorded, and then iteratively played back and recorded in a feedback loop. The text recommended by Lucier to be read aloud by the performer explains this process to the audience:

> I am sitting in a room different from the one you are in now. I am recording the sound of my speaking voice and I am going to play it back into the room again and again until the resonant frequencies of the room reinforce themselves so that any semblance of my speech, with perhaps the exception of rhythm, is destroyed. What you will hear, then, are the natural resonant frequencies of the room articulated by speech. I regard this activity not so much as a demonstration of a physical fact, but more as a way to smooth out any irregularities my speech might have. (Lucier 1969)

With each iteration of the feedback loop the transformations of noise on the voice are layered and reinforced until the effects of the noise become so pronounced that the speech 'becomes unintelligible and the room's character […] becomes dominant' (Emmerson 2007: 134). In addition to the effects of noise imparted by the space, Emmerson (2007: 134) highlights that the noise inherent in the recording and playback media, microphone and loudspeaker all also contribute to this transformation. Through the effects of these transformations, shifting sinusoidal drones usually begin to emerge. Although the words on the recording become increasingly unintelligible, remnants of the rhythm often remain; the dynamic of the pitched drones loosely aligning with the rhythmic articulations of the original voice recording. Through feedback, this process foregrounds the subtle and often unnoticed modifications imparted by noise on a sound during the process of recording and playback.

Lucier's *I am Sitting in a Room* has been widely performed by many different performers in a multitude of diverse spaces. While most performances of *I am Sitting in a Room* share some similarities, the noise inherent in each space and the recording equipment used is different and as such each performance of the piece develops in unique ways.[21] As well as performances that adhere to the score, Lucier's *I am Sitting in a Room* has also inspired numerous derivative works. For example, composer Patrick Liddell's (2010) piece *Video Room 1000* applied the format of Lucier's *I am Sitting in a Room* to the virtual space of YouTube.[22] Rather than creating a feedback loop in a physical space, Liddell uploaded, ripped and reuploaded the same video to YouTube a thousand

[21] A marathon online concert staged for Lucier's 90th birthday consisted of 90 iterations of *I am Sitting in a Room* by 90 different artists in different spaces. This concert provides some indication of the broad range of variation possible from Lucier's feedback process. For details of this concert and links to recordings of the concert see: (ISSUE Project Room 2021)

[22] A similar approach can be found in the piece *I am Sitting in a Zoom* by composer John Richards (2020), a version of Lucier's *I am Sitting in a Room* designed to be performed on the video conferencing software Zoom.

times. With each iteration of this process the visuals become increasingly pixelated, and colour shifted, and the audio becomes heavily filtered and distorted. This is due to the video file being recompressed on each upload using lossy compression algorithms, which minimise file size by removing data from the file. The algorithms used for lossy compression are often designed to remove information that is unlikely to be noticed as missing. For example, the widely used lossy MP3 audio format utilises a mathematical model of human hearing in order to remove 'parts of the audio signal that are unlikely to be audible' (Sterne 2012: 1–2). Liddell's *Video Room 1000* uncovers and forefronts the usually unnoticed effects of noise inherent in digital compression through the gradual transformation of both the audio and the visual content of the video throughout the development of the piece.

Both *I am Sitting in a Room* and *Video Room 1000* are examples of process music as the structure of the piece is a result of a gradual, repeated process. The description of this process in the text, combined with the repetitive, gradual, and linear form, enables the listener to perceive the process and transformation taking place, highlighting the often-unnoticed effects of noise. Due to its iterative nature, feedback lends itself well to pieces of music that utilise processes as a structural tool. However, not all practitioners utilising feedback to emphasise the effects of noise make this iterative process available to the listener.

Previously Unreleased Mixtape 1995-2016

Graham Dunning's *Previously Unreleased Mixtape 1995-2016* is a continuous mix made from recordings of Dunning's live performances and studio experiments spanning two decades. Like *I am Sitting in a* Room Dunning also utilises a feedback loop that emphasises the transformative effects of noise. However, unlike *I am Sitting in a Room*, here only one iteration of the feedback loop is available to the listener, rather than the entire process. *Previously Unreleased Mixtape 1995-2016* is distributed on cassette tapes which are duplicated one at a time iteratively as part of a feedback loop. Dunning describes this process as:

> An infinite number of cassettes, each duplicated from the one before it. As such the quality is reduced with each iteration. The black & white photocopied covers are duplicated following the same process. (Dunning 2017)

By creating generations of tapes, each duplicated from the previous, Dunning utilises the effects of noise inherent in the medium of magnetic tape to transform the original material. As listening to one of these cassettes only gives access to a single iteration of the process, the listener is unable to hear the full process unfold. As such, it is less apparent how the original audio has been manipulated, blurring the separation between the original recording and the effects of noise.

Those familiar with magnetic tape may be able to identify specific characteristics of tape when listening – the loss of high frequencies, tape saturation and the distinctive hiss – however, numerous track titles including: *'Tape Sampling', 'Just Hiss // Hum 4tr'* and '*Live at noise=noise, tape bootleg'* allude to the fact that tape technology was utilised in the original recordings and that these tape characteristics may or may not be a result of the feedback process. Although the page selling the cassette states that there is no digital version of *Previously Unreleased Mixtape 1995-2016*, the cassette comes with a secret digital download to the original files which allows some comparisons between the two to be drawn.[23] However, while listening to the two versions does allow for broader comparisons in quality to be drawn, as *Previously Unreleased Mixtape 1995-2016* is around 90 minutes long, when listening to each in succession it is difficult to perceive individual changes. Additionally, (on my version of the cassette tape at least) the track order of the digital files does not correlate with the content of the cassette, perhaps due to errors in duplication which have been replicated between cassettes, further making direct comparisons difficult.

As Dunning does not make the full process audible to the listener, it may appear that Dunning does not intend for the feedback process to be perceptible to the listener. However, the information accompanying the cassette is a description of the process, which draws the listener's attention to this and the potential effects of noise. Through this Dunning actively encourages what composer Denis Smalley (1997: 109) refers to as 'technological listening': 'when a listener "perceives" the technology or technique behind the music rather than the music itself'. For Smalley (1997: 108), technological listening is predominantly viewed negatively, and listeners are encouraged to avoid it. He states that 'surrendering the natural desire to uncover the mysteries of electroacoustic sound-making is a difficult but necessary and logical sacrifice', viewing technological listening as a distraction to the musical intention of the composer. However, by encouraging this, Dunning transforms the listening experience of *Previously Unreleased Mixtape 1995-2016.* Rather than the listener simply hearing a low-quality recording, Dunning encourages the listener to directly engage with the effects of noise and become an active participant. Rather than making the effects of noise obvious to the listener by allowing them to hear them unfold in a full gradual process, giving the listener just one step of the process invites the listener to question what they are hearing.

The various approaches to utilising and emphasising the effects of noise inherent in audio playback discussed throughout this section, explore the transformative potential of inherent noise and the subsequent unfixing of fixed media. Embracing this as a feature rather than a bug of the medium, these techniques and practices frame the inevitable transformations of noise as a positive, utilising

[23] The secret download has been written about here with permission from Dunning.

the variation it introduces creatively. This approach of embracing inherent noise as a feature, underpinned the composition and presentation of the portfolio piece *Wallpaper.*

5.2 Wallpaper

Wallpaper is a fixed media composition that was created in response to the UK Covid-19 lockdown which began in March 2020. Due to this period of imposed isolation many looked to the internet to replace in-person communication, in particular utilising video calling software such as Zoom and Skype. However, those who lacked access to the internet were excluded from these virtual social spaces. When composing *Wallpaper,* I looked to explore this shift in communication habits and highlight the experiences of those who do not have access to the internet by utilising the noise inherent in both online virtual meeting software and telephone calls. This section examines how the transformative effects of noise from these two different means of communication were utilised in *Wallpaper,* highlighting how the practices discussed above in section 5.1 informed the techniques used. It explores how the noise inherent in Zoom meetings was employed and emphasised through feedback in order to generate the sound material for the composition and how the presentation of the final fixed media composition over a telephone hotline unfixed the piece, creating a variable and interactive listening experience through the nose inherent in that technology.

5.2.1 Wallpapering

The initial concept for *Wallpaper* was developed as a result of two contrasting experiences I had during lockdown. Firstly, my regular telephone conversations with my grandmother ('Nan') where she spoke often about missing seeing her friends and family; her regrets that she had been so resistant to getting the internet installed in her house and how down (or in her words 'feckin' miserable') she felt. These telephone conversations sat in stark juxtaposition to the various group online video meetings, I and many others were participating in at this time. The ability to see each other and meet as a group in a virtual space provided a simulacrum of in-person socialisation. However, while the online meetings provided something akin to in-person contact, the noise of this technology served as regular reminder of the reality of the situation. I wanted to utilise the words of those who were isolating without the internet as the primary sound source for the composition. After discussing this with my Nan, she curated a list of quotes she had gathered from phone calls with friends who were in a similar situation to herself. These quotes combined with those I had written down from my phone calls with Nan became the text utilised in this piece.[24]

[24] I had originally hoped to use recordings of phone calls with my Nan and her friends however, Nan and all others involved were keen to not have their voices feature in the piece.

This text was recorded in a guided improvised recording session hosted on a conference call on Zoom with four sopranos: Patricia Auchterlonie, Mimi Doulton, Ella Taylor, and Juliet Wallace. Numerous sources of noise were identified using Shannon's model, as outlined in 2.2, and used to transform the audio during this recording session. As the effects of several of these noise sources were often subtle, we also experimented with feedback in order to emphasise the transformations taking place. Due to the filtering, compression and noise suppression utilised by Zoom, all sounds recorded on this session were transformed dynamically and spectrally (Zoom Video Communications, Inc. 2021). In addition to this, the equipment used on the call had a significant impact on the sound produced. The performers were not using high quality recording equipment on the call. Instead, they used a variety of laptops, tablets and phones with built-in microphones and speakers, each with different and varied noise inherent in them. Each of these transformed the spectral content of the performers' voices in unique ways, providing each with a specific timbre, similar to specialised speakers in an Acousmonium. As well as these transformations, within the recording session we collaborated as a group to interrogate and explore other ways the noise inherent in video conferencing could be used to transform spoken and sung sounds. These included attempting to speak and sing in unison, which created dense conflicting rhythms due to the latency of the call and singing as loud as possible in order to distort the microphones and the call itself. However, by far the most overt transformations occurred when feedback loops similar to those utilised by Lucier were created in the call to emphasise the transformative effects of noise.

In order to achieve these feedback loops, each of the performers joined the call on two devices simultaneously and placed the two devices close enough together so that each device was able to pick up the sound coming from the other. This feedback was not near instantaneous like a microphone in front of a loudspeaker as similar to Lucier's use of a tape buffer to create a 'time delayed' loop of feedback (Emmerson 2007: 134), the latency of the conference call over the internet created a buffer which elongated the iterative feedback process. However, unlike *I Am Sitting in A Room* the length of this buffer was relatively short, varying with the quality of the connection and reaching just a few seconds at its maximum. This meant that while elongated, the process unfolded faster than in the Lucier. Also, since each performer had two devices on the call there were multiple feedback loops occurring within this virtual space which resulted in a less clearly linear and more complex development throughout the feedback process. This complexity of development was intensified by the Acoustic Echo Cancellation (AEC) processing used by Zoom which is designed to suppress the effects of feedback (Zoom Video Communications, Inc. 2021). However, when confronted with five simultaneous feedback loops the AEC was unable to function

correctly and when forced into a state of failure it began to filter, mute, and unmute elements of the call unpredictably.

Unlike Lucier, the effects of noise drawn out through this feedback were predominantly not from an acoustic space but, were instead from a combination of the virtual space and the microphones and speakers used. The audio equipment used on the call had a significant impact on the sound produced. When fed back, each of the devices' unique spectral transformations resulted in different frequencies for each performer, resulting in a wide variety of different pitched resonant drones being created. In addition to this, similar to Liddell's *Video Room 1000*, the feedback loops created within this virtual space emphasised the subtle effects of noise inherent in the data compression utilised by Zoom; with each repetition low and high frequencies were removed and compression artefacts were brought to the fore. Differing from Lucier's utilisation of the iterative nature of feedback as a process-based structure, the feedback loops recorded for *Wallpaper* are not presented linearly within the final piece. Similar to Dunning's presentation of the feedback process in *Previously Unreleased Mixtape 1995-2016,* in *Wallpaper* the listener does not hear the entirety of the process unfold. However, whereas Dunning presents the listener with just one stage of the feedback process, within *Wallpaper* multiple different recordings of feedback loops are overlayed and intertwined; some progress linearly, whereas others are combined and edited to alter their development. As a result, the boundaries between the effects of noise and the original sound are further blurred for the listener.

The decision to utilise voice as the main source sound within the composition, gives the listener additional insight into the transformations taking place. In general, humans are incredibly adept at detecting the human voice, as psychoacoustics and speech processing researchers Birger Kollmeier, Thomas Brand and Bernd Meyer note:

> Acoustically produced speech is a very special sound to our ears and brains. Humans are able to extract the information in a spoken message extremely efficiently, even if the speech energy is lower than any competing background sound (Kollmeier *et al.* 2008: 61)

This propensity for identifying the human voice, provides the listener with the ability to distinguish between the original sound and the transformations of noise more clearly than with other sounds. As Smalley (1993: 294) describes, when listening to vocal sounds we 'can quickly distinguish between the real and unreal, between reality and fantasy, and appreciate the passage between them'. As a result of this, when listening to *Wallpaper* the use of vocal sampling gives the listener an advantage in identifying the transformations taking place despite having not been presented with the full feedback process. While we are adept at identifying the human voice, there is a limit to our

ability to do so, *Wallpaper* plays on this. By burying and emerging processed and unprocessed vocal recordings within the other layers of the composition through the piece's development, the listener is presented with a challenge to identify what they say, actively encouraging technological listening. However, how exactly all of this carries through and is perceived varies depending on how the listener is presented the piece.

5.2.2 +44 330 818 0351

Wallpaper is available in two different versions accessed via two different technologies. As is common in fixed media composition today, it is available to stream and download via the internet. However, as the piece is specifically about those who do not have access to the internet at this time, I also sought to make *Wallpaper* available offline. As such the piece is also available as a telephone hotline available on +44 330 818 0351.[25] The idea to present the piece this way came towards the end of the composition process and was originally set up so that my Nan could hear the piece.[26] However, the process of setting up and testing this hotline highlighted a number of unique aspects of the noise inherent in this medium. These presented interesting creative potential and influenced the composition process going forward.

Listening to an early draft of *Wallpaper* over the telephone hotline for the first time was a relatively surprising experience. While I had anticipated that it would be different to playback over studio monitors, the sound was altered more drastically than expected; the majority of the playback was near silent or inaudible and parts of the piece that did come through were often distorted beyond any recognition. Using Shannon's model as a framework, as outlined in 2.2, I researched the various noise sources acting upon the signal in order to better understand how to compose with them and utilise them within this piece. The distortions I heard were primarily due to the transformations of noise inherent in the various layers of data compression involved in transferring audio over a contemporary telephone line, particularly as much of this compression is specialised for reproducing speech not music. When transmitting a sound over contemporary telephone equipment the audio is often compressed multiple times, utilising different codecs. At no point does a contemporary telephone system approach the quality of a CD – stereo with a 44.1 kHz sample rate and a 16-bit bit depth. The low quality of telephone audio is primarily a product of the digitisation of the telephone system over the past few decades. Maryanne Amacher's *City-Links* project which utilised the still

[25] Calls cost a standard landline rate.
[26] Unfortunately, Nan's hearing aids introduced one layer of noise too many and she couldn't actually hear any of the piece over the phone line.

mostly analogue telephone system of the 1970's transmitted audio over long distances that were of 'FM quality' (Cimini 2017: 93).

The telephone hotline for *Wallpaper* is controlled and transmitted from a Voice over IP (VoIP) web service, which transmits all audio using the G.711 codec ('Anveo Network' n.d.). The G.711 codec is one of the highest quality audio codecs commonly utilised in contemporary telephone communications: a mono signal with a sample rate of 8 kHz and an 8-bit bit depth (ITU-T 1990: 1). Taking the original studio quality file of *Wallpaper* and transmitting it using the G.711 codec transformed the piece through noise in multiple ways. The low sample rate resulted in a reduced bandwidth, removing frequencies above 4 kHz. This bandwidth limiting should only cause 'minor speech degradation', but when applied to a broadband signal like music is considerably more noticeable (Hanzo *et al.* 2007: 12). This bandwidth limiting produced, to me, a relatively pleasing effect similar to bandwidth limited loudspeakers used in Acousmoniums. This effect is evocative of a previous time, giving a sense of temporal distance to the piece when compared to the original quality file. However, other effects of noise, such as the limited dynamic range and high noise floor caused by the low bit depth, were less pleasing. Uploading an 8 kHz, 8-bit, mono render of the piece – that used dynamic compression and limiting to even out and reduce the dynamic range – minimised some of these unwanted effects of noise. The conversion to G.711 before transmission is only the beginning of the journey for *Wallpaper* as it travels through the telephone system and unlike some of the noise introduced by the VoIP service, the effects of noise later in the process of transmission proved significantly more interesting results.

As a signal travels through the telephone network it is further compressed in a variety of different ways (Hecht 2014). These compression algorithms are often designed to reduce background noise, are specialised for sending voice and many, including the widely used Adaptive Multi-Rate (AMR) audio codec, involve only sending some of the raw audio data and instead synthesise parts of the sound according to models of vocal information to reduce the required bit rate (Hanzo *et al.* 2007: 306–7). With so many (often unknown) variables when sending a sound through a phone line, it is hard to know for sure what has affected what. However, it seems logical that the background noise reduction was responsible for the large periods of silence as the relatively static drone material in the piece was identified as background noise and removed. Through experimentation I found that applying a modulating tremolo effect to the drone material tricked the background noise reduction into sometimes treating the drones as foreground material. Similar to Amacher's use of the noise inherent to the human ear to introduce distortion, transmitting modulated drones over the phone results in an irregular, bubbling like texture punctuated with a myriad of crackles and pops caused by the background noise reduction flipping between transmitting the drone and attempting to filter it

out. The specialisation of the audio codecs used in the telephone system towards voices resulted in perhaps the most interesting aspect of this medium. During transmission the telephone system transforms *Wallpaper,* bringing much of the vocal material to the fore, even when it is hard to perceive in the original quality file. As a result, for those listening over the telephone line the vocal material is often clearer than in the online version.

How an audio signal is processed and manipulated by the noise of the telephone network is highly variable; a landline sounds different to a mobile phone, mobile phones sound different to each other and the same mobile phone will sound different depending on its location and the time of day (Hecht 2014). There are several reasons for this variability, one prominent example being the use of the AMR audio codec on calls from mobile phones – which have accounted for more than 80% of calls to the *Wallpaper* hotline to date – which varies the bit rate of the audio during the call depending on the sound being made and the strength of signal (Hanzo *et al.* 2007: 311–12). This combined with other variables such as the phone used or the infrastructure of the telephone network in that location, mean that each time *Wallpaper* is played back over the telephone line it is transformed by noise in different ways. In the case of a landline the manipulations can be quite subtle, however on a cheaper mobile phone handset with poor signal, the audio can often be distorted and manipulated almost beyond recognition.[27] Similar to Amacher's *Third Ear Music* or the transformations of an Acousmonium in concert the transformations of the telephone line are a transitory experience. Unlike Dunning's *Previously Unreleased Mixtape 1995-2016* where each cassette is a 'fixed' point in a process, it is not usually possible to rewind a telephone call and listen to it again in the same way you can a cassette tape. During each call to the phone line the piece is transformed by noise in different ways, creating a unique transformation of the piece, producing an experience for the listener similar to a live performance.

Utilising the transformative effects of noise, both within the composition process and in the presentation of *Wallpaper*, makes a feature of the unfixed nature of fixed media composition. As a result of this, the listener is encouraged to interact with the piece in relatively unconventional ways. By utilising vocal sounds effected with noise emphasised by feedback, the piece invites technological listening in order to draw the listener's attention to the effects of noise in online conference calling software. In addition to this, the delivery of the piece over a telephone line both invites further

[27] This variability is documented in the three recordings of the piece included with the online version. These three recordings were captured using a telephone pick-up coil which was attached to a public telephone box, an iPhone 6 with 4G signal and an Honor 10 Lite with HSDPA signal while on a walk.

technological listening, drawing attention to the effects of the noise inherent in the telephone system, and allows the listener to create unlimited unique transformations of the piece.

5.3 Conclusion

During every playback, 'fixed' sounds are altered and manipulated by noise. Rather than viewing this as a negative, by embracing this as a feature, systems for the playback of recorded sound can be repurposed as transformative tools. Throughout this chapter we have explored how incorporating this unfixing of fixed media compositions through the noise inherent in their playback, presents significant creative potential. The effects of this noise can transform recorded sound extensively, creating something new and often unique.

By examining the work of creative sound practitioners working with fixed media, numerous approaches and techniques for utilising this noise have been identified. These techniques can be used in conjunction with the repurposing of Shannon's theory outlined in 2.2 in order to utilise and emphasise sources of noise identified in audio playback systems. The techniques include simply playing back a sound through specific equipment as found in the design of Acousmoniums; introducing new frequencies by overloading and distorting the medium of playback as used by Amacher and accentuating the transformative effects of noise through feedback as used by Lucier, Liddel and Dunning. These techniques were explored and developed further through the composition of the portfolio piece *Wallpaper.* The composition process for *Wallpaper* utilised Shannon's model to identify sources of noise on both *Zoom* video conference calls and the telephone network and explored how to apply and emphasise their transformative effects through practice. This process explored how the noise inherent in a medium of playback can be utilised to transform audio both throughout the compositional process and in the final presentation of the piece. Using this noise, results in a fixed-media composition, which is both interactive and infinitely variable.

These examples and methods are far from exhaustive and have applications beyond fixed media composition. Inherent noise is everywhere, and its transformative effects are as varied as noise is ubiquitous. Identifying and exploring the transformative applications of noise inherent in any part of the composition process has the potential to unlock new ways of engaging with and approaching composition.

Chapter 6:

Conclusion

Through a repurposing of Claude Shannon's (1948) *A Mathematical Theory of Communication,* this thesis proposed a new approach to utilising noise within composition. Within Shannon's theory, noise is framed as an inherent part of a communication system that acts upon and alters the signal that is being transmitted (Shannon & Weaver 1949: 34). The compositional approach outlined in this thesis, looks to utilise these effects of noise as a means of transforming and generating material for creative sound practice. This reframing of noise as a transformative tool for composition differs from conventional discourse on composing with noise which, primarily looks to define noise as a material property of a sound, through quantitative or qualitative judgements. For example, Roads (2015: 208) treats noise as a sound material, outlining an approach for composing with noise, referred to as the *Pitch-Noise Continuum,* which considers non-periodic, spectrally dense sounds to be noise, placing this in opposition to pitch. Similarly, Russolo's (2009) 1913 composition manifesto *The Art of Noises* also considers noise to be a specific type of sound, although in this case Russolo utilises a qualitative judgement, considering noise to be unwanted sound. The approach to utilising noise as a transformative and generative tool outlined in this thesis is not intended as a definitive method for composing with noise, designed to usurp material-based approaches to utilising noise. Instead, it is presented in order to provide an alternative way of thinking about the role noise can play in creative sound practice, that can co-exist with other approaches to composition.

As well as outlining this approach to composition, the discussion in this thesis has sought to identify the implications of working with this approach. This discussion has been derived from a practice-based approach to research, used in order to identify and interrogate potential creative applications of Shannon's theory. Through this practice-based research, a portfolio of creative practice utilising this approach to noise was produced. During the development of this portfolio, it was found that the potential for noise to transform and generate materials for composition has a broad range of applications across the diverse field of creative sound practice. This range of potential applications is reflected in both the portfolio and thesis which look to three different areas of creative sound practice: improvisation, notated composition, and fixed-media electroacoustic composition. Within the portfolio, applications of noise within improvisation were examined through the development of a new performance practice called *Glitch Turntablism*, which uses CD players that have been modified to allow a performer to introduce noise into the playback media. The notated compositions in the portfolio, *Music for Piano for Loadbang* and *Man in Regent Street* explored applications of noise beyond the sonic, introducing noise into the visual communication system of music notation in order to transform and generate musical materials and structures. Finally, the fixed-media composition *Wallpaper* looked to the noise inherent in the playback of audio, utilising a telephone line in order to introduce variation into the 'fixed' composition to create an interactive listening experience.

While investigating applications of the transformative and generative potential of noise through practice, it became apparent that this approach provides more than just a novel method for composition. Engaging with noise in the numerous communication systems that make up creative sound practice, has the potential to challenge commonly held concepts and assumptions of how these communications function. Through a discussion of the portfolio as well as related work by other practitioners, this thesis considered how utilising noise results in this, as well as how this destabilisation of preconceived notions of creative sound practice can be engaged with and utilised creatively. Chapters 3, 4 and 5 each relate to one of the three areas of creative sound practice found in the portfolio – improvisation, notated composition, and fixed-media composition – considering how utilising the transformative potential of noise challenges these specific fields and how this can be employed.

Chapter 3: Improvising with Playback Media, explored the practice of performing with playback media – such as vinyl and CDs – identifying how introducing noise into these systems in order to push them into a state of failure can cause these devices to function like an improviser. It considered how these devices can be thought as improvisers, examining the way noise causes playback media to exhibit agency over the structure and musical content of the improvisation, and the ways human

improvisers can communicate with the playback media. The potential for this improvisatory nature of failing playback media was explored through the development of *Glitch Turntablism*. This exploration identified how the numerous different effects of noise upon CD players, give the devices agency over the performance and how this can be utilised to result in improvisations that are produced in collaboration with the CD players. This chapter also considered the limitations of translating this live performance practice into a studio environment, identifying two different approaches to maintaining and representing this collaborative relationship created through noise, within this change of presentation.

Chapter 4: **Scores and Visual Noise** outlined approaches to introducing noise into music notation in order to disrupt communication between the composer and performer. Implementing noise in this way called into question the conventional composer/performer relationship by bringing the creative control the performer has over the realisation of a piece to the fore. Through an examination of the portfolio compositions *Music for Piano for Loadbang* and *Man in Regent Street*, this discussion identified how actively encouraging the creative input of the performer through the transformative potential of noise, can introduce indeterminacy into the piece, resulting in music with complex, evolving structures.

Finally, Chapter 5: (Un)fixed Media, looked to the noise inherent in the playback of fixed-media compositions, identifying how the transformative properties of this inherent noise call into question the fixity of this medium. As well as identifying numerous approaches to utilising this inherent noise creatively, through a discussion of the portfolio composition *Wallpaper* and its presentation over a telephone hotline, this chapter considered how the transformative nature of inherent noise can be engaged with deliberately to create unique, interactive presentations of fixed-media compositions. In addition it considered how engaging with this noise directly and making it a feature of the music can induce a positive form of what Smalley (1997: 109) refers to as 'technological listening' – where 'a listener "perceives" the technology or technique behind the music' – encouraging the listener to question what they are hearing.

The approach to composition outlined and explored throughout this thesis and portfolio, offers a new way of considering the role of noise that has the potential to be utilised by practitioners across the broad spectrum of creative sound practice. This is not just limited to practitioners who may conventionally think of themselves as working with noise. Almost all creative sound practice is made up of a multitude of different communications, this reframing of noise highlights how each of these communications has the potential to transform or generate. The portfolio and thesis presented here are just the start of an exploration of the potential of this approach to composing with noise. While

this discussion has focused primarily on composition and sound-based practice, it seems likely that this approach could be developed further in future to consider how the creative potential of noise can be utilised in other forms of creative practice. It is hoped that this research, and the development of this approach, will encourage other practitioners to engage with and explore the multitude of ways noise can transform, generate, and challenge. Given the omnipresence of noise, the possibilities for how, where, and why to utilise this approach are near limitless.

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