A Neuropsychophilosophical Investigation of Musical Improvisation

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Abstract

Musical improvisation, spontaneous and creative play with musical materials, offers opportunities to understand aspects of creative cognition and of the human condition in navigating an unpredictable world. This research investigated the role of auditory imagery, the imagination of the sound of the music, in improvisation. Two complementary approaches were adopted. The first addressed improvisers' experience with a focus on the role of auditory imagery and its relationship to their views on improvisation, mind and body, using qualitative interview and survey methods. Two studies were carried out with findings that suggest that anticipatory auditory imagery is regarded as an essential element which validates improvisation as a creative practice. The second approach investigated the embodied aspect of anticipatory imagery in an experimental setting. A new guitar-based altered auditory feedback paradigm was developed to find out about the effects of the familiarity of hand shape on judgements of sonic congruence. These new findings suggest that judgements of how a guitar chord will sound partly depend on the familiarity of the hand shape used to play them. The implications of these findings for the role of auditory imagery in improvisation were considered in the context of tensions between the ethnographic and scientific perspectives. This thesis concludes by advocating a rejection of Cartesian dualist conceptions of creativity in favour of an embodied ecological account which can reconcile the findings of cognitive science with improvisers' experience and valuing of what they do.

Statement of Contributions

Study 2: The MAX/MSP application, MATLAB codes and R codes used for the linear mixed effects modelling were developed by Andrew Goldman at Columbia University. Andrew Goldman and Tyreek Jackson (Columbia University) helped with the design of the stimuli and the statistical analysis.

Study 3: the MALAB program which ran the survey and processed the data was developed by Andrew Goldman.

Peer-Reviewed Publications and Presentations

The publications and presentations below are based on material from this thesis.

Publications

Phillips, K. (2016). *Are We Really Hearing in Our Heads What We Think We're Hearing? The Role of Audiation in Musical Improvisation.* Proceedings of the 9th International Conference of Students of Systematic Musicology (SysMus16), Jyväskylä, Finland.

A version of the research presented in Chapter 4 is under review in:

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Conference Presentations

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Phillips, K., Goldman, A. & Jackson, T. (2018). *The effect of hand shape familiarity on guitarists' perceptions of sonic congruence: An analysis using Linear Mixed Effects Models*. Paper presented at the International Conference on Music Perception and Cognition and the European Society for the Cognitive Sciences of Music (ICMPC15-ESCOM10) Conference, Graz, Austria.

Phillips, K. (2018). *The paradoxes of jazz improvisation: a philosophical appraisal*. Poster presented at the International Conference on Music Perception and Cognition and the European Society for the Cognitive Sciences of Music (ICMPC15-ESCOM10) Conference, Graz, Austria.

Phillips, K., Goldman, A. & Jackson, T. (2018). *The effect of hand shape familiarity on guitarists' perceptions of sonic congruence*. Paper presented at the 11th International Conference of Students of Systematic Musicology (SysMus18), Belo Horizonte, Brazil.

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Phillips, K. (2016). *Creativity in improvisation*. Paper presented at the Creative Humanities Thinking, Making and Meaning AHRC NWCDTP Postgraduate Conference, Manchester, UK.

Phillips, K. (2016). *Are We Really Hearing in Our Heads What We Think We're Hearing? The Role of Audiation in Musical Improvisation.* Paper presented at the 9th International Conference of Students of Systematic Musicology (SysMus16), Jyväskylä, Finland.

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I dedicate this thesis to my late father, Alan. In so many ways, I could not have done it without you.

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Chapter 1

Introduction

> Among improvising musicians there is endless speculation about its nature but only an academic would have the temerity to mount a theory of improvisation. (Bailey, 1993, p. 3)

1.1 Context

Improvisation is an essential element in all our lives and so pervasive that perhaps we do not give it the attention it deserves. Our lives would be very different if we were restricted to sets of scripted behaviours triggered by the situations we encounter. It only takes a moment's thought on the current state of artificial intelligence to realise that the normal everyday adaptions that we make in context do not reflect a trivial ability, even if we take them for granted. Driving home, cooking a meal, having a conversation; it might be possible to do these things automatically sometimes, but what if there is a diversion, a missing ingredient, or a remark that forces us to radically rethink? This kind of focus on freedom within constraint prompted the philosopher Gilbert Ryle to characterise improvisation thus: "If he is not at once improvising and improvising warily, he is not engaging his somewhat trained wits in some momentarily live issue, but perhaps acting from sheer unthinking habit" (Ryle, 1976, p. 77). Ubiquitous though improvisation might be, its essentially variable nature makes it an elusive target for empirical study.

Music is a favourable domain for the study of improvisation from a cognitive-scientific perspective because it involves so many cognitive processes of interest simultaneously (Brown, Zatorre, & Penhune, 2015) and produces a rich data source for analysis: music. The attitude towards improvisation from within the music community, and from critics and philosophers has been mixed. This word improvisation itself might be partly to blame, with its connotations of acting without preparation. The etymology, from the Latin *improvisus* indicates that a better foundation for the concept of improvisation is the notion of the unforeseen. It is possible to prepare for the unforeseen, as evidenced by the thousands of hours spent by jazz musicians in the practice room (Berliner, 1994). The intimation of paradox in the balance between freedom and constraint, or habit and novelty has prompted detractors from different perspectives. John Cage resisted improvisation in his music because he thought that performers, given the opportunity to improvise, resorted to memory or habit (Lewis, 1996). Boulez, on the other hand considered that the problem with improvisation is *insufficient* memory in performers' habits to permit them to produce the requisite complexity for creative spontaneity (Peters, 2009). The German philosopher and composer Adorno's writings on jazz have been criticised as prejudiced and dogmatic but some authors (Paddison, 1982; Peters, 2009; Witkin, 2000) have argued that his critiques should not be simply dismissed. One of Adorno's criticisms of jazz is that the limited possibilities inherent in circumscribing harmonic structures results in "pseudo-individualisation" (Adorno, Leppert, & Gillespie, 2002, p. 445). It is this context which motivates George Lewis to quote from the same article by Ryle and point out that it is those who *do not* improvise who act from unthinking habit (Lewis, 2009).

1.2 Two Cultures

With a nod to C. P. Snow, the cognitive-scientific perspective describes improvisation in terms of working memory, motor control, auditory perception, and hierarchical processes. This involves a high degree of automaticity at lower levels, such as individual note selection (Ashley, 2016; Beaty, 2015; Bengtsson, Csíkszentmihályi, & Ullén, 2007; Berkowitz & Ansari, 2008; Brown et al., 2015; Pressing, 1988). Creativity is computable (Johnson-Laird, 2002) and its neural underpinnings involve a balance between cognitive control and mind wandering mechanisms in the brain (Beaty, Benedek, Silvia, & Schacter, 2016). An implied philosophical stance is materialist and reductionist. Improvisation is amenable to a mechanistic explanation whereby the task of improvising is specified, and the necessary cognitive processes are decomposed into simpler elements. In principle, the neural correlates of these can be described as processes in a physical system: the brain. This is by no means the only possible interpretation but is set forward as the thesis to the antithesis of the following section.

The view from musical culture is rather different. Unlike some of the critics mentioned above, there are those who value improvisation as a creative activity a great deal, occasionally even imputing mystical properties:

> If one of my friends is ill, I'd like to play a certain song and he will be cured; when he'd be broke, I'd bring out a different song and immediately he'd receive all the money he needed…The true powers of music are still unknown. To be able to control them must be, I believe, the goal of every musician. (Porter 1998 p 211)

The path to the Romantic conception of the improvising musician as free autonomous creative agent is traceable through the history of philosophy and aesthetics. Plato famously distrusted music "…for any musical innovation is full of danger to the whole state" (Plato, 428-328 BCE/2018, Republic, Book IV). Through his characters, Plato clearly recognises the value and potential power of music, for this reason it is dangerous if not properly regulated. Although it could be argued that Plato's conception of the appropriate role of music is as accompaniment to dance and song (Laws, Book II), Plato's metaphysics introduces dualism at the heart of philosophy. The concept of the timeless immaterial realm of Platonic forms, through the influence of Kant's notion of genius, all paved the way for German Romantic thought (Warren, 2009) and the idea of absolute music (Dahlhaus, 1991). The term *absolute music* is attributed to Richard Wagner, but its original meaning was more in line with Plato's notion that mere instrumental music is lacking, as music needs words to be intelligible. It is only gradually that German Romantic philosophy transformed the concept into a reversal of this original meaning, so that absolute music came to refer to instrumental music as the purest form (Dahlhaus, 1991). The idea of absolute music allows the development of the *Werktreue* concept in classical music, whereby performers must try to be true to the musical work, which is seen as the singular creation of a composer (Benson, 2003). I am here adopting the convention of classical with a small 'c' to refer to serious art music in general, as Benson does. These ideas are the recent antecedents of the apotheosis of improvisation in jazz, in that they promoted an idealised conception of composition as accessing ideal objects via the imagination. Improvisers co-opted this view of composition and reframed it as a real-time activity of composing during performance just as, ironically, the concept of *Werktreue* also contributed to the decline of improvisational practice in classical music itself (Berkowitz, 2010). This modern ideal of improvisation promoted in the ethnographic and pedagogical literature therefore emphasises pre-hearing in the mind's ear what the improviser will play to the extent of validating improvisation as a creative practice (Berliner, 1994; Coker, Casale, Campbell, & Greene, 1970).

1.3 A Third Culture: The Willing of a Future Past

Non-idiomatic improvisation, sometimes perhaps inappropriately labelled 'free improvisation', is informed by critical theory and Continental philosophy in dealing with the aporias of improvisation and how these relate to some of its discourses and practices. The phrase "willed future past" as used by Peters (2009, p. 5) captures two important features of improvisation: its temporal nature, and the role of agency. If what separates improvisation from other music-making is its degree of underdetermination by any pre-existing artefact or memory trace, this leaves the improviser free to mark the unmarked space in such a way that it becomes a past that is worthy of eternal recurrence. This is a Nietzschean concept which expresses a choice to embrace the possibility that our lives could recur in exactly the same way innumerable times (Kain, 2007), and thereby free ourselves from subjugation to meaningless suffering. In the context of non-idiomatic improvisation, there is a sense in which the freedom from a score and from conventional form brings a risk of arbitrariness. How to begin? Why *this* musical gesture *now?* Because I will it to be this way, and in so willing I embrace the possibility that in the future, this will be a past that is worthy of recurring infinitely many times in exactly the same way.

It could be argued that non-idiomatic improvisation is no freer from form or convention than other forms of improvisation (Peters, 2009), it merely has a different set of conventions. Further, underdetermination is not as rigorous a criterion to distinguish between improvised and non-improvised forms as it might seem. The reason is that the criterion fails to distinguish between expressive/interpretive variation of pre-existing composition and improvisation unless one arbitrarily selects the criteria that specify which attributes of the music to be considered. For example, if our focus is on melodic variation, we can ask what is the probability that the note in position n in a series will be x (after post hoc trimming of trills), with the idea that in a recital this will be determined by the score, whereas in improvisation it is not. This merely begs the question however, since if the focus were inter-onset intervals then a recitation with spontaneous rubato would be underdetermined in comparison to a relatively isochronous melodic improvisation. A counter to these arguments is that as with any fixed points on continua, there may be no principled line to draw that distinguishes one category from another, but on the continuum from black to white, we can distinguish most of the lights from darks to fit the purposes at hand. In other words, it will all come out in the wash, in that behaviours that people pick out as improvisatory can be studied in terms of differences in what people do compared to other musical activities, and the same is true for the distinction between idiomatic and non-idiomatic improvising. Non-idiomatic improvisation aspires to radical freedom from conventions, form and pre-composed musical materials and attempts to situate its practice at the unconstrained end of the continuum to which improvisation belongs. This position characterises its relation to the paradoxes of improvisation: how do we exercise freedom within constraint, and how do we construe improvisation as creative behaviour by a conscious agent when so much expert behaviour in this domain seems to be characterised by unconscious automatic processes which deploy and adapt pre-existing musical materials and formulae?

Returning to Adorno's particularly scathing criticism of idiomatic improvisation such as is found in mainstream jazz, his point is that rather than enacting a dialectic between structure and freedom, jazz improvisation merely plays with surface detail. Purporting to be an exemplar of freedom, the concatenation of formulae circumscribed by a rigid harmonic structure fails in its own terms:

> Hence, very few possibilities for actual improvisation remain, due to the necessity of merely melodically circumscribing the same underlying harmonic functions. Since these possibilities were very quickly exhausted, stereotyping of improvisatory details speedily occurred. Thus, standardization of the norm enhances in a purely technical way standardization of its own deviation—pseudo-individualization. (Adorno et al., 2002, p. 445)

Adorno has sometimes been dismissed as not understanding jazz or being out of date (Paddison, 1982), and certainly a rebuttal is available in terms of the vast possibilities inherent within processes based on finite combinatorics. To see that this is so, one need only consider the possible number of chess games (Shannon, 1950). It might be thought that in any case, non-idiomatic, or so-called 'free' improvisation escapes these criticisms by eschewing tonality and harmonic or metrical structures. However, this leaves the deeper philosophical problems relating to freedom and agency. Derrida understands this: "And so I believe in improvisation, and I fight for improvisation, but with the belief that it is impossible." (Dick & Ziering, 2002). What is relevant here in Derrida's thought is that our experience in time is always conditioned by the tension between the irreplaceable singularity and the machine-like iterability of an event (Derrida, 1988). Peters characterises the dilemma for improvisers in terms of the difference between Levinas's *il y a* 'there is' and the Heideggerian *es gibt* 'it gives'. Peters' concept of the willing of a future past invokes the Nietzschean notions of eternal recurrence and the will-to-power in order to argue that true improvisation involves the giving of the 'there', again and again as if anew. The improviser nimbly and with a sense of irony navigates the formula-space to deploy what is required in the moment (however replete with protensive and retensive folds one construes the 'moment' to be). With irony because knowing the arbitrary component in the marking of an unmarked space 'why that mark now?', the improviser does it anyway. This is reminiscent of an argument advanced by the philosopher Thomas Nagel regarding the absurdity of existence. He characterises Camus' response to absurdity in *The Myth of Sisyphus* as finding a nobility in the defiance and scorn of absurdity. Nagel's point is that to shake one's fist in the face of absurdity in this way is to take the matter too seriously. If the human condition is absurd in part because we realise that nothing matters, then this ought not to matter either and irony is a more fitting response than defiance (Nagel, 1971). Irony might also be a better response to the potential absurdity of arbitrariness in improvisation than an appeal to eternal recurrence. Whether one construes eternal recurrence in an 'as if' way, or whether considerations of cosmology and transfinite arithmetic lead us to take the doctrine literally, it is difficult to see how this can impinge on our assessment of an improvisation's value now. As Nagel points out:

> It is often remarked that nothing we do now will matter in a million years. But if that is true, then by the same token, nothing that will be the case in a million years matters

> now. In particular, it does not matter now that in a million years nothing we do now will matter. (Nagel, 1971, p. 716)

This recoil argument counts against an appeal to eternal recurrence by undermining the intuitive appeal of grounding value relative to the evaluative context of a future time, even if this is a future recurrence repeated *ad infinitum*. The other important part of Peters' phrase invokes the will, and that improvisation is free will embodied in a creative act is part of the legitimizing discourse that surrounds improvisation as a social practice (Peters, 2009; Warren, 2009). Creativity itself is thought of as linked with the imagination, which operates in a non-deterministic, non-materialist realm (Kant, 1790/1914). This way of thinking, compatible with Cartesian dualism gives rise to an idealised model of improvisation which will be introduced in Chapter 2. The sense of agency which gives an attribution of authorship to the creative act, predicated as it is on free will and access to knowledge of our own cognitive processes, particularly their temporal order and causal status, is problematic. There are also *philosophical* difficulties with the Cartesian model of improvisation, including the interaction problem that besets substance dualism (Lycan, 2013). This arises because it is not at all clear how a non-material substance could causally affect matter, or vice versa, since causality itself is a property of the material realm. Without a bidirectional causal relation, interaction as normally understood is not possible, hence any access to non-material ideal musical objects would be unable to have a causal role in their being played via a material body. On the other hand, if the Cartesian model is abandoned in favour of a materialist account, there is still of course the small matter of whether free will is compatible with determinism. These issues will be discussed further in Chapter 6. This thesis argues that an inter-disciplinary debate between philosophy and cognitive science would be useful for practitioners and educators of improvisation, so that we can better understand what improvisers are doing and how that might relate to philosophical questions about the nature and value of creativity. The perspective of cognitive science, in thinking of improvisation as a set of behaviours which access and deploy musical knowledge in different ways to non-improvisatory behaviours (Goldman, 2013), is amenable to experimental investigation of these phenomena that can inform the debate going forward. These considerations are what prompted this research programme.

1.4 Background

I have been a jazz guitarist, improviser and music educator for almost three decades and I have encountered the ideal of pre-hearing within the improvising community many times. My interest in philosophy and psychology led me to want to investigate the role of auditory imagery in improvisation and to start with the question, is imagery as reliable as it seems? This was prompted in part by an example from the visual imagery domain, following from experiments on mental rotation (Shepard & Metzler, 1971). The simple block objects used in these experiments seemed to me to be easy to imagine and rotate in my 'mind's eye' but Dennett's (1991) example of an object neatly illustrates that a seemingly vivid and controllable image can break down when interrogated in a certain way (Figure 1.1).

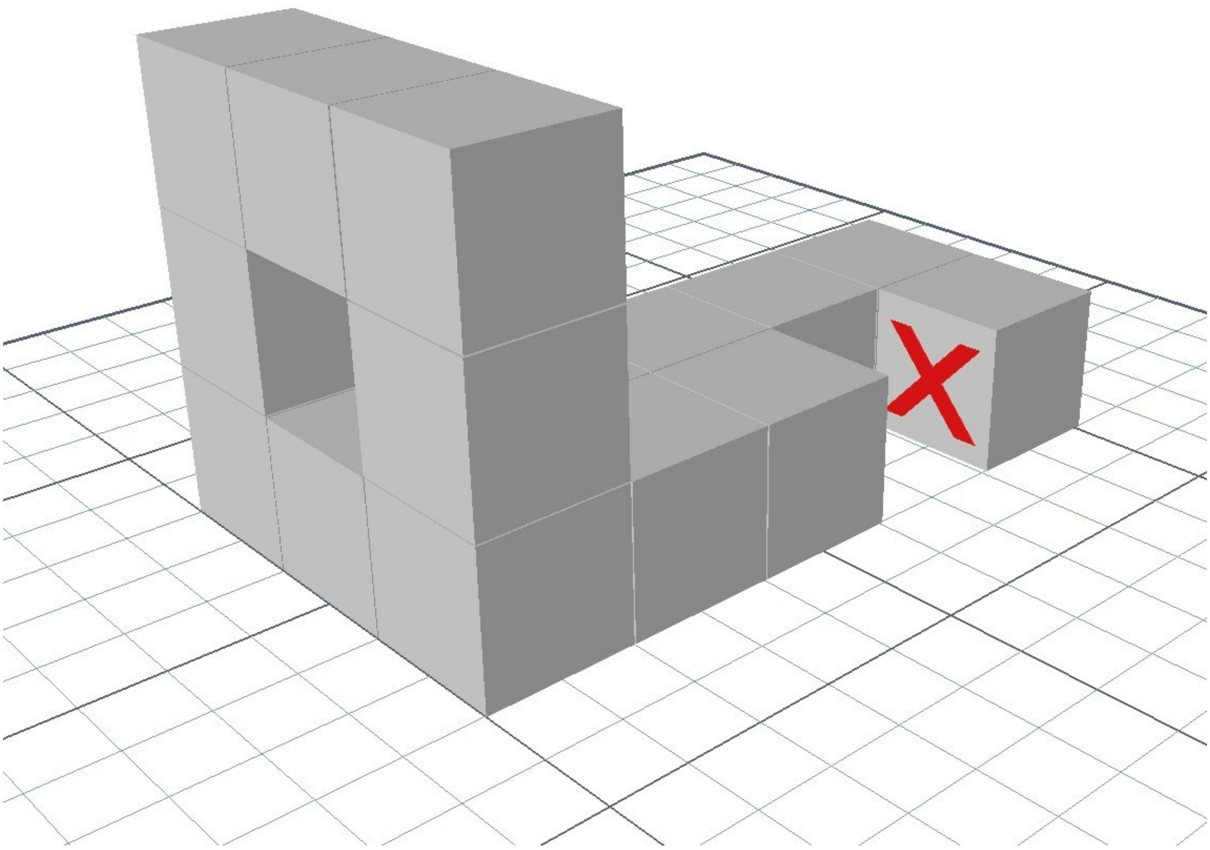


Figure 1.1. Above, a simple block object like the ones used in mental rotation experiments. Imagine it is made of 1cm cubes and you can look through the hole in the front surface. How much if any of the red cross is visible? How did you solve the task (Dennett, 1991)?

When asked if the cross is visible, people use techniques comparable to imagining ray diagrams rather than simply rotating the mental image and looking through the hole with their mind's eye (Dennett, 1993). This implies that our intuitions about our own imagery abilities could be mistaken (for further examples, see Pylyshyn, 2003). There are analogous findings that cast doubt on other cornerstones of Romantic conceptions of improvisation, such as our notions of autonomy and agency. Accordingly, for an improviser to feel responsible for creating the music, she must feel that she caused the music to happen as a deliberate act. This sense of agency has been investigated experimentally and shown to depend on judgements of time and causality. Crucially, manipulations of perceived timing affect judgements of causation, and vice versa (see Vuorre, 2017 for a review). In a study using transcranial magnetic stimulation (TMS) to evoke involuntary hand movements, Haggard, Clark, and Kalogeras (2002) found evidence of 'intentional binding'. Participants in this study either made voluntary key presses or experienced a TMS-induced movement. When these were followed by a tone 250ms later participants' judgement of the time interval was shortened from baseline in the voluntary condition and lengthened in the involuntary one. In the former, they judged the timing of the action as later and the timing of the tone as earlier, whereas the effect was reversed in the latter condition. These authors concluded that voluntary actions and their perceptual consequences appear closer together in time. On short time scales, if events are seen as causally connected, the temporal order of events can even be perceived to be reordered to fit this interpretation (Bechlivanidis & Lagnado, 2016). Could the sense of agency itself be subject to manipulation? Wegner and Wheatley (1999) induced a spurious feeling of wilful action in participants by priming them to think about the stopping point of a mouse pointer on a screen immediately before a confederate moved it there. Whether they perceived these events because of their own intention was sensitive to the timing of the priming stimulus, the effect being greatest when the prime was between 1-5 seconds beforehand. The authors infer these findings to be the result of a phenomenon they call apparent mental causation (see Figure 1.2). In another study, Bear and Bloom (2016) asked participants to rapidly choose from a set of options before one random option was made salient. The results showed that they were unaware that a later event had influenced their judgement of whether they had made a choice.

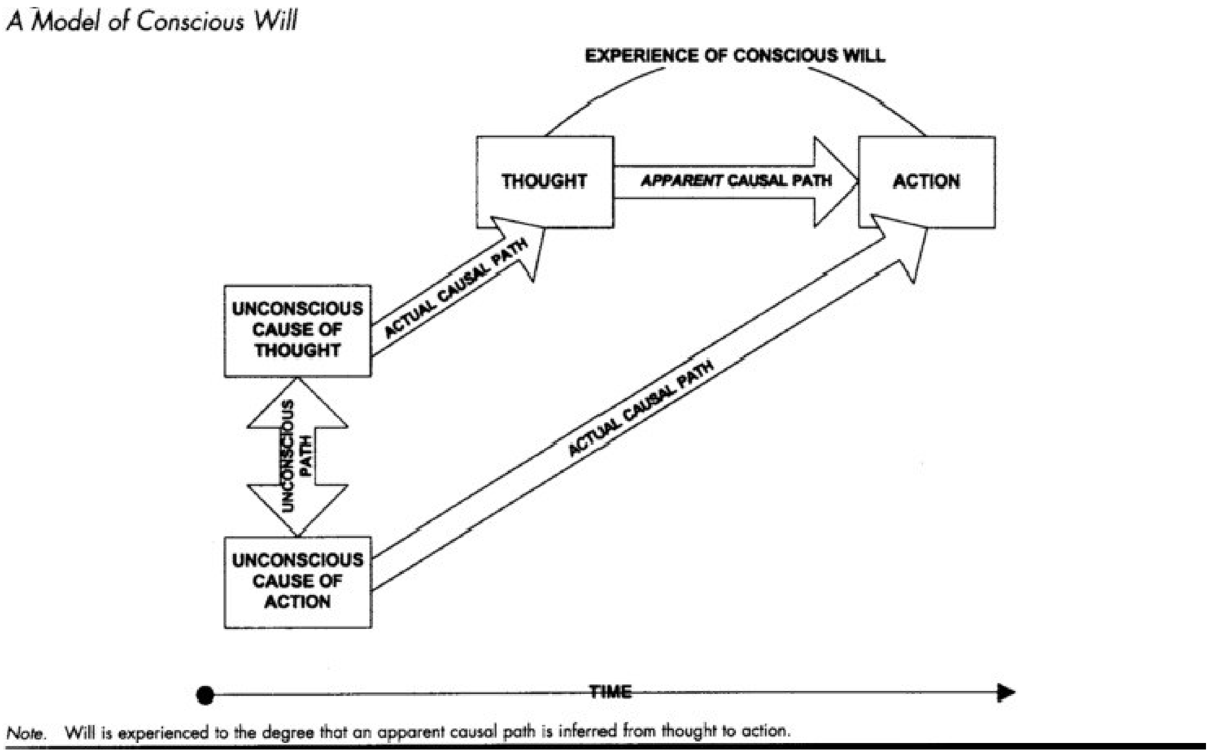


Figure 1.2. A schematic representation of apparent mental causation from Wegner and Wheatley (1999, p. 483).

In summary, the ideal of pre-hearing music in the imagination and construing this as a freely willed act which causes the music to be enacted is called into question by some findings that judgements of the veridicality of imagery, causality and the temporal structure of events can be unreliable.

1.5 Purpose and Research Questions

The purpose of this thesis is to investigate the role of auditory imagery in improvisation with a view to suggesting ways in which the cognitive-scientific perspective might inform improvisation practice and pedagogy. I suggest that a critical examination of philosophical and theoretical frameworks can offer an account of improvisation which is compatible with cognitive neuroscience, without jeopardising its value as a creative activity. In doing so, I examine the following research questions:

1. What is improvisers' experience of their use of auditory imagery in improvisation? How is important is it to them? How does it fit with other aspects of the process?
2. Does the familiarity of bodily aspects of music-producing gestures affect musicians' anticipation of the resulting sound?

3. Is improvisers' privileging of auditory imagery related to the extent to which they have a dualist worldview?

Chapter 2 gives a review of the literature and sets the stage for Chapter 3 in which I report a qualitative study which addresses question 1. Chapters 4 and 5 report Studies 2, 3 and 4 addressing question 2. Chapter 6 goes into more depth on the philosophical issues raised in attempting to reconcile the different perspectives on improvising and reports the findings of Study 5, which investigates question 3.

Chapter 2

Literature Review

2.1 Introduction

The context of this review is to assess existing research concerning the role of auditory imagery in improvisation. Edwin Gordon used a closely related term ‘Audiation’, which he defined as follows: “Audiation takes place when one hears music through recall or creativity, the sound not being physically present except when one is engaging in performance” (Gordon, 1979, p. 43). For clarity, the term ‘auditory imagery’ will be used for processes which could be characterised as ‘hearing in the mind’s ear’. The different types of imagery will be discussed in detail in section 2.2.

Musical improvisation is a broad term but as a first approximation, it can be defined as the production of unscripted musical material in real time. It can take many forms, including solo and collaborative improvisation, on a spectrum from ‘free’ improvising to contexts in which tonal, rhythmic, formal and idiomatic constraints are applied. Improvisation requires the simultaneous involvement and coordination of numerous skills, placing demands on working memory, memory retrieval, auditory and sensory-motor systems (Beaty, 2015; Brown et al., 2015; Pressing, 1998a). In group settings, improvisers must also interact musically with other musicians, attend to cues, monitor turn-taking and adapt their musical output according to social feedback. Improvisation will be covered in more depth in section 2.3.

My primary focus in this review is on melodic improvisation with harmonic accompaniment in the jazz idiom, as this involves the fundamental aspects of improvising whilst also being amenable to experimental interrogation (Fidlon, 2011; Goldman, 2013; Norgaard, 2011; Norgaard, Emerson, Dawn, & Fidlon, 2016). What is clear from the literature is that pre-hearing in the mind’s ear (prospective auditory imagery) is considered by practitioners and educators to be an integral part of the process of improvisation (Azzara, 1993; Berliner, 1994; Gordon, 1989; Kratus, 1991). What seems less clear is the precise role that such imagery plays in generating musical ideas and how this might be reconciled with a cognitive-scientific account of improvisation. The theoretical frameworks of common coding, sensory-motor coupling and embodied cognition have been fruitful in the investigation of musical performance (D'ausilio, Altenmüller, Olivetti Belardinelli, & Lotze, 2006; Hommel, 2009; Lima, Krishnan, & Scott, 2016; Maes, 2016; Novembre & Keller, 2014). These approaches converge to the notion that musical imagery is inextricably multi-modal (Keller, 2012; Lotze, 2013; Schiavio & Timmers, 2016), and this is supported by evidence from brain scanning studies, which will be discussed in detail in section 2.7 (for a review, see Beaty, 2015). Further, cognitive models of improvisation and the hierarchical nature of action control suggest a high degree of automaticity in complex goal-directed behaviours of this kind (Pacherie, 2008; Pressing, 1988). Evidence in support of this has been found in behavioural studies (Fidlon, 2011; Norgaard, Emerson, Dawn, & Fidlon, 2016).

The structure of the review is as follows: The nature of auditory imagery and the question of what is meant by 'improvisation' are considered in more detail, leading to a discussion of two key cognitive models (Johnson-Laird, 2002; Pressing, 1988). The evidential support offered for Pressing's model by some recent studies is assessed and then more generally the experimental evidence from behavioural studies and studies employing brain scanning techniques such as fMRI and EEG are discussed in relation to the cognitive processes involved in improvisation. The theoretical frameworks mentioned above are then considered in terms of their implications for the role of audiation in improvisation. The nature of imagery, the role of working memory and the relative domain specificity and generality of the relevant cognitive processes are then considered in order to inform the choice of suitable experimental methods. In the conclusion, I argue that audiation is valued in improvisation to the extent that it has a normative role in relation to practice. This merits an investigation of the nature of auditory imagery within a cognitive-scientific paradigm to elucidate this role and inform pedagogy and practice. The aim of this thesis to address important questions about the role of auditory imagery in improvisation that are not answered in the literature.

2.2 Auditory Imagery

2.2.1 Overview of Mental Imagery

Mental imagery could be characterised as a quasi-perceptual phenomenon, which resembles the experience of perceiving but in the absence of a corresponding external stimulus (Tian & Poeppel, 2010), or in the case of motor imagery, overt action. There has been some debate as to the extent that mental imagery resembles perception and on the level of abstraction and semantic content of visual imagery (Eysenck & Keane, 2015; Hinton, 1979; Kosslyn, Thompson, Kim, & Alpert, 1995; Lima, Krishnan, & Scott, 2016; Pylyshyn, 2003), and this also applies to auditory imagery (Linke & Cusack, 2015). Sometimes 'imagery' can be associated with the visual modality by default, but the derivation of 'image', via *imago* (Latin), which had various connotations such as picture, death mask, effigy, shadow, scheme, echo, metaphor, illusion, idea, conception, covers a large semantic field (Godøy & Jørgensen, 2001). The debate over imagery has a long history in philosophy and psychology and has not been settled yet. Aristotle used the term *phantasmata* and seems to view mental images as linked to perception, as does the majority view of modern psychology (Thomas, 2018). Descartes makes the distinction between knowledge via perception as very clear and distinct, whereas we can form what seems to us to be a veridical mental picture of a triangle but not, for example, of a thousand-sided figure. Hume offers a critique of the view that it is just the 'force and vivacity' with which impressions strike us that allows us to distinguish between perception and imagination, pointing to some internally generated sensations like pain and some ideas such as the continued existence of unperceived objects, as counter-examples. However, he does also seem to hold that the distinction between imagery and perception is one of vividness rather than of kind:

> A painter, who intended to represent a passion or emotion of any kind, would endeavour to get a sight of a person actuated by a like emotion, in order to enliven his ideas, and give them a force and vivacity superior to what is found in those, which are mere fictions of the imagination. (Hume, 1739/2017, p. 63)

Hume also links this contrast in vividness to memory, holding that this can distinguish between remembered and imagined mental content, which could be relevant for improvisation. If improvisers are recalling musical phrase fragments from long term memory, then perhaps this facilitates their veridical mental representation.

Kant developed the philosophy of perception and imagination considerably following Hume. His transcendental deduction concluded that space and time are a priori necessary categories by which our perceptual and cognitive apparatus can make sense of the world (Kant, 1781/2011). Kant's notion of apperception, which is the self-consciousness humans have, requires the synthesis of percepts via concepts. Perception is conception plus sensations, and the imagination (*Einbildungskraft*) is not only responsible for imagery but also for our ability to synthesise sensations in order to form perceptions. This bears directly on the debate about the semantic content of imagery as some philosophers hold that this means that mental content is necessarily conceptual (Conceptualism). However, there are non-conceptualists who draw an opposite conclusion from Kant's philosophy (Hanna, 2011), and these views resonate with embodied perspectives of contemporary psychology. Musical imagery is thus also used by listeners and is responsible for aesthetic judgements, in that hearing music *as* music is dependent on this faculty of imagination. Images can come to mind in an explicit and distinct or an implicit and indistinct mode. For example, if in hearing a Tristan chord, someone can distinguish the notes and can hear it *as* Tristan-type then this is the distinct mode (Godøy & Jørgensen, 2001). For Husserl (1901/2001), listening to music involves the constitution of ideal objects (musical structures and features such as symmetry, repetition, contrast and variation) by abstracting salient features and formal properties from sensations and drawing on knowledge. As this is a temporal process, it has *protensive* and *retensive* aspects in addition to binding events in the subjective present. In other words, the structure of consciousness is such that 'now' always contains elements of anticipation and memory. The temporal aspects of imagery in the context of improvisation will be discussed further in section 2.9.5.

At the end of the 19th century the discipline of psychology began to emerge as separate and distinct from philosophy, although each continues to be influenced by the other up to the present day. William James was a pioneer in ideomotor theory in America but along with Wilhelm Wundt in Germany, he also gave imagery a central role in cognition. Two distinct lines of thought on imagery emerged at this stage. A student of Wundt, Titchener and one of his students Perky further developed the notion that images and percepts are experientially alike. Another student of Wundt's, Oswald Külpe, sought to establish that some mental contents were unlike images or perception. The resulting dispute between these opposing positions became known as the *imageless thought* controversy which played a role in the rise of behaviourism and resonates with current debates between *picture theory* and *description theory* accounts of mental imagery (Kosslyn et al., 1995; Pylyshyn, 2003; Thomas, 2018). Meanwhile in philosophy, criticism of the picture theory of visual mental imagery was made by Wittgenstein (1967) and developed by Ryle (1949/2015). He makes the point that in the visual modality, we already have experiences of portraits and pictures which exist and represent objects. Hence, we are tempted to assume that mental images are in some way like this, that they must exist somewhere within the private domain of our heads. However, Ryle thinks this to misconstrue what we are doing when we visually imagine a scene. Rather than looking at a scene projected on some mental canvas, we are using our knowledge of what we *would* see if it were in front of us in order to *take ourselves* to be seeing it. So, if someone imagines their nursery, they are not looking at a picture or likeness in some private mental gallery, rather, they are seeming to see the actual nursery when in fact they are not. "He is not being a spectator of a resemblance of his nursery, but he is resembling a spectator of his nursery" (Ryle, 1949/2015, Chapter VIII, Section 2). These arguments were further developed by Dennett (1993), in his criticism of what he calls the 'Cartesian Theatre' model of conscious experience. To think that images must be in some way re-presented inwardly is implicitly to suppose that there is some kind of inner audience, an homunculus who watches the show. This leads to an infinite regress, as for the homunculus to experience the show given this model of conscious experience, it must itself have its own homunculus within, and so on. The reason Dennett calls this Cartesian, is that representationalist theories that commit the 'homunculus fallacy' in this way have inherited Descartes' notion that the nervous system presents information to some inner judge.

Another strand of the imagery debate also concerns differences between imagery and perception. Imagery is under voluntary control whereas perception is not. We can choose to imagine, for example, a tiger and perhaps change it to a leopard. When confronted with a tiger, our experience is constrained by the stimulus. We can also keep sampling the stimulus and learn new information, perhaps even count the tiger's stripes. In contrast, Wittgenstein argued that we cannot derive new information from imagery (Wittgenstein, 1967). Although this might be overstating the case, it can be difficult to derive information from manipulating an image that is readily available from manipulating an object, as Dennett's mental rotation object demonstrates (see Figure 1.1, Dennett, 1993). The relevance of this is that if visual mental images can be reinterpreted to yield a feature that was not initially apparent, this is taken as support for Kossleyn's quasi-pictorial theory, since this predicts that the mental image is functioning like a pictorial representation. Description theorists on the other hand have argued that images of ambiguous figures like the infamous duck-rabbit and other bistable phenomena like the Necker cube do not behave like percepts. That is, participants in experiments are unable to detect the duck if they memorised the picture as a rabbit, even though they are able to redraw the figure from memory and *then* see the duck interpretation, and their imagined cubes do not spontaneously flip (Pylyshyn, 2003). However, there is evidence that reinterpretation is possible, if difficult. Kamermans, Pouw, Mast, and Paas (2017) found that about 30% of participants were able to access the alternative interpretation of memorised figures. As the alternative interpretations are most visible when the figure is rotated 180 degrees, a prediction that follows from this is that those who are independently assessed to have greater mental rotation abilities would be better detectors, and this is what Mast and Kosslyn (2002) found. Pouw, Aslanidou, Kamermans, and Paas (2017) found evidence that this phenomenon is not restricted to the visual domain but can also occur in the haptic modality. This is relevant because although the focus of this review is on the role of auditory imagery in improvisation, musical imagery also involves visual, tactile, proprioceptive and perhaps most importantly, motor components (Bangert et al., 2006; D'Ausilio et al., 2010; Keller et al., 2010; Lima et al., 2016).

Brain scanning evidence that visual imagery activates areas of the visual cortex involved in early visual perception processing has also been interpreted as supporting the picture theory side of the imagery debate (Kosslyn & Thompson, 2003). The evidence in the auditory domain is mixed however, with some studies showing activation in the primary auditory cortex but the majority showing activation in secondary rather than primary areas (see Hubbard, 2010, for a review). Even if this evidence were unequivocal, description theorists point to the fact that activation in visual areas does not tell us what the representational format of the image is, without begging the question of whether perception is itself representational (Degenaar & Myin, 2014; Pylyshyn, 2003). There is also a deeper problem with both the description and picture theories of imagery. Each side of the debate has tacitly adopted the computational metaphor of processing, whereby visual information is represented *somehow* in the system, whilst each side has attacked caricatures of the other. Kosslyn's theory does not posit actual pictures illuminated inside the brain and Pylyshin's does not assume that an image of a cat is like an internal monologue of a natural language description (Thomas, 2018). Conversely, the more nuanced the arguments on each side become about representational format, the less clear it becomes that the brain instantiates images in any way that is really like the metaphors they deploy. What neither side has solved reduces to the so called 'hard problem of consciousness' (Chalmers, 1995), which in this context means that no account is given of how brain processes result in conscious experience. This in turn means that the representationalist computational metaphor is a contentious unargued-for premise. Recent perspectives such as enactivist, embodied and grounded perspectives have begun to challenge this view however, and these will be discussed more fully in later sections. For now, one example will be sufficient to make the point. Ryle was perhaps prescient when he characterised imagining as a species of *doing* rather than like perceiving, and as a kind of expectation of what would be present to perception (Ryle, 1949/2015), as this sounds like a description of current enactive theories (Thomas, 1999). Indeed, modern theories of perception and predictive coding see perception itself as anything but passive (Schröger, Marzecová, & SanMiguel, 2015; Talsma, 2015). An example that supports an enactive interpretation of imagery as an alternative to the picture and description accounts based on the information processing metaphor, is the presence of saccades during visual imagery (Thomas, 2018). These small eye movements are essential to the functioning of the visual system and their similarity during imagery of a scene to how they would be when actually viewing that scene implies that the visual system is enacting the processes involved in vision (Fourtassi et al., 2013; Johansson & Johansson, 2014). Moreover, disrupting these movements by moving the eyes in a way incongruous with the pattern relevant to the image disrupts imagery in a way analogous to that in which auditory imagery can be disrupted by articulatory suppression (Brodsky, Henik, Rubinstein, & Zorman, 2003; Brodsky, Kessler, Rubinstein, Ginsborg, & Henik, 2008; Thomas, 2018). An important implication for this thesis which will be discussed in more detail in subsequent sections is that mental imagery engages sensorimotor systems and is multimodal. In particular, the motor system is involved in auditory imagery and perception so that our anticipation of the sound of what is played is necessarily modulated by movement (Study 2). In the context of musical performance, sound-producing actions can be divided into *ballistic* and *sustained* types, which (along with some intermediates) can be concatenated and subsumed into higher level gestures in a hierarchical structure (Godøy & Jørgensen, 2001). Where several different action trajectories are fused into a single action unit this is termed *co-articulation.* An issue central to this thesis and investigated in Study 2 is the extent to which coarticulations are subject to *motor equivalence* (Bhangal, Cho, Geisler, & Morsella, 2016; Morsella, Godwin, Jantz, Krieger, & Gazzaley, 2016) such that a given melody or rhythm pattern might have several ways of being executed and imagined, with invariant features preserved even on different instruments. This concept is also related to *effector independence* (Shea & Wulf, 2005) which means that for example a pianist has different options for the fingering to use for a given musical fragment. The generative capacity due to motor equivalence is something that listeners to music will share depending on their level of musical training and experience in playing the instruments they are hearing. This suggests a continuum between vague, low resolution images and high-resolution images for musical sound. Low resolution images can be envisaged via general categories (hitting something) but these can have variants (hitting a cowbell with a stick, a wooden block with a mallet). The more detailed the subdivisions available, the higher the resolution of available images (Godøy & Jørgensen, 2001; Godøy & Rolf Inge, 2010). Given that in idiomatic contexts, improvisers could be expected to have high-resolution imagery for music produced by their own instrument, a central question addressed by this thesis is the nature of imagery for what is about to be improvised.

2.2.2 Types of Auditory Imagery

Auditory imagery refers to inner speech, images of natural sounds such as dogs barking and breaking glass, and musical imagery. This last category can be broadly divided into involuntary musical imagery (INMI, or ‘earworms’) or voluntary musical imagery, for example deliberately imagining a favourite piece of music, or experiencing imagery during a purposive activity such as reading a score (notational audiation). Within voluntary imagery, a further distinction can be made, between autonomous imagery, which occurs in the absence of corresponding perceptual stimuli, and coperceptual imagery, in which imaginary projections occur as a response to perceptual input (Reybrouck, 2001). Finally, imagery can be prospective (anticipatory) and could be regarded as a kind of expectation (Keller et al., 2010). The kind of imagery which is at issue in this review is both coperceptual and prospective, in the sense that it is an anticipation of the sound of that is about to be played, and rather than occurring in the absence of perceptual stimuli, it is produced in the context of the perception of what the improviser is playing, and often also while perceiving a musical accompaniment.

2.2.3 A Functional Role for Auditory Imagery in Improvisation: Schema Theory

If such coperceptual prospective imagery is not merely epiphenomenal, then it would be useful to consider its functional role in improvisation within a theoretical perspective that can account for the effects of musical training. Schema theory (Schmidt, 1975) proposes that abstract knowledge structures (schemas) based on proportional principles are involved in motor control. Invariant properties of schemas, such as relative timing and force, are scalable according to parameters that depend on context. Schema theory is an open-loop theory such that feedback is used for online error correction and hence is compatible with Pressing's (1988) cognitive theory of improvisation, which will be discussed in section 2.4. Schemas are developed during training according to Hebbian learning principles involving long-term potentiation (LTP) and depression (LTD). LTP and LTD depend on synaptic plasticity, such that the strength and/or speed of transmission of signals between neurons can be tuned by experience and remain relatively stable over long periods of time. The various mechanisms involved in synaptic plasticity are beyond the scope of this thesis (see Citri & Malenka, 2008, for a review). The important point is that initial blocked training during which an agent has knowledge of the results (KR) of their actions forms an association between the firing of neurons involved in enacting a motor program and those involved in the perception of its consequences. Variable training with partial KR subsequently consolidates the schema by enhancing the ability to scale responses to fit the context according to variable parameters (Shea & Wulf, 2005). Evidence for long-term neuroplastic reorganization in musicians will be discussed in more detail in sections 2.7 and 2.8, however it is worth noting that the enhanced neural efficiency and automaticity seen in expertise is compatible both with Pressing's (1988) cognitive model, and with and with fMRI results showing deactivations in relevant brain areas (for example Pinho, 1014). The latter is because efficient neural processes require less oxygenated blood to carry out cognitive tasks. A possible functional role for imagery in improvisation compatible with schema theory rests on the distinction between the recall schema and the recognition schema. The recall schema extrapolates from the relationship between past outcomes and response specifications to produce current responses to achieve a desired effect. The recognition schema generates the expected sensory consequences of the movement, including the anticipated vision and audition (Schmidt, 1975). This is compatible with auditory-motor coupling and ideo-motor theories discussed in subsequent sections (2.6.2, 2.6.3). Crucially for jazz improvisation, the precise movements required for a novel musical idea need not have been rehearsed previously because in schema theory, it is the *mapping* of movements to consequences that is stored. At issue in this thesis is the level of abstraction at which this mapping between movement and perceptual consequences operates (See Study 2 and sections 2.8.4 and 7.4), and whether conscious prospective auditory imagery informs the recognition schema in its control and evaluation of movement.

2.2.4 Auditory Imagery in Improvisation: The Views of Practitioners and Pedagogues

Before considering improvisation in more detail in the next section, as a first approximation improvisation can be regarded as the composition of music during its performance (Solomon, 1986). Berliner (1994, p. 248) reports New Orleans jazz musicians' advice: "if you can't sing it, you can't play it", interpreting this as "exhorting soloists to perform melodies that they can conceptualize clearly in their singing minds." This quotation is one of many from musicians expressing the view that auditory imagery is an essential part of improvisation. This view is also expressed by educators (Azzara, 1993; Gordon, 1989; Kratus, 1991, 1995; Wiskirchen, 1975), the following quotation being a good example: "The jazz improviser pre-hears in his mind the next musical event" (Coker, Casale, Campbell, & Greene, 1970, from the first paragraph of the introduction). The necessity for such conscious prospective auditory imagery for improvising represents what I shall refer to as the 'Ideal Model' in this thesis, a simplified schematic of which is given in Figure 2.1 below:

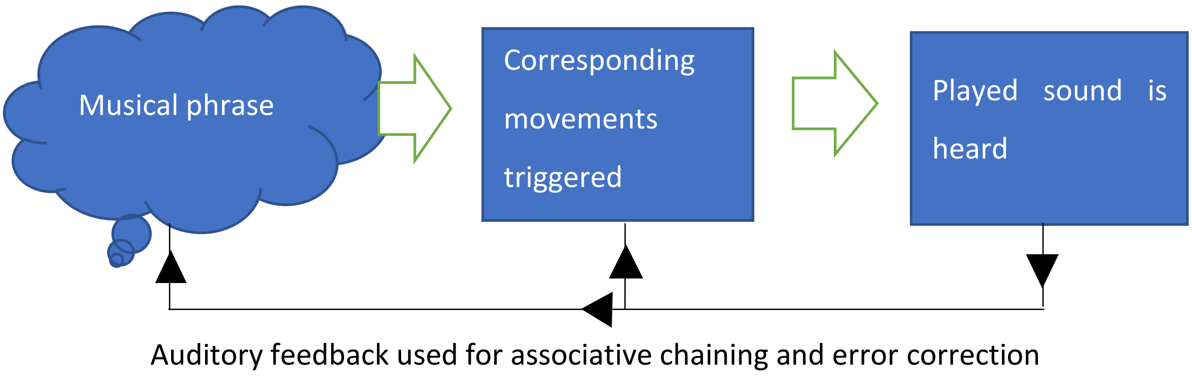


Figure 2.1. A musical phrase is formed in the imagination which triggers the specific bodily movements necessary to play the phrase on an instrument, for example finger, hand and arm movements for the guitar. The auditory feedback in the form of the perceived sound of the phrase being played is used for online error correction and also as an input for the imagination, so that the solo can develop in an associative chain. I shall return to the question of whether the Ideal Model can be reconciled with a cognitive-scientific view of improvising as a process in Chapter 6. The next section considers improvisation in more detail.

2.3 Improvisation

2.3.1 Overview of Improvisation

Bach and Beethoven were improvisers (Alperson, 1984) and there are treatises on improvisation offering advice like the following from a treatise by Corri from 1810:

> By this means and by transposing certain preludes in different keys, the Scholar may form endless variety, and with perseverance become so habituated to passages, Arpeggios and Modulation, that the Ear will imperceptibly guide the fingers, and direct the fancy to model preludes in various shapes. (cited in Berkowitz, 2010, p. 57)

Improvisation was an integral part of the Baroque keyboard performance tradition (Moersch, 2009). The distinctions between composer and performer and between composition and improvisation were not always as they are today in classical music, where only a minority of performers improvise even the cadenzas (Berkowitz, 2010). The kind of improvisation which involves spontaneous manipulation of melodic, harmonic and rhythmic parameters is now associated with the jazz idiom (Berliner, 1994), whereas a classical performer's manipulation of tone, articulation and timing for expressive purposes is not counted as improvisation.

Seeing this as an artificial distinction, Benson (2003) sees all musical performance as improvisatory and gives a taxonomy of kinds of improvising ranging from "improvisation$_1$", which refers to the latter kind of expressive classical performance, to "improvisation$_{11}$", which involves practices where the rules of the improvisatory tradition themselves can be modified. Examples of this kind of improvisation can be found in the free jazz genre, by artists such as Ornette Coleman, McCoy Tyner and the later John Coltrane. In contrast, non-idiomatic improvisation was heavily influenced by the experimental classical music tradition, extrapolated to a stance that rejects rules altogether. The focus on classical and jazz music represents a fraction of musical practice globally and the terminology of improvisation does not necessarily map in a straightforward way onto participatory musics (Turino, 2009) or to traditions like Persian music (Nettl, 2009). Participatory music has an ethos of inclusion such that musical specialists and non-specialists take part and this results in performances characterised by formulaic variation within a loose model (Turino, 2009). In participatory music, the flexible concatenation of motifs which can be embellished in different ways to fit the context has much in common with models of mainstream jazz improvisation but there is less emphasis on individual invention and priority is given to group play and participation (Kvifte, 2001). The *radif* in Persian music is a collection of approximately 270 short pieces which are memorised. These are divided into 12 *dastaghs* which are roughly equivalent to Western modes or Indian ragas. Each *dastagh* has a prescribed point of entry and ways of elaborating precomposed elements and what counts as successful improvisation reflects the cultural norms within the practice (Nettl, 2009). What these examples have in common is the blurring of the distinctions between pre-composition and improvisation. They also illustrate the importance of cultural factors in what counts as improvisation.

2.3.2 Issues of Creativity, Novelty and Value: Initial Questions

The concept of musical improvisation might at first seem straightforward, a question of simply making up music on the spot, or spontaneous creativity involving composition during performance. Closer inspection reveals certain fundamental philosophical issues, however. These relate to the nature of creativity, what it means to be spontaneous, and why we value improvising. When a musician improvises a melodic line on stage, in what way does this count as creative? Does the musical output have to be novel, in the sense of never having been played before? If so, and we subsequently discover that a musical phrase or line has been played before, we would need to re-evaluate musical output that had seemed creative, even in the absence of any connection between the two occurrences of the phrase, which seems counter-intuitive. Perhaps the criterion should be that the phrase has never been played before by that particular musician (Johnson-Laird, 2002)? However, if that were the case then the majority of the output of Charlie Parker, one of the most important innovators in jazz improvisation, would not meet this criterion, as many of his solos contain phrases or 'licks' that occur at least twice in his recorded corpus (Norgaard, 2014; Weisberg et al., 2004). This also relates to the concept of spontaneity since if a pattern has been used before, how can its re-use count as spontaneous? Perhaps spontaneity is best thought of as operating within parameters and within a given context. In jazz, performers tend to take turns for solos, follow social conventions relevant to the performance situation, interact with other performers, and play with reference to certain tonal rules (Monson, 2009) (there might be some free improvising contexts in which an improviser is as likely to juggle or eat a ham sandwich as play a solo, but these remain in the minority). Given such constraints and the need to play something that works when it is the soloist's turn, some models of improvisation suggest that players often draw on an 'idea bank' (Berliner, 1994; Norgaard, 2011). This comprises a store of phrases and schemas that help in the fluent production of melodic material in the context of rapidly shifting harmonic soundscapes. This has some overlap with Pressing's (1988) concept of the 'referent' and shares its commitment to the computational metaphor as a way of characterising mental processes. This aspect of cognitivism will be critiqued in later sections of this chapter, which will address alternative models including enactivist, embodied and dynamical systems approaches

If spontaneity is regarded as operating on one or more parameters at the level of the deployment of musical material, including pre-composed phrases in different combinations and allowing for transformations to fit to the context, could this be sufficient to ground creativity? It is possible that a continuum exists, ranging from completely pre-composed phrases in a performer's idea bank that are deployed with little or no alteration, to phrases that are conceived anew in a particular performance situation. However, even at the *de novo* end of such a continuum, at least within the mainstream jazz tradition, creativity involves the combination of pre-existing musical materials. That is to say, the continuum of frequency and timbre making up a possible soundscape already has elements preselected for use. Notes are members of discrete pitch classes which are selected in the context of their membership of pitch class sets (musical keys or tonalities) and combined according to the musical grammar of the jazz idiom to produce intelligible phrases. Choices of timbre are constrained both by idiomatic concerns and the physical properties of instruments. The creativity in mainstream jazz soloing then, is perhaps best considered to involve the fluent production of aesthetically pleasing melodic and rhythmic phrases via the constrained combination of pre-existing musical elements.

2.3.3 An Analogy with Language

If this seems to circumscribe the creativity of jazz soloing too much, then perhaps it is worth considering the analogy between music and language. Both involve the combination of a limited number of fixed elements (phonemes, pitches) which are combined into hierarchical structures according to syntactical rules. To take this analogy further, rehearsed musical performance would be akin to delivering a memorised speech, whereas improvisation would be analogous to conversational speech (Johnson-Laird, 2002; Lehmann & Goldhahn, 2016). Azzara (1993, p. 330) states “improvisation is to music what speaking is to language”. Both improvisation and speech use formulas or patterns (Fidlon, 2011; Lehmann & Goldhahn, 2016; Merker, 2006; Norgaard, 2014; Weisberg et al., 2004; Wray & Perkins, 2000), but it doesn’t follow that these are the only strategies used or that their use circumscribes creativity to the extent that the output is trivial. To argue that jazz improvisation is not very creative or spontaneous based on its use of formulas to combine existing elements would therefore also deny the possibility of saying novel, interesting and witty things in conversation, which seems untenable.

2.3.4 Improvisation as a Process

A useful distinction can be made between ‘improvisation’, when used as a noun, and the term when used as a verb (Alperson, 1984; Berliner, 1994). As Goldman (2013, 2016) points out, a focus on the musical product lends itself to the consideration of music-theoretic constraints, but these do not necessarily align with the cognitive constraints on improvisation as a process. It is not clear from a cognitive perspective that there is a *continuum* as such, between deploying pre-composed ideas and inventing new ones; there could be a few discrete processes producing the range of musical output. In cognitive terms, composition, recall and improvisation all occur in 'real-time' in the sense that the necessary mental operations involved unfold in time and are thus constrained by, for example, how much information can be attended to at once, working memory span, and so on. Improvisation is constrained by the limits of how improvisers can think and move when interfacing with their instrument in performance (Bailey, 1993; Baily & Driver, 1992). The relevant questions here involve which elements of the improvising *process* make some ideas improvise-able, and others not (Goldman, 2013). Nonetheless, musicians do make a distinction between deploying pre-composed ideas and inventing new ones (Berliner, 1994, p. 222). The latter is valued more highly and is seen as rarer (Macdonald & Wilson, 2005), but there are philosophical difficulties in deciding what counts as 'new' in jazz improvisation if this is seen as a process of constrained recombination of pre-existing musical materials. How much of the material in a musical phrase can have been played before, *in the same order* and the phrase still count as new? Are the elements of recombination restricted to the note level or do combinations of phrase-fragments in a novel order qualify as new? How many alterations to a phrase fragment to fit the context can be carried out before the result is new? These are paradoxes of the continuum. Even if these problems are solvable, there remains the question of how the newness of any idea could be known. A new-sounding phrase might have had hours of preparation and rehearsal in the practice room and there is evidence that even expert listeners can find it difficult to tell whether performances are improvised or not (Lehmann & Kopiez, 2010). The improviser themselves might not remember the origin of a musical motif played in performance. These issues will be discussed in more depth in Chapter 6.

2.3.5 Distinctions: Creativity, Originality and Value Revisited

Having made a distinction between improvisation as process and product, other useful distinctions can be made which will clarify some of the questions put in the first section. The so called 'standard definition' of creativity links originality to effectiveness, which in turn can take the form of value (Runco & Jaeger, 2012). Williamon, Thompson, Lisboa, and Wiffen (2006) offer an insightful elaboration of the relationship between creativity, originality and value, albeit in the context of Classical music performance, but which nonetheless helpfully disambiguates these concepts. Creativity is seen as an attribute of cognitive processes, characterised along a continuum of probability of arrival at a particular outcome or solution, from predictable (for example, identical to a previous instance) to highly unexpected. Originality can be formal or conceptual and is also a matter of degree. It is not equated with how objectively different a work is from all other instances of the same type, but rather with how readily it is distinguished from those instances by relevantly qualified observers within the culture. This shift of focus from an ontological to an epistemological perspective has some advantages, in that it reflects how the term 'original' is actually used and helps to deal with the problem mentioned above, regarding novel phrases. To elaborate this problem further, suppose someone plays a solo that seems novel and is acclaimed as creative, but many years later, a highly similar but obscure solo is discovered which predates theirs, and was unknown to them. A retrospective re-evaluation of creativity is not necessary, since creativity is an agent-specific property of the generative *process,* rather than of the product. This realisation redirects our attention to the aspect of novelty. Whilst it is impossible to ever rule out the subsequent discovery of an independently derived prior product, the problem of how the novelty of a solo can ever be known is circumvented in Williamon et al. (2006)'s model. Given the model's focus on originality as judged by the community at the time, the originality of a solo is not retrospectively invalidated by such a discovery, precisely because they evaluate the *process* (Johnson-Laird (2002) deals with this problem differently, by defining creativity in terms of being novel *for the agent,* and only optionally novel for society). The third concept, 'value' is characterised thus: "the overall 'value' of a product or idea is the mean value ascribed to it by individuals within a given culture" (Williamon et al., 2006, pp. 170-171). This might at first seem to be a circular definition, but its function is to locate value in a communal and to some extent inter-subjectively justifiable *judgement*, rather than intrinsic to the product. Insofar as this represents a philosophical stance on value, it is the one which I will adopt in this review.

If improvisation is valued in virtue of its perceived creativity and originality, these issues raise questions relating to why we value it based on these criteria. One can be creative but not *particularly* original and vice versa. Indeed, works that are 'too original' might not be valued when they are produced, even if subsequent generations judge them more favourably (Williamon et al., 2006). Even if improvisation is not usually a totally spontaneous act of sui generis composition, perhaps a close consideration of the process will reveal sufficient insights to ground its value. Finally, the value of creativity itself might rest on a set of implicit premises including those which relate to the philosophical concept of free will, which might be challenged by mechanistic interpretations of the findings of cognitive neuroscience. A full discussion of the philosophy is beyond the scope of this review, but some of the issues are relevant in respect of musicians' conception of what they are doing in the context of the norms of improvisation practice and pedagogy. One way to make progress in addressing these issues and gain a clearer perspective on improvisation and the role of auditory imagery, is to consider the activity of improvising from a cognitive perspective.

2.4 Cognitive Models of Improvisation

2.4.1 Pressing's Model

Pressing (1988) proposed a cognitive model in which a musical improvisation is seen as a series of 'event clusters'. Each event cluster comprises a group of musical notes performed via the triggering of a stored motor program. Here Pressing is adapting the idea of a Generalised Motor Program (GMP) from schema theory (Schmidt, 1975), where an abstract representation of a set of movements to achieve a goal is established through practice. In a given situation, a rule (or schema) allows parameters to scale absolute features of the movement (for example force and timing) whilst preserving their relative values. In Pressing's model, anticipation and feedback mechanisms have a role to play in guiding musical action. The selection of a given event cluster might be constrained by preceding clusters or take the form of an interrupt to the sequence, thus beginning a new sequence of clusters. Feedback is used to minimise the discrepancy between the desired outcome and performance. This allows the fluent and expressive concatenation of motor programs based on such control parameters as note placement, motoric feel, timbre, dynamics, pitch relationships, emotion and expressive design. Some aspects of schema theory have been superseded by more recent research (Schmidt, 2003; Shea & Wulf, 2005), but the hierarchical organisation of complex sensorimotor behaviour remains as an important theoretical perspective (Pacherie, 2008).

An important feature of feedback and error correction in this model is an emphasis on redundancy, such that auditory, tactile, visual, proprioceptive and kinaesthetic modalities of feedback are available, but only a small proportion of this feedback might be used at any given time. The flexible dynamic interplay between these different mental representations afforded by cognitive control of attentional resources is a crucial aspect underpinning improvisational fluency (Fidlon, 2011; Pressing, 1988). In contrast, the modalities of idea generation and feedforward mechanisms are not specified in detail in Pressing's model, with the former ascribed to vague central cognitive processes and the latter characterised as higher levels of cognitive control biasing lower levels toward anticipated actions. Although Pressing makes an inference that anticipated output could be in the form of an auditory image (Pressing, 1988), it seems difficult to rule out the possibility that a similar redundancy operates in the feedforward direction as in the feedback direction. That is to say, the anticipation could be in the form of, for example, motor imagery or perhaps any of the other modalities available, hence the role of auditory imagery in improvisation as envisaged by Pressing, is unclear. I shall return to the question of forward and inverse internal models in later sections and consider some evidence from brain scanning techniques which bears on the question of the modality of anticipation.

2.4.2 Johnson-Laird's Model

Johnson-Laird's cognitive model of improvisation characterises the process in terms of algorithmic demand (Johnson-Laird, 2002). A premise of the model is that creative processes in general are computable, and hence jazz improvisation as an example of such a process, is also computable. What this means is that improvised musical output could be effectively produced by the execution of a finite set of instructions (an algorithm). What kind of algorithm could suffice to produce melodic jazz improvisations? Johnson-Laird postulates three possible types of algorithm for creativity: neo-Darwinian, neo-Lamarckian, and the third is a hybrid of the first two.

A neo-Darwinian algorithm involving multiple generation and selection of phrases for output would require the intermediate results (the candidate musical phrases to be evaluated) to be stored in working memory. In humans, this would produce a slowing of performance as the working memory load increased because, Johnson-Laird argues, working memory capacity represents a 'cognitive bottleneck'. As musicians seem able to improvise complex ideas as fast as they can play their instrument, Johnson-Laird rules out algorithms that need to store intermediate results during processing. Thus, phrases must be produced by a kind of neo-Lamarckian algorithm whereby all the parameters constraining possible output are used in the idea generation process.

Johnson-Laird's model does not mention mental imagery as a possible source for musical idea generation. Like Pressing's model, the concern is not with precisely how the processes involved in improvisation are subjectively experienced. However, in contrast to Pressing's emphasis on stored motor programs, Johnson-Laird proposes that musical output is generated algorithmically in real time, rather than by the retrieval of phrases or phrase fragments from memory. In this sense, these two dominant cognitive models in the literature could be said to be competing representations of improvisation. There are three main reasons that Johnson-Laird advances to reject 'motif theories' according to which solos involve the linking of stored phrases. Firstly, somebody must invent motifs in the first place, in which case they are not retrieving them from memory. Second, analyses of corpora reveal that some phrases only appear once in solos. This leads to the third reason, which is that the memorisation of a sufficient number of such phrases or phrase fragments to produce complete improvised solos is impractical (Johnson-Laird, 2002; Lewis, 1996). A counter-argument to the first reason is that the invention of motifs could occur off-line (in the practice room) and they could then be retrieved from memory onstage. The second reason might be considered by returning to the analogy with language. Analysis of conversational speech reveals that a similar percentage of it consists of patterns or formulas to that found for pattern use in jazz solos (Norgaard, 2014; Weisberg et al., 2004; Wray & Perkins, 2000). Since neither figure is 100% then it can be argued that other generative strategies must play a role in speaking and improvising, however it seems the evidence does not support algorithmic generation as the dominant strategy (Norgaard, 2014; Norgaard, Spencer, & Montiel, 2013). This in turn casts doubt on the third reason, as it seems unlikely that the issue is one of practicality since such a high percentage of pattern use is already evident. More likely is that, as in conversation, formulaic recombination serves as a default strategy and grammatical (algorithmic) generation steps in when the context requires a more inventive response (Wray & Perkins, 2000). Despite there being many possible ways that an algorithmic process (generative grammar) could produce semantically equivalent utterances, only a tiny proportion of such are used (Pawley & Syder, 1983). Yet this reliance of formulas in conversation does not generally produce stilted or disjointed speech as if from a phrasebook. Hence Johnson-Laird's objections do not stand up to close scrutiny. However one possibility is that Pressing's and Johnson-Laird's models might be reconciled by considering a suitable musical unit above the note level for algorithms to act upon (Fidlon, 2011). I shall return to this question in section 2.9.5 The Temporal Dimension of Improvisation. In the next section I will consider some recent studies which have offered support for Pressing's model and discuss their implications for the role of auditory imagery.

2.5 Recent Evidence in Support of Pressing's Model

2.5.1 Corpus Analysis and Computer Modelling

Martin Norgaard used a computer programme to look for intervallic and rhythmic patterns in a corpus of 48 improvised Charlie Parker solos (Norgaard, 2014). A musical phrase only qualified as a pattern if it occurred more than once in the corpus. He found that patterns were ubiquitous, with many patterns occurring in different solos as well as within solos. 82.6% of the notes in the corpus began a 4-interval pattern with the mean number of instances in the corpus being 26.3. The longest pattern identified was 49 intervals and the mean length of pattern was 7.3 intervals. When patterns were matched for rhythm and intervals, 57.6% of notes were found to begin 4-interval/rhythm patterns.

Although these results are suggestive of Parker having inserted many pre-learned patterns into his solos, there are alternative explanations for the data. Firstly, any sufficiently long and complex string might yield patterns purely by chance or as an artefact of the search algorithm (McKay, Bar-Natan, Bar-Hillel, & Kalai, 1999). Secondly, an algorithm such as that proposed by Johnson-Laird might converge to a similar distribution of patterns, given the constraints of tonal harmony and considerations of contour and rhythm that could also influence a human improviser. In order to rule out the first alternative, Norgaard randomly shuffled the intervals in the corpus whilst preserving the interval distribution. When the analysis was carried out again on the shuffled corpus, the distribution of patterns was markedly different, with far fewer patterns overall, and a sharp decline in pattern frequency as pattern length increased. To counter the second objection, that patterned output could be derived algorithmically, Norgaard created a new corpus of solos using a program (Impro-Visor) which uses rules derived from actual Parker solos but does not use stored phrases. With this artificial corpus the results again differed markedly from those with Parker's actual corpus. The longest pattern found in the algorithmically generated solos was only 10 intervals long (compared to 49 for Parker) and the percentages for pattern use were much lower. This result seems to counter the possibility that the distribution of pattern use in Parker's solos could be a necessary artefact of improvising with tonal material in an algorithmic way.

Norgaard further tested the hypothesis that stored patterns are used by human improvisers by developing his own algorithm to generate improvised melodies (Norgaard, Spencer, et al., 2013). This algorithm was based on a Markov Chain principle, such that an initial four note interval pattern is randomly selected, then each subsequent note is generated only on the basis of the previous four notes. This process is iterated until the required number of notes is reached. The algorithm chooses the next note based on the probability that the resulting pattern occurred in the input corpus (the same Charlie Parker corpus as in the study above) and incorporates both rhythmic and melodic features. The results, based on a comparison of pattern use and interval distribution, again showed a higher correlation with the actual Parker solos than attempts by an algorithm (Impro-Visor) based on tonal rules derived from Parker's corpus. It is important to note that the stored patterns in Norgaard's algorithm were not used in such a way as to be simply *inserted* and concatenated. If that were the case, then it would be trivially true that the output would resemble the corpus. Rather, the input corpus is used to create a stochastic matrix that governs the probabilistic generation of subsequent notes. So this approach is as *algorithmic* as approaches that use tonal rules in a way consistent with Johnson-Laird's model. The essential difference is in the use of stored patterns rather than rules. Furthermore, in contrast to other Markov chain algorithms (Pachet, 2012), Norgaard did not use style specific or tonal rules to guide higher-level processes that govern the overall architecture of the solo.

Despite Norgaard's persuasive argument that his results support Pressing's (1988) model, he does concede that it is still possible that future refinements to tonal rule-based algorithms could produce outputs that more closely resemble human solos, for example by using more sophisticated rules. One limitation of Norgaard's algorithm is that it does not deal with ‘vertical’ or harmonic concerns in the way that human improvisers seem to do. For example, one of the improvising strategies identified by participants in Norgaard’s interview study (2011), involved the selection of notes with specific attention to the underlying harmonic structure of the music, to which the algorithm is blind. Another limitation is that higher levels of control that deal with the architecture of a solo, such as thematic development or the balance and timing of tension and release, are incapable of being captured by Markovian processes (Pachet, 2012). Norgaard states that “the design could be augmented to incorporate constraints related to a given chord progression, larger architectural structures, and interaction with external factors” (Norgaard, Spencer, et al., 2013, p. 253), and as such this can be regarded as a work in progress. In order to rule out the possibility that Parker is a special case, Norgaard used one corpus of fiddle improvisations by Aubrey Hanie, and another of Bach’s *Partitas and Sonatas for Solo Violin*, BWV 1001–1006 as inputs to the same algorithm, again with favourable results (Norgaard, Spencer, et al., 2013).

Although computer modelling approaches offer insights into what is required to produce improvised output, they do not tell us directly what humans actually do. This is because computers instantiate improvisation in a completely different way to humans. Computers use serial Von Neumann architecture (instructions are executed one at a time in very fast succession), whereas the brain’s distributed systems seem to work in parallel (Pinho, de Manzano, Fransson, Eriksson, & Ullén, 2014). Norgaard’s assertion, based on his review of the literature, is that stored motor patterns have an auditory component, but it is possible that auditory imagery is not necessary when motor programs enact patterns retrieved from long term memory (Hargreaves, 2012). Indeed there is evidence that improvised content involves subconscious automatic processes at the level of note choice (Limb & Braun, 2008; Norgaard, 2011), however it is also possible to use implicit processes to enact conscious intentions (Berkowitz, 2010). In summary, the evidence from both the analysis of Charlie Parker’s corpus of solos and the comparison of computer generated solos to actual human output gives support to Pressing’s cognitive model of improvisation, particularly with regard to the use of stored patterns, but the question of role of auditory imagery remains open.

2.5.2 A Behavioural Approach

I now turn to an approach which seeks to test improvisation experimentally in order to shed light on the underlying cognitive processes underpinning jazz improvising in humans. In a study with jazz pianists (Goldman, 2013), participants improvised right handed or left handed, in a familiar or unfamiliar key (Bb Major, B Major) and alternating between improvising melody or bass line between hands. The notion that there might be such a thing as an unfamiliar key for a highly trained pianist used to performing repertoire in all keys needs clarification, however. In this experiment, participants were jazz pianists improvising on the chord changes to Gershwin's *I got Rhythm,* which is most often played in flat keys which are suited to horn players. B Major is therefore a less familiar key for improvisation on these changes. The improvisations in unfamiliar conditions contained a higher proportion of diatonic pitch classes, and lower pitch class variation as measured by the entropy value of the analysed MIDI file, interpreted as an indication that these improvisations were simpler and more predictable. A main effect of key was found, and in follow up interviews with participants, they reported that improvising in B was a more conscious effortful process than in Bb. Goldman argues that without access to familiar motor patterns, improvisers fall back on explicit knowledge of music theory, the implication being that stored motor patterns have a significant role in improvisation as normally practiced in familiar conditions.

An important aspect of Goldman's methodology is his focus on a cognitive-scientific approach to improvisation in contradistinction to a music-theoretic framework. This allows the cognitive processes involved in the interface between body and instrument to be investigated experimentally, with music-theoretic considerations used as tools to interpret data rather than being the defining concepts. From a music-theoretic point of view, the tasks of improvising in the keys of Bb and B could be regarded as equivalent, but because of the nature of the body-instrument interface for pianists and differences in familiarity between these keys, they are revealed to be quite different from a cognitive perspective. This manifested in musicians reporting that they used different strategies, for example relying on explicit knowledge of tonality in the key of B in contrast to implicit, or procedural knowledge in Bb (Goldman, 2013). In common with Norgaard, Goldman posits that when musicians use stored motor programs, these are accompanied by an auditory image, even when exhibiting the fluency and automaticity of 'muscle memory' in familiar improvising conditions (Goldman, 2012, 2013). In this, both authors explicitly draw on theories of action control that involve sensorimotor integration. In the next section I will consider the cognitive basis of improvisation, survey the evidence on auditory-motor coupling and then move on to review the general findings of studies using brain scanning techniques.

2.6 Cognitive Processes Subserving Improvisation

2.6.1 Introduction

Musical improvisation can be regarded as a hierarchically organised goal-directed behaviour (Berkowitz & Ansari, 2008; Limb & Braun, 2008; Pressing, 1988), which balances the need to generate self-directed creative thoughts with the need to deploy these in the context of task specific constraints (Beaty et al., 2016). This is indicative of the cooperation of large-scale brain networks involved in spontaneous thought and cognitive control, the involvement of working memory, motor control and sensorimotor integration (Beaty, 2015). At the superordinate level, relatively abstract notions of how to construct the solo, such as the tonalities and dynamic changes used to build and release tension, can occupy attentional resources in the form of conscious *sketch planning* (Norgaard, 2011). This is possible due to the subordinate levels being delegated to more automatic processes thus freeing attentional and cognitive resources for superordinate level tasks. In particular, the sequential concatenation of complex motor sequences depends on automatic processes. These were initially theorised in terms of schema theory as generalised motor programs (Pressing, 1988; Schmidt, 1975). Schema theory and the concept of the generalised motor program (GMP) have been criticised for over-reliance on the symbolic computing metaphor. The GMP was originally developed as an open loop concept, meaning that feedback was not necessary for error correction with GMPs typically operating on timescales of around 250ms or less (Shea & Wulf, 2005). This presents a problem for how GMPs can explain complex action sequences such as a golf swing or music-producing gestures that unfold over longer timescales. These concerns prompted the different theoretical approach relying on dynamical systems theory, which rejects the top down symbolic representation of schema theory (Newell, 2003), although see Schmidt (2003) for a rebuttal. A refinement of the GMP concept, the *scalable response structure* is better able to deal with longer sequential motor processes such as those involved in improvisation, however (Shea & Wulf, 2005). If these motor processes are accompanied by auditory images, as postulated by Norgaard and Goldman, this would seem to entail sensorimotor integration in the form of auditory-motor coupling.

2.6.2 Auditory-Motor Coupling

What evidence is there for auditory-motor coupling and how are complicated sequences of movements linked to aural images in musicians? Bangert and Altenmüller (2003) conducted a study in which two groups of non-musicians underwent training sessions for five weeks to learn sequences of key presses on a piano keyboard. These were in the form of acoustically presented target melodies which increased in difficulty in response to the level of success for each item. The range was restricted to five notes (C-G) played by the right hand only, which was shielded from view. In one of the groups (the map group), the standard key-to-pitch mapping was used, whilst in the other (no map), pitches were assigned randomly on each training trial. EEG measurements were taken using probe tasks in auditory only (passive listening) and motor only (arbitrary silent key presses) conditions. Results showed increased activity in right anterior hemispheric brain regions only in the map group, supporting the hypothesis that brain plasticity in this region allows training-induced auditory-motor associations to be formed.

Further evidence was found for these associations using transcranial magnetic stimulation (D'ausilio, Altenmüller, Olivetti Belardinelli, & Lotze, 2006); a greater motor excitability was found when pianists listened to a piece they had rehearsed compared to one they had not. This effect increased with longer training time and was observed after only 30 minutes' rehearsal, although there is also evidence that the representation of a practiced piece changes in terms of its level of abstraction, at least in expert musicians (Palmer & Meyer, 2000; Schmidt, 2003; Shea & Wulf, 2005). Drost et al (2005b) also found that induced motor effects can be produced by auditory stimuli representing potential perceptual effects. In this study, pianists were required to play pairs of tones in response to notation in the presence of auditory task-irrelevant distractor intervals, which could be congruent or incongruent. In subsequent experiments, coloured squares were used as imperative stimuli to control for expertise in music reading, and non-musicians were also tested. Pianists but not non-musicians had slower reaction times in incongruent conditions and experienced induced false responses (Drost et al., 2005b). This behavioural evidence lends further support for training induced auditory-motor coupling in musicians in the auditory to motor direction. That is, stimulus in the auditory modality was seen to influence motor behaviour. If motor behaviour also induces an auditory image in musicians then auditory-motor coupling could be said to be bidirectional, but obtaining behavioural evidence for this is more difficult, because imagery is an introspective state, immediately accessible only for the participants themselves.

In order to infer such evidence, Keller and Koch (2008) had participants complete sequences of key presses on three vertically aligned keys in response to arbitrary colour patch stimuli. In some conditions, key presses were congruently mapped to the pitch height of the produced tones, whilst in others the mapping was scrambled, or no tones were produced. They found that participants' mean reaction times were lower in the congruent condition and that this effect was greater in participants with more musical experience. The authors hypothesise that greater musical experience enhances action planning via the anticipation of the auditory effects of key presses, and that this is enhanced in musicians due to learned associations between physical height and melodic contour. According to the spacial musical association of response codes or SMARC effect (Lidji, Kolinsky, Lochy, & Morais, 2007; Stewart, Verdonschot, Nasralla, & Lanipekun, 2013), in pianists this effect has a left-right dimension but in score-dependent musicians the vertical dimension is also enhanced. This experiment did not use a traditional instrument, such as a piano, so the effect was instrument-independent, however no independent behavioural data was gathered to establish whether auditory imagery was actually used by participants (Hubbard, 2010). How might action planning involve imagery and what are the implications for the neural bases of musical behaviour in terms of auditory imagery?

2.6.3 Ideo-Motor Theories

Some closely related theories of action control that could provide an answer are based on the Ideo-motor principle (for a review, see Shin, Proctor, & Capaldi, 2010). What these theories share is the concept that there is a tight linkage between actions and their perceptual consequences. One branch amongst Ideo-motor theories is the common coding paradigm, which is directly relevant to the relation of auditory imagery to music. The core concept of this paradigm is that the cognitive representation of actions is coded in the same representational format as their perceptual consequences (for a review of M/EEG, TMS and fMRI evidence supporting common neural coding in musicians, see Novembre & Keller, 2014). Since the perceptual consequences of enacting a motor program (or scalable response structure) to produce a musical phrase include how that phrase sounds, the common coding approach proposes that the bidirectional coupling of the motor program and the perception of the sound produced is achieved via this common representational format, such that hearing the sound can prime the motor program, and enacting the program invokes an auditory image as an anticipation of how the musical output will sound. An example of a common coding theory is the Theory of Event Coding (TEC) (Camus, Hommel, Brunel, & Brouillet, 2017; Hommel, 2004, 2009). In TEC, the action-event coupling is achieved via event files: hierarchically organised networks of neural codes that relate to different aspects of events, such as activation contexts, actions, perceptual effects and thoughts that regularly accompany a given event. When one node in such a network is activated, the activation spreads to other members of the network, following pattern completion logic. Context-specific priming can modulate the relative strengths of activations in a task-sensitive way (Hommel, 2009).

2.6.4 The Mirror Neuron System, Simulation and Emulation

As well as TEC, and other common coding theories that belong to the broader theoretical framework of Ideo-motor theory, there are some other perspectives that share many of the key-concepts and can further elucidate these issues. The next to be discussed is the proposed mirror neuron system (MNS). Originally identified in the F5 region of the macaque monkey premotor cortex, mirror neurons are a distinct sub-population of neurons which are activated both by performing an action and by observing the same action being performed by another individual (Gallese, Fadiga, Fogassi, & Rizzolatti, 1996). Although the evidence for a homologous system in humans is less direct due to the fact that invasive techniques such as implanting electrodes directly into the brain are not used, non-invasive methods such as transcranial magnetic stimulation and brain scanning methods have been used to support this idea (Rizzolatti & Craighero, 2004). It might seem that a system which is hypothesised to involve motor resonance in response to *visual* observations is of limited relevance to the current discussion of auditory-motor coupling but there are several interesting findings which are of relevance. The first is that subsequent experiments with monkeys it was found that motor resonance occurred in response to the *sound* of actions, leading to the hypothesis that there are sub-populations of *echo* neurons (Kohler et al., 2002). Moreover, the human homologue of the mirror neuron system involves frontoparietal circuits including Broca's area, which has been suggested to be involved in domain-general system for the production of action sequences, including the novel sequences involved in improvisation (Berkowitz & Ansari, 2008). Two studies have shown that the inferior parietal and ventral premotor areas (the MNS) are engaged in the learning of guitar chords by imitation and the results further show that the left dorsolateral prefrontal cortex (DLPFC) is active during motor preparation for unfamiliar chords (Buccino et al., 2004; Vogt et al., 2007). Given the hypothesised role of the DLPFC in the selection and combination of existing elements in the motor repertoire to produce unpractised actions, this sheds light on its involvement in improvisation discussed in section 2.8 below. In contrast to common coding paradigms which posit a shared representational format for perceptual and motor processes, the mirror neuron system is an explanation at the neural level such that a sub-population of the motor system itself represents perceived actions, allowing understanding and prediction which facilitates imitative learning, but also offers an explanation of other aspects of musical engagement. Overy and Molnar-Szakacs (2009) outline the Shared Affective Motion Experience model of musical engagement whereby the human mirror neuron system forms a domain-general system for processing the combinatorial rules involved in music, language and sequential action. They also propose the anterior insula as a conduit to the limbic system to account for our emotional engagement. The mirror neuron system account can be considered to be one of a family of *simulation* theories in that part of the motor system is involved in action cognition whilst not actually executing a movement (O'Shea & Moran, 2017).

Another simulation theory that is more directly related to imagery rather than the representation of observed actions is motor simulation theory (Jeannerod, 2001). This is based on the idea of functional equivalence: motor imagery is taken to be covert action which uses the same neural mechanisms as for motor preparation and action but with the difference that the action is inhibited. Motor imagery could be a feature of the motor control component of auditory-motor coupling in musical performance. There are also parallels with sports psychology, reflecting similarities between elite performance in music and sport. For example, Holmes and Collins (2001) propose a systematic model for the use of imagery by athletes, based on functional equivalence between motor imagery and motor preparation/execution. That imagery and execution rely on overlapping neural correlates in this model resembles features of common coding paradigms mentioned above, but here rather than a common representational format accessible by both systems, the emphasis is on the use of the motor system to predict the outcomes of actions. In an experiment targeting the dorsal premotor cortex (involved in motor resonance in response to observed hand actions, see MNS discussed above), Hadley, Novembre, Keller, and Pickering (2015) used transcranial magnetic stimulation to show a causal role in the operation of this area in the accuracy of musical turn-taking. They conclude that motor simulation is an important mechanism in musical synchronisation.

Another related class of theories which could account for auditory-motor coupling is emulation theories. The distinction between simulation and emulation is pertinent to music performance. Whereas the former has a focus on motor imagery, the latter widens this to include multimodal predictions of the perceptual consequences of actions (Grush, 2004). Although emulation in the motor control context involves the prediction of sensory consequences involved in movement, such as proprioceptive factors, this could be extended to other modalities, most importantly the prediction of the resulting sound.

There is a great deal of support amongst motor control approaches for Pressing's ideas of feedback and feedforward mechanisms in error detection and control, for example action-perception coupling theories posit forward and inverse modelling (Keller, 2012; Lotze, 2013; Maes, Leman, Palmer, & Wanderley, 2014). Forward modelling means that the perceptual consequences of planned actions are predicted, via the production of an 'efference copy' of the motor command, allowing for the prediction of errors before the sensory consequences of an action are perceived (Maidhof, Vavatzanidis, Prinz, Rieger, & Koelsch, 2010; Ruiz, Jabusch, & Altenmüller, 2009). Inverse modelling involves the linking of perceived or intended sensory states with the motor commands needed to enact behaviour which has those states as perceptual consequences. As discussed above, these sensory states could include how the music will sound; in other words, the intention or anticipation could be in the form of auditory imagery. There remains a fundamental question about the mirror neuron, simulation and emulation theories discussed so far, however: to what extent are they compatible? If they are in fact competing explanations for the same phenomena, they ought to generate different predictions that can be tested. O'Shea and Moran (2017) offer a useful appraisal of the relative merits of motor simulation, motor emulation and embodied cognition frameworks for motor control, whilst pointing out some mutual incompatibilities. Gentsch, Weber, Synofzik, Vosgerau, and Schütz-Bosbach (2016) also give a very helpful taxonomy of common coding, simulation, and internal model theories. The first category includes ideomotor theories and TEC, the second includes simulation theory itself, mirror neurons, motor imagery and perceptual symbols accounts. The last category includes motor control, emulation and predictive coding accounts. In the final section, embodied and grounded cognition will be discussed.

2.6.5 Embodied and Grounded Perspectives

If ambiguities of terminology beset the theories discussed above, this is no less true of embodied cognition. The essential differences between these theories and the motor control, simulation, emulation and common coding theories discussed above could be expressed in terms of a continuum between the computational metaphors involved in forward and inverse models and the degree to which these are representational at the motor control end, and the non-Cartesian, non-representational non-computational stance at the embodied end. This is related to other debates in cognitive science, for example to what degree are cognitive processes carrying out amodal symbol manipulation as opposed to reactivating perceptual or motor states? In mental imagery, to what degree is abstract amodal content involved (Kosslyn et al., 1995; Pylyshyn, 2003)? Embodied cognition does not just say that the bodily states affect thinking, that would be trivial. To varying degrees, embodied theories hypothesise that even the most abstract seeming thought, such as mathematical reasoning, involves sensory-motor processes (Fischer, 2012). Some embodied perspectives emphasise the role of the environment (situatedness) and social aspects (Iyer, 2002; Smith & Semin, 2004). The term 'grounded' cognition is used by some authors to refer to the grounding of cognition in sensory-motor processes , by others to refer to the symbol grounding problem (Glenberg & Robertson, 2000; Harnad, 1990). This problem refers to the issue of how arbitrary amodal symbols can be tied to meaning. If such symbols just refer to other symbols, how does the system know what it is thinking about? Harnad (1990) gives an example of trying to learn Chinese using a dictionary which is written in Chinese. This echoes the Chinese Room thought experiment deployed to criticise the idea that artificial intelligence could instantiate consciousness (Searle, 1980). In this thought experiment an operator, who does not know Chinese, receives Chinese symbols as input, follows symbol manipulation rules, and delivers output in the form of (other) Chinese symbols. In this way the system mimics the behaviour of a Chinese brain, but neither the operator nor the system understands any Chinese. This question of how to tie amodal symbols to referents is a serious one, which in part motivates grounded cognition's rejection of the idea that meaning inheres in the arbitrary relation of abstract amodal symbols to their referents, or to each other. Grounded cognition solves this problem with perceptual symbols (Barsalou, 1999), which being based on sensorimotor simulation, are not *arbitrarily* related to referents. Instead, meaning is grounded in the possibilities for action. Glenberg and Robertson (2000, p. 383) characterise the comprehending of the meaning of a sentence like "Jareb stood on the chair to change the light bulb" as involving indexing the phrases to perceptual symbols (or objects), derive affordances for these, and mesh these affordances guided by syntax. In the context, a chair affords being stood on to change the bulb. This concept of an *affordance* developed by Gibson (Eysenck & Keane, 2015), is important in the application of grounded cognition to music and will be discussed in more detail in the next section. What distinguishes grounded from embodied cognition is partly a matter of terminology (Gentsch et al., 2016), but essentially grounded paradigms do not just include embodied (sensorimotor) aspects. They hold that "cognition is typically grounded in multiple ways, including simulations, situated action, and, on occasion, bodily states" (Barsalou, 2008, p. 619). Another important difference is that grounded paradigms based on perceptual symbols involve multimodal simulation which is representational in character, whereas some embodied paradigms which emphasise cognition as interaction with the environment, have more in common with dynamical systems approaches in that they are not representational (O'Shea, 2017). These perspectives and the related enactivist "4E cognition" view (Torrance & Schumann, 2018) will be further discussed in Chapter 7 in terms of musical embodiment which is situated in an environment in which musicians interface with their instruments (De Souza, 2017).

2.6.6 Affordances in Musical Contexts

When an agent encounters an object or system, properties of the agent and of the system combined offer opportunities for interaction; these are *affordances* (Greeno, 1994). A large stone might be throwable for an adult human but not for a child (Windsor & De Bézenac, 2012), meaning that the same object offers different affordances to different agents depending on their attributes. As originally conceived by Gibson, affordances are directly perceived (Eysenck & Keane, 2015) rather than recognised and there is some evidence that this can be the case. For example, Pappas and Mack (2008) found evidence that affordances produced motor priming even though presented objects were undetectable due to masking or attentional blink. However, the concept has been developed to include recognised affordances (Greeno, 1994). Affordances are directly applicable to musical performance, as what a musician can play in a context depends on their abilities after training on an instrument, and on the attributes of the instrument itself. The guitar affords subtle blues-inflected pitch bends to a guitarist, whilst this is not the case for a non-guitarist and is not possible on a standard piano. What is improvisable also depends on the affordances offered by an instrument to a player (Love, 2017). This is not a static set of possibilities, since the effectivities of a musician change with training and in the other direction, instruments are designed with human physical capabilities in mind and as people train, explore and expand their capabilities, new instruments are designed in response (Windsor & De Bézenac, 2012).

2.6.7 Conclusion

A considerable amount of experimental evidence supports the bidirectional linking of motor behaviour and auditory representations during musical activity, supporting the theoretical framework adopted by Norgaard (2014) and Goldman (2013), consistent with Pressing's (1988) prescient cognitive model. However, although these theories of action control are consistent with a role for prospective auditory imagery in improvisation, they leave open some questions regarding how the various models are instantiated in the brain (Matyja, 2015). Another criticism is that although these are models of sensorimotor *integration*, the language of feedback and feedforward draws on an information processing metaphor which actually assumes a degree sensorimotor *segregation.* Brincker (2015) offers an alternative model which employs the concept of social affordance space tracking, and although a detailed discussion is beyond the scope of this review, it is worth noting that there are different theoretical perspectives on improvisation and questions about which are the most valid for a given improvisatory behaviour are far from settled. For example, motor simulation theories are incompatible with embodied approaches as the former considers imagery as representational whereas embodied theories emphasise the interaction of the body and the environment in a non-representational way (O'Shea, 2017). What is needed is more research which explicitly seeks findings in favour of specific models rather than delivering evidence which can be interpreted differently according to incompatible theoretical positions. Two brief examples might be illustrative here: a similar incompatibility exists between the cognitivist stance which posits motor programmes and dynamical systems approaches, in which complex movements depend on emergent properties of moving limbs at a lower hierarchical level, rather than top-down control. What kind of evidence would favour one approach over another? Consider the sequence of electromyogram (EMG) signals from agonist and antagonist muscles during rapid elbow extension movements. These could be interpreted within both stances *unless* the movement is unexpectedly suppressed. A motor programme interpretation would predict that the EMG signals would still be present, whereas the dynamical systems approach entails that such a sequence is a property of *actual* movement, and would therefore not be present (Schmidt, 2003). Another example is a study by Amsel, Urbach, and Kutas (2014) which was designed to test different predictions made by amodal and grounded cognition paradigms. They presented monochromatic object words in low and high contrast conditions and participants made judgements of the validity of object/colour or object/location combinations (for example, green lime or blue lime, kitchen banana, bedroom banana). The authors collected reaction times and event related potential (ERP) data which showed that low contrast differentially affected colour decisions, suggesting the involvement of visuo-perceptual states in accessing knowledge about an object's colour. Further, the time course of the ERP data is incompatible with amodal processing followed by visuo-perceptual involvement. Unless experimenters can produce designs which can similarly distinguish between, for example, motor simulation theories and embodied paradigms, questions of which theoretical framework should be favoured will remain unanswered. Whilst a detailed mechanistic explanation with the necessary evidence to settle these broad theoretical controversies might not be available for some time, there is evidence from brain scanning techniques that facilitates a degree of triangulation between approaches, which is considered in the next section.

2.7 Functional Brain Scanning Methods

2.7.1 fMRI

The first experimental method used to investigate the process of improvisation considered in this section is functional magnetic resonance imaging (fMRI). This technique uses a scanner to detect differences in the levels of oxygenated blood in different regions of the brain during experimental tasks. The blood oxygenation level-dependent (BOLD) contrast is used as a proxy for brain activity in a given region on the basis that more active regions have a higher energy demand. This triggers a haemodynamic response such that oxygenated blood is delivered to the active regions in the brain. The technique has a temporal resolution of 2-3 seconds (Posse et al., 2012) and can sometimes give a good indication of which brain areas are relatively active or inactive during experimental tasks compared to a control task or rest. To what extent can this method elucidate the role of auditory imagery in improvisation? Beaty (2015) presents a synthesis of the findings of fMRI studies and discusses their implications for Pressing's model. He finds that many studies report that a network of prefrontal brain regions is involved in improvising, including the pre-supplementary motor area (pre-SMA), the medial prefrontal cortex (MPFC), the inferior frontal gyrus (IFG), the dorsolateral prefrontal cortex (DLPFC) and the dorsal premotor cortex (PMD).

Given the hypothesised functional roles of these regions in the literature, Beaty finds some support for Pressing's cognitive model. For example, the left IFG is associated with controlled memory retrieval and the supplementary motor area (SMA) and PMD are associated with the coordinated selection of motor sequences. However, there are some discrepant results between studies, for example Limb and Braun (2008) found deactivations in the DLPFC when jazz pianists improvised (on a non-metallic keyboard) in an fMRI scanner, which the authors hypothesise is indicative of 'flow states' (Csikszentmihalyi & Lefevre, 1989; Ullén et al., 2012), characterised by a reduction in executive control. However, other studies found *activations* of the DLPFC (Bengtsson et al., 2007; de Manzano & Ullén, 2012a), so the precise nature and extent of executive control during improvisation is unclear, although these discrepancies might be due to differences in task and cohort between the studies (Pinho, Ullén, Castelo-Branco, Fransson, & de Manzano, 2016). The improvising experts in Limb and Braun's study were playing over a familiar chord progression, allowing for a high degree of automaticity (cf. Goldman, 2013), whereas the other studies involved classical pianists engaged in tasks that are akin to pseudo-random generation. Both factors, the difference in relevant improvising experience between cohorts, and the level of executive control required to ensure that output evinces randomness, are plausible explanations of these differing results. One other study which did have expert improvisers as participants in an ecologically valid task but found activations of the DLPFC is worthy of note. Donnay, Rankin, Lopez-Gonzalez, Jiradejvong, and Limb (2014) had participants 'trade fours', which is a form of interactive musical communication in improvising. It is possible, as these authors hypothesise, that in trading fours the improvised content is constrained in virtue of being a response to an improvised idea in a musical conversation. The DLPFC activation is therefore compatible with the need to hold elements of the heard phrase in working memory, and to respond with a phrase which relates to it.

2.7.2 Direct Evidence for Auditory imagery

Returning to the question of auditory imagery, there is evidence that this is associated with activity in the posterior superior temporal gyrus (pSTG), (Halpern & Zatorre, 1999; Zatorre & Halpern, 2005). Further, functional connections between the pSTG and areas involved in movement and planning have been proposed (Lahav, Saltzman, & Schlaug, 2007; Zatorre, Chen, & Penhune, 2007), which could serve as a neural basis for the audio-motor coupling discussed in the previous section, (for fMRI evidence of both the auditory-motor and motor-auditory directions of coupling see Bangert et al., 2006). Zhang, Chen, Wen, Lu, and Liu (2017) had participants watch silent visualisations of music while imagining the sound. They found increased bilateral activation in Wernicke's area compared to when they listened to the same music. Interestingly, they also found connections with the dorsal attention network and the motor control areas. This supports the bidirectional auditory-motor coupling view. The involvement of Wernicke's area and its right homologue might also point to an overlap with language processing systems in addition to the involvement of Broca's area and its right homologue in the processing of musical syntax (Cheung, Meyer, Friederici, & Koelsch, 2018; Patel, 2003). The involvement of the SMA and pre-SMA in auditory imagery (see Lima et al., 2016, for a review) is particularly interesting. In studies on notational audiation the authors found that imagery was disrupted by articulatory suppression (Brodsky et al., 2003), and by using larynx-electromyography that imagery evoked covert excitation of the vocal folds (Brodsky et al., 2008). Their interpretation was that reading a score evoked auditory imagery in a process of inwardly "singing to oneself", even though no lyrics were involved (Brodsky et al., 2008, p. 442) and cite evidence for the involvement of the SMA as further support. Further research is needed to establish whether this is the case phenomenologically, or whether the generation of imagery recruits areas associated with language (Broca's area, Wernicke's area) in domain-general ways. The activation of the pre-SMA and the boundary area between the SMA and pre-SMA during auditory processing and imagery could be interpreted as the activation of motor representations involved in sound production (Lima et al., 2016), which is compatible with embodied and grounded cognition paradigms. The role of the pre-SMA in sequential action planning and sensorimotor integration would be crucial to improvisation in any case.

Only two studies were reported by Beaty (2015) to have found increased activation in the pSTG compared to a memory retrieval control task (Donnay et al., 2014; Liu et al., 2012), implying that direct evidence for auditory imagery is limited. However, this might be because both the primary auditory cortex and secondary auditory areas are recruited in music perception (Zatorre & Halpern, 2005) and the fMRI studies surveyed by Beaty all involved improvisers who heard what they played and in many cases they also heard an accompaniment. It is therefore difficult for fMRI studies to find a signature of activation for auditory imagery in improvisation when the same brain regions are involved in music perception (Keller, 2012). It is also likely, given the evidence for auditory-motor coupling cited above, that imagery is present during tasks which involve playing from memory. In that case, brain activation in improvisation *in contrast* to playing from memory might not detect auditory imagery, since this would be involved in both conditions.

2.7.3 Further Methodological Problems

Improvisation involves many simultaneous cognitive processes (Bashwiner, Wertz, Flores, & Jung, 2016; Beaty, 2015; de Manzano & Ullén, 2012b; Limb & Braun, 2008; Norgaard, 2014; Pinho et al., 2014), and so there is an inevitable trade-off between ecological validity and isolating the specific neural correlates of any subset of these processes. Also, it should be remembered that fMRI uses the BOLD (blood oxygenation level dependant) response as a proxy for increased processing in a brain region but has a limited temporal resolution which can be as low as 1 second. The haemodynamic response itself can also exhibit a time lag which is of the order of 8-30 seconds (Pillai, 2014, p. 79; for an account of recent advances resulting in temporal resolutions of the order of 100ms, see Posse et al., 2012). By contrast, the threshold of metrical perception is approximately 100ms (London, 2012). Nor does the fMRI technique give much detail of the nature of the processing involved (Linke & Cusack, 2015). For example, if the automaticity of a cognitive task via practice results in greater neural efficiency, then fMRI would not necessarily find an activation in the relevant brain area, since less oxygenated blood would be needed. Evidence for this was found in a study by Pinho et al. (2014) where activation in frontoparietal executive areas was negatively correlated with hours of improvising experience, but the latter was positively correlated with functional connectivity of the bilateral dorsolateral prefrontal cortices, dorsal premotor cortices, and presupplementary areas.

Activity in a brain area does not necessarily imply that the same neural processing is happening there on each occasion since the complexity of the brain is such that it is possible that the same brain regions contain multiple separate neural processing systems (Grahn, 2012). Further, there are questions over the validity of the reverse inference from the activation of a brain region to the involvement of particular cognitive processes (Poldrack, 2006). This problem is further compounded by the differing and contentious definitions of improvisation that are operationalised in different experiments. For example, if improvisation is characterised in terms of the free generation of novel sequences, this could be operationalised as a pseudorandom generation task (Berkowitz & Ansari, 2008). As the corpora analyses discussed above reveal a high degree of pattern use however, this is not necessarily a good way to characterise what improvisers do. On the other hand, experiments with more ecologically valid tasks such as in Limb and Braun's (2008) study still rely on interpreting activation patterns in terms of the hypothesised roles of brain regions from previous studies. These are then used to bolster the interpretation of which cognitive process are involved in improvising, but without a rigorous cognitive-scientific specification of improvisation as a process, this reasoning risks being circular (Goldman, 2015). Finally, a recent study casts doubt on the statistical methods used in fMRI studies to infer clusters of voxels as indicative of brain activation (Eklund, Nichols, & Knutsson, 2016). These authors conducted a study with 499 healthy volunteers in an attempt to validate the statistical methods used in fMRI analysis and found false-positive error rates of up to 70% instead of the required 5% when using the three most popular analysis software packages. This result potentially calls into question the interpretation of fMRI studies to date.

2.7.4 Summary of fMRI Findings

Notwithstanding the caveats mentioned above regarding the limitations of fMRI methods, the studies which investigated improvisation using ecologically valid tasks of relatively unconstrained improvisation with expert improvisers (Limb & Braun, 2008; Liu et al., 2012), consistently found a signature pattern of activations and deactivations of particular brain regions. Activations were found in areas associated with motor control and sensorimotor integration (SMA, pre-SMA, PMD) and in areas responsible for the processing of musical syntax (IFG, Broca's Area and right homologue). A focal activation in the medial prefrontal cortex (MPFC, Brodmann area 10) was also found. This is thought to be an integrative area involved in maintaining a diverse set of subroutines involved in the maintenance of a higher-order goal (Limb & Braun, 2008; Rutherford, 2014). Deactivations were found in the lateral orbitofrontal cortex (LOFC) and the dorsolateral prefrontal cortex (DLPFC), the latter deactivation was also found by Pinho et al. (2014). These areas are thought to be involved in explicit task monitoring, correction and stepwise implementation. This kind of thinking, which requires intermediate steps to be stored in working memory, is found in explicit logico-deductive problem solving. Therefore, the deactivation of the LOFC and DLPFC in improvisation is consistent with its characterisation as a largely automatic, unselfconscious process (Goldman, 2013; Johnson-Laird, 2002; Kratus, 1995; Norgaard et al., 2016; Sudnow, 1978). The role of auditory imagery in improvisation remains unclear given the methodological limitations of fMRI but, a meta-analysis by McNorgan (2012) further supports the involvement of the posterior Superior Temporal Gyrus (pSTG) in auditory imagery. Crucially, the consistent involvement of auditory association, motor, and sensorimotor integration areas supports an interpretation of musical auditory imagery as a form of grounded cognition (2.6.5).

2.8 EEG and MEG Techniques

2.8.1 Introduction

In contrast to fMRI, which has good spatial resolution but poor temporal resolution, electroencephalography (EEG) has a temporal resolution of the order of milliseconds, much more suitable for the timescales of music cognition (London, 2012), but it has poor spatial resolution relative to fMRI and must therefore rely on evidence from other techniques for the identification of the brain regions responsible (Pillai, 2014). Some of the EEG evidence in support of auditory-motor coupling has already been mentioned, but there is also some support for auditory imagery in studies using this technique.

2.8.2 Responses to Notation

In addition to the fMRI evidence mentioned above relating to aural imagery in response to music notation, an electroencephalography study by Schön and Besson (2005) found that N1 event related potentials (ERPs) were stronger when there was a mismatch between the notation and an audible melody. That notation can elicit aural imagery was also supported by two studies which used magnetoencephalography (MEG). Shürmann, Raij, Fujiki and Hari (2002) used MEG to test musicians' brain activity as they imagined the sound of a visually presented note in standard notation. A visual control task was used to exclude effects that were due to visual processing. In the second study, MEG was used to test participants' response to mismatches between auditory stimuli comprising randomly generated twelve-tone sequences and their visually presented scores (Yumoto et al., 2005). These findings also implicate the involvement of the Superior Temporal Gyrus in auditory imagery, however there were some differences in lateralization in the results which might be explained by the differing experimental tasks. Also, it is possible that pitch contour processing and pitch interval processing are dealt with by different systems with pitch contour processing lateralized in the right hemisphere (Hyde, Peretz, & Zatorre, 2008; Lee, Janata, Frost, Hanke, & Granger, 2011). It should be noted that these studies did not collect independent behavioural data to establish that imagery was used by participants in the experimental tasks. This is a weakness of some experimental designs involving brain scanning techniques, because they rely on participant self-report or an assumption based on the type of experimental task to establish imagery use. This is a problem in research on imagery more generally because it is difficult to design experiments with behavioural measures that causally implicate mental imagery. An example of a study which did use this kind of behavioural data is Halpern and Zatorre (1999), in which the time taken by participants in an imagery condition for short, medium and long melodies was analysed, establishing that this varied in line with the duration of the actual melodies.

2.8.3 EEG and Altered Auditory Feedback

Another way to investigate the role of auditory imagery using EEG is via altered auditory feedback (AAF). In the context of the common coding paradigm discussed above, auditory imagery means that participants form expectations of the perceptual effects of motor commands in the form of auditory images. If the notes they hear are sometimes manipulated by the experimenter, this ought to produce a mismatch between the image and the perceived note. This in turn leads to the hypothesis that EEG will be able to detect a signature of this mismatch. Maidhof et al, (2010) analysed the EEG results of participants who played scales and patterns bimanually on a MIDI keyboard. One note chosen at random between the 40th and 60th played was lowered by a semitone. This was contrasted with a passive listening task in which the same stimulus underwent the same manipulation. The results showed a greater magnitude early negativity (N200) deflection in the action condition compared to the listening condition. The authors conclude that the results "indicate that the feedback ERN/N200 is influenced by the expectancies generated by the intention and action of the pianists to produce a certain auditory effect" (Maidhof et al., 2010, p. 2410). In addition, the hypothesised neural generators for the N200 lie in the Rostral Cingulate Zone (RCZ) which is thought to have a role in action monitoring relevant to piano performance (Ruiz et al., 2009).

2.8.4 Different Error Related Potentials

According to the common coding paradigms discussed above, there are two distinct processes that could produce an ERP indicative of a mismatch. One involves a difference between the efference copy of a motor command and the triggered motor program, the other occurs if auditory feedback differs from the anticipated result. Whereas the latter requires knowledge of results (KR), the former does not and in some cases the ERP can even precede the completion of the action (Ruiz et al., 2009). One EEG study used AAF to manipulate feedback so that the wrong tone would be heard even though the correct motor response was given (Lutz, Puorger, Cheetham, & Jancke, 2013). Musical novices completed a series of trials which allowed them to develop an internal model which mapped key presses to tones. A comparison of results from early and late trials showed a modulation of an error related negativity (ERN) peaking at 100ms, whilst a later feedback related potential (FRP) at 250ms remained unchanged. That the early ERN was affected as a result of learning implies that some comparison with an internal representation or prediction, facilitated by training, is being carried out by participants. This is because the ERN onset at 100ms is too early to be a response to feedback and the effect was seen in later trials after training. These results are compatible with common coding, which predicts that the comparison of the efference copy with the performed action requires an internal auditory-motor coupling model, which can precede the mismatch between the auditory feedback and the anticipatory auditory image (audiation). Also, when this mismatch is a result of the manipulation of feedback, there should be no discrepancy between the efference copy and the action, since the latter is correct. In this way, the experimental design allows for the separation of these components, perhaps shedding light on the aforementioned issue of the modality of feedforward mechanisms in Pressing's (1988) cognitive model of improvisation (for a detailed schematic of the interrelation of forward and inverse models in the motorcontrol domain, see Ptak, Schnider, & Fellrath, 2017; and in the speech production domain, see Tian & Poeppel, 2010).

2.8.5 Summary of EEG and MEG Findings

The evidence from studies using EEG and MEG brain scanning techniques offers support to the explanatory framework of sensorimotor integration and common coding as well as suggesting the involvement of fronto-parietal circuits and the superior temporal gyrus in improvisation. That the latter seems to be implicated both in auditory imagery and working memory (Zatorre & Halpern, 2005; Zatorre & Samson, 1991), suggests that a useful strategy might be to look more closely at the structure of working memory in musicians. The EEG evidence also suggests that error-related potentials and altered auditory feedback could be used to investigate the limits of auditory imagery experimentally.

2.8.6 Recent fMRI and EEG Evidence for Differences Between Improvising and Score-dependent Musicians

In section 2.6 it was argued that musical performance is dependent on training-induced bidirectional auditory-motor coupling. Although perhaps most music students receive ear training and a grounding in different genres of music, improvising musicians train differently to score-dependent musicians in their daily practice by emphasising learning by ear as opposed to sight-reading and memorising (Berliner, 1994). This suggests the following predictions: first, improvisers should have relatively enhanced auditory-motor transformation skills and score dependents should have enhanced visuo-motor skills. Second, following from the notion that improvisers access musical knowledge-structures differently to non-improvisers, they could exhibit genre-dependent responses and expectancies whilst perceiving music which reflect this. Evidence for the latter prediction comes from a study which combines EEG and behavioural data in a design which exploits jazz musicians' knowledge of chord substitutions which fulfil analogous harmonic functions. Goldman, Jackson, and Sajda (2018) created an oddball task in which they systematically manipulated chord deviants with respect to whether they were valid substitutions in jazz harmony. The results showed significant correlations between improvisation experience and the responses to the different kinds of stimuli. This finding is further supported by Bianco, Novembre, Keller, Villringer, and Sammler (2018) who also found EEG and behavioural differences, this time between classical and jazz pianists during a silent imitation task. The first prediction, that auditory-motor skills are enhanced in improvisers compared to score-dependent musicians gains support from Harris and de Jong (2015), who found fMRI evidence of increased activation in areas involved in audio-motor transformations in the former group.

2.9 Toward an Experimental Paradigm

2.9.1 Introduction

Considering the literature to date, the questions that remain regarding the role of auditory imagery in improvisation include: If musicians are hearing in their heads what they improvise, how accurate and detailed is this imagery? When does it occur in the generative process, prior to phrase generation, simultaneously or post-hoc? What is the size of the musical unit that is at the appropriate level of description to be imagined (a note, phrase or something in between)? In order to progress toward an experimental method to address these questions, I now turn to the issue of working memory.

2.9.2 Working Memory

Working memory (WM) can be defined as a cognitive process for temporary storage of task-relevant information for goal-directed behaviours (Huang, Matysiak, Heil, König, & Brosch, 2016). There is some evidence that musicians use working memory in a different way to non-musicians. Baddeley and Hitch's model of working memory (WM) has, to a first approximation, a central executive, an episodic buffer, a visuo-spatial sketchpad and a phonological loop (Baddeley, 2001, 2010; Baddeley & Hitch, 1974). However, in an fMRI study comparing musicians and non-musicians, Schulze, Zysset, Mueller, Friederici, and Koelsch (2011) found evidence that musicians also have a 'tonal loop' for the maintenance of tonal information in WM. Furthermore, in addition to the core areas of overlap for WM for verbal and tonal material in both groups (including Broca's Area, SMA, premotor cortex, the left insular cortex and the inferior parietal lobe), the additional areas used by musicians for tonal material include areas involved in movement (right globus pallidus, the right caudate nucleus, and the left cerebellum). This adds further support for the concept of sensorimotor integration discussed in previous sections. However, some more recent findings have implicated articulatory rehearsal in the maintenance of melodies in working memory (Nees, Corrini, Leong, & Harris, 2017; Soemer & Saito, 2015). This is consistent with the core areas of overlap for verbal and tonal WM mentioned above and with earlier studies on auditory imagery in response to notation (Brodsky et al., 2003; Brodsky et al., 2008). Further research is therefore needed to explore which elements of non-verbal sounds require specialised WM systems in musicians.

2.9.3 Shared Syntactical Integration Resource Hypothesis

The involvement of Broca's area also raises the question of the degree of domain-specificity or generality of the cognitive processes involved in improvisation, which could be relevant in terms of experimental design. In other words, are these processes specific to music, or does musical behaviour co-opt cognitive resources that can be used for a number of tasks? Broca's area was thought to be language-specific, with its right homologue being involved in the processing of musical syntax. Recently however, Fedorenko, Duncan, and Kanwisher (2012) found evidence of both language-specific and domain-general regions within Broca's area. Some authors have also offered evidence for shared resources in music cognition, for example, Patel (2003) posits the Shared Syntactical Integration Resource Hypothesis, whereby both language and music make use of a domain-general syntax processing system (but for contrary views, see Bigand, Delbé, Poulin-Charronnat, Leman, & Tillmann, 2014; Perruchet & Poulin-Charronnat, 2013).

2.9.4 Experimental Access to Online Imagery

Despite this possibility of resource sharing, the evidence suggests that the tonal loop is specific to the maintenance of tonal materials in WM, hence this might be a suitable target for experimental manipulation if there is sufficient reason to suppose that auditory imagery in improvisation requires WM for pitches. There is an a priori reason to suppose this if improvisation involves *prior* auditory imagery of musical phrases, since this would include a pitch sequence maintained and possibly manipulated in conscious awareness. A number of authors also reach the conclusion that WM is involved in musical imagery (Aleman & Van't Wout, 2004; Bailes, Bishop, Stevens, & Dean, 2012; Herholz, Lappe, Knief, & Pantev, 2008; Keller, 2012; Schulze et al., 2011). Of particular importance here is the use of 'online' musical imagery, that is to say, anticipatory imagery during performance as this would constitute auditory imagery during improvisation. Although not directly related to improvisation, Bishop, Bailes, and Dean (2013) conducted a study to investigate the use of imagery during the performance of composed melodies, with a focus on imagery for dynamics and articulation. Participants learned two short melodies from scores on a MIDI enabled piano and then gave expressive performances, one of which they chose as a baseline performance.

They then were presented with dynamic and articulation marks on scores, which were revealed as they played via a monitor. The task required them to answer 'yes' or 'no' as to whether the marks coincided with their intentions in three conditions: as they played normally (audio-motor), as they played with audio feedback muted (motor only) and as they imagined the melodies in response to the score. An important aspect of the design of this study was that participants gave their verbal reports as they were playing, their reaction times could be taken, and their responses compared with their baseline performance (they were instructed to keep the expressive features the same across performances). Finally, participants completed the verbal task in a listening only condition. As the authors point out, a frequent and valid criticism of imagery studies is that no independent behavioural data is taken to verify that participants actually use imagery to do the task (Hubbard, 2010). In this case, an alternative strategy to do the task would be the use of declarative knowledge relating to the kinds of dynamics and articulation associated with musical structures, rather than imagery. However, the results did not show the faster response times which would be expected using declarative knowledge, which would allow participants to skip ahead rather than represent the unfolding time course of imagery. Given that the verbal report protocol promoted conscious intention rather than implicit or automatic processes, imagery is conscious and preserves the temporal properties of the music, slower response times imply the use of imagery. Bishop et al. (2013) conclude that the use of online imagery during performance facilitates articulation and expressivity, and that strength of imagery improves with musical expertise. Interestingly, although no correlation was found with working memory capacity in this study, the involvement of working memory was a premise. Keller (2012) states: "Thus, anticipatory imagery facilitates the planning and execution of musical actions. This type of imagery is a top–down controlled process to the extent that the performance goal—a representation of the ideal sound—is kept active in working memory", (p 209). There are a number of issues of relevance in this and the other studies mentioned in this section. Despite Johnson-Laird's (2002) characterisation of improvisation as not requiring working memory for intermediate results, perhaps a different kind of working memory is involved in online musical imagery (Schulze et al., 2011). The auditory component of such imagery could be characterised as a top-down, deliberate conscious process interfacing with lower-level audio-motor associations (Keller, 2012). Rather than thinking of this in terms of the computational metaphor such that this use of WM is to store intermediate results in an algorithmic procedure, WM is part of the process which enables the image to be part of conscious awareness. So, for this kind of deliberate use of musical imagery in the auditory modality, which is the appropriate musical unit to consider as a likely candidate for the contents of auditory imagery, and what is its temporal span?

2.9.5 The Temporal Dimension of Improvisation

> For the moment it's the jazz that's playing; there's no melody, only notes, a host of little jolts. They know no rest, an unchanging order gives birth to them and destroys them, without ever giving them time to recover, to exist for themselves. (Sartre, 1965, p. 37)

Imagining in the auditory modality is something that, by definition, a musician is consciously aware of. Conscious awareness itself involves the integration of different modalities of perception and cognition within a temporal framework. This poses a problem: how does the brain give us an intelligible conscious experience through time when the different sensory modalities have different latencies in terms of processing? The answer seems to be that we generate a 'subjective now' which is a time-frame of approximately 3 seconds, within which events are bound together in conscious experience (Bao et al., 2015). This is particularly relevant to sensorimotor integration and hence to musical improvisation. In fact there is evidence that jazz solos are constructed from the concatenation of 'mid-level units' (MLUs) of approximately 2-3 seconds (Frieler, Schütz, & Pfleiderer, 2016). Therefore, the MLU is a good candidate for the correct level of description of the contents of auditory imagery. The MLU lies between the individual note and larger structural units such as a chorus. The average duration of MLUs in the corpus analysed by Frieler et al. was 2.3 seconds, which is in good agreement with the duration of the subjective present, and roughly corresponds with the musical phrase level (Frieler et al., 2016). This means that the musical unit hypothesised to be the building block of jazz solos lies within the temporal span of the subjective present, and hence the phenomenal contents of auditory imagery is likely to correspond to the MLU. This is also of a suitable size to be held in working memory as a target for musical output, which is compatible with the findings of studies indicating the involvement of brain areas associated with working memory in auditory imagery (Zatorre & Samson, 1991). In a recent analysis of the solos by John Coltrane on his composition *Giant Steps,* Lehmann and Goldhahn (2016) also found units of approximately 3 seconds, which they termed ‘motor-output units’, or ‘playing bursts’. These authors also make the link with the duration of the subjective present.

2.9.6 Blocking Paradigms

These considerations suggest that one way to investigate the extent of auditory imagery in improvisation is via a blocking paradigm which seeks to prevent or impede the use of tonal working memory during the task of improvising. In this kind of design, the assumption is that if a concurrent or flanker task which occupies particular cognitive resources impacts on the main experimental task performance, then the latter also uses these resources. Here, a flanker task which uses the tonal loop, for example remembering a short melody, could fulfil this role. As a control, a flanker task which uses the cognitive resources of the phonological loop could be used. The musical output for both conditions could then be analysed in terms of entropy and pitch class distribution (Goldman, 2013) and compared with improvisations produced in a no flanker task condition (normal improvisation). Some recent studies have used concurrent tasks such as counting shoulder taps (Fidlon, 2011; Norgaard et al., 2016) and the results suggest that for expert improvisers, the extra cognitive load and divided attention in dual-task paradigms do not significantly impact on either task performance, although Norgaard’s results show greater pattern use in the dual task condition. However, if prospective auditory imagery requires the tonal loop, then a testable hypothesis is that improvisation would be impacted more significantly by a dual-task which involves the tonal loop than by a comparable one that does not. However, given more recent evidence in favour of the role of articulatory rehearsal in the retention of melodies (Nees et al., 2017), more research is needed before undertaking such a study.

2.9.7 AAF and EEG

A second experimental design is suggested by the literature on altered auditory feedback (AAF), this time in order to investigate the accuracy of auditory imagery. If an improviser has an accurate auditory image of their musical output, then experimental manipulation of the output which is fed back to them should elicit a feedback related negativity (FRN) (Lutz et al., 2013; Maidhof et al., 2010). By contrast, if their auditory image is not always accurate, for example during very complex improvisation, then they might fail to detect a mismatch between the altered feedback and the normal perceptual consequences of their actions. In this case the FRN would be absent. Participants could improvise monophonically whilst some random pitch manipulations are carried out on the auditory feedback, and EEG data taken. Although this might be a promising direction for future research, given the noisy nature of EEG data and its corresponding need to be carried out multiple times on the same task, much more work is needed to develop this paradigm for improvisation (although see Mouraux & Iannetti, 2008 for some techniques for single-trial ERPs). An alternative approach with AAF which tests the validity of the Ideal Model of improvisation is described in Chapter 4.

2.9.8 The Need for Further Research on Auditory imagery

Despite the difficulty of studying auditory imagery in improvisation experimentally, two experimental methods have been proposed in outline to begin to address questions arising from the gaps identified in the literature. As auditory imagery is a form of mental imagery, open to introspection by the participant but difficult to access for the experimenter, could it be argued that as long as improvisers know that they audiate, their self-report renders such research superfluous? In this section I argue that improvisers perceive the use of prospective auditory imagery as a moral imperative which validates the authenticity of improvisation, but that the nature of imagery is complex and our introspection is not necessarily clear or reliable. Hence a better understanding of auditory imagery will allow for a re-examination of its role in the process of improvisation with a potentially positive impact on self-efficacy.

2.9.9 The Normative Aspect of Auditory imagery

One issue that recurs throughout the literature on improvisation is that the role of auditory imagery has a normative aspect, even to the extent that accurate auditory imagery is regarded as necessary for improvisation to be valid: "Playing with a friend helped one student who was also a teaching assistant realize the importance of playing only what one was honestly hearing… We need to tell students that *if you don't hear a thing, you're cheating!!"* (Nettl, 2009, p. 177). Berliner (1994, p. 248) reports New Orleans musicians' advice: "if you can't sing it, you can't play it", interpreting this as "exhorting soloists to perform melodies that they can conceptualize clearly in their singing minds.” The jazz pianist Chick Corea has reputedly said: "Only play what you hear. If you don't hear anything, don't play anything" (Rutherford, 2014, p. 15), which is reminiscent of Miles Davis’s injunction: “Play what you hear, not what you know” (reported in Berliner, 1994, p. 263). The injunction to play only what one honestly hears is identified by Day (2000) as arising from a kind of moral perfectionism, which he characterises as a commitment to speaking and acting authentically, as true to oneself, coupled with a dissatisfaction with one’s current state of development. A related injunction entailed by moral perfectionism in the context of the jazz solo is the rejection of the formulaic in favour of the new. As mentioned in the first section, musicians do in fact value improvisations that evince novelty (Macdonald & Wilson, 2005), and there is evidence of a correlation between success on divergent thinking tasks, which involve the suppression of habitual associations in favour of novel ones, and improvisational expertise (Berkowitz, 2010). The tension between these injunctions consists on the one hand in improvisers’ ability to produce formulaic material via a motoric generative strategy without auditory imagery (Hargreaves, 2012; Kratus, 1995), whilst on the other auditory-motor coupling is weaker for novel and hence unfamiliar material. Therefore, it might be difficult to play something new and know how it will sound in advance. Nothing prevents prospective auditory imagery strategies from producing formulaic material of course, and one solution would be an abstract schema-level mapping which could predict the perceptual consequences of novel movements. However, it is not clear that the evidence supports this.

2.9.10 Jazz Improvisation as a Social Practice

It could be argued that jazz improvisation, considered as a social practice with attendant norms, is best considered within the framework of virtue ethics (Banks, 2012), an excellent modern explication of which is given by MacIntyre (1981). Indeed, although Day’s context draws on Kant’s moral and aesthetic theories, he also mentions ‘practical wisdom’ (Day, 2000, p. 100), which, along with virtue and *Eudaimonia,* is a central concept in virtue ethics. From this standpoint, the ability to audiate is seen as a standard of excellence toward which to strive in the social practice of improvisation. There is a resonance between Day’s notion of moral perfectionism and MacIntyre’s conception of a social practice: “A practice involves standards of excellence and obedience to rules as well as the achievement of goods. To enter into a practice is to accept the authority of those standards and the inadequacy of my own performance as judged by them" (MacIntyre, 1981, p. 190). Prospective auditory imagery is a standard of excellence that is necessary (though not sufficient) to validate jazz soloing as authentic.

2.9.11 The Experience of Improvisers

Regardless of the precise theoretical and sociological standpoint taken, given the evidence from the literature cited above and the emphasis given on ear training in jazz educational programmes, there is a prima facie case that auditory imagery is seen as important by jazz students, educators and practitioners. This raises important questions: how is auditory imagery in improvisation experienced by improvisers? How does their experience relate to the normative aspect of auditory imagery promulgated by jazz pedagogy? Given the gaps in the literature on the nature and limits of auditory imagery, what should an experimental programme try to find out that might enhance the teaching and practice of improvisation? To address the first question requires engagement with musicians using a qualitative methodology to generate rich data reflecting the complexity and nuance of their experience of improvisation. Some qualitative studies have asked improvisers about various aspects of their experience (Macdonald & Wilson, 2005; Norgaard, 2011, 2016) but although some have addressed idea generation, none have specifically asked musicians about their experience of auditory imagery during the improvisation process. Nor have any studies specifically addressed whether musicians' concepts and experience of auditory imagery is compatible with the experimental findings on improvisation to date, or with the normative portrayal of auditory imagery by jazz educators. Study 1 investigates musicians' experience of improvising using semi-structured interviews with a focus on the role of auditory imagery in idea generation.

2.9.12 The Possibility of a Mismatch

The ideal model of improvisation offered in the literature is one in which musical ideas are pre-audiated, that is, the process of idea generation involves conceiving a sequence of novel musical phrases in the aural imagination. These are converted into musical output by automatic motor processes modulated by feedforward models and feedback. In order to be confident they were living up to this ideal, an improviser would need to know that: their aural images were of high enough fidelity to specify a unique musical phrase, they occur prior to the motor behaviour and the musical output matches the aural image. Taking these issues in turn, the first point to make is that although we might assume that we have the ability to form imagery which resembles perception, that resemblance can easily break down. Dennett (1993) gives the following example for visual imagery. Imagine a simple square three by three crossword grid. In your mind's eye, starting with the leftmost column, fill in the following words down the columns: GAS, OIL, DRY. Can you read off the horizontal words? If the grid were printed in front of you, the horizontal ones would be difficult not to perceive, whereas this is not the case in imagination. Even a simple 3D object such as a cube, which might seem easy to imagine and inspect in the mind's eye, resists the kind of simple interrogation that would be easy with the perceived object. For example, imagine you are balancing a cube resting on a single vertex on a table in front of you with your finger touching the top vertex vertically above the point of contact with the table. Indicate with the index finger of your other hand the location in space of the other vertices. When faced with this task, many people indicate four corners of a square in a horizontal plane equidistant from the top and bottom vertex (Hinton, 1979). But this is in fact a tetrahedron. What this suggests is that despite the debate between Kosslyn and Pylyshyn on the nature of imagery having largely been settled in favour of the former (Eysenck & Keane, 2015), images may still be structured by semantic elements. This means images might have limitations that are not apparent unless they are probed in a certain way.

Is there evidence that such limitations might obtain for musical imagery? One context in which musicians report the use of auditory imagery is silent score reading. Results from two studies suggest auditory imagery is used by musicians in response to a written score (Brodsky et al., 2003; Brodsky et al., 2008). It is interesting to note that the results also suggest limits to aural imagination, as the authors report that when silently reading a score, only one third of participants could distinguish an embedded familiar melody from a lure. In contrast, when heard externally, the embedded melody was easily identified. This seems especially significant given that participants had been selected on the basis of their high aural abilities, yet the majority could not imagine how a score would sound with the necessary fidelity to reliably complete the experimental task. How confident can an improviser be, in the midst of this complex set of cognitive tasks, that their imagery is accurate? What of the second point, that imagery is prior to production? Keller (2012) posits both top-down prospective imagery using inverse models *and* bottom-up imagery triggered by the motor behaviour, which is concurrent or post-hoc. Fidlon (2011) doubts that improvisation uses prospective imagery, based partly on his interpretation of Johnson-Laird's (2002) prohibition on the use of working memory for the storage of intermediate results, and also on the results of two studies he conducted. The first was the shoulder tap concurrent task experiment mentioned above, which he interprets as supporting evidence for the lack of involvement of working memory. The second study involved interrupting solos and asking musicians to describe what they were to play next. The results showed that the more improvisational expertise a participant had, the less detailed their descriptions of upcoming content was. This is consistent with abstract superordinate goals being expressed as sketch planning, whilst the detail of forthcoming musical events are filled in by automatic unconscious processes (Norgaard, 2014; Pressing, 1988). However tonal working memory might be of a different nature than that prohibited by Johnson-Laird's principle of algorithmic demand. One example he gives of improvising in a way requiring the storage of intermediate results is that of producing solos that are palindromes. Intuitively, this kind of computational demand seems qualitatively different to the kind of demand from the maintenance of imagery, but that might be because of the computational metaphors we use and the fact that the latter seems much easier. Can a musician tell when in the temporal sequence imagery occurs? Since anticipatory imagery is linked with intention and agency, and there are well documented problems with accurate ascription of the temporal sequence of mental events and judgements of agency and causality (Bear & Bloom, 2016; Libet, Gleason, Wright, & Pearl, 1983; Matsuhashi & Hallett, 2008; Wegner & Wheatley, 1999), this seems problematic. On the third point, to be confident that the output matched the auditory image, and notwithstanding the difficulties of interrogating imagery, the improviser would need an accurate memory of the image for comparison, whilst performing all of the other cognitive tasks involved in improvising, which again seems problematic. Finally, it could be argued that an inverse model generates anticipatory imagery but the process is *unconscious.* However, this seems contradictory as surely it is constitutive of *imagery* that it has phenomenal content.

2.9.13 Self Efficacy

Self-efficacy is the task-specific set of beliefs and attitudes that constitute the conviction that one can execute the task successfully (Ritchie & Williamon, 2011). In order to develop self-efficacy, students must experience mastery, which in turn requires that clear goals be attainable. Self-efficacy has also been shown to be a significant factor in jazz improvisation achievement (Ciorba, 2009), as have self-evaluation and aural imitation (May, 2003). The central paradoxes of improvisation are that it is free, yet constrained, flow-state-effortless as if the music plays the musician, yet deliberate, think-ahead, agent-driven. Given the need for clear attainable goals, the need for further research into the role of auditory imagery seems clear also. These concerns in conjunction with the findings of Study1 informed the design of a survey (Study 5), whilst Studies 2, 3 and 4 assess the influence of hand shape familiarity on the accuracy of anticipatory auditory images (forward models) using altered auditory feedback.

Chapter 3: Study 1

Investigating Improvisers' Perspectives Using Video-Stimulated Recall

3.1 Introduction

The perspectives offered by the ethnographic literature and pedagogical materials portray improvisation as a creative process whereby the products of musical imagination are translated into music-producing actions. Many of the interviews with artists in this literature suggest that the involvement of auditory imagery in the generative process is necessary to validate improvisation as a creative act. However, such interviews with artists are not usually conducted with specific reference to an improvisation they have recently undertaken, with the experience of what they did fresh in their minds. This raises questions about the extent to which artists who discuss the process of improvisation in general terms are accessing their own direct experiences and to what extent they are also reflecting social norms, such as the imperative to pre-hear their output. Study 1 therefore asked participants to comment on video recordings of their improvisations immediately after being recorded. Semi-structured interviews were used to investigate how improvisation was perceived by participants with a focus on the following specific research questions: what strategies (if any) are improvisers aware of using when they improvise? To what extent did they think they used prospective auditory imagery? How did they experience the timing of their thought processes relative to what they played? How conscious do they think their processes were? Finally, participants were asked about what motivated them to improvise.

3.2 Background

As discussed in Chapter 1, tonal jazz improvisation can be seen as a complex, hierarchical internally goal-directed set of behaviours, which in experts is likely to involve a degree of automaticity at the level of note choice and motor intentions (Ashley, 2016; Beaty, 2015; Berkowitz, 2010; Pacherie, 2008; Pressing, 1988). If conscious involvement in these processes is limited, this in turn limits what is available to introspection and hence what can be verbalised in a retrospective report. There is therefore a concern that when participants are asked for a verbal report of processes that are inaccessible to verbalization, they could offer a kind of confabulation, in which their account reflects what they deem to be the 'right answer', either in terms of the study (task demand) or norms of the social practice of improvisation. Thus although both Berliner (1994) and Monson (2009) conduct interviews with jazz musicians about their thought processes, they illustrate the responses with musical examples from those artists' extant recordings, which were not usually made near the time of the interviews. There is therefore some doubt about how accurate these accounts are in their portrayal of the actual thought processes involved.

Some studies have used 'thinking out loud' protocols to remove the retrospective aspect to reports, for example having participants verbalise the thought processes involved as they solved arithmetical problems (Pirie, 1996). In this kind of design, participants verbalise their thought process as they carry out a task. Although this strategy addresses the problems of retrospective reports, it introduces a complication in that verbalising whilst carrying out a task can alter the cognitive processes used (Ericsson, 2003). In any case contemporaneous verbal reporting does not suit all tasks and is not suitable for the present study, for example a saxophonist would be unable to verbalise whilst improvising. Even for instruments such as the piano, where verbalising whilst playing is physically possible, given the speed and cognitive demands of improvisation, it would not be possible for verbal reports to track thinking without interference with the task. Some studies have sought to mitigate the retrospective element by eliciting reports immediately after a musical performance (Norgaard, 2011, 2016; Wilson & MacDonald, 2015) and the method of using a video recording to help stimulate participants' memories of their thought processes has an established history (Mackenzie & Kerr, 2012; Pirie, 1996; Rowe, 2009; Wilson & MacDonald, 2015).

Mendonça and Wallace (2004) used this combination of methods to study the thought processes of improvisers. Three professional jazz duos were each video recorded playing and improvising on three jazz standards and one improvised piece. Each participant was then interviewed immediately afterwards as they watched the video playback and commented on their performance. The interviews were also video recorded and then analysed and coded according the principles of retrospective verbal protocol analysis (Ericsson & Simon, 1993), using an analytic framework informed by the literature. Their focus was twofold, coding for instances of creative cognition (including idea generation and evaluation), and for temporal aspects of improvising. Their results showed a consistency in proportions of coding types across groups and, surprisingly, between the tonal and 'free' improvising conditions. The authors report that the improvised pieces were idiomatic in nature and this offers a possible explanation for this latter result. The results did not report much detail in terms of specific thought processes and there was not a focus on auditory imagery in this study, but the authors' interpretation of one instance of idea generation is worthy of note. One participant reported 'hearing melodies' and trying to play them and this is interpreted by the authors as a process of retrieval rather than of composition, however it is not clear why this is necessarily the case. This raises an important issue regarding the role of memory retrieval in improvisation which relates directly to the role of 'formulas' discussed earlier. The implication seems to be that the inner hearing of a musical unit as large as a melody indicates retrieval from long term memory. However, if the participant was using the term 'melodies' to denote the end product of a process of concatenation of smaller mid-level units then perhaps these units (or melodic fragments) could be held and manipulated in working memory. This is compatible with the interpretation that auditory imagery has a role in idea generation as a compositional rather than merely a retrieval process, since those musical materials being recalled could in principle be recombined and manipulated during performance in ways that are responsive to their anticipated sound.

Two other case studies worthy of note each used a single improvising duo and deployed audio-stimulated retrospective recall within minutes of the participants recording their improvisations (Pras, Schober, & Spiro, 2017; Schober & Spiro, 2014). The focus of these investigations was to interrogate the extent to which successful improvisation involves a shared understanding of musical events and their meaning whilst improvising, rather than idea generation or auditory imagery. The findings were that agreement between participants on statements about the improvisations was low. Further, the agreement between statements produced by the performers was not higher than that produced by each performer and an expert listener. These results challenge some assumptions about the privileged access performers might have to shared meaning, notwithstanding the caveats that there was some compromise to ecological validity represented by the performers not having met before, and playing behind a screen so they could not see each other. These were single case studies, which indicates that caution is needed to interpret these results, but they do suggest that there is a potential discrepancy between participants' verbal reports and the processes they use to improvise successfully. This is because the improvisations worked despite a lack of shared narrative about what was happening, which could indicate that the kind of declarative knowledge on which such narratives are based is epiphenomenal. Rather, perhaps forms of implicit or procedural knowledge are more important in successful improvisation.

Two more studies (Norgaard, 2011, 2016) have also sought to investigate the thought processes involved in improvisation using stimulated recall immediately after participants improvised. In these studies, individuals improvised to a backing track, which sacrifices the ecological validity of having the interactive element of duos in return for focusing in much more detail on the thought processes of individuals. Instead of video recordings, audio recordings and notation were used to aid recall. In the first study, elite-level jazz artists listened to recordings of their solos whilst they viewed an approximate transcription and were asked to offer a commentary on the solo during semi-structured interviews. A thematic analysis was carried out yielding six main themes: *evaluative monitoring* and *sketch planning* were general processes, whilst *melodic priority, harmonic priority, idea bank* and *re-use of ideas* were generative processes. The second study replicated this design but with developing jazz musicians aged 12-17 years and used an a priori coding scheme based on the results of the first study. Considering both studies, the results showed that all the participants used these generative strategies and engaged in evaluative monitoring but the degree of planning ahead varied with expertise. Experts planned their improvisations to a greater extent than novices, which is in line with other research (Fidlon, 2011). The generative categories also show some overlap with those derived from the literature by Hargreaves (2012) but whereas the latter specifically mentions audiation (in the sense of auditory imagery) as a possible source of ideas, this is not a focus of Norgaard's studies. It is possible that having participants study the transcription of their solo in standard notation as they listened and commented biased them toward a more music-theoretic 'product' view, rather than thinking of phenomenological aspects of process (Goldman, 2015). Study 1 therefore sought to address these issues by replicating some of the features of Norgaard's studies whilst opting for video rather than audio-stimulated recall, without notation and also by adopting a specific focus on auditory imagery.

3.3 Aims

The aims of the study were to obtain accounts of musicians' experience of idea generation in improvisation, with particular reference to the role of auditory imagery, consciousness, strategy use and the perceived timing of mental events. Participants were also invited to talk about why they improvise and what they value in the practice.

3.4 Research Design

As the research questions were informed by the literature prior to coding and influenced the design of the semi-structured interview, a deductive 'top-down' approach was taken to identifying themes in the data. Thematic Analysis was selected as a suitable method because its epistemological and ontological commitments are compatible with this mixed-methods research programme, which is situated within a Critical Realist stance (Sims-Schouten, Riley, & Willig, 2007). Other qualitative methodologies such as Grounded Theory, Interpretive Phenomenological Analysis and Discourse Analysis were rejected, since emergent themes are more compatible with an inductive rather than deductive analysis, whilst the meaning of experience for the participants, although important, was not the primary research focus and nor was the role of language (Braun & Clarke, 2006).

3.5 Method

3.5.1 Participants

An opportunity sample of six musicians who self-identified as improvisers participated in the study. They were selected on the criteria of being expert improvisers and being available to do recordings and interviews at the Royal Northern College of Music, UK. Three participants were students at the college, a snowball sample comprising a male guitarist aged 21, a male pianist aged 26, and a female saxophonist, aged 19. The other three were musicians who were active in the Greater Manchester jazz community as well as having played nationally and internationally. Table 3.1 below gives the list of participants. The interpretation of 'Years of Study' included individual instrumental lessons as well as formal courses.

Table 3.1

List of participants with demographic information

Participant ID	Age	Gender	Main Instrument	Years of Playing Main Instrument	Years of Study in Music
1	21	M	Guitar	17	5
2	26	M	Piano	20	20
3	32	M	Guitar	22	13
4	49	M	Trombone	38	38
5	27	M	Saxophone	20	16
6	19	F	Saxophone	5	10

M age = 29, SD = 10.83, M Years of Playing = 20.33, SD = 10.60, M Years of Study = 17, SD = 11.49

3.5.2 Setting

Five of the video recording and interview sessions were carried out in Studios within the Royal Northern College of Music. These rooms were sound proofed and had stereo playback facilities, so the backing track could be played to participants at a suitable volume. The other interview took place at the participant's home.

3.5.3 Procedure

Ethical approval was obtained from the ethics committee of the Royal Northern College of Music. Each participant was given an information sheet (Appendix 1), briefed about the procedure and informed about the track they would be playing along to, and then filled out a short biographical information form (Appendix 2). All participants played with a backing version of John Coltrane's "Blue Train", which is a medium jazz blues swing in E flat (from the Hal Leonard *Jazz Play Along* series, volume 13). Participants were given the opportunity to see the music chart and warm up before the recording but did not rehearse this specific tune. They were then video recorded whilst playing along to the track, which began and ended with the melody played on saxophone and had six choruses with piano, bass and drums as backing to participants' improvised solos (total track duration 4:01 minutes). Due to a technical difficulty with the recording, Participant 4 did a second take.

In the next phase of the session, as close to immediately after the recording as practicable, participants were interviewed whilst watching the video playback of their improvisations. Both the improvisations and the subsequent interviews were video recorded on a Zoom Q8 video recorder and a back-up audio recording of the interview phase was made using Voice Recorder software on an iPhone 4s. The video playback was viewed on a Toshiba Satellite laptop; participants having been invited to control the playback, pausing, rewinding or skipping as they saw fit, during the interview. Each participant was invited to give a commentary on their solo, analogous to a director's commentary on a DVD (Norgaard, 2011), focusing on their thought processes, where ideas came from and the timing of decisions they made about what to play. The same set of prompt questions was used for the interviews (Appendix 3), but interviews were semi-structured, in that questions for clarification could be asked if necessary, and interesting responses developed further in dialogue (Rubin & Rubin, 2011). Participants were aware of the research focus of the study on auditory imagery and although this was not emphasised in the briefing, it was the theme of one of the prompt questions: "How much of what you played do you think you heard in your head?"

3.5.4 Data Collection and Analysis

Interviews were transcribed into the Nvivo 10 qualitative analysis software package and within this kind of qualitative design, data analysis begins at the data collection stage (Braun & Clarke, 2006; Creswell & Creswell, 2017). The level of detail in the transcription included duplicate syllables and words, dysfluency markers, and indications of laughter and other non-verbal gestures, but not precise timings of pauses or notation to precisely indicate simultaneity of speaking, as for example in a Jefferson transcription. This level was chosen in order to strike a balance between detail and readability, given that the relevance of such dysfluencies and non-verbal data could not be ruled out prior to data analysis. Each interview was transcribed before the next was carried out and these were then read and re-read for familiarization with the data. After all the transcriptions of the interviews were complete, the phase of generating initial codes was carried out, leading on to the phases of gathering codes into provisional themes, comparing codes with codes and reviewing these with reference to the source material at those codes. Subsequently, overarching themes were identified and the relationships between them used to develop the structure of a thematic map (Creswell & Creswell, 2017). The Nvivo CAQDAS programme facilitated easy access to all the quotations under a given code across the interviews and provided ways to visualise and organise the code structure. The programme associates sections of text in the transcribed interviews with 'nodes', which can be given a label and arranged in a hierarchical structure. Nvivo also allows easy recording of the thought processes that led to decisions to change codes and coding structure by via the creation of memos linked to nodes, thereby aiding reflexivity.

3.6 Results

The process of thematic analysis yielded five main themes: Generative Processes, Romantic Ideals, Moral Perfectionism, Evaluation and Comfort Zone. These themes were further related to the categories Cognitive, Affective and Motivation. Another important attribute was Consciousness, which tracked participants' judgements and experiences in terms of how conscious they were of what they were doing while they improvised. As this was an attribute applying in different degrees to all other processes, it was treated as a potential property of all themes rather than a theme in itself. Table 3.2 gives a list of the main themes and subthemes, Figure 3.1 gives a pictorial representation of the data in the form of a thematic map. Subthemes are colour-coded purple, with necessarily conscious processes in green. Overarching categories that organise the main themes are shown as octagons, whilst main themes are ellipses. Single relation arrows signify that main themes are associated with categories (or subthemes with themes) and bidirectional relationships are shown as double arrows.

Table 3.2

Table of Main Themes and Subthemes

Main Themes	Subthemes	Category
Generative Processes	Music Theoretic, Idea Bank, Interface with Instrument, Rhythmic, Auditory Imagery, Planning.	Cognitive
Evaluation	Over-playing, Positive, Gap Between Intent and Execution.	Cognitive/Affective
Arousal & Valence	Comfort Zone, Enjoyment, Confidence.	Affective
Moral Perfectionism	Improvisation as a Social Practice, You've Got to Train Your Improvisation.	Motivation
Romantic Ideals	Creativity, In the Moment, Freedom.	Motivation

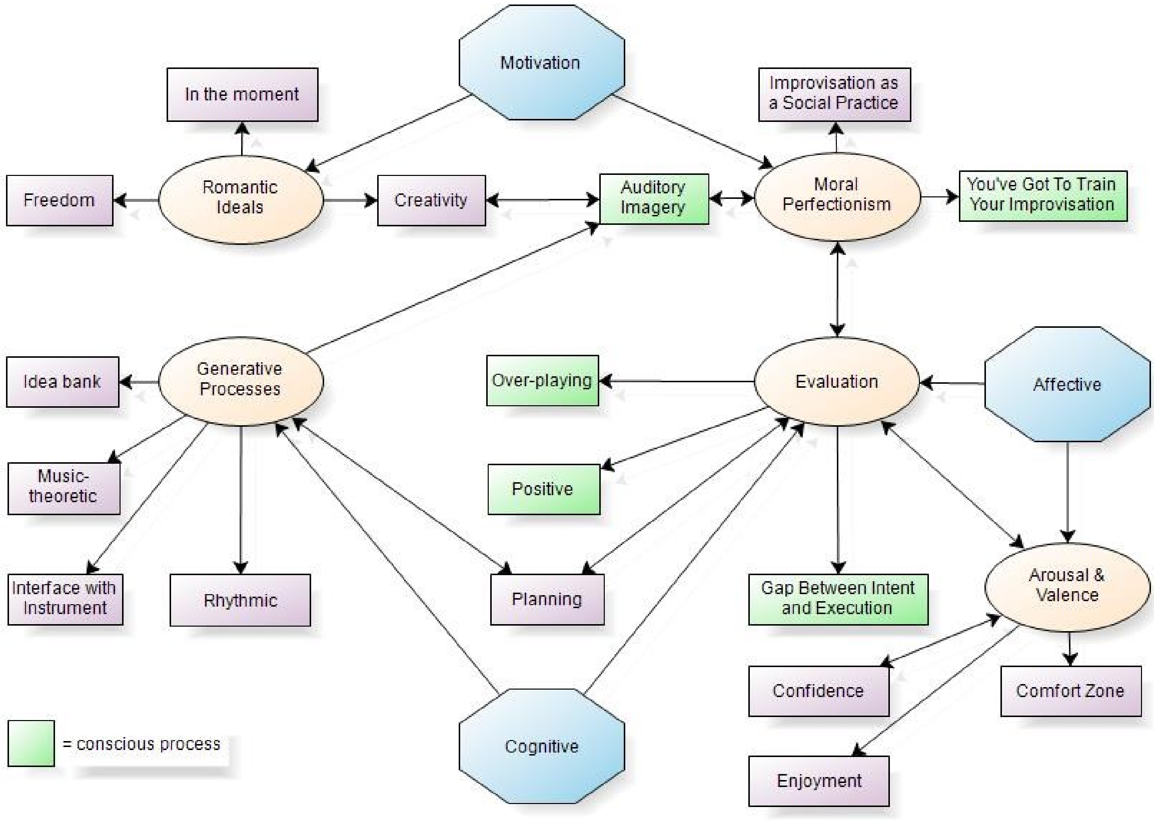


Figure 3.1. Thematic Map of the coded interview data. The five main themes are shown as ovals, with their subthemes connected to them by arrows. Subordinate relationships are shown as single arrows and bidirectional interactions by double arrows. The octagons represent higher order organising principles. Subthemes which imply a necessarily conscious process appear in green.

3.4.1 Main Theme: Generative Processes

This theme was the most represented in the data with 288 references across all six participants. There is some researcher judgement involved in deciding what counts as a single reference given that the boundary between a single utterance and multiple sequential utterances for a given code is blurred. Although the number of references is indicative of the prevalence of this theme across the data, this is not a counting exercise and the significance of a theme in relation to the research question cannot be judged by measures of relative frequency. The high number of references also reflects this theme's breadth and the correspondingly high number of subthemes.

The subtheme Music Theoretic had 57 references by five of the participants. This subtheme includes instances where participants described musical phrases in their improvised solos in terms of particular scales, named intervals, fitting phrases to named chords or harmonic structures, and anything else the researcher considered as within the domain of music theory. The 21-year-old guitarist, for example, described how he was using one particular scale in preference to another "Yeah, Bb Whole Tone...I think on the...in place of the Lydian Dominant." The pianist described a part of a phrase as "I think, sort of a resolve on to the Ab almost to get that sort of dissonance initially of the 6th and the sharp 9". This subtheme resembles idea generation strategies identified in the literature, but with important differences. Hargreaves (2012) identified three categories of idea generation, Strategy-generated, Audiation-generated and Motor-generated. Music Theoretic bears a relation to the first category, which includes the use of music-theoretic strategies. The important feature of this category in Hargreaves' theoretical framework is that strategies are conscious methods that allow improvisers to solve musical problems. Other strategy types include rhythmic displacement (included here in the subtheme Rhythmic) and chromaticism. It is important to recognise that participants describing what they did in music-theoretic terms in a retrospective protocol does not necessarily imply that they were consciously deploying such declarative knowledge during the improvisation. Consciousness was one focus of the interviews (see Appendix 3) and the corresponding node in Nvivo contained 126 references across all 6 participants in the present study. For example, this quotation from the pianist illustrates the point: "Well I think I articulated it quite well, it's only in retrospect... it wasn't that I was coming up to it and thinking 'right I'm gonna play the minor 7', I was just playing". Often, participants were not sure how much of their thought processes were conscious, so the current theoretical framework differs from that offered by Hargreaves, in that music-theoretic descriptions are taken to indicate one way in which participants make sense of what they did in the context of their musical practice habits. These were retrospective accounts informed by their knowledge of music theory, rather than reports of necessarily conscious explicit theory-driven strategies.

Norgaard (2011) codes instances involving music-theoretic descriptions as 'Idea Bank', on the basis that some stored ideas are abstract patterns that need to be fitted into current improvisations by changing some parameters (Pressing, 1988; Schmidt, 2003). The current study also includes a subtheme of Generative Strategies called Idea Bank, coding for precomposed materials and this itself has separate subthemes for processes involving abstract structures. For example, the following quotation from the male saxophonist was coded as ‘algorithmic’ (a subtheme of Idea Bank), even though it was described partly in music-theoretic terms: “So it's starting on concert Bb, going up Bb, Eb, Ab and then moving that up in minor thirds.” All participants reported using preformed musical materials, some of which were developed from their own ideas and worked on in the practice room, others being derived from the work of other artists, with varying degrees of adaptation. The above example of selecting a start note, playing the note a perfect fourth above, then a perfect fourth above that and then shifting the whole pattern in ascending minor thirds, is clearly expressible as an algorithm. The saxophonist said that he took the idea from John Coltrane, and so this was also coded as an influence of a specific artist.

Another important subtheme was Interface with Instrument (34 references, 5 participants, which expresses not only the idea that a given instrument places constraints on what is improvisable, but also that particular instruments offer affordances that a musician can use as generative strategies during improvisation (Bailey, 1993; Baily & Driver, 1992; Goldman, 2013; Windsor & De Bézenac, 2012). “I think there's that thing of the fight with the mechanics is... provides some of the interest of the instrument” (Male Trombonist, 49). This subtheme clearly bears a relation to Hargreaves’ (2012) Motor-generated category, but gives emphasis to the role of the instrument interface in idea generation without assuming the primacy of motor processes:

> I think there's as you say there's like the technical boundary of you've got to end it in this position here in terms of frets or like keys on the piano or... I dunno fingerings on the saxophone or something (Male Guitarist, 21).

The present study has a focus on the role of auditory imagery and the node ‘Imagery’ contained 43 references and included all six participants. 37 of the references were specific to the auditory modality, with the remainder being visual, multimodal or unspecific. The subtheme Auditory Imagery is colour-coded green in Figure 3.1 to denote that this is necessarily a conscious component of the improvising process, however some participants were unsure of the timing of the imagery relative to what they played, for example the twenty-one-year-old guitarist remarked that “I dunno whether it was… hearing the idea first and then it coming out, or the the idea being there, hearing it." In contrast, the male saxophonist said "so I think of them as instantaneous things," and the thirty-two-year-old guitarist stated "Yeah, no I think, er er yeah certainly today I think that the delay's an example of there being a delay between the thought and the action". Auditory Imagery is shown as connected in bidirectional relationships with the main theme 'Moral Perfectionism' and the subtheme Creativity (Figure 3.1). These relationships will be discussed below, under the relevant theme and subtheme headings.

The subtheme Rhythmic (21 references, 5 participants) relates to generative strategies where the rhythmic aspect was a primary feature of how the musical material was generated. There is some overlap with the preceding subtheme Auditory Imagery, as this quotation from the pianist (male, 26 years old) illustrates: "I think it will come through practice because I'm getting better at it... singing the actual notes themselves, but yeah rhythmically, I think I'm able to translate exactly what I'm hearing to the piano." The notion of translation was alluded to by four of the participants and will be discussed further under the main theme 'Moral Perfectionism'. Another example of a rhythmic generative strategy was given by the male saxophonist:

> Yeah, so that that, yeah obviously there wasn't much of a a melodic component to to that little four-bar stretch or whatever it was, but then y'know, carries on into a a phrase but erm I think that that's comin' off the back of erm yeah, well yeah it's just playing around with rhythm.

'Planning' (22 references, all 6 participants), is a subtheme referring to the process of attending to aspects of solo development and architecture. This theme is closely related to Norgaard's (2011, 2016) theme '*sketch planning*' which he derived from interviews with elite and emerging jazz artists. He hypothesises, in keeping with Pressing's (1988) model, that automaticity in processes lower in the hierarchy free cognitive resources for such super-ordinal tasks as attending to the overall shape of the solo. This subtheme has bidirectional relationships with Generative Processes and with Evaluation (Figure 3.1) because evaluation can relate to how well the solo is meeting the objectives of the current plan, which in turn might be updated as a result of the evaluation. Such updating might also influence the choice of generative strategies and vice versa. The following quotation from the trombonist (Male, 49) is illustrative:

> …but it's planned kind of through experience of, er you know, wanting to put something across that has some kind of impact and that's how to do it if you want to kinda carry a solo over a few choruses, you... you build it er and then 'n try and give it some kind of finish that people will... y'know can can applaud er and enjoy, so it's like, an audience satisfaction kind of approach to it.

In keeping with Norgaard's (2011,2016) findings, the two most experienced improvisers (the trombonist and the male saxophonist) indicated that they had planned the solo, while the less experienced improvisers indicated that they did not plan their solo. Participants were not sure how explicit or conscious this process was. The trombonist's quotation above suggests solos are "… planned kind of through experience", which could be interpreted as indicating procedural knowledge rather than conscious deliberation:

> Yes. Yeah, I'd say... that again maybe isn't so much of a conscious thing but again, like you were saying about structuring and and developing through a solo, y'know, at the start playing longer notes, phrases that are are more in, y'know you have to you have to go on some sort of journey (Saxophonist, Male 27).

The pianist reported forming a sketch plan for the upcoming chorus based on his evaluation of how the previous chorus had gone, despite having stated that he hadn't planned the solo at all:

> That came out there, because I thought, great, this chorus has gone down the pan a little bit... let's stick something in that I know will spice it up [laughs] yeah I think that's that's what happened there and then at the end of this chorus I thought " I've played too much, I'm gonna take it right down... and yeah… lots of space...

A plausible explanation for this is that he interpreted the question about how much he planned his solo to mean how much he had planned in advance of starting, rather than referring to plans formed during the solo.

3.4.2 Main Theme: Evaluation

All the participants reported their evaluations of aspects of their solos (135 references). In many instances they were reporting the evaluations they had made at the time of playing and sometimes also how this affected what they played next, as was discussed above under the subtheme Planning. In other instances what was reported was a retrospective evaluation at the time of watching the playback, sometimes noticing a discrepancy between their memory of what they had intended and their appraisal of what the playback had revealed, as in this quotation from the thirty-two-year-old guitarist:

> …and there were a couple of moments when watching back and I was like oh rhythmically that's not what I thought... like erm playing... it's like oh I can see what you meant but you're slightly... oh it's just slipping out of the pocket?

Evaluation is shown with a bidirectional relationship to planning, as discussed above, and also with bidirectional links to the main themes 'Arousal & Valence' and 'Moral Perfectionism' (Figure 3.1). In the former case, this is because the evaluation of playing can affect emotions and vice versa. The relationship between Evaluation and Moral Perfectionism will be discussed under the latter theme.

The majority of evaluations were coded as 'negative' which had 107 references compared to 14 positive references. It is possible that the experimental situation promoted a disproportionate amount of self-criticism, or perhaps there is a degree of self-selection in the sample, in that more contemplative musicians given to introspection might be more likely to volunteer and such a cohort might be prone to self-criticism. Further research would be needed to determine how representative this level of negativity is. The subtheme Positive contains all positive evaluations, whereas negative evaluations contained the main subthemes 'Gap between Intent and Execution' and 'Over-playing'.

Some of the references in Positive were about accuracy and could be considered opposite to references coded in Gap between Intent and Execution, as in this quotation from the pianist: "I've found that generally it's spot on rhythmically…" The female saxophonist's remark "…something kind of clicked and I was kinda like 'ok, I kind of know what I'm doing now'" reports her positive evaluation as she was playing. Other references were reports of retrospective evaluations upon seeing and hearing the playback: "…there's some interesting bits in there that I think, that was quite interesting what I did there", (Guitarist, Male 32). Participants also talked in terms of liking what they had done and a "good experience".

All the participants contributed to the subtheme Gap between Intent and Execution, which given the complex nature of improvisation is not surprising. The trombonist, who was the most experienced participant, explained the concept of the ‘musical save’ (Berliner, 1994, p. 210):

> …especially if you get higher through the register, you might go to play a note and nah that's not gonna,,, it's gonna come out and er you're gonna end up in trouble, so er and as an experienced performer you you knock out a completely wrong note and you just and you pull that into something you turn that into something so that it sounds like oh obviously that's what I meant!

Sometimes these instances were seen as ‘happy accidents’ leading to novel idea generation: “…there have also been times where something comes out that I didn't intend, that actually by happenstance I s'pose more than anything else, erm actually is quite interesting and can take you down another way” (Saxophonist, Male 27). However, most were negative evaluations describing instances where what was played was different to what was intended. Sometimes participants offered explanations in terms of a deficit in their ability to translate their ideas: “But there are times when something else will come out, y'know erm and er as far as I would view it it's just because I haven't practiced those things enough yet for the link to be properly established…” (Saxophonist, Male 27). This notion of translation, and the striving of participants to get better at it has links to the themes Auditory Imagery and Moral Perfectionism.

Participants described portions of their solos in which they rambled, lacked cohesion or became lost, but the next most common negative evaluation description became the subtheme Over-playing (12 references, 2 participants). This quotation from the pianist exemplifies the kinds of judgements which were coded to this subtheme: “Just kind of, er notes... yeah, I felt, I felt I remember that distinctly 'cos I thought I've just played far too much in the second half of that chorus.” The implication of playing too much meaning that there are “just notes” is subsequently clarified by the same participant: “I'm playing too much and I can't make sense of what I'm playing, and it's almost just sort of watching my fingers do their thing without y'know, it sort of becomes a muscle memory thing at points.” The inability of the participant to make sense of what he was playing exemplifies an opposition between auditory and motor-generated ideas. As Hargreaves (2012) points out, it is possible to execute motor patterns without knowing how they will sound (see also Sudnow, 1978).

3.4.3 Main Theme: Arousal and Valence

Whereas Evaluation has both cognitive and affective components, Arousal and Valence reflects emotional responses and is therefore connected to only one organising principle, Affective (Figure 3.1). It has a bidirectional relationship with Evaluation and three main subthemes, Comfort Zone, Enjoyment and Confidence.

Comfort Zone gathers responses that relate to how comfortable participants were while improvising. These related to the familiarity with the genre (jazz blues), to aspects of the playing situation, such as playing to a backing track or being video recorded, and to how far they pushed themselves in their playing in various ways. An example of the issue of being in a more or less comfortable register is exemplified by the following:

> I think you can definitely tell, in terms of like the... like my relation with the instr[ument] like how I can definitely tell that when I get down to the lower sections where it like, where it's a bit less… comfortable and in terms of actually playing, I tend to end up kind of starting phrases and going low and then, because I'm not comfortable in that part of the instrument as much as I am in the middle, it's kind of like sometimes it just kind of dies off (Saxophonist, Female 19).

Some participants were more comfortable improvising on the jazz blues format than others, the female saxophonist remarked that “it's just a case of getting more used to playing something that's slightly different harmonically to what I'm constantly doing”, whereas the male saxophonist said “and then it's fine afterwards. I mean this is all the first bit's just fairly sort of standard blues stuff, I don't think I'm.... not reinventing any wheels...” The experimental setting and playing to a backing track seemed to allow some participants to be in their comfort zone because they were not being stretched by interaction with other players:

> Whereas this, this is almost...it's quite easy to do, 'cos nothing...nothing's going to challenge me, nothing's going to kick me up the bum and push more, er and try and pull the carpet from under me as well, there's that... (Trombonist, Male 49).

All the participants commented on how playing to a backing track differed from their normal experience of improvisation. These were coded in Nvivo under the node Ecological Validity, which will be discussed in the section on the limitations of the study.

Some participants also commented on how much they enjoyed playing with other people, as in this quotation from the trombonist: “the joy of playing with other people is that they might just suddenly disappear, or... or it might just like push and give more.” The subtheme Enjoyment captures these, and also sources of enjoyment more intrinsic to the music, as in this example from the pianist: “I just really enjoy the sound of sort of jumping around in 4ths.” The thirty-two-year-old guitarist contrasted the subjective enjoyment of his band with the indifference of the few audience members at one gig:

> Like, his friends stayed right at the other end of the room or outside, smoking er and it was great it was really really, like erm really enjoyed what we... what we did and we had a really good time, despite there being no atmosphere and it being, y'know, awful er in terms of attendance.

The pianist also alluded to the distinction between a performer’s and the audience’s enjoyment, albeit in the negative in this case: “I don't know how many people are enjoying this, but probably less than were before"... maybe not but... I'm certainly not enjoying it as much.”

Confidence is a subtheme which relates to participants’ level of confidence during their improvisation. This was affected by issues such as familiarity with the genre, interface with the instrument and evaluation and planning. The following quotations illustrate these issues in turn. “Blueses aren't one of my favourite things to play over, yeah and… just quite often just not as confident on that as I would feel on other things I think” (Saxophonist, Female 19). “Yeah, I think so just because not feeling confident enough to move it on to the second string... and being content to just land... land on the...stay on the first string for that whole phrase I guess” (Guitarist, Male 21). “So, first time I was like 'Alright, I can hear delays, that's where it's goin’, I want some delays, oh I've bottled it! Move on'” (Guitarist, Male 32). These comments from the three subthemes are informative about the relationship of the main theme Arousal and Valence to the main theme Evaluation. The level of confidence affected and was affected by the unfolding plan, and evaluation of how the solo had progressed affected enjoyment and confidence.

3.4.4 Main theme: Moral Perfectionism

Day (2000) describes moral perfectionism as "a thinking whose distinctive features are a commitment to speaking and acting true to oneself, combined with a thoroughgoing dissatisfaction with oneself as one now stands." Day develops this concept in the context of the practice of jazz improvisation in terms of how the improviser's training facilitates their ability to eschew conventional responses and achieve "the sound of surprise", (Day, 2000, p. 100). The present study relates this concept more directly to auditory imagery and situates it within improvisation as a social practice (MacIntyre, 1981). Moral Perfectionism therefore has a close bidirectional relationship with Auditory Imagery and its subthemes are Improvisation as a Social Practice and You've Got to Train Your Improvisation. The role of evaluation is crucial: participants described how they strive to get better at improvising and how this was informed by their judgement of their own playing. Hence the relationship between the main themes Evaluation and Moral Perfectionism is bidirectional, to reflect the iterative process of training, performance and evaluation. The urge to self-improvement is related to motivation and so this organising principle (blue octagon) links to Moral Perfectionism (as well as Romantic Ideals, Figure 3.1).

Jazz improvisation meets the criteria to be counted as a social practice in that it is a complex socially situated activity with internal standards of excellence which are necessary in order to realise goods intrinsic to the activity (MacIntyre, 1981). To achieve these standards not only requires many hours of instrumental practice but also listening to and transcribing the relevant music, playing with others and learning from more experienced practitioners (Berliner, 1994). In this way, improvisers learn the norms and conventions of jazz as well as genre-specific and performance skills. The subtheme Improvisation as a Social Practice (41 references, 6 participants), reflects these facets of participants' contributions:

> And I think it's maybe sort of part of the same thing that there's erm, there's a scene or y'know, a way of playing these days that kind of uses free improvisation and all of that, erm but doesn't discount things like form. and the i... like, there are improvisers who er...so me and […], my brother used to do this... like we'd improvise but then we'd remember what we started with and so we'd maybe like come back to that...
> (Guitarist, Male 32)

Here, the guitarist was contrasting the norms of two sub-genres of jazz improvisation, in ‘free improvisation’ as normally conducted form and structure are avoided, but he indicates that in his experience, attending to structure and returning to themes has become an acceptable aspect of non-idiomatic improvisation more recently. Many participants mentioned the importance of playing with others, but in this example the same participant questions the boundary of the practice of improvisation itself:

> Then you get the erm, then you get the debate of whether or not you're improvising if you're playing by yourself. Which, a few people, Peter Brotzmann included, that I've been reading recently...Yeah. sort of saying, nah! It's not improvising if you're playing by yourself because there's no conversation.

Participants also indicated their knowledge of the canonical version of the tune ‘Blue Trane’ (the backing track), as well as their wider listening in order to gain familiarity with the genre. The following quotations are illustrative: “At the second chorus, at the beginning... I was wondering ‘could I do it’? And I know in the John Coltrane recording there is a harmony”, (Trombonist, Male 49).

> Obviously if I didn't listen to loads of jazz I wouldn't swing, I wouldn't articulate correctly, I wouldn't understand the tone, all that sort of thing, so much of what is integral to whatever I imagine and then comes out of my horn is just purely through listening to loads of stuff. And there are also a lot of moments on gigs where, I'll start to play something... and then it'll trigger in my head, y'know y'know, either a phrase that I've heard, y'know Dexter Gordon play… (Saxophonist, Male 26).

This quotation underscores the importance of enculturation via listening extensively to jazz, whilst also implicitly endorsing the view that improvisation involves prospective imagination, which is informed and educated through listening and absorbing the norms of the genre. The trombonist also mentions the importance of listening, but gives an emphasis to improvisation being a socially situated creative process:

> I have practiced improvising, and I and I do still practice improvising... but er... a lot of the practice that I do is playing with other… other musicians and hearing them and listening to other music, so er to try and get that to influence what I'm doing, to kinda give more repertoire (Trombonist, Male 49).

You've Got to Train Your Improvisation was an 'in vivo' code, which is to say that a participant's own words were used for the title of this theme. Participants related not just the training involved in achieving technical mastery of an instrument, but also training to link this technique with their musical imagination:

> …in the long run it's like one of the things I'm most looking forward to...it's like er I was talking to Jason Rebello when he came and did a masterclass here... it was brilliant...and he was saying that all of his practice is oriented around there being no sort of translation in between thinking of the idea and it happening, and like trusting that your ideas your ideas are appropriate to that musical moment… (Guitarist, Male 21).

This resonates with Day's conception of the role of training being to educate experience so that in the unrehearsed activity of jazz improvisation, that experience is worthy of trust. Four of the six participants spoke explicitly in terms of the improvising process as one of the translation of musical ideas into musical output. Here, the asymptotic ideal is that having the idea becomes one with producing the corresponding output: the intervening translation process having tended to zero. One of the strategies to achieve the link between idea and output mentioned by some participants was singing: "I mean what I'm trying to do, as an exercise, is try and practice singing what I'm hearing as I'm playing" (Pianist, Male 26). This participant was clear about the required priority and ordering of the process, attributing the following piece of 'jazz lore' to the pianist Gerald Clayton: "Don't sing what you play, play what you sing!"

3.4.5 Main theme: Romantic Ideals

The three subthemes Creativity, In the Moment, and Freedom, all relate to participants' transference of Romantic concepts of musical agency to the domain of improvisation (Warren, 2009). Most of the responses coded under this theme were gathered in response to the question on the interview schedule which related to motivation: "What draws you to improvising? Could you say more about why you do it?" The female saxophonist's response to this question mentioned issues of self-expression and identity, "I feel in a lot of ways it's a lot more expressive than written… well I think it very much depends on what it is for me personally like as a saxophone player", as well as freedom "it's quite liberating to be able to improvise and kind of just do what you want in your head rather than having something written down". Her response also links creativity with being in the moment: "…generally it just it feels more interesting to play something that's just in the moment, kind of make it up as you go along!" The pianist's response also links creativity and time: "Yeah I think it's.. it's just 'cos it's such a creative... a creative thing, and I'm a composer as well, and I just think they go hand in hand, 'cos it's almost like real-time composition." This echoes definitions of improvisation found in the literature and further underscores improvisation as a creative process (but see Sarath, 1996 for an explication of the distinction between improvisation and composition). Some participants explicitly made the link between creativity and novelty: "You're kinda creating music, you're making different... you're making the music different every time", (Trombonist, Male, 49). The link between creativity and auditory imagery (Figure 3.1) is clear from the context of the references to translation of ideas throughout the data: the ideal is that musical ideas are created by being heard in the head and translated seamlessly into musical output.

For some participants, being in the moment seemed to have particular significance:

> Well I, er I think it's 'cos I, in terms of erm, what I strive for in improvising, certainly in free improvising is to be expressing myself right now and present in in the moment… reading around and playing lots of free improvised music, it's... that erm, reacting and being present is... is kind of the whole point... I think (Guitarist, Male 33).

Being in the moment was sometimes associated with 'flow states' (Csikszentmihalyi & Lefevre, 1989) and in one case even with what could be called 'transcendental' experiences:

> …it's almost that feeling of y'know, the numinous and greater connection y'know, when you really lose yourself and you're... in the moment, with other people around you and you're creating something y'know you feel like you're plugged into a bigger thing, it's amazing, yeah it's the best feeling (Saxophonist, Male 27).

These subthemes were interconnected in that they all relate to Romantic concepts of the improviser as autonomous creative artist. The final subtheme, Freedom is integral to this: "And, I do kind of find it more rewarding in terms of like the freedom of it, within reasonable restrictions, than say, playing repertoire that's already been written", (Guitarist, Male 21). The idea of freedom within constraints was implicit in many of the responses to earlier questions about improvising strategies. For example, although the improvisations were not always conceptualised as completely novel, in that some fragments had been used before, participants considered themselves free to combine these fragments in novel ways in the moment so that no two improvisations would ever turn out to be identical. Freedom was one element that motivated participants to improvise, although sometimes this was expressed as a negative freedom, that is as a ‘freedom from’ constraints such as having a restricted role in which a score has to be followed:

> I didn't like it, being just being sat there and having to play when I was told and play these notes on the page, erm which was what I was training to do, er and I found it easier to have minimal direction er and just to kind of go off that made that made a lot more sense to me than having a lot of music written down (Trombonist, Male 49).

3.7 Discussion

3.7.1 Summary

Six participants were video-recorded whilst improvising to a backing track, and each gave a commentary on their solo whilst watching the video playback. Semi-structured interviews focused on their use of strategies for improvising, the timing of their decisions, degree of conscious awareness, the use of auditory imagery and finally, their motivation for improvising. A thematic analysis of the transcriptions of the interviews yielded five main themes: Generative Strategies, Evaluation, Affect and Valence, Moral Perfectionism and Romantic Ideals.

3.7.2 Idea Generation Strategies, Timing and Consciousness

These improvisers each used multiple strategies for their improvisations, including recombining and adapting musical material from their ‘idea bank’, music-theoretic-inspired thinking, motoric-influenced thinking, rhythm-focussed strategies and auditory imagery. These results are compatible with previous findings (Berkowitz, 2010; Berliner, 1994; Hargreaves, 2012; Norgaard, 2011, 2016; Pressing, 1988), and also offer further insights into the role of auditory imagery in the context of multiple strategy use. Participants were less sure of the relative timing and degree of consciousness of their decisions as these got closer in time to actual playing. So, planning at the level of the next chorus was mostly reported as totally conscious and experienced in a determinate time window, for example at the end of the preceding chorus. Decisions relating to strategy selection, or upcoming rhythm placement or note choice are lower in the hierarchy of the improvisation process and likely to be more automatic. Some participants judged that they made these decisions immediately prior to enacting them whilst others were unsure if their awareness was prior, simultaneous or post hoc. There was a corresponding lack of consensus on the level of awareness involved in the different strategies. With imagery-based strategy, participants reported being conscious of the image, but with motoric and idea bank strategies, participants often reported not being conscious, or not thinking about it, or acting 'instinctively'. It might be thought that the use of music theory would be a conscious process, involving accessing declarative knowledge about, for example, chord-scale relationships. Although it could be used in this way (Hargreaves, 2012), these participants often reported the music-theoretic aspect retrospectively, without the implication of conscious prior choice of musical material on music-theoretic grounds. This is not to say that chord-scale relationships were epiphenomenal, rather these relationships were converted from explicit declarative knowledge into implicit procedural knowledge via many hours in the practice room (Berliner, 1994).

3.7.3 Auditory Imagery

The responses of participants to the question: 'how much of what you played do you think you heard in your head?' raise the question of the extent to which auditory imagery played a causal role in the improvisations. The least experienced improviser (participant 6) responded by saying "about fifty/sixty percent probably" and went on to say "I think if it was something that I was I'd played loads and knew really well and kind of had… knew it under my fingers really well, then…what I was hearing in my head would come out a lot more…" This is compatible with the results of studies which suggest that the strength of auditory-motor coupling for a given musical pattern increases with practice (Bangert & Altenmüller, 2003; Lahav et al., 2007; Maidhof et al., 2010; Stewart et al., 2013; Zatorre et al., 2007). However, this same participant's motivation for improvisation linked freedom, novelty, creativity and being 'in the moment': "it's quite liberating to be able to improvise and kind of just do what you want in your head… it just it feels more interesting to play something that's just in the moment, kind of make it up as you go along!" Here is an illustration of a tension between two imperatives: novelty and authenticity. The more novel and hence less familiar the prospective musical utterance is, the weaker the auditory-motor coupling which allows it to be the translation of an idea in the moment. Given that the ideal of authenticity in creativity is identified by these participants with hearing an idea and translating it seamlessly, this tension must be resolved in order for their improvisations to be successful in their terms. This is a concern which is central to Day's (2000) concept of moral perfectionism: how do improvisers avoid habitual responses and yet remain creative? The participants in this study were unsure how much they heard in their head of what they played. Even the most experienced improviser amongst the participants (Trombonist, Male 49): "I think I'd probably be modest and say not a great deal, but then I think I'd probably find that yeah there probably was more er more of the sounds in my head." The male saxophonist and the twenty-one-year-old guitarist were the most confident of the six participants that they had mostly used auditory imagery: "I'd say the majority of it, but it's hard to know because they're they're instantaneous, aren't they?" (Saxophonist, Male 27). However, the guitarist was unsure about when the inner hearing was taking place, while the saxophonist regarded it to be simultaneous to playing, such that he knew when his output diverged from his idea. Both stated that some of what they experienced as auditory imagery was not novel, in the sense that it was already in their 'idea bank', suggesting fluency/novelty trade-off. The lack of certainty regarding the temporal ordering of imagery and playing is reinforced by evidence that judgements of temporal ordering and causality are not necessarily accurate (Bear & Bloom, 2016; Wegner, 2004; Wegner & Wheatley, 1999). Taken together, these findings raise further questions about the causal role of imagery and the characterisation offered by these participants, namely of creativity involving the translation of ideas into musical output. This looks very like the Ideal Model (figure 2.1) discussed in Chapter 2 and this interview study has provided further evidence for its endorsement by musicians but also for its limitations as a viable model.

3.8 Conclusion

The interview data offered by these participants give a rich and detailed portrayal of the improvising process which extends the findings in the literature and poses interesting questions of how to reconcile different aspects of their accounts. These improvisers reported using multiple strategies for improvising, they engaged in planning and evaluation, and were clearly motivated by notions of freedom and creativity. Some of them also spoke of their excitement and enjoyment in the process and these were also likely motivating factors. Although the use of auditory imagery was seen as essential to creative improvising, participants were not sure how much imagery they had used, or whether it was prior to playing or contemporaneous with musical behaviour. Some participants expressed a striving to improve in their ability to translate musical ideas from their heads to the instrument, evincing a moral perfectionism within the social practice of improvisation.

3.9 Limitations and Further Research

Given that the participants knew that auditory imagery was a focus of the study and all of them were asked the probe question: "how much of what you played do you think you heard in your head?", it is not surprising that all the participants were coded for this subtheme. This also raises the issue of task-demand, in other words, to what extent were participants giving what they thought were 'right answers' in terms of the research question? A related issue concerns the extent to which participants were self-selecting regarding auditory imagery. However, most of the participants agreed to the interview before they knew the focus of the study, and in terms of task-demand, the responses are in line with the literature (Berliner, 1994; Coker et al., 1970; Gordon, 1989; Kratus, 1991; Norgaard, 2011). Even if an element of conforming to the social norms of improvisation is a factor in participants' expression of the desirability of pre-hearing musical material, this would nonetheless be evidence for the finding that these improvisers recognise that norm and feel some pressure to conform to it.

All the participants in this study mentioned that improvising to a backing track was not the same as improvising with other musicians. Future research could address this issue of ecological validity by studying ensembles. As this researcher conducted the interviews with research questions informing the design, there is a risk of bias. To counter this, a selection of the coding and transcripts were checked by more senior researchers. As the video data of the improvisations were available some triangulation was also possible, in that where participants reported using particular scales or melodic intervals, these were checked against the recording. This is a small sample size (*N* = 6), in keeping with such qualitative studies (Creswell & Creswell, 2017).

This study did not investigate the reasons for participants' endorsement of Romantic notions of creativity. It could be that the image of the jazz musician portrayed in the literature as someone whose creativity depends on prospective auditory imagery acts as a role model. There could also be a kind of implicit Cartesian dualism (Demertzi et al., 2009; Hamilton & Hamilton, 2015; Hofer & Pintrich, 1997; Stanovich, 1989) which predisposed musicians to prioritise conscious imagination over implicit or embodied paradigms. To investigate whether the findings of this study are reflected in a larger population of improvisers, Study 5 (Chapter 6) administers an online survey to improvisers who identify primarily as students, practitioners or educators. Study 5 also examines the possible connection between Dualist thinking and the relative importance to improvisers of prospective auditory imagery.

Chapter 4: Study 2

The Effect of Hand Shape Familiarity on Guitarists' Perceptions of Sonic Congruence: An Altered Auditory Feedback Study

4.1 Introduction

As discussed in Chapter 2, musical performance involves complex coordination between motor control and its intended action-effects (perception-action coupling). It could be argued that the development of the link between motor behaviour and intended sound is part of what constitutes musical skill. Studies also suggest that the strength of auditory-motor coupling is greater for musical materials which have been practiced (D'Ausilio et al., 2010; Lahav et al., 2007). This raises the question of the level of description at which this coupling operates. One possibility is that musicians have trained on their instruments so much that they have developed a veridical mapping from an auditory image of the sound to be produced and an abstract representation of pitch-triggering events on their instrument. For example, a pianist might have the sound of a chord in mind, which maps to a pattern of notes on the keyboard in a way which does not depend on the particular movements or fingers used to play it. In contrast, the correct level of description could be at the level of musical gestures, such that musical training links a given set of movements used to a produce a musical phrase or chord to the corresponding action-effect, namely the sound of the phrase or chord. This view is compatible with some of the theoretical perspectives discussed in Chapter 2, such as motor simulation/emulation theories (Grush, 2004; Jeannerod, 2001), common coding paradigms (Hommel, 2009; Novembre & Keller, 2014) and embodied cognition (Maes, 2016), which emphasize the interaction between movement, cognition and perception. It follows that the findings of this experiment cannot provide evidence for a specific form of ideomotor theory or speak to the question of whether motor simulation theories or embodied paradigms should be favoured. The findings can however bear on the question of whether the Ideal Model (Figure 2.1) of improvisation discussed in Chapter 2 could be instantiated or needs revision in order to take into account the role of the familiarity of the sound-producing gestures that musicians make.

There is some evidence from behavioural studies that in the case of two-tone sequences, hearing a task-irrelevant but incongruous stimulus can induce motor errors (Drost et al., 2005b). Pianists played pairs of tones in response to notation in the presence of auditory task-irrelevant distractor intervals, which could be congruent or incongruent. In subsequent experiments, coloured squares were used as imperative stimuli to control for expertise in music reading, and non-musicians were also tested. Pianists but not non-musicians had slower reaction times in incongruent conditions and experienced induced false responses. Simultaneously hearing an incongruous chord also slowed reaction times (Drost, Rieger, Brass, Gunter, & Prinz, 2005a). These findings are compatible with bidirectional auditory-motor mapping, such that anticipatory auditory images of tones and chords are linked to the movements used to enact them, and vice versa. More recently, several studies have shown a link between movements and their intended effects in a number of domains (Camus et al., 2017; Kilteni, Andersson, Houborg, & Ehrsson, 2018). Crump, Logan, and Kimbrough (2012) conducted an experiment in which guitarists and non-guitarists were asked to name a chord either from its sound or from a photograph of a hand playing the chord on a guitar fingerboard. The non-guitarists received some pre-trial training, so they could recognise the chords. In each trial, the sound was either congruent or incongruent with the visual stimulus. In half of the trials participants had to ignore the visual presentation and name the heard chord, in the other half the situation was reversed. The authors found a significant Stroop effect with the guitarists only and they conclude that guitarists have multimodal representations of chords involving visual, auditory and kinaesthetic modalities. One prediction that could be made on the basis that visual, auditory and kinaesthetic modalities interact is that music composed or improvised using a given instrument will bear some signature of the affordances offered by that instrument. In terms of the guitar, there have been several studies looking at how the layout of the guitar fingerboard and how guitarists' hands move in response to it, affects the music (Dean, 2014; Finkelman, 1997; Scott, 2003). Directly relevant to the current study is that "Guitarists are likely to associate heard chords with particular finger configurations on their instrument" (Baker, 2001, p. 251).

Auditory-motor coupling has been investigated using altered auditory feedback (AAF) paradigms in which the expected auditory result of an action is artificially manipulated in order to probe the nature of action-effect representations (Furuya & Soechting, 2010; Maidhof et al., 2010; Mathias, Gehring, & Palmer, 2017; Pfordresher & Mantell, 2012). Typically, participants play a MIDI keyboard whilst they listen to the electronically generated sound. This technology is relatively easy to use experimentally, and such keyboards are both readily available and of high enough quality so as not to jeopardise ecological validity. The auditory feedback can be manipulated online as the participant plays with very low latency, and the timing and accuracy of their playing is again relatively easy to extract from the MIDI data. As musical performance requires the sequencing of a complex series of actions under time constraints, auditory-motor coupling operates in different ways to facilitate the process. Waiting for feedback and checking for divergence from the intended outcome is too slow to be the sole error correction mechanism in musical performance. In addition to feedback error checking, auditory-motor coupling can facilitate error correction and action planning via feedforward processes. As different parameters of musical performance make different cognitive demands on performers, AAF offers an opportunity to vary the corresponding feedback parameters separately and study the effects. The studies mentioned above have interrogated auditory-motor coupling by disrupting the auditory feedback, separately altering the timing, loudness or pitch of musical notes as participants played. By observing the disruptions to musical performance resulting from these manipulations, the way these separate aspects place demands on action control and are managed by feedback and feedforward processes can be inferred. For example, the way that delayed auditory feedback disrupted the timing of performance in a tapping task was found to depend on the participants' finger trajectory (Pfordresher & Dalla Bella, 2011). In a piano task, loudness alterations disrupted note velocity in an inconsistent way and pitch alterations increased the error rate (incorrect notes) and perturbed the velocity and timing in both hands (Furuya & Soechting, 2010). The effects of altered auditory feedback support the hypothesis that during musical performance, the planning of future actions co-occurs with the perception of auditory feedback. Mathias et al. (2017) altered the pitch of notes so that they resembled either the next, the present or a past note. Only the next note condition disrupted behaviour by causing a slowing following feedback. This was accompanied by a larger evoked auditory N1 potential.

The authors conclude that interference with the forward model due to the feedback resembling the upcoming note explains this effect.

It should be noted that because the studies with instruments used MIDI piano keyboards, which have a one-to-one mapping of keys to pitches with a left-right association with pitch height, this represents a subset of musician-instrument interfaces. Whilst this is not a problem in principle for these experimental designs, it would be desirable to extend the paradigm to other instruments. This experiment extends the AAF paradigm to the guitar and exploits its many-to-one mapping of fingerboard locations to pitches. This allows the investigation of auditory-motor coupling at the level of musical gesture, by varying the hand shape used to play the same chord in two different locations on the guitar. Although it is technically possible to vary the hand shape to play a given chord on the piano, this can result in using the hand in ways that would not usually arise in a playing context (Novembre & Keller, 2011). In contrast, on the guitar it is possible to use a hand shape usually associated with a given chord and a less familiar shape for the same chord which is still ecologically valid. This study investigated whether the familiarity of the hand shape used to play a chord affects participants' judgements of whether the action-effect is congruent or not. There were two main hypotheses:

1. Judgements of sonic congruence would be faster and more accurate on average in the familiar compared to the unfamiliar hand shape conditions.
2. Participants with more improvising experience would perform better on the task than participants with less improvising experience.

The motivation for the second hypothesis was a prediction that the practice of 'playing by ear' which is more common in improvisers would facilitate more accurate forward models in this task due to enhanced audiomotor transformation ability (Bianco et al., 2018; Harris & de Jong, 2015; Harris, van Kranenburg, & de Jong, 2016).

Non-improvising musicians' training involves sight-reading and memorising complex pieces. By contrast, improvisers often train and learn by doing a lot of listening and imitating. These differences of emphasis promote the development of visuo-motor and audio-motor transformation skills respectively. A prediction that follows from this is that these two groups would show different responses to music indicative of the differences in these skills. In more general terms, the different priorities involved in different genres affect training which in turn should lead to differences in skills which are testable. Some recent studies have found evidence in support of this, for example Bianco et al. (2018) collected EEG and behavioural data and found that jazz pianists were more flexible in updating their action plan in response to harmonically incongruent chords in comparison to classical pianists. The classical pianists, however, were more accurate in fixing local parameters of fingering. Przysinda, Zeng, Maves, Arkin, and Loui (2017) found that jazz musicians differed from non-improvising musicians in terms of expectancy, preferring unexpected chord sequences. In a study of pianists with differing amounts of improvising experience, Goldman et al. (2018) collected EEG and behavioural data during an oddball task. Participants responded to different kinds of deviants within chord sequences, some of which corresponded to substitutions used in jazz and others which did not. The amount of estimated improvisation hours predicted the responses to the different types of deviant. Harris and de Jong (2015) conducted an fMRI experiment with a between-groups design. They compared classically trained-score-dependent keyboard performers and classically-trained improvising keyboard performers. The task was either a passive appraisal listening task or a listening task in which participants imagined they were playing along with the music. The authors found greater activations in right-lateralised posterior-superior parietal and dorsal premotor cortices. In contrast, score-dependent musicians recruited left hemisphere motor areas and the posterior part of the right superior temporal sulcus. The implication that the authors draw from this is that improvising musicians have enhanced auditory-motor transformation abilities, whilst score-dependent musicians develop a mapping between aural and symbolic representations. In a follow-up study, Harris et al. (2016) compared participants from the same groups who had participated in the fMRI study in an imitation task. Participants listened to short unfamiliar two-part excerpts and attempted to play them on a digital piano. Improvising musicians were better at replicating the rhythm and pitch of heard music than their score-dependent counterparts. What these studies suggest is that different musical training and genre experience affects how musicians access musical knowledge-structures. This study allows two hypotheses to be tested using altered auditory feedback on the guitar, in a new ecologically valid motoric context not covered by the existing literature.

4.2 Method

4.2.1 Participants

Participants (*N* = 21, 19 males, 2 females; *M* age = 26.52 years, *SD* = 9.00) were all guitarists who played right-handed and were university/conservatory students or professionals in the Manchester and Leeds areas (Table 4.1). Participant 12 was excluded from the analysis because they seemed to have difficulty in doing the task according to instructions and their accuracy was very close to chance level (55.7%).

Table 4.1

Participant Information.						
Participant	Age	Sex	Self-Identification as improviser (1-7)	Imp hours	Total Hours	Handedness
1	20	M	7	2184	4836	-100
2	22	M	6	4862	8970	50
3	33	M	7	4550	4940	100
4	20	M	6	312	4628	100
5	26	M	7	2704	18408	100
6	26	M	5	5980	15340	100
7	21	M	5	1404	4264	87.5
8	19	M	5	1196	4004	100
9	21	M	7	2054	6552	-100
10	22	M	6	4576	8424	-100
11	36	F	5	2808	19968	87.5
13	20	M	7	4420	6448	62.5
14	22	M	5	3328	4368	25
15	20	M	7	5850	11700	37.5
16	18	M	6	689	2444	87.5
17	43	M	6	10608	46540	100
18	39	F	2	1248	24960	100
19	34	M	3	15912	21840	100
20	50	M	7	9984	13702	100
21	23	M	6	2600	4160	100
Mean age = 26.75 years (SD =9.18).						

Recruitment was via college faculty members asking for volunteers, and snowball sampling of Manchester and Leeds musicians. None of the participants were compensated, in accordance with RNCM's ethics policies.

4.2.2 Stimuli and Apparatus

A short form was given to participants to collect demographic information, an estimate of improvising hours and a self-rating as an improviser (Appendix 5) and a short form of the Edinburgh Handedness Inventory (Veale, 2014) was administered (Appendix 6). The imperative visual stimulus in each trial was in the form of a tablature diagram depicting one of 16 possible guitar chords (Figure 4.1).

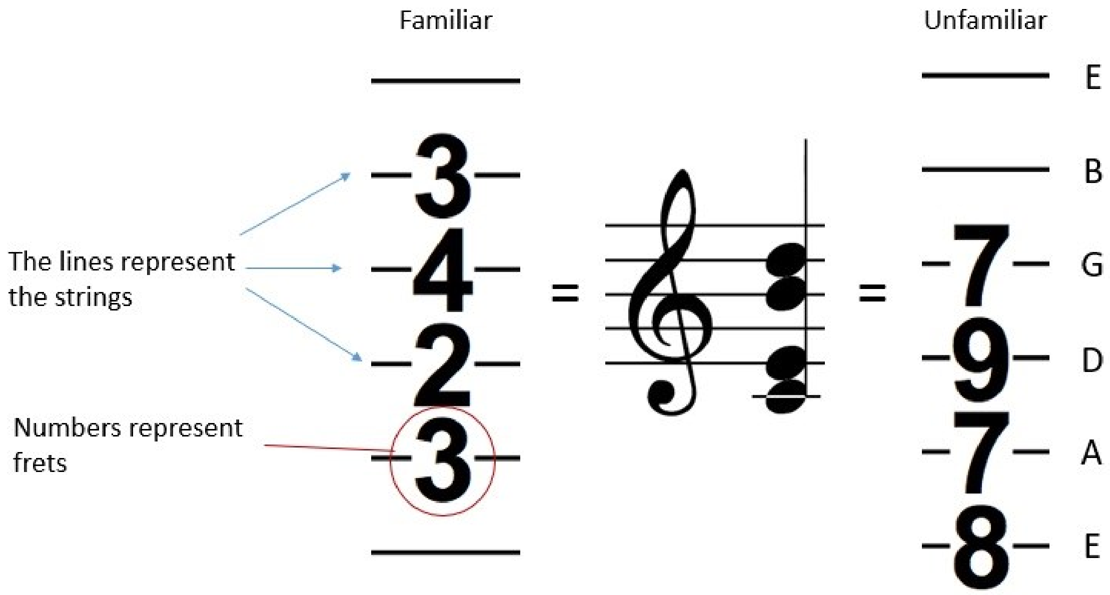


Figure 4.1. Two of the visual stimuli, one familiar, the other unfamiliar, both corresponding to the chord Cmaj 9. Participants see only one stimulus at a time and just the horizontal lines and numbers with no captions or labels.

Tablature diagrams were created with the Encore music software program. These were visually presented on a Toshiba Satellite laptop via custom software created with MAXMSP (version 7.3.1), which also delivered auditory feedback and recorded response data. Participants used Bose QuietComfort 25 noise cancelling headphones, which cancelled the sound from the actual guitar strings such that only the computer-generated sound could be heard. Participants played chords on a guitar fitted with a Fishman Tripleplay MIDI guitar pickup and responded via a Fishman FC-1 foot controller. Because MAXMSP takes some amount of time to render the MIDI sound, a latency test was conducted to ensure the jitter between the MIDI input and the sound rendering was low. To do this, a version of the

MAXMSP software was created which emitted a sound when the congruence choice was made and tested without headphones so that the chord onset was also audible. An audio recording of the experiment running with two trial blocks was then made on a separate laptop. The inter onset intervals between chord and selection noise in the audio recording were then compared with the reaction times recorded by MAXMSP, and confirmed the setup had an acceptable amount of jitter (3.55 ms).

4.2.3 Design

Four conditions comprised two factors with two levels each. The factors were familiarity of guitar chord shape (familiar, unfamiliar) and auditory feedback congruence (congruent, incongruent) (see Procedure section below for details).

4.2.4 Procedure

After giving informed consent and reading an information sheet (Appendix 4), each participant completed the short form including demographic information and estimates of playing and improvising hours and the short form of the Edinburgh Handedness Inventory (Veale, 2014). The participants were seated wearing headphones in front of the laptop screen at a comfortable viewing distance. An experimenter stood behind each participant at an angle to observe their responses and take notes. The experimental phase consisted of four blocks of sixty-four trials each. Tablature diagrams were placed in a different random order for each participant using MATLAB. Each diagram specified one of eight distinct four-note chords in either a familiar or less familiar position on the guitar fingerboard. Due to the layout of notes in standard tuning, chords in less familiar positions required either a less familiar hand shape, or a shape not usually associated with the given chord type, despite producing the same auditory result as the familiar hand shape version of that chord (keeping in mind that the MIDI setup controlled for timbral differences that would otherwise occur on an acoustic guitar).

In each trial participants were presented with a fixation cross lasting 1500ms followed by a tablature diagram, which was displayed for between 1500–2500ms (the precise time was randomly determined on each trial in order to introduce jitter and prevent participants from knowing exactly when they would play the chords). When the diagram disappeared from the laptop screen, participants played the corresponding chord on the same Fender Esprit guitar and heard only the audio generated by the MAXMSP patch through the headphones. Each chord shape had a congruent and incongruent feedback condition so that altered feedback was counterbalanced across familiarity. Thus in half of the trials the auditory feedback was altered by changing the pitch of one of the notes and the stimulus order was randomised differently for each participant. The alterations were always such that the resulting chord was of a type already present in the stimulus set to prevent participants using an oddball strategy to solve the task. Participants then judged whether the feedback was altered or not, responding as quickly and accurately as possible by pressing either a left or right button on the FC-1 foot controller. Whether left or right corresponded to congruency was counterbalanced across participants. Feedback was given onscreen with the words 'correct' or 'incorrect' for responses, 'too slow' if they did not respond within 4 seconds, 'error' if they played the chord incorrectly and 'didn't play' if they did not play the chord within 8 seconds. Reaction times and error rates were collected by the presentation software for analysis. In a subsequent session, approximately two weeks later, participants ranked the familiarity of the stimuli by means of a survey (see Chapter 5 for details).

4.2.5 Data Analysis

Several options were considered for data analysis. Reaction time (RT) data tend not to be normally distributed because the limits for short reaction times operate differently to long ones. This is because there is an inherent latency involved in cognitive processes, such that times of the order of 100ms or lower are likely to be fast guesses or accidents (Whelan, 2008). By contrast, there is no absolute constraint on how slowly participants can react. Hence some very long reaction times can be the result of inattention or confusion or might reflect slower more deliberate cognitive strategies which are not the target of study. The resulting distribution has a long tail on the right and could be modelled as an ex-Gaussian distribution, a convolution of exponential and Gaussian distributions, or a shifted Wald. Although some researchers have attempted to interpret parameters for the different parts of distributions in terms of cognitive processes, these efforts lack a clear theoretical basis and were not attempted here (Matzke & Wagenmakers, 2009).

A number of possible statistical techniques and models can be used for this type of data. The combination of the error and RT data into an inverse efficiency score, given by dividing the mean or median reaction time by the percentage of correct responses in each participant in each condition, was rejected in this case because the overall percentage correct was 79% which falls outside the recommended threshold of 90% accuracy (Bruyer & Brysbaert, 2011). Two other transforms of the data, inverse RT and log RT were considered, but rejected on the basis that data becomes more difficult to interpret after transformation, and no significant advantages were seen. Drift diffusion models are also used (Goldfarb, Leonard, Simen, Caicedo-Núñez, & Holmes, 2014; Wagenmakers, 2009), but were rejected as too complex. Another commonly used approach for RT data with this design is a two-way repeated measures ANOVA. However a linear mixed-effects model (LMM) approach was chosen on the basis of its ability to test random effects (item, subject) within one structure rather than with separate ANOVAs (Matuschek, Kliegl, Vasishth, Baayen, & Bates, 2017).

So, to assess the effect of congruence and familiarity, a linear mixed effects model was constructed to predict reaction times with the fixed effects of congruence (congruent vs. incongruent auditory feedback), familiarity rating and the congruence * familiarity interaction. To account for the possibility that participants got faster over the course of the experiment due to a training effect, an additional fixed effect of occurrence was included, which was the number of times that particular chord had occurred over the course of the experiment by that trial (e.g., the reaction time associated with the fourth time a particular chord type was presented would have an occurrence value of four, regardless of the congruence of the feedback—a maximum occurrence value is thus 16). The random effects of participant number and chord number were also included, the former to take account of participants' overall differences in reaction times, and the latter because chord types themselves may have introduced additional variance if some were easier to identify than others. Reaction times that were longer than 2500ms were excluded from analysis (6.69% of the data).

The model was constructed in R using the lme4 package (Bates, Maechler, Bolker, & Walker, 2015) and the statistical significance of the factors was assessed using the lmerTest package

(Kuznetsova, Brockhoff, & Christensen, 2017), which uses likelihood ratio tests with the full model compared to the model without each variable of interest. An initial model that allowed for random slopes was constructed. The random slopes model allows each participant and chord number to have a different slope for the fixed effects in case some participants and chord numbers are more affected by congruence than others. This model did not converge and so was replaced with a fixed-slopes model. A mixed effects logistic regression with the same fixed and random effects was also conducted, but to predict whether the participant correctly responded (including trials in which participants were too slow to respond as incorrect). This model did not allow for random slopes. Familiarity data on the 1-7 scale was z-scored to produce standardised units of familiarity, to deal with the variability in the range of the scale used by different participants.

4.3 Results

In response to the statement on the form 'I identify as an improviser' on a scale of 1 (*strongly disagree*) to 7 (*strongly agree*), participants mean score was 5.71 (SD = 1.35). Participants were also asked to estimate their total playing hours and their total improvising hours on the guitar (Pinho, de Manzano, Fransson, Eriksson, & Ullén, 2014), *M TotalHours* = 11695.05, *SD* = 10382.07; *M ImpHours* = 4267.10, *SD* = 3813.53. Neither ImpHours nor TotalHours were significant predictors. The Edinburgh Handedness inventory scores did not reach significance either and so these factors were omitted from the final model.

For the model with the overall chord familiarity rating, congruence had a significant effect, with incongruent stimuli increasing reaction times by 81.87ms ± 33.61ms, $t(3264.00) = 2.44$, $p = .015$. Familiarity rating also had a significant effect with each additional standardized unit of familiarity lowering reaction times by 19.58 ± 4.91ms, $t(3269.00) = -3.99$, $p < .001$. Participants responded more quickly with congruent auditory feedback, and when the stimuli were familiar. Occurrence was also significant, with each occurrence lowering the response time by 11.41ms ± 1.60ms, $t(3261.00) = -7.12$, $p < .001$. The congruence * familiarity interaction was not significant (see Table 4.1, model 1). For the model with the hand-shape familiarity rating, again, congruence had a significant effect, lowering reaction times by 62.77 ± 15.02ms, $t(3067.80) = 4.18$, $p < .001$. Each additional standardized unit of the hand-shape familiarity rating lowered reaction times by 66.26 ± 10.71ms, $t(3068.10) = -6.19$, $p < .001$. Occurrence still had a significant effect here with each occurrence lowering the response time by 13.88 ± 1.63ms, $t(3063.00) = -8.53$, $p < .001$. The congruence * familiarity interaction was also not significant in this model (see Table 4.2, model 2).

It should be noted that visual inspection of a plot of the residuals of these two models as a function of the fitted values suggested heteroscedasticity (see Appendix 8), with higher fitted reaction times having larger residuals than lower reaction times. A Spearman correlation test (Yin & Carroll, 1990) indicated that this relationship was significant (for the overall familiarity rating, rho = .36, $p < .001$, and for the hand-shape familiarity model, rho = .37, $p < .001$). Heteroscedastic models can potentially inflate Type I errors (Caudill, 1988). However, when the mixed effects models were recomputed with log-transformed reaction times, this reduced this heteroscedasticity (for the model with the overall familiarity rating, rho = .15, $p < .001$, and for model with the hand-shape familiarity rating, rho = .17, $p < .001$), while preserving the statistical significance of the same fixed effects. Also, a 2x2 repeated measures ANOVA was conducted by transforming the familiarity rating into a categorical variable (familiar vs. unfamiliar) using a median split of the ratings and ignoring 'occurrence'. In this case, the median reaction time for each participant in each condition was used, and still returned very similar effects. These additional models were consistent with the main findings and thus increase confidence that the effects in the original model are not in fact Type I errors. The mixed effects logistic regression used to predict whether participants answered correctly or not returned similar results. For the model with the general familiarity rating, congruence significantly increased the probability of a correct response, $B = -0.87$, $z = -10.81$, $p < .001$, as did the familiarity rating, $B = 0.16$, $z = 2.53$, $p = .011$, and the occurrence, $B = 0.03$, $z = 2.93$, $p = .003$. There was no interaction between familiarity and congruence. In the model with the hand-shape familiarity rating, congruence was a significant predictor of a correct response, $B = -1.07$, $z = -11.46$, $p < .001$, as was the hand-shape familiarity rating, $B = 0.24$, $z = 3.31$, $p = .001$, and occurrence, $B = 0.05$, $z = 4.54$, $p < .001$. In both models, congruence, familiarity, and later-occurring stimuli predicted a higher probability of a correct response.

Table 4.2

Model 1

	Estimate	Std. Error	df	t value	Pr(>|t|)	Significance
(Intercept)	1722.495	86.746	27	19.857	< 2e-16	***
Congruence	81.872	33.614	3264	2.436	0.0149	*
Familiarity (overall)	-19.581	4.91	3269	-3.988	6.81E-05	***
Occurrence	-11.408	1.601	3261	-7.124	1.28E-12	***
Congruence:Familiarity	-5.571	7.013	3261	-0.794	0.427	
Model 2						
	Estimate	Std. Error	df	t value	Pr(>|t|)	Significance
(Intercept)	1622.631	85.229	22.5	19.038	2.22E-15	***
Congruence	62.773	15.021	3067.8	4.179	3.01E-05	***
Familiarity (hand shape)	-66.264	10.713	3068.1	-6.185	7.02E-10	***
Occurrence	-13.875	1.627	3063	-8.528	< 2e-16	***
Congruence:Familiarity	5.68	15.758	3063.2	0.36	0.719	

Summary statistics for the linear mixed effects models with the overall familiarity rating of each chord (Model 1) and the familiarity rating specifically for hand shape (Model 2). Reaction times are in ms. Significance codes: <.001***, <.01**, <.05*.

4.4 Discussion

This experiment investigated the role of familiarity in the acuity of anticipatory auditory images with the following hypotheses.

1. Judgements of sonic congruence would be faster and more accurate on average in the familiar compared to the unfamiliar hand shape conditions.
2. Participants with more improvising experience would perform better on the task than participants who less improvising experience.

The results supported the first hypothesis but not the second. When participants played more familiar chords, they were faster and more accurate in their judgements of the congruence of the auditory feedback. This study tested both for the familiarity of each *chord shape* and also the *hand shape* used to play each chord, in separate surveys conducted with the participants. The results were similar regardless of which measure of familiarity was used in the models. The estimated number of improvising hours was not a significant predictor of task performance.

These results suggest that despite years of exposure to repeated associations between individual locations on the fingerboard and their corresponding musical pitches, guitarists do not simply use this place-to-pitch mapping of individual notes and combine these to form expectations of how a chord will sound. Instead, guitarists move and place their left hands into more or less familiar shapes to play the chords such that some hand shapes have a stronger coupling to the intended sound of a familiar chord than others. This might seem at odds with some findings suggesting that in musical experts there is a flexibility in the way musical goals are realised motorically. For example, Palmer and Meyer (2000) conducted learning transfer experiments with expert and novice pianists. Whilst novices exhibited transfer on both motoric and pitch dimensions, experts only exhibited transfer when the pitch class sequence was preserved. The authors interpret this to show that expert musicians have motor independence in the realisation of musical goals. However, some of the stimuli involved playing a black key with the thumb which could be argued to be motorically (and haptically) different. This might have hindered task-transfer in the condition that was designed to be motorically similar, casting the motor independence interpretation into doubt.

Novembre and Keller (2011) conducted a study in which pianists watched silent videos of right-hand piano chord sequences and were required to copy these on a silent keyboard. Some of the chords were harmonically incongruent in that they violated expectations generated by the tonal context. Others were tonally congruent but with nonstandard fingering. The pattern of responses was such that the more experienced participants were slower on the incongruent compared to the nonstandard fingering condition, whilst this was reversed for relative novices. As there was no auditory stimulus or feedback, the authors conclude that this effect represents an ‘action-grammar’, but they also do not rule out the contribution of auditory imagery as anticipated action-effects. Moreover, they also conclude that experts are biased toward higher level goal-dependent features and have flexibility in how to implement them. However, this does not rule out that even for experts, the familiarity of hand shape can facilitate performance, all other things being equal. One unavoidable flaw in Novembre and Keller's study is that because of the one-to-one key-to-pitch mapping of the piano, the way that familiarity of motor representation was manipulated introduced unusual hand shapes for the chords that pianists would not normally use. In contrast the stimuli in the present study exploit the many-to-one mapping of the guitar fingerboard to allow the same hand shape to play a familiarly associated chord or a less familiar one. The finding that responses were slower in the latter case raises interesting questions about how the affordances offered by different instruments influence the way in which different motor representations facilitate the implementation of musical goals.

Evidence was not found for the second hypothesis. Each participant estimated their total improvising hours (Pinho, 2014) in order for the second hypothesis to be tested, that improvisers' enhanced auditory-motor representations would facilitate task performance. Neither this nor the estimate of total hours (overall experience) was significant in the model. One reason for this could be that forward models are equally strong for familiar shapes for both groups in the context of individual chords, since both groups have had similar exposure to the links between individual chord hand shapes and resulting sounds. Even if the familiarity of certain hand shapes differed across groups, it is the participant's *own* rating of familiarity that is the predictor, so this study was deliberately designed to control for this difference. This interpretation rejects the idea of a general auditory-motor advantage for improvisers. Indeed, the studies quoted above found context dependent differences which directly related to genre-specific practices, within harmonic contexts. The present study tested judgements of sonic congruence of chords in the absence of harmonic context and it could be argued that improvisation does not bear directly on this ability. Another possible reason is that the sample did not contain a sufficient number of participants who could be classed as non-improvisers. The mean percentage of estimated total playing hours that were spent improvising was 43% (*SD* = 25). Only four participants reported having spent less than 20% of their total playing time improvising and in the Likert scale rating, only two participants rated 'I identify as an improviser' lower than 5. Finally, a training effect was observed, suggesting that the unfamiliar auditory-motor couplings could be learned relatively quickly.

A surprising result is that the interaction between congruence and familiarity did not reach significance in either the chord shape or hand shape model. This means that regardless of whether participants rated the familiarity of the chord in its location on the finger board or the familiarity of the hand shape they used to play it, incongruence adversely affected task performance to the same degree on average in both the familiar and unfamiliar conditions. Whilst remaining somewhat agnostic on the level of representation or embodiment which best characterises auditory-motor coupling, a main premise of this study is that participants are partly facilitated in their perceptual judgements by familiarity of movement or proprioception. This could be interpreted in a theoretical framework involving the use of an internal forward model of some kind to solve the task, as in motor control or motor imagery theories but is also compatible with multi-modal emulation theories and simulation theories including the grounded cognition paradigm. It will be argued in Chapter 7 that this last framework best accounts for musical performance, but for now the use of the term 'forward model' will serve as shorthand for the anticipatory process which facilitates judgement, without intending a specific commitment to one of these theories. What the finding that hand shape familiarity facilitates task performance supports is the interpretation that rather than being a purely abstract amodal form of processing or simply an anticipatory image in the auditory modality alone, movement and/or proprioceptive and haptic modalities play a part. This is because different hand shapes require different movements to execute them, when in place the fingers of the left hand vary in how they are arranged (proprioception) and the feel of different strings in different locations is not uniform (haptic).

It might be expected that as the familiar hand shapes facilitate accurate forward models, the mismatch with incongruent feedback impacts on reaction time due to the use of cognitive resources involved in error monitoring and response conflict (Folstein & Van Petten, 2008; Ullsperger, Fischer, Nigbur, & Endrass, 2014; Yeung, Botvinick, & Cohen, 2004). However, the situation in this experiment is different to those which describe slower responses on Stroop or Simon task in incongruent conditions (Botvinick, Cohen, & Carter, 2004; Yeung et al., 2004). In a Stroop task, the stimuli are either congruent or incongruent between aspects of the same stimulus array. For example, participants might be asked to indicate the font colour of a colour word like 'green'. Responses are faster on average when the word and font colour are congruent (Adleman et al., 2002). The word 'green' written in a red font has a manifest incongruency between the word meaning and the font colour. An example of a Simon task could be to press a key on the right in response to red objects on a screen, and a left key for green objects. In this case, congruent trials in which red objects appear on the right of the screen and green on the left are faster than incongruent trials (Simon & Berbaum, 1990) and although the positioning of the response on left or right is not relevant to the task, the incongruency affects performance. In contrast to these situations, in the present study the altered auditory feedback is only incongruous with the unaltered chord, which is not part of the presented auditory stimulus, unlike a Stroop task. The response of left or right foot does not have any correspondence with an aspect of the auditory feedback, unlike a Simon task. There is some evidence that expectancy violations produced by altered auditory feedback do involve at least some of the same neural mechanisms that are involved in the Stroop and Simon cases, however. Maidhof et al. (2010) found N200 and P3a responses to altered auditory feedback in pianists which were consistent with the involvement of the anterior cingulate cortex. This structure is thought to be involved in error detection and conflict monitoring, serving to trigger alterations in cognitive control (Botvinick et al., 2004). The use of these cognitive resources could be responsible for the slowing of reaction times in the incongruent condition in this study. If the slower reaction times on incongruent trials are a result of expectancy violation processing, then the question arises as to why this effect does not vary with the strength of the expectancy. In other words, it seems likely that familiarity and congruence would interact, because if the forward model is less accurate or distinct in the unfamiliar condition then the mismatch due to incongruence would be less acute and be less disruptive. To take an extreme case for illustrative purposes, if the shape is so unfamiliar that the forward model is absent or not accurate enough to distinguish between congruent and incongruent feedback, then incongruence ought not to have any impact at all on reaction time. In other words, the 'system' has no way to know that the feedback is incongruent, so there should be no shift of attention or extra demand on cognitive resources.

One explanation for the lack of interaction between familiarity and congruence is that even in the unfamiliar condition, the proportion of the forward models that were accurate enough to be impacted by incongruence was sufficiently high to render the interaction not significant. That is, even in the unfamiliar condition, forward models were present and facilitated performance, just not as much as in the familiar condition. This interpretation is supported by the idea of redundancy (Pressing, 1988), in that different modalities can contribute to the forward model. There might therefore have been a threshold effect rather than a continuum of facilitation due to hand shape familiarity. Given that reaction time data was taken from correct trials only, this might have had a higher proportion of unfamiliar trials in which the forward model reached this threshold. Another explanation is that incongruence acts at a lower hierarchical level, such that a mismatch response is triggered by incongruency but is not accessible to the higher-level process which discriminates between complex musical phenomena such as chords. There is some support in the literature that incongruence could trigger an error detection response as an automatic low-level process that does not require attention (SanMiguel, Widmann, Bendixen, Trujillo-Barreto, & Schröger, 2013; Schröger et al., 2015). However, this process alone cannot serve as an explanation for the findings of this study, because the fact that incongruence impacted performance at all would then be unexplained. What is needed is a theoretical basis for the possibility that attentional resources are impacted by incongruence, but that this does not influence the component of the cognitive process of judgement whereby hand shape facilitates a forward model. This will be discussed further in the next section.

4.5 Limitations and Future Research

Response times were collected only after the participants had already moved their left hand to form the chord shape, so it is not clear whether familiarity of movement or proprioceptive familiarity was responsible for these results. However, in either case, features of the person-instrument interface have an influence on the speed and accuracy of responses. No behavioural evidence was gathered to determine whether participants' forward models used auditory imagery, although many participants commented that they did try to imagine how the chord should sound. Some also mentioned using explicit declarative knowledge of music theory to try to solve the task, for example realising that a given shape was a major 9th chord, but they would then compare the actual sound with their memory of how a major 9th *should* sound. An assumption informing the experimental design was that such deliberate processes invoking music theoretical concepts would be too slow to be useful in a speeded response task (Bago & De Neys, 2017; Tversky & Kahneman, 1974, 1983). The visual stimulus disappeared before participants could play, to minimise any effect of the tablature diagram itself on performance. However, because participants had 8 seconds to form the shape on the guitar prior to them playing the chord and the timer starting, it cannot be ruled out that they could have used this time to access theoretical knowledge from long term memory. In this case, what could be driving the main effect is that familiarity with the chord shape indexes the familiarity with how the chord sounds, via an internal chord lexicon which pairs shapes and familiar chord types (major 9th, dominant 7th etc) in an amodal music-theoretic format. One response to this is that no significant differences in the results were found between the model in which participants rated *chord shape* familiarity and the one in which they rated *hand shape* familiarity. Further research is needed to fully investigate this possibility however.

The lack of interaction between congruence of auditory feedback and the familiarity of chord/hand shape discussed above raises questions about how possibly different cognitive processes used to solve the task could operate together. One experimental approach which has the potential to make progress in this area is to use electroencephalography (EEG) in combination with behavioural data. Altered auditory feedback can elicit an auditory N1 component at about 100 ms after stimulus onset, a feedback related negativity (FRN), maximal between 150 to 250 ms, and a P3 component (Mathias et al., 2017; Proverbio, Cozzi, Orlandi, & Carminati, 2017). The time course and scalp distribution of these EEG measurements together with their hypothesised neural generators could offer some insights into how quickly incongruence is detected and whether the use of attentional resources is responsible for increased reaction times in the incongruent condition.

Further research with the guitar could extend this result for chords to involve melodic phrases implemented in different fingerboard configurations, thereby further elucidating the role of its instrumental affordances in music cognition. More broadly, future research could be extended to other instruments, for example aerophone instruments such as brass or woodwind which not only present a motorically different interface to the piano and guitar, but also do not have the same kind of pitch-to-place mapping.

Given that a training effect was observed, it could be inferred that learning new motor or proprioceptive patterns to the extent that anticipation is facilitated is a relatively speedy process. Further research could investigate whether general musical expertise or a genre-specific skill profile modulates learning. It could also be the case that the kind of training given by this experimental procedure could have benefit in a pedagogical context. Further research could establish whether incorporating a training regime involving unfamiliar shapes for familiar chords with a sonic congruence judging task under AAF would enhance musicians' flexibility of musical goal realisation in comparison to standard ear training programmes.

4.6 Conclusion

In the broader context of perception-action coupling, the study of musical expertise offers an excellent opportunity to investigate the cognitive processes involved in the context of training-induced differences. The extension of the AAF paradigm to the guitar, which differs from the piano both motorically and in its pitch-to-place mapping, sheds further light on the role of instrumental affordances in musical perception and cognition. These results are compatible with the theoretical framework of grounded cognition, according to which cognition, movement and the person-instrument interface are all enmeshed and incompatible with the Ideal Model of improvisation proposed in Chapter 2.

Chapter 5

Two Chord Familiarity Studies

5.1 Introduction

The stimuli for Study 2 above were designed by this researcher based on over three decades of experience as a guitarist and guitar tutor to include eight chords, each of which had two versions. Each version was the same chord voicing (the same notes in the same order) but differed in terms of the location, physical pattern and geometrical pattern of notes on the guitar fingerboard (see Appendix 9 for the full stimulus set). One of each pair was intended to be a more familiar shape than the other. Familiarity in this context is a relation between either a configuration of notes in a location on the guitar fingerboard (Study 3) or the left-hand shape used to play the chord (Study 4) and a given participant in Study 2. The familiarity of a shape is likely to depend on how many times a guitarist has played the chord before. This in turn will depend on the genres of music they are most used to playing, their musical education and breadth of musical knowledge and experience. Given that chord familiarity was hypothesised to be a predictor variable in Study 2, it was important to obtain measures of familiarity for each chord for each participant. A behavioural measure of familiarity would be difficult if not impossible to obtain. For example, a measure of the time taken from visual stimulus to being able to play the chord would have a potential confounds of the physical ease of playing a chord, and the visual complexity of the stimulus. Studies 3 and 4 therefore collected self-report familiarity data from the participants of Study 2.

5.2 Study 3 Method

5.2.1 Participants

The participants of Study 2 all agreed to take part in Study 3 as a follow up and there was no attrition.

5.2.2 Stimuli and Apparatus

The stimuli were identical to those used in Study 2 and were presented on the same Toshiba laptop in MATLAB. Participants used their own guitar as an aid to recall.

5.2.3 Procedure

Participants took part in this study typically 2-3 weeks after they did Study 2. The main reason for the time delay was to minimise any influence of task performance in Study 2 on familiarity ratings. In addition, Study 2 usually took more than an hour to complete and including familiarity rating would have made the session too long. After giving written informed consent (Appendix 13), participants were seated at a comfortable viewing distance from the laptop screen and were told to respond to each tablature diagram by playing the chord on their own guitar. The reason for this was that it was the familiarity of *playing* the chord that was being investigated, whereas if they had responded to the diagrams alone this might have involved more abstract declarative knowledge. Participants were instructed to disregard the sound features such as the chord quality or how familiar the chord sounded but instead were to concentrate on the familiarity of the chord shape. The MATLAB programme displayed a screen with instructions to respond by pressing keys 1-7 on the laptop keyboard along with the corresponding Likert ratings ranging from '1 = very unfamiliar, almost never use' to '7 = very familiar, almost always use this'. Participants were also given a printed copy to look at during the procedure in case they forgot the precise ratings to which the keys corresponded. They began by pressing any key when ready.

Tablature diagrams were then presented on the screen individually in a different random order for each participant, with each diagram appearing a total of three times. The next diagram was prompted by the rating key press from the previous stimulus, so this was not a timed task; participants could take as long as they wanted to try the shape on their guitar and respond when they were ready. The procedure usually took about 10 minutes to complete. Rating data were collected by the same MATLAB script for analysis.

5.2.4 Data Analysis

A separate MATLAB script was used to prepare the familiarity rating data for inclusion in the first linear mixed effects model used for the data analysis in Study 2. As each chord was rated three times by each participant, the mean of these scores was calculated to give each participant's final rating figure. To account for the likelihood that participants might use the Likert scale differently, for example some avoiding the end range values more than others, each participant's set of final ratings was then z-scored to give standardised ratings of familiarity. The fixed effect of familiarity in the model was treated as a continuous predictor variable using these standardised units of familiarity. Although there has been some controversy over the validity of using ordinal data, aggregating items and treating the resulting interval data as measuring a continuous latent variable, the risks of Type 1 errors have been overstated (Norman, 2010).

5.3 Results

Each chord had two versions: a shape intended to be familiar and its unfamiliar counterpart. The standardised familiarity rating for each chord and each participant is shown in Appendix 10. Participants rated the familiar versions as more familiar than their unfamiliar counterparts and a paired samples t-test showed this difference was significant, $t(20) = 13.67$ $p < .001$. This parametric test was carried out on ordinal data on the basis that the averaged familiarity values track a latent variable which can be treated as interval. However, subsequent tests were non-parametric so as to err on the side of caution. Figure 5.1 shows the mean standardised familiarity rating for each chord.

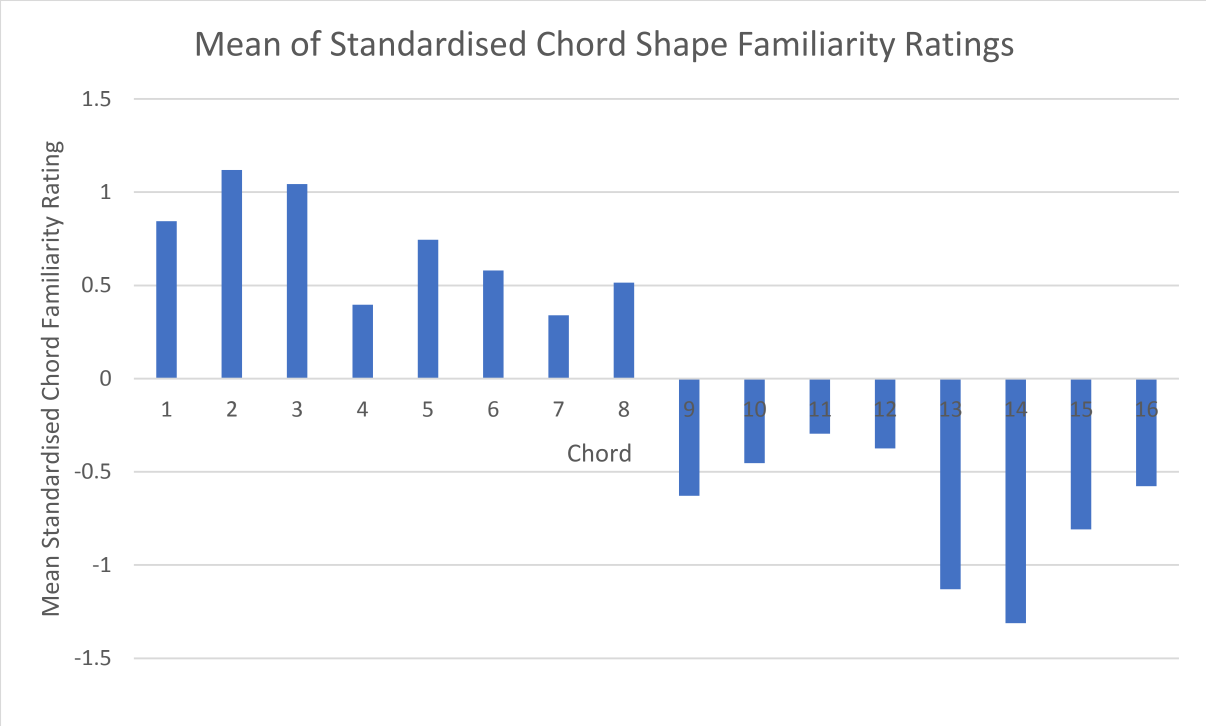


Figure 5.1. shows the means of the standardised familiarity ratings for the chord shapes. The chords designed to be familiar are numbered 1-8 and the unfamiliar ones are 9-16 (11-18 in the original stimulus list.

5.4 Discussion

These results show that on average, these participants agreed with the judgement of familiarity of the shapes which was made in creating the stimulus set. Although there are some examples where individual participants rated some chords in the opposite direction, this is not relevant to the familiarity rating in the model, since the predictor 'familiarity' uses each participant's rating for each chord. Further research could find out if these familiarity judgements hold for a larger population of guitarists so that these stimuli could be used in further experiments to test the effects of familiarity with higher participant numbers. Some of the individual differences in familiarity rating might be traced to differences in genre specialism. For example, two of the participants who gave chord 14 a relatively high familiarity rating had reported that they play rock or metal. Sometimes in these genres, the low E string is down-tuned to a D which provides a shape similar to chord 14 as a staple 'power chord' frequently used in these genres. Subsequent studies could refine the stimuli to be targeted for specific genres to investigate the role of familiarity in a more ecologically valid way.

Study 2 used the familiarity rating as a predictor and found that it facilitated judgements of sonic congruence under conditions where auditory feedback was manipulated at random in half the trials. The hypothesis was that the physical movement and/or proprioceptive factors of the different hand shapes was driving this effect. However, because of possible ambiguity in the instructions given that might have led participants to rate the familiarity of the *chord* shape in the context of its fingerboard position rather than the hand shape they used, Study 4 was designed for the same participants to focus specifically on the familiarity of the hand shape that they used to play each chord, irrespective of its position or chord quality.

5.5 Study 4 Method

5.5.1 Participants

Of the original 21 participants who took part in Study 2, 18 took part in this survey. This represents an attrition rate of just over 14%.

5.5.2 Stimuli and Apparatus

The stimuli were again identical to those used in Study 2 (Appendix 9). In contrast to Study 3, Study 4 was delivered as on online survey using the Bristol Online Survey platform. The question responses featured the same 7-point Likert rankings with the same wording. A MATLAB script was used to generate a random sequence of stimuli such that each chord appeared three times and there were no consecutive occurrences of the same chord. This sequence determined the order of questions written in the survey. As the Bristol Online Survey platform lacks the facility, a separate randomisation for each participant was not possible.

5.5.3 Procedure

Participants were sent a link to the online survey about six months after Study 2. They were told that they were not obliged to take part, that their information would be treated confidentially, and they could stop at any time without consequence, in accordance with RNCM ethical policy. Their completing the survey was taken to indicate that they had given informed consent. Participants were instructed to use their guitar to play the shapes before making their judgement as in Study 3. The main difference between this and Study 3 in terms of the instructions, was they emphasised that the familiarity rating referred to the hand shape used to play the chord rather than any other attribute, such as fingerboard location, which strings were played, or whether the shape was usually associated with the given chord or its sound. The survey was estimated to take about twenty minutes to complete.

5.5.4 Data Analysis

The data analysis was as in Study 3, with each participant's average familiarity scores being z-scored to produce standardised familiarity units for use in the second Linear Mixed Effects model in Study 2.

5.6 Results

Participants' ratings of hand shape can be seen in Figure 5.2. As with Study 3, Participants rated the shapes designed to be familiar as more familiar on average than their unfamiliar counterparts. See Appendix 10 for the standardised hand shape familiarity ratings for each chord and each participant.

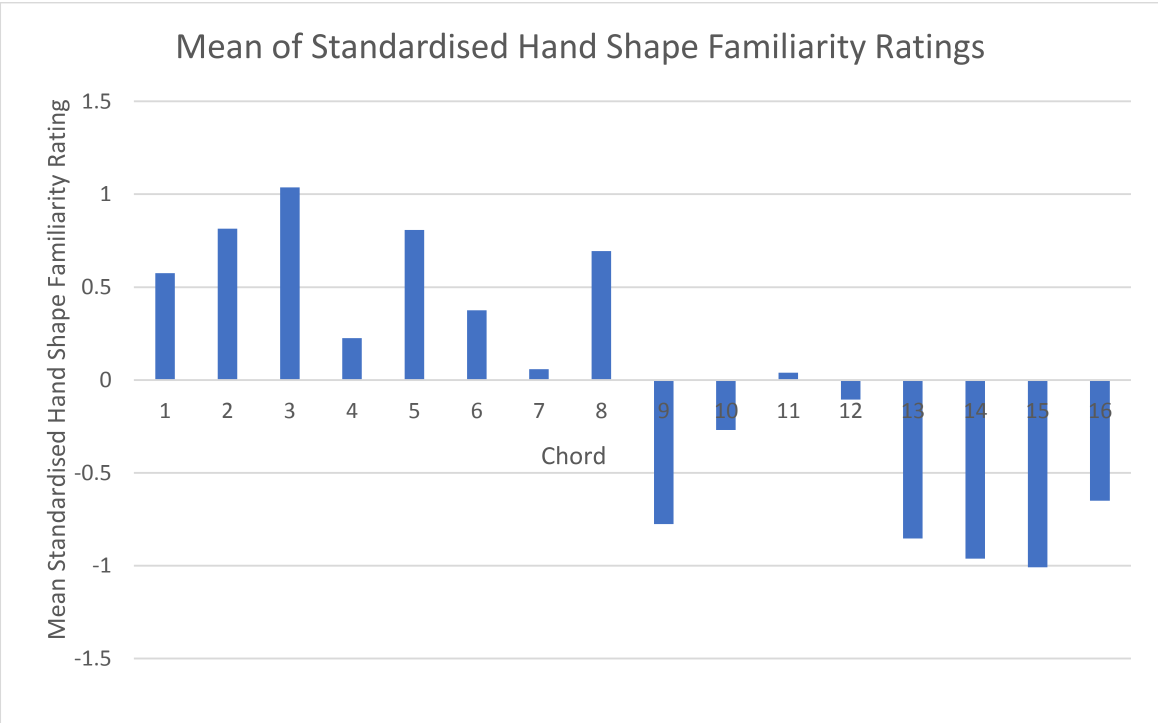


Figure 5.2. The mean standardised hand shape familiarity rating for each chord.

The chord shape results were obtained from the 21 original participants and 18 of them also participated in the hand shape study. Although the attrition limits the direct comparison of data, it can be seen from Figure 5.3 that there was some similarity in the ratings.

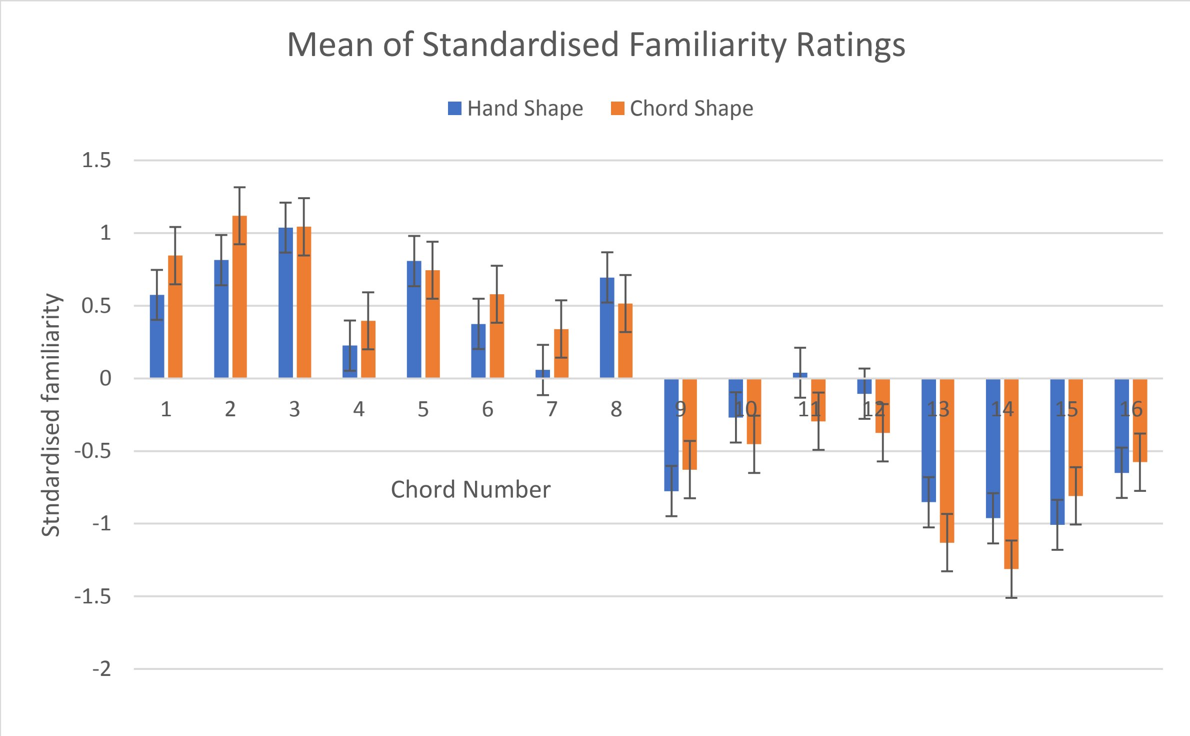


Figure 5.3. A comparison of hand shape and chord shape familiarity ratings. Error bars show 1 standard error.

5.7 General Discussion

The emphasis of the second study was on the familiarity of hand shape rather than chord shape. The second linear mixed effects model in Study 2 used this new measure of familiarity and returned very similar results to the first model. One interpretation of this is that the effect of familiarity is robust irrespective of which measure is used, but this raises questions about what precisely is being measured by each type of familiarity. In addition to the well-known limitations of self-report protocols when investigating expert behaviour (Beilock, Wierenga, & Carr, 2002; Bermúdez, 2017; Ericsson, 2003), familiarity judgements in these studies could have been informed by elements that were difficult to disentangle. The chords had different degrees of harmonic tension and complexity, some were potentially familiar shapes in terms of fret pattern but appeared on a different set of strings than they normally would, some shapes were played in locations where the frets were widely spaced at the bottom of the neck and others higher up where the frets are close together, and so on. Despite the fact that participants were instructed to ignore any of these factors that did not relate to hand shape, they might have found this difficult in some cases. For example, when viewed as an abstract juxtaposition of dots, the shapes in Figure 5.4 below could be interpreted as identical. However, a Wilcoxon signed-rank test analysis of the hand shape familiarity rating data for this chord pair shows that they were in fact rated differently (Z = -2.86, p = .004).

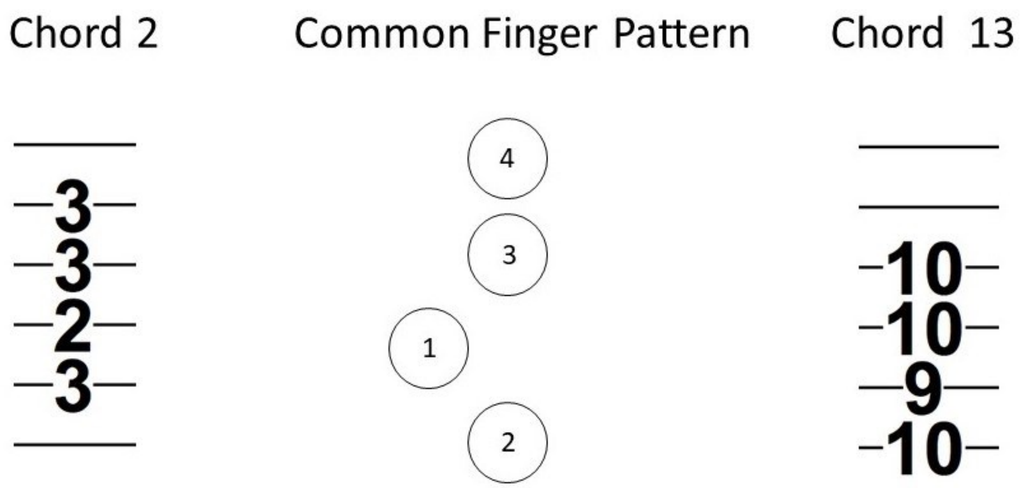
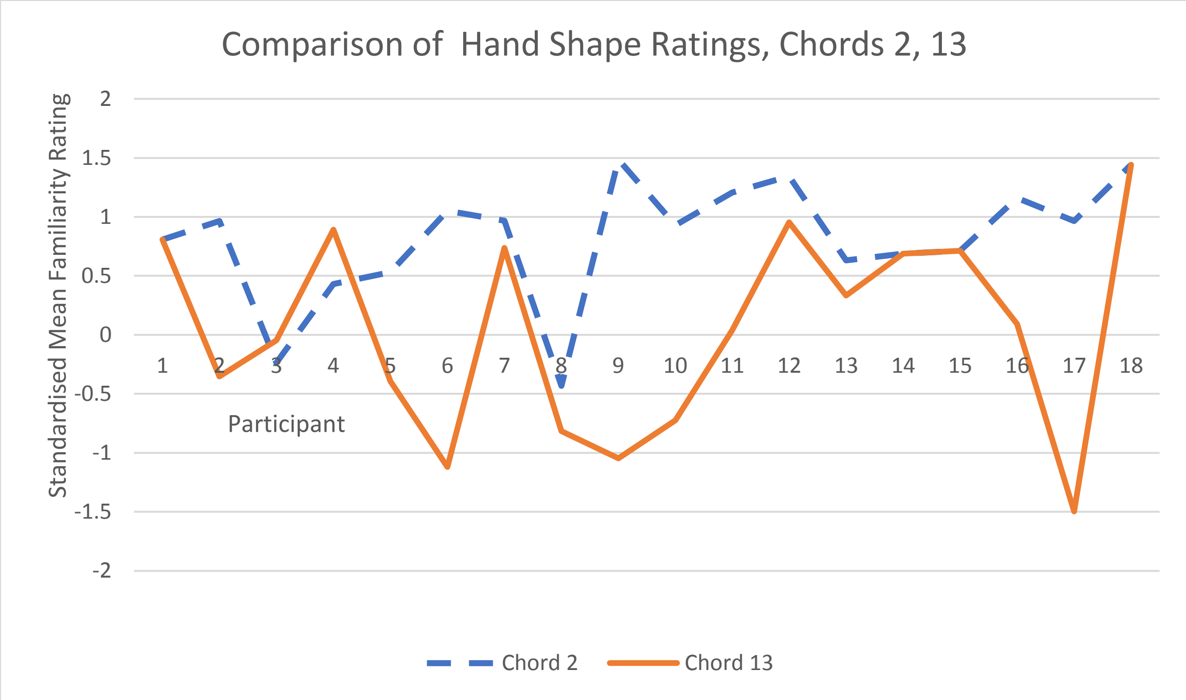
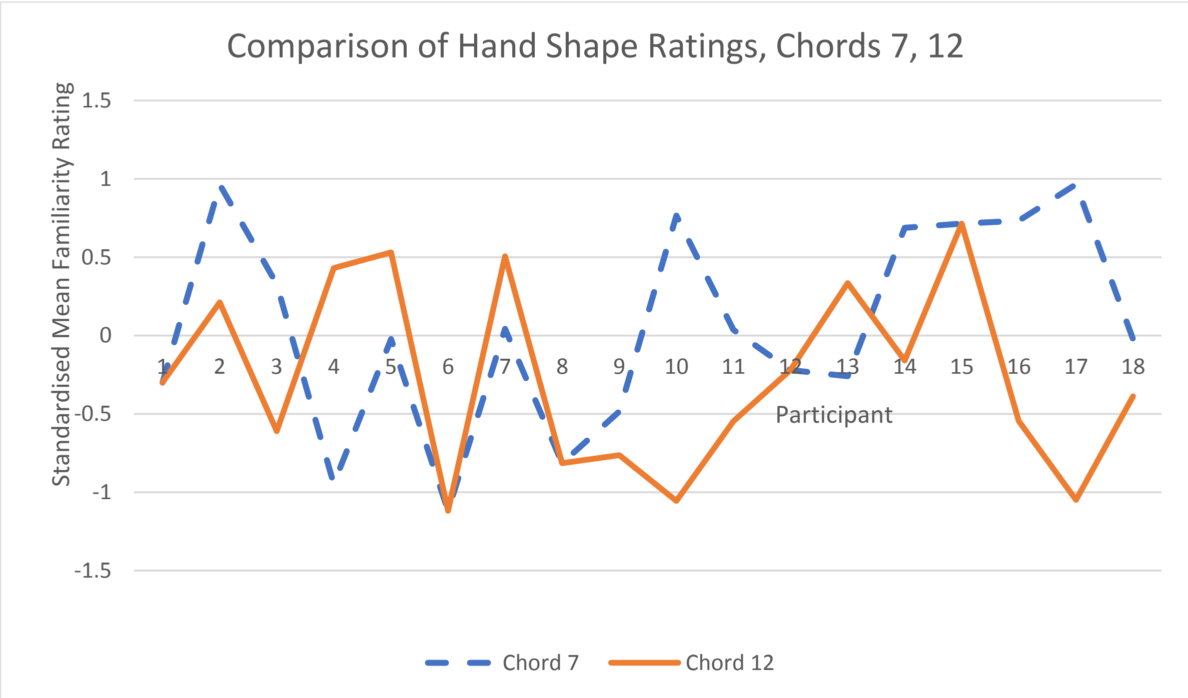


Figure 5.4. Chord 2 (familiar) and chord 13 (unfamiliar). Both chords are played with a common finger pattern. The centre diagram shows the finger numbers (1-4, with 4 as the little finger), as well as the geometrical pattern of locations on the fingerboard of the guitar.

There are two other chord pairs which have this property of having identical abstract finger patterns, namely 7, 12 and 11, 17. However, in each of these pairs, the first chord was not rated significantly differently to the second (Z = -1.50, p = .133 and Z = -.85, p = .394 respectively). Figure 5.5 shows the mean standardised familiarity rating for the three pairs of chords for each participant. Whether factors such as fret spacing or string thickness changed the experience of playing the chord (proprioceptively, haptically), or despite the instructions to the contrary, participants were still judging familiarity in terms of the common or uncommon *association* between shape and chord is not completely clear from the available data. A consideration of the properties of these chord pairs is inconclusive. Chords 7 and 12 are in the same fret position but on different strings, therefore their relative fret spacing is also the same. This might suggest that it is fret spacing driving the difference in rating for 2 and 13 and explain why there was no significant difference in the rating for 7 and 12.


Comparison of Hand Shape Ratings, Chords 2, 13
Standardised Mean Familiarity Rating
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Participant
Chord 2
Chord 13


Comparison of Hand Shape Ratings, Chords 7, 12
Standardised Mean Familiarity Rating
1.5
1
0.5
0
-0.5
-1
-1.5
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Participant
Chord 7
Chord 12

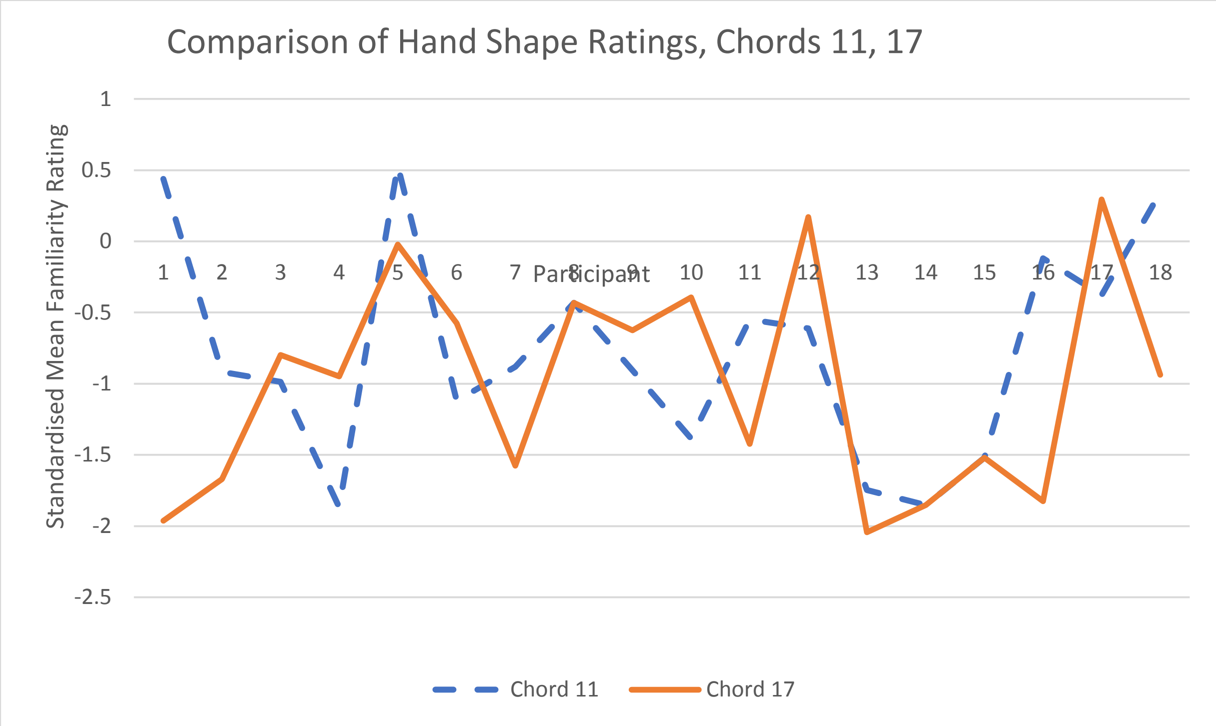


Figure 5.5. A comparison of the standardised mean hand shape ratings for the chord pairs 2 and 13, 7 and 12, and 11 and 17. Each pair has chords with the same abstract 'dot' pattern of fret locations but on different strings.

In contrast, chord 2 is at frets 2 and 3 where the fret spacing is considerably wider than chord 13's at frets 9 and 10. A wider fret spacing means that the fingers of the left hand are more spaced out, leading to different proprioceptive feedback. However, the remaining pair (chords 11 and 17) also has a large difference in fret spacing but was not rated significantly differently, which seems to contradict this explanation. One explanation for this might be that both chords in this pair were designed as unfamiliar, whereas the other two pairs comprised a familiar and unfamiliar chord. Hence, it could be that although the fret spacing was different, both chords were rated as roughly equally unfamiliar but for different reasons, by most participants. Although this could be tested in future studies, fret spacing seems unlikely to be the decisive factor. Fret spacing differs for very familiar shapes such as chord 2 as they are played higher up the neck of the guitar, guitarists are used to this and so it seems unlikely that they would rate a C9 chord at frets 2 and 3 as more familiar than F9 at frets 7 and 8. The most likely explanation is that participants were unable to separate the association of the chord shape to the heard chord from the hand shape used. Chord 13 is part of a class of altered dominant chord voicings which are less common on strings 3-6. However, caution must be exercised with these results, as one final possibility is that the small sample size in Study 4 (N = 18) was such that a few of the participants who did not follow the instructions skewed the results.

5.8 Limitations and Future Research

These studies had small sample sizes, so no measures of internal validity could be calculated for the familiarity survey rating data. This limitation was mitigated to some extent by the within-subjects design, as it was each participant's familiarity rating for each chord that was used as the predictor variable in the linear mixed model in Study 2. This model was not therefore relying on a consensus measure of familiarity for chord or hand shapes which would have needed a larger sample size. It was not possible to randomise the order differently for each participant in Study 4 due to the limitations of the online survey platform used. There are concerns about the reliability of self-report measures for introspective states (Berger, Dennehy, Bargh, & Morsella, 2016; Nisbett & Wilson, 1977). In the case of Studies 3 and 4, these were not cognitive processes that might be unavailable to introspection, nor were the questions asking respondents to reflect on things they have done some time ago, or that they generally do. Instead, they were asked to rate their subjective feeling of familiarity immediately after playing the chord. Although these factors might alleviate some of the reliability problems, familiarity itself could involve different elements which depend on musical context and which might be inaccessible to participants playing them in these studies. As pointed out in the discussion, it might be difficult for participants to ignore other factors, such as the most familiar chord sound to chord shape mapping. As testing the embodied feeling of familiarity involved participants playing the chord, they would have heard the chord they played, which could therefore be a confounding factor.

Future research could address this in several ways. A larger sample could be asked to rate familiarity with a more extensive set of chords and genre specialism data could be taken to see if some shapes were more familiar to, for example, rock versus jazz players. Another familiarity rating study could be done where the sound of the heard chord is masked to remove this as a potential confounder. It might also be possible to gather behavioural data, such as the time taken to play a chord from a visual stimulus, although this runs the risk of introducing further possible confounds, such as visual complexity of the stimulus and physical playability of the chord.

5.9 Conclusion

Two studies were carried out with the participants of Study 2 to measure the familiarity of the chords used as the imperative visual stimuli. The first study measured chord shape familiarity, taking into account the shape-chord association of the shape in the given location. The second study emphasized the hand shape used to play the chord as the index of familiarity. The ratings of familiarity differed from each other but both sets of results rated the familiarity of chords designed to be familiar higher than their unfamiliar counterparts. Each measure was incorporated into separate models used for analysis of Study 2's results and both models returned very similar results, showing a significant facilitating effect of familiarity on judgements of how the chord should sound.

Chapter 6

Study 5: The Improvisation and Mind-Body Survey

6.1 Background

6.1.1 Auditory Imagery, Authenticity and Moral Perfectionism

The responses of the participants of Study 1 and subsequent thematic analysis confirmed that prospective auditory imagery as a generative strategy is important to them. Not only was this connected to moral perfectionism (Day, 2000), it was also accompanied by concepts relating to Romantic notions of creativity, freedom and 'being in the moment'. Participants also reported multiple generative strategies, which do not need auditory imagery, for example motoric strategies (Hargreaves, 2012). This is a coherent picture insofar as the practicalities of improvisation require a degree of redundancy in order to keep the flow of improvisation going, so that if one strategy is not available at a given moment, there are others to use (Pressing, 1988). Moral perfectionism could then arise as a consequence of the dissonance between these Romantic ideals and what improvisers know they do, in the following way. As discussed in Chapter 3, moral perfectionism is characterised by a commitment to authenticity coupled with a dissatisfaction with one's current state of development. Prospective auditory imagery has the status of being necessary to validate improvising as a creative activity for these participants and this is also linked to the concept of authenticity: "He, I had a lesson with him once, and he was like ' Right, just play me something'. So I improvised something, and he stopped... and he was like 'you didn't hear that though, did you?' Was like 'Nooo...' [laughs]" (participant 3 in Study 1, Guitarist, Male 32). In further responding to questioning about the timing of his imagining, the same participant said this a few sentences later: "Yes so I... I guess what I'm trying to think now is whether I... erm if it's... whether I'm a fraud or not!" He had seen the tension between his aesthetic of 'being in the moment' and the necessity of imagining how things would sound *in advance.* Playing something true, in other words improvising authentically, is linked to prospective auditory imagery for these participants and in the literature also (Berliner, 1994). Given that these improvisers are aware that some of their generative strategies do not use auditory imagery in advance of playing, it follows that they know that they are not always improvising authentically in these terms.

Since they clearly value and strive for authenticity, this means they are dissatisfied with their current abilities to pre-hear in their mind's ear and are trying to improve them.

6.1.2 Why Prioritise *Prospective* Auditory Imagery?

In some ways the reason the auditory modality is privileged is obvious. The aesthetic appreciation of music is primarily a response to how it sounds. It might be objected that other aspects of the performance colour an audience's appreciation. For example, studies in which participants are asked to rate performances in which the audio and the video are transposed show that visual aspects have an effect, as does the impact of blind auditions for orchestras (Goldin & Rouse, 2000). However, whilst we might close our eyes to listen or listen to an audio only recording, it is unlikely that we would watch a video of music without the sound. That auditory imagery must be *prospective* for improvisation to be considered authentic relates to the Romantic notions of creativity and freedom. As mentioned above, there is a tension between this imperative and the other ideal subtheme from Study 1, 'in the moment' which is related to feelings of connectedness, flow states and the feeling that the music is playing the musician rather than vice versa, which is sometimes called the creator and witness phenomenon (Berkowitz, 2010). Participant 1's quotation given in Chapter 3 perhaps contains an attempt to resolve this tension "…no sort of translation in between thinking of the idea and it happening…". What could this mean? That an idea is 'thought of' is taken as a premise; the context suggests that this is a musical idea which is imagined in the auditory modality. That the idea 'happens' implies a claim that what is played stands in a certain relation to the idea. A literal interpretation that this is an identity relation would depend on a dual-aspect conception, whereby the phenomenological aspect of imagining the sound is copresent with the sound-producing movements. In other words, the auditory image and the movements that manipulate an instrument are both aspects of the same entity. This interpretation makes clearer what could be meant by 'no translation'. It is not necessary to translate an idea into movement if the idea and the movement are different aspects of the same thing. This also resolves the tension between being in the moment and imagining how something will sound in advance, since thinking of the sound is contemporaneous to action.

The dual-aspect strategy resolves one tension between prospection and being in the moment, but at the expense of creating another. Collapsing the idea and the action into different aspects of the same thing removes the justification for considering the idea as having a causal role. For the idea to cause the sound we hear, it must be prospective, as this condition is constitutive of causation, in that causes precede effects. An important and related issue is whether the idea in the form of an auditory image needs to be veridical. In other words, it is one thing to ask whether the auditory image *causes* the music played to be a particular way, it is another to ask whether this causal role depends on the image being an accurate representation of the music. This could be argued to be a matter of degree, but if the creativity of improvisation is predicated on playing what we *hear in our head,* then clearly the auditory image must resemble what we play enough to uniquely specify the important parameters of musical content. If this were not the case, then there would be no basis for the proposition that what is played represents the particular sound that is imagined. The ultimate consequence of this would be that the vaguest impression of imagined sound with little correspondence with the musical output could be adduced as inspiration. Whilst this might not be absurd, it is a long way from the ideal we are discussing. Which musical parameters count as important depends on the context and the priorities of improvisers. Melodic and rhythmic content seem to be fundamental in idiomatic contexts (Berkowitz, 2010; Berliner, 1994), whereas timbral and dynamic properties could be emphasized in non-idiomatic improvisations. (It is interesting to note that one participant in Study 1 indicated a dissociation whereby he had a strong image of rhythmic content but not the specific notes for some phrases). These considerations are more generally the basis and motivation of ideomotor theories in connecting thought, action and action-consequences which were discussed in Chapter 2. In proposing that action goals are represented in terms of their perceptual consequences, they offer a possible theoretical grounding for prospective auditory imagery. However, given these consequences are multi-modal, the motivation for singling out the auditory modality is likely to come from other factors and influences. One such is the Romantic ideal of the creative artist.

6.1.3 The Romantic Ideal of the Creative Artist

Why does the Romantic ideal of creativity necessitate that the process of creating music is one in which the sound of the music is imagined in advance? For those enculturated in the traditions of Western art music, the answer is perhaps again intuitively obvious. A musical work is the product of the creative imagination of a composer, who then writes it down as a score. Improvisers have adapted this concept in seeing improvisation as real-time composition by bypassing the writing down stage and substituting the transduction of the idea into the corresponding sound-creating movement (Berliner, 1994). The idea that the imagination is the source of creativity in this way has a long history and a comprehensive review of the relevant literature is beyond the scope of this thesis. Instead, some key ideas relating to the ontology of music, creativity and dualism will now be developed.

The development of the concept of forms takes place throughout the writings attributed to Plato (Plato, 428-328 BCE/2018), the central idea being that the world as we experience it is populated by entities which appear to have properties such as, for example, beauty or of being large. They appear this way because they partake of (or resemble, depending on which theory of forms is adopted) the *form* which is beauty or largeness. A form is unchanging and eternal, whereas a physical object which instantiates it is subject to change and decay. This idea is dualist in that there are two distinct ontological realms. It has been extremely influential in the history of philosophy and consequently on considerations of what music is and what it might mean to create it. To be a Platonist with respect to a domain such as mathematics or music is therefore to hold that numbers or musical works are *themselves* abstract objects. When we use numbers or hear a performance of a musical work, we are dealing with *instances* (or instantiations) of those abstract objects. This worldview directly informed the (relatively late) development of the modern concept of the musical work itself (Dahlhaus, 1991). The terminology of Peirce's type/token distinction (Peirce, 1906) has been adopted by Platonists to describe the relationship of musical works to their performances. In this schema, a *type* is analogous to a form, for example the word 'the' in the English language. In the sense of being a type, there is only one word 'the', but there are thirty-five *tokens* of it on this page. The main division in contemporary musical ontology is between Platonists and Nominalists (those who hold that abstract objects do not exist, see for example Kania, 2013). It is the former position that informed the development of the Romantic ideal of the creative artist. Dualist metaphysics in the Renaissance developed the idea of a timeless immaterial mode of existence which was separate from material reality, in part to try to solve problems of how to reconcile a universe which appeared mechanistic with free will. Descartes identified our being as free agents with an immaterial soul which interacted with the material brain and body via the pineal gland (Lokhorst, 2017). Although the cognitive-scientific worldview rejects this theory, dualism is still an implicit position for many people even within the scientific disciplines (Demertzi et al., 2009). That artistic creativity has its source in a nonmaterial realm and is the deliberate act of a free agent via their imagination then finds its articulation in Kant's *Critique of Judgement*. Kant's philosophy is explicitly dualist:

> Such representations of the Imagination we may call *Ideas,* partly because they at least strive after something which lies beyond the bounds of experience, and so seek to approximate to a representation of concepts of Reason (intellectual Ideas), thus giving to the latter the appearance of objective reality, - but especially because no concept can be fully adequate to them as internal intuitions. (Kant, 1790/1914, p. 66)

Kant's figure of the artistic genius, developed by subsequent philosophers such as Schopenhauer is the compliment of the idea of absolute music (Dahlhaus, 1991). The latter, the ineffable inhabitant of the Platonic realm of ideal forms, is brought into being as a willed act, in the imagination of the former.

This is the context from which the idealised model of improvisation described in this thesis is developed, and this makes clear why within this model prospective auditory imagery is seen as a necessary condition for improvisation to be creatively valid. Improvisation, seen as real-time composition, is like musical composition in general in that what is created is an abstract sound structure in the imagination of the composer. This is not *sufficient* for creativity as normally understood. As discussed in Chapter 2, the 'standard definition' of creativity links originality and effectiveness, which in the case of art is associated with aesthetic value. Runco and Jaeger (2012) make the case that the definition has a longer history than is usually supposed (or attributed); they trace its first unambiguous formulation back to Stein in 1953 but the concept can be inferred from *The Critique of Judgement.* Kant states that:

> We thus see (1) that genius is a *talent* for producing that for which no definite rule can be given; it is not a mere aptitude for what can be learnt by rule. Hence *Originality* must be its first property. (2) But since it also can produce original nonsense, its products must be models, *i.e. exemplary*. (Kant, 1790/1914, p. 63)

In this dualist worldview, originality is such that no definite rule can be given to the creative process, a position which is the antithesis of the notion that creativity is computable (Johnson-Laird, 2002). This situates creativity in the non-deterministic Platonic realm rather than the deterministic physical one, because if creativity were deterministic then, in principle, a set of rules could be specified. This is also entailed by the Romantic ideal of freedom, which regards free will as non-deterministic. Freedom was also a motivating factor for improvising for participants in Study 1.

In summary, Romantic ideals of creativity and freedom and the influence of dualist philosophy have informed a view of improvisation in which prospective auditory imagery is necessary but not sufficient for validation as a creative process. Platonism, Cartesian dualism and the concept of absolute music have also contributed to a view that creative improvisation is a non-deterministic free act of imagining sound structures which are instantiated in real time during performance. This is in contrast with Johnson-Laird's (2002) model which sees creativity as computable and more broadly with cognitive-scientific perspectives on improvisation. This raises the question of whether the still prevalent idealised conception of improvisation is partly due to implicit dualism on the part of improvisers and perhaps their educators. The next section will briefly review the evidence on contemporary dualism, leading to the aims of Study 5.

6.1.4 Contemporary Dualism and the Mind-Body Problem

Cognitive models of improvisation involve three levels of description, the computational level describes and operationalises the task goals, the algorithmic level describes the cognitive processes necessary to meet them and the implementation level specifies the neural substrates of cognition (Loui, 2018). What this exemplifies is the prevailing computational metaphor used to understand the mental aspect of complex human activity. This cognitive-scientific perspective is implicitly physicalist (materialist) in the sense that our thoughts and experiences are taken to belong to one level of description of what brains do, whereas the neural substrates of these belong to another level of description of the same phenomenon. This is incompatible with Cartesian dualism because the different levels describe only one kind of substance, namely matter. (For simplicity, matter and energy are considered here as aspects of the one material reality). There are different philosophical positions available within physicalism, for example *property dualism* holds that one kind of substance can have physical and mental properties, whereas *reductive physicalism* is the view that mental states simply *are* physical states (Forstmann & Burgmer, 2018). However, despite the cognitive-scientific consensus that rejects it, substance dualism is still influential in the contemporary debate which has become known as the mind-body problem (McGinn, 1989), a rough description of which is: what is the relationship between the physical body, often focusing on the brain, and the mind? One reason dualism might still have an intuitive appeal relates to our abilities to infer the mental states of others even though we know that these states are hidden, which gives rise to an implicit division into covert-mental and visible-physical (Forstmann & Burgmer, 2018). Another reason for the intuitive appeal of dualist views is what David Chalmers named the 'hard problem of consciousness' (Chalmers, 1995). This refers to the intuition that conscious processes, such as directing attention, integrating information or motor control are relatively easy to explain in terms of neural mechanisms without the sense that something has been left out. The hard problem refers to how to explain how and why any neural mechanism gives rise to conscious *experience.* The dualist solution is to say that the mind and the brain are separate, fundamentally different ontological kinds. Several studies have been carried out to investigate the prevalence of dualist beliefs, using different instruments, often to see if the measure of dualism correlates with other attitudes, for example belief in the paranormal. Stanovich (1989) developed a 27-item self-report measure of dualistic beliefs regarding the mind-body problem and found that among a sample of American undergraduates, their dualism score was positively correlated with their level of belief in extrasensory perception. Dualist views were relatively common even amongst medical and paramedical professionals, according to the findings of a study carried out by Demertzi et al. (2009), using a four-item dualism scale. Their first sample included 250 students at Edinburgh University, studying different academic disciplines. Those studying humanities-based courses were more likely than those studying the sciences to have higher dualism scores. A more surprising finding was from their second sample, comprising 1858 participants attending public or scientific meetings on consciousness in Liege, 782 of whom were medical professionals and 290 from paramedical professions. 39.5% of the medical professionals and 38.2% of the paramedical professionals endorsed a statement which distinguished the mind and brain as separate. Dualist preconceptions were also amongst the most popular responses by students of various disciplines (including psychology) to a mind-body questionnaire (Fahrenberg & Cheetham, 2000), who also thought that these views have practical consequences within their professional domains. There is also evidence from a study carried out with Swedish university students that dualistic beliefs are related to personal values. Grankvist, Kajonius, and Persson (2016) used a five-item Likert scale to assess dualistic beliefs and found a correlation with the results from a personal beliefs inventory. Participants with stronger dualistic beliefs attached less importance to power (prestige, social status, control of resources and people). These findings raise the question of the practical consequences that holding various positions on the mind-body problem might have for improvisers.

Hamilton and Hamilton (2015) advocate a set of pedagogical approaches for psychology students designed to engender a more critical approach to the implicit dualist assumptions they might hold. The authors argue that Cartesian dualist epistemology can be detrimental to learning and cite several studies in support of this assertion. There are, however, two problems with their position. The first is that although the literature they cite does associate having a dualist *epistemology* with poorer learning outcomes (for example Lonka & Lindblom-Ylänne, 1996; Ryan, 1984), the link between Cartesian dualism and epistemic dualism is not made. Whereas the former is a variety of substance dualism with direct implications for the mind-body problem, the latter relates to different conceptions of *knowledge.* In this context, dualism refers to an absolutist right-versus-wrong worldview and is contrasted with constructivist and relativist positions (Hofer & Pintrich, 1997; Muis, 2004). The second is that there are problems with the psychometric instruments used in the literature to measure epistemic beliefs (DeBacker, Crowson, Beesley, Thoma, & Hestevold, 2008). Some of these relate to a lack of rigour in the conceptualisation of epistemic belief, for example some measures include items about learning which are not strictly epistemic. For example, the Epistemological Questionnaire (EQ) (Schommer, 1990) has items such as "Successful students understand things quickly", which expresses a belief about learning rather than about knowledge. Others pertain to low levels of internal consistency and an over-reliance on empirical rather than theoretical foundations. One study did consider the effects of epistemic beliefs in the domain of music. Nielsen (2012) found that music students who believed that ability is fixed were less likely to use metacognitive and effort regulation strategies for musical practice. An interesting result of the multivariate analysis was that jazz students were more likely to hold that the ability to learn an instrument is fixed. Another finding of this study linked more sophisticated views on the structure of knowledge with the use of metacognitive, organisation and elaboration strategies. These findings need to be treated with caution because the measure of epistemic belief used was adapted from the Epistemological Questionnaire (EQ) (Schommer, 1990) in order to relate to music. Not only does the EQ contain items which are about learning rather than epistemic beliefs, the factor structure resulting from this multidimensionality has been criticised for being unstable (DeBacker et al., 2008). Nielsen's study therefore potentially inherits these problems from the EQ by also blurring the distinction between epistemic and learning beliefs and using an instrument with questionable reliability. The author carried out a factor analysis, partially replicating Schommer's factor structure with modest internal reliability (α's between .66 and .50). Despite these caveats, this study lends further evidential support for the link between attitudes to learning and self-regulation to musical practice and performance. This is directly relevant to this thesis, as the self-regulation has been found to be an important component of expertise in jazz improvisation (Biasutti & Frezza, 2009; May, 2003; Wopereis, Stoyanov, Kirschner, & Van Merriënboer, 2013).

6.2 Aims

The thematic analysis from Study 1 generated some themes which described some of the processes involved in improvisation for the participants. The use of multiple strategies, having an 'idea bank' of preformed ideas, being 'in the moment' and the need to pre-hear what is played were amongst those which are also mentioned in the literature (Berliner, 1994; Norgaard, 2011), but due to the nature of qualitative research the number of participants was small (N = 6). The primary aim of this study was therefore to see whether these themes were endorsed by a larger population of improvisers. A second aim was to see if there were any significant differences between students, musicians and educators, with the hypotheses that students would rate items relating to conscious processes and basic skills higher than the other groups. In addition, this study tested the hypothesis that the prioritisation of prospective imagery is positively correlated with implicit Cartesian dualism.

6.3 Method

6.3.1 Participants

Participants who were self-declared as either a music student whose instruction or practice included improvisation, a musician who improvises or an educator whose teaching includes improvisation were eligible to take part in the study (*N* = 114, 24 students, 74 musicians, 16 educators, 72 male, 39 female, 3 preferred not to say). The modal class of self-reported estimates of improvising experience (5-year intervals until over 30) was over 30 years. Recruitment was via distribution to students and staff by administrators in UK conservatoires and universities and via social media. One participant was excluded from the Likert analyses because they did not answer any of the rating questions. Participation was anonymous and the data confidential in line with the relevant ethics policies.

6.3.2 Materials

The survey was administered online on the Bristol Online Survey platform (Appendix 7). There were two sections, section 1 comprised questions about improvisation derived from Study 1 and the literature, whereas section 2 was a validated dualism scale (Preston, Ritter, & Hepler, 2013; Stanovich, 1989).

Section 1. There were 16 rating questions which invited a response on a seven-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). There were three versions of section 1 which differed slightly in the wording of five of the questions, depending on whether the routing in the survey directed the participant as a student, musician or educator. For example, a student or musician would see “I am completely free to play what I want to play while improvising”, whereas an educator would see “My teaching encourages students to develop to a stage where they are completely free to play what they want to play while improvising”. The reason for changing the wording for the educators was to focus their responses on this role rather than on their own practice as improvisers. Although for many in this group their practice could match their pedagogical stance, there also might be some who are no longer performers themselves. If so, wording that is appropriate for eliciting responses from students and musicians that reflect what they do during improvisation would not be appropriate. The sacrifice of direct comparisons between all groups involving these questions was therefore judged to be worth making for inclusivity. Questions 1 and 5, "When improvising, it is important to play in time" and "Good instrumental technique is needed for effective improvising" were designed to measure attitudes to the element of improvising expertise that Wopereis et al. (2013) named "basic skills" in their cluster map. Question 2 "Improvising well involves playing something new" relates to the creativity theme in Study 1. Question 3 "You have to take risks to improvise well" is informed by Study 1's subtheme 'comfort zone' and the cluster 'Risk-taking' from Wopereis et al. (2013). Question 8 counter-balances this in asking participants to rate their agreement with: "It is important to avoid errors while improvising". The 'sketch planning' theme from Norgaard (2011) also featured in Study 1 so Question 4 addresses this "During an improvisation, it is important to think of a plan for what will come next, so the improvisation has some structure, or 'tells a story'." Question 6 tackles the issue of prospective auditory imagery "Creative improvising involves pre-hearing in your imagination what you are going to play on your instrument before you play it". Interaction with other musicians and the audience were subthemes in Study 1 and was also captured by Wopereis et al.'s item "…who responds to other musicians" in their Responsivity cluster. In the present survey, Question 7 asks for a rating of agreement with the statement "Effective improvisers are aware of their environment and respond to what is going on", and therefore interrogates the wider concept of listening and responding to external factors including other musicians, the audience and features of the context. Question 9 refers to the degree to which improvisers value appropriateness to the idiom "Improvising well involves playing in a way that fits the idiom or style of the music". The extent to which improvisation involves conscious processes was an issue that arose in Study 1 and was treated as a potential feature of all the themes. Participants in that study expressed a lot of uncertainty about how conscious they were of the processes and strategies they used during idea generation. Question 10 "Generating ideas in improvisation mostly involves deliberate conscious processes" addresses the issue. Another theme from Study 1 'Idea Bank', which is also found in the literature (Berliner, 1994; Norgaard, 2011) motivated Question 11 "I have an 'idea bank' of musical ideas that I can use when I improvise". Similarly, multiple strategy use was investigated by Question 12 "I have many different ways to generate ideas while improvising". The subtheme 'in the moment' inspired Question 13 "Improvising is about being in the moment", while the 'creator and witness' phenomenon mentioned above motivated Question 14 "When I am improvising well, the music seems to happen without my being aware of how I am doing it". Freedom was a motivating factor for participants in Study 1, so Question 15 probes the Romantic notion of the free agent: "I am completely free to play what I want to play while improvising". Finally, there was a question relating to the creator/witness idea and to expert automaticity "My body knows what to do to improvise and I don't know or imagine what I will play before I play it." This question directly counterbalances Question 6 in that it can be interpreted as contradicting the idea of imagining the sound in advance. As such, this question offers an embodied alternative which should be anticorrelated with Questions 4, 6 and 10 and might correlate to an extent with Questions 13 and 14, since being 'in the moment' and the music happening without the feeling of conscious awareness of how, are consistent with not overthinking and letting the body get on with doing what it knows. As questions 4, 6 and 10 involve conscious processes, the mean rating for these three questions was calculated as a conscious processes index. Questions 13, 14 and 16 reflect non-conscious processes in the sense that being 'in the moment', the creator/witness phenomenon and the body 'knowing' what to do are the antithesis of conscious processes. These were therefore also combined to form a non-conscious processes index, with the hypothesis that the two indices would be negatively correlated. Questions 2, 6 and 15 correspond to Romantic Ideal subthemes of creativity and freedom in Study 1 and were therefore combined into a romantic ideals index. The section concluded with a free text response question which was worded slightly differently for each group. Students saw "Which elements of improvisation do you think your teachers emphasise as most important? Please comment briefly below." The version for musicians was "Which elements of improvisation do you think you emphasise as…" Educators saw "Which elements of improvisation do you think you emphasise as most important in your teaching? Please comment briefly below."

Section 2. This validated scale (Appendix 7) was the same for all participants, comprising 14 seven-point Likert questions and a free text response question at the end where participants were invited to give any further thoughts. This section asked participants about their attitudes to the mind and body. The original scale was developed by Stanovich (1989) as a measure of implicit theories on the mind/body problem held by non-specialists in this area and had 27 items. Factor analysis by subsequent authors and considerations of item complexity and questionnaire length resulted in scales with fewer items being developed (Demertzi et al., 2009; Grankvist et al., 2016; Hook & Farah, 2013). The dualism scale used in this study was a

14-item scale derived from items used in two experiments by Preston et al. (2013). Items such as “people have a non-physical soul (or spirit) that animates the physical body” and “A person’s soul persists after one dies” are compatible with Cartesian (substance) dualism. Reverse-coded items included “The mind is equivalent to the brain” and “One’s thoughts, personality, preferences, and choices are all just a product of brain functions”, which correspond to a physicalist view of the mind. The scores for the items on this scale which explicitly mentioned the soul were combined into a subscale called ‘substance dualism’, for theoretical reasons which are discussed in the next section.

6.3.4 Procedure

The following instructions were given at the beginning of the survey:

> In this part of the survey, you will be asked about different aspects of musical improvisation. Each question asks you to indicate on a scale (1-7) how much you agree or disagree with a statement about improvisation. For singers, where statements include a reference to your instrument, this refers to your voice. Please try to respond to each question according to your judgement and experience. If you find yourself thinking 'the answer depends on...', please use your judgement to give what you think is the best answer you can.

At the beginning of section 2, these instructions were given:

> In this section, the statements are about the mind/body. Philosophers have been debating what is called the mind-body problem for thousands of years, and there is still no broad agreement on the main issues. There are no 'right' answers and these questions are not dependent on the questions in section 1. Please indicate your level of agreement or disagreement with each statement (1-7).

In accordance with RNCM and CUK ethics procedures, respondents were advised that they could withdraw from the survey at any time without penalty and could decide not to answer some questions. They were told that by filling out the survey they were taken to have given informed consent. The final page thanked respondents for participating and gave contact details for myself and my supervisor in case they had concerns or questions.

6.3.5 Data Analysis

Statistical analysis was carried out using IBM SPSS version 22. Kolmogorov-Smirnoff tests were carried out to test normality. As this was an exploratory survey using ordinal data, a cautious approach was taken to avoid type 1 errors. There is some controversy over the use of parametric tests with ordinal data (although see Norman, 2010, for a defense of their use) and non-parametric tests with Bonferroni corrections were used where appropriate. Reliability analyses (Cronbach's alpha) were conducted on the improvisation and dualism inventories as a whole and also on each of the subscales derived from the improvisation section (Table 6.5). These were the basic skills index (BSI, questions 1, 5, 8, 9), the conscious processes index (CPI, questions 4, 6 and 10), the non-conscious processes index (nCPI, questions 13, 14, and 16) and the romantic ideals index (RII, questions 2, 6 and 15). Due to the multidimensionality of the dualism scale, Cronbach's alpha was also computed for the substance dualism subscale (SD), which combined questions 5, 6, 7, 11 and 14 from the main dualism scale (Table 6.5). Exploratory factor analyses were carried out on the improvisation measure to see to what extent the factor structure of the improvisation section of the survey corroborated the derived subscales. This procedure was repeated for the dualism scale to investigate the nature of its multidimensionality. The method used was principal axis factor analysis with varimax rotation using Kaiser normalisation. Correlations and group comparisons between the students and musicians for these subscales were carried out (Tables 6.6 and 6.7).

The thematic analysis was carried out with the aid of the Nvivo 10 CADQAS software. This program codes text at *nodes* which form a data structure which can be visualised and manipulated. The free text response for both questions for each respondent was copied into Nvivo as a separate source. This allowed for easy comparisons between their response to each section and cross referencing with their rating data. The next stage involved generating initial codes for the entire data corpus. Following this, these initial codes were aggregated into provisional themes, by comparing the contents coded at different nodes with each other and reviewing these to look for similarities and differences. Subsequently, overarching themes were identified which were separate for the improvisation and dualism responses.

6.4 Results

6.4.1 Improvisation Likert Questions

The mean ratings and standard deviations (relating to a 7-point Likert scale) for each improvisation question are shown in Table 6.1. It should be noted that questions 11, 12, 14, 15 and 16 have slightly different wording for the educators only, therefore direct comparisons involving the educators with these questions are not valid (questions indicated with a *). The students saw an identical set of rating questions to the musicians, with the only difference in wording being in the free text question, which invited them to comment further on the elements their teachers emphasised. As such, their rating results are directly comparable with those of the musicians.

There was a bias toward agreement for these questions, with only two having mean ratings below the midpoint of neither agree nor disagree (4) and Kolmogorov-Smirnoff tests showed that the data is not normally distributed, apart from in the case of two of the subscales, the Basic Skills Index and the Conscious Processes Index which are discussed below. This is probably because all the suggestions for possible elements of improvising were at least credible, however the data still clearly show which items were most endorsed. Considering first the results for all groups (Table 6.1), the importance of listening and being responsive was the highest rated, closely followed by 'being in the moment' and the idea of multiple generative strategies.

Table 6.1

Mean Improvisation Question Ratings

Group Question	Students Mean (*SD*)	Musicians Mean (*SD*)	Educators Mean (*SD*)	All Groups Mean (*SD*)
7. Effective improvisers are aware of their environment and respond to what is going on.	6.42 (0.88)	6.64 (0.65)	6.40 (0.63)	6.56 (0.71)
13. Improvising is about 'being in the moment'.	5.71 (1.04)	6.23 (1.27)	5.87 (1.55)	6.09 (1.28)
12. I have many different ways to generate ideas while improvising.*	5.13 (1.45)	5.81 (1.22)	6.27 (0.88)	5.73 (1.28)
3. You have to take risks to improvise well.	5.08 (1.77	5.89 (1.36)	5.33 (1.80)	5.64 (1.54)
14. When I am improvising well, the music seems to happen without me being aware of how I am doing it.*	5.04 (1.68)	5.66 (1.62)	5.33 (2.16)	5.49 (1.72)
5. Good instrumental technique is needed for effective improvising.	5.63 (1.24)	4.81 (2.08)	4.93 (2.02)	5.00 (1.94)
9. Improvising well involves playing in a way that fits the idiom or style of the music.	5.29 (1.46)	4.85 (1.88)	4.60 (2.23)	4.91 (1.84)
15. I am completely free to play what I want to play while improvising.*	3.58 (1.77)	4.80 (1.84)	6.27 (1.03)	4.73 (1.89)
11. I have an 'idea bank' of musical ideas that I can use when I improvise.*	5.21 (1.56)	4.47 (2.05)	4.67 (1.84)	4.65 (1.94)
1. When improvising, it is important to play in time.	4.96 (1.92)	4.15 (2.05)	5.27 (2.12)	4.47 (2.06)
6. Creative improvising involves pre-hearing in your imagination what you are going to play on your instrument before you play it.	4.54 (1.89)	4.27 (2.01)	4.80 (1.82)	4.40 (1.95)
4. During an improvisation, it is important to think of a plan for what will come next, so the improvisation has some structure, or 'tells a story'.	4.88 (1.90)	4.12 (2.01)	4.53 (1.81)	4.34 (1.97)
16. My body knows what to do to improvise and I don't know or imagine what I will play before I play it.*	3.88 (2.85)	4.19 (1.76)	5.80 (1.08)	4.34 (1.84)
2. Improvising well involves playing something new.	3.67 (1.79)	4.49 (1.92)	2.13 (1.92)	4.27 (1.91)
10. Generating ideas in improvisation mostly involves deliberate conscious thought processes.	4.75 (1.80)	3.27 (1.88)	3.07 (1.39)	3.56 (1.90)
8. It is important to avoid errors while improvising.	2.96 (1.63)	2.53 (1.69)	2.13 (1.41)	2.57 (1.65)

A summary of the mean Likert ratings and standard deviations for each improvisation item, the rank order is for all groups. Starred items have a slightly different wording for the educator group.

The lowest rated item was “It is important to avoid errors while improvising” (2.57) which contrasts with the third highest rated “You have to take risks to improvise well” (5.64). The other item below neutral was ‘’Generating ideas in improvisation mostly involves deliberate conscious thought processes” and was anticorrelated with ‘improvising is about ‘being in the moment’’ (r_s = -.339, 95% BCa CI [-.490, -.164,], p < .01). As expected, the conscious and non-conscious process indices were negatively correlated (r_s = -.382, 95% BCa CI [-.544, -.191], p < .01). This lends support to these indices measuring different dimensions of improvising, the first relating to consciousness and prospection, whilst the second tracks flow-like unselfconscious states. The educator group was excluded from this comparison because the non-conscious process index includes questions with different wording for them. Although the item ‘Creative improvising involves pre-hearing in your imagination what you are going to play on your instrument before you play it’ only had a mean rating of 4.40 with a standard deviation of 1.95, it was still the case that 35% of all participants either moderately or strongly agreed, and 55% agreed with the item to some extent. Some of the items in the improvisation (and dualism) sections were aggregated to form subscales. This was done based on the results of Study 1 and on theoretical considerations based on the literature. In this initial exploratory step, the mean of the scores for each item in the subscale was used without weightings. Table 6.3 gives a correlation matrix for all the subscales created in this way, for the student and musician groups. Educators were excluded due to them having five differently worded questions. Educators were excluded from the factor analysis for the 16-item improvisation survey due to the slightly different wording in five of the questions for this group, leaving 98 respondents. The Kaiser-Meyer-Olkin (KMO) measure for sampling adequacy was in the acceptable range, KMO = .70. The KMO results for individual items were all above the minimum of .5 apart from item 2 (Field, 2013). Five factors had eigenvalues over Kaiser’s criterion of 1 and when combined they explained 63.18% of the variance. The analysis was re-run, omitting item 2, giving an increased KMO of .73 with all the individual results over .5. Four factors had eigenvalues over 1 in this case, explaining 58.08% of the variance in combination. Due to the relatively low sample size and the number of items, Kaiser’s criterion might not be the best indicator of the most sensible solution in this case so after examination of the scree plot and the factor loadings, a three-factor solution was chosen, explaining

49.50% of the variance. The results of the exploratory factor analysis and reliability tests for the improvisation scale are shown in Table 6.6.

6.4.2 Dualism Scale Likert Questions

The mean ratings and standard deviations for the dualism inventory are shown in Table 6.2. Kolmogorov-Smirnoff tests showed that the dualism data is normally distributed, but the substance dualism subscale (discussed below) is not. An additional respondent was excluded from this part of the analysis because they only answered four questions in the dualism section. Two other respondents had one missing data point each in the dualism scale and these were replaced using the mean of their other ratings (Downey & King, 1998). The mean dualism score was 3.99 (*SD* = 1.02). The correlation between the dualism score and the prospective auditory imagery item in the improvisation section (Question 6) was not significant, (r_s = -.131, 95% BCa CI [-.310, .053] p = .156). The results of the factor analysis for the 14-item dualism scale are given in Table 6.7. As the questions were the same for all groups, only two respondents were excluded due to missing values, leaving 112 respondents. The KMO measure for sampling adequacy was in the acceptable range, KMO = .80. The KMO results for individual items were all above the minimum of .5 (Field, 2013). Three factors had eigenvalues over Kaiser's criterion of 1 and when combined they explained 59.12% of the variance. After examining the points of inflexion in the scree plot and the factor loadings, this solution was chosen.

Table 6.2

Mean Dualism Scale Question Ratings

Group Question	Students Mean (SD)	Musicians Mean (SD)	Educators Mean (SD)	All Groups Mean *(SD)*
2. It is impossible for science to ever have a complete understanding of the mind.	4.92 (1.72)	4.30 (2.01)	4.40 (2.06)	4.44 (1.96)
4. Whether one is a good or bad person can be completely altered by changes in the brain.*	3.88 (1.73)	4.11 (1.85)	4.50 (1.87)	4.11 (1.82)
12. The mind is a non-physical property.	4.63 (1.41)	3.82 (2.07)	4.57 (1.95)	4.09 (1.95)
10. In the future, it may be possible to know someone's personality by looking at their brain activity.*	4.42 (1.41)	3.91 (1.78)	3.71 (1.77)	3.89 (1.70)
6. People have a non-physical soul (or spirit) that animates the physical body.	4.58 (2.02)	3.53 (2.17)	3.79 (2.15)	3.79 (2.16)
9. The mind interacts with the brain, but is separate from brain.	3.79 (1.38)	3.68 (1.79)	3.93 (1.49)	3.74 (1.66)
13. In the future, it may be possible to know exactly what another person is thinking by looking at their brain activity.*	3.71 (1.57)	3.81 (1.96)	2.80 (1.70)	3.65 (1.87)
3. One's thoughts, personality, preferences, and choices are all just a product of brain functions.*	4.38 (1.66)	3.58 (2.05)	2.53 (1.77)	3.61 (2.00)
5. Aspects of mind that science cannot explain are best explained by the soul.	4.38 (1.61)	3.24 (1.94)	4.21 (2.19)	3.61 (1.96)
1. The mind is equivalent to the brain.*	4.08 (1.64)	3.57 (2.03)	3.00 (2.24)	3.60 (1.99)
7. A person's soul persists after one dies.	3.92 (2.02)	3.30 (2.16)	4.07 (2.34)	3.53 (2.16)
14. I believe the mind and soul are the same thing.	3.46 (1.38)	3.65 (1.88)	2.71 (1.49)	3.49 (1.76)
11. The true self is not governed by the brain, but by a person's soul.	4.00 (1.44)	3.16 (1.76)	3.71 (1.77)	3.41 (1.72)
8. Free will is an illusion produced by the brain.*	3.29 (1.81)	3.41 (1.94)	3.21 (2.15)	3.36 (1.93)

The mean ratings and standard deviations for the dualism scale are shown. The rank order is for all groups. The starred items are reverse scored.

6.4.3 Correlations, Group Comparisons and Reliability Analyses

Some correlations and comparisons of interest were carried out based on theoretical considerations, before the main body of statistical tests. The correlation between the Substance Dualism score and Improvisation Question 6 was not significant (r_s = .08, 95% BCa CI [-.098, .266], p = .405). Improvisation Question 16 correlated with improvisation Question 13 (r_s = .49, 95% BCa CI [.317, .624], p < .01) and 14 (r_s = .54, 95% BCa CI [.376, .701], p < .01). A Wilcoxon signed-rank test showed the higher rating for Improvisation Question 5 than Improvisation Question 1 was significant (T = 2243.50, p = .021, r = .15). There was also a significant positive correlation between the BSI and the CPI (r_s = .54, 95% BCa CI [.335, .628], p < .001).

The following group comparisons were also carried out. Levene's test showed that the homogeneity of variance assumption was met except for the novice/expert comparison with question 5. Question 10 was rated significantly higher by those with 5 years or fewer estimated years of improvising experience (U = 669.50, z = -2.22, p = .027, r = -.21). The student group also rated Question 10 higher than musicians (U = 503.50, z = -3.22, p = .001, r = -.23). Comparison of the CPI between these groups did not show a significant difference (U = 727.50, z = -1.70, p = .088, r = -.11). The means for the BSI for students and musicians/educators showed a significant difference (M_s = 4.52, SD = 1.43, $M_{m/e}$ = 4.11, SD = 1.31, U = 772.50, z = -2.02, p = .044, r = -0.13). A similar comparison of the BSI between the relative novices and those with over 5 years' improvising experience was not significant (U = 797.00, z = -1.25, p = .211, r = -.12). Both groups rated the item on technique (Question 5) highly (M_{novice} = 5.48, SD = 1.36 and M_{expert} = 4.90, SD = 2.04) and the difference was not significant (U = 865.00, z = -.76, p = .446, r = -.07). As these were hypothesised and tested before the other comparisons, the significance level is not corrected and the correlations involve the educators because these subscales have no differently worded questions.

Table 6.3

Spearman's Rho Correlation Coefficients

Sub-scales	1	2	3	4
Substance Dualism	-			
Romantic Ideal	.07	-		
Conscious Process	.019	(.20)	-	
Non-Conscious	.08	(.45**)	-.38**	-
Basic Skills	.15	.30**	.54**	-.06

Note: * = $p < .05$, **= $p < .01$, Bonferroni corrected. Figures in brackets refer to correlations between subscales with one shared item.

Table 6.4 gives the significance levels for comparisons between the student and musician groups for each subscale, Table 6.5 gives internal reliability results for the initial scales/subscales.

Table 6.4

Comparison of Mean Scores between the Student and Musician Groups

Subscale	Significance Level
Substance dualism	$p = .027$
Romantic Ideal	$p = .010$ *
Conscious Processes	$p = .022$
Non-conscious Processes	$p = .090$
Basic Skills	$p = .048$

The significance levels are for Mann-Whitney U-tests. * = significant $p < .05$, Bonferroni corrected.

Table 6.5

Internal Reliability Tests for the Initial Scales and Subscales

Variable	Cronbach's Alpha
Improvisation (all questions)	.59
Dualism Scale (all questions)	.81
Substance Dualism	.79
Romantic Ideal	.16
Conscious Processes	.67
Non-conscious Processes	.75
Basic Skills	.68

The educators were not included in analyses involving differently worded questions.

Table 6.6

Summary of the Exploratory Factor Analysis Results for the Improvisation Survey

	Rotated Factor Loadings		
Question	1	2	3
α =	.78	.79	-
6. Creative improvising involves pre-hearing in your imagination what you are going to play on your instrument before you play it.	.74		
9. Improvising well involves playing in a way that fits the idiom or style of the music.	.64		
5. Good instrumental technique is needed for effective improvising.	.62		
4. During an improvisation, it is important to think of a plan for what will come next, so the improvisation has some structure, or 'tells a story'.	.60		
1. When improvising, it is important to play in time.	.55		
8. It is important to avoid errors while improvising.	.50		
10. Generating ideas in improvisation mostly involves deliberate conscious thought processes.			
11. I have an 'idea bank' of musical ideas that I can use when I improvise.			
14. When I am improvising well, the music seems to happen without me being aware of how I am doing it.		.80	
15. I am completely free to play what I want to play while improvising.		.71	
16. My body knows what to do to improvise and I don't know or imagine what I will play before I play it.		.68	
13. Improvising is about 'being in the moment'.		.61	
3. You have to take risks to improvise well.			
12. I have many different ways to generate ideas while improvising.			
7. Effective improvisers are aware of their environment and respond to what is going on.			.73
2. Improvising well involves playing something new. (Excluded, KMO < .5)			

Factor loadings above .5 are shown. This level is regarded as significant for this sample size. Reliability for factor 3 could not be tested as it had only one item loading above .5.

Table 6.7

Summary of the Factor Analysis Results for the Dualism Scale

	Rotated Factor Loadings		
Question	1	2	3
α =	.92	.75	.50
6. People have a non-physical soul (or spirit) that animates the physical body.	.93		
5. Aspects of mind that science cannot explain are best explained by the soul.	.88		
11. The true self is not governed by the brain, but by a person's soul.	.81		
7. A person's soul persists after one dies.	.75		
2. It is impossible for science to ever have a complete understanding of the mind.	(.50)		
12. The mind is a non-physical property.	(.41)		
10. In the future, it may be possible to know someone's personality by looking at their brain activity.*		.83	
13. In the future, it may be possible to know exactly what another person is thinking by looking at their brain activity.*		.70	
3. One's thoughts, personality, preferences, and choices are all just a product of brain functions.*		(.50)	
14. I believe the mind and soul are the same thing.			
8. Free will is an illusion produced by the brain.*			
1. The mind is equivalent to the brain.*			.66
9. The mind interacts with the brain, but is separate from brain.			-.57
4. Whether one is a good or bad person can be completely altered by changes in the brain.*			
Factor loadings above .5 are shown. A factor loading above .512 is regarded as significant for a sample size of 100 (*N* = 112).			

In addition to the scale ratings, participants stated what their main instruments were and gave an estimate of how many years of improvising experience they had.

6.4.4 Thematic Analysis of Free Text Responses

The survey gave an opportunity for respondents to add comments at the end of each section via a free text response question. As discussed in 6.3.2, the improvisation question for musicians invited further comments on which elements of improvisation they emphasise as important, with slightly different wording for students and educators. 92 participants responded to this question, whereas 35 participants responded to a similar question at the end of the dualism section, which invited further thoughts on the mind and body. The five main themes from the thematic analysis of the improvisation data is given in Table 6.8.

Table 6.8

Main Themes and Example Subthemes, Improvisation Data

Main theme	Subthemes
Basic Skills	Idiom, Technique, Rhythm
Awareness	Listening, Communication with Other Players, Responsivity,
Attitudes, Emotions	Risk Taking, Openness, Centred
Creativity	Spontaneity, Originality, Creating Colours in Sound
Non-cognitivist	In the Moment, Intuitive, Movement
The main themes are listed from highest to lowest number of references per theme.	

The *Basic Skills* (95 references) theme included references relating to core skills in improvisation. The subtheme ''inner hearing" was included in this theme based on the exploratory factor analysis of the improvisation survey data. An example response coded at *Idiom* was "Make sure what is played is suited to the piece in the given genre" (student, female, drums, 1-5 years improvising experience). There were 10 responses that either explicitly mentioned technique or an equivalent concept, as in the following "Facility on your instrument" (educator, male, trombone/voice, experience not disclosed). The theme *Rhythm* also had 10 responses, often in the context of a list of important elements, which is to be expected given the question "Which elements of improvisation…" as in this example "Listening, intonation, tuning, rhythm" (musician, male, piano, 16-20 years).

Awareness (50 references) captured those responses relating to listening, being aware of the environment, being aware of others and responsivity. Some examples include "Listening and responding" (musician, male, guitarist, over 30 years improvising experience), "If improvising with others, listening out to what they are playing", (music student, female, pianist, 25-30 years' experience) and "an ability to dialogue" (educator, preferred not to answer, pianist, over 30 years' experience).

Responses related to attitudes, such as being open, being in the correct frame of mind (centred) and the attitude to risk taking were included in *Attitudes, Emotions* (21 references) along with emotional aspects like pleasure, or fear of making errors. The following quotation was coded at the subthemes *Risk Taking* and *Fear of Making Errors* "…and mistakes can happen since we experiment, but if we don't dare because of fear of making a mistake then the improvisation might become not alive, boring, drilled in and predictable" (musician, female, violin, 1-5 years).

Creativity (20 references) included references to spontaneity and originality as well as those which explicitly used the term "creativity", as the following quotation illustrates "time alone exploring your instrument to come up with new things - new pitches, things that have never been tried by you before such as chords on flutes" (musician, female, flute, 21-25 years).

The final main theme was *Non-cognitivist* (18 references), which gathered together responses evincing the opposite of conscious, deliberate processes that invoke the cognitive metaphor. The title is not meant to imply that cognition is not a feature of the processes, rather it implies that their basis can be distributed and embodied rather than conforming to cognitive models. The following was coded at the subtheme *In the Moment* "being in the moment, high degree of presence and attention" (musician, male, saxophonist, over 30 years' experience). Three responses were coded at *Intuitive*, this being a good example "sometimes to ignore the conscious mind & completely embrace the intuitive" (musician, male, saxophone, 26-30 years). Other responses were coded under subthemes *Movement*, *Body* and *Flow*.
The results of the thematic analysis for the dualism scale are given in Table 6.9.

Table 6.9

Main Themes and Example Subthemes, Dualism Scale

Main theme	Subthemes
Non-Dualist	Scepticism, Reductive Physicalism, Philosophical
Dualist	Substance Dualism, Other Dualist Categories
Critique of Questions	Bad Questions, Definition of Terms, Good Questions
The main themes are listed from highest to lowest number of references per theme.	

Non-Dualist had the largest number of references (22) in the dualist section. As fewer participants responded to the dualism free text response question than to the equivalent question at the end of the improvisation section, the number of references and subthemes is lower. This main theme aggregated the different kinds of non-dualist responses. The following quotation is representative of many responses coded at *Scepticism* “The soul is an abstract concept requiring blind faith. The mind and body constitute a more reasonable and tangible means of quantifying human traits using evidence. I prescribe a healthy dose of skepticism for the rest” (musician, male, double bass, 26-30 years).

The *Dualist* main theme has 17 references. Its largest subtheme *Substance Dualism* contains responses which endorse the existence of a soul or non-material mind as distinct from the brain, as in this example “However, I believe the soul occupies more than just a person's brain (or mind)” (musician, female, voice/piano, over 30 years). Dualist positions such as interactionism and property dualism which were not based on differences in substance were coded at the subtheme *Other Dualist Categories*. The following quotation is an example of property dualism “I think consciousness is just a property that arises from information interacting with itself in an extremely complex manner” (musician, male, piano, 11-15 years).

The *Critique of Questions* main theme was the third largest (16 references) and apart from the three references in the subtheme *Good Questions* these responses were critical of the dualism questions. The following quotations give an indication of the kind of objections raised:

> Most of the questions are bad questions since the questioner does not define his understanding of mind, soul, etc. No differentiation between traditional understandings of nous, psyche , areas such as emotion, desire or appetitive function. A ghost in the machine notion is proposed but most research today no longer thinks along these lines nor does it ignore the role of emotion. It is also not clear what is understood by the word ‘science’ or whether this is conceived as only what we can currently measure or in its older and perhaps newer meaning of what we can know (from ‘scire’?). For these and other reasons I find these questions unanswerable and, Im sorry to say, invalid from a research point of view unless you want to show that

> people have very fuzzy ideas about what they think these words might mean to them (musician, prefer not to say, pianist, over 30 years' experience).

In this example, the respondent expresses what could be interpreted as the inability of the questions to capture the nuances of her position:

> I think we have an embodied mind and that improvising involves highly sophisticated processing at an essentially physical level. I do not consider the soul to be an explanation of this & that some questions were misleading - so I answered these as neither agree nor disagree (musician, female, piano/percussion, over 30 years' experience).

6.5 Discussion

This study investigated the importance of some elements of improvisation and possible links with implicit dualism by means of a survey. The main aims were to see whether themes from Study 1 generalise to a larger population of improvisers, and to test the hypothesis that the rating of the importance of prospective imagery in improvisation positively correlates with dualism score. Two group difference hypotheses were tested, that the conscious processes item would be rated higher by students than the other groups, and that they would rate basic skill elements as more important. Some additional hypotheses were developed during data analysis and will be discussed below. The study found that the tested themes from Study 1 were endorsed by respondents. However, no correlation was found between the prospective auditory imagery rating and the dualism score. Evidence was found in support of the group difference hypotheses.

In terms of the similarities and differences in rank order between groups in the improvisation section, all groups rated Question 7 highest and question 8 lowest. As only one of the individual item comparisons between the students and musicians reached significance after corrections for familywise error, conclusions based on these group-wise rank order results should be treated with caution. It should be noted that Bonferroni corrections result in conservative significance values, however. The item which was significantly different was Question 10 "Generating ideas in improvisation mostly involves deliberate conscious thought processes". This was rated significantly higher by students than by musicians. The same caution needs to be exercised in interpreting the dualism scale rankings as with the improvisation items. The dualism scale has shown good internal reliability in previous studies (Preston et al., 2013), and the value of Cronbach's alpha for this study was .81, also showing good reliability. The student and educator group sample sizes are small (24 and 16) and running multiple tests to compare ratings of items within groups would inflate familywise error (Field, 2013). However, looking at the pattern of ranking for the starred (reverse-scored) items in all participants, as well as individual groups, is at least suggestive that the responses were not consistent with a unidimensional interpretation of dualism. This also raises questions about the construct validity of the items. For example, in the student group, question 4 "Whether one is a good or bad person can be completely altered by changes in the brain*" has the highest mean rating, whereas question 3 "One's thoughts, personality, preferences, and choices are all just a product of brain functions*", has the lowest. The possibility of interpreting these findings in the context of dualism being a multidimensional construct is discussed in the next section.

Some of the themes from Study 1 have been reflected in the responses in this survey, suggesting that they might generalise to a wider population of improvisers. That the highest rated improvisation item was about being aware and responsive reinforces the finding from Study 1, that participants commented on how different playing to a backing track is to improvising with others and having an audience response (coded under Ecological Validity and Communication). No one disagreed with this item and the main theme from the thematic analysis in this study *Awareness,* which relates to this item, had the second highest number of responses. This finding also agrees with the literature, for example, Biasutti (2015, p. 3) characterises improvisation as an "Interactive process. It has an adaptable nature, it allows you to answer to context variables, it can be adjusted instantly. Challenge between performers, taking risks." The item about risk taking also scored highly in the survey, whereas the lowest scoring item "It is important to avoid errors while improvising", was one of the two with a mean rating in the 'disagree range'. A risk in improvisation is that one might commit errors which cannot be revised or edited, in contrast to the process of composition. It is reasonable to interpret this result as a relative valuing of the risk side of the trade-off between being musically adventurous and striving to be error-free. The responses coded at *Risk Taking* in the thematic analysis also support this interpretation, the quotation from the subtheme above characterising not taking risks leading to improvisation becoming boring and predictable. It might be thought that the item “Improvising well involves playing something new” would relate to the concept of risk taking because it requires the inherently risky avoidance of the familiar, but this item was ranked fourth from lowest. A visual inspection of the distribution of the responses from each group shows that risk taking ratings are skewed towards the higher end, whereas ratings for novelty are more evenly spread (Appendix 11). The questions are worded slightly differently, but if anything, the greater emphasis in *you have* to take risks ought to have produced the opposite effect, with participants who were unsure of the absolute necessity being more neutral or disagreeing.

The items pertaining to ‘being in the moment’ (question 13) and the creator and witness phenomenon (question 14) also both scored highly, although another item that might have been expected to be associated with these “My body knows what to do to improvise and I don't know or imagine what I will play before I play it” (Question 16) was rated fourth from lowest. However, it was significantly positively correlated with the “in the moment” and the creator and witness items. These comparisons excluded the educator group due to the involvement of differently worded questions. That the second lowest scoring item was “Generating ideas in improvisation mostly involves deliberate conscious thought processes” (mean score = 3.56) raises interesting questions. Improvising is clearly not regarded as a simple opposition between Romantic ideals and a cognitive-scientific view informed by the embodied cognition paradigm. If improvisers value being in the moment and flow states in which the music seems to happen without conscious deliberation, then it could be that participants see the source of the improvising behaviour as situated in the unconscious mind, but do not see the mind as embodied to the extent that they would ascribe agency to the body per se. That the indices denoting conscious versus non-conscious processes *were* negatively correlated does suggest an opposition between deliberate thinking and conscious imagination on the one hand, and states that are much less self-conscious on the other. Arguably, the non-conscious processes index could be associated with an appreciation of the importance of ‘flow’ in improvisation (Biasutti & Frezza, 2009). Flow states are characterised by pleasurable absorption in a task which balances the required (high) skill with an agent’s capabilities and sometimes results in distortions in the perception of time (Csikszentmihalyi & Lefevre, 1989). The main theme *non-cognitive* had subthemes *in the moment*, *flow* and *body.* Seven responses specifically referenced ‘being in the moment’ or the ‘now’ and two mentioned flow explicitly. Participants in Study 1 linked pleasurable absorption as motivating states with being ‘in the moment’ and with instances “where you're just kind of, creating and not thinking about it” (Pianist, Male, 26, Study 1). Flow states have also been linked to creativity in musical composition (MacDonald, Byrne, & Carlton, 2006). Although being ‘in the moment’ might also indicate a transformation of time and some of the other characteristics of flow such as lack of self-consciousness, the creator/witness phenomenon might represent a distinct state. It is sometimes portrayed as a feeling of the ‘music playing the performer’ (Berkowitz, 2010), a kind of letting go of control, which contrasts with the ‘sense of control’ dimension of flow. Question 14 is framed in terms of a lack of awareness of *how* the music is produced rather than a lack of control per se, but the extent to which people feel in control when they are unaware of how they are carrying out an activity is a complicated issue. Further research could clarify how closely the index created here reflects an endorsement of flow as being important in improvisation.

A finding from previous dual-task paradigm and speak aloud protocol experiments is that experts tend to be less consciously aware of what they are doing (Fidlon, 2011; Norgaard et al., 2016), leading to the prediction that those with less improvising experience should rate Question 10 “Generating ideas in improvisation mostly involves deliberate conscious thought processes” higher than those with more experience. A comparison of the ratings of those who reported up to 5 years of improvising experience with those with over 5 years’ experience showed that this was also the case with these improvisers, with the former group rating the item significantly higher, in line with the prediction. However, a similar comparison for the conscious processes index score between the same expertise-level groups was not significant. These comparisons involved the educators group because none of the consciousness questions have different wording. Interestingly, the one comparison between of mean ratings of individual improvisation items between the student and musician groups which was significant after Bonferroni correction was question 10. The inclusion of the modifier ‘deliberate’ was to make a distinction between conscious skilled but often automatic behaviour, as for example when driving we only become fully aware of the process if something unusual happens (like a cat running into the road) and being aware of the thought processes involved in thinking of what to play next. Students rated this significantly higher than musicians, which is in line with the hypothesis mentioned above that experts exhibit less conscious deliberation over what to play next.

The ratings for questions 1, 5, 8 and 9 all relate to basic skills (Wopereis et al., 2013) like playing in time, having good technique, avoiding errors and playing in a genre-appropriate way. These items were therefore combined to form a basic skills index (BSI) with two hypotheses. The first is that this index would have a higher average rating for music students than musicians or educators. The idea behind this was that for those currently receiving music education, their focus would be more likely to be on the importance of developing basic skills, whereas working musicians might have a different focus, emphasising listening, creativity and communication. That is, basic skills might be taken as a given by working musicians and educators, therefore other factors which discriminate between able and less able improvisers might be seen as relatively more important. The second hypothesis is that the BSI should positively correlate with the conscious processes index (CPI) because those who are still at a stage where they are focused on basic skills are less expert, which in turn is associated with more conscious deliberation. The data supports both hypotheses, with the means for the BSI for students and musicians/educators showing a significant difference. As was expected, there was also a significant positive correlation between the BSI and the CPI, because those focusing on basic skills are likely to be less experienced. It might be thought that the difference in BSI would also been seen in a comparison between those with less than 5 years' improvising experience and experts, with relative novices having a greater emphasis on basic skills, however, this was not significant. This could be because some of those with the most experience are educators, who might still hold the inculcation of basic skills as important. Also, it might be the case that some of the items for the scale, such as instrumental technique, are still endorsed as a necessary condition even if they are not a primary focus. This is supported by the mean ratings for each group for the instrumental technique item being high and not significantly different. Table 6.3 shows the correlation matrix for all the subscales. CPI and nCPI were negatively correlated as expected, although this was a lower correlation than is desirable. The correlation between the RI and nCPI can be partially explained by the overlapping item shared by both indices, which is question 13. BSI and CPI were positively correlated as noted above, but less expectedly the RI and the BSI had a small positive correlation. The explanation for this is that the RI was not found to be reliable ($\alpha = .16$) and as it shares one item with the CPI (question 6) and one with the nCPI (question 13) correlations involving the RI and these scales should be disregarded.

Another subtheme of improvising described in Study 1 and endorsed by the survey respondents was the item on multiple strategy use, which had the third highest average rating (5.73). This result agrees with previous findings (Hargreaves, 2012; Norgaard, 2011, 2016) and adds support to the results of Study 1 regarding generative strategies in improvisation. Harmonic, melodic and rhythmic elements were often mentioned, as in the following "intuitive understanding of harmonic theory that can be applied on the fly, a good sense of what a beautiful melody is and the ability to take a theme and incrementally develop it" (musician, male, pianist, 11-15 years' experience). Another participant mentioned the interrelation of melodic and harmonic features "involvement in the music (sound, rhythms, melodic/harmonic relations) [line break] interaction" (musician, saxophonist, male, over 30 years' experience), raising the issue of whether generative strategies have clear boundaries. Norgaard (2011) identified the generative strategies harmonic priority in which ideas are inspired by the chordal accompaniment and melodic priority in which intervallic relations and melodic considerations are most important. In practice the particular melodic priorities that are applicable might well depend to a large extent on the harmonic context, making for a melodic/harmonic relation strategy.

The theme from Study 1 which also featured in Norgaard's (2011, 2016) studies was investigated with the item "I have an 'idea bank' of musical ideas that I can use when I improvise." Educators saw: "I encourage students to develop an 'idea bank' of musical ideas that they can use when they improvise." Eight of the sixteen educators agreed with this to some extent, whereas 18 out of 24 students and 47 out of the 74 musicians agreed with their version of the item. The mean rating (4.65) was lowered by the 21 musicians who strongly and moderately disagreed, which could be due to this group having a contingent of non-idiomatic improvisers, but as genre data were not collected it is not possible to verify this.

Of the two 'basic skills' items, the importance of good instrumental technique was rated slightly but significantly higher than playing in time. This could be due to good instrumental technique being regarded as a given by idiomatic improvisers, which is also supported by the thematic analysis: “Having a good technique allows you to concentrate on generating the improvisation rather than the physical playing”, (musician, male, saxophonist, 16-20 years’ experience). Although the *ability* to play in time is arguably also a given and partly constitutive of technique, there is perhaps some ambiguity in the statement “When improvising, it is important to play in time”, as this could be interpreted as the necessity for ‘strict’ time. The following quotation illustrates this: “Knowing how to play around with the the musical pulse whilst remaining in time.” (student, female, viola player, 1-5 years’ experience). Whilst both the students and the educators had a positively skewed distribution for the playing in time item, the musicians were more polarised, 12 strongly disagreeing, 13 strongly agreeing and 21 being neutral. This item had the highest standard deviation.

Freedom, creativity and being in the moment were related themes from Study 1 which, as was argued in the introduction to this chapter, are elements of Romantic concepts of the improviser. Given that creativity is not seen as algorithmic or deterministic within this worldview, freedom is seen as a necessary condition of creative improvisation. It is also a motivation for improvisers: “I think there is, in anybody who improvises, a desire for some version of freedom, or their idea of freedom” (David Toop, quoted in Burnard, 2012, p. 156). The item “I am completely free to play what I want to play while improvising” was deliberately framed with the modifier ‘completely’ such that strong agreement was intended to situate respondents within the Romantic idea of freedom, rather than a more cognitive freedom-within-constraints stance. (The version for educators asked if their teaching encouraged students to develop to this stage). Despite the high bar set by ‘completely’, the item was still rated eighth (just inside the highest half), with an average rating of 4.73 (1.89). That the notion of freedom as linked to being in the moment and taking risks, in contradistinction to the mechanistic and the predictable was evident from the thematic analysis and illustrated by the quotation on p 149. Other responses link freedom to intuition, to the body and to flow, whereas the following coded at *freedom* seems to recognise that freedom is circumscribed: “Freedom is not freedom to 'do anything'. Freedom is dealing with consequences those of your actions and the actions of others and rubbing them together till [sic] they spark” (musician, male, ‘whatever is to hand’, 21-25 years’ experience). This recognises that freedom, be it negative ‘freedom from’ or positive ‘freedom to’ is situated within a context of encounters with others and a responsibility to the integrity of improvising (Peters, 2009).

The hypothesis that the rating for the prospective auditory imagery item would be positively correlated with the dualism score was not supported by the data. One reason for this could be that the necessity to employ prospective auditory imagery is not specifically related to dualistic beliefs or a Romantic conception of the improviser-as-creative-artist. Rather, pre-hearing in the imagination could be a norm of improvisation that is not only compatible with non-dualist views but also one that is just as likely to be adhered to by non-dualists (in the Cartesian sense). There is no necessary contradiction in an improviser holding a physicalist stance whilst thinking she should play what she means and to really *mean* it, she must first *imagine the sound* of it. The set of norms within the social practice of improvising can therefore be adopted irrespective of implicit dualism or its lack. Conflict would only arise if there were an explicit consideration of the ramifications of a worldview that was incompatible with this conception of improvising. To be experienced as conflict, this incompatibility would have to result in a form of cognitive dissonance. This is perhaps unlikely, as the kind of philosophical reasoning that would reveal such an incompatibility is a specialist pursuit and even then, could equally be used to find a compatible solution given the cognitive bias of motivated reasoning (Kahan, 2012). In any case, people can and must tolerate internal inconsistency in practice however much they value it as an ideal. For example, even if one is committed to the norm of consistency within a domain where it might seem appropriate, like assessing the truth of propositions, the paradox of the preface (Makinson, 1965) bites in the following way. Suppose an agent A believes the propositions p_1, $p_{2, \ldots}$ p_n are true, but also, due to knowledge of their own fallibility, that they are likely to be wrong about at least one of them. If we call the proposition that at least one of them is false p_f, then the set p_1, $p_{2, \ldots}$ $p_{n\,,}$ p_f is such that to believe all of them is inconsistent, even though A has good reason to do so. If the impossibility of consistency arises in such an arid domain as formal logic, then it is likely that some inconsistencies in beliefs could be encountered by improvisers. The results of Study 1 showed that improvisers were aware of not meeting ideals and had strategies to deal with this despite their tendency to moral perfectionism. So, even if they became aware of an inconsistency between their physicalist stance and their image of the creative improviser, they might simply compartmentalise in order to avoid cognitive dissonance (Bortolotti, 2003).

That is, someone can hold mutually incompatible sets of beliefs in separate 'compartments' in their minds to avoid any two contradictory beliefs being brought to conscious attention simultaneously. More succinctly, they might just avoid over-thinking it.

Another reason that no correlation was found might be due to the limitations of the dualism scale used to measure attitudes. The results of the factor analysis will be discussed in the next section (general limitations will be considered in the final part of this chapter). Although the dualism scale has good internal reliability (Preston et al., 2013; Stanovich, 1989), there are some doubts as to its unidimensionality, in other words it is not clear that the items are really measuring a single construct. In developing the original scale, Stanovich (1989), explicitly states that different items reflect different aspects of dualism (substance dualism, property dualism) and philosophical positions (identity theory, eliminative materialism), but still used the scale to produce a single dualism score. Riekki, Lindeman, and Lipsanen (2013) adapted the scale by simplifying some items, excluding others and introducing new items which targeted *monism* (minds and bodies are the same) and *emergentism* (minds are qualitatively distinct from brains, but interrelated). Their factor analysis identified three factors which they identified with monism, emergentism and *reflective dualism* (mind and body are qualitatively different). Forstmann and Burgmer (2018) conducted a factor analysis on a similar twelve-item scale and concluded that it measured two separate concepts, substance dualism (the mind and brain are separate substances) and reductive physicalism (the mind can be reduced to the physical brain), which were negatively correlated with each other. Moreover, they found that substance dualism but not reductive physicalism predicted belief in free will. The free will issue is directly relevant given that Romantic conceptions of creative improvisation involve willed creative acts of imagination, for which free will would be a prerequisite. This is also relevant to the present study given that the dualism scale used here has a free will item: "Free will is an illusion produced by the brain". Using this item in a scale designed to produce a single dualism score is problematic, because there is a popular current philosophical stance on free will which holds that it is compatible with determinism (Fischer & Ravizza, 2000; Forstmann & Burgmer, 2018; Nahmias, Morris, Nadelhoffer, & Turner, 2005). What this means is that it is perfectly possible to be a reductive physicalist (even if this is also held to entail determinism) and yet reject the notion that free will is an illusion, providing one interprets this as *compatibilist* free will. A consideration of the items of the dualism scale used in the present study suggests that they too track distinct concepts just as the scale used by Forstmann and Burgmer (2018), but there are more than two concepts involved. For example, items that mention 'the soul' as non-physical or as surviving death, are measuring substance dualism. On the other hand, items such as "the mind is equivalent to the brain" seem to be measuring reductive physicalism, whilst "The mind is a non-physical property" is clearly a framing of the label *property dualism* into a question. This is problematic in part because these categories are far from exhaustive in this complex area. One could adhere to variety of property dualism such that there is only one substance, but also hold that although the mind is a property of the physical brain, it is not reducible to it. This non-reductive physicalism would not be adequately disambiguated by the scale; a property dualist might not agree that the mind is equivalent to the brain, but nor would they agree that the mind and brain are different ontological kinds. By contrast, a property dualist might give a high rating to the item "The mind is a non-physical property" depending on their ontology of properties. This is because it is not clear that a property is a *physical* entity. This item seems therefore to fail to disentangle substance and property dualism, despite these stances being distinct and having very different ontological commitments. Further, items such as "In the future, it may be possible to know exactly what another person is thinking by looking at their brain activity" conflates the epistemic issue of what it might be possible to know *in principle* with the ontological issue of the relation between mind and body. This shows the difficulty of assessing beliefs in such a complex domain with a questionnaire. Even if a factor analysis and reliability measure are conducted, this is no guarantee that what is measured corresponds with how a researcher interprets the construct. For example, in measuring free will beliefs, Forstmann and Burgmer (2018) include items such as "A supercomputer that could know everything about the way the universe is now could know everything about the way the universe will be in the future" in a determinism subscale. However, this conflates determinism with predictability which are not only distinct but more importantly, determinism does not imply predictability *even in principle,* as in mathematically chaotic systems future states can be unpredictable *and* deterministic. It might be thought that such esoteric concerns might not be relevant to the issue of improvisation but there is evidence that implicit and intuitive 'folk' beliefs about dualism and free will can affect judgements and behaviour (Forstmann, Burgmer, & Mussweiler, 2012; Mehta, 2011). To explore whether the multidimensionality of the dualism scale is a factor in this study, a substance dualism subscale was created by scoring all the items that explicitly refer to the soul (5, 6, 7, 11 and 14). However, this was not correlated with ratings for the prospective imagery question either. A factor analysis involving both sections of the survey was therefore carried out to investigate the data further.

The rotated factor solution for the improvisation section of the survey yielded three factors (Table 6.6). As questions 1, 5, 8 and 9 loaded onto factor 1, this closely resembles the basic skills index (BSI), but with two additional items, questions 4 (importance of planning) and 6 (pre-hearing what is to be played). This is consistent with the interpretation given above that the norm of prospective auditory imagery is seen as a basic skill of improvisation and is independent of metaphysical considerations. Norgaard's (2011, 2016) theme of sketch planning was also a theme of Study 1, and the responses of the participants were compatible with this being part of the craft of improvising. It seems reasonable that this factor should retain the name 'basic skills'. Factor 2 resembles the non-conscious processes index, combining 'in the moment', the creator/witness phenomenon, and the body knowing what to do, with the extra item of being free (questions 13, 14, 15 and 16). These items all suggest that a suitable designation for the factor is 'flow'. Even though the creator/witness phenomenon differs from some definitions of flow (Csikszentmihalyi & Lefevre, 1989) in that control is in a sense ceded to the music, all of these items are compatible with an immersed engagement and connection with music which characterises flow states. The third factor had only one item with a significant loading, which was question 7 "Effective improvisers are aware of their environment and respond to what is going on". This factor was therefore called 'responsive awareness', although the loading by only one item is probably indicative of the need to refine the design of the survey. This item had the highest mean rating, lowest standard deviation and nobody disagreed with it. The other two factors had an acceptable level of internal reliability (α = .78, .79) for this exploratory stage of research (Lance, Butts, & Michels, 2006). The Romantic ideals and conscious processes indices were not supported. The former had a very low value of Cronbach's alpha (α = .16 Table 6.5) and Question 6 features in both sub-scales, and ordinarily items do not appear in more than one factor, hence the factor structure revealed by the analysis is more rigorous.

The factor analysis for the dualism scale also suggested that three factors best represent the data. Forstmann and Burgmer (2018) carried out a principal component analysis and extracted two factors which they equated with substance dualism and reductive physicalism. They did this on the basis that the items that they found which loaded on the first factor were predominantly those relating to the concept of a soul, whereas on the second the items related to whether the mind is reducible to attributes of the brain. This study used exploratory factor analysis with a smaller sample size, which might explain why the solution is different. The two solutions do agree regarding substance dualism, however. Table 6.7 shows that the four items with significant loadings on factor 1 all explicitly mention the soul, hence a suitable designation for this factor is *substance dualism*. Given that question 6 specifically identifies the soul as non-physical and question 7 mentions the possibility that the soul persists after one dies, two different kinds of substance are implied for anyone who accepts the existence of the material universe. One is a physical substance which constitutes matter and includes the brain and the other is non-material and can exist independently after the brain decomposes. However, factor 2 differs from Forstmann and Burgmer's reductive physicalism factor in the following way. The two significant loadings on factor 2 are both epistemic rather than ontological questions (10 and 13). They are suggesting that it might be possible to *know* what someone is thinking or their personality from their brain activity. The underlying assumption motivating these questions might be that in order to know A given B, A must completely depend on B in some way. For example, suppose that what someone is thinking *supervenes* on their brain processes. That would mean that there could be no changes in what they were thinking unless there were corresponding changes in their brain processes. A further deduction is required to identify this as reductive physicalism, which is that the supervenience relationship between thought and brain processes, *rules out* an immaterial soul. This assumption is made by Riekki et al. (2013) as evidenced by their inclusion of one of Stanovich's original items "For each thought that I have, there exists a certain state that my brain is" in their monism factor. Although this deduction has an intuitive appeal on the grounds that it seems to make the soul redundant in explanatory terms, it does not strictly follow. One could be a Cartesian dualist and think that the soul interacts with the brain and *both* are necessary for what we call thought in the material realm. In other words, if the physical brain is an essential mediator between the thoughts originating in an immaterial soul and the material realm in which they can influence behaviour, the supervenience relation implied by this item could still hold. Also, as pointed out above, respondents could fail to endorse these items purely on epistemic grounds if they thought that there were limits in principle to what could be found out by brain scanning techniques. Since this could be independent of their ontological stance, it can be argued that these items do not measure dualism effectively because a dualist can hold that thoughts are predictable from brains and reductive physicalists could hold that they are not, and vice versa. Factor 2 is therefore called *supervenience.* Factor 3 in this study most closely resembles reductive physicalism as the items which load onto it posit mind-brain identity and one negatively correlated alternative (interactionism), hence this factor is called *reductive physicalism*. This factor does track dualism more effectively than factor 2, since endorsing mind-brain identity is non-dualist. Interactionism is dualist by definition and could be interpreted as noncommittal between substance and property dualism, but endorsing either is antithetical to reductive physicalism, which is why the item is negatively correlated. In summary and bearing in mind caveats about the relatively small sample size in this study, more research is needed to develop a suitable instrument to target Cartesian substance dualism so that its relationship to improvisation can be investigated.

The thematic analysis of the responses to the free text question on the mind-body problem also suggest that this scale might not have captured the nuances of respondents' beliefs, as the quotation from the female pianist/percussionist on p.150 illustrates. She alludes to embodied cognition and yet also invokes the computational metaphor from a reductive physicalist stance in her critique of the questions. Six responses were coded at *No Idea,* two of them contained the phrase and the others intimated that the respondent either didn't feel qualified to answer or didn't think much about the issues. This could be a reason why there were much fewer responses than to the improvisation free text question, although other factors like being close to the end of the survey might have played a part also.

One participant who had to be excluded from the Likert analysis because they did not answer any of the questions did respond with "Play what you hear. 'What you hear' can be an eternally expanded lexicon/resource, always open to expansion." He apologised for not being able to deal with the questions, saying of the dualism section that they were not qualified to answer (educator, male, double bass, over 30 years' experience). However, as with the second example above some respondents evinced sophisticated philosophical thought in their responses, for example explicitly espousing property dualist, embodied or enactive paradigms. One of the respondents who expressed dissatisfaction with the dualism questions gave this as a reason for answering ‘neither agree nor disagree’ to all of them.

6.6 Limitations and Further Research

Although useful to investigate whether the themes from Study 1 generalise to a wider population of improvisers, there are some limitations to the present study. Firstly, self-report measures are not necessarily reliable when asking experts about the strategies and processes they have used because a high degree of automaticity leads to a kind of ‘expertise-induced amnesia’ (Beilock et al., 2002; Bermúdez, 2017). A similar limitation also applies with ratings of the importance of different elements of improvisation. Respondents are asked to deliberate and judge in the absence of the activity, possibly leading to discrepancies between what they say is important and what they actually do. There is also the issue of social desirability bias, but as with Study 1 this is mitigated by the goal of the study being to enquire about the norms of the social practice of improvising that influence respondents. Consequently, if a response is made desirable it will be precisely because it is a norm. Also, this bias is less of an issue with computer-administered questionnaires than with face to face interviews (Richman, Kiesler, Weisband, & Drasgow, 1999).

Measuring dualism is a very complex endeavour and the scale used was unsatisfactory in that it was likely multidimensional in structure and conflated some epistemic and ontological issues. This was confirmed by exploratory factor analysis which was in partial agreement with Forstmann and Burgmer (2018) in finding that substance dualism was only one factor in a multidimensional scale. One of the other two factors gave support to the concern over separating epistemic concepts and the final factor identified mind-brain identity as a separate construct. In addition, some of the responses suggest that the instructions given were not sufficient to contextualise the questions and reassure respondents that there are no agreed definitions of notions such as the soul. Future studies could refine the items on the scale to address these issues. As discussed above, given that the subscale relating to substance dualism differentially predicted belief in free will (also multidimensional) and that the latter might play a role in concepts of creativity, further research could devise both a more comprehensive and nuanced instrument to interrogate which factors play an important role in improvisers' self-concept.

This study took a first step in investigating a possible correlation between dualism and the role of prospective auditory imagery as a norm of improvising. A limitation of this part of the study was that a single item (Question 6 of the improvisation section) was compared with a dualism score derived from multiple questions. In a first step to remedy this, a Romantic Ideal index was created by combining items 2, 6, 13 and 15 of the improvisation section. These addressed creativity (playing something new), prospective auditory imagery, being in the moment and freedom respectively. Although this was hypothesised to be positively correlated with the substance dualism subscale, this was not significant (Table 6.3). A reliability analysis gave some support to the other theory-derived constructs, although a future project could take this further and devise multiple items designed to be combined into a score to assess commitment to prospective auditory imagery, rather than asking a single question. Putative items would be subject to a vetting process by a panel of experts and then a sample size of 300 or more would be ideal to carry out a factor analysis and assess reliability. Although the sub-scales for this study were derived from the literature and theoretical considerations, a factor analysis and reliability analysis should be part of an iterative method to develop future measurement instruments for this research area. Other potentially related constructs, such as freedom/free will, moral perfectionism and creativity could also be included in addition to dualism for a more comprehensive investigation.

6.7 Conclusion

This study tested whether some of the themes from Study 1 would be endorsed by a larger cohort of improvisers belonging to three groups; students, musicians and improvisers. Some elements of improvisation that feature in the literature, such as basic skills were also included. In addition, a new approach was adopted whereby the possible correlation between respondents' rating for the importance of prospective auditory imagery and their level of Cartesian dualism was investigated. This represents first steps in this research area as no other studies have so far looked at dualism in relation to improvisation.

The highest rated item underscored the importance of improvisers being responsive and aware, which was expressed by participants in Study 1 as a dissatisfaction with the lack of interactivity in playing to a backing track. The importance of prospective imagery, multiple strategy use for idea generation, having an 'idea bank', being free and being 'in the moment' were all themes from Study 1 which gained further evidential support from this present study. The risk side of the risk-taking/error avoidance trade-off was favoured. That improvising is largely a result of conscious processes was not endorsed but the finding that improvising experience negatively correlates with the rating for this item needs further investigation. Four exploratory subscales based on Study 1 and theoretical considerations were created, a basic skills index (BSI), a conscious processes index (CPI), some non-conscious processes index (nCPI) and a romantic ideal index (RII). The CPI was found to be higher in students than musicians, in line with previous research. The BSI was hypothesised to be positively correlated to the CPI and the data supports this. The RII was not found to be reliable. An exploratory factor analysis on the improvisation scale found three factors, the first of which (*basic skills*) was an equivalent BSI but with the addition of the prospective auditory imagery item. This suggests that pre-hearing in the imagination is taken to be a basic skill of improvisation. The second had all of the items of the nCPI but added the freedom item, suggesting that this factor should be called *flow*. The third factor (*responsive awareness*) had only the awareness item with a significant loading, with which no one disagreed. The importance of prospective auditory imagery was endorsed but not correlated with the dualism score, or the substance dualism subscale. The limitations and complexities of the dualism scale were discussed. This was hypothesised to be multidimensional and flaws such as confusion between epistemological and ontological concepts were identified. Factor analysis of the dualism scale supported the hypothesis of multidimensionality and a separate factor containing only epistemological items was identified. Finally, strategies for future research to address these issues were outlined.

Chapter 7

General Discussion

> I don’t care if it’s John Coltrane, or the Art Ensemble of Chicago, or the greatest or the worst improvisers that ever lived, if you play 200 nights in a row, you are not going to be playing different shit every night. You’re just not. There’s this mystical version of what jazz improvisation is that implies that every single time you play, that you’re going to go to this far off mystical place and you’re going to discover this universe. (Pat Metheney, cited in Dean, 2014, p. 70)

7.1 Overview

This thesis comprised five studies conducted as part of a research programme investigating the role of auditory imagery in improvisation. A review of the existing literature motivated the following research questions:

1. What is improvisers’ experience of their use of auditory imagery in improvisation? How important is it to them? How does it fit with other aspects of the process?
2. Does the familiarity of bodily aspects of music-producing gestures affect musicians’ anticipation of the resulting sound?
3. Is improvisers’ privileging of auditory imagery related to the extent to which they have a dualist worldview?

Study 1 addressed the first research question, by enquiring into the experience of improvisers using video-stimulated recall, semi-structured interviews and thematic analysis. The second research question was investigated by Study 2, which is the first study to extend the altered auditory feedback paradigm to the guitar, to look at the effect of hand shape familiarity on judgements of whether auditory feedback had been altered. Studies 3 and 4 provided chord shape and hand shape familiarity survey data respectively, for use in Study 2. Finally, Study 5 involved the creation of an improvisation survey to extend the findings of Study 1 in addressing improvisers’ experience to a larger population, including students, performers and educators. Study 5 also investigated the role of mind-body dualism using a validated dualism scale and looked at the connections between what these respondents believe about the importance of different components of the improvisation process and their level of dualistic beliefs, thereby addressing the third research question. After a brief recap of the important points of the literature review, the findings of each study are summarised in more detail, starting with Study 1. Then the linked studies 2, 3 and 4 will be summarised, followed by a discussion about the implications of the findings for the plausibility of the Ideal Model. Then the findings of Study 5 will be considered as a prelude to some suggestions for a revised model which preserves improvisation as a valuable creative activity whilst being consistent with the cognitive-scientific paradigm. This will lead to a discussion of the implications for improvisation pedagogy. Finally, limitations of this research and some possible future studies will be considered.

7.2 Summary of Literature Review

The first important theme arising from the literature is the portrayal of auditory imagery. Some of the ethnographic literature on jazz improvisation suggests that improvisers are exposed to an idealised model of improvisation, which prioritises prospective auditory imagery to the extent that its status as a norm is that of a necessary condition to validate improvisation as a creative practice (Berliner, 1994; Sudnow, 1978, 2001). The following example from Sudnow's autoethnographic account of learning to improvise on the piano is illustrative:

> How do I know just what each of these little slices of space will sound like, as a joint knowing of my voice and fingers, going there together, not singing along with the fingers, but singing with the fingers? (Sudnow, 2001, p. 129)

This is reinforced by improvisation pedagogy. The influential music educator Edwin Gordon, using his term *audiation* for auditory imagery stated:

> Unless one can audiate what he is going to create and improvise before he performs it or even attempts to notate it, all that may be heard at best are the mechanics of scales and arpeggios, and at worst, mere exploration. (Gordon, 1989, p. 78)

This principle was adopted by Kratus (1991) in his seven-stage developmental approach to improvisation education and is expressed widely in different forms within jazz education (Azzara, 1993; Coker et al., 1970; Gordon, 1989; Kratus, 1995; Wiskirchen, 1975). A nuanced interpretation is that an *ability* to know how something that is about to be played will sound is not the same as conscious prospective auditory imagery. Thus, it is the ability rather than imagery which underwrites meaningful improvising in this view. Sudnow's account is certainly consistent with this interpretation. This view also gains support from Kratus (1995) who states that audiation allows improvisers to make predictions about what sounds will occur, but that these are likely to occur in a split second and be unconscious. However, this nuance seems lost in the talk of pre-hearing in the mind's ear in much of the literature (Berliner, 1994; Coker et al., 1970; Wiskirchen, 1975). This in turn contributes to a kind of moral perfectionism whereby musicians are dissatisfied with their current ability to pre-hear what they play and are always striving to improve (Day, 2000). In combination with the influence of dualist philosophy and Romantic ideals on the development of the idea of absolute music (Dahlhaus, 1991; Warren, 2009), this emphasis on auditory imagery promotes the Ideal Model (Figure 2.1).

The second important theme derived from the literature is the portrayal of improvisation in the cognitive-scientific domain. This has a very different emphasis from that described in the ethnographic and pedagogical literature and this thesis argues that there are tensions between these perspectives. Two main cognitive models of improvisation were considered in Chapter 2, Pressing's model involving hierarchical retrieval of stored patterns (Pressing, 1988, 1998a, 1998b), and Johnson-Laird's algorithmic model (Johnson-Laird, 2002). Pressing's model gained some evidential support from neuroscientific sources and corpus analysis (Beaty, 2015; Norgaard, Spencer, et al., 2013). Johnson-Laird's algorithmic model's prediction that working memory is not used in improvisation is supported by behavioural results (Fidlon, 2011). However, the cognitive view relies on the information processing metaphor, which has been challenged by competing paradigms forming mutually incompatible explanatory frameworks for the complex interplay between different cognitive processes. What these frameworks have in common is that they cast doubt on the feasibility of an idealised model that puts such an emphasis on conscious auditory prospection. It is particularly the case with grounded, enactive or embodied paradigms but also with simulation theories of motor control, that the anticipation of the sound of what is being played on an instrument is affected by other modalities than audition, including how the body moves (Jeannerod, 2001; O'Shea & Moran, 2017). Even if the computational metaphor is accepted, cognitive models of improvisation are informed by theories describing complex sensorimotor tasks in terms of a hierarchical structure with chunking of lower-level automated units (Fidlon, 2011; Pacherie, 2008; Pressing, 1988), leaving little opportunity for conscious prospection. The aims of this research programme were therefore to find out about improvisers' experience with a focus on auditory imagery, and to investigate the effect of the body on the anticipation of the intended sound. An overarching goal is to suggest possible ways to reconcile these two very different accounts, the first being influenced by Romantic ideals and dualist philosophy and the second being rooted in the scientific worldview.

7.3 Study 1: Investigating Improvisers' Perspectives Using Video-Stimulated Recall

Study 1 investigated not only the participant improvisers' own conceptions of their cognitive processes and strategies for idea generation, it looked specifically at their views on auditory imagery and more broadly at their motivation for improvising. The findings suggest that auditory imagery does fulfil the role of a norm of the social practice of improvisation for them. In line with the Ideal Model (Figure 2.1) and the Romantic notion of the creative artist, participants saw the goal of improvising to be the translation of music created in the imagination into sound, via their instrument. They also reported using multiple generative strategies, some of which do not necessarily involve prospective auditory imagery. This was accompanied by a moral perfectionism which expressed their current dissatisfaction with this translation ability. Moral perfectionism is by its nature the pursuit of an unattainable ideal, in this case that the idea becoming sound becomes effortless, to the extent that the musician is no longer conscious of it. One participant described a masterclass with a renowned jazz pianist: "all of his practice is oriented around there being no sort of translation in between thinking of the idea and it happening, and like trusting that your ideas your ideas are appropriate to that musical moment…" (Guitarist, Male 21). This precisely echoes Day's (2000, p. 100) quoting of Stanley Cavell on moral perfectionism: "The moral of this practice is to educate your experience sufficiently so that it is worthy of trust" and was coded in the thematic analysis with an in vivo code, *you've got to train your improvisation*. Freedom was a motivating factor to improvise, both in terms of a negative freedom, expressed as the freedom from the restrictions of fulfilling the prescribed role of playing from a score or part, and a positive freedom to be creative. Another important theme was being *in the moment* which was both an ethos and a motivating factor, as participants linked this to flow states which they found to be intrinsically rewarding: “high as a kite when I'm doing those sorts of gigs” (Saxophonist, Male 27). Study 1 also elucidated some of the tensions and contradictions between some of the different imperatives in improvising. Being ‘in the moment’ was sometimes subordinate to thinking about what to do next or using and developing ideas that had already been played. The imperative to pre-hear was balanced with the use of other generative strategies, such as music-theoretic and motor-generated ideas. Participants also recognised that originality is circumscribed by the need to have an idea bank of precomposed materials and more abstract ideas of how to negotiate harmonic structures.

As discussed in Chapter 2, originality can be construed as the concatenation and parametrisation of precomposed ideas: “How you put it together, how you sort of dissemble it..and reassemble it..“ (Pianist, Male 26). Given these ideas have been rehearsed, auditory-motor associations should be more established than with less familiar musical fragments (D’Ausilio et al., 2010; Lahav et al., 2007). Although this does not imply prospective auditory imagery, it does suggest that the player is likely to know if what they played was what they intended. One participant in Study 1 expressed this well in echoing the analogy to language (section 2.3.2):

> …it's just happening it's it's like speech, I'm not thinking beforehand, the words're just coming out of my mouth, the notes are just coming out of the instrument, where...when it does become obvious, like say when your tongue trips up, while you're trying to speak then that's when you become ... aware of what you're saying. (Saxophonist, Male 27)

Study 1 gives some insight into how the processes of improvisation are experienced by this small sample of jazz musicians and music students. Both the Ideal Model picture and the cognitive-scientific view were apparent in their account. The former was expressed by an adherence to Romantic ideals of being in the moment, creativity and freedom compatible with the role model of the creative artist, which is itself a legacy of dualist philosophy and German Romantic thought. The latter was expressed by participants’ reporting of multiple idea generation strategies in line with Pressing’s (1988) cognitive model and Norgaard’s studies (2011, 2016). In addition, they were unsure as to the degree to which conscious thought was involved in improvisation and sometimes said that processes were intuitive rather than conscious, suggesting a degree of automaticity at lower hierarchical levels. A degree of uncertainty in the timing of their thoughts relative to the time of music production was also reported, which supports some of the points made above about the epistemic limits to which improvisers are subject.

Study 1 yielded rich data from a small number of improvisers suggesting that they privileged prospective auditory imagery. This informed the design of Study 2, which investigated whether the familiarity of hand shape affects anticipation of how a chord will sound, rather than this being purely restricted to the auditory modality. These findings also motivated Study 5 which had the aims of investigating whether the results of Study 1 were reflected in a larger population of improvisers, and whether there were any differences between students, musicians and educators. Study 5 also sought to further investigate whether there was a correlation between dualism and the aspect of the Ideal Model that privileges prospective auditory imagery. The parallel strand of research that motivated Study 2 was informed by the cognitive-scientific literature, particularly studies which suggest that imagery is multimodal rather than just auditory (Berkowitz, 2010; Keller, 2012; Schiavio & Timmers, 2016) and the theoretical frameworks which support the concept that perception and cognition are embodied. What this means is that the way musicians encounter and think about music is affected by bodily aspects of performance, such as how they have learned to move and the shapes their bodies make to enact music-producing gestures.

7.4 Studies 2, 3 & 4: The Effect of Hand Shape Familiarity on Guitarists' Perceptions of Sonic Congruence

This study is the first to extend the altered auditory feedback (AAF) paradigm to the guitar, which differs in some important ways from the keyboard instruments which are most often used for AAF experiments. Each key on the piano maps to only one pitch and the keys are laid out so that low pitches are on the left and pitches get higher in the left-to-right direction. Hence there is a left-right spatial musical association of response codes (SMARC) effect which could be a factor in the way anticipations of auditory feedback affect action control.

Furthermore, the tradition of piano pedagogy is such that the hand shapes used to play chords tend to be prescribed. This means that it is difficult to separate familiar hand shapes from the chords associated with them without using a hand shape which would not normally be used, thus compromising ecological validity. Motorically, the nature of bimanual coordination on the piano is characterised by each hand producing sounds independently by pressing keys. In contrast, the guitar fingerboard is laid out so that the same note can be played in different locations. For example, the C at fret 1 on string 2 can also be played at fret 5 on string 3 or fret 10 on string 4, and so on, representing a many-to-one place-to-pitch mapping in contrast to the piano's one-to-one mapping. In consequence, there are two orthogonal directions that can be associated with pitch height, one is along any string, with ascending pitch in the direction of the guitar body. The other has ascending pitch in the direction from the thickest string to the thinnest (spatially this is vertically downwards on a normally strung instrument with the neck held horizontally). This has the consequence that ecologically valid hand shapes that are both familiar and unfamiliar can be used to play chords. The unfamiliar shapes are ecologically valid in the sense that they do not violate the prescribed ways to play the chord they express. The reverse possibility of using a familiar hand shape on a different set of strings so that the shape-chord association was less familiar was also exploited in this study. Motorically, the guitar differs from the piano in that except for specialist two-hand tapping playing techniques, the two hands work together to produce the sound. The focus of Study 2 was on the left-hand shape, which is used to fret the notes on the fingerboard.

The task of Study 2 was a two-alternative forced choice discrimination judgement in which participants had to decide whether the auditory feedback had been altered or not when they played chords in response to tablature diagrams. The alterations consisted of one of the notes of the chord being raised or lowered, either by a tone or a semitone. The main findings were that reaction times were shorter, and accuracy was greater when chord (or hand) shapes were rated as more familiar, and when the auditory feedback was congruent. Reaction times were recorded from the onset of the chord when the participant had already moved the left hand into position, so the movement involved only the right hand either strumming or grabbing the strings. As this did not vary between left hand shapes, the facilitation of the task must have derived from some attribute of the familiarity of the chord shape, hand shape or the strength of the association between either kind of shape and the sound of the chord.

Although no direct measure of auditory imagery is yet possible and no independent behavioural measure was taken to verify that participants used anticipatory auditory imagery to solve the task in Study 2, previous studies have suggested that such imagery is used to facilitate both musical and experimental task performance (Keller, 2012; Keller et al., 2010). As this was a timed task, slow deliberative judgements based on music theory are less likely, although participants could use the time between the presentation of the visual stimulus and when they played the chord (up to 8 seconds) to prepare their *expectation*. A few participants who reported using theoretical considerations during the debrief spoke in terms of realising that a chord was for example a major 9^{th}, and then they used their knowledge of how a major 9^{th} should *sound* to solve the task. The form of knowledge of how something *should* sound is very likely to be an auditory image retrieved from long term memory. It is not clear what alternative forms of knowledge could have this role and phenomenological quality, in fact. These findings therefore bear on the central question of the role of auditory imagery in improvisation, in ways which will now be discussed.

The results suggest that auditory-motor coupling is heterogeneous with respect to the guitar, which builds on previous work suggesting that the quality of improvisation can be affected by the familiarity of different musical keys on the piano (Fidlon, 2011; Goldman, 2013; Norgaard et al., 2016). Improvising on the piano over a blues in Bb is motorically different to improvising over the same progression in B, because the piano keyboard has an irregular pattern of white and black notes. These studies similarly demonstrate a heterogeneity in auditory-motor coupling, but at the level of melodic patterns. Whereas they show that fewer motor patterns for melodic fragments are available in unfamiliar keys, Study 2 looks at the effect of familiarity in the motor-to-auditory direction. If participants are using a prospective auditory image to compare the actual feedback, then the findings suggest that familiarity facilitates the comparison. Because the different shapes expressed the same chord heard via MIDI, this effect cannot be due to factors like familiarity with chord quality, timbre or harmonic tension. If the effect is driven by the familiarity of the hand shape, then this would imply that proprioceptive or haptic rather than kinaesthetic or motoric factors influence the effectiveness of the anticipatory image, given the left hand is held still executing the chord for the timed part of each trial. An alternative explanation is that in the unfamiliar condition, the auditory-motor link itself is less robust, or takes longer to retrieve. This second possibility does not directly implicate the embodied aspect of musical cognition, because it is compatible with a semantic or amodal retrieval process from memory, even if the format of the anticipation that is retrieved is an image. In other words, whilst grounded and embodied theoretical frameworks would favour the first explanation because what have been regarded as abstract or semantic cognitive processes use simulation or perceptual symbols, the second explanation is consistent with amodal theoretical positions. A third possibility in terms of motor control theories is that the motor program that enacts the hand shape uses a forward model (efference copy), and an inverse model (reafference, in the form of the expected sensory consequences of the action including the sound), and *neither* are conscious. In this case, participants would detect the discrepancy in retrospect, which could mean that any reports of anticipatory images are postdictive or due to task demand. As the quotation from the saxophonist in Study 1 suggested (Section 7.3), this is how improvisation and conversational speech seem also, in that we know in retrospect when what we have played, or said, was what we intended.

What these three explanations have in common however, is that they all suggest that the affordances offered by instruments involve a heterogeneity of auditory-motor coupling which undermines the Ideal Model of improvisation. One way that music could be conceived in the imagination and translated to the instrument is if the improviser simply has a veridical mapping from pitch image to its place on the instrument that is accessible in real time. In this way, any novel (for the agent) melodic phrase is matched to a series of places on the instrument. Heterogeneity of auditory-motor coupling is incompatible with such a simple mapping. What this suggests is that even if an improviser had the good sense to imagine melodic phrases that were physically playable, the more novel a phrase is for them, the less motorically available it is. This could be a reason for the novelty/fluency trade-off as implied by some of the responses by participants in Study 1, as in this example “I think it wasn't, yeah it wasn't that I thought it was wrong, it was that I wasn't ...think I wasn't confident enough because I haven't done it before perhaps...” (Pianist, Male, 26). This contrasted with the saxophonist’s description of part of his solo “I mean this is all[I] the first bit's just fairly sort of standard blues stuff, I don't think I'm.... not reinventing any wheels...“ (Saxophonist, Male, 26). These participants talked of practicing standard ways around chord sequences to play fluently. The notion of such a trade-off was also supported by the inverse relationship between the rating of risk-taking and error avoidance in Study 5. Auditory-motor couplings that are well established via practice can be automatic and have a low risk of error, but at the cost of having less novelty, hence solos perceived to be the concatenation of well-rehearsed 'licks' are less valued (Macdonald & Wilson, 2005)

Study 3 was carried out in person with each of the participants from Study 2 to ascertain their familiarity with each chord shape in the stimulus set. Participants were instructed to rate how familiar each chord was on a scale from 1-7, in the position on the neck and on the given strings in the experiment. For example, stimulus 2 (C9) is a very common shape, especially for guitarists versed in jazz or funk. As discussed in Chapter 5, this is the same shape as stimulus 13 if viewed as an abstract dot pattern (see Figure 5.4), but stimulus 13 is at a higher fret and on strings 3-6 instead of strings 2-5. Stimulus 13 (Appendix 9) is actually the *unfamiliar* version of stimulus 3; both express D7#9, again a very common chord which is used in jazz, rock and funk. Participants were encouraged to try each chord on the guitar before rating it. The reason for this was to allow for the possibility that semantic retrieval of the chord type from the visual stimulus alone might represent a different cognitive process from rating the familiarity of the experience of physically playing it. Given that Study 2 hypothesised that the latter kind of familiarity would facilitate the task, trying to make the familiarity rating experience match this aspect of the experimental one made sense. The protocol for Study 4 differed in that it was an electronic survey and was therefore not conducted in the presence of a researcher, although the instructions asked the participants to play the shapes on their guitar, as in Study 3. The main difference from Study 3 was that participants were explicitly instructed to *ignore* the location on the neck and which strings the chord was to be played on and focus only on the familiarity of the hand shape they used to play it. Again, if the shape is viewed as an abstract pattern of dots, as in a chord diagram, following these instructions should have yielded similar ratings for stimulus 2 and stimulus 13, but in fact they were significantly different.

The two main possible reasons for this align with two of the candidate explanations for the main findings of Study 2. It could be that playing the chords on the guitar before rating their familiarity did evoke the familiarity of the *physical experience* and this included some differences that are not apparent from the perspective of chords-as-dot-patterns. Stimulus 2 is near the headstock end of the guitar where the fret spacing is wider than at stimulus 13's location. This would involve a more spread out finger spacing in the former case, leading to different proprioceptive feedback. Contributing further to this difference, the wrist angle and angle of the forearm to the upper arm change as the left hand moves along the fingerboard. Strings 3-6 feel different to strings 2-5 since three instead of two are wound rather than plain. On electric guitars it is often the case that the thickest three strings have a steel core which has a wire wound around it, so that they have a ridged texture. Also, the higher number (lower pitch) strings are thicker so both of these factors could lead to different haptic feedback. If these reasons contributed to the different familiarity ratings, then this is compatible with the embodied explanation of the findings of Study 2, namely that physical familiarity of the hand shape facilitated task performance. However, this explanation also involves extending the familiarity both to the arm and wrist, and to haptic as well as proprioceptive feedback. The second possibility is that participants were rating the familiarity of the *chord shape to chord sound relationship* in both Study 3 and Study 4. This means that in effect their responses were compliant with the instructions for Study 3 in Study 4 also. Considering stimulus 2 and stimulus 13 again, 2 was originally designed to be familiar, whereas 13 is not usually played with its root on string 6, so it looks like the common shape for a 9th chord but expresses a 7#9th instead. Participants rated 13 as less familiar than 2 on average in both studies and this was the same for all the stimulus pairs which had the same abstract dot shape. This fits with the explanation that it was the chord shape to sound mapping that was being rated, since stimulus 2 resulted in the familiar C9 sound, whereas stimulus 13 is much less commonly used to play D7#9. It could be that participants could not ignore the salience of the mapping despite the instructions to the contrary. This explanation could be interpreted in terms of heterogeneity of auditory-motor coupling within an embodied paradigm, if it is the hand shape to sound mapping that is being rated. However, it is also compatible with the second amodal processing explanation given for the main findings, namely that the familiarity of the chord-to-sound mapping depends to an extent on semantic memory for the chord type which is associated via an abstract internal lexicon with an expected sound.

Given that the familiarity ratings were on average in line with the intended design of the stimuli and that the statistical models gave similar results regardless of which familiarity rating was used, the findings of Study 2 call the role of prospective auditory imagery in improvisation into question. This is because shape familiarity is not an intrinsically musical property, but it affects the anticipation of how the music will sound, which suggests that there is not a straight forward translation from imagined sound to actual sound. Rather than the abstract schema-level mapping which could predict the sound made by novel movements (2.9.9), what is most motorically familiar has the strongest auditory-motor link. Therefore, this is likely to act both as a constraint and a generative strategy. This is not to say that improvisers never experience prospective auditory imagery, of course. The participants in Study 1 reported doing so, but not all the time, and they also reported other generative strategies which did not involve pre-hearing in the imagination. These findings therefore further support an alternative view of multimodal engagement and multiple strategy use, suggesting that a reassessment of pre-hearing in the imagination as the 'gold standard' of improvising would be appropriate.

7.5 Study 5: The Improvisation and Mind-Body Survey

Study 5 was the first study to specifically investigate the relationship between respondents' conceptions of the important elements and processes involved in improvisation and their beliefs regarding the relationship of mind to body. An online survey comprising a first section on improvisation and a second section on mind-body dualism gleaned 114 respondents in total. In addition to 7-point Likert questions there were two free text response questions, one per section. The primary aims of the study were to build on the findings of Study 1 by asking a larger cohort of improvisers about some of its central themes. Further, respondents were asked whether they identified mainly as students, musicians or educators to find out about possible differences between these groups, to address questions such as whether experience level or playing context changes the perceived importance of different elements of improvisation. The final aim was to test the hypothesis that the rating of importance given to prospective auditory imagery is correlated with respondents' score on the dualism scale.

The improvisation section of the survey was derived specifically for this study based on the results of Study 1. This included questions designed to find out whether multiple strategy use, sketch planning, idea bank (Norgaard, 2011), and prospective auditory imagery would be endorsed by a larger sample of improvisers than the six participants of Study 1. In addition, four questions were included on basic skills and one on the importance of taking risks (Wopereis et al., 2013). Questions on the importance of playing something new and being free were inspired by the Romantic Ideals theme in Study 1. Finally, some questions on being in the moment, body-knowledge, the creator-witness phenomenon and being aware of the environment were included, based on some themes in Study 1 and the literature. The mind-body dualism section of the survey was adapted from a scale created by Stanovich (1989) in a study which had the aim of investigating the prevalence of dualistic beliefs and their relationship to religiosity and belief in extrasensory perception. The version chosen for this survey was a combination of the dualism items used by Preston et al. (2013) in two experiments. The reasons for this were that as some authors have noted (Hook & Farah, 2013; Riekki et al., 2013), some of the items on Stanovich's original scale were ambiguous and the scale used by Preston et al. was shorter but retained a good measure of internal reliability (Cronbach's α = .84).

The main findings of this study were that items derived from the themes of Study 1 were rated as important components of improvisation by improvisers (N = 113, one participant having been excluded because they gave no ratings). The importance of prospective auditory imagery was endorsed and reinforced by some of the free text responses. This suggests that the Ideal Model of improvisation introduced in Chapter 2 has some currency. Two of the themes of Norgaard's (2011) thematic analysis were replicated, the use of multiple generative strategies and the concept of a store of ideas which can be called upon in improvisation (idea bank). Also in line with previous research (Fidlon, 2011; Norgaard et al., 2016), the rating of items that mentioned necessarily conscious processes were on average lower for musicians than for students. This finding gives further support to the hypothesis that experts rely less on conscious processes than novices. An exploratory factor analysis gave a three-factor solution, with factors *basic skills, flow* and *responsive awareness.* No support was found for the hypothesis that the importance of prospective auditory imagery was correlated with implicit mind-body dualism as measured by the 14-item dualism scale. Factor analysis for this scale also yielded three factors, which is in line with previous research showing the multidimensionality of the measure (Forstmann & Burgmer, 2018; Riekki et al., 2013). The factors were *substance dualism, supervenience* and *reductive physicalism.* A consideration of the philosophical complexities surrounding this issue strongly indicates that further work is needed to develop a suitable measure to assess dualism which clearly targets different ontological and epistemic commitments. As *substance dualism* most closely reflected the Romantic concepts that were influential in ethnographic portrayals of the improviser-as-creative-artist, the correlation of this with the rating for auditory imagery was also tested but was not significant. However, the loading of the prospective auditory imagery item onto the *basic skills* improvisation factor suggests that pre-hearing in the imagination is regarded as central to improvisational competence. Hence even if the Ideal Model has been influenced by Romantic notions and dualist philosophy, the norm of prospective auditory imagery that it advocates can be adopted regardless of whether a musician holds dualist beliefs or not. The Ideal Model of improvisation is incompatible with the findings of Study 2 and with some of the findings of cognitive science (as discussed in Chapter 6) but there is an irony that the dualist and cognitive views can both can be criticised for a reliance on the computational metaphor (Schiavio & van der Schyff, 2016). Whilst cognitivism is more explicit in this reliance, framing improvisation in terms of input, representation, information processing and output, dualism just adds something to the mechanism: a connection to a non-material reality.

7.6 Implications

The results of this research indicate that the norm of prospective auditory imagery has currency. However, the idealised model of improvising to which it contributes is not informed by the findings such as those from Study 2 which suggest that multimodal factors including movement and proprioception play an important part in the process. Further, there are difficulties and contradictions within the idealised model of improvisation which need to be addressed to provide a coherent account which reconciles improvisers' experience with the findings of cognitive science. This thesis proposes that there are philosophical solutions available which could benefit the practice and pedagogy of improvisation. I will therefore begin this section by clarifying some of the paradoxes and difficulties that were explored in previous chapters.

7.6.1 Paradoxes

Chapters 1 and 6 indicated some internal difficulties with Platonist ontologies of music. Platonism suggests three propositions which form an inconsistent set (Cameron, 2008):

P1. Musical works are created.

P2. Musical works are abstract objects.

P3. Abstract objects cannot be created.

P1 has an intuitive appeal for composers and improvisers alike: music is brought into being by what they do. The motivation for P2 is a connected set of intuitions about the ontology of musical works arrived at by considering the differences between *performances* of works and the works themselves. The work is heard in performance, but this is taken to be an instantiation of a pre-existing entity because even if there were no further performances, it would seem counter-intuitive to suppose that the work would cease to exist. If works are not identical to their performances, then they must be something else. Similarly, if all the scores of a piece of music were destroyed, it would not follow that the work itself no longer exists, as it could be performed from memory. The kind of thing that has this property according to Platonism is an abstract object, but this raises a further problem expressed by P3: abstract objects are generally taken to inhabit an acausal, atemporal, ideal realm. Since creation is the *causing* of something to exist there is a contradiction. One way out of the impasse is to reject Platonism, for example by holding that musical works are their performances or that they do not exist, but either option seems counterintuitive. Platonists might seek to deny one of P1-P3. For example, P2 could be denied by saying that musical works are brought about by a composer *indicating* an abstract sound structure and giving instructions for its performance. The work is not identical to the sound structure and the contradiction is avoided, but at the expense of having to introduce the concept of indicating an abstract structure, which is rather vague and counterintuitive in that it does not easily fit with ordinary language use relating to what composers take themselves to be doing. In the context of improvisation, these difficulties are compounded by apparently contradictory definitions, for example:

1) "The creation of a musical work, or the final form of a musical work, as it is being performed" (Sadie & Grove, 1980, p. 31)
2) "A necessary condition of improvisation is that it *not* be the performance of a work." (Wolterstorff, cited in Burnard, 2012, p. 151).

If improvisation is not the performance of a work, is this compatible with the notion of the creation of a work as it is performed? This raises the problem of how to distinguish between the creation of a work as it is performed and the performance of a work as it is created, to which there might not be a solution even in principle and the latter fails to meet Wolterstorff's essential criterion. If what is meant is that improvisation is not the performance of a *prior* musical work, then how far in advance is an improviser allowed to conceive of or assemble ideas for the performance? Perhaps we could stipulate that the work is not by somebody else other than the performer, but then there are similar sorites paradoxes regarding how much material could be borrowed or part of a collective lexicon. A sorites paradox (Horgan, 1994) refers to a situation analogous to the following. Suppose there is a heap of sand. It seems reasonable to take as a premise that removal of a single grain will not cause the heap to cease to be a heap. Another apparently reasonable premise is that if this process of removing a grain is repeated a sufficient number of times, the heap will cease to exist. The resulting contradiction expresses a difficulty with definitions involving vague criteria when applied in contexts where there is a continuum. How then do we disambiguate a composer performing her own work and her improvising? Is there a principled distinction between expressive interpretive variations and those that characterise improvisation? Returning to the debate between Platonist and nominalist accounts of a musical work, the former is problematic in the context of improvisation, given doubts about the ontological status of created abstracta and Platonism's appeal to type/token duality. So, in improvisation, we have an instantiation of a type via a singular unique token which is the only possible token of the type, which seems unsatisfactory. A nominalist account faces similar difficulties, in that if a work is a set of concrete particulars then an improvisation creates a work of which the only particular is itself. Whilst this is not strictly contradictory it is difficult to see what explanatory work is being done by the definition (for a discussion of these issues, see Bertinetto, 2012). It could be argued that, as with the definition of music the problem might be that it is not possible to specify improvisation in terms of necessary and sufficient conditions. However, a similar problem with the definition of 'game', which motivated Wittgenstein's concept of family resemblance, has perhaps yielded to Bernard Suits' "the voluntary attempt to overcome unnecessary obstacles" (Suits, 2014, p. xiii). Therefore perhaps a better way to resolve these contradictions and difficulties regarding the ontology of musical works in relation to improvisation is to make the product/process distinction mentioned in 2.3.3 and abandon the work concept in favour of considering how musicians relate to musical knowledge structures as a set of *processes* (Benson, 2003; Goldman, 2013, 2016).

Whilst the process focus facilitates a cognitive-scientific research programme to investigate improvisation, it does not resolve the apparent tensions between the Ideal Model discussed in Chapter 2 and the findings of cognitive science. To recap, according to the Ideal Model an essential element of improvisation is pre-hearing in the imagination what is played on an instrument. The Romantic ideal of the improviser suggests three conditions must be met by auditory imagery, it is:

1) Prior
2) Veridical
3) Causal

A further condition, which is epistemic, is implied by the role of auditory imagery in its validation of improvisation as a creative activity:

4) It must be known that conditions 1-3 are met.

Condition 4 is a necessary condition of validation because if it is not possible to know whether the conditions that validate an activity obtain, then it follows that it is not possible to know its validity and establishing validity is constitutive of validation. The cognitive-scientific perspective casts doubt on whether 4 can be met in ordinary improvising situations however. The reason is that there are experimental findings relating to conditions 1-3 which call into question both their truth and knowability and these will now be considered in turn.

As discussed in Chapter 6, auditory imagery must be prior to the decisions which determine the movements necessary to enact music-producing gestures to conform to the ideal of the creative artist who creates music in their imagination. However, the timing of events from a phenomenological point of view does not necessarily correspond with the temporal ordering of their occurrence (Dominik et al., 2018; Libet et al., 1983; Matsuhashi & Hallett, 2008). These findings suggest that the process of preparation to move begins before participants are consciously aware of their choice to move, yet their experience of agency is such that the choice causes the movement. Another example which is illustrative is that of the illusion of apparent motion (Figure 7.1).

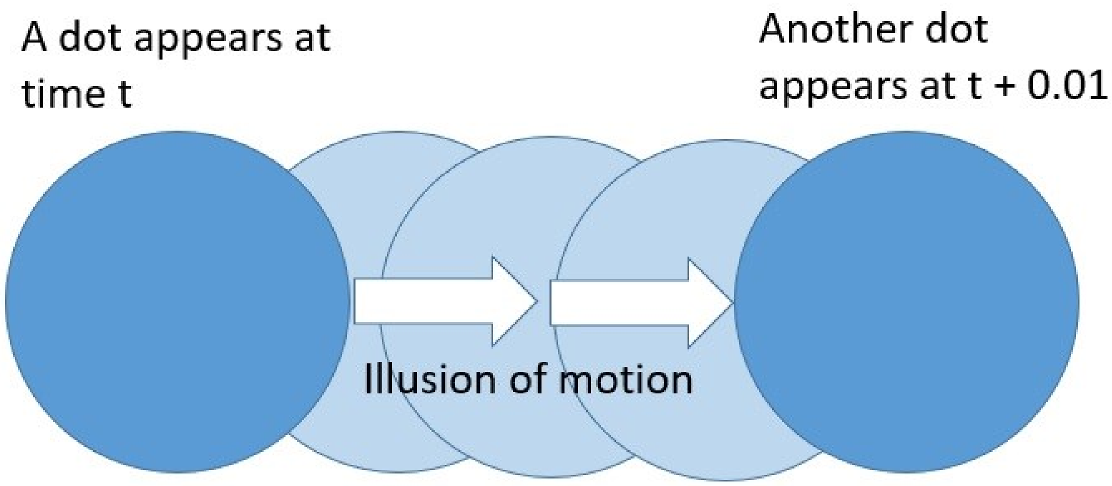


Figure 7.1. We experience motion as happening before the second dot appears at t + 0.01 but the second dot must be perceived before apparent motion can be inferred.

The illusion of apparent motion involves the experience of motion followed by experiencing the second dot as its terminus. Since motion cannot be inferred by the visual system *before* the second dot is perceived but is *experienced* afterwards, it follows that the temporal order of *experience* is not a simple representation of the temporal order of events in the brain. This also occurs in the auditory domain, such that the experience of sounds on small timescales does not match the temporal order of the sound-causing events, for example the 'octave illusion' created by a misattribution of time across perceptual streams (Mehta, Jacoby, Yasin, Oxenham, & Shamma, 2017). Hence it is not clear whether musical imagery is in fact prior, and even if it is experienced as preceding movement, there is no guarantee that this experience is reliable.

Turning to condition 2, this states that the auditory image must be veridical in that it must resemble the music that is played. If this were not the case, it would not be meaningful to assert that image was *of the music.* As mentioned in section 2.9.12, the accuracy of mental images is circumscribed. For another visual imagery example, imagine a tiger. Can you count its stripes? As with the example of the object made of cubes in the Introduction and the imaginary cube balanced by its vertex on the table top given in 2.9.12, the limitation in the image is not necessarily apparent until a particular question is asked. One difference between imagery and perception is the way the perceptual field can be 'resampled' with attention to certain details if these had not been already noticed. We do not have to expend effort on cognitive control to hold the percept in mind whilst we do this. There is some evidence that auditory imagery ability varies considerably amongst individuals both in terms of its vividness and control (Gelding, Thompson, & Johnson, 2015). Interestingly, self-reports of auditory imagery ability have also been correlated with behavioural and neural differences (Halpern, 2015; Pfordresher & Halpern, 2013). As mentioned in Chapter 2 though, even musicians selected for their notational audiation ability were poor at spotting embedded (embellished) melodies in scores in silent compared to listening conditions (Brodsky et al., 2008). The veridicality of auditory imagery and the ability to know it are both therefore questionable.

Finally, whilst conditions 1 and 2 are necessary for 3, they do not entail it. Even if an accurate auditory image precedes the movements made to enact the music, it does not follow that the image played a causal role. For example, suppose a well-established motor programme is the cause of the movement, but during its execution it not only produces an efference copy to aid in predicting the future motor state of the system (forward model), it also produces a reafference copy (inverse model) to predict the sensory consequences of the action, in the form of an auditory image. Suppose further that there are no execution errors, and because of the unreliability of judging the temporal order of events discussed above, the image seems to precede the decision to execute the motor programme, even though it does not. Then in terms of the causal chain that results in the music being played, the auditory image is epiphenomenal. Moreover, even if it were causal in some cases, it is difficult to see how this could be known (condition 4), as not only is judgement of temporal order problematic, so are judgements of causality and agency. These are also related, for example by manipulating the timing of a priming word Wegner and Wheatley (1999) were able to induce a misattribution of mental causation in participants; convincing them they had caused a mouse pointer to stop on a given image on a screen even though this was in fact done by an experimenter. Not only does the temporal order of events effect judgements of causality, the relationship is bidirectional. Bechlivanidis and Lagnado (2016) used simple Michotte-style displays in which simple objects move on a screen and participants perceive them as interacting causally. The authors manipulated these apparent causal connections with the result that participants changed their interpretation of the temporal order of events to match. Hence, it is plausible that if a musician believes that imagery is causal, this might also cast doubt on their judgement that it is prior (condition 1). In summary, the foundation of the Romantic ideal of improvisation is based on potentially paradoxical definitions, a problematic ontology and has unresolved tensions with the findings of cognitive science.

7.6.2 Resolutions

If the Ideal Model of improvisation is untenable on these grounds, it would be useful to consider alternative philosophical and psychological bases for improvising which are compatible with current scientific knowledge. The first step is to employ the product-process distinction in saying that improvisation is a way of making music characterised by a flexibility in accessing musical knowledge-structures (Goldman, 2016; Goldman et al., 2018). This flexibility allows for spontaneous music making which is responsive to the situation and to the musical offerings of other musicians. Whereas in classical music, examples of flexibility involve expressive timbral manipulations, rubato and changes of articulation, what is usually called idiomatic improvisation in the jazz genre involves harmonic substitutions and flexibility of note selection. In this way, music making is seen as a collection of activities within which some parameters can vary according to context. Those parameters which differ most with respect to improvisation reflect the norms of the activity as a social practice rather than a fundamental ontological difference. This still perhaps leaves the ontology of music as an unresolved problem in philosophy but not one that needs to be a particular issue for improvisers. It is not necessary to assume that a musical *work* is being created, which removes one motivation for the Cartesian view. Only in thinking of music as a product do the intuitions arise that works must have an ideal Platonic existence. Next, the epistemic difficulties of establishing the priority and causal role of auditory imagery matter because of how creative music making is conceptualised. These difficulties subside if prospective auditory imagery is not necessary for creative improvising. This might sound counter-intuitive. Take for example the autoethnography by Sudnow (1978), or the jazz improvisation education programme offered by Kratus (1995). These accounts are teleological; they both describe stages of development which *progress* through exploratory phases to develop “the skill to hear musical patterns inwardly as they are about to be played“ (Kratus, 1991, p. 38). Or as Sudnow put it

“I take my fingers to places so deeply ‘mindful’ of what they will sound like that I can sing *at the same time*” (Sudnow, 1978, p. 150, emphasis in original). Yet Sudnow is aware of the epistemic issues outlined above, as he goes on to say, “Am I really singing along behind the sounds at a rapid rate, with a differential lag in timing I do not notice, some split-second ‘neurological’ delay?” (ibid, p.151). In a footnote (ibid p. 149-151) he gives some details of his attempts to settle this issue. Sudnow set up his electric piano through an amplifier with a footswitch which could mute the sound in the room. Whilst recording the signal from the piano and the sound in the room, he would play and sing with the intent of the singing and playing being melodically matched in terms of pitch. Some of the time, he muted the piano whilst continuing to play and sing, allowing for a comparison between the played and sung pitches on the recording. Sudnow reports that when auditory feedback from the piano was absent, the sung and played pitches often diverged. This is not a report of a peer reviewed study and so the account is suggestive rather than definitive. Its potential as a future direction of research will be discussed in the relevant section below. However, whilst Sudnow’s account is compatible with the hypothesis that singing relies on auditory feedback, such that singing tracks playing rather than vice versa, there is an alternative interpretation more in keeping with Sudnow’s central thesis. This is that movement and sound are so intimately intertwined that one in the absence of the other violates ecological validity to the extent of disrupting the process of playing-singing. It might be objected that there are studies which show that performance by expert pianists is not significantly disrupted by a lack of auditory feedback (Finney & Palmer, 2003; Finney, 1997; Repp, 1999). Whilst these findings do support this, by necessity, to test accuracy of performance against a fixed target, these pianists were playing a piece either from memory or a score. This is not the same set of cognitive processes as in improvisation and so is not directly comparable.

Sudnow’s work can be read as an embodied account and interpreted from the ecological perspective (Borgo, 2007; Love, 2017; Torrance & Schumann, 2018; Windsor & De Bézenac, 2012). This rejects the computational metaphor whereby improvisation involves input which is converted into abstract symbols which are manipulated algorithmically to give an output which is converted into movement. Although some simulations of improvisation using computer programs and drawing on the models proposed by Pressing (1988) and Johnson-Laird (2002) have had modest success (Norgaard, Montiel, & Spencer, 2013; Pachet, 2012), simulation is not instantiation. Nobody gets wet during a computer simulation of a weather system and it is unlikely that anyone would assume that the model operates in a way that resembles weather. The ecological perspective rejects the computational metaphor in favour of a navigational one in which the improviser has ways of moving to traverse the musical landscape. The affordances offered by the improviser's instrument are complemented by those offered by the referent (Pressing, 1988). Within the computational metaphor, the referent forms a conceptual frame encompassing meter, harmonic structure and melodic forms which serves to restrict the space of possible action and therefore make processing easier. From an ecological perspective, the referent offers affordances, ways of moving to navigate the musical space, and will depend on the individual's previous experience of moving in relation to the referent (Love, 2017). The relation of these affordances to the referent is not rule-based and music-theoretic, it is a non-conceptual kind of "absorbed coping" which "does not require that the agent's movements be governed by an intention in action that represents the action's success conditions" (Dreyfus, 1999, p. 4). Torrance and Schumann (2018) refine this view of skilled action in the context of jazz improvisation to include a superordinate level of mindful monitoring which fits well with the hierarchical models discussed earlier. Their enactivist interpretation also utilises the navigation metaphor whilst acknowledging that we lay down our paths in interacting with the world according to our abilities and our sense-making natures. One of the participants in Study 5 summed up this perspective very well "Cognition is embodied, extended, enacted and embedded. This applies significantly to improvisation" (educator, female, live electronics, 11-15 years). As with any theoretical framework there are different positions and emphases, some of which are incompatible (Menary, 2010), but the enactive approach shares important elements with grounded cognition. Both are committed to embodiment, and situatedness (embedded). The extent to which cognition is extended into the environment is still a matter of active debate but both perspectives recognise the role of what an organism does in cognition, the enactive aspect (Menary, 2010). The crucial aspect shared by these approaches is their rejection of the computational information processing metaphor and as such they offer further resolutions to the problems summarised in 7.6.1. Firstly, these perspectives are compatible with findings from cognitive science (Goldman, 2013; Maes et al., 2014) so adopting a view of improvising informed by them removes a potential tension between improvisers' conception of their practice and their knowledge of scientific findings. Second, the emphasis on the enmeshed nature of cognition and movement follows on from the product/process distinction and further undermines the philosophical basis for the primacy of prospective auditory imagery. If how musicians move is integral to how they think, why are motoric modes of musical cognition not just as valid as auditory modes? The evidence that music is not purely the result of auditory cognition is found in the influence of instrumental affordances in musical composition and improvisation. For example, in considering folk blues guitar practice, Baily and Driver (1992) contend that musical patterns are not remembered and represented solely in the aural modality, but instead are represented as movement patterns with kinaesthetic, visual and tactile elements as well as auditory consequences. Their central thesis is that the guitar is laid out in such a way as to encourage spatial thinking, and they give musical examples in support of this view (Lay Lady Lay, p. 67, All Day and All Night, p. 68). The motor structure of a musical style, comprising the ways of moving used to enact the style is affected in part by the morphology of the instrument. Musicians form a style-specific motor grammar through learning canonical works within the style. Further evidence for the influence of the layout of the guitar fingerboard on musical output comes from an analysis of the improvised solos of the jazz guitarist Pat Metheny by Dean (2014). Baker (2001) gives examples including Beethoven, Stravinsky and Schubert to show that even orchestral or string quartet works evince keyboard influenced structures. Further, the extended and distributed aspects of cognition inherent in grounded and enactive frameworks undermine the Cartesian and Romantic ideas of creativity. If the creative improviser is seen as a distributed set of interacting, extended and embodied cognitive systems, this means that it makes no sense to locate creativity in a single modality. If it is accepted that the kinaesthetic, auditory, visual, tactile and proprioceptive modalities are enmeshed and form a creatively valid whole, the epistemic problems of establishing that auditory imagery is prior, veridical and causal disappear. In summary, embodied, grounded and enactive perspectives are compatible with cognitive science and in removing the problems associated with the Ideal Model of improvisation (Figure 2.1) offer a fruitful alternative basis for informing improvisation pedagogy and interpreting practice.

7.6.3 Pedagogy

Self-efficacy is an important predictor of success in music performance (Bonneville-Roussy, Vallerand, & Bouffard, 2013; McPherson & McCormick, 2006) and jazz improvisation (Ciorba, 2009). An individual's self-efficacy is "the conviction that one can successfully execute the behavior required to produce the outcomes" (Bandura, Adams, & Beyer, 1977, p. 126). Self-efficacy beliefs are task-specific within a domain, for example a musician could have high self-efficacy for playing a classical piano piece whilst having low self-efficacy for piano improvisation on a jazz standard (Ritchie & Williamon, 2011). A view which promotes prospective auditory imagery as the *sine qua non* of improvisation is likely to have a negative impact on self-efficacy for improvising because, as the results of Studies 1 and 5 suggest, this does not align with experience. Participants were aware of multiple strategy use, that auditory imagery was only sometimes present and were not sure of the timing of imagery as being prior. In contrast, if a grounded/enactive/ecological approach were adopted and advocated within jazz pedagogy, this has the potential to enhance self-efficacy as well as promote a better learning environment for improvisation (Borgo, 2007).

The rejection of dualism which characterises the ecological perspective could also be of benefit in the pedagogical context. Dualist epistemic beliefs are associated with poorer academic performance in a number of domains (Hamilton & Hamilton, 2015; Lonka & Lindblom-Ylänne, 1996; Muis, 2004; Ryan, 1984; Schommer, 1990) and in music with less adaptive practice strategies (Nielsen, 2012). There is evidence that epistemic beliefs are malleable and that explicit examination of such beliefs can be beneficial in bringing about positive change toward more sophisticated non-dualist views of knowledge (Muis, 2004). One possibility to address this would be to introduce critical thinking into improvisation pedagogy so that improvisers would have enhanced opportunities to examine any implicit beliefs they might hold about the nature of improvisation. As with the concept of epistemic beliefs, there are still debates and issues in the field relating to the definition, theoretical basis and measurement of critical thinking (Larsson, 2017), but the definition "critical thinking is reasonable reflective thinking focused on deciding what to believe or do" (Ennis, 1993, p. 180) is a starting point. This definition gives a good indication of the meaning of the concept but by itself is vague, so Ennis gives elaborations, including "Judge the credibility of sources", "Identify conclusions, reasons, and assumptions" and "Judge the quality of an argument, including the acceptability of its reasons, assumptions, and evidence". Recent meta-analyses have suggested that critical thinking interventions can be effective, but that they work best when they are explicit and domain-specific (Abrami et al., 2008; Huber & Kuncel, 2016; Lee, Lee, Gong, Bae, & Choi, 2016). Given that critical thinking also has links to creativity (DeHaan, 2009), its inclusion in an ecological jazz education programme could help to provide a fertile environment for developing improvisers.

7.7 Limitations

Many of the limitations of this research programme have been discussed in the chapters relating to individual studies. However, some important general points will be mentioned here. Improvisation is unpredictable by nature and this sharpens the difficulty in striking a balance between ecological validity and experimental control. Study 1 used a backing track, which gave a degree of control in that participants all responded in the context of the same referent. This was also decided upon with practical considerations in mind. This does represent an important limitation and the participants indicated that they felt that they did not improvise as they would have done with a live band.

Study 2 did not address improvisation directly for similar reasons, in that introducing a paradigm for guitar and altered auditory feedback involving the precise measurement of reaction times necessitated the experimental control given by a predictable task. Imagery is also challenging to study experimentally because it is a conscious state to which a participant can have introspective access, but the experimenter does not. An array of self-report measures, brain scanning techniques and behavioural evidence has been used to combat this difficulty, but this remains a limitation in this area. That the relation of Study 2 to auditory imagery is inferential rather than direct is a limitation of this study which could be addressed in future studies.

Studies 3 and 4 encountered problems relating to the complexity of operationalising and measuring the familiarity of chords. These are complex phenomena with potentially distinct dimensions along which familiarity could operate, which necessitates further work to develop robust measures. A similar limitation affected Study 5 also, improvisation is a complex human activity and further work is needed to develop measures which can more accurately and specifically target the elements of interest to researchers. Much conceptual work needs to be done to improve the philosophical rigour of the measurement of dualism and related positions on the mind-body problem if their relation to other constructs is to be investigated.

7.8 Future Directions

There are some possible developments which follow the ethos of this research programme and some specific directions suggested by its findings. Research into the relation of instrumental affordances and improvisatory behaviour could follow on from studies with pianists (Goldman, 2013) by using the MIDI guitar technology used in Study 2. Whereas Goldman's study looked at improvising in two different musical keys which are very different in their motoric familiarity (B, Bb), the guitar is a transposing instrument and does not have this property. It does offer a different set of affordances which could be tested, however. For example, playing in the same key in a relatively unfamiliar position on high frets could be investigated.

If auditory imagery is usually used by improvisers then its disruption in a dual-task paradigm experiment might result in detectable alterations in improvisations, even if other strategies are used to compensate. Given it is likely that musical imagery in improvisation would involve working memory (Kalakoski, 2001) and that recent findings suggest that working memory for tonal material is disrupted by articulatory suppression (Nees et al., 2017), a dual-task experiment could explore this by using articulatory suppression and a control task and comparing measures such as transitional entropy and pattern use applied to musical output (Goldman, 2013; Norgaard et al., 2016).

Hargreaves (2012) theorises that audiated ideas are conceived in relative pitch and must be converted to absolute pitch to be played in a given musical context. One prediction that follows from this is that if improvisers use auditory imagery in improvisation, the brain areas involved in such a conversion would be more active than in a control musical performance that does not require this process. Studies using fMRI have used contrasts between motorically balanced memorised performance and improvising tasks to investigate which brain regions are differentially activated/deactivated (de Manzano & Ullén, 2012a; Donnay et al., 2014; Limb & Braun, 2008). One potential brain region of interest for future experiments is the intraparietal sulcus which seems to be part of a domain-general system associated with such transformations and has been implicated in musical transposition (Foster & Zatorre, 2010).

Two surprising findings from Study 2 suggest possibilities for further studies. The first is that improvisers did not do better on the task, despite the more prominent role of auditory-motor transformations in improvisers' practice compared to non-improvisers. One reason for this might be that the participants did not contain enough genuine non-improvisers. A follow-up experiment could be done with a between-groups component and in addition independent measures of auditory imagery ability could be taken to investigate whether this correlates with task performance. The second possibility is suggested by the puzzling lack of interaction between familiarity and congruence. Study 2 could be extended with the introduction of EEG techniques to investigate the nature and time course of event related potentials to clarify what strategies are being used in different conditions. Comparison of N200 and P3 responses could indicate the extent to which an incongruity is registered even if it does not facilitate performance, whilst timing and scalp distributions could suggest possible cognitive processes.

Finally, the procedure that Sudnow (1978) described, in which he sang along to his improvised melodies on an electric piano and periodically muted the sound of the piano in the room, could form the basis of an experiment. As he kept recording the signal from the piano, he could find out to what extent his singing and playing diverged in the piano muted condition. Although challenging in terms of technological issues like latency and jitter, it might be possible to answer Sudnow's question about the relative timing of singing and playing. It is likely that some improvisers would diverge more than others and the correlation between divergence and scores on auditory imagery measures, as well as other parameters (tonality, key, tempo) could be tested.

7.9 Conclusion

The research conducted for this thesis investigated the role of auditory imagery in improvisation and found that its role was important as a validating principle of improvisation for these participants. The role of embodiment in the anticipation of musical sound was investigated in the first study to use altered auditory feedback with guitar. This contributed the novel findings that the familiarity of the hand shape affects both the accuracy and timing of judgements of sonic congruence. The first study to investigate the possible relationship of dualism to beliefs about improvisation made significant progress in developing measures to further investigate this relationship. This thesis represents part of an ongoing cognitive-scientific inquiry into improvisation and offers some philosophical resolutions to the tensions between the norms of improvisation practice and the findings of cognitive science. This thesis started from the question "are we really hearing in our heads what we think we're hearing?" Inevitably perhaps, no definitive answer can be given, but a tentative one could be "possibly not, but it does not matter."

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Appendix 1

Participant Information Sheet

Research Project Title

‘Are we really hearing in our heads what we think we’re hearing?’: the role of audiation in musical improvisation.

Invitation

You are being invited to take part in a research project. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Please ask me if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Thank you for reading this.

What is the purpose of the project?

The purpose of this project is to find out about what people hear in their heads while they improvise. The project is expected to last three years.

Why have I been chosen?

You have been chosen because you are an expert improviser.

Do I have to take part?

It is up to you to decide whether or not to take part. Refusal to take part will involve no penalty or loss of benefits to which you are otherwise entitled. If you do decide to take part, you will be given this information sheet to keep (and be asked to sign a consent form). If you decide to take part you are still free to withdraw at any time, without penalty or loss of benefits, and without giving a reason.

What will happen to me if I take part?

You will be asked to play an improvised solo over a backing track whilst being videoed. The video will then be played back to you and you will be asked to comment on your solo, focusing on where your ideas came from and what you were thinking as you played. Your comments will be audio recorded, transcribed, and checked with you for accuracy before analysis. The recording and interview procedure should last about 90 minutes.

What do I have to do?

If you agree to take part, you will be asked to commit to come with your instrument to a 90-minute recording and interview session at The Royal Northern College of Music, or if this is not convenient it might be possible to do the session at another venue, for example your home or studio.

What are the possible disadvantages and risks of taking part?

You might find improvising in a research context unfamiliar and this is potentially stressful, however I will do my best to put you at your ease during the process and you will be debriefed afterwards.

What are the possible benefits of taking part?

Whilst there are no immediate benefits for those people participating in the project, it is hoped that this work will add to our knowledge of the process of improvisation and will help to improve its teaching and practice.

What happens if the study has to be terminated?

If the study has to be terminated, then you will be told why this has happened.

Will my taking part in this project be kept confidential?

All information which is collected about you during the course of the research will be kept strictly confidential. Any information about you that is disseminated will have your name and address removed so that you cannot be identified by it.

What happens immediately after data collection?

You will be debriefed soon as the data collection is complete. During the debrief you will have the opportunity to ask any questions about the research or raise any concerns you have.

What will happen to the results of the research project?

The results of this research will be published as part of a PhD thesis on improvisation and might also be published in journals and presented at conferences. You will be able to get a copy of the thesis from me using the contact details below.

Who has reviewed the project?

This project has been reviewed by the RNCM's Research Ethics Committee (REC) overseen by the Research Committee.

Contact for further information

Keith Phillips
3 Cleveland Road,
Heaton Mersey,
Stockport
SK4 4BS
Email: keith.phillips@student.rncm.ac.uk
Mobile: 07984902507

Dr Freya Bailes
UAF in Music, Media and Mediation
School of Music (Faculty Performance, Visual Arts & Comms)
University of Leeds
LS2 9JT
f.bailes@leeds.ac.uk

You will be given a copy of this Participant Information Sheet and a signed Participant Consent Form to keep.

Thank you for spending the time to consider taking part in this research project!

Appendix 2

Biographical details

This information will assist in the analysis of your interviews, but you are under no obligation to complete this questionnaire. Please feel free to omit any questions if you so wish. Your answers will be kept confidential and any data published will be anonymized.

Name:

Age: __________

If you play any instruments other than the one you played in the recording, please list them below:

Please give estimates for the following questions.

Number of years you have been playing your instrument: _____

Number of years of formal musical training: _____

Number of years of formal training which includes instruction in improvisation (if any): _____

The age at which you started playing: _____

If you have played professionally, what year did you play your first paid gig? _____

On average how many gigs do you play per month? _____

On average, how much time do you spend playing your instrument per day? _____

On average, what portion of time spent playing your instrument involves improvisation? _____

Appendix 3

Interview Schedule-reading copy

Introduction

Is it ok to record the interview? Do you agree that the video and audio recordings can be used for research purposes? (The data will be kept securely and the data anonymized before any results are shared of course).

So, I'm going to play back the video of your improvisation, try to commentate on what you did, like a director's cut commentary on the special features section of a DVD. Try to focus on things like, what you were thinking, where ideas came from, when did you have ideas for what you played, and so on.

If you want to pause playback during your commentary, just press this button [INDICATE PAUSE]. L might sometimes pause or rewind playback to ask particular questions if relevant. You can stop or take a break at any time

Starter Questions

Have you participated in research before?

How did it feel to improvise while being video recorded in this setting?

Main Section

Where did the ideas come from do you think?

What strategies, if any, did you use to generate ideas?

When did you take the particular decisions that informed what you played?

How planned was your improvisation overall?

To what extent were conscious processes involved?

How much of what you played do you think you heard in your head?

How much of what you played came from your 'idea bank' and how much represents material that you think you haven't played before?

Did you modify any ideas in your repertoire for this improvisation?

Follow up

What draws you to improvising? Could you say more about why you do it?

Is there anything else you would like to add about your solo or your experience of the process today?

Close

Thank you very much for doing this today, please feel free to contact me via email if you have any questions, goodbye.

Appendix 4

Participant Information Sheet

Research Project Title

The Effect of Hand Shape Familiarity on Guitarists' Perceptions of Sonic Congruence: An Altered Auditory Feedback Study.

Invitation

You are being invited to take part in a research project. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Please ask me if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Thank you for reading this.

What is the purpose of the project?

The purpose of this project is to investigate how the accuracy of guitarists' judgement of sonic congruence is affected by chord shape familiarity. The project is expected to last ten weeks.

Why have I been chosen?

You have been chosen because you are an expert guitarist.

Do I have to take part?

It is up to you to decide whether or not to take part. Refusal to take part will involve no penalty or loss of benefits to which you are otherwise entitled. If you do decide to take part, you will be given this information sheet to keep (and be asked to sign a consent form). If you decide to take part you are still free to withdraw at any time, without penalty or loss of benefits, and without giving a reason.

What will happen to me if I take part?

Firstly, you will be asked to fill out a short questionnaire. You will then be asked to play some chords on a MIDI (Music Information Digital Interface) enabled guitar. Each chord will be presented using tablature notation on a laptop screen. You will be able to hear the MIDI output through headphones which will also screen out any acoustic feedback. On some occasions at random, the MIDI output will be altered by changing one of the notes in the chord. You will be asked to indicate as quickly as possible via foot pedals, whether you think the heard chord has been altered or not. I will ask a few short follow-up questions about your experience. Your responses and reaction times will then be analysed. The experiment comprises four blocks of sixty-four trials, each trial lasting a few seconds. The experiment is expected to last about 90 minutes in total. You will be asked to complete a rating of familiarity on the chord shapes within a few weeks of the experiment by pressing response keys on a laptop as each tablature image is presented. This should last between 10 and 20 minutes.

What do I have to do?

If you agree to take part, you will be asked to commit to participate in a 90-minute experimental session and one follow up 10-20 minute rating session (as detailed above) at The Royal Northern College of Music.

What are the possible disadvantages and risks of taking part?

You might find participating in research unfamiliar and this is potentially stressful, however I will do my best to put you at your ease during the process and you will be debriefed afterwards.

What are the possible benefits of taking part?

Whilst there are no immediate benefits for those people participating in the project, it is hoped that this work will add to our knowledge about auditory imagery which could help to improve music teaching and practice.

What happens if the study has to be terminated?

If the study has to be terminated, then you will be told why this has happened.

Will my taking part in this project be kept confidential?

All information which is collected about you during the course of the research will be kept strictly confidential. Any information about you that is disseminated will have your name and address removed so that you cannot be identified by it.

What happens immediately after data collection?

You will be debriefed soon as the data collection is complete. During the debrief you will have the opportunity to ask any questions about the research or raise any concerns you have.

What will happen to the results of the research project?

The results of this research will be published as part of a PhD thesis on improvisation and might also be published in journals and presented at conferences. You will be able to get a copy of the thesis from me using the contact details below.

Who has reviewed the project?

This project has been reviewed by the RNCM's Research Ethics Committee (REC) overseen by the Research Committee.

Contact for further information

Keith Phillips
3 Cleveland Road,
Heaton Mersey,
Stockport
SK4 4BS
Email: keith.phillips@student.rncm.ac.uk
Mobile: 07984902507

Michelle Phillips
Head of Undergraduate Programmes
Royal Northern College of Music
124 Oxford Road
Manchester
M13 9RD

You will be given a copy of this Participant Information Sheet and a signed Participant Consent Form to keep.

Thank you for spending the time to consider taking part in this research project!

Appendix 5

This information will assist in the analysis of the experiment, but you are under no obligation to complete this questionnaire. Please feel free to omit any questions if you so wish. Your answers will be kept confidential and any data published will be anonymized.

Name: _________________________

Age: __________ Sex: Male ☐ Female ☐ Prefer not to disclose ☐

Do you have normal hearing? (Y/N): _____ Do you have absolute (perfect) pitch? (Y/N)____

I identify as an improviser (please circle or highlight a number):

1	2	3	4	5	6	7
Strongly disagree			*Neither agree nor disagree*			*Strongly agree*

Please list the instruments you play, the number of years you have formally studied each and the number of years you have improvised on each.

Instrument	**Years of Formal Study**	**Years of improvising**

For each of the following age ranges, please give an estimate for the average number of hours of **guitar playing** you did per week, and the average number of these hours that involved improvising:

Age Range	**Average playing hours/week**	**of which improvising**
< 11 years		
12-17 years		
18 years +		

Please give a short description of your experience with improvisation:

Appendix 6

Name: ____________________ Date:

Edinburgh Handedness Inventory - Short Form

Please indicate your preferences in the use of hands in the following activities or objects:

	Always right	Usually right	Both equally	Usually left	Always left
Writing					
Throwing					
Toothbrush					
Spoon					

Appendix 7

Improvisation and Mind/Body Questionnaire

Introduction

This survey is part of a research project investigating musical improvisation. In part 1, you will be asked some questions about what you think are important features of good improvising. In part 2, you will be asked some questions about other attitudes that are not directly related to music but which focus on the brain, mind and body. We are interested in how these attitudes to improvisation and to the mind/body might be related. There are also a few questions about you.

Your data will be kept confidential and you will not be identifiable if the research is presented or published. You can withdraw from this survey at any time without penalty and you can miss out questions if you would prefer not to answer.

This survey has been given ethical approval by the RNCM ethics committee. We will infer by your completing this survey that you give informed consent to your taking part in this research.

If you have any questions regarding the survey, please email keith.phillips@student.rncm.ac.uk

Do you play, sing and/or teach music that involves improvisation?

1 / 24

About you

Please indicate which of the following options applies most to you. For example, if you both perform and teach improvisation, pick the one that you do most. If you do activities equally, you can choose either option.

2 / 24

Part 1: What makes a good improvisation?

In this part of the survey, you will be asked about different aspects of musical improvisation. Each question asks you to indicate on a scale (1-7) how much you agree or disagree with a statement about improvisation. For singers, where statements include a reference to your instrument, this refers to your voice.

Please try to respond to each question according to your judgement and experience. If you find yourself thinking 'the answer depends on...', please use your judgement to give what you think is the best answer you can.

When improvising, it is important to play in time.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 1	☐	☐	☐	☐	☐	☐	☐

Improvising well involves playing something new.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 2	☐	☐	☐	☐	☐	☐	☐

You have to take risks to improvise well.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 3	☐	☐	☐	☐	☐	☐	☐

3 / 24

During an improvisation, it is important to think of a plan for what will come next, so the improvisation has some structure, or 'tells a story'.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 4	☐	☐	☐	☐	☐	☐	☐

Good instrumental technique is needed for effective improvising.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 5	☐	☐	☐	☐	☐	☐	☐

Creative improvising involves pre-hearing in your imagination what you are going to play on your instrument before you play it.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 6	☐	☐	☐	☐	☐	☐	☐

Effective improvisers are aware of their environment and respond to what is going on.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 7	☐	☐	☐	☐	☐	☐	☐

It is important to avoid errors while improvising.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 8	☐	☐	☐	☐	☐	☐	☐

Improvising well involves playing in a way that fits the idiom or style of the music.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 9	☐	☐	☐	☐	☐	☐	☐

Generating ideas in improvisation mostly involves deliberate conscious thought processes.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 10	☐	☐	☐	☐	☐	☐	☐

I have an 'idea bank' of musical ideas that I can use when I improvise.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 11	☐	☐	☐	☐	☐	☐	☐

I have many different ways to generate ideas while improvising.

5 / 24

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 12	☐	☐	☐	☐	☐	☐	☐

Improvising is about 'being in the moment'.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 13	☐	☐	☐	☐	☐	☐	☐

When I am improvising well, the music seems to happen without me being aware of how I am doing it.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 14	☐	☐	☐	☐	☐	☐	☐

I am completely free to play what I want to play while improvising.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 15	☐	☐	☐	☐	☐	☐	☐

My body knows what to do to improvise and I don't know or imagine what I will play before I play it.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 16	☐	☐	☐	☐	☐	☐	☐

Which elements of improvisation do you think your teachers emphasise as most important? Please comment briefly below.

7 / 24

This section repeats twice, with only slightly different wording (see Chapter 6 in the main text).

Instructions for Part 2.

In this section, the statements are about the mind/body. Philosophers have been debating what is called the mind-body problem for thousands of years, and there is still no broad agreement on the main issues. There are no 'right' answers and these questions are not dependent on the questions in section 1. Please indicate your level of agreement or disagreement with each statement (1-7).

Part 2: Questions about the mind/body.

The mind is equivalent to the brain.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 1	☐	☐	☐	☐	☐	☐	☐

It is impossible for science to ever have a complete understanding of the mind.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 2	☐	☐	☐	☐	☐	☐	☐

One's thoughts, personality, preferences, and choices are all just a product of brain functions.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 3	☐	☐	☐	☐	☐	☐	☐

Whether one is a good or bad person can be completely altered by changes in the brain.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 4	☐	☐	☐	☐	☐	☐	☐

Aspects of mind that science cannot explain are best explained by the soul.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 5							

People have a non-physical soul (or spirit) that animates the physical body.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 6.							

A person's soul persists after one dies.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 7							

Free will is an illusion produced by the brain.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 8							

The mind interacts with the brain, but is separate from brain.

20 / 24

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 9	☐	☐	☐	☐	☐	☐	☐

In the future, it may be possible to know someone's personality by looking at their brain activity.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 10	☐	☐	☐	☐	☐	☐	☐

The true self is not governed by the brain, but by a person's soul.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 11	☐	☐	☐	☐	☐	☐	☐

The mind is a non-physical property.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 12	☐	☐	☐	☐	☐	☐	☐

In the future, it may be possible to know exactly what another person is thinking by looking at their brain activity.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 13							

I believe the mind and soul are the same thing.

	Strongly disagree	Moderately disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Moderately agree	Strongly agree
Question 14							

If you have any further views about the relationship between mind, body and soul, please feel free to express them briefly here.

Part 3: A bit more about you

Are you:

- Female
- Male
- Other
- I would prefer not to answer

Please specify the your main improvising instrument (if you are primarily a singer, please put 'voice'):

Please give an estimate of the number of years of improvising experience you have.

- Under 1 year
- 1-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-25 years
- 26-30 years
- Over 30 years

Finish

Thank you very much for taking part!

If you have any questions, please feel free to contact me at keith.phillips@student.rncm.ac.uk

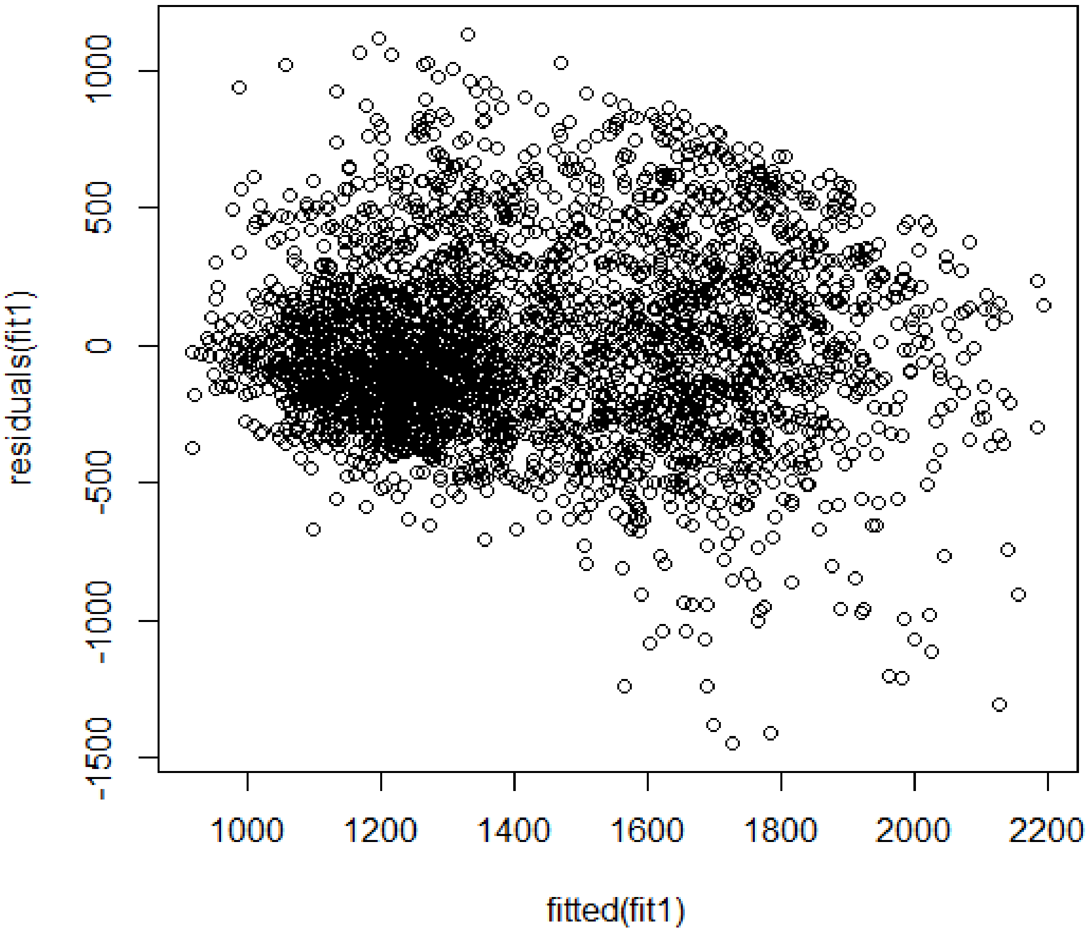
Key for selection options

1 - Do you play, sing and/or teach music that involves improvisation?
  Yes
  No

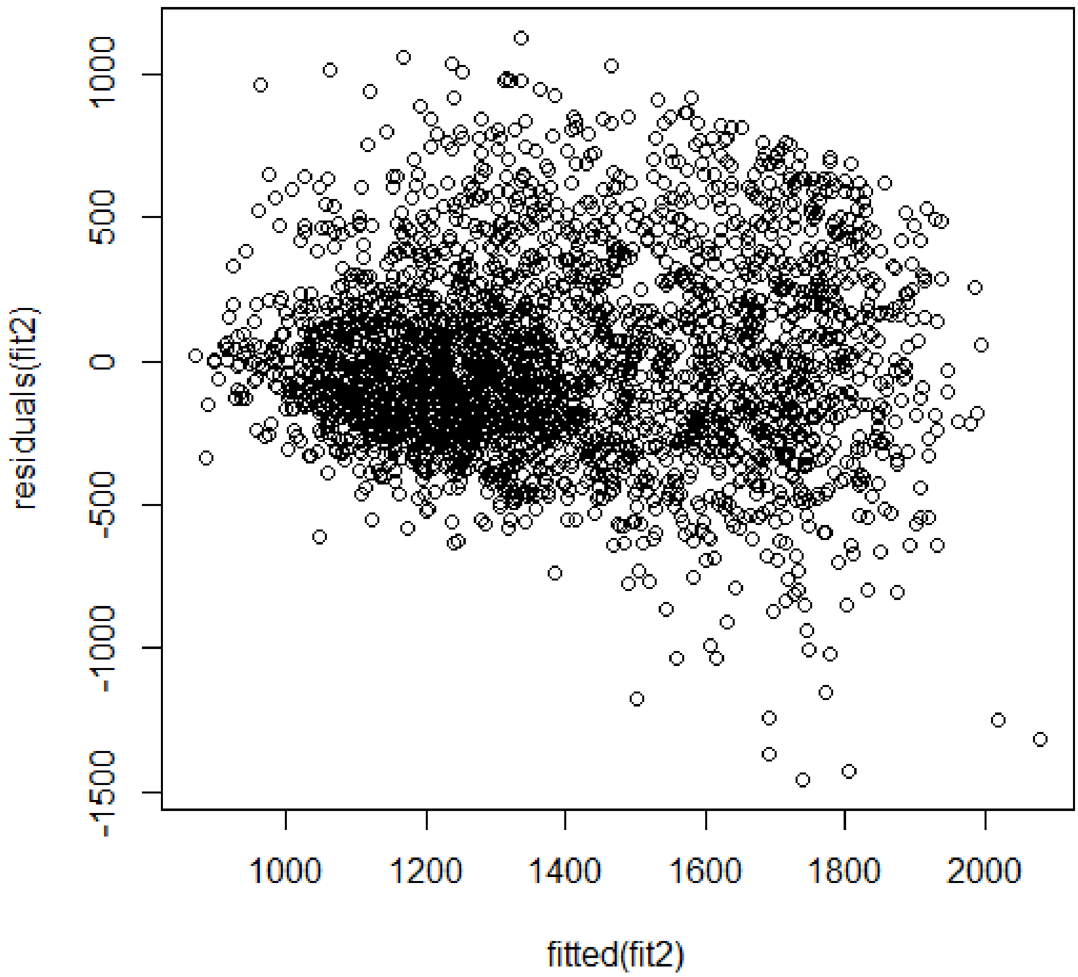
2 - Please indicate which of the following options applies most to you. For example, if you both perform and teach improvisation, pick the one that you do most. If you do activities equally, you can choose either option.
  I am a music student who improvises.
  I am a musician who improvises.
  I am a Teacher/Lecturer/Tutor who teaches improvisation.

Appendix 8

Residual plot for Model 1 (Study 2), showing heteroskedasticity.

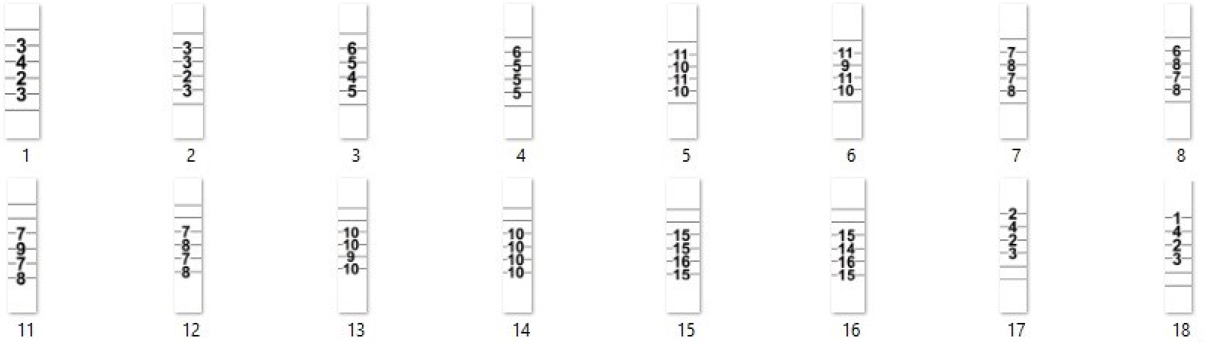


As above but for Model 2.



Appendix 9

The full stimulus set for Study 2.



Appendix 10

Familiarity Rating for Each Chord, All Participants Study 2/3

	Stimulus															
Participant	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
1	1.59	1.38	0.32	1.38	0.32	0.11	-0.10	0.53	-0.53	-0.96	-1.17	1.38	-1.17	-1.38	-0.96	-0.74
2	0.97	0.64	1.30	0.97	1.14	1.30	1.14	-0.19	-0.19	-0.35	-1.01	-1.18	-1.18	-1.18	-1.01	-1.18
3	1.00	1.15	1.00	1.00	1.00	0.52	1.00	1.00	-0.92	-1.08	-0.92	-0.12	-0.92	-1.40	-1.40	-0.92
4	0.88	0.88	0.88	0.00	0.22	0.22	0.88	0.88	-0.44	-0.44	-0.22	-0.22	-2.20	-2.42	0.22	0.88
5	1.30	1.30	1.30	1.30	0.93	1.30	-0.18	-0.56	-0.18	-0.56	-0.93	-0.93	-0.93	-0.93	-1.30	-0.93
6	-0.74	0.34	0.52	1.42	0.88	-0.56	-0.38	1.96	-0.74	0.34	-0.56	-1.11	-1.11	-1.28	-0.56	1.60
7	0.42	1.43	0.22	0.01	1.63	0.42	0.82	0.22	-0.59	0.42	1.02	-0.19	-1.40	-1.80	-1.20	-1.40
8	1.27	1.10	1.27	0.94	-0.52	0.13	-1.00	1.43	1.10	-0.52	-0.19	-0.52	-1.49	-1.49	-0.84	-0.68
9	1.29	1.29	1.29	0.77	1.29	1.03	0.64	-1.06	-0.41	-0.28	-1.06	-1.06	-1.06	-1.06	-0.54	-1.06
10	0.78	1.08	0.93	1.08	1.08	0.63	1.08	0.63	-0.87	-1.33	-0.87	-0.58	-1.63	-1.63	-0.27	-0.12
11	1.01	1.01	0.88	-0.40	1.13	1.13	0.24	1.13	-1.16	-0.14	1.01	-1.16	-1.16	-1.16	-1.16	-1.16
12	0.74	1.40	0.41	0.57	1.40	1.07	-0.08	1.40	-1.23	-0.57	-0.57	-0.24	-1.56	-1.56	-0.24	-0.90
13	0.70	1.22	1.22	0.36	-0.16	1.22	-1.03	1.05	-1.03	-1.03	0.88	0.88	-1.55	-0.68	-1.20	-0.86
14	0.82	0.82	1.53	-1.08	0.82	0.82	0.58	0.82	-0.14	0.10	0.82	-0.61	-2.03	-1.32	-1.08	-0.84
15	1.26	1.51	1.51	0.02	0.02	0.26	0.02	-0.73	-1.23	0.51	0.76	-1.72	0.02	-1.23	-1.48	0.51
16	1.30	1.30	1.30	-0.51	0.55	-0.81	-0.06	1.30	-0.36	-0.66	1.00	0.55	-0.96	-1.11	-1.41	-1.41
17	1.10	1.10	0.97	1.10	1.10	1.10	1.10	-0.37	-0.23	-0.63	-1.30	-0.63	-1.30	-1.30	-0.63	-1.17
18	1.23	1.23	1.23	-0.27	1.23	1.23	1.23	0.10	-1.03	-1.03	-1.03	-1.03	-1.03	-0.90	-0.65	-0.53
19	0.94	0.94	0.94	-0.12	0.94	0.94	0.94	0.94	-1.80	0.03	0.03	0.03	-1.35	-1.04	-1.80	-0.58
20	0.27	1.19	1.19	-0.34	1.19	1.19	1.19	0.89	-0.65	-0.81	-0.96	-1.12	-1.27	-1.27	0.41	-1.12
21	-0.38	1.18	1.70	0.14	-0.55	-1.07	-0.90	-0.55	-0.55	-0.55	-0.90	1.70	1.53	-1.42	0.14	0.49

Table of Standardised Hand Shape Familiarity Ratings Study2/Study4.

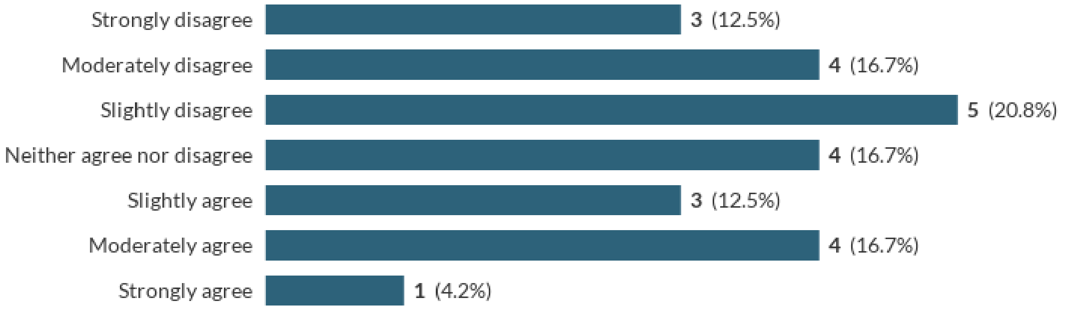
	Stimulus															
Participant	1	2	3	4	5	6	7	8	11	12	13	14	15	16	17	18
1	0.81	0.81	0.81	0.81	0.81	0.81	-0.30	0.81	0.44	-0.30	0.81	-0.30	-1.41	-1.22	-1.96	-1.41
2	0.59	0.96	0.96	0.96	0.96	0.96	0.96	0.40	-0.92	0.21	-0.35	-0.16	-1.11	-1.48	-1.67	-1.29
3	1.46	-0.23	1.46	0.89	0.89	0.33	0.33	1.46	-0.99	-0.61	-0.05	-0.42	-1.17	-1.17	-0.80	-1.36
4	0.43	0.43	0.89	0.43	0.89	0.89	-0.95	-0.03	-1.87	0.43	0.89	-2.33	0.43	-0.03	-0.95	0.43
5	0.53	0.53	0.53	0.53	0.53	-0.02	-0.02	0.53	0.53	0.53	-0.39	0.53	-2.05	-2.79	-0.02	0.53
6	-0.58	1.05	0.51	0.51	2.14	0.51	-1.12	1.05	-1.12	-1.12	-1.12	0.51	-1.12	-0.03	-0.58	0.51
7	-0.19	0.97	0.74	0.04	0.97	0.51	0.04	0.97	-0.88	0.51	0.74	0.27	0.51	-1.34	-1.58	-2.27
8	0.34	-0.43	1.49	1.49	-1.20	0.72	-0.82	1.49	-0.43	-0.82	-0.82	1.49	-0.82	-0.43	-0.43	-0.82
9	1.49	1.49	1.49	0.64	1.49	0.50	-0.48	-0.48	-0.91	-0.76	-1.05	-0.34	-0.62	-0.91	-0.62	-0.91
10	1.10	0.93	0.77	1.10	1.10	0.43	0.77	0.60	-1.39	-1.05	-0.72	-0.39	-1.72	-1.39	-0.39	0.27
11	0.91	1.21	1.50	-0.84	0.91	0.62	0.04	1.21	-0.55	-0.55	0.04	0.33	-0.84	-1.72	-1.42	-0.84
15	0.17	1.35	1.35	-1.00	0.95	-0.61	-0.22	1.35	-0.61	-0.22	0.95	-2.18	-1.00	-0.22	0.17	-0.22
16	0.33	0.63	1.23	-0.26	1.23	0.33	-0.26	1.23	-1.75	0.33	0.33	0.33	0.04	-0.26	-2.04	-1.45
17	0.69	0.69	0.69	0.69	0.69	0.69	0.69	-0.16	-1.85	-0.16	0.69	0.69	0.26	-0.58	-1.85	-1.85
18	0.71	0.71	0.71	-1.15	0.71	0.71	0.71	0.71	-1.52	0.71	0.71	0.34	-1.40	0.34	-1.52	-1.52
19	1.16	1.16	1.16	-0.97	0.52	-0.12	0.73	1.16	-0.12	-0.55	0.09	-0.12	-1.40	-1.40	-1.83	0.52
20	0.97	0.97	0.97	-0.15	0.97	0.97	0.97	0.97	-0.38	-1.05	-1.50	-1.05	-1.72	-0.83	0.29	-0.38
21	-0.57	1.44	1.44	0.34	-0.02	-1.49	-0.02	-0.76	0.34	-0.39	1.44	0.89	-0.21	-1.85	-0.94	0.34

Participants 12, 13, 14 from Studies 2 and 3 did not take part in Study 4

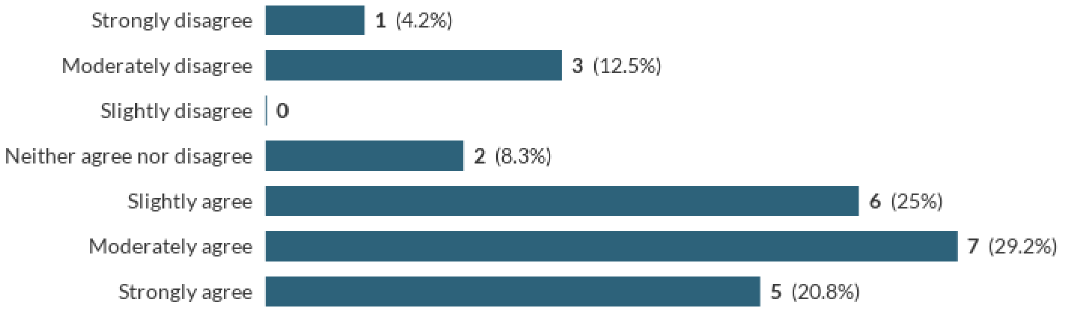
Appendix 11

Distributions of Answers by Group, Questions 2, 3, Study 5.

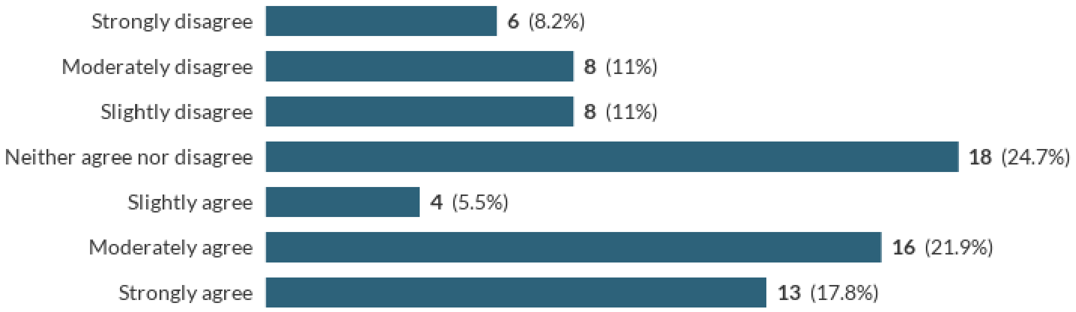
Qu2 Students

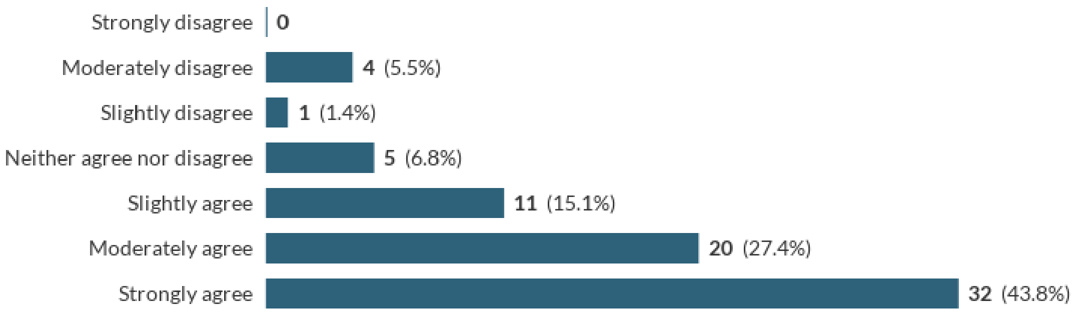


Qu3 Students

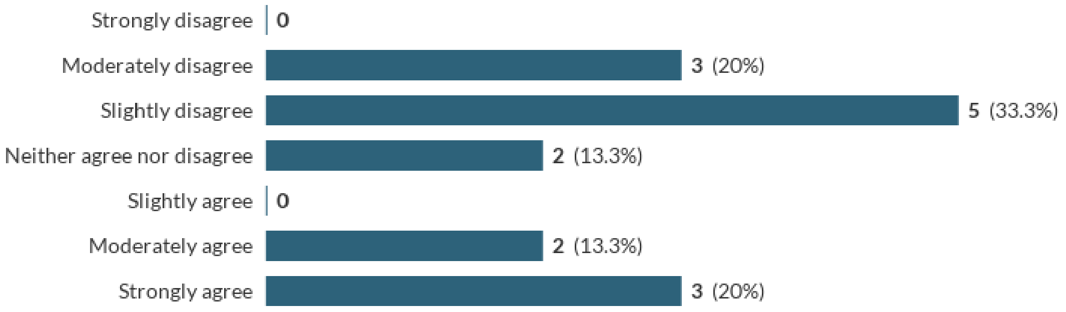


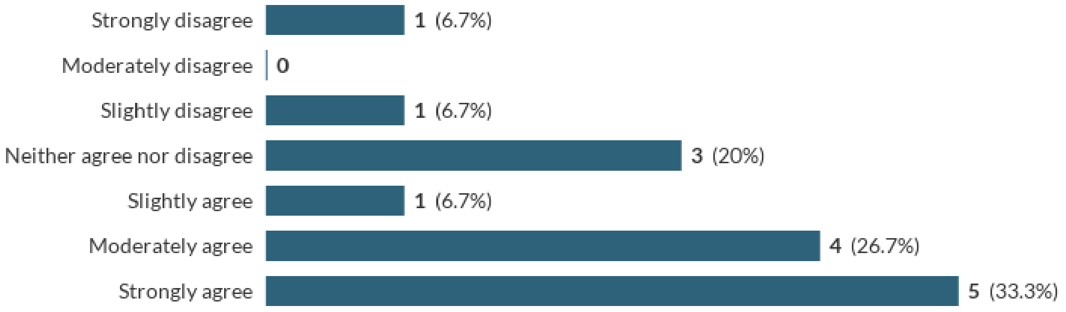
Musicians





Educators


Strongly disagree 0
Moderately disagree 3 (20%)
Slightly disagree 5 (33.3%)
Neither agree nor disagree 2 (13.3%)
Slightly agree 0
Moderately agree 2 (13.3%)
Strongly agree 3 (20%)


Strongly disagree 1 (6.7%)
Moderately disagree 0
Slightly disagree 1 (6.7%)
Neither agree nor disagree 3 (20%)
Slightly agree 1 (6.7%)
Moderately agree 4 (26.7%)
Strongly agree 5 (33.3%)

Appendix 12

Transcribed interviews Study 1.

Participant 1

KRP: Ok, so basically, as I described I'm gonna be asking you to..to sort of do a commentary and just comment on the ideas as you're....
01: Yeah
KRP: er listening to the playback and watching the playback of yourself
01: Will it just be a case of er watching it once through and documenting it as I remember? Or will it be watching it a few times?
KRP: Yeah, but, do feel you can...you can watch it through a number of times, you can also erm press pause...
01: Yeah
KRP: ..at any time, if you feel like something's happening there that takes longer to describe than
01: Yeah
KRP: the event itself, so you need to pause it to describe it, that's fine.
01:Yeah
KRP: er You can stop and take a break any time you like as well obviously...
01: Ok
KRP: ..and just *stop..*
01: [Laughs]
KRP: ..any time you like... That's the ethical side...Yeah...
01: I just don't wanna hear myself...
KRP: I just don't have to take this anymore... [paraphrasing film quote].. so erm...ok..have you...have you actually done research before, have you actually ever participated er in a kind of, er have you been a participant in research before?
01: Not in..not in terms of practical research
KRP: No?
01: it being a reflection on what I'm doing.
KRP: Right. So you don't..you might have done a questionnaires or, something
01: Yeah that's true
KRP: but but not this kind
01: No... certainly not this kind..
KRP: and and how did it..feel to improvise under that..kind of different scrutiny, because you are a performer obviously, but it might feel a bit different...I dunno?
01: I s'pose it was slightly different, in the sense that ..y..like it made me think of almost.. y'know... the nomenclature behind what was actually going on as opposed to ah that's the...that's the effect...that I want...it's kind of like, ok this is the scale I'm gonna do.....occasionally
KRP: So are you saying that you..you felt it might...it..
01: It wasn't that different...
KRP:..you might have had more explicit thoughts at the time you were doing it? Or...are you saying?
01: Possibly, yeah
KRP: Interesting...OK...well let's let's start off, if you
01: I mean...I'll [inaudible (I)] shall I press play from there?
KRP: Yeah you you can have control of it, you just play..[audio from playback (AP)]...thIis is you warming up I think..and then I paused it
01: Ah it's erm... I think it's going to stop in a sec.....ok this is tho one isn't it?
KRP: Yeah
AP
KRP: Nice development of the melody there...
01: I think that's [I] Coltrane version...trombone and sax harmony...
KRP: Yeah

01: Sounds empty without it
KRP: Mmm..
01: So...[/A] you...you know how Coltrane starts his solo kind of based off the...I think it's some kind of quartal idea
KRP: Yeah
01: ..that revolves around the 4 and the 9...
KRP: Yeah
01: So my initial thought was to..like g-go there... start on the 9th umm..
KRP: Mmm
01: ...but it ends up with...as quartals..[A] .in [I]...just general bluesy style...major..[/A].and then.. a sort of.. turnaround using the natural...seven
KRP: Uh hmm...
01: Erm... a II V I basically..
KRP: Uh huh
01; [Hums] Erm...[A] yeah double stops...[/A]...yeah erm..that's sixths isn't it..
KRP: Yeah
01: Yeah sixths, erm.. and using melodic minor I think...yeah..[demos on guitar]...yeah that's right..[A]..er arpeggios...ah ok...[/A] using the flat 5...like a little motif thing...and then ending up on the natural 5 [do be do *uh*..do be do uh] [A] [I].. yeah minor 9...[/A] Bb whole tone?
KRP: That was an interesting one, yeah..
01: Yeah, Bb whole tone...I think on the...in place of the lydian dominant...
KRP: Ok
01: 'Cos I guess you got the sharp 4 in there haven't you and the..[demos on guitar DG]..yeah and the dominant 7 [A] [/A]....I think I aimed to do more of that but it just didn't come out actually...but I guess..B- like Blue Trane has quite a bit of scope for that [A]
KRP: Mmm
01: yeah...the same...[/A] yeah like Stanley Turrentine maybe [A] [hums] er I'll just go back [I]
KRP: Yeah sure
01: [/A] Altered isn't it? Erm...from Bb minor to...Bb altered..to prepare the 4th [demos on guitar]...yeah [A] [/A] [hums] Natural 7 again..[DG] er...I think it...I think it's dominant preparation on the... on A7.
KRP: I was just..if you just go back like 2 seconds or something it sounds like you're gonna go into a erm a more lydian dominanty..
01: Yeah [A]
KRP...thing.
01: Ah yeah [/A]
KRP: That's off the arpeggio on the top isn't it?
01: Yeah
KRP: Yeah? [DG]
01: Yeah
KRP: Yeah
01: yeah that's the lydian dominant....yeah as I say I kind of probably intended for more of that to come out but, you know how it is, it just didn't go that way erm [A]
KRP: Oh, I do!
01: Laughs yeah [/A]...and that's a...that's just an augmented shape isn't it?
KRP: Yeah
01: Going down in whole tones..
KRP: Yup
01: Onto the...and then landing on the 9 of the Eb.
KRP: Uh hum [A]....do you think you were aiming for the 9?
01: Yeah..[/A]..Yeah I think so..just because [DG] not feeling confident enough to move it on to the second string... and being content to just land... land on the...stay on the first string for that whole phrase I guess..
KRP: Uh hum

01; Yeah...I think that was intentional...[DG] .there were several things in here that weren't intentional [A]. This is probably where I finish [I] Ah ok...a bit of like, call and response...[/A] That's probably the first time I started listening to the piano.
KRP: Right, yeah yeah...interacting with the backing.
01: Yeah...I guess that's the difference isn't it, like, playing with a backing track you tend not to really be that concerned?
KRP: Yes, I suppose you don't...
01: I suppose I should be more..
KRP: ...see it, well quite rightly, it's not an agent,
01: Yeah
KRP: it's not something with whom you're reacting
01: it's almost providing a timing [I]
KRP: and who can react to what you play, so you probably don't..erm feel it's something to interact with, so you don't use that part of the improvising so..
01: Which is a shame because there's actually..there is enough in there to..to go off...and that, for me, was probably the most enjoyable bit of of the, like, the choruses with, interacting with..
KRP: Mmm
01: with like the theme that the piano's laying down and then responding to it
KRP: Yeah
01: For, I don't know how many bars, it was only about 4 bars I guess. Yes it's an interesting point, I don't play much with backing tracks...erm so I guess that in itself effects how you.. how you play in these conditions.
KRP: Yup, yeah, I think it does, I think there's there's a challenge to ecological validity in that as you...as they call it but.. on the other hand.it controls for other factors I guess..
01: Yeah
KRP: because everybody gets the same...so..
01: Exactly...
KRP: So it's a trade-off, it's always a trade-off
01: It's er...oh er like in science when you have fixed conditions? Erm er ah...thinking back to 6th form days...
KRP: Oh right...
01: conducting experiments and you've got to keep...oh, controlled variables!
KRP: Yeah yeah
01: [A] Er...[I]...[/A] er Whole tone again...
KRP: uh hmm
01: .. based on what the piano was doing I think
KRP: You've got quite a lot out of the whole tone in this, haven't you I think?
01: yeah probably, that's probably the [cough] like [cough]
KRP: 'Cos as you say, it's lydian dominant/whole tone it's quite, y'know, there's a lot of overlap isn't there?
01: yeah
KRP: And and that's imp.. sort of spelled out, particularly on the 4 chord...
01: Yeah
KRP: ..in the accompaniment isn't it? You've..
01: Yeah
KRP: ..got quite a lot of that #11...9/#11y
01: Yeah...
KRP: ..harmony in the ah..
01: ...definitely. In the original!
KRP: Yes
01: It's there...and then the colour [DG] of just it being like a #9 harmony on the 4...I mean on the 5 sorry. [A]
KRP: Um
01: [I] some octaves....whole-half diminished [/A]
KRP: Uh huh

01: [DG] Yeah, whole-half diminished...[DG] [A] on the dominant..
KRP: Uh hum
01: Oh and that's the end of it yeah, but I think there was something else taking off....[/A] yeah, which was like... arpeggios...ascending up...up the scale in terms of starting on the ascending scale..
KRP: Which scale?
01: F....dorian...yeah dorian [DG]
KRP: Yeah? That's interesting...
01: ... and then it kind of...
KRP: And you're in the...
01: [A] died...
KRP: I did look over at you...but you were...[mimes focus]
01: laughs yeah I caught the erm...tsk tsk [mimes cymbal] ...
KRP: Yeah...
01: ...and thought 'oh oh, I should have paid more attention to that!' but yeah thanks for the head's up..
KRP: Yeah, erm that, that was great, so so can I ask you just a few other, like, questions around that? So..
01: Yeah
KRP: So, erm, if I asked a general question where did ideas come from do you think? What would you say?
01: Er... several places I suppose...one, like not recently having listened to it, but in the past being familiar with the 'Trane...so...knowing some of Coltrane's solo...
KRP: Yeah, 'cos you said a couple of things, you said that the harmony you put into the head was in the original...
01: Yeah...exactly..
KRP: and the Coltrane
01: Yeah
KRP: ...solo starts off in quite the way.. ...in a similar way to the way you do
01: Yeah on the on the 9th...and then...I suppose it's kind of...that's prevalent in like all the jazz we're making... in that it comes from somewhere else, it's like...erm... the recycling of ideas...and reforming...
KRP: There's a sense in which, I mean there's a danger here perhaps that...that when...you report verbally what you did, there might be an inherent bias in terms of you report what is more easily verbally reportable...
01: yeah...exactly...
KRP: It doesn't necessarily sa...y'know mean that you didn't have other things that are perhaps harder to articulate, I mean would you say that?
01: Yeah
KRP: I mean, what...'cos if I say "strategies" that sort've...y'know...'cos I've got a question here "what strategies if any did you use to generate ideas?", but then again. that a...in a sense a loaded question, 'cos it's...
01: Yeah
KRP: ...like saying, you were strategic...but maybe you were intuitive? Maybe you...
01: yeah, I'd say... It's intuitively strategic, in the sense that, you're trying to make...you're attempting to kind of make use of the the colour changes...
KRP: Mmm
01: So basically I...I guess, in a blues you're kind of guided by the voice leading and the changes of colour available..
KRP: Yes.
01: ..in it. So it's not necessarily like..I don't think I was very kind of motivic... but rather sort of [pause] not ...that is to say, not trying to write a motif that I can carry on through a chorus for example. Which would have worked fine..I guess erm but rather to create motifs, almost kinda independently, based on the kind of the colour qualities of the harmonies. erm
KRP: That makes sense.
01:The...another source of ideas was the listening...
KRP: um

01: Which is a.. which is a big thing...for exa...and as we were discussing earlier like, if there'd been musicians in the room the visual connection with them would probably lead you on to more ideas.
KRP: Yes.
01: Er, in relation to what they were doing..or otherwise...just inspired by what they're doing.
KRP: Yeah, uh when we do it usually, unless we're doing it on our own, in which case there wouldn't be a backing, there is...the interaction is a..is a real kind of important part of it, I would say.
01: Hugely, yeah I find that a lot within my band with the drummer, he's really er inventive.
KRP: Did you have any idea about when you were taking decisions relative to when you played them?
01: Er, what d'you mean?
KRP: I suppose, erm decisions that informed what you played, so...
01: Yeah..
KRP: ...so you in retrospect you've said "oh I've...I did that because, or I did this and I ended up on there, but looking back at it do you have any sense of in terms of the timing, in terms of the timeline of think of something - play something, or play something - think of something, or..simultaneous, do you think it was prior to? A lot prior to? Simultaneous?
01: Er
KRP: After the fact?
01: I'd say it's largely...it's interesting..thinking about it, but largely immediately prior to.
KRP: Right.
01: Erm..and sometimes while you're playing something you do the next idea occurs out of it so that is present with the idea
KRP Hmm
01: Erm I think the very fact that you have to come up with ideas, kind of keep..carries that on in a sort of chain reaction.
KRP: Ah, so so you're kind of responding to what you have done..
01: Yeah
KRP: an idea you have had or you have articulated and that spurs...
01: yeah the danger of that being if you're not happy with your previous idea..
KRP: True!
01: ..it's very..or not being able to spur an idea
KRP: Well, would you say then that you might deploy a different strategy if that arises? I mean, or..
01: yeah..
KRP: How planned overall do you think your solo was?
01: Er not not very planned at all..
KRP: and..
01: Although saying that we have like, y'know long term preparations... like continual day to day preparations which is almost a tactile familiarity that we have with the instrument..
KRP: Yeah
01: Almost like the key you're in prepares what, *can* prepare to an extent what's gonna come out..
KRP: Yeah
01: Which is the interesting factor behind this one, because say it was in F
KRP: Umm?
01: Then, like the number of times we've played Billie's Bounce and stuff, and all those bebop tunes..
KRP: Yeah
01: ..would have just led to a load of, I don't know, like name dropping...lick dropping and stuff..
KRP: Yeah, because it's very very familiar and..
01: Yeah
KRP: ..say under the fingers?
01: Exactly
KRP: Erm so that leads I suppose neatly to to what extent you think conscious processes are involved...in...in this?
01: Er...I ...I guess it's all consciously processed, isn't it in the extent that we're very conscientious with trying to formulate ideas?
KRP: Are you? ...did did you find...that...
01: Although we're not massively conscientious of it are we...

KRP: I suppose it's a hard question because it depends what it means, it depends ...'cos I think to some extent, you might think that, some of the processes have to be below conscious awareness..
01: Yeah..
KRP: but when they culminate in an idea that you articulate, some of the automated things have been kind of, taken care of?
01: Yeah
KRP: Y'know, in the extreme example, you wouldn't be thinking consciously, well I need to move my second finger to there, and then I..
01: Yeah, true, true
KRP: I suppose I'm thinking of it in terms of...on the level of description of ideas...'cos I'm thinking about idea generation...obviously the thing behind it was, what I'm getting to as well is how much you think you, how much of what you played do you think you heard in your head?
01: yeah, ah yeah I know what you mean...
KRP: Which is like the theme, you know... whereas
01: In terms of what you mentioned about the technical...conscious of the technical nature of it all?
KRP: Mmm
01: And there being that idea of like er, conscious of inconstance consciousness of constance and unconsciousness of inconstance...and consciousness of constance..and there's like four..
KRP: oh, that sounds like a Johari Window or something..
01: He he yeah...
KRP: Doesn't it? Yes it's like Donald Rumsfeld...
01: Ah, I dunno...
KRP: The known knowns. The known unknowns, the unknown unknowns...
01: Yeah exactly
KRP: so on...
01: I think that's what it comes out of there was an interesting seminar in college about that..
KRP: Ah right
01: but it is it is that kind of thing of we play so much on our instrument that we're no longer thinking about the technical boundaries, most of the time..
KRP: Mm
01: Apart from when that hinders what we're hearing in our heads I guess. [I]
KRP: Yeh, so in..in terms of that, I mean playing there, did you did you feel.. that happened at all?
01: No, and that's probably largely tempo related, like erm so if I was playing like Cherokee at breakneck speed, I'd probably be hearing things and it not being able to come out.
KRP: Right
01: Because of not being technically correct
KRP: Yeh
01: It not being practical for me at the moment and things erm
KRP: So how much of what you played then do you think you heard in your head?
01: Erm I had more time to hear things in my head'n although sayin'... that's a bit of a conundrum...I'd say most of it...
KRP: Yeah? And how much would you say, kind of came from an idea bank? I mean you mentioned that idea
01: Yeah
KRP:... before if it were something like a blues in F, Billies Bounce something like that, then you might have had more of an idea bank that's specific to that, but of course we can have..which are more like quotations or adaptions of actual phrases, but I guess we can have idea banks...of our own repertoire of phrases and vocabulary..
01: That I was about to say...I guess..like, an amount, a certain proportion of what we hear in our head is or comes out of that- our idea bank, in itself. So so I.. I'd say there's quite a bit of crossover, it kind of being like a.. like a venn diagram approach to it
KRP: Mmm
01: Er..I dunno whether it was..hearing the idea first and then it coming out, or the the idea being there, hearing it, and then it coming out.
KRP: Exactly!

01:But I think it's.. I think it's one of the two for most of that I reckon.
KRP: Right... that's I.. that's interesting...yeah... 'course we're not ourselves necessarily the reliable judge of that.
01: No, exactly...
KRP: ..all the time, which is what I'm trying to get at I guess...
01: Yeah, it's hard to be impartial actually...
KRP: Impossible, probably..
01: Yeah
KRP: Erm...were you conscious of modifying any of the ideas that you have in your idea bank for this solo, d'you think?
01: In terms of specific examples?
KRP: Yeah..I mean, did you...d'you remember doing that, or.. or d'you think...
01: Yeah, probably the lydian dominant ones..
KRP: Yeah
01: like, ah I'm trying to think...erm...I tend to find with scales like that that aren't your typical major/minor er.. sort of harmonies..if you do something that is based on a scale, like an altered scale, at this stage, for me they come from like the idea bank, so I reckon that I was pretty consciously drawing from those ideas and modifying them according to how long I had to play.. like in terms of bars...
KRP: Yeh
01: .. and just actual kind of seconds worth, to fit them in
KRP: Yeah, so that's almost like... online tweaking to fit
01: Yeah
KRP: .. what what was...errr.. the context?
01: Yeah..
KRP: Yeah? Erm...
01: Like I guess like the shifting er augmented er triad
KRP: Yeah
01: ..is probably an idea that I I've thought about before but you you rarely get the opportunity to kind've multiply it like, four. five times.
KRP: Mmm... yeah I s'pose..
01: in sequence, so..
KRP: That's one of...that was an interesting example and that's one of the reasons I I was sort of asking about whether you aimed to land on the 9th
01: Yeah...
KRP: 'cos in order...and that relates to the timing whether conscious or otherwise, that if you had in your head, you knew where the endpoint was because you can anticipate the harmony, you know when you wanna end on the 9th, and there's no other ways I guess, in terms of how it seems to you in your head that you can aim for that, you can aim for the sound maybe,
01: Mmm
KRP: if you had a sound image of the 9..or you can just know..that that's a nice place to end..
01: To end it..
KRP: and not...not necessarily need to..you would in some sense need that implicit knowledge at least of how long you've got so how many iterations of that you can fit in
01: Yeah and where that's gonna.. you're gonna have to land
KRP: so that you have to land on there when the chord change comes..
01: Yeah
KRP: .. which is probably all handled subconsciously, but I don't know, you might think differently? I mean I..
01: I'm not sure if it is handled subconsciously, that kind of thing
KRP: Right, yeah?
01: I think there's as you say there's like the technical boundary
KRP: Yeah,
01: of you've got to end it in this position here in terms of frets or like keys on the piano
KRP: yeah
01: or... I dunno fingerings on the saxophone or something

KRP: yeah, I don't I don't know
01: I I'm not sure about that but...but I think there are probably like there's probably two or three notes that I would've been content with landing on..
KRP: Yeah
01: ...in that specific example
KRP: interesting..erm...so I've just go er a couple of questions to sort of draw it to a close, erm, so the first thing is is what draws you to improvising would you say, could you say more about why you do it?
01: Er..like ..
KRP: Assuming you are drawn to it and you don't just hate every minute!
01: I guess I started out improvising so I kind of... I don't really feel like... I feel... y'know I I would improvise before I would read music kind of when I was growing up as a kid, so for me it just feels...like a more natural thing to do than to read off the page anyway..so and then you've got to train your improvisation, that's something I'm kind of like really fascinated by..
KRP: Mmm
01: and in the long run it's like one of the things I'm most looking forward to...it's like er I was talking to Jason Rebello when he came and did a masterclass here...
KRP: Oh, right!
01: it was brilliant...and he was saying that all of his practice is oriented around erm there being no sort of translation in between thinking of the idea and it happening.
KRP: Right yeah
01: and, and like trusting that your ideas your ideas are appropriate to that musical moment and stuff and so I think one of the things that draws me to improvisation is like eventually hopefully reaching that stage.
KRP: Ah..
01 And, I dokind of find it more rewarding in terms of like the freedom of it..within within reasonable restrictions, than say, playing repertoire that's already been written.
KRP Ok, so it's like freedom within constraint.
01: Yeah, like if there were no constraints I wouldn't find it very appealing at all.
KRP: Right, so you're not necessarily heading for the free improvising cercuit?
01: no..exactly yeah.....yeah it's erm
KRP: And then finally is there anything else you'd like to add about your solo or your experience of the process today?
01: [laughs] I wouldn't mind doing another take or two but...
KRP: Ever the perfectionist...
01: but erm we probably would have been here all day!
KRP: Well, yeah so...
01: No it was a really good that was a really good experience actually...
KRP: Good!
01: I I say that as if I'm surprised but...erm yeah it's not something you get to do every day and kind of... it's good to think twice about everything
KRP: Yeah, well er thank you very much for doing this today and and y'know please feel free to contact me via the email if you have any other questions and then when anything comes out of it I'll let you have copies of..
01: yeah I look forward to reading about it and everything yeah, exciting!
KRP: Great!
01: Thanks Keith!
KRP: Alright.

Participant 2

KRP: Ok, so have you participated in research before?

02: Er... Yes, once once before, er what was it? It was oh it was a long time ago er.... it was someone from the psychology department back at Edinburgh University.
KRP: Mmm
02: Er... analysing...er.. eye tracking movement I think...and how...yeah Something like that, it was...
KRP: So, eye trackers, was it was it to do with sight reading? Or something else?
02: Yeah there were all sorts of things actually, er yeah just sort of clicking on the screen y'know, when you saw whatever it was that came up and that kind of thing and, all sorts of...yeah but that's I think that's about it....
KRP: Mmm
02: Yeah...that I can think of right now
KRP: So, how did it feel to improvise while being video recorded in this setting in terms of research setting, rather than say, performance or rehearsal?
02: Ah, it didn't feel... it didn't feel too much different, I think I felt sort of more relaxed because there wasn't a premiss, it was just sort of do...do what you do 'n y'know don't sort of think about it just do it, whereas perhaps a rehearsal it's sort of focussed on "I need to achieve this" or...I mean there's still something that we're achieving, recording y'know, me improvising, but I think...yeah, it was just a lot more relaxed.
KRP: Yeah, no that's great, well...have a... let's shall we start playing it back, you..
02: Yep sure,
KRP: As I say, you can just.. pause or rewind anytime.
02: Uh huh. [AP] Hmm maybe have a little look back at that...[/AP] [RW]
KRP: Sure
02: [AP] So I think the first left hand voicing that I used...that was just because..it was the same voicing from the head, I think...I just thought "that's a good place to start".. I'm sorry I took it back a bit far... Yeah, [/AP] I think I just wanted.... I've started, y'know? This is... this is me, in now... I think that's what I... yeah.
KRP: So a strong opening statement..
02: Yeah I think just 'cos it's such a strong head I think if it was something a bit more moody a bit more... y'know perhaps a sort of ballad or something that's, y'know perhaps you'd come in...creep in a bit more gradually, but I just thought mmm...in...'cos it's sort of that...you got that sharp 9 thing going on in the head...
KRP: Yeah...
02: ...and I just thought... yeah, I think that's, well that's why, I don't know if I thought, like, I'm going to do that, but that's why looking back at it, that's why I did it.
KRP: And what aboout the initial melodic line, the right hand? What do you think about that?
[Note, at from this point repetitions and dysfluencies are not transcribed unless they are likely to affect meaning]
02: Sort of hit the 6th...yeah I just thought 'cos that's gonna really grind for a second...and I yeah, so I used those first four bars to create a bit of tension and then.. I think, sort of a resolve on to the Ab almost to get that sort of dissonance initially of the 6th and the sharp 9, I think ah well I've got a sort of 13th isn't it? I've got a 13th on the left hand as well, so I think that's initially there that's what's happening and then sort of a resolve back to the ah Ab...[AP]...[/AP] and that...that 4ths thing...'babadah boom bah' [intoned] is something that it's just come into my playing recently, I'm not sure, it's something that's... I just really enjoy the sound of sort of jumping around in 4ths, I think I did it a bit later on as well, anyway we'll listen to it...[AP] there babadah bah and then...so that.. heh [/AP] that's a little lick that I stole from a trombone player that I used to play in a '20's band with, he played it once on a gig and I stopped him after the tune, I said "What was that? Play that again!" [laughs] And then, yeah, it's just... I don't play it a lot, it just sort of happened to come out there, works quite well in a blues thing. [AP] Just kind of walking 6ths with a kind of chromatic kind of passing... You know what I think there, I actually lost the thread a little bit, so [RW] so this is sort of a bit of a line going through here, that's that done, and then here, just sort of lose it.. what am I doing what am I doing? And then I sort of find it I think, just that sort of meandering about slightly. Oh I just played a little..[/AP] accidentally played a quote from a tune I'm learning at the moment, d'yknow 'In Walked Bud' by Thelonius Monk"?
KRP: I'm not that familiar with it, I've heard it I think...but
02: baduhbadah bah baduh bum [intoned] Sort of played [AP]

KRP: Oh yeah.
02: So there you go that's maybe where that came from!
KRP: Do you think, at the time [/AP] at hte time you played that you weren't thinking of it as a quote, you've only...
02: I had no idea I'd played it, until now...
KRP: right, interesting...
02: yeah, I had no idea I played that...erm yeah, so that last chorus, actually let's [AP] so the chorus where I was meandering, slightly just trying to find something to latch onto...I think this chorus I was just playing and there wasn't really much of a purpose, there's not like much of a...just kind of, er notes... yeah, I felt, I felt I remember that distinctly 'cos I thought I've just played far too much in the second half of that chorus.
KRP: So, in terms of meandering, when you're feeling, or you feel, that there wasn't much purpose, how do you think you generate the content when that's happenening?
02: For me it's just taking some, just stopping playing, I just gotta stop playing...heh 'cos if you keep playing I think it's hard 'cos you're... you need to get.. just take a moment to get a perspective on what's happeneng, take a breath and then come back, and I think...
KRP: So that's how to regain direction or focus or purpose is what you were saying?
02: yeah, or just sort of find something new, just try to think of something new, that..
KRP: Yeah?
02: Yeah, that you can develop, 'cos I definitely just just play... I was just sort of playing around the yeah just sort of arpeggiating the chords, and not actually creating a melody, I mean y'know for an effect you can... obviously arpeggiating chords is... is great but, I was try'na here I'm trying to create a melodic line...
KRP: Ok
02: ..and I just [AP] [I] yeah so that chorus there, I just thought.... and then... then [/AP] I've brought in a new rhythmic idea, here which is baduh gah dah [intoned] yeah, and it's just by giving it some space, I dunno, I'm able to create something that's that I can, that's I dunno, that I can communicate better. [AP] [/AP] So sort of same issue in that chorus, I'd say I had a momentary bit- the beginning, [AP] so this is still meandering...here [/AP] [AP] this is the end of the first meandering chorus... and then, anidea here... which I liked, then I just started playing...it sort of loses the melodic flow here... and I think I just played a sort of a turnaround [/AP], almost like a learnt.. a learnet sort of.. thing y'know, just like something to play over a turnaround but not necessarily..it's just kind of... perhaps more of a muscle memory thing? That came out there, because I thought, great, this chorus has gone down the pan a little bit... let's stick something in that I know will spice it up [laughs] yeah I think that's that's what happened there and then at the end of this chorus I thought " I've played too much, I'm gonna take it right down... and yeah.. [AP] lot's of space... that's a bit of Thelonius Monk coming out there, I've been listening to a lot of him lately! [laughs]
KRP: Yeah got a dissertation haven't you so...
02: This is the head here we go...yeah
KRP: So, I can definitely here the Monk influence in this in that last one.
02: Yeah...yeah but I think that's... yeah so that's the way I sort of approach it, if I feel like I've.. I'm playing too much and I can't make sense of what I'm playing, and it's almost just sort of watching my fingers do their thing without y'know it sort of becomes a muscle memory thing at points... at which point I think.. "Stop! .. 'cos, y'know... I don't know how many people are enjoying this, but probably less than were before"... maybe not but... I'm certainly not enjoying it as much because I feel like I'm just yeah playing without creating anything er co..like, cohesive? Basically, so it just sort of feels like it's just like learnt things, licks and tricks, just playing those, so my approach is to stop.
KRP: So when.. so you're when you become conscious of overuse of muscle memory in your terms, that kind of generates an interrupt?
02: Uh hum
KRP: So it's like you take stock or you take strategies to...
02: Yeah, sometimes it's really, I mean in this...
KRP: ...change direction
02: in this context it's so relaxed, y'know, I'm not nervous or anything I'm just playing that, it's very easy to do, and it will just be sort of four bars, y'know like that turnaround at the end... I think that's...

that was too much y'know there wasn't much going on there, and I was able to stop, and yeah bring it right back down to a single melodic line and take out, y'know take all the texture out and start.. start with something smaller basically, whereas if I'm onstage and feeling a bit nervous... er I'll find that I just carry on, perhaps playing, sort of learnt licks and tricks for longer, because it takes me in..., I'm sort of "oh I need to keep playing, , y'know I'm, I need to impress, or need to do this or whatever..." but and you s.. yeah, the sort of nerves get the better of you I think.
KRP: That's what I was thinking before about the.. how does, how do we generate content when we're.. it's almost like the inspirational equivalent of treading water or something like that, how do, y'know how do you stay afloat whilst in those kinda gaps in inspiration or thought process?
02: Yeah.
KRP: Interesting and I think what you've described a little bit is muscle memory and er leaned kind of ways round progressions so when you said the the sort of turnaround, when you had a sort of way round that you perhaps felt you could rely on/
02: Yeah..
KRP: Erm, so any any more ideas about strategies you used to generate ideas, that came/cropped up there?
02: Erm..I think I'm quite a rythmic player at points, y'know, I've talked about melody loads and loads but...yeah I do like to play with... yeah just sort of create rhythmic ideas that aren't necessarily melodic in their content...I'll maybe just have a quick listen back and see if I can find a couple [AP] sort of playing with rhythmic accents, y'know and sort of stretching the time or augmenting it or... This is very much sort of, straight...sort of there...that's sort of slightly, it's not particularly adventurous but...
KRP: I detected precessing slightly... it's sort of moving relative to the
02: Yeah...S o there.. that kind of thing [/AP] I really do try and just, y'know when I play something I really like and I think "that's great" however simple it is, I'll then try and develop it, erm yeah, sometimes try and take it, y'know I'll try and take it as far as I can, or sometimes..or, well that's not true actually, sometimes I'll take it further than others is what I mean...so here, I don't think I take it very far.. [AP] sort of new idea there...so yeah [/AP] Yeah, and that sort of pentatonic run down I just, it just sort of... feel like it's just kind of lazy! [laughs]
KRP: [laughs]
02: Y'know, you're just sort of at that point, because I thought ah.. because I've done *so much* in that turnaround, I need to sort of fill in that gap and keep it moving towards the sort of barline, and so I think that..that sort of pentatonic run down was just sort of filler1 [laughs] Rather than...[AP] out of sort of, I dunno..[/AP] Yeah, for me the interest I guess is in the left hand there, 'cos it's rhythmic again, rhytmic sort of accents there. [AP] [/AP]
KRP: Erm, how planned overall did you think the improvisation was?
02: Well I didn't plan any of it [laughs] in advance, I didn't even really think about it... I think the most thinking I did was, you said it was going to be Blue Trane, I thought "How does that go?".. bah bah be ...bah buh... yeah that's the one, and then... that was it...
KRP: So in the course of actully playing do you think you had like erm, any sketch ideas, in terms of how it had gone already informing what you might do next, y'know maybe just on the level of strategy or something 'cos I think you've described a little bit about that, about thinking "oh well, I'd played too much during that chorus...
02: Uh hmm.
KRP: .. this chorus I'm going to empty it out or contrast" ?
02: Yeah, erm I guess there's y'know there's certain ideas, yeah I mean a lot of that, a lot of it I've played before, but just not sort of in that order, there aren't certain points, er, wait in fact.. no that's a lie, I'd say the very very end, you know when the head comes back in.. [AP] and I went up to.. that sort of this...[mimes] this thing, yeah I think I would've carried on with that sort of thing and that's very much a sort of... I mean I didn't predetermine it but, when I start playing a blues, I think " Right, there's that, that thing sounds really good if you y'know hit into...build up one chorus, and then hit into the next with the.. the little trill on the 5th and 7th.
KRP: Yeah?
02: And the flat.. flat 7th yeah... yeah, so that's possibly one thing, erm yeah and what else? Yeah I think I did it hitting the flat 3 and the 6, at the same time..
KRP: Uh hmm?

02: ...is quite a nice effect, and I think, more ofen than not I'll bring it into a blues, and I think on this one, I probably thought yeah, this would be... 'cos I started with that actually...my very first note was like the... the sort of 13th... [laughs].. with the flat 3 so, I think immediately I sort of established that that could be an idea in the improvisation
KRP: Mmm, to what extent do you think conscious processes were involved?
02: I think just in terms of what I mentioned before in terms of the relisation that I'm over-playing, so that's the term I was trying to think of before, over-playing, that's er yeah and points, and sort of realising that, coming out of your, 'cos it brings you... for me anyway, it brings me out of that sort of in the moment state, where you're just kind of, creating and not thinking about it, and then...like when you start over-playing and you realise that you start over-playing, it brings you out of that er..yeah, and then I sort of become conscious of what I'm doing, and think "Right, how do I, like s...change this? Y'kmow, how do I get away from, like the thing I'm not liking and make something I do like? And that's about it. Just stopping. [laughs] And just taking a breath really.
KRP: Mmm, right. Erm, how much of what you played do you think you heard in your head?
02: Erm I think the rhythmic, all the sort of rhythmic ideas, especially the ones that are more spaced out, that definitely all comes, that's all, like I hear all of that and... yeah so I mean like, I don't do.. I was just trying to naturally improvise how I would there, I mean what I'm trying to do, as an exercise, is try and practice singing what I'm hearing as I'm playing.

Participant 3

03: So I'm gonna talk like this and mumble the whole time... [covers mouth]
KRP: No, don't do that... and do make sure that you..
03: Pop!
KRP: Gotta transcibe that now!
03: Ha! Ha ha ha ha [drums table] Power!
KRP: So...
03: Yeah... shall we just have a listen? [AP] At this point...I'm getting the chords wrong...[/AP]so I think it's minor...
KRP: Ah...
03: ...and this is from memory...from the... like, from the past.. having done Blue 'Trane before erm in my 'ead, it's a minor blues, and now I don't think it's a minor blues...
KRP: Right, yeah..
03: ...having having played it, but at that point I'm playing that E... Eb minor
KRP: Yeah.
03: ahh there's a note in the piano.. god.. that isn't quite right, ah well let's try Ab minor for the next one... errr!
KRP: Mmm. I...mm..I think with a sharp 9...
03: Yeah...
KRP: ...feel you can...you can work your way into that can't you? That it's not like a straight major blues either.
03: Yes. Yes. Yeahyeahyeahyeahyeah.
KRP: And the way some arrangements are it can be played...
03: Either or.
KRP: Either...
03: Yeah. Yeah so, at the moment I'm just playing chords behind the head and trying to find the right ones! [AP] Ah see, got it! [playback (PB)] I meant to be late there...still haven't worked out what's happening on the Ab chord. [PB] My fingering's not great!
KRP: Dshh!
KRP: That sounds almost like a quote...
03: It does doesn't it! [AP] Er... it wasn't...but it sort of was!

KRP: Sort of Blue Monk isn't it?
03: It was Blue..er [hums quote]
KRP: Yeah.
03: Is that Blue Monk?
KRP: Oh no, it's er Straight No Chaser isn't it?
03: Straight No Chaser! Yeah, so the first... so I noticed it er [AP] so at that [RW] I kind of..played the first.. I pl..yeah so at the [hums quote] at that point I was like 'Ahh ohhh... I carried on in the rhythm of, but not in..not necessariy the right notes..
KRP: Although a similar chromatic contour.
03: Yeah, yeahyeahyeah.
KRP: 'Cos I wonder whether you'd been led that way because you started out in a quite chromatic...
03: Yeah...
KRP: ...bluesy way...
03: yes ...yeahyeahyeahyeahyeah.
KRP: but with chraomaticism and then... it sort of...
03: Yeah... well I think the first chorus er or whatever, at least the first bit I'm definitely playing like I'm playing how I tend to play on blues I think.
KRP: Hmm.
03: Which is mostly around like minor pentatonic maybe dorian with chromatic notes in it...
KRP: Yeah.
03: ...er that kind of [hums example] landing on the major third of the II chord is...that I did a bit earlier... is something I think I do a lot... when playing in this.
KRP: Where do you think it came from?
03: Dunno...The ether? No, I dunno. Er where did I... as in how I learnt to do that? Or...
KRP: Yeah, I suppose there's two questions there, one is where.. how did it develop as part of your lexicon...
03: Yep.
KRP: ... if that's a good way to describe it, and how does it appear as something that's available... what's it like for you?
03: In the moment?
KRP: In the moment yeah.
03: Er, I don't know I think it was sort of instinctive then, like it kind of well, so how does it develop....... er? I remember, 'cos I was in like a blues band at school, so it's 'blues scale all the way, blues scale all the way' and I remember sort of discovering that there were other notes that you could play and I think that one was a particularly strong one.
KRP: Yeah.
03: Y'know, er when I was first starting to play in a jazz... or what I thought was a jazz kind of way... erm it's just a sweeter note, er so maybe it had a lasting effect on me, I don't know? Have to see how many times I do it... ha ha, yeah [AP]. Ok, so at this point... [/AP] so at that point, er... I'm thinkin' 'ah I should put some delays on here', er and sort of build up a... a thing that I guess made it sound more post-rocky than it did., like, so just stacked delays.
KRP: Sort of rhythmically... is that in a sense of emulating what a pedal does?... Or is it..
03: No, as in, I didn't do it, but I thought...I was like 'oh I can hear some delays', like I could... I was... yeah.
KRP: So I'm wondering whether what you're playing rhythmically, has some relation to...
03: The delays that aren't there?
KRP:... the delays that happen with a pedal, which then informs how you play anyway...
03: Ooh...
KRP: ...which then informs how you use the pedal?
03: Ooh yeah
KRP: It's that kind of, reciprocal redefinition maybe?
03: Er, am I kind of...so you're asking whether I'm trying to emulate what a pedal might do?
KRP: Maybe unconsciously, that if you're thinking about delays and then you're playing 'di...di...di...', er, something like that, I don't know?
03: Er, I dunno, was I that rhythmic? I dunno, let's have a listen again.

KRP: Hmm, the other thing I thought about that was that the voicing you put in is lifted straight from the piano part, isn't it?
03: It could be...
KRP: Sounds very very...
03: ...it's a 7... [AP]... 7th... flat 9.. 7th sharp 9 again. [PB] [RW several times]. Just before here... Oh yeah...yeah I don't know, because... 'cos what I was hear...what I was hearing... oops, shush. [/AP]. What I was hearing wasn't, erm... er... wasn't that. Like it wasn't like, it wasn't that I was hearing the delays to be like rhythmic like that... it was... I think I'm playing leaving space for delays maybe? Or like 'ah this, this would...this would, and everything and this would develop...like, should I stick that on, and it'll be like dub dub dlll dcrrr....whhhchhh'.
KRP: So it shades more into...
03: Good luck transcibing that by the way!
KRP: Ahwr...
03: [Laughs]
KRP: Why you...!
03: [Laughs]
KRP: Erm, so is is it shading into like a sound, or timbre or...
03: Yes. Yeahyeahyeahyeahyeahyeah...
KRP:... that you're hearing?
03: ...yeahyeahyeahyeahyeah.
KRP: And what d'you think prevented you fro... from enacting that one?
03: Dunno, er I just second guessed myself, like... er...
KRP: By the time you'd thought it had gone?
03: Yeah? Possibly, b-but also, I dunno because we'd had the conversation on the phone earlier, about whether to bring pedals...
KRP: Um.
03: ...er, I was just, it was jus...I was just unconscious, it was like 'oh...oh I'm hearin', oh I s'pose I did bring 'em, oh but I wasn't gonna bring 'em, oh should I have done it? Or like, am I just imagining that I wanna play that because I've brought them? Would I be hearing this if this ped... if this wasn't here? It's hardly like I'm hearing a like a choir of saxaphones...' I din't think all of that! But I think there's that slight bit of doubt...from...
KRP: Mmm. I think I might code that as 'overthinking'!
03: [Laughs]. [AP] Bit of chromaticism...[I]...Ha ha ha... landed on the wrong note!
KRP: When you say...[/AP] ... the wrong note?
03: Oh I, I hit em... that phrase... hopefully I sort of recover, but I landed on the Bb [AP] [RW] instead of an Ab... before this [RW]... you see that ' derrryadaa'?
KRP: Yeah. So you're saying that wasn't intentional?
03: I don't think so. I think...just from the way that I...just from the way that ... I like that bit!
KRP: Yeah!
03: Erm, so [/AP]
KRP: Shall we just play that bit again..?
03: Well just.. just go back and talk about the other bit first...[I]
KRP: Yea yeah, ok yeah.
03: Er [AP] So from the way I play this line.. [I] ... in a minute... it lands on Bb, I've... watching me now, I know that I meant the phrase to end there. [RW] Like, cos I... yeah [/AP]
KRP: So you accent that 'ptsch .. deh'
03: Yeah and it's slightly pushed ahead of the..sort of one innit? '...deh'. And...like I... I don't remember thinkin' at the time, but watching me now, I'm like 'oh'... the way that I'm playin', maybe it's, er I've not got a like a phrase in mind or er, I'm gonna play *this* for this amount of time, but I think maybe there's this kind of... er like, a sort of rhythmic resolution thing?
KRP: Uh hm.
03: Where erm, like just sort of aiming for ... I know where I'm gonna land... and then where I landed... heh heh it's like 'oh it's the 9th, ahhh' Erm, but than actually I quite like where it goes next.
KRP: Hmm ok...

03: Then I... I sort of...[AP] that sort of like becomes a bit of a... that sliding down there, yeah, some of the phrases alright.
KRP: Nice build of tension there!
03: Yeahhh! At this point I'm thinking 'Oh I'm playing in octaves, yeah it's the jazz thing and arrgh stop it...'
KRP: [Laughs]
03: But yeah again that... I wasn't...there were the... there it was just a tension thing, like maybe the first, I can't remember where I started, but maybe the first note or two were...were, y'know... were in-key or something. [RW]
KRP: Let's see...
03: In-key, out [RW] so yeah, so the first note was just the...was the Bb... Oh I started singing here as well!
KRP: Oh yeah.
03: And then stopped... [AP] So the first it's a Bb and then I move up to the B natural, where you might do if you were doing a minor blues, you might, er... the ch... the whole chord might shift up there, be like a V then a flat VI back to the V, erm, so I sort of did that, and then I was like 'ah I could keep going', and then again it wasn't, ah y'know I don't know the relationship between what I was playing and the chords, but I know that I'm aiming for that... Eb...
KRP: And in terms of the target, how is that... how do you experience that aiming? What's it like?
03: Er... agai...it's it' a tension thing, so I know that I'm ramping the tension up and at this point it's gonna, I'm... it's gonna... resolve...
KRP: Yeah... ah.
03: Er that.. that is how I felt...I think.
KRP: Mmm...
03: Like it's a
KRP: And the...yrr... 'cos you said you knew you were aiming for the Eb, would you have thought that explicitly, in terms of the note value? Or, was it just a destination you could feel ahead? Or hear ahead?
03: Uh huh...
KRP: Or...
03: I mean, er...so I guess there's a few points in th... in this where I play kind of quite chromatically, er and...I guess once I'd... maybe it comes more from placement? So once I'd set off on that ascending thing, I was like 'right er..the I chord is coming back round again at the top of the form' Right? So, I think I was... it's sort of... a turnaround thing, like I was aim... aiming to kinda, resolve, rhythmically and like resolve the tension. Er, yeah I don't know if I'd have known that I was aim... aiming for the Eb when I set off, because I wasn't planning on doing that when I set off, d'know what I mean, I was playin' the Bb and then 'oh I'll move up, to the B', erm and then, I was like 'oh, just keep goin', and then once I was, I don't know, up around a C#, D? I don't know, it was... like it sort of.... and then... and maybe my sort of, awereness widened a bit? And it was like 'ok well the one is coming back round, so and I'm approaching the one, so there... whereas if I'd... maybe done it from somewhere else... and maybe [I] the third or something or don't know. Although having said that, the third is... either of the thirds seema little bit... ambiguous in this, so...
KRP: 'Cos of the sharp 9?
03: 'Cos of the sharp 9 thing, so I think probably I... I wasn't really [I] so much.
KRP: Alright, so..[AP]
03: Uh, I'm Wes Montgomery! [Laughs]
KRP: love a bit of Wes!
03: dunno what I did there. [PB] Again I think I might be late. [PB] [/AP]
KRP: How do you mean?
03: Er, I think I had the idea, and then... executed it after I... watching back there, stuff that I'm playing immediately before... [AP][RW] This... would be... [/AP], like, I think that's [imitates vocally] it's probably where I had the idea, to... to bring the delays in. Erm, and then maybe because I'd bottled out of it earlier, I was like 'ah fuck it, I'm doing it anyway!' For the benefit of the tape [both laugh] that is a technical term. [AP] And then so at this point, I'm like 'Yep, happy with that'. [/AP] But that pedal there... So I'm I'm pointing to the Danelectro reel echo, that isn't on ma board, er enables me to play... to leave the tails going?

KRP: ooh yeah.
03: Er, so actually what I wanted to do then was to turn, turn the delay off, but keep play... er keep the, [tut] keep the echo going but continue playing without it...
KRP: Yeah.
03:... feeding the echo. Which I can do with that one, which I've been using it a lot recently.
KRP: Hmm.
03: Er... [AP] and so what I do instead... is just turn the... just turn the... the level down a bit and then eventually just turn it off there. Totally didn't pluck it...[laughs]
KRP: No, it's... it's a lot to think about, especially in a, kind of setting like this.
03: And at this point I'm like 'I give it.. give up with playing the thirds and sevenths, I'm just gonna play the higher chords! No, noone's happy with that Anton... Ooh, bit of vibrato is it? [laughs] [/AP]
KRP: [I] So er, yeah...So...
03: The red light's not on any more...
KRP: Oh...
Technical interruption.
KRP: So er, I guess we're at the stage where... are there any other thoughts or considerations on that solo that you want to bring up or anything you wanna go over?
03: Erm... no? [laughs]
KRP: Ok...
03: No, I dunno, this isn't something I would normally do, as in playing like this.
KRP: Yep.
03: Erm, I think I have done a lot of it in the past...
KRP: Hmm.
03: ... more than I maybe give myself credit for...
KRP: Hmm
03:...but I... I enjoyed that but I don... er.. it's a little alien, so it felt a little alien for me.
KRP: How... how do you think it kind of differs from what you do usually, what's the main differences in terms of...
03: Erm... so most of the improvising that I do tends to be without chord sequences, so it tends to be free in that sense, or starting from an idea or working towards an idea, like y'know a riff, or [I] possibilly use this tonality here, but... I think er [I] yes it's, yes I think it's rare that I'd play over chords like that...these days.
KRP: Hmm...I suppose one of the focuses of this is, I mean there are some like, guide questions into like, what strategies, if any, did you use to generate ideas?
03: Er [laughs]...
KRP: How planned was your improvisation overrall? [reading guide questions]
03: Erm... how...?
KRP: Things like that, I suppse you're saying those things differ quite a lot in... in what you normally do, fom this?
03: Well... er... well no I can answer the..planned... how planned was the improvisation overrall, not very...er... I could like... oh it's gone off again!
technical interruption
03: So, I picked a key or worked, or you told me the key, rather so I... but I didn't think 'oh I'm gonna have like, I'm gonna peak at this point, or I'm gonna... so I didn't plan, structure or...yeah, I guess...no it's gone off again... I guess, it wasn't planned. But there are things that I do around blues, like like watching back 'oh I often do that, oh I often do that'. Yeah.
KRP: Mmm. So that relates to that conversation we had before and relates to this question of er 'how much of what you played came from your idea bank and how muchrepresents material that you... you haven't played before?'
03: Yeah, ok er.. er, so I surprised myself a couple of times watching back, er... there's like a couple of points, like when I landed on the wrong note and then I went into the descending thing, that sort of, to me that didn't sound... listening back I was like 'oh...ah...ha, hey who knew?', er...
KRP: So that was like an opportunity to develop an idea...
03: Yeah.
KRP: ...that you might not have thought of...

03: Yeah.
KRP: ... consciously ahead of time if it had been straight from... your internal repertoire?
03: Yeah, but then also like I'm not, I'm not thinking about my internal repertoire.
KRP: Hmm.
03: So, I er, like I do that kind of tension... chromatic-y tension thing... I guess...
KRP Hmm.
03: ... but it's not like, kind of before we're playing I was like'I'm gonna do some of that chromatic-y tension stuff'.
KRP: Mmm.
03: Although maybe subconsciously 'cos it's... I couldn't work out the voicings from the piano..., or the... y'know the exact chords, er in terms of extensions and things, then maybe that, sort of, fed into that a little bit? And also that, er which pleasingly, I don't think I did as much as I suspected I might have done, the targeting the sixth of the mode or tha major third of the II chord.
KRP: Hmm.
03: Er, it's something that... maybe a little tic of mine?
KRP: [I] So, to what extent were conscious processes involved?
03: Er.. generally... as a negative? So when it stopped me using the delays that first time...
KRP: Hmm.
03:...or then, also thinking 'oh I wish I'd had the other delay pedal in'.
KRP: Mmm.
03: Like 'how... how can I get out of this?'. So there's a little bit of... I think, what I hear... yeah, so first time I was like 'Alright, I can hear delays, that's where it's goin, I want some delays, oh I've bottled it! Move on'. And then the second time I was like 'Right, ok I can hear some delays, great I got 'em in, oh no I meant the *other* delays!'.
KRP: [laughs]
03: Or like, rather like so then it was then there was a bit of conscious 'er how can I do that?' er, problem solving- just turn... turn it down rther than killing it straight away. But it's... yeah... I don't think... I dunno if I felt particularly conscious? Of, well y'know, whilst I was playing of like note choices and things like that. It's not like I felt that it was... all blowing through me unhindered and it was beautiful and it was the, what's his name, Kenny Werner? Effortless Mastery...
KRP: Oh yeah.
03 :...thing, it wasn't like it was flowing out of me, er...[laughs] so I'm not making a value judgement one way or another! I don't think it was... I don't I don't feel... many conscious processes, but then that... could that, on the whole I suppose that's up to you, whether that's just me over-romanticising or not! [laughs]
KRP: And how much of what you played do you think you heard in your head?
03: Prrr... uh ghuh... don't know, jus' some bits sort of stand out as... definitely... er, the delays or no delays that we've talked about...
KRP: Yeah.
03: ... erm that was a definite kind of, oh er ha ha I can hear that, and then either executin' it, or er not executin' it, or executing it badly or whatever. Er, that little Straight No Chaser quote, if that was it, was that... [sings tune] yeah, erm... think maybe I heard the... I know, played the start of it and then and then kind of heard... heard it as part of a bigger thing... and so went with that. Er... yeah, difficult isn't it?
KRP: Always!
03: Ha ha...
KRP: Erm, ...
03: You'd have to ask Mike Walker, 'cos he would know how much I heard or not!
KRP: [laughs]
03: Or Steve Berry! I had a lesson with
KRP: Yeah...I might ask him actually...
03: Steve Steve would be great, 'cos he's here anyway a lot. He, I had a lesson with him once, and he was like ' Right, just play me something'. So I improvised something, and he stopped... and he was like 'you didn't hear that though, did you?' Was like 'Nooo...' [laughs]
KRP: [laughs] Found you out!
03: Yeah!

KRP: In terms of the timing, erm when do you think you took the particular decisions to play what you played relative playing them? 'Cos you mentioned something about thinking of the delay...
03: Yeah.
KRP: ... but then it being late when you enacted it.
03: Yeah.
KRP: So would that imply that sometimes, there's a think of things ahead? Or are you thinking of things as you're doing them mostly, or or not? How would you describe it?
03: Yeah, no I think, er prrr yeah certainly today I think that the delay's an example of there being a delay between the thought and the action, erm but with note choice it's more it... it can be more immediate I guess. Erm, yeah I dunno, god this is really making me question everything! It's 'orribe!
KRP: You did sign a waiver!
03: Ha ha yeah. [laughs] yes, yeah yeah yeah. Endings [I] carreer.
KRP: Immediately would mean contemperaneously would you say? Is that what you mean by immediate?
03: Er if I knew what that word meant, I might!
KRP: Like at the same time as... or simultaneous to... y'know inseperable in time from doing it.
03: From doing it, yeah that's nteresting that I used that choice of language... er, I think I said 'more immediate'.
KRP: Ok.
03: Maybe. So ther's... ther's less.... Hmm... hmmm.... huh... ha ha ha.
KRP: Y'see it's... it's difficult to introspect on...
03: Yeah.
KRP: ... processes that we just do.
03: Yeah yeah yeah. Yes soI... I guess what I'm trying to think now is whether I... erm if it's... whether I'm fraud or not!
KRP: Ok!
03: [laughs] As in like, 'cos if I'm saying that there's less delay from the decision to the note coming out then that means I'm thinking ahead regardless of how... like...many [I] like frac... fractions of a second that is and certainly that was the case with the delays.
KRP: Yeah. I'm interested to...to explore why one way of thinking or another might be normative in that sense, or in other words why it might... why we might charicature it by saying 'am I a fraud'...
03: Yeah yeah well I think it's 'cos...
KRP: Why why is one valued more than the other?
03: Well I, er I think it's 'cos I, in terms of erm, what I strive for in improvisating, certainly in free improvising, is to be expressing myself right now and and present in in the moment so erm er and I'm, y'know, that's I guess certainly since , like a workshop with Mike Walker ten thir... twelve or so years ago... yeah eleven years ago this summer! Er, ah it was, like that the idea of only playing what you hear... erm is has some ki... er some kind of ideal to work towards, for me, I was like, alright that's what....yeah.
KRP: So. let's play Devil's advocate for a minute...
03: Please!
KRP: ... and say, what if we hear it in advance?
03: Yeah...
KRP: Does that invalidate it?
03: Well yeah, maybe not... yeah... maybe not.
KRP: So there's a couple of aesthetics there that you've come up with that are linked but are distinct as far as I can tell, one is being in the moment?
03: Yeah.
KRP: And the other is playing what you hear.
03: Yeah.
KRP: They're logically independent in a way, because ...
03: Yeah.
KRP: ... if you heard it all in advance then played it...
03: Yeah.
KRP: It... it doesn't strike me at any rate that that would be... of less value.

03: Yeah.
KRP: Other than that you're not then in the moment...
03: Yeah yeah yeah.
KRP: ...then again has anyone, to you, or have you made the philosophical argument of why being in the moment is of more value than expressing something you've thought of carefully?
03: Er well again from er... er reading around and playing lots of free improvised music, it's... that erm, reacting and being present is... is kind of the whole point... I think. So I think that's where that value system came from.
KRP: Hmm.
03: It came up recently, we had er... erm, oh I had like er a day in Crewe with a bunch of improvisers, that this gur runs, and you... you put a different group together, improvise for fifteen minutes and then talk about it. And I was saying I had a really terrible time in one particular grouping and anyway, we were discussing the idea of playing something that's disruptive... like being disruptive... which i..., erm I say, in this music, I guess if if.. in jazz y'know, you could be, you could play 'out' or you could, as a drummer you could push or drag the time, or y'know, stop or, there are things you can do, but someone was making the point, was like if you're... if you're being disuptive in free improvisation, surely... surely you *can't be,* 'cos you just hear everything as a contribution to the pallette, so and then someone said 'well yeah, but y'know you can play thngs that are against the grain' and then I forget who, but made the very good point that's like but if you... as a player if you take something and it's disruptive, so if if you play something that I take as disruptive, that's *my* problem because what's... what's being disruptive then is my ideas about where it's going to go and then I'm priviledging my like I'm er... make... making a heirarchical thing where there shouldn't be one. A heirarchical structure like 'ah, I hear...' ... and I definitely... I definitely do this, in terms of... with kind of delays and loops like time-based stuff I'm like 'ok I can hear a thing here', like... it can build and yeah it's gonna go like this... and then, and so now I'm sort of wondering if... like what would it take to stop me! [laughs]
KRP: [laughs]
03: D'you know what I mean? If I'm...
KRP: Interesting! Mmm.
03: And there's there's there's there's plenty of um times when I have thought 'ah what I'm playing now could really lead into a... a texture, and I kind of set it up and maybe record some stuff into loop pedals whilst... yeah it just with whatever it is I'm playing...
KRP: Hmm.
03: ... and whilst responding and then not use it, because the the moment's passed.
KRP: Yeah.
03: So the like...
KRP: Isn't it... doesn't that imply potentially a division of attention, which is antithetical to the pure notion being in the moment?
03: Yeah... yes! [laughs] Er, yeah so in terms of....
KRP: But that's an artifact of technology in a way?
03: Yeah, but then it's...
KRP: 'Cos you have to cue up the loop to make the texture that you think of in advance...
03: Yeah exactly, yeah [coughs] it's not like... yeah it's not like I've got a pre-made loop/sample with bassy texture, scratchy texture- go! Erm, Adam, my supervisor, has written a chapter o...er about erm, using idioms in what has previously been referred to as 'non-idiomatic improvisation'.
KRP: Yeah.
03: And I think it's maybe sort of part of the same thing that there's erm, theres a scene or y'know, a way of playing these days that kind of uses free improvisation and all of that, erm but doesn't discount things like form. and the i... like, there are improvisers who er...so me and Johhny, my brother used to do this... like we'd improvise but then we'd remember what we started with and so we'd maybe like come back to that...
KRP: Yeah.
03:... at the end, as a... as a formal thing. Ermand that's not necessarily right or wrong, but it's... it's certainly that it's yeah it's that division of attention thing... it's like the the micro and macro...
KRP: Yeah.

03: I'w... in one sense we're improvising with... I guess one view of free improvisation would be that it... it's mac... it's micro, right we're just here right now, we're just looking at what's happening right now...
KRP: Hmm.
03: ...and it...that changes or... really quickly and we're present all the time and then but then also you can pull out and free improvising with the macro... the structures actually like improvising structures... as aspart of it, if you see what I mean...
KRP: Mmm.
03: Dunno how this relates to... what you want...
KRP: Gold dust!
03: Is it? [laughs]
KRP: I think, just as... to draw it to a close, er now you're teetering on the event horizon of the existential abyss... we can er...
03: [laughs]
KRP: I can do my follow-up question...
03: Brilliant!
KRP: Which is...
03: What are you having for lunch?
KRP: [laughs] What draws you to improvising, could you say more about why you do it?
03: [laughs] Fuck... ha ha ha ha ha ha... erm... prrrwww... so I know what I *should* say... y'know I know that I've got stock answers to that question [I] 'cos it's genuine it's different every time and that's exciting, to sort of hear why... er hear how things unfold, erm I don't r... I don't really ever remember being drawn to it, other than I always did it? Erm and I get bored easily if I have to do a job, as in er so with Beats 'n Pieces, er I get a couple of solos but they're very prescribed
KRP: Yeah.
03: And it's like, ok I'm doing this thing now but I'm... I'm fulfilling a role and I'm... I'm less... I dunno... I think I'm... so, I did a couple of gigs recently, myself and Cath Roberts, baritone sax player, some some of the stuff we've done has involved written material but this was all free improvised and we basically, we played a gig in Antwerp to the bar owner. Like, his friends stayed right at the other end of the room or outside, smoking er and it was great it was really really like erm really enjoyed what we... what we did and we had a really good time, despite there being no atmosphere and it being, y'know, awful er [laughs] in terms of attendance. But with Beats 'n Pieces I think if there's a if.. if the crowd doesn't respond, or if there isn't a feeling then I have a bad gig, I think, I think. Erm, which is at odds with my stance that I like to take that I'm not interested in what the audience is doing, I'm like I don't... active active disinterest in anything beyond the edge of the stage or circle or whatever we're playing in. erm so maybe that's related to why I like improvising because it enables me to... it's just talking to my... to the other musicians and that's where my attention is, and when it's like 'oh right well I've gotta play this figure for a bit, I've gotta follow that...' then if... then I sort of glance around the room and if there's no energy coming back from the audience, then it's like 'oh pfff'. It's depressing maybe, or a bit more boring. But then I'm sure I've had bad improv gigs where there's been an audience and y'know that isn't into it and maybe maybe it's just...
KRP: Do you think you've had a bad improv gig where the audiencne *has* been into it?
03: Ha! I'll just ring round them and ask! [laughs] Erm... have I had bad improv gigs when the audience has been into it? [pause] Possibly? I mean with this... with this day a few weeks ago in Crewe, Centrifuge, we were talking about the... sorry 'Centrifuge' is the name of the night, might not work that out when you transcribe it, so we were talking about, like I was saying I had a really bad time, and I hadn't felt that anything we were trying was working, but people who were listening, who were all improvisers themselves, we were all... sort of the day is designed to help us think about improvising, talk in ways that we don't normally talk about it, and erm, they said 'oh it was really great those bits' like when when you're uncomfortable, when you're having to work at things, that's when the most exciting things happen. Erm, so I think that maybe they had enjoyed and I hadn't.
KRP: Hmm.
03: But then that's not necessarily the same thing as having a bad gig, 'cos really if I listen back to it, then it might be like 'oh, yeah that was cool!'
KRP: Uh hmm.

03: Erm, doubt it though. [laughs]
KRP: Well...
03: But, yeah...
KRP: ... subjective experience at the time? Does that match, or correlate perfectly with aesthetic value in retrospect?
03: Well yeah, no I guess not!
KRP: Thankfully I'm not having to answer that question, so...
03: I didn't answer anything you asked me... 'cos I couldn't remember what you were saying[I]
KRP: No, you were great, that was absolutely great! Goldmine, honestly.
03: Ha!
KRP: Erm, so just to conclude is there anything else you'd like to add about your solo or your experience of the process today?
03: Erm. Errr... I'd like to do it with a real band, or with other musicians.
KRP: Yeah.
03: Erm and then have the, I guess it'd be way more complex...
KRP: Would, er but I th... I think I get what you mean, in the sense of the ecological validity of having an interaction with real people.
03: Yeah, yeahyeahyeah.
KRP: Which is the way we've mostly improvised in, when we're doing it for real.
03: And maybe with a backing track I can afford to kind of... 'cos it's not listening to me...
KRP: Yeah.
03: I can go wherever I want...
KRP: Yeah.
03: ... and 'Ohhh well like oooh...back now', and there were a couple of moments when watching back and I was like oh rhythmically that's not what I thought... like erm playing... it's like oh I can see what you meant but you're slightly... oh its just slipping out of the pocket?
KRP: Yeah.
03: That's a... a thing I could use?
KRP: Certainly!
03: And there was just sort of ' oh, catching up with where I was up to', I think maybe if there... if there was a live band with a bit more like give and take. erm oh I'd probably still be out of time! [laughs] but I I don't know not sure where I'm going to here but er yeah it'd be nice, again also because it means you're in a world that you're more er comfortable in? Or more frequently in than playing with jazz standards.
KRP: Hmm. Well that might... that's certainly something I could consider for a follow up, or maybe get people to just do what they do...
03: Yeah.
KRP: ... even if they're just doing it on their own...
03: Yeah.
KRP: It's possible... [I]
03: Then you get the erm, then you get the debate of whether or not you're improvising if you're playing by yourself.
KRP: Yeah?
03: Which, a few people, Peter Brotzmann included, that I've been reading recently...
KRP: Yeah.
03: ... sort of saying, nah! It's not improvising if you're playing by youself because there's no conversation.
KRP: Ok, interesting.
03: Erm, yeah
KRP: I'll have to look into that one.
03: Send you a couple of quotes if you like?
KRP: That'd be great, if you could!
03: Yeah.
KRP: That'd be fantastic.

03: Er yeah. But that sort of triggered my... the next stage of my research I think. 'Cos I've been getting people to record themselves by themselves...
KRP: Yeah.
03: With a li... with a little bit of stimulus from me, like a little written thing, and then weaving that into the fabric of the finished piece.
KRP: yeah.
03: So pulling ideas out or... or certain things, but I think now I'm gonna do that but with duos and trios so, me actually go and meet up with these people...
KRP: Yeah.
03: ... and it's nothing to do with making sure I'm not in Crewe very much.
KRP: [laughs] No! Yeah be good if you c...
03: But yeah, but then there is... th... like yeah... that's not that's just a couple of opinions that I've dug out recently...
KRP: What's your stance on it?
03: [breath/sigh]
KRP: Or do you not know yet?
03: Well, I mean I think it is... if the like the dictionary definition of it you are improvising aren't you? Because... because! But I think what Brotzmann's saying is that when he plays solo and a lot of people have said similar things, you kind of have to plan it... or have areas that you're gonna call on erm in order to sustain it for any kind of meaningful period of time
KRP: Hmm.
03: Er which is why they're saying it's maybe not improvising... but then but [breath] then a sort of counter thing I sort of read was, you're unless you then consider you're having a conversation with the space, or with the audience, or y'know there's there's there's things to play off, like if there's a really long reverb or... yeah you're improvising with the atmosphere...
KRP: Hmm.
03: ... or, er the angry mob [laughs]... or yeah [I] or for me actually or maybe you saw one of the solos I did for Rod's thing or not, I'm not sure but it like... pedals as well.
KRP: Hmm.
03: And not in a way of like 'oh here's a loop I'm gonna just wail over the top' but in a kind of... yes it's still all me, me and me but it's kind of, maybe it's a conversation between myself and the equipment, though I don't I don't know. And maybe improvisation doesn't have to be a conversation, in which case a lot of the points are null and void anyway!
KRP: Well, tha... it's well...
03: Yes.
KRP: ... that's just where I'm... I'm wary of erm getting too heavily into the philosophy but there we go...
03: Er yeah, quite.
KRP: right well, er we're gonna stop there...

Participant 4

KRP: [AP] So you can pause at any time.
04: [/AP] In terms of ideas, I've got no kind of clear thought of where the... of where it comes from, except I'm just playing over a scale, and it's kind of like watching it, it's like really obvious to me, the degree to which I'm simply playing over a scale... er and... to a degree, managing the mechanics of the instrument within that scale, and possibly adding things from outside the scale... but expanding it around the... yeah.
KRP: So the core, you would say that you're using to bounce off is... is the scale?
04: Yes.
KRP: Which scale?
04: Er... something based around Eb minor, but effectively... effectively the Eb blues scale.
KRP: Uh hmm?
04: So an Eb kind of pentatonic... er... with the with the... but an Eb minor scale. Carry on, please.

KRP: [AP]
04: [/AP] The other thing that's quite interesting of doing this is that... I mean the backing's not as loud as playing with er... with live instrumentation, I mean, I know it could have been louder but... erm, that was my choice, but but on the other hand, you're also not being accompanied... there is an accompaniment, but it's not it's erm... it's not listening to me. so that makes an awful lot of difference in terms of what I do, er... in that, for me normally it's like, so there is something of a conversation, at least with the drum kit, but often with other members of... other poeple in the band, that I would expect to hear things thrown back, and ideas thrown ack at me to play off.
KRP: How do you think that affects what you played here?
04: Erm... I think it probably kept me within more of a safety net. I'd probably be pushed by other people to kinda like, play a little bit faster, er and do more and work a bit harder. Whereas this, this is almost...it's quite easy to do, 'cos nothing...nothing's going to challenge me, nothing's going to kick me up the bum and push more, er and try and pull the carpet from under me as well, there's that... y'know, there's always that possibility of someone pulling a carpet, like whether it's a chord or, or a or a or a rhythm from the drums that kind of takes things away, er y'know, it might... er 'cos the joy of playing with other people is that they might just suddenly disappear, or... or it might just like push and give more, or... or there might be surprises that kinda take you in a different direction,er which makes you kinda stick more surprises in and it meant that I couldn't, I had no control... as well, so I was literally playing over, playing over an accompaniment..
KRP: Do you think you felt that at the time, was there any difference for this being the second take?
04: Yes there was, yes. Er, I was a lot more... er confident, I mean it's not a difficult.. not a difficult sequence or anything like that, but erm...er..er ...erm but I'd done the working out er, on the first take.
KRP: Plus, I suppose there's... even though there's no conversation, there's a sense in which the accompaniment could be unpredictable the first time you hear it, whereas on some unconscious level maybe, having heard it once, it was even more predictable than it was the first time?
04: Possibly, yeah but I think... possibly I might have... it might have been best to have turned it up more... because um...yeah maybe... yeah I wasn't really paying much attention to it, I was hearing the ride cymbal...
KRP: Ah...
04: ... as much as anything else. Yeah... [indicates I should resume playback]
KRP: [AP]
04: See I can just hear the ride cymbal.
KRP: I think you decided to do a harmony on this didn't you?
04: Yes.
KRP: Second time. When did you decide do you think?
04: At the second chorus, at the beginning,.. I was wondering, could I do it? And I know in the John Coltrane recording there is a harmony.
KRP: Yeah. [AP ends] Book early!
04: Indeed, every time!
KRP: So... there are a few times there where you're playing, erm phrases that repeat and change their accent over the kind of where they fall on... in the barline...
04: Um
KRP: ... erm... is that something that... or is any of it...to what extent do you think any of that was planned in terms of the solo... the architecture of it, or... or anything about it?
04: Er, to refer back to the question you asked earlier how... er how it differed the second time, er I think with some understanding of how long it was going to be... with with a bit of an idea of how long it was going to be, erm and I think as well alluding to that notion that er knowing what the accompaniment would be like, even subconsciously, er yeah I did format to a degree that I would start off kinda like somewhere in the middle of er my range, although yeah kinda...er yeah I started off quite low, er but built up, not only the range but also er...the kind of... the the intensity of what I was playing so, it's quite... it became more intense as it got to the end er and in the, I think it's in the penultimate chorus I go kinda quite high, in my for my... for my register at least. Er, erm so, in a way that's planned, it's planned... uh I wasn't standing there thinking of it at that point, but it's planned kind of through experience of, er you know, wanting to put something across that has some kind of impact and that's how to do it if you want to kinda carry a solo over a few choruses, you... you build it er and then 'n try

and give it some kind of finish that people will... can y'know can can applaud er and enjoy, so it's like, an audience satisfaction kind of approach to it.
KRP: Finish with a flourish!
04: Indeed.
KRP: Er, let's have a listen t... just to where you did start out... [AP] in terms of register, erm.
04: I think the start of it as well, is a little bit... er with the nature of the the tune... always influenced by er Miles Davis. [I] Forgot what the track is...
KRP: [/AP] I... in what way by Miles Davis? Is there a particular track you're thinking of?
04: [sings 'So What']
KRP: 'So what'.
04: 'So What', yeah it's that the way Miles Davis starts off 'So What'... yeah, it's kind of...that.. a similar approach to doing it there...
KRP: In terms of phrasing?
04: Erm... um mmm
KRP: Or note choice, or...feel?
04: Note choice, and ujst that kind of like playing a very strong kind of first quite long first note... of a phrase or a i...[I]. kinda of like approach it...That first note is quite a strong... as well as... [ASK] don't know how to put it.
KRP: Yeah [AP] That theme seemed to come back a couple of times, that precession.
04: The.. becession?
KRP: [/AP] [sings phrase] Where you've got a phrase which reduplicates but because it's concatenated if you like, joined on directly, it doesn't fall in the same place in the bar or the format.
04: Yeah.
KRP: Er, and it does seem to me to... to follow that erm strong opening phrase, in terms of could almost be vocal, and it makes a statement.
04: Hmm.
KRP: And then the dynamics of it mean that towards the end, you're getting, as you said...[AP] [FW] That's the veryvery end... let me just go back and... [RW] ...high register.
04: Yeah, I mean yeah as I get to like quite an intense bit I will use [/AP]...yeah the, like I'll push the kind of the boundaries ofthe time a bit more, er play play around with it. er and as I said before I'd normally expect that to be kinda like reflected back at me and probably pushed even more.
KRP: Mmm the c..conversation?
04: Yes.
KRP: Yeah. So that was a reduplicative phrase again wasn't it? Let's just check [RW] [AP][/AP] Yeah. Erm, so in terms of where did the ideas came from, you said before you you have no idea, really?
04: Er... in that I know that they've kind of picked up in over years and years of listening and playing. They're all there, they're nothing kinda like, new.
KRP: So in that in... in terms of that, how much of it do you think you were drawing on your idea bank, and how much of it would you say you've perhaps never played before?
04: How do you mean? Sorry. Oh of that?
KRP: Well in terms of an idea bank or a vocabulary or a lexicon?
04: I don't think... I don't think for one second that there was any of that that I've never played before...
KRP: Hmm.
04: ... and I think... I mean I... er... I don't f.. yeah, I can't talk for anyone else and I'm not going to talk for anyone else... er that's... in er.... in this kind of style of music, that would be what I do, that w... there are... there is a cupboard full of i... not that full necessarily, but there's a couple of ideas er that I draw from, and that I play around with, er and that's my comfort zone in this, if I y'know er and I'd have to... there might be circumstances where I dig deep and kinda like push further er and that would probably be with someone else helping me to do that, or encouraging me to do that.
KRP: Mmm.
04: But, er yeah in thi... an example like this where I just want to kind of play the... the right notes er, over a few choruses [I] not digging that deep, and it is all stuff that I'd played before.
KRP: To what extent do you think you modified the ideas in your repertoire during this? Do you think you modified any of the ideas for *this* improvisation?
04: er...

KRP: Or do you think...just slotting in?
04: Erm, well the other thing to look back on is, erm that, er we've had this discussion before, that the trombone is bound by its own mechanics, playing the trombone is bound by its own mechanics...
KRP: Mmm.
04: ... and so to play... you're playing in two different scales, er can totally change what you're likely to do, if it had been a semitone higher, I probably would have played very differently, because it's a very different set of scale... er slide positions, and, just the whole mindset is different.
KRP: Would it have been more difficult to play...
04: No.
KRP: in say E minor?
04: No.
KRP: Than Eb minor?
04: No. It would have been different.
KRP: Just different?
04: Yeah
KRP: That's interesting.
04: It would've been...
KRP: You were saying before when you were looking... one of your first reactions when you looked at it before was that you could tell you were playing off a scale and dealing with the mechanics of the instrument.
04: Yes.
KRP: So, could you say a bit more about that dealing with the mechanics of the instrument?
04: Erm...
KRP: How does that affect the kind of ideas that you can draw on?
04: Erm [long pause] er I don't know if the trombone... to what degree the trombone is unique in er... in that every note has a d... that has a different quality to it, and thus every scale has has a has a different quality to it, er and from that point of view, different problems that come with it in the way that you play it... erm... and er I supposeit it... it comes...I'm thinking also of visualising er that set of notes er in order then to kinda like play across those... that set of notes and then to try and broaden that visualisation to... to include other notes, y'know what... what might they be? Er... how how can I kinda expand on the repertoire of notes that are going to fit into that... into that improvisation, erm... and I think that's the difficulty with the trombone, is... is that ability to... to hear the notes and visualise them before you play them, which... which is what you have to do with the trombone. I'm not sure...
KRP: Interesting...
04: ... not sure.
KRP: I mean, to what extent do you think conscious processes were involved? I mean it's interesting you say 'visualise', erm because I would guess one of the things that is different about the trombone, as opposed to say, the piano or the guitar, is that there isn't the kind of visual and spacial pattern available that you've learned by association, there's a pattern of movement or there's a pattern of positions...
04: Mmm.
KRP: ... but I don't think that's necessarily the same. So maybe that's one way that trombone is different from, say the piano, where if you're playing in E minor, there's a regular pattern that you could, er visualise in a certain way, but would you... would you say that's different on the trombone or would you say you do visualise the pattern of... ?
04: That's what I'm saying is that you do... you have to visualise, but obviously it's internally visual because you can't look at what it's gonna be 'cos I mean the slide is a... is... isn't hasn't got enough dimensions to it, it's er... playing a note involves that physical, y'know you're pla... you're creating the sound with your mouth...
KRP: Yeah.
04: ... and so for every note is y'know er it's a it's a, well I s'pose it's kinda like very much sensory, the whole thing is... multisensory. er... and so to er prepare to play each note... er is a combination of... er preparations, er y'know p putting the slide in the right place and making sure you.. your embrouchure is in the right place and how you're going to tongue that and how you're going to breathe before it, etc.
KRP: Would you say though that most of those things are automatic?
04: Yes, most of them are automatic, yes.

KRP: So, then again, when you're saying 'visualise', what... what is it that... what's it like in your head... as you're about to play something, would you say? Co... would 'visualise' be the way you would put it? [pause] Or are you using 'visualise' as a kind of catch-all generic term for 'imagine'?
04: Erm..
KRP: Again, the the etymology of 'imagine' is in with 'image', so we're bound by a lot of language.
04: I think the trouble is, as you talk more is that I get to a point where er erm er, as happens if I'm trying to teach, i've kind of been trying to imagine what it is that I do, and I possibly over-imagine so I'm not sure...
KRP: Mmm.
04: ... and it gets to the point where I'm not sure if I'm talking rubbish, but yeah there is... there's in terms of the scale itself there's an there is a er... there is a to a degree a visualisation of what... what the notes are that I can easily use, that you know I have... have ready to do... to play.
KRP: What does that look like?
04: What does it look like?
KRP: Yeah, 'cos you said 'visualisation', well what does it look like? Could you draw it?
04: No I couldn't draw it, no 'cos... er, well yes using 'visualisation' is a catch-all, it's a serie... yes...er, it's my... in my my own notion of what visualisation is, and it includes er essentially sensory things. The fact that playing a B would be... like that [mimes slide position]... I'm thinking of playing that tune in E now, so...
KRP: Oh!
04: ... thinking of that kinda playing B and D and E and then G, and A and where they'd be, and then sticking in a... an F#.
KRP: Right. So you're... to me that sounds like you're erm talking about multimodal imagery that is to do with sensorimotor integration, that's that's what it sounds like to me.
04: That! I'm sure that descibes it nicely.
KRP: What strategies, if any, did you use to generate ideas?
04: Experience, I think. Erm... I think the more the more I think about it, the more... there have been times when I have practiced improvising, and I and I do still practice improvising... but er... a lot of the practice that I do is playing with other other musicians and hearing them and and listening to other music, so er to try and get that to influence what I'm doing, to kinda give more repertoire.
KRP: Erm, in terms of the timing, just to return to that question of the timing of when you thought what you thought, you said that, erm you decided to do the harmony in the second chorus at the end, at the beginning of that chorus, orat the beginning of the first chorus at the end?
04: It was during the second chorus at the beginning, I was thinking 'oh the harmony would be nice here' and so I stuck the harmony in on the last phrase of the second second chorus at the beginning... and then but had it in my mind that I'd do it in the second chorus at the end.
KRP: Right. So, is... would you say there are any other instances where you've thought that far ahead, or is that a very specific instance?
04: Erm... well you mention you mentioned planning before, and the notion er and I think I was aware playing it the second time, that I did have that planning o-o-overall plan of building up er range and building up intensity to a point that I thought would be kinda like towards the end of the... of the solo before the chorus came back in again,
KRP: Um.
04: Er so there's an awareness of that, so it is a kind of planning but er not one that... y'know I wouldn't have said it.
KRP: So, it's like a different level of description?
04: Yeah.
KRP: The content? Rather than thinking of individual motifs, ideas, phrases you're talking about the overall plan of how it's gonna go?
04: Mmm, yeah, and I think what kind of mu... shows how it's kinda planning but it's not that kinda like deep is wh... when I described what I thought at the beginning of the solo was like, and then you played it, it was nothing like I'd descibed it to be, er and somewhat y'know, there's a thought in my head but it's actually er, and I suppo...th-th-there's a similarity there to composition, if I go to write something, I might have a plan, and I want to write something that's like *this* er but no no no, it never ends up like that it goes it goes in a different direction, and I think improvisation is often the same thing, you might

say I want to do a solo that's like this, er but no you get sucked along and it's like this instead, er and even though I'm whingeing about kind of y'know I'm sticking to one scale pattern and I'm doing the same thing, there is that... it does... y'know there is that variation, y'know if I did the solo again, part of it would be very similar, but the shape of it and the y'know the overall sound would be different... I hope!

KRP: Mmm! How much of what you played d'you think you heard in your head?

04: I don't know... th-that's er I've been thinking about that as we've been talking... and erm I've been made aware whilst teaching a pianist trombone how essential it is to have the sound of y'notes in your head 'cos otherwise you you just can't play them and and so I I think I'd probably be modest and say not a great deal, but then I think I'd probably find that yeah there probably was more er more of the sounds in my head, erm and then some of the surprises of where I go to play a note that I think I'm hearing but then another note comes out and that's either good or bad... but er... yeah I think... I think if I... in fact I think if I could sing the solo that I thought I was going to play, it probably would be less interesting than the solo that I'd end up playing, 'cos I think there's that thing of the fight with the mechanics is... provides some of the interest of the instrument.

KRP: Interesting, so... is that one way that... or another way that the trombone might be different from, for example the piano in that you're saying if you don't have the note in your head, you can't actually physically play the note, well of course that's not true of a piano because you just press a key?

04: Mmm.

KRP: So, what is it about the trombone that makes that different, because in principle if you'd learned all the motor actions necessary and the millimetre precision of the slide et cetera, you wouldn't need to hear it to actualy play it, but are you saying that like the violin, you tend to microtune as you converge to the note?

04: No, no it's not... this is to do with 'cos the slide is a minimal part of how you play the trombone, th-the most most of the work is going on with your mouth and the accuracy er is is a lot to do with your mouth, and you might kinda go to play er especially if you get higher through the register, you might go to play a note and nah that's not gonna,,, it's gonna come out and er you're gonna end up in trouble, so er and as an experienced performer you you knock out a completely wrong note and you just and you pull that into something you turn that into something so that it sounds like oh obviously that's what I meant!

KRP: So is that what you meant when you said that what you might play playing the trombone would be more interesting than if you just sang it, is that one of the reasons, because...

04: One of the reasons yeah, 'cos 'cos yeah you go...

KRP: ... you have to roll with it...

04: Yes.

KRP: Sometimes? And that makes you and that prompts you to play things that you wouldn't have otherwise thought of doing if you'd just sung it?

04: Yes.

KRP: Are there any other ways in which, say if you just sang a chorus, d'you think that would be different? Would it be different if you, in some ways, sang it but mimed playing? I suppose that's almost impossible because, if playing is in the mouth you wouldn't be able to get the note out and mime the embrouchure bit?

04: Yeah it's it's the embrouchure, there's some mechanics there that is the difficult bit, y'know like I say, the slide is the... the minimal part of it.

KRP: That's interesting because it... it speaks against the idea of these, erm musical ideas forming in the imagination irrespective of the method of delivery... and then you just, playing them.

04: Yeah.

KRP: You're you're describing something that's not like that at all, something that to me at any rate sounds more embodied.

04: That's in... so what do you mean by embodied?

KRP: That the sensory side and the imagination side are bound up with what we actually do with our bodies. So the movement...

04: Mmm.

KRP: ... and the way our bodies interact with the world.

04: I think I [U].. yeah and mo... possibly an interesting way of describing what it is to improvise on the trombone is a very physical instrument er and it it is... has got... kind of a lot more... er greater parameters than other instruments, in that you can't play as fast, you can't play across the range quite so quickly, erm er er... and you get knackered and you have to breathe, erm so... so yea the character of the instrument characterises what you're going to play. Which is why it's sometimes easier to go into comedy.
KRP: [Laughs] Ok... erm, so one one more of the set questions that I guess is what draws you t-to improvising? Y'know, could you say more about why you do it?
04: Erm, I got kinda stock answers to that and erm I remember being I never played in the orchestra at college er being in the wind orchestra at college and er somebody pointing a stick at me and I was supposed to play this particular note and that note wasn't going to come out and it was just awful and I didn't like it, being just being sat there and having to play when I was told and play these notes on the page, erm which was what I was training to do, er and I found it easier to have minimal direction er and just to to kind of go off that made that made a lot more sense to me than having a lot of music written down, erm er and wha and whether that's what draws it to me... it's I I I think I like er the process of er it's 'cos y-you're kinda creating music, you're making different... you're making the music different every time, er er you're giving movement and life to a piece of music er er and making it different every time and I think that's what that's what excites me, erm er I think I think that's it.
KRP: Ok so, is there anything else you'd like to add about your solo or your experience of the process today?
04: No, not really no.
KRP: have you ever participated in research before?
04: Er, no no I haven't.
KRP: Um, how did it feel to sort of improvise in this sort of setting being recorded as you knew it was, for research?
04: Erm, it was a little like doing a recording in a studio but er slightly less intense.
KRP: Mm, fair enough thank you ver much...
04: Thank you.
KRP: ...for participating today and please feel free to contact me, er via email if you have any questions, goodbye!
04: Oh, I will!

Participant 5

KRP: So... erm right so the idea is, you you can control the playback...
05: Yeah ok.
KRP: Or we both can 'n y'know if I see something that I think 'Ooh that's interesting and I go back, fair enough, similarly for you...
05: Uh hmm.
KRP: ...if you want to describe something that's happening and you want to pause it at that stage fine, or go back or whatever...
05: Yeah!
KRP:erm the idea is that you give a kind of... [AP] [/AP] whoopsie! That you give a DVD commentary...
05: Ok.
KRP: ... kind of director's cut, kind of...
05: This is what.
KRP: ... this is... and the focus of that is kind of idea generation, really.
05: Mmm
KRP: So it's like, where did that come from...?
05: Sure.
KRP: ...what were you thinking then? What was the timing of the decision relative to when you played it?
05: Ah ok, yeah.
KRP: Y'know, those kind of themes. When did that pop into your head, what kind of thing was in your head that led...

05: At that moment.
KRP: ...y'know that sort of thing.
05: Sure.
KRP: So if we set off... you can stop at any time, pause, rewind... whatever.
05: [AP] Yeah. Well basically all that was going through my head when I was playing the tune is that, I dont think I've ever played it... so I was just actually trying to remember the tune so... [laughs] I might've played it y'know, off a lead sheet when I was sixteen or something, but it's not a blues I ever call on jams or anything... I should do! So... so that was what all the fluff at the start was about! [laughs]
KRP: Do you mean the tasteful embellishments?
05: Well [laughs] that was intentional, the rest of it was not! [laughs] Anyway... I should be saying some things rather than just listening... so....[/AP] so I mean that... I think that's pretty much the same rhythm that Coltrane starts with, isn't it?
KRP: Ok.
05: I think that's all that was in my head at this... [AP] to to launch off... or he does er something similar at the top of some chorus. [/AP] Yeah, I also wasn't listening [AP] particularly carefully.
KRP: What gives you that impression?
05: Well...[/AP] well I went to the... major third to resolve and that was just not going on in the piano very much, my concert G just sounded quite... quite bright and out of place.
KRP: Mmm.
05: And that gave me a bit [AP] of a pause [I]... and then it's fine afterwards. I mean this is all[I] the first bit's just fairly sort of standard blues stuff, I don't think I'm.... not reinventing any wheels... and then, I was just delaying the resolutions... through the II-V-I... but a lot of this is well, y'know if you were playing with a live rhythm section obviously...[laughs] it would be a different thing.[long listen to AP] The pianist was listening there, that was nice! Yeah...
KRP: So that...
05: Yeah, so that... that bit, if you wanna specifically [/AP] look at that... erm, that, erm that is er... a thing I took from Coltrane...
KRP: 'Cos that sounds quartal to me...
05: Yeahyeahyeah, so it's staring on concert Bb, going up Bb. Eb, Ab and then moving that up in minor thirds...
KRP: Yeah... yeah that's...
05: ... and then just sort of altering mmm but but erm... yeah mmm it's certainly those...tha... those harmonic groupings is something I took from Coltrane.
KRP: Mmm.
05: Er, when I was doing that dissertation I was saying about, that was, one of the big things was divisions of the octave, erm and different groupings within that as a way to get outside harmony, but keep it with a logical flow. Y...y'know, obviously once you start sequencing, then you can just go outside and it, your... the audience's ear follows it, y'know if...
KRP: So what you're saying is that the audience, erm follows the internal logic of the phrase...
05: Exactly yeah...
KRP: ... and the fact that...
05: ... despite th... the notes in the middle are pretty unrelated harmonically to the the chord, so say I... by the time I get to erm the second sequence, I'm playing concert, er E... E, A er D, but over Eb... y'know...
KRP: Yep.
05: ... Eb7 so that er y'know it doesn't really bear much relation to what's going on... y'know, you could rationalise it...
KRP: You could say it's starting on the flat 9...
05: Yeah but then, going to the #11 and the major 7 doesn't seem like a particularly logical...
KRP: No!
05: But, y'know it won't sound good if you do that on its own [laughs] y'know so yeah but then...erm so so that's a particular thing I took from Coltrane, I... and tho...those sorts of harmonic splits I do tend to play about with quite a lot as a way of going outside, and especially if you've got a pianist who's on board with that then you can have a lot of fun with those things. [AP] And then y'know just taking the rhythm from the piano... shifting them.. that was... that was a less logical... [/AP] ... y'know, I wasn't

particularly intending er there to be much of a logic to the jumps there, it was slightly more randomised er move about, just sort of going where I felt rather than with a harmonic logic behind it...
KRP: Right.
05: ... it was just sequencing the little tone.
KRP: Right... so...
05: Just it was more of a rhythmic thing.
KRP: In terms of the feeling...
05: Uh hmm?
KRP: ... what was that like in your head? What kind of feeling was it?
05: What kind of feeling?
KRP: Mmm.
05: Erm...
KRP: So, to give a kind of example...
05: Yeah.
KRP: ... of a kind of answer, it's... it's like, in your head what was it like for you to experience the feel of what you wanted to play? So cou..
05: Ok so just erm... so in that moment, that that was y'know just like speech erm I heard the 'badoo badoo' in the piano and so I just immediately went to that sort of that ...[taps on table] y'know sort of, what do you call it erm what's the name of that er 'acciaccatura'? .. type rhythm or whatever the proper term would be y'know what I mean er, and then I sort of let it go where just as y'know if I was to say words aloud, there wasn't a forethought with the harmonic movement there, it was [sings pitches in the rhythm] y'know, just sort of moving the thing around wherever it felt...
KRP: So...
05: ... comfortable.
KRP: Yeah so it's... so it's the nature of that feeling of it being...
05: Yeah.
KRP: ... of it being comfortable that I'm trying to get at in a way because... have another play of it.
05: Yeah
KRP: Have a listen.
05: [AP][/AP] Y...
KRP: I detect a pattern!
05: Yeah, it wasn't an intentional pattern, w..or it wasn't a consciously intentional pattern, there was a... [sings pitches in rhythm 'badoo badoo...'] yeah.
KRP: Mmm [mimes finger movements as if playing keyboard]
05: But I wasn't I certainly wasn't consciously aware when I was playing that bit of the pattern, that's just... that that's [I] it was probably what... what was in my subconscious...
KRP: Yeah.
05: ... from from working on...
KRP: So...
05: ... sequencing patterns and things but but in that moment it was just a phrase I played, I wasn't rationalising it in my head as a sequence.
KRP: No, but an... I guess there are lots of ways of experiencing in your head that don't involve having music-theoretic considerations or clarity of knowledge...
05: Yeah... yeah.
KRP: ...in that way, and you expressed it as, in a couple of ways, one was to say 'randomised' which was an interesting way to put it, and the other...
05: Yeah.
KRP: ... is to say 'feel'. So I suppose what I'm trying to get at is if you think back, or you think what it's like for you when those things happen, what is the con... is is there a conscious component to it is one thing...
05: So...
KRP: ... or, if you could describe the contents of your conscious experience at the time, would it be related, and how would it be related to what you played?
05: Ok, so it's interesting though, 'cos like my.. my memory of playing that phrase was that I... I wanted to take that that little rhythm and take it outside...

KRP: Yeah.
05: ... and in my head I wanted to do that rather randomly...
KRP: Yes.
05: ...and obviously in actuality that's not what happened 'cos there is a really clear sequence there when you listen, back...
KRP: [laughs]
05: ... erm which I'd say is more indicative of human capacity for actual randomness off... off the cuff, randomness or perceived randomness, if you actually want to sound random it's not very random is it? It's actually a really specific thing to play things that sound like they're random...
KRP: It's...
05: ... y'know what I mean?
KRP: ... it's cognitively I think a very different process...
05: Yeah.
KRP: ... from improvising, to generate pseudorandom... strings of notes.
05: Yeah.
KRP: It's actually quite hard...
05: Yes.
KRP: It's cognitively quite demanding.
05: Exactly, yeahyeahyeahyeah, so I mean...
KRP: ...and I think you're right
05: ...so I slipped into something that was a clear pattern, but that wasn't the intent of the line, and in my head when I was playing it I wasn't hearing it as a... an obvious sequence... but obviously, listening back...
KRP: In retrospect, yeah.
05: ...it's extremely apparent y'know! [laughs] Em.. but that that wasn't my my thought at the time. 'Cos I mean, y'know... the act of it being a sequence makes it erm, sound clearer but a lot of the notes aren't particularly [AP] harmonically y'know, er they're not 'in', y'know... [/AP] Yeah, so...
KRP: [mimes piano fingering] Well it evinces that principle that you were just talking about before, which is er.. an internal logic in a patterned phrase counterbalances the tension of the outsideness.
05: Yes, absolutely, yeahyeah. Yeah.
KRP: And it gives the audience a sense of tension and release but not total randomness in fact.
05: Yeah yeah.
KRP: Er...[AP][/AP] lots lots of erm, to me, lots of playing with expressive timbre and rhythm there?
05: Yeah, so that that, yeah obviously there wasn't much of a a melodic component to to that little four bar stretch or whatever it was, but then y'know, carries on into a a phrase but erm I think that that's comin' off the back of erm yeah, well yeah it's just playing around with rhythm, the same way I was thinking when with the 'badoo badoo badoo badoo' it's just y'know...
KRP: A continuation?
05: Yea yeah that.
KRP: There's... there's also, I mean a sense of if you look where we are in the arc of the solo...
05: Uh hm.
KRP: ...erm, there is still a sense in which we craft the dynamics of it, so there is a kind of climactic aspect...
05: I mean or or by...
KRP: Y'know...
05: Yeah.
KRP: ... what Mike Walker says about y'know, getting yer knob out at some stage [laughs].
05: [laughs] But I think that the big... the big thing with this which is obviously the more artificial setup, is that I would always be the person in control of when that climax is, whereas I... I was y'know cut short and told this is the end because the rhythm section started playing the tune again. Whereas I'm y'know, as people who play with me regularly will tell you, I'm a swine for playing far too long and the solos tend to be about, y'know three, four minutes whereas... so the actual improvising aspect of this is maybe about two... two and a half minutes something like that? The actual... y'know outside of the two heads, either end...
KRP: Yeah.

05: ...erm so I I never quite got to the point where I was fully going for it, I woud've still been building, y'know.
KRP: Plus, I would imagine that you rely on a certain push back...
05: Yes!
KRP: ...from the things that you offer...
05: Oh yeah, absolutely.
KRP: ... and there's a dialogue then that happens.
05: Yeah, I mean it was nice there was one or two moments where something on the backing track fell in the right place and then you'reyou're able to sort of y'know imagine it was a [laughs] an interaction but, yeah very much reliant on that normally.
KRP: [AP]
05: Yeah that was me realising that the rhythm section was going round the head. [/AP] There was er an accidental little bit of that erm Coltrane lick I showed you.
KRP: Yeah.
05: [AP] Yeah [rewinds] [/AP] [sings]
KRP: Ah.
05: But it crept in somewhere.
KRP: Yeah, well you could say its...
05: [I] but it's y'know...
KRP: ... a recombination...
05: Yeah.
KRP: ...to fit the context of material.
05: Yeah. But also, it's y'know, that little bit of it alone is just jazz phrase 162 or whatever, [KRP laughs] really standard bit of bebop language there, which obviously y'know a lot of bits of the solo are just y'know, standard bebop or blues language y'know. There wasn't too much out and out beboppy stuff but...
KRP: Hmm.
05: ... erm, yeah, so I'm when I'm playing those sort of phrases erm and there's a bit of a different mental process going on to the sort of sequencing stuff like that it is just y'know, rattling off words almost more in a way. Y'know, if I'm speaking a sentence there's very little conscious thought going on it's just these things are coming out of my mouth because I understand sentence structure and grammar and all that.
KRP: So, what you're saying there is that the conscious awareness is not at the level of automatic processes that handle the grammatical construction of the ideas you're trying to express?
05: So, so within the... playing phrases like that, so say a lot of the phrases that I played there, th the bluesy bebop lines er some of them in their entirety I've never... i'm not aware of ever having played before, so it it's still being improvised, it's not like 'I've learnt this phrase and I'm dropping it in, here'...
KRP: Yeah.
05: ... but y'know all the little corners of it are standard resolutions, enclosures, y'know little harmonic devices that make you sound like y'know, you're playing jazz, y'know? Y'know er which is y'know the syntax of the language of playing jazz y'know?
05: Yeah.
05: And so they don't really require conscious thought above y'know minimum operating level, 'cos I've done practice when I was younger and I know what those things are so I don't need to worry about them they just flow out without me having to worry. Erm, but there's, y'know it it's not just regurgitation in that way, in that yknow when obviously you learn words when you're a child, but every sentence you speak it's unlikely that many of your sentences have been said in their entirety in the same way before. Like so much of this conversation I'd say that my sentences I've probably never said before in my life 'cos I've never sat in this sort of context, so but it's not like I'm having to really consciously think of how each of my words and how they relate to the one before or after, it's it's very background processing, all that, so a lot of the solo is just that, it's not stuff that I'm ... I was thinking particularly hard about at the time, it was just coming out.
KRP: So, I mean you've spoken a little bit about erm, some of it being beboppy, or not, do you think that is akin to a kind of dialect?
05: I suppose so...

KRP: To use that language analogy, is it like speaking a bit in the bebop dialect as opposed to a more mainstream jazz dialect, or... a blues dialect?
05: Yeah, I mean I suppose I suppose to me I I would probably use bebop and mainstream jazz dialect as the same dialect in my head I'd say just... though that's possibly because of how I came into jazz I mean when I started out listening it was Parker...
KRP: Yeah.
05: ...that I first got into and then branched out from there so in my head that is... and I'd say that other people that are considered mainstream, so Alan Barnes, people like that, they're very boppy players y'know so I would consider those so... but certainly like, if I go into a bluesy thing rather than that boppy sort of thing, it is a different dialect and I'm thinking differently, and not not only in terms of the the note choices, but the way I articulate and place the rhythms will be different as well. I mean, t-to me anyway, most of just y'know if I if I want to dip into that bluesy sort of feel, y'know there's there's only really one or two things that makes [I] playing a blues scale is... is just bluesy! y'know 'cos B. B. King made an entire career out of just playing, y'know five notes!
KRP: Yep.
05: Erm y'know and obviously that just takes you straight into that, and y'know when you listen to loads of great, I mean, even like Parker for instance, doing loads of bob, then he'll just stick in a a really dirty blues scale... even over y'know like er y'know the dominant chord where the notes of the tonic erm blues scale don't actually really fit particularly well but it just sounds really raunchy and bluesy and y'know, erm so th there is a lot of that erm going on in my head, so I try and dip into bits of bits of bluesy playing, not not exclusively just blues scale but erm, y'know...
KRP: Mmm.
05: Emphasising the the the flat seven or the interplay between the major and minor third, y'know gives quite a bluesy sound I think I did a little bit of that here and there erm. That's one of the things I quite like erm, which the the rhythm section weren't doing so explicitly through the first four bars of the one four, one one having that interplay of dipping the the concert G down to a Gb and back again, I I like to to mess about with that and then if you you think that the fourth bar is a more altered harmony then you get the the Gb back again as well. Erm, it being a fairly standard...
KRP: I mean, I hear the the four chord on that as being quite #11ey.
05: Mmm.
KRP: Er, I hear the the tonic as being kind of, skeletal.
05: Yeah, it's faily open.
KRP: And then the the like the five chord is quite #9ey.
05: Yeah. Yeah, yeah.
KRP: Erm, so to to summarize, I mean, there's... I've got some standard questions...
05: Yeah...
KRP: ... I ask everyone, erm one of them is where do the ideas come from do you think? And you've spoken quite a lot about that, already.
05: So, so I'd say just as an addendum maybe to that, erm, obviously most of my ideas come from listening to loads of jazz... y'know, so erm...
KRP: And are you saying that they then emerge, or is there a balance between explicit working out what... the ideas are?
05: Yeah, there's definitely a balance, ah yeayeah but in... so... it depends what you mean by by the 'idea' as well, 'cos there's y'know there's the the pitches but there's also all of the delivery and things like that, and obviously if I didn't listen to loads of jazz I wouldn't swing, I wouldn't articulate correctly, I wouldn't understand the tone, all that sort of thing, so so much of what is integral to whatever I imagine and then comes out of my horn is is just purely through listening to loads of stuff. And th-there are also a lot of moments on gigs where, I'll start to play something... and then it'll trigger in my head, y'know y'know, either a phrase that I've heard, y'know Dexter Gordon play, or a tune y'know, and I might not even be able to remember the name of the tune but a standard that I know, or something and then you just carry with it and play the rest of that phrase or that tune, and might never have done it before, but because all the other building blocks are in place of y'know, enclosures and jazz harmony and contrapuntal elaboration of static harmony and all, y'know the y'know standard sort of bop devices, I just y'know, I'll hear the phrase in my head say that oh, yeah 'Dexter carried that on, like *that*' so I'll just carry on like that. And y'know, sometimes it might not come out as I intended, 'cos I'm not, y'know, the

musician I want to be yet! [laughs] But, erm most of the time y'know, it comes out as as I'm trying to replicate from my, from my head.
KRP: Hmm, I mean, to what extent er, well how much of what you played in this improvisation do you think you heard in your head?
05: Erm, I'd say the majority of it, but it's hard to know because they're they're instantaneous aren't they? So it is a difficult one to judge. When when I'm playing the standard bop harmony, that's y'know it's it's really easy because y'know, it's mostly just outlining chord tones and stuff, it's very obvious harmonic leaps, y'know.
KRP: Yeah.
05: Erm but er, yeah, some of the stuff where I'm going more outside and sequencing and stuff, erm some of the sort of quartal stuff I was doing, not for a while but at a point I did practice quite a lot, so the sound of that is quite strong in my head, so I can always hear that, that's not a problem. And a few of the bits where I wasn't doing standard thing... or y'know, more y'know run-of-the-mill stuff...
KRP: So like that pattern that we subsequently...
05: Yes.
KRP: ...saw had emerged...
05: Yeah.
KRP: ...but that you said you weren't consciously aware of the pattern aspect of it...
05: Yeah.
KRP: ...when you were playing it...
05: It's hard to know whether... 'cos my ...yeah... I'd imagine I didn't hear that exactly as it came out... but it could be that I was hearing it like that but wasn't aware of the pattern behind it as I was thinking it but...
KRP: Could've been, which do you think?
05: Ffff... you could toss a coin for that to be honest, I I couldn't tell you, I...
KRP: Which relates to another question I wanted to raise as well which is....
05: Mmmmm difficult, it's really hard to know, yeah.
KRP: ...the timing of that, so the timing of decisions that inform ideas, I mean I guess, it will depend on whether your idea has come from your idea bank, like we were talking about before...
05: Mmm.
KRP: ...or whether it's a response to something you heard on the backing?
05: Yeah
KRP: That you're modifying on the fly? Whether it's music-theoretic in it's origin, whether you're thinking 'oh, I want to generate something that sounds a little outside, I know a device, I can do that, which is erm, consecutive fourths shifting in minor thirds, say?
05: Uh hmm. Yeah.
KRP: So those will all perhaps have a different process behind them but what... what do you think, in terms of the timing of when you made decisions...
05: So I...
KRP: ...relative to when you played them?
05: ...so I I try to never decide in advance anything when I'm improvising, so I... I don't think at any point in that, I did anything other than, just play something absolutely in the instant, now obviously that doesn't mean that it's not stuff that I haven't thought about before at some point, y'know it's what you were saying but, erm even stuff that maybe is a bit more not sort of, he he, not sort of shoehorned in but maybe a bit more sort of drag-and-drop, here is my quartal thing [laughs] y'know. erm I didn't know before I started playing that I was gonna do that and there's there's lots of other sort of Coltrane-type harmonic patterns, y'know done lots of stuff with pentatonics around major minor thirds and stuff like that that could easily have been... y'know when I was in that mood for something that was a bit more out, there's lots of potential things that I could've dipped into, that just happened to be the one that at that point felt 'that's that's what I'm gonna do'...
KRP: So...
05: ... and even... yeah go on.
KRP: ...you were saying, again a... you're saying 'felt' so does that, is that like saying you weren't deliberately or consciously thinking?
05: No, I wasn't deliberately thinking.

KRP: Were you thinking at all on the level of overall sketch planning, so something like 'oh, well I...I I feel like I want to be more outside now'?
05: Yes. Yeah, I'd say... i-d yeah and that... that again maybe isn't so much of a conscious thing but again, like you were saying about structuring and and developing through a solo, y'know, at the start playing longer notes, phrases that are are more in, y'know you have to you have to go on some sort of journey, y'know it's a very cliched thing but obviously because it's trick... y'know, you couldn't start out, well you could start out with that, but there's there's less room to to go from there, especially with the backing track thing, if you had a live rhythm section maybe you could do something really out and just go completely free or whatever you know, but you're already setting the bar very high if you start with some y'know quartal shifting harmony y'know...
KRP: Doesn't give you many places to go?
05: Yeah...
KRP: So...
05: ...unless you're Coltrane or Chris Potter or something, but...
KRP: There's there's something emerging from this which I hadn't thought about that much before, well I have, but in different contexts that's that's another thing, but the distinction between how people construe conscious thought and say, feeling because of course I would say that...
05: Mmm...
KRP: ...to be a feeling, it's constitutive of having a feeling that you're conscious of that. You can't...
05: Well the the feeling arises and then you're conscious of it, is that not, I mean that's a that's a question y'know...
KRP: Yeah!
05: So are you... I would have thought the conscious thought arises from the feeling... the feeling the... is prior?
KRP: Well, I I think many of the contents of conscious thought are prior to becoming aware of them...
05: Oh oh for sure yeah yeah...
KRP: ... but the but the...
05: ..ab absolutely absolutely.
KRP: ...idea that you felt a certain way, are you are you saying that when when you're looking back at it and you're talking about feeling a certain thing, that that's a... that might be... that you weren't consciously aware of that feeling at the time, but you know in retrospect looking at it that that must be what...
05: Er n..., I don't think it's... I don't think it's labelling post event, no erm...only it could be to do... I'm I I just know how it feels for me when I'm soloing and it gets to that point where I want to stop just playing inside the harmony [laughs] and there is a definite point, possibly where I just get fed up with myself where I go... I'll want to break things open a bit more and see where they start to go, erm and in this case that was what came out when I had that thought or feeling however you're going to label that, of that bit's done for now and I'm going to start trying to explore something different y'know.
KRP: So, I think just so I've asked everyone the same amount...
05: Mmm mm...
KRP: and the same things, and I think you've probably answered a lot of these...
05: Yeah.
KRP: [I] but so, what strategies if any did you use to generate ideas?
05: Erm... I mean aside from, y'know hours spent practicing at home and in practice rooms, erm, is that what you're talking about or do you just mean absolutely now? Ok, so I mean transcribing, er er just...
KRP: I suppose I'm interested in when you actually did them, did you use strategies there?
05: There? Erm... except, ok so I mean my... I suppose the approach when I'm improvising, erm again it's very different with a backing track to a live group, because with a live group I would be almost exclusively relying on, not relying but being part of, y'know the conversation with three other musicians say, on the stage and that's a constantly evolving dynamic and that would be constantly altering where you decide to go.
KRP: Mmm.
05: ...and that that probably requires a lot more conscious thought because you're actively hearing things and adjusting and thinking 'ok what was that, I want to do this with that, I want to shape this in this way or whatever y'know, there's there's a lot more happening... when it's a a backing track like that there's

more limited potential for that, but my my general approach to improvising is to see what happens and then react to it. Erm, it was that it felt a bit different here, and it was a bit more bit more like, y'know just chatting away monologuing, rather than that that dialogue, yes.
KRP: Did you modify any ideas in your repertoire for this improvisation?
05: Erm, yeah so, er so like like we talked about, say just first of all with the standard bebop language y'know, I'd say any individual aspect of it, y'know if you were to cut three notes out, y'know I've played them all somewhere before in pretty much exactly the same context but as a whole, those ideas, a lot of them that would have been the first time they came through as a whole. Erm, and the rhythmic placement, maybe different all that sort of thing, erm the one th the most obvious bit of that was just the bit where the the space was left and then the piano did the acciaccatura 'badum badum', er I'd never done that before and that came out as we've discussed y'know.
KRP: Yeah..
05: 'Badoo, badoo, badoo, badoo'
KRP: Erm... I think we've covered most of the others like how planned was your improvisation overall?
05: Yeah.
KRP: And to what extent were conscious processes involved, we've covered. Erm I think maybe just to sort of wrap up the shape of it erm, could you say something about what draws you to improvising?
05:Mmm!
KRP: Could you say more about why you do it?
05: Yeah, erm er I can absolutely honestly say that improvising with a live band is the most exciting thing I do in my life and that's why I do it as a living. Y'know it's the best feeling anyone can have I think. Erm er yeah, there's...y'know without wanting to sound too potentially poncey about the whole thing, it's almost that feeling of y'know, the numinous and greater connection y'know, when you really lose yourself and you're... in the moment, with other people around you and you're creating something y'know you feel like you're plugged into a a bigger thing, it's amazing, yeah it's the best feeling.
KRP: No, the ponceyer the better, I mean...
05: [laughs] Without wanting to sound too poncey, here's something *really* poncey!
KRP: [I] I'm interested by the term 'numinous', what what do you mean by that?
05: Erm, well, pfffr... er you know when people have say, you know, religious revelatory moments? Or er y'know or erm, just deep meditation and you feel connected to the world as one small part of a... a whole?
KRP: Yeah.
05: That that feeling.
KRP: Yeah.
05: I...I get that in a small way if I'm in a a true... y'know i...it's one thing playing standards in a restaurant, that's not what I'm talking about, y'know but if I'm on a gig doing, say like a post-Coltrane thing, er or if I'm playing with one of my groups so I've written the music and it's a listening crowd that are really into it and the atmosphere's right, and you can allow yourself to just completely get lost, you stop feeling like you're... one pa... y'know the it's...
KRP: The fundamental interconnectedness of all things?
05: Well [laughs] well yeah, w-withinn the context of of the music y'know you're the the music is a whole, yo... and you feel part of the whole rather than 'I'm playing a saxophone' you feel like you're the band making the music... i-it just it becomes more than yourself, I think that's probably the way to put it.
KRP: Right, yeah... d'you draw any kind of wider implication from that, I mean because there are different ways to conceptualise that I s'pose. Have you heard of the idea of flow states?
05: No, run flow states by me please?
KRP: They, well that would be a cognitive way of looking at that mental phenomenon of feeling really engaged in something such that the subjective experience of time is altered...
05: Oh, yeah yeah...
KRP: ...the feeling of almost being like the music is playing you rather...
05: Yeah.
KRP: ...than vice versa.
05: Yeah.

KRP: That's been described in terms of flow states and the neural correlates of that have been looked into etc etc.
05: Yeah.
KRP: Well that whole way of looking at it is one way of conceptualising that idea, er the... there are others, there are more kind of, like I don't know for the want of a better word, metaphysical or spiritual or different ways of construing that, and the value of music, I don't know whether y'know you have any wider thoughts on that, or whether you are content with just the description of being one with th music?
05: Erm, I mean wouldn't when you're talking about things like y'know erm... perceptions of time altering, that that's definitely... that happens, y'know the perception obviously er changes and 'cos I mean the the speed of thought and execution that happens when I'm improvising y'know in in a really intense setting say, is is is like far greater than I could probably achieve sitting doing any other sort of y'know, intellectual task erm but it's still very much in the moment y'know, erm so the yeah, I mean I'd I'd be fascinated to know more what is going on and that's happening, but I'm pretty sure in terms of what my my brain is achieving it's achieving far more [laughs] in those moments than it does i in that space of time doing anything else.
KRP: And that feels very good?
05: Oh yeah, yeah... high as a kite when I'm doing those sorts of gigs. Can't can't sleep for about four or five hours when I get back from a gig like that. Yeah. [laughs]
KRP: Ok, well to wrap up, I would say erm is there anything else you would like to add about your solo or your experience of the process today?
05: Erm, so when when you were talking about erm, y'know how how much your, y'know to what degree I heard things in my head as I was playing, I'd say pretty much all the time I've got a constant stream in my head of of what the music is and most of the time it's the same as what's coming out of the instrument.
KRP: Uh hmm.
05: But there are times when something else will come out, y'know erm and er as far as I would view it it's just because I haven't practiced those things enough yet for the link to be properly established that when, I'm hearing that over that sequence then actually this is what I'm supposed to be playing not that other thing that I had in my head.
KRP: Erm... that's an interesting way round to put it erm because I think a lot of people would say the thing in their head is what is prior I suppose, or what needs to be expressed, so...
05: Oh yeah yeah no, I'm trying to match what comes out obviously to what's in my head.
KRP: Yes.
05: Or or what's in my head is the thing I'm trying to achieve.
KRP: Yes, but almost there, you hinted at the idea that that maybe it would go in the other direction I don't know.
05: No, no no sorry, I I if...
KRP: Or are you thinking...
05: ...that's what I said then I...
KRP: No, it's an inference I'm drawing it's not what you said I think, it's it's...

05: Hmm, ok.
KRP: ...if you had to modify one of the things, what you're saying is you would modify what you actually articulate so that it matched...
05: Yeah, yeah yeah.
KRP: ...what's in your head?
05: Well, th-there have also been times where something comes out that I didn't intend, that actually by happenstance I s'pose more than anything else, erm actually is quite interesting and can take you down another way, and then you... but then there's the whole thing because I didn't intend it, you need to think back and try and work out what what it was in the first place and then do the backwards work and then get it into your imagination, so I s'pose there is a [I] and and that's what practice is about isn't it? You're informing your imagination so that when you actually come to improvise, things that you're thinking in your head are more interesting. So obviously listening to lots of different styles of music, erm, things that are more harmonically... y'know if you go and listen to Stravinsky you'll play some really interesting jazz, y'know? Erm, 'cos you're just informing your imagination? Y'know, your aural auditory

imagination, y'know erm so it is definitely a two-way proess, as I see it, erm but when I'm actually improvising what I'm trying to do always is get out what's in in my head. Yeah a-and then because y'know, I'm not a perfect musician *yet* erm, [laughs] y'know that link is not always a hundred percent, and obviously I strive to get it better all the time. And but I think it probably it'll never match up entirely because y'know, the more you develop, the the greater your imagination for things will be and the harder it is to keep the link a hundred percent and I don't know, perhaps unless you have, perfect pitch or something like that I don't know. And then maybe those links are just solid, I'm not sure.
KRP: But the interesting, it's... the the links to an extent are associations between motor patterns...
05: Yes.
KRP: ...and how they're gonna sound...
05: Yes, yeahyeah. You're associating a sound with that... yeah.
KRP: ...mmm...but supposing they're at the the level of description of mid-level units, that line up with say, the subjective present, which is 2-3 seconds, erm the issue then is, to what extent do you hear these things in advance... 'cos if you hear them too much in advance, surely you'd get lag?
05: Yeah no, I I don't I don't erm...
KRP: [I]
05: ...so I think of them as instantaneous things.
KRP: So it might be that you hear what you're *doing*?
05: Yes but then, when they diverge, that's when it becomes obvious...
KRP: Mmm.
05: ...y'know so so when you were asking me about, y'know when am I thinking when I'm doing it, it's hard to say because the... it's just happening it's it's like speech, I'm not thinking beforehand, the words're just coming out of my mouth, the notes are just coming out of the instrument, where...when it does become obvious, like say when your tongue trips up, while you're trying to speak then that's when you become ara... aware of what you're saying, more so I think. So...
KRP: [I]
05: So when my thoughts diverge from what's coming out, then I go 'ah', y'know, I know that that's not what was *here* [indicates head] y'know.
KRP: Yeah. Makes sense.
05: If that makes sense?
KRP: It does... does it's a good analogy, language I think.
05: Yeah 'cos 'cos it's pretty much about the only [laughs] useful way to talk about it I think.
KRP: Alright well thank you very much for doing this today...
05: No, it's a pleasure, thank you very much, very enjoyable.
KRP: and feel free to contact me via email...
05: [laughs]
KRP: ...if you have any questions. Goodbye!
05: Pleasure...

Participant 6

KRP: Ok, so... have er re/ have you ever done any research before?
06: No.
KRP: Ok so first time... How was it then? How did it feel to improvise in this setting?
06: Er I think it was a bit weird because like, obviously especially like... erm doing it to a backing track and not with like actual players was kind of like, that was a bit weird but erm... yeah it's not quite being like a performance it yeah kind of #was a bit# kind of off-putting in some respects 'cos it was like it wasn't just like a normal playing session kind of thing.
KRP: #Yeah.# Mmm, and how how do you think that affected what you did, i-#in terms of#...
06: #I think I# I tended to over-think things a little bit too much, #'cos it wasn't as easy to kind of get into it, I think I was kind of like started to panic about certain things just because... yeah 'cos it felt different, and er yeah.
KRP: #Mmm# And d'you think that was mainly the fact that it was a backing track and you could and there wasn't that #usual#...

06: #Yeah there wasn't# like the interaction and things and yeah 'cos I think if it had been like the same the same setting but with a band or something it would've been more comfortable and I could've just kind of got into it more like a performance...
KRP: Yeah.
06: ...but yeah.
KRP: Oh, makes sense. Ok, well erm like I said, you can control the feed/ er the playback so you just usual controls, I'll set it going, and then if you or if either of us feel there's something interesting erm and we want to chat about that we can stop it and...it's probably easier or/ in terms of recording not to talk over the playback # 'cos# then when I've got to try and transcribe it, it's like...
06: #Yeah.# Yeah.
KRP: ...but y'know, so hopefully. [AP]
06: [/AP] Think in that bit erm obviously with the still being the head going on already, I think I was just kind of trying to make sure I wasn't plaring over the head too much? And I was just being conscious of not like, just kind of making it too everything overlapping.
KRP: So a bit more sparse than #you would#?
06: #Yeah#, I wasn't just like going for it I was just kind of backing off a bit while that was still...
KRP: Ok. [AP]
06: [/AP] Think there's a couple of notes there [mimes playing saxaphone] and I could tell I was kinda I've played it and was kinda like not sure of that that was like doesn't feel quite right and rather than kind of sticking to my guns and trying to come out I've kind of petered off a bit. It's a bit kind of kind #of# gave up on it a little bit.
KRP: #So# So that that idea of conviction of sticking to your guns, what what would that have been like if if you'd played something and and felt you weren'r sure about how it felt, what would you do if you had stuck to your guns, would you say usually #,y'know in a playing...#
06: I probably would have like either just stuck on that note and just kind of played it with conviction and just been like yeah that sounds a bit dodgy but I meant it...
KRP: Yeah.
06: ...erm, or like, tried to resolve it somehow so it sounded a bit but I think there like, I kind of attempted to resolve it but kind of went for another kind of naff note and just kind of was like ah ok never mind. Erm, I think if I if like, again with this kind of like backing track thing, if I'd been playing with other players I think, like I know like cer/ certain people I play with tend to like they notice somethink like that, they'll kind of play something to kind of be like to push me on and kind of make me not just kind of peter off and give up.
KRP: Mmm.[AP]
06: [/AP] [Laughs] I think that bit was definitely like I played some really dodgy notes and I was just like I was going to do some more chromatic things and kind of make it look like I did it on purpose! [laughs]
KRP: Yeah, I noticed there's there's a pattern there, there was a like er, a figure? [#sings imitation of pattern#]
06: Yeah.
KRP: D/ is that something that you where where do you think that came from that [sings imitation of pattern]
06: I think I've definitely like played it in a transcription or heard it somewhere, and then, erm whether it was in the context of the actual like descending chromatic thing or just a part of a phrasing, but yeah it was definitey kind of er, I've played some dodgy notes so I'm gonna make it look like that's what I intended kind of thing as a way to kind of get out of the dodgy phrase [I].
KRP: Yes [AP]
06: [/AP] I think you can definitely tell, in terms of like the... like my relation with the instr/ [miming playing] like how I I can definitely tell that when I get down to the lower sections where it like where it's a bit less comfort comfortable and in terms of actually playing, I tend to end up kind of starting phrases and going low and then, because I'm not comfortable in that part of the instrument as much as I am in the middle, it's kind of like sometimes it just kind of dies off and not necessarily I think... #yeah#
KRP: #So#, is that you're talking about the lower register?
06: Yeah.
KRP: And and what what are the technical factors that make that more difficult for you would you say?

06: You I think you need you there's a lot more support and like it's a lot it's a lot more difficult to make the notes sound or like sound nice at least.
KRP: In terms of tone?
06: Yeah, and like in terms of I dunno like a lot of the time if you try and do something that's quite kind of chilled like obviously like 'cos it's with jazz stuff it's easier in some respects because a lot of the time you can kind of do the whole subtone thing it's quite airy and can sound quite nice but somet/ like if you don't support that then it can sound a bit naff and there was a few moments there where I think I kind of was like I started doing going a bit lower and it sounded a bit bleugh, so it just kind of died out a little bit. [laughs]
KRP: [AP]
06: [/AP] I think there was a there was a little phrase that I kept I like I repeated a few times I think I think, I noticed this as well before that I was... like I felt like I was struggling like again with the backing track thing because obviously there's nothing really to go against so it was kind of like I was kind of having to kind of use myself as something to go against a little bit #some of the time# so I think that's like that th/ the repeat of the phrase thing I kind of tried to do that, but I think it perhaps would've been would've felt stronger if someone else was there with me doin' it if you know what I mean, that's kind of like I think there's a little a little bit dodgily done! [laughs] Yeah, I think erm if there was someone else [mimes drumming] to kind of like be like 'yeah just repeat this, and we'll kind of go along with it' then it would have been... would've worked a bit better.
KRP: #Yeah# So... in terms of the individual phrases there, you're sort of bouncing off what you've done before #in some ways, to an extent# so interacting with yourself because you're not getting anything that's responding to what you're doing from the #backing, is that right#?
06: #Yeah# #Yeah# I think so yeah, I think like I might have done a similar kind of thing if I was playing with other people anyway, but I think kind of one of the things I was thinking in my head at that point was probably that like 'cos there wasn't much else going on that I kind of needed to have interaction with myself if that makes sense?
KRP: Yeah, yeah. Erm, in terms of the timing of when you decided to play certain phrases if we just listen to that 'cos there are some patterns in there that seem to erm in terms of interval patterns they they seem to traverse harmonized, if you see what I mean, #it's like a# a contour to them [mimes saw tooth with finger] and you might play them on a different start note #but with# a similar contour fitting to the key and where you are in the backing #is that#, or at least that's my impression, erm so when, just if we look back at that little section there when you come out of the low register, let's see if we can... [AP].
06: #Uh huh#. #Uh hmm.# #Yeah#
KRP: Might be a bit earlier than that actually [rewinds playback]. [/AP] So there, you you had like that cascade #down# phrase, that motif [mimes downward motion] that you developed, do you think, look I mean, you might not be able to tell now, of course, 'cos it's in retrospect. But... [AP] at that point [points at playback], or the point before, where where [/AP] do you think you knew that cascade might've #been coming#?
06 #Yeah#. #I think it was just a kind of like in the moment kind of thing I think I #just# played the first one and kind of realised that's something else I can do on different... #places#(?)
KRP: #Mmm# #So it's like#... so in part it's like an associative chain, 'I've done that', #and that# makes the next thing occur to you which #makes the next thing#...
06: #Yeah#. #Yeah, yeah#.
KRP: An that, so i/ would you say that's a way of erm reacting to yourself as well?
06: Yeah, I think so.
KRP: [AP]
06: [/AP] [laughs] I think at that point I was probably kind of like stuck for ideas, I went 'that's a thing I did before, I can do that again' kind of thing.
KRP: Is is is it identical? I don't think #it's identical#.
06: #I don't think#, but I think it's quite quite similar I think...
KRP: Yeah.
06: ... to something I'd already done, but I think it's obviously a case of like, I wasn't necessarily a hundred percent confident on the chords for the whole time, so I think it it was like kind of a 'oh I can do that and that works' kind of thing, like something to fall back on.
KRP: How did you find the key, 'cos it's concert Eb isn't it? #For a blues sequence#?

06: It's, yeah, it's not too bad, I think... ah blueses aren't one of my...
KRP: Things?
06: ...favourite things to play over, yeah and [I] just quite often just not as confident on that as I would feel on other things I think.
KRP: What what is it you find about the blues, is it the the sort of that you don't have something to work against that strongly er suggests things or is it a different...?
06: I think it might be partly to do with like the fact that a lot of sort of practicing jazz like harmony and improvisation is based on like two five ones and stuff, and when there's not loads of them everywhere, it's kind of like not as obvious as what I can kind of lock into kind of thing?
KRP: Mmm.
06: I think I think it's just a term of... erm it's just a case of getting more used to playing somthing that's slightly different harmonically to what I'm constantly doing [I]
KRP: [AP]
06 [/AP] I think, at that point, 'cos I've started to like use a bit more space and stuff, I think I'd started to get a little bit more comfortable with what I was playin' so it wasn/ like I think, for a lot of it I was kind of still trying to work my way round like what my fingers were doing kind of stuff, and then when I... something kind of clicked and I was kinda like 'ok, I kind of know what I'm doing now', I kind of calmed down and then I was like 'ok I can actually think about more about in terms of phrasing and things and not just constantly playing and trying to work out where I was. [lots of miming playing during this section]
KRP: Which ironically I think is where the head came back!
06: Yeah! [laughs]
KRP: [AP] [/AP] Thoughts on that last #time through# with the head again?
06: #Erm#, I think there's a... [dysfluency] it was kind of li/ like you said like I'd just got comfortable with what I was playing then the head came back and it's something different and like I I still kind of hadn't got my head round it at the beginning so, I was again kind of a little bit uncomfortable and kind of playing perhaps a bit too much like more than I needed to just because I was kind of making up for if I'd done a dodgy note I wanted to make.... do one that was nice!
KRP: And that's about kind of riso/ resolution #and# and making it er work?
06: #Yeah#.
KRP: Mmm. So, in terms of... I've got I've got some, like questions I ask everyone just to, er make it a bit standard, so where did the ideas come from, d'you think?
06: Erm...
KRP: Not necessarily just in this but #focusing on what we've looked at #.
06: ... #I think# a lot of it is based, well [dysfluency] especially jazz improvisations a lot of it is based on things you've listened to and, even if it's not directly like learning like licks and just playing licks like, a lot of what you're playin' is things you've heard and has subconsciously gone in I think.
KRP: Mm. You said you've done a lot of practice over things that are very two five one based...
06: #Yeah#.
KRP: .. #so# y/ y'know, a lot of the jazz standards have two five ones that modulate in different keys, so like All the Things You Are or something like that, six two five one four will modulate and then another erm two five one and then another like six two five one four, something like that, would you, er you say you you practice over those so what do you think would be the difference between something like that playing over something like that and playing over something like this, in terms of where the ideas would come from..# because# you you probably listen #to# various things, but is there a difference in in how you practice as well as what you listen to that makes a difference to where the ideas come from do you think?
06: #Ah#. #Yeah#. I think, I...like, things like two five one kinda based stuff I think because a lot of it is things that I've transcribed and things like that erm, it's a a lot of it is I think things that I've picked up on while transcribing and learnt the things, whereas I think things like this that I've not necessarily erm done as much of that kind of thing on, er it's m/ I think the two like more two five one kinda stuff is like things that I've literally learnt by writing down and practicing like learning how to play it, whereas stuff like that is like, I've listened to that quite a lot so it's gone in in a different way, #if that makes sense#?
KRP: #So when when# yeah, so when you say you've transcribed erm is it particular people?

06: There was quite quite a few different people really, erm...
KRP: And do you think... is it your intuition that, when you've transcibed these things and you've actually played them and learned them in that sense, would you say that well how would you say that that gives you ideas when *you* improvise?
06: I think it's kind of gives you a basis of how to like link things together like say if say if you start playing a phrase and then you get to like a two five one at the end and like you've always kind of got s/ a sort of safety net to fall back on so it doesn't necessarily have to be like just a sh/ like a long string of licks that you've learnt kinda thing, but it's just kind of like even if that's just a basis for what you end up playing, even if it's just a couple of notes that start it off, it's always just kind of like it's k/ it's like, I think of it like learning a language, like you you're learning like the like words or phrases erm but putting them together in your own way kinda thing?
KRP: Yeah. Yeah that makes a lot of sense. Erm, what strategies if any did you use to generate ideas?
06: Erm... I'm not sure, I think it part of it's just kind of hearing what I imagine other players would sound like in my head and kind of tying to, not replicate but kind of use that as inspiration kind of thing and...
KRP: What elements of the of what you're playing do you think that relates to, does it relate to er, tone, timing, rhythm, phrases, #note content#?
06: #Probably# a little bit of everything #really#, just I think like there's different different players erm influence different things more than others.
KRP: #Yeah#. Erm you... we've talked a little bit about the relative timing of when you made decisions erm compared to what you played, and you were saying in terms of er that cascade phrase it was very much in the moment sort of reacting to what you'd just done. Were there any times in which that was different, or or was it y'know o/ on a different level did you have a view of what you might do in the next chorus compared to what you'd done in this chorus, or was it very much...
06: I think it was for this it was very much erm just kind of playing in the moment and sort of seeing what happened kind of thing but I think there were other ocasions where I'm playing and I'm specifically thinking like I might have played something on the first time round and than it gets to the second time round and I'd kind of started playing something on the first time which I kind of in my head, might have carried on, but then the second time actually like picked up on it again and went back and kind of elaborated on that a little bit.
KRP: Yeah. Erm how planned was your improvisation overrall?
06: Not at all really, just...[shakes head]
KRP: To what extent were conscious processes involved?
06: Erm, I think in terms of like harmony and what notes I was playing, that was l/ like the part I was actively thinking about logically, and then when it came to actually like, playing phrases and things, that was just kind of a th/ there wasn't kind of a a logical process to it, it was just a...
KRP: So how would that interact then, because obviously y/ you're there you're listening to the backing, you know it's a blues, so there's a sense in which you probably have some expectations #about# the format, and after you've heard it once through, that's #reinforced# presumably? Do you think th/ that the conscious awareness of of say, well, tha/ I mean as... that's the question I guess, did you...d'you think you had a conscious awareness at the time you were playing, of what the chords were or what notes would fit over what? Or was it #less like that?#
06: #Mm# #uh huh#. #Erm# Yeah I think I was I was aware aware of it and like I said, 'cos it's not necessarily the thing that I'm most erm most confident on I think as it went along and I got more comfortable with it I kind of thought about it less and did it more intuitively. Erm I think at the start I was very much trying to like think about it and work it out kind of thing erm but yeah I just kind of let it get more comfortable and then it bcame more natural.
KRP: So that's what you were saying at the beginning wasn't it, that you thought you might have over-thought it a bit #and# that that was due to the setting and the fact that it was a backing?
06: #Yeah#, yeah.
KRP: Erm so were the kinds of thoughts you were having to over-think it at the level of explicit note values, music theory, phrases or or was it...?
06: I think a little bit yeah i/ it was like it was 'cos I was very much trying to kind of make sure I was comfortable in the key so I was kind of playing more notes than I needed to because it was kind of it's almost like note checking to a certain extent and making sure I kind of knew what notes worked and

then the more I kind of was aware of that the less I was playing because I could think more musically in terms of like logistically.
KRP: And so your initial thoughts on note selection in terms of note checking, would that come from a scale or arpeggio pattern or w/ would it be kind of more, I don't #know#?
06: #Erm# I think it's just kind of trying to play phrases that I thought would work 'cos [dysfluency] I was like trying to do that but trying to do it in a musical way so... erm but I think it kind of m/ by the process of kind of having to do that kind of makes what you're playing slightly less musical because it's i/ it is just double checking things work kind of thing but then yeah the more you become comfortable in the key the more y/ you're comfortable playing musically rather than trying to work out what you're doing.
KRP: Mmm. Erm, how much of what you played do you think you heard in your head?
06: I think, I'd say... about fifty sixty percent probably? Or at least like I'd say like most phrases at least started with the notes I intended them to start with and then it might have been like I heard a beginning and then kind of then just kind of went and did something that finished the phrase but wasn't necessarily exactly what I'd planned or or heard in my head.
KRP: And in ter/ getting back to the timing of hearing it in your head and playing, do you have any thoughts on that?
06: Erm...
KRP: ...to relative to the playing bit and then hearing what you've played where does the hearing in your head come in?
06: Erm I I feel like it's very much dependent on how comfortable you are with that particular tune, so I think if it was something that I was I'd played loads and knew really well and kind of had knew it under my fingers really well then I'd erm I'd be a lot more th/ what I was hearing in my head would come out a lot more than things like this that I was less comfortable with.
KRP: Did you erm find, or how much of what you played came from your idea bank? Er and how much represents material that you think you haven't played before?
06: Erm...
KRP: Do you know what I mean by an idea bank?
06: I think so, yeah erm... I'm not sure, it's difficult to say 'cos I think there's a lot of things which I... I I think I play quite often that I don't necessarily realise I play a lot of the time and it's kind of like an automatic thing that, because it's something I've worked out which is comfortable but I've not necessarily actively sat and learned it and worked it out, it's just something that I've happened to play in a few solos and then something's just kind of like remembered it and I go back to it but so it's probably I don't know I reckon around thirty forty percent is probably stuff that I've actively kind of I'm aware of having as ideas and then the rest of it is kind of just built around that I think.
KRP: It's probably why they... or why it's recommended to record yourself? [I]
06: Yeah yeah I quite often find if I like if I've recorded myself and like I listen to a couple of different things it's like 'oh, I keep doing that' but I'm not aware of the fact that I keep repeating something.
KRP: It's good good to kind of weed out those musical tics!
06: Yeah.
KRP: Erm, did you modify any of the ideas in your repertoire for *this* improvisation?
06: Erm I think there was probably an there's there's a fair bit of things that I kind of unintentionally because it it was things that I hadn't necessarily thought about having learnt, sorry that makes no sense, the stuff I hadn't consciously learnt erm but was like these kind of ideas that I'd subconsciously taken on into my playing I think it a lot of it was/ wasn't necessarily like an exact phrase that I'd learnt it was kind of a sort of idea of a shape of a phrase or a a few notes that worked together, so it was never necessarily like this exact thing, it was kind of like a this is like ki/ a kind of idea and there's different ways of approaching it or playing it kinda thing.
KRP: What d'you think would change if you did modify an idea? What would you modify about it generally do you think?
06: I think it'd be things like erm rhythmically, like where it started and ended in the bar and things and how it resolved I think it would depend on I think it could change a l/ a lot more if I was like playing with other people in terms of how they were playing with me and reacting kinda thing I think that would kind of give me more ideas to bounce off.

KRP: D'you reckon that the ideas in your idea bank that are accessible are the same for every key or not?
06: Definitely not I think I tend to learn like especially if like say I I've learnt a transciption of something and then there's one particular phrase I pick out and think ok I'm gonna try and learn that in every key, no matter how hard I try I always find that the key I found it in originally is always the one it's strongest in no matter what like how much I practice I'll sort of just because like it was taken from the specific like transcription it's always much more comfortable in that key.
KRP: That's interesting isn't it? Mmm yeah 'cos yeah when when that happens, is there always something about the way that the phrase functions inthe key that it came from that you can identify in terms of manipulation of the instrument ot whatever that would explain it or is it just just a feeling thing 'ah that's just where that's the key it belongs in'?
06: I think sometimes it's to do with it's more comfortable there on the instrument kind of thing 'cos a lot of the time like say you might be learning a phrase and it goes up into altissimo and it's like that wouldn't be a comfortable thing for just like it's kind of like that's the kind of thing I'd have to more actively think about if I was playing it in the middle of the solo, erm i/ erm rather than it just be in the middle of the register erm but erm yeah I think I think part of it's just to do with if I've like learnt a transcription and there's a particular part in it it's because it's like it's kind of like that's where it originally l/ like that's kind of home for that little phrase and so I always kind of associate it with that so it's never quite as...
KRP: And I guess it's possible if you'd done an analysis of your practice pattern that that's where the key you practiced it in the most #in total# because that's where it came #from# and you originally practiced it to get it #right# from the original #context#, then the transposition to other keys, you're gonna time slice that to every other key and you're not, it's unlikely you'd spend as much time on any other key than the #first# key, that's possible but... it's just a y'know
06: #Yeah#, #yeah#, #yeah#,#yeah#.
KRP: Erm, so just to say a bit more, what what do you think draws you to improvising, could you say more about why you do it?
06: Erm I think it's just a very different way of sort of I I feel in a lot of ways it's a lot more expressive than written er well I think it very much depends on what it is for me personally like as a saxaphone player I the kind of sort of classical music I listen to is not the like standard class/ classical saxaphone repertoire because it's it's that's all very like modern things that are just not really the kind of thing I'm into so I think I kind of naturally gravitated to like things like jazz and pop, because in terms of my what I could play, it was they were kind of things that musically interested me the most, but I think I also just there's something quite erm I dunno it's quite liberating to be able to improvise and kind of just do what you want in your head rather than having something written down and you have to 'cos I think it like I do enjoy that in some er some contexts but I think I generally it just it feels more interesting to play something that's just in the moment, kind of make it up as you go along!
KRP: Erm ok that's that's erm very interesting, very good er is there anything else you would like to add about your solo or or about your experience of the process today, is there anything?
06: Er, I don't think so really I think yeah it's just [I] it's difficult to I don't think that's necessarily a hundred percent erm what would I would usually play like because of the fact that it was to the backing track rather people but yeah.
KRP: Yeah, er a lot of participants have said that erm so it is y'know one of the limitations of this and with a budget...
06: Mmm yeah [laughs].
KRP: ...we could have perhaps hired a band, and that so for future studies that might that's something that we might well take on board [I] so thank you very much for doing this today, really appreciate it and please feel free to contact me via any y'know mobile or or email or if you have any questions and any feedback about when it comes out, I'll send your way as well if you'd like.
06: Yeah, #that'd be great#
KRP: #Alright#. #Thank you#.
06: #Thank you#.

Appendix 13

Participant Consent Form

Title of Project: 'Are we really hearing in our heads what we think we're hearing?': the role of auditory imagery in musical improvisation.

Name of Researcher: Keith Phillips

Participant Identification Number for this project:

Please initial box

1. I confirm that I have read and understand the information sheet/letter (delete as applicable) dated for the project in which I have been asked to take part and have had the opportunity to ask questions. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason. ☐
3. I understand that my responses will be anonymised before any results are shared. I give permission for members of the research team to have access to the video recording of my improvisation. I understand that all personal data about me will be kept confidential. ☐
4. I understand that the investigator(s) must adhere to the Ethical Code of Practice set down by The British Psychological Society. ☐
5. I agree to take part in the above research project. ☐

Name of Participant	Date	Signature
Name of person taking consent (*if different from lead researcher*)	Date	Signature
Researcher	Date	Signature

Copies:
One copy for the participant and one copy for the supervisor or researcher.

Supplementary Material

Proceedings of the 9th International Conference of Students of Systematic Musicology (SysMus16), Jyväskylä, Finland, 8th - 10th June 2016. Birgitta Burger, Joshua Bamford, & Emily Carlson (Eds.).

Are We Really Hearing in Our Heads What We Think We're Hearing? The Role of Audiation in Musical Improvisation.

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Abstract

An important and valued part of the skill of musical improvisation is to be able to play what we hear in our head (audiation). Improvisation is a cognitively demanding activity, involving the production of musical material in real time. This requires the simultaneous involvement and coordination of many different skills, and places demands on working memory, memory retrieval, auditory and sensory-motor systems. Some recent studies support a cognitive model of improvisation which posits the deployment of stored rhythmic and melodic patterns via motor programmes. According to the theory of event coding, actions and their perceptual consequences share the same cognitive representation and behavioural and fMRI studies have offered evidence supporting this theory. Since musical actions have sounds as perceptual consequences and sensorimotor coupling is bidirectional, this is compatible with improvisers imagining the sounds as they play them. However, phenomenological accounts and interview studies suggest musicians use different strategies to generate ideas in improvisation, such as music-theoretic ideas and motor patterns or 'muscle memory'. So questions remain regarding the precise role of audiation in improvisation: what is musicians' experience of musical imagery as they improvise? Is auditory imagery cognitively prior to action or post hoc? How accurate is auditory imagery? What proportion of musical output involves audiation and how sensitive is this to context? The aim of this paper is to offer a coherent explanatory framework for improvisation from the perspective of cognitive psychology and to propose experimental paradigms to begin to answer some of these questions. On the basis of a review of the literature, it is concluded that two approaches offer a way forward: altered auditory feedback (AAF) and a blocking paradigm in which interference conditions seek to disrupt the tonal loop in working memory.

Keywords: Audiation, improvisation, common coding, altered auditory feedback, tonal loop

Introduction

'Audiation' is a term coined by Edwin Gordon (1979) and in this context it means imagining the music being improvised. Musical improvisation is a complex human activity which also has different meanings in different contexts and resists easy definition. The focus in this paper is on jazz improvisation in a tonal context which is a process involving the composition or selection and deployment of musical material in real time.

Improvisation has proved difficult to investigate experimentally, due to the involvement of many rapid simultaneous cognitive processes and its inherent unpredictability. Some progress has been made in this area recently however, using methods such as computer analysis of solos (Norgaard, 2014), algorithmic generation (Norgaard, Spencer, & Montiel, 2013; Pachet, 2012), behavioural experiments (Goldman, 2013) and fMRI (Donnay, Rankin, Lopez-Gonzalez, Jiradejvong, & Limb, 2014; Limb & Braun, 2008).

Brain scanning techniques (fMRI, EEG, MEG) have also been used to investigate auditory imagery (audiation) in other contexts, such as silent score reading (Brodsky, Kessler, Rubinstein, Ginsborg, & Henik, 2008) and in comparison to perception (Schaefer, Desain, & Farquhar, 2013). However, questions remain regarding the role of audiation in the improvisatory context because the brain regions hypothesized to be involved in imagery overlap with those involved in perception and motor planning (Zatorre & Halpern, 2005), which are also integral to improvisation. How accurate and how detailed is audiation? When does it occur in the process?

Also, interviews with artist-level musicians indicate that they use a variety of strategies for idea generation when improvising (Hargreaves, 2012; Norgaard, 2011). Some of these, such as 'muscle memory' or strategies based on music-theoretic considerations do not seem to necessitate audiation. So, what proportion of improvised musical output requires audiation and how sensitive is this to context? In order to make progress in addressing these questions experimentally, a cognitive-scientific frame of reference is required (Goldman, 2013).

A cognitive-scientific approach

Pressing (1988) proposed a cognitive model of improvisation in which musical output is seen as a series of 'event clusters', each comprising a group of notes preformed via the triggering of a stored motor program. Action monitoring occurs through the use of both feedback and feedforward mechanisms. Recent studies have offered some support for this model (for a review, see Beaty, 2015).

Furthermore, the theoretical perspective of common coding paradigms, such as the Theory of Event Coding (Hommel, 2009) offers a coherent and evidence based explanatory framework within which the instantiation of Pressing's model can be situated. From the common coding perspective, actions share neural codes with their intended perceptual consequences and this is consistent with improvisers having an aural image of phrases they play.

Action control is achieved by anticipation of the sensory consequences of motor programs once selected (forward model) or these programs can be selected on the basis of the intended sensory consequences (inverse models). Together with the use of auditory feedback for error correction, these mechanisms constitute the feedback and feedforward aspects of Pressing's model. These mechanisms are not mutually exclusive and their relative importance in the improvisation process bears on the questions posed regarding the role of audiation.

Tonal Working Memory

Another important theoretical perspective involves the role of working memory (WM) in audiation. In addition to the phonological loop component of WM proposed by Baddeley and Hitch (1974), recent studies have found evidence that musicians use a 'tonal loop' for the processing of non-verbal auditory imagery (Schulze & Koelsch, 2012; Schulze, Zysset, Mueller, Friederici, & Koelsch, 2011; Yu et al., 2015). Some of the brain areas involved (for example Broca's area and the premotor cortex) are hypothesized to have a role in the planning and control of actions (Schulze et al., 2011) and this is consistent with brain plasticity in musicians facilitating sensorimotor coupling through practice.

These theoretical perspectives suggest two experimental approaches that could make progress in elucidating the role of audiation in improvisation.

Methods

The first approach involves the use of altered auditory feedback (AAF) in conjunction with electroencephalography (EEG). This approach has been used to investigate action control in musicians (Lutz, Puorger, Cheetham, & Jancke, 2013; Maidhof, Vavatzanidis, Prinz, Rieger, & Koelsch, 2010; Pfordresher, Mantell, Brown, Zivadinov, & Cox, 2014), but this author is not aware of any studies which have used it in the context of improvisation.

In the proposed study, participants would be required to improvise monophonically to a backing track. The auditory feedback would be subject to pitch manipulations and EEG data captured. The hypothesis is that a feedback related-negativity FRN would be elicited at about 250ms (Lutz et al., 2013) only in the presence of accurate audiation of what participants improvise. The musical conditions such as tempo and harmonic complexity of the backing, as well as the nature of pitch manipulations could then be varied.

The second approach uses a blocking paradigm (Brodsky et al., 2008). Participants will be required to improvise normally and also under interference conditions designed to either use the resources of tonal working memory (humming a familiar tune), or to use different resources while representing a similar cognitive loading (e.g. reciting digits). The hypothesis is that tonal working memory is required for audiation. If the nature of the improvisations produced were to differ significantly when the use of tonal working memory is blocked, this would give support for the use of audiation during improvisation. Quantitative measures such as entropy and pitch class distribution (Goldman, 2013) and qualitative measures such as expert rating could be used to assess musical output.

Results

At the time of writing there are no results available as the experiments are still being developed.

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