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The Improvising Body

Exploring the Continuities from Biological Life to Musical Practice

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Abstract

Improvisation is a prevalent part of how we engage with our world—both in creative practices and everyday life. Even basic living organisms such as a biological cell have the capacity to act and adapt to situations spontaneously. This thesis offers an account of improvisation that aims to recognise the deep continuities between improvised creative practice and the embodied adaptive capacities innate within living systems. I support this exploration through an interdisciplinary approach that draws on work in enactive cognitive science, ecological psychology, phenomenology, and my own experience as an improvising practitioner. Through this lens I examine the presence of improvisation in basic biological life, sensorimotor agency, musical practice, and plans and planning. Accompanying the thesis is a creative artefact that was shaped by the written work. These recordings also serve as examples used to illustrate the concepts within a musical practice.

Statement of Originality

This is to certify that the intellectual content of this thesis is the product of my own work and that all assistance received in the preparation of this thesis and sources have been acknowledged. This thesis has not been submitted for any other degree or purpose.

Accompanying Artefact

TENGU

Recorded from the 29th – 30th of July 2023, at Brian Brown Studio, Melbourne Conservatorium of Music.

Featuring: Trumpet – Miles Rooney
Double Bass – Harry Birch
Drum kit – Dylan van der Schyff
Mixed by Erin Sherlock and Pat Telfer

Track List

MD Duo	7:00
Chăngdì	10:59
TENGU	4:01
Vers Presque Rien	8:38
Harmonic Guide	3:53

Laying Down a Path in Walking

Recorded from the 16th – 17th of August 2023, at Rancom Studios, Botany.

Featuring: Trumpet – Miles Rooney
Tenor Saxophone – Tessie Overmyer
Piano – Mathew Harris
Double Bass – Harry Birch
Drum kit – Ryu Kodama
Mixed by Domenic Corso and mastered by Michael Lynch

Track List (Selected)

Rolling Gestures	2:53
Through a lens	6:34
In Walking	6:05

Preface

The creative artefact is made up of two recording sessions, one with a trio and the other with the ensemble Jiem. The trio album, entitled *TENGU*, was recorded from the 29th – 30th of July 2023, at Brian Brown Studio, Melbourne Conservatorium of Music. It was recorded by Dylan van der Schyff and mixed by Erin Sherlock and Patrick Telfer. It features Miles Rooney; Harry Birch; and Dylan van der Schyff. The Jiem album, entitled *Laying Down a Path in Walking*, was recorded from the 16th – 17th of August 2023, at Rancom Studios, Botany. It was recorded and mixed by Domenic Corso and mastered by Michael Lynch. It features Miles Rooney; Tessie Overmyer; Mathew Harris; and Ryu Kodama. I have only included select tracks from this album.

This thesis includes a publication entitled 'The Ecological Dynamics of Trumpet Improvisation', published in the Springer Journal *Cognitive Processing*, volume 25, pages 163–171 (2024). https://doi.org/10.1007/s10339-023-01159-9. The basis for the article came from my honours research prior to enrolling in the masters, however, this work was thoroughly developed through three rounds of extensive peer review and was accepted 18 months into my candidature.

I also acknowledge that I received funding from: Research Training Program Scholarship (Fee offset) 2022; The Marion Thomas award 2023; and Fine Arts and Music Research Support Bursary 2023.

Acknowledgements

I would like to thank my supervisors Dylan van der Schyff and Andrea Keller for their wisdom, patience, and encouragement. Dylan's scholarly work is what inspired me to undertake this research in the first place, and Andrea's music has shaped my development as a musician for many years. I am also grateful to my parents and my brothers for their continued support during my studies. I also wish to thank my partner Sophie who, when helping me, knew exactly when to be kind and when to be blunt. Thank you to the Jiem members: Tessie Overmyer; Harry Birch; Mathew Harris; and Ryu Kodama for their contribution to the creative work. I have very much appreciated both your musicianship and friendship. Finally, a big thank you to everyone who took the time to read and comment on my drafts: Aliya Sztulman; Sam Dobson; Patrick McGivern; Hilary Geddes; Tonya Rooney; Lotte Latukefu; and Valerie Harwood.

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Chapter One: Introduction

Improvisation is an activity that is as ubiquitous as it is elusive. It is a prevalent part of both music making and our everyday interactions with the world, yet it can appear at times to be ineffable. Improvisors can often be highly skilled but struggle to clearly describe their experiences. Bailey (1992) writes that "Improvisation enjoys the curious distinction of being both the most widely practised of all musical activities and the least acknowledged and understood" (p. ix).

Interestingly, authors have begun to discuss improvisation as it connects to our more general adaptive experiences of being-in-the-world. Higgins and Mantie (2013) for example, write that "improvisation is a distinctive way of being in and through music that reflects the fact that the act of living is largely improvisatory (p. 38). Pianist Vijay Iyer, has asserted that "improvisation should actually be regarded as identical with what we call experience […] there is, in fact, no difference between human experience and the act of improvisation, which means that we're actually always improvising (Miller & Iyer, 2020, p. 227). He then states:

> You might say that there are degrees, layers or levels to what we call "improvisation." There's a primal level at which we learn how to just be in the world, and then there's another level at which we're responding to conditions that are thrust upon us. (p. 227)

This view appears to be supported by recent developments in cognitive science that see cognition not as a passive stimulus response, but an active and adaptive engagement with the world (Varela et al., 1993). Theorists such as Torrance and Schumann (2019) and Gallagher (2023) have begun drawing on these approaches to provide deeper insight into what improvisation is and, likewise, use improvisation to understand the nature of cognition.

I aim to contribute to this discussion by drawing on key ideas and themes in embodied cognitive science to better understand the nature and meaning of improvisation and music.

Like Higgins and Mantie (2013) and Miller and Iyer (2020), I explore improvisation as a part of a continuum that is supported by our nature as living adaptive agents. In doing so I examine the dynamics of improvisation as its spans living organisms, everyday life, and into the material and social environments where musical improvisation plays out. As I explain, the lenses provided by embodied cognitive science are useful for establishing a vocabulary for conceptualising and describing processes involving adaptivity, habits, engaging with objects and social environments, and refining the relationship between improvisation and planning. This research is motivated by my interest in the ways improvisation emerges in our everyday interactions as well as my own practice as an improvising musician.

Background and motivations

Early on in my undergraduate jazz degree, I had a very specific idea of what improvisation was. The kind of standardised learning in music institutions can sometimes imply a view of improvisation that is abstract and narrow. One can begin to think that learning and reproducing a concept or melodic phrase represents what improvisation is. I was lucky enough, however, to learn from many teachers during those years who broadened my view. I began to think about the role of the body—such as the breath, one's tone, articulation, and finger patterns. I became involved in ensembles that focused on free improvisation, exploring ideas such as synergy and coordination. I was also interested in how these kinds of interactions that are stressed in freely improvised music appeared in more constrained or conventional settings.

A common analogy in jazz education, used to encourage interactivity, is to compare improvising with having a conversation. Although this is meant as a learning heuristic, there are many parallels one can draw. When talking to someone, one comes up with responses or topics in-the-moment based on what has just been said and our history of conversations. We

all use common “licks” like “Hey, how’s it going?” and “Good thanks, how are you?”. Our conversations are also exploratory, we sometimes find ourselves coming up with novel ideas that were only possible through the ongoing interactions between you and the other person. Crossley (2021) writes that “all conversation is improvised, to some extent, because each party must respond more or less immediately to the communications of others without knowing the details of those communications in advance” (p. 78).

Improvisation is also present in our everyday lives through the ways we navigate and adapt to situations. Even when we make and follow plans, we act in ways that are flexible and context sensitive. Moreover, improvisation can be exploratory and is an important part of our development. As Iyer (2014) describes, "babies learn to talk by babbling; they learn to walk by staggering, finding their balance, stumbling, finding something to hold onto; they learn to eat efficiently by first making a lot of messes” (p. 75). Music improvisation can involve a similar form of exploration—of both the world and the self (Høffding & Schiavio, 2021). Observing improvisation in everyday life can reshape the way we think about improvisation in musical situations. For example, many decisions that are made in music improvisation are not purely aesthetic but involve a degree of functional problem solving. As a trumpet player I am often enacting musical material according to the condition of my body, such as whether I am feeling fit or fatigued. This broadened “everyday” view also recognises how improvisation can occur in supposed non-improvised situations. When playing in a horn section, I am often playing pre-composed lines. The amount of direction given to me, however, can vary greatly. Sometimes deciding on dynamics, articulations, and feel can be at my own discretion in that moment. I draw from an extensive history of horn lines that inform me of what may be appropriate for the situation and, in-the-moment, use this knowledge to make informed decisions on how to play. Moreover, musical situations are not always tight and predictable, and musicians must be flexible and adaptive.

Reflecting on these intuitive, first-hand experiences, I began to consider improvisation—both in music and everyday life—as a recursive activity. That is, in real time, improvisation involves actions that alters one's situation, and then follows with a response to this new situation—which itself becomes a new situation altering action (Bertram, 2021; Høffding & Satne, 2021). According to Crossley (2021) "it is of the essence of improvisation that the sequence of steps involved is neither planned nor routinized, that each builds upon and responds to the one which precedes it in a contingent process" (p. 79). At a similar time I was introduced to the enactive approach and the work of Varela et al. (1991), who see this kind of recursion as central to life and cognition. According to the enactive approach, our path—although constrained and enabled by our past and our abilities—is not predetermined but laid down through our activity. Varela et al. (1991) suggest that "we are always constrained by the path we have laid down, but there is no ultimate ground to prescribe the steps that we take" (p. 214). Cognition and meaning making in life are thus a process of *laying down a path in walking*. This seems to echo the claim, discussed at the start of this chapter by Higgins and Mantie (2013) and Miller and Iyer (2020), that living is largely an improvised activity.

I propose that this path laying, central to life, is continuous with our improvised musical activities, and I aim to highlight this continuity throughout the thesis. I hope to gain a deeper insight into music improvisation as well as the nature of improvisation more generally by examining the fundamental capacities of living systems. Improvisation is such a far-reaching phenomenon that it can be hard to see where it begins and where it ends. We use it to explore and adapt to situations as well as generate aesthetic experiences through performance. Observing the more fundamental adaptive capacities for action, and then building our way to music making will hopefully lead to a richer understanding of what improvisation is and lay a preliminary framework for how we might talk about it. Moreover,

undertaking this research has allowed me to reflect on my own practice as an improvisor. I believe this work can provide opportunity for other improvisors to do the same.

I have primarily taken a theoretical approach, drawing from work in embodied cognitive science and phenomenology to help advance these questions. However, both the theoretical work and my practice as an improvising trumpet player were mutually informing during the candidature. The thesis is accompanied by a creative artefact which I refer to throughout. These references serve as examples meant to illustrate the theoretical concepts in real world situations—both as a way of describing a creative practice or as a novel approach to a creative process. In the remainder of this chapter, I will outline my methodological approach and the theoretical framework in greater detail.

Methodology and theoretical framework

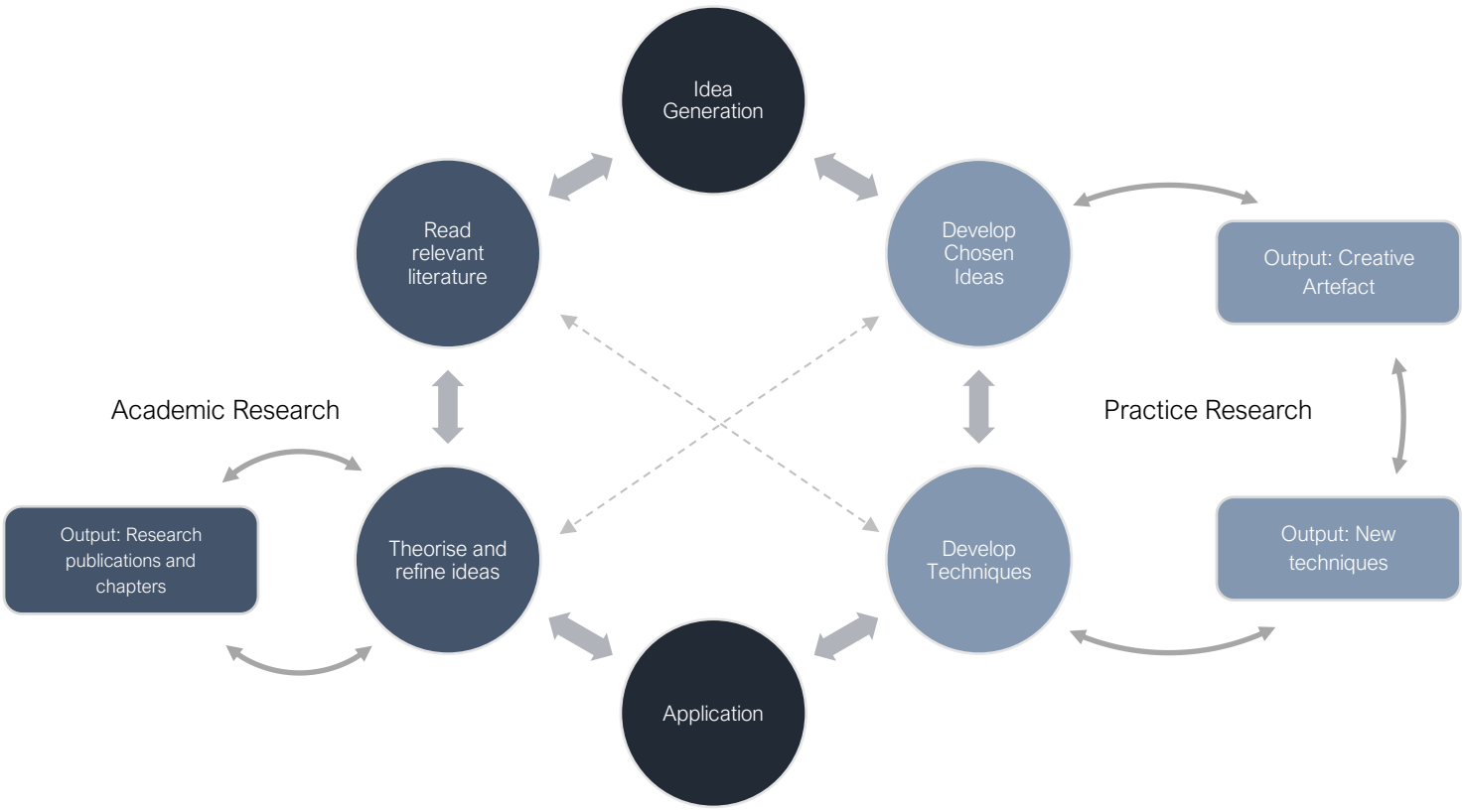
My research methodology involves two mutually influencing areas of enquiry: research and practice (Smith & Dean, 2009). The topic of improvisation invites an interdisciplinary perspective and has seen growing interest in philosophy (Ravn et al., 2021; Ryan, 2019); neuroscience (Limb & Braun, 2008); cognitive science (Dean & Bailes, 2016; Walton et al., 2015); as well as musicology and practitioner-led research (Gill, 2023; McLean, 2018; Slater, 2020). Moreover, many authors have shown interest in the ubiquity of improvisation in music making and our everyday lives, as well as the complex and deeply intertwined relationship between the two (See Krueger & Salice, 2021; Ryle, 1976; Torrance & Schumann, 2019).

While the theoretical contribution makes up a larger portion of the thesis, there is much to be gained from the reflections of one's own know-how and experience (See Sudnow & Dreyfus, 2001). Reflections on my experiences of improvising have shaped my reading of the literature and many of the philosophical arguments I present. Likewise, the theoretical research provided interesting ways of examining my own practice and performance. These

areas of enquiry form interacting epicycles from which the research and practice emerge (See fig. 1). Throughout the chapters I have placed tables that refer to the artefact, pointing out the ways in which the theory appears in practice. These references draw on the theoretical work in the thesis and my own anecdotal experiences as an improvisor-practitioner.

Figure 1

Research-Practice Cycles



Note. The cycle can be read clockwise, illustrating how the practice shaped the theoretical research, or anti-clockwise demonstrating the influence of the theoretical research on my practice. Movement, to a lesser extent, is also possible within the cycle (Adapted from Smith & Dean, 2009, p. 20).

I have situated this research within the *4E* approach to cognitive science (Newen et al., 2018; Rowlands, 2010). This framework sees the mind as emerging out of interactions between the body (which includes the brain) and the environment. The 4E's may be summarised as:

- **Embodied:** Cognitive processes are not limited to the brain but instead are distributed across the body.
- **Embedded:** The embodied mind is embedded within a physical and social environment.
- **Extended:** The body may integrate external resources from the environment to augment its abilities.
- **Enactive:** The structure and abilities of an embodied agent determines the ways in which the environment presents itself. As the agent moves through the environment it enacts a meaningful world.

I should note however that the 4E framework is not necessarily a unified approach. For example, there are a variety of interpretations of how seriously we might take the role of the body (Gallagher, 2011). Moreover, there are debates on whether we should conceptualise the extended mind as functionally equivalent computations occurring within external objects (Clark & Chalmers, 1998) or as the integration of objects into the body schema (Di Paolo, 2009; Thompson & Stapleton, 2009). The approach I take throughout this thesis is most closely associated with the enactive approach, specifically *autopoietic enactivism*. This approach takes seriously the role of the body and the environment. Moreover, the enactive approach seeks to trace the deep continuities between mind and life, viewing the mind as originating from the processes that occur in living biological systems (Maturana & Varela, 1980; Thompson, 2010; Varela et al., 1991).

In recent years the 4E framework has played an increasing role in music research. This is especially in regard to creativity (Sawyer & DeZutter, 2009; Schiavio & Kimmel, 2021; van der Schyff & Schiavio, 2022; Van Der Schyff et al., 2018); music emotions (Schiavio et al., 2017; van der Schyff & Krueger, 2019); and education (Schiavio & van der Schyff, 2018; van der Schyff et al., 2016). From an enactive perspective, music making is an activity that is continuous with our primordial capacities for behaviour. Throughout the following chapters I suggest that improvisation involves a similar kind of continuity, making it an innate part of both music and life.

Outline of chapters

In chapter two I propose that biological life already implies a level of improvisation. Drawing from the enactive approach I observe life at the level of a biological cell, showing how autonomy, adaptivity, and sense-making allows organisms to respond to aspects of the environment in-the-moment. I define our basic adaptive behaviours as a kind of *proto-improvisation*, a precursor to more intentional forms of improvisation. Although I suggest these lay along a continuum.

Chapter three follows on by exploring a new level of agency afforded by the sensorimotor system. While the biological cell acts primarily in regard to sustaining its existence, sensorimotor agency allows for a greater range of action selection, including actions that are not necessarily driven by metabolism. In this chapter I discuss the development of habits that structure our improvised activities, drawing on Merleau-Ponty's phenomenology. I then take an enactive view, discussing our skills and habits in terms of networks of sensorimotor schemes.

Chapter four is a paper published during my candidature titled "The ecological dynamics of trumpet improvisation" (Rooney, 2024). In the article I use concepts from ecological

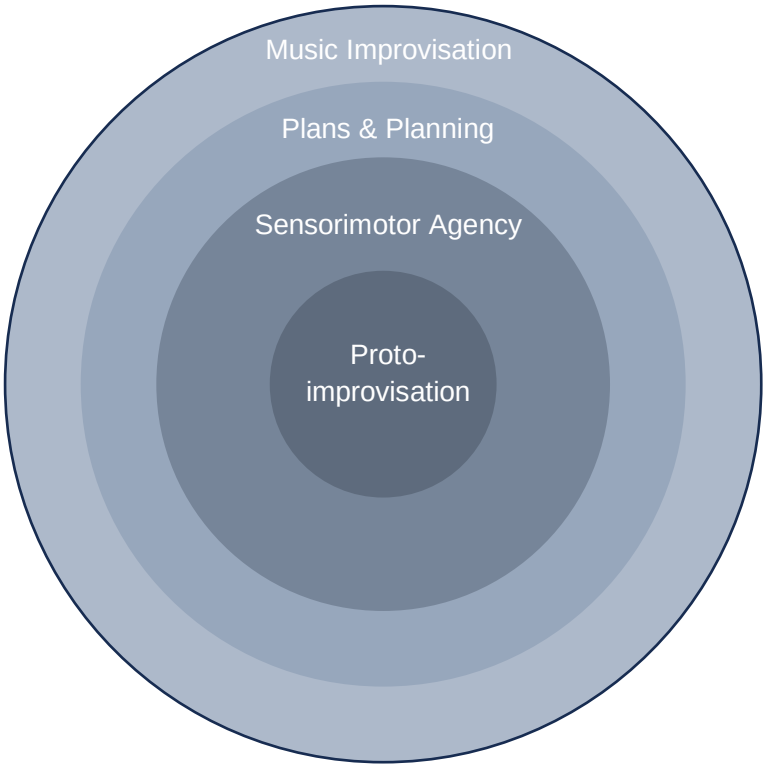
psychology and dynamical systems to discuss the relationship between the improvisor, instrument, and environment, primarily in regard to trumpet playing. I consider the improvising musician as an adaptive system whose behaviour is a self-organised response to a set of constraints. I should note that this chapter has been kept largely the same as the published version. Because of this, there may be passages that are reiterated in other sections of the thesis.

Finally, chapter five examines the continuities between improvisation and planning. I suggest that although we commonly view these two phenomena as antonymic activities, they share many characteristics. I use an enactive-ecological framework to illustrate that our activities, from real time improvisation to planning over longer timescales, is an embodied activity that involves engagement with environmental affordances.

Each chapter addresses aspects of improvisation in life along a continuum from basic adaptive behaviours to plans and planning. This progression is cumulative, each stage is a necessary requirement for the following stages. Fig 2. illustrates this by showing the cumulative continuum from our basic adaptive behaviour to music improvisation. Our basic biological organisation, that is our autonomy, adaptivity, and agency, already suggests a form of proto-improvisation. The introduction of the nervous system sees a greater variety of action selection possibilities. Improvisation then becomes enmeshed within layers of habits and sensorimotor schemes, forming a body with goals and preferences beyond metabolism. The improvisor acts in the moment but they also create and follow plans. This allows them to adapt to future possibilities.

Figure 2

Cumulative Continuum



The overarching goal of this dissertation is to develop an account of improvisation, both in life and in music, that emphasises our primordial ways of dealing with the world. I view music improvisation as "continuous with (but not simply reducible to) the forms of adaptive interactivity that characterize how even very simple life forms enact survival-relevant relationships within the sociomaterial environments they inhabit" (van der Schyff et al., 2022, p. 19). This is with the hope of providing a framework for understanding and describing improvisation, as well as opening potential avenues for novel creative processes and learning.

Chapter Two: Proto-Improvisation

The world we are situated in is dynamic and can, at times, be messy and unpredictable. Our environments invite us to act and make decisions in-the-moment, and our own precariousness makes adaptivity a necessity. Alperson (2010) writes:

> [The] developmental arc and limitations of human knowledge and abilities, the recalcitrance of the world to human will, and the open-endedness and fragility of existence, all of which call upon us to think and act spontaneously as we make our way through our lives. We appreciate improvisation, therefore, as spontaneous achievement within the constraints of the possible. (p. 274)

An improvisor's actions are constrained and enabled by a history of interactions with the world, but they are not determined. Improvisors are autonomous agents that lay down their own path. The "continual unfolding of the process of an organism's meaning-making encounter with its environment is like an improvising jazz musician generating musical responses that make sense in the context of her fellow players' (and her own) previous musical "moves" (Torrance & Schumann, 2019, p. 254). Improvisors skilfully navigate their environments, and the music reflects these adaptive processes. Whatever salience arises through action is not solely dictated externally or in advance but comes out of the interaction between brain, body, and environment.

In this chapter, I outline the ways in which life already implies a level of improvisation, starting from our most basic biological organisation. Living systems such as organisms and animals need to act in ways that maintain their physical form, in and against their environment. This feature of life is referred to as biological autonomy. To do this, creatures must also be able to adjust their behaviour in flexible and adaptive ways to maintain themselves in response to perturbations and environmental pressures. I want to suggest that our intentional improvisatory acts are rooted in these more general capacities. While I argue

that these adaptive capacities underpin our ability to engage in acts that we call improvisation, there is a danger of confusing these more basic acts with complex cultural or interpersonal activities like intentional music improvisation (Krueger & Salice, 2021). I will, therefore, refer to these basic adaptive capacities as a form of "proto-improvisation."

Autonomy, adaptivity, and sense-making

Living systems are never in a state of equilibrium. They are in a constant state of adaptivity, whether that be maintaining a steady stream of nutrients, avoiding dangers, or coordinating social interactions. A change in one's body or one's environment leads to a reconfiguration in how we interface with the world. This is a circular process that involves affecting the environment and being affected by the environment. Our worlds are not pregiven but formed in and by our own activity. It is a process of "laying down a path in walking" (Varela et al., 1993). This process of adaptivity and bringing forth salience is referred to as sense-making which is, from the enactive view, synonymous with cognition. This may include very simple forms of sense-making (seeking food, making adjustments) or complicated forms such as interaction and working together (referred to as participatory sense-making). Activities such as music improvisation are rooted in these primordial capacities for enaction.

A characterising trait of biological organisms is that they are able to actively realise and maintain their own identity and meaning, rather than their identity being imposed externally (Thompson, 2010). This ability to self-individuate is referred to as biological autonomy and is defined through its *operational closure*. Operational closure refers to how a living agent generates their own meaning and identity, defining themselves as a distinct entity within and in relation to an environment. In contrast, an operationally open system such as a computing machine requires an external agent (a human being), to bring them into existence and attribute meaning to them and their processing outputs—they are not meaningful in and

of themselves. That is, an operationally open system has their ontological footing outside of themselves. According to Varela (1979), operational closure expresses two aspects of a living system's organisation. Firstly, the organisation of the system constitutes a unity. By unity, he is referring to "that which is distinguishable from a background" (Maturana & Varela, 1980, p. 138). The network of processes demarcates a boundary between itself (the system) and its environment. Secondly, processes within the closed network are recursive in that they enable one another and are inter-dependent such that if you were to remove a process the whole system would collapse.

A paradigmatic case of biological autonomy is the cell whose autonomy (operational closure) is generated and maintained through a process of autopoiesis (literally self-making). The cell forms a semi-permeable boundary that sets itself apart from its environment but allows for interactions such as the penetration of nutrients. The history of interactions between a living system and its environment defines its structural coupling. The cell is thus operationally closed but thermodynamically open (Varela et al., 1993). The cell's ongoing generation and maintenance is not regulated by a central control system but instead occurs through a process of self-organisation. Self-organisation describes how macro or global patterns of behaviour emerge out of micro or local interactions (Thompson, 2010). This form of behaviour can be observed at many scales and in both living and non-living systems. A common example in living systems is the flocking behaviour of birds. The behaviour of the birds is not guided by a single conductor, but instead interactions such as avoiding collisions and staying close—as to avoid predators—leads to the emergence of a global behaviour (McGivern, 2014; Reynolds, 1987). For the autopoietic cell, the forming and maintenance of its boundary (global behaviour) is an outcome of interactions between the components of its network as it makes energy exchanges with the environment. The cell determines its identity by producing a boundary through its own metabolic processes. However, the metabolic

processes are themselves reliant on having that boundary. The inter-dependence of these recursive processes means that "should this process of self-production be interrupted, the cellular components no longer form a unity, gradually diffusing back into a molecular soup" (Thompson, 2010, p. 46). The organisation of the system is thus crucial to its continuance (Beer & Di Paolo, 2023). This suggests that living systems act under *precarious conditions.*

For a biological organism that is autonomous (operationally closed), self-making (autopoietic), and precarious, there are a set of possible states within which the organism can survive or not. This is referred to as the organism's domain or boundary of viability (Varela et al., 1993). Living systems are rarely striving for optimisation, and instead seek out the more realistic option of viability. This provides the organism with a much wider possibility of states in which it can survive.[1] In order to account for the organism's interactions with the world, beyond an oversimplified binary of life and death, the notion of adaptivity is required. Adaptivity describes the ability to monitor and regulate processes so as to avoid crossing the boundary of viability. It also provides us with a more nuanced view of the possible states within this boundary. Organisms are adaptive if they have the mechanisms to regulate their interactions with the environment. This allows for selective openness to things of benefit to its self-production and those that are of detriment to its operational closure (Di Paolo, 2005). This kind of behaviour suggests a form of intrinsic normativity related to self-maintenance or self-continuance. That is, aspects of the environment are evaluated as beneficial or detrimental to the health of the system.[2]

The term sense-making is a central concept to the enactive approach and refers to an organism's adaptive engagement with the environment. This behaviour occurs according to

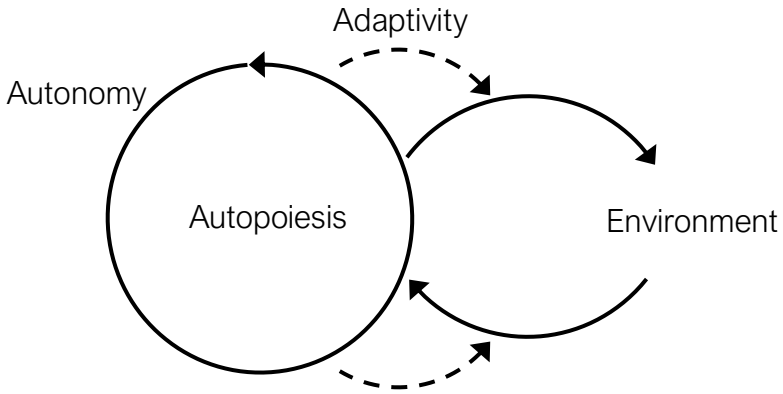
[1] The notion of a domain of viability may be a useful heuristic for describing the kinds of stability and instability improvising musicians may explore. As a musical event is not a "life or death situation", musicians have the opportunity to push these limits, exploring the boundaries of a viable performance.

[2] In the human form of life, we also act according to sociocultural norms, as well as the norms we develop through habitual behaviour.

the intrinsic norms that evaluate whether a situation is beneficial or detrimental to maintaining the process of autopoiesis and their identity (Di Paolo, 2005). The organism "brings forth or enacts its own identity and makes sense of the world from the perspective of that identity" (Thompson, 2010, p. 153).

Figure 3

Sense-making



Note. The sense-maker actively engages with its environment on the basis of maintaining its autonomy. Through adaptive interactions it shapes the environmental conditions which in turn feedback into the sense-maker's perception (Adapted from Froese and Di Paolo, 2011, p. 10 [CC 3.0]).

The emergence of a self through autopoiesis necessitates the co-emergence of a "domain of interactions proper to that self, an environment or *umwelt*" (Thompson, 2010, p. 158). Through sense-making, living organisms enact a world of salience and significance.[3] The concept of sense-making highlights how meaningful activity is not restricted to a classical subject-object dichotomy. Instead it "entails that meaning is not to be found in the external

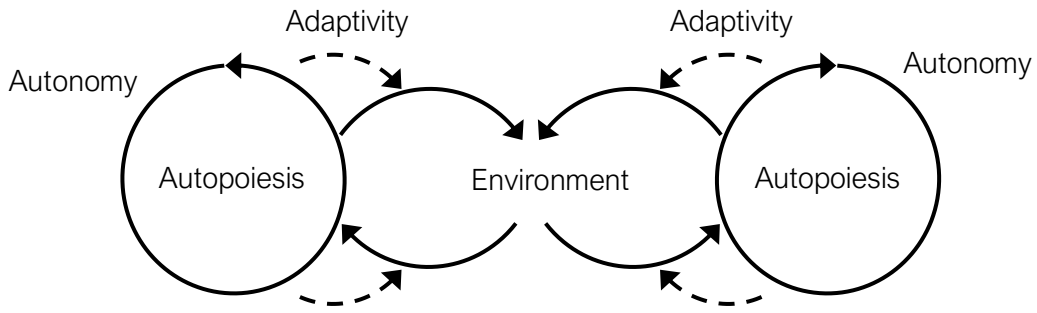
[3] Stapleton (2022) stresses that this is not to say that a cell experiences significance in a reflective way.

environment or in the internal dynamics of the system but is instead an aspect of the relational domain established between the two" (Froese & Di Paolo, 2011, p. 7). The notion of sense-making has also been expanded to include the sense-making activity of multiple agents within an environment. When multiple agents inhabit the same ecological space, they enable and constrain one another's action possibilities—shaping the kinds of interaction possibilities and thus the kind of meaning-making that can occur. This coordinated sense-making is referred to as *participatory sense-making* (De Jaegher & Di Paolo, 2007).

The multi-agent interactions that occur through participatory sense-making can form their own emergent autonomy. For example, the slime mould *Dycostelium discoideumare* is a single celled organism that feeds on bacteria. When food resources within the slime mould's environment become scarce, they can coordinate their interactions to the extent that they form a multi-cellular slug. This slug is capable of travelling further distances to find food before transforming into a fruiting body that spreads new spores. In this case, the individual cells coordinate their actions to form a new autonomous organisation (Froese & Di Paolo, 2011).

Figure 4

Participatory Sense-making



Note. A process of participatory sense-making: Two sense-making systems inhabiting a shared ecology. The two autopoietic systems mutually enable and constrain one another

through their shared sense-making activity (Adapted from Froese and Di Paolo, 2011, p. 11 [CC.3.0])

Figure 5

Reference to the Artefact 1

The trio recording provided a variety of opportunities to explore the ways improvisors coordinate their actions within their ecology to enact shared meaningful musical experiences. I wanted to explore the idea of participatory sense-making through an improvised small ensemble that drew on minimal or no pre-determined material. This was to emphasise the process of inhabiting a shared space. De Jaegher and Di Paolo (2007) write that there are different degrees of participation along a spectrum. On one end we see individual sense-making that is affected by the existence of other agents within the shared space. This may involve minimal levels of coordination. On the other end, "we find the sophisticated cases where we fully and directly participate in a joint process of sense-making and the whole sense-making activity becomes a shared one" (p. 497). In the trio recording we played with this idea of different degrees of participation (or joint coordination). For example, in *TENGU* the rhythm section was given the minimal instruction "fast underlying bits". I wanted to set for them a very basic idea so that the rest of the musical activity would be jointly enacted in-the-moment. For myself, I wanted to limit my participation in the sense-making activity. I played mostly prewritten phrases over the top of the coordinated activity of the rhythm section. We might put this on one end of the spectrum: my individual sense-making was modulated as we were playing in the same room, however, there was less joint coordination. On the other hand, a song like *Chăngdí* or *Vers Presque Rien* involved high degrees of participation, every member was sensitive to each other's actions and there was a collective intentionality toward producing a joint sound.

Proto-improvisation

Barandiaran et al. (2009) suggest that for a living system to be classed as a genuine agent it must satisfy three conditions: "(a) there is a system as a *distinguishable entity* that is different from its environment, (b) this system is *doing* something by itself in that environment, and (c) it does so according to a certain goal or *norm*" (p. 369). Point (a) has been observed as the

living system's autonomy (or operational closure) and point (c) its adaptivity. Point (b) highlights what enactivists refer to as interactional asymmetry. The concept of interactional asymmetry is crucial to an account of improvisation. It illustrates the way in which an organism acts on its own behalf, deploying its adaptive capacities to realise and maintain its well-being. This includes the regulation of the organism's own endogenous processes in relation to its coupling with the world, drawing upon the abilities it has developed to maintain a level of homeostasis. As agents we are the source of our own activity and "not always just a passive sufferer of external forces" (Di Paolo, Bhurman, et al., 2017, p. 116). I suggest that the appearance of agency—the ability to adaptively perform actions on one's own behalf—forms the basis of proto-improvisation.

The notion of proto-improvisation is exemplified by the chemotactic behaviour of E. coli bacterium within a sugar gradient. Although it does not have a nervous system, E. coli does have methods for perception and action. This is referred to as the two-component signal transduction (TCST) system (van Duijn et al., 2006). E. coli possesses an array of sensors that detect the presence of attractants and repellents within the environment. In a neutral environment absent of a chemical gradient, the "bacterial cell executes a three-dimensional random walk consisting of runs of swimming in a straight line punctuated by tumbles during which the cell briefly stops and randomly reorients before swimming off in a new, arbitrary direction" (Falke et al., 1997, p. 460). The E. coli's sensory system can monitor the concentration changes of attractants and repellents within a gradient over time. The chemosensory system sends signals to a collection of tail-like organs called flagella that form a kind of propeller. The flagella decrease the probability of tumbling to maintain its propulsion up the attractant gradient. If the attractant concentration decreases or a repellent is sensed, then a signal is sent to increase the frequency of tumbling. According to Falke et al. (1997), "[t]he net effect of this temporal sensing and regulation is to change the random walk

into a biased walk, in which the cell tends to migrate up an attractant gradient or down a repellent gradient as it swims" (p. 460). The E. coli also utilises a second adaptation system that acts as a basic form of memory.[4] This means that E coli can sense changes in its immediate environment and adapt its behaviours accordingly. It exhibits very basic characteristics of selection and adaption that emerges from the interaction between biological and environmental constraints.

While the motile bacterium may not experience the world in a goal oriented and reflective way, it does "embody a rudimentary form of corporeal or proprioceptive consciousness" (Thompson, 2010, p. 161). Likewise, van Duijn et al. (2006) has suggested that this behaviour may indicate a form of "minimal cognition". Enactivists have similarly used the behaviour of an E. coli bacterium as a paradigmatic example of sense-making. When describing, for example, the behaviour of the bacteria within a sugar gradient, relational terms such as attractants and repellents are used. The status of the sugar as an attractant is relational to the bacteria's metabolism and its continuance. This highlights how, even for a prokaryotic cell, one's adaptive interactions with the world (their sense-making activities) transform one's environment into a world of salience (Thompson & Stapleton, 2009).

Chapter Conclusion: Scaling up from basic life to musical improvisation

The insights outlined above begin to highlight the continuity between mind and life, where cognition is continuous with the adaptive processes involved in maintaining a living agent's biological autonomy—or its "self"—within a precarious and contingent environment. This perspective allows us to consider the origins of musical improvisation in terms of more basic

[4] A process of methylation occurs in response to attractants and repellents but over longer timescales. While "[t]he occupancy of the binding site reflects current conditions, whereas the level of methylation reflects past conditions. The cell is able to respond to changes in the ambient concentration by comparing these two indicators" (Berg, 2000, p. 28).

forms of sense-making. This does not necessarily mean that we should equate the activity of a biological cell with an improvising musician. However, these more sophisticated social and technological activities have a primordial grounding in the principles of autonomy, adaptivity, and sense-making. I wrote that a bacterium enacts meaning through its proto-improvisational activity within an attractant gradient. For the bacterium, the sugar gradient has significance in relation to its survival (maintaining its autonomy). Whilst musical improvisation is not concerned with life and death as such—as with the bacterium's relationship to the attractant—they engage in adaptive and meaningful ways of maintaining their relationships with and within the musical environment. Along these lines Høffding and Schiavio (2021) note:

> More complex animals, like expert musicians, are also invested in exploring and producing a satisfying and meaningful musical performance. Here, the "gradient" is not sugar [attractant] but, for instance, experiences of musical absorption or aesthetic satisfaction as well as novel form of interaction. (p. 814)

Fig. 6 provides a rough depiction of the progression and relationship between structural aspects of a living system (left) and the behavioural/cognitive domain or outcome (right). The left column illustrates the increasing forms of sophisticated autonomy and, the right, the increasing mediacy, that is, our detachment from purely metabolic forms of normativity. This list is cumulative, the next step relying on the previous. For example, the intrinsic teleology or purpose to maintain one's "self" is an outcome of the generation of a self through autopoiesis, and the process of sense-making relies on both autonomy and adaptivity. I should note that proto-music and music is not a final product of evolution but developed and evolved with humans through the introduction of more sophisticated forms of action, such as, the ability to entrain and act socially. This evolutionary development is also entangled within cultural developments (See der Schyff, 2013; Tomlinson, 2015; van der Schyff & Schiavio, 2017).

In musical improvisation we utilise these primordial adaptive capacities to enact musical experiences. While the proto-improvisational cell is bound by these capacities, within the human form of life and in an artistic context, we can play with them, pushing them into new configurations. Artists—especially in forms such as impressionism—make use of our perceptual capacities to generate visceral aesthetic experiences.

Figure 6

Mind in Life Continuity

Cumulatively Increasing sophistication ↓

Biological Structure		Cognitive Capacity	
Autonomy	The system's operational closure and self-making (autopoiesis) forms an identity or self.	Intrinsic Teleology	Purposiveness toward maintaining its "self".
Adaptivity	The re-organisation of an organism's endogenous processes to maintain its autonomy.	Sense-making	The world is made sense of through the organism's adaptive activity. This activity enacts a world that is significant to the organism.
Interactional Asymmetry	The source of activity in the regulation of sensorimotor interactions with the environment.	Agency	An organism can act on their own behalf.
Mentality	Behaviour is, additionally, regulated by norms outside of metabolic requirements. The introduction of the nervous system allows for larger range of action selection.	Cognition/Behaviour	Non-metabolic normativity leads to the formation of more sophisticated forms of behaviour seen, for example, in the human form of life.
Sociality	Behaviour is regulated by norms outside of the self, such as social interactions.	Social cognition/behaviour	The development of social interaction, entrainment, and coordination augment our behavioural possibilities. We develop the ability to play with adaptive capacities.
Culture	Culture, biology, and evolution, form interacting and co-determining epicycles. This leads to the development of complex tool use as well as cultural activities like music, art, and dance. Art and creative behaviour use, juxtapose, and play with adaptive biological behaviours and cognitive capacities.		

Note. Not meant to be understood as linear.

The concept of proto-improvisation introduced in this chapter reflects the basic adaptive and sense-making capacities we bring to all interactions. I believe this concept also helps us to address some issues with the scope of what we mean by improvisation. Many authors have different notions of what improvisation entails. Ryle (1976), for example, is broad with his definition, encompassing nearly all facets of human activity. Other authors such as Krueger and Salice (2021) see every-day and music improvisation as distinct phenomena—music improvisation being an intentionally decided on activity, as opposed to an adaptive response to a perturbation. Moreover, there is also a phenomenological difference between adapting to a situation and intentionally deciding to improvise. With this in mind, I suggest that we view improvisation along a continuum of activities from basic adaptivity or proto-improvisation to more consciously decided upon musical improvisation. This may provide a useful way of dealing with these challenges of scope and phenomenology. In the next chapter I look beyond the biological cell to the behavioural domain of the sensorimotor body. I explore how the forming of habits and sensorimotor schemes structure our improvised behaviour, affording a kind of agency that is, unlike the bacterium, semi-decoupled from metabolic processes. It is from this point that we begin to see the ability to play with our adaptive capacities, in ways that are no longer directly connected to our survival.

Chapter Three: Habits and Sensorimotor Agency

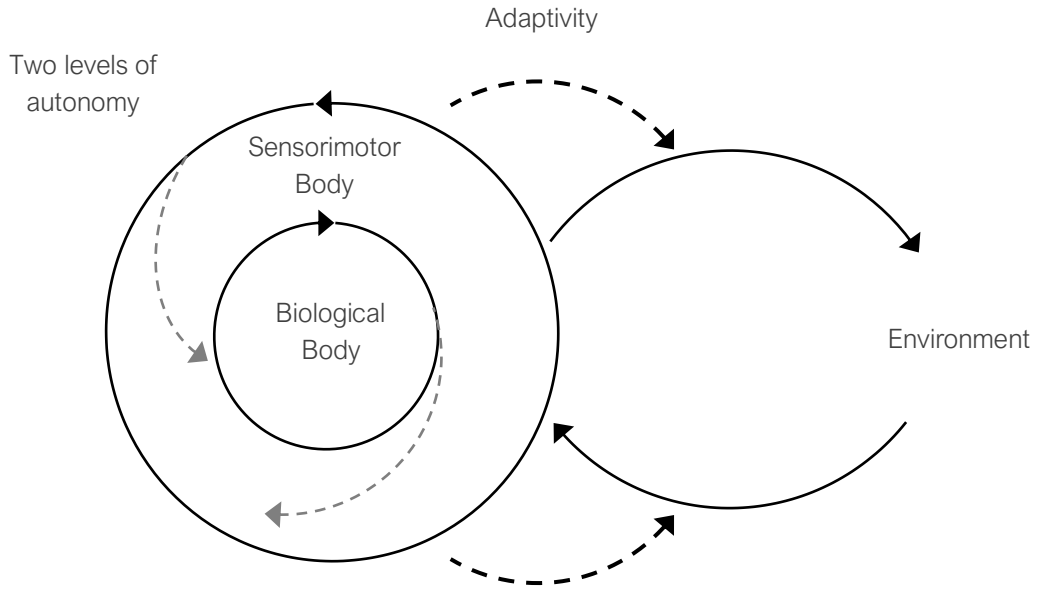
Even a basic organism like a bacterium exhibits a kind of proto-improvisation through its adaptive behaviour as it generates and maintains its identity within an environment. However, clearly improvisation in the human form of life involves more than adaptively generating and maintaining oneself. With the introduction of additional biological mechanisms such as the nervous system, we see more complex modes of action selection.[5] The nervous system in animals and humans connects the sensory and motor processes, establishing a sensorimotor self and sensorimotor world (Thompson, 2010, p. 59) (See fig. 7). This is an important point of transition from our discussion in the previous chapter. The idea of a sensorimotor self is necessary if want to move our discussion beyond unicellular organisms to improvising musicians. While the E. coli bacterium is a useful example of basic adaptivity, its behaviour is driven by survival. The sensorimotor body, however, forms its own operational closure that affords a kind of agency that is "enabled and constrained, but ultimately underdetermined, by biology" (p. 142). The value of actions in sensorimotor agents (animals and people) can exist on top of viability, and even be in tension with it (p. 143). This opens us up to a wider range of action possibilities. di Paolo, Buhrmann, et al. (2017) write that:

> [A]t some point we may speak of a sensorimotor subject, whose richer world of interactions opens up an equally richer domain of new sources of normativity. A sensorimotor subject's activities become meaningful not only in virtue of their contribution to biological survival, but also in virtue of their contribution to the stability and coherence of a sensorimotor repertoire. (di Paolo, Buhrmann, et al., 2017, p. 39)

[5] Some researchers state that we should not think of the introduction of the nervous system as an ontological step in cognition but rather the augmentation of abilities already present in unicellular organisms like the E. coli bacteria (van Duijn, 2006).

Figure 7

Sensorimotor Body



Note. The living system coupled to its environment. Like fig. 3 but now with the addition of a sensorimotor body, forming an its own autonomy that is enabled and constrained by the biological body.

Along with this sensorimotor repertoire, we also see the ability to build skills and habits. In this chapter, I aim to examine the nature of habits and their role in improvisation. I firstly look to a phenomenological perspective, suggesting that we form habits through the sedimentation of our improvised experiences. Likewise, these sedimentations (habits) structure our improvised behaviour. I then turn to enactive cognitive science which views habits and improvisation in terms of sensorimotor schemes that form behavioural networks. To conclude, I briefly detail the improvisor's experience of having agency—that is, their *sense of agency*. As I wrote at the end of the previous chapter, improvisors play with their adaptive capacities to explore novel patterns of behaviour. We can see this in the way that improvisors will, at times, relinquish their sense of agency eliciting adaptive responses. I use

discussions of Torban Snekkestad's practice as an example of this. I examine how he uses instability in musician-instrument and ensemble interactions to generate interesting musical material (See Høffding & Snekkestad, 2021; Ravn & Høffding, 2021).

Phenomenological view of habits

As much as an improvisor is acting in-the-moment, they do not enact their improvisations ex nihilo, but instead bring reworkings of past materials (Benson, 2003; Crossley, 2021) as well as a rich assortment of skills, habits, and practices. Sense-making activities (such as improvisation) depend upon a history of structural coupling between the improvisor and their social and material environment. Our development also occurs through an engagement with objects (such as tools or instruments) and is informed by the history of these tools and socio-material environments. As we navigate our world, we construct meaningful patterns of behaviour that become sedimented, forming our skills and habits. These habits both structure our experience and shape our musical identities. Our habitual predispositions towards certain musical actions are part of the process of self-individuation[6] and make our practice coherent and recognisable to listeners. The improvisor uses habits to achieve goals and aesthetic outcomes, yet there is a complex circularity as goals and aesthetic outcomes in turn shape the development of habits. Habits, musical aesthetics, and goals are inseparable.[7]

As simpler lifeforms such as a biological cell adapt to situations, they find recurrent patterns of behaviour that work toward maintaining their autonomy. However, if those patterns become too rigid, they can also become dangerous—they need to be flexible and open to change. For more complex animals, recurrent behavioural patterns take the form of habits. In his discussion on improvisation and enactivism, Gallagher (2023) illustrates that

[6] The concept of self-individuation was introduced in Chapter 2.

[7] The improvising reader may note this when thinking about their own habits and aesthetic goals.

habits are not rigid automatisms but "an open and adaptive way in which an autonomous agent learns to cope with familiar or unfamiliar situations" (p. 6). Rather than being recurrent automatic responses, habits predispose us towards certain actions and make us sensitive to certain environmental stimuli (and adverse to others) (Dewey, 1922). This view recognises how habits can be deployed within a wide variety of dynamic contexts. One also has the agency to resist and break habits in improvisational settings. Gallagher (2023) writes that the "breaking of habit (declining the usual affordances), which happens in the immediacy of performance, comes without a prediction of what happens next, except the most general prediction or experienced anticipation that something will happen" (p. 6). Merleau-Ponty was also critical of the view that habits are the rigid automatisms or reflexes that seem to oppose creativity and innovation. He instead introduces an important perspective on habits that is open, flexible, and situated.[8] This perspective is more in line with the adaptive and flexible nature of improvisation.

However, before looking further into Merleau-Ponty's perspective on habit, it is crucial that we first unpack his unique perspective on the body. Merleau-Ponty often distinguishes between the objective body and the phenomenal body.[9] The former refers to the objective physiological qualities of the body, that is, the body as an "object among objects" while the latter refers to our first-person point of view of the world through our body, the living body that is the centre of our life world (Merleau-Ponty, 2013). Moreover, this body senses the world not as a collection of individual parts, "but rather the global awareness of my posture in the inter-sensory world, a "form" in Gestalt psychology's sense of the word" (Merleau-Ponty, 2013, p. 102). We have an innate sense of our body's relation to itself and to the world. Merleau-Ponty (2013) writes:

[8] See also Dewey's work on habits and Bourdieu's work on Habitus.

[9] This distinction is also found in the German Körper and Leib.

> [M]y entire body is not for me an assemblage of organs juxta-posed in space. I hold my body as an indivisible possession and I know the position of each of my limbs through a body schema that envelops them all. (pp. 100-101)

Merleau-Ponty's notion of body schema makes explicit the embeddedness of the body in an environment[10], "the body schema is, in the end, a manner of expressing that my body is in and toward the world." (p. 103). Gallagher (2005) summarises the concept of the body schema as:

> [A] system of sensory-motor processes that constantly regulate posture and movement—processes that function without reflective awareness or the necessity of perceptual monitoring. Body schemas can also be thought of as a collection of sensory-motor interactions that individually define a specific movement or posture, including elementary (relatively defined) movements, such as the rotation of a wrist within a larger movement or the movement of hand to mouth. (p. 38)

The body schema is open to the sensory information of the environment and the various possibilities for bodily interaction—we perceive in terms of what we can do. Over time, our experiences become sedimented, we form habits that reconfigure our body schema and this sedimentation then structures the way in which the world solicits the body schema. However, Merleau-Ponty (2013) warns us that sedimentation is not some passive representation filed away in our consciousness but something that remains strongly linked to our activities:

> For me, my apartment is not a series of strongly connected images. It only remains around me as my familiar domain if I still hold "in my hands" or "in my legs" its principal distances and directions, and only if a multitude of intentional threads run out toward it from my body. (pp. 131-132)

So, for Merleau-Ponty the structure of the world is presented to us through our active engagement with it. This active engagement is neither completely open and spontaneous nor

[10] The environment as it relates to the body is sometimes referred to as an umwelt or milieu. Organisms may inhabit the same geographical locations but different environments.

rigidly habitual, but a unification of both: “The structure “world,” with its double moment of sedimentation and spontaneity, is at the center of consciousness” (Merleau-Ponty, 2013, p. 132). This point is pertinent to the notion of improvisation as an agent’s skilled engagement with the world. Habitual behaviour is not a concept that conflicts with improvisation but is an inherent aspect of it. Activities may be more habitual or more spontaneous, but will always contain some element of both, they are interwoven. Bourdieu (1990)—whose work on habitus relates closely with the notion of habit I have so far discussed—writes:

> even when the agents' dispositions are as perfectly harmonized as possible and when the sequence of actions and reactions seems entirely predictable from outside, uncertainty remains as to the outcome of the interaction until the whole sequence is completed. The most ordinary and even the seemingly most routine exchanges of ordinary life, like the 'little gifts' that 'bind friendship', presuppose an improvisation, and therefore a constant uncertainty, which, as we say, make all their charm, and hence all their social efficacy. (pp. 98-99)

Another point to recognise is that much in the way that our habitual body structures our improvised actions, our improvised actions contribute to the process of sedimentation. Moreover, the engagement of an improvisor’s body schema with their environment forms a kind of sense-making activity, and meaning and significance is an emergent property of this interaction. The sedimentation of the improvisor’s spontaneous sense-making activities over time shape and provide opportunities for new ways of sense-making as well as the development of new habits (Crossley, 2001).

An enactive view of habits and sensorimotor schemes

The enactive approach has been highly influenced by Merleau-Ponty’s phenomenology. The enactive notion of habits similarly focuses on the action capabilities of the body and the sedimentation of experience but attempts to formalise these ideas from the perspective of embodied cognitive science. For the enactive approach, the concept of habits and

sensorimotor schemes are central to building a theory of behaviour based around the sensorimotor body, and processes beyond basic metabolic needs.

According to Di Paolo, Bhurman, et al. (2017), sensorimotor schemes are "reusable, interlocking, organized sets of coordination patterns between body and environment." (p. 81). They are deployed in order to carry out a task and relate to some kind of normative framework (Segundo-Ortin, 2020, p. 7). For enactivists, habits are "self-sustaining precarious sensorimotor schemes" (Di Paolo, Bhurman, et al., 2017, p. 144). They are precarious since these schemes are only self-sustaining if they are continually enacted. These schemes (habits) will otherwise dissolve. Habits—when enacted at sufficient frequency and duration—predispose the agent towards further repetitions. This relates to discussions earlier in this chapter on habits as the sedimentation of experience. Although I have argued that habits can be adaptive and open, in our everyday experience we understand that habits can, at times, be inflexible and hard to break from. Through repetition over extended periods, habits may dissolve at a slower rate but also lose their situation sensitivity and ability to switch between actions with ease.[11] Di Paolo, Bhurman, et al. (2017) describes this as the hardening of habits.

Habits and schemes are rarely enacted in isolation but instead are often bundled together forming a highly interconnected network. The communication within the network of schemes and habits means that development of habits through continual enactment also contributes to other interconnected habits. While the hardening of habits may reduce precariousness (leading to loss of sensitivity, adaptivity, metastability), the interdependence of schemes makes them more metastable and adaptive.

[11] In dynamical terms this is referred to as metastability. A metastable state is one that can change states easily, it is poised. Metastability is a crucial aspect of spontaneous adaptive behaviour.

Figure 8

Reference to the Artefact 2

Sensorimotor schemes have two sides, the support structures from the body and the support structures from the environment. For a drummer, their sensorimotor schemes and habits have been developed in relation to the spatiality of the drumkit. In the song *Châng dí,* Dylan interestingly spread several singing bowls across the room. This kind of unconventional set up disrupts the schemes and especially habits that have been developed, urging a reorganisation of the network. This may be a useful exercise for improvisors reading this. How can we disrupt or reconfigure the ways in which we interface with the world? It can be as simple as how you spatially organise yourself in relation to the instrument.

The communication between habits and sensorimotor schemes is illustrated through behavioural genres. Schemes are enacted and evaluated (normatively) in relation to one another. For example, the trumpeter grasps the trumpet appropriately, one hand holding the valve casing and the other placing three fingers on the corresponding valves; they then bring the trumpet toward their lips already beginning to form the embouchure; the embouchure is adjusted slightly as the mouthpiece is placed on the lips; they take a breath making sure to inhale enough; the tip of the tongue is placed behind the teeth producing positive pressure; the appropriate valves are depressed; the tongue is released and a note is produced. These interrelated schemes make up a micro-network that facilitates producing a tone on the trumpet. Di Paolo, Bhurman, et al. (2017) illustrate that this activity is not a strict rule-based program. However, some actions must take place in a certain order for the subsequent actions to succeed. Furthermore, there are preferable orders for the sequence to organise toward. Again, the enacting of these sequences is normative in that they're evaluated as better or worse in relation to one another. If there is a breakdown somewhere in the sequence some kind of adjustment is required. If a musician's hand is clasping the trumpet tightly your actions may be biased away from playing a fast flourish of semi quavers. Or perhaps if the

trumpeter's facial muscles become fatigued, the network of sensorimotor schemes will be then biased towards enacting patterns of behaviour according to the breakdown in that step in the sequence. The types of schemes that makeup the network may or may not operate in one order. There may be an order they tend to fall into, often in response to different environmental conditions. The network of schemes illustrates the variability and adaptability of (habitual) behaviour that has so far been discussed. Moreover, we begin to see forms of normativity that are semi-decoupled from the intrinsic norm of metabolic self-maintenance. These norms relate, for example, to the coherence of our sensorimotor activity—x was clumsy and so makes it difficult to enact y—or aesthetic norms—how do these actions relate to my aesthetic goals and preferences. Most often these functional and aesthetic norms are closely intertwined.

The network of schemes forms a complex dynamic system, where the global behaviour of the system emerges out of local interactions between its parts. Because of the nature of complex systems, the development of and communication between schemes can emerge non-linearly. By non-linear, I mean that causality within the system does not occur in one direction or with a one-to-one mapping (Chemero, 2009). The behaviour of the system is dependent on its organisation and parameters (in this case, the situation or environment). Changes in one part of the system ripple throughout the network and can result in quasi unpredictable outcomes. An interesting example of this is playing trumpet left-handed. On some occasions I will switch hands when practicing trumpet. I am often surprised by how much I can play even though I haven't spent much time with that hand. Although the skill level is far lower than my dominant hand, having some degree of dexterity in my left hand may demonstrate the way that the development of skill is a distributed process across the network of schemes. Referring back to Merleau-Ponty (2013), my left hand is not an "object among objects" but part of an "indivisible possession", the network of schemes that form the

lived body. Di Paolo, Bhurman, et al. (2017) suggests that "we should aim at a concept of sensorimotor agency not so much based on an aggregation of individually self-sustaining habits, but on a network of "mutually interweaving" schemes" (p. 148).

Sense of agency

So far, we have found that our engagement with the world sediments, forming sensorimotor schemes and over time, habits. The notion of the lived body—which is made up of these habits and schemes—provides a perspective closer to improvisation in the human form of life, compared to the proto-improvisational behaviour of a biological cell. Our sensorimotor body (a network of habits and schemes) affords us a form of agency that—although constrained and enabled by it—is mostly decoupled from metabolic processes.

Before concluding this chapter, I would like to briefly address the experience of this agency. That is, the awareness that our actions are our own and that we are in control. This phenomenological aspect of agency is referred to as our *sense of agency*. Di Paolo, Bhurman, et al. (2017) write that even when we fall into highly habitual non-conscious patterns of behaviour like opening a door or tying our shoes we have an innate sense that we are controlling our actions (pp. 183-184). Moreover, Gallagher and Zahavi (2020) write that our sense of agency "may involve a thin, pre-reflective awareness of what I am doing, or it may involve a more explicit consciousness filled with well-developed reasons" (p. 183).[12] The sensorimotor account discussed in this chapter illustrates a coordination between the agent and the external environment. When enacting a scheme, for example playing a phrase on the trumpet, the scheme must be supported by both my body and by the environment. If this coordination is successful and without obstacles there is an innate sense of being in control.

[12] This distinction possibly aligns with the phenomenological difference between proto-improvisation (adaptivity) and explicit musical improvisation.

This experience is "phenomenologically recessive", it fades into the background of our consciousness (Di Paolo, Bhurman, et al., 2017, p. 203). In contrast, if an obstacle or perturbation challenges the fluency of this sensorimotor coordination, we may experience that we are exerting control or even losing control. In these situations, we become, phenomenologically, highly aware of our sense of agency. Our sense of agency (being in control) relates closely to our capacity to adapt to situations (or improvise). The perturbation causes the sensorimotor system to reconfigure until control is regained. In everyday situations, we generally consider perturbations to our stability as negative. Yet, many musical improvisors play with the concept of stability, perturbation, and relinquishing control—using perturbations to elicit adaptive, creative, and novel responses. In Høffding and Snekkestad (2021) and Ravn and Høffding (2021), saxophonist Snekkestad states that he explores the oscillating of agency and stability by utilising techniques such as multi-phonics that can be unstable and unpredictable. They provide a feeling that the instrument has its own agency. The unpredictability of these techniques means that Snekkestad maintains a metastable state, that is he is poised. Behaviours from the instrument that were not anticipated require a reconfiguration of the body or even the arc of the improvisation. This can lead to creative outcomes that may not have otherwise appeared. He also describes the experience of playing with certain musicians who intentionally "pull the rug out". This refers to instances where musicians may deliberately destabilise a situation, eliciting adaptive responses.

Figure 9

Reference to the Artefact 3

In *Vers Presque Rein* I was influenced by this idea of "letting go of control" to a certain extent by navigating the sub harmonics of the trumpet. I play very softly and explore how certain multi-phonics as well as different non pitched sounds such as breath noise emerge. I am still technically working out how

to control these sounds and so the unpredictability challenges me to respond in different ways. There is a point where a kind of squealing sound began that I did not expect, however I ended up leaning into this.

Chapter Conclusion

In this chapter, I firstly highlighted a conceptual transition necessary to move beyond purely adaptive behaviour related to metabolism and survival. With the introduction of more mechanisms for action and perception such as the nervous system, we see the emergence of a sensorimotor body. This affords a kind of agency that is still rooted in our biology, but not fully determined by it. From the perspective of the sensorimotor self, I then discussed the notion of habits from Merleau-Pontian phenomenology and enactive cognitive science. Some key takeaways were that habits are not rigid and automatic, but flexible and context sensitive. Habits structure our improvised behaviour and vice versa: improvising is necessary for the development of habits. The enactive perspective highlighted how habits and sensorimotor schemes form interconnected self-organising networks. This may provide a useful model for discussing the interconnection of actions, from small scales like forming an embouchure to larger scales such as performing a set of music. Lastly, I detailed the experience of being a sensorimotor agent, looking at the ways improvisors relinquish control and stability to elicit novel patterns of behaviour.

In the next chapter, I apply the themes of embodied adaptive behaviour discussed so far within the context of a musical practice, namely improvised trumpet playing. I explore the relationship between improvisor, instrument, and environment through the lens of ecological psychology and dynamical systems theory, viewing the improvisor as an adaptive self-organising system acting within a set of constraints. Moreover, I view perception in terms of affordances.

Chapter Four: The Ecological Dynamics of Trumpet Improvisation

As we have seen, improvisation is a term that can be difficult to define. So far, I have focused on our basic adaptive capacities and the nature of habits. In this chapter I shift my focus to exploring the dynamics of an instrument, specifically in regard to improvised trumpet playing. Commonly improvisation refers to a form of unscripted activity, where an agent is able to come up with patterns of behaviour in the moment. For example, improvising musicians are able to produce complex melodic, rhythmic, and textural material in the moment, while simultaneously responding adaptively to situations. Two well-known models of musical improvisation are provided by Pressing (1988) and Johnson-Laird (2002). The former is a reductionist view that improvisation involves learned event clusters that are ordered through *associative* or *interrupt generation*. The latter, in contrast, suggests that improvisers learn and apply different rules or algorithms. Norgaard (2011) proposes a combination where improvisation is, at different times and depending on the situation, one or the other. What these models have in common is their emphasis on pitch or melodic generation and their commitment to in-the-head processing theories of cognition. As an alternative, this chapter takes a broader view of improvisation, one that is continuous with the kinds of skilful and embodied engagement intrinsic to everyday life. When we perform intentional or goal-related activities, the environments we move through are not static, nor are they necessarily accommodating. A broader sense of improvisation describes our sensitivity to features of the dynamic and ever-changing environments we inhabit, and the adaptive behaviours we develop to skilfully cope with environmental pressures (Krueger & Salice, 2021). Improvisation involves ongoing interactions between the body, environment, technologies, and social norms—it is a multidimensional skilled activity that is an inherent

part of our lives. To capture the dynamic relationship between body and environment in improvisation, I utilise principles from ecological psychology and dynamical systems theory—approaches well acquainted with the idea of fluid skilled action.

The first section of this chapter will introduce the ecological approach and the concept of *affordances* or possibilities for action. The ecological approach considers perception in terms of how one can interact with their environment, thus usefully establishing a framework that acknowledges the reciprocal relationship between an agent (in this case improviser), object (instrument), and environment. In the second section, I discuss the dynamic relationship between trumpet and trumpeter, examining how the improviser engages with available affordances to navigate musical situations. This enquiry into the musician–instrument–environment relationship is framed by theoretical work from the cognitive sciences, literature surrounding brass playing, and my personal insight as a professional improviser and trumpet player. I have also attempted to present my discussions of trumpet playing in a way that is intuitive and accessible to non-trumpet players. Continuing this dynamical perspective, the third section considers the improviser as an adaptive self-organising system under a set of control parameters or *constraints*. In the final section I briefly look at how the addition of other Es (embodied, embedded, enactive, and extended) may develop this approach going forward.

Affordances in improvisation

The term affordance was used, most notably, by James Gibson (1979) in The Ecological Approach to Visual Perception. Affordances play a pivotal role in the shift away from dominant cognitive theories that focus on in-the-head processing, instead placing emphasis on the direct role played by the environment. Gibson believed that the world contained structured meaningful information that could be directly perceived by the observer. This

theory extends upon Gestalt psychology's notion of valences – that the value of objects in the environment is immediately apparent and so can invite interaction of various kinds. Gibson states that "The post box invites the mailing of a letter, the handle wants to be grasped, and things tell us what to do with them" (p. 130). When the observer directly perceives the environment, they perceive the kinds of action and interaction possibilities *afforded* to them. Gibson writes "Affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill" (p. 119). Affordances also exhibit a bidirectionality. That is, they are not subjective or objective but instead an emergent property of the two. Gibson is quite explicit about this:

> An affordance is neither an objective property nor a subjective property; or it is both if you like. An affordance cuts across the dichotomy of subjective-objective and helps us to understand its inadequacy. It is equally a fact of the environment and a fact of behavior. It is both physical and psychical, yet neither. An affordance points both ways, to the environment and to the observer. (p. 129)

Affordances are out there in the environment, but they are not abstract qualities. They are the world perceived in relation to aspects of the agent, such as their physiology and abilities. This has been an important insight into the field of skill development, particularly in sports. Chow et al. (2016) suggests that:

> [A]ffordances are available in every performance environment to be used to regulate behaviours. Affordances should not be considered as entities that are perceived but rather as functional relationships formed between an individual performer and a performance environment. This definition emphasises the functional, rather than structural, properties of a performance environment (i.e. what an object, surface or another individual offers an athlete in terms of opportunities for actions). (p. 30)

What we might gather from this is that affordances denote the interactive aspects of the environment: we perceive in terms of what we can do. With this in mind, what are the affordances available to an improvising musician? Firstly, the instrument itself affords

several action possibilities. On a trumpet, the mouthpiece placed into the lead pipe affords a tone to an agent with the ability to form an embouchure. Notice that the tone is not intrinsic to just the trumpet or the trumpet player but is an emergent relationship between the two.

The instrument provides a landscape of affordances, and the types of affordances available solicit certain kinds of interactions (due to the relation between the structure of the trumpet and the trumpeter's physiology) (Rietveld & Kiverstein, 2014). According to Rietveld et al. (2018), solicitations are "the affordances that show up as relevant to a situated individual, and generate bodily states of action readiness" (p. 11). Furthermore, we skilfully engage with multiple relevant affordances simultaneously. For an improvisor, this may be in respect to not only the physical relationship between body and instrument but also the improvisor's creative goals, aesthetic preferences, and performance situation. While an object or situation may afford a multitude of action possibilities, an improvisor is "drawn to affordances that they care about and are able to act on" (p. 12). That is, the affordances relevant to performing the appropriate actions will have a greater inviting character. "These solicitations "stand out" as relevant (against the background of other affordances in the situation)" (p. 15). A musician performing a composed work will be drawn to affordances related to successfully performing that work. However, an improvisor with more open-ended performance goals may experience a different set of solicitations. For example, many improvisors are highly sensitive to the soliciting affordances provided by the unique construction of various instruments. This is sometimes referred to as instrumental idiomaticity (De Souza, 2017; Huron & Berec, 2009). That is, the relationship between the structure of the instrument and the structure of the body encourages certain kinds of interactions. Instruments with a regular spacing of intervals and frets that are consistent semitones (like the guitar) can solicit or encourage the use of chromaticism. The guitarist can maintain the same hand shapes and simply move side to side or up and down. Changing the

tuning to irregular intervals (like an open D tuning) instead makes it desirable to perform diatonically within the key of D. A guitarist could play chromatically in an open D tuning if the task specifically prescribed it, however, it is important to note the difference between what is specifically prescribed and what actions the instrument invites. Historically these idiomatic features have, over time, shaped the developments in musical genres and playing styles (De Souza, 2017; Rockwell, 2009). In later sections I will look at idiosyncratic features of the trumpet such as the mouthpiece, partial series, and valves. These properties afford and invite interactions and ways of improvising distinct from other instruments such as the guitar.

Although certain affordances will stand out to improvisors, they need not always respond to these solicitations. At times improvisors will engage with affordances for functional reasons, and sometimes for aesthetic or creative ones—and these affordances may be less obvious choices or even hidden. For many musicians, the preparatory phases of their practice are often spent exploring and discovering these less obvious or hidden affordances to innovate novel forms of timbre, expression, rhythm, and melody. For example, a trumpet player can manipulate the embouchure to activate the trumpet in such a way that it produces either multiple clear tones or adds a type of distortion to the sound. This is commonly referred to as a split-tone.[13] Producing a split-tone deviates quite dramatically from conventional trumpet playing and can be unintuitive and difficult to perform consistently. Improvisors developing this technique must spend considerable time searching for and learning to access these "split-tone" affordances.

[13] An alternative but similar effect is the multiphonic which is produced by singing and playing the trumpet simultaneously.

Perceiving affordances

The ecological approach suggests that the way we perceive and interact with affordances is shaped by intention, attention, and calibration (Jacobs & Michaels, 2007). These perceptual systems act to direct and differentiate the information in the environment being perceived by the observer. As previously mentioned, an object may afford a number of possible interactions, but what is of importance to the observer is the affordances relevant to performance tasks. One's *intention* sets the goal or task needed to be completed indicating what the affordances should be relevant to. For example, the types of trumpet affordances perceived differ greatly depending on if I intend to play the trumpet or clean it. Similarly, affordances may differ depending on if the performance involves free improvisation, chord changes, genre-specific improvisational language, or a composed work. Moreover, I may intend to fit neatly within these contexts, or I may want to go against them, enacting new worlds of salience. *Attention* refers to our sensitivity to relevant and beneficial affordances. Our capacity to skilfully interact with the world relies on the ability to perceive affordances that help us complete our intended tasks. However, over time our attention to relevant affordances and our bodily dimensions and action capacities develop and change. A constant process of *calibration* is required to maintain tight integration between perception and action (Araujo et al., 2009). For example, while a trumpet remains relatively unchanging the trumpeter can feel very different day to day. Things you could play one day may not come so easily the next. Often, a warmup involves a process of calibrating the affordances perceived with the abilities of the body on that day. A final point on the perception of affordances is that while affordances provide perceptual information that shapes behaviour, behaviour (as the agent moves through the environment) changes the array of available affordances (di Paolo, Buhrmann, et al., 2017). This dynamical view of affordances is also introduced by

Chemero (2009) as affordances 2.0. He suggests that affordances "causally interact in real time and are causally dependent on one another" (p. 151).

To summarise, an expert improvisor is attuned (through a history of interactions with the environment) to affordances relevant to their task domain. They can also adapt these affordances to suit the contingencies of a given situation. The affordances significant to engaging with the trumpet within an improvised environment stand out to the improvisor. And the instrument becomes an integral part of the domain of musical meaning-making, which includes musician, instrument, and environment (the social, acoustic, and material space) as an extended evolving system. The trumpeter's attention is on functional ways of engaging with trumpet affordances, and as the agent–environment relationship is continually changing, they are constantly calibrating and adapting to maintain or enact new musical relationships.

Sociocultural environments

In more recent years the role of affordances has been extended further to account for not only our physical environments but the complex sociocultural environments and practices we are embedded in. The complexity of the human way of life reveals a further layer to the previous definitions, adding a socio-normative aspect to the perception of and interaction with affordances. Not only to we act in response to physical features of the environment, we must also engage with and act appropriately within certain social norms (Rietveld, 2008; Rietveld & Kiverstein, 2014). McLean (2018) illustrates this in his development of a solo drum set practice. Although his practice is largely focused on exploring patterns of behaviour based on his sensorimotor interactions with the drumkit, he also situates his research within a community of musicians referred to as Antripodean improvisors. He outlines the community's antecedents and current members as well as his relationship with them and their

influence on his music practice and research. This community is a small group of improvising musicians within Australia that are defined under a variety of criteria. Although he does not explicitly use the term affordance, by specifying the environments his embodied practice is embedded within, Mclean demonstrates the interwoven physical and social nature of his aesthetic selection and development process. His patterns of behaviour are not only afforded to him by the drum set but by the social community he is embedded in.

Coordinating body and trumpet

So far, we have seen that the instrument and environment present us with a range of opportunities for action with varying degrees of solicitation. In this section, I illustrate some ways an improvisor coordinates their body with instrumental affordances, specifically within the context of trumpet playing. I do so by detailing the processes of sound production, pitch changes, articulation, and use of the valves. These sensorimotor schemes play an important role in the generation of melodic, rhythmic, and timbral material. I draw upon not only the surrounding literature, but also my observations and experiences as a practitioner-researcher, professional trumpeter, and improviser.

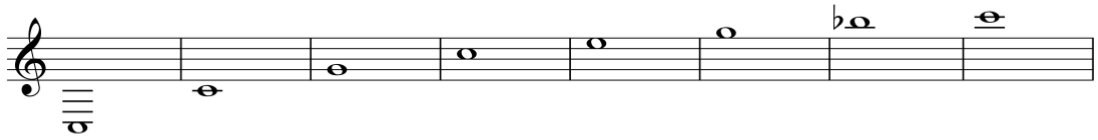
Producing even just a single note on the trumpet involves a complex coordination of the trumpeter's physiology (respiratory muscles, throat, tongue, embouchure, lips, hands, and posture) and the material and mechanical aspects of the instrument (valves, mouthpiece, bore size, bell dimensions, and type of metal). This type of behaviour is referred to as synergy—that is, the temporary grouping and unification of elements within a system to produce emergent outcomes (Kelso, 2012). The initial source of energy (air) comes from the respiratory muscles. Bouhuys (1969) refers to the chest as a kind of "elastic bellows" (p. 1200), it has a natural resting position it returns to. If we inspire to full capacity and then relax the inspiratory muscles, the chest returns to the resting position and the air is expired.

The inspiratory muscles can also act as a kind of brake, managing the decrease in chest volume as it returns to its resting position and controlling the rate that the air is expired. The expiratory muscles can then be employed to maintain a constant expiration beyond the resting position. Furthermore, the expiratory muscles can help to produce greater pressure beyond the natural elasticity of the chest. Bouhuys states that: “To accomplish a simple action like breathing out against a constant pressure requires a complex motor act which involves precise regulation of the state of contraction of both inspiratory muscles and expiratory muscles” (p. 1201). The air column produced by the respiratory muscles forms a positive pressure behind the closed lips, pushing the lips open and producing vertical and horizontal motions. As the air flows out, the pressure changes, and the lips close. This set of events repeats as a cycle sending pulses of high-pressure air into the instrument. The auto-oscillation of the lips (repeated open–close cycle) collaborates with the natural resonances of the instrument to produce notes in the partial series (also referred to as harmonic series) (Boutin et al., 2015; Wolfe et al., 2015).

The fundamental pitch and the harmonic series of the instrument are dependent on the length of the pipe. The valves provide access to more tubing, allowing transposition of the available partial series when used in combination. The trumpet’s fundamental pitch with no valves depressed is C (or concert Bb), with each of the six subsequent valve combinations lowering this by one semitone. Using the valves, the trumpet player has the opportunity to not only move between partials—as is done on a natural trumpet—but also within partials. The movement between partials is a result of airspeed being manipulated by the aperture of the lips and by the tongue position. This is in relation to the air pressure initiated by the respiratory muscles. By adjusting the size of the aperture, the trumpet player produces a faster airstream and a higher frequency (pitch) or a slower airstream and a lower frequency.

Figure 10

Bb Trumpet Partial Series



The amplitude of the tone produced by the trumpet correlates to the volume of air being accelerated through the instrument. By opening the aperture wider, a greater volume of air may travel into the trumpet. A consequence, however, is the way that this affects airspeed, meaning there is greater reliance on the initial respiratory processes to maintain enough pressure to hold and change pitch. Consider a garden hose: if one puts their thumb over the nozzle, the output of water is faster and at a higher pressure. This is opposed to increasing the volume of water output by turning the tap. Thus, to interact with the partial affordances, the trumpet player must coordinate the air generator (inspiratory and expiratory muscles) and air manipulators (tongue, aperture, and embouchure). They must make synergetic adjustments to control and maintain air pressure, speed, and volume in order to control pitch changes, amplitude, and timbre.

Taxonomy of articulations

While improvising, the trumpet player draws on a wide repertoire of articulations. These articulations can play both an aesthetic and functional role when navigating musical situations. The movement between partials, produced only by a change in aperture and tongue position, is referred to as a *lip slur*. If this movement is initially articulated by the tongue it is referred to as a *tweet*. A *bugle* is a movement between partials where both partials

are articulated by the tongue. Both the bugle and the tweet make use of the momentum from the initially articulated note to move between partials. Articulations are the different onsets of notes produced by the trumpeter. A basic example of this is the breath attack where air generated by the trumpet player produces a vibration in the lips → mouthpiece → trumpet producing a tone. Building from this foundation, the *single tongue* is an articulation type that utilises the interactions between the air generated by the trumpeter and the tongue. The tongue blocks the flow of air into the trumpet creating compression in the mouth. When released, the compressed air produces a note with a faster and harder onset than the breath attack. Producing a breath attack requires full use of the respiratory muscles making it a cumbersome method of articulation. The tongue instead makes use of air stored in the mouth, allowing for greater agility and a more nuanced range of attacks. For example, varying levels of compression can produce a range of onset attack types like tah, dah, and dat sounds (Wolfe et al., 2015). The *slur* refers to movements between pitches produced by changes in valve combinations only, without the use of the tongue. The trumpeter will often use tongued and slurred articulations in combination—referred to as back-tonguing. Finally, the ghost tongue is an articulation type where the tongue does not fully stop the flow of air, producing an implied note that sets the tongue up for the next note in the melodic phrase. Although articulation is just one facet of trumpet playing, it already involves the complex self-organisation of various parts of the body. These articulation options become an important part of the improvisor's flexible and adaptive navigation of musical situations.

Degeneracy and multifunctionality in trumpet playing

As previously mentioned, there are seven possible conventional valve combinations. These seven combinations fit within the first interval C–G. However, as the performer ascends the harmonic series, the intervals between partials progressively shrink. Within the next interval G–C only five combinations fit. The remaining combinations overlap with the previous

interval series meaning G and F# can now be played in multiple ways. The valve combinations change as the notes get higher and notes can have alternative valve positions, providing an irregular pitch workspace for the trumpet player. The different articulation types, ways of making pitch changes, and valve combinations available to the trumpeter suggest that there is not a clear "one-to-one mapping between structure and function" but instead involves degeneracy and multi-functionality (Kelso, 2012, p. 907). Degeneracy refers to the capacity for different components to produce the same or similar behaviours, allowing for a variety of ways to execute performance tasks. Degeneracy can be seen in the coordination of various valve and alternative valve positions that allow the same melodic lines to be played using different valve combinations.

Figure 11

Seven chromatic valve combinations

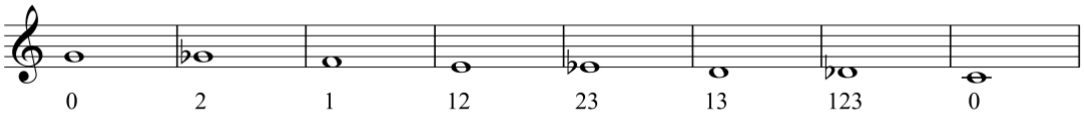
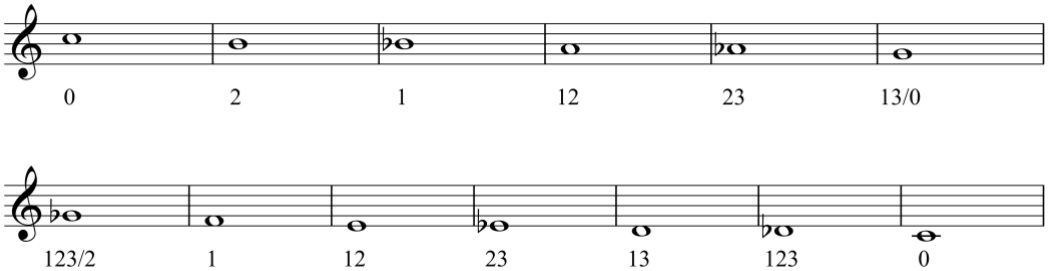


Figure 12

Alternative valve positions



Furthermore, a single pitch can be sounded using a number of different articulations and airspeed can be manipulated by the aperture of the embouchure, the tongue, and respiratory muscles. Complementary to degeneracy is multi-functionality where the same elements may have different functions (Kelso, 2012). The tongue is a crucial feature of both articulation and partial movement, offering multiple functions. Likewise, the trumpet's irregular pitch space means that the same valve combinations can produce different melodic lines.

The dynamic nature of improvisation requires skills that are both stable and flexible (Thelen & Smith, 2006), and as we have seen, the trumpet presents the improvisor with a wide variety of interaction possibilities. Over time, through practice and performance, the improvisor begins to enact meaningful relationships with the instrument. This process of *attunement*, or resonance to meaningful information variables in the environment, allows the development of flexible performance solutions that make use of degeneracy and multi-functionality (Bruineberg et al., 2021).

Figure 13

Reference to Artefact the 4

The song *Rolling Gestures* was inspired by the relationship between the body and the instrument discussed above. I wanted to create a piece of music that was generated through bodily movement, rather than trying to map onto the body pitches and rhythms written on paper. I had been practicing using gestures such as forward and backward rolling motions with the hand and then exploring these movements on different harmonics, articulation types, and intervals. Because the intervals across the harmonic series change, I can produce many different sounds even with the same hand gesture. I could also comfortably keep the motion going for an extended period. The piece started off as an 'improvisation' but now has become themes that I consistently draw on that make it recognisable as that piece of music. The whole piece is made up of these backward and forward rolling gestures. This piece of music is afforded and constrained by the degeneracy and multifunctionality of the trumpet as well as the way the improvisor and instrument interface.

Dynamical systems theory and constraints on improvisation

Trumpeter Slater (2020) describes the term "spontaneous improvisation" as equivalent to self-organisation under a set of constraints (p. 35). Following this, I take the improviser to be an adaptive system whose behaviours are self-organised responses to a set of constraints. The tools provided by dynamical systems theory prove useful for describing this type of adaptive self-organising behaviour. For example, improvisers will have patterns of behaviour that are, depending on the circumstance, more resistant to perturbation than others. In dynamical systems theory, these stable patterns of behaviour are referred to as *attractors*. These attractors are represented on a topographical space referred to as a *phase portrait*. Areas with deep basins indicate stability and resistance to perturbation. Areas with shallower basins are more indicative of instability and less resistance to change (Strogatz, 2015). These concepts can be used to describe how a trumpet player might change articulation in the course of an improvisation. For example, a slower tempo might afford single tonguing. While at faster tempos this technique becomes less stable, perhaps resulting in the use of slurring and legato back-tonguing (this is not dissimilar to the changes in gait as one transitions from a walk to a jog to a run). In other words, at moderate tempos, all articulation types are relatively stable (implying a deeper basin of attraction). But as the activity reaches a critical tempo or speed the single-tonguing attractor becomes shallower and less resistant to perturbation while the back-tonguing and slur remains stable. This prompts the system to organise toward the techniques that are more stable at this speed, namely the back-tonguing and slur. This is of course just one example of how dynamical systems theory could be used to examine improvisation (For more examples see Van Der Schyff et al., 2018; Walton et al., 2015).

Constraints in improvisation

Constraints are certain features or structures that determine the degrees-of-freedom of a self-organising system, shaping the types of behaviours the system can perform. Constraints can enable behaviours that would not otherwise be possible and even be used to bias a system's behaviour towards "positive functional outcomes" (Baggs et al., 2020, p. 5). In fact the term *constrain-to-afford* is a key tenet of ecological dynamics approaches to skill acquisition (Renshaw et al., 2019). This is because by shaping the kinds of actions we can perform, constraints enable different kinds of affordances to attend to.

Newell (1986) proposes that three categories of constraints interact to produce coordinated behaviour: organism (or individual), environmental, and task constraints. Individual constraints refer to the structure of the trumpet player such as posture, respiratory muscles, facial muscles, and fingers. It may also be extended to the playing experience of the individual as well as their motivation and emotional state. Environmental constraints include the physical, social, and socio-cultural environments as well as the events and objects that exist within them (Davids et al., 2007). For example, this would include the performance space (physical environment), the music generated by other performers (musical environment), the social environment (audience, or relationship with other ensemble members), and the wider sociocultural environment (community, scene). These environmental constraints are external structures that challenge the stability of the individual. To regain stability, after some perturbation from the environment, the individual must adapt or self-organise in some way dependent on a third element, the task.

Task constraints refer to the rules, intentions, or activity goals imposed on or by the individual (Newell, 1986). Task constraints are ways we can choose to structure our behaviour (in a parameterised way rather than prescriptive). For example, imposing a harmonic framework to improvise within (or outside of). Improvisers might also bring to a

performance a subset of tasks to move between such as attempting to synchronise with ensemble members or "pull the rug out*"* (See Ravn & Høffding, 2021). Features of the environment might constitute a task constraint depending on the context. Environmental constraints reflect the ambient conditions surrounding the performer as opposed to specific tasks imposed to produce a result. The specificity of performance tasks, that is the degree to which a performance task constrains the activity, also impacts how patterns of behaviour form. This is again as the system's ability to self-organise is contingent on its degrees-of-freedom. A common example in certain styles within the jazz genre is the need to play with certain inflections, language, or within a strict harmonic framework. These normative rules constrain the various ways in which an improviser responds to the environment.

Musician–instrument phenomenology and dynamics

Before concluding, I would like to briefly clarify some interactional and experiential aspects of the relationship between improvisor, instrument, and environment. For expert musicians their instruments can become "transparent"—this refers to how the instrument becomes incorporated into their cognitive domain as an almost seamless extension of their body (something that the musician perceives the world with and through) (Nijs, 2017; Nijs et al., 2013). In this instance the equipment or instrument functionally becomes part of the individual constraints. This type of experience can be described in a number of ways (for e.g., ready-to-hand, smooth coping, maximal grip), but generally this is seen as a result of things going well. The instrument does not interrupt the musician's skilful engagement with the environment or *flow* (Csikszentmihalyi, 1990). Even for expert improvisors this can be difficult to achieve as the dynamic musical environment offers numerous opportunities for small breakdowns that temporarily bring the instrument to the improvisor's attention.

Furthermore, the context or task can specify the way in which the instrument presents itself or withdraws from an improvisor's attention. Many improvising musicians explicitly centre their practice on the range of affordances made available by the instrument. The instrument becomes a focal point of the task domain, resisting withdrawal from one's perception. From a dynamical perspective, some musicians will intentionally seek out unstable instrument interactions (also recall the previous discussion on exploring hidden affordances). For example, saxophonist Torban Snekkestad notes that at times his solo improvisation with the saxophone is more like playing duo. The instability (shallow basins) of certain interactions such as multiphonics almost gives the sense of interacting with another agent. One that can play with you or against you (Ravn & Høffding, 2021, p. 531). A key point here is that our skilful engagement and phenomenological experience is highly dependent on the state of the individual, environment, and task (See Christensen et al., 2016). The improvisor's aim may be to engage with the musical environment directly or they may put the instrument at the centre of their improvised practice. In other words, it seems that predominantly the instrument fluctuates between transparent, translucent, and opaque.

Figure 14

Reference to the Artefact 5

Tools in our extended ecology structure the kinds of compositional affordances available us. For example, the piano both visually and tactilely offers a different experience to a trumpet. manuscript, or notation software. My initial compositions were influenced by this idea. I recorded a series of solo trumpet improvisations, some following certain loose parameters (large intervals etc), exploring hand gestures, or completely free. I would then select and transcribe recordings I liked. After the transcription stage, the compositions were arranged through several mediums—although primarily trumpet, piano, and manuscript software were used. The songs *In Walking* and *Through a Lens* were written in this way. These different modes are not the same as a jazz quintet, but they represent the quintet in different ways. They provide different kinds of affordances and varying degrees of solicitation.

The visual and kinaesthetic feedback and the patterns of behaviour solicited by a trumpet are vastly different from a piano or notation software. Furthermore, these different tools were deployed in different situations and spaces. One interesting outcome of this, for example, was I found that melodies generated from solo trumpet improvisations floated over bar lines more freely than compositions enacted within the grid of a notation software. This compositional method served as a kind of 'proof of concept', illustrating the way our tools play a central role in constituting our experience.

Chapter Conclusion: Some additional E's

At the start of this chapter, I suggested that we enquire into the nature of improvisation by examining some of its broader aspects, relating to the adaptive and embodied ways we interact with our environments. To capture this, I considered improvisation using principles from ecological and dynamical systems approaches. The ecological concept of affordances established that improvisers perceive emergent relations between the agent and environment or *opportunities for action*. This bidirectional relationship between agent and environment remained a theme throughout the chapter. It was found that affordances can solicit different forms of actions depending on features of the physical and social environment, and the abilities and preferences of the improviser. Furthermore, it was noted that our perception of affordances is dependent upon aspects of our intention, attention, and calibration. In the second section, I examined the way an improviser engages with available affordances to navigate musical situations. I detailed the activity of trumpet playing in terms of synergetic and dynamical interactions between the physiology of the trumpeter and the material and mechanical elements of the trumpet. This view illustrated the ways that trumpet players make use of degeneracy and multi-functionality to adopt flexible task solutions. The third section expanded upon this dynamical view, seeing the improvisor as an adaptive dynamical system under a set of constraints.

While so far, I have been predominantly referring to principles from ecological psychology and dynamical systems theory, many of the ideas I have mentioned align with what is known as 4E cognitive science (Newen et al., 2018). The 4E framework seeks to provide an alternative to the still pervasive cognitivist program that focuses on information-processing in the brain. Although many of the 4E perspectives overlap, the general view is that cognition is:

1. Embodied: Cognition is not a process reserved solely for the head but is instead constituted by the body as a whole.
2. Embedded: The body does not act within a vacuum but is instead *embedded* within a rich ecological environment (physical, social, and cultural).
3. Extended: The interactions between an embodied agent and an object in the environment (such as a tool or instrument) allow us to augment or *extend* our abilities to act in ways that would otherwise be difficult or impossible.
4. Enactive: Meaning making emerges out of adaptive interactivity between an agent and their environment. By adaptively engaging with our environments, we enact meaningful experiences.

The four Es provide a valuable framework for exploring music, improvisation, and creativity (See Schyff et al., 2022; Van Der Schyff et al., 2018). For example, Torrance and Schumann (2019) draw a parallel between the enactive concept of sense-making and improvisation suggesting that the "continual unfolding of the process of an organism's meaning-making encounter with its environment is like an improvising jazz musician generating musical responses that make sense in the context of her fellow players' (and her own) previous musical "moves" (p. 254). In the previous sections I mentioned that trumpet players utilise a repertoire of articulations and valve combinations to navigate musical environments. These,

as well as timbre and pitch choices, emerge through the trumpeter's sense-making activity. Their significance or valence are enacted as they relate to the improviser's self-maintenance.

The use of 4E aligned frameworks shows great promise in both describing and analysing an improvisor's practice as well as finding new avenues and tools for practitioners to improvise with. Although I draw informally from my own practice there is potential for further work that provides more personalised insight into behaviours and processes of improvisor practitioners. For example, Høffding and Snekkestad (2021) explore and categorise the improvisatory techniques used by saxophonist Torban Snekkestad. The authors focus on Snekkstad's technical abilities, perceptual techniques, and mental and meta techniques. Although the authors' use of enactive-ecological terminology is somewhat minimal, it clearly underlies the research. By offering a detailed account of Snekkstad's personal improvisatory techniques the authors provide insight into the enactive aspects of improvised performance such as the improvisor's agency, instrument-agent relationship, and relationship to the audience. Further uses of this 4E perspective can also be seen in the field of practice-led research. For example, Slater (2020) and McLean (2018) employ ecological and embodied frameworks in their practice to develop novel improvisatory tools and skills. This chapter seeks to contribute to this line of work by presenting an explicitly ecological and dynamical approach, helping to clarify how the concepts and principles from these approaches may relate to music improvisation. More specifically I have attempted to offer some preliminary suggestions at how these principles might apply in the context of a specific musical practice, namely improvised trumpet playing. It is hoped that continued enquiry will further enhance this type of research. For example, looking more closely at the types of phase transitions a trumpet player enacts within the contingencies of performance (DST), as well as how these experiences might be described using a 4E lens. These insights could potentially benefit research and practice in both music and the cognitive sciences.

Chapter Five: Improvisation and Planning

The aim of this thesis has been to explore the continuum of improvised activities. Firstly, I discussed the adaptive biological cell that improvises through a process of sense-making, enacting a world of significance as it moves through it. I then explored how the emergence of a sensorimotor self affords a more sophisticated form of agency, that is constrained but not necessarily determined by the norm of self-maintenance. At the sensorimotor level we saw the emergence of a body schema, our first-person point of view as agents with bodies. Through our embodied experience of the world, we develop habits and sensorimotor schemes that enable networks of behavioural possibilities. I then examined the relationship between improvisor, trumpet, and environment through the lens of ecological psychology and dynamical systems theory. From this vantage point I would like to focus on how we may integrate, what one might consider more "mental" activities, into our continuum. Specifically, I will focus on activities such as planning that are oriented towards future possibilities.

It can be common to draw a hard line between an activity that is planned and one that is improvised. One usually considers an activity that follows a plan as something pre-determined—the steps to achieving a goal have been set, and the agent knows what actions they will enact. In contrast, an improvised activity is often considered not pre-determined, but instead, enacted in that moment. These common assumptions often extend to the actions needed to create the plan—that is, planning. While improvisation is relevant to one's current motivational state, planning refers to a preparation for anticipated actions and motivations in the future (Dickinson, 2011, p. 90). These aspects seem to characterise, at least in part, our assumptions towards improvised and planned activities. In this chapter, however, I would like to challenge some of these natural attitudes. I propose that improvisation and planning are, in

many ways, intertwined and, at times, overlapping cognitive activities. I believe this is especially apparent when framed within an ecological-enactive perspective.

I begin this chapter by first discussing the relationship between improvisation and plans. I suggest that plans, no matter how detailed, always require some degree of improvisation. Thinking of plans as scaffolds for improvisation may better recognise their intertwined relationship. I then introduce the mesh cognitive architecture (Christensen et al., 2016; Gallagher & Varga, 2020) as a way to integrate mental acts and cognitive control into the approach developed so far.[14] I then look at some of the continuities between improvisation and planning. I conclude the chapter by exploring the view that both improvisation and planning involve engaging with affordances over multiple timescales. This affordance-based view dissolves some of the hard distinctions between present improvisation and future planning and instead views both phenomena as interconnected across a larger unfolding activity.

Plans as scaffolds for improvisation

Plans are created before an activity in its anticipation, avoiding the need to invent solutions in-the-moment. Although, when observing an agent in its environment, plans can be limited in two ways. Firstly, they rely on the planner's ability to accurately anticipate how a situation will play out, as well as the situation's degree of inherent unpredictability. Secondly, a plan cannot account for every detail even in a perfectly predictable situation. Instead, it is up to the agent implementing the plan to determine how to get from one step to the next, usually in-the-moment. So, it seems that the following of plans requires some degree of improvisation, whether that be by filling in details, or by adjusting plans to unpredicted changes in our

[14] I use this term cautiously as I believe we should not fall back into traditional conceptions of what a cognitive act is. The Gallagher & Varga (2020) use the term cognitive control. I will go into more detail later in the chapter.

dynamic environments. Agre and Chapman (1987) illustrate this by making a useful distinction between the kind of plan followed by a computing device, compared to a plan enacted by a living person in-the-world.[15] When a computer enacts a plan, there is a one-to-one relationship between the plan and the action enacted. Computer programs are designed to follow plans (lines of code in the programs), executing them in the same way every time. They are often rigid, and a change can cause the whole system to fall apart. However, this is not the case for a plan in the human sense. Agre and Chapman (1987) state that "Nobody could doubt that people often make and follow plans. But the complexity, uncertainty, and immediacy of the real world require a central role for moment-to-moment improvisation" (p. 268). This is true even for so called non-improvised musical activities such as a classical ensemble responding to a musical score (plan). For example, Ryan (2019) describes how orchestral musicians must still respond to performance spaces, adjusting their phrasing, flourishes, or articulation to the situation and people around them:

> Such responses are not all drawn up in advance, even across hours of copious practice and with the use of a score. These different patterns of responsiveness - which could take place among musicians, between musicians and the audience, or between audience members themselves - emerge spontaneously in the moment and help create subtle nuances and differences night after night. Furthermore, insofar as they arise spontaneously, they are improvised in an at least one important sense of the term. (p. 15)

The orchestra is following a plan constructed by the composer. The plan has been preserved within the notes on the page that signal to the members of the ensemble what to play. The amount of information specified in the plan can differ from piece to piece. It may be up to the musicians to infer how long each note should be held or at what dynamic, or the plan may be highly detailed, leaving little room for any personal input. Even in these highly constrained

[15] They distinguish them as capital P Planning and lowercase p planning (p. 268).

situations the musicians must coordinate their actions, adapt to time changes, and tuning. We might refer to this as a more minimal form of improvisation, closer to the proto improvisation discussed in chapter two. There is certainly a phenomenological difference that must be acknowledged between saying I am going to improvise, and I am adapting—although the former is rooted in our capacity for the latter.

Being autonomous living agents, we are aware of our own precariousness, and thus constantly adapt to situations in order to maintain our autonomy (Di Paolo, Bhurman, et al., 2017). The world is not a static place that can be fully accounted for, and our bodies are not particularly good at repeating things in the exact same way[16]—we continually rely on adaptive and flexible ways of acting. When we enact a plan, we create a path or a guide to follow, but this does not necessarily specify the decisions that take place moment-to-moment between each step in the plan. Plans can be highly detailed, leaving little room for improvisation, or they may be open, leaving much room. As biological beings, we are always improvising (or proto-improvising) to some degree. Following plans involves contingencies, allowing for in-the-moment deviation "based on how the world is now" (Agre & Chapman, 1987, p. 268).

As plans require a certain degree of openness and flexibility—leaving room for improvisation—it may be useful to conceptualise them as scaffolds for (improvised) behaviour. From this perspective, plans enacted through one's planning activity are structures that, when deployed later, support or scaffold our patterns of behaviour—often with the aim of reducing improvisation (Neto et al., 2023). They provide guiding information (through affordances) and constrain our possible actions in order to enable certain kinds of behaviours. We often scaffold our behaviour through the support of environmental resources such as

[16] What one might refer to as "automatic" processes are actually still ecologically situated, even if at times they appear automatic (Gallagher & Varga, 2020).

shopping lists, phone reminders, and—in the case of compositions—in manuscripts (Sterelny, 2010). When we write ourselves a shopping list, we structure our shopping behaviour in a way that reduces the need for improvisation, that is, our actions are scaffolded by the shopping list. Similarly, when we compose a piece of music, we bias the musician toward certain behaviours and constrain the musician's actions toward specific affordances. Scaffolds can also augment our ability to act. Composed melodies, for example, can often allow for complex coordination that may not be otherwise possible. We might assume that these musical scaffolds only pertain to jazz ensembles that use melodies and harmonic frameworks to structure their improvisations. However, scaffolds can also provide a way of describing the presence of improvisation in situations we may not usually consider improvised. A piece of chamber music for a string quartet scaffolds and constrains the musicians toward certain patterns of behaviour. Yet, we can appreciate that within these structures are certain improvised freedoms. As with the previously mentioned orchestral members, the string players coordinate tempo, tuning, and phrasing with themselves and the other members (Seddon & Biasutti, 2009). Although, we should also recognise that, at times, pre-written pieces of music (scaffolds) may constrain the performer's degrees-of-freedom to such an extent that their phenomenological experience of the performance may not feel improvised.

Mesh approach

In chapter three I discussed the idea of a sensorimotor body that's behaviour is heavily structured by the sedimentation of experience, or habits. This marked a transition from the basic adaptive behaviours of the biological cell but did not necessarily say much about our higher order cognitive capacities. Traditionally, cognitive psychology has viewed cognitive control (control through conscious awareness) and automatic control (without conscious

awareness) as two distinct processes (Frankish, 2010). In this section I will introduce the *mesh* framework developed by Christensen et al. (2016) and more recently Gallagher and Varga (2020).

Mesh integrates cognitive and automatic control in a way that is more in line with the enactivist approach being developed in this thesis. According to Christensen et al. (2016):

> Mesh sees a broadly hierarchical division of control responsibilities, with cognitive control usually focused on strategic aspects of performance and automatic processes more concerned with implementation […] Mesh proposes that controlled and automatic processes are closely integrated in skilled action, and that cognitive control directly influences motor execution in many cases. (p. 43)

Cognitive control is viewed as a form of situation awareness, where "attention is directed to relevant information which serves to elaborate or revise the interpretation. Situation awareness serves to establish a cognitive and motor configuration appropriate to the context" (p. 43). Gallagher and Varga (2020) develop this approach, by presenting an enhanced mesh architecture that is more situated and ecological. They write that top-down situated awareness may involve not only "thoughtful, reflective consciousness" but "a thin performative pre-reflective awareness, with different gradations in between, allowing for such variations as selective target control, conscious monitoring, a sense of one's rightly configured body, performative awareness, and pre-reflective awareness" (p. 5). Moreover, Gallagher and Varga (2020) suggest that bottom-up body-schematic processes should not be viewed as "automatic" but instead they are situated, adaptive, and flexible.[17] Our bodies are "already context sensitive, anchored in the situation, but at the same time smart, open, and adaptive, such that they elicit or shape or enable the cognitive elements required for performance" (p. 5).

[17] See chapter three on body schema and habits.

Gallagher and Varga (2020) also argue that control is not only a top-down cognitive process but can also come from bottom-up motoric processes, what they call intrinsic control. They write that: "Variations in heedful and targeted (attentive, perceptual) awareness are constrained and enabled by a consolidation of fine, detailed motor control (body-schematic) processes, which are not perfectly general or automatic but attuned to the specifics of the situation" (p. 6). The authors also introduce some additional dimensions to mesh through the notion of affect (emotion, hunger, fatigue). Affect plays an important role in our "ability to cope with the world and, along with skills and habits, introduces possible modulations of functional integration with that world" (p. 6). Affect situates the meshed architecture in the world, bringing with it not only embodied but embedded and extended dimensions of cognition.

> In this respect, ecological, normative, cultural, and intersubjective aspects of the physical and social environments, including physical and social affordances, play a role and contribute to task-dependent structures in performance […] the musical instruments, the performance space, and the music itself shape the musical performance. (p. 6)

The enhanced mesh architecture appears to be in line with the phenomenology of improvisation, which involves both situated bodily know-how, and the kinds of intentional awareness associated with self-monitoring online decision making. Improvisation involves both intrinsic control—fast skilful adaptive coping facilitated by the body schema and habits—and varying degrees of situated awareness and reflection. Improvisation may also simultaneously involve planning—such as planning what to do next while I am currently engaged in action. As I will explore in the remainder of the chapter, planning may similarly involve meshed cognitive and intrinsic control.

Continuities between improvisation and planning

With this mesh model in mind, I wish to explore some of the ways improvisation and planning appear, at times, to be continuous with one another. Planning is a situated process that unfolds over time, involving adaptivity, exploration, and trial and error. The two activities share many characteristics such as: "temporally extended structure, orientation towards a goal, and reliance on pre-existing skills, habits and cultural resources" (Preston, 2021, p. 13). One possible way to look at this continuity is by viewing improvisation as a type of planning. Hakli (2021) does this by referring to improvisation as *online planning*. He first defines planning as a "construction of sequences of action targeted to reach a certain goal when executed" (p. 32). He then suggests that "actions are improvised just in case their intentional execution starts immediately when they have been selected […] improvisation means construction of a sequence of actions aiming at a goal, that is, construction of a plan, during its execution" (p. 37). In contrast to *offline planning*, where one has prior information about the environment, online planning describes the real time adjustments one must make to new information. For Hakli, planning (offline planning) and improvisation (online planning) lay across a continuum. He writes:

> Improvisation is in the end of the continuum where the time difference between action selection and action execution approaches zero, whereas typical planning is in the opposite end in which there is sufficient time between action selection and execution to leave room for consideration of alternative courses of actions, and comparison, evaluation, and revision of candidate plans. (p. 44)

Another possible view is the *iceberg model,* introduced by Preston (2021). Preston similarly acknowledges the continuities between improvisation and planning, although prefers to avoid assimilating one into the other. Instead, the iceberg model sees planning as a smaller but more noticeable process at the tip of the iceberg. Like the portion of the iceberg below the surface, improvisation makes up the bulk of our everyday activities and is out of our view—

that is, improvisation is a prevalent enough part of our day-to-day that it often goes unnoticed. Furthermore, the "tip is continuous with the rest of the iceberg and is made of the same stuff" (p. 23), however, each end is exposed to different conditions. Finally, much in the same way that the buoyancy of this portion supports the iceberg's tip, improvisation facilitates the implementation of plans. Both online planning and iceberg models are useful for highlighting that improvisation and planning are interconnected. Improvisation certainly involves some in-the-moment planning, and vice versa we may view planning as a kind of improvising (See Benson, 2003). I also agree with the view from Preston (2021) that improvisation is necessary for the implementation of plans and, moreover, while improvisation and planning may be made of the same stuff, they are exposed to different conditions.

In the context of music, planning can refer to composing. Much like in visual artforms such as sculpture and painting, when one composes, they produce an artefact that is easily distinguishable from the artist. In performance, however, musician and music are tightly intertwined—the music begins and ends throughout the duration of the performer's activity (Iyer, 2016). While improvisation is a type of performance, it is also often referred to as a type of composition that occurs in-the-moment (Alperson, 1984). Furthermore, the process of composing that occurs over extended timescales, appears to also involve some level of performance or improvisation. For example, Alperson (1984) writes that:

> a composer sits at a piano, imagining various musical formulations, actually playing (performing) this or that formulation at the keyboard. In a case such as this, the process of composing a piece of music explicitly involves the process of performing it. (p. 19)

There are overlapping processes between improvisation and planning. Both activities involve performing an action and then responding to that action, forming a recursive and unfolding

behaviour.[18] Crossley (2021) writes that "Works do not occur to composers all at once but rather take shape through a process in which they respond, at a later stage, to what they have produced at earlier stages" (p. 82).

Planning can occur in a variety of ways. Often it is driven by clear goals in mind—for example, it might involve thinking about how to achieve a given outcome and the ways in which one might accomplish this. Yet, plans may also develop out of more open-ended activities. Improvisors will sometimes or workshop material, developing it through joint improvisation. These activities are viewed as improvised, yet compositions (or plans) emerge from these improvisations. In this case, why not view the composer as a kind of improvisor who takes material they invent in-the-moment and arranges it over longer timescales to become a composition? Crossley (2021) writes:

> improvisation plays a role in composition, such that some sections of a composed piece might be considered crystallised or sedimented improvisations. The plan, which reduces the need for improvisation, is in some part formed by way of it […] planning which precedes and prepares planned action is itself improvised.[19] (p. 82)

The approaches discussed throughout this section highlight some possible ways of conceptualising the continuities between planning and improvisation. In the following sections I wish to build on these approaches by viewing improvisation and planning within an ecological-enactive lens.

[18] Not unlike laying down a path in walking.

[19] Also recall the earlier quote by Alperson (1984), suggesting that composition involves a level of performance.

Improvisation and Planning as an Unfolding Activity: Coordinating affordances over multiple timescales

Earlier in the chapter, when introducing the mesh approach, I illustrated how cognitive control is mutually shaped by our embodied and situated motoric processes—referred to as intrinsic control. In this section I aim to build on this view by showing how "mental" activities that extend temporally into the future are similarly embodied and situated. I do so through the concept of affordances, viewing improvisation and planning as an engagement with multiple affordances across multiple timescales. I suggest that this perspective may contribute toward dissolving the hard distinction between these two activities.

Planning is something that we do, it is a "kind of active engagement with possibilities" (Gallagher, 2017, p. 193). [20] It can involve the re-enactment of our embodied perceptual capacities (Thompson, 2010) and be scaffolded by our bodies, gestures, and tools (Gallagher, 2017). Gallagher writes:

> Imagining involves a variety of different practices—some of them actively embodied, some of them involving the manipulation of bits of the environment, some of them sitting still and picturing something by manipulating concepts or thoughts or images (re-enacted perceptions)—which in any case may still involve affective and kinaesthetic aspects of embodiment. (p. 195)

He suggests that "concepts or thoughts can be regarded as nothing other than affordances that offer (or solicit us to) possibilities to follow one path or another as we engage in thinking" (p. 195). As discussed in the previous chapter, affordances describe a relationship between opportunities for action in the environment and an agent with the abilities to act on those opportunities (Gibson, 1979). Over the years the notion of affordances has evolved to capture a greater breadth of human behaviour. It has been found that we also perceive social

[20] Much of the literature in this area focuses on the notion of imagination. However, I believe this work similarly pertains to planning.

affordances and, furthermore, our perception is shaped by the sociocultural practices we are embedded in (Rietveld et al., 2018). Affordances perceived will be more or less relevant to the agent within the context of that practice (Rietveld & Kiverstein, 2014). This contributes to the way an agent may, unreflectively, feel that there is a certain way of going about things, experiencing what Rietveld (2008) calls "directed discontent". That is, there is a kind of pre-reflective feeling of attraction or repulsion towards a certain action or outcome. Drawing on recent work by van Dijk and Rietveld (2020, 2021), I consider improvisation and planning as coordination with multiple affordances. van Dijk and Rietveld (2020, 2021) suggest that much in the same way we can respond appropriately to the immediate environment we can perceive and respond to affordances that occur over larger timescales. A trumpet can afford stringing together sets of notes, different timbres, articulations, and dynamics. These smaller affordances, however, also allow for the enacting of larger scale affordances such as performing a trumpet solo or the affordance of performing three sets of music. Affordances can thus be nested, intertwining over multiple timescales.

van Dijk and Rietveld (2021) stress the unfolding nature of activity over time. They see activity as something ongoing—as opposed to *actions* which are discrete occurrences within the activity. Importantly, actions become more determinate as the activity unfolds. Certain action possibilities disappear, and new possibilities are enacted as we participate in the ongoing activity.

> What action is performed is therefore only completely determined when the activity, the performance, is over […] what action was performed and how materials entered into it, got determined in activity: time matters constitutively, and activity does not come pre-formed, but it is performed. (van Dijk & Rietveld, 2021, p. 356)

They add that "any activity that appears as a finished action can be part of a continuing string of actions that forms a larger activity still unfolding" (p. 356). On the trumpet, the inhalation by the respiratory muscles, the contraction of the facial muscles, and the downward force

exerted by the fingers will reduce the number of possible actions as they organise towards producing a note. When the note is produced, this smaller scale action plays a determining role in the larger ongoing activity of improvising a melody. By enacting an affordance, you provide the conditions for the subsequent affordances that make up the larger scale affordance—such as the notes, the solo, the set of music (van Dijk & Rietveld, 2021, p. 360).

Much larger scale activities established by many people over many years can also shape the ways we participate in activities over smaller timescales. van Dijk and Rietveld (2021) refer to this as "practices". As a jazz musician you are participating within an established practice that constrains and enables the kinds of smaller scales activities you participate in. However, "as practices are ongoing, they too are increasingly determined and continued in and by the current activity" (van Dijk & Rietveld, 2021, p. 357). So, the determination of activity points both ways, larger scale practices shaping smaller scale activities and vice versa. This is certainly visible when we think of the ways the jazz practice has changed and evolved over time. "[I]n affordances the unfolded actions (previously) established in a practice form the terms in which materials currently invite further activity to continue that practice in a particular way" (359)

As affordances are possibilities for action—that is, actions that have not yet occurred—they are inherently directed forward toward the future. The way we may relate this to the notion of planning is that the affordance occurring over a larger timescale is still perceived as an inviting possibility for action. The composer enacts and perceives the possibility for a piece of music (a composition affordance) in a way that is not totally unlike the enactment of a single note to play—although a larger scale affordance is far less determinate. The composer perceives the possibility to write a piece of music. This may take hours, days, or even months, but the composer will act in ways that make the composition affordance more determinate by acting on smaller scale affordances like melodies, chords,

arc, and even emotion. These smaller scale affordances intertwine to constitute the larger scale affordance of the composition. These affordances are enacted concurrently but determined at different rates. If my notation software subscription malfunctions, my time spent on fixing it—although part of the unfolding process—does not contribute much to the composition.

So far, I have highlighted that not only do we perceive immediate affordances, but we also perceive affordances that are temporally extended over larger timescales. This seems to align with the points argued in the previous sections that improvisation and planning share characteristics. We might think of improvisation and planning as the perception and coordination of affordances over different timescales within an unfolding activity. From this perspective, adaptivity still plays an important role in both improvisation and planning. Authors van Dijk and Rietveld (2021) write that a skilled agent that is enmeshed in an activity will perceive the inviting affordances determining that activity, and experience the direction of the activity unfolding. Over shorter timescales this is experienced as perceiving the next appropriate step along the process. Our responses to these affordances are often fast and unreflective, like fixing a mistake as you see it. For larger scale affordances: "Skilled individuals that have extended along a sufficiently long and relevant history of previous activities (i.e. they have a relevant ability), have acquired the responsiveness to attune to the direction of unfolding affordances along such larger timescales" (p. 362). That is, they can perceive and respond to the ways interacting with smaller scale affordances will allow the larger scale affordances to maintain an inviting character. Importantly however, our attunement may not necessarily be of something discrete. It "merely requires the openness and receptivity to the movement of an increasingly determining situation, seeing *along* the direction in which the situation is unfolding" (p. 367). This supports the claim that planning can be an adaptive and situated activity much like improvisation.

Creative processes as an engagement with multiple affordances

Before concluding, I want to briefly address the situations where a "planned" outcome may not be clearly formed early on, and instead emerges through the activity. This is especially pertinent to creative processes that may begin with minimal pre-conceptions. Both the planning and improvisation contribute to forming a product which slowly becomes more determined over time. I noted previously that as activities become more determined over time the number of affordances reduce. van Dijk and Rietveld (2020) write that during these early stages of the creative process, the indeterminacy of the activity means that many affordances are relevant to the agent. They view this openness to a wide variety of possibilities as being *imaginative*. They state that "[w]hen an inviting affordance is still early in the process of enactment (it is still largely indeterminate), coordination with this affordance, given the current situation, may be experienced as imaginative." (p. 16). Over time as clear goals form, certain affordances will gain a greater inviting character. The activity becomes more determined and will be experienced less as imaginative and more in terms of the steps necessary to reach the goal.

Figure 15

Reference to the artefact 6

Indeterminate and imaginative

Dylan and I began the first day as just a duo. We briefly chatted about some sound ideas—sparsity, quietness, large sound—but did not dwell too long on them. The track *MD Duo* captures our first play together and involved no discussion. That did not mean the session was totally unstructured, I had some ideas of what a drum and trumpet might sound like—for example, *On Running* by Barker and Slater (2016). I was also familiar with Dylan's music and musical background and so had a degree of expectation. This kind of situation highlights the flexibility and openness of the improvisor and the shared sociocultural practices both improvisors are embedded in. Even in highly

unstructured musical situations, the improvisation still does not emerge ex nihlo but is structured by our personal histories and shared practices. This first session documents a moment of becoming acquainted with one another and can be defined as indeterminate and imaginative in terms of how our understanding of the project as a whole would emerge.

Increasing Determinacy: An unfolding activity

The initial goals of the recording project were relatively open-ended and the trajectory relatively undetermined at this point in the session. Thus, an expansive set of relevant affordances were available. Through our initial play through, Dylan and I enacted (both reflectively and unreflectively) a set of norms that would structure the subsequent performances. These norms are not strict rules, but rather a context or precedent that shapes the kinds of affordances co-enacted by the ensemble members. Many of the songs followed a process of initially starting with an exploratory activity (imaginative), and slowly developing as more relevant soliciting affordances appeared. We found that over time it became clearer which affordances were more relevant to the project and which were less. This is what van Dijk and Rietveld (2020) refer to as increasing determinacy. There was a gradual change from "What shall we do next?" to "This is what we need to do next".

Connecting Improvisation and Planning

This affordances-based framework highlights how there is a kind of improvised adjustment at both ends. Initially the project was improvised in that we had a very open-ended distal goal, so our focus was on the proximate goals in front of us. However, with some time distal goals formed. These goals shape the present behaviour but are also shaped by the present behaviour. As improvisors within the human form of life we are able to see how our acts affect the trajectory of our unfolding activities, and thus make necessary adjustments at both ends.

Chapter Conclusion

The aim of this chapter has been to challenge the common assumption that improvisation and planning are separate activities. I have attempted to identify just some of the ways these activities appear to overlap. Firstly, I highlighted that for biological beings, plans are not strict computer programs but are instead scaffolds for improvised activities. Plans require both filling in and a certain level of flexibility—leaving room for improvisation. I then

introduced the mesh cognitive architecture as a way of integrating mental acts with the sensorimotor approach established in chapter three. From this basis I explored the ways aspects of planning—the construction of a plan—may be continuous with features of improvisation. Finally, drawing on recent work in ecological-enactive cognitive science, I emphasised that planning is not something detached from our engagement with the world but is an actively embodied, embedded, extended, and enactive process—much like improvisation.

I used the concept of affordances to highlight how improvisation is continuous with planning, challenging the common assumption that they are distinct processes. Following the work of van Dijk and Rietveld (2020, 2021), I proposed that both improvisation and planning involve the enactment and coordination of multiple affordances over multiple timescales. From this perspective, we might think of improvisation and planning as the perception and adaptive coordination of affordances over different timescales within an unfolding activity.

Conclusion

The overarching theme of this thesis has been the continuity that exists between our basic adaptive capacities for action and musical improvisation. I have tried to illustrate that improvisation is not a rarefied phenomenon but is an innate part of living. We can see the first signs of improvisation in the way basic organisms adapt to their environments in order to maintain their biological autonomy. I termed this basic adaptive proclivity as proto-improvisation to distinguish it from more intentional forms of artistic improvised practice. Improvisation in music, dance, and art is rooted in and reflects these more primordial aspects of life. Within a musical practice, improvisors maintain certain personal and social balances, push the balances into new configurations, and play with and juxtapose perceptual capacities in new ways. These situations may draw on the emotional and affective experiences associated with precariousness and risk in living systems without posing direct risks to survival. Accordingly, musicians can relinquish and even play with their agency, pushing the boundaries of viability within musical situations.

Following on from this, chapter three outlined two views of habits: phenomenological and enactivist. I demonstrated how at the sensorimotor level, an improvisor's perception of the world is through the lived body, or the body schema. We perceive the world through a body that is not an "object among objects" but a whole form. As I discussed, our experience of the world, through the body schema, sediments to form habits that, in turn, structures our improvised experience. From an enactivist perspective we engage with the world through sensorimotor schemes. These schemes, over time, can become stable enough to form habits. Habits and schemes interconnect to form larger networks and behavioural genres. This examination of habits illustrates how the improvisor does not come to the improvisation

empty handed. They bring a rich history of interactions, skills, schemes, and habits that structure the way they "lay down a path in walking".

Chapter four shifted focus to a specific musical practice, namely improvised trumpet playing. I established that the improvisor perceives in terms of affordances—that is, emergent relations between the agent and opportunities for action in the environment. I then examined the way an improvisor coordinates their body with instrumental affordances to navigate musical situations. At the time of writing and publishing this chapter, I was not as aware of the idea of sensorimotor schemes. In retrospect, my detailing of instrumental affordances, especially of finger patterns and articulations, could have been reconsidered in terms of sensorimotor schemes.

Finally, chapter five explored the notion of plans and planning, illustrating how they are a necessary and intertwined aspect of our improvised behaviour. A key point was that both improvisation and planning are continuous with one another—both activities being an engagement with affordances over multiple timescales. This highlighted how improvisation and planning are both adaptive, embodied, embedded, extended, and enactive phenomena.

Additionally, throughout the thesis, I inserted references to the accompanying artefact as a way to demonstrate the theoretical concepts in the context of a real-world musical practice.

Limitations and possibilities

Each of these chapters provided a preliminary look into improvisation from the perspective of phenomenology and enactive/4E cognitive science. It is my hope that this contribution will open potential avenues for further work. For example, as mentioned, one might develop a more in-depth taxonomy of musician–instrument interactions (finger–valve combinations and articulations) from the perspective of sensorimotor schemes. I have attempted to situate this

thesis somewhere in between the worlds of practice-led research and philosophical enquiry. I believe that the 4E approach is a valuable framework for bringing these areas together. There is also opportunity for more qualitative research—such as phenomenological interviews and participant observation (See Høffding, 2018)—and quantitative research (See Walton et al., 2015; Walton et al., 2018) within the approach I have been attempting to develop. Moreover, I focused much of my attention on the individual improvisor, yet improvisation is very much a social activity. Although I do introduce some aspects of social interaction and culture, this could be expanded upon much more (Krueger, 2011, 2019).

Viewing the improvisor as an adaptive self-organising system within a set of constraints—as I did in chapter four—may have interesting learning implications. One might consider the kinds of constraints that could be useful for enabling learning. What kinds of practise or training is representative of real-life situations? And what constraints direct the improvisor to certain affordances or outcomes? While the ecological dynamics approach is very well established in sports skill development, it has only recently been introduced to the field of musical education and performance. This approach has, however, been gaining momentum as a useful framework for music practitioner research (See Calligeros, 2023; Clarke et al., 2013; Gill, 2023; Schiavio & Kimmel, 2021; Slater, 2020). The two tunes *In Walking* and *Through a Lens* were an example of taking 4E and improvisational concepts and applying them to a creative process. The application of concepts from 4E cognition to musical practice has also been underexplored and may provide novel ways of approach music practitioner research.

The concept of affordances appeared many times throughout the thesis as it is a useful conceptual tool for discussing improvisation. Our musical worlds are rich in available affordances such as: our instruments, ensemble members, audiences, and musical practices (genres) (Krueger, 2014). These affordances become intertwined within our improvised (and

planning) activities. Furthermore, our improvised activities contribute to the enactment and shape the inviting character of these affordances. Plans (as scaffolds for improvisation) may also be viewed as a set of affordances one engages with. Reading sheet music for a piece that has been composed within a classical tradition provides the musician with a whole set of different affordances to someone improvising within a harmonic framework situated within a jazz tradition. Kimmel and Groth (2023) provide a valuable example of how affordances may be used to examine and analyse a creative process. This kind of analysis could be integrated with the affordance-based understanding of improvisation and planning I discussed in the previous chapter. One could use a similar approach to describe the development of a musical work over short and long timescales.

Finally, while I have drawn on enactive cognitive science to understand the nature of improvisation, I am also contributing to the current literature that is expanding the insights of enactive cognitive science across multiple domains. It is my hope that these insights may feedback into how we think about "E" cognition. Both "E" approaches and improvisation research have the opportunity to be mutually benefiting domains of enquiry.

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