Scott Saunders (Grad Dip. Music)

“Towards an Aesthetic of Groove”

Master of Philosophy (Music) University of Newcastle

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Statement of Originality

The thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to the final version of my thesis being made available worldwide when deposited in the University’s Digital Repository, subject to the provisions of the Copyright Act 1968.

31 July 2015

Scott Saunders
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Abstract

The ideas expressed in the word “Groove” (also “Swing” or “Feel”) are commonly associated with the phenomenon of music that induces rhythmic bodily responses, usually expressed through dance. In musicology groove refers to the subtleties of rhythmic performance that are seemingly impossible to notate, instinctive, ineffable. The idea of groove has been recognised informally by musical practitioners and listeners, particularly in the idiom of jazz, during the 20th century and into the present. These same rhythmic phenomena occur in the long and ongoing African musical cultures that informed jazz and other contemporary music forms. In the 21st century groove remains a potent affective musical phenomenon that is highly prized within contemporary popular music culture by musicians, producers and audiences alike, as is demonstrated by the enormous popularity of this music and its wide influence throughout popular culture via hip hop, R & B, EDM, etc.

Despite the widespread influence of groove and a general recognition of its existence and significance, there appears to be no clear and concise musical description of the phenomenon. The aim of this work is to survey the key areas of research and related concepts in the relatively recent field of groove music, and to contribute criteria for groove that are tested against classic examples of the form. The criteria will also be tested through the creative work of original groove compositions, performances and productions by the author.
Chapter 1 Introduction

Outlining and defining the field of research and its significance

I have had a lifelong fascination for the way particular types of music motivates people to dance, and, the pleasurable and even euphoric states that can be induced by continued synchronized movement to dance music. This fascination became a guiding inspiration in my career as a professional musician. After more than 30 years experience creating, performing, teaching and recording music that is designed to make people move, I found myself asking the question “How does groove work?”

In 1990 I attended the New Orleans Jazz and Heritage festival\(^1\) with my partner. At the end of a long day of walking through the dense crowd in sweltering humidity, and having listened to numerous impressive musical acts, we were utterly exhausted. As we headed for the exit, keen to get some rest, we were enthralled by the sounds of the Dirty Dozen Brass Band, an ensemble steeped in the highly syncopated and rhythmically potent New Orleans recipe for groove that has informed so much of 20\(^{th}\) century popular music. We dragged ourselves over to the tent where they were playing, feeling “dead on our feet”, but within a few bars of the next tune we found ourselves dancing ecstatically and we continued to do so for the entire set. What was this mysterious force that breathed new life into us?

The study of groove music is a relatively new and growing field\(^2\), but to date it has been characterised by great diversity of inquiry and methodology. There is a significant body of research and writing on the subject but there is no clear, consistent and coherent theory of groove. This work aims to draw on this diverse body of research and writing on the subject to synthesise a theoretical framework of groove.

If groove has the power to move people, two significant issues are suggested:

- The way groove music functions
- The way people respond to groove music.

The current work is primarily an investigation into the first issue. However this cannot be successfully undertaken without some consideration of the second issue.

\(^1\) (www.nojazzfest.com)

\(^2\) Two new books specifically on Groove were published in September 2014: (Abel, 2014),(Roholt, 2014). As this thesis was being finalised at the time these publications will not discussed.
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This work is written from the multiple perspectives of a groove performer and composer, as well as a music researcher and educator. The aim of this work is to identify the nature of groove and develop criteria to describe and evaluate it in a way that is useful for performers, composers, educators and theorists.

The question this research attempts to answer could be put thus:

*How can the primarily rhythmic phenomena of groove, which relies on specific and idiosyncratic temporal event locations be accurately described and codified to develop criteria for its evaluation?*

**What is groove?**

Descriptions and definitions of groove unfailingly reference motion with respect to the body, and this investigation is part of a larger quest to understand groove’s universality as music that appears to be “designed” by and for the human body. This sense of embodiment includes the externality of physical performance and reception, and the internality of the neurological science of cognition and motor function. The word “Groove” has been chosen from a number of related terms; funk, swing, feel, beat, etc., because it has gained currency with contemporary musicians, writers and researchers as a more general term that refers to, and incorporates, these related ideas. Feld offers the following account of groove:

*In vernacular a "groove" refers to an intuitive sense of style as process, a perception of a cycle in motion, a form or organizing pattern being revealed, a recurrent clustering of elements through time* (Feld, 1988, p. 74)

The current meaning of groove derives from the gramophone and, as a metaphor, is striking. The etymological roots of the word gramophone mean “written-sound” or “letter-voice”; this suggests a kind of text. However, rather than the discrete information of written text or musical score, this is an early example of what would later come to be known as “analogue audio technology”. In this sense the groove in a gramophone disc is a continuous, contoured and literally plastic analogy of time and space, a physical embodiment of sound waves and the movement that has produced them. It is the continuousness and cyclical predictability of the technology that lends meaning to the phrase “in the groove”. What is in the groove is the stylus which, in order to reconstruct the time-space analogue as sound, must maintain a relative stasis, and which surrenders itself to the repetitively revolving groove with the utmost sensitivity. This metaphor is remarkably apt for the experience of groove from the perspective of both the performer and listener. There is a sense of surrender to the music made possible
by the continuity and security of the groove. The stasis of the stylus is also a metaphor for the way the experience of groove can create a sense of “being in the moment”, of “time standing still”. Anecdotally groove is something that the participant should not think about too much or they will “lose it”. This ability of groove to create paradoxical states of effortless concentration and unconscious awareness is central to its effect upon a listener. The gramophone is also important because it is the technology that ended the dominance of text and score for recording and disseminating music, and moved popular musical culture to the aural and oral transmission of folk music, prehistory and pre-literacy.  

The next section surveys the usage of the word groove in order to establish an historical and cultural context for its current usage, and by doing so clarify its meaning.

> Linguistic shorthands like the terms "groove," "sound," or "beat" significantly code an unspecifiable but ordered sense of something (Meyer's "implicative relationships" and "felt probabilities") that is sustained in a distinctive, regular and attractive way, working to draw a listener in (Feld, 1988) p76

Groove is now a familiar word that has entered common usage in multiple languages and which has attracted growing research interest, and the fact that it may be used as a noun or a verb and, by conjugation, an adjective or adverb in a variety of different contexts demands some clarification. The word groove has been used for centuries, with synonyms like, rut, furrow, channel etc., The meaning changed with the introduction of the gramophone, as discussed above, and the literally grooved discs it utilised. The ideas expressed by the words “Groove”, “Swing” and “Feel” usually refer to the subtleties of rhythmic performance that are seemingly impossible to notate, instinctive and ineffable. During the 20th century this concept has been recognised informally by musical practitioners and listeners particularly in, but not limited to, Afro-American musical idioms including Jazz, Soul, Funk and Latin. When the Duke Ellington song states “It Don’t Mean a Thing if it Ain’t Got that Swing” (Ellington, 1932), a song that introduced the term “Swing” to a wider public and heralded the Swing Era of the 1930s, both musicians and listeners understood what was being expressed even if they could not articulate its meaning.

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3 There are parallels here with Marshal McLuhan’s writing on 20th century media and popular culture after the “Guttenberg Universe” of printing and text based communication.
The musicological definitions of western art music have struggled at times in addressing the questions of groove or swing, as the definition below attests:

A quality attributed to jazz performance. Although basic to the perception and performance of jazz, swing has resisted concise definition or description. Most attempts at such refer to it as primarily a rhythmic phenomenon, resulting from the conflict between a fixed pulse and the wide variety of actual durations and accents that a jazz performer plays against that pulse (Robinson, 1988).

For all the apparent lack of definition, this quote focuses on two of the most essential characteristics of groove, being:

- The establishment of a clear and consistent pulse (whether actual or virtual)
- The highly sophisticated and repetitive temporal arrangements of musical events with reference to this pulse.

The New Grove Dictionary of Jazz defines the word groove in a manner closer to current usage. It locates its appearance from the mid 1930s and is coincident with the aforementioned Swing era. The meaning of the term “groove,” and the question of whether or not it is present in a performance, is every bit as arguable and qualitative as “swing”, and if possible even more elusive, because it applies so far beyond the world of jazz. Within jazz circles, Gold identifies the phrase “in the groove” – which from around 1936 to 1945 (i.e., during the height of the swing era) was in widespread use in referring to jazz performances which were “excellent” or, by extension, “sophisticated” – and the term “groove” – referring in the 1940s and 1950s to “routine, preference, style, source of pleasure.” These usages underline the importance of aesthetic judgements in identifying the presence of, or evaluating, a groove; by further extension, a groove might perhaps be boring, or bad, or an inept appropriation (B. Kernfeld, 1988).

This suggests that groove is an aesthetic term that evaluates music’s ability to provide a “source of pleasure” and, within the context of the Swing culture of this era, one could assume was inextricably linked with the music’s ability to induce and sustain dancing. It could also be inferred that the pleasure referred to is a sustained state of consciousness, hence the phrase “In the groove” which appears in the titles of two sound recordings from this era;

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4 The concept of “Swing” as a musical device is closely related to groove (as seen above) and will be discussed in detail later.
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“In the Groove” (1937, Decca 1621), by Andy Kirk’s Big Band and Chick Webb’s “In the Groove at the Grove” (1939, Decca 2323). This use of the word groove as a noun suggests the possibilities of: a universal “groove consciousness” that can be entered into, that music can have “a” (indefinite) groove, or it could refer to a more specific “the” (definite) groove. This research aims to identify general criteria for groove in music that can be applied to the analysis of specific, groove examples.

Groove can also be used as a verb, both in the context of performance and reception. An individual musician or an ensemble can be “grooving”, as can the audience and dancers, depending upon the quality of groove provided by the music. Eventually, by the mid 1960s, the word had assumed an adjectival form as “Groovy”, and became an all-purpose superlative, along with all that was “hip”, “cool” and “with-it”, for the post-beat generation of young hipsters and hippies. This zeitgeist was effectively captured in the Paul Simon song “Feelin’ Groovy” (Simon, 1966). This usage suggests that the meaning and usage of groove had expanded to describe a psychological state of being “at one with the world”. This transcendent consciousness can be a significant component of a groove experience and a major motivation for creating groove. With reference to the same mid 60s time period, the Google Ngram viewer (Ngram, 2014) (an online analytic tool for tracking word usage in publications) registers the appearance of the terms “Groovy”, “Funky” and “Groove Music” around 1965. Here the usage is a categorical adjective that identifies a musical style based around groove, and which also coincides with the emergence of a closely related stylistic innovation described as “Funk”, as exemplified by the James Brown band of that time. As Danielsen observes in a paragraph with the heading “From Songs to Grooves”:

“Cold Sweat” is often regarded as James Brown’s first funk tune. The groove is not very different from a predominantly R&B song such as “Papa’s got a Brand New Bag”. Nevertheless the change is substantial (Danielsen, 2006) p40 (my emphasis).

Danielsen goes on to talk about the “Grooves of James Brown” and “Funk Grooves”. This usage suggests that a distinction between the terms groove and funk is necessary for the clarity of this work. Funk applies to stylistic and cultural aspects of a piece of music that originated from a specific period and is underpinned by the rhythmic structures of groove. Funk can be viewed as a type of groove music, or conversely, funk music by definition must have a groove. This idea can be applied to other musical styles, for example, “Swing music” as a style can be said to have a groove, as discussed above. Swing is also a specific rhythmic technique that can be
used in creating a groove. Confusion surrounding some of these terms will be addressed in later chapters, an important part of the purpose of this work. Groove is the internal engine that drives various styles of music.

It is important from the outset to make clear that aspects of groove can, and have, appeared in various disparate musical cultures and at different times and locations. Elements of groove can be found in traditional music throughout the world as well as in various works in the western classical canon. However, the historical, cultural and musical reference period for this research encompasses the later part of the 20th century to the present. This research also aims to address the development of groove in the 21st century and to speculate on future developments.

The dominant groove paradigms in contemporary popular music are informed by a predominantly Afro-American cultural context and by the musical cultures of the pan-African diaspora. To understand contemporary groove music, it is necessary to refer to its African genesis. Current groove music can be viewed as the survival and adaptation of African musical forms brought to the Americas by African slaves. One of the focal points for this conservation of African cultural tradition was New Orleans and specifically “Congo Square”, an open-air civic space in the city. Louisiana was under French jurisdiction until Napoleon sold it to the United States in 1803. Unlike in the other North American colonies that were British ruled the French had allowed the African slaves in New Orleans to keep their drums, and other instruments, and to congregate on Sundays to play, sing and dance. This practice was maintained well into the 19th century, and was vitally important in nurturing and cross-fertilising African musical practice, and ultimately informing jazz and other highly significant American musical traditions. These quotes, from a chapter entitled “The Pre-History of Jazz” in Gioia’s History of Jazz, are apposite.

*The scene could be Africa. In fact, it is nineteenth century New Orleans. Scattered first hand accounts provide us with tantalising details of these slave dances that took place in the open area then known as Congo Square* (Gioia, 1997) p3.

*One thing however is clear. Although we are inclined these days to view the intersection of European-American and African currents in music as a theoretical, almost metaphysical issue, these storied accounts of Congo Square dances provide us with a real time and place, and actual transfer of totally African ritual to the native soil of the New World* (Gioia, 1997) p4.
As a result of this, the ethnomusicology of African music continues to provide insights into the structures of contemporary groove music.

Contemporary groove music reached a transformative and defining musical, historical and cultural phase in late 1960s/early 1970s black America, a period that produced some of the most iconic and influential groove based music. This critical period was the apotheosis of Afro-American musical development in the post war decades that saw the flowering and cross-fertilisation of Gospel music, with its extended and ecstatic transcendental repetition and chanting, the “soulful” sounds of “Hard Bop” jazz, the maturation of a “Rock’ n’ Roll” production techniques, Miles Davis’ exploration of modal composition, rock timbres and funky drumbeats, and the rise of the DJ based club dance culture and the “Discotheque”. The background of civil unrest, the assassination of Martin Luther King Jnr and a newfound “loud and proud” black consciousness also informed these developments. The groove-based music of this period was the product of the preceding decades of musical development, and has continued to inform and shape the groove music of subsequent decades. Many would argue that this music has provided the quintessential templates for contemporary groove based music. James Brown’s Funky Drummer (1970) and the Winston family’s Amen Brother (1969) became the most sampled and re-purposed musical artefacts of the late 20th century, and provided foundation templates for hip-hop and related music cultures that followed. The pre-eminent practitioner and self-proclaimed originator of the “funkiest groove styles” was James Brown, but he did not achieve this without the contributions of band members, particularly the bass player of the time, Bootsy Collins, and the drummers Clyde Stubblefield and Jabbo Starks, who were responsible for shaping a prototypical funk groove style.

Through the development of sampling technology, and the compositional and production strategies it afforded, musicians were able to deconstruct these and other classic recordings to extract the groove as a digital audio artefact to be repurposed and incorporated into new compositions and productions. Hip hop production, for example, grew out of a vinyl based DJ culture of turntable manipulation that made an already repetitive musical form even more identically repetitive. By spinning back and repeatedly replaying sections of records that were mostly just a “rhythm section groove” to create a backing for MC to rap over, the contemporary groove aesthetic was created. The advent of the sampler meant these “break”

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sections of the song could be digitally captured and triggered at will. Where grooves used to be transferred and reproduced through performance and memory, digital audio technology has created the possibility for an archive or lexicon of grooves to exist as cultural objects or creative capital, so called “breakbeats”.

*Breakbeats are drum patterns sampled from percussion-only sections, or “breaks”, of old funk records. As in Hip Hop music, where the practice of sampling breakbeats began, some of the most widely used breaks in EDM come from James Brown tracks* (Butler, 2006) (Butler, 2006) p78.

As a result of this development in music production methodology, current Digital Audio Workstations (or DAWs) like *Logic Pro* or *Ableton Live* now come with a library of drumbeats, bass lines and other assorted groove templates as compositional materials.

The most profound recent development in groove, and one that creates new challenges for groove studies, is the ability to design a rhythmic “performance” offline, in non-linear digital production environments. Whereas groove was once the domain of expert performance, of subtle gestures and human “feel”, rhythms can now be programmed with extraordinary exactitude to create un-performable performances. This has produced what have been identified as two paradoxically different effects, “exaggerated expressivity” and “exaggerated virtuosity” (Danielsen, 2010). In exaggerated expressivity the micro-timing placements of rhythmic elements are highly idiosyncratic and located in a way that is difficult to replicate in human performance. There may also be multiple rhythmic structures co-existing that could be potentially contradictory and confusing for ensemble performers. On the other hand, the exaggerated virtuosity includes, for example, an extremely rapid succession of events beyond human motor control, or an extreme metronomic accuracy in the performance. A good example of this can be seen in the music of Kraftwerk and in early drum machine driven hip-hop music that was accompanied by the robotic “body-popping” dance styles of its “B-Boy” devotees. One could speculate that the pleasure here is derived from a sense of “super human” motor control. This fact points to one of the strange conundrums of groove. Human beings can be highly sensitive to and profoundly affected by the finest of temporal detail in a variety of rhythmic structures composed of seemingly contradictory qualities.

Some music may exhibit groove criteria momentarily or in a limited form, and it has been argued that groove characteristics appear in many musical traditions and practices, including,
for example, early western music. The challenges presented in developing criteria of this nature are eloquently expressed in this quote:

_Extreme caution should be exercised in evaluating the universality of a theory. If it is too specific to a small domain of musical phenomena, a theory may mistake the unique aspects of a very few compositions for general principles. On the other hand, if the theory is too general, the degree to which it may illuminate specific problems may be marginal when compared with the effort expended in arriving at general principals and solutions._ (Yeston, 1974) p148.

The most efficacious way to proceed is to match the criteria against an idealised groove music in which most or all of the criteria being discussed are persistent and pervasive. This will be demonstrated in the analysis examples in Chapter 4, some of which have come from the “Golden Age of Groove” discussed above.

Establishing criteria of any kind involves identifying the component qualities of a phenomenon and, in some cases, establishing metrics to evaluate them quantitatively.

The following quote gives a sense of the scope of this enquiry:

_The power of music is in its participatory discrepancies, and these are basically of two kinds: processual and textural. Music, to be personally involving and socially valuable, must be “out of time” and “out of tune.” For “participatory discrepancies” one could substitute “inflection,” “articulation,” “creative tensions,” “relaxed dynamisms,” “semiconscious or unconscious slightly out of syncnesses.” For “process” one could substitute “beat,” “drive,” “groove,” “swing,” “push,” etc., and for “texture” one could substitute “timbre,” “sound,” “tone qualities” “as arranged by,” and so forth_ (C. Keil, 1987) p275.

This gives a good starting point for establishing criteria for groove, and indeed some of these terms or related concepts will appear in the criteria. In particular the terms used here for the “processual”, ⁶ that is, “beat”, “drive,” “groove,” “swing,” “push”, all imply motion of some kind and allude to the central feature of this music: the creation of a cognitive response that initiates and sustains actual or virtual human movement.

It is central to the aims of this research to establish a rubric of concepts that can provide an analytical framework that can be applied to this discussion of the examples of groove music and the creative folio in this thesis, define the criteria for groove, and therefore posit a definition of groove.

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⁶ By processual Keil means (inter)-active, performative, in real time.
There is an important distinction to be made between the structural musicological phenomena and their perceptual and cognitive processing by a participant. The use of the word participant is a nod to Keil and his previously mentioned concepts, participatory discrepancies and the participatory mode. Far from being a recent musical phenomenon located within a contemporary cultural context, groove is possibly the most universal, primal and essentially human of musical activities. It has been argued that ritualistic activities at the very emergence of human culture could have involved music that meets the criteria for groove, and that groove is involved in the development of evolutionary adaptive behaviours:

_I will be specifically concerned with musical emotion—how music produces emotion, and what musical emotion is or does. In an ethological view, the biological purpose of emotions is to motivate behavior—to make us respond appropriately to the sorts of occurrences in the environment that could affect us, for good or ill. In this sense, then, musical experience was originally functional_ (Dissanayake, 2006) p1.

At the other end of the historical timeline the current success of groove based music in colonising popular culture, like a musical virus, has reached near ubiquity. Afro-American groove styles such as hip hop, R & B, house and techno have become the dominant paradigms of popular music internationally, and the videos that accompany the music regularly contain images of dancing, in particular synchronised group dancing. There is a clear anthropological parallel to be drawn here between the African cultural mores that informed current Afro-American based groove music, with their fluid distinction between performer and audience, and the current groove context of nightclubs, festivals and the like where the audience/dancers are the performers who are under lights and performing what could be characterised as contemporary mate selection rituals. The possibility of exploring the continuity between the pre-historic and the present day incarnations of groove is compelling and tantalising. Pursuing this would far exceed the scope of this work. Nonetheless this broad cultural context informs the ethos of this work.

One of the primary aspects of groove is its relationship to both the human body and embodied cognition. One hypothesis put forward in this research is that groove music is essentially a gestural music that is formed and scaled in a way that optimally accommodates the human body and assists in organising comfortable energised movement. Research in this area (Waadeland, 2001) points to the idea that human beings process sounds in terms of perceived
sources. These sources may include non-aural input. Groove music appears to maximise this effect and produce empathetic motor responses that connect multiple regions of the brain. This explains the way groove music combined with the visual stimulus of other dancers, be they in a video clip or sharing the dance-floor, can create a “contagious” effect. In this sense a phrase such as “infectious rhythms” seems accurate rather than metaphorical.

The study of music psychology and cognition has identified a complex of inter-related neural structures and mechanisms that are the areas most involved in experiencing and responding to groove, as well as being the areas which groove could activate to the benefit of the wellbeing and functionality of the neural systems. Therefore the production and appreciation of groove has the potential to create both affective and effective positive human responses by engaging with the most fundamental cognitive and motor functions.

**Summary**

Thus far in this thesis a sense of what groove is, a cultural, historical and musicological context for groove music, and an understanding of the development of groove and its ascendancy to dominance in contemporary popular music have been established in general terms. Groove is now an accepted concept, a common and influential musical technique and has a significant affect and effect on listeners. It describes musical/rhythmic phenomena that can be identified intuitively (implicit knowledge). However, a clear and empirical description of the phenomena is needed (explicit knowledge).

**Structure of the thesis/exegesis**

The aim of the current research is to:

1. Describe and explain groove as a musical phenomenon
2. Review and synthesise research and writing on groove
3. Develop criteria for groove
4. Apply this criteria to key examples of the form
5. Apply the criteria to a folio of original work
6. Discuss conclusions and future directions for groove research

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7 *There is some similarity here with William Burroughs’ statement “language is a virus”. (Burroughs, 1962)*
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The structure shown above is reflected in the 6 chapters of this thesis and demonstrates a logical progression from idea to research, categorisation, testing against examples and demonstration of current creative practice.

Chapter 1 has introduced the idea of groove, described the appearance of the term and its musical, historical and cultural context and explored the usage of the word and the gramophone metaphor that informed grooves appropriation into a contemporary idiom.

Following the introduction Chapter 2 is a literature review of writers and technologies. It will develop further the musicological and cultural context for a discussion of groove and identify key concepts and arguments. Because the body of literature specifically addressing groove is relatively recent and limited this chapter surveys a wide range of texts from disparate disciplines to establish a framework for the analysis of groove. The utilisation of groove concepts in the design of significant music production technologies and products, and their application and musical outcomes will also be addressed to afford further insight into the nature of groove.

Having established a language and context for the discussion of groove in Chapter 2, Chapter 3 is the pivotal chapter in the work that proposes criteria for groove music based upon the evaluation and synthesis of relevant ideas from the previous chapters. This chapter will identify and describe some of the most common techniques and characteristics that create the phenomenon of groove in music. The intention is to develop criteria for groove that are not only useful in the analysis and discussion of groove in music but also to assist in the creation of effective groove outcomes by performers, producers and composers.

In Chapter 4 The criteria developed in Chapter 3 will then be tested against three examples of groove music, two from the influential early period of groove music: “Sex Machine” (Brown, 1970) and “Chameleon” (Hancock, 1973) and a third example that illustrates recent developments in groove production, “Numbers on Boards” (Thornton, 2013). The intention is to test the criteria against recognised examples of groove music that, in the case of the first two works, are seen as iconic touchstones for subsequent music, the third work being a contemporary example.
Chapter 5 discusses the original creative folio of musical works by the author using the criteria outlined in Chapter 3 and the analytical methodology developed in Chapter 4 and applied to classic groove examples. The works in the folio represent a range of styles and strategies for groove composition and production including commissioned work for a large-scale community music project and laptop based digital music production. The significance of this chapter, as with this research in general, lies in identifying composition and production strategies that have been implicit and based on unconscious habituation and entrainment through years of performing and producing, and making this knowledge explicit to exert greater creative control in developing groove music. The choice of works demonstrates both the intuitive process demanded by commissions and deadlines, and a more conscious experimentation with the possibilities of non-linear digital audio production software. It is important to note that when appraising groove examples in the folio the nature of the form makes the significance of duration of the work problematic. Some of the work will appear to be “miniatures” however the creative focus of groove creation is to create a highly effective structure of a few seconds duration that becomes the cyclical base for a performance that is indefinite in duration. The “devil is in the detail” and a good analogy for groove creation could be the design and construction of a highly sophisticated watch mechanism.

Chapter 6 provides a conclusion and speculation with a general discussion of groove music research, its possible future directions and applications.
Chapter 2 Literature review of writers and related technologies

As discussed in the previous chapter groove is not a new phenomenon but is a relatively recent field of research. The most primal proto-musical activities of human beings may have had groove attributes, and the same attributes can be found in a vast range of musical practice throughout history and in various geographical regions and cultures. It is of interest that it has taken so long for groove to attract serious attention. The study of groove has presented significant challenges to music research, and has necessitated an intensified effort to create an analytical language and methodology to understand it. It should also be clear that groove is a multi-dimensional human phenomenon that involves an intimate and symbiotic relationship between mind and body that can be viewed from multiple perspectives and disciplines. Like the parable of the blind men and the elephant, examining differing elements of groove can provide seemingly unrelated outcomes. As a result, this literature review is necessarily disparate in nature and has been organised by discipline or area of research.

Overview of research

The study of groove is located within a general reappraisal of and investigation into the nature of musical rhythm in the late 20th century. The discussion of groove has been informed by significant music theory texts of this period, sometimes reaching the limits of these texts with respect to explaining and describing groove as a departure point. The rhythmic analysis and descriptions applicable to music of a classical western canon has, for example, commonly referred to poetic feet (iambs, dactyls, etc.) and systems of stresses and accents, however these strategies are ineffective when investigating the complexity and subtly of groove rhythms. Several writers, notably (Cooper.G.W&Meyer.L.B, 1960; Lerdahl, 1983; Meyer, 1956; Yeston, 1974) have contributed valuable insights to this discourse on rhythm, and in so doing have drawn on other disciplines, such as psychology, philosophy and linguistics, to inform their various projects. Although none of them have anything to say that directly addresses the concept of groove, they are important references that inform the following generations of writers who are investigating groove. Examples of extra-musicological perspectives include: a gestalt psychology approach to pattern recognition in rhythm, a shift towards the importance of the listener’s active participation in constructing musical meaning, (Lerdahl, 1983), and a stratification approach to rhythm (Yeston, 1974). These works were, in some cases, an attempt to deal with the post war developments in serious music, (serialism, atonality, rhythmic complexity, etc.) and, although useful insights and concepts were introduced, this new music
theory was still not able to describe, analyse and evaluate the phenomenon of groove in music.

**Groovology**

The formal study of groove begins with Charles Keil and his coining of the term “Groovology”. His article *Motion and Feeling through Music* (C. Keil, 1966) is a spirited response to Leonard Meyer’s (1956) book *Emotion and Meaning in Music*. Keil succinctly addresses the perceived inadequacies of Meyer’s theory with respect to non-Western musical traditions and, in particular, African and African influenced jazz and Latin music. One of the key issues addressed by Keil is that Meyer, and by implication western art music, has focussed on the syntactical and structural aspects of music (notation/scores) at the expense of the subtleties that give rhythmic music significance to a listener: improvisation, performance and gesture. Keil does not refute Meyer, but observes that the theory is incomplete and cannot be effectively applied to an analysis of the large and growing body of groove music. Keil has been a champion for the cause of groove studies for decades. His work has contributed many concepts and terms that have become widely referred to in subsequent literature including “participatory discrepancies” or the small “differences that make a difference” in the temporal location of musical events that appear through the interaction of ensemble performance, in particular improvised jazz. These phenomena can also be found in the multi-rhythmic group performances of African music or the multi-limbed performance of a drummer. This is an enduring concept in groove discourse that focuses debate on the micro-rhythmic detail. Keil also coined the terms vital drive meaning the perceived energy generated by groove and swing and “engendered feeling”(C. Keil, 1966) as a counter to Meyer’s (1956) “embodied meaning”. This is a fundamental shift in musicology from a formalist analysis towards an approach informed by cognitive science, psychology, linguistics, aesthetics and philosophy. From effect to affect, from the conscious to the unconscious and also, a shift that introduces the body into the discussion. The nature of this shift is captured in this quote:

> Even in these civilized musical systems, syntax does not invite the listener to participate in the phenomena with the same powers that process and texture have. It is really only in relatively recent historical periods of Western music that syntax and a peculiarly rationalist approach to it (Weber 1958) have managed to squeeze the mysteries of musical participation to the furthest corners of our awareness (C. Keil, 1987) p275.

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8 Meyer’s use of the word “embodied” is confusing and unfortunate with respect to the current discussion. He refers to meaning that is “embodied” in the music itself as distinct from the “designative” meanings of words or signs.
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Keil remains a tireless and passionate advocate, some might say evangelist, for the relevance and possible extramusical applications of groove:

*The budding field of applied groovology is in the process of being defined. We hope it will include fields as diverse as comedy timing, sports psychology (in the zone), physiotherapies (in flow), etc. (C. C. Keil, P., 2012)*

Popular music and ethnomusicology have made a significant contribution to developing an understanding of groove music, because the study of non-western music demands a non-score based analysis of musical performance within cultural and social contexts. Furthermore the insights into the complex multi-rhythmic structures of African music can be applied effectively to an analysis of the Afro-American groove music. Notably, Charles Keil’s close friend and colleague, (Feld, 1988), is an ethnomusicologist and co-authored *Music Grooves* (C. Keil & Feld, 2005), a key text in the field. Feld (1988) has written extensively on Papua New Guinean culture and described alternative forms of musical consciousness applicable to groove. Ethnomusicological studies of African music (Nketia, 1974) have developed new paradigms for musical analysis informed by cultural, anthropological and sociological perspectives that are appropriate to an understanding of groove music. Like the African music that is clearly its primary source, groove music exists in a cultural context that is performative and involves an (inter-)active, dancing and collaborative audience. This is a culture of musical community where the musical experience is the product of everyone present, and where the distinction between audience and performer is less defined and more fluid.

**Groove and embodiment**

Many definitions of groove (and swing) focus on the response of the listener and the ability the music has to induce bodily movements. The following are typical:

*Swing occurs when a listener inadvertently starts tapping his foot, snapping his fingers, moving his body or head to the beat of the music* (Schuller, 1989) p223.

*The practical question is something like: what do we have to do with our bodies playing these instruments and singing in order to get their bodies moving, bobbing their heads, snapping their fingers, up from their tables and dancing? The mystery: how do people and musicking become consubstantial, a communion, communitas, a sacrament, the music inside the people and the people inside the music* (C. Keil, 2004) p1
When exposed to music that we perceive as swinging, we often want to tap our foot, clap our hands, move our body, or, perhaps, dance to the music. In this way we experience how swinging and “groovy” music initializes “energy” and generates movements in our body, thus, various body movements may be seen as a consequence of an experience of swing (Waadeland, 2001) p23.

In the realm of jazz, a persistently repeated pattern ... Connections to dance are important, and the statement that a performance has, or achieves, a groove, usually means that it somehow compels the body to move. Still more generally, the term has a sexual origin and connotation that is obvious, requiring no explanation (Barry Kernfeld, 1988).

Positing groove with reference to the body, as in all the definitions cited above, is common and telling, particularly through the reference to a sexual origin, as it suggests that a more complete understanding of groove may be achieved through an exploration of the relationship between the musical phenomena and the embodied human responses they elicit. A more thorough exploration of embodied cognition and groove would be rewarding, but is outside the scope of the current work; suffice to say that this recognition of embodiment is important to a definition and understanding of groove. The rise in the study of groove coincides with and corresponds to an interest in embodiment and gesture, not just within music and the arts but also other disciplines. The Philosophy of (Merleau-Ponty, 1962) is apposite here, as is (Johnson, 2007, p. 8) who has also contributed insights regarding embodied cognition relevant to the understanding of groove.

Merleau-Ponty saw correctly that gestures have embodied meaning in just the same way as art does. Here is the way he thought about this. A composer does not first have pre-conceived meanings in her head, which she then somehow cleverly expresses in musical pitch contours. Merleau-Ponty saw that the meaning emerges only in and through the act of making music. Music is not an external sign system we use to express non-musical meanings or concepts. Rather, the meaning exists in the enactment (Johnson, 2007) p93.

And, The musical meaning of a sonata is inseparable from the sounds which are its vehicle: before we have heard it no analysis enables us to anticipate it; once the performance is over, we shall, in our intellectual analyses of the music, be unable to do anything but carry ourselves back to the moment of experiencing it. During the performance, the notes are not only the ‘signs’ of the sonata, but it is there through them, it enters into them (Merleau-Ponty, 1962) p182.
The composer and theorist Roger Sessions had similar insights into the importance of embodied musical experience:

> It seems to me that the essential medium of music, the basis of its expressive powers and the element which gives it its unique quality among the arts, is time, made living for us through its expressive essence, movement.... Similarly, our feeling for rhythm in the stricter sense, derives from the subtle and more expressive nervous and muscular movements, such as occur in speech, song, gesture, and the dance (Sessions.R, 1963) p105.

**Psychology and Neurology**

This focus on embodiment with respect to groove is found in (V. Iyer, 2002) who refers to current research into cognition and perception that points to a strong neurological relationship between rhythmic perception and motor control. Researchers in music psychology and neurology describe structures and cognitive processes that work together fugally and argues that musicality, and particularly rhythmicality, are essential to the physical and emotional functionality of human beings:

> The characteristics of human moving that we are calling "musicality" are innately adapted to be inter-mental, inter-subjective phenomena transmitting information about rhythms in minds of human actors. Musicality appears to be a human psychological process intimately linked with the unique intensity of the human need to make, learn and transmit meaning in the experience of acting in common social experience. And its uniqueness is, I believe, rooted in the peculiar way we, as an intensely social species, walk about in the world, manipulate it and express our selective will and imagination in polyrhythmic narratives of bodily mime while we share person-person-object awareness (Trevarthen, 1999) p155.

Groove music appears to utilise these structures and, in doing so, may help to regulate and exercise them, resulting in positive health outcomes. It could be argued that groove music is a very pure and direct musical expression of our motor neurological system. It seems telling that, in this work, musical metaphors are sometimes used to describe the neurological functionality such as:

> It is proposed that evolution of human bipedal locomotion and the pressure of social intelligence set free a new polyrhythmia of motive processes, and that these generate fugal complexes of the Intrinsic Motive Pulse (IMP), with radical consequences for human imagination, thinking, remembering and communicating. Gestural mimesis and rhythmic
narrative expression of purposes and images of awareness, regulated by, and regulating, dynamic emotional processes, form the foundations of human Intersubjectivity, and of musicality. Acquired musical skill and the conventions of musical culture are animated from this core process in the human mind (Trevarthen, 1999) p155. (My emphasis)

This counters Stephen Pinker’s (Pinker, 1997) claim that music is just “auditory cheesecake” or the pleasant by-product of evolution.

Theory of gesture

Middleton (Middleton, 1993) discusses the concept of groove and specific genre grooves in developing a methodology for popular music analysis that combines the formalism of musicology with the techniques of anthropology and cultural theory.

My proposal is directed towards a search for a theory of gesture. This I understand as possessing affective and cognitive as well as kinetic aspects - by which I mean simply that how we feel and how we understand musical sounds is organised through processural shapes which seem to be analogous to physical gestures. Such a broadened notion of gesture does not deny that in some sense a theory of gesture would be also a theory of rhythm; but a satisfactory theory of rhythm is one of the things musicology does not possess, and if it did, it would necessarily encompass far more musical parameters than just the obviously rhythmic (Middleton, 1993) p177.

For the sense of groove under discussion in this theory, gesture is crucial in making the link between the music and the embodied cognition of co-ordinated motor responses in the listener. The current work could be seen as an answer to Middleton’s call for a “theory of rhythm”.

Waadeland (Waadeland, 2001) is the Norwegian musicologist who has studied the ability of listeners to “recover” bodily movements from musical information. This work is placed in the context of Plato’s idea of rhythmos as “ordered motion” and several German musicological studies of the 20’s and 30’s that discuss “gestural rhythm” in listeners and conductors.

A very interesting approach in classifying motional aspects of rhythm experience is given by empirical studies which demonstrate that listeners can recover motion information in the musical acoustic signal and convert this information into overt movements of the body. In these studies the principal methodology for demonstrating that in fact music does convey movement information is the reconstitution of an analogous spatial movement by a human listener. The
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listener’s body thus acts as a transducer for the coding of musical movement (Waadeland, 2001) p24.

Waadeland has also developed a useful mathematical model involving frequency modulation to generate rhythmic deviations. These researchers and writers have all approached the same problem of groove, but have asked different questions and employed different methodologies. Middleton has placed the music in a cultural context; Iyer is a jazz and hip hop musician who has attempted to look inside the experience of groove; and Waadeland is a percussionist with a mathematical background who has attempted to find a way to accurately describe and categorise temporal phenomena.

In keeping with the importance of the listener’s response in understanding groove expressed previously in this work, Madison has conducted quantitative psychological research into this area. These researches explored the categorisation of musical styles with reference to the amount of groove and swing perceived by the listener. Some of the results are summarised here:

There is a quality of music that makes people tap their feet, rock their head, and get up and dance. The consistency of this experience among listeners was examined, in terms of differences in ratings across 64 music examples taken from commercially available recordings. Results show that ratings of groove, operationally defined as “wanting to move some part of the body in relation to some aspect of the sound pattern,” exhibited considerable interindividual consistency. Covariance patterns among the 14 rated words indicated four prominent factors, which could be labelled regular/irregular, groove, having swing, and flowing. Considering the wide range of music examples used, these factors are interpreted as reflecting psychological dimensions independent of musical genre and style (Madison, 2006)p201.

The significant point here is that a neurological and psychological predetermination for groove response appears to be a common human trait. Madison also acknowledges that he is one of a relatively small group doing similar research into groove, and cites several of these authors including Iyer (1998), Keil (2005), Prögler (1995) and Waadeland (2001). This is an area of research that could yield significant insights into the nature of groove music through an analysis of a range of specific physiological and psychological responses to various musical stimuli.
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Scandinavian research

The most coherent, or at least interconnected, body of research on groove music to date has come from Norway and Sweden, with Anne Danielsen at the University of Oslo being one of the driving forces. Her seminal work on James Brown and Parliament (Danielsen, 2006) and her insightful articles have made significant contributions to the debate. To inform her work, Danielsen (2010) has drawn upon an impressive and extensive range of thinkers, including musicologists, philosophers, anthropologists, linguists, cultural theorists and historians. She has also edited a book, with several contributors from The University of Oslo music department that addresses the brave new world of musical rhythm in a non-linear digital context. This book demonstrates new methodologies for groove research that can be applied to the most recent developments in rhythmic composition and production by combining digital audio technology with informed and expert knowledge of groove music genres. (Kvifte, 2004) is another voice in this Scandinavian school who refers back to Keil and yet looks to mathematical and statistical models to describe not only African-American musical phenomena, but also the phrasing of traditional Norwegian fiddle playing. He also refers back to an important earlier research project headed by Bengtsson et al. that developed the concept of “SYVAR” (a contraction of “Systematic Variations”) and that has some resonance with Keils’ Participatory Discrepancies or PDs.

Shortly, it is about investigations that take their point of departure not in the printed score but in sounding ‘musical’ events, and that partly study properties of these events, and partly relations between these properties and reactions of the receiver (Bengtsson. Gabrielsson, 1969) p49.

Madison (Sweden), Danielsen and Waadaland (Norway), mentioned above, have added to an apparently disproportionate groove research momentum that is centred in Scandinavia.

Anacrusis

An important contribution to an understanding of groove is The Power of Anacrusis in Rhythm (Butterfield 2006). As stated in its abstract:

Research on expressive micro-timing in jazz and other groove-based musics has largely followed suit and neglected the relevance of syntactical pattern for the production of engendered feeling. By contrast, I propose that engendered feeling arises from the systematic interaction of participatory discrepancies with aspects of syntactical pattern. Supplementing Christopher Hasty’s theory of metric projection with empirical research on expressive micro-timing, I show how participatory discrepancies, operating at the sub-syntactical level, condition
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the way we experience rhythmic grooves at the syntactical level specifically through the operation of anacrusis at multiple levels of rhythmic structure, for it is the strategic manipulation of anacrusis that drives an effective groove (my emphasis).

Where Keil has focussed his interest on the sub-syntactical Participatory Discrepancies (PDs), the work of Butterfield is compelling in its explanation of the way groove works on a syntactical or structural level. Although the micro-timing details of a groove are important, Butterfield shows that groove music is propelled by anacrustic gestures, thus building on the work of Hasty:

Christopher Hasty’s theory of metric projection, elaborated in his book Meter as Rhythm (1997), provides a useful analytical framework for illuminating the production of engendered feeling at the syntactical level in groove-based musics. Hasty characterizes meter in terms of the ongoing “projection” of durations. The beginning of any particular sound event—a clap, for example—opens up a potential for the becoming of duration (Butterfield 2006).

Butterfield describes anacrustic rhythmic events as:

...seeming to come, as it were, “from nowhere.” Anacrusis points forward; it is anticipatory, directed toward a future event. Continuation in a sense points backward as a denial of ending for a prior beginning (Butterfield 2006).

This discussion, which draws on the work of (Hasty, 1997) and is another response to the ever-present Keil, contributes some important insights into groove. Firstly, it questions the assumption that the key to understanding groove resides wholly within the micro-timing differences or sub-syntactical, participatory discrepancies, and counters this with a convincing argument that demonstrates, with the supporting analysis of examples, that the syntactical, structural and therefore notatable elements of the music can be equally significant factors in creating groove. Secondly, it argues that the mechanism of anacrusis in rhythm is fundamental to groove.

Butterfield’s integration of different levels of analysis in the form of score excerpts and micro-timing data creates a more complete and convincing description of the mechanics of groove. This recognition of the primary importance of anacrusis in music is neither new nor specifically related to groove:

The sense of effort, preparation, suspense, which is the psychological equivalent of the up-beat, finds its prototype in the act of inhalation, and the sense of weight, release, and finality produced by the down-beat corresponds most intimately to the act of exhalation. “In the
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“beginning was rhythm”, remarked Hans von Bulow; another distinguished musician remarked later that life begins, according to this above analogy, with an up-beat, the first breath of the new born child corresponding to the preparatory anacrusis of a musical statement, and ends, like the most natural and satisfying rhythm, with a down-beat (Sessions.R, 1963, p. 108).

EDM (Electronic Dance Music)

Recent decades have seen a steady growth of groove-based music from an underground predominantly urban and black culture to its current global domination of popular music. This is unquestionably the music culture that is producing and consuming the greatest amount of groove music both at the present time or any time. A common general descriptor for a range of these related musical styles is Electronic Dance Music, EDM. A more specific and genre focussed research project into the Electronic Dance Music/DJ culture that has steadily developed since the 1970s has been undertaken by (Butler, 2001, 2006) This work provides a well-informed and critical analysis of the more electronically mediated developments in groove music that have become ubiquitous in popular culture. The book contains many examples that are well documented with scores, diagrams and an audio CD including, for example, analysis of the classic Detroit techno track “Jerical” by Jeff Mills, “Cups” by iconic UK dance act Underworld and several others. Although this appears to be a specialist investigation into a specific genre, the principles discussed significantly correspond with other research, and can be applied to groove theory in general.

Technological implementation

Groove concepts have been used in the design of digital audio production products, both hardware and software, to describe various methods of analysing and/or positioning rhythmic audio events. One early example is Roland Corporation’s TR 808 drum machine (1980) and Roger Linn and two of his most influential and enduring creations, the Linn LM-1 Drum machine (1979) and the Akai MPC60 (1988). The early adopters of these new technologies were musicians making groove music, notably Prince, Michael Jackson, Kraftwerk and others. These designs, particularly those of Linn, implemented key groove concepts. As rhythm machines, they provided an unfailingly reliable pulse, the metronomic sense so important to groove, and the addition of a variable swing parameter, as described previously, allowed for the first non-linear management of consistent micro-timing deviations from this pulse. This created an aesthetic shift in popular music that we are still feeling today. Quantisation involves MIDI based mathematical correction or re-organisation of temporal event location in reference to a metrical matrix. This means that MIDI the temporal musical events in performances,
whether played in by a performer or constructed within the software, can be moved to the nearest temporal location in a mathematically designed groove template of idiosyncratic beat subdivisions. This functionality first appeared with hardware based MIDI sequencers. Digital Audio Workstations (DAWs) now have a selection of swing and groove templates, some of which are based on previous hardware designs and allow for the user to create their own templates. It is now also common to extract the groove from audio material by using a software algorithm to detect the transients in an audio recording of specific bar and beat length and translate the information into MIDI notes and a groove template. Ableton Live software, for example, has extensive capabilities for groove analysis, extraction and application within a production session.

**Definition of terms, new musical language**

One significant outcome of this research is the realisation that a clear and consistent musicological language regarding rhythm has not been established. Much writing on the subject of rhythmic phenomena found outside European art music involves reappraising definitions and terminology in order to proceed with a meaningful discourse regarding rhythm. This applies not only to recent and more fluid concepts such as Groove and Swing, but also to familiar and seemingly indisputable concepts like, rhythm, beat, pulse, stress and accent. As Kolinski states:

*In his book Rhythm and Tempo (1953), Curt Sachs refers to de Groot’s statement, made 40 years ago, that the term “rhythm” has been used in at least fifty different meanings, not to mention the conflicting interpretations of the term metre and of its correlation with rhythm. Sachs complains “The confusion is terrifying indeed” and Paul Creston, in his Principles of Rhythm comments, “It must be admitted, there is confusion; and a sampling of the usual definitions of the term reveals distorted logic, vague fantasy or downright ignorance (Kolinski, 1973) p494.*

The context for definitions is the listener’s perception, a position expressed by Lerdahl and Jackendoff:

*We take the goal of a theory of music to be a formal description of the musical intuitions of a listener experienced in a musical idiom* (Lerdahl, 1983) (my emphasis).

And:

*In our view, the central task of music theory should be to explicate this mentally produced organization. Seen in this way, music theory takes a place among traditional areas of cognitive psychology such as theories of vision and language* (Lerdahl, 1983) p8 (my emphasis).
Micro-timing research

Research using empirical mathematical methodologies has examined the sub-structural and sub-syntactical aspects of groove and produced quantitative descriptions of micro-timing variations in musical events with respect to an isochronous (i.e. metronomic) pulse (Iyer 2002); (McGuiness, 2005); (Prögler, 1995). The McGuiness (2003) covert clock theory suggests that there are multiple divisions of the tactus coexisting as “nested clocks” within the dominant rhythmic structure. Micro-timing deviations are an important concept in discussing groove and refer to events that occur at the sub-syntactical level (Butterfield 2006; Prögler, 1995) in the range of approximately 10 to 50 milliseconds that is below the threshold of conscious motor control or perception and defy conventional musical notation.

Micro timing refers to the entire range of subtactus, non-notatable rhythmic expression, pertaining both to music and to speech, from which much musical rhythm originates (V. S. Iyer, 1998) p10.

Blimes offers a succinct summation of the concepts of syntactical and sub-syntactical by describing the relationship as the symbolic versus the continuous:

Historically, musical information processing has come in two forms: symbolic and continuous. Symbolic musical information processing operates on a discrete domain. Here, the main concept is quantization and there are three types. Time quantization is most common. This is when the duration between note events is a multiple of some time quantum. There is also pitch quantization, in which an instrument is represented by a small subset of the pitches it can produce. Finally, tempo quantization is when there are instantaneous jumps in tempo at various positions in a musical piece. Musical counterpoint, traditional musical harmony, grammar approaches to musical representation, and unembellished standard musical notation are all examples of representations used in symbolic musical information processing. On the other hand, continuous musical information processing operates on a continuous domain. Herein lies the expression. Here is where we find accelerando, rubato, accentuation, pause, timbre variation, crescendo, etc. Here is where we find music’s life. I claim, however, that we need both. To successfully model music, we need to study both the symbolic and the numerical aspects of music. (Blimes, 1993) p16

Musicology has shown increasing interest in micro-timing research in recent decades. A significant amount of the research has focussed on expressive performance in the context of classical repertoire. In this score based context, one area of research addresses how multiple performances of the same score differ (Clynes, 1987). This points to the fact that musical
performance involves precise and subtle deviations in the temporal location of notes with respect to a notation based time grid. In music events occur very slightly early or late compared to where they would occur if played strictly as written. These deviations are recognised as a legitimate and even necessary component of musical phrasing and have been discussed with respect to numerous classical composers and performers from various eras usually in terms of tempo rubato or retardation and acceleration against a regular pulse. The latter idea was familiar to Mozart and Chopin in the context of piano music, where the left hand keeps a steady accompaniment while the right hand plays expressively around the beat. The translation of rubato from the Italian is stolen and its musical usage infers stolen time

Yeston addresses this in an article that begins with these questions:

*Tempo rubato may be generally described as a practice whereby a performer deviates, by tempo variation and other means, from the notated rhythmic values of a score. The effect of this practice poses some interesting problems for music theory, particularly in the context of metrical music. To what extent does a performer’s informality with regularity of tempo and prescribed durational values risk obscuring the metric structure of a piece? How much and what kind of change is permissible? And finally, should a specific meter survive through a highly distorting rubato treatment, what are the inherent structural aspects of a musical work that provide for such survival (Yeston, 1975) p286*

He goes on to state that a precise meaning of rubato has remained elusive for over 400 years, and quotes historical sources such as Leopold Mozart and C.P.E. Bach amongst others to make a case for a phenomenon that has some affinity with groove. This is similar to something that Sarah Martin has called compensating rubato:

*I will focus on the traditional notion of ‘compensating’ rubato. What I am calling ‘compensating’ rubato is my preferred term for the general idea that time lost by shortening note values or accelerating at one point in the music must be compensated for by a commensurate lingering at another point, or vice versa. This basic idea, not necessarily designated ‘compensating’, crops up remarkably frequently in a variety of forms in a vast body of literature dating from the early eighteenth to the early twentieth century (Martin, 2002) p96.*

There has also been work done on early music performance techniques that suggests a similar presence of performance groove. What is different with respect to groove, as we define it here, is that temporal deviations in event location are repeated extremely consistently and accurately as a cyclical component of the music. If any time is stolen it is returned by the end of the cycle to create a zero sum rubato.
Scott SAUNDERS, Master of Philosophy “Towards an Aesthetic of Groove”

Summary

In conclusion, groove provides a fascinating prism which, when presented to various disciplines and methodologies, affords a range of insights. In order to fully grasp the significance of groove it must be placed in an historical and cultural perspective that looks beyond the dominant western musicological paradigms for new concepts and language with which to describe it. It is possible to look towards psychology and cognition studies, as well as neurobiology, and to see how groove is processed and understood by the human brain. Philosophy and aesthetics also assist in understanding the profound affective responses that can be aroused in the groover. This seemingly circumscribed topic is actually a very rich field for research, and has the potential to provide significant insights that are not just musicological, but can contribute to a greater understanding of embodied human cognition and consciousness, and inform interdisciplinary applications for health and wellbeing.

The review of literature and artists in this chapter has demonstrated that, although groove is a comparatively recent area of study, there is a significant body of extant research. It should also be clear that the nature of this research is disparate and represents numerous approaches to the phenomenon of groove. The goal of the current work is to, where possible, synthesise this research to develop a clear, concise and coherent criteria for groove. The focus will be on the more concrete empirical work that deals with music analysis and concepts, and audio research data derived from critical analysis of musical examples. However other extramusical aspects of groove, and the insights they contribute, will always inform the inquiry.
Chapter 3 Criteria for groove

Background

It is important to be clear that, as a primarily aesthetic question, the existence and quality of groove is ultimately evaluated in the consciousness of the listener. In a very real sense there cannot be a groove without a groover, (Keil’s “participant”), be they performer or audience. So the context for the criteria of groove must necessarily include the cognitive responses of the participant to the musical structures described. It is beyond the scope of the current work to discuss the phenomenology, psychology, neuroscience and philosophy of groove. The criteria for groove discussed here address the musical, and particularly rhythmic, aspects only. However, it is hoped that a clear and concise understanding of the musical phenomena will be useful in groove cognition research.

Many of the musical qualities found in groove can be paradoxical or ambiguous and it is possible, even probable, that these tensions and oppositions are important factors in groove. A good example of this is the apparent contradictions in machine groove produced by drum machines, sequencers and computers. These are effective and affective forms of groove, lacking performative human gestures and with a super human temporal precision that seems counter-intuitive to the organic nature of pre-electronic groove production. Therefore, in creating criteria for groove, there is a need to allow for various criteria to be dominant in one musical context and yet manifest quite differently in another. There is no one simple recipe for groove, only categories, tendencies and their interactions, and some criteria may appear in differing combinations and proportions in a wide range of music.

Groove criteria

Overview

Central to this research is the distinction between the syntactical (structural) and sub-syntactical (micro-timing) with respect to rhythmic analysis. These concepts have been identified and adapted from the work of various authors discussed in chapter 2 including: Keil,
Butterfield, Blimes and McGuiness. The nature of this distinction lies in the temporal location of musical events and can be summarised thus:

**Syntactical/structural events**

- Rational
- Above a cognitive motor threshold
- Can be notated and described in accepted musical language
- Performed with conscious control.

**Sub-syntactical/micro-timing events**

- Irrational
- Below a cognitive motor threshold
- Problematic for conventional notation
- Unconscious element of performance.

The chart below (Fig 1) gives a schematic overview of groove criteria divided into major subcategories.
**Syntactical/structural criteria**

**A) Pulse as reference or point of departure**

The single most important organising principle of groove is the establishment of a pulse, a sense of consistent isochronous (temporally equivalent) reference points from which all other rhythmic events derive their significance. Here is another definition:

*Literally, pulse denotes any periodicity inherent or perceived in any rhythm or combination of rhythms* (V. S. Iyer, 1998) p8.

This definition refers to the fact that pulse does not need to be explicitly expressed; it can be inherent or perceived. This phenomenon could be described using Deleuze’s idea of the actual and the virtual.

*We opposed the virtual and the real: although it could not have been more precise before now, this terminology must be corrected. The virtual is opposed not to the real but to the actual.*
virtual is fully real in so far as it is virtual. Exactly what Proust said of states of resonance must be said of the virtual: 'Real without being actual, ideal without being abstract'; and symbolic without being fictional. Indeed, the virtual must be defined as strictly a part of the real object - as though the object had one part of itself in the virtual into which it plunged as though into an objective dimension (Deleuze, 1994) p208.

It is critically important for the listener to establish a cognitive temporal reference in the pulse, and in Deleuze’s terms this may be virtual, but no less real. This ability to cognitively generate an isochronous pulse from a variety of complex rhythmic stimuli is one of the things that make this music so engaging for the listener. By extension the actual/virtual distinction can and will be applied to various rhythmic phenomena in addition to the pulse. The importance of the consistency of pulse in groove music cannot be overstated. Although it is possible to create a more fluid groove as a soloist or small ensemble based on a highly interactive performance technique, the backbone of the vast majority of contemporary groove based music is a highly metronomic sense of pulse. This is part of the paradox of groove music. It is the relationship between the metronomic sense of pulse and the specific and idiosyncratic repetition of musical events placed with reference to the pulse that create a propulsive rhythmic tension. The pulse represents the middle stratum in a hierarchical architectonic rhythmic system where other strata are inferred by integer multiplication or division of its temporal value.

**Pulse and beat**

The word beat is used in two senses with respect to the pulse. Firstly, beat refers to precise temporal locations of pulse events analogous to the ticks of a metronome. In a metric context beat can also be used to identify temporal pulse locations as beat 1, beat 2, etc. Secondly, beat can be used as a relative temporal unit, for example, “the bass note has the duration of half a beat” or “the groove cycle is 8 beats in duration”. In this work the usage of the word beat, as referring to a specific rhythm (e.g. drum beat), has been avoided (See Chapter 2)

The following is a summary of pulse criteria for groove:

- The listener must be able to discern a clear, consistent and sustained isochronous pulse;
- The sense of pulse is the key organising temporal reference for the listener and, as stated previously, may be actual (explicit) or virtual (implicit) or a combination of both;
- All rhythmic events in a groove have a specific quantifiable temporal relationship to the pulse and to each other with respect to the pulse.
Establishing pulse is essential to groove, and pre-requisite to any other rhythmic structures. The heartbeat metaphor implied by the word pulse is telling and as with the recurring references to the body in this work the regularity and rate of the pulse are as essential to the effectiveness of the groove as they are to physical health and wellbeing. The consistency of pulse provides an important predictive framework for the listener. Once established, a pulse will give the listener a contextual sense of temporal security that facilitates confident motor control. The importance of anticipation in music, with regard to the listener’s engagement and affective reward, has been addressed by Meyer (Meyer, 1956), however, this was in the context of the more teleological musical structures found in the western classical music canon. More recent investigations into groove have observed a different kind of anticipation that involves repetitive cycles such as those found in groove music. (Huron, 2006; Witek, 2009).

B) Tempo/tactus in groove

Tactus is related to the concept of pulse and is usually thought of in terms of a comfortable tempo range for musical rhythm based upon the spontaneous natural rhythms of human motion: moderate walking pace, human heartbeat, chewing, baby suckling and sexual activity, for example:

*The listener tends to focus primarily on one (or two) intermediate level(s) in which the beats pass by at a moderate rate. This is the level at which the conductor waves his baton, the listener taps his foot, and the dancer completes a shift in weight* (Lerdahl, 1983) p22.

This can be understood as the range of comfortable spontaneous repetitive human movement. This range is generally accepted to be a temporal value of approximately 300 to 500 milliseconds (Fraisse, 1982; V. S. Iyer, 1998), and equates to tempos of 75 to 180 beats per minute with an easy walking pace of 112 BPM at the middle of the range. The significance of these temporal dimensions can be intuitively confirmed by imagining various activities being performed to a metronome with settings in this range.

The two relevant concepts established in this area are: Spontaneous Tempo, which is, as the name suggests, tempi spontaneously generated by subjects; and Preferred Tempo, which are tempi that are selected or determined by subjects interactively. Findings for both fall within the tactus range described above. This has implications for a discussion of tempo and meter criteria for groove in the context of embodied cognition.

Groove music tempi appear to fall within a range that equates to the concept of tactus.
The wider context of tempo

Groove music marked a lowering of tempo in comparison to the popular music that preceded it. A similar change occurred in jazz with a move away from be-bop to the more soulful syncopated grooves of Hard Bop, a music that was proto-typical to the groove music that followed it. This tempo change can also be seen within the work of specific artists. As Danielsen has observed in identifying “Cold Sweat” as James Brown’s first funk/groove work:

_The decrease of tempo from 148bpm in… “I Got You” to 116bpm in “Cold Sweat”, is an important aspect of this change, … it leaves room for a more detailed shaping of micro-level events as well as the delimitation of each rhythmic gesture (Danielsen, 2006) p40._

The tempi of groove music in general are slower than rock’ n’ roll, which relies on a more raw and insistent energy. A similar tempo trajectory could be mapped across the Beatles’ music as they incorporated more groove characteristics. For example, (Fig 2) shows a clear decrease in tempi post 1965.9

<table>
<thead>
<tr>
<th>Song</th>
<th>BPM</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Love Me Do</td>
<td>148</td>
<td>1962</td>
</tr>
<tr>
<td>From Me To You</td>
<td>137</td>
<td>1963</td>
</tr>
<tr>
<td>She Loves You</td>
<td>150</td>
<td>1963</td>
</tr>
<tr>
<td>Sgt Pepper’s…</td>
<td>95</td>
<td>1967</td>
</tr>
<tr>
<td>All You Need is Love</td>
<td>113</td>
<td>1967</td>
</tr>
</tbody>
</table>

_Figure 2 Beatles song tempi illustrating a general tendency to lower values_

The point being made here is crucial to a discussion of tempo with respect to groove, because the capacity for groove diminishes as the tempo increases. This is due to the decrease in latitude for temporally idiosyncratic events that can be performed or, responded to. At 70 BPM, for example, the tempo of Isaac Hayes’ version of “Walk On By” on the release _Hot Buttered Soul_ (1969), has a great deal of temporal latitude for the detailed drum gestures, giving a heightened sense of groove and expressiveness. At this tempo there is a palpable anticipation between the beats of the pulse, creating cognitive space for prediction, anticipation and reward. This track was subsequently sampled and used by numerous hip-hop artists, including Compton’s Most Wanted, 3rd Bass, Wu Tang Clan and Notorious Big. All of these artists work in a genre that prizes slower tempi that accommodate the temporally

idiosyncratic linguistic gymnastics of rappers/MCs. It could be argued that lower tempi afford greater subtlety of cognitive and physical interaction for the participant and as tempi increase this simplifies until, at an upper limit of 140-160bpm, as exemplified by classic early ‘60s pop songs (See Beatles’ tempi above or Del Shannon’s “Runaway”10), drum n’ bass, Punk Rock pogoing or the strident physicality of Offenbach’s “CanCan”, responses are limited to simple repetitive motor co-ordination. This simplicity has a corollary in higher energy levels of sustained jumping and bouncing movements. However, as these higher tempi approach the upper limit of the tactus range, some listeners may respond by recalibrating their response to a half time interpretation of the pulse to accommodate greater detail and control in their actions. Conversely, music at slower tempi such as hip hop at approximately 80 BPM can afford detailed groove, or be recalibrated up to double time, to afford the characteristic jumping movements of some hip hoppers. Jamaican music is an interesting case in point with regard to this phenomenon. The change from the Ska music of the ‘60s, with its upbeat feel and high pop music tempi, to the groovier “Reggae” in the late ‘60s and early ‘70s involved not just a slower tempo, but a sense of two possible readings of tempo that incorporated the gestures of ska into an expanded temporal framework.

**Tempo, individualism, dancing and the performing audience**

The slowing of tempo, with regard to dance-oriented music, affords far greater conscious control of movement while dancing. This is congruent with the context of the social, cultural and political ethos of the late 60s that encouraged individual freedom of expression, and from which groove music emerged. Freed from the need to conform to the predetermined formal movements that make synchronised dancing with a partner possible, dancing became far more individualistic and improvisatory. This marks the start of a cultural shift towards a sharing of creative focus and responsibility, a shift from the performer to the audience that has continued to the present. This change is a movement back to the communal experience of music where the distinction between performer and listener is blurred. From the dance floor exhibitionism of disco to the extraordinary dominance of dance and groove music in current popular club and festival culture, the dancer is as much the centre of attention as the source of the music. In groove music now, the listener is a performer. With this understanding the musicological sense of groove shifts from evaluating the music as a complete self-contained

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10 [https://www.youtube.com/watch?v=jrMUh07fa3D8&list=RvjrMUh07fa3D8#t=23](https://www.youtube.com/watch?v=jrMUh07fa3D8&list=RvjrMUh07fa3D8#t=23) This film clip is a good example of the simplistic bouncing “aerobic” movement higher tempos elicit as demonstrated by the female dancers.
Scott SAUNDERS, Master of Philosophy “Towards an Aesthetic of Groove”

artwork to being a sophisticated ground that affords dancing figures inspiration and sustained creativity.

C) Groove and meter

Most accounts of meter in music dictionaries and classic texts refer to systems of accent and stress grouping (Meyer, 1956) or the interaction between two or more pulses of different periodicities, usually having an integer mathematical ratio (Yeston, 1974). In the case of groove neither of these definitions is entirely appropriate. With respect to accent and stress, groove music involves multiple rhythmic strata with specific accent patterns that are often posited against the pulse. With respect to the description of meter by interactive pulses, the nature of groove requires the clear establishment of a dominant pulse. Groove relies on a clear sense of meter that is established by combined repetitive rhythmic structures with respect to the pulse.

In groove music, meter has a sense of defining a fixed pulse based framework for repetition. In non-groove based music, meter is subordinated to a supporting role in a linear-teleological context, meaning that the significant musical content is carried along on a meter, or that meter is generated by the musical content. Meter is therefore a parameter that may alter or be open to interpretation. However, in groove music, meter marks out a rhythmic structure that is established by sustained repetition within which significant musical content is perceived as non-linear processes of repetition and difference. In this sense meter is best understood as being cyclical, a view supported by recent research (Witek, 2009). This sense of meter is also described as a macroperiod:

*The macroperiod has duration within the capacity of echoic memory—the ‘psychological present’*


Hasty uses the idea of a temporal container:

*Rather than being viewed as a process, meter is identified with products conceived as spans of time. Regarded as products, bar measures can be treated as containers that in turn form the content of larger containers. In this way, bars function to segment the musical fabric into a succession of relatively small units. These unit products are then combined to form larger unit products in a hierarchy of segmentations that leads from measure to sub-phrase to phrase to phrase group to section and finally to the unity of the entire composition* (Hasty, 1997) p175.
This could be described as an enclosed temporal field\textsuperscript{11}, which is both static and dynamic, and which both creates and is created by a sense of rhythmic symmetry and beat salience. Groove meter expresses a sense of non-rotational rhythmic structure with an unequivocal cycle commencement that a listener infers from the rhythmic information presented. This is exemplified eloquently in James Brown’s insistence on the importance of the one, meaning the clear expression of beat one in the cycle. Meter is directly referential to the pulse, and this marking of time allows for the listener/dancer to synchronise a reference point before negotiating the complex and sometimes ambiguous musical information in the following temporal field. The sense of meter in groove is a temporal cognitive framework within which the listener has a sense of time standing still through repetition.

The most common meter for groove music is 4/4, and there appears to be sound and self-evident reasons for this.\textsuperscript{12} The bipedal four-limbed nature of human physiology is a strong influence on both performers and dancers. The binary pairs of left/right, up/down, and forward/backward, when physically expressed through the four limbs of the body, naturally generate “compound binaries” of quadruple meter. It is also common for groove structures to be expressed as 2 bar phrases or 8 beats of pulse, or 16 beats, etc. A simple explanation is that this is a further binary extension to create a duple or quadruple metric structure. Meters other than 4, and related binary multiples/divisions, are possible, and some exploration of these possibilities has been undertaken from the modest foray of Dave Brubeck’s “Take five” to the more sophisticated and challenging work of Steve Coleman.\textsuperscript{13} This leads to a discussion of the most explicit expression of 4/4 meter.

**D) The function of backbeat in groove**

Backbeat is a common element in popular music of Afro-American derivation and in current groove based popular music it is utterly ubiquitous. Backbeat is the clear accented expression of the second and fourth beat in 4/4 meter, and in groove music it is the most consistent and reliable expression of the pulse. Backbeat is usually stated by the snare drum in the drum-kit

\textsuperscript{11} This is the author’s suggested term to describe the paradoxical sense of perceiving groove as simultaneously temporal and spatial.

\textsuperscript{12} The Stratification of Musical Rhythm (Yeston, 1974) has a description of Hauptmann’s ideas in The Nature and Harmony of Music (1888) regarding the development of meter through application of Hegelian dialectics. Starting with duple and progressing to triple and finally quadruple as a synthesis of the former meters.

\textsuperscript{13} Steve Coleman and Five Elements; progressive jazz ensemble
rhythm, but can be doubled or replaced by other timbres. Also common are hetero-temporal events involving multiple individual onsets occurring in extremely close proximity to each other and a pulse beat that are perceived as a single composite event. For example the combination of snare drum, percussion instruments, e.g. tambourine, handclaps, and brief gestures from rhythm guitar, brass or strings. 14 The development of the backbeat phenomenon has been traced back to marching band practices in New Orleans through ragtime and jazz, and is discussed in depth in a PhD on the subject (Tamlyn, 1998). Backbeat could be viewed as a very simple metrical displacement dissonance that counters the traditional emphasis on the first and third beats; however it is so ingrained in the Afro-American musical sensibility as to be instinctively metrically consonant. Any Black Baptist church congregation will enthusiastically clap on the “2 & 4”, and the practice has spread through popular musical culture so pervasively that clapping on the “1 & 3” now appears unusual and “uncool”. 15 This emphasis on the “2 & 4” could be interpreted as part of a dialogic “call and response” structure with the “1 & 3” of the meter and, as such, is a macro model for the micro-rhythmic interactivity that is so indicative of groove. The backbeat almost always has the characteristics of:

- Brief duration/envelope
- A bright timbre with similarly high harmonic content to white noise
- Often a perceived higher dynamic level.

These characteristics have the effect of marking, and drawing attention to a precise temporal location within the groove matrix and, as such, backbeat can be seen as a powerful organising reference point in the music that often maintains greater consistency than any other rhythmic elements. It is also a clear and attractive target for anacrustic rhythmic structures that create the sense of moving forward toward these backbeats that produce the vital drive of groove.

A clear example of the way backbeat is the most reliable actual expression of pulse and meter in groove music is demonstrated by the technique used when DJs cut a beat by manually stopping the turntable. In this case DJs will invariably search for a backbeat reference point in the headphones before dropping the track back in on a 2 beat by recommencing the rotation of the vinyl groove with a backbeat in the track positioned at the stylus. Another example of this importance of backbeat as a secure metric reference occurs when sampling break beats. Break beats rely on the precise definition of the rotational duration of a digitally recorded

14 For an excellent example of a backbeat comprising multiple timbres in a heterophonic cluster see “It’s a Man’s World” by James Brown

15 Rev Al Green church service; http://www.youtube.com/watch?v=cv48usNgId
groove cycle in order to create an audio file that can be looped or seamlessly repeated, thus determining the meter. As groove music may contain complex rhythmic information that does not express simple downbeats, finding effective editing points can be problematic. More often than not the most reliable and effective reference points to use on the backbeat are snare drums. Snare drums are often high in dynamic, have a clear transient to easily identify a temporal location and are a clear expression of the pulse.

E) The function of architectonic subdivision in groove

Pulse is an essential criterion for groove, as noted above, and so is the temporal subdivision of pulse by simple integers, most commonly 2, 3 and 4. Subdivision is a familiar musical concept, however in groove it is used in specific ways that provide the temporal framework for values in other criteria discussed later. Subdivision:

- Sets precise durational values for musical events to achieve maximal temporal differentiation (see below) and implication of virtual beats,
- Creates a hierarchy of beat salience with reference to the pulse.

Commonly architectonic rhythmic structure has been used to locate the onset of events but groove music has an additional focus on the cessation of events creating a sense of “windows” for rhythmic events.

Another way hierarchy is expressed in groove structures could be described as “beat salience inversion” because contrary to a classical top down hierarchical order of accents groove works from the bottom up accenting what are conventionally less salient beats to infer the architectonic structure above.

Musical events can be perceived as being located on an architectonic subdivision matrix when their precise actual location is not. This is due to category perception, where rhythmic objects can be temporally associated with, or grouped in proximity to, a significant beat or subdivision. Subdivision is also a useful musical concept for notation, analysis and communication regarding groove.

F) Metrical dissonance

Metrical dissonance is an important element in groove rhythms, and its most common forms are grouping and displacement dissonances. Both of these forms rely upon architectonic subdivision.
In grouping dissonances subdivisions are often grouped in 3s with an added group of 2 or 4 to complete the groove cycle. This results in syncopation and sub-cycles that are asynchronous with the primary pulse. For example, the rhythmic structures of a Bossa-Nova rhythm, a highly influential Brazilian groove template (Fig. 3), involve a basic 1/8th note pulse usually played on hi hats accompanied by a kick drum gesture on beats 1 and 3, preceded by an 1/8th note anacrustic event (H).

![Figure 3 Basic Bossa-Nova rhythm showing metrical dissonance groupings](image)

All of this is a very consonant expression of the pulse and its subdivisions, with the kick drum approximating a heartbeat. However, the figure that gives the rhythm its characteristic quality is usually played as a side-stick on the snare drum commencing on beat 1 of a 2 bar cycle (C). This part is spaced out in 1/8th groups of 3:3:4:3:3. The total of these values is 16: the number of 1/8th notes in a 2 bar cycle. The predominance of groups of 3 creates metrical dissonance and syncopations. The pattern commences with all elements occurring simultaneously on beat 1 establishing the non-rotational structure of 2 bar cycle (C), with the first two kick and snare events coincident. However, for the rest of the cycle, these two timbres do not coincide at all, creating maximal temporal differentiation (G). Variants of this pattern using groups of three are extremely common throughout groove-based music, and are related to the Clave pattern (Fig 4), usually played on the eponymous instrument that is ubiquitous in Cuban music and provides a crucial underlying rhythmic reference for all the other instrumental parts. The kick drum part can be interpreted as an example of a displacement dissonance where the duration of its cycle matches an integer division of the pulse. However, it recurs on a weak beat of the architectonic subdivision. It is also a good example of the anacrustic (H) gestures common in groove and described next.

![Figure 4 Clave “forward” showing metrical dissonance patterns](image)
Displacement dissonances are also common to groove, with a clear example being the sustained offbeat skank found in reggae of the similar hi-hat patterns in House music. These are a displacement of the pulse that may have a subtle micro-timing location or Swing to them.

These ideas are central to groove music because the listener is engaged by musical information that is ambiguous, contradictory and yet repetitive, and thus presents tantalising problems for mind and body to solve. It is common to find an ebb and flow of metrical consonance and dissonance within the temporal field of a groove, with the greatest consonance usually coinciding with the one. Once the commencement of the cycle is marked and the pulse stated, subsequent rhythmic events will unfold as various dissonant and syncopated structures, testing the listener’s ability to maintain the embodied pulse. This usually resolves with anacrustic structures leading back to the commencement of the cycle.

**G) Maximal temporal differentiation**

The musical events in groove are characterised by maximal differentiation, both timbrally and temporally. This means that there is a significant range and variety of timbres amongst a performing ensemble and even within an individual instrumental or vocal performance. This is a feature of much African musical performance practice noted (Danielsen, 2006; Wilson, 1974) and sometimes described as the heterogeneous sound ideal. It is recognised as being important in ensuring clear identification of the multiple rhythmic and melodic strata that make up the complex composite texture of the music. In a similar manner, the pervasively percussive nature of African music means that the durations of musical events are brief and, as a result, mark discrete temporal locations allowing for a far greater temporal density of events.

Given this, for the groove performer the durations and terminations of notes are critical for creating temporal windows for other note onsets. This effect is also supported by a tendency for the various ensemble parts to interlock in a complimentary and discreet manner. The characteristics of maximal differentiation create the conditions for extremely complex and vibrant pointillistic musical textures in groove. This effect appears in some dance music productions where the various musical events are produced predominantly as a series of discrete events with minimal coincidence. This creates a mixing strategy where elements do not compete for sonic space and can each be given maximum level.
H) Anacrustic structures

Anacrusis is an extremely important structural technique in groove creation. Pulse and meter set up predictive frameworks for the entrained listener for whom the reliability of these elements is crucial in sustaining the synchronised motion of dancing. This predictive framework is enhanced by anacrustic rhythmic structures, as identified by Butterfield (Butterfield 2006). These events are always anticipatory, looking forward to another event, and make a significant contribution to the sense of impetus that is synonymous with groove. These anacrustic events can be seen as preparatory in a motor co-ordination sequence, and they assist dancers in guiding their bodies to a satisfying resolution on a pulse beat. There is also a paradoxical satisfaction to be found in an anacrusis that precedes an absent pulse event, or “virtual” pulse, where the listener’s status as a “quasi-performer” is reified by their embodiment and potential expression of that pulse. Anacrustic events can be compounded into phrases or nested in a series of anticipations leading from a sub-resolution to another resolution, and so on. Anacrusis can also be seen as intersecting with other rhythmic concepts such as metric dissonance and syncopation. Anacrusis is also assisted by and related to various musical techniques and technologies that are discussed later.

Some of the most effective aspects of groove appear to operate in a difficult to define grey area between accurate architectonic subdivision and the subtle micro-temporal deviations that Keil refers to as Participatory Discrepancies, which brings us to the sub-syntactical micro-timing criteria.

Sub-syntactical/ micro-timing criteria

I) Phrasing and micro-timing in groove

The most obvious form of micro-timing in groove occurs in the expressive phrasing of an interpretive performance. This idea can be viewed as bringing the music to life from the score by the subtle temporal placement of notes either before or after the precise location described by notation. The idea of expressive phrasing can be found in the vocal delivery and instrumental performance of all musical traditions, and it remains very important in groove-based music. However, this sense of phrasing is more fluid and narrative and generally does not have the same repetitive, structural and functional significance that the phrasing of repeated groove figures has. It is the consistent repetition of a rhythmic phrase that is one of the characteristic features of a groove, and it is telling that the lead vocal phrases in a classic James Brown track, for example, are brief repeated motifs that resemble the instrumental
building blocks of the music. The introduction of digital samplers afforded identical repetition of rhythmic segments and musical phrases excised from longer performances, and transformed them into repeated rhythmic groove gestures with an extreme regularity of phrasing that exceeds the limits of human performance.

**J) Swing and micro-timing in groove**

Swing is a pervasive and important concept in the creation of groove, and in some contexts has been synonymous with groove. It is a term that has been used with respect to a style of music and even a historical cultural period, the Swing Era of the ‘30s much like the Jazz Age of the ‘20s. The first line of the entry for “Swing” in Grove online is typical:

(1) A way of playing music that results in a feeling of forward motion or momentum, often accompanied by a propensity to embody the music in some form of rhythmic movement (Spring, 2014).

Swing (or the related shuffle) appears in various musical genres and is extensively used in Afro-American music, particularly jazz.

Swing as a technical musical term refers to the subdivision of a beat into 2 elements of different durations. The first element is usually longer in duration than the second with a common ratio being 2:1, or, in musical theory terms, a triplet figure with the first two triplets fused. Swing commonly uses the first and/or last sub-beats in a group of, usually three, subdivisions with the last sub-beat accented. This produces an asymmetrical syncopated temporal subdivision. This asymmetry gives the rhythm an anacrustic forward impetus. However, in groove the ratio or amount of swing is open to variation, either in performance or in non-linear programming, to create differing degrees of forward momentum. This is an example of micro-timing and anacrustic momentum. Skipping is the perfect gestural metaphor/analogy for swing. In efficient walking an equal subdivision of time between each foot’s motion and contact with the ground is maintained and the force of each propulsive leg is pushing off a grounded position. However, in skipping an anacrustic strategy means that each forward thrust is a combination of both legs coming from an aerial position. The foot that last left the ground lands in a pre-emptive manner and immediately transfers energy to the other, which has the greater propulsive role and recommences the cycle. Like swing here propulsive energy in skipping comes from the pre-emptive pushing of a note before a downbeat.

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16 See quotes in Chapter 1
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Skipping is an efficient use of energy however, like groove it requires an operational tempo range (tactus) and the energy to sustain it.

In order to notate swing feel efficiently, popular sheet music publications will often print the simple symmetrical subdivision of quavers in notation with an expressive caveat at the first bar, suggesting that this subdivision be played “with swing” as a crotchet (1/4 note) and a quaver (1/8th note) as a quaver triplet subdivision. Shuffle often refers to the same idea using the first and last sub-beats of a group of 4 subdivisions (1/16th’s) and has a more pronounced asymmetry. (Fig 5) ¹⁷ illustrates these ideas with a very familiar melody. Bars 2, 3 and 7 (smaller ovals), demonstrate the shuffle rhythm described above, however this would feel at odds with the triplets in bars 5 and 6 (large oval), if played as written.

Notating the first two notes in bars 2, 3 and 7 as a ¼ note and 1/8th note in a 1/8th note triplet group would produce a more natural triplet swing, as described above, consistent with bars 5 and 6. Alternatively the whole piece could be played as a shuffle. Either way it is most likely that the melody would be performed with a consistent sense of swing.

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¹⁷ http://www.smart-central.com/RowRow.htm
The terms swing and shuffle are often used interchangeably and, as will be discussed later, there is a variable range of swing possible between the two examples described above. The precise ratios of asymmetrical subdivisions occurring in practice are highly variable and often do not exhibit simple integer based mathematical ratios.

The limits of the conventional notation allow for a pulse to be divided most commonly into 2, 3 or 4, (and less commonly 6 and 8) temporally equivalent subdivisions, with perhaps the inclusion of a grace note or ornament. In the performance of groove-based music often the temporal subdivisions and correspondent micro-timing locations of events do not conform to these simple mathematical ratios. In fact it appears that the essence of expressive feel playing is to find a subtly different but consistently repeated location for events in the temporal field. This is often described as being “in the pocket” by groove players. A good example of this is the idiosyncratic placement of a snare backbeat slightly later than the mathematical subdivision for beats 2 and 4. In line with this idea the designers of influential music technology and their products mentioned previously, such as Roger Linn with the LM-1 drum machine and The Akai MPC 60, incorporated a parametric control of the subdivision of the tactus labelled Swing. The swing had a range of 50% to 100%, with 50% representing even quavers, 66% approximating 1/8th note triplet swing as described above, and 75% being a semiquaver or 1/16th note shuffle. What is most interesting here is the ability to have gradations of swing, and to give your programmed music a reliably irrational asymmetrical subdivision. Subsequently the same kind of swing and groove variability has been included in digital music production technology and the software based Digital Audio Workstations that have followed.

K) Maximal timbral individuation

In addition to the brief durations discussed above, individuation of musical events through distinctive envelopes and timbral modulations are also common. This tendency can be traced from African talking drums to the dynamic use of plunger mutes on brass instruments in jazz in the '30s and its electronic equivalents; the Wah-Wah pedal and synthesiser envelopes. These techniques are all gestural and therefore energised, as well as having a linguistic significance as the talking drum implies. They all ensure maximal individuation and variation within the limitation of maximal temporal differentiation.
I) Heterotemporal composite events

This is micro-timing in groove music that occurs in the context of timbre and envelope. Rather than indicating a sense of melodic heterophony, it refers to the occurrence of multiple musical events within a close temporal proximity that are perceived as a single gestalt event. The design of a snare drum achieves this by transferring the discrete impact of the stick to multiple metal strands that each produces secondary impacts. It seems reasonable to suggest here that the snare is designed to accompany the synchronised bipedal movement of marching and the hetero-temporal events of multiple boots hitting the ground as a gestalt gesture on pulse beats. This phenomenon is also exemplified by the handclaps, the composite sound of multiple pairs of hands clapping. Whether a recorded group clap track in a multi track production or its facsimile in the form of a sample or drum machine sound, it is a recurrent element in much groove music. It has the function of blurring specific beats, often the backbeat, so as to soften the blow, while at the same time creating a gestural gestalt of group participation. These two functions work in tandem to accommodate the listener joining in clapping the backbeat, but with a more forgiving window of opportunity for rhythmic inclusion. Another example is the use of brushes. The multiple metal wires creates a, composite hetero-temporal event. Once contact is made performance techniques become a rhythmic calligraphy, literally painting in time. Here again is a rhythmic performance technique of remarkable subtlety that would be highly resistant to notation.

Extra-syntactic criteria

These criteria can involve both syntactic and sub-syntactic expression and so do not fit the previous categories neatly. They are included as additional observations.

M) Rhythmic vectors

In line with a focus on a gestural gestalt interpretation of groove cognition, there are identifiable musical structures that create a perceived effect of energy and motion. These phenomena resist notation because traditional western notation and theory tends to focus on the onset of notes that atrophy. The structure of groove music’s mechanisms focuses as much, and sometimes more, on the termination of notes.
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To accommodate this phenomenon I will use the term rhythmic vectors, co-opting the concept of “a force with direction” from physics.\(^{19}\) This is much like the gesture of a hand moving to a drum, a foot to the ground or an arrow hitting its target. It is the antithesis of atrophy, a gestural language of energy, and motion. One of the clearest and simplest examples of this phenomenon is the hi-hat cymbal. Developed from the hand held clash cymbals used in orchestras and military bands (and which again were designed to be struck together to create a note that dies away) hi-hat cymbals are brought together with force and precision by the drummer’s foot in addition to being struck by a stick, thus providing one of the few instrumental designs that facilitate accurate definition of the end of a note. This closing on a beat has been a characteristic of the instrument’s performance language since its invention. It creates the sense of a temporal location for the completion of movement rather than its initiation. This movement is analogous to human movement towards rest, for example, the gestural shape of a handclap or movement of a foot to ground and weight bearing rest. It is also highly anacrustic.

It seems telling that the hi-hat was perfected in the jazz age of the ‘20s and has been ubiquitous in drum kits to the present day and is essential to the familiar and somewhat clichéd “tssh-ta-ta, tssh-ta-ta” swing motif in jazz drumming. It is also of interest that it is a component of one of the most gestural of instruments, the drum kit. The four-limbed physicality of this instrument has long been part of its performance ethos and is used to great effect by the more flamboyant exponents. In addition to this, in groove pedagogy particularly with bass players, simply making the player more aware of when they end notes improves the groove. This idea expresses itself in anacrustic structures and various envelope types.

N) Gestural structures and rhythm

As discussed in Chapter 1 a defining characteristic of groove is the close reciprocal relationship between the music and the body. This has been commented on in terms of the embodied reception of the music; however the corollary is the embodied gestural production of the music. The gestural nature of groove is evident when playing a drum-kit and in the drumming of the African musical traditions that inform contemporary groove music and continue in the

\(^{19}\) Vector, in physics, a quantity that has both magnitude and direction. It is typically represented by an arrow whose direction is the same as that of the quantity and whose length is proportional to the quantity’s magnitude.

http://www.britannica.com/EBchecked/topic/1240588/vector
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form of conga drums. This idea is also found in the fluid repetitive movements of forearm and wrist in a funky rhythm guitar part or, on a smaller scale, in the wrist flourishes of slapping and plucking and electric bass. The ambidextrous interplay of left and right hands in keyboard players is somewhat similar to the African drum techniques. The shapes and gestures that are most comfortably repeated for extended periods have a significant influence on creating the rhythmic parts played in groove. The sense of gesture is essential to the creation of groove structures. These structures become familiar groove tropes and may be appropriated and reconstructed in a non-linear production context. The psychological research discussed in Chapter 2 (Waadeland, 2001) shows that listeners recover significant gestural information from rhythm in music that can be converted to cognitive motor control. The nature of groove generally elicits highly gestural responses from dancers as witnessed on most dance-floors. Gesture’s importance in popular culture is exemplified by the popular phenomenon of “Air Guitar” contests where performers without instruments (or should that be with virtual instruments?) are judged by their gestural embodiment of music.

Summary

These criteria for groove aim to identify significant musical characteristics found in groove music.

The criteria can be summarised as:

**Syntactic**

- (A) The presence of isochronous pulse, metronomic sense
- (B) Tempo within the tactus range of 70-140 BPM
- (C) A cyclical sense of meter as an “enclosed temporal field”
- (D) The presence of backbeat
- (E) Architechttonic subdivision
- (F) Metrical grouping and displacement dissonances
- (G) Maximal temporal and timbral differentiation
- (H) Anacrustic structures.

**Sub-Syntactic**

- (I) Non-repetitive micro-timing structures: Phrasing /Rubato
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• (J) Repetitive micro-timing structures: Swing
• (K) Maximal individuation of envelope and timbral modulations
• (L) Hetero-temporal events.

Extra-syntactic/other

• (M) Rhythmic vectors
• (N) Gestural structures.

This list of criteria is not necessarily comprehensive, and not all of the criteria will be present in any given example of groove music. The criteria are highly interactive and dynamic, for example maximal individuation will facilitate multiple metric dissonances, rhythmic vectors are usually anacrustic, metrical displacement dissonance can have swing, etc. These criteria can hopefully be an effective analytical tool for identifying groove music, and in the next chapter they will be tested against two classic groove works and a more recent work that demonstrates an ongoing creative dialogue with the limits of groove’s parameters.

A simple groove analysis example

This familiar rhythmic figure has some simple characteristics that fit the criteria and are common to many classic groove rhythms. A brief discussion will demonstrate the application of groove concepts.

Firstly, this brief but enduring composition has appeared organically and anonymously from a communal music context. It has long been a staple of football crowds and is in wide current usage. The work has a definite pulse and its tempo, circa 105 bpm, is in the comfortable tactus (A) range of groove. It is metrical and has a 4/4, 2 bar, 8 beat cycle (C). It has basic subdivisions (E). The first musical events establish the pulse and the non-rotational structure of the meter, before intimating the subsequent subdivisions. The first bar is metrically consonant and the second bar is comparatively metrically dissonant (F). The dissonance could be interpreted as

Figure 6 Football chant with beats numbered, drum kit transcription below (missing “-3 beat” highlighted) [Audio file M01]
either displacement and/or grouping, as the syncopated 2+ could be the start of another group of three or be displaced by an 1/8\textsuperscript{th} note. Importantly the 2+ is highly anacrustic (H) to a virtual pulse on 3 that is conspicuous by its absence.

This “missing 3” (Fig. 6 highlighted) is common in some classic grooves, as will be demonstrated in Chapter 4. To complete the cycle we have an acacrustic event on 3+ leading to a pulse beat on 4 that is also anacrustic to recommencement of the cycle. Given the context of a vast football crowd we can add the criteria of hetero temporal events (L) such as group clapping. However, there would be significant motivation to limit this variance on the final two events, “Our team”, to express solidarity through temporal accuracy. By adding the concept of back beat, (D) transposing this rhythm to a drum kit and assigning all events on 2 or 4 beats to the snare drum, and the rest to the kick, a familiar drum beat appears. It is interesting that a rhythmic structure that has appeared spontaneously and organically exhibits so many of the groove criteria discussed above.

Chapter 4 Analysis of reference works

Introduction

The purpose of this chapter is to test the criteria established in Chapter 3 against specific examples of groove music. The first two examples have been chosen for being representative of a golden age of groove as discussed in Chapter 1. “Sex Machine” is arguably the first widely disseminated, popular music groove track, and its historical importance and influence cannot be overstated. The second example “Chameleon” is also an iconic groove track in its own way. Released in 1973, it is the work of Herbie Hancock, a consummate jazz musician steeped in the “Soul Jazz”, “Hard Bop” and “Modal Jazz” that were precursors of “Funk” groove music, and represents a conscious intention to synthesise the developments of James Brown et al. with jazz sensibilities to create what would come to be known as a “Jazz-Funk” “fusion”. It was also an attempt to reconnect jazz with a younger black audience who wanted dance music. To this end the music was even tested in club performances around the San Francisco Bay area to ascertain its effectiveness on the dance floor, as is documented by Pond (Steven F Pond, 2005; Steven.F Pond, 2013). The subsequent influence of the techniques exemplified by these works on music production methodologies and techniques has been profound and lasting.
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The third example, “Numbers on Boards”, demonstrates a contemporary take on an evolving groove aesthetic. Current hip hop producers are testing the limits of what is rhythmically acceptable and appropriate for groove music as much they are pushing lyrical boundaries. It is of particular interest that as this work approaches the limits of micro-timing deviation it also enters a realm of notation and an even lower level of pulse subdivision.

Analysis terms and quantitative methodology

In order to gain quantitative information regarding temporal relationships within examples, the groove music examples were imported as a complete audio file into a Digital Audio Workstation (DAW), in this case Logic Pro. The file was then evaluated and a segment of audio was selected as being representative of the metrically based groove cycle or “temporal field”. The accuracy of the segmentation was judged subjectively by its effectiveness when “looped” in the software. Once an audio segment is deemed to be appropriate and accurate as a groove cycle, it is then placed on a metrical timeline in the digital audio production software. The tempo of the software is then adjusted so that its duration corresponds to the appropriate metric value on the timeline. For example a loop that is two bars of 4/4 time (or 8 beats) in length should match the same duration of bars/beats once the tempo is adjusted. Thus, the tempo of the loop is ascertained heuristically. Most of the technical and quantitative analysis for identifying temporal musical locations was conducted using Logic Pro’s archetectonic subdivision based terminology.

Bars: Beats: Division: Ticks

Bars and Beats are self-explanatory with division referring to the equal temporal divisions of the beat, usually 4 x 1/16th notes. Those three levels cover the Syntactic subdivisions and constitute a temporal reference grid that can be used for “strict” quantisation. Ticks subdivide each “division” into 240 equitemporal locations. This creates a sub-syntactic or micro-temporal domain where musical events can be observed or placed with a specificity that is not possible with conscious motor control and is beyond musical notation. Logic offers 4 options for the format of this system, particularly with regard to “Ticks”. For all references in this work I have used the [1.1.1.0.] option. This means [1.1.1.0.] is the first possible temporal location; Bar 1: Beat 1: Division 1: precisely, with 0 ticks added. The location; [1.1.1.1.] is 1 tick later. If a snare drum is located at [5.2.1.23], it is on the second beat of bar 5, but is 23 ticks late and an event on [7.4.4.239] is anticipating the downbeat of bar 8 by 1 tick. Thus, we have a concise and
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effective way of communicating micro-timing musical phenomena with respect to pulse. An absolute temporal reference at a tempo of 120 BPM is:

- 1 beat = 500 milliseconds (ms)
- 1 x 1/16th = 125 ms
- 1 x tick = 0.52 ms

Brown, J. “Get Up (I Feel Like a Sex Machine)”, 1970 [Audio M02]

Overview

This work has the reputation as an iconic exemplar of groove music and as such has had some previous analytical scrutiny, notably by (Danielsen, 2006). This analysis is indeed thorough and informative; however there are points of agreement and difference between it and this thesis. Danielsen’s work refers to similar concepts as those discussed here, but the work is more discursive. The goal of this thesis is to identify and test precise and reliable criteria for groove. To this end a quantitative micro-temporal analysis is included at the end of the discussion. This analysis of “Sex Machine” reveals multiple musical examples of the proposed criteria, and uses almost all of the criteria.

Syntactical Analysis

Pulse

“Sex Machine” has a very clear sense of pulse that is consistently and explicitly expressed by the hi-hat part on drums, and is also stated in interlocking gestures by several different parts. It is interesting that the work commences with a very clear expression of the pulse, with its first subdivision stopping on beat 4 and followed by an anacrustic bass gesture. Perhaps this is a way of entraining a listener to the underlying pulse before proceeding to “push and pull” around it.
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Tactus/tempo
This clear and consistent pulse has a tempo of approximately 107 BPM. This tempo sits in the middle tactus range that affords comfortable, smooth and unhurried bodily movement while allowing for a high degree of subdivision and micro timing that would otherwise be lost at higher tempos.

The role of groove in the drums
This sense of clear and simple subdivision is taken up in this example by the drum kit part and the snare consistently marks the 2 and 4 beats of the 4/4 bar or (D) Backbeat, discussed previously. In contemporary music a common kick drum pattern plays beats 1 and 3 alternating with the snare drum backbeat on 2 and 4. In this example the second kick beat is displaced one 1/8\(^{th}\) note later to fall on the 3+. Thus the kick drums divide the bar into 5 x 1/8\(^{th}\) notes and 3 x 1/8\(^{th}\) notes, a typically asymmetrical arrangement of two prime numbers that is characteristic of (F) Metrically Dissonant grouping strategies found in groove. This delaying of the second kick drum has the important effects of firstly drawing attention to a virtual pulse beat 3 (Fig. 7 highlighted) that is conspicuous by its absence, and secondly by becoming part of an (H) Anacrustic push towards the second snare on beat 4 that seems to complete the bar before the bass and vocal gestures launch into the next bar.

![Figure 7 “Sex Machine” drum part showing anacrustic events (H) backbeat (D) and metrical dissonance (F)](image)

The hi-hat figure closely resembles the quintessential pattern found in jazz where, in a similar manner, the cymbals close on the backbeat while also emphasising downbeats. The hi-hats part has a common structure that predominantly keeps a ticking expression for the first 1/8\(^{th}\) note architectonic subdivision of the pulse, but with two important differences. First, the hi-hats close from the 1\(^{st}\) note to the 2\(^{nd}\) beat of the bar, and similarly the 3+ to the 4\(^{th}\) beat. This closure of the hi-hat coincides with a snare drum note and brief and percussive guitar chord on the backbeat (2). These elements combine to create a Hetero-temporal (L) cluster around the second beat of the bar. This has the effect of accenting the beat while making a precise temporal location slightly ambiguous. It could be argued that this has the effect of cushioning the landing or being forgiving of the inaccuracy of a dancer. This could also be viewed as an example of participatory discrepancies (C. Keil, 1987), both between the performers and as a
gestural analogy to group clapping for the listener. The other important characteristic of the hi-hat part is the intermittent embellishment of the regular pulse with a swung triplet figure (J) that implies an additional subdivision of $1/16^{th}$ note triplets. (See Fig. 7). This introduces an implied substratum that contributes to the subtle virtual rhythmic dissonances that are essential to groove. This intermittent use of the $1/16^{th}$ triplet implies a virtual presence of this subdivision globally for a listener. It could be suggested that this hi-hat pattern belongs to the gestural vocabulary of Afro-American drumming and is included without specific reference to other rhythmic elements in the work in a discrete rhythmic stratum that introduces “participatory discrepancies” and rhythmic ambiguity. It also brings a “skip” to the drumbeat by adding an Anacrustic event (H) just before the next downbeat. This tendency in groove music to have “pre-emptive” beats that seem to propel the music and the listener forward, particularly toward strong pulse beats, has been observed by (Danielsen, 2012) and others.

**The bass part**
The bass part (Fig. 8) creates a number of interlocking relationships with the drum part, and a sense of a two bar cycle (C), as opposed to one bar cycle of the drums. In the first two beats of the bar the bass reinforces the statement of the pulse and the non-rotational structure of the rhythm by having strong tonic notes on beats one and two; however, the second half of bar 1 is characterised by strong syncopated notes and beats 3 and 4 are not played (highlighted). Beat 3 comprises a $1/16^{th}$ note rest followed by the subsequent 3 beats with an accent on the last being the $1/16^{th}$ beat before beat 4 is expressed by the kick. This is followed by a pre-emptive bass note on the final $1/16^{th}$ of the bar leading to the first beat of the next bar and the beginning of variation in the two bar bass cycle. In the second cycle the first two beats are played in a similar manner to the first bar; however the last half of the bar becomes more consonant with the drums by accenting the kick and snare parts. In so doing this creates a strong consonant anacrustic effect on the fourth beat that moves toward the recommencement of the cycle. It is interesting that in both the bass and drum parts beat 3 is left relatively unaddressed apart from a simple hi-hat note.

Figure 8 "Sex Machine" bass guitar part with metrical dissonance groupings (F) and anacrustic events (H).
Another rhythmic analysis of the bass part reveals a three-note grouping metrical dissonance (F), a common feature of groove-based music (Fig. 8). Even though the accented beats may suggest an alternative reading of two note groups with an ascending pitch vector, we can clearly discern five groups of 3 x 1/16ths followed by the single linking beat at the end in the first bar, and 4 groups of 3 followed by a group of 4 in the second bar. In the first bar of the two-bar cycle the bass has an anticipated accent note before the 3 beat that it shares with the guitar part. This is another example of anticipatory propulsion, in this case to a virtual 4 beat. The next bass note falls on the final 1/16th note of the bar, and acts as a similarly propulsive anacrusis (H) to the downbeat of the next bar. It should be noted that although the bass part is consistent in its repetition of the key phrases in the part, particularly those on downbeats early in the bar, there is a high degree of subtle variation around the part as is described above and established in the first few bars of the work.

It can be argued that the development of a new idiom and accompanying technique for the bass guitar was crucial in the development of groove and funk music in the later 20th century. The bass instrument was no longer confined to a dutiful subservience to harmonic, melodic and rhythmic instruments, but freed to become the rhythmic, melodic and harmonic core that weaves through and enlivens groove structures. It is common to find the bass given more freedom in its part than either the drums or guitar that remain resolutely with their respective patterns.

This careful balance between the repetition and difference in the bass part is a hallmark of groove music. There is security, but also some unpredictability.

The role of the rhythm guitar

![Figure 9 "Sex Machine" rhythm guitar part with beat 3 highlighted](image)

This part is quite simple and consistent (Fig. 9). It creates a sense of difference between the two halves of the one bar cycle that are more subtly present in the other two parts. The first two chords are clearly on the tactus, playing beats 1 and 2 with very short percussive envelopes. This matches the kick and snare beats on the drums and the tonic notes of the bass creating hetero-phonic accented beats (L). However, a strong point of difference in the guitar part comes with beat 3 where the bass and drums are conspicuously absent, (apart from a
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single hi-hat beat); here an accented longer (agogic) IV chord is resolved on the fourth (or last) 1/16\(^{\text{th}}\) of beat 3 just before the snare beat on the 4. This is another example of pushing or pre-emptive/anacrustic beats (H) and (G) maximal differentiation. The structure of these three different instrumental parts, bass and two guitars, around beat 3 can be interpreted as a propulsive structure that moves to the beat 4 a clearly differentiated backbeat (D) (G).

The role of the 2\(^{\text{nd}}\) guitar

![Figure 10 “Sex Machine” Guitar 2 with “missing 3” highlighted](image)

The second guitar part (fig 10) is interesting for its simplicity, and rhythmic consonance, in comparison to other parts discussed. It marks out the first half of each bar with 1/8\(^{\text{th}}\) notes that culminate in an accented anacrusis note (H) that is answered by the antiphonal response of rhythm guitar. The two guitar parts have a strong rhythmic consonance with each other, and the bass and drums followed by a more dissonant second half of the bar. This guitar part is good example of the need for groove arranging to have elements that are strong and simple reference points for the deviations and discrepancies of other parts in relation to the pulse.

![Figure 11 “Sex Machine- arrangement” with alternate transcriptions of vocals and absence of beat 3 in all parts but rhythm guitar and hi hat](image)

Vocal parts
The key vocal parts (Fig. 11) in the work also demonstrate some of the criteria for groove. James Brown’s repeated call to “get on up” is another propulsive gesture that moves towards “the one”, as he famously described beat 1 of the bar, the commencement of the cycle and the cornerstone of non-rotational structure for the groove. However, the vocal slurs across this beat and concludes the word “up” with a plosive “pa” with an idiosyncratic temporal location (I) near the 1/8th note after the one (see micro-timing analysis below). This is another example of the interplay between the perceived clarity of the temporal location of the pulse and the contradictory ambiguity of the gestures around it. As noted before, this creates a softening of the landing for someone moving to the music. It is also an example of the interlocking and dovetailing between parts that is common in groove tracks. The final plosive “pa” of “up(a)” coincides with the beginning of the hi-hat gesture, which, in turn, ends with a snare beat, a guitar chord and the beginning of the answering vocal phrase.

![Figure 12 “Sex Machine” vocals (highlighted missing 3) and drums below](image)

This vocal phrase starts on a backbeat, beat 2, and so coincides with a snare, bass and guitar. The phrasing of the answering “get on up” makes it hard to hear as a 1/16th or triplet timing due to the 1/16th triplet hi-hat gesture that leads to a relatively unaddressed beat 3. To continue the idea of interlocking parts the combined gestures of beat 2 lead towards the guitar note on beat, which is itself part of a gesture that leads to another pre-emptive pushing anticipation just before beat 4. In the figure below the two vocal parts, which work in a discrete antiphonal “call and response” manner, are transcribed on one line. The answering line has been transcribed both as 1/16th note syncopation and triplets. The point here is to listen to the performance and ascertain which is more appropriate. The truth lies somewhere between the two, being a good example of the micro-timing deviations from the grid of musical notation found in expressive phrasing (I). Both vocal parts are highly anacrustic (H) and push hard respectively to the important 1 and 3 beats of the meter and, combined with the psychological imperative in the exhortation to movement found in the lyric, create a compelling and propulsive effect. It is interesting to note that the lyric turns the traditional
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reading of metric salience on its head by stating the word “up” on what are traditionally downbeats.

Sub-syntactical quantitative data

Transient analysis

The audio file was observed and auditioned to identify transients that can be used as temporal markers for the onsets of musical events. The tempo of the 2 bar excerpt was ascertained heuristically until the seamless looping of the audio file matched a 2 bar duration in the timeline of Logic software (seen in the yellow strip in Fig. 13). Once the audio file matches the timeline it is possible to generate quantitative values for micro-timing deviations both in ticks (as explained above) and converted to milliseconds using a simple proportional formula based on tempo. In addition, another simple calculation was made to express temporal differences in terms of a percentage of the subdivision duration, in this case a 1/16th note. The chart (Fig 14) was created with the method described. In addition to temporal information each segment was identified as an instrument, although this sometimes includes hetero-temporal events (L) as well as maximally differentiated events (G). From this data, observations can be made in the context of the groove criteria.

Figure 13 Loop with transient segments

The majority of rhythmic events display some micro-timing deviation from accurate subdivision with only a couple of events falling precisely on a location with an unequivocal expression possible in notation. The amount of micro-timing deviation varies significantly and is relatively consistent within instrumental parts or categories. For example, the snare drum on the backbeat (D) is consistently slightly late within a range of 8-25ms, whereas, the bass varies widely from coinciding with the kick on “the one” to being extremely “late” on an “off beat” anacrusis (H)(I) to the order of 96ms.
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Sex Machine Microtiming analysis

<table>
<thead>
<tr>
<th>Bar/Beat</th>
<th>Ticks ms</th>
<th>% sub</th>
<th>Instrument</th>
<th>Criteria Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1.1</td>
<td>0 0.0</td>
<td>0%</td>
<td>Bass/Kick/ Hat</td>
<td>L</td>
</tr>
<tr>
<td>1.1.2</td>
<td>97 56.7</td>
<td>40%</td>
<td>Guitar</td>
<td>I microtiming phrasing</td>
</tr>
<tr>
<td>1.1.2</td>
<td>190 111.0</td>
<td>79%</td>
<td>GTR</td>
<td></td>
</tr>
<tr>
<td>1.1.3</td>
<td>29 16.9</td>
<td>12%</td>
<td>Open Hat</td>
<td>Open Hat a little late</td>
</tr>
<tr>
<td>1.1.4</td>
<td>119 69.5</td>
<td>50%</td>
<td>Bass</td>
<td>H Bass considerably late</td>
</tr>
<tr>
<td>1.2.1</td>
<td>23 13.4</td>
<td>10%</td>
<td>Snare/bass</td>
<td>D Strong backbeat slightly late + Guitar</td>
</tr>
<tr>
<td>1.2.1</td>
<td>99 57.8</td>
<td>41%</td>
<td>Bass</td>
<td>H Bass considerably late</td>
</tr>
<tr>
<td>1.2.1</td>
<td>234 136.7</td>
<td>98%</td>
<td>„It</td>
<td>Vocal early</td>
</tr>
<tr>
<td>1.2.1</td>
<td>107 62.5</td>
<td>45%</td>
<td>vox „On”</td>
<td></td>
</tr>
<tr>
<td>1.2.1</td>
<td>107.5 77%</td>
<td>77%</td>
<td>vox „Oh”</td>
<td></td>
</tr>
<tr>
<td>1.2.3</td>
<td>36 21.0</td>
<td>15%</td>
<td>Bass</td>
<td>Bass accurate on upbeat</td>
</tr>
<tr>
<td>1.2.3</td>
<td>141 82.4</td>
<td>59%</td>
<td>vox „Uh”</td>
<td></td>
</tr>
<tr>
<td>1.2.4</td>
<td>83 48.5</td>
<td>35%</td>
<td>vox „Ah”</td>
<td>H Vocal early</td>
</tr>
<tr>
<td>1.2.4</td>
<td>152 88.8</td>
<td>63%</td>
<td>vox „Up”</td>
<td></td>
</tr>
<tr>
<td>1.3.1</td>
<td>80 46.7</td>
<td>33%</td>
<td>GTR</td>
<td>G Guitar on beat 3 Pulse is late max differentiation</td>
</tr>
<tr>
<td>1.3.2</td>
<td>53 31.0</td>
<td>22%</td>
<td>Bass</td>
<td></td>
</tr>
<tr>
<td>1.3.4</td>
<td>0 0.0</td>
<td>0%</td>
<td>Open Hats</td>
<td>Offbeat open hat accurately on subdivision</td>
</tr>
<tr>
<td>1.3.5</td>
<td>84 49.1</td>
<td>35%</td>
<td>Hats</td>
<td></td>
</tr>
<tr>
<td>1.3.5</td>
<td>165 96.4</td>
<td>69%</td>
<td>Bass Hats+</td>
<td>Short guitar anticipates snare, ends before the snare.</td>
</tr>
<tr>
<td>1.4.1</td>
<td>30 17.5</td>
<td>13%</td>
<td>Snare</td>
<td>D,G Clean max differentiation</td>
</tr>
<tr>
<td>1.4.2</td>
<td>150 87.6</td>
<td>63%</td>
<td>Hat</td>
<td></td>
</tr>
<tr>
<td>1.4.3</td>
<td>90 52.6</td>
<td>38%</td>
<td>Vox „Ge.”</td>
<td></td>
</tr>
<tr>
<td>1.4.3</td>
<td>171 99.9</td>
<td>71%</td>
<td>Vox „Et”</td>
<td></td>
</tr>
<tr>
<td>1.4.4</td>
<td>51 29.8</td>
<td>21%</td>
<td>Vox „Uh”</td>
<td></td>
</tr>
<tr>
<td>1.4.4</td>
<td>239 139.6</td>
<td>100%</td>
<td>Bass/Kick/Gtr</td>
<td>L Close enough to be back on pulse downbeat.</td>
</tr>
<tr>
<td>1.2.2</td>
<td>0 0.0</td>
<td>0%</td>
<td>Bass/Kick/Gtr</td>
<td></td>
</tr>
<tr>
<td>1.2.2</td>
<td>39 22.8</td>
<td>16%</td>
<td>Vox „Aw”</td>
<td></td>
</tr>
<tr>
<td>1.2.2</td>
<td>129 75.4</td>
<td>54%</td>
<td>Vox „Pah”</td>
<td>I Microtiming phrasing</td>
</tr>
<tr>
<td>1.2.3</td>
<td>0 0.0</td>
<td>0%</td>
<td>Bass Op Hats, GTR</td>
<td>Open hat accurate. Bass Gtr Fusion</td>
</tr>
<tr>
<td>1.2.4</td>
<td>50 29.2</td>
<td>21%</td>
<td>Bass Hats</td>
<td></td>
</tr>
<tr>
<td>1.2.4</td>
<td>8 4.7</td>
<td>3%</td>
<td>Bass/Snare/ GTR</td>
<td>D,L Bass, Snare accurate, Gtr heterotemporal fusion</td>
</tr>
<tr>
<td>1.2.4</td>
<td>129 75.4</td>
<td>54%</td>
<td>Bass/Vox „Get”</td>
<td></td>
</tr>
<tr>
<td>1.2.4</td>
<td>58 33.9</td>
<td>24%</td>
<td>Vox „UP”</td>
<td></td>
</tr>
<tr>
<td>1.2.4</td>
<td>27 15.8</td>
<td>11%</td>
<td>Hat</td>
<td></td>
</tr>
<tr>
<td>1.2.4</td>
<td>122 71.3</td>
<td>51%</td>
<td>Vox</td>
<td></td>
</tr>
<tr>
<td>1.2.4</td>
<td>191 111.6</td>
<td>80%</td>
<td>GTR</td>
<td></td>
</tr>
<tr>
<td>1.2.4</td>
<td>57 33.3</td>
<td>24%</td>
<td>Vox „Uh”</td>
<td></td>
</tr>
<tr>
<td>1.2.4</td>
<td>159 92.9</td>
<td>66%</td>
<td>Vox „Up”</td>
<td></td>
</tr>
<tr>
<td>1.2.4</td>
<td>51 29.8</td>
<td>21%</td>
<td>Gtr Chord</td>
<td>G slightly late on 3 beat max Differentiation</td>
</tr>
<tr>
<td>1.2.4</td>
<td>45 26.3</td>
<td>15%</td>
<td>Bass</td>
<td></td>
</tr>
<tr>
<td>1.2.4</td>
<td>236 137.9</td>
<td>98%</td>
<td>O Hats / GTR</td>
<td>Hats very slightly early</td>
</tr>
<tr>
<td>1.2.4</td>
<td>79 46.1</td>
<td>33%</td>
<td>Bass /GTR</td>
<td>Late</td>
</tr>
<tr>
<td>1.2.4</td>
<td>80 46.7</td>
<td>33%</td>
<td>Gtr short</td>
<td></td>
</tr>
<tr>
<td>1.2.4</td>
<td>25 14.6</td>
<td>10%</td>
<td>Bass/ Snare</td>
<td>D,L Bass and snare tight on the pulse beat 4</td>
</tr>
<tr>
<td>1.2.4</td>
<td>150 87.6</td>
<td>63%</td>
<td>Vox „AE”</td>
<td></td>
</tr>
<tr>
<td>1.2.4</td>
<td>235 137.3</td>
<td>98%</td>
<td>Bass /Vox</td>
<td>H Slightly early bass. (2.4.2.0.)</td>
</tr>
<tr>
<td>1.2.4</td>
<td>91 53.2</td>
<td>38%</td>
<td>Vox</td>
<td></td>
</tr>
<tr>
<td>1.2.4</td>
<td>162 94.6</td>
<td>68%</td>
<td>Vox „Oh”</td>
<td></td>
</tr>
<tr>
<td>1.2.4</td>
<td>22 12.9</td>
<td>9%</td>
<td>Bass / Hats</td>
<td>H Bass anacrusis slightly late</td>
</tr>
<tr>
<td>1.2.4</td>
<td>56 32.7</td>
<td>23%</td>
<td>Vox „SSSS”</td>
<td></td>
</tr>
</tbody>
</table>

Figure 14 “Sex machine” table of transient onset events with micro-timing locations

This reinforces the groove characteristic of clear non-rotational structure and rhythmic consonance on the commencement of a metric cycle, followed by a range of idiosyncratic rhythmic events. In this case the bass has expressive latitude to “lay back”, to be “in the pocket” or “behind the beat”, while consistently recovering at the end of the cycle to create a “zero sum rubato”(I).
The vocal rhythm is even more variably expressive, sometimes just ahead of the beat and sometimes behind creating temporal differentiation from the other parts (I). The drums supply the counter by “holding it down”. As noted above, the snares have the least variation and are consistently close to the architechtontic grid, as are the hi-hats with one observed precisely on the beat at 1.3.3.0. The kick drum marks the cycle (C) clearly, and whenever there are composite events involving drums the other instruments seem to match the drum event deviation.

Some events were discrete and highly differentiated (the snare events in particular where highly differentiated segments, as were the guitar chords on beat 3)\(^{20}\) others were complex composite timbres such as the kick drum, bass, hi-hats and both guitars that appear on beat one (1.1.1.0. and 2.1.1.0.). This characteristic has been noted as Differentiated or Hetero-temporal.

**Summary**

Although each instrumental part discussed above could be said to have its own groove or feel, it is the dialogic way they combine that creates the meta-groove of the piece, and in so doing a “whole that is greater than the sum of the parts”. Each bar begins with all instruments agreeing on “the one” as a point of reference (although the bass and main vocal sometimes anticipates this in a similar manner to the propulsive Tumbao of Afro-Cuban music); subsequently each part seems to follow its own logic, but can only be understood in terms of the other parts as they weave in and out of metrical dissonance and consonance creating near misses that are either hetero-phonic, anticipatory or refer to virtual structures. The overriding effect is one of forward propulsion through powerful anacrustic structures that move towards the backbeat on beats 2 and 4. Another observation is that this groove establishes a binary composite rhythm over a one bar cycle that commences with a strong and clearly stated first and second beat, exhibiting a high degree of consonance between parts, then moves to a 3rd beat expressed by a single guitar chord, and progresses through the relatively unstable and anacrustic beats 3 and 4 to find a secure footing again at the commencement of the next cycle. This sets up a binary meta-rhythm that cycles between relative rhythmic consonance and dissonance.

\(^{20}\) This high degree of differentiation allows for the possibility of “sampling” individual timbres. The snare drum event audio segments in sex machine could be very effectively removed and reused in another context, via a sampler or audio production software, as a discrete timbral element.
Hancock, H. “Chameleon” 1973 CBS Records [Audio M03]

Introduction

“Chameleon” Hancock 1973 is a well-known composition/production that regularly appears in lists of the “Funkiest” or “Grooviest” tracks compiled by groove enthusiasts, and is regularly covered by both music students and professionals. As such, it is a standard or classic of the genre. It represents a new and innovative development that successfully incorporates jazz into the groove aesthetic. Miles Davis commenced this Jazz-Funk fusion project with the albums In a Silent Way and Bitches Brew, both recorded in 1969. In Miles Davis’ music, although there are strong elements of both rock and funk aesthetics at work, it still has a free-flowing polyphonic/polyrhythmic improvisational structure that comes from giving the musicians the same kind of simultaneous autonomy found in the earliest New Orleans jazz forms. What is different about “Chameleon” is that it integrates the funk and groove techniques of James Brown, discussed above, with a jazz aesthetic. The groove develops through repetition of a sophisticated 2 bar rhythmic structure with minor variations, underpinned by the rhythm section of a synthesiser bass and drums.

The cultural context of this work, referred to previously, is a pivotal moment in the development of Afro-American music and consciousness that refers back to a proud African heritage of which the groove aesthetic is a potent signifier. The track comes from an album entitled Head Hunters, a provocative and playful reference to the primitive, primal and authentic Africa. On the track “Watermelon Man”, one of the structural elements of the groove that introduces the work is an approximation of a simple Hindewhu figure quoted from recordings of Mbuti Pygmies (1961).21 Similarly, the cover has Hancock wearing what looks like a large full-head mask similar to those worn for mystical ceremonies, but with the ironic addition of a Vu meter for a mouth and knobs for eyes creating a techno-primitive irony.

This is an apt metaphor for the music itself, a synthesis of African rhythmic sensibilities, electronic instruments and funk production techniques. In a similar fashion Bitches Brew (Davis) has a cover full of African cultural references and a track that refers to Voo-Doo. Some other signs of the zeitgeist include the fact that both Miles Davis and Herbie Hancock have been quoted citing James Brown and Sly Stone as influences, (Head Hunters has a track titled

21 Hindewhu is a style of singing/whistle-playing of the BaBenzélé
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“In addition, Herbie played on *In a Silent Way* and Bennie Maupin, who features extensively on *Head Hunters* playing Saxophone and Bass Clarinet, played on *Bitches Brew*. This album, and this track in particular, are key artefacts from the crucial transitional period for contemporary music embracing the groove aesthetic. *Head Hunters* became the highest selling jazz record to that date earning platinum record status and influencing many subsequent recordings.

![Figure 15 Head Hunters album cover](image)

**Groove analysis**

“Chameleon” has two distinct musical (textures/sections). This analysis addresses the first section. “Chameleon” has a number of elements in common with “Sex Machine”, which was previously analysed. It has a clear and consistent pulse (B). It is in a meter of 4 and is structured predominantly around a 2 bar groove cycle (C) (Steven F Pond, 2005). The tempo is in a similar range to “Sex Machine” (106 BPM approx.) reaching approximately 104 BPM at the three-minute mark after a steady accelerando from an initial tempo of 93 BPM (B). All the elements of this sophisticated rhythmic structure are introduced sequentially, giving the listener an insight into its construction.

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22 *This concept comes via Butterfield and may need to be explored more.*
Synthesiser bass groove.

Figure 16 “Chameleon” bass part showing metrical dissonance (F), anacrustic events (H) “missing 3”

The first element to appear is the synthesiser bass part with its strongly anacrustic (H) three note figure that leads to a strong 1 beat of brief duration (Fig. 16). This gesture demonstrates compound anacrusis in that there are 2 steps to the resolution. The entire phrase moves toward the commencement beat of the next bar and therefore helps to establish the non-rotational structure of the groove cycle (C). In addition, at a lower level of subdivision, the next note falls on an “offbeat”, the 3+, which is an anacrusis for beat 4 followed by a gesture moving from the 4+ to the beat 1 of the following bar and mirroring the first phrase. This gives forward momentum and strongly establishes the tactus/pulse/tempo of the work. The qualities of the bass lines discussed here are reminiscent of “walking” jazz bass styles; however instead of the bass part articulating the ¼ note pulse at a higher tempo, here the same gestures are rendered as 1/8th notes at a lower (half) tempo. In a similar manner to “Sex Machine”, the bass establishes a sense of pulse (A) and anacrusis (H) culminating in a first beat of the bar. Importantly, this first bass note on beat 1 is of relatively brief duration and is followed by two very brief syncopated notes that occur on the 4th 1/16th note of beat one and the 3+. The durations separating these three notes are two groups of 3 x 1/16th notes, a contra-metric (F) structural device that is found in the bass part of “Sex Machine”, and is common to much groove music. The simple six-note rhythmic riff of the bass part, repeated for most of the work, creates a binary relationship between anacrustic/commetrical (or metrically consonant) gestures that confirms the pulse, and contra-metric/syncopation that do not, creating a cycling sense of tension and release in the groove. (Butterfield 2006) found that the syntactical syncopation is enhanced by the sub-syntactical micro-timing placement (I) of the final bass notes in the figure that are later than the strict subdivisions, as written in a range of 10 to 20 milliseconds (the rising arrows in fig 16). This creates a relaxed “laid back”, “in the

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23 This incorporation of jazz gestures into a “half time” lower tempo pulse is a common occurrence in groove music and echoes previous discussion regarding the comparatively lower tempos found in groove music that allow for greater latitude for micro timing events. As noted previously, a similar adjustment was made in moving from ska to reggae in Jamaica.
Scott SAUNDERS, Master of Philosophy “Towards an Aesthetic of Groove”

pocket” performance. This slight delaying of some events creates the perception that the beginning of the next cycle is relatively “early” each time it occurs thus energising the listener’s attention.

The drum kit part

![Drum Set Image](image.png)

Figure 17 “Chameleon” drum part showing “missing (3)” and anacrustic events (H).

Butterfield (Butterfield 2006) notes that the drum part can be understood as a basic generic drum pattern with two crucial displacements.

![Generic Drum-Beat Image](image.png)

Figure 18 Generic drum-beat

The hi-hats maintain a constant 1/8th note pulse with accents on the on beats of the meter. This is a common role for this instrument in jazz and rock drumming and is unremarkable. Its role is to establish and maintain a reliable temporal framework against which the more contrametric events may be judged. To derive the “Chameleon” pattern (Fig. 17) from the pattern in (Fig. 18) move the first snare drum one 1/16th earlier and move the second kick drum one 1/16th later. At the syntactical level the effect is to create an anacrusis (H) with the snare drum that implies the virtual beat 2 that follows it and, in a similar manner, the displaced kick drum expected at beat 3 is missing (Fig. 17) but is followed by a compound anacrusis (H). The 2nd 1/16th of beat 3 kick drum leads to the next kick drum on 3+ which in turn leads to the snare on beat 4 creating a compound anacrustic gesture, similar to that found in the bass part as described above. The drum part also has two distinct halves. In the first half the kick drum is on beat 1, a strong downbeat, but the snare is highly syncopated/contra-metric, and in the second half the opposite occurs, the kick drum notes are syncopated/ contra-metric and the snare is firmly placed on backbeat 4. There is some variation in the drum part, particularly at the end of 2 or 4 bar cycles where the kick will sometimes follow the 3 bass notes leading to the one. Alternatively, place a kick on the 4 beat and delay the snare to the 4+ has the effect of
being fills. However, unlike many drum fills that are differentiated in character to the musical material they emerge from, here they work in a syntactical manner to surprise the listener by shuffling and displacing familiar material. This means that the fills are not a respite from the groove, but a variation on the groove. In addition to syntactical structural elements there is a similar sub-syntactical micro-timing delay in the drums as observed by Butterfield. The first snare in particular coincides with the G natural syncopated and “laid back” bass note. The drums have a similar rhythmic tension and release within a bar to the bass with “late” snares creating a perceived earliness of beat 1.

**Keyboard parts**

Once the bass and drum parts are established, three clavinet parts enter. The first is a highly syncopated monophonic line that picks up on the 1/16\(^{th}\) note subdivision hinted at by one syncopated note in the bass part and two in the drums. Here the keyboard part reinforces the anacrusis (H) on the 4 beat and clearly states the 1 beat that follows, creating a very strong sense of the “one” and the cycle start, but after this uses 1/16\(^{th}\) notes in highly syncopated figures. Notably, this part has the only note other than hi hats that states beat 2 (Fig. 19). The second clavinet enters with anacrustic gestures starting on the last 1/16\(^{th}\) of the bar, then states the first beat with a wah-wah gesture of 2x 1/8\(^{th}\) notes.

![Figure 19 Keyboard parts transcription showing only one note on beat 2 (*) and highlighted tacet beats 3 and 4.](image)

Chords that coincide with a bass note and kick drum note respectively follow; however the third chord begins a dialogic relationship between clavinet parts. Clavinet 3 continues this pattern by playing the 1+ with the first two parts, the only time all 3 parts coincide (x in circle Fig. 19), thus reinforcing a sense of the first beat, but then plays two chords that the rhythmic placement of clavinet 2 displaces 1x 1/16\(^{th}\) later. Highlighted in (Fig 20) is the conspicuous absence of musical events on pulse downbeats, creating a lively dialogic interplay between all three clavinet parts, and the more commetric elements of the rhythm-section. It has been
noted that groove music, and the African music that inspired it often tends towards a “heterophonic ideal” of maximal timbral differentiation so that all the parts can be clearly heard. The parts here are all “overdubs” of the same clavinet, and so timbrally similar. However, similarity is overcome by technical and production means. One of the clavinet parts is performed with a wah-wah pedal to alter timbre and create maximal individuation (K), separating it from the two parts that are maximally temporally differentiated (G). Differentiation is also achieved spatially by panning the three parts in the mix: centre, right and left respectively. This creates an exciting sense of spatial differentiation, stereophonic interactivity and movement (Fig 20).

Summary

“Chameleon” demonstrates numerous groove criteria, and it could be argued it has incorporated some of the techniques pioneered by James Brown as demonstrated in “Sex Machine”. There are clear commonalities between “Chameleon” and “Sex Machine”: the first beat of the cycle is clearly stated with four out of five instruments playing a strong downbeat at the start of each bar, and the 3 beat is not expressed, apart from a regular pulse note on the hi-hats. The strong first beat is preceded by anacrustic (pre-emptive) structures and followed by contra-metric figures. There is a dialogic interaction between parts creating interplay and a sense of movement. The combined anacrustic structures work at different levels, but all have the same effect of creating forward momentum towards the backbeat (D) on beats 2 and 4 of the bar. Thus we can suggest that this is an early example of using and adapting a groove template.
Pusha T. “Numbers on the Boards” 2013 Island/ Def Jam [Audio M04]

Background
Groove evolution. Sub-syntactic to hypo (micro)-syntactic
Groove has continued to develop and evolve with its audience. One of the most significant developments in the creation of groove music has been the introduction of the non-linear music production environment. The widespread use of samplers, sequencers and drum machines in the 1980s introduced the possibility of controlling the temporal location of musical events with unprecedented accuracy and detail. This included the embedded micro-timing information imported with a sample, the quantisation and MIDI control of a sequencer, and the swing and feel adjustments on drum machines. For the first time in contemporary popular culture the temporal architecture of music was designed rather than performed. A non-linear aesthetic has pushed the boundaries of rhythmic awareness by creating structures that would be extremely difficult to perform. However, they are nonetheless accommodated into the established groove matrix as exciting aberrations and rhythmic tensions by the reception of adept listeners and dancers. Usually these events take the form of the micro-timing displacement of an event from its notional and notational location, and this creates a simulacrum of the subtleties of musical performance. The distinction has been made previously between the syntactical or structural/notational level of groove formation and the sub-syntactical or micro timing of groove. Many of the rhythmic events occur at temporal locations that make categorisation at sub-syntactic or syntactic levels problematic. The resultant effect is challenging and unfamiliar, but also exciting and potent with rhythmic dissonance and tension.

Criteria and analysis
A digital audio recording of the track “Numbers on Boards” (Thornton, 2013) was imported to a Logic pro session for analysis, as described previously. Two temporal diagnostic methods were used. In addition to manually segmenting on transients in the audio file, a MIDI file was created using Logic Pro’s “Audio to MIDI groove” algorithm to extract and mediate similar temporal information as a MIDI file and score.

In (Fig 21) the segmented audio can be seen against a bar and beat ruler placed above it as a reference, indicating a 2 bar audio file with clearly visible transients of percussive events. This piece is a good example of the hip-hop aesthetic of minimalism and maximal temporal individuation of events (G). In this case, for example, from a palette of only seven percussive timbres that are labelled, Kick Perc X, Snare, Hat and Perc 1, 2, and 3, none occur simultaneously, but are instead sequential and discrete (see Fig. 23 for event position list).
“So out it’s back in”

One of the key distinctions made in this research is between the “syntactical” and the “sub-syntactical” in groove. An analysis of “Numbers on Boards” tests this distinction with rhythmic events located at the extremity of sub-syntactical micro-timing displacement and in tantalising proximity to syntactical architectural subdivisions. The paradoxical conclusion to be drawn is that some extreme micro-timing events may be so “out of time” they coincide with a lower level architectural subdivision and are therefore notatable, which suggests new rhythmic compositional and performance possibilities.
(Fig 24) is a graphic representation of the amount of micro-timing deviation from the subdivision grid for various timbres and beats in the rhythmic structure of “Numbers on Boards”. If every event occurred accurately on the appropriate 1/16th note division of the beat, they would appear on the bottom line or “X” axis of the graph. The “Y” axis measures how “late” the rhythmic event actually occurs compared to its notional location on a subdivision grid. The temporal values are “ticks”, because they give a musical reference where 120 “ticks” equals half a 1/16th or a 1/32nd note.

The first event, the kick drum on 1.1.1.0, is precisely on the first beat of the bar. The kick drum at 2.1.1.0 is also precisely on the first beat of the second bar. Along with the first snare drum at 1.2.1.0 (2nd beat, bar 1) these events establish a strong sense of pulse (A), meter (B) and backbeat (D). (A), (B) and (D) serve as references for the extremely contra-metric events that occur subsequently. They also validate the tempo analysis of the loop.

It has been established that micro-timing events in groove music are typically late rather than early with respect to the reference grid of subdivision, commonly 1/16ths. In “Numbers on Boards” there is a wide range of temporal displacement values of musical events, to the extent that categorisation within the criterion of syntactic/sub-syntactic becomes problematic as they approach or exceed 120 ticks.
Grouping events by their magnitude of temporal displacement, the kick drums (blue diamonds) on beat 1 of each bar have no delay; nor does the snare on bar 1, beat 2 or the final hi-hat. These events create a strong sense of meter and groove cycle length against which other events are compared. The two kick drums, falling precisely on the first beat of each bar, thus exactly bisecting the cycle, are particularly effective. However, the other hi-hat beats (marked with red squares) sit at around 20 ticks late (14ms) with values of 17, 27 and 19. Next the snare drums at 40 ticks, for the beat 4s of both bars, and 29 for the beat 2, are in a familiar range of “in the pocket” relaxed performance. However, the anacrustic pre-kick drums are all in the range of 80 ticks or more, being approximately 60ms. (A duration that exceeds a nominal temporal cognition widow of about 50ms.). The following kick drums, at 58 and 22 ticks, tend back toward the grid, but are still significantly late. However, the events of most interest are the timbres that I have labelled Perc (for percussive sound). These events all approach or exceed 120 ticks late, which puts them so late that they could be interpreted and indeed notated as being closer to the next 1/16th, or on the next hierarchical subdivision of 1/32nd notes.

The cumulative effect of these percussive events creates highly anacrustic gestures that stretch our cognition of what is syntactic or sub-syntactic, and also what is anacrustic or not. In the case of Perc 3, for example, is it so late that it has coalesced with the snare to create a composite hetero-temporal event that is experienced as an early, blurred backbeat/snare.
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In Figures 25 and 26 we see graphic representations of the transients converted to MIDI events via the Logic Pro “Audio to MIDI Groove Template” function. (Fig 25) shows the “Piano Roll” view with a bar/beat ruler above and event positions to the right. (Fig 26) shows the result of transforming the MIDI information to a score via quantisation to a 1/32\textsuperscript{nd} matrix.

![Figure 25 “MIDI extraction” of transient locations](image)

![Figure 26 “MIDI extraction” transformed into score with 1/32 quantisation](image)

Here the anacrustic “sub-syntactical” groove events are displaced so significantly that they have become “syntactical” and can be understood, scored and even performed with conventional notation (Fig. 26 in highlight). This opens up a new area of research into scoring groove music for more established and conventional contexts, a symphony orchestra for example.

Conclusion

This chapter has analysed three examples of groove music that are acknowledged as exemplary groove works by critics and audience alike, and by establishing that they are rich in the characteristics described in the criteria, has validated it. Each example has a specific relevance to the discussion.

Firstly, “Sex Machine” is an iconic template of sorts, often regarded as a blueprint for what would follow. “Chameleon” is an example of how an astute musician can appropriate this blueprint and synthesise it with another musical aesthetic. This musical “modus operandi” has
become dominant and enduring, and is still current (listen to the “menu” music on Foxtel, for example). Thirdly, “Numbers on Boards” tests the limits for the parameters of groove criteria. The current groove aesthetic in hip-hop production means pushing temporal boundaries and satisfying the tastes of an audience who like their micro-timing deviations to be even more deviant.

The following chapter will be an analysis and discussion of the author’s original groove works. These works were created in a range of contexts using different compositional and production strategies. However, the criteria are well represented whether through conscious intention or intuitive creation.
Chapter 5 Review of creative work

The purpose of this chapter is to test the groove criteria described in Chapter 3 against a range of original creative works. The range of groove-based work I have either created or collaborated on during my research has been extremely varied and has given me the opportunity to evaluate groove production and performance in many different contexts. At one end of the scale, I have written and arranged music for a large community based ensemble and, at the other end, created groove performance experiments on a laptop.

The structure of this chapter

First in this chapter a professional background statement will give an aesthetic and methodological context for the work. Second, an overview of the different groove composition/production technologies and methodologies used in the creation of the folio will be presented. Finally, a list of titles of the creative works will precede detailed analysis of each work to identify groove characteristics using the criteria described in Chapter 3. The nature of the creative process has involved both consciously applying groove criteria as a technique, and working intuitively to unconsciously create groove outcomes that are identified using the criteria after the fact.

Professional background statement

Ensemble groove performance: dig (Directions in Groove)

The most formative period of my career as a musician, and where I developed my groove ethos and methodology, was my time as a writer and performer with the band dig (Directions In Groove) 1991–99. As the name of the band suggests, the overarching aesthetic, or context, was creating groove music. Initially, the music was influenced by the “touchstones and templates” of the golden age of groove (referred to in Chapter 1) and the experimental “Jazz Groove” hybrids of the subsequent decade. We had unwittingly created the “right music at the right time” to be included in a new category or genre dubbed “Acid Jazz” by the British music press. This also marked a resurgence of interest in groove-based music, driven primarily by DJs, which has continued into the present and expanded into the more mainstream popular culture.

A key formative influence on the early dig was the work of Herbie Hancock. In the set-list of the band’s first performance were two of his compositions, “Chameleon” (see Chapter 4 analysis) and “Cantaloupe Island”. James Brown also loomed large in the collective creative
consciousness of the band, and many of the criteria discussed were implemented unconsciously by arranging material with riffs and motifs modelled on classic groove templates.

**A heuristic compositional methodology for groove**

This created an autonomous yet co-operative arranging methodology of “jamming” the work into existence. By this I mean individual musicians used heuristic and interactive processes to form instrumental parts in relation to each other. The result of this process has been described previously here as a “dialogic mode”\(^{24}\), particularly in regard to African music. Some African musicians have been quoted as stating that their musical part is not only determined by its relationship with other parts, but is problematic to perform or understand in isolation (Chernoff, 1981).

As a result of this, an important aspect of the “groove based” creative ethos of the band was to establish creative equality. As bandleader and organiser I could see that, in a groove based context, the traditional division copyright and royalties needed to be reassessed. By virtue of the primacy of notation, and traditional musicological and legal assumptions regarding authorship, the “songwriter(s)” (i.e. of melodic and harmonic content) received credit and copyright. The rest of the band, usually the rhythm section of drums and bass (i.e. the rhythmic groove content) were uncredited and disenfranchised from the financial value of their creativity. This flies in the face of the extraordinary creative contribution of the rhythm section in groove music. I made certain that the copyright and credits for all compositions and recordings would be collective, an even 5 x 20% split.

It is hoped that one contribution this work can make is to recognise the value of groove musicians and establish a better understanding of their skills. The critical evaluation of the contributions of my colleagues and the processes employed, and the responses of audiences internationally as a gauge of groove effectiveness, has had a profound influence on my understanding of groove performance. However, now I am interested in combining my performance experience with contemporary computer software based practice using some of the techniques and insights I have gained in the current research.

\(^{24}\) Dialogic mode is a term quoted by Danielsen and used to describe a criterion in Chapter 3
Review of technology and methodology used in folio

The range of technologies and methodologies, and the software used, can be categorised as follows:

- **Traditional Notation/Performance**
  - Sibelius (Avid)

- **Non-linear DAW production/ Linear, closed, audio timeline outcome**
  - Logic Pro (Apple)

- **Non-linear object-based production/Cyclic, open (interactive) performance outcome**
  - Audio Mulch
  - Live (Ableton)

Each of these approaches offers different possibilities and limitations, and this bears some explanation.

The traditional approach is self-explanatory. The second approach has similarities to the traditional approach in the sense that the final result is pre-composed, but it is also “pre-produced”. By this I mean that the exact nature of the audio outcome experienced by the listener is predetermined and unalterable. With the traditional approach, different performances of the same work may be distinct, but this is not possible with the second approach. What is different again with the third approach is that it offers a middle way, a best of both worlds where some aspects of the composition are pre-determined, but others rely on the interactivity of the performer and the behaviour of the internally interactive structures created within the software. In addition to this, the non-teleological and cyclic nature of these software platforms is perfectly suited to a groove aesthetic.

In creating exploratory groove music studies, a key objective for this creative research is the development of a performance/production practice through the use of current computer-based hardware and software technologies and techniques while building on and incorporating my experience as a more traditional groove based composer, performer and producer. This can be seen as a logical development in my professional career from a more conventional interactive ensemble performance groove model to one of hybrid linear/non-linear production techniques then finally achieving an autonomous performance/production. This development mirrors recent developments in general groove production methods where there has been increasing research, development and delivery of software and hardware products designed for a groove methodology and aesthetic. A significant component of this
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Creative research involves exploring and evaluating the capabilities of these products in groove creation, and identifying the possibilities for implementing groove criteria using their designs. Several examples that represent a variety of approaches will be discussed.

List of examples

1. Aren’t You Glad You’re in Gladstone! (QMF 2013) Score/Performance
2. This is the Beginning of Something (Diffuse Live Performance 2012) Live recording/ (Audio Mulch)
3. Test loops 2.1 (Audio Mulch)
4. New Tron (Logic) Performance/Programming/Production

Creative Folio

Example #1 “Aren’t You Glad You’re in Gladstone!” [Audio M05a&b]

Compositional methodology and technology

Traditional Notation/Performance, Software: Sibelius (Avid)

Context for groove composition

This example was one piece in a composition and musical direction commission for the Queensland Music Festival 2013 event in Gladstone. This was a large-scale community music theatre production designed to explore the history and character of the region and its people. The brief for the opening musical piece was to help establish an historical and cultural context for the narrative: the 1960s mining and mineral boom seen through the eyes of a family moving to the town for work. The vision of the director and writer was to have a rousing upbeat number that involved choreographed dancing, backing vocals and a full band including horns. My answer was to reference “Motown” popular songs and their arranging styles, which would have been widely heard in the period and which were also notable for the stylised choreography of its performers. The output of Motown records can be seen as a body of work that fits the description of “Touchstones and Templates” for groove as mentioned in Chapter 1. The “house band” at Motown was tellingly nicknamed “The Funk Brothers” and was responsible for an extraordinary output of groove based musical accompaniments for the headline singers on the label.
As both composer and musical director on the project, I was able to implement strategies for groove at both the syntactical (macro) level, by composing and arranging through notation, and at the sub-syntactical (micro) level of performative practice. The latter was communicated by conceptual communication using metaphors and musical demonstration by instrumental and vocal performance. The community-based non-professional nature of the project meant that a balance needed to be struck between creating challenging and effective artistic outcomes and not exceeding the musical ability and commitment of the participants. My compositional method for a popular music context like this is improvisational and heuristic, but within this process groove criteria characteristics spontaneously emerged.

The role of the drum pattern in groove

As a starting point I referenced a type of drumbeat pattern that is quintessentially and distinctly Motown and can be described as a “groove template” (Fig. 29).

![Figure 27 "Motown Drum Kit 1" beat in Sibelius](image)

In a similar manner, the drummer involved in the project was a musician of some decades experience in popular music forms, but who could not read music. However, when asked to play a “classic Motown beat”, he retrieved and performed an almost identical template beat from his internal library of rhythmic forms.

The key identifying features of the beat includes:

- Consistent expression of a tactus pulse on the snare drum (march tempo) (A)
- Strong “one” beat with simultaneous kick/snare/hats
- Syncopated kick drum beats as a displacement dissonance (F) that can be interpreted as anacrustic to snare events on pulse beats and resolving to a consonance at the start of each cycle.

It is of note that, in this context, the performance tempo arrived at for the piece was 128 bpm, close to the 130 bpm suggested by the Sibelius template, and similar to the “Motown”

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26 One of my references for the composition was “Uptight” by Stevie Wonder
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templates it is derived from. This tempo is at the upper range of groove tempos described in the criteria and is highly effective for simple, bouncy, energetic, co-ordinated choreography, which was exactly what was required in this context. (B)

Groove aspects of the drum part

An interesting aspect of the drumbeat used here is that the sense of backbeat (D), so common and important in groove, is not stated as clearly as in other examples. The snare that would usually take the backbeat role is playing all 4 beats of a bar equally, and so beats 2 and 4 have no priority. A common solution to this, particularly in the Motown genre, was to build a composite backbeat event (D)(L). For example, another reference template is a rhythm guitar part of bright and brief chords played in a percussive manner on the 2 and 4 supplemented by handclaps and hand percussion, like tambourine for example. This is what I did with my guitarist, who understood the effectiveness of extremely short durations (G) and of blending with the snare to become a composite “hetero-phonic and hetero-temporal” event (L).

The role of harmonic structure in groove

By improvising ideas on a keyboard to this beat, I developed a bass line and simple right hand gesture in a mixolydian mode, and this became the basic reference structure for arranging the groove. Other parts in the arrangement were either derived from or related to this basic structure. (See Fig. 30).

![Figure 28 Improvised piano figure](image)

The harmonic structure alternates between G major [I chord] and D minor seventh [v minor] chord. This creates a simple sense of harmonic tension and resolution that is matched by the metrical dissonance patterns of the other parts of the arrangement (F).
A two bar structure in 4 meter (C), as is common in previous groove examples, was created with a bass line that had significant rhythmic correspondence with the drum part. The left hand bass part states the pulse early in the cycle and is followed by a metrical displacement dissonance (F) that creates uncertainty and suspense, followed by anacrustic gestures (H) leading to a satisfying downbeat or “one” at the start of the next cycle (C). The regular alternation between rhythmic consonance and dissonance has been noted in previous examples and could be described as “rhythmic consonance alternation” at an architechttonic level higher than the pulse. For example, the first bar of the left hand part has four of the six notes on the pulse whereas the second bar has one out of five. The syncopated notes are marked with rising arrows, and are an example of a displacement metrical dissonance (F). These ideas are well represented in the criteria and the historical examples analysed in Chapter 4. The left hand of the piano became the bass part (see Fig. 28) and, from a performance and musical direction point of view, the bass player’s performance of the part lacked groove because little attention was being paid to note length. By instructing the instrumentalist to play notes with shorter durations and, in particular, making syncopated notes very brief and terminating notes just before another instrument’s note onset, we achieved maximal temporal differentiation (G), that is, the hearing of a discrete series of musical events. For example, the last bass note in the first bar must end before the following downbeat of kick and snare to make them temporally distinct. It also has the effect of creating rhythmic tension in the bass as the syncopated notes are left “hanging” until they hit the ground of a strong downbeat.

Figure 29 “Aren't You Glad...” “Motown” bass showing metrical dissonance (F) and anacrustic events (H)

Brass arranging for groove

Because some elements of the brass arrangement are derived from the piano part they will not be referred to again. The composite backbeat idea discussed above is supplemented by the brass arrangement (see Fig. 32 score). The lower brass instruments, the tuba and bass trombone, play a simple figure on the first two beats of the two bar pattern, reinforcing the
pulse notes of the bass in the rhythm section. A low tonic on the first beat is followed by another one octave higher on beat 2. The higher brass also plays a brief archetypal, idiomatic “funk horns” gesture on beat 2, reinforcing the backbeat (D). Both these elements conform to groove criteria by observing a maximal differentiation in timbre, register and discrete temporal location and duration (G). The higher brass part is followed immediately by a figure in the saxophones that follows the contour of the bass part. The brass and reeds parts are precisely temporally differentiated (G), thus creating a dialogic or conversational “call and response” interplay. The final element is the baritone saxophone part that has two distinctly differentiated elements (G). It is part of the blended saxophones figure just described, but it also drops significantly in register to reinforce the tonic on the first beat of each 2 bar cycle, and this note is preceded by an anacrusitic leading note (H), again a gesture that is common to the idiom and could be described as a quote from the Motown arranging manual.27

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27 Another reference is “Back in My Arms Again” by Diana Ross.
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The sum total of these elements became the basic “fall back” groove of a song played by a live ensemble in a music theatre context that had to “fill in” for indeterminate durations dependant upon the action on stage. (This is an example of the usage of the word “groove” as a specific, repeated, rhythmic compositional structure).

One final element of the arrangement, the French horn, bears some attention. Given the community nature of the project, the presence of an enthusiastic French horn player meant that writing a part for her was a fait accompli. In creating the part (highlighted in Fig. 29) I felt it needed to be different from all the other horns. My reference point for this instrument in pop music was the Beach Boys, and I imagined a flowing counter melody. In retrospect, I was unconsciously going against all the groove criteria to achieve this result. The relatively long note lengths, sustained envelopes, legato articulations and a limited melodic register all contributed to a “non-groovy” counter-melody that was highly differentiated from the other parts.

Summary

Through a process that could be described as improvisation and quotation, of creation and re-creation, a musical composition for amateur musicians was developed that ultimately met a significant number of the groove criteria. This work was written while the concepts underpinning the criteria were still forming and, as such, were implicit rather than explicit in the process. In creating this work, historical templates of notatable syntactic groove structures were used intuitively to produce a highly satisfying performance outcome. It is a testament to the robustness and the effectiveness of the syntactic groove criteria used that amateur musicians were able to reproduce a serviceable facsimile of an iconic groove structure. It could be assumed that this was aided by the acculturation of the musicians, having been exposed to the extraordinarily universal penetration of Motown songs into popular culture.
Example #2: “This is the Beginning of Something” [Audio M06a&b]

Compositional methodology and technology

Solo live laptop performance at “Diffusion” Bon Marche Studio UTS June 2012
Software: Audio Mulch

Background/context

“This is the Beginning of Something” stands in stark contrast to the first example in some significant ways. It is my first solo laptop composition and performance piece, and it came at the prompting of Dr Jon Drummond at UTS. The “Diffuse” concert series contained an open ten minute spot, and he encouraged me to fill it. Accepting his invitation involved an element of risk however the exploratory ethos of the concerts ensured some latitude. I threw a number of ideas, including groove criteria, into the mix and created an “experimental” work. The piece was realised within a virtual digital software environment rather than the traditional ensemble context, but not conceived with a clear aesthetic reference to a groove “touchstone or template”. In this way it is also an exercise in applying groove criteria in a minimal and culturally neutral strategy to test for a “threshold for groove”. This exercise asks the question: How many criteria applied in what manner will generate an intuitively recognized groove? My intention was to be playful, but at the same time intriguing and quite mesmerising, particularly given the 10 minute time frame.

In creating this work I also wanted to explore the possibilities of Audio Mulch software and, in so doing, implement the groove criteria as discussed, but in a more experimental and speculative manner. My intention was to add minimal performance input that would be processed by the software to generate maximal rhythmic and harmonic outcomes.

Production strategy

A description for the composition/production methodology used here could be non-linear/object-based/open (interactive) performance outcome. The distinction being made here is that where some non-linear digital production software strategies produce a fixed and repeatable audio outcome, an object-based interactive strategy means audio outcomes are dependant upon the interaction between processing devices and external inputs to an open system. Consequently the outcomes are not fixed and repeatable, creating a process where performance, composition and production are combined in an act that produces unique
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outcomes. The Australian software “Audio Mulch” is one such non-linear object-based interactive environment. (See Fig. 33)

The equipment used for the performance was:

• Mac laptop with Audio Mulch software
• Microphone
• Digital audio interface
• Control Surface (Akai APC40)
• MIDI keyboard with controllers.

![Diagram of signal flow](image)

Figure 31 “This is...” Audio Mulch overview showing signal flow from top to sound out at the bottom

Methodology

The only audio input to the system was live vocal performances captured by the “Livelooper” contraption in Audio Mulch. The loop or cycle (C) length can be set, in this case to the two bars of 4/4 meter commonly found in groove, as demonstrated in previous examples. Once the audio is captured it is repeated (looped) indeterminately, has an individual signal output from the contraption and can be muted. This allows for a single vocal input to generate polyphonic outputs that can be routed for individual signal processing. “Livelooper” allows for sixteen
simultaneous loops and, in this instance, the first eight received spoken word inputs and were routed to individual processors, creating maximal differentiation (G), while the other eight received sung notes that formed chords and were fed to a common processor to create homogeneity. The performance/production also used a drum machine within the software to provide rhythmic counterpoint to the differentiated spoken vocal material, while a software synthesiser, played live, reinforced the non-rhythmic, sung vocal material. An arpeggiator was programmed to play a random selection of notes from the harmonic structure of the piece on pulse beats, thus occupying a middle ground role combining rhythmic and harmonic elements.

The role of delay line granulation in groove

One of the experimental strategies employed to introduce various criteria was feeding the spoken word audio to the “DL Granulator” and “Nebuliser” contraptions in Audio Mulch. These are both delay line granulation devices that capture very brief segments of input audio as “grains” and process them using quantised delays, grain duration, envelope control and register transposition. This creates a pre-determined system that enforces several significant groove criteria. The primary criteria of pulse (A), tempo and meter are global structural parameters in the software, and are referred to by the contraptions. In this case it is a tempo of 125bpm that is within the tactus (B) range of the criteria and 4/4 meter with a two bar cycle, (C) as determined by the drum and arpeggiator matrixes (see Fig. 34).

The slicing of audio into discrete temporal units of specified duration achieves the maximal temporal differentiation criterion (G) and approaches the percussive ideal of envelopes in groove. The delays in the granular devices are quantised to subdivisions of the pulse and, as
such, create multiple rhythmic layers with attendant metrical dissonance (F) and micro timing deviations afforded by the amount of quantisation. The quantisation resolutions used were:

<table>
<thead>
<tr>
<th>Audio Mulch</th>
<th>Conventional Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
<td>Crotchet/Quarter note</td>
</tr>
<tr>
<td>1/4 [3:2]</td>
<td>Crotchet/Quarter note [triplets]</td>
</tr>
<tr>
<td>1/8</td>
<td>Quaver/ eighth note</td>
</tr>
<tr>
<td>1/8 [3:2]</td>
<td>Quaver/ eighth note [triplets]</td>
</tr>
<tr>
<td>1/16</td>
<td>Semiquaver/ sixteenth note</td>
</tr>
<tr>
<td>1/16 [3:2]</td>
<td>Semiquaver/ sixteenth note [triplets]</td>
</tr>
</tbody>
</table>

The transposition parameters in the granulation contraptions process the original input pitches/frequencies of the material and modulate them over a possible range of two octaves with definable upper and lower limits. This means that each device’s processed output can be limited in register or varied widely producing a series of notes that can be “streamed” by the listener into multiple registers. Both of these effects contribute to the maximal differentiation of timbre and register as groove criteria (G) (Fig 36).

In order to bring the listener’s attention to both the granulation process described above and my compositional strategies, I used a very simple and brief spoken text as input into the system. That text was: “This is the beginning of something”. This was meant to be ironic and self-referential, particularly as each word would be truncated, granulated, delayed, detuned, envelope shaped and repeated in various quantised divisions of the pulse to create overlapping contrapuntal textures.
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The limited input material means that the listener can hear its transformation and reiteration, and observe its processing into rhythmic compositional material.

Control surface as performance

The Akai control surface consisted of a matrix of buttons and a series of faders that could be assigned to any appropriate parameter in the Audio Mulch software, including off/on toggles, mute buttons, triggers for contrapotions, volume and other parameter controls, etc. I used it to trigger the “Livelooper” contraption in Audio Mulch that receives external audio and allocates it to a series of repeating loops. Livelooper has individual outputs for each loop, within the performance, allowing for the routing of each loop to individual granulation devices. The control surface was also used to mute and unmute the outputs of the Livelooper via a mixer. It was also used to change the parameters of the granulation devices, particularly feedback and delay time. This created a layered and dialogic texture that had some groove characteristics. However, the first section of the work lacked a strong, recognisable groove identity from the lack of clear non-rotational rhythmic symmetry (C) (otherwise referred to previously as James Browns’ “One”) and a strong backbeat (D).

The importance of backbeat and drums in the groove

This lack of a clear groove cycle was incrementally remedied by the staggered introduction of individual timbres in a programmed drum rhythm via the “Drums” contraption. This created a more familiar groove structure to orientate the listener. Once established, the drumbeat gives the previously ambiguous rhythmic content of the delay granulators a new groove context whereby they gain clear syncopated and metrically dissonant identities (F).

Counter-groove

Part of the compositional strategy with this experiment was to apply groove criteria, but also to work against them. In opposition to the highly diverse rhythmic and registration outcomes of the first eight processed vocal loops, the next eight loops in the performance were all long static notes of constant pitch routed to a common delay. The harmonic structures used in this vocal arrangement, supported by similar synthesiser chords, were designed to be ambiguous. The chords are all derived from a variation of Messiaen’s third mode of limited transposition. In this case the notes chosen were C, D#, E, G, Ab, B and C. These notes allowed three transpositions of a major third and afforded intervals of major and three minor triads, major 7ths and an augmented 5th but nothing that resembles functional harmony. Like diminished
and whole-tone systems, there is no clear tonal centre. This means that the harmony does not reinforce the groove cycle with a clear sense of harmonic rhythm or resolution. This strategy tempered the effectiveness of the groove created, but did produce an interesting hybrid groove tension.

**Summary**

This work must be seen as an opening gambit in developing a solo performance practice and, as such, is an experiment. The intention of this work was to test the limits, or perhaps the threshold, of the groove criteria by implementing them in a less intuitive and more experimental manner, and in some cases subverting the effectiveness of groove criteria, such as an initial absence of backbeat and the lack of functional harmony. Omitting or minimising some of the key criteria created a different, subtler groove style.
**Example 3: Test Loops (Study #001) [Audio M07]**

**Compositional methodology and technology**

Non-linear compositional strategy, loop and object based.

Software: Audio Mulch

**Context**

This is a further exploration of Audio Mulch as a groove composition environment. In this case, the intention was to test the micro timing possibilities for the non-linear temporal location of events in a repeated rhythm, and to observe the interaction of the programmed rhythm with various pre-recorded rhythmic performances. This work was a study or exercise and should not be viewed as a completed work, but more as a work in progress in an ongoing process of developing techniques.

**Analysis**

This example involved rhythmic generation and interaction via a virtual drum machine (“drums” contraption) and “loop players”. This example demonstrates the way various interlocking rhythmic performance elements can produce groove outcomes. The central idea in this work is the use of very fine micro timing positioning of elements in a drum machine matrix to approximate the expressive aspect of a real performance. This programming is then matched against various audio loops of real performances, from varied origins, and their inherent expressive micro timing deviations. This strategy is designed to produce Keil’s concept of “participatory discrepancies”.

**Drum programming and micro-timing groove**

The “drums” contraption in Audio Mulch comprises a list of audio files, selected by the user and triggered by creating event locations on a timeline matrix of variable temporal resolution. (See Fig. 37). The resolution chosen in this example was 1/64[3:2] or 64th notes and triplets. This resolution is an architectonic subdivision (E) for simple but effective micro-timing positioning of specific timbres in the drum program. The audio files selected are a typical drum-kit grouping of timbres, kick drums (2 for variation in timbre), snare and hi-hats.
To these were added a handclap and a high-pitched wood block. Two “loop player” contraptions were used to add recorded percussion performances, two of which are African hand-drums and percussion, with the third being Chinese woodblocks. Each of these elements came with idiomatic micro temporal groove information.

**Loop-players**

The “loop players” in Audio Mulch can be loaded with an audio file that is time-stretched to match the tempo and metrical structure of the environment. When working in a metrical/groove context it is essential that the audio file is metrically accurate and parsable. For example, if the audio file being used is an accurate “2 bar loop” at original tempo T1, and is loaded into “loop player” with a metric setting of 2 bars, it will now be a 2 bar loop at a new tempo T2. If “loop player” is set to 4 bars it will be time-stretched to twice the duration or “half time”. If “loop-player” is set to 1 bar it will be time-stretched to half the duration or “double time”. The structuring of this beat is an experiment in combining multiple groove layers that comprise micro timing elements to observe how they interact with respect to beat cognition and limits to rhythmic layering. This experiment will also investigate the efficacy of this combination for groove construction. The audio example demonstrates the layers by building up the complete set of possible rhythms layer by layer. Starting from the bottom, the kick drum appears as an ambiguous instrument that lacks a clear sense of orientation. Supplementary beats are introduced, but a sense of meter and orientation is still elusive.

The introduction of handclaps on the “back beat” (D) creates a clear sense of metric orientation (C). The kick drums are now “working off” a clear reference and the syncopation in
the part now makes sense. The next element introduced is a hi-hat pattern that states the next level of architectonic division on the “off” or “and” beats in the bar. This metrical displacement dissonance (F) is very typical of much electronic dance music, for example Chicago “house music”. To this is added a woodblock sound playing something like a “Clave” rhythm as found in Afro-Cuban music, and this is followed by a syncopated snare drum pattern that anticipates the backbeat. This creates an important sense of interplay and is also a production technique in dance music where the clarity and dynamics of all the elements in a mix are enhanced by maintaining maximal differentiation (G).

Micro-timing implementation

Some experimentation with micro-timing placement was used in the drum program. Kick drums are generally on the pulse or its subdivision with syncopated anacrusic (H) “pre beats” being slightly late. Following conventional wisdom in groove playing and programming, the back beat “handclaps” were placed late (by 1/48 beat which at 100bpm is 12.5ms) and the hi-hats were placed early by the same amount. These placements created a push and pull tension within the pattern. It is interesting that when the live performances on the loop-players were introduced they had the effect of knitting together all the elements and “lubricating” the moving parts of the machine. It seems that increased activity involving subtle rhythmic ambiguity can be less taxing on cognitive strategies for rhythm.

Conclusion

The non-linear programming of rhythm in an environment that allows for micro-temporal precision can produce compelling groove outcomes; however the introduction of accurately looped authentic groove performances in synchronised cycles appears to give the non-linear programming a more “human feel” by association and interaction. This humanising effect is clearly apparent when comparing the programmed rhythm before and after the introduction of the real performances, and is characteristic of ensemble performance, something this experiment mimics on a “software stage”.

Example #4: New Tron [Audio M08]

Compositional methodology and technology

Non-linear production.
Software: Logic Pro

Context

This example uses Logic software, and so uses non-linear techniques on a timeline. Unlike the performative and sometimes unrepeatable results produced by Audio Mulch, Logic is a more traditional composition/production environment as it is designed to create a complete and repeatable digital audio production. This includes the ability to record audio, record or write MIDI performances that can be edited to create a virtual composite ensemble, and allows micro temporal editing, location and analysis of audio files. This affords a more detailed context to observe groove. Again, this example is a work in progress that will be completed with real brass and strings performances and have a vocal line. For the purposes of this work, it is the details of the groove creation and experimentation that are important rather than the sense of a complete work. It is hoped that this will give some insight into the disproportionate time and effort that goes into perfecting a brief groove structure that will inform an entire work, much like the first two bars of “Sex Machine” discussed in Chapter 4.

Analysis

A compositional process for groove music can often start with a harmonic progression that can be anything from two to eight bars in length and which marks the length of a larger cycle for the groove, which is how this process started. In keeping with a compositional style that reflects the influence of “hip hop” production techniques, the next step in the process was to incorporate pre-existing groove materials by way of importing a two bar audio loop. In this case, the compositional software platform was Apple’s Logic Pro, a Digital Audio Workstation (DAW) that includes a substantial library of audio content. This library is named “Apple Loops”, one would assume in deference to the sampler based culture of hip hop where brief groove segments were recorded from vinyl records in order to be “looped” or repeated. In this way a composer can import a groove matrix template that other elements of the production will refer to. Most serious artists shun “Apple Loops” because of their ubiquitousness, and therefore banality, which is seen to compromise originality and artistic integrity. However, they can provide a convenient and useful starting point for developing ideas and creating a “demo” or prototype for the final product. This demo will include audio recordings and loops, MIDI performances and other information that may be replaced, transformed or survive intact into the final production. This describes the current work where my intention was to develop a reference groove for a track with a “hip hop”
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aesthetic. After auditioning a dozen or so drumbeat loops, I chose one with the title “Hip Hop Crate Digger Beat”. 28

If groove can be said to have a range of “grooviness”, a “groove spectrum”, then at 98 BPM this example would be posited towards the lower end and could be described as “laid back” or “chilled out”. To describe why this is the case, it is useful to make comparisons with the other works analysed.

Compared to the other drum grooves, this is simpler. There is less contra-metricity or rhythmic dissonance at the structural level; however subtle micro timing of some events can be discerned.

Figure 35 “Hip Hop Crate Digger Beat” segmented by cutting on transients.

Micro-temporal analysis

The numbers at the right on (Fig. 35) give a temporal location for the beginning of each audio segment in terms of bars, beats and subdivisions. In this case we have a bar number, the beat number with respect to meter (in this case four), a subdivision of the beat (in this case dividing the beat into 4 or 1/16th notes) and finally a subdivision of the 1/16th note into 240 “ticks”. Therefore, at a tempo of 98 BPM, a tick is equivalent to approximately 0.64 milliseconds (see Fig. 36).

The analysis of the two bar drum sample commences at bar 53.1.1.0.

28 This title makes a reference to the techniques referred to above. Sampling (digital recording) and re-contextualisation of classic groove material from vinyl records has been central to the hip hop production ethos and the idea of “Crate Digging” refers to the practice of flicking through crates of second hand vinyl records looking for the hidden gold of obscure high quality groove content. (This makes the title unintentionally ironic in light of the above comment regarding the ubiquitousness of Apple Loops.) However the drum part supplied with this label is a serviceable example of this aesthetic.
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The audio analysis of the drum groove via Logic software shows that kick drums on beats 1 and 3 are located precisely on the beat, however the anacrustic kick drums on the 2+ and 4+a are late in a range of 11 to 14 ticks (1%-1.5% of a beat or 7-9 ms). It also reveals a hidden sub/low frequency tone that follows the attack of the kick proper by 128 ticks, or just over a 1/32nd beat later, giving the kick a subtle rhythmic envelope. It is difficult to discern this effect when listening to the complete audio file, but it is clearly audible when the first half beat of the kick drum sound has been muted. This suggests a production technique of creating a composite kick drum event from multiple samples.

Sub-syntactical swing and groove

Regarding the sub-syntactical micro-timing elements of the loop, the “swing” (J) of the hi-hat part can be observed. The first clearly audible hi-hat appears right on the beat at 53.1.3.0, but the following event at 53.1.4.9 is 9 ticks or nearly 6ms “later” than its notional and notational location. This gives it swing, the asymmetrical and anacrustic “push” toward the following beat and the subsequent snare and kick beats maintain a similar late displacement of 10 ticks. This pattern continues and culminates in a highly anacrustic kick drum at 53.4.4.13 that is 13 ticks late (after a hi-hat that is right on the offbeat at 53.4.3.0) and similarly the last three events of the loop are the “on” hi-hat at 54.4.3.0, the “swung” hat follows it, and a final kick, 74 ticks or almost 50ms late (I), creates a strong anacrusis (H) that launches into the next cycle of the groove. None of the events in this loop are “early” in comparison to a notational matrix. All displacements are later and sub-syntactical in magnitude. This creates the “laid back” feeling of the groove, yet maintains energy by making key elements like kick drums on the downbeat appear to be early relative to the late events.
The hi-hat part maintains a consistent contra-metric pulse on the “off beats” or “ands” (1+, 2+, 3+, 4+) and, as discussed earlier, has a “swing” to it, with the first of each pair of 1/16ths consonant with the tactus and subdivision, while the second is late, giving a clear and stable metric structure for the kick and snare to engage with in a dialogic relationship that produces anacrustic gestures (H). An important contributing factor is the use of maximal temporal and timbral differentiation (G), with significantly more of the drum timbres in the rhythmic structure, perceived as a succession of discrete events. I stress the importance of maximal differentiation being a perceived quality because, due to dynamics and timbre, some events may mask others. In “New Tron” there are hi-hat events on the downbeats that are overshadowed by the kick and snare events, hence the only perceived simultaneous events occur at 3+ where the kick and hi-hat coincide. The idea is further expressed by the last event of each bar: a 1/16th kick note replaces what would be a hi-hat note in the established pattern. This effect produces dialogic gestures where the different timbres combine to create an anacrustic phrase (H). The first hi-hats on the 2+ tend to the snare, the second pair of hats
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combine with the kick drum to form a gesture to the kick on beat 3 followed by a double anacrusis structure of hats to snare to hat and culminating in the final and most contra-metric event in the one bar pattern, the kick drum that “pushes” anacrustically into recommencing the cycle.

In (Fig. 40), in the first bar, the arrows are anacrustic tendencies (H), and the dashes show masked notes. The second bar shows the maximal differentiation (G) of the perceived events.

![Drum Set](image)

Figure 37 “New Tron” Hip Hop Crate Digger Beat” with backbeat (D), anacrustic events (H) and maximal differentiation (G)

**Groove simplicity for accompaniment**

A general stylistic observation here is that the drum part is typical of a hip-hop aesthetic, as its structural simplicity affords greater latitude for the “MC” or “Rapper” to create virtuosic vocalisations in reference to it. The syntactical structures display anacrustic forward momentum and the sub-syntactical information in the loop reinforces this and gives clear micro-rhythmic cues for phrasing and “feel”. A hip-hop vocalist will sometimes “lay back” ever further behind the beat and then recover at crucial metrically consonant beats (I). This is in some ways similar to the way simple arrangements of markers on a ski slope create the context for virtuosic slalom “performances”. It also leaves latitude for other parts, which may be performed or sampled, to be added to contribute further groove information to the whole piece with less rhythmic conflict.

**Harmonic strata**

The next stratum added is the harmonic progression recorded using a Fender Rhodes piano sound with stereo tremolo. The part itself is a simple statement of the four chords played on the first beat of each bar, with the tremolo set to a rate that is approximately 1/8th triplets. This is partly due to the lack of accurate control on the effect, but is also welcomed for the slightly irrational micro-timing element it contributes to the overall groove. It appears that analogue delays and tremolos sit more comfortably in a mix than their digitally precise counterparts. This tremolo creates a subtle and intriguing movement to the part that interacts with the micro-timing inter-relationships around it.
Once a harmonic and rhythmic reference structure has been achieved, the next logical move is to create a bass line. As seen in previous examples the bass is an extremely important part in most groove music as its relationship with the drums generates the basic groove energy.

**Synthesiser bass part**

![Synthesiser bass part](image)

*Figure 38 “New Tron” synthesiser bass part with anacrustic events (H) and highlighted “missing 3”*

The bass part was developed through intuitive performance. It “felt right” to have a strong bass note on beat 1 (the one) of an 1/8th note duration, followed by a simple four note 1/8th’s figure on scale notes from supertonic to the dominant, the root of the next chord. This momentum moves toward a virtual downbeat as the following bar is tacet. This absence leaves a vacuum that an embodied listener/dancer will attempt to fill. The following figure is a syncopated 1/16th note that acts as an anacrusis to bar 3 and a 4 x 1/8th note figure similar to bar 1, though this time it is an ascending arpeggio of notes from the Fm7 chord in that bar. This creates a compound anacrustic figure (H), an anacrusis to an anacrusis, with strong forward momentum toward beat 3 of the bar. Where the first bar had a clear expression of beat 3, here we have an anticipatory note on 2+ tied into the note on beat 3. At this point, the synthesised bass has been programmed with delayed pitch modulation (vibrato) that does not become effective until the note has exceeded 1.2 seconds in duration. This means that the beat 3 of bar 3 is not expressed clearly as it has an anacrusis before it and modulation after, but no clear event on the beat. Beat 3 is also missing in bars 2 and 4 (see Fig. 38 highlights). In the fourth bar the rhythmic dissonance increases with a 4 x 1/16th note figure with the last note seeming to be the start of a very syncopated phrase that avoids the strong pulse beats, 2, 3 and 4, and is highly anacrustic towards the first beat of the next bar being the start of the next 4 bar cycle. Here, in the bass part, we can see increasing contra-metric or rhythmically dissonant activity through the cycle building compound anacrustic anticipatory tension that is released with the “one” that commences the following cycle (C).
As stated earlier, the bass part was improvised and was therefore the result of an intuitive, and to some extent sub-conscious, creative process. Analysis of the relationship between bass and drum parts reveals significant correlations at critical points in the groove cycle (C). The bass part creates dialogic and anacrustic gestures, in combination with the drums, reinforcing similar gestures within the drum part itself. In keeping with the other examples, the bass and kick drum are consonant on beat 1 clearly marking the start of the groove cycle (C). The bass figure on beats 3 and 4 is an anacrustic figure that ends on the accented 4+ sitting between snare drum and kick in the corresponding drum figure. This is another example of maximal differentiation (G).

At the end of bar 3, the bass and kick drum are congruent on an anticipated 1/16th note that leads to a well-integrated bass and drum relationship where the bass matches the kick and snare parts, but ties across the kick on beat 3. The following bar has less congruence and greater rhythmic dissonance and individuation. This bass and drum kit relationship demonstrates a carefully managed balance between the rhythmic consonance and dissonance or commetricity and contra-metricity that moves from relative simplicity and commetricity to greater contra-metricity and more complex compound anacrustic structures that propel the listener into the beginning of the next groove cycle.

**Clavinet part in the groove**

The clavinet part was created intuitively, as was the bass part, and comes from a repertoire of figures that I have used in the past to good effect in creating groove music. The part is a simple “diatonic rhythm” made up of note groups in the pattern 3,3,4,3,3 (a la Bossa Nova). The part starts on beat one of the bar, emphasising “the one” and contributing to non-rotational structure. When analysed in relation to the drum part there is significant consonance with the hi-hat part, with four out of five clavinet events coinciding with the hats and, like the hi-hats, the clavinet has significant temporal differentiation from the kick and snare parts. This reinforces the dialogic interplay and timbral differentiation between groove strata in the piece.
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Figure 40 “New Tron” bass/drums/Rhodes/clav/violin/synth brass

Dialogic interplay between synthesiser, violins and clavichord

Upon analysis, dialogic relationships between the synthesiser, violin and clavichord part emerge (Fig 40). Starting with the clavichord and the violin, the latter has clear accented notes in the gaps of the former’s part on beat 2, backbeat (D), and the final sixteenth of the bar creating maximal and timbral differentiation (G). In addition, the synthesiser brass line over the first bar has an anacrustically (H) metrical displacement dissonance in that the four note descending groups of pitches commence before a pulse beat. In the second bar the synthesiser part carefully avoids any coincidence with the clavichord part below it.

Note duration and groove

Note duration is extremely important in groove music. Groove relies on identification of precise temporal events and this is best achieved by a “pointalistic” approach. Playing a figure based around 1/16th note subdivisions will be “groovier” if the note lengths are as close to 1/16ths as possible, thus creating maximal temporal differentiation. Another example is the extended bass note in bar 3 (Fig. 39/40 above) that should be terminated precisely at the commencement of the snare on beat 4. Any sloppy playing of indeterminate durations will undermine the groove. Precise, and therefore usually shorter, durations create more discrete rhythmic events and therefore more space for the principles of maximal temporal differentiation and dialogic interplay to occur.
Legato synthesiser performance

Legato synthesiser performance is where the control parameters of the instrument and the program of particular sounds respond to overlapping note durations. A synthesiser with a monophonic sound and “legato” setting, as was the design of the famous Mini Moog, will retrigger the envelope attack and any modulation settings only when the notes are temporally discrete. If a series of notes overlap temporally, the sustain phase of the envelope continues as does any modulation commenced at the first note of the series. The bass part in New Tron bar 3 is a good example. The synthesiser bass sound is monophonic and legato as described above, so the 5-note figure commencing from the 1/16th note at the end of bar 2 must be played tenuto to get the full note value, but at the same time have very brief gaps between the notes so as to allow the attack/decay front of the envelope to clearly define the notes and postpone the delayed onset of the pitch modulation until the longer final note is held.

This work was an exercise in a more intuitive and performative compositional method and also a quantitative evaluation of some familiar groove techniques and structures. The consistent implementation of groove criteria indicates a corresponding, internalised aesthetic guiding compositional decisions and improvised performances, a groove aesthetic.

Chapter conclusion

This chapter has discussed four very different works that demonstrate various methodologies and techniques for producing groove. They have ranged from traditional performance to experimental software programming, and from an intuitive improvisation to intentional investigation, and yet they have all clearly exhibited characteristics of the groove criteria. The presence of the same phenomena across all examples, both historical and creative, suggests that groove can be analysed, described, de-constructed and re-constructed by utilising the groove criteria presented in this work.
Chapter 6 Conclusion

Groove music is now almost ubiquitous. To suggest that it is the most popular music in the world would not be hyperbole. And yet there still appears to be a widely held preconception that it resists explanation or description, even by recognised groove practitioners.

The above research has gone some way into providing a more detailed description of the musical techniques of groove by synthesising previous research in the area with the observations discussed here. Some people may be attached to the apparent mystery surrounding groove, preferring nebulous explanations that involve intuition, genetic or racial inheritance, innate musicality, acculturation, and so on. This research cannot disprove or deny the existence of any of these factors, and any or all of them may be present in specific musical examples or musicians. However, what this work has done is to describe groove music clearly and empirically in terms of temporally located musical events and the way in which they are structured with respect to established musical frameworks. From this, we can infer that it is possible to create groove music from this empirical base. It is, however, very important to acknowledge the crucial importance of the micro-timing subtleties and nuances of groove that intensify the syntactical structures, giving them distinct characteristics that may be associated with an individual musician, a musical genre, era or an entire musical culture. Acquiring the sub-syntactical, unconscious, micro-timing skills and techniques that produce the musical results may be attended by a certain mystery and involve indirect and abstruse methods of communication such as metaphor, gesture, visualisation etc., as befits an oral and aural tradition. However, the rhythmic results are simply temporally located events that have relationships with other temporally located events.

The concepts established and codified in the criteria comprise a taxonomy of techniques, a catalogue of musical phenomena that can be used to generate groove outcomes or to analyse groove music. The validity of these criteria has been tested against both classic examples of groove music, and also within the creative examples discussed, as proof of the concept. In this way it is hoped that this work can at least serve as a clear and informative reference for other research in this field, and as a useful resource for composers, performers and producers who wish to create groove outcomes.

Further research

This research has been necessarily limited in scope to identifying and describing the musicological/musical criteria for groove in music. However, in the course of achieving this, it
has been necessary to examine groove in broader, historical, social, cultural, philosophical, psychological and physiological contexts. Further research into groove, through these paradigms, could produce extraordinary insights that are significant to both the discipline in question and groove music research itself. What follows is a brief summary of these research areas and the potential outcomes.

Recent publications

During the finalising of this thesis in September 2014 two books were published on the subject of groove, both with a more philosophical interest in the subject (Abel, 2014; Roholt, 2014) It was not possible to respond to these works in this thesis. It is the author’s hope that this marks the start of a new and expansive phase of groove research, and that there is latitude to continue the research begun here.

Terminology of rhythm

The terminology in the analysis of rhythm requires some attention to develop an agreed nomenclature and taxonomy of rhythmic phenomena. This is an area that could benefit from a dialogue between contemporary music scholars and practitioners, musicologists, ethnomusicologists, and music theorists, to develop consistency and accuracy when discussing a phenomenon such as groove. Rhythmic terminology was problematic when writing this research. Conscious decisions had to be made regarding the appropriateness of competing terms. The terminology of rhythm also seems to lag behind musical developments, with groove being a good example. Musicology needs to develop a rhythmic language with far greater precision and finesse.

In resolving this issue some traditional concepts may be challenged or re-organised into a new system, particularly with respect to ideas of metrical consonance and dissonance (or is that rhythmic dissonance? syncopation? Contra-metricity? polyrhythm? Etc.?).

Groove and the body

There is a clear implication that the musical phenomena identified and discussed here have direct relationships with, and indeed draw their significance from, human physiology, embodied cognitive strategies, neurological structures and resultant motor coordination. This would appear to be a very rich area for future research into rhythm and the body that may produce not just musical insights, but also practical applications for increasing mental and physical health. Exercise is indicated as a mitigating factor in major international health issues
such as heart disease, depression, diabetes, etc. One of the fundamental, indeed, defining characteristics of groove is that it motivates human beings to move. The reason it does this appears to involve a spatio-temporal symbiosis between the dimensions and gestures of the music and those of the human body, and reward based cognitive engagement based on predictive strategies. This relationship is also informed by the participant’s age, acculturation, health, etc. Understanding this and developing a new exercise culture, and specific programmes for various cohorts of participants, could produce significant health and wellbeing outcomes.

A new groove culture
In contemporary culture, groove/dancing has been contained in designated areas that could be characterised as:

- Nightclubs, music festivals, young single people, alcohol, recreational drugs, etc.
- Aerobics, Zumba, regimented, fitness etc.
- Filmclips, Dancesport, TV dance competitions, professional dance

A long-term goal for the reintegration of groove into culture would involve creating alternative spaces or venues that offer universal engagement regardless of age, gender or appearance, or, conversely, that focus on specific groups, and encourage people to reclaim groove as a healthy birthright.

As discussed in Chapter 1 groove music may have been the original music, inseparable from dance, chant and ritual. The latent potential for this participation can be seen in the football chant discussed in Chapter 3.

Mind/body time/space
There is another way that groove inverts the accepted musicological paradigm, and it comes as a product of the shift in emphasis on the body. Groove creates a different perception of time. In a classical musicological model the listener is assumed to be in an ideal listening environment, for example a darkened auditorium, where the presence of the performer’s bodies is restrained, gesture is minimised, and where the listener transcends their own body and travels through time via the idealised musical forms and teleological/narrative structures of the composer. In the groove context this consciousness is inverted, the listener is a “groover”, intensely aware of their body, its gestures and the gestures of performers and other “groovers”, and, through the repetition of non-teleological music, they transcend time. Groove creates a different consciousness, an eternal moment, a paradoxical energised stasis. Unlike a
common musicological focus on an idealised “Platonic” musical form, in which repetition would seem unremarkable, groove appears to be alive, made anew again and again, each incarnation an expression of human energy and, as it progresses, stamina.

**Psychology/flow**

The concept of flow as proposed by (Csikszentmihalyi, 1990) is highly appropriate for the experience of groove music. Rhythmic dissonance and ambiguity creates a challenge for the listener/dancer. This keeps attention and awareness active and engaged with the music. It also allows for different degrees of ability across a range of participants. The difficulty could be characterised by the amount of rhythmic/metric dissonance present. Studying physical and cognitive responses to groove music may provide psychological insights.

**Conclusion**

The understanding of groove from a musicological viewpoint may have important extra-musical applications. And conversely, to really understand the significance of groove it must be viewed within its cultural, aesthetic, philosophical, physical and psychological contexts. The study of this phenomenon seems long overdue however the groundwork has been done and there is now a sense of momentum building in this area. The real challenge is not so much the understanding of groove, although more can be done in this respect, but how to apply this knowledge in ways that realise its enormous potential to direct and empower human behaviours.
References

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Criteria Reference Diagram

- Groove Criteria
  - Syntactic
  - Sub-Syntactic
  - Other
    - M) Rhythmic Vectors
    - N) Gesture
  - A) Pulse
  - B) Tempo/Tactus
  - C) Meter/Cycle
  - D) Backbeat
  - E) Architectonic Subdivision
  - F) Metrical Dissonance
  - G) Maximal Differentiation
  - H) Anacrustic Structures
  - I) Phrasing/Rubato
  - J) Swing
  - K) Maximal individualization
  - L) Heterotemporal events
Appendix 1

Supplementary works

In addition to the works discussed above I include three other works commissioned and produced during this research. There will be no in depth analysis as above, but a brief note will give some context to the application of groove criteria in the works. These works provide further listening and exploration of the criteria and compliment and augment the range of creative work presented.

The commission

Dave Mason, the songwriter and vocalist for the iconic Australian band “The Reels”, and regularly counted amongst the greatest Australian songwriters, commissioned me to create new arrangements of his songs for a new performance project (I performed with The Reels in 1982). He described it as “Arty Karaoke”. In collaboration with a graphic designer we created a three screen video projection with synchronised instrumental music track for Dave to sing with. This was performed at selected small venues, including at galleries, theatres etc. The 3 songs were:

- This Guy’s in Love (Bacharah/David) (a cover revived by Dave in 1982)
- Quasimodo’s Dream (Mason)
- Shout and Deliver (Mason)

Although none of these songs would be considered groove music per se but use groove techniques. They attest to the fact that groove can function effectively within song and other forms, and that there are degrees of groove. Groove criteria can be employed selectively and judiciously.

Listening notes

This Guy’s in Love [Audio M09]

An interesting challenge here was the tempo requested. At 70 BPM we are at the bottom of the range of tactus tempi described in the criteria (B). There was also a direction to create a sense of space, which at this tempo is given, what is difficult is navigating the space without losing energy. The track was conceived as a piece of “lounge music” for a trio of drums, bass and vibraphone. The hi-hats create interest by playing triplet figures giving a swing (J), however some metrical dissonances are created by accents in groups of 2 (F). There is a clear
backbeat on the snare that is a strong metric reference. The bass plays on the pulse, but also picks up on swing inflections while the vibraphone is very expressive in its phrasing. This was to create a slight sense of unease. The gunshots were added to match the video content of Jodie Foster, John Hinckley and his subsequent assassination attempt on Ronald Reagan.

*Quasimodo’s Dream [Audio M10]*

The Reels music always had reggae and ska influences, but they were not overt. They were structural rather than stylistic. For this arrangement Dave chose to expose the hidden reggae nature of Quasimodo’s dream by giving me Dub reggae references. The arrangement is based around a “One Drop” reggae style where a composite backbeat (D) of kick, snare, hats and various other elements is the most distinct organising element. Other elements include anacrustic gestures (H) around the backbeat, typical reggae displacement dissonances on hi-hats, and chordal elements and delays are used to create metrical dissonances that can be “irrational”. At 60BPM I is even lower in tempo than this guy’s in love and on the threshold of listeners recalibrating to 120 BPM.

*Shout and Deliver [Audio M11]*

This piece starts with synthesiser and hi-hats playing metrically displaced parts before an anacrustic fill introduces the drum rhythm proper. This work relies on simple repetitive displacement dissonances (F), swing (J) and anacrustic gestures (H) of house music and ska to create “bouncy forward” momentum.
Appendix 2

Audio recordings supplied on USB stick

M01a England football chant (p55)
M01b Football chant Drum kit transcription (p55)
M02 Sex machine (p58)
M03 Chameleon (p67)
M04 Numbers on Boards (p73)
M05a Aren’t You Glad you’re in Gladstone? Audio (p82)
M05b Aren’t You Glad you’re in Gladstone? Video (p82)
M06a This is the Beginning of Something (Live) (p88)
M06b This is the Beginning of Something (Studio) (p88)
M07 Test Loops (#001) (p94)
M08 New Tron (p97)
M09 This Guy’s in Love (p112)
M10 Quasimodo’s Dream (p113)
M11 Shout and Deliver (p113)