Refractions of Time: Towards an Integrated Rhythmic – Melodic System for Improvisation

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Statement of Originality

This is to certify that the content of this thesis is my own work. This thesis has not been submitted for any other degree or purpose.

I certify that the intellectual content of this thesis is the product of my own work, and that all assistance received in preparing this thesis and all sources have been acknowledged.

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Abstract

This research is an auto-ethnographical study tracing my path toward incorporating numerical sequences into an improvisational vocabulary for the saxophone. It emerged from a desire to disrupt habitual patterns of rhythmic phrasing as well as from attempts to apply Greg Sheehan's number-based rhythms to a monophonic melodic instrument. While these rhythms offer rich material for exploration, there is limited guidance on how numerical structures might be translated into melodic-rhythmic vocabulary for pitched instruments. An engagement with rhythmic number sequences revealed that familiar pitch materials often reinforced habitual melodic responses, creating the need for new pitch sets capable of supporting rhythmic complexity within melodic improvisation. Through studying the structure of the Ethiopian *Anchihoye kinit*, I developed a template for creating and expanding a new set of hemitonic pentatonic scales. These newly constructed pitch sets, integrated with number-based rhythms, form the core inputs of this project.

A personalised, practice-led method was developed to familiarise these rhythms and explore their application alongside new pitch material. The resulting improvisational frameworks contained environments in which new rhythmic phrases could be absorbed into my improvisational vocabulary. While developed through saxophone practice, this research outlines an adaptable approach to integrating number-based rhythmic systems into improvisation across a range of pitched instruments.

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1 Background and Methodological Approach

1.1 Introduction

In this exegesis, I will demonstrate how I have adapted Australian percussionist Greg Sheehan's rhythmics concepts to the saxophone within an improvisational framework, and how these ideas intersect with my parallel exploration of hemitonic pentatonic scales.[1] This project led to the creation of a new set of scales derived from the Ethiopian *Anchihoye kinit* [2] (scale) and to the development of a practical method for integrating these scales with number-based rhythmic structures drawn from Sheehan's book *The Rhythm Diaries* (2021). Through this process I have developed a set of practical tools for expanding my rhythmic vocabulary and for shaping melodic approaches that support, complement, and extend these rhythmic ideas during improvisation.

1.2 About the Document

The exegesis is accompanied by a creative work of audio recordings comprised of eight original compositions. Notes on the recording process and the music are found in chapter 4.6 Creative Work. The .wav files can be found in the accompanying folder or can be accessed to stream via a private link to Soundcloud (internet connection is required for all audio and video links) – click on the link below.

Link to creative work

Links to audio examples can be accessed through their own hyperlinks to Soundcloud found throughout the thesis. A master page of all audio examples and be found on the link below.

Link to audio examples

Links to video examples can be accessed through hyperlinks to YouTube found throughout the thesis.

1 A hemitonic pentatonic scale is a five-note scale that includes one or more semitones, giving it a distinctive tension and colour compared to the more common anhemitonic (no-semitone) pentatonics.
2 The Ethiopian word '*Kiñit*' is used to describe a tone system with a specific interval structure. The closest translation in English is the word 'scale', and both will be used in this paper when referring to Ethiopian *kiñit* / scales.

Scales discovered in this research, along with exercises and improvisational frameworks, can be found in the appendix towards the end of this document. All recordings and texts referenced in this thesis can be found in the discography and bibliography.

As the research focusses on the saxophone, all pitch material is discussed using the transposed key appropriate to the instruments being played in each recorded example.

1.3 Musical Background

My foundational training as a jazz saxophonist at the Sydney Conservatorium of Music in the late 1990s provided a strong grounding in melody, rhythm, harmony, and the stylistic lineage of jazz. Although I was aware of other musical traditions at the time, my focus was largely on bebop, post-bop, and the contemporary jazz idioms that emerged from the United States in the mid-twentieth century.

However, the broader musical landscape of my upbringing in Auckland, Aotearoa New Zealand – marked by significant cultural diversity – exerted a deeper long-term influence. I attended jazz and African music workshops with my parents, absorbed Māori and Pacific Island music at school assemblies, and encountered Japanese and Chinese musical traditions through travel and community environments. These formative experiences nurtured a fascination with traditional and folk music globally and cultivated an openness to non-Western rhythmic and melodic practices.

Throughout my career as a Sydney-based saxophonist, I have performed extensively in ensembles representing musical cultures from Ethiopia, India, Sri Lanka, Jamaica, Macedonia, Nigeria and Colombia. I have learnt directly from musicians including Mike Nock (NZ/AUS), Gordon Brisker (USA), Ferus Mustafov (Macedonia), and Sanjeev Shankar (India), and have collaborated with artists such as Dereb Desalegn (Ethiopia), Bobby Singh (India), Sarangan Sriranganathan (Sri Lanka), Ras Roni (Barbados), and Greg Sheehan (Australia). These encounters reinforced my interest in the rhythmic propulsion, melismatic ornamentation, intervallic colour, and improvisational vocabulary characteristic of musical traditions outside the Western canon.

Two musical relationships became especially formative for the research presented in this exegesis: my longstanding collaboration with Australian percussionist Greg Sheehan, and my work with Ethiopian vocalist Dereb Desalegn. From Sheehan, I witnessed a highly personal rhythmic language that he communicated with generosity and clarity - one that has

profoundly shaped the rhythmic thinking of many Australian musicians and academics. My collaboration with Desalegn introduced me to the melodic and expressive traditions of Ethiopian music and the structural uniqueness of the *kinit* system.

1.4 Research Questions

These two influences generated the central research questions that guide this project: how can Greg Sheehan's rhythmic concepts be applied to the saxophone in an improvisational context, and in what ways can the melodic and harmonic material be generated by using hemitonic pentatonics as the primary pitch resource?

My early explorations revealed that applying Sheehan's rhythmic concepts to the saxophone required a complementary pitch system capable of matching their asymmetry and expressive tension. Initial attempts using familiar jazz scales produced predictable gestures that felt creatively limiting, prompting me to seek melodic and harmonic material that was more engaging and open-ended. This led me to construct and explore new scales – particularly those derived from the *Anchihoye* structure – and to develop a practice method that integrated rhythm and pitch within the improvisational practice outlined here.

The remainder of this chapter provides a detailed discussion of the two central conceptual inputs: Sheehan's rhythmic systems and the Ethiopian *Anchihoye kinit*, before moving into a review of the literature and an outline of the methodology.

1.5 Greg Sheehan's Rhythmic Concepts

Greg Sheehan's rhythmic systems, especially his number diamonds, are central to this research. Recognised as one of Australia's most influential improvising musicians since the 1970s (Shand, 2008), Sheehan has shaped the rhythmic vocabulary of numerous ensembles and individual performers (Evans, 2014). His book *The Rhythm Diaries* (2021) documents the rhythmic systems he developed alongside their visual representations and his personal reflections.

Sheehan's number structures emerged from Indian rhythmic pedagogy, exploration of body percussion, and a personal interest in visualising numerical relationships. A number diamond may be defined as the cyclic permutation of a number sequence containing only two distinct integers, one of which is repeated. For example, the number sequence 3–3–2 generates the two permutated sequences 3–2–3 and 2–2–3. Sheehan initially experimented with square

diagrams before developing the diamond format, a visual orientation that he found more fluid for reading both horizontally and vertically (Hill, 2002, p. 28; Sheehan, 2021, p. 21), as will be demonstrated in Section 2.3.7. Figures 1–2 show this orientation shift and in Audio Example 1, I count out the sequence 332 323 233, alternating between spoken and clapped subdivisions. In subsequent sections, I will name number diamonds by the numerals within their first lines. For example, '332 diamond' refers to the complete number diamond structure as seen in Figure 2.

Figure 1: 332 square

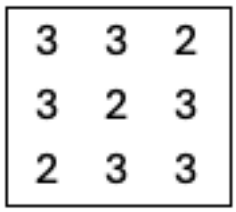
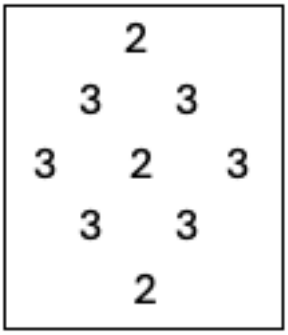


Figure 2: 332 diamond



Audio Example 1: Clapping and counting 332

Link to Audio Example: Clapping and counting 332

Sheehan presents these diamonds as an open conceptual tool rather than a closed method. He stresses that the system offers an "open slate" for creative work: the digits themselves do not encode metre, articulation, accent, or timbre (Sheehan, 2021). Instead, each digit represents a unit of duration that can be subdivided, combined, displaced, or otherwise manipulated according to context. This non-prescriptive quality is both a strength and a challenge. It enables a wide range of stylistic applications, but it also requires the practitioner to devise their own strategies for phrasing, articulation, and integration with pitch materials. This openness also explains why Sheehan's processes are not limited to particular stylistic domains or instruments, allowing musicians from any field to adapt them (Barker, 2015, p. 63).

1.5.1 Challenges for Monophonic Instruments

For monophonic instrumentalists such as saxophonists, this openness raises particular questions. While *The Rhythm Diaries* includes sticking patterns for percussionists and examples of how other musicians have used the system, it offers little guidance on how to translate

number diamonds into melodic-rhythmic vocabulary on pitched instruments. Decisions about scale choice, melodic contour, phrasing and articulation must therefore be generated by the player. One of the core contributions of the present research is addressing this gap from the perspective of an improvisor.

As my engagement with Sheehan's number systems deepened, it became clear that rhythm alone could not determine the direction of my improvisational development. While the asymmetry and rhythmic tension created by number diamonds opened rich possibilities, applying familiar pitch material to these structures often led to predictable outcomes that lacked the creative satisfaction I was seeking. This experience prompted a desire for a more distinctive and compelling melodic environment.

This realisation led me back to another major influence in my musical life: the hemitonic pentatonic *kinit* of Ethiopia. Their distinctive intervallic design, expressive flexibility and ongoing presence in my performance practice suggested a compatible partner for Sheehan's rhythmic concepts.

1.6 Ethiopian Musical Systems and Influence

My long-standing interest in Ethiopian music, particularly the modern genres of Ethio-groove and Ethio-Jazz [3] that emerged in the 1960s and 70s, has played a significant role in shaping the research presented in this thesis. This music, developed largely through the work of composer and multi-instrumentalist Mulatu Astatke, introduced me to sonic worlds that differed markedly from the United States-centric jazz practice in which I initially trained.

My first encounter with Ethiopian music came through a compilation cassette made for me by my brother, and its distinctiveness made a lasting impression. A few years later I met Ethiopian vocalist Dereb Desalegn in Sydney, who invited me to join his band, Dereb the Ambassador. This collaboration, documented on the group's 2011 self-titled album, immersed me directly in Ethiopian musical practice. Desalegn's background as an *Azmari* musician from Gonder (Kawase, 2007, p. 73),[4] and his deep familiarity with regional styles,

3 Danny Mekonnen chose the term Ethio-groove 'to represent the genre of music created by the bands that draw their repertoire from 1960's to 1970's Ethiopia' (Mekonnen, D. 2010) and goes on to say that Ethio-jazz is more specific to Mulatu Astatke's musical influences and while he influences many Ethio-groove bands, the term Ethio-jazz does not fit for all.

4 Under the name Derbe Zenebe, Desalegn is mentioned as a prominent Azmari musician in journal article 'Filming Itinerant Musicians in Ethiopia: Azmari and Lalibaloc: The Camera as Evidence of Communication'. Kawase, I. (2007).

exposed me to the subtle phrasing, expressive ornaments and distinctive scalar systems that underpin much traditional and contemporary Ethiopian music.

The saxophone occupies a prominent place in Ethio-Jazz, where its sound is shaped by melismatic phrasing, wide-vibrato timbral inflections and ornamental leaps, all integrated with the melodic and rhythmic language of the *kinit*. One of the major recorded sources for Ethiopian saxophone style is Getatchew Mekurya's *Negus of Ethiopian Sax* (Mekurya, 1970/2000). Two hemitonic pentatonics in particular – the *Tizeta* minor *kinit* and the *Anchihoye kinit* – became central to my own improvisational vocabulary. These scales appear widely in the Ethiopiques recordings that first captured my interest and later became the basis for significant musical experiences, including recordings with Desalegn and performances of the Ethiopian repertoire in Australia.

For the purposes of this research, the term *scale* refers specifically to a consecutive series of pitches within the twelve-semitone octave of equal temperament. Microtonal tuning systems fall outside the scope of this research and therefore are not considered.

1.6.1 Introduction to the *Anchihoye Kinit*

The *Anchihoye kinit* is widely used across both secular and religious Ethiopian traditions. Timkehet (2013) states that name of the *kinit* derives from the traditional song *Anchihoye Lene,* with a prominent recording of the *kinit* being *Addis Ababa Bête* (Eshete, 2005). The *kinit* features frequently in celebratory music, including wedding repertoires, with several examples appearing on the album *Wedding Songs* (Selamawit, 1972). Other well-known recordings also employing melodic or harmonic material derived from the *Anchihoye kinit* include *Etu Gela* (Ahmed, 2005) and *Yekatit* (Astatke, 1998).

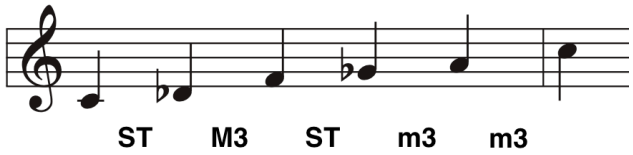
In recent decades, the use of the *Anchihoye kinit* has extended into the Australian music scene. Jeremy Rose's composition *Entering the Subconsciousness* (Compass Quartet, 2013) employs a mode of the *kinit* as a basis for melodic development. My own recorded work with Dereb the Ambassador includes several pieces built directly on the *kinit* – *Addis Ababa Bete*, *Etu Gela*, and *Kulun* (Dereb the Ambassador, 2011). Additionally, I have integrated the *Anchihoye kinit* into several compositions for my ensemble Mister Ott, including *Mattaraja*, *Octopussy* (Mister Ott, 2015), and *Dragon Majesty* (Mister Ott, 2016).

The *Anchihoye kinit* is a hemitonic pentatonic scale containing two semitones (ST), two minor thirds (m3), and one major third (M3), arranged in the intervallic pattern ST–M3–ST–m3–

m3. This structure produces a sound world far removed from the anhemitonic pentatonics (not containing semitones) commonly used in jazz, offering both heightened tension and lyrical melodic possibilities.

Figure 3 shows the scale in C, and Audio Example 2 demonstrates its sonority on the tenor saxophone with a brief improvisation.

Figure 3: C Anchihoye kinit with structure



Audio Example 2: C Anchihoye kinit and improvisation

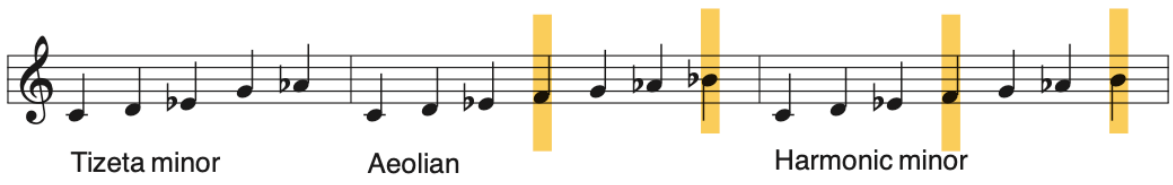
Link to Audio Example: C Anchihoye Kinit and Improvisation

1.6.2 Early Engagement with Hemitonic Pentatonics

My early engagement with Ethiopian hemitonic pentatonics began with the *Tizeta* minor *kinit*, whose intervallic structure immediately distinguished it from the 'nearby' aeolian and harmonic minor scales familiar within Western practice. Improvising on the *Tizeta* minor *kinit* produced melodic phrases that emphasised its distinctive interval profile. The prevalence of major third intervals within its intervallic structure creates a sound world markedly different from the scalar materials that I had previously used.

Figure 4 illustrates the notes present in the aeolian and harmonic minor scales that do not appear in the *Tizeta* minor *kinit*, and Audio Example 3 demonstrates my improvisational approach across these three materials.

Figure 4: C Tizeta minor comparison with absent notes in highlight



Audio Example 3: Scale Comparison

Link to Audio Example: Scale Comparison

I have been working with hemitonic pentatonics since 2009, continually returning to both the *Tizeta* minor and *Anchihoye kinit* as central components of my creative practice. My initial learning took place through immersion in traditional Ethiopian performance contexts, studying recordings and working closely with vocalist Dereb Desalegn.

Ethiopian ornamental vocabulary emphasises melisma, rapid scalar flourishes, and expressive leaps into tension notes - elements that strongly shaped my early improvisations (Audio Example 4).

Audio Example 4: An impression of Ethiopian style improvisation on the Anchihoye kinit

Audio Example: Ethiopian style improvisation on Anchihoye Kinit

In the years leading up to this research, my practice gradually shifted toward a more personal and exploratory approach to these pentatonic scales. I began improvising slowly and without ornamentation, moving deliberately through the full range of the saxophone, across all twelve keys and all five modes of each *kinit,* and incorporating multiphonic techniques. This helped internalise the scales as flexible sonic environments rather than fixed stylistic signifiers. As the present research took shape, I refined this routine further to emphasise familiarisation with newly formed scales and integrations with number-based rhythmic structures.

1.6.3 Modal Exploration and Theoretical Considerations

The *Anchihoye kinit's* unusual intervallic structure invited deeper modal exploration. I investigated whether modal rotations of the scale would retain its characteristic qualities or reveal new improvisational potential. Shifting the tonal focus within a fixed collection of pitches can meaningfully reframe emotional character, encourage motivic development, and guide the structural direction within improvisation.

Following Hannaford (2021), I treat modes as rotations of a principal scalar set. While modal thinking is foundational to jazz practice – for example, understanding the second mode of the C major scale as D Dorian – pentatonic modes are less commonly explored and far less systematically named. Later in this research I will show that any scale can be treated as the 'parent' mode with subsequent modes.

To assist with classification of new encountered scales, I drew on online databases created by Ian Ring and William Zeitler, both of which provide extensive naming conventions and modal relationships for pentatonic and other scale types. I used Ian Ring's *Scale Finder* and consulted William Zeitler's *All the Scales* website to compare interval structures and naming

conventions. Where appropriate, I have used Zeitler's terminology for the scales employed in this research.

Questions of scale perception were also relevant to this investigation. Temperley and Tan (2013) demonstrate that listeners' emotional responses to diatonic modes - such as the perceived 'happiness' of a scale - depend not only on familiarity but also on the relative 'sharpness' of the scale. Audio Example 5 demonstrates how the different modes of F major produce distinct expressive qualities, and this research similarly evaluates the emotional and expressive qualities of newly developed pentatonic modes.

Audio Example 5: Demonstrating moods of diatonic modes

Link to Audio Example: Demonstrating moods of diatonic scales

In early 2022, before this research formally began, I experimented with using Sheehan's diamonds as rhythmic generators while composing. At that time, I still relied on familiar scalar material. Although I was regularly working with hemitonic pentatonics, my use of these *kinit* had been shaped by Ethiopian rhythmic contexts, and they did not immediately align with Sheehan's number systems. These early experiments highlighted the need to understand how other saxophonists had approached external rhythmic or scalar frameworks, prompting a closer examination of the relevant literature.

1.7 Literature Review

The following review of the literature situates the project within the existing scholarship on Sheehan's rhythmic systems, Ethiopian hemitonic pentatonics, and saxophone research that integrates external rhythmic or scalar frameworks.

1.7.1 Sheehan's Concepts in Australian Research

Scholarly interest in Sheehan's work began with Barry Hill (2002), who interviewed Sheehan, analysed his rhythmic concepts, and used them as compositional generators. Luke O'Neill (2013) similarly applied number sequences to his compositional process, influencing bar lengths, arpeggio lengths, intervallic structures, and melodic durations.

Subsequent research has expanded the scope of application. Barker (2015) incorporated number diamonds into his study of rhythmic structures from the east coast of Korea, treating them as archetypal form generators within a cross-cultural creative practice. Rose (2015) used number diamonds such as '223' and '11-11-11-3' to generate horn section rhythms and to

reframe Balinese Selisir material in a jazz ensemble context. Hale (2018) utilised number diamonds as a tool to connect traditional Korean rhythmic practices and emphasised their capacity to produce ambiguous, "knotty" variations. McLean (2018) described number diamonds as a key procedural resource for what he termed the "Antripodean community", where they are used to develop "grouping-series-derived improvisational skills" (McLean, 2018, p. 14).

Keegan (2022) integrated Sheehan's ideas into his *Vocabulary of Melodic - Rhythm Phrases*, drawing on number sequences to organise saxophone articulation and phrasing within a constrained hexatonic pitch set. Gill (2023) developed a monophonic approach that used number sequences as a basis for saxophone articulation patterns, further demonstrating how Sheehan's concepts can be adapted for melodic instruments.

Sheehan's rhythmic approaches are evident on recordings in which he performs, including *The Life of My Time* (Sheehan, 2009), *Metrical* (Circle of Rhythm, 2008), and the earlier ensemble album *F.A.T.S.* (2000). As Fiddes (2016) and others note, musicians such as Scott Tinkler first engaged with these ideas through performing with Sheehan in groups like F.A.T.S. Tinkler provides an example of an artist who has expanded these techniques into his own compositions and his approach to improvised rhythmic generation, taking them well beyond diamond shapes.

Importantly, Sheehan's influence extends beyond the projects he directly contributed to. His rhythmic concepts have shaped the improvisational vocabularies of several Australian musicians, and traces of his approach can be heard on later recordings such as *Unofficial Winner* (Twelve Tone Diamonds, 2004), *Iron in the Blood* (Rose & Earshift Orchestra, 2015), and *Ritual Diamonds* (Hale, 2023), in which performers draw upon rhythmic systems, grouping strategies, and improvisational practices associated with his work. Taken together, these examples show how Sheehan's ideas have circulated widely, informing a diverse range of rhythmic and compositional practices within the Australian improvising community.

This broader uptake is reflected in a growing body of scholarship that examines the creative potential of number diamonds and related rhythmic devices. Collectively, this body of work shows number diamonds being used as compositional generators (Hill, 2002; O'Neill, 2013; Rose, 2015), rhythmic organisational tools (Barker, 2015; Hale, 2018), vehicles for cross-cultural engagement (Barker, 2015; Hale, 2018), and pedagogical frameworks for rhythmic internalisation (Keegan, 2022; McLean, 2018, Gill, 2023). However, across this literature,

applications tend to focus on rhythm or pre-compositional structure. Very little work examines how number diamonds can be systematically combined with new melodic materials - particularly hemitonic pentatonics or synthetic pitch sets - and almost none follows how these interactions unfold in real-time saxophone improvisation. It is into this space that the present research is directed.

These studies contextualise the broader rhythmic environment in which this research is situated and highlight the need for a complementary pitch framework, developed through my engagement with the Ethiopian kinit system.

1.7.2 Scholarship on Ethiopian Hemitonic Pentatonics

The structure of the *Anchihoye kinit* has been documented by Ethiopian scholar Ezra Abate (2009) and first appeared in scholarly work through Michael Powne's analysis (1968). Ethnomusicologist Cynthia Tse Kimberlin (1989) further contextualised its usage through her detailed discussion of ornamentation practices in Ethiopian contemporary song.

More recently, music-information-retrieval (MIR) research has confirmed the distinctiveness of the *kinit.* Retta et al. (2023) compiled a dataset of Ethiopian sacred and secular recordings and demonstrated strong inter-annotator agreement in classifying examples of the *Anchihoye kinit*, supporting its recognisable musical identity across performers and contexts.

Representing the *Anchihoye kinit* in Western notation raises issues of accuracy and cultural translation. As Johnson notes – drawing on the work of Weisser and Falceto (2012) and Kimberlin (1976) – the notated versions of Ethiopian scales represent only approximations of the wide tuning variations used by traditional musicians. He cautions that such notation can be problematic because it risks standardising these practices according to external, Western-derived frameworks (Johnson, 2021, p. 20). While acknowledging these concerns, I notate the *Anchihoye kinit* in pentatonic scale form using twelve-tone equal temperament for practical use within my improvisational work. This approach enables clearer structural analysis and facilitates its adaptation into my pitch-based explorations.

Despite its long history within Ethiopia, the *kinit* appears in none of the major Western scale thesauruses, including Slonimsky (1947) and Lateef (1981). As Johnson (2021) observes, only the global popularisation of Ethiopian music - through the *Ethiopiques* series and films such as Jim Jarmusch's *Broken Flowers* - brought these *kinit* into wider musical awareness.

1.7.3 Saxophone Research Integrating External Systems

The work of four Sydney based saxophonists – Sandy Evans, Jeremy Rose, Matt Keegan, and Sam Gill – has been particularly important in framing this research, as each combines external scalar or rhythmic systems with improvisation on the saxophone in distinct ways.

Sandy Evans has an extensive history of collaboration with Carnatic musicians. In her research, she develops "effective approaches to intercultural collaboration between jazz musicians and Carnatic musicians" (Evans, 2014). She demonstrates relationships between common jazz pentatonics and Carnatic raga (Evans, 2014, p. 66) and confronts the absence of functional harmony in Carnatic music, noting that while some concepts parallel jazz practice, their aesthetic and structural roles differ significantly. To work chromatically within raga-based contexts, she devised a system for generating pitch material by transposing a raga through a diminished chord, creating four new modes (Evans, 2014, p.69). In developing rhythmic vocabulary, Evans emphasises that "achieving enough familiarity with rhythmic patterns to improvise with them intuitively requires extensive practice" and that melodic shapes must clarify, rather than obscure, the rhythmic patterns (Evans, 2014, p. 123). Her research also details Carnatic approaches to rhythm and the systems used to navigate complex rhythmic environments as an improvisor. Evans acknowledges Sheehan's influence on her rhythmic thinking but does not explicitly use his number diamonds to construct her own improvisational vocabulary.

Jeremy Rose's work intersects with this project in two key fashions: his use of the *Anchihoye kinit* and his application of Sheehan's number diamonds in composition. In his piece *Entering the Subconsciousness*, Rose uses the *Anchihoye kinit* to generate a new heptatonic scale for improvisation, although he does not describe a systematic method for deriving or naming this scale (Rose, 2015, p. 87). Elsewhere, Rose employs number diamonds such as 2–2–3 and 11–11–11–3 to structure rhythmic material in compositions like *The Marauder Within* and *Border Control*, using them as a means of engaging with non-Western modal material in ways that avoid simple stylistic imitation (Rose, 2015, pp. 89, 92). I have also been influenced by Rose's compositional style through our work together in the Compass saxophone quartet, where he explored combinations of the *Anchihoye kinit* and Sheehan's rhythmic concepts. Rose's thesis, however, remains focused on composition rather than the systematic expansion of an improvisational saxophone vocabulary.

Matt Keegan created a system for embodying rhythm on the saxophone, developing a set of guiding melodic limitations that "systemise the contour of pitch to reflect the structure of rhythmic phrases" (Keegan, 2022, p. 8). He uses number sequences and navigational systems to construct a series of saxophone exercises he calls the Vocabulary of Melodic–Rhythm Phrases (VMRP), incorporating Sheehan's rhythmic concepts as part of this process. Keegan's chosen pitch material is a six-note Hexatonic Master Mode (HMM), derived from Messiaen's ten-note Master Mode. As he explains, the HMM preserves the symmetry and general functionality of the larger scale while reducing pitch options; this directs focus toward rhythmic intent and facilitates adaptation to different harmonic contexts (Keegan, 2022, p. 120). The vocabulary he presents shows the HMM combined with a comprehensive array of rhythmic structures, mostly in ascending and descending patterns. His system provides a direct pathway to embody rhythmic concepts in preparation for improvisation, but the process of using this material as spontaneous melodic vocabulary is not discussed in depth. For instance, while Keegan's composition *Dub Dupki* uses rhythms adapted from the 9–9–6 diamond, he does not elaborate on the associated melodic or harmonic decision-making.

Sam Gill's research also engages with Sheehan's rhythmic concepts, with his work centred on acquiring greater spontaneity, creative variety, and instrumental dexterity in his improvisational practice. His methodology employed subdivision recontextualization, using pitch inputs, rhythm inputs and specific practice procedures as task constraints. Number diamonds were used to generate articulation sequences over streams of evenly spaced notes (Gill, 2023, p. 19). Pitch sequences were also used as inputs, with seven-note pitch sets drawn from Elliot Carter's *Harmony Book.* Five-note and six-note pitch sets were also used, though the method by which there were derived is not specified. These elements were combined within a multi-parameter patterning routine. A point of difference with Evan's approach is that Gill deliberately chose pitch inputs that were misaligned with the rhythmic patterns of the diamonds, as a way to disrupt entrenched improvisational habits of aligning pitch contour with rhythmic contour. Gill also explored using composite polyrhythms as rhythmic inputs, which he ultimately set aside for aesthetic reasons (Gill, 2023, p 55). Gill explicitly prioritised skill acquisition over vocabulary expansion, focusing on technical refinement and rhythmic flexibility. He does not propose a method for adapting Sheehan's rhythmic concepts to the saxophone but instead uses them as tools for facilitating change in his musical behaviours.

Together, these studies demonstrate that practice-led saxophone research can effectively integrate external rhythmic and scalar systems, but that they also reveal gaps in these systems.

They do not address the generation of new scale materials for, nor do they examine how Sheehan's number-based systems might interact with contrasting scalar environments in real-time improvisation. This gap provides the foundation for the methodological approach outlined in the following section.

My research project treats rhythm and pitch as interdependent, developing new scales derived from the *Anchihoye kinit* and exploring how they combine with Sheehan-inspired number structures to form an integrated improvisational methodology for the saxophone.

1.8 Methodology

This study is situated within a regional practice-based research context. Practice-based methodologies have become central to jazz scholarship in Australia and Aotearoa New Zealand, with numerous researchers demonstrating how creative practice can function as both method and outcome (see Barker, 2015; Barry, 2017; Botting, 2018; Calligeros, 2023; Cameron, 2024; Dobson, 2022; Evans, 2014; Field, 2018; Gander, 2017; Gill, 2023; Green, 2023; Hale, 2018; Keegan, 2022; Kim, 2022; King, 2021; Manins, 2019; McLean, 2018; McMahon, 2022; Meagher, 2022; Rooney, 2024; Rose, 2015; Slater, 2020; Stephenson, 2020). Much of this work is informed by Smith and Dean's concept of the Iterative Cyclic Web, in which practice and research continually inform one another (Smith & Dean, 2009).

My project draws on this lineage and is practice-led**,** autoethnographic, and grounded in self-regulated learning. As with the work of Evans (2014), Barker (2015), Gander (2017), McLean (2018), Slater (2020), Keegan (2022) and others, my own creative practice - particularly my improvisation, composition, and practice routines - serves as both the primary research area and the material from which new knowledge is generated. Following Jones' definition (2018, p. 4), this research can be understood as a form of critical autoethnography, in which autobiography, my own practice and musical history, meets ethnography, as well as the cultures and musical communities I engage with.

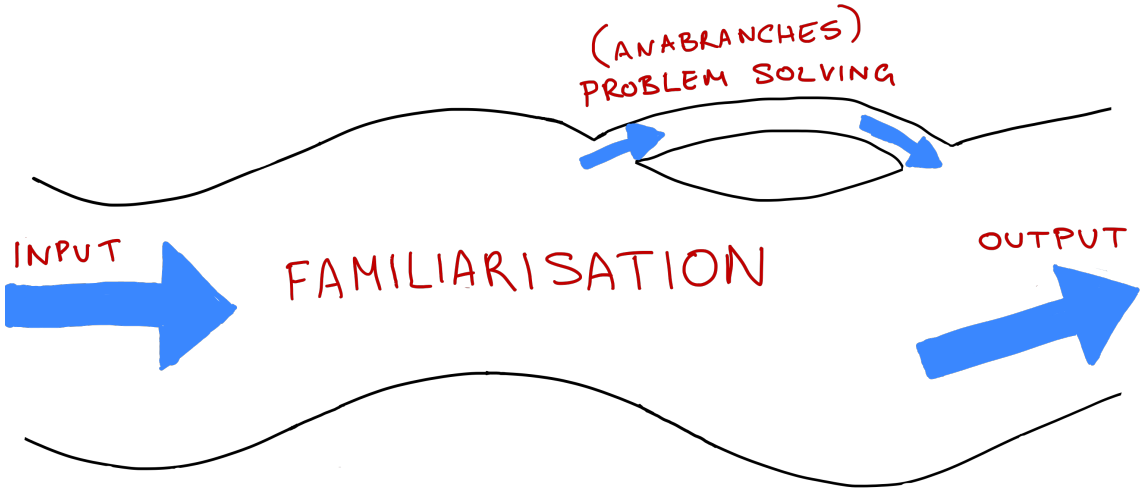
Practice-led research in Australian jazz scholarship is typically characterised by iterative relationships between musical action, reflection and refinement. Evans (2014) describes a three-phase model of learning, syncretising and applying new ideas. Gander (2017) proposes Transitional Synthesis and an Iterative Loop Cycle to describe how new materials are absorbed and transformed. McLean (2018) formulates a Practice/Research Cycle, while Hale (2018) emphasises "Creative Exaptation", the flow of action from aesthetic encounter to the

generation of new work. Other researchers, including Botting (2018), Slater (2020), McMahon (2022), Kim (2022) and Green (2023), foreground self-regulated learning to guide creative decision-making.

Despite differences in terminology, these models share several assumptions: practice generates research material; reflection on practice produces insight; and those insights reshape subsequent practice, creating a continual feedback loop between making and thinking. My methodology aligns with this broader landscape. Like Evans, I use improvisation as a setting for learning and absorbing new ideas. Like Gander and McLean, I work cyclically, allowing each iteration of practice to inform the next; and like Slater and his successors, my process is self-regulated and responsive.

At the same time, the specific needs of this project – combining *Anchihoye*-derived scales with Sheehan's number-based rhythmic systems – requires a methodology that can accommodate both structured inputs (scale and rhythm materials) and open exploratory improvisation. To describe the way these elements interact in practice, I use the metaphor of a "familiarisation river". Inputs (scales and rhythms) flow into the river and pass through stages of exploration and familiarisation before emerging as musical outcomes. Along the way, the river occasionally diverts into anabranches: temporary side-channels representing problem-solving detours when technical or conceptual obstacles arise. Some of these anabranches rejoin the main flow once an issue is resolved; others become standalone exercises or ideas that may be re-integrated later. Within this metaphor, the key methodological components are input, exploration, familiarisation, problem solving (anabranches), and outcome. Figure 5 illustrates this flow.

Figure 5: Familiarisation flow illustration



1.8.1 Input: Introducing New Scale and Rhythm Materials

Inputs take two main forms:

- *Scale inputs*: new pitch sets drawn from hemitonic pentatonics, modes of the *Anchihoye kinit*, or scales created through processes such as "one-step altered".
- *Rhythm inputs*: number sequences and structures taken from Sheehan's *Rhythm Diaries*, including diamonds, triangles, layers and pathways.

1.8.2 Exploration: Improvisational Investigation

Two forms of exploration were used:

- *Exploratory improvisation*: free improvisation without imposed constraints or inputs, used to check in with my creative impulses and to identify potential scale or rhythm candidates.
- *Input exploration*: focused improvisation that deliberately restricts pitch or rhythm to a specific input, in order to reveal its possibilities and limitations.

Audio Example 6 demonstrates exploratory improvisation, and Audio Examples 7-8 show my approach to input exploration.

Audio Example 6: Exploratory Improvisation

Link to Audio Example: Exploratory Improvisation

Audio Example 7: Scale Input Improvisation

Link to Audio Example: Scale Input Improvisation

Audio Example 8: Rhythm Input Improvisation

Link to Audio Example: Rhythm Input Improvisation

1.8.3 Familiarisation: Internalising Rhythms and Scales

Familiarisation is the process through which inputs become part of a playable, intuitive vocabulary. For scale inputs, this involves extended improvisation that explores intervallic possibilities, chordal implications, and motivic potential - often initially in a rubato context alongside a reference pitch, and later against pulse. For rhythm familiarisation, I employed:

- vocalisation (counting or using syllables),
- hand rhythm exercises (e.g., hand tapping or "patsching"), and
- application on the instrument.

My utilisation of vocalisation reflects influences from Carnatic *konnakol*, Hindustani *padhant*, and the embodied rhythm practices seen in the work of Keegan (Keegan, 2022, p. 144) and others, while remaining personal to my own practice. Internalising rhythm through both vocalisations and exercises is something that I have done within my practice for many years, and I demonstrate my approach in Audio Example 9 and Video Examples 1 + 2.

Audio Example 9: 666554 Vocalisation

Link to Audio Example: 666554 vocalisation

Video Example 1: 552 diamond - hand rhythm exercises

Link to Video Example: 552 diamond - hand rhythm exercises

Video Example 2: 552 diamond layers + F# Thacritonic on the Saxophone

Link to Video Example: 552 diamond layers + F# Thacritonic

1.8.4 Problem Solving: Anabranches

When technical limitations such as difficult intervallic leaps, unusual finger patterns, or articulation impede fluency, the process temporarily leaves the main "river" and focuses on targeted exercises. These may involve notated studies, slow-practice passages, or isolated rhythmic drills. Some of these strands rejoin the main familiarisation process once fluency is achieved; others remain as independent etudes or conceptual offshoots. Audio Example 10 shows a practice session in which a technical obstacle was encountered while practising a hemitonic pentatonic scale in fourths. The unfamiliar intervallic patterns prompted the creation of specific exercise to increase technical fluency across those intervals.

Audio Example 10: F Laritonic in 4ths first attempt

Link to Audio Example: F Laritonic in 4ths first attempt

I liken these detours to anabranches: sections of a river that diverge from the main channel before rejoining it downstream. When a technical issue arises, I often notate targeted exercises. Once these have been practised to the point of ease, the idea can return to the original familiarisation process. For example, the challenge encountered in Audio Example

10 prompted a series of exercises and practice sessions that ultimately resolved the issue. After achieving fluency in fourths, I was able to return to the familiarisation process involving the Laritonic scale.

If the technical hurdle proves too great, the input may be set aside, becoming akin to a billabong – separated from the main flow yet still available as a potential source of new musical ideas and exploration. During this research, many inputs were set aside once I recognised they were not suitable, whether through immediate assessment or after repeated unsuccessful attempts to overcome technical obstacles. Some of these 'billabongs' were later revisited. For instance, creating harmonic structures from the new scales initially felt unmanageable, but by the end of the research I was able to incorporate harmonic movement into my improvisations.

1.8.5 Creative Outputs

The outputs of each practice cycle took the form of recorded improvisations, compositional sketches, and notated exercises. Some emerged directly from problem-solving processes, becoming personal or pedagogical studies, while others functioned as artistic artefacts that documented the evolving vocabulary. These recordings and exercises frequently provided the raw material from which later improvisational frameworks were constructed.

1.9 Creative Practice Journal

Early on in the process I noticed that I was lacking some structure in my research and needed a reliable way to track practice sessions, readings, reflections, thoughts collected while travelling, meetings, lessons, and research. To address this, I created a Creative Practice Journal (CPJ), which became an integral part of the research. The CPJ created much-needed structure around practice sessions, helped to recognise patterns in my playing, and pointed to areas that needed attention. I also included other musical experiences relevant to the research such as analysis of performances, rehearsals, directed music listening, composing and attending concerts.

Performance and rehearsal reflections were particularly valuable journal entries. During a performance with my band *Mister Ott*, I recorded my first attempt at using the *Laritonic* scale in an improvisation over my composition *Highway One.* Because the scale wasn't particularly suited to the key of the piece, I noted that future experiments would benefit from a composition specifically designed for the *Laritonic* scale, while I continued to explore more

suitable options for *Highway One.* At a rehearsal with my quartet *Volant*, I successfully experimented with using the *Kygitonic* scale while improvising. However, attempts to incorporate complicated rhythm groupings failed due to limited familiarity and insufficient preparation. These reflections helped clarify the need for continued familiarisation with these rhythmic concepts in my improvisational language.

The creative practice journal (CPJ) is now a valuable resource that I constantly refer to for clarity in my current research and for material to support emerging concepts.

1.10 Chapter Summary

The convergence of these musical influences, conceptual frameworks, and methodological considerations established the groundwork for developing a personal system of scale and rhythm integration. With the *Anchihoye*-derived pitch materials and Sheehan's number-based rhythmic structures identified as the core inputs of the project, the next step was to determine how these ideas could be explored, internalised, and applied to the saxophone.

1.11 Chapter Outlines

While Chapter 1 has covered the background and explained the methodology of this thesis, Chapter 2 details the early practical processes through which new newly constructed scales and number-based rhythmic materials were constructed, explored and internalised. This chapter outlines early practice routines, diagnostic strategies, and the formation of a structured practice method.

Chapter 3 examines how rhythmic and pitch materials interact within improvisational frameworks. It outlines the rhythmic structures, melodic strategies, and harmonic approaches that shaped the development of new improvisational vocabulary.

Chapter 4 presents the artistic, technical, and conceptual outcomes of the project, including expansions in improvisational vocabulary, structural awareness, creative outputs, and implications for future research and broader instrumental application.

Chapter 5 summarises the research findings, reflects on the methodological and artistic contributions and identifies potential directions for further exploration.

The exegesis is accompanied by eight original creative works, an appendix containing scales materials and exercises, and full discography and bibliography listings.

2 Practice Processes and Input Development

The following chapter outlines the initial steps and processes used in both scale selection and the creation of an appropriate training method for applying rhythmic skills to the saxophone. Practice sessions conducted throughout the duration of this research led to the formation of a system that facilitated a personal approach to improvisation. This system helped guide a way to new harmonic and melodic invention combined with a saxophone-specific approach to applying Sheehan's number sequences.

2.1 Early Practice Structure

A practice routine was devised to gain fluency on the instrument and to build familiarity with new scales and rhythms, with the overall aim of developing an improvisational vocabulary. It was important to me that this routine integrated melodic, harmonic and rhythmic concepts, as this would better support a more well-rounded vocabulary. The desired musical outcome was conceived as a blend of melodic, harmonic and rhythmic materials working together as a whole, with the final implementation left open to be determined as the music took shape. While a single practice session could focus on one element in isolation, multiple sessions were required to address all the components of the process.

The early practise sessions followed a simple structure:
1 - free improvisation,
2 - scale exploration, and
3 - rhythm exploration.

Starting with free improvisation helped to set the scene for the session. For me, this stage was a meditative process that helped focus the mind and prepare it for creative practice. The harmonic and rhythmic processes were initially worked on separately to develop both the materials and the training method. Initially, I worked mostly working with familiar scales, but I found that through the improvisation process I began to explore new pitch sets that needed to be identified. Over time, these sessions evolved to incorporate a purpose-built set of inputs consisting of newly developed scales and rhythmic concepts.

2.1.1 Physical and Technical Obstacles

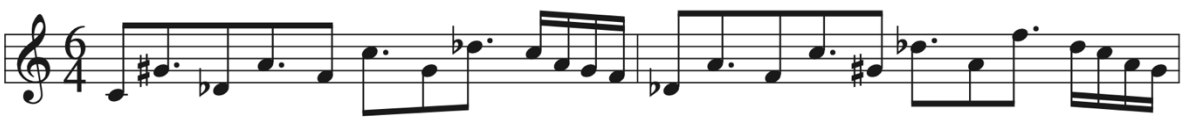
Early practice sessions were mostly concerned with dealing with physical and technical obstacles or distractions. These issues were important to address in the early stages of the project.

Muscle fatigue for a saxophonist is mostly focused on the shoulders, back, forearms and the jaw muscles supporting the mouthpiece. Neck and shoulder muscle strain from prolonged use of a traditional saxophone sling resulted in serious neck pain. The use of the 'Sax Holder' by Jazzlab[5] helped to divert weight away from the cervical spine (Piatek et al., 2018, pp. 251-257)[6] but came with its own issues, impacting the trapezius muscles of the shoulders. This can be painful and restrict head rotation. Alternating between neck straps, switching between standing and sitting, and keeping my posture moving helped alleviate these issues.

2.1.2 Technical Limitations and Diagnostic Exercises

During the first practice phase, I created a series of exercises to help identify and address any technical issues such as a weak finger or unfamiliarity with a certain scale. Due to the unusual structure of these new scales, muscle memory could not be relied on, and I had to retrain my fingers to get used to these new structures. Interval-based exercises were designed to address these fingering issues as I found traditional scalar work - ascending and descending patterns - too rigid and restrictive in its melodic application. These exercises laid the groundwork for the establishment of improvisational vocabulary found in the improvisational frameworks. Figure 6 shows an excerpt of a fourths-based exercise designed to address intervallic challenges associated with the C *Loritonic* scale (C Db F G# A), discovered during this research. Fourth-based in this case refers to scale step movement of fourths – for example: scale step one 'C' to scale step four 'G#'. The full exercise is found in the appendix on page 69.

Figure 6: C Loritonic scale fourths-based exercise



5 https://jazzlab.com/en/saxholder/
6 A study done in 2018 by Piatek et al. shows that the "use of the Sax-holder resulted in a physiologically favourable axial position of the head".

2.1.3 Cognitive Load

Working with unfamiliar scale structures and number-bases rhythms at the same time often led to cognitive overload. Early attempts in combining a new scale with a complex new rhythm diamond often fell apart, with the combined load of dealing with new fingering, intervallic structure, rhythmic shapes and articulation hurdles being too much to deal with. It was clear that various aspects needed to be fully addressed or internalised before moving on to the instrument. I therefore adopted a staged approach to the familiarisation of both scale and rhythm inputs. These early struggles were an important step in the shaping of the methodology.

2.2 Scale Inputs and Construction Methods

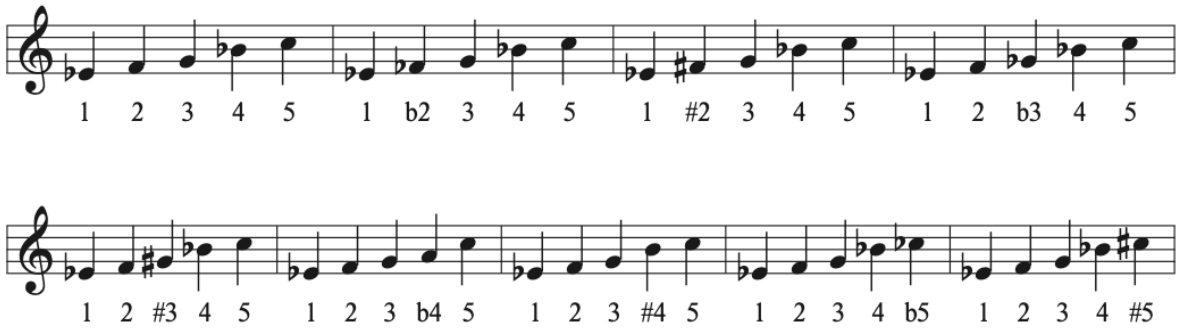
One of the key aims of this research was to find a suitable melodic and harmonic template to draw from while expanding my rhythmic vocabulary. When I first experimented with the number diamonds found in *The Rhythm Diaries*, I felt that the harmonic material I was employing was the wrong fit. It was leading to generic and predictable melodic and harmonic outcomes, and I needed a more sophisticated harmonic template from which to draw from. Adopting new pitch sets shifted this tendency helping to force new melodic trajectories and fresh phrasing. It also helped embrace new intervallic structures, and explore new emotional terrain. In order to find these new pitch sets I created my own intuitive method of scale alteration and creation.

2.2.1 One-Step Altered Method

The first breakthrough in scale creation came from a simple observation: shifting any single note of a familiar pentatonic scale by a semitone produces a completely new pitch set. This emerged while improvising on the Eb major pentatonic scale, where I noticed that altering any note by a half-step generated a different scale. This process is somewhat explored in various jazz method books, such as Jerry Bergonzi's 1994 publication "Vol. 2 Pentatonics".

Figure 7 illustrates eight of these new scales, and in Audio Example 11, I demonstrate how each altered step changes the overall character of the scale.

Figure 7: Eb major pentatonic with one-step altered applied



Audio Example 11: Scale comparison of 'one-step altered' on Eb pentatonic

Link to Audio Example: Scale comparison of 'one-step altered' on Eb pentatonic

To my knowledge, this specific process has not been used by other musicians for scale creation, although I acknowledge that synthetic or newly invented scales have been explored by European composers since the early twentieth century.

Many more scales can be created beyond the examples shown here by altering more than one note at a time or by shifting a note by more than a semitone. This technique of scale creation led to the discovery of new pentatonic scales I had not encountered before, as well as uncovering modes of existing ones. I refer to this process as *one-step altered*.

2.2.2 *Kinit* Derived Scale Families

To narrow the field of possibility for this project, I focused on scales derived from the structure of the *Anchihoye kinit*. Its interval structure provides an unusually varied set of intervals, making it a fertile source for generating pitch sets.

I began by writing out the five modes of the *Anchihoye kinit* and then located each one on Ring's *Scale Finder* using names assigned from Zeitler's database. During this process, I noticed that the third mode of the *Anchihoye kinit* was only one pitch away from a scale that had been created earlier in the research through the use of the one-step altered method. Once identified, these pitch sets became the *Daptitonic* and *Laritonic* scales.

I then compiled all fifteen possible scales generated from this structure. Figure 8 presents these in the key of C, labelled with Zeitler's names and Ring's numerical identifiers. In this listing, I use Zeitler's name *Zynitonic* in place of *Anchihoye*, in keeping with my adopted naming system. For clarity, I organised the scales into groups containing either an unbroken diminished triad, a minor triad, or a major triad.

Figure 8: Scales derived from the structure of the Anchihoye kinit

THE FIFTEEN VARIATIONS OF STRUCTURE: ST M3 ST m3 m3

Diminished triad (m3 m3)

Mode 1	m3 m3 ST M3 ST	C Eb F# G B	Kygitonic	2249
Mode 2	m3 ST M3 ST m3	C D# E G# A	Mocritonic	793
Mode 3	ST M3 ST m3 m3	C Db F Gb A	Zynitonic	611
Mode 3	M3 ST m3 m3 ST	C E F Ab B	Lycritonic	2353
Mode 4	ST m3 m3 ST M3	C Db E G Ab	Daptitonic	403

Minor triad (m3 M3)

Mode 1	m3 M3 ST m3 ST	C Eb G Ab B	Kyritonic	2441
Mode 2	M3 ST m3 ST m3	C E F G# A	Zothitonic	817
Mode 3	ST m3 ST m3 M3	C Db E F Ab	Phrolitonic	307
Mode 4	m3 ST m3 M3 ST	C D# E G B	Ionagitonic	2201
Mode 5	ST m3 M3 ST m3	C Db E G# A	Aeolapritonic	787

Major triad (M3 m3)

Mode 1	M3 m3 ST m3 ST	C E G Ab B	Zacritonic	2449
Mode 2	m3 ST m3 ST M3	C D# E G Ab	Laritonic	409
Mode 3	ST m3 ST M3 m3	C Db E F A	Thacritonic	563
Mode 4	m3 ST M3 m3 ST	C D# E Ab B	Styditonic	2329
Mode 5	ST M3 m3 ST m3	C Db F G# A	Loritonic	803

According to Ring's *Scale Finder*, four of these scales correspond to Indian ragas, - *Raga Multani* (*Kygitonic), Raga Girija* (*Lycritonic*), *Raga Reva (Daptitonic),* and *Raga Megharanjani (Phrolitonic).* As this project does not attempt to perform or interpret these ragas within their traditional contexts, I shall use Zeitler's neutral naming system to avoid confusion with cultural or stylistic authenticity. To my knowledge, the remaining ten scales – *Mocritonic, Zynitonic, Kyritonic, Zothitonic, Ionagitonic, Aeolapritonic, Zacritonic, Laritonic, Thacritonic, Styditonic* and *Loritonic* – are not in use or part of any musical tradition. The successful application of this method in scale creation suggests that further discoveries are possible.

2.2.3 One-Note Added

After developing this family of *Anchihoye*-derived pentatonics, I took the one-step altered concept further by intuitively adding one note to a given scale. This opened the door to exploring new hexatonic and heptatonic scales built from hemitonic pentatonics. Discoveries led to the use of the *Aerythimic, Bogian, Bocrimic, and Lygimic* scales in improvisational frameworks. Compositional results of this scale creation method are seen in *Hexigra Drift*

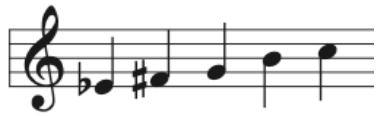
which uses the E *Bocrimic* scale (E G A B♭ C♯ D), and in *Quintara Flow* which uses the C *Bogian* scale (C D Eb F# G Ab B).

Adopting new pitch sets forced new melodic pathways and fresh phrasing, providing a set of pitch material suitable for coupling with Sheehan's rhythmic concepts. Using the one-step altered method helped source new pitch material that embraced new intervallic structures and explored new emotional terrain. Incorporatating an extra level of scale construction in the one-note added method broadened my capacity to adapt pitch material to the needs of the emerging music.

2.2.4 Familiarisation Through Drone Work

To familiarise myself with each new scale, I undertook exploratory improvisations performed over a reference tone (or drone), generated by a synthesiser. This reference tone helped me to hear clearly how each note sat against the fundamental note of the scale, paying attention to the tension or weight of each scale step. Each new scale came with its own points of resolution or harmonic qualities. For example, the *Mocritonic* scale (Figure 9) has dual-tonal qualities. It contains both major and minor third intervals from the tonic, as well as major and minor sixths, giving it a unique ability to move between major and minor tonalities. In addition, the complete absence of a perfect fourth or fifth above the tonic reduces points of harmonic rest, increasing the role of the tonic as a resting point.

Figure 9: Eb Mocritonic scale



Working on scales with a drone became an important part of scale familiarisation. Audio Example 12 demonstrates an exploration of the *Mocritonic* scale, revealing the expressive potential inherent in this scale.

Audio Example 12: Eb Mocritonic scale improvisation

Link to Audio Example: Eb Mocritonic scale improvisation

Regular use of a drone as part of the creative practice was foreshadowed in some of my earlier creative work. For example, the introduction to *Moon Rock,* recorded in 2023 on the album *Volant* (Ottignon, 2024), uses a sustained bowed note from the acoustic bass to provide a modal anchor point for improvisation.

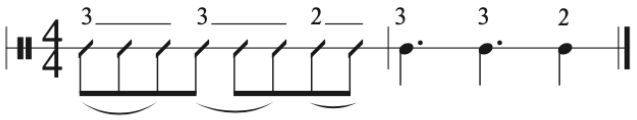
2.3 Rhythm Inputs and Early Rhythmic Exploration

A key insight early in the research process was that rhythm familiarisation required a staged approach, with rhythmic inputs isolated and developed gradually. This was achieved through vocalisation, body percussion and establishing an appropriate metre.

2.3.1 Establishing Pulse and Metre

As Sheehan's number patterns aren't attached to a specific metre, I needed to choose which time signature to apply and how the numbers would be related. In this research, I treat each number as either a grouping of single note quavers or as groupings of quavers played as single sustained notes. For example: the number 332 could either be eight quavers, or two dotted crotchets followed by a crotchet. The sequence totals eight quavers, which works well in 4/4 as seen in Figure 10.

Figure 10: 332 rhythm in 4/4



I began to see which number sequences worked in particular metres, grouping them into duple or triple metre, or odd-time signatures. In some cases, selecting where the pulse would be felt became a creative decision. I also experimented with placing a rhythmic sequence over different metres to see how they would change, which would be useful later when designing improvisational frameworks.

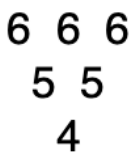
By establishing the pulse early in the process, it became easier to embody the rhythm, and this formed the basis for further rhythmic innovation.

2.3.2 Vocalisation and Component Breakdown

As I was familiar with the process of vocalising rhythms, it was a logical choice for internalising complex number sequences. The first rhythmic pattern I worked on was the 666554 triangle from *The Rhythm Diaries* (Sheehan, 2021, pp. 73-77), reproduced here in Figure 11. This sequence of numbers can be represented visually as a triangle, and the resulting phrases span two bars of 4/4 time. Rhythm triangles create rhythmic cadences that

differ from those generated by the permutation structure of diamonds. In this case, there is a sense of contraction of note length and the introduction of a third sequential integer.

Figure 11: 666554 triangle



As a solution, I vocalised the rhythms to 'demystify' and unlock the key to understanding this number pattern. Audio Example 13 demonstrates how these numbers fit over the pulse.

Audio Example 13: 666554 counting numbers in 4/4

Link to Audio Example: 666554 counting numbers in 4/4

As suggested by Sheehan, I often choose to break the numbers down to smaller components. For example, 5 could be either 3–2 or 2–3. The rhythmic variants outlined in Section 2.3.5 can be used to express each integer. In the case of the improvisational framework *Hexigra Shift,* I have used the following rhythmic expressions of numbers:

- 6 = 3–3
- 5 = 2–3
- 4 remains the same

Figure 12 shows the 666554 sequence as groupings of quavers, and Figure 13 shows the same groupings in 4/4 time. Audio Example 14 counts out the components above.

Figure 12: 666554 grouping in quavers

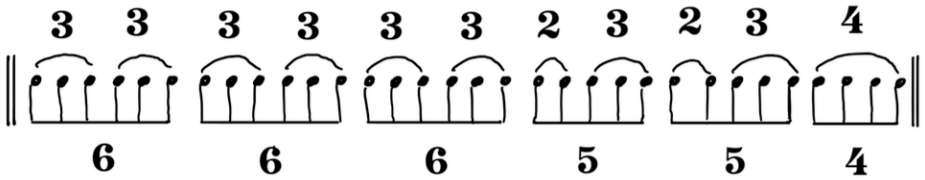
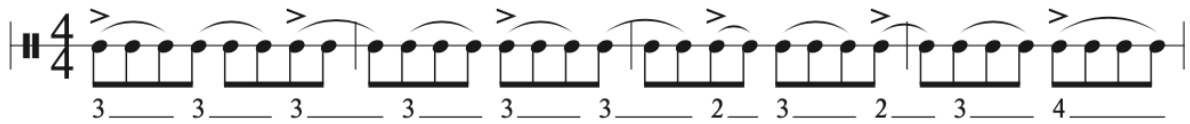


Figure 13: 666554 groupings in quavers in 4/4



Audio Example 14: 666554 counting out components

Link to Audio Example: 666554 counting out components

As vocalising numbers can become cumbersome at increased tempos, using the syllables 'da' and 'ga' increases fluency (Audio Example 15).

Audio Example 15: 666554 vocalised fast

Link to Audio Example: 666554 vocalised fast

Mastering the rhythms first with the voice leads perfectly into the use of body percussion to internalise rhythms even further.

2.3.3 Hand Rhythm and Embodied Work

To further internalise these rhythms, I practiced tapping the rhythms out with my thighs using 'patsching' techniques [7] (Sanford, 2016). This helped to familiarise myself with the sequence and its internal components. I found this approach to be an excellent way to navigate complex numbers as a preparatory step before applying the rhythms to the saxophone. Initially this was to help internalise the 666554 triangle, but it proved a valuable tool to use for all future number sequences.

Pages 15 and 27-33 of *The Rhythm Diaries* (Sheehan, 2021) include valuable sticking patterns that helped with left-right hand co-ordination during patsching exercises. In Video Example 3, these suggested sticking patterns informed my patsching of the 5's and 7's, with beginnings of each grouping played with my right hand, and other quavers played by my left hand.

Video Example 3: Patsching increasing numbers

Link to Video Example: Patsching increasing numbers

[7] Patsching is a *'Technique of body percussion. The palm of the hand rhythmically strikes the thigh, normally close to the knee. Usually both thighs are lightly struck simultaneously, but patsching can also alternate between the thighs. It can be done while seated or standing and on bare flesh or clothing.'* The Grove Dictionary of Musical Instruments (2015) – Oxford University Press

These body percussion exercises became especially useful for working through layers and pathways of diamonds, exposing areas of rhythmic weakness that needed attention.

Vocalisation and body percussion became essential parts of my familiarisation routine. Whenever instrumental application of rhythms became confusing, both these techniques were a solid base to return to ensure that patterns were fully grasped before the addition of pitch.

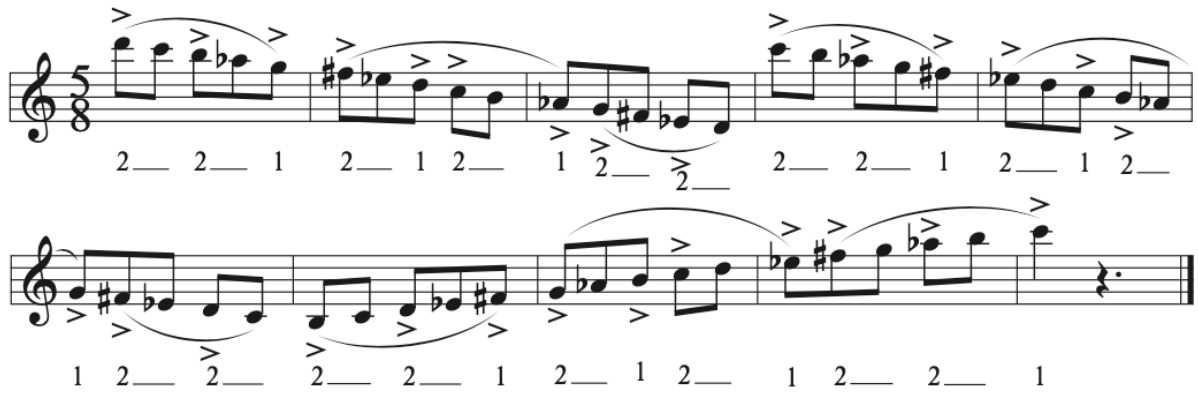
2.3.4 Articulation Challenges

One of the challenges I faced was adapting pre-existing tonguing and articulation techniques to new rhythmic sequences. Usual tonguing habits were ill-equipped to tackle these unpredictable new rhythms. I had to retrain this part of my technique through a variety of self-generated exercises.

A good example of this is found in the improvisational framework *Quintara Flow* (Figure 14). The number sequences of the 221 diamond required using different combinations of tonguing, slurring and accents, which helped to outline the different components and groupings used in the diamond. This resulted in shifting accent points and required the application of specific articulations. Slurs in this case were used to help identify crucial downbeats within the three-bar phrase, based on a new sequence of quavers: 5–6–4. Video Example 4 shows how this articulation is performed on the saxophone. For this section of *Quintara Flow* I use the following number expression:

- 5 = 2–2–1
- 6 = 2–1–2–1
- 4 = 2–2

Figure 14: Articulation in Quintara Flow



Video Example 4: Articulation in Quintara Flow

Link to Video Example: Articulation in Quintara Flow Bars 40-49

Mastering the articulation of complex rhythmic phrases continues to be an important step in gaining fluency with these new rhythms on the saxophone. Once mastered, each new melodic phrase becomes part of the improvisational vocabulary. Newly acquired articulation skills are easily transferred from scale to scale, while new fingering challenges are encountered with each new scale. Each new scale can be transposed into twelve keys, but certain keys are harder to execute than others. While I have spent time mastering jazz-associated scales in twelve keys, it was beyond the scope of this research to attempt that for each new scale encountered.

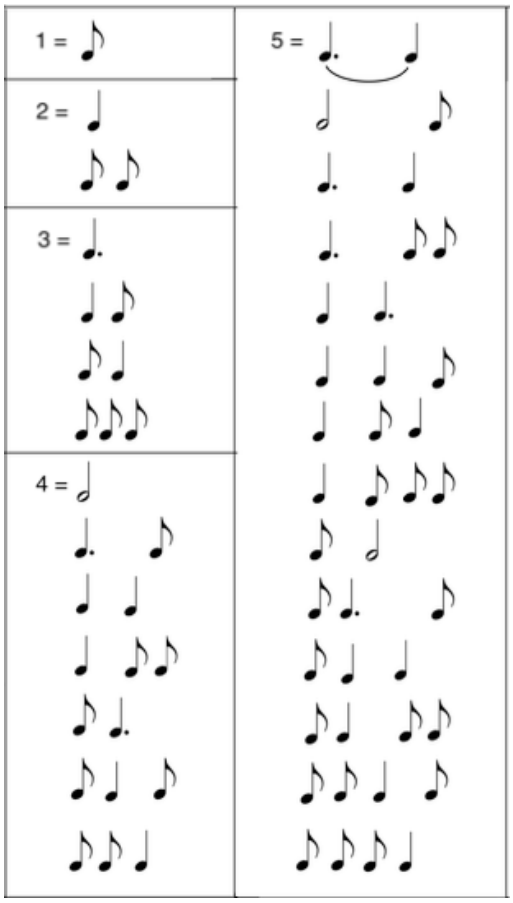
2.3.5 Rhythmic Variants and Duration Choices

In order to generate melodic material from Sheehan's number sequences, I needed to determine how note lengths, rhythmic variants, and subdivisions would be expressed for each number. For ease of explanation and comparison rhythmic variants were standardised, using quavers, crotchets and minims used to reflect structural possibilities.

- 1 is expressed as a quaver.
- 2 may be expressed as two quavers or a crotchet.
- Larger numbers are formed through combinations of these durations.

Figure 15 shows all the rhythmic variants that are possible for numbers 1 – 5. Compositional application of rhythmic variants within number sequences will be discussed in Section 3.2.2.

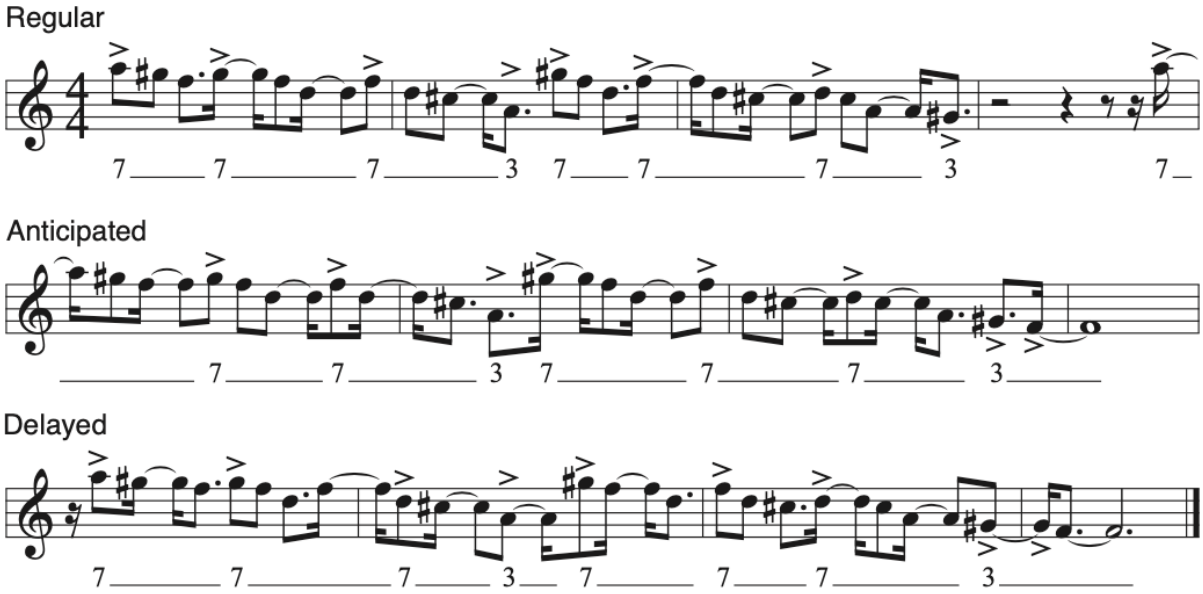
Figure 15: Rhythmic variants for numbers 1-5



2.3.6 Displaced Phrasing

A practice technique taught to me by Sheehan involves shifting a phrase forward or backward in time. In its simplest form, this means taking a rhythmic cell – for example, 7773 – and practising it in three positions: starting squarely on the beat, delayed by a quaver, and anticipated by a quaver. Audio Example 16 illustrate this process with an improvised variation of Figure 16. The regular phrase is played at the beginning, the anticipated phrase at 0:17, and the delayed phrase at 0:34.

Figure 16: 7773 regular, anticipated, and displaced



Audio Example 16: 7773 Regular, anticipated, delayed

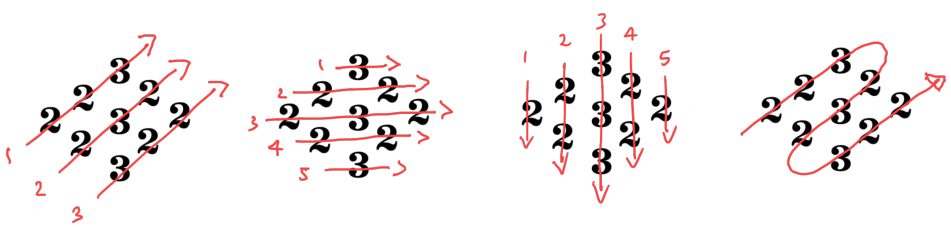
Link to Audio Example: 7773 Regular, anticipated, delayed

Not only does this exercise create different syncopations with the bar, but it also helps to deepen an awareness of the pulse. Phrases like these are immediately absorbed into the improvisational vocabulary.

2.3.7 Pathways and Layers

Being aware of Sheehan's number diamonds, I understood that a key feature was their ability to be navigated in multiple ways: diagonally, horizontally, vertically, or by taking a curved route. These different *pathways* offer distinct rhythmic shapes that can expand improvisational vocabulary and provide new structural ideas for composition. Figure 17 shows several pathways found in the 223 diamond, adapted from page 38 of *The Rhythm Diaries*. The first and last pathways result in the same number sequence.

Figure 17: Pathways for the 223 diamond



Each diamond also has its own internal *layers*, understood here as groupings of integers. For example, the 223 diamond has the layers 223, 232, and 322, which can be used independently or in combination. Repeating layers became a way to internalise different rhythms and was also useful for creating structure within improvisational frameworks. Three layers and two pathways are presented in Audio Example 17. For readability the integers are presented as spaced groupings rather than a continuous string (223 232 322). In this research the term *grouping* refers to these collections of spaced integers, which inform articulation and phrasing. Percussion accompaniment is provided to add rhythmic context and to clearly state the start of each grouping.

Layer 1: 223 x 4

Layer 2: 232 x 4

Layer 3: 322 x 4

Pathway 1: 223 232 322 x 4

Pathway 2: 222 333 222 x 4

Audio Example 17: 223 layers and pathways

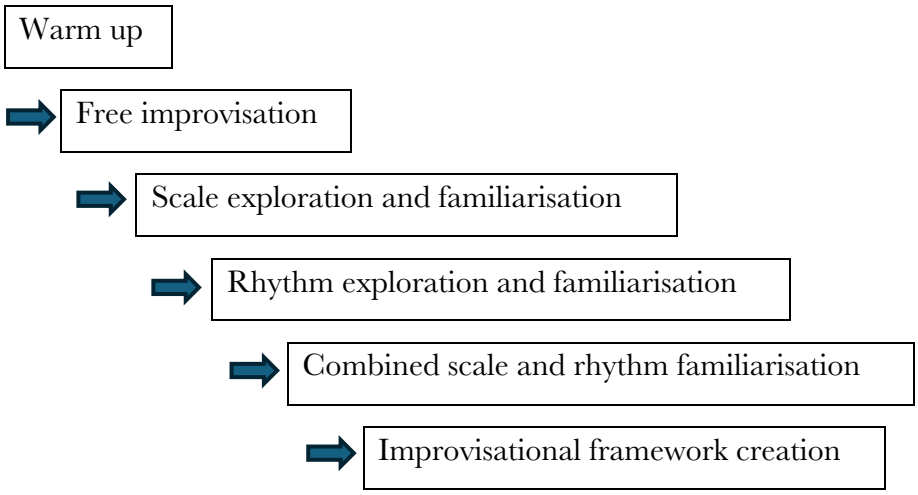
Link to Audio Example: 223 layers and pathways

Layers and pathways of Sheehan's number sequences formed the rhythmic basis for the practice routine and later helped shape the structure within improvisational frameworks and influence the contour and length of melodic phrases.

2.4 Practice Routine Formation

A structured routine was essential for integrating melodic, harmonic, and rhythmic elements, supporting fluency on the instrument, and facilitating composition. I wanted a routine that combined both the exploratory nature of improvisation and the discipline required to internalise unfamiliar material. Eugene Ball argues that practice regimes must prepare the improviser to improvise and proposes an integration of technical and creative components by basing improvisations on the "idea" being proposed in the exercise (Ball, 2004, p.56). This way of thinking aligns with my desire to explore these new rhythms and scales through periods of improvisation, and through the subsequent creation of exercises to address technical issues.

The routine followed a loose progression from unstructured playing toward more focused work.



This order ensured that each session began with creative openness before moving into more targeted work. It also provided a way for scale and rhythm inputs to be absorbed gradually, rather than forced into predetermined shapes.

2.4.1 Full Routine in Detail

Phase 1

1. Warm-up (instrument setup, stretching, breathing, long tones).
2. Free improvisation to assess creative inclination and select scale material.

Phase 2

1. Exploration of new scale input, preferably with a drone.

Phase 3

1. Rhythm input exploration
    i. Hands
    ii. Vocal
    iii. On the instrument.
2. Integration of scale and rhythm
3. Work on articulation and rhythmic flexibility.

Phase 4

1. Creation of improvisational frameworks (solo saxophone or multitracked ensemble).
2. Map out form and structure of frameworks.

This routine has proven to be robust, multi-faceted and capable of multiple outcomes. The period of free improvisation is a good way to check-in with creative impulses.

Phase 3 is best done with either a metronome or some form of rhythmic backing. Rhythmic flexibility is achieved by either switching pulses or moving between rhythmic pathways or sequences.

2.5 Multitracking as a Practice Tool

During practice sessions working on the new rhythmic patterns, I realised I needed a consistent pulse to lock into rhythmically. Practising with a metronome felt too robotic, simplistic and not very conducive to creative practise.

To address this, I began using the Logic Pro to record multiple tracks of saxophones, bass, and percussion instruments, each one outlining a particular layer or pathway of a rhythm diamond. These interlocking parts provided a rhythmic bed that was both musical and contained elements of the rhythms I could lock into. This is turn was far easier to improvise to than the previous experience with the metronome.

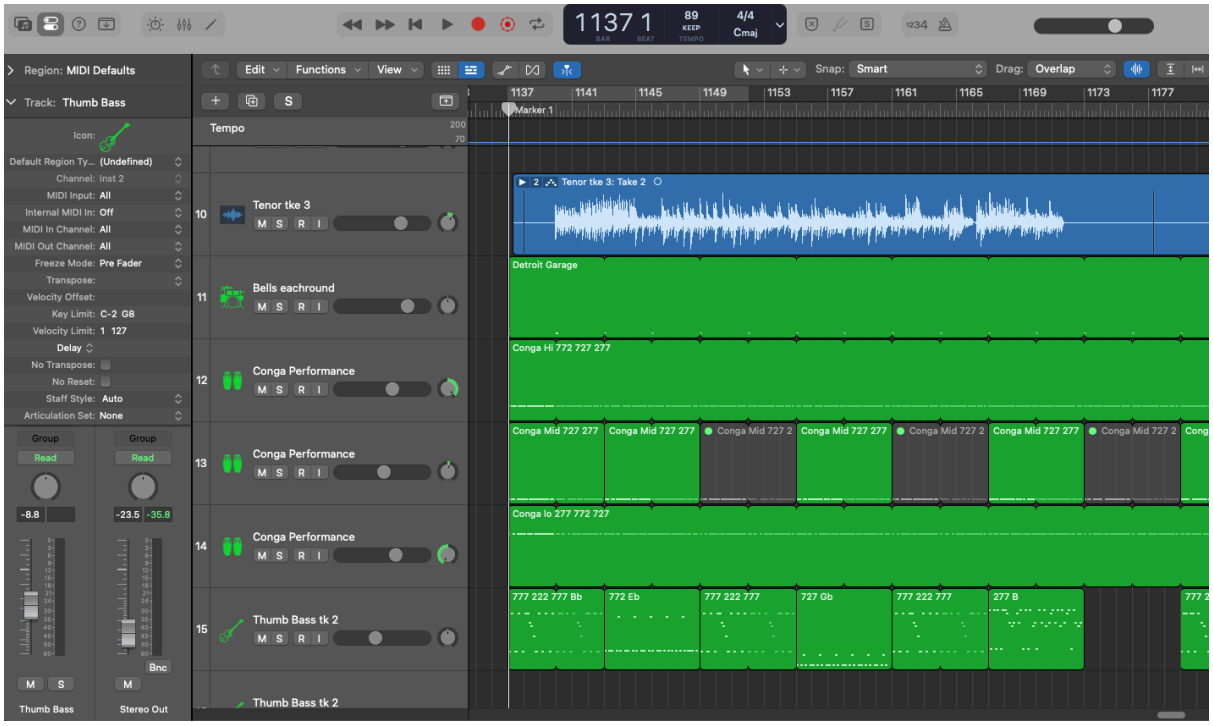
Another benefit of hearing multiple pathways of diamonds layered over one another was witnessing the emergence of consolidated rhythms, which became a feature of both the improvisational frameworks, vocabulary and final creative works. In *Echo Cog Drift* for example, I constructed a rhythmic bed using several pathways of the 772 diamond, combined with melodic phrases built from notes of the *Loritonic* scale. With these parts in place, improvisation and framework development worked in tandem created a feedback loop of creative ideas.

Figure 18 shows the Logic session used to create the rhythmic bed for *Echo Cog Drift,* and Audio Example 18 presents the accompanying audio.

Audio Example 18: Echo Cog Drift midi with sax impro

Link to Audio Example: Echo Cog Drift midi with sax impro

Figure 18: Logic DAW session for Echo Cog Drift



Multi-tracking became a key component of my practice routine, allowing me to test out scales and rhythms in a more musical environment. Being able to hear how the new scales sounded over harmonic accompaniments like bass parts or layered saxophones was invaluable, and the rhythmic loops created were perfect for deeper familiarisation and exploration of new rhythms. It was also part of the creative process, in which new ideas quickly formed alongside the building of frameworks. This tool helped bridge the gap between isolated practice and improvisational performance.

2.6 Chapter Summary

This chapter has outlined the practice processes developed to allow familiarisation with new scales and number-based rhythms on the saxophone.

Technical obstacles, scale creation, rhythmic complexity, and cognitive overload showed that the initial practice system required further refinement. A targeted staged routine was developed for each input.

Exercises were developed to solve articulation and fingering concerns that emerged along the familiarisation river, functioning as anabranches that briefly diverted my attention before rejoining the main flow of practice. New scales were created through intuitive methods of scale construction, and these pitch sets were explored and familiarised through improvisation

over pitched drones, forming part of the river's ongoing movement. The rhythmic complexity of new number sequences was reduced by establishing a metre and using vocalisation and body-percussion methods for internalisation.

Further internalisation and familiarisation were achieved through the use of multi-tracking techniques.

Building on these practice processes, Chapter 3 turns to the improvisational frameworks through which new rhythmic and pitch materials were combined to generate new melodic vocabulary.

3 Improvisational Frameworks and Vocabulary Application

To help facilitate the internalisation of new scales and rhythms, and to create structural frameworks within which to improvise melodies utilising the new rhythm and scale inputs. In this chapter, I will demonstrate the techniques used to develop these frameworks: creating rhythmic structures, incorporating inputs generated from my master lists of scales and rhythms, and using multitracking techniques. Melodic motion evolved naturally in response to rhythm application and phrasing was determined by the structural form of the frameworks.

These improvisational frameworks provided a contained setting in which rhythm and pitch could be explored in combination. Each framework contains a rhythmic structure based on pathways, layers, or consolidated rhythms. There is an assigned scale or pitch set. Different types of motion were used to create melodic structure, and the resulting phrase structure is derived from the internal logic of the framework. This sets up the development of melodic vocabulary.

Each improvisational framework developed in this project highlights a different relationship between number-based rhythmic structures and the newly constructed scales. The following sections outline these elements as independent processes, illustrating how they function within the broader method rather than through detailed case studies of individual works. These frameworks naturally evolved into compositions that comprise the eight creative works presented alongside this exegesis and are outlined in the section titled: Creative Work.

3.1 Rhythmic Structures Within the Frameworks

The rhythmic foundation of each improvisational framework is created from number sequence sourced from *The Rhythm Diaries*, using pathways, layers, or consolidated rhythms to generate structure. These pathways provide a linear sequence of durations, and within number diamonds, each layer allows for repetition before moving on to the next layer. Consolidated rhythms combine several layers or pathways into a single composite line, creating a rhythmic anchor for improvisation.

These structures determine the length of each cycle, the placement of accents, and the phrasing options available within the framework. In some frameworks, such as *Quintara Flow*, the rhythmic shape is built directly from the repeating pathway. In others, including *Hexigra*

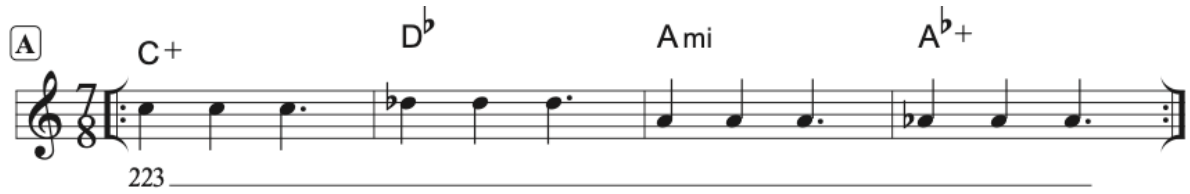
Shift, more complex sequences of pathways create longer phrase lengths and intricate accent patterns. In *Syncretic Drift*, the consolidated rhythm provides the main structural guide for shaping melodic material.

Together, these rhythmic structures form the foundation for the melodic and phrase-design processes described in the following sections.

3.1.1 Repeated Layer

Repeated layers serve several roles within the improvisational frameworks. They can establish a clear sense of meter or pulse, provide time to familiarise the ear and body with a rhythmic idea, or create a moment of stability before moving into more complex material. *Septarhythmic* uses repeated layers of 223 to anchor the framework within its 7/8 time feel, with the pitch material being cycled to produce four-bar phrases. Figure 19 and Audio Example 19 illustrate this.

Figure 19: Septarhythmic repeated layer



Audio Example 19: Septarhythmic repeated layer

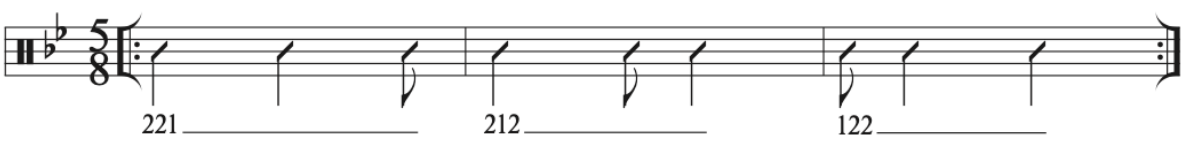
Link to Audio Example: Septarhythmic repeated layer

3.1.2 Full Diamond

One of the pathways favoured in this research is when each layer is played sequentially. Sheehan calls this "playing through the diamond" (Sheehan, 2021, p. 23), but for the purposes of this research I will use the term *full diamond.*

Figure 20 shows the full diamond pathway found in *Quintara Flow*.

Figure 20: Full diamond pathway in Quintara Flow

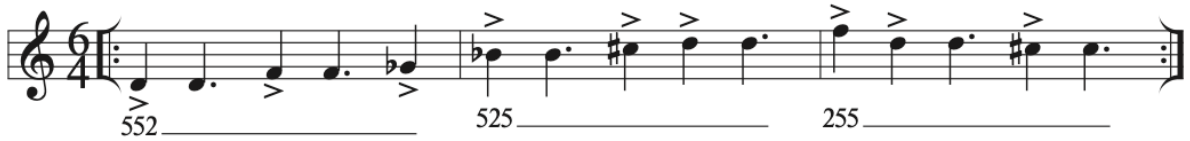


Another example is found in the framework *Novrix* which contains the full diamond sequence 552 525 255, a shape that felt balanced and intuitive to play. In Audio example 20, I improvise over the full diamond of 552 525 255 and in Figure 21 one can see the melody written for this section outlining the harmonic and rhythmic structure of the phrase.

Audio Example 20: Novrix full diamond pathway

Link to Audio Example: Novrix full diamond pathway

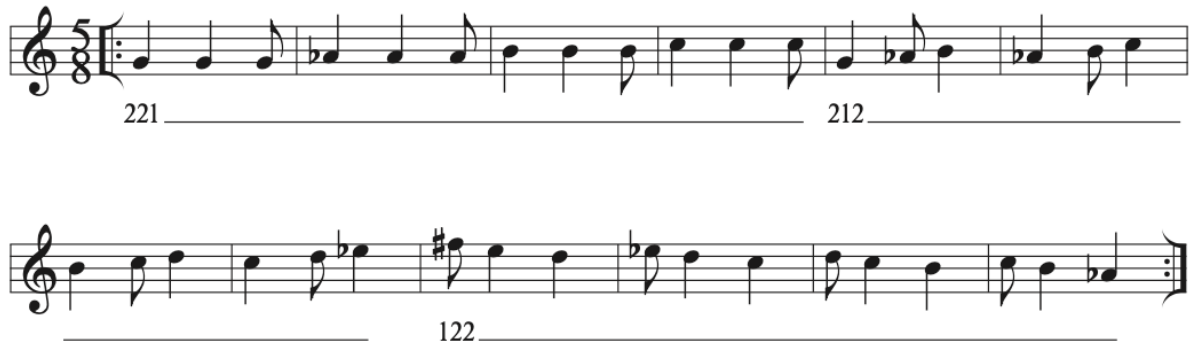
Figure 21: Pathway 552 525 255 in Novrix



3.1.3 Stretched Full Diamond

Another useful variation is the *stretched full diamond*, where each layer is repeated before moving on. While I could find no mention of this pathway in *The Rhythm Diaries,* Sheehan does use this pathway in his workshops as a learning step before playing through the diamond. Having more time to sit with each layer can create smoother transitions between contrasting rhythms and became a useful compositional tool in *Quintara Flow* (Figure 22).

Figure 22: Stretched full diamond of Quintara Flow



3.1.4 Vertical Pathways

I also explored *vertical* pathways, where the diamond is read vertically and from left to right rather than following the layers. This produces a distinct rhythmic contour. For the *772* diamond, reading it this way yields the sequence 777 222 777, which has a strong

symmetrical feel and generates different phrasing possibilities to the full diamond pathway. Audio Example 21 demonstrates this approach in 4/4 metre.

Audio Example 21: Echo Cog Drift vertical pathway

Link to Audio Example: Echo Cog Drift vertical pathway

3.1.5 Vertical Full Diamond

Finally, I experimented with combining the vertical concept with the full diamond structure. In *Novrix*, this resulted in a longer and more complex pattern built from a 552 diamond:

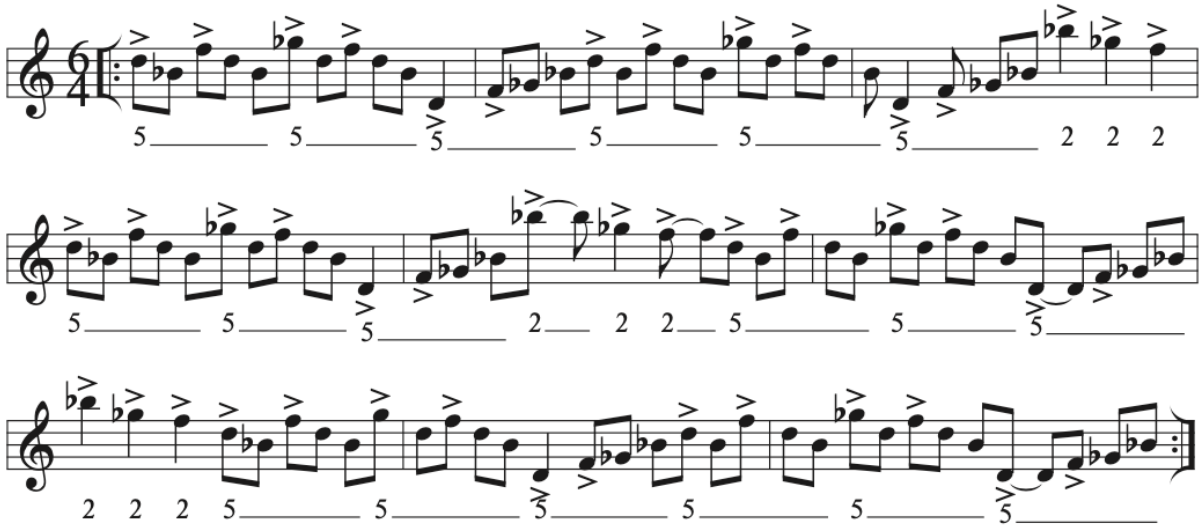
555 555 222

555 222 555

222 555 555

This provides an extended framework that opened up broader possibilities for melodic interpretation and compositional choice. Figure 23 shows a nine-bar phrase of a vertical full diamond pathway found in *Novrix,* utilising the rhythmic variant 2-3 to accent the 5's.

Figure 23: Vertical full diamond style found in Novrix



3.1.6 Consolidated Rhythm

A key development in the project was the creation of *consolidated rhythms,* that is to say composite rhythmic shapes formed by combining multiple layers or pathways so that their shared structure could be internalised during improvisation. While Gill (2023) experimented with using composite polyrhythms, he discarded this method of rhythmic organisation for aesthetic reasons. I found that consolidated rhythms provided something to latch on to during

moments of rhythmic uncertainty, offering a stable reference point within more complex material. Two frameworks in particular, *Syncretic Drift* and *Echo Cog Drift*, illustrate different ways consolidated rhythms functioned within the project.

Syncretic Drift was developed from repeated iterations of three, four and five quavers. The idea was inspired by Greg Sheehan's TEDx performance [8] where he conducts the audience as a multi-part percussion ensemble creating polyrhythmic body-percussion parts.

In *Syncretic Drift,* I created a structure that switched regularly between the three different pulses, using three different time signatures to highlight the shift and can be heard in the final creative work performance of this framework. Each layer is sixty quavers long, meaning each layer can be played concurrently without altering the form.

A: layers of 3 quavers over 5 bars of 12/8
B: layers of 4 quavers over 5 bars of 3/2
C: layers of 5 quavers over 12 bars of 5/8

The composite rhythm of the three layers serves as the basis for the rhythm and contour of the melodic line, which was constructed using the F *Daptitonic* scale (F F# A C Db). Because the consolidated rhythm was used to generate the phrasing structure, the resulting melody naturally formed five-bar phrases. While accenting each grouping worked clearly in 12/8 and 3/2, accenting groups of three or four in 5/8 proved challenging. A practical solution was to notate and feel this in 5/4**.**

Figure 24 shows the composite rhythm in 12/8 written for percussion and Figures 25-28 present the same consolidated rhythm expressed melodically in the different time signatures. Audio Example 22 presents an excerpt of the A section melody, which is in 12/8 metre. Groupings of three are notated on the bottom voice, fours in the middle voice and fives in the top voice.

8 Fibonacci Melody: Greg Sheehan at TEDxSydney 2013
https://www.youtube.com/watch?v=DqOp2176wr8&t=1s

Figure 24: Composite rhythm for percussion in Syncretic Drift

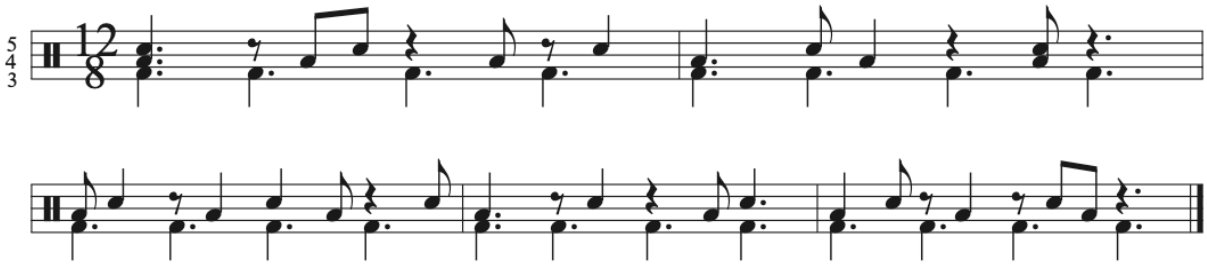


Figure 25: Melody of Syncretic Drift using consolidated rhythm in 12/8

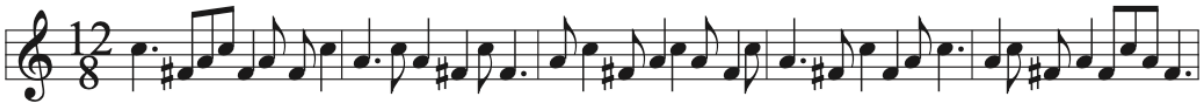


Figure 26: Melody of Syncretic Drift using consolidated rhythm in 3/2

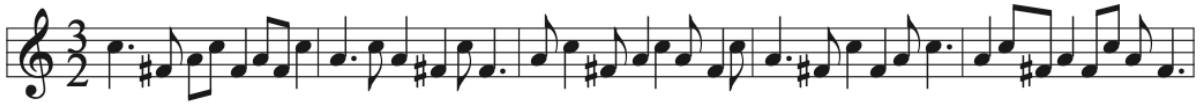


Figure 27: Melody of Syncretic Drift using consolidated rhythm in 5/8

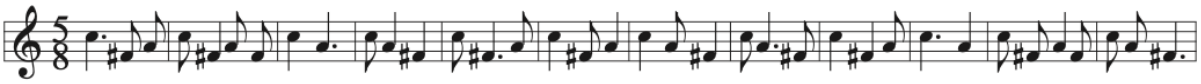
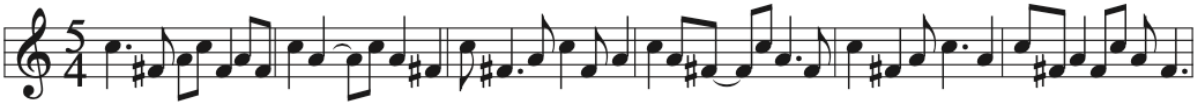


Figure 28: Melody of Syncretic Drift using consolidated rhythm in 5/4



Audio Example 22: Syncretic Drift – A section melody

Link to Audio Example: Syncretic Drift – A section melody

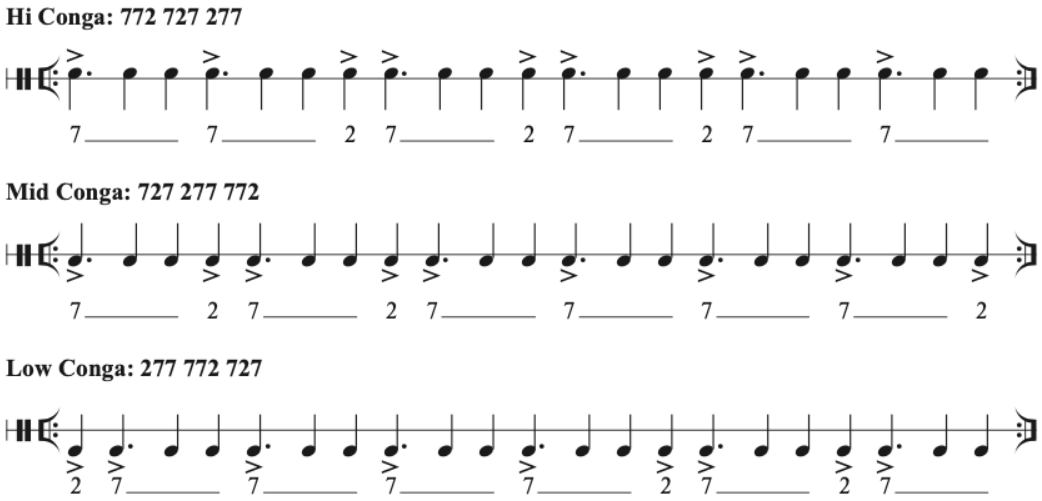
In *Echo Cog Drift*, consolidated rhythm emerged from overlapping multiple percussion pathways. This is a different use of the consolidated rhythm, with pathways being played by different instruments rather than on a single instrument. These midi parts are:

- a high-conga outlining the full-diamond pathway 772 727 277,
- a mid-conga expressing 727 277 772,
- and a low-conga playing 277 772 727.

The three conga parts overlap to create a unified underlying structure that became the rhythmic foundation for the improvisation.

Figure 29 shows these three percussion parts with their number sequences.

Figure 29: Conga parts for Echo Cog Drift



In Video Example 5, I present four layers of percussion in Logic Pro including a wood block part of 777 222 777 and a metronome in 4/4 for reference.

Video Example 5: Echo Cog Drift midi percussion

Link to Video Example: Echo Cog Drift midi percussion

3.1.7 Number Triangles

Number triangles function differently to number diamonds because while the various pathways are of equal duration, the layers are not. In the framework *Hexigra Shift*, the pathways employed were the full triangle (666554), the reverse full triangle (455666), and the internal pathway (654656). Each of these pathways totals 32, making them well suited to a 4/4-time signature. I chose not to investigate the resulting meter shifts that would result from repeating layers of this triangle. Figure 30 shows the rhythm pathways used in *Hexigra Shift*, and Figure 30 shows this written out for alto saxophone with some articulation indicated.

Figure 30: Rhythm triangle pathways found in Hexigra Shift

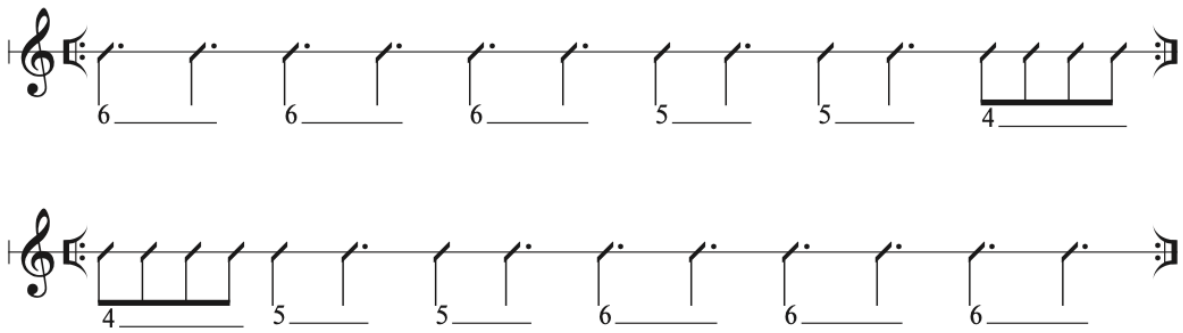
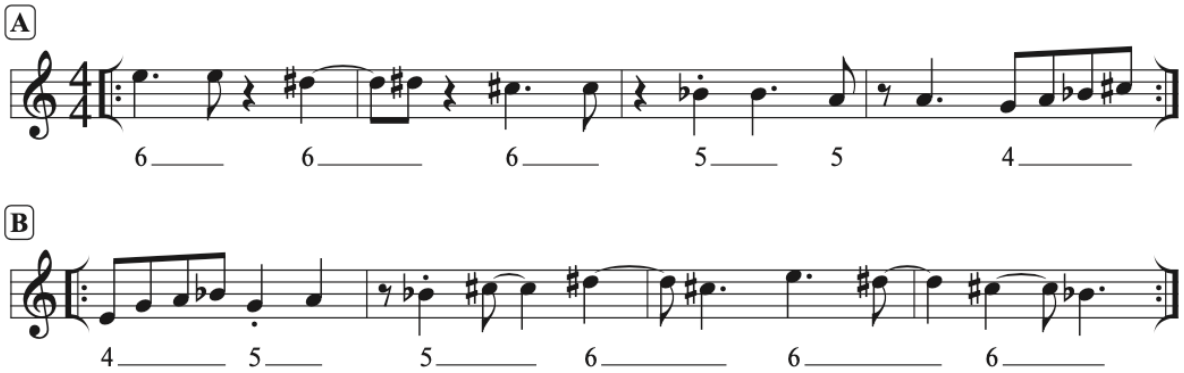


Figure 31: Section A + B melody of Hexigra Shift for alto saxophone



3.2 Melodic and Harmonic Methods

3.2.1 Melodic Motion

Melodic material within the frameworks was generated by applying stepwise, non-stepwise and static motion to the chosen scale. Stepwise motion involves moving through neighbouring scale tones, while non-stepwise motion creates wider intervallic leaps that highlighted the asymmetry of the hemitonic pentatonic and newly developed scales. Finally, static motion provided a contrast through the use of sustained or repeated notes.

The improvisational frameworks use these forms of motion in different ways. For example, *Quintara Flow* relies heavily on stepwise lines, moving up and down the scale, which gives clear melodic contour to the fast moving rhythmic pulse.

Hexigra Shift uses a mixture of stepwise and non-stepwise motion (Figure 32). The descending pattern moves stepwise down the scale, including leaps to achieve this, while helping to reinforce the rhythmic groupings.

Figure 32: Stepwise and non-stepwise melodic motion in Hexigra Shift

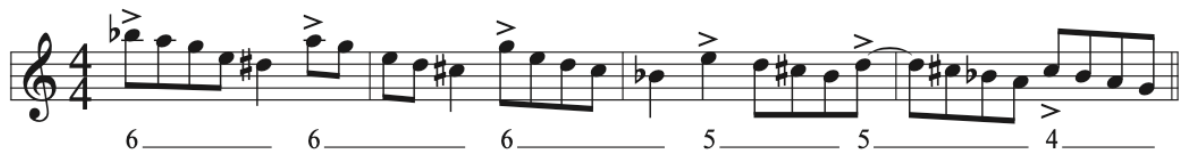
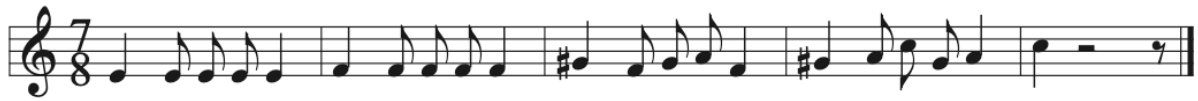


Figure 33 shows an example of the static motion found in *Septarhythmic*.

Figure 33: Static motion found in Septarhythmic



3.2.2 Melodic Phrasing Length

The melodic phrasing developed for each framework was a response to the underlying rhythmic structure of the framework. Each numerical sequence produced different phrase lengths and contours, reflected in the melodic writing.

In this project, each improvisational framework applies the rhythmic variants introduced in Section 2.3.5 differently, employing its own combination of these variants. For instance, *Hexigra Shift* uses:

- 6 = two dotted crotchets (3-3)
- 5 = crotchet + dotted crotchet (2-3)
- 4 = all quavers (1-1-1-1)

This selection of variants shapes the subsequent phrasing as well as accent patterns and melodic motion.

Quintara Flow uses a range of melodic phrase lengths. The first layer of the 221 sequence is repeated, generating four-bar phrases to sit naturally in the 5/8 metre. The full diamond, however, necessitated three-bar phrases. The stretched full diamond technique is also utilised, resulting in phrases over a nine-bar cycle.

Together, these differing phrase lengths produced expressive and flexible improvisational lines that reflected the underlying numerical structures.

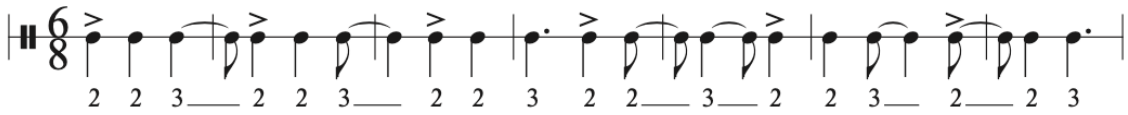
3.2.3 Shifting Metrical Contexts

As mentioned earlier, part of this research revolves around different metric placements for the same numerical pattern. I have long been interested in rhythmic hemiola, where three beats are superimposed over two beats, or vice versa. This was a feature in some of the music on the album *Dereb the Ambassador* (2011), where 3/4 beat and 6/8 metres occur simultaneously.

This interest led to experiments in which I would try number sequences in both duple and triple metres to feel the different metrical subdivisions. For example, I practised the 223 rhythm diamond in both 7/4 (duple-metre) and 42/8 (triple-metre). Figure 34 shows a seven-

bar phrase of 223 in 6/8. Seeing it written out like this in Western notation helped clarify where the perceived downbeats were landing and assisted in maintaining a stable sense of pulse.

Figure 34: 223 phrases in 6/8



In many cases, aligning the diamonds with Western metres highlighted similarities with rhythmic structures from other musical cultures. The 332 rhythm corresponds to the Cuban *tresillo*. The *son* and *rumba claves* could be thought of as 33424 and 34324 respectively. Even the standard African 12/8 bell pattern can be viewed as the number sequence 2212221.

These metric frameworks can be understood through the lens of countermetrical pulse streams as defined by Hannaford (2012) and discussed by Gill (2023), where pulse streams move at faster or slower speeds to the metrical pulse. Incorporating polyrhythmic phrasing in improvisational practice became a focus for this research, and following on from Gill and Hannaford I use ratios such as 3:2 to describe these polyrhythms.

By incorporating shifting pulses into the frameworks, I was able to gain a better understanding of how the number sequences can be used interchangeably. *Syncretic Drift* moves between duple, triple, and quintuple metre, and *Novrix* starts in triple metre and ends in duple metre.

Working through these shifting pulses provided a more comprehensive grasp of the patterns and led to applying them more freely in improvisation.

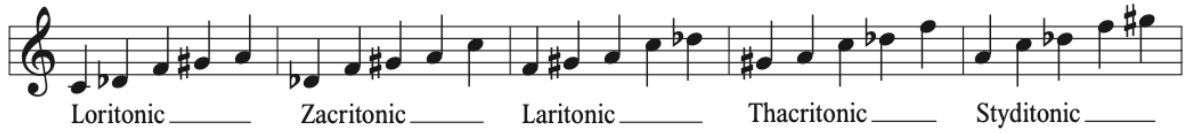
3.2.4 Scale-Shifting

The improvisational framework *Dabrisa* shifts between three different scale types: *Daptitonic*, *Thalimic,* and *Ionythimic.* In common jazz practice, chords typically allow for multiple scale possibilities, whereas in this research the scales themselves are predetermined, with chord changes used only sparingly. This movement between these specified scales within a piece is referred to as *scale-shifting*.

3.2.5 Modal Interchange

Echo Cog Drift uses modal interchange as a structural tool to expand the harmonic range of a single scale. Using the C *Loritonic* scale (C Db F G# A) as its pitch set, each section of the framework shifts its modal orientation. Each section draws on a different mode of the scale, with three additional modes employed: *Laritonic*, *Thacritonic, and Zacritonic.* In Figure 35 I use C Loritonic as the 'parent' mode to create its four subsequent modes.

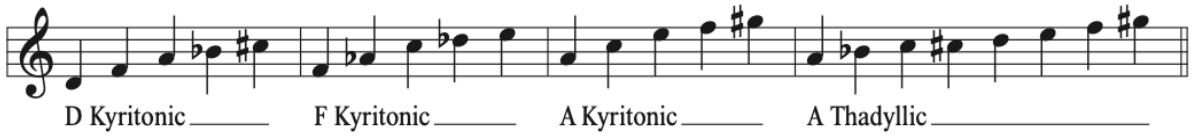
Figure 35: The modes of C Loritonic



3.2.6 Modulation + Composite Scales

Aeralex uses modulation and composite scales to vary tonal centres within a framework. The *Kyritonic* scale is used in three different keys, each built off the first three notes of D *Kyritonic*. By combining all three of these scales together you get the pitch set A Bb C C# D E F G#, identified in the *Scale Finder* as the *Thadyllic* scale. This composite scale creation method was only briefly investigated in this research. Figure 36 shows these four scales as found in framework *Aeralex.*

Figure 36: Scales in Aeralex



3.3 Chapter Summary

The improvisational frameworks served as practical testing grounds in which rhythmic ideas, melodic motion, and structure evolved together. In Chapter 4, I provide an examination of the results and outcomes.

4 Research Outcomes

Working with Greg Sheehan's rhythmic concepts in conjunction with a new set of scales created and expanded from the structure of the *Anchihoye kinit* has led to the expansion of my improvisational vocabulary. The combination of different improvisational frameworks helped familiarise challenging rhythmic structures while leading to the application of consolidated rhythms as a melodic phrase generator. This research offers a case study in new music generation that utilises a purpose built practice method evolving out of improvisational practice sessions.

4.1 Expansion of Improvisational Vocabulary

Working extensively with number sequences and structures such as full or stretched diamond pathways introduced a wide range of new rhythmic language full of syncopation and unique phrasing. This work led to increased fluency with rhythmic groupings of 5 and 7, displaced and anticipated phrases, and polyrhythms such as 5:4 and 7:4 – materials that previously felt out of reach. Introducing rests into key points of the number sequences created additional phrasing space and new dynamic options. Focused attention on articulation emerged in response to early technical challenges, particularly with quintuplets, which is demonstrated in the framework *Quintara Flow.*

The creation of new scale materials alongside these rhythmic explorations became an essential part of the process. By constructing all fifteen scales derived from the structure of the *Anchihoye kinit*, in addition to use of the one-step altered and one-note added methods of scale construction, I was able to create an expansive and adaptable palette from which to draw from. Each scale had its own distinctive set of intervals, subsequent triadic structures, and expressive qualities. Through sustained improvisation with an accompanying drone, I developed a deeper understanding of how each scale functions. Further work within improvisational frameworks showed how they functioned in different musical contexts. Fluency was gained in navigating some of larger intervallic leaps encountered, such as those found in the fourths exercise developed for the *Laritonic* scale.

An unexpected result was the discovery and adoption of the dual-tonal scales *Styditonic, Laritonic, Mocritonic, Phrolitonic* and *Lygimic*, which all have both major and minor tonalities. Examples of these are found in the improvisational frameworks: *Echo Cog Drift, Novrix, and Aeralex.*

Together, acquiring these new skills strengthened my melodic invention giving me a broader expressive range to draw from.

4.2 Expanded Structural Awareness

By working within new improvisational structures, I have strengthened my ability to construct phrases over different bar lengths. Due to structures created to explore the number-sequences, phrases and musical ideas often needed to span three or five bar lengths, while still clearly leading back into the next cycle. This structural awareness can be heard in the phrasing found in *Syncretic Drift* and *Septarhythmic*.

Leading up to this research, attempting unfamiliar rhythmic ideas often caused me to lose the form of the underlying structure and to break the improvisational flow of ideas. However, the familiarisation process of working with both the new rhythmic language and the new structural frameworks, enhanced my ability to maintain form and flow in previously challenging environments. The expanded vocabulary and heightened awareness of pulse have allowed me to take greater risks both rhythmically and melodically, with successful ventures outside the tonal centre and rhythmic pulse evident in *Syncretic Drift* and *Novrix*.

4.3 Creative and Artistic Outcomes

The recordings provided alongside this exegesis demonstrate the effectiveness of the practice-model and are a record of an evolving vocabulary. There is the integration of complex rhythmic sequences with explorations of new scale forms, resulting in increased spontaneity, expressiveness and structural clarity in improvisations. Some frameworks extend the original modal exploration of each scale by using scale-shifting and modal interchange techniques that expand the harmonic range found within each framework.

More broadly, this research offers a case study in new music generation through systematic rhythmic and melodic exploration. A methodology is proposed for constructing and applying new scales and rhythms in conjunction with each other for the purposes of improvisation. Central to this was the development of a practice routine that supported the steady familiarisation of the new concepts, allowing each element to be absorbed gradually before being combined in more advanced improvisational settings. One of the main aims of this project was to find a practical way to apply number diamonds to the saxophone. The accompanying recordings show that this has been achieved alongside the creation of new melodic phrasing, articulation patterns and rhythmic language.

Together, these outcomes show that integrated development of rhythmic and melodic vocabulary is musically productive, offering a flexible system designed to enable greater freedom and confidence in improvisation and for composition.

4.1.1 Final Practice Session Results

At the conclusion of the research, a final practice session was undertaken, with the objective of creating a solo work for saxophone. Over three days, the practice method was applied to select and explore rhythmic and scalar inputs, develop an improvisational framework, rehearse it, and record the outcome. The resulting framework and recording of *Aeralex* demonstrate that the practice method effectively facilitates the generation of new music through the integration of novel rhythmic and harmonic concepts. Furthermore, it has proven to be an efficient approach for incorporating unfamiliar rhythms and scales into an improvisational vocabulary.

4.4 Future Research

Future research could explore how both Sheehan's rhythmic concepts and scale generation processes in this project might be integrated into pedagogical practice. A staged sequence of familiarisation exercises, combined with the gradual introduction of rhythmic and pitch inputs, offers a promising framework to incorporate these new concepts into student learning. Consolidated rhythms, in particular, present fertile ground for further development in both solo and ensemble contexts, raising questions about how multiple improvisors might navigate shared and interlocking rhythmic layers. These rhythmic consolidations also suggest potential applications for jazz and chamber ensembles, as well as opportunities for expanding melodic composition.

There is also significant scope to extend the melodic and harmonic functionality of hemitonic pentatonics. Future work could investigate how these scales might generate chord progressions, interact with neighbouring or composite scales, or integrate with other pitch systems. While this research focused on improvisational vocabulary for the saxophone, the processes developed here are readily adaptable to a wide range of melodic instruments, offering a broad platform for continued exploration.

4.5 Applicability to Other Instruments

Although this research was developed through the lens of solo saxophone practice, the underlying concepts are readily applicable to a wide range of melodic instruments. The combination of newly developed pitch sets, and number-based rhythmic structures can be applied by any musician interested in developing their improvisational vocabulary. Instrumentalists able to generate harmonic or chordal voices may find new and interesting ways to develop these concepts. The combination of scale creation with new rhythmic trajectories can support linear improvisation, accompaniment approaches and broader compositional thinking. This suggests that the framework and flexible set of tools developed here extend beyond the saxophone to improvising musicians and composers across diverse musical environments.

4.6 Creative Work

The creative work component of this research comprises a studio recording of eight improvisational frameworks. The recording was produced over one day in 2025 at Golden Retriever Studios, Marrickville (NSW), and was engineered and mixed by Simon Berckelman. Preparation for the recording included structured practice sessions with Hayley Chan, focusing on translating the rhythmic concepts to the drum kit, as well as a full ensemble rehearsal.

The performers on the recording are:

- Matthew Ottignon – tenor and alto saxophones, percussion
- Cameron Undy – electric bass
- Hayley Chan – drum kit, bongos, cowbell
- Youssef Sawires – congas, shakers

One framework is presented as a solo saxophone performance.

Track listing:
Refractions of Time (54:00)

1- Septarhythmic (6:42)
2- Novrix (8:32)
3- Echo Cog Drift (5:11)
4- Syncretic Drift (7:46)

5- Hexigra Shift (7:08)
6- Dabrisa (4:46)
7- Quintara Flow (7:08)
8- Aeralex (6:45) – Solo saxophone

For each improvisational framework, this chapter outlines the primary rhythmic and pitch-based components, alongside relevant information concerning their adaptation and application. A score for each framework is found in the appendix.

Septarhythmic

Septarhythmic (pages 82-83) is structured around the 223 number diamond in a 7/8 metre. Using the C *Aerythmic* scale, different modal contexts are used in the exploration of each layer. The framework concludes with a unison melodic passage performed over the consolidated rhythmic structure of all three layers. While this consolidated rhythm closely resembles the 232 layer, it alters the placement of quavers and the resulting accent patterns, producing a different rhythmic effect.

Novrix

Novrix (pages 78-79) is structured in two connected parts, each based on the 552 diamond but employing different pitch inputs and meters. Part One is set in 12/8 and explores the G# *Lygimic* scale, outlining its dual major-minor tonal character. Part Two transitions via an accelerando into 6/4, introducing the D *Styditonic* scale and a recontextualization of the rhythmic material.

Multiple pathways are employed, including the full diamond and vertical pathways, culminating in a consolidated rhythm derived from all four pathways. The framework concludes with an extended exploration of the stretched full diamond number sequence.

Echo Cog Drift

Echo Cog Drift (page 76) is based on the 772 number diamond in 4/4, with C *Loritonic* as the primary pitch input. Additional modal contexts (F *Laritonic*, Ab *Thacritonic*, and Db *Zacritonic*) are introduced through modal interchange during layer exploration. The number '2' is occasionally interpreted as silence rather than a sounded rhythm. The vertical pathway is primarily used, with a short instance of the full diamond at the conclusion.

Syncretic Drift

Syncretic Drift (page 84) explores the interaction of a 3:4:5 polyrhythm across multiple metres (12/8, 3/2, and 5/8). The initial pitch set is F *Daptitonic*, with modal interchange providing contrasting harmonic environments. The melodic structure is derived from the composite rhythm of the polyrhythm. In 5/8, the emphasis shifts to the Db augmented triad, resulting in increased harmonic openness.

Hexigra Shift

Hexigra Shift (page 77) is constructed around the 666554 triangle in 8/4 and employs the E *Aeradimic* scale. This scale was created using a combination of construction methods. Starting with the *Anchihoye* scale, the one-step altered and one-note added methods were utilised to create a new hexatonic scale containing a full diminished 7th chord. Chord symbols are included in the score as improvisational reference points rather than prescriptive harmonic material. Their function is to highlight potential chordal implications within the scale.

Dabrisa

Dabrisa (pages 74-75) was developed through an exploratory process centred on improvisation in 7/8, incorporating multiple improvised numerical sequences, with the only rhythmic input being metre. Harmonic direction emerged from the pitch content of MIDI percussion, with scale choices responding to implied tonal centres rather than predetermined harmonic plans. The absence of a defined harmonic basis resulted in less stable harmonic outcomes, suggesting that the pitch-input method developed in this research plays a critical role in supporting coherent harmonic structure. This framework therefore functions as a comparative case, demonstrating the limitations that arise without structured input of pitch and rhythm.

Quintara Flow

Quintara Flow (pages 80-81) is based on the 221 number diamond in 5/8 and employs the *Bogian* scale.
This scale was derived from C *Kygitonic* using the one-note added method, resulting in a heptatonic pitch set most commonly associated with the *Double Harmonic Minor* scale.
As the expanded pitch content supports more traditional harmonic applications, chord symbols are used again as improvisational guides. The full diamond and stretched full diamond pathways are explored.

Aeralex

Aeralex (pages 71-73) is an exploration of the 1–2–3–4–5–6 magic triangle [9] within a 21/8 metre. The number sequences use different combinations of all six numbers, creating seven-beat phrases within the triple metre. Three different Kyritonic scales were used: D, F, and A. An A *Thadyllic* scale was also created from the composite pitch collection of the three *Kyritonic* scales. Chord symbols were used, and a form outlining the different key centres was created. Towards the end of the piece, there is a brief metric modulation into 6/4. This framework was developed towards the end of the research period as a solo saxophone work. While it explores new concepts such as magic triangles and composite scales, these fall outside the scope of the research.

4.7 Chapter Summary

This chapter has outlined the artistic, technical, and conceptual outcomes of the project, showing how the integration of newly constructed scales with Sheehan's number-based rhythmic systems expanded my improvisational vocabulary and strengthened my structural awareness. Through the development of improvisational frameworks, consolidated rhythmic structures, and a purpose-built practice method, the project generated new melodic and rhythmic possibilities reflected in the eight recorded creative works. Together, these outcomes illustrate the effectiveness and adaptability of the approach and show how a systematic yet exploratory engagement with rhythm and pitch can produce a flexible improvisational language that supports further creative development across diverse musical contexts.

[9] A magic triangle (or perimeter magic triangle) is an arrangement of consecutive integers where there is the same number of integers on each side of the triangle, and the sum of each side is constant.

5 Conclusion

This research addressed a clear gap in existing scholarship: how Greg Sheehan's rhythmic concepts can be intentionally applied to the saxophone to expand rhythmic vocabulary for improvisation. While *The Rhythm Diaries* documents Sheehan's rhythmic concepts in detail, it offers limited guidance on how number diamonds might be translated into melodic-rhythmic vocabulary on pitched instruments. As a result, decisions relating to scale choice, melodic contour, phrasing and articulation are largely left to the performer. Although previous research engages with aspects of this territory, it does not address this problem directly.

This practice-led enquiry responds to that gap through the integration of Sheehan's number sequences with newly generated pitch material. A personalised practice routine was devised to build rhythmic fluency and develop melodic articulation, allowing rhythmic ideas to directly inform melodic decision-making. The process encouraged responsiveness, with technical challenges becoming creative catalysts rather than obstacles.

The introduction of new scales disrupted habitual melodic responses and provided engaging pitch material. Scale construction techniques allowed pitch material to evolve in response to musical needs, embracing new intervallic structures and expressive possibilities. Through the development of improvisational frameworks, new approaches to phrasing and form emerged. The resulting frameworks and recordings demonstrate how unfamiliar materials can become expressive and intuitive through repeated contact, reflection, and refinement.

It was not the intention of this research to produce a complete system for adapting Sheehan's concepts to the saxophone, but rather to initiate a practical approach that is readily adaptable to other melodic instruments. By focusing on process rather than prescription, this thesis demonstrates that a personalised improvisational approach can emerge from the thoughtful integration of diverse musical influences.

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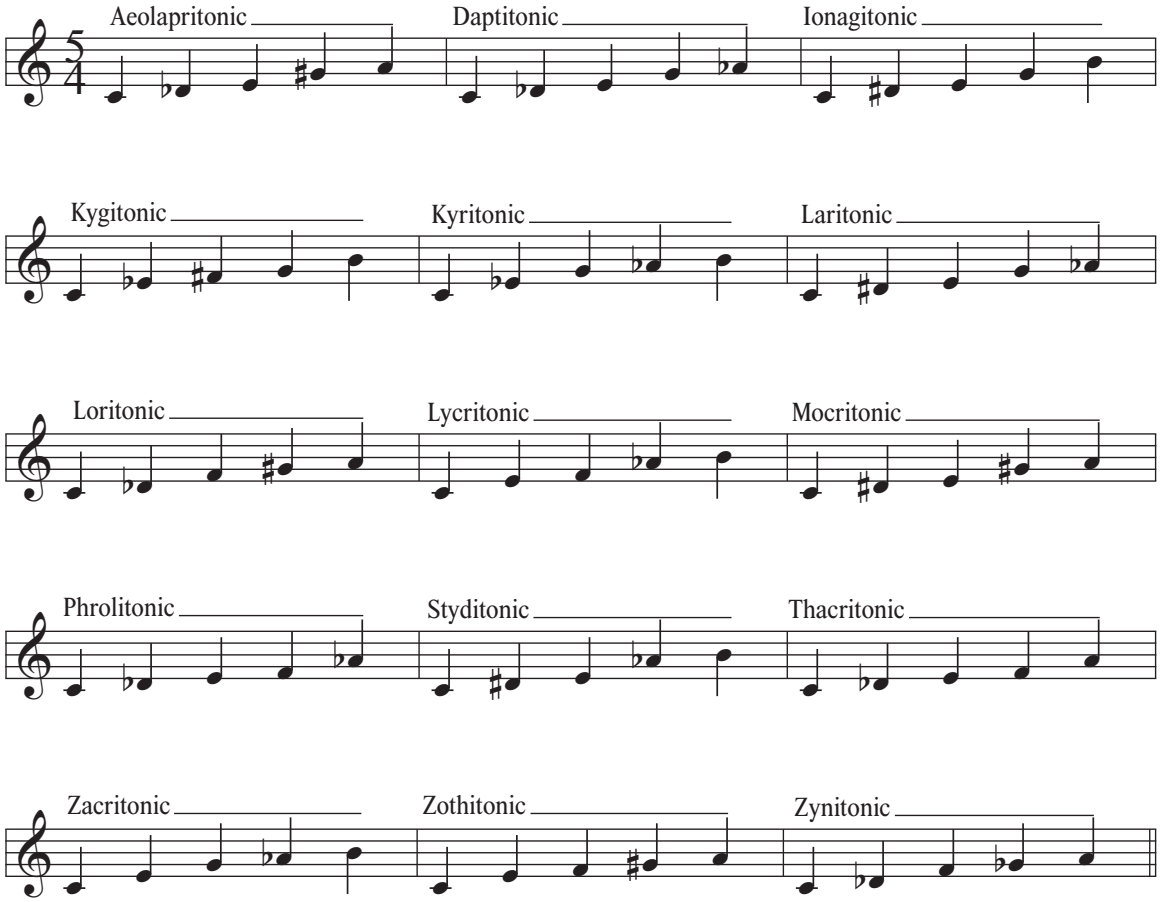
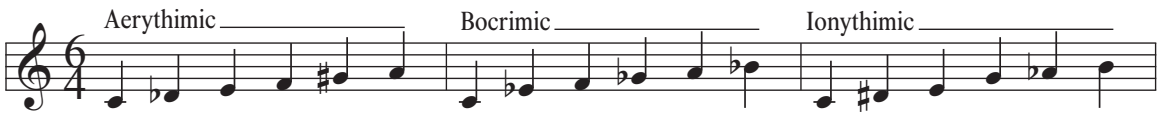
Appendix

Scales in C

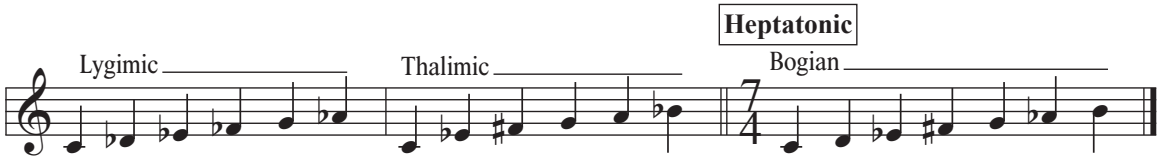
Pentatonic



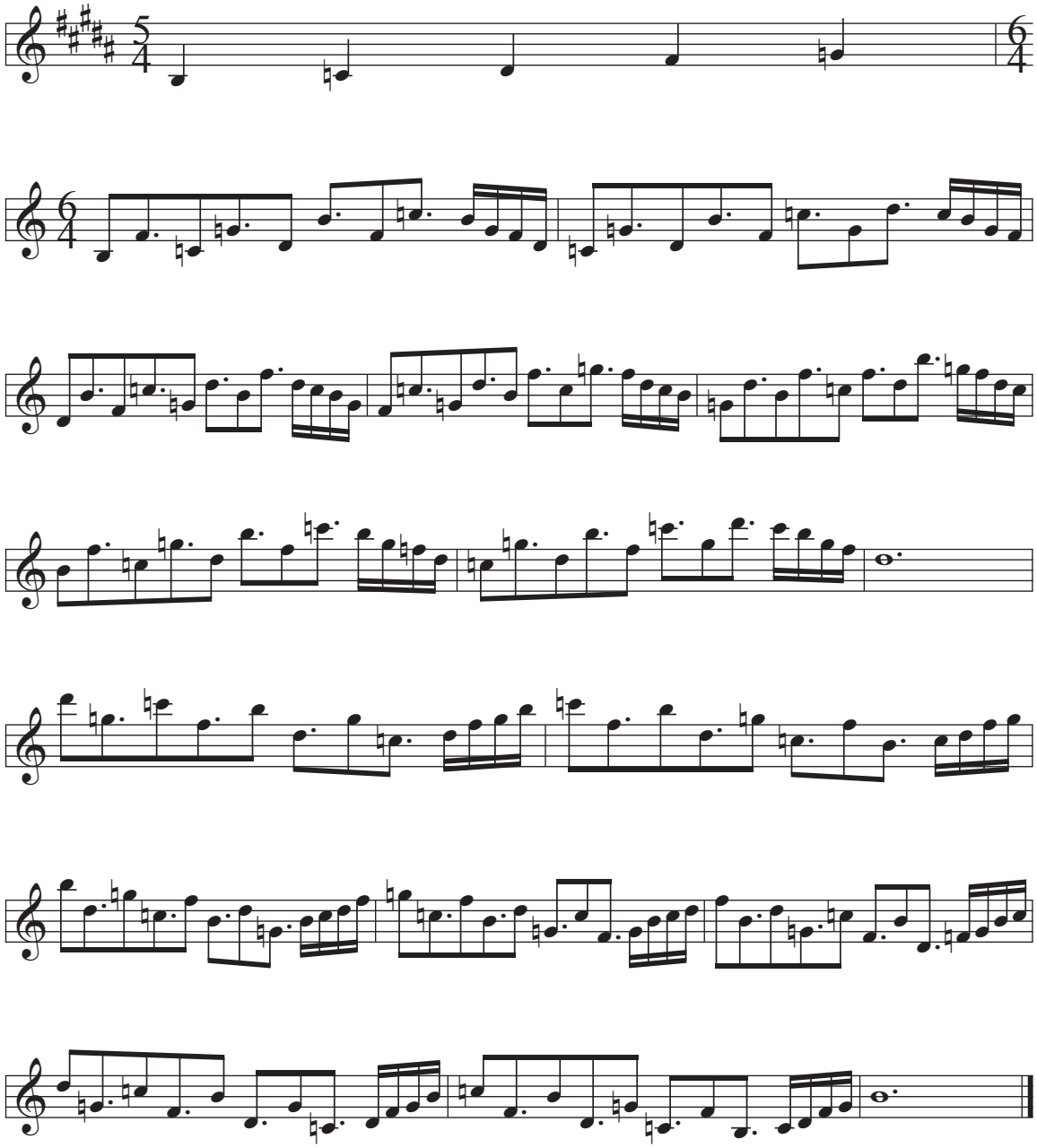
Hexatonic



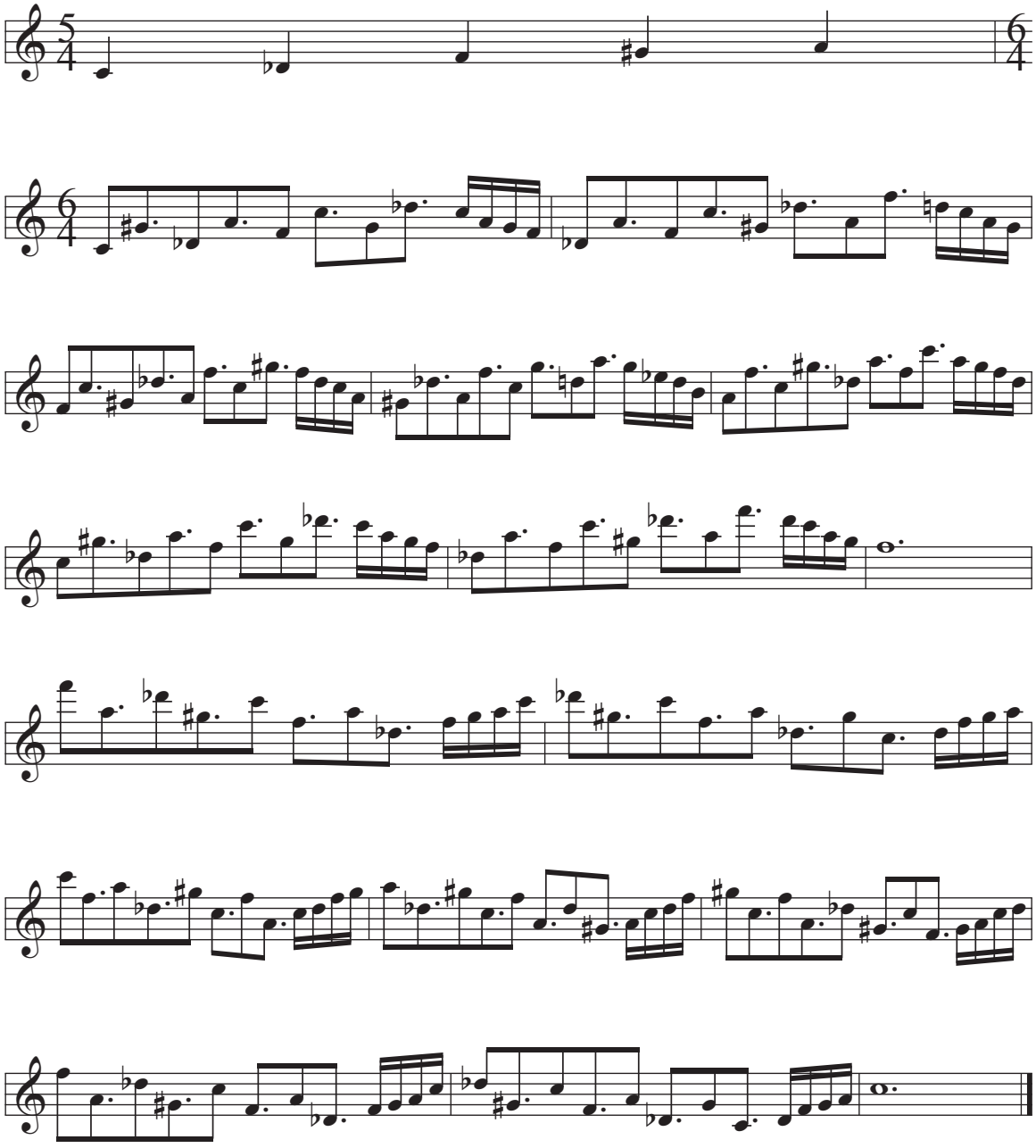
Heptatonic



Daptitonic in Fourths

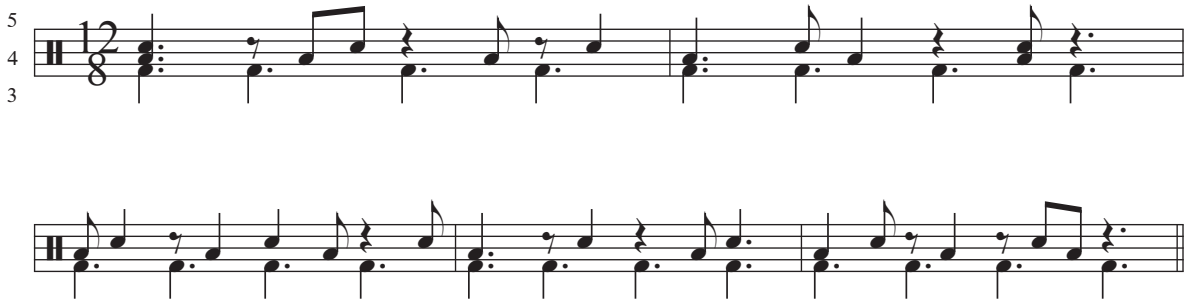


Loritonic in Fourths

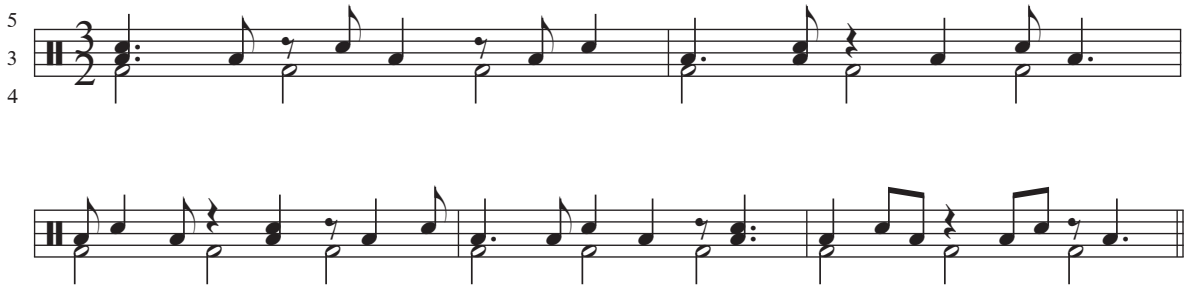


Composite Rhythms

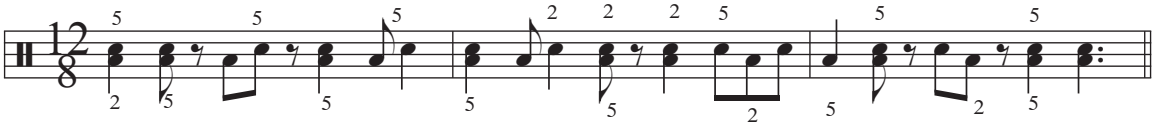
3-4-5 in 12/8



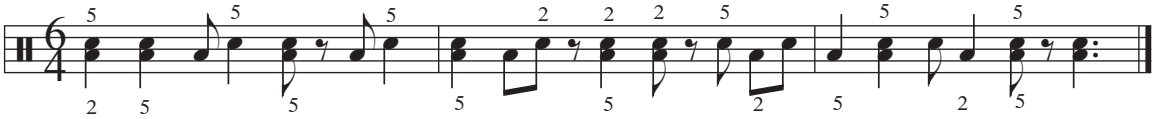
3-4-5 in 3/2



552 pathways in 12/8



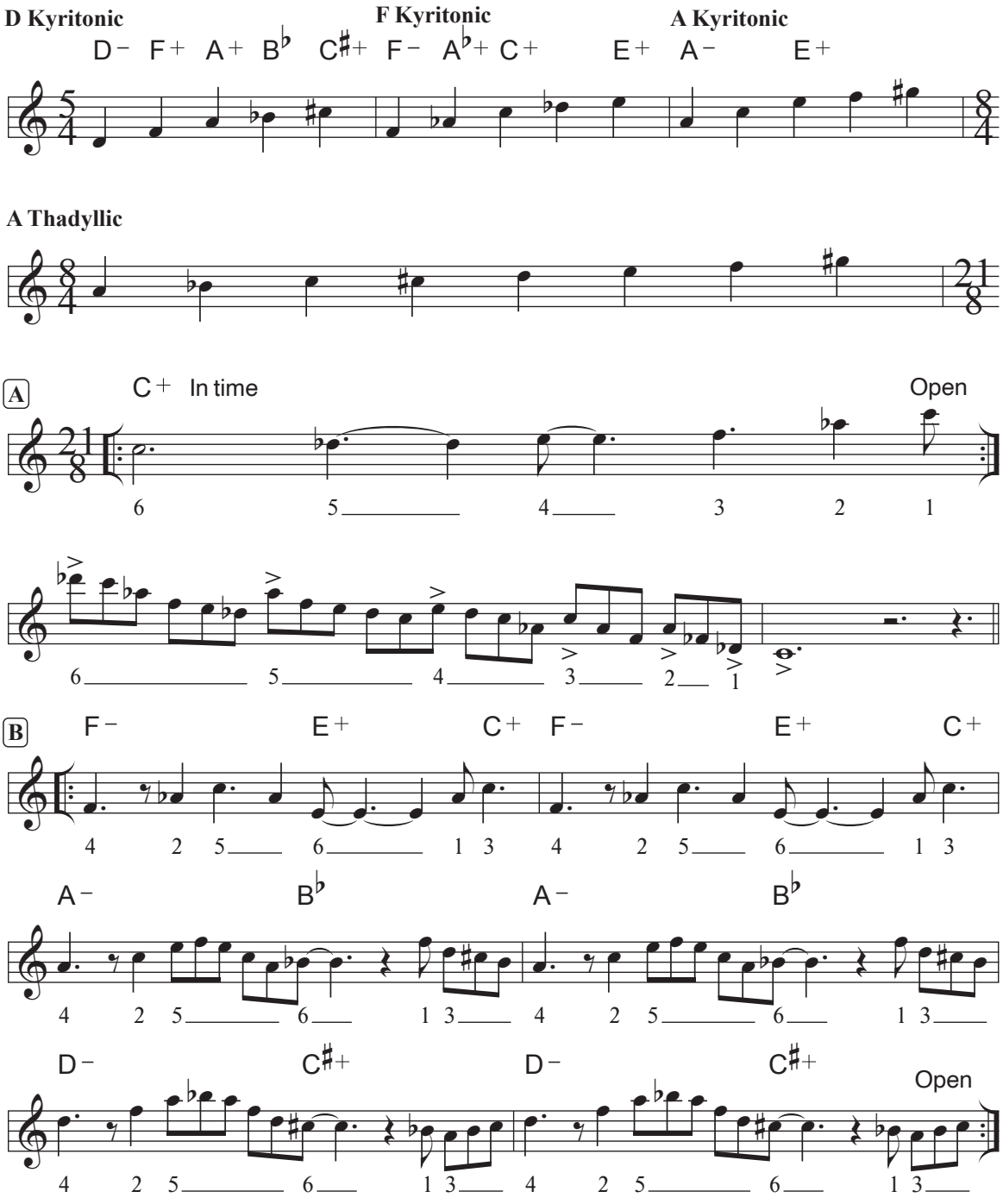
552 pathways in 6/4

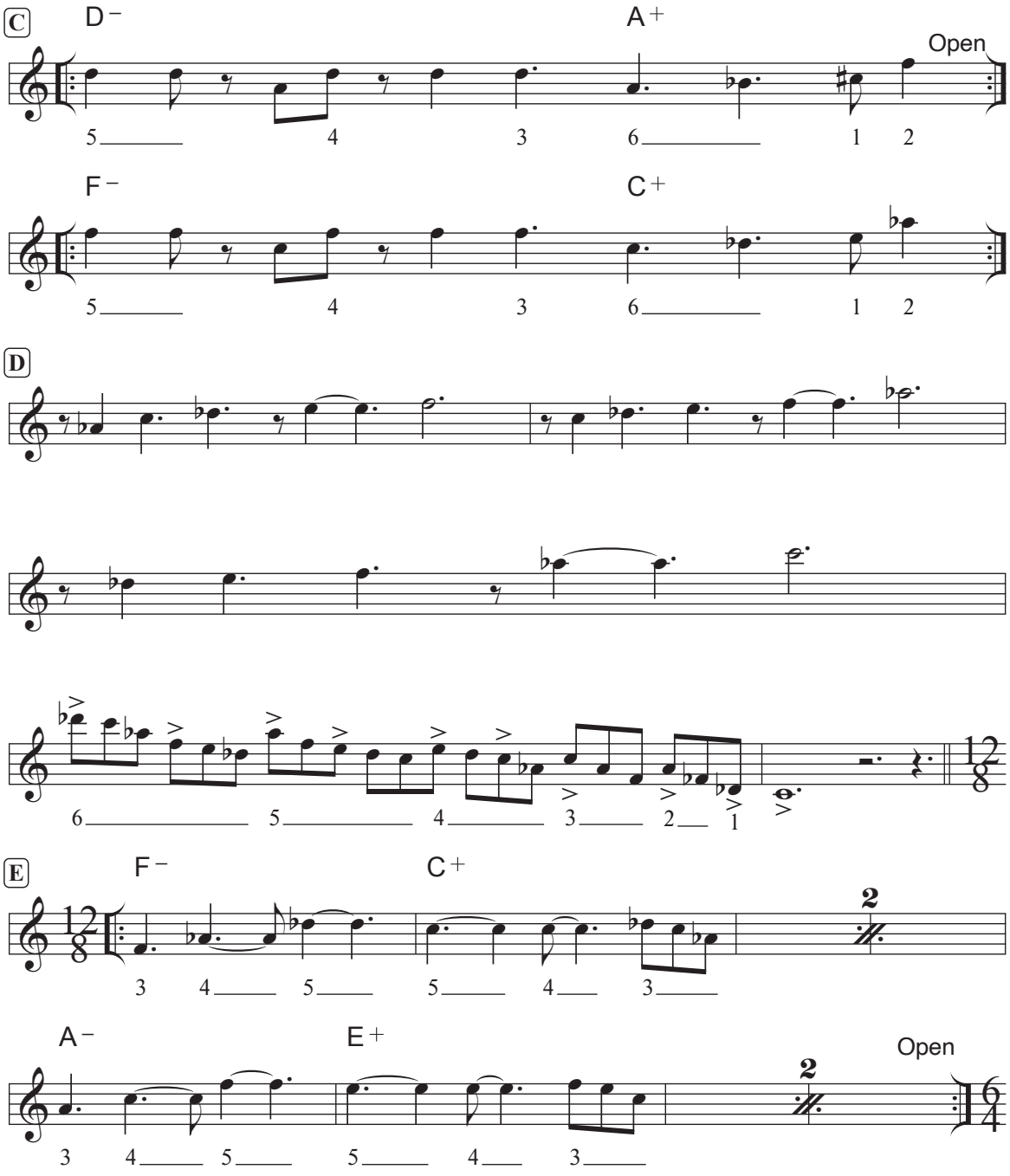


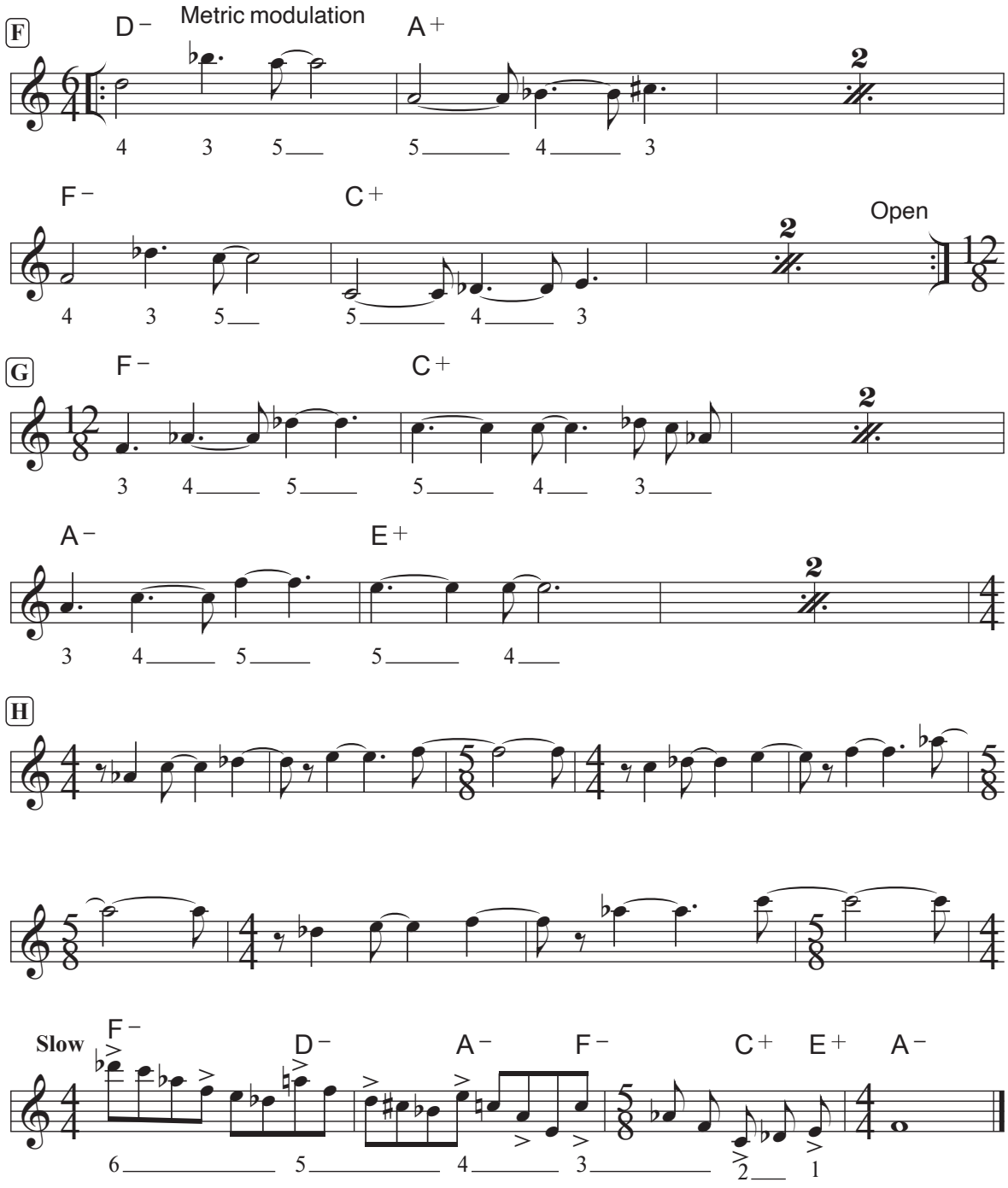
Aeralex

Tenor Sax

Scale exploration

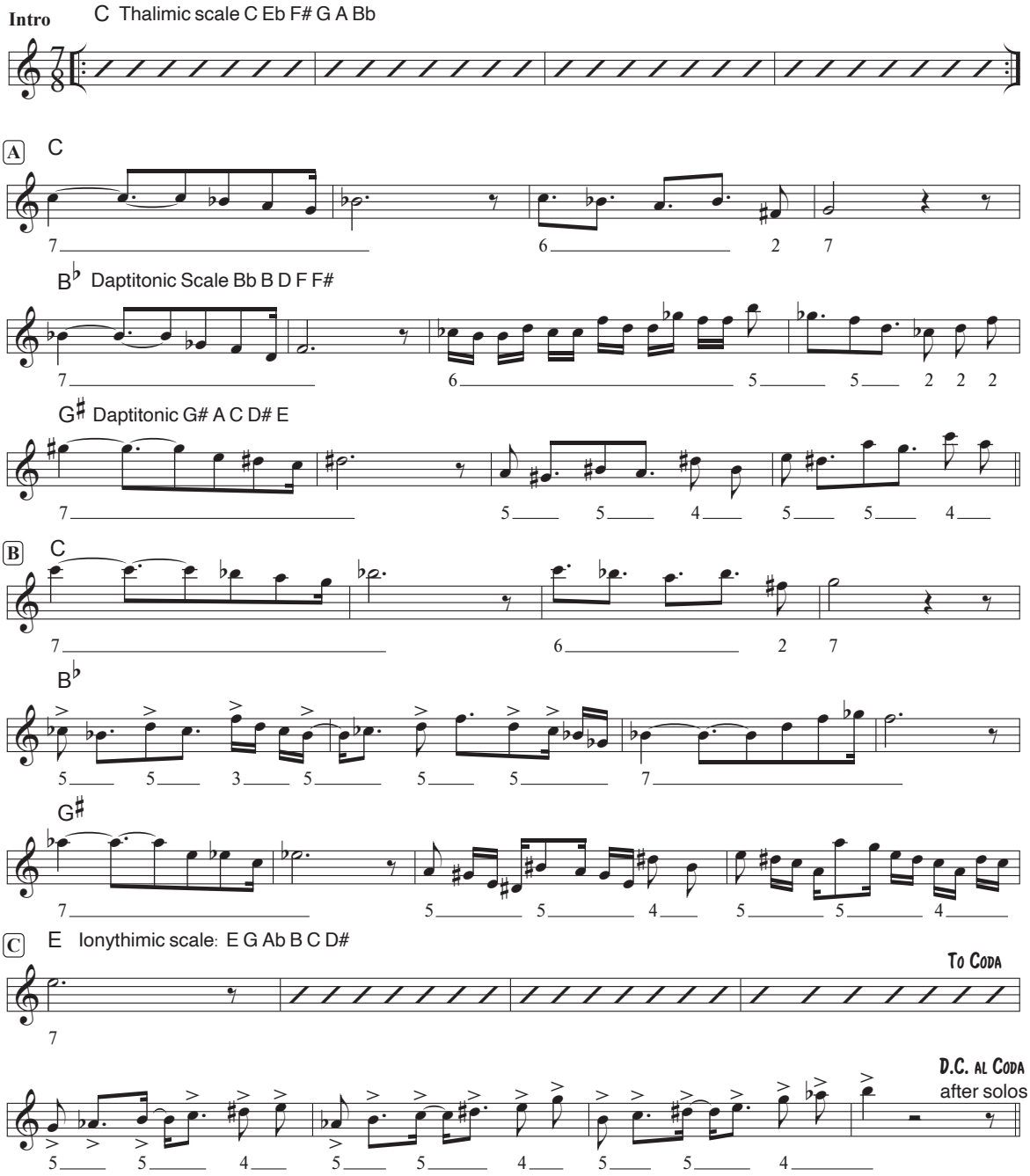



C
D −
A +
Open
5 4 3 6 1 2
F −
C +
5 4 3 6 1 2
D
6 5 4 3 2 1
12/8
E
F −
C +
2
3 4 5 5 4 3
A −
E +
Open
2
3 4 5 5 4 3
6/4

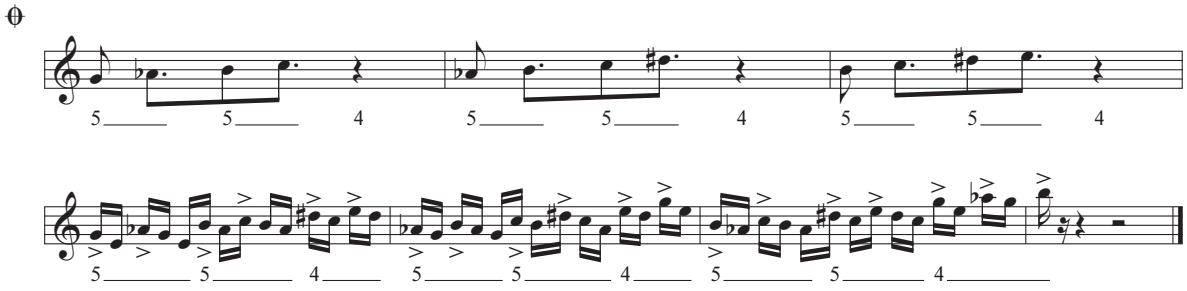

F
D −
Metric modulation
A +
2
F −
C +
Open
G
A −
E +
H
Slow

Dabrisa

Alto Sax



SOLO FORM:
ABC (all bars are sevens only)

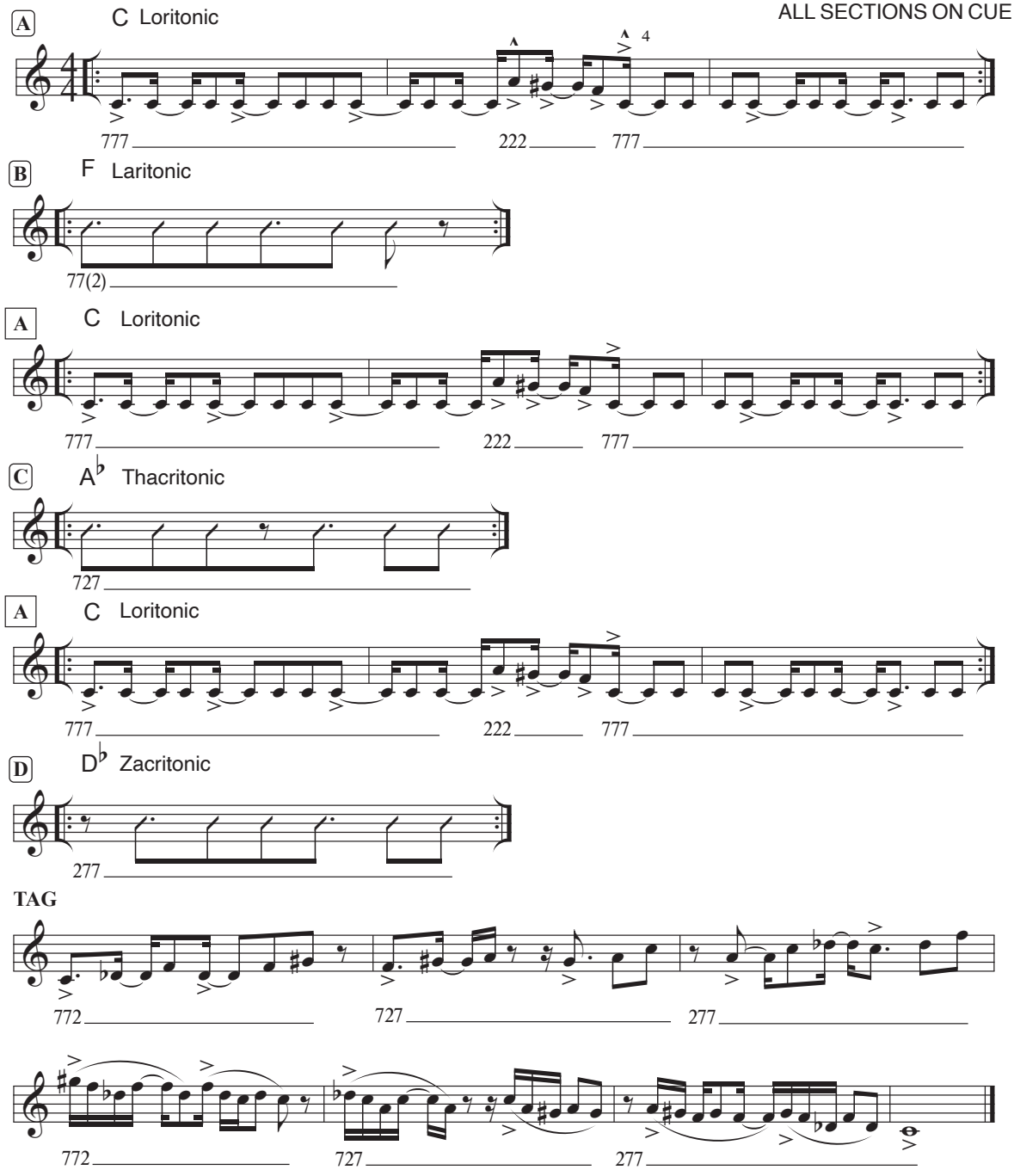


Echo Cog Drift

Tenor Sax

Loritonic: C Db F G# A

ALL SECTIONS ON CUE

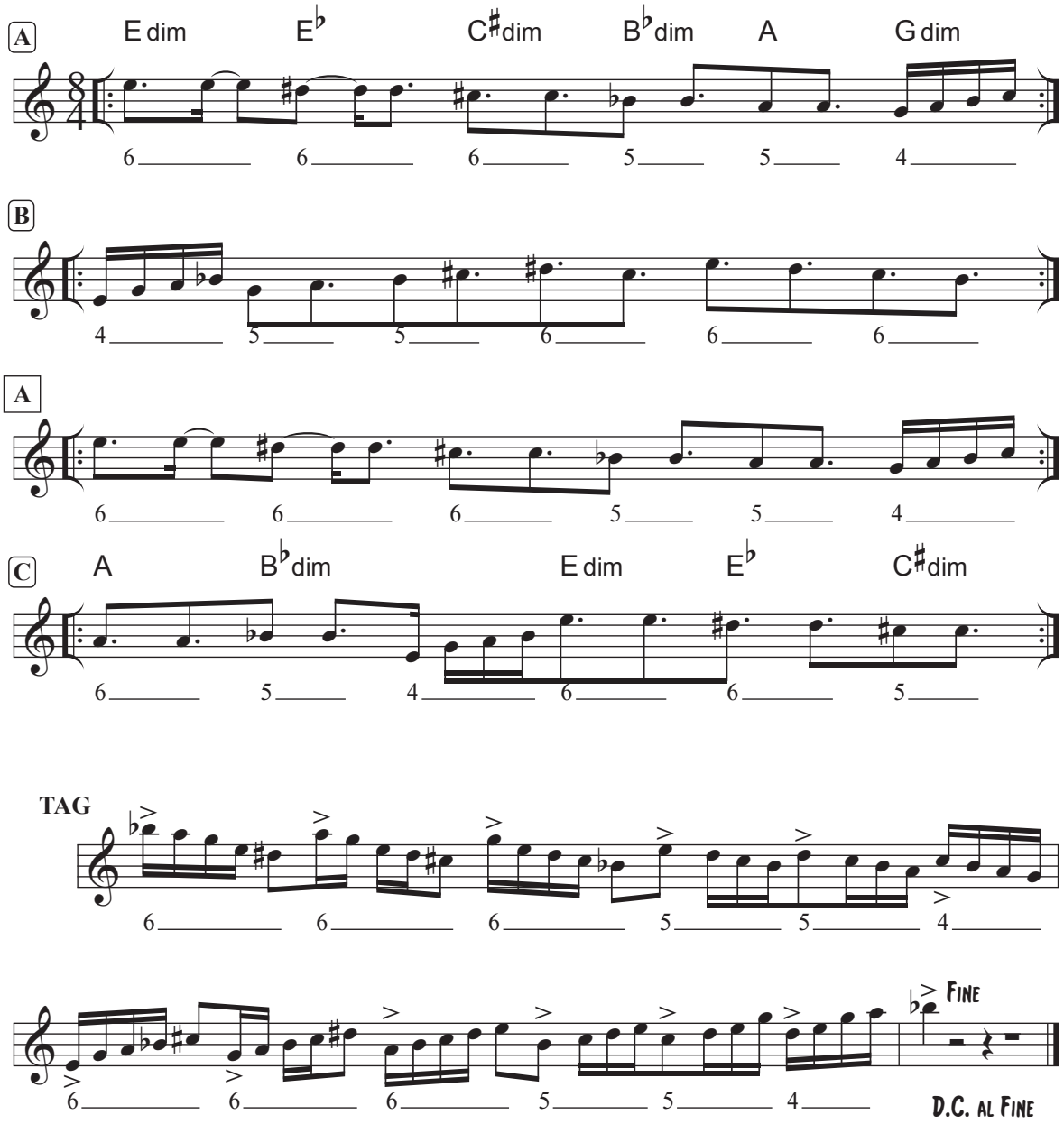


Hexigra Shift

Alto Sax

Aeradimic scale: E G A Bb C# D#

ALL SECTIONS ON CUE

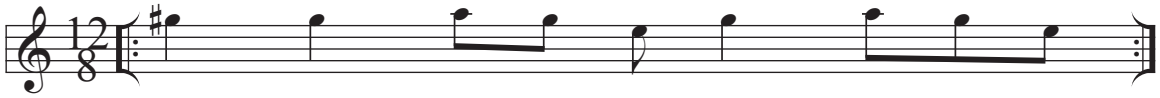


Novrix

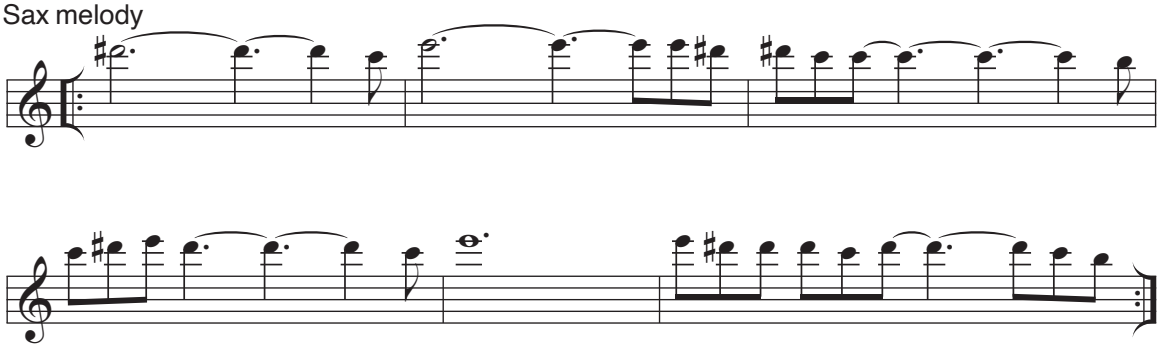
Tenor Sax

Lygimic scale: G# A B C D# E

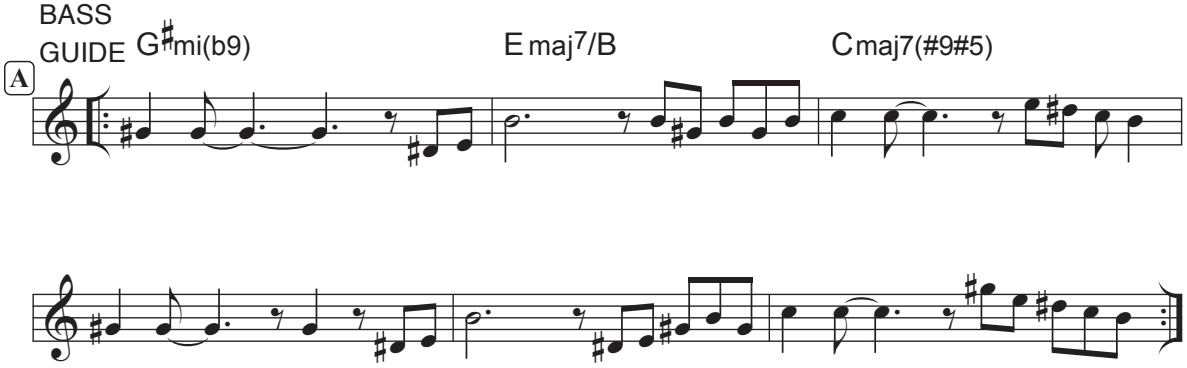
Sax riff



Sax melody

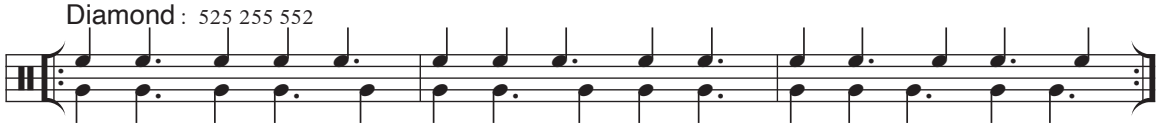


BASS GUIDE



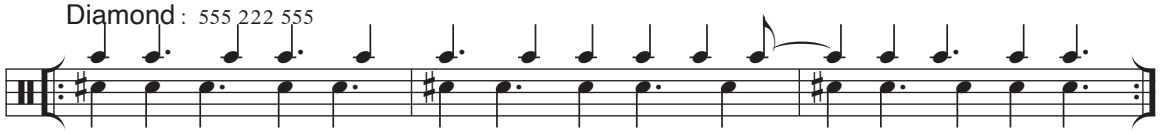
DRUM/PERC GUIDE

Diamond : 525 255 552

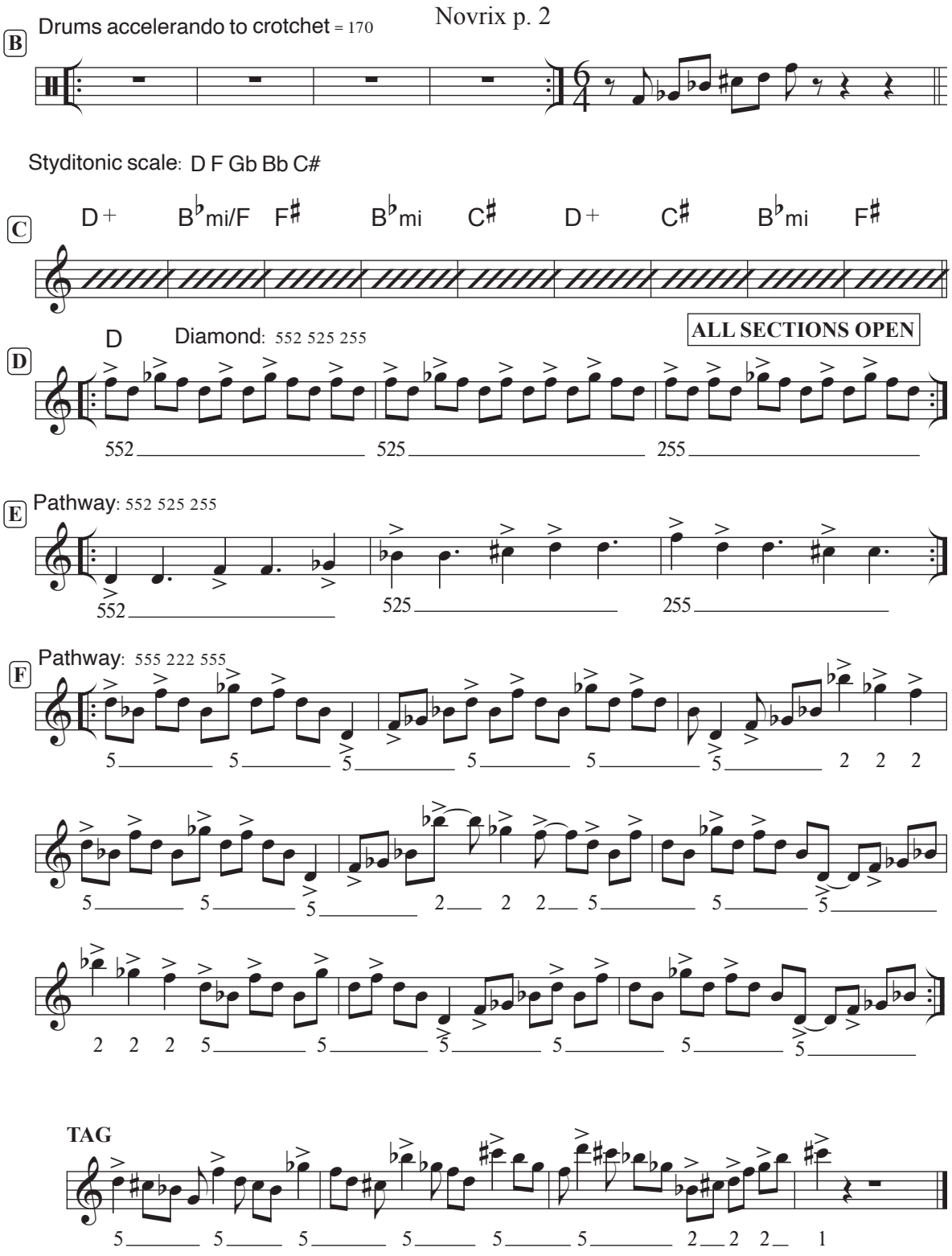


Diamond : 552 525 255

Diamond : 555 222 555



Diamond : 255 552 525

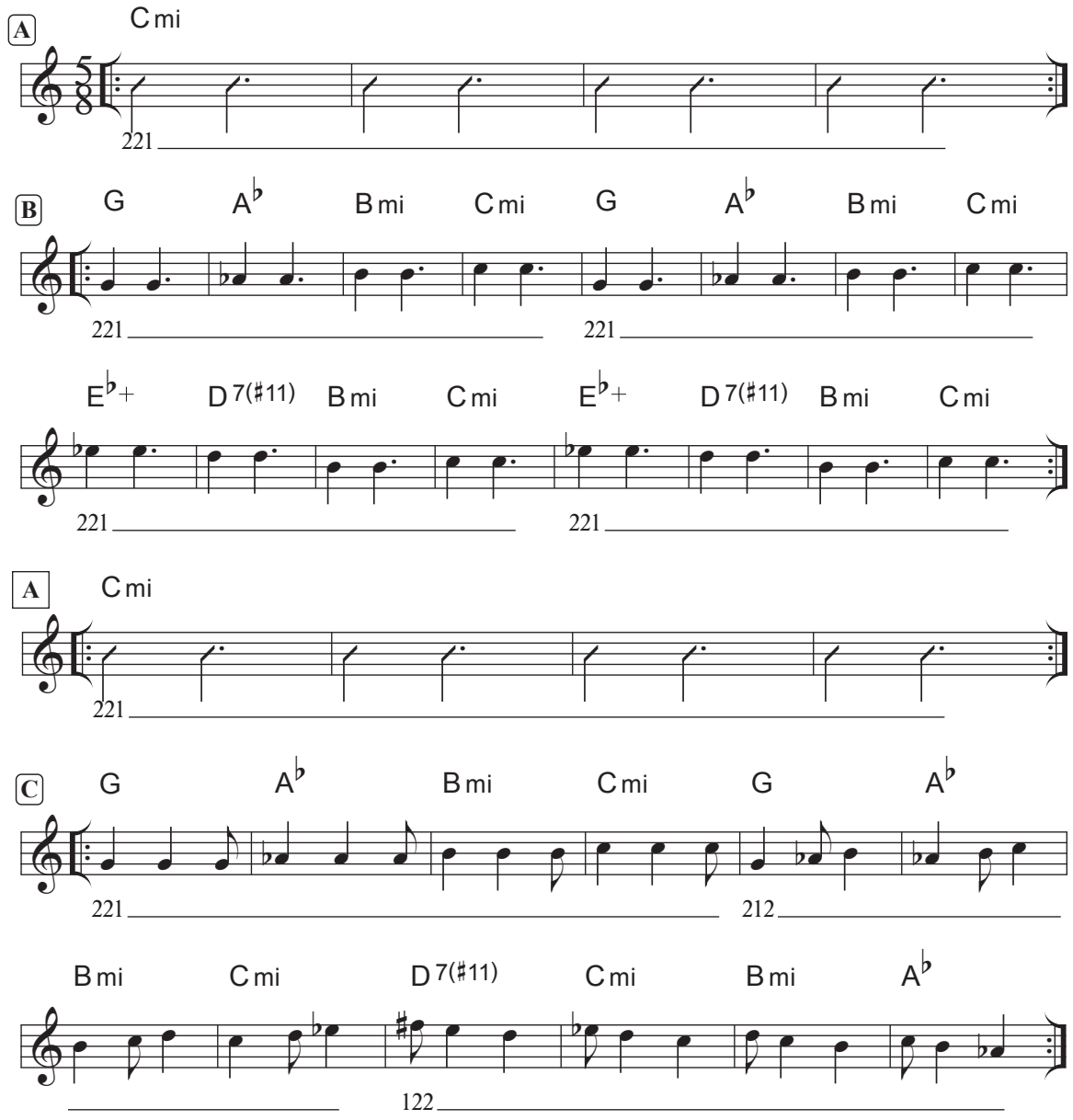

B
Drums accelerando to crotchet = 170
Styditonic scale: D F Gb Bb C#
C
D+ B♭mi/F F♯ B♭mi C♯ D+ C♯ B♭mi F♯
D
D Diamond: 552 525 255
ALL SECTIONS OPEN
552 525 255
E
Pathway: 552 525 255
552 525 255
F
Pathway: 555 222 555
TAG

Quintara Flow

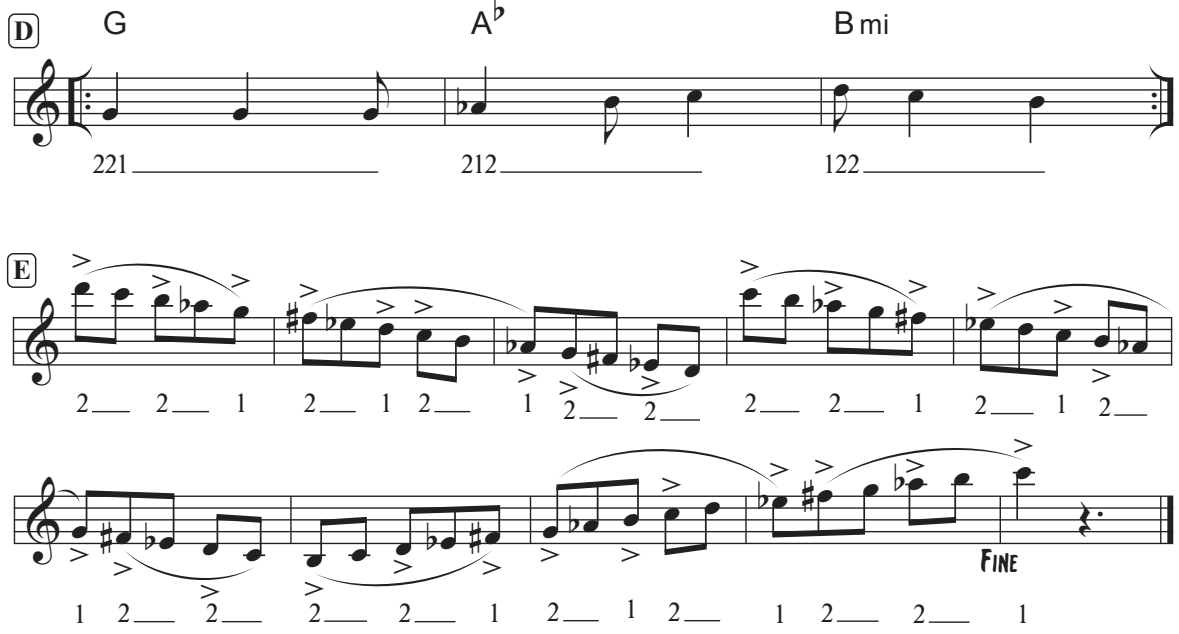
Tenor Sax

C Bogian: C D Eb F# G Ab B

ALL SECTIONS ON CUE



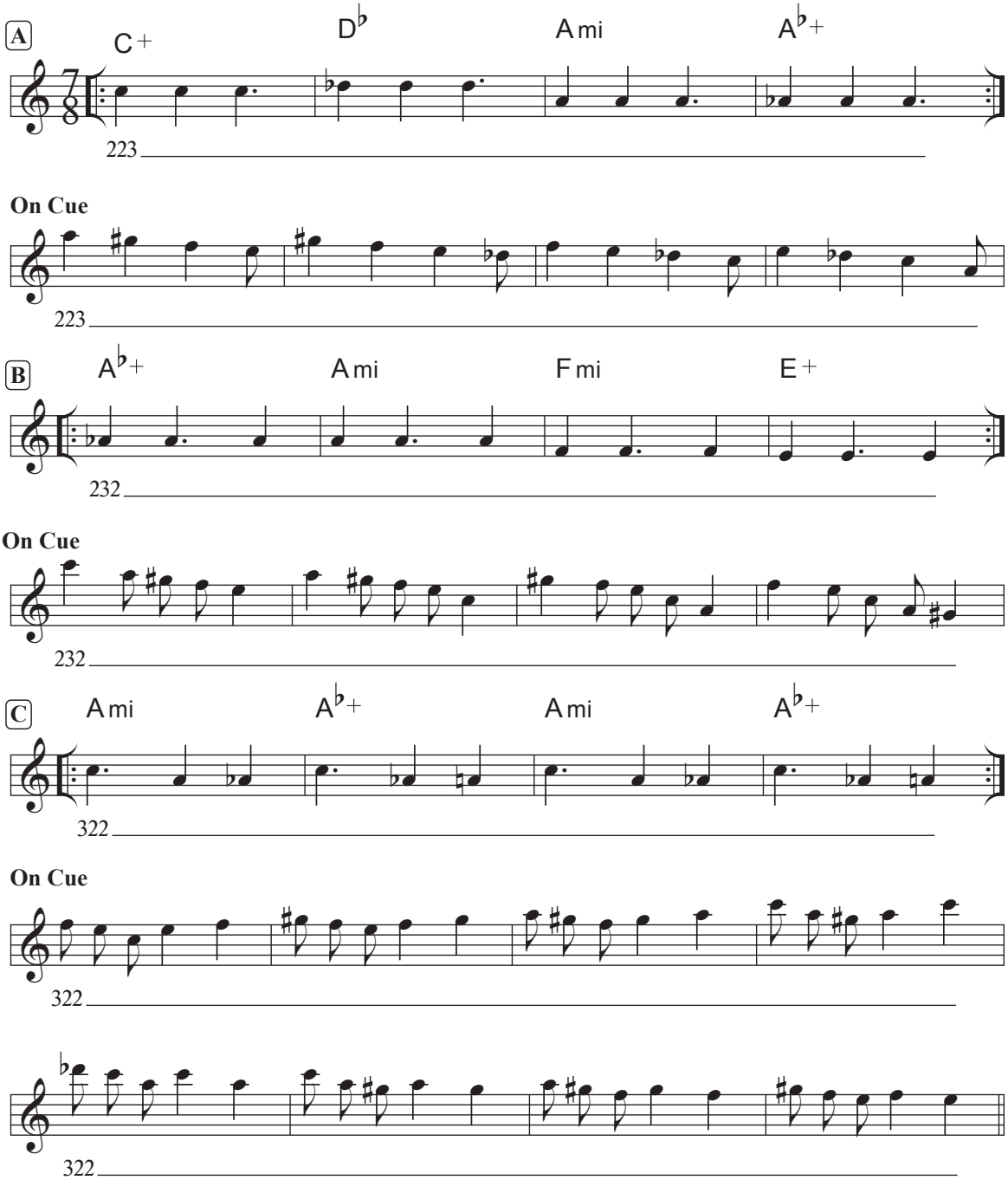
Quintara Flow
221 p. 2



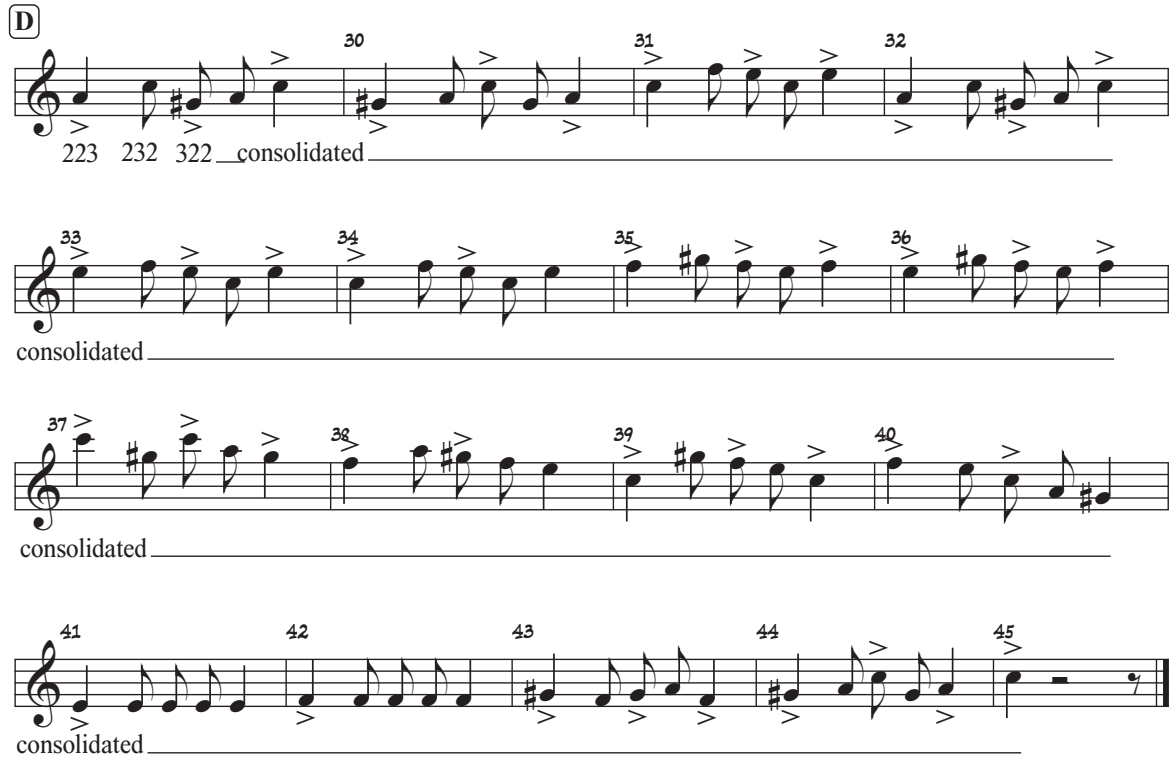
Septarhythmic

Tenor Sax

Aerythimic scale: C Db E F G# A



Septarythmic
223 p. 2

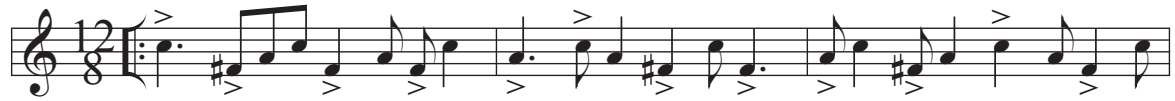


Syncretic Drift

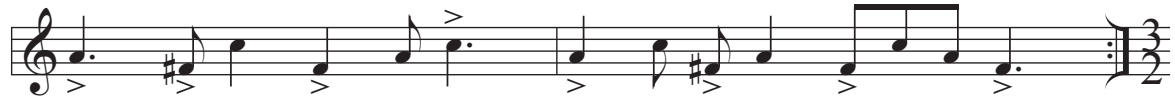
Tenor Sax

F Daptitonic: F F# A C Db

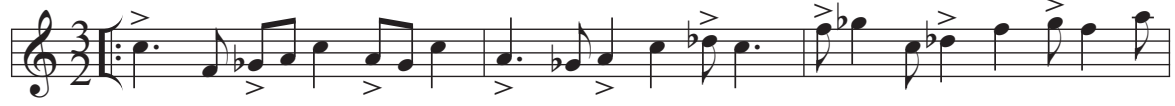
A C Zynitonic

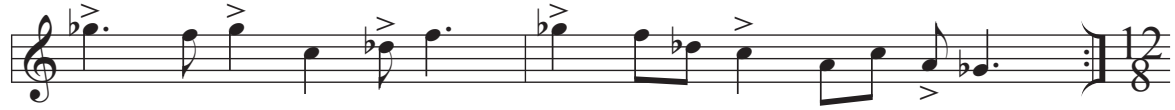


bass bass line under bass solo

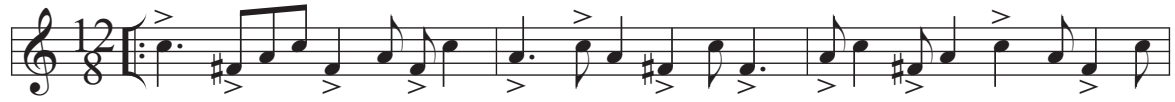


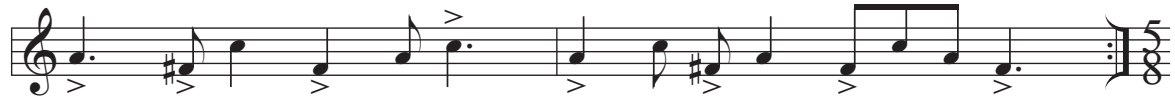
B F Daptitonic



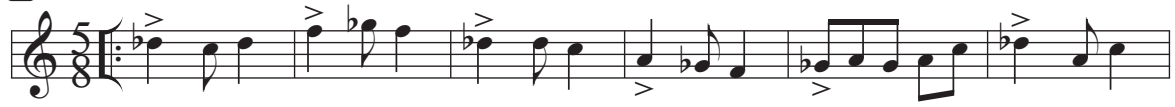


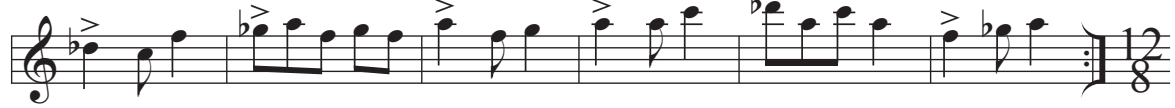
C C Zynitonic





D D♭ Lycritonic





Play free on last chorus of sax solo

DC for solos