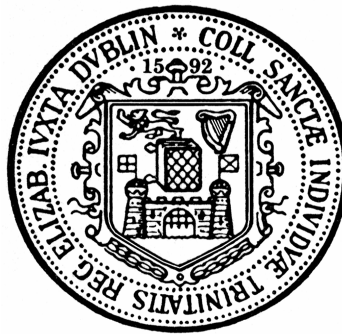


The Blues, Microtonality & the Guitar

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Submitted as part fulfilment for the degree of M.Phil.

2018

Declaration

I hereby declare that this thesis has not been submitted as an exercise for a degree at this or any other University and that it is entirely my own work.

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Abstract

The Blues, Microtonality and Guitar is a research thesis that investigates the informal and formal application of microtonality in blues and contemporary music. The composition constructed from the findings of research conducted into music notation, practical performance techniques and compositional concepts when applying microtonality to the guitar aims to add important information to this developing area of study. The background of the blues genre and its relationship with microtonality, along with the study of current and historical contemporary composers, aims to provide new compositional processes and systems that can aid both the guitarist and the composer. Analysis of classic blues vocal performances provide an insight into microtonal pitches sung in relation to our current tuning system and new concepts are applied to accentuate and explore this microtonal content in both improvisation and composition. These new systems will be tested on guitar and investigated through the composing of experimental etudes that explore new creative possibilities aimed at encouraging the modern guitarist to take a structured approach to practicing and exploiting microtonality in their work.

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Table of Contents

Abstract	ii
Acknowledgements	iii
Table of Contents.....	iv
Table of Figures	vii
List of Tables.....	x
1. Introduction	1
1.1 Chapter Introduction.....	1
1.2 The Guitar Problem	2
1.3 Research Objectives.....	3
1.4 Thesis Structure	4
2. Background	6
2.1 Chapter Introduction.....	6
2.2.1 The Blues & Microtonality	6
2.2.2 The Blue Note.....	6
2.2.3 Blues Vocals	7
2.2.4 Blues Harmonica Tuning	9
2.3.1 Microtonality & Contemporary Composers	11
2.3.2 Harry Partch (1901 - 1974).....	13
2.3.2 Lou Harrison (1917 - 2003).....	16
2.3.4 Ben Johnston (1926 - Present).....	17
2.3.5 James Tenney (1934 - 2006).....	19
2.4 The Modern Microtonal Guitar	23
2.5 Chapter Conclusion.....	25
3 Modern Microtonal Composers	26

3.1	Chapter Introduction.....	26
3.2.1	Michael Nielsen	26
3.2.2	Donnacha Dennehy	30
3.2.3	Garrett Sholdice	32
3.3	Chapter Conclusion.....	35
4	Analysing the Blues	36
4.1	Chapter Introduction.....	36
4.2.1	Joe Monzo.....	36
4.3.1	Analysis – Artists & Material	38
4.3.2	Blues Chord Progressions	40
4.3.3	Pitch Analysers and Tools	43
4.3.4	Pitch Analysis – Keys & Ranges	47
4.3.5	Guitar Tuning	52
4.3.6	Pitch Distribution.....	54
4.3.7	Comparing 3rds, 5ths & 7ths	56
4.4.1	Charlie Patton Analysis	59
4.5	Chapter Conclusion.....	60
5	Microtonal Experiments & Etudes	61
5.1	Chapter Introduction.....	61
5.2.1	Guitar Sensitivity.....	61
5.2.2	Equipment & Guitars.....	61
5.3	MAX/MSP & Reaper.....	64
5.4.1	Concepts And Etudes	67
5.4.2	Quartertone Approach Note Concept	67
5.4.3	Quartertone Etudes.....	72
5.4.4	Harmonics Etudes.....	76

5.4.5	Open Tuning & Scordatura Etudes	78
5.4.6	Blues Cells Concept & Etude.....	82
5.5	Chapter Conclusion.....	85
6.	Future Shades Of Blue	87
6.1	Chapter Introduction.....	87
6.2.1	The Composition – Future Shades Of Blue	87
6.2.2	Movement I.....	88
6.2.3	Movement II.....	93
6.2.4	Movement III.....	95
6.3	Critical Evaluation & Chapter Conclusion	98
7.	Testing	102
7.1	Chapter Introduction.....	102
7.2.1	Testing Quartertone Exercises / Visualizing Quarter & Sixth-tones.....	103
7.2.2	Testing - Microtonal Interval shapes	106
7.2.3	Testing Performance Techniques.....	107
7.4	Testing Results.....	108
7.5	Chapter Conclusion.....	111
8.	Conclusion	112
8.1	Conclusion.....	112
8.2	Evaluation of Approach & Recommended Further Research	113
8.3	Personal Summary	115
	Bibliography.....	116
	Appendix A - Full Score – Future Shades of Blue Movements I-III.....	126
	Appendix B - Media Disc Contents.....	127

Table of Figures

Figure 1.1 Replacement guitar necks	2
Figure 2.1 Eric Clapton and the blue note	7
Figure 2.2 Albert King string bending	7
Figure 2.3 Bessie Smith.....	8
Figure 2.4 Derek Trucks.....	8
Figure 2.5 The Sarod	9
Figure 2.6 Three harmonica tunings.....	10
Figure 2.7 Harry Partch	14
Figure 2.8 Harry Partch's 43 Note scale	15
Figure 2.9 Hal Willner's Weird Nightmare	15
Figure 2.10 Three Indigenous Songs extract.....	21
Figure 2.11 John Schneider playing Novatone fingerboard.....	23
Figure 2.12 David Fiuczynski, Jon Catler, Tolgahan Cogulu	24
Figure 3.1 Mike Nielsen etude for guitar with added frets.....	28
Figure 3.2 Score extract Aisling Gheal	31
Figure 3.3 Extract of Sonate by Garrett Sholdice.....	33
Figure 3.4 Sholdice choice of microtonal accidentals.....	33
Figure 4.1 Joe Monzo Robert Johnson analysis	36
Figure 4.2 Joe Monzo Tall chart analysis in cent deviation	37
Figure 4.3 Traditional Twelve bar blues	40
Figure 4.4 Charlie Parker's Blues for Alice.....	41
Figure 4.5 Howlin' Wolf's Smokestack Lightnin' riff	41
Figure 4.6 Eight bar blues	42
Figure 4.7 John Lee Hooker excerpt from Tupelo	42

Figure 4.8 Pitch analysis in VoceVista Video.....	43
Figure 4.9 Pitch analysis in Adobe Audition.....	44
Figure 4.10 Pitch analysis in WavePad	44
Figure 4.11 Screen shot of Melodyne analysis.....	46
Figure 4.12 Blind Willie Mctell pitch analysis	48
Figure 4.13 Muddy Waters pitch analysis.....	49
Figure 4.14 Blind Willie Johnson pitch analysis.....	50
Figure 4.15 Pitch Distribution / Tall chart.....	55
Figure 4.16 Charlie Patton pitch analysis score	59
Figure 5.1 Fretless guitar	62
Figure 5.2 Gibson SG Standard used for slide	62
Figure 5.3 Hexaphonic and vibrato arm equipped guitar	63
Figure 5.4 Breakout Box and digital interface	64
Figure 5.5 MAX/MSP patch.....	65
Figure 5.6 DAW Reaper with plug-in Pitchproof.....	66
Figure 5.7 Behringer Midi foot controller.....	66
Figure 5.8 Notation for Quartertone approach 1, QT- to TN	69
Figure 5.9 Notation for Double Quartertone approach 6, HS-, QT-, HS+, QT+, TN	70
Figure 5.10 Notation for Quartertone written solo.....	72
Figure 5.11 Slide and Vibrato arm etude #6.....	73
Figure 5.12 Slide, Vibrato arm and quartertone walking bass line	75
Figure 5.13 Harmonics etude #10 extract.....	76
Figure 5.14 Etude #12 extract	77
Figure 5.15 Open tuning etude #13 - Hill Country Blues	79
Figure 5.16 Open tuning etude #14 - Piedmont Blues	80

Figure 5.17 Open tuning etude #15 - D Cross minor tuning	81
Figure 5.18 Blues cells chosen from Robert Johnson analysis	82
Figure 5.19 Blues cells re-written as interval shapes.....	83
Figure 5.20 Blues cells etude - Score extract	84
Figure 6.1 Visual overview, Three movements.....	88
Figure 6.2 Charlie Patton analysis - Assigned to guitar trio.....	89
Figure 6.3 Charlie Patton - Viable pitches	90
Figure 6.4 Visual Overview of Movement I	91
Figure 6.5 Melodic motif from third section of Movement I.....	92
Figure 6.6 Five-limit lattice from the James Tenney score for Bridges.....	93
Figure 6.7 Adaptation of Tenney's system to guitar with hybrid blues scale	94
Figure 6.8 Visual representation of Movement III <i>Future Shades of Blue</i>	95
Figure 6.9 Excerpt from Movement III <i>Future Shades of Blue</i>	96
Figure 6.10 Pitch deviations and Midi Controller set up for Guitar 2.....	97
Figure 6.11 Proposed experiment Midi Controller, open tunings and MAX.....	99
Figure 7.1 Microtonal notation and the guitar neck	103
Figure 7.2 Visualization technique.....	104
Figure 7.3 Notation for quartertone approach 1, QT- to TN	105
Figure 7.4 Notation for quartertone approach 4, HS+ QT+ to TN.....	105
Figure 7.5 Notation for quartertone approach 10, QT- HS+ QT+ to TN	106
Figure 7.6 Interval shape exercise – From etude #17.....	107
Figure 7.7 Vibrato arm motif from <i>Future Shades of Blue</i> (Mvt III).....	107
Figure 7.8 Four bar slide phrase from <i>Future Shades of Blue</i> (Mvt III)	108

List of Tables

Table 2.1 C Diatonic harmonica intervals in C (1st Position).....	11
Table 2.2 C Diatonic harmonica intervals in G (2 nd Position)	11
Table 2.3 Major Scale just intonation ratios.....	13
Table 2.4 Cent difference between equal temperament and just intonation.....	13
Table 2.5 Ben Johnston notation	18
Table 2.6 Tuning for Septet for 6 electric guitar and electric bass.....	20
Table 2.7 Tuning for <i>Water on the mountain... Fire in heaven</i>	22
Table 3.1 Ultramicrochromatic scale within a 12-Tet tone, Bb to C	27
Table 4.1 Details of recordings analysed	38
Table 4.2 Keys & ranges of blues songs analysed	51
Table 4.3 Preferred guitar tunings of blues artists analysed.....	52
Table 4.4 Big Bill Broonzy pitch distribution	54
Table 4.5 Comparing 3 ^{rds}	56
Table 4.6 Comparing 5 ^{ths}	57
Table 4.7 Comparing minor 7 ^{ths}	58
Table 4.8 Charlie Patton pitch distribution and tall chart.....	60
Table 5.1 Sixteen Quartertone approaches.....	68
Table 5.2 Quartertone and double target note pproach	71
Table 6.1 Scordatura tuning for solo guitar (Mvt II).....	94
Table 7.1 Participation response.....	108
Table 7.2 Overview of popular feedback from microtonal exercises	109

1. Introduction

1.1 Chapter Introduction

There are three main areas investigated in this thesis:

- Microtonality in the blues
- Microtonality in contemporary composition
- Practical applications of microtonality to the guitar

New compositional techniques were developed from detailed musical analysis of blues vocals and the experimental application of contemporary compositional techniques and concepts to the guitar. The compositions created from the research, analysis and testing of new notational systems aim to contribute to a better understanding of microtonality and its application to the guitar. Microtonality in blues is often overlooked but plays a very important role in the genre, especially when performing melodies, improvising and providing chordal accompaniment. The focus on microtonal elements in the blues will look into the practical musical notation of techniques which aim to advance the communication between composer and guitarist. If a composer can present higher level of detail to a performer, that is practically achievable, then microtonality could be incorporated with more frequency.

The emphasis on blues music helps the thesis focus on popular techniques such as string bending and bottleneck slide that are associated with the genre and the guitar so that the modern guitarist can utilize more microtonality in their performance without modification to the instrument. There are currently no disciplined guitar specific systems available where microtonality can be practiced and incorporated into a guitarists vocabulary. A system has been designed for this thesis inspired by jazz pedagogy to methodically aid the guitarist in this area.

1.2 The Guitar Problem

The modern guitarist has many different issues when performing written notation and often possess a very different skill set to other instrumentalists. It is very common for a blues guitarist in particular to have mastered a high level of performance techniques but be unable to execute written notation with a similar level of expression than if purely improvising.

The notes between the frets can be achieved using popular blues guitar techniques such as string bending and bottleneck slide guitar but how can the player be instructed to perform pitches without overly complicated notation systems? Microtonal pitches can be achieved and executed convincingly if simplified and if the player possesses good technique and aural judgement. Quartertone bends are often notated in transcriptions of guitar music but rarely presented in compositions that emphasise the quality and effect of these notes. Consistency in performance can be a problem and varies depending on the experience of the player, especially as the guitar fret is not present to help pitch the note. Achieving specific pitches that measure less than a quartertone is much harder but necessary when playing notes in chords that are justly tuned to the harmonic series.

Many different solutions have been explored mainly using different guitar necks with fretboards designed to utilise specific tuning systems. Figure 1.1 below shows two replacement neck commercially available for electric guitar through FreeTone Music (Free Note Music, 2018). Many options are now available and the two pictured are fretted to contain 36 just intonated pitches per octave.



Figure 1.1 Replacement Guitar Necks (Free Note Music, 2018)

Replacement necks can be intimidating and expensive for blues guitarists who want to incorporate more microtonality into their performance. This thesis hopes to provide research into techniques and concepts which are accessible to most guitarists and composers and will add to their skillset without microtonality obstructing their normal playing.

If a common microtonal language was used by composers and a system practiced by a guitarist to play microtonal pitches it would certainly encourage more use of notes outside of the regular western tuning system. If these pitches were brought forward and started to play a more dominant role than just decorative approaches and ornaments of a melody consisting of non-microtonal notes, what would it sound like? The techniques used by microtonal composers could be applied to blues and blues approaches could be applied to contemporary compositions to create new musical collaborations and concepts for creative musicians.

1.3 Research Objectives

After exploring different techniques via the composition of experimental etudes a full composition was developed. This incorporated elements found during the pitch analysis of vocals performed on classic blues recordings, the application of identified microtonal compositional techniques used by contemporary composers, and an exploration of the practical applications the guitarist can use to create microtonal pitches.

Even if the guitarist decides not to emphasise microtonality in their playing, a structured system for practice would be a useful tool to improve technical and aural skills, helping the player achieve a higher level of vocal-like playing of melodies and soloing. If the expressive ability of a musician can be raised through the awareness of microtonality by exploring it's usage in blues, contemporary music and other practical applications then advancements could be made in educational systems for guitarists and guitar transcriptions of classic recording could be presented with additional microtonal instructions.

The positives and negatives that arise from exploring microtonality in relation to blues, guitar and contemporary music aim to contribute a forward development in experimental composition for blues guitar. Highlighting microtonality over the more obvious qualities

the genre is more commonly known for, such as pure expression and rhythm, aims to bring a fresh perspective that could possibly be developed further by modern blues musicians.

The number of guitarists experimenting with microtonality in relation to the popularity of the instrument is small. The information available is mostly unstructured, therefore this thesis aims to document the links between blues and microtonality through research, analysis and practical experiments that include the application of approaches used by contemporary composers to inspire new concepts for composition.

The blues has been a huge influence on other forms of music, such as rock, jazz and pop culture yet it has experienced very little development since the resurgence in the interest of Afro-American blues performers such as BB King in the 1960's and the mainly guitar virtuoso culture that has dominated the genre since Stevie Ray Vaughan in the early 1980's. These experiments could contribute to pushing the genre past the bound-by-tradition issues and possibly unearth new avenues of creativity.

1.4 Thesis Structure

Chapter 2 is a detailed background study on the important issues to consider when dealing with microtonality and the guitar. This is presented so the reader understands the complexity of the subject and reasons why this area is still developing.

Microtonality in the blues is commonplace but not usually the main focus of attention. The informal use of microtones by the blues is addressed alongside an investigation into the formal and structured applications used by influential contemporary composer's. The development of the equal temperament tuning systems is discussed to put into perspective the pros and cons of our current tuning system, microtonality and alternative tunings. Modern practitioners of microtonal guitar and the current trends in communication used by educators are also presented.

Chapter 3 presents the preferences and most important issues currently experienced by microtonal composers. Interviews were conducted with contemporary Irish composers Mike Nielsen, Donnacha Dennehy and Garrett Sholdice providing insight into the modern use of microtonality and the guitar. The research recommendations made by

these composers helped identify the best material to be analysed and important aspects to explore when creating experimental compositions.

Chapter 4 presents the research analysis into the blues and its microtonal content. Ten classic blues vocal performances were analysed, attempting to identify patterns and commonalities that can help determine why certain pitches and their deviations from equal temperament are included in the blues. The analysed pitches were attempted on the guitar by simplifying the pitches and exploring different techniques.

Chapter 5 explains the practical application of microtonality to the guitar. The choice of techniques include fretless guitar, slide guitar, vibrato arm and the use of a hexaphonic pickup which can send out a separate signal for each string to facilitate re-tuning via the interactive software program MAX/MSP.

The 17 etudes written focused on the application of different techniques along with the experimental application of the pitch analysis results. This process helped identify the microtonal limitations and advantages which could be used in the final composition.

Chapter 6 looks at the final composition titled *Future Shades of Blue*. The reasons for including particular microtonal techniques and concepts in three movements of the suite are explained and critically evaluated to show what has been learnt from the compositional process.

Chapter 7 presents the testing of microtonal concepts on guitarists. To test the different notation systems used and the practical application of microtonal techniques, guitarists of different backgrounds were asked to play six exercises that explore:

- A new quartertone approach system for improvisation
- A new interval shape based representation of microtonal notation
- Practical performance of notated blues phrases with microtonal content.

Finally Chapter 8 provides the conclusions drawn from this research thesis. The compositional and practical successes and failures produced by the research are discussed along with suggestions and microtonal possibilities for future researchers to develop.

2. Background

2.1.1 Chapter Introduction

This chapter gives an overview of the microtonal content often found in blues and the structured methods contemporary composers have used to incorporate microtonality into their work. The guitar and its current relationship with microtonality is outlined with a look at the current practitioners and modifications that have been made to the guitar to avail of microtonal pitches.

2.2.1 The Blues & Microtonality

The guitar is a universally popular instrument that is synonymous with the blues. For nearly one hundred years blues performers have utilized its expressive quality on recordings through accompaniment and soloing. The main microtonal elements of a blues recording can include:

- Microtonal guitar techniques (slides, string bending)
- Melisma in vocal performance
- Pre-war harmonica just intonation tuning

Blues musicians have had a very different relationship with microtonality than contemporary composers. Microtonality is formally explored in contemporary music but it features in blues music at an intuitive or informal level. Many early blues ensembles included musicians playing homemade accompanying instruments such as the washboard, spoons, combs, washtub bass and blowing into a jug, and these mainly produced sounds with an indefinite pitch. As the blues developed slide played with a pocket knife on the strings of a guitar and string bending began to be used to imitate the vocal inflections. All contained microtonality and became an integral part of the music (Mann, 1999).

2.2.2 The Blue Note

One major characteristic of the blues and its use of microtonality is the blue note. These pitches usually appear as lowered 3rds, 5ths and 7ths but any note can be bent or altered in blues music to create blue notes, they are used as expressive notes by the performer.



Figure 2.1 Eric Clapton and the Blue Note (Hal Leonard, 2008)

Figure 2.1 contains an extract from Eric Clapton's version of Robert Johnson's *Sweet Home Chicago*. Clapton bends the G note up a quartertone in the key of E demonstrating a typical blue note in guitar playing but other typical techniques employed by blues guitarists such as hammer on, vibrato, slides are also indicated.

Figure 2.2 Albert King String Bending (Higgins, 1999)

Figure 2.2 shows Albert King's extreme use of microtonal string bending on the opening solo to *Born Under A Bad Sign*. The majority of his solos contain long periods of expressive improvisation, utilising microtonal notes within the bent string. This style was a huge influence on modern blues guitarist including Eric Clapton & Stevie Ray Vaughan.

2.2.3 Blues Vocals

"The literature on African American singing is copious. There is a general agreement on the core tendencies: short phrases, often falling or circling in shape, usually pentatonic or modal but with much microtonal inflection, pitch bending and glissando, the pitches often much repeated; call and response (antiphonal) relationships between performers; off beat accent, syncopation and rhythmically flexible phrasing; huge variety of register (including falsetto) and of timbre (including shouts, whoops, yells,

growls, humming and wordless moans)”. John Potter *The Cambridge Companion to Singing* (Potter, 2000).



Figure 2.3 Bessie Smith (Hewett, 2015)

Many of the microtonal elements in blues guitar playing come from the imitation of blues or gospel inspired vocalists. Derek Trucks is a guitarist who demonstrates perfectly the blues vocal and guitar relationship with a bottleneck slide. Trucks has studied blues, gospel vocal inflections and Indian classical techniques and applied them to guitar. In a guitarist magazine interview (Music Radar, 2010) he compares the blues to Indian qawwali music where the Sarod, a fretless stringed instrument shown in Figure 2.5, plays microtonal vocal-like melodies.



Figure 2.4 Derek Trucks (Music Radar, 2010)

“for me they sound like they are coming from the same place, it’s devotional music, one comes from the desert the other one the Delta, the deep south.” Derek Trucks (Music Radar, 2010).



Figure 2.5 The Sarod (Courtney, 2018)

The first successful blues recording artists in the 1920's were female singers such as Mamie Smith, Ma Rainey and Bessie Smith (Figure 2.3). These early vocal recordings display the blues fully formed and containing all the harmonic devices that can be heard in blues guitar in the decades that followed.

“Against the background of a strong central tonality, blues singers develop themes and melodic variations largely independent of the guitar chords used in the accompaniment. The intonation, often with glides and considerable melisma, sometimes deviates by microtonal values from the standard tunings of the guitar or the piano” Gerhard Kubik (Kubik, 2013).

Like many traditional folk forms, the blues does not conform to the rigid rules of western harmony. The use of minor scales over major chords would be another example of a blues musician's intuitive application of musical harmony that would be considered dissonant in traditional western harmony.

2.2.4 Blues Harmonica Tuning

Pre-war just intonation harmonica tuning was used by Sonny Boy Williamson, Little Walter and Sonny Terry (Sonny Boys Music, 2017). This tuning was particularly good for chords as it reduced the beating effect that is created when two consecutively played

notes that are close together in frequency, usually within a minor 3rd interval, create a tremolo effect through constructive and destructive interference. The psychoacoustic details are beyond the scope of this thesis but it is important to acknowledge that our perception of sound and frequency identification are heavily influenced by the disturbance of hair cells in regions of the basilar membrane inside our cochlea. This critical band region is defined by the distance two notes need to be apart to not cause any interference or the beating effect (Doty, 2002). The three main tuning systems employed by blues harmonica players are:

- 12 tone equal temperament, for melodic players
- Compromised just intonation for hybrid melodies and chords
- Just intonation, for beat free chord playing, this is the pre-war tuning commonly used by blues harmonica players.

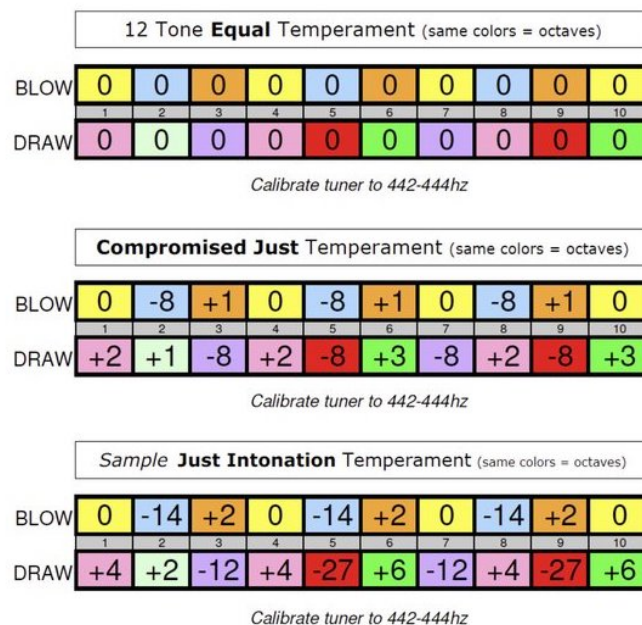


Figure 2.6 Three Harmonica Tunings (Sonny Boys Music, 2017)

Three common harmonica tunings are shown in Figure 2.6. Note that the just intonated harmonica has a 7th that is 27 cents lower than in equal temperament (ET), and the 3rd is 12 cents lower than in ET.

Blues players traditionally use 10 hole harmonicas and produce notes by exhaling (blow) and inhaling (draw) into the instrument. These harmonicas are generally used in two ways. If you play the C harmonica against some diatonic chords in the key of C. e.g. C, F & G the sound produced will be in the style associated with Bob Dylan and melodic folk playing as you are playing the notes of the C major scale with chords that belong to the key of C. This is called 1st position or straight harp and has more traditional melodic applications due to the major scale harmonic relationship (see Table 2.1 for the intervals produced in 1st position). If you play a G7 chord or a blues progression in the key of G (G7, C7, D7) you can use the very same harmonica to create Blues phrases over that progression. This is called 2nd position or cross harp and results in the mixolydian mode, which is very commonly used in blues and rock music (see Table 2.2 for the intervals produced in 2nd position).

	1	2	3	4	5	6	7	8	9	10
Blow	R	3rd	5th	R	3rd	5th	R	3rd	5th	R
Draw	2nd	5th	7th	2nd	4th	6th	7th	2nd	4th	6th

Table 2.1 C Diatonic Harmonica Intervals in C (1st Position)

	1	2	3	4	5	6	7	8	9	10
Blow	4th	6th	R	4th	6th	R	4th	6th	R	4th
Draw	5th	R	3rd	5th	b7th	2nd	3rd	5th	b7	2nd

Table 2.2 C Diatonic Harmonica Intervals in G (2nd Position)

Depending on the frequency, amplitude and timbre the ear can distinguish a difference of 5 cents or less in a complex tone such as a vocal note (Hyperphysics, 2016), so the difference between just tuning harmonica and equal temperament is clearly audible. Many other draw notes can be bent easily which makes 2nd position very expressive compared to 1st position and is therefore widely used by blues harmonica players.

2.3.1 Microtonality & Contemporary Composers

Microtonality can be very simply described as the use of notes that are less than 100 cents apart. These closer relationships have been explored by contemporary composers, particularly over the last one hundred years. Composers such as Charles Ives explored

quarter tones and John Cage had experimented with a 84-Tet scale, inspired by George Orwell's 1984, six equally spaced pitches were inserted between the regular 100 cent spacing of a semitone (Harrop, 2004).

'a reduction of natural relations to manageable ones'

Arnold Schoenberg on equal temperament (Schoenberg, 2010).

Many tuning systems have been used throughout the history of music but the most common in western music is equal temperament. An octave measures 1200 cents and in equal temperament this is divided into 12 equally spaced notes, 100 cents apart. The evolution of this system came from the composers increasing need for modulation as music progressed over the centuries from sixteenth century plainchants to the complexities of twentieth century composition. Just intonation is a tuning system based on the harmonic series and the overtones produced by a fundamental frequency or note. Each fundamental produces a unique set of pitches, if you think of the fundamental as a key centre, then composing in multiple keys is problematic as most instruments do not have the facility to play all pitches.

The following brief overview on the history of tuning is included to put into perspective our currently used western tuning system and its development.

- Early music and early Renaissance: (early 16th Century) Pythagorean tuning was used with music mostly performed by human voice in chant music. Pythagorean tuning is based on ratios of the numbers 1, 2, 3 and 4. These create consonant octaves, perfect 4^{ths} and 5^{ths}. The 3^{rds} and 6th intervals were treated as dissonances until early Renaissance (Doty, 2002).
- Renaissance & Baroque: (Late 15th to Early 18th Century) Meantone temperament tuning was used in conjunction with the historical development of keyboard and fretted stringed instruments. This is western music's most successful tuning system as it lasted for 400 years and focused on creating consonant 3^{rds} and producing major and minor triads that work together based on a central key (Gann, 1997).
- Baroque to Early Modern (Late 17th Century to Early 20th Century) Well Temperament is a term for tunings that facilitate the modulation to different keys. Depending on the closeness or remoteness from the central key, the modulations

were considered to have different colours (Doty, 2002). This tuning is commonly associated with Bach's 24 preludes and fugues *Well Tempered Clavier* where he attempts to demonstrate the different colours of all keys.

- Modern Era (Early 20th Century to Current) Equal Temperament facilitates complex chromatic harmonies. The octave is divided into twelve equal parts and all intervals are compromised or not considered consonant except the octave. This is the current western standard tuning, unfortunately it is a system that contains inferior consonances and dissonances than pitches produced by just intonation (Gann, 1997).

Vocalists and fretless stringed instruments like the violin, viola, cello and double bass have more freedom to produce pitches so are often used in microtonal music. Intervals and pitches are expressed by ratios in just intonation, Table 2.3 shows the ratios used for a just intonated major scale.

Root	2 nd	3 rd	4 th	5 th	6 th	7 th	Octave
1:1	9:8	5:4	4:3	3:2	5:3	15:8	2:1

Table 2.3 Major Scale Just Intonation Ratios

Therefore the 2nd vibrates nine times to every eight vibrations of the root (or fundamental), and the 6th vibrates five times to every three vibrations of the root. Table 2.4 shows the difference between just intonation and equal temperament in cents.

	Root	2 nd	3 rd	4 th	5 th	6 th	7 th	Octave
Equal Temp.	0	200	400	500	700	900	1100	1200
Just Int.	0	203.91	386.31	498.04	701.96	884.36	1088.27	1200
Difference	0	-3.91	13.69	1.96	-1.96	15.64	11.73	0

Table 2.4 Cent Difference - Equal Temperament and Just Intonation

2.3.2 Harry Partch (1901 – 1974)

Harry Partch released the book *Genesis of Music* in 1947 which described his individual methods for composing with microtonality and the building of his new instruments constructed specifically to play his tuning systems (Partch, 1974).



Figure 2.7 Harry Partch (Lyra, 2011)

The tuning systems presented in the book would educate and inspire many twentieth century composers like Lou Harrison, Ben Johnson and James Tenney (who studied with Partch) to compose with just intonation (Gilmore, 2003). Partch was initially inspired by German physicist Herman Helmholtz and his book *On the Sensations of Tone* which explored the perception of sound and acoustics (Helmholtz, 2013). Reflecting on Partch's influence on microtonal music and the composers he inspired, one of the most interesting aspects of his legacy is how he highlighted the way in which the composer needs to make microtonality *his own* to work successfully. Unlike the strict musical rules of counterpoint and complex permutations of the 12-Tet scale presented in Arnold Schoenberg's twelve tone techniques, Partch suggested that microtonality could be conceptually adapted to a composer's individual tastes and needs. Partch divided his octave into 43 unequal parts (as shown in Figure 2.8) which produces a vastly different array of options for tones than equal temperament. His instruments were built to play parts of this scale so with the right combination of instruments, a composer could avail of all of these 43 pitches. The scale was mostly constructed from intervals produced by the first eleven harmonics of the harmonic series. Partch therefore coined the term 11-limit and this terminology is now commonplace in microtonal language with 5-limit, 7-limit also widely used. To make a scale that satisfied his requirement some arbitrary pitches were inserted to fill gaps that 11-limit produced. This demonstrates the pragmatic approach which Partch suggested can be used by microtonal composer to realise their artistic ambitions.

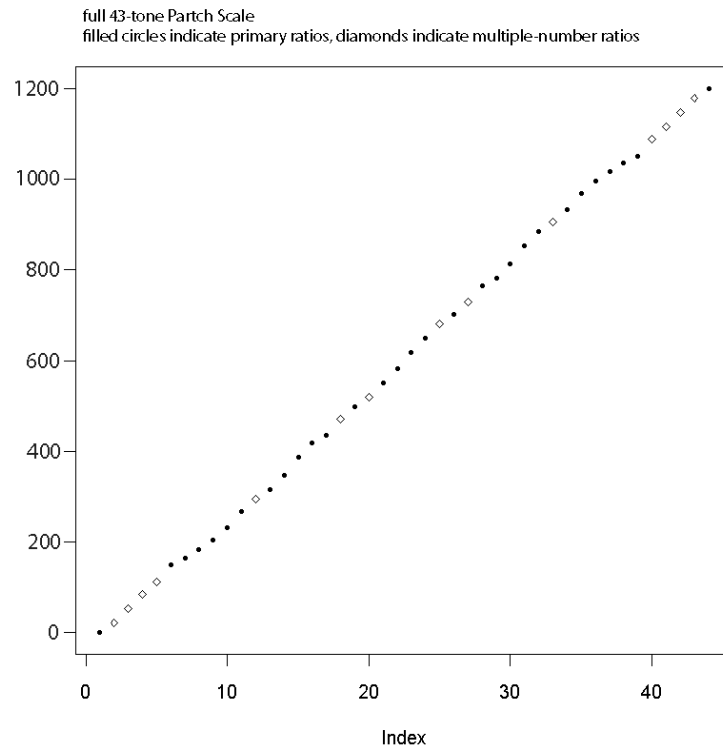


Figure 2.8 Harry Partch's 43 Note Scale (Garton, 2011)

The second half of the twentieth century saw many composers taking unique approaches to composing with microtonality inspired by Partch.

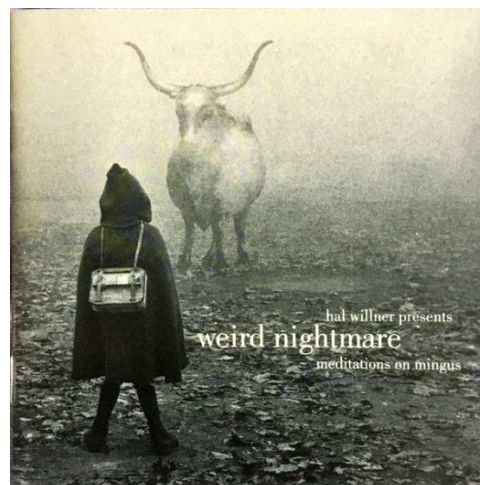


Figure 2.9 Hal Willner's Weird Nightmare (Willner, 1992)

Partch's homemade instruments are still used today and featured on the Hal Willner's 1992 album *Weird Nightmare, Meditations on Mingus* that included contemporary jazz guitarists Bill Frisell and Marc Ribot who are known for experimental works as well as

popular artists Elvis Costello and Leonard Cohen. The resulting blend of microtonality, poetry, contemporary jazz and popular artists produces a very accessible recording that is seldom referenced but deserves more exposure as the further development of these types of collaborations could help the compositional use of microtonality become more commonplace.

2.3.2 Lou Harrison (1917 - 2003)

'At least half of my music is based on non-Western influences' Lou Harrison (Keislar, et al., 1991)

Californian composer Lou Harrison learnt about microtonality mostly through the study of Harry Partch's book *Genesis of a Music* (Partch, 1974). The 1950's saw a surge in interest for the study of ethnomusicology in universities and Harrison was a composer who embraced non-western indigenous music and is well known for his compositions for Gamelan.

Heidi Von Grunden's book on Lou Harrison's music (Gunden, 1995) presents an in-depth analysis of his works and his approach to microtonality, such as:

- Harrison believed in music for pleasure and often financed projects himself with the emphasis on pieces being easy to perform and enjoyable for the audience.
- He used two different approaches to just intonation. The first is a strict style structured using modes of 5, 6 or 7 pitches, which can be heard in his work *Seven Pastorales* (1949). The second he referred to as "free style" and can be heard in the piece *Simfony in Free Style* (1955), Harrison describes his approach to choosing pitches as "to freely assemble or compose with whatever intervals one feels as he goes along... lovely new devices and expressions are available in this style" (Harrison, 1993).
- Harrison made microtonal use of tuned water bowls, trombones, drones, strings and tuned keyboards.
- Harrison was fond of using Ptolemy's intense diatonic justly tuned major scale and building his own tetra chords based on this system. Tetra chords are scales built by separating the octave into two groups and are separated by a chosen interval. For example, in Ptolemy's intense just tuning the first four notes in the

major scale (C, D, E, F) are spaced by the familiar tone-tone-semitone pattern with the ratios 9:8, 10:9, 16:15. These ratios are repeated between the last four notes in the major scale (G, A, B, C) but in the order 9:8, 10:9, 16:15, and the interval that separates the two tetrachords is 9:8. These ratios are known as superparticular ratios as the numerator is one whole number larger than the denominator. The main difference to equal temperament here is the justly narrower major 3rd (E is 14cent lower), the major 6th (A is 16cent lower), and the major 7th (B is 12cent lower). This system plays a large part in many Lou Harrison compositions.

- Harrison was less concerned with developing new systems for microtonal composition and building new instruments like Harry Partch.

Harrison composed for solo resonator guitar in the piece *Scenes From Nék Chand*. The tri-cone resonator was popular in the 1920s and 30s and frequently used by blues musicians due to its built in amplification cones. The piece makes use of bottleneck slide, harmonics and repositioned frets to avail of just intonation pitches. Harrison had experimented with guitar composition and just intonation back as far as 1952 but it wasn't until 1977 when he met Tom Stone (who had just invented interchangeable fretboards for the guitar) that he started to compose structured works like *Serenade for Guitar & Optional Percussion* (Fiore, 2012). Harrison plays an important role in the development of microtonal composition as he was highly respected by his peers and contributed works for guitar that inspired other composers (Fiore, 2013).

2.3.4 Ben Johnston (1926 - Present)

“For (Ben) Johnson, adjusting the acoustical lie of equal temperament was almost a religious issue” Heidi Von Grunden (Gunden, 1986).

Ben Johnson's approach to developing the foundations laid down by Harry Partch was very different than Lou Harrison. Johnston was interested in devising new concepts for using microtonality. By applying his knowledge of western compositional methods, he has devised systems that have inspired composers to work outside the 12-Tet system.

“I’ve developed a system of extended just intonation. Extended just intonation means pushing beyond one overtone series into a multiplicity of overtone series with common tones” Ben Johnston (Keislar, et al., 1991).

Perhaps Johnson’s most successful uses of microtonality are found in his highly regarded ten string quartets. After years of trying to create microtonal scales through electronics and facing many obstacles in institutions that were not open to using synthesisers, and after studying with John Cage in 1957 and 1959, he began to focus on producing microtones via acoustic instruments (Gunden, 1986).

Johnson developed a notation system for composing with a 53 note scale system which includes the additional use of accidental symbols that lower or raise the pitch. These symbols help communicate higher and lower versions of the same note. Just intonation produces many different versions of the same interval. In Johnston’s 53 note scale the additional symbols in Table 2.5 show accidentals that appear before a note to adjust the pitch. It therefore possible to have multiple pitches for the same note, the perfect 5th interval in the key of C between D and A is not a 3:2 just intonated interval, it is 22cents flat so the minus symbol can be used to communicate this to the player. The #/b symbols raise and lower pitches by a narrower 70 cent than conventional notation (100 cent). The 7/arrows and 3’s represent the 7/11/13 prime limit tunings that Harry Partch developed and explaining in his book *A Genesis of Music* (Partch, 1974).

Basic Accidentals	
b / #	Raises/lowers by 25:24 (70.7 cents) Difference between 25:16 (5 ⁴ :2 ⁴) and 24:16 (3:2)
+ / -	Raise/lowers by 81:80 (21.5 cents) Difference between 81:64 (3 ⁴ :2 ⁴) and 80:64 (5:4)
∟ / 7	Raises/lowers by 36:35 (48.8 cents) Difference between 36:32 (9:8) and 35:32
↑ / ↓	Raises/lowers by 33:32 (53.3 cents) Difference between 11:8 and 4:3
3 / ε	Raises/lowers by 65:64 (26.8 cents) Difference between 13:8 and 8:5
Some Compound Accidentals	
#+ / b-	Raises/lowers by 135:128 (25:24 + 81:80)
∟- / 7+	Raises/lowers by 64:63 (36:35 - 81:80)
# / 7	Raises/lowers by 15:14 (36:35 + 25:24)

Table 2.5 Ben Johnston Notation (Doty, 2002)

“It is customary to describe a given just scale or tuning system as belonging to a particular prime limit. If, for example, we say that a particular composition uses five limit just intonation, we mean that only intervals based on the primes 2, 3, and 5 are involved. All of the possible intervals within a given prime limit can be explained as products of the primary intervals within that limit. Thus all of the possible intervals within the five limit can be explained as products of the primary intervals 2:1, 3:2 and 5:4 (or of 2:1, 4:3 and 8:5)” David B. Doty (Doty, 2002).

Ben Johnson explored microtonality by applying western traditions and serialism techniques, his extended just intonation provided an application for more dissonant pitches that helped musicians and composers develop a language to effectively communicate the unfamiliar (Sabat, 2009).

Ben Johnston collaborated with microtonal guitarist John Schneider on the composition *Tavern*, mixing spoken poetry and microtonal guitar written for an adapted fingerboard. When compared to Lou Harrison’s guitar compositions Johnston’s application of microtones is much more perceivable and deviates further from equal temperament via his extended just intonation system. The Harrison/Johnston comparison demonstrates two contrasting stylistic approaches to using microtonality in guitar composition.

2.3.5 James Tenney (1934-2006)

“We are collectively at a moment in history where a chasm faces us, which we must bridge or fall into” Ben Johnston (Johnston, 1977).

James Tenney is another American composer, theorist and teacher who has been a major influence on the use of alternate tuning systems in contemporary composition. Many academic papers and interviewees reference Tenney as an important figure.

“In my opinion, Jim Tenney was the most important and brilliant composer/theorist of the second half of the twentieth century. I usually avoid statements like that: they’re by definition fatuous, and it’s not a competition. But for Jim I’ll make an exception. After Cage, no other composer so elegantly and beautifully integrated ideas and music. No one else’s work, as a whole, is as profound, experimental, wide-ranging, accomplished, or revolutionary” Larry Polansky (Polansky, 2007).

The previous composers mentioned used acoustic and resonator style guitars but James Tenney was one of the first to adapt microtonal composition to electric guitar ensembles.

Tenney's 1981 composition *Septet for 6 electric guitar and electric bass* uses *scordatura* (i.e. the re-tuning of open strings) to create just intonated pitches.

Gtr 1 0c	Gtr 2 -14c	Gtr 3 -49c	Gtr 4 -17c	Gtr 5 -33c	Gtr 6 -31	Bass 0c
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Table 2.6 Tuning for Septet (Tenney, 1996)

Tuning strings by their deviations from equal temperament, such as -31cent to produce a just minor 7th, -14cent to produce a just major 3rd and -49cent to produce just sharp 4th, enable just intonated pitches to be played but limits the notes you can play per string. The use of multiple players can produce new textures and chords otherwise unachievable. In *Septet* he also superimposed rhythms based on the just intonation ratios of the harmonics.

Tenney's composition *Bridge* retunes two pianos to pitches based on the 5-limit lattice so some notes are tuned a quarter tone apart. This retuning of the piano has been done by other composers, most notably Gerard Grisey in *Vortex Temporum* where the piano strings of a diminished chord are detuned by a quartertone and the acoustical wave patterns like a sine, square and jagged wave inspired the shape and contour of the music. Contemporary composers like Tenney and Grisey approach composition in a highly structured way that sees through a process or concept to an exhausting level. Blues musicians are mainly concerned with communicating the shared feelings of a community or individuality through expressive dynamics, rhythm and narrative. Composers like Tenney are also attempting to achieve this through their own creative processes.

Tenney's interest in the blues can be heard in the piece *Three Indigenous Songs*, here demonstrating through a strict process that music can be both emotional and intellectual. He uses spectral techniques to score the sound of Jaybird Colemans voice and harmonica from the 1927 recording of *No More Good Water*. The piece is written for 2 piccolos, alto flute, bassoon or tuba and 2 percussion. Figure 7 show an extract from this piece which explores Tenney's music in detail (Wannamaker, 2008).



Figure 2.10 Three Indigenous Songs extract (Wannamaker, 2008)

(a) Score extract from *Three Indigenous Songs*.

(b) The first three vocal formants in Hertz.

(c) Equal tempered approximations to harmonic series.

Tenney's close friend Larry Polanski describes the piece as attempting to:

“synthesise the sounds of human voice by using the instruments to simulate the various formants and noise transients of the different speech sounds. They are transcriptions in the strictest sense, and there is a wonderfully disarming lack of compositional technique other than the audacious decision to actually do it” Larry Polansky (Polansky, 1983).

Tenney is expressing the sound of blues music through sophisticated spectral arranging techniques. The original recording and Tenney's acoustic simulation provide interesting juxtapositions of the same material.

The 1985 composition *Water on the mountain... Fire in heaven* for six electric guitars has the instruments tuned a sixth of a semi tone apart.

Gtr 1 +33c	Gtr 2 +17c	Gtr 3 0c	Gtr 4 -17c	Gtr 5 -33c	Gtr 6 -50c
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Table 2.7 Tuning for *Water on the mountain... Fire in heaven* (Tenney, 1991)

The different approach to *scordatura* in this piece presents a very different microtonal texture than heard in *Septet*. The piece is in three movements and Tenney gives each guitar two staves, the top staff for movement one, the second staff for movement two and staves one and two combined for movement three. Each guitar tunes their strings as normal except increasing or decreasing the strings by the amount assigned to them. This means the tuning sounds normal until they play with the other guitars and the microtonal effects are heard.

Tenney's writings and interest in Gestalt principles and phenomenology, along with his experiences performing with Harry Partch, Steve Reich, Philip Glass and studying composition with John Cage and Edgard Varese, helped him form a unique compositional style and aesthetic.

2.4 The Modern Microtonal Guitar



Figure 2.11 John Schneider playing Novatone fingerboard (Mattingly, 2018)

Figure 2.11 shows John Schneider playing a 1982 Bob Mattingly guitar with custom interchangeable fingerboards made by Novatone (Schneider, 1992). As mentioned earlier in this chapter, a number of microtonal guitar compositions by Lou Harrison and Ben Johnston made use of adapted guitars with removeable necks such as this. These were first developed in the late 1970's and built to specific tuning systems. These specialized guitars are virtually unheard of in the mainstream guitar culture but at this time awareness is spreading through social media platforms popular with guitarists such as YouTube. Educational content channels on YouTube now commonly have tens or even hundreds of thousands of subscribers with the content aimed towards contemporary composition and advanced theory that often focuses on microtonality. Three current practitioners include:

- Adam Neely (Neely, 2018) Berklee Graduate, Bass Player, provides fast paced, accessible video essays on music theory.
- David Bruce (Bruce, 2018) Royal College of Music Graduate, Composer, provides online video essays on music composition.
- Samuel Andreyev (Andreyev, 2018) Conservatoire de Paris graduate, Composer, interviews and analysis videos on contemporary music.

The information provided by these videos help spread an awareness of alternate techniques for creativity and provide an overview of microtonal concepts that can inspire musicians and composers.



Figure 2.12 David Fiuczynski, Jon Catler, Tolgahan Cogulu

Figure 2.12 shows three modern guitarists who have explored microtonality, namely, from left to right, David Fiuczynski (Berklee, 2018), Jon Catler (Free Note Music, 2018), Tolgahan Cogulu (Cogulu, 2017).

Professor David Fiuczynski of Berklee College fuses folk forms with microtonality in his courses and recordings with his band The Screaming Headless Torsos (Screaming Headless Torsos, 2018). American guitarist Jon Catler is one of the rare blues artists to experiment formally with microtonality. Catler plays in a traditional blues rock style but mainly uses fixed-fret, 31 tone equal tempered guitar (octave divided into 31 equal steps, 38.71 cents apart) and fretless guitars (Free Note Music, 2018). Classical guitarist Tolgahan Cogulu developed a microtonal guitar with moveable frets with the objective of playing microtonal versions of western classical pieces and perform pieces in tunings other than equal temperament (Cogulu, 2017).

2.5 Chapter Conclusion

The contemporary composer and the blues performer approach the use of microtonality in different ways. The sliding vocal moans and expressive bending of notes help the blues musician communicate meanings that reflect real world sounds, often imitating trains, the rhythms of work song and feelings connected to relationships and life experiences. The contemporary composer has the technical skills to analyse, synthesise and orchestrate these sounds which can take advantage of the expressive qualities of the blues whilst adding new musical settings and additional concepts. Composing with microtonality is not a new concept but it is possible that the ease of which information is now accessed by the general public, via platforms such as YouTube, will contribute to developing a new widespread interest, awareness and understanding of microtonality.

The range of pitches available in microtonal music allows composers and blues artist to develop their own individual approach and unique style to suit their taste and objectives.

In Chapter 3 the most current generation of composers who have explored microtonality will be discussed.

3. Modern Microtonal Composers

3.1 Chapter Introduction

The three microtonal elements addressed in this thesis are specific to blues, contemporary composition and the application to guitar. To create a meaningful and coherent composition that utilizes notation systems and contemporary compositional techniques, leading exponents of the related areas were consulted to focus the research and identify specific areas that would maximise the research results. Three Irish academic practitioners agreed to take part: Dr. Donnacha Dennehy now based in Princeton University, took part via email interview. Dr. Michael Nielsen and Dr. Garrett Sholdice were interviewed twice, once in person and once via email questionnaire. This personal interaction and exchange of thoughts relating to microtonality provided a valuable insight into personal experiences of the modern composer and the pragmatic advice offered helped save valuable time when the compositional experiments were performed and helped the research approach to analysis and notation.

3.2.1 Michael Nielsen

Michael Nielsen explored microtonality in his PhD (Nielsen, 2017) and master's thesis (Nielsen, 2003). Three microtonal guitar techniques were explored by Nielsen, they included:

- Adding 19 additional extra frets to the normal 21 frets of a guitar. This was achieved by reversing the guitar neck and installing the smaller to larger divisions found between frets 21- 0 to fret 0 - 21. The super imposing of the reversed fret arrangement on top of the tradition frets enables the guitar to produce a combination of equal temperament and microtonal notes.
- Picking on the opposite side of a stopped string to produce microtones.
- Exploiting the hammer-on technique that produces a note either side of the fretted note. A two pickup combination was used, one under the bridge as normal and the unconventional use of a pickup underneath the nut.

Nielsen talked about his major microtonal influences:

“I like how Partch developed systems and modified/developed instruments to accommodate them. Other important composers include: Hába, Carrillo, Johnson, Harrison, Wyschnegradsky, Ives and Catler” Michael Nielsen (Nielsen, 2018).

As an internationally respected jazz musician, Nielsen has a different background and approach to microtonality than contemporary composers. The analysis performed in his microtonal research was based on improvisation, i.e. through recording performances and later analyzing the microtonal content.

“My PhD was improvisatory in nature where outcomes were analysed. This allowed me to create music at a high level and analyse the content. The most important outcome was the realization that I could identify three systems: 12-Tet, microtonal and an amalgamation of both which I termed ultramicrochromatic” Michael Nielsen (Nielsen, 2018).

Nielsen defines his term ultramicrochromatic as follows:

“Ultramicrochromatic relates to one scale comprised of a microtonal system and 12-Tet chromatic system; no more than two notes from either system may be consecutive” Michael Nielsen (Nielsen, 2017)

This method ensures microtonality is always present in the improvisations and there is a balance between the 12-Tet system (equal temperament) and the use of microtones.

Developed tablature	1/-/5	1/1/5	1/2/5	2/-/5	2/1/5	2/2/5 (3/-1/5)	3/-/5
<i>Ultramicrochromatic</i> scale cycle no.	4	5	6	7	8	9	10
<i>Ultramicrochromatic</i> scale (5 th str. A)	Bb	Bb+16	Bb+50	B	B+29	C-27	C
Intervallic cent sizes	16	34	50	29	44	27	
Accumulative Cent sizes	16	50	100	129	173	200	

Table 3.1 Ultramicrochromatic scale within a 12-TET tone, Bb to C (Nielsen, 2017)

The ultramicrochromatic system is very much an improvising jazz musician’s perspective on microtonality, as there is always a consideration of the underlying harmony and the notes relationship to a chord. Contemporary composers often choose devices such as canons that aim to create critical relationships with the material, and a

studied knowledge of counterpoint combined with modern concepts like the aleatoric chance procedures developed by John Cage.

Nielsen encourages musicians to improvise with microtonality which was implemented in this thesis when constructing etudes. Many of the etudes written for this thesis contained written accompaniments with experimental string bending, slide, fretless and vibrato arm improvisations performed over the top.

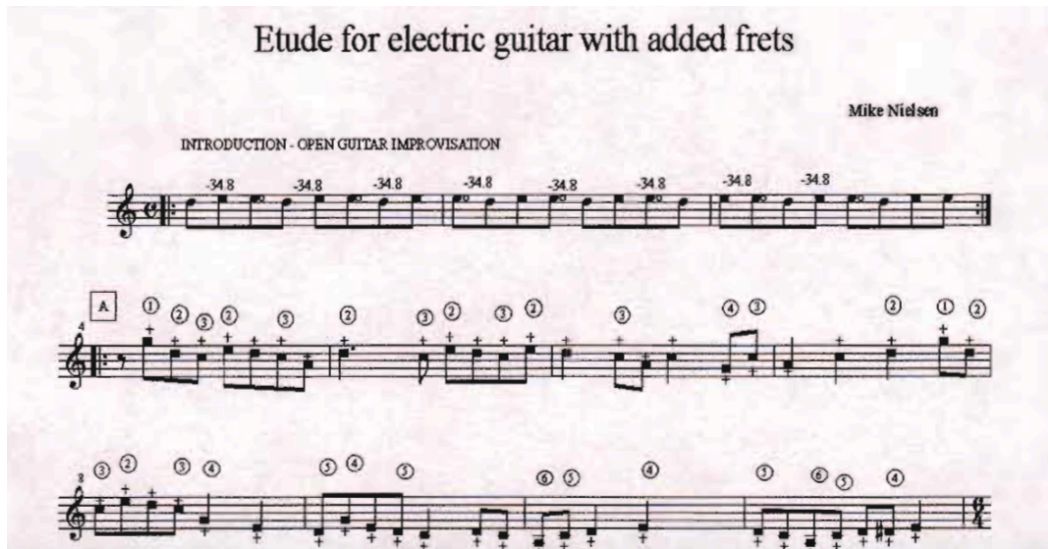


Figure 3.1 Mike Nielsen Etude for guitar with added frets (Nielsen, 2003)

Figure 3.1 shows the microtonal notation used by Nielsen with square note heads representing microtones, numbers in circles are strings as in classical notation, and plus signs (+) indicate the additional microtonal frets above the regular frets.

In the interview conducted for this research, Nielsen was asked about his microtonal notational preferences:

“There is no unified system and I learned from Partch that it is best to develop your own system if one has developed a unique instrument/system. I use a modified tablature system with square-headed notes and cent offsets. Carrillo presented a tablature system which provided simplified notation related to smaller-equally tempered systems. There are many notation systems which have been developed. Musicians need to work on acquiring a new notational language. Ezra Sims relayed to me in an email that some musicians preferred to learn his quarter-tone music from an audio file as opposed to notation” Michael Nielsen (Nielsen, 2018).

There are several statements here that resonated with the goals of this thesis

- The need to develop your own system
- Musicians need to develop a new notational language
- Some musicians prefer to play microtones by ear and memory

There is obviously a clashing issue between the first two statements in that if new systems are constantly being developed and individualized it is difficult for musicians settle on a common language. The third issue brings validation to the blues and its microtonal content as blues performers already informally play microtonally by ear and memory. If there was more awareness of the microtonal pitches being performed maybe they would be emphasised, and new styles would emerge.

One issue when first attempting to compose with microtones is calculating the achievable deviations from equal temperament and notating them in a way you can expect to be performed accurately.

“The smallest microtone in my system is 16 cents, also, the system it contains a varied compendium of microtones. Microtones may be superimposed over 12-Tet music or vice versa without restrictions” Michael Nielsen (Nielsen, 2018).

Nielsen is open to the use of microtones in conjunction with standard tuned instruments which would enable him to switch between his normal jazz performance background and insert the new microtonal approaches when desired.

Spontaneous scordatura is sometimes executed by Nielsen in performance by detuning a string and emphasising pitches so that another ensemble member must adjust to him. This additional technique adds free style playfulness to microtonality which is quite rare and could be developed by educators as an introduction to playing outside 12-Tet, encouraging aural awareness and the experimentation of microtonality for students.

Blues and jazz are very closely linked as musical genres, Nielsen’s background has clearly played an influential role in his research into microtonality. The implementation stages of this research include experimental applications of jazz practice techniques to microtonality.

3.2.2 Donnacha Dennehy

Donnacha Dennehy is a founding member of the Crash Ensemble (1997) and one of Ireland's leading contemporary composers and academics (Contemporary Music Centre, Ireland, 2018)

Dennehy describes his first exposure to microtonality as follows:

"I suppose it really goes right back to my childhood and my encounters with amateur versions of the sean nós tradition at my grandmother's house. That left a mark, that there was a whole world between the notes on the piano as it were" Donnacha Dennehy (Dennehy, 2018).

There are similarities here to the blues as Irish *sean nós* vocal tradition takes a similar non-formal approach to microtonality. Dennehy has used microtonality in works such as *Grá agus Bás*, combining the use of traditional Irish folk melodies with just intonation.

Dennehy performed pitch analysis of acclaimed *sean nós* singer Iarla Ó Lionáird. In the article *Owning Overtones* written by Dennehy for the January 2015 Tempo Magazine he describes the process of working with Iarla and constructing *Grá agus Bás*.

"I recorded Iarla singing one or two songs from the sean nós tradition. We then discussed their meanings and origins, with Iarla very kindly offering on-the-spot translations... After the sessions, I transcribed the songs by hand and then analyzed them in the pitch-analysis program Melodyne... the Melodyne analyses were essential to my harmonic/timbral understanding of them. Apart from the emotional significance that the sean nós repertoire had for me, the principal impetus for my wanting to deal with this repertoire compositionally was that I suddenly became aware of an artistic opportunity that was exciting to me. I was struck by all the microtonal variation that exists in any sean nós song and was disappointed by the way that it was always removed in any commercial arrangements of the repertoire for singers and instruments" Donnacha Dennehy (Dennehy, 2015).

The same can be said of commercial arrangements of traditional blues songs where the microtonal detail is not represented in the music and the emotional content can be lost.

"I usually designate the governing fundamental for any given passage and then use numbers such as 7 11 13 above the accidentals to show what overtones these notes would be given that fundamental - that then influences how the players tune it. I also use quartertone signs and arrows etc. for further clarification. Nearly all use of microtones

in my music is due to my considering these as overtones in some way. Occasionally I have "ripple" motions outside that" Donnacha Dennehy (Dennehy, 2018).

The chord in Figure 3.2 shows Dennehy's notation for strings. The (7°) beside the Bb and F note indicates to play a septimal minor 3rd and septimal minor 7th. Septimal minor 3rd, 5th and minor 7th can be heard in blues vocal pitching.

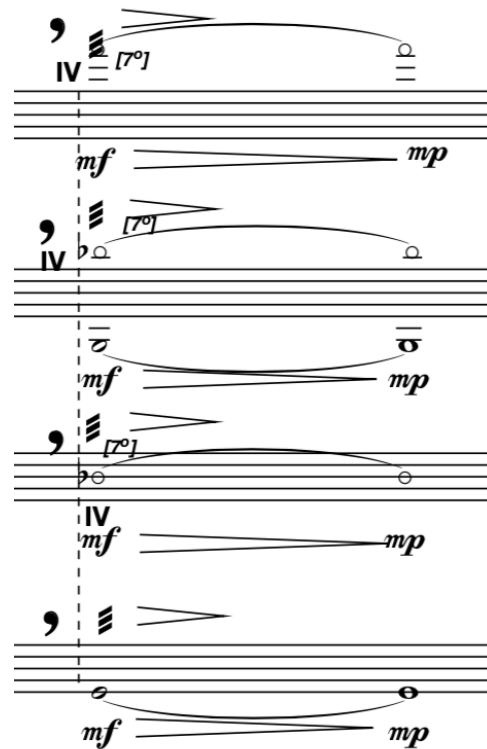


Figure 3.2 Score extract Aisling Gheal (Crash Ensemble, 2010)

This whole string chord be expressed as a ratio as follows, assuming C0 as 1/1:

$$3 (= G1) : 12 (=G3) : 28 (=Bb4) : 56 (=Bb5) : 84 (=F6)$$

Here we see the clear difference in approach to Nielsen in that Dennehy is more concerned with the spectral application of specific overtones and their composed context. The opposite approaches of improvised microtones and highly conceived just intonated harmonies further emphasizes the opinion that individuals need to find a system that they can exploit to suit their needs.

Dennehy's communicates the smallest values he uses are just intonated major 3rds and minor 7^{ths}.

“I have notated the 5th harmonic explicitly (-14 cents) but in general I would only ever ask for a deviation greater than 1/8 tone, such as the 7th harmonic (-31)” Donnacha Dennehy (Dennehy, 2018).

Dennehy’s advice on analyzing blues music was to look at older recordings and this influenced the choice of songs presented in the analysis, as did James Tenney’s choice of Jaybird Colemans 1927 recording of *No More Good Water for Three Indigenous Songs*.

“I would listen to the very old recordings, before the massive drive for a more commercial equaling-out took hold. There you will hear the real grit of it.. I did this with sean nós and Irish fiddle music” Donnacha Dennehy (Dennehy, 2018).

As the microtonal parallels between blues and *sean nós* became evident, the processes learnt from Dennehy interview and his application of microtones in *Grá agus Bás* gave extra momentum and inspiration to the experimental etudes and compositions discussed later in this thesis

3.2.3 Garrett Sholdice

Garrett Sholdice is an Irish composer and academic who represents a modern generation of composers who experiment with microtonality. Sholdice is a very active member of the modern music community in Ireland with his production company and record label.

There is a clear line of influence that includes many of the aforementioned composers, Sholdice describes the strong influence Donnacha Dennehy had on him from his undergraduate studies:

“He exposed me to music in Just intonation by La Monte Young, and spectral music by Gérard Grisey and James Tenney. Around that time I also met Tenney, and the musicologist/microtonality expert Bob Gilmore – and as a result of these interactions I became very enthusiastic about the harmonic series as structural harmony” Garrett Sholdice (Sholdice, 2018).

La Monte Young is one of the most influential figures in contemporary music for his contribution to the development of minimalism and compositions such as *The Well-Tuned Piano*, a piano composition that takes five to six hours to perform and based on a modified seven limit tuning.

Figure 3.3 displays a score extract from Sholdice's 2009 piece *Sonate for Baroque Violin and Five String Bass*, this shows a notation system similar to Dennehy's with the instrument strings notated with roman numerals and partial numbers indicated in the following number.

"For example, 'II:7' above a pitch in the double bass part indicates that the pitch notated is the 7th partial on the G string" Garrett Sholdice (Sholdice, 2018).

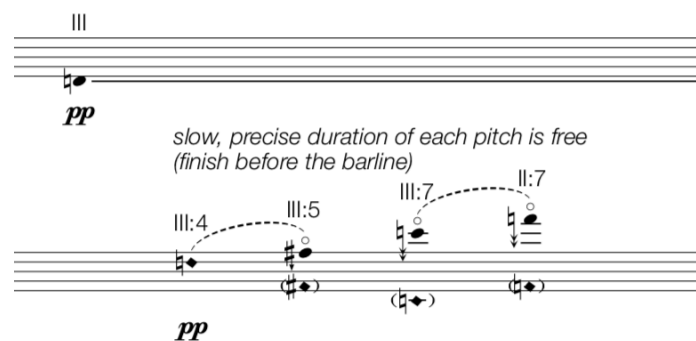


Figure 3.3 Extract of Sonate by Garrett Sholdice (Sholdice, 2007)

The harmonics in brackets represent the suggested node (harmonic) to be touched and above is the desired sounding pitch. When the node and desired note are the same only the diamond note head is written.

The performance notes in Figure 3.4 show Sholdice's use of microtonal accidentals. The accidental symbols used for one sixth of a semitone (16.6cents) are used later in the composition/score for this thesis but represent sixth-tones (one sixth of a whole tone 33cent).

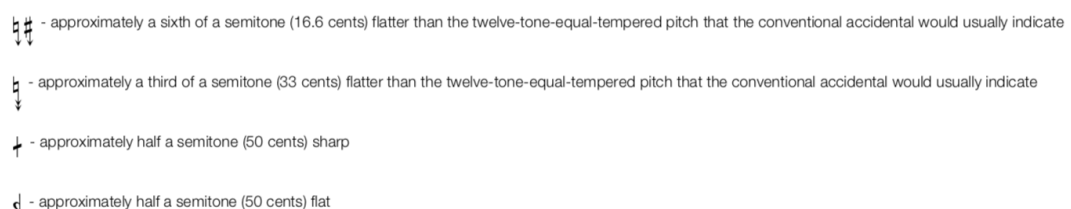


Figure 3.4 Sholdice choice of microtonal accidentals (Sholdice, 2007)

Although similar symbols and techniques are used by different composers there is still very little standardization of the notational systems, therefore the use of the symbols should be defined by the composer to make the performance of the score as clear as possible.

Sholdice was asked about his experience of performing musicians pitch accuracy and notating deviations from 12-Tet:

“I composed a piece for Trio Scordatura about ten years ago. The piece was composed in 11-limit just intonation – I used a mode which was derived from Harry Partch’s 43-tone scale. The score used accidentals for pitches approximately a sixth of a semitone deviant from 12-tet, as well as pitches approximately a third of a semitone deviant, and quarter-tones. I also included the exact ratios I intended above the notes. I took this approach in the score because Trio Scordatura are specialists in microtonal music and have quite a bit of experience in performing music by Harry Partch. I don’t think I ever again approached this degree of intonation specificity in a score – and I only did so in this case because I knew the musicians would know exactly what I intended” Garrett Sholdice (Sholdice, 2018).

The interview provides insight into the tradition of composers taking an already existing concept (Partch’s 43 tone scale) and adapting it to their own needs. Composers have done this through the centuries from the studying and adapting Bach chorales to the different applications Schoenberg’s 12 tone system. This was later attempted in Movement II of the composition *Future Shades of Blue* with the adaptation of a James Tenney tuning.

“I don’t think we have a particularly well-developed vocabulary around tuning. I am always struck by how difficult it can be to effectively and articulately address tuning as an issue with even professional musicians” Garrett Sholdice (Sholdice, 2018).

In the above quotation, Sholdice states the importance of educating musicians and providing a general awareness of how and why composers choose to work with microtonality. Ensembles like Trio Scordatura are made up of specialized musician well informed on microtonal practices. Guitarists are very much unaware of such procedure but recent interest in the microtonal work by Australian rock band *King Gizzard and the Wizard Lizard* has fueled a curiosity in online guitar communities that could see many more guitarists working with microtones and developing the language in relation to the guitar.

Sholdice describes his preferences when writing for guitar and just intonation.

“I think if I were seeking to write JI music for guitar now I would probably still use ringing re-tuned open strings and natural harmonics” Garret Sholdice (Sholdice, 2018).

These techniques were applied extensively in the etudes and the open tunings studied in relation to blues players. This inspired a MAX/MSP patch to be developed that switched between open string tunings with just intonation deviations.

3.3 Chapter Conclusion

The research recommendations made by those interviewed for this thesis helped concentrate the analysis and compositional approaches to specific details that would best influence the composition and development of microtonal guitar techniques. There is a shared view regarding the development of microtonal communication by further establishing its existing notational systems whilst still allowing the composer to create individual applications to best suit their needs.

Now that historical and current practices in contemporary composition have been discussed we can move forward to approaching the analysis of blues and its microtonal content. The concepts learnt from this research and guidance from the participating composers greatly informed the methodology and implementation of the research.

4. Analysing the Blues

4.1 Chapter Introduction

In Chapter 2 we saw how composer James Tenney created the piece *Three Indigenous Songs* from his analysis of a blues recording and used spectral composition techniques to create a piece that represents both the blues and contemporary composition. The pitch analysis aims to provide detailed information on the microtonal pitches performed vocally by blues artist and inspire concepts for the compositional process to follow.

4.2.1 Joe Monzo

The composer and creator of an online microtonality resource the *Encyclopaedia of Microtonal Music-theory*, Joe Monzo (Monzo, 1998), analysed Robert Johnson's vocal and documented the pitch deviations from equal temperament that Johnson sang.

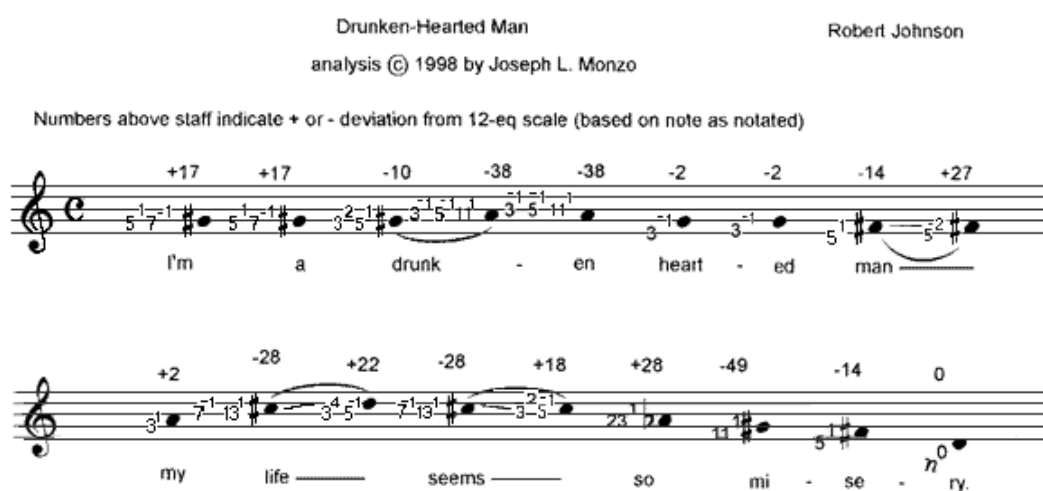


Figure 4.1 Joe Monzo Robert Johnson Analysis (Monzo, 1998)

Figure 4.1 shows the analysis of Robert Johnson's vocal on *Drunken Hearted Man*. The deviations from equal temperament are written above the notes. This demonstrates how blues performers commonly move outside equal temperament tuning and Monzo's system provides a template for analysis that utilize visual diagrams. These would influence the documentation of the analysis completed in this thesis. Figure 4.1 shows the use standard notation without rhythm to concentrate on the microtonal pitch deviations.

Robert Johnson
***Drunken Hearted Man* vocal**
rational analysis by Monzo
graph of cents values

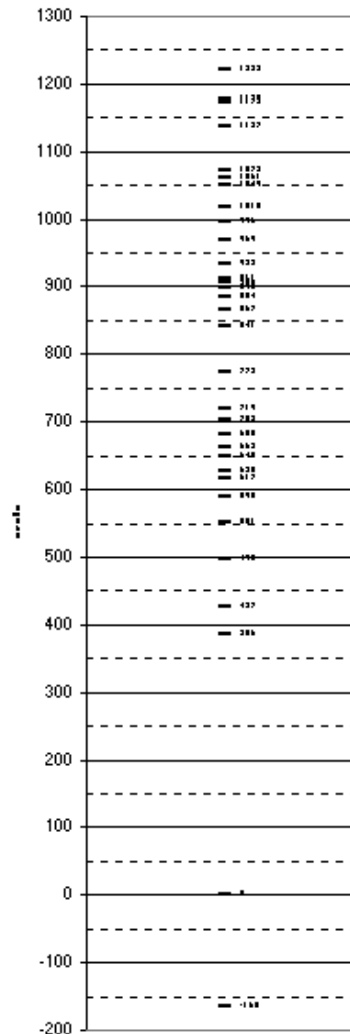


Figure 4.2 Joe Monzo Tall chart analysis in cent deviation (Monzo, 1998)

The tall chart in Figure 4.2 visually displays the vocal pitches within an octave. Unfortunately, the resolution provided by Monzo is very low and the pitch numbers are not legible. However, this visual display of pitch deviations still conveys information very well by providing an overview of the pitches sung as a whole. It is clear that very few notes sung, are perfect 12-Tet pitches.

Blues vocal analysis was also performed in “Microtonal Analysis of a Blues vocal - Can Hatsune-Miku Sing the Blues” by Hayashi, Bachelder & Nakajima (Hayashi, et al., 2014). Here they analysed the microtonal elements of a blues vocal with the objective

of improving vocal synthesizer technology that could emulate equal temperament convincingly but lacks in the performance of rock & blues music.

4.3.1 Analysis – Artists & Material

The material chosen for analysis focused on classic recordings made by African American blues artists. A decision was made to focus on earlier recordings, influenced by the Donnacha Dennehy interview, as their tuning would be least affected by western preferences for equal temperament. In addition, performances of recordings made in a post war traditional studio setting would have been more influenced by the industry standards of producers and expectations of recording labels. Modern production trends produce very different results than older recordings. Pre-war recordings and the field recordings of ethnomusicologist Alan Lomax (who documented performances by many rural blues artists) display the unaffected natural beauty of a blues performance.

Artist / Song	Region	Year of Recording	Blues Style	Ensemble / Solo	Chord Progression
Muddy Waters <i>Manish Boy</i>	Chicago	1977	Electric	Full Band	12 Bar
Son House <i>John The Revelator</i>	Mississippi Delta	1965	Gospel Blues	Acapella	8 Bar
Big Bill Broonzy <i>Key To The Highway</i>	Chicago	1957	Country/Folk Blues	Guitar & Vocal	8 Bar
Blind Willie Johnson <i>Dark Was The Night</i>	Texas	1927	Gospel Blues	Guitar & Vocal	Non specific
Howlin' Wolf <i>Smokestack Lightnin'</i>	Chicago,	1956	Electric Blues,	Full Band	Non specific (Hill Country Blues)
Lonnie Johnson <i>Another Night To Cry</i>	Louisiana	1962	Country Blues	Guitar & Vocal	12 Bar
Robert Johnson <i>Me & The Devil</i>	Mississippi Delta	1937	Country Blues	Guitar & Vocal	12 Bar
Charlie Patton <i>34 Blues</i>	Mississippi Delta	1934	Country Blues	Guitar & Vocal	12 Bar
Skip James <i>Devil Took My Woman</i>	Mississippi Delta	1931	Country Blues	Guitar & Vocal	5 Bar on vocal
Blind Willie McTell <i>Writing Paper Blues</i>	Atlanta	1927	Piedmont blues	Guitar & Vocal	12 bar

Table 4.1 Details of Recording Analysed

Essential details on the ten recordings analysed are presented in Table 4.1. This includes the region in which the recording was made. There are two important regional characteristics that influence the recording: 1) where the artist originates from and 2) the region in which he or she became best known for working and producing music. Many blues artists grew up in rural communities but travelled to the cities during what is known as the great migration. For blues related artists this would have probably been in the post-depression era 1940-1970. Huge numbers of African Americans travelled from the southern states to the industrial cities of the north like Chicago and Detroit. The urban or city blues scene developed around artists like Muddy Waters, Howlin Wolf in Chicago and John Lee Hooker in Detroit. Most blues artists represent a regional duality, all three of the aforementioned artists came from the Mississippi Delta but their names are mainly associated with their adopted cities and the record labels like Vee-Jay, Delmark and Chess that established their careers (Wald, 2004).

The date of the recordings range from 1927 -1977. This 50-year period runs in parallel not only with the creation of the music industry, but the unprecedented development in technology and the socioeconomics changes for African Americans. The earlier country blues recordings from 1927 and 1931 feature Blind Willie Johnson and Skip James. These performances would have been recorded on very basic equipment and without any manipulation that is commonplace in modern digital recording technology. The virtuosic performance interaction between the accompanying instrument and vocal by the solo performers displays a level of co-ordination that is extremely difficult to reproduce.

Vocal pitch analysis is more accurate when the audio contains the isolated voice. This influenced decisions when choosing some of the blues pieces for analysis. The acapella gospel vocal by Son House and Muddy Waters singing in the gaps of the ensemble on the intro to *Manish* Boy contain exposed vocal performances which make pitch analysis easier. The country blues, acoustic guitar and vocal performances display individuality in the accompanying techniques, such as the complex slide background figures produced by Blind Willie Johnson, the virtuoso switching from chordal to jazz influenced lines of Lonnie Johnson and the alternating bass patterns and rhythms of the Piedmont fingerpicking style associated with Blind Willie McTell.

4.3.2 Blues Chord Progressions

'When the chord changes, you change!' Joe Pass (Sudo, 1997)

12 Bar Blues

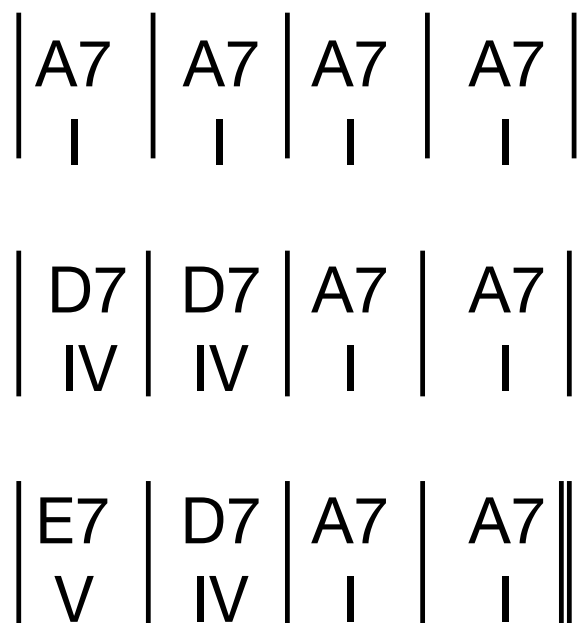


Figure 4.3 Traditional Twelve Bar Blues

The pitch analysis will be presented as deviation from equal temperament in cents. The chord progression on which the performer is singing will influence their choice of notes and the way in which they perform, particularly the characteristic bending of notes associated with the blues. The 12 bar format of the blues is a standard form therefore five out of the ten pieces in this form were chosen. The 12 bar blues (Figure 4.3) is a practical form for both the beginner or the advanced musician as the player can choose to harmonically follow the chord changes or play with less concern for harmony and focus more on a dynamic or emotive performance.

Blues For Alice

By Charlie Parker

VERVE 8010/VERVE 2515

The musical score for 'Blues For Alice' by Charlie Parker is presented in three staves. The tempo is marked as 165. The key signature is one flat (Bb). The first staff (labeled 1) contains the following chords: F, Eø, A7, D-, G7, C-, and F7. The second staff (labeled 2) contains: Bb7, Bb-, Eb7, A-, Ab-, and Db7. The third staff (labeled 3) contains: G-, C7, F7, G-, and C7. The music features complex melodic lines with many accidentals and a 12-bar structure.

Figure 4.4 Charlie Parker's Blues for Alice (Woideck, 1998)

The jazz saxophonist Charlie Parker wrote *Blues For Alice* in 1951 (Figure 4.4) which demonstrates how a virtuoso musician can adapt the 12 bar form to suit their creative needs. This example inserts chord changes that requires advanced musicianship to perform and allows more harmonically complex improvisations and melodies than a traditional three chords of a 12 bar blues.

The musical score for 'Smokestack Lightnin'' by Howlin' Wolf is shown in two parts. The top part is a melody in treble clef, 4/4 time, with a single Em chord indicated above it. The bottom part is a guitar riff in tablature format, with fret numbers (0, 3, 2, 4, 4, 2, 0, 2) written on the strings. The riff is divided into two measures by a double bar line.

Figure 4.5 Howlin' Wolf's Smokestack Lightnin' riff (Sokolow, et al., 1996)

Smokestack lightnin' is a Hill Country Blues style piece which would represents a harmonically static progression, especially in comparison to *Blues For Alice*, as it often contains a single chord, repetitious groove and can contain unusual bar lengths within its form.

8 Bar Blues



Figure 4.6 Eight Bar Blues (Hal Leonard, 1991)

The 8 bar blues of *Key To The Highway* sits somewhere in the middle but still requires discipline from the performer to navigate the chord changes when improvising. In the form for *Devil Took My Woman* Skip James sings his verves in 5 bar sections with the instrumental parts in 6 bar section. This is his intuitive approach and as a solo performer he is free to change the harmony as he pleases. Blind Willie Johnson's wordless gospel vocal on *Dark Was the Night* is similar. The section lengths vary constantly throughout. The adaptable and flexible form of the blues is a characteristic of older blues musicians and it is rare for modern players to move freely between chords. John Lee Hooker would often create changes in time signatures not usually associated with blues music. The example in Figure 4.7 shows an excerpt from *Tupelo* by John Lee Hooker where he creates the time signature changes from 6/8 to 3/8 and 6/8 multiple times within the same song, essentially adding or dropping a beat intuitively. These uses of informal time signature changes draws an interesting parallel to the informal use of microtonal pitch in blues. The blues artists are doing what feels natural to them, unaware of the resulting musical complexities, unlike the predetermined, calculated approach of contemporary composers.

The musical score for John Lee Hooker's 'Tupelo' is presented in three staves. The top staff shows the harmonic structure with chords E7, A5 G5 E5, N.C., and E7. The middle staff contains the vocal melody with lyrics 'bout it. Nineteen and thirty - two.' The bottom staff shows the bass line with various rhythmic notations including 2, 0, 3, 0, 2, 0, 2, 0, and X. The score illustrates time signature changes from 6/8 to 3/8 and back to 6/8.

Figure 4.7 John Lee Hooker excerpt from *Tupelo* (Hal Leonard, 1991)

4.3.3 Pitch Analysers and Tools

There are many commercial and free pitch analyser programs now currently available. Unfortunately, it is still impossible for any program to perfectly extract a desired sound or musical part from audio without undesired artefacts. The programs considered for use in this thesis included

- Melodyne by Celemony
- VoceVista Video by Sygyt Software
- Audition by Adobe
- Wavepad by NCH Software
- Tony by Isophonics
- Praat by University of Amsterdam

An extract of slide guitar playing was used as a test piece with Melodyne being identified as most suitable for this thesis. The high sensitivity of Audition and Wavepad produced accurate results with isolated audio but became problematic when working with audio files with multiple instruments. These programs became very useful for double checking results after using Melodyne or manipulating the audio before analysis. The VoceVista Video has a similar user friendly interface to Melodyne but the demonstration edition that was tested detected the pitch less accurately than Melodyne.



Figure 4.8 Pitch analysis in VoceVista Video

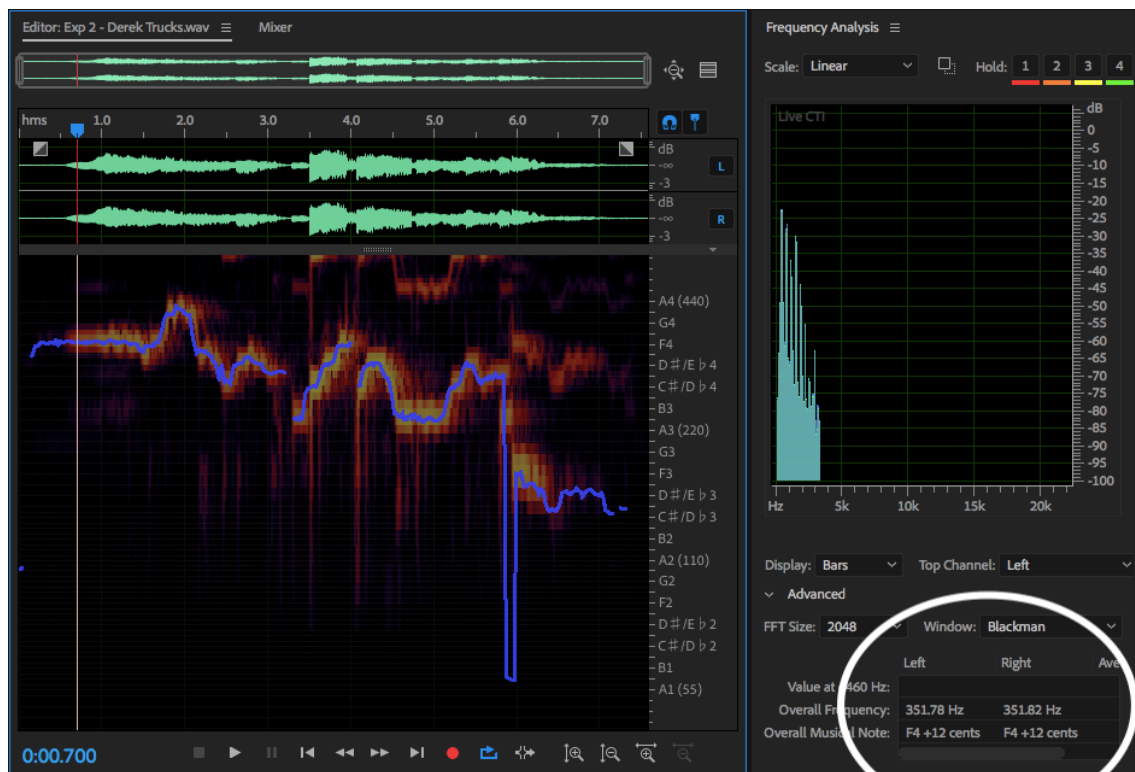


Figure 4.9 Pitch analysis in Adobe Audition

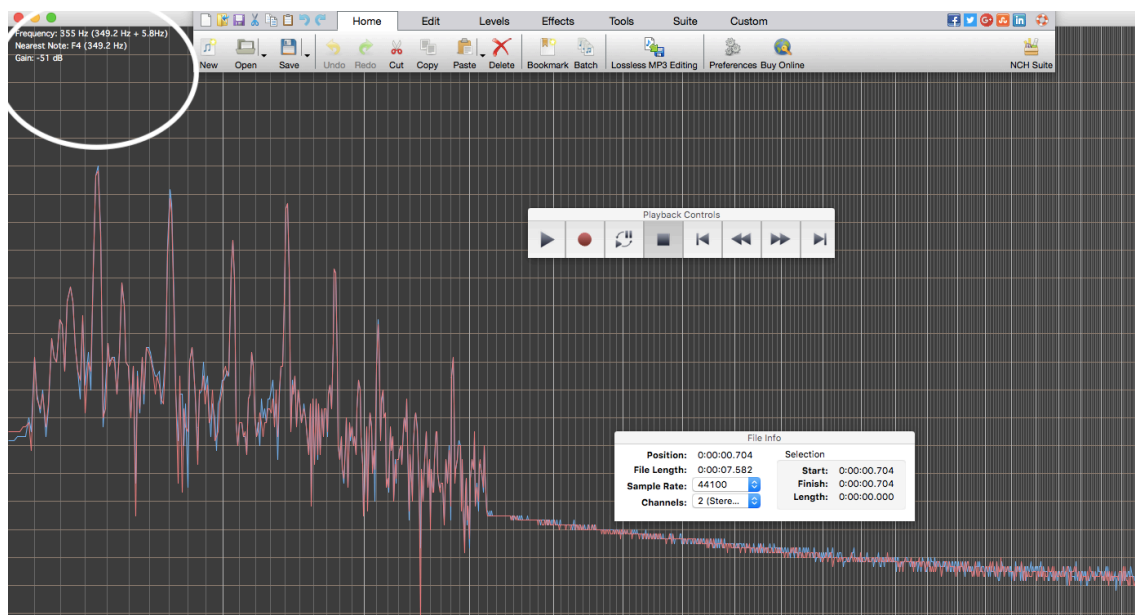


Figure 4.10 Pitch analysis in WavePad

Screen shots from the pitch analysis testing in Wavepad, Audition and VoceVista Video (Figure 4.8-4.10) show a 10cent difference between Audition and VoceVista with WavePad displaying frequency only and no difference in cent to the equal tempered note.

The two non-commercial programs Tony & Praat did not suit this research due to their limited display of results and significantly less user friendly platforms. The entry level edition of Melodyne Essential 4 was purchased for this thesis. This edition contains the relevant features for a similar research that requires pitch analysis and editing (Celemony, 2018).

The experiments performed proved that the most accurate results were produced by time stretching the audio file first in Adobe Audition before loading into Melodyne. This helped the pitch analysing program to identify the frequencies and enabled a closer resolution on the movement of the pitches in the audio. Melodyne does not simply present the result of the pitches cleanly without input from the user. Each note needs to be identified and there are many issues to consider when deciding on what pitch best represents the note and is documented. The guitar accompaniment recordings would most probably have been made without any regard for tuning to the equal temperament standard of 440hz for the note of A. The audio files were pitch shifted up or down before analysis, so they can be analysed and compared against the same standard reference. This was done by looking at the strongest fundamental performed in Adobe Audition and calculating the cent difference.

If Melodyne was clearly displaying a note from another part of the audio the iPhone application Pitch Analyser by Supertintin Co. Ltd was occasionally used. The pitch was either looped in a digital audio workstation, imitated vocally or on slide guitar to match the required frequency and documented. The process of singing into a pitch tracker contributed to a personal advancement in understanding of the sensitivity of frequency analysis and pitch perception.

John The Revelator by Son House is an acapella piece accompanied only by hand claps. In Figure 4.11 two hand claps can be seen at the bottom of the screen and demonstrate how they interrupt the pitch tracking of the vocal line momentarily. A recording with many percussive elements will certainly interfere with the pitch tracking to a higher degree. The red lines on the screen represent the sliding movement of the vocal line. It is difficult to pin point exactly where a vocal slide starts, these calculations had to be documented as a combination of aural perception and the visual representation supplied by Melodyne. If the lowest point of the sliding line was documented, it would rarely represent what the listener perceives as the starting note and if just the perceived note

4.3.4 Pitch Analysis – Keys & Ranges

Analysis of the blues recordings and the vocal pitches performed were made by looking at the results in different ways. The objective is to find patterns and frequently occurring pitches that deviate from equal temperament to inspire and influence new concepts for composing and generating material to compose with.

The first process was to produce a score for each piece that provided information on the notes sung with the notation rhythm omitted. This would allow the analysis to focus on the pitch deviations from equal temperament, clear relationship to the words sung and to categorise notes as sliding approaches, intended melody notes or ornamentations that are clearly contributing melisma (decorative pitches). These scores are useful practically as they provide enough information so an attempt can be made to replicate the vocal line on the guitar.

The Blind Willie McTell score in Figure 4.12 displays the melisma occurring on several syllables and the notation system used to differentiate between the different note functions. The melodic notes are indicated with whole note or non-filled note heads. Approach notes sliding towards the main melodic pitch are notated with black note heads in brackets with straight line slide indications and the decorative ornamentations with black note heads with a slur marking attaching them to the main melodic notes. The slide almost always appears before and below the main melodic notes, sliding upwards and sometimes delaying its resolution with a perceivable note very close to its melodic destination.

The ornamentations can appear many times on a sung syllable and mostly bridge a gap between two stronger melodic notes. The fast moving melismatic notes make the microtonal deviation from equal temperament less dissonant than the numbers might suggest. They move very quickly and because they are not as strong perceptually we accept them as notes of lesser importance. The concept of bringing these pitches forward and letting them share equal importance with the melody notes is an area explored in the etudes composed for this thesis.

Pitch Analysis - Blind Willie McTell

Writing Paper Blues (Verse Five / Pitched -79cents)

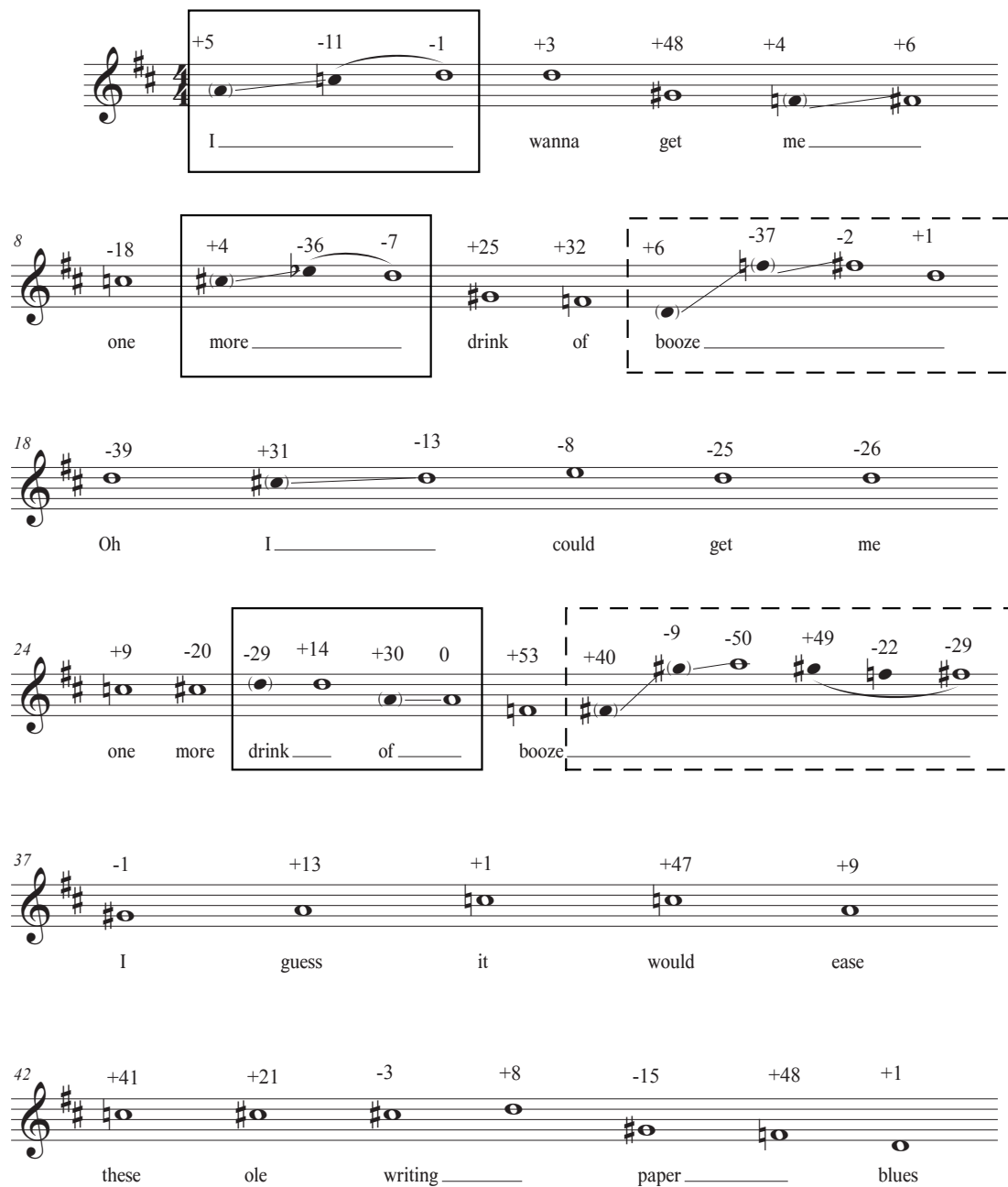


Figure 4.12 Blind Willie McTell Pitch Analysis

In the Muddy Waters score he sings the same word “*everything*” three times, these are indicated by black rectangles. Each repetition is sung slightly higher than the last resulting in a rise in anticipation. These pitch differences give character and colour to the repeated line which demonstrates a parallel to the traditional compositional technique of developing material over time. The continuing theme of intuitive application of compositional techniques is demonstrated here again with Muddy Waters applying subtle variations onto limited material.

Pitch Analysis - Muddy Waters

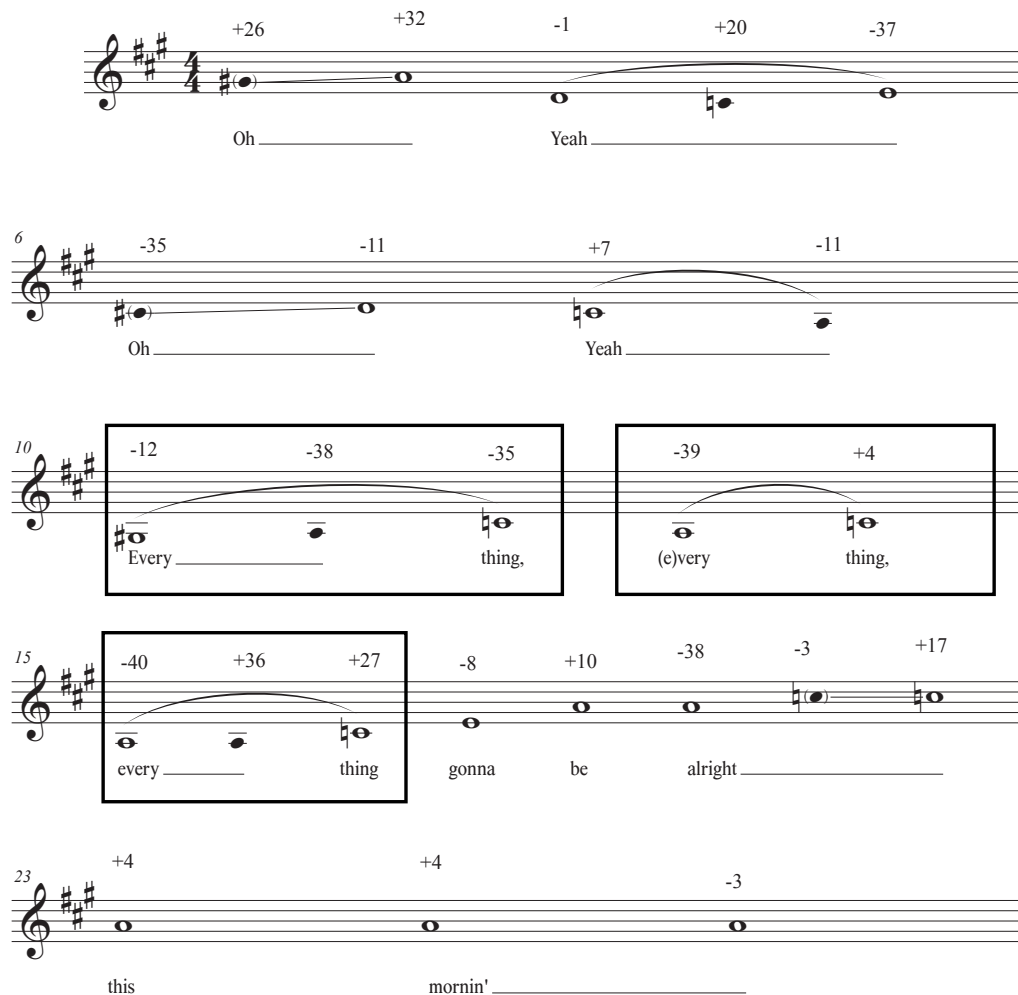


Figure 4.13 Muddy Waters Pitch Analysis

The Blind Willie Johnson score in Figure 4.14 identifies some major 3rd intervals in the key of D that are significantly flattened. A just intonated major 3rd is 14cents flatter than an equal tempered 3rd and a minor 3rd is 16cents sharper than an equal tempered minor 3rd. These narrower major 3rds occur frequently throughout the analysis showing a common characteristic in the blues style of singing.

Pitch Analysis - Blind Willie Johnson

Dark Was The Night (Verse 1) / Pitched -38cents

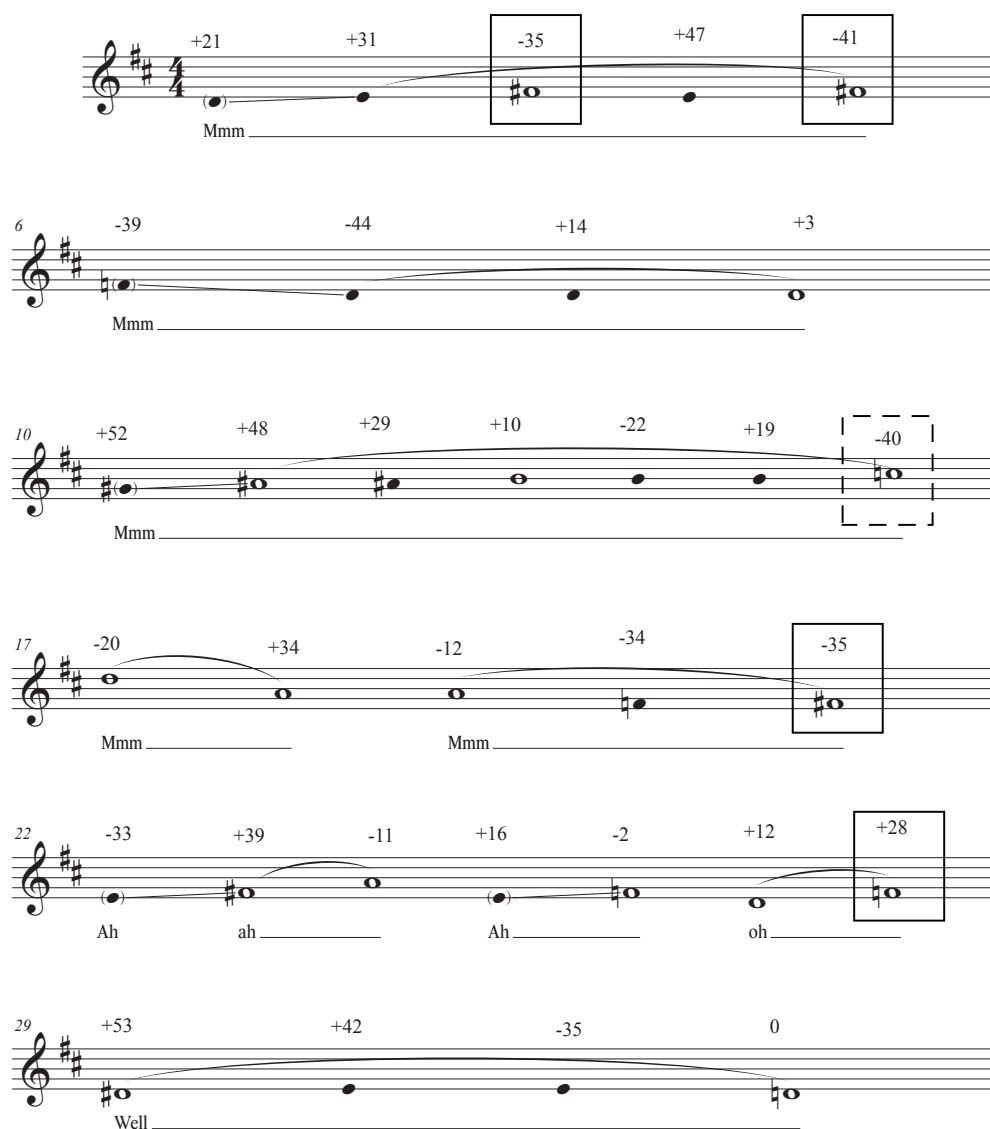


Figure 4.14 Blind Willie Johnson Pitch Analysis

The box around the F natural shows the minor 3rd to be sharpened by 28cents which also suggests the vocal tuning wants to naturally move in the direction of the just intonated pitches. The dotted line box indicates a minor 7 interval that is sung 40cents flatter than equal temperament which is very close to the just intonated minor 7 which is 31cents flatter than equal temperament. These observations around the 3rds and 7ths were observed for all ten songs and also included the deviations of the 5th, narrowing the focus of the analysis to the chord tones of a dominant 7th chord.

Keys & Ranges						
Artist	Guitar Tuning	Key	b3rd (Lowest/ Highest)	3rd (Lowest/ Highest)	5 th (Lowest/ Highest)	b7 th (Lowest/ Highest)
Muddy Waters	Standard	A	-35 +27		-37	
Son House	N/A	D	+41	-49 +18	-7 +20	
Big Bill Broonzy	Standard	E	-36 +52	-22	+3	
Blind Willie Johnson	Open D	D	-2 +28	-41	+34	-40
Howlin' Wolf	Standard	E	+53			+1
Lonnie Johnson	Standard	C	-27	+49	+34	-41
Robert Johnson	Standard	Bb	-45 +13	-33 +21	-17	-49
Charlie Patton	Standard	D	-15	-55	-37	-59
Skip James	Cross Note Tuning	D	-41	+21	-9	-42
Blind Willie McTell	Open E tuned down to D	D	+53	-29 +6	-50	-18

Table 4.2 Keys & Ranges of Blues Songs Analysed

The ten blues songs chosen are in a variety of keys with D being the most common. Robert Johnson almost certainly used a capo on the first fret which enabled him to raise the pitch and still perform as if in the key of A.

Table 4.2 allows us to compare the keys, the guitar tuning system and the ranges of the 3rds, 5ths and minor 7ths present, the natural 7th pitches are not included as they appear to be melodic decorations or approaches to the root. The constant movement of pitches

should be considered when analysing as the bending and vibrato of notes produces a wide range of pitches that deviate from equal temperament. The pitches are always moving and very rarely static. Only the melodic notes are included in Table 4.2 to compare the range of activity on these notes. The 3rds clearly contain the most activity and cover a range of a quartertone above the major 3rd (+49) to a quartertone below the minor 3rd (-45), the 5th is similar ranging from a sixth-tone above (+34) to a quartertone below (-50), the minor 7th only appears as a flattened deviation from equal temperament and goes down a little over a quartertone (-59). The comparison of these ranges in melodic pitches around the 3rd show a fairly distributed array of notes, suggesting the pitch choice is not strictly required to fall within 5cents of the equal tempered tuning when singing blues. There are similar numbers in some areas but no significant pattern to show a specific pitch is required for any of these intervals. The 3rd is definitely not required to be tuned to equal temperament.

4.3.5 Guitar Tuning

Featured blues artists commonly used guitar tunings		
Artist	Tuning (Low to High)	Notes, other songs and references
Muddy Waters	Open G / Spanish DGDGBD	I Can't Be Satisfied Rollin' & Tumblin'
Son House	Open G / Spanish DGDGBD	My Black Mama
Big Bill Broonzy	Standard	When Did You Leave Heaven Hey Hey
Blind Willie Johnson	Open D / Vestapol DADF#AD	Dark Was The Night
Howlin' Wolf	Standard	Killing Floor
Lonnie Johnson	Standard & DGDGBE	Life Saver Blues
Robert Johnson	Standard Drop D - DADGBE Open A - AEAC#E Open E - EBEG#BE	Me & The Devil Blues Malted Milk, Drunken Hearted Man Walking Blues, Crossroad Blues Ramblin' On My Mind, Hellhound On My Trail. Robert Johnson tunings and use of the Capo are controversial, it is possible some recording sessions were recorded at a higher speed by engineer therefore affecting the pitch.
Charlie Patton	Open G / Spanish DGDGBD	Screamin' & Hollerin' The Blues
Skip James	Cross-Note Tuning DADFAD	Devil Gt My Woman
Blind Willie McTell	Open E / Vestapol EBEG#BE	Writing Paper Blues Uses E tuning but tuned low and sound close to D

Table 4.3 Preferred Guitar Tunings of Blues Artists Analysed

The guitar tuning has also been considered during analysis as this would have strongly influenced the vocal pitching. As the performer sings, the guitar would be tuned by ear and therefore not strictly referenced to equal temperament. The beating that occurs between notes that are slightly out of tune are likely to influence the musician's perception of what they consider in tune or not as they tune their instruments and sing against them. The different tuning systems popular with blues musicians are mainly in sharp keys such as G, D, A and E with a strong emphasis on manipulating the open string notes to their choice of key.

Table 4.3 shows the blues artists chosen to analyse and their favoured guitar tunings. All blues artists would use a variety of guitar tunings, this table concentrates the tuning system most commonly associated with the artist. One of the most interesting comparisons is the use of open D tuning, which is also known as Vestapol tuning (named after a popular instrumental parlour song published in 1854 called *The Siege Of Sevastopol* (Duncan, 2001) and the Cross-Note tuning. The lowering of the third string to the F natural in the key of D creates a D minor tuning often referred to as crossed note tuning. Skip James is the most well-known blues musician to use this tuning but he does not play the minor tuning to play minor songs (Mann, 1999). He often plays with his first finger on the major 3rd (F#) which allows him to occasionally play the open string and let the minor 3rd ring out. This creates a darker texture than the more popular open D major tuning. The D major tuning exploits the minor 3rd by bending notes three frets above the open string. This creates intervals exclusively associated with the blues as the combined major 3rd and microtonally bent minor 3rd conjoin to create a momentary dissonant effect that will almost certainly be resolved by the minor 3rd falling back down to the root. Similar to the analysis presented in Table 4.2 the unrestricted and wide range of 3rd that can be produced when playing blues accompaniment is equal to that of the lead vocal line.

4.3.6 Pitch Distribution

Big Bill Broonzy <i>Key To The Highway (Third Verse)</i>			
Interval	Melody Notes (Emphasized or longer notes in bold)	Ornaments	Approach Notes
Root	-38, -8, -4, +6 +9 , +12	-32, -4, +16	
b2			+18
2	-15, +6, +12, +30 , +50	-24, +39	-8, +4, +38
b3	-36 , -11 , -7, -5, +6, +9, +28 , +32 , +47, +52	-37, -27	
3	-22	-38, -20, -2	
4	+17		
b5	+33		
5	+3 , +18	-15	
b6			
6	+26, +33 , +36 , +38	+33	
b7		+40	
7	+39, +46 , +57	+36	-7, +45

Table 4.4 Big Bill Broonzy Pitch Distribution

Table 4.4 shows the distribution of melodic notes, ornamented and approach notes for Big Bill Broonzy's *Key To The Highway*. The approach notes are all placed on the 2nd degree, just below the 3rd or on the natural 7th just below the root. This shows a pattern in Broonzy's vocal style. The singer appears to have a preference for approaching the 3rd and 7th with a microtonal slide.

The ornaments show a pattern where the 6th, minor 7th and 7th contain notes close to a sixth-tone higher and the R (root), minor 2nd, 2nd, minor 3rd and natural 3rd all contain notes close to a sixth-tone flat. These microtonal pitches above and below the melody notes in different interval areas imply that decorations could be following a pattern. Jazz musicians can play any note on their instrument on any chord if they practice patterns that resolve pitches to a target note. This analysis provokes the thought, is it possible to practice these patterns with microtones and widening the harmonic possibilities of improvisation?

Big Bill Broonzy
Key To The Highway (Third Verse)

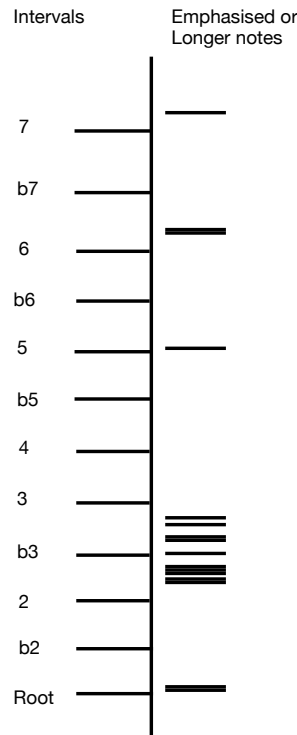


Figure 4.15 Pitch Distribution Tall Chart

If the emphasised notes from *Key The Highway* are presented against the 12-Tet scale, as in Figure 4.15, another perspective on the content of melodic notes is visible. The activity around the flattened 3rd degree is clearly identifying a preference for under pitching to create that classic blues moan and visually indicates the minor 3rd is sung in the areas of a septimal minor 3rd which has the ratio of 7/6 and is 267cents wide. The sharpened 6th activity could be bending towards the narrower septimal minor 7th interval which has the ratio 7/4. This interval is used frequently by composers as it has a more consonant tone than the dissonant 9/4 just intonated minor 7th which is much closer to an equal tempered minor 7th. These relationship gets closer again when you consider this interval is often notated by composers like Ben Johnson in 24-Tet notation as a quartertone below the flat 3rd and minor 7th.

These septimal intervals derive from the seven limit tuning system that uses harmonics from the overtone series up to the seventh harmonic. This seven limit tuning provides the intervals to create a consonant sounding dominant seventh chords. In three and five

limit tuning the intervals that make up a dominant seventh are dissonant sounding and therefore traditionally this tension would influence resolving of the dominant chord but the pure consonance provided by seven limit supports the dominant and is therefore more stable and less inclined to resolve. In my interview with Garrett Sholdice we discussed the 7/4 interval.

“The seventh partial. I think this is the moment in the harmonic series where you really perceive something new in something familiar. The 7/4 interval is a minor seventh, and identifiable as such. But, crucially, it’s consonant – it just sits there, ringing beautifully, it doesn’t want to go anywhere” Garrett Sholdice (Sholdice, 2018).

As we saw in earlier in Figure 4.3, the traditional twelve bar blues is made up of three static dominant chords. The intuitive tuning of the blues musician has clear seven limit tendencies that supports its harmonic structure. With the septimal seven limit intervals based around the 3rd, 5th and minor 7th in mind the analysis will now take a closer look for patterns and trends that were close to this tuning system and other microtonal consonances.

4.3.7 Comparing 3rds, 5ths & 7ths

Comparing 3rds			
Artist	Influential Chord Progression	Minor 3rds	Major 3rds
Muddy Waters	No	-35, +4, +7, +17, +27	
Son House	No	+41	-49, -26, -23, -22, -21, -11, 0, +18, +25, +30
Big Bill Broonzy	Yes	-36, -11, -7, -5, +6, +9, +28, +32, +47, +52	-22
Blind Willie Johnson	No	-2, +28	-41, -35, -35, +39
Howlin’ Wolf	No	+11, +22, +42, +53	-32
Lonnie Johnson	Yes	-27, -5, -5, -4, -1, 0, +6, +23, +53	+7, +49
Robert Johnson	Yes	-45, -29, +3, +6, +10, +13	-33, -22, -21, -7, +7, +21,
Charlie Patton	Yes	-15, -2, +39	-55, -40, -35
Skip James	Yes	Key of D but melody sung over A7, the b3rds on A7 chord would be -52, -42, -37	+21
Blind Willie McTell	Yes	+9, +32, +41, +48, +53	-29, -20, -3, -2, +6, +21

Table 4.5 Comparing 3^{rds}

A comparison of all the 3^{rds} are presented in Table 4.5. The septimal minor 3^{rds} is 33cents lower than equal tempered minor 3^{rds} and the septimal major 3^{rds} is 35cent sharper. There are very few instances of septimal major 3^{rds} but over 50% fall in the area of the septimal minor 3^{rds}. Halfway between the minor and major 3^{rds} at 350cents is often called the neutral 3rds and can be represented by the intervals 11/9 from 11 limit tuning at 347cents and 16/13 from 13 limit tuning at 359cents. If we consider the neutral 3^{rds} as a quarter tone sharp minor 3^{rds} or a quartertone flat major 3^{rds} then we see almost all the songs have figures that fall in this region.

Comparing 5ths		
Artist	b5ths	Nat 5ths
Muddy Waters		-37, -8
Son House	-47, -25, +23, +39	-30, -7, +18, +20, +26
Big Bill Broonzy	+33	+3, +18
Blind Willie Johnson		-12, -11, +34
Howlin' Wolf		
Lonnie Johnson	+11	
Robert Johnson	+27	-17, -14, -7
Charlie Patton	-19	-37, -23, -18, -15, -12, -9
Skip James	Key of D but melody sung over A7, the b5th on A7 chord would be -44	-9, -2 Key of D but melody sung over A7, the 5th on A7 chord would be -41, -36, -33, -19, -10, +48
Blind Willie McTell	-15, +1, +25, +48	-50, 0, +9, +13

Table 4.6 Comparing 5^{ths}

The tritone (b5th) and natural 5th are presented in Table 4.6. The tritone is important in blues as it is commonly represented by chromatically bridging the gap between the 4th and the 5th degree in regular 12-Tet tuning. There are two septimal tritones, the lesser septimal tritone with the ratio 7/5 at 582cents and its less commonly used wider inversion the greater septimal tritone with the ratio 10/7 at 617cents. The lesser tritone is the most consonant of the many possible tritones and in this analysis Charlie Patton sings it almost exactly whilst Son House and Skip James sing quartertone flat tritones. The 11 limit tritone is 49cent flatter than in equal temperament, so they are very close to this tuning. Lonnie Johnson and Robert Johnson sing in a slightly sharper range that could be considered greater septimal tritones. The natural 5th shows a trend for quartertone and sixth-tone flattened notes with two 5^{ths} sharpened by a sixth-tone. The 5th degree is the

most stable interval after the octave with a ratio of 3/2, for perfect just intonation you can raise the 5th by 2 cents. The majority of the activity around the 5th is similar to the 3^{rds} as they are slightly narrower intervals that allow room for bending and expressive pitching.

Comparing b7ths Here we are not concerned with the Nat 7 th as they are most likely decorations of the root, raised 6 th are included as they could be considered b7ths, flattened over a quartertone.		
Artist	6ths	b7ths
Muddy Waters		
Son House		
Big Bill Broonzy	+26, +33 , +36 , +38	
Blind Willie Johnson	+10	-40
Howlin' Wolf		+1 , +5
Lonnie Johnson	-4, +34, +54	-41 , +54, +70
Robert Johnson		-49 , +28
Charlie Patton	+1	-59 , -30 , -6
Skip James	-12, -11 , +8, +48 Key of D but melody sung over A7, the 6th on A7 chord would be +21	-42 , -37 Key of D but melody sung over A7, the b7th on A7 chord would be -48 , -37 , -27
Blind Willie McTell		-18 , +1, +41

Table 4.7 Comparing minor 7^{ths}

The 7/4 septimal minor 7th is 31 cents flatter than a 12-Tet tempered minor 7th and represented as 950cents in 24tet tuning. There are many examples in Table 4.7 of the blues vocal pitches having a strong leaning towards this interval from both the raised 6th and flattened minor 7th.

The score in Figure 4.16 and accompanying Table 4.8 from the Charlie Patton analysis later become sources of inspiration and compositional material as microtonal phrases are extracted for further exploration.

The further study of the microtones produced by 7, 11 and 13 limit could show further trends and commonalities in the blues songs. For example: several intervals introduced to a semitone by the 7 limit are 15/24 at 119cents, 21/20 at 84.5cents, 28/27 at 63cents and four microtones 36/35 at 48cents, 49/48 at 35.7cents, 50/49 at 35cents and 64/63 at 27.3cents. Compositionally these smaller intervals can be utilized as melody notes and can facilitate voice leading when applied to microtonal composition. Attempting to play

them on the guitar with a slide suggest logical and pragmatic considerations need to be considered. It was discovered whilst attempting these analysed pieces on slide guitar that simplifying blues melodies and performing improvisations with sixth and quarter tones is an achievable compromise that sounds authentic. This is one of the major findings produced by the analysis as from here the microtones can be explored in a practical manner and not just theoretically.

4.4.1 Charlie Patton Analysis

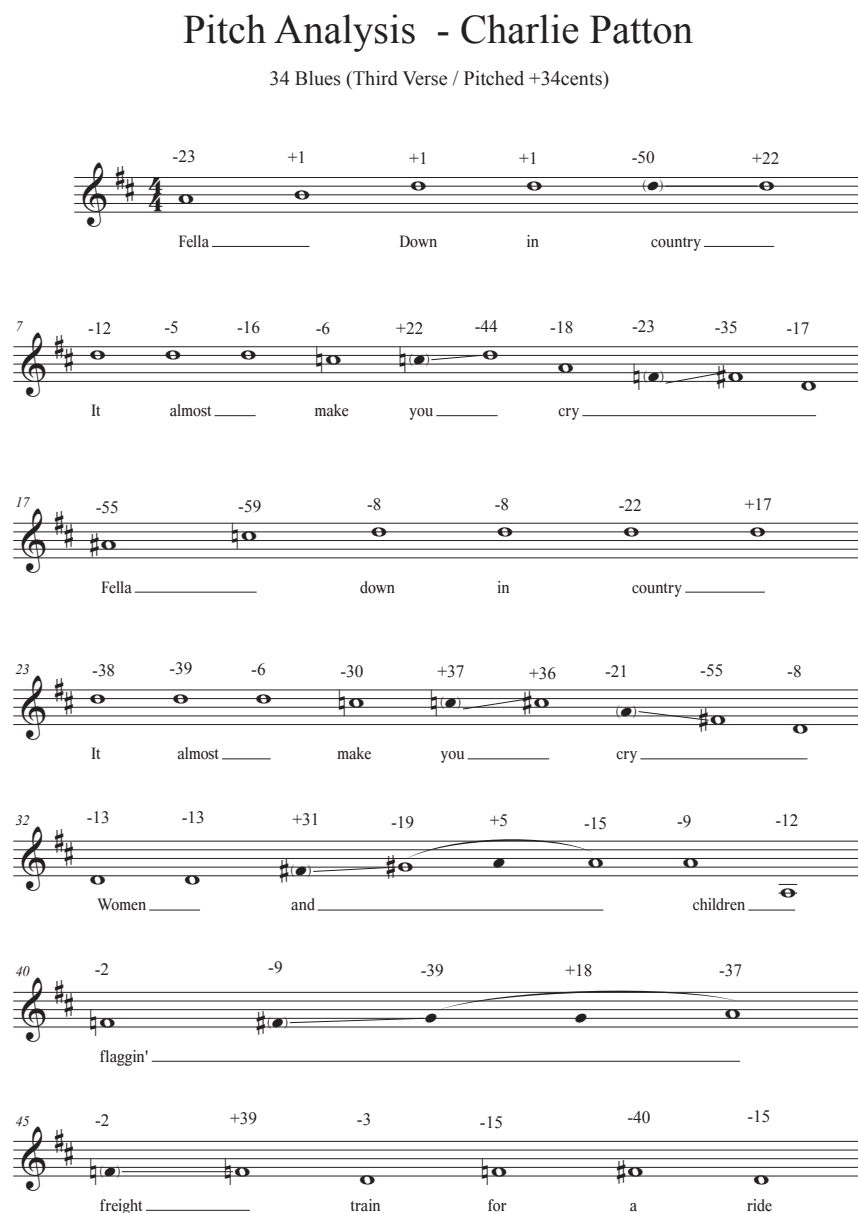


Figure 4.16 Charlie Patton Pitch Analysis Score

Charlie Patton Pitched +34cents 34 Blues (Third Verse)				Charlie Patton 34 Blues (Third Verse)
Interval	Melody Notes (Emphasized or longer notes in bold)	Ornaments	Approach Notes	
Root	-44, -38, -39, -22, -17, -16, -15, -13, -13 , -12, -8, -8, -8, -6, -5, -3, +1, +1, +17, +22		-50	<div> <div>Intervals</div> <div>Emphasised or Longer notes</div> </div>
b2				
2				
b3	-15, -2, +39		-23, -2	
3	-55, -40, -35		-9, +31	
4		-39, +18		
b5	-19			
5	-37, -23, -18, -15, -12, -9,	+5	21,	
b6	-55			
6	+1			
b7	-59, -30, -6		+22, +37	
7	+36			

Table 4.8 Charlie Patton Pitch Distribution and Tall Chart

All notation, tables and tall charts for the ten analysed blues pieces are available to view on the accompanying media disc.

4.5 Chapter Conclusion

The analysis presented highlights the microtonal content of blues music and the wide ranging variety tones when pitching 3^{rds}, 5^{ths} and minor 7^{ths}. It has become clear that the blues is made up of many more intervals than is contained in the popular 12-Tet blues scales that are currently taught and studied. There are many different microtonal colours that contribute to the blues genre and this thesis aims to bring some microtonal intervals to the forefront, utilizing them by developing new strategies and applying compositional techniques. Inspired by the analysis findings, experimental etudes have been constructed that will explore the different performance and compositional possibilities on the guitar. The practical attempts to perform the transcribed pitches has resulted in a concept to simplify the vast array of pitches to sixth and quartertones. This pragmatic simplification of pitches will now be carried over to the implementation stage of the research.

5. Microtonal Experiments & Etudes

5.1 Chapter Introduction

There are many different ways for the modern guitarist to achieve microtonal pitches. The techniques chosen to explore in this thesis focus mainly on string bending, bottleneck slide, vibrato arm techniques, fretless guitar, scordatura (tuning open strings to microtonal pitches) and the use of a hexaphonic pickup. Most guitarists do not own a microtonal fretboard, fretless guitar or a hexaphonic pickup system but string bending, slide and vibrato arm techniques can all produce microtones and be performed on a standard electric guitar. A system will be developed for guitarists to practice microtones and concepts developed to help a guitarist execute microtonal passages within a composition or improvisation. This chapter provides an overview on the equipment, guitars used and the practical implementation of techniques via experimental etudes.

The 17 Etudes composed for this research are included in the accompanying media disc.

5.2.1 Guitar Sensitivity

In my interview conducted with the luthier John Moriarty (Moriarty, 2018) he points out that microtonality can commonly be performed unintentionally by guitarists. His experience building and setting up instruments for players of different technical ability and genetic make-up has shown hand size and even the softness of the fingertips play a part in performance intonation. High frets and string plucking can unintentionally create microtonal pitches with different applications of pressure. This is an important consideration which complies with the theory that microtonality is a unique experience in both aural perception and performance awareness.

5.2.2 Equipment & Guitars

In preparation for this thesis various tools were gathered to help perform the experimental applications of microtonality to the guitar. The Hutchings fretless guitar (Figure 5.1) gives access to a wide range of microtonal pitches. This instrument requires an advanced level of experience and technique to successfully produce accurate tones. String bending

is not practical possibility on a fretless instrument because the string requires the fret to assist its movement upwards or downwards.



Figure 5.1 Fretless Guitar

A Gibson SG will be used for slide (Figure 5.2). Many great slide blues artists like Derek Trucks and Duane Allman have used this model guitar as it is very effective for slide & provides good high neck access.



Figure 5.2 Gibson SG Standard used for slide

Slide guitar is a technique that most rock and blues influenced players experiment with to provide an extra musical colour in performance. Like most alternative techniques, a players experience and ability can vary depending on their exposure to the technique.



Figure 5.3 Hexaphonic and vibrato arm equipped guitar

The Fender Roland Ready Stratocaster (Figure 5.3) has a built in hexaphonic pickup that can send separate signals for each string. A program was written in the interactive software program MAX/MSP to explore the use of microtonality on this instrument. This guitar is also fitted with a vibrato arm system that allows the pitch to be altered by moving the metal bar attached to the bridge.

Other notable manufactures of guitars with microtonal capabilities include:

- Line 6 produce a guitar (Variax model) that has selectable open tunings and interface workbench that allows custom tunings.
- Godin Guitars produce a guitar (Godin LGX SA) with a built in transducer system/piezo hexaphonic pickup. These possess a more acoustic tone due to the pickup being built into the bridge.
- Eastwood Guitars commercially produce a microtonal fretboard electric guitar.

The hexaphonic pickup requires a breakout box (Figure 5.4 left) to send the six string signals to an audio interface. The Apogee Quartet shown only provides four inputs, a six input interface should be used so all six strings can be manipulated in the MAX/MSP patch.



Figure 5.4 Breakout Box and Digital Interface

5.3 MAX /MSP & Reaper

MAX/MSP is an interactive software program for music and multimedia. V.J Manzo defines the interactive system in his book *MAX/MSP/Jitter for Music*.

“An interactive music system is a hardware/software configuration that allows an individual to accomplish a musical task, typically in real time, through some interaction... These systems typically have some set of controls, hardware or software, such as switches , keys, buttons and sensors by which musical elements like harmony, rhythm, dynamics and timbre can be manipulated in real time through user interaction”
V.J Manzo (Manzo, 2016).

Pitch is our main concern and the program, or patch as they are called in MAX, will facilitate the retuning of each individual string via the hexaphonic pickup.

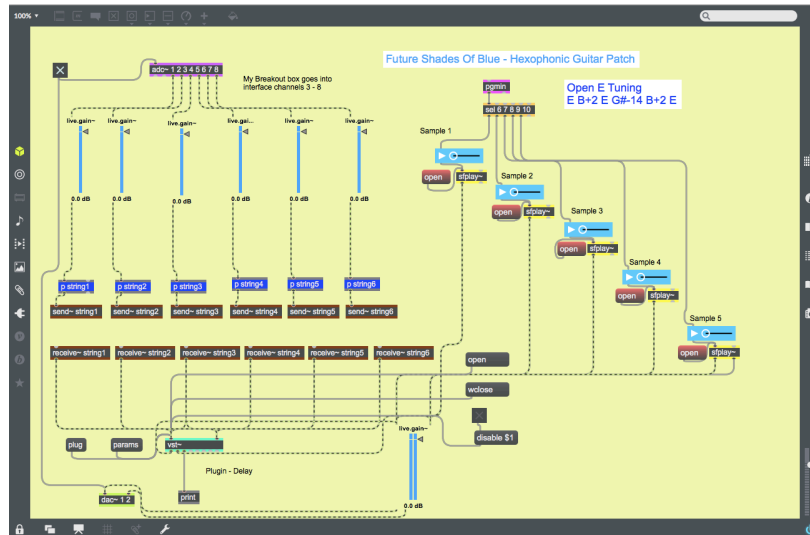


Figure 5.5 MAX/MSP patch developed for tuning experiments

Figure 5.5 shows the MAX patch developed for Guitar 2, Mvt III of *Future Shades of Blue*. The guitar can play just intonated chords and control samples via a midi controller.

Reaper was also used for the experiments. When using a hexaphonic pickup with a breakout box into an interface, with 6 or more inputs, you can assign each string to a different track in a digital audio workstation. The tuning of each string can then be adjusted with addition software within the program, commonly known as plug-ins. Pitch shifting plugins used in these experiments include:

- Pitch Proof by Aegean Music
- Pitchshift by SoundHack
- SoundShifter by Waves
- VoicePitcher V3 by ToneBooth
- ReaPitch by Steinberg Media
- AUPitch. by Apple

Pitch Proof was identified as the most effective and reliable plug-in during testing. The DAW Reaper, guitar, interface, guitar technique and other technologies can have an effect on the pitch shifting performance. A different technique or set up may perform better with a another plug-in such as SoundShifter by Waves. It is advised other researchers explore these pitch shifting options to identify the best choice of plug-in for their system.



Figure 5.6 DAW Reaper with plug-in Pitchproof

Figure 5.6 shows a Reaper session with six tracks, one for each string and the plug-in used to adjust each string. This system provided fast, accurate exploration of different tuning systems without the need to adjust the tuning pegs on the guitar.



Figure 5.7 Behringer Midi foot controller

Parameters in MAX and Reaper were controlled via a Behringer midi foot controller shown in Figure 5.7, making the performance of multiple tunings possible.

5.4.1 Concepts And Etudes

A process of experimentation via the structured application of the key concepts involved in performing and composing with microtonality were explored by constructing short technical exercises, commonly known as etudes, that contributed to the familiarisation and consolidation of the background material, musical analysis and theory. The etudes are composed in groups that explore very specific approaches, both compositionally and technically on the guitar.

The etudes focused on quartertones, sixth-tones, accompaniment, open tunings, improvisation, 5 limit tuning, 7 limit tuning, blues styles, consonant and dissonant etudes, microtonal notation systems, applying contemporary compositional concepts, applying jazz improvisational techniques. These were performed on guitar exploring microtonal applications such as bottleneck slide, vibrato arm, fretless guitar, hexaphonic pickup and harmonics.

With the use of hexaphonic pickup system and the digital audio workstation Reaper the audio could be recorded with a clean separation for each string. This facilitated the separate manipulation of the tuning to suit the microtonal concept being explored.

5.4.2 Quartertone Approach Note Concept

The first set of etudes developed the concept of quartertone approach note techniques for improvisation. A popular jazz improvisation technique from the bebop era involves the targeting notes belonging to a chord, or superimposed chord, and to approach a target note (usually a chord tone) via other chord tones, passing tones or chromatic approaches. The analysis showed many of the microtonal notes in the analysis to be approaches or ornaments of longer more stable notes. A concept was developed to systematically apply the commonly practiced chromatic approaches to quartertones.

<p style="text-align: center;"><u>16 Quartertone Approaches</u></p> <p style="text-align: center;">QT+ / QT- = Quartertone above/below target note</p> <p style="text-align: center;">HS+ / HS- = Half Step above/below target note</p> <p style="text-align: center;">TN = Target Note</p>					
1	QT-	TN			
2	QT+	TN			
3	HS-	QT-	TN		
4	HS+	QT+	TN		
5	HS+	QT+	HS-	QT-	TN
6	HS-	QT-	HS+	QT+	TN
7	HS+	QT+	QT-	TN	
8	HS-	QT-	QT+	TN	
9	QT+	HS-	QT-	TN	
10	QT-	HS+	QT+	TN	
11	HS-	QT+	QT-	TN	
12	HS+	QT-	QT+	TN	
13	QT-	HS-	QT+	TN	
14	QT+	HS+	QT-	TN	
15	HS+	HS-	QT+	QT-	TN
16	HS-	HS+	QT-	QT+	TN

Table 5.1 Sixteen Quartertone Approaches

Notation for all 16 approaches can be found on the accompanying media disc.

An example of the first six quartertone approaches to the target note of C would be:

1. B+50cents to C
2. C+50cents to C
3. B to B+50cents to C
4. C# to C+50cents to C
5. C# to C+50cents to B to B+50cents to C
6. B to B+50cents to C# to C+50cents to C

These approaches on slide guitar and fretless guitar are very achievable and the experienced musician can quickly adapt from working in 12-Tet to a 24-Tet system. The aural development that takes place is surprisingly quick and working with this system, in a disciplined way, quickly shows the melodic and harmonic restrictions of the 12-Tet system. The sixteen approaches were initially practiced on the chord tones of a major triad, minor triad and dominant 7th chord in all keys, this could be developed further into other chord types. Improvisations were then performed over standard blues progressions. The approaches were then applied to the minor blues scale (R, b3, 4, b5, 5, b7) and the major blues scale (R, 2, b3, 3, 5, 6) by systematically applying the sixteen different approaches to each degree of the scale. The two scales were then combined to form a hybrid octatonic blues scale (R, 2, b3, 3, 4, b5, 5, b7) that contained the 12-Tet chromatic steps between the 2nd and 5th degree and minor 7th. The decision to leave out the 6th degree was based on the analysis research that showed the blues vocal had tendencies to sound microtonal pitches mainly below the 3rd, 5th and 7th.

The communication of microtonality between composers and performers through different notation systems should be considered at this point. Many composers have developed their own notation systems to communicate their compositions and the system used can vary depending on the specific aims of the piece, the musicians familiarity with notation & their ability execute microtones and adaptability of the instruments used.

The 16 quartertone approaches were written into the notation software finale using the symbols considered standard for quartertones and later sixth-tones.



Figure 5.8 Notation for Quartertone Approach 1, QT- to TN

(Audio - Media Disc – Quartertone Approach Ex. 1)

(Audio - Media Disc – Quartertone Approach Ex. 6)

This system produces a resolved sound due to the targeting of the pitches commonly found in the 12-Tet scale. In a formal way the quartertone approaches produce a microtonal sound that imitates the decorative melisma found in blues music but improvising with the approaches still requires an advanced knowledge in the application of phrasing and dynamics to replicate vocal ornamentations with any authenticity.

This concept was adapted further by adding a double target note (DTN) which requires the addition of one extra note from the scale immediately before resolving the quartertone approach.

1 - QT-, DTN Interval Chart Quartertone below, double target note.						
7+50c, R, R	7+50c, b3, R	7+50c, 3, R	7+50c, 4, R	7+50c, b5, R	7+50c, 5, R	7+50c, b7, R
2+50c, R, b3	2+50c, b3, b3	2+50c, 3, b3	2+50c, 4, b3	2+50c, b5, b3	2+50c, 5, b3	2+50c, b7, b3
2+50c, R, 3	2+50c, b3, 3	2+50c, 3, 3	2+50c, 4, 3	2+50c, b5, 3	2+50c, 5, 3	2+50c, b7, 3
3+50c, R, 4	3+50c, b3, 4	3+50c, 3, 4	3+50c, 4, 4	3+50c, b5, 4	3+50c, 5, 4	3+50c, b7, 4
4+50c, R, b5	4+50c, b3, b5	4+50c, 3, b5	4+50c, 4, b5	4+50c, b5, b5	4+50c, 5, b5	4+50c, b7, b5
5-50, R, 5	5-50, b3, 5	5-50, 3, 5	5-50, 4, 5	5-50, b5, 5	5-50, 5, 5	5-50, b7, 5
6+50c, R, b7	6+50c, b3, b7	6+50c, 3, b7	6+50c, 4, b7	6+50c, b5, b7	6+50c, 5, b7	6+50c, b7, b7

Table 5.2 Quartertone and Double Target Note Approach

Tables for all double target note approaches can be found accompanying media disc.

Table 5.2 shows the application of the first quartertone approach with an added scale note before resolving. This produces 49 new patterns for each original quartertone approach. When applied to all sixteen original approaches there is a total of 784 new patterns to use in improvisation. For a musician interested in developing their ear and practical microtonal skills on their instrument this process would help the hearing and performance of microtones significantly.

The technical exercise presented provide a structured introduction to the practical practice and notation of quartertone that enables the progression into composition. A selection of etudes composed during the research are now presented to show the practical implementation of analysis finding and concepts developed.

5.4.3 Quartertone Etudes



Figure 5.10 Notation for Quartertone Written Solo

(Audio - Media Disc – Etude #3)

Figure 5.10 shows the notation for quartertone written solo over the chord changes to *Key To The Highway* which is one of the most popular songs in the eight bar blues form (Rubin, 2008). The etude only contains the notes from the hybrid blues scale in the key of A with quartertone approaches. The concept of restricting the etude to the use of this scale and ensuring the target notes follow the chord progression is consistent with how blues artists commonly improvise with a single scale and adapt the scale to the chord changes. The combination of triplets and swung eight notes is also a stylistic application making the etude challenging to perform accurately with a bottleneck slide, even at a slow tempo.

The musical score is for "Slide and Vibrato Arm Etude #6" and is written for three guitars and a bass. The key signature has one sharp (F#) and the time signature is 4/4. The score is divided into four systems, each containing three staves. The parts are labeled as follows:

- Slide Gtr 1:** The top staff in each system, featuring melodic lines with slides and vibrato.
- Vib Arm Gtr 2:** The middle staff in each system, featuring melodic lines with vibrato.
- Bass Gtr 3:** The bottom staff in each system, featuring a bass line with various chords and melodic lines.

The chords and melodic lines are as follows:

- System 1:** Slide Gtr 1 has a melodic line starting on A4. Vib Arm Gtr 2 has a melodic line starting on A4. Bass Gtr 3 has a bass line with chords A5, C5, and G/B.
- System 2:** Slide Gtr 1 has a melodic line starting on A4. Vib Arm Gtr 2 has a melodic line starting on A4. Bass Gtr 3 has a bass line with chords Dm, C/E, B/D#, E5, and C5.
- System 3:** Slide Gtr 1 has a melodic line starting on A4. Vib Arm Gtr 2 has a melodic line starting on A4. Bass Gtr 3 has a bass line with chords E5, D5, and C5.
- System 4:** Slide Gtr 1 has a melodic line starting on A4. Vib Arm Gtr 2 has a melodic line starting on A4. Bass Gtr 3 has a bass line with chords D5 and A5.

Figure 5.11 Slide and Vibrato Arm Etude #6

(Audio - Media Disc –Etude #6)

Several trio etudes were written to explore the sound of overlapping quartertone parts on the guitar. Figure 5.11 shows the notation for Etude #6 which is written over a more contemporary rock progression and explores the practical pitching of quartertones using the vibrato arm on the electric guitar as well as bottle neck slide. The bass part is purely supportive and contains no microtonality. The fretless guitar was also attempted on both the guitar 1 and guitar 2 parts. The etude proved that quartertones were very achievable and the communication of the notation suitable for guitar techniques.

Gtr Ad Lib (Use microtonal bends)

The musical score is written for three parts: Slide Gtr 1, Vib Arm Gtr 2, and Bass. It is in 4/4 time. The first system (measures 1-4) shows the beginning of the piece. The second system (measures 5-8) continues the progression. The third system (measures 9-12) includes a D7 chord for the bass. The guitar parts feature quartertones and microtonal bends, while the bass part provides a walking line.

Figure 5.12 Slide, Vibrato Arm and Quartertone Walking Bass Line

The image displays three systems of musical notation for a guitar etude. Each system consists of a treble clef staff and a bass clef staff. The first system, starting at measure 13, includes an A7 chord marking. The second system, starting at measure 17, includes E7 and D7 chord markings. The third system, starting at measure 21, includes an A7 chord marking. The bass lines are characterized by a steady, descending quarter-note pattern, while the treble lines feature more complex, melodic figures with slides and vibrato.

Figure 5.12 Slide, Vibrato Arm and Quartertone Walking Bass Line

(Audio - Media Disc –Etude #9)

Trio Etude #9 in Figure 5.12 explored the microtonal possibilities of walking bass and quartertone harmonies based on a style similar to the Miles Davis blues *Freddie The Freeloader*. A fourth guitar improvises traditionally in standard tuning over the top of background quartertone figures produced by bottleneck slide and vibrato arm. The descending bass line was played on a fretless guitar, pitched down one octave and walks in quartertone steps. The low register of the bass line makes the microtonal steps less perceivable than in the guitar parts but still produces a familiar double bass like sound. Although the guitar parts create a slightly warped or blurred harmony due the sustained timbre produce by the slide and vibrato arm it still produces a very useable effect therefore could be used in an arrangement.

5.4.4 Harmonics Etudes

Harmonics are not a technique commonly associated with the blues but can be useful for adding microtonal pitches to a composition. Many contemporary guitarists with blues backgrounds have utilized harmonics particularly Jeff Beck on his compositions *Where Were You* & *Two Rivers* (Carson, 2001).

Producing harmonics on the guitar is the easiest way to avail of just intonated pitches without altering any aspects of the instrument although the limitations are quickly evident. The first five harmonics on the guitar are fairly easy to produce with higher harmonics possible depending on the sound set up for the guitar. Attacking notes closer to the bridge will excite string nodes and combined with an overdriven sound will enable the higher harmonics to sound easier. Unfortunately they can be fairly weak sounding and therefore limit the application of these pitches to situations when they will be audible.

The image shows a musical score for 'Harmonics Etude #10 Extract' in 4/4 time, key of D major. It consists of three staves, all using treble clefs. The top staff is labeled 'G String Harm. Octave pedal 8va' and contains two notes marked with diamond-shaped note heads, with a bracket indicating they are an octave apart. The middle staff is labeled 'G string Harm.' and contains a sequence of notes marked with diamond-shaped note heads. The bottom staff is labeled 'G String Harm. Octave pedal 8vb' and contains a sequence of notes marked with diamond-shaped note heads. Fret positions are indicated below the staves: 'Fret 5' for the top staff, 'Fret 7 5' for the middle staff, and 'Fret 12 7' for the bottom staff. The notes in the middle and bottom staves are grouped in pairs, with a '5' written above each pair.

Figure 5.13 Harmonics Etude #10 Extract

(Audio & Full Score - Media Disc –Etude #10)

Figure 5.13 shows an extract from Etude #10 which explores the notation of harmonics by adjusting note heads to diamonds and under each staff indicates the position the harmonic played in relation the fret. All notes in this etude are played on the G string but the top staff is pitch up an octave and lower staff pitch down one octave. The rhythmical superimposition of five over four in the lower part creates a texture more

associated with contemporary composition but the addition of a blues improvisation using microtonal vibrato arm pitches (not notated) result in an effective combination of the two styles.

The image displays a musical score for Etude #12, consisting of two systems of three staves each. The key signature is three sharps (F#, C#, G#) and the time signature is 4/4.

First System:

- Staff 1 (Top):** Labeled "Fret -3". It contains a single note with a microtonal vibrato arm pitch symbol (a circle with a vertical line through it) and a slur over it. A fret number "4" is written below the staff.
- Staff 2 (Middle):** Labeled "Fret 5". It contains a series of eighth notes with microtonal vibrato arm pitch symbols. A fret number "5" is written below the staff.
- Staff 3 (Bottom):** Labeled "Fret 12". It contains a series of eighth notes with microtonal vibrato arm pitch symbols. A fret number "12" is written below the staff.

Second System:

- Staff 1 (Top):** Labeled "Fret 5". It contains a single note with a microtonal vibrato arm pitch symbol and a slur over it. A fret number "5" is written below the staff.
- Staff 2 (Middle):** Labeled "Fret 4". It contains a series of eighth notes with microtonal vibrato arm pitch symbols. A fret number "4" is written below the staff.
- Staff 3 (Bottom):** Labeled "Fret 12". It contains a series of eighth notes with microtonal vibrato arm pitch symbols. A fret number "12" is written below the staff.

Annotations:

- Between the first and second systems, there are two text blocks:
 - "Strings 3 & 4 Tuned to E
Played simultaneously
String 4 pitched down 8vb"
 - "String 6
Pitched down 8vb"
- At the end of each system, there are double bar lines with a "2" above them, indicating a repeat or a specific measure.

Figure 5.14 Etude #12 extract
(Audio & Full Score - Media Disc –Etude #12)

This idea is further explored in Etude #12 (Figure 5.14) creating rhythmical patterns from the natural harmonics to create a background for a slide improvisation that utilizes quartertones. This is the first etude to experiment with the detuning of strings to facilitate strings use of natural harmonics.

The harmonic etudes contain the least amount of adventurous, audible microtonally but can be effective in creating minimalist inspired parts in the style of Steve Reich and Philip Glass and potentially add microtonal textures to a composition.

5.4.5 Open Tuning & Scordatura Etudes

The accompaniment role of the guitar in blues is very important as it provides rhythm and harmonic support for the vocal or soloing instrument. If the harmony in a composition is mainly static, as in a hill country blues, the application of just intonated chords can be created by re-tuning to the desired chord and making microtonal adjustments to create purer intervals. When the harmony is moving through chord progressions, such as a twelve bar blues, we should treat each chord as if it is a new key centre. This is a very technical challenge on the guitar but an important consideration taking the essential role of chordal accompaniment into account. This was investigated by researching tuning systems that are popular to blues players, some of which previously introduced in Chapter 4.3.5. The etudes were written to explore accompaniment and the possible harmonic base that could be created for future use in compositions. They therefore sound less microtonal than the 5-limit etudes but provide a background to which microtonal melodies can later be added. These etudes combine traditional and modern techniques for providing microtonal harmony that are further explored in the final composition.

Gtr 1
Standard Tuning

Gtr 2
E B E G# D E
B +2cents
G# -14cents
D -31cents

Figure 5.15 Open Tuning Etude #13 - Hill Country Blues

(Audio - Media Disc –Etude #13)

The score for open tuning Etude #13 in Figure 5.15 shows a basic fingerpicking, hill country blues pattern in a modified open E tuning. The hexaphonic pickup guitar is played in standard tuning but the strings are manipulated in DAW Reaper using the VST plug in Pitch Proof by Aegean Music to E B E G# D E (low to high).

The open tuned B is raised by 2cents, the G# flattened by 14 cents and D lowered by 31 cents to create a just intonated open E dominant seven tuning.

An improvisation is performed over the accompaniment on bottleneck slide guitar. It is clear the underlying harmony influences the tuning of the improvisation, away from equal temperament, utilizing more just intonated pitches.

A7

*Gtr 1 - Improvise
long microtonal
pitches with slide
& ebow*

*Gtr 2 Tuned
E A E A C# E
E +2cents
C# -14cents*

Figure 5.16 Open Tuning Etude #14 - Piedmont Blues

(Audio & Full Score - Media Disc –Etude #14)

The excerpt from open tuning Etude #14 in Figure 5.16 creates more harmonic movement with long sustaining microtonal pitches provided by the slide. The chords change but the tuning stays the same in this etude which means the A chord is just intonated but the other chords in the progression are not. A judgement was made to not change for each chord here as the results sounded satisfactory when combined with the long overlying microtonal pitches. The results of this etude proves that compromises can be made and normal aural assessment can still be applied to make decisions on the composition. One does not need to be tied to the rules of just intonation.

Mike Brookfield

A *Brush Strings With Thumb*

Gtrs Tuned
DADFAD
A -2cents
F-16cents

p
Play as harmonics

mf

String/Fret 6/5 4/7 6/7 4/5 3/12

B

4/12 6/5 6/7 6/5 4/7

4/12

Figure 5.17 Open Tuning Etude #15 - D Cross Minor Tuning

(Audio & Full Score - Media Disc –Etude #15)

Etude #15 in Figure 5.17 is based on a cross note minor tuning system previously discussed in relation to Skip James in Chapter 4.3.5. This etude further explores more contemporary textures with the use of harmonics, time signature changes and the just intonated minor chord is played with brushing of the thumb to create a subtle texture that allows dynamic development. The chord can be shifted up to the fifth and seventh fret to create a just intonated Gm and Am chord. This etude was used as a backing track to

practice the slide playing of long microtonal pitches which helped connect the contemporary compositional aesthetic and traditional blues playing.

5.4.6 Blues Cells Concept & Etude

One of the most technically difficult and desirable things an improvising musician can do on their instrument is convincingly playing with a sense of phrasing and pitch that is equally as good as a vocal performance. The analysis presented in Chapter 4 provides us with an opportunity to attempt reproducing the microtonal pitches sung by blues musicians and exploit them for composition effect.

Each of the ten pieces analysed were attempted on bottleneck slide guitar and three small phrases were extracted per song. These phrases are called blues cells and will be translated into new material to build an etude.

Robert Johnson

The figure displays three musical staves, each representing a different phrase from Robert Johnson's 'Early in the Morning'. Each staff is in 4/4 time and features a treble clef with a key signature of two flats (B-flat and E-flat). The notes are marked with microtonal adjustments in cents, indicated by numbers above the notes.

- Staff 1:** Labeled '1' on the left. The notes are: Early (microtonal +25), this (microtonal -22), morning (microtonal +10), this (microtonal -13), morning (microtonal +13), this (microtonal -16), morning (microtonal +3).
- Staff 2:** Labeled '2' on the left. The notes are: And (microtonal -29), I (microtonal +10), said (microtonal +9), hello (microtonal +27), Satan (microtonal -14), Satan (microtonal -49), Satan (microtonal -17), Satan (microtonal -7).
- Staff 3:** Labeled '3' on the left. The notes are: Early (microtonal -45), this (microtonal -7), this (microtonal 0), morning (microtonal -6), morning (microtonal +17), Ooh (microtonal +21).

Below these three staves is a single staff labeled '1', '2', and '3' above the first three measures. This staff shows the extracted blues cells, where each note is given equal pitch (no microtonal adjustments) and is marked with a black note head.

Figure 5.18 Blues Cells Chosen from Robert Johnson Analysis

The notation in Figure 5.18 shows the original lines (cells) extracted from the Robert Johnson score and labelled one to three. The notation on the bottom line with the black note heads, labelled one to three, are the matching cells but each note is now given equal

importance. The cells are notated with sixth-tone accidentals as well as quartertone accidentals which means the performer will have to approximate these pitches with string bending, bottleneck slide or vibrato arm.

Each cell is written out in intervals with an accompanying contour line that reflects the intervallic shape of the phrase.

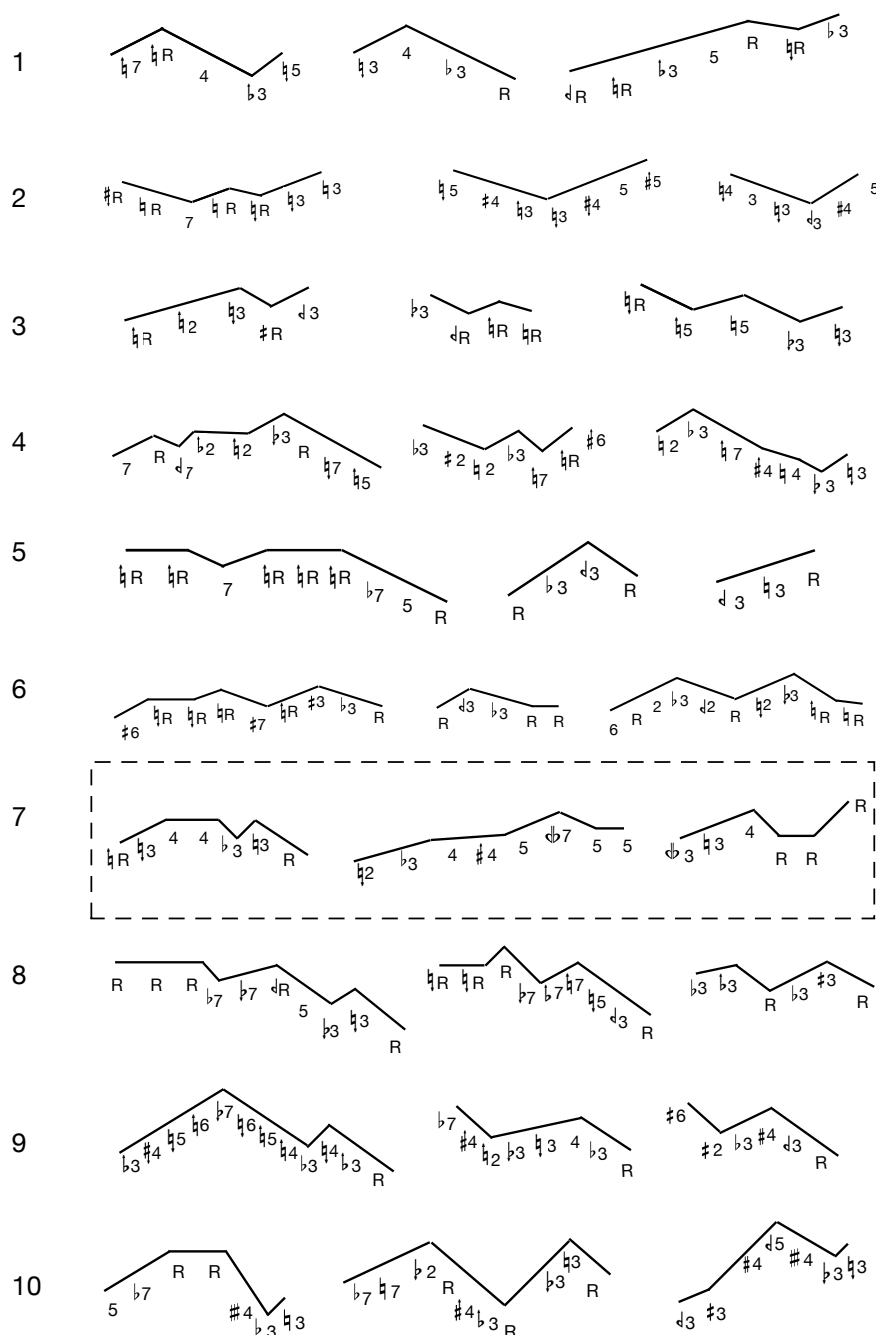


Figure 5.19 All Blues Cells re-written as interval shapes

Figure 5.19 contains all thirty blues cells with the Robert Johnson selections highlighted. These interval shapes provide a different perspective on the microtonal phrases previously analysed and now taking the new form of material for composition.

The composition etude constructed from the blues cells uses a guitar playing just intonated chords and two guitars performing the cells. The 30 blues cells were matched into pairs taking the number of notes contained in each phrase and the contour shape of the phrase into account. The two guitars played the pairs simultaneously and transposed the blues cells to fit each chord using bends, bottleneck slide, vibrato arm or harmonics if possible.

Blues Cells Composition #1
Mike Brookfield

60 bpm

Gtr 1
(Cell 1)

0:00

0:06

E7
4 Bars

Gtr 1
(Cell 2)

Gtr 2
(Cell 28)

A7
4 Bars

Gtr 1
(Cell 11)

Gtr 2
(Cell 14)

G7
4 Bars

Figure 5.20 Blues Cells Etude Score Extract

(Audio & Full Score - Media Disc –Etude #17)

The first page of the score to Etude #17 is shown in Figure. 5.20. This alternate form of notation was created from the pitch cells and aims to communicate microtones to the musician in a composition or to be used by a composer that requires elements of improvisation with specific microtonal pitches. Jazz musicians will be familiar with the intervallic shapes and applying them to different chord types when performing improvisations over chord progressions. This system was taught by jazz teacher Charlie Banacos (Banacos, 2018). The first page shown contains twelve bars with the chords of E7, A7, G7 played on the accompanying guitar for four bars each. Guitar one starts the improvisation and guitar two joins in approximately 6 seconds later. Each blues cell should be spread over four bar or can be played faster and repeated but the cell must be completed within the four bars and the note order maintained exactly as presented. The performers are encouraged to play with close attention to the other performer, sometimes playing notes alternately and at other time creating spontaneous microtonal harmony. The indeterminacy of this piece is connected to both the improvisational aspects of blues and the aleatory/chance operations of contemporary composers like John Cage. If the piece was practiced to a high level the interval contour line could also be interpreted as dynamic phasing which would add extra detail this experimental scoring system.

5.5 Chapter Conclusion

All of the guitar techniques explored proved they can achieve microtones but there are individual concerns and limitations that should be taken into account when performing or composing with them. There are six techniques identified that are to contribute to the final composition. These are listed below with their individual concerns:

- Slide guitar provides good access to microtonal pitches but the glissando or portamento approach or movement between notes is a very distinct effect that will often not be desired.
- The vibrato arm sensitivity will vary with each guitar and the players set up preference. How many springs used in the vibrato system and the angle at which the bridge is set both influence the pitch accuracy of this technique.
- String bending produces established blues textures but the technique is limited to certain situations. It is very hard to perform a melodic line accurately were the microtonal pitch required are less than a quartertone.

- Harmonics give perfect just intonated pitches but note choices are limited due to the open tuned strings and the scale length of the guitar, the longer bass neck facilitates more harmonics. Picking close to the bridge allows higher harmonics to be produced. The higher harmonics can be weak sounding therefore limiting the application, some notes may not be perceivable in louder musical situations.
- Scordatura can produce a wide range of microtonal effects with very different degrees of dissonance. The technique suits guitar ensembles and string groups each playing a specific harmonic role.
- The hexaphonic pickup provides more accurate tuning possibilities than scordatura as you can define the exact deviation in computer software. Some etudes were recorded with scordatura and then alternatively the hexaphonic pickup. When compared the scordatura had a more pleasant timbre, as the string were not digitally altered, but the hexaphonic pickup provided more accurate and perceivable microtonal deviations.

These techniques and applications are combined with the research and pitch analysis to form a guitar trio composition titled *Future Shades of Blue*.

6. Future Shades Of Blue

6.1 Chapter Introduction

The research findings are consolidated to form a composition that takes advantage of the pitch analysis results, and explores microtonal guitar techniques and new compositional systems.

The full score can be found in Appendix A. The audio, score, MAX patch, pitch shifting plug-in and samples are included in the accompanying media disc.

6.2.1 The Composition – Future Shades Of Blue

The main composition focuses on elements developed from the research and combined to show a varied depth of microtonal content. The composition is made up of three movements, a guitar trio format for movements 1 & 2 and solo guitar for movement 2. Consideration has been given to the ability level of the performers with the hierarchy of an advanced part for guitar 1, intermediate level part for guitar 2 and the simpler part of guitar 3 which switches to bass in the third movement. An overview of the composition shows there are three main concepts utilized

- Movement I - Inspired by pitch analysis of Charlie Patton 1934 recording *34 Blues*
- Movement II - inspired by *Bridge* by James Tenney, concept applied to solo guitar.
- Movement III - Explores the Hill country blues style played by blues musicians like John Lee Hooker with the use of hexophonic guitar and quarter & sixth-tone soloing techniques for blues guitar.

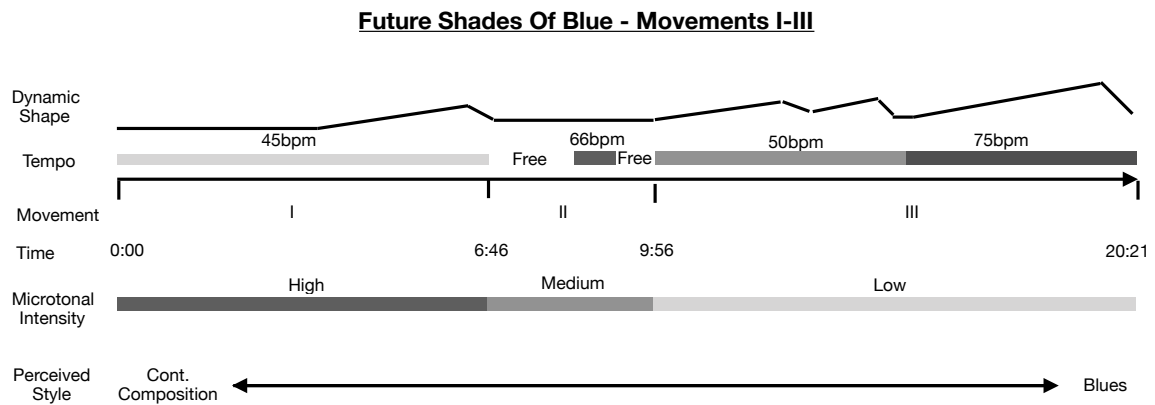


Figure 6.1 Visual Overview of all three movements

6.2.2 Movement I

The material generated for the first movement came from the pitch analysis of the Charlie Patton 1934 recording *34 Blues*. The long tones or emphasised pitches that were graphed during the analysis stage were used by simplifying the pitches to quartertones, sixth-tones and 12-Tet notes. The diagram in Figure 6.2 shows how the three categories of notes (quartertone, sixth-tone and 12-Tet) have been assigned to different guitar parts.

The three guitars were limited to the pitches assigned to them but the intervals are allowed to change with the chord progression and key changes. The notation in Figure 6.3 displays how Guitar 1 is limited to four notes, the $b3^{rd}$, 3^{rd} , 5^{th} , $b7^{th}$ and this guitar is instructed to tune down -33cent to match a sixth-tone deviation from equal temperament. The three or four octave range for each note is also displayed in Figure 6.3. This provides a good range of pitches for the creation of microtonal effects and harmonies. Guitar 2 is assigned two notes, the $b3$ and 6^{th} but tunes +50 cent sharper than equal temperament. Guitar 3 is tuned to standard with the sixth string lowered to a D. All three guitars are assigned a $b3$, so it is possible to perform three different tunings for the note of F in the key of D. These closely pitched notes interfere with each other to create beating effects and unpredictable psychoacoustic by-products. The microtonal composition by James Tenney *Water on the mountain... Fire in heaven* previously mentioned in Chapter 2.2.4 inspired the use of this compositional technique.

Charlie Patton
34 Blues (Third Verse)

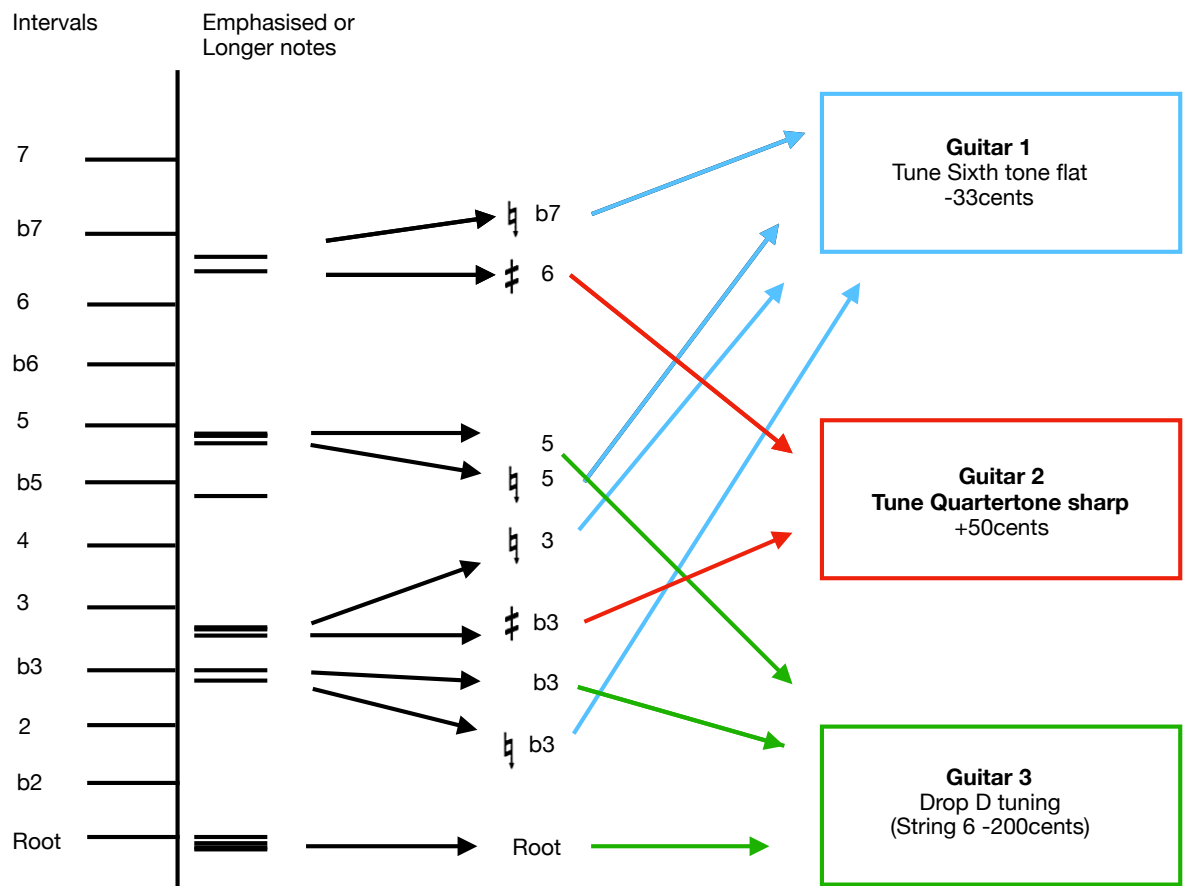


Figure 6.2 Charlie Patton analysis pitches assigned to guitar trio

Future Shades Of Blue (I)

(Charlie Patton)

Mike Brookfield

D(I)

Guitar 1
-33cents
Plays b3, 3, 5, b7

Guitar 2
+50cents
Plays b3, 6

Guitar 3
Drop D tuning
Plays R, b3, 5

G(IV)

A(v)

©mikebrookfield

Figure 6.3 Reference for all viable pitches for each guitar part

The first movement was the last of the three movements to be composed and contains the most experimental writing of the three movements. The form for the first movement is constructed around a traditional twelve bar blues. The slow development of the piece is intended to build towards the climax that arrives in the third movement, allowing time to explore longer dissonance and consonances between pitches at a slow pace that focuses the listener on the microtonality early on in the composition. The first movement intends to focus the listener on the microtonal beating effects between notes, microtonal harmonies and the shift from transient free volume swells to fully articulated notes. The traditional compositional use of harmony and melody is replaced by the exploration of the interacting microtones and the creation of textures.

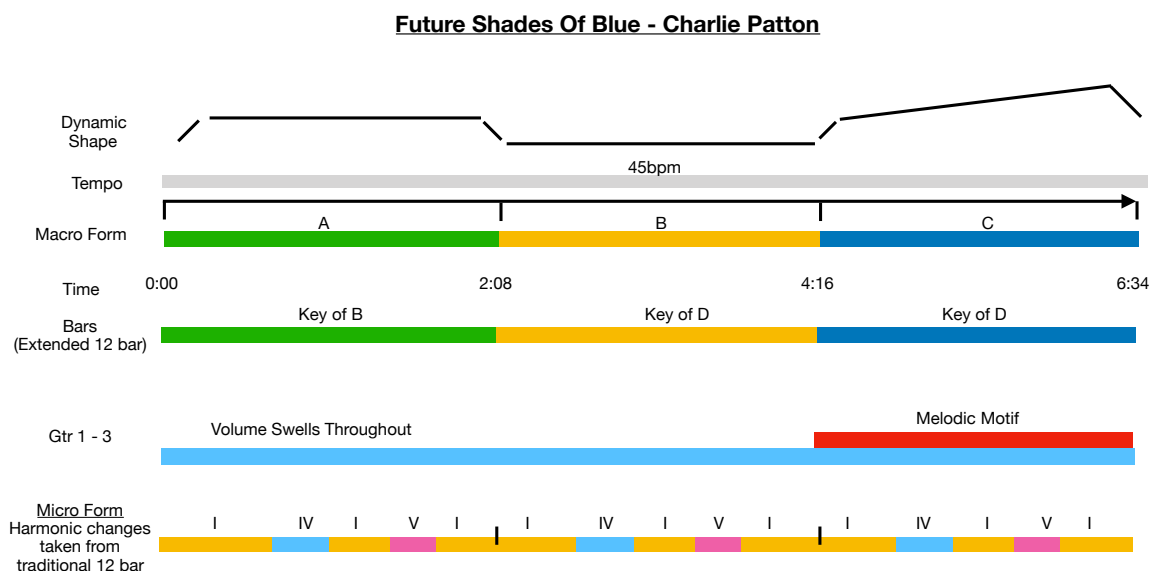


Figure 6.4 Visual overview of Movement I

The diagram in Figure 6.4 shows a visual representation of the form. The regular twelve bar blues form is doubled to twenty four, the tempo of 45bpm adds a static quality to sections A and B. The last section C contains more traditional material with the 12 bar blues structure being much easier to aurally identify.

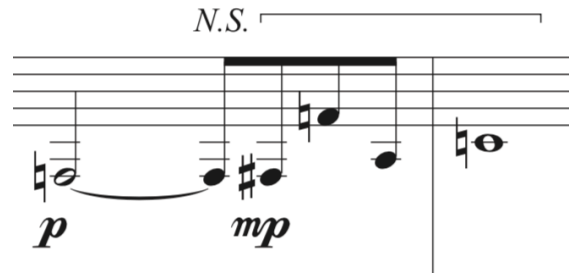


Figure 6.5 Melodic Motif from third section of Movement I

The motif seen in Fig. 6.5 from guitar 1 is repeated and developed in section C and the microtonality is kept to the forefront of the composition until the end of the movement. The predictable patterns in section C are relatively easy for western ears to accept despite their strangeness and the closeness of microtonal pitches, especially after the ambiguous nature of section A and cinematic use of samples in section B. This movement develops from the experimental to a sound that would not be dissimilar to the aesthetic and instrumentation on a Tom Waits recording with Marc Ribot on guitar. The research conducted into Harry Partch had led to an appreciation of *Weird Nightmare* (Willner, 1992) previously mentioned in Chapter 2.2.2, the studying of guitar performances on this recording by Bill Frisell and Marc Ribot became an influence on section C. The development from abstract to a clearly recognisable form is intended to bring the listener into the blues, a juxtaposition morphing from the contemporary compositional sound to the simplicity of a blues form.

The samples used in section B were the last to be added and intended to conceptually tie all musical elements together. The Charlie Patton recording used for analysis was manipulated in various ways to communicate meanings associated with the original recording

- Extracting a guitar part and looping to create a repetitive figure
- Vocal extracts edited placed with the form of section B
- Vocal time stretched in the program PaulStretch to create long sustained drone
- Experiments were performed on drones with pitch shifting to create microtonal harmonies that fit with the underlying progression
- Time stretched part manipulated with the MAX patch SugarSynth to create train-like sounds and different speeds

These textures were introduced to communicate meanings behind the lyrics of the original song.

“fella down in the country it almost make you cry, women & children hitching freight trains for a ride” (Patton, 1934).

The three part form to the first movement explores the dissonant use of microtonality, this progressively decreases throughout the three movements.

6.2.3 Movement II

In the research conducted into contemporary compositional microtonal techniques, several different concepts were inspired and developed from the work of James Tenney. Tenney’s composition *Bridge – Two Pianos, Eight Hands* is based on the 5-limit tuning system. The 5-limit tuning is the system of tuning limited to pitches produced by multiplying a fundamental base note frequency by the integers 2, 3 and 5. (Doty, 2002)

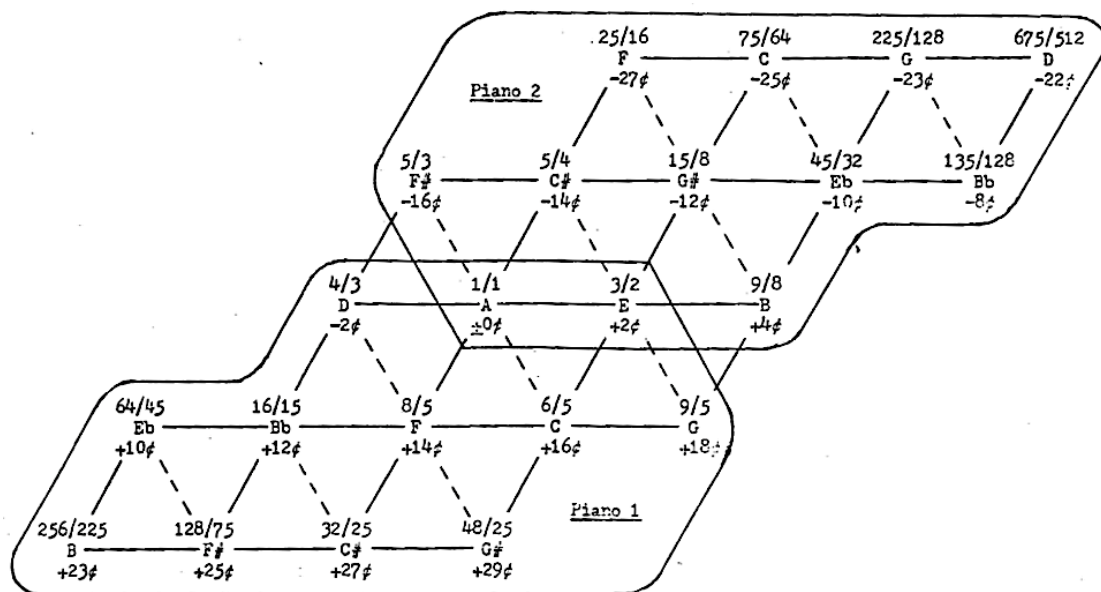


Figure 6.6 Five-limit lattice from the James Tenney score for *Bridges* (Tenney, 1990)

Figure 6.6 shows a lattice diagram of the 5 limit tuning system taken from the performance notes in the score for *Bridges*. Tenney has assigned the lower portion of the lattice to piano 1 and the higher portion to piano 2. This requires the two pianos to be tuned differently and subsequently results in the pianos playing different microtonal pitches for the same notes except the A and E that overlap in the centre of the lattice.

The horizontal lines in the lattice show the intervals of a 5th from left to right and intervals of a 4th from right to left. The diagonal lines ascending to the right and descending to the left are major 3^{rds}. The dotted diagonal line ascending to the left and descending to the right are minor 3^{rds}. This concept was used to produce a solo etude where the six strings of the guitar represent the six horizontal lines in the lattice. To keep a close conceptual connection to the blues only the notes of the hybrid blues scale are chosen to be played from the lattice, this time including the 6th degree resulting in the nine note scale R, 2, b3, 3, 4, b5, 5, 6, b7.

String 1	String 2	String 3	String 4	String 5	String 6
-24cent	-13cent	+2cent	0	+14	+25

Table 6.1 Scordatura tuning for solo guitar (Mvt II)

In the top line of the lattice the notes deviate in cents from equal temperament in range from -27 to -22 (left to right), the average is calculated at -24.5 cents and assigned to the first string. This process is repeated for each line and assigned to strings one to six. Each string can only play the notes specific to their line.

Example: In the key of A the first string can only play the pitches C, G, D and the second string can only play the pitches F#, C#, Eb.

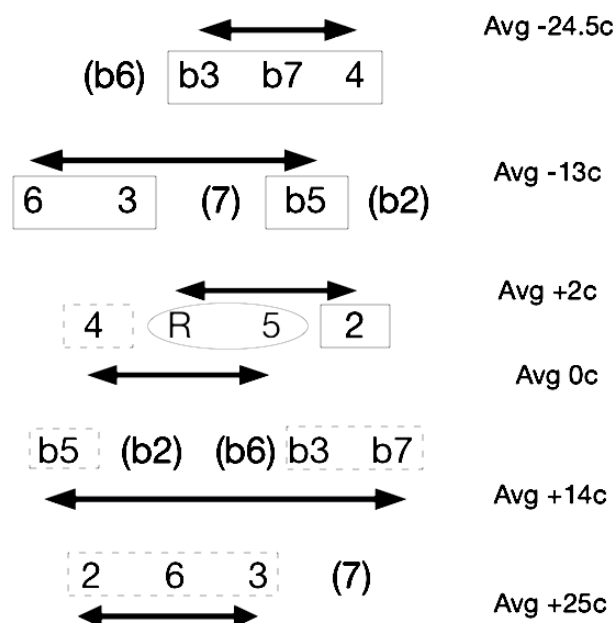


Figure 6.7 Adaptation of Tenney's system to guitar with hybrid blues scale

Fig 6.7 shows the 5-limit lattice and its application to the six strings of the guitar. The dotted line rectangle boxes in the lower half show the notes belonging the hybrid scale which are assigned to the lower three strings and the normal rectangle boxes represent the scale assigned to the higher three strings. The oval in the centre represents the overlap in the lattice. There are expansion possibilities for this concept which could develop into arrangements for ensembles, the chords created could be assigned to different instruments and exploited for compositional effect.

The sound of the hybrid scale is not representative of the blues but does create microtonal textures. The combination of contemporary compositional technique and the hybrid scale taken from the blues has resulted in a new concept for solo guitar composition.

6.2.4 Movement III

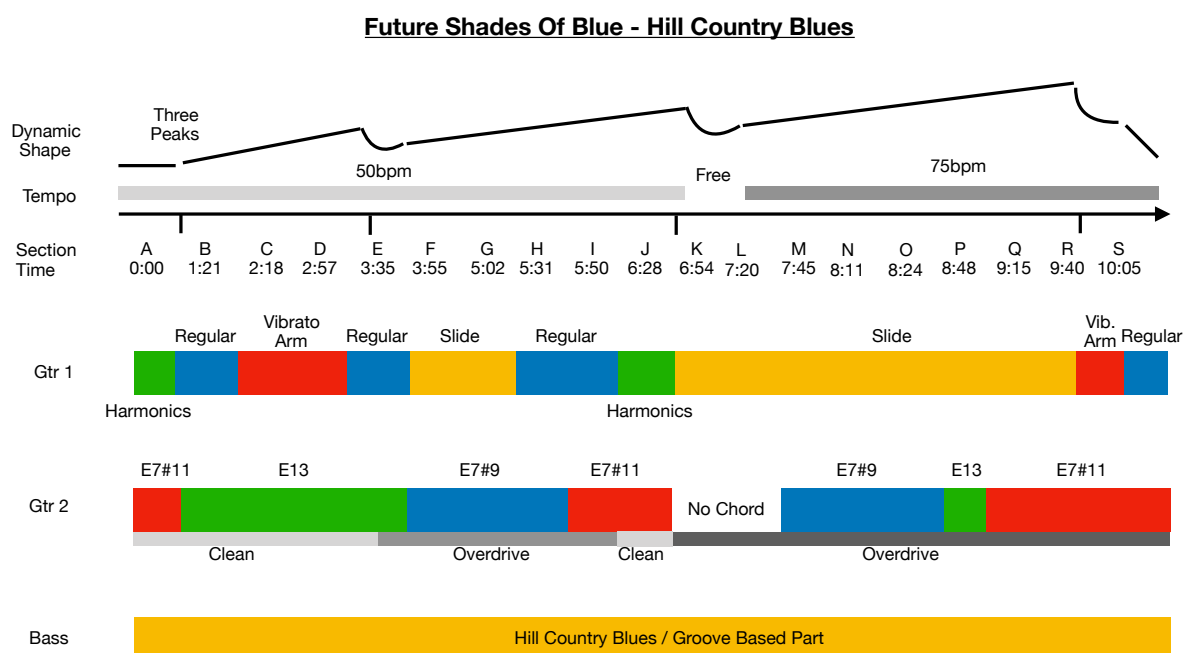


Figure 6.8 Visual representation of Movement III *Future Shades of Blue*

The third movement focuses on the exploration of microtonal guitar techniques.

The guitar tunings are as follows:

- Guitar 1 switches between a standard tuned guitar and guitar tuned to open E, low to high E, B, E, G# (-14cent), B, E for slide.
- Guitar 2 switches between different just intonated chords produced by the hexaphonic guitar and MAX patch.
- Guitar 3. Electric bass part with scordatura, tuning low to high E, A (-31cents), D (-33cents), G.

The opening section explores harmonics in the guitar parts and a Charlie Patton sample similar to the first movement is introduced at the end of this section. This movement contains written improvisations that are executed with different guitar techniques.

Future Shades Of Blue
(Movement III)

The image shows a musical score excerpt for 'Future Shades Of Blue (Movement III)'. It consists of three staves. The top staff is in treble clef with a key signature of three sharps (F#, C#, G#) and a time signature of 4/4. It begins at measure 71 with a forte (f) dynamic. The melody features a series of eighth notes with microtonal adjustments, indicated by a dashed line labeled 'Vibrato arm'. The middle staff is also in treble clef with the same key signature, showing a just intonated E7#9 chord. The bottom staff is in bass clef with the same key signature, starting at measure 71 with a harmonic on the detuned D string. The score concludes with three quarter notes in the top staff, each marked with a 1/4 microtonal adjustment.

Figure 6.9 Excerpt from Movement III *Future Shades of Blue*

Figure 6.9 displays a reoccurring melodic motif that is played with microtonal movements of the vibrato arm and then repeated with staccato string bends. The chord below is a just intonated E7#9 chord the G natural is -33cent, D -31 cents and G# -14 cent. Different adjustments were explored for the G natural and the septimal minor 3rd adjustment of -33cent sounded the most appropriate fit in this context. Tremolando feature frequently on the first and movements third movements, the bass uses it here with a minor 7th played as a harmonic on the detuned D string.

The Diagram in Fig 6.10 shows the pitch deviations created for guitar 2 and suggested set up for the midi controller. String 2 on the Dom7#11 chord has two options of deviation (excluding to 100cents to drop B to A#) -17cents a common tritone deviation from the 7-limit and -49cents from the 11 limit tuning system.



Future Shades Of Blues - Midi Controller for tuning and samples			
	Chord type	Deviations	Notes to Fret (String/Fret)
1	Dom #11	String 1 +4cents, (F#) String 2 -117cents (A#) or -149c String 3 -14(G#) String 4 -31(Open D)	1/2 2/0 3/1 4/0 5/0 6/0
2	Dom 13	String 1 +4 (F#) String 2 -16 (C#) String 3 -14 String 4 -31cents (D)	1/2 2/2 3/1 4/0 5/0 6/0
3	Dom7#9	String 1 -33 (G) String 2 -31cents (D) String 3 -14 (G#) String 4 (E)	1/3 2/3 3/1 4/2 5/0 6/0
4	-	-	-
5	Zero reset	-	-
6	Sample 1	Mvt I, Bar 0	
7	Sample 2	Mvt I, Bar 24	
8	Sample 3	Mvt I, Bar 74	
9	Sample 4	Mvt III, Bar 13	
10	Sample 5	Mvt III, Bar 81	

Figure 6.10 Pitch deviations and midi controller set up for Guitar 2

The slow paced build of the third movement is based on the hill country style of blues. The groove and pace should give a hypnotic feel where there is no sense of urgency in the music. Towards the end of the piece the performance of microtones on slide aims inject some more expressive feeling and dynamics content which often associated with the blues genre.

6.3 Critical Evaluation & Chapter Conclusion

“For art to succeed, it simply needs to be “good”, it doesn’t need to be “correct” in the educational-intellectual sense” Garrett Sholdice (Sholdice, 2018).

The formal composing and the learning of microtonal performance techniques has facilitated the development of new concepts that combine blues and contemporary composition to varying microtonal intensities. These concepts can be further expanded and refined for different ensembles and applying different parameters such as tempo, range and dynamics. Composing with microtonality can help develop the ear to become more accustomed to pitches outside of equal temperament. One’s ear quickly adjusts to new tuning systems, especially when working closely with them in a composition where constant revising and adjustments are being made. Reflecting on the composition, revisions to *Future Shades of Blue* could include

- More dissonant content and less subtle use of microtones. The concept of starting with the most intense microtonality and slowly resolving over the three movement worked on some levels. This facilitated the exploration of guitar techniques but left the composition as a whole feeling less adventurous towards the second half. This could have been a miscalculation made early on, thinking less microtonal content would make it easier to build the piece in a tradition blues fashion and with subtle added microtonality to raise intensity. Unfortunately the attempts to raise a crescendo with just intonated chords and microtonal movements in the lead guitar fell slightly short of the target on this attempt. The stronger microtonal concepts used earlier in the piece felt more cohesive and exciting considering the research objectives.
- Restructuring the form to bring more microtonal elements in during the third movement. With the benefit of hindsight and increased knowledge of microtonal concepts it would have interesting to use the Ben Johnston technique of multiple, combined sets of overtones with common tones to create more dense chordal textures (Gunden, 1986). Breaking away from traditional chords momentarily, this may have helped define a new section in the third movement.
- The tempos were set very early on in the composition stage, not really allowing for a progression in technical ability. The overall tempo could be experimented with in the movements more, adding some forward motion/brightness and overall

development, especially to movements one and three. The techniques explored in movement three are phrased slightly cautiously to allow for the practical performance of the written parts. Now these techniques have been confidently explored future applications are likely to push the limits of ability.

- A MAX patch is currently being developed that explores chord progressions and not just chord types. The research conducted into the tuning preferences of blues artist and concepts developed by composers now provides huge options that were not explored in this composition. Figure 6.11 shows the proposed experiment to explore chord progressions that combine open tunings in MAX with just intonated adjustments. The concept in the third movement was to use a static hill country blues groove but the composition could benefit from some added chord progressions that would help the form and mark developments within the piece.

	Key	Chords (I, IV, V)	Tuning system (Low to High)	
Pedal 1	A	A, D, E	E A E A* C# E^	Open A
Pedal 2	B	B, E, F#	F# B D# F# B* D#^	Custom
Pedal 3	C	C, D, G	C C G C* E G^	Overtone tuning
Pedal 4	D	D, G, A	D A D* F# A D~	Open D
Pedal 5	E	E, A, B	E B E* G# B E~	Open E
Pedal 6	G	G, C, D	D G D G* B D^.	Open G
Pedal 7	Am	Am, Dm, Em	E A E A* C E^	Cross note in A
Pedal 8	Dm	Dm, Gm, Am	D A D* F A D~	Cross note in D
Pedal 9	Em	Em, Am, Bm	E B E* G B E~	Cross note in E
Pedal 10	Gm	Gm, Cm, Dm	D G D G* Bb D^	Cross note in G
CC Controller 1	*Drops root note down to just intonated b7th			
CC Controller 2	~ Raises root up to just intonated 9th or ^ Raises 5th up to just intonated 13th			

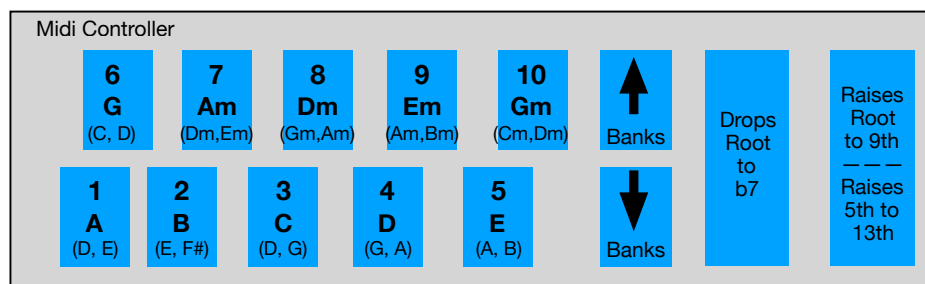


Figure 6.11 Proposed experiment combining MIDI controlled open tunings and MAX

- Incorporating unusual bar lengths and time signatures to reflect the intuitive use in blues to develop of third movement. The influence of the John Lee Hooker *Tupelo* example shown in Section 4.3.2 felt like a missed opportunity but will be explored in future revisions. The blues and its intuitive dropping of beats could be scored and accentuated with the added influence of contemporary compositional techniques.
- Produce a more dynamic and natural recording that builds effectively through live performance interaction. The studio recording to a click track produces a good demonstration of the composition but lacks the natural interaction and flow required for the expressive nature of the blues. A revised version of *Future Shades of Blue* performed and recorded by a live ensemble is hoped to be scheduled which will produce more exciting results.
- Inclusion of percussion and tuned percussion inspired by the Weird Nightmare (Willner, 1992) recording mentioned in Chapter 2.2.2. The research resulted in a re-discovery of this recording that has always been a personal favourite. This recording's use of Harry Partch instruments was unknown to me until the thesis research began. The connection inspired confidence and added momentum to the research, being drawn to such a recording without predetermined reasons or objectives made my relationship with microtonality feel very natural. Using similar percussive techniques, both ambient and groove based could enhance future versions.
- Applying the James Tenney *Bridge* tuning to guitar in the second movement was very inspiring. Lots of extra material was written but not included in the solo piece which felt like it should be three minutes and no longer. A re-scoring of the distribution of notes from solo guitar to guitar trio would allow more overlapping of sustained pitches. This may take the form of a new composition but applying it to this movement would benefit the research and personal development of the idea needed.
- Use the Muddy Waters phrase from Figure 4.12 as inspiration. This was attempted but not successfully realised to suit composition. Develop a three note phrase microtonally similar to Muddy Waters sang the same word three times with microtonal adjustments.

- Add Ebow and other guitar sustaining techniques to the first movement to enhance microtonal effects. Unfortunately an Ebow was not sourced in time to be used in *Future Shades of Blue*. The pitches recorded do not sustain well in the opening and die away a little too quickly. The combination of Ebow and volume swells in the first movement would enhance the effects produced by the interacting pitches and create a more intense microtonal experience.
- *Future Shades of Blue* is mostly constructed from experiences gained through the research etudes. The attempt to include many of the microtonal techniques and concepts researched in the piece at the same time as learning them was slightly conflicting. The many aspects of microtonality researched produced an overlap where it became difficult to avoid the piece sounding like a large scale etude. The personal advancement in learning a whole new process for organising sound that allows the use of all possible pitches was very exciting and inspirational. Many alternate choices could have been made in the compositional stages of this piece but it felt most important to include many of the elements that relate to this thesis. This may have compromised the artistic outcome of the composition but nevertheless further informed the research. Future microtonal compositions will focus on fewer elements and single out specific concepts with self-imposed limitations that help the construction process and identity of the piece.

7. Testing

7.1 Chapter Introduction

There were three areas tested by guitarists of varying technical ability and previous exposure to microtonality:

- Quartertone exercises
- Interval shapes from Blues Analysis
- Guitar techniques

Most guitarists will have attempted microtonality through the use of string bending. The notation systems used that include quartertones and sixth-tones and interval shapes are intimidating for a modern guitarists as many do not possess reading skills on a par with other instrumentalists. The alternative notation systems available to the guitarist, such as TAB and chord symbol charts have resulted in guitar syllabuses like Rockschool which contain less emphasis on reading skills in their exams (Rockschool, 2018). This would be a major problem on other instruments but the cultural applications of the guitar in modern music do not require all creative guitarist to concentrate on sight reading skills to achieve their goals. Many high level players asked to take part the testing declined due to a lack of confidence in their ability to read the exercises, some could not transfer the notation onto their instrument to make any meaningful judgements. Some of the most insightful feedback was provided by instrumentalists who do not consider guitar their first instrument but made successful attempts due to good reading skills and their previous exposure to microtonal notation through contemporary composition.

7.2.1 Testing Quartertone Exercises / Visualizing Quarter & Sixth-tones

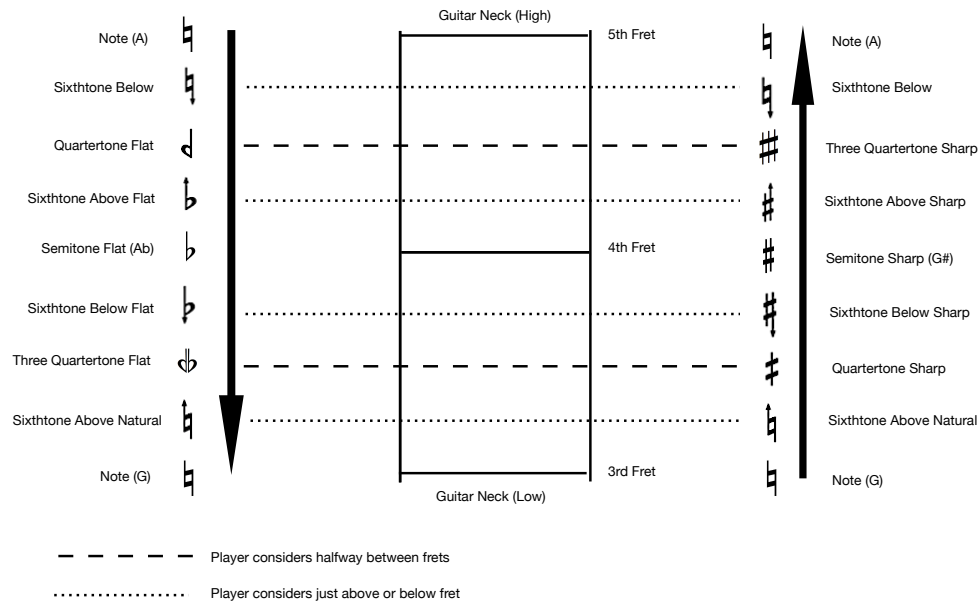


Figure 7.1 Microtonal Notation and the Guitar Neck

The detailed reference chart seen in figure 7.1 shows the microtonal notation descending and ascending in relation to the guitar fretboard. These symbols are already established ways of communicating pitches in microtonal notation. Several guitarists commented on their preference for the sharp symbols, they felt more intuitive to read than the flat symbols and performed those pitches faster.

Some guitarists struggled to get through the first exercises so suggestions were provided that made a huge difference to their confidence in achieving pitches. The suggestions included the points below:

- By using quartertones and sixth-tones you are using two methods to achieve microtones.
- When a guitarist is asked to play three extra notes between frets to achieve eighth-tones it feels impossible, especially higher up the fretboard.

- If you think exactly halfway (quartertones) between frets, then slightly above and slightly below the fret (sixth-tones), you might achieve pitches very similar to eighth-tones but the thought process is much simpler.
- I'd recommend experimenting with slide first.

This casual approach had a significant effect on the performer as he felt much less under pressure to produce an extra 3 pitches with the space of a semitone. The visual representation in Figure 7.2 helps communicate the concept.

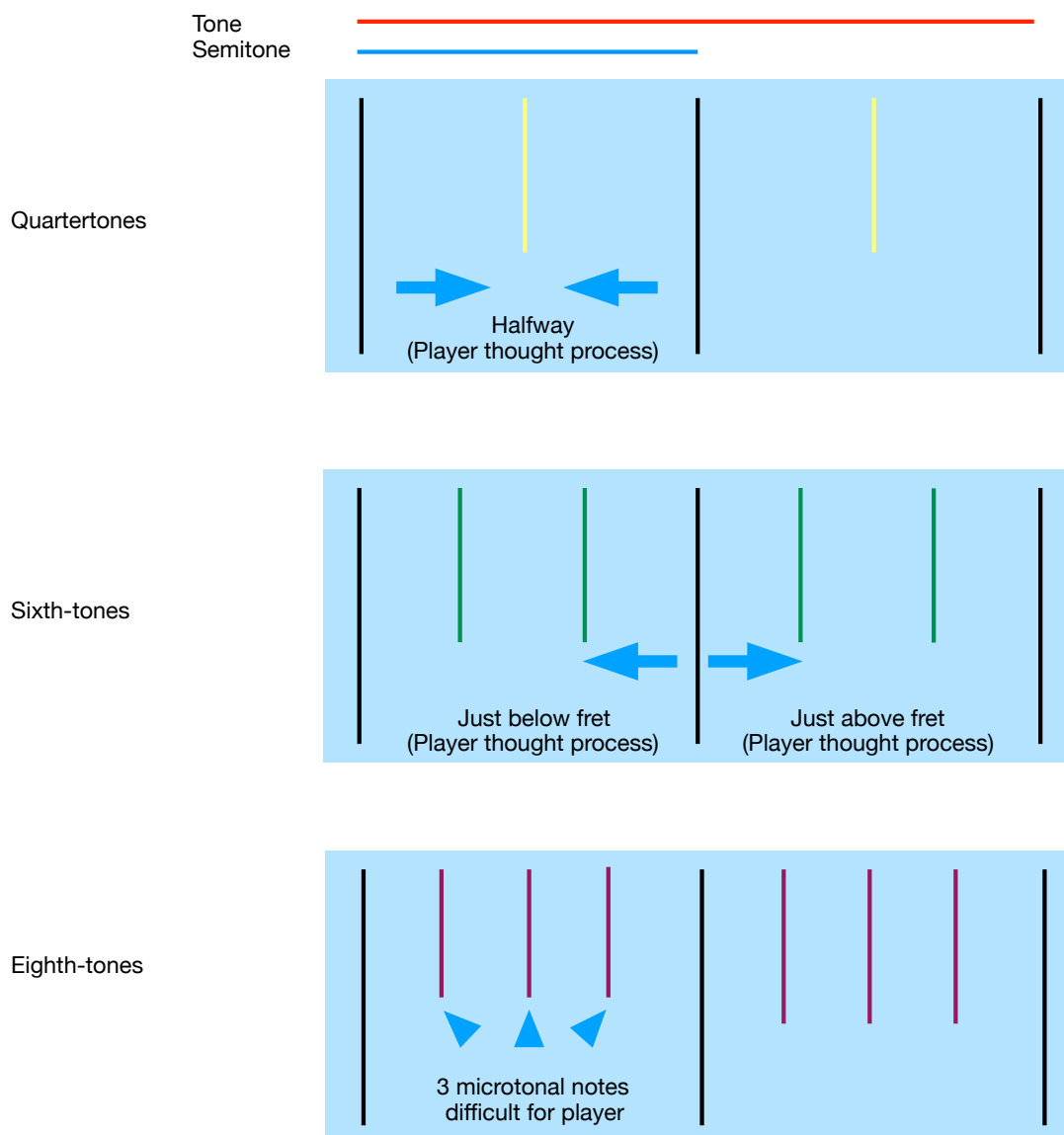


Figure 7.2 Visualization technique and representation of player thought process

The quartertone exercises were presented in the form of three progressive applications to a hybrid blues scale, the same as first presented in Figure 5.8 and present again below in Figure 7.3.



Figure 7.3 Notation for Quartertone Approach 1, QT- to TN

(Audio - Media Disc – Quartertone Approach Ex. 1)

This was then progressed to an exercise approaching the same notes but a double quartertone above shown in Figure 7.4.



Figure 7.4 Notation for Quartertone Approach 4, HS+ QT+ to TN

(Audio - Media Disc – Quartertone Approach Ex. 4)

The final quartertone approach exercise combined the first two, creating a quartertone below, double quartertone above approach. The exercises are written so the quartertones resolve on the downbeat, creating more stability for the player and follows the jazz technique of resolving on the down beat with chord tones and bebop scales.



Figure 7.5 Notation for Quartertone Approach 10, QT- HS+ QT+ to TN

(Audio - Media Disc – Quartertone Approach Ex. 10)

This progressive system can be practiced on other instruments. Further testing by string players who have been exposed to microtonal notation before would provide further useful feedback on both the progressive system (sixteen quartertone approaches) and the visualization concept for achieving quartertones and sixth-tones.

Most guitarists struggled with the reading of these exercises and therefore missed out on aural and technical benefits they aim to produce. The guitarists who persisted with the exercises commented that they started to think differently about the fretboard and the pitches available to them.

7.2.2 Testing - Microtonal Interval shapes

The fourth exercise presented was the interval shapes seen in Fig. 7.6, this approach attempts to move away from traditional notation. These interval shapes are used by jazz

musicians to create melodic patterns through chord progressions. This system was shown to me by jazz educator Charlie Banacos (Banacos, 2018). This system could encourage improvisational elements within microtonal compositions and performances.

Guitarists found this exercise easier than reading the quartertone approaches if they came from a jazz background. Guitarists with classical background found it less intuitive because of the lack of rhythmical notation and tradition detail.

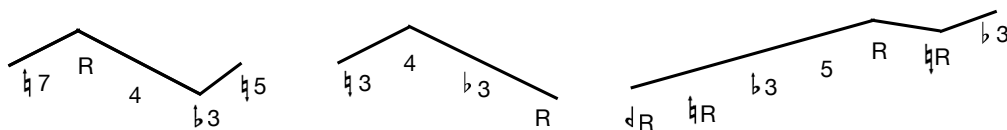


Figure 7.6 Interval Shape Exercise – From Etude #17

7.2.3 Testing Performance Techniques

Two extracts from the main composition were used for exercises five and six.



demonstrated to the player, they almost immediately reproduce the notes proving that many guitarists can play the pitches easily but communicating the information through notation is still a problem.



Figure 7.8 Four Bar Slide Phrase from *Future Shades of Blue* (Mvt III)

7.4 Testing Results

The feedback from guitarists was very limited. The difficulty of the exercises had a negative effect on the willingness of guitarists to partake. The steep learning curve in adjusting to the additional accidentals put many off but those who persisted with the first steps progressed through the exercises.

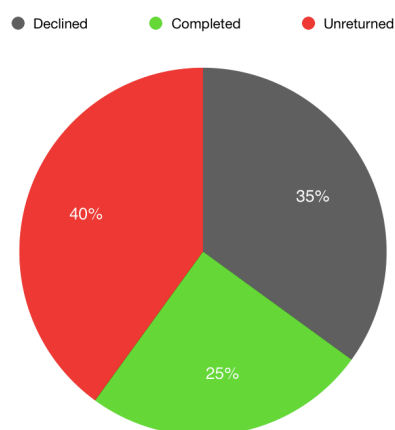


Table 7.1 Participation response

Subjects ranged from expert level electric guitarists and classical guitarists to intermediate students with no previous microtonal exposure. The feedback shown in

Table 7.1 shows the response rating from guitarists asked to participate. Twenty guitarists were asked and seven were unwilling to participate, citing non interest in microtonality or expressing lack of knowledge or ability that would be useful to the survey. Thirteen agreed but only five completed the exercises with feedback.

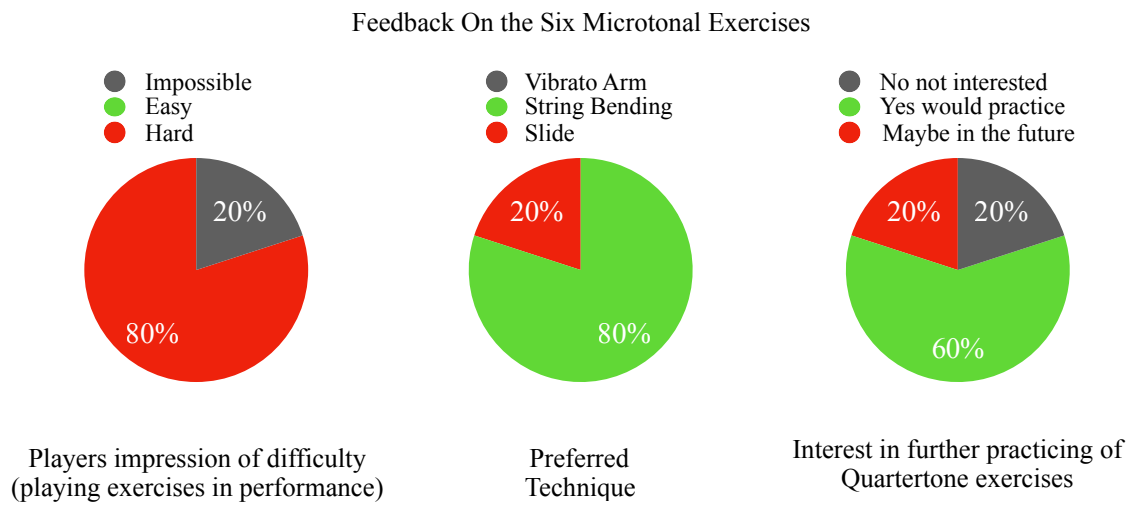


Table 7.2 Overview of popular feedback from microtonal exercises

- Table 7.2 shows that all guitarists found the microtonal notation difficult but acknowledged this was mainly due to unfamiliarity and more exposure would breed confidence.
- Preparation time. The scenario was suggested that they had a 20 minute preparation time for each exercise for performance. The majority had concerns about executing the lines confidently and would prefer to memorise with more preparation time.
- Confidence in gauging microtones. All guitarist had concerns about playing microtonality in performance but would be prepared to attempt if the microtonal content was low but would not be comfortable with higher microtonal content.
- The most common feedback was the preference for string bending. Subjects were encouraged to try different techniques but had a strong leaning towards string bending as the other techniques like slide and vibrato arm would not be an everyday technique for a non-electric or blues guitarist.
- Slide was the second rated preferred technique and when discussed with the participant after some practice agreed this technique to be the most accurate for accessing pitches.

- Vibrato arm. The majority did not feel they could confidently judge the notated pitches but achieved aural judgement improvements over a short practice time. The lack of visual reference was raised as a concern. Pitches were more confidently achieved when performed with the fretting hand in relation to frets.
- Quartertones sharps and Sixth-tone sharps were too difficult to judge for intermediate players who could not distinguish between the pitches in performance. The expert level players could achieve the tones separately but needed to allow for a margin of error, depending on tempo and range of notes.
- Quartertone flats and sixth-tone flats were more achievable on slide. This could be due to the physical act of lowering with the fret still visible. Obscuring of the fret when playing slide a quarter or sixth-tone sharp impairs the visual judgement.
- The interval shape notation system was easier to read than the notation but was limited to certain situations. Guitarist agreed they would be prepared to work with this system at short notice for improvisational sections in a composition.
- Knowledge of intervals. Jazz influenced players preferred the new interval shape notation system more than classical players which could be a reflection on the background practice systems used by the different genres.
- Sharps vs flats. Nearly all guitarists found reading the sharp accidentals easier than the flats.
- Accidental and enharmonic spelling. One subject recommended the accidentals used should be in context with the key centre. The exercises presented the accidentals with sharps and flats working in the direction of the music. The majority thought this best represented the melodic contour of the line despite having more accidentals to read. This preference could be related to a jazz or classical background, when working in different genres the most appropriate approach should be considered.
- Development. All participants agreed after the exercises their aural awareness had been raised and could see beneficial applications in the music they would normally perform. The nonclassical players were most interested in practicing the quartertone exercise to develop or add into their improvisational skill set.
- Psychological approach. The exercises were demanding and different personalities types played a role in the confidence and openness to the research.

Some subjects were very resistant, misunderstanding the research and doubting their own individual ability which was not the focus of the exercises.

7.5 Chapter Conclusion

If a microtonal composition that includes guitar is to be performed with minimum preparation and sight reading, several issues need to be considered such as the reading ability, technical background and openness to new sounds of the player. As many guitarist are rarely exposed to the formal use of microtonality, a guitarist with prior experience or expertise would be an advantage on a recording or live session. The guitarist can deal with a certain quantity of microtonal pitches at sight but reaches a point where the intensity and realistic reading expectations become too much. Helping the player with additional audio examples and preparation time would be to the composers benefit.

The exercises proved that advancements in microtonal aural awareness can be achieved quickly and most players experienced an appreciation for pitches they don't usually play but preferred to stay in their comfort zone of string bending, despite being able to produce more accurate pitches with the bottleneck slide with practice. Using the interval shapes notation in compositions and where improvisation is required, was a successful discovery that could produce interesting and varied results making each performance unique.

The visualization technique for achieving quarter and sixth-tones enhanced performance considerably and provided the player with a simpler thought process that decreased the stress of achieving pitches in a small range. With structured practice the guitarist can take advantage of these exercises to add more vocal-like melisma to their playing or work towards a more confident performance of microtones. Considering melisma is one of the strongest characteristics of expressive singing, it proves that practicing of microtonality should be considered by all guitarist wishing to enhance their improvisations around melodies and not confined to guitarists working in contemporary composition ensembles.

8. Conclusion

8.1 Conclusion

“for a bridge over the abyss to hold it must be anchored far in the past and far in the future” Ben Johnston (Johnston, 1977).

The notational systems researched and tested show a long term view is required to successfully incorporate microtonality into the vocabulary of the modern guitarist. The research suggests the teaching of standard notation reading in guitar education is essential to the development of microtonal communication. The advanced notation reading skills required in microtonality can become an unnecessary barrier for a guitarist more than capable of practically executing the music. Testing showed that the majority of guitarists memorise microtonal passages and the reading of microtonal accidentals can be affected by physical obstructions or the lack of visual reference. The new interval shapes notation were successfully tested and provide a system that composers and guitarist can use to communicate, this system was found to be limited to improvisational situations.

The analysis of blues vocal provided results that show the performed pitches do not occur on equal tempered notes. The equally spaced notes of the 12-Tet system only provide a format for measuring the sung pitches by their deviations and tell us very little about their relationships. The research analysis suggests that using the 12-Tet as a reference is only one perspective on the pitches and other systems could be developed that might provide pitch analysis information other than cent deviation to 12-Tet. The close pitching to seven limit interval ratios and other prime limits prove that blues vocal has just intonated tendencies when singing melodic notes, and when sliding or bending pitches expressively.

The pitch analysis inspired the quartertone approach system which progressively educates a guitarist on incorporating microtones into their improvisations. Musicians who tested the quartertone approaches expressed positive interest in the system and experienced improved microtonal awareness after attempting three exercises. The approaches are compatible with the 12-Tet system but further development could encourage resolving to pitches other than equal tempered notes. This was experimented with in the blues cells etude and final composition where written improvisations brought

the microtonal elements found in the pitch analysis to the forefront and not used purely as decorative or ornamentations of a melody.

The narrowing of focus towards the compositional concepts of James Tenney was informed by the interviews performed with current practitioners. Tenney's microtonal pieces became a focus of inspiration due to their strong conceptual approaches that enabled the adaptation of blues guitar techniques, application of pitch analysis results, scordatura and hybrid blues scales.

The feedback from current practitioners raised the question of how do we create a common system for microtonal communication if individual systems are so often needed to perform the unique approaches to microtonal composition of the composer. This question remains unresolved but, as a dual notation problem, it will benefit from further research as more systems are created and as the modern guitarists progressively gets more exposure to microtonality.

8.2 Evaluation of Approach & Recommended Further Research

It quickly became evident in the research that there are many avenues that could be explored when researching microtonal blues and contemporary composition related to the guitar. There were many relevant contemporary pieces such as Tristan Murail's *Vampir* (Jameson, 2015) that could have been included in the research to provide additional inspiration to inform the composition. The research focused on a select few that felt most relevant and would have the most impact on the thesis outcome. Reflecting on the research, approaches that could be refined include:

- Simpler testing procedures could have been applied which would have enabled more participants. As contemporary composition was an important aspect to this thesis it felt appropriate to not use TAB and concentrate on the guitarists reaction to standard notation and microtonality first. Future research could aim to make exercises simpler and more accessible, this would help the inclusion of more guitarist of different abilities and backgrounds. The use of TAB could be useful, but it should be noted this is a guitar specific language that most non-guitarist composers and instrumentalists do not use.

- The pitch analysis concentrated on vocals but other instruments such as harmonica and guitar techniques performed on bottleneck slide, string bending on classic recordings would add to the research.
- The microtonal vibrato techniques of Jeff Beck (Carson, 2001) would have been interesting additions to pitch analysis.
- Use of a Line 6 Variax guitar, which has selectable built in open tunings and custom tunings are possible. This system could possibly provide faster flexibility for achieving just intonated chords.
- Incorporating the use of microtonal fretboards for devising new blues specific tuning/arrangements of frets.
- Guitarists in testing preferred visual references. Devising a visual platform that displayed a guitarists microtonal gestures when performing with a vibrato arm (or other microtonal technique) could be an interesting interactive experiment that could aid the judgement of pitches.
- The blues duality of its informal application of microtonal pitches and intuitive use of complex rhythms by older blues musician could be used to add new rhythmical concepts to blues composition.
- Composition techniques could concentrate on creating artistic results and less on etude/technical applications.
- Monitoring the effectiveness of the new quartertone approach system and documenting it's influence on a guitarists use of microtonality after practicing the system for different periodization's such as one month, three months, six months.

This thesis concludes by urging guitarists to practice/experiment with microtonality and composers to avail of the new concepts/notation system developed and expand upon them. This research thesis into blues, contemporary composition and guitar presents evidence that it is possible to freely compose new blues music outside of the 12-Tet system, without the need for equal temperament to dominant the choice of pitches.

8.3 Personal Summary

The completion of this thesis has opened up a new world of possibilities for my own personal growth as a composer and musician. Viewing the thesis now as a whole on completion demonstrates a journey from the inquisitive to the converted. There were self-doubts early on that my ears would not adjust to certain pitches and would be unable to compose music worthy of the research. As my understanding of both contemporary music and blues deepened the self-doubting disappeared and the boundaries started to fall away. Experimenting with microtonality and analysing the blues has made me aware of my own and other musicians narrow perspective on tuning.

My search to find new concepts for creativity has suddenly presented the overwhelming realization that all pitches are possible and free to use if you are brave enough. You can avail of just intonation ratios and prime limits or tune one guitar string to the scrape of a chair and another to sound of a passing car if you wish. The compositions to be written going forward will almost certainly stretch out further to embrace both the pure and dissonant extremes microtonal composition has to offer. Overall, I learnt a new sense of pitch democracy that can live creatively alongside both the beauty and tyranny of equal temperament.

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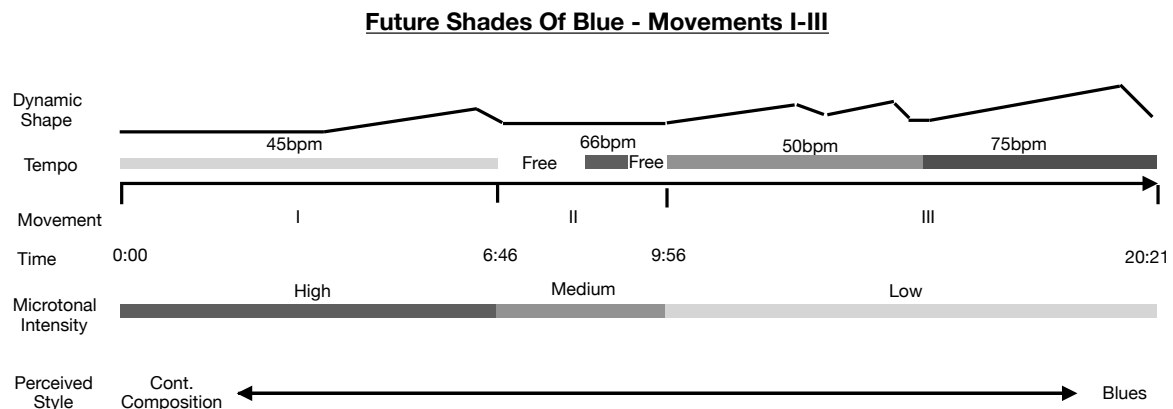
Appendix A - Full Score

Future Shades Of Blue

Microtonal Composition for Guitar Trio

Composer: Mike Brookfield

Performance Instructions



Future Shades of Blue is a composition that combines contemporary composition techniques for modern guitar with traditional electric blues playing. The microtonality in the piece ranges from the strong to the subtle. Tuning preparation prior to performance should be done with a high level of accuracy and checked regularly.

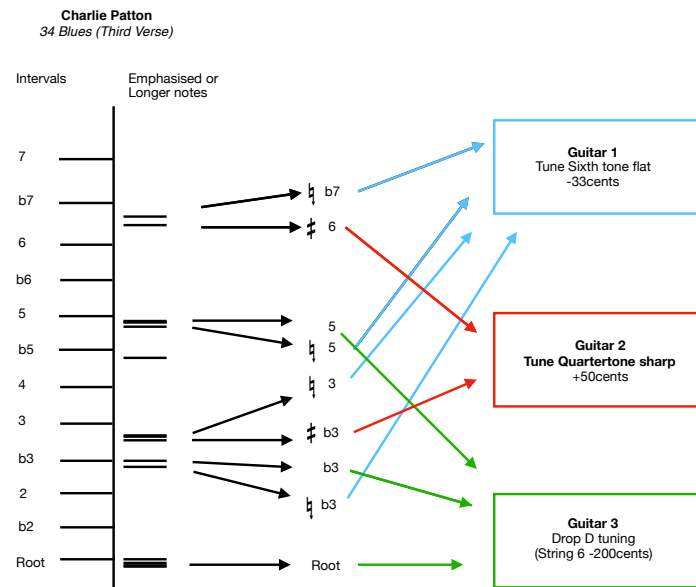
All single note passages and the solo movement are all played without a plectrum but chordal passages and harmonics can be played with a pick. Vibrato should be avoided in the first movement, can be used very lightly in the second and the strong blues influence of the third movement allows more intuitive use but the microtonality scored should not be compromised.

Dynamics play a very important role in blues music and this piece reflects that influence by building slowly over the three movements. Aural awareness and communication between players is essential to preserve the critical relationships that build between parts.

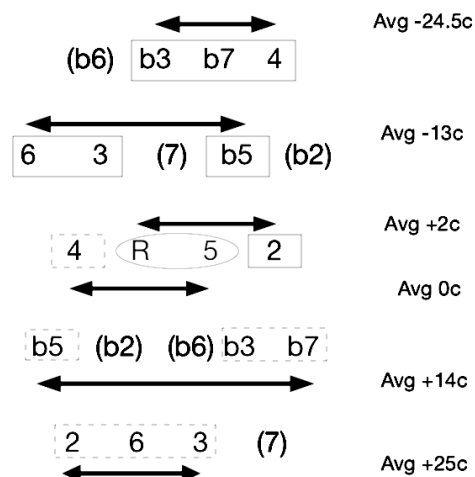
The experimental elements in this piece aim to bring together two very different approaches to microtonality.

Mike Brookfield 14/08/18

Movement I – Constructed from the pitch analysis of James Patton’s 1934 recording of *34 Blues*. Long or emphasised pitches sung by Charlie Patton were simplified to sixth-tones, quartertones and 12 Tet notes and assigned to each guitar. .



Movement II - Influenced by the five limit system used by James Tenney in his composition *Bridge*. A hybrid major/minor blues scale was taken from the lattice and the pitch deviations from equal temperament are applied to solo guitar. The diagram below shows the first string down to the sixth string, the pitches in rectangle boxes are the pitches selected to be played (hybrid blues scale) and the pitch deviation for each string



Movement III – Just intonated chord playing, Harmonics, Bass scordatura and quartertone/sixth-tone improvisational techniques are explored via string bending, slide & vibrato arm techniques in this slow building hill country style blues.

Technical Requirements

Fixed bridge (no vibrato system) guitars are recommended for parts other than guitar one in movement three. This facilitates faster retuning if required. All three guitar set ups require a volume pedal to create dynamic swells and is a useful tool for the performer to control the mix of the performance, especially when switching between guitars. Three amplifiers used.

Guitar 1 -Three guitars required.

Movement I - all strings detuned -33 cents.

Movement II is tuned high to low -24, -13, +2, 0, +14, +25

Movement III is standard tuning but requires a vibrato arm equipped guitar. Setting the bridge so at maximum pull the vibrato arm produces a major second interval on the second string is recommended. The slide parts require open E tuning (low to high) E B E G# B E, the guitar used here can be the same guitar used for movement one tuned by another member of ensemble during movement II.

Guitar 2 - Two guitars required.

Movement I - all strings tuned +50 cents. Midi controller used to trigger Charlie Patton samples.

Movement II – N/A

Movement III – Hexaphonic pickup equipped guitar, 13 pin cable, breakout box, 6 input interface, foot pedal midi controller laptop and Max patch. Midi controller used to trigger Charlie Patton samples.

Guitar 3 – One guitar, one electric bass guitar required.

Movement I – Sixth string detuned to D (-200 cents) known as drop D.

Movement II – N/A

Movement III – Bass guitar tunes the second string down -33 cents and third string -31 cents. This tuning is used as only the D note (minor 7th in the key of E) is played on the third string and only the G natural is played on the second string (septimal minor 3rd in key of E). As these deviations are so close to each other (only 2 cents apart) the player is allowed to switch the notes and play the D notes on the second string and G naturals on the third strings.

Future Shades Of Blue

Gtrs 1 - 3

Volume swells thought
unless indicated

(Movement I)

Mike Brookfield

♩ = 45

A

B

Guitar 1
All Strings -33cents
Plays b3, 3, 5, b7

Guitar 2
All Strings +50cents
Plays b3, 6

Guitar 3
Drop D tuning
Plays R, b3, 5

Samples from
Charlie Patton's
34 Blues
(Midi Controller)

Guitar loop

mf *mp* *mf* *mp*

mp *ppp*

B

mf *mp* *mf* *mp*

mp *p* *mp*

mf *mf*

N.H. VII

N.H. XII

10 E

mp *mf* *mf* *mp* *mp* *mf*

N.H. -III

14 B

mp *mf* *p* *mp* *p* *mf* *mp*

N.H. VII N.H. XII

(1:30) F#

18

mf *mp* *mf* *p* *mp* *p*

B

22

mp *mf* *mf* *mp*

mp

N.H. V *N.H. XII* *N.H. VII*

mf

mp

(Guitar loop/Time stretched & granulated parts)

Fella down in the country...

mp

B

(2:12) **D**

p *mp* *p* *p*

p *p* *p* *p*

p *p* *p* *p*

It almost make you cry...

D

No swells (N.S.)

30

p

30

G

34

N.S.

mp

34

38 **D** *N.S.*

mp

38

Fella down in the country...

(3:40) **A** *N.S.*

mp

42

mp

mp

42

Women & children...

Flaggin' freight trains for a ride

D

46

mp *N.S.* *mf* *N.S.* *mp* *p* *mf* *mf*

N.S. 3

46

C

(4:24) **D**

N.S. *N.S.*

p *mp* *p* *mf*

p *p*

50

mp *ppp*

54 **D**

N.S.

mp *p* *mf*

p

p

(5:07) **G**

58 N.S.

p *mf* *mp* *mf*

N.S.

p *mf* *mf mp* *p*

N.S.

mf *mp* *mf*

(5:29)

D

62

mf

p

p

N.S.

N.S.

N.S.

f

f

mf

mf

This musical system covers measures 62 to 65. The key signature has two sharps (F# and C#). Measure 62 features a melody in the upper voice with a *mf* dynamic, while the lower voices play chords with a *p* dynamic. Measures 63 and 64 are marked *N.S.* (No Sustaining Pedal) and contain sustained chords. Measure 65 shows a melodic phrase in the upper voice with a *f* dynamic, and the lower voices with a *mf* dynamic. A crescendo hairpin is visible across measures 63 and 64.

66

f

mf

f

A

This musical system covers measures 66 to 69. The key signature has two sharps. Measure 66 begins with a melodic phrase in the upper voice marked *f*. The lower voices play sustained chords, with the left hand marked *mf*. Measures 67 and 68 continue with sustained chords in the lower voices. Measure 69 features a melodic phrase in the upper voice. A crescendo hairpin is present across measures 67 and 68.

D

70 N.S.

mf

mf

mf

Guitar 1 Segue Part II (Change to 5 limit tuned Gtr)
Guitars 2 & 3 prepare for Part III

74

mf

mf

f

f

f

f

Segue to MVT II
Slight overlap on sample

74

Guitar loop

mp

Tuning
 (Low to high)
 6 - E +25cent
 5 - A +14cent
 4 - D
 3 - G +2cent,
 2 - B -13cent
 1 - E -24cent

Future Shades Of Blue (Movement II)

Mike Brookfield

A

rubato

Solo Gtr

Measures 1-8 of section A. The notation is in treble clef with a key signature of three sharps (F#, C#, G#) and a 4/4 time signature. It features a series of eighth and quarter notes with various fret numbers (1, 2, 3, 4, 5, 6) and fingerings (1, 2, 3, 4, 5) indicated above the notes. Dynamic markings include *p* (piano) at the start and end of the section.

B

(E)

Measures 9-15 of section B. The notation is in treble clef with a key signature of three sharps (F#, C#, G#) and a 3/4 time signature. It features a series of eighth and quarter notes with various fret numbers (1, 2, 3, 4, 5, 6) and fingerings (1, 2, 3, 4, 5) indicated above the notes. Dynamic markings include *mp* (mezzo-piano), *mf* (mezzo-forte), and *p* (piano).

Future Shades Of Blue
(Movement II)

(A)

18

mf

(D)

20

f

22

p *mp*

C (A)

espress.

mf

27

mp

29

p

Future Shades Of Blue
(Movement II)

3

31 *mf*

33 *p* *pp*

35 *mf* *f*

37 *mf*

39 *f* *p*

41 *mp* *mf*

Future Shades Of Blue (Movement II)

D ♩ = 66 *a tempo*

Measures 39-53: *a tempo*. Measures 45-48: *rit.*. Measure 49: *mf*. Measure 50: *mp*. Measure 51: *p*.

E *rubato*

Measures 54-57: *pp*. Measure 58: *mp*. Measure 59: *mf*.

Future Shades Of Blue (Movement III)

Mike Brookfield

Tempo ♩. = 50

Electric Guitar 1
Standard Guitar with
vibrato arm
& Slide Guitar Tuned
EBEG#BE
(G#-14cents)

Electric Guitar 2
Hexophonic Guitar
Max/Midi pedal assigned
to chords E13, E7#9, E7#11

Electric Bass
2nd String -33cents
3rd String -31cents

A (0:00)

Controller Pedal 1

mf

E7#11

N.H. Fret V

mp

p

3

Slight below (s.b.)

N.H. XII

3

Future Shades Of Blue
(Movement III)

5

Measures 5 and 6 of the musical score. The key signature is three sharps (F#, C#, G#). The score is written for three staves: Treble 1, Treble 2, and Bass. Measure 5 features a half note G#4 in Treble 1, a half note G#3 in Treble 2, and a half note G#2 in Bass. Measure 6 features a half note G#4 in Treble 1, a half note G#3 in Treble 2, and a half note G#2 in Bass. The Treble 2 and Bass staves have a fermata over the measure.

7

Measures 7 and 8 of the musical score. The key signature is three sharps (F#, C#, G#). The score is written for three staves: Treble 1, Treble 2, and Bass. Measure 7 features a half note G#4 in Treble 1, a half note G#3 in Treble 2, and a half note G#2 in Bass. Measure 8 features a half note G#4 in Treble 1, a half note G#3 in Treble 2, and a half note G#2 in Bass. The Treble 2 and Bass staves have a fermata over the measure. The Treble 1 staff has a fermata over the measure.

s.b.

Slight Above (s.a.)

9

Measures 9 and 10 of the musical score. The key signature is three sharps (F#, C#, G#). The score is written for three staves: Treble 1, Treble 2, and Bass. Measure 9 features a half note G#4 in Treble 1, a half note G#3 in Treble 2, and a half note G#2 in Bass. Measure 10 features a half note G#4 in Treble 1, a half note G#3 in Treble 2, and a half note G#2 in Bass. The Treble 2 and Bass staves have a fermata over the measure.

Future Shades Of Blue
(Movement III)

3

11

11

s.b.

13 (1:01)

13

p

C. Patton
Sample
(Trainlike)

13

15

s.b.

s.a.

mp

15

Future Shades Of Blue
(Movement III)**B**

(1:21)

Controller Pedal 2

mf

mp

17

mp

E 13

1/4

1/4

1/4

1/4

Detailed description: This system contains measures 17 and 18. Measure 17 features a treble staff with a half note G#4, a wavy line above it, and a piano part with a half note G#2 and a sustained chord of E3, G#2, and B2. Measure 18 continues with a treble staff melody of quarter notes A#4, G#4, F#4, and E4, and a piano part with quarter notes G#2, F#2, E2, and D#2. Dynamics include *mf* for the treble in measure 17 and *mp* for both staves in measure 17, and *mp* for the piano in measure 18. A 'Controller Pedal 2' box is present in measure 17.

19

1/4

mp

Detailed description: This system contains measures 19 and 20. Measure 19 has a treble staff with a half note G#4 and a wavy line, and a piano part with a half note G#2 and a sustained chord of E3, G#2, and B2. Measure 20 features a treble staff melody of quarter notes A#4, G#4, F#4, and E4, and a piano part with quarter notes G#2, F#2, E2, and D#2. The dynamic *mp* is indicated for the piano part in measure 19.

21

1/4

1/4

1/4

1/4

mp

Detailed description: This system contains measures 21 and 22. Measure 21 has a treble staff melody of quarter notes A#4, G#4, F#4, and E4, and a piano part with a half note G#2 and a sustained chord of E3, G#2, and B2. Measure 22 continues with a treble staff melody of quarter notes A#4, G#4, F#4, and E4, and a piano part with quarter notes G#2, F#2, E2, and D#2. The dynamic *mp* is indicated for the piano part in measure 21. Quarter note markings (1/4) are present above the treble staff in both measures.

Future Shades Of Blue
(Movement III)

5

23

23

mp

Detailed description: This system contains measures 23 and 24. Measure 23 features a treble staff with a melodic line starting on G4, moving to A4, B4, and C5, with a wavy line above the staff. The middle staff has a complex chordal texture with multiple voices. The bass staff has a steady eighth-note accompaniment. Measure 24 continues the melodic line in the treble staff, ending with a quarter note on C5. The middle staff has a sustained chord, and the bass staff continues the eighth-note pattern.

25

(Pre bend)

25

mp

Detailed description: This system contains measures 25 and 26. Measure 25 features a treble staff with a melodic line starting on G4, moving to A4, B4, and C5, with a wavy line above the staff. The middle staff has a complex chordal texture with multiple voices. The bass staff has a steady eighth-note accompaniment. Measure 26 continues the melodic line in the treble staff, ending with a quarter note on C5. The middle staff has a sustained chord, and the bass staff continues the eighth-note pattern.

27

27

mp

Detailed description: This system contains measures 27 and 28. Measure 27 features a treble staff with a melodic line starting on G4, moving to A4, B4, and C5, with a wavy line above the staff. The middle staff has a complex chordal texture with multiple voices. The bass staff has a steady eighth-note accompaniment. Measure 28 continues the melodic line in the treble staff, ending with a quarter note on C5. The middle staff has a sustained chord, and the bass staff continues the eighth-note pattern.

Future Shades Of Blue
(Movement III)

6

C

(2:18)

Vibrato arm

Measures 29-30 of the musical score. The key signature is three sharps (F#, C#, G#). The score is written for three staves: Treble, Middle, and Bass. Measure 29 features a melodic line in the Treble staff with a vibrato arm, a rhythmic accompaniment in the Middle staff, and a bass line in the Bass staff. Measure 30 includes a whole note chord in the Treble staff marked *N.H.* and *s.b.*, and a whole note chord in the Middle staff. The Bass staff continues with a half note. The dynamic *mp* is indicated below the Bass staff.

Measures 31-32 of the musical score. The key signature is three sharps (F#, C#, G#). The score is written for three staves: Treble, Middle, and Bass. Measure 31 features a melodic line in the Treble staff with a vibrato arm, a rhythmic accompaniment in the Middle staff, and a bass line in the Bass staff. Measure 32 includes a whole note chord in the Treble staff, a whole note chord in the Middle staff, and a whole note chord in the Bass staff. The dynamic *mp* is indicated below the Bass staff.

Measures 33-34 of the musical score. The key signature is three sharps (F#, C#, G#). The score is written for three staves: Treble, Middle, and Bass. Measure 33 features a melodic line in the Treble staff with a vibrato arm, a rhythmic accompaniment in the Middle staff, and a bass line in the Bass staff. Measure 34 includes a whole note chord in the Treble staff marked *f*, a whole note chord in the Middle staff, and a whole note chord in the Bass staff. The dynamic *mp* is indicated below the Bass staff.

Future Shades Of Blue
(Movement III)

7

35

mp

D (2:57) *N.H.*

35

mf s.a. s.b. *f*

37

mp

39

mf s.a. s.b. *f* *Vibrato arm*

39

mp

Future Shades Of Blue
(Movement III)

41

mf

41

43

N.H. XII

43

E (3:35)

45

Future Shades Of Blue
(Movement III)

9

47

N.H.

$\frac{1}{4}$

F (3:55) *N.H.*

Guitar change(to slide)

Controller Pedal 3 E7#9

mf

49

mf

51

f

51

Future Shades Of Blue
(Movement III)

53

53

This system contains measures 53 and 54. The key signature is three sharps (F#, C#, G#). The music is written for three staves: Treble, Middle, and Bass. Measure 53 features a melodic line in the Treble staff with eighth and sixteenth notes, and a bass line in the Bass staff. Measure 54 continues the melodic line with a half note and a quarter note, and the bass line with a half note and a quarter note. The Middle staff contains chords in both measures.

55

55

mf

55

This system contains measures 55 and 56. The key signature is three sharps. Measure 55 features a melodic line in the Treble staff with eighth and sixteenth notes, and a bass line in the Bass staff. Measure 56 continues the melodic line with a half note and a quarter note, and the bass line with a half note and a quarter note. The Middle staff contains chords in both measures. The dynamic marking *mf* is present in measure 55.

57

57

N.H. XII

N.H. VII

57

This system contains measures 57 and 58. The key signature is three sharps. Measure 57 features a melodic line in the Treble staff with eighth and sixteenth notes, and a bass line in the Bass staff. Measure 58 continues the melodic line with a half note and a quarter note, and the bass line with a half note and a quarter note. The Middle staff contains chords in both measures. The dynamic marking *N.H. XII* is present in measure 57, and *N.H. VII* is present in measure 58.

Future Shades Of Blue
(Movement III)

11

59

N.H. XII

N.H. VII

61

mf

G

(5:02)

63

f

Future Shades Of Blue
(Movement III)

65

65

67

ff

H

(5:31)

Guitar change(to standard)

mf

f

N.H. XII

Future Shades Of Blue
(Movement III)

13

Vibrato arm -----

71

f

71

I (5:50)

Controller Pedal 1 E7#11

73

mf

73

75

mf

75

ff *s.b.*

Future Shades Of Blue
(Movement III)

77

2

ff

mp

mf

s.a.

1/2

79

mf

1/2

J

(6:28)

81

mf

mp

s.b.

C. Patton
Sample
(Trainlike)

81

Future Shades Of Blue
(Movement III)

15

84

(6:54) *rubato*

mf

84

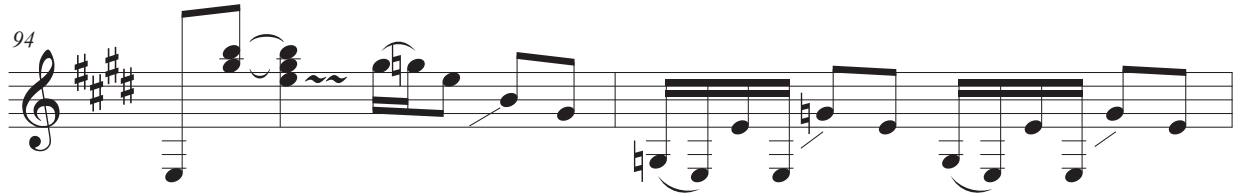
84

K

Guitar 1

88

90

Future Shades Of Blue
(Movement III)**L** (7:20) Tempo ♩ = 75

Measures 96-97 of the score. Measure 96 features a treble clef staff with a whole note chord and a half note, and a bass line with eighth notes. Measure 97 continues the melodic and harmonic progression.

Measures 98-99 of the score. Measure 98 features a treble clef staff with a whole note chord and a half note, and a bass line with eighth notes. Measure 99 continues the melodic and harmonic progression.

M (7:45)

Controller Pedal 3 E7#9

100 *mf*

102 *mp*

102

104 *f*

104

Future Shades Of Blue
(Movement III)

106

mp

106

N (8:11)

f

mp

cont. simile

f

mf

f

108

110

f

mp

mf

f

110

Future Shades Of Blue
(Movement III)

19

O

(8:24)

This musical score is for the piece "Future Shades Of Blue (Movement III)" and begins at measure 112. The music is written for a piano in the key of E major (three sharps) and 4/4 time. The score is divided into three systems, each containing a grand staff (treble and bass clefs).

System 1 (Measures 112-113): The right-hand part features a melodic line with eighth and quarter notes, accented in measures 112 and 113. The left-hand part plays a steady eighth-note accompaniment. A chord symbol "E7#9" is indicated above the first measure. The system concludes with a repeat sign.

System 2 (Measures 114-115): The right-hand part continues the melodic development with a triplet in measure 114 and a half-note rest. The left-hand part maintains the eighth-note accompaniment. The system concludes with a repeat sign.

System 3 (Measures 116-117): The right-hand part resumes the melodic line with a half-note rest in measure 116. The left-hand part continues the accompaniment. The system concludes with a repeat sign.

Throughout the score, the instruction "cont. simile" is present, indicating that the performance should continue with a similar character to the previous section.

Future Shades Of Blue
(Movement III)

118

P (8:48)

Controller Pedal 2 E 13

120

cont. simile

122

122

Future Shades Of Blue
(Movement III)

21

124

124

126

126

Q (9:15)

Controller Pedal 1 ***f*** E7#11

cont. simile

128

Future Shades Of Blue
(Movement III)

130

First system of music, measures 130-131. The system consists of three staves. The top staff is in treble clef with a key signature of three sharps (F#, C#, G#) and contains a complex melodic line with many beamed sixteenth notes and slurs. The middle staff is in treble clef with the same key signature and contains a whole rest followed by a repeat sign. The bottom staff is in bass clef with the same key signature and contains a bass line with dotted half notes and eighth notes.

132

Second system of music, measures 132-133. The system consists of three staves. The top staff is in treble clef with a key signature of three sharps (F#, C#, G#) and contains a complex melodic line with many beamed sixteenth notes and slurs. The middle staff is in treble clef with the same key signature and contains a whole rest followed by a repeat sign. The bottom staff is in bass clef with the same key signature and contains a bass line with dotted half notes and eighth notes.

134

Third system of music, measures 134-135. The system consists of three staves. The top staff is in treble clef with a key signature of three sharps (F#, C#, G#) and contains a complex melodic line with many beamed sixteenth notes and slurs. The middle staff is in treble clef with the same key signature and contains a whole rest followed by a repeat sign. The bottom staff is in bass clef with the same key signature and contains a bass line with dotted half notes and eighth notes.

Future Shades Of Blue
(Movement III)

23

R (9:40)

136

mf

E7#11

138

Guitar change(to standard)

138

mf

140

Vibrato arm

140

mp

Future Shades Of Blue
(Movement III)

142

3 3 3 1/4

142

S (10:05)

mp

144

mf

146 *Ad lib Blues*

mp

146

mp

Appendix B - Media Disc Contents

1 Main Composition – Score & Audio

- Future Shades of Blue – Full Audio
- Future Shades Of Blue – Full Score

2 17 Etudes – Audio & Charts

- Etudes 1 – 4 Preliminary Etudes - Audio Etude #3 only
- Etudes 5 – 9 Quartertone Etudes - All Audio Included
- Etudes 10 – 12 Harmonics Etudes - All Audio Included
- Etudes 13 – 15 Open Tuning Etudes - All Audio Included
- Etude 16 The original Etude inspired by *Bridge* -James Tenney
 - Later developed into Mvt II of *Future Shades of Blue*– Audio Included
- Etude 17 Blues Cells Etude
 - Experiment with pitch analysis results and interval shapes notation system– Audio Included

6 Quartertone Approach System

- 16 Quartertone Exercises
- Double Target Note Quartertone Exercises
- Audio examples – Quartertone Exercises 1, 4, 6 &10

7 Pitch Analysis of Ten Blues Artists

- Notation Charts
- Pitch Tables & Tall Charts

8 Addition Media for *Future Shades of Blue*

- MAX Patch for *Future Shades of Blue*
- Pitch Proof Plug-In (Mac)
- Samples for *Future Shades of Blue*