Adapting and Applying Central Javanese Gamelan Music Theory in Electroacoustic Composition and Performance

Part I of II

Thesis submitted in partial fulfilment of requirements for the degree of Ph. D.

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iv Abstract

This thesis represents an investigation of composition and performance processes from gamelan music (particularly the traditional form *karawitan*), and the potential for their application in the medium of electroacoustic music. The research was developed through a mixture of theory and practice in a feedback relationship; the written thesis accompanies a portfolio of compositions and arrangements of traditional pieces, alongside software developed in Max/MSP to emulate and expand upon selected aspects of gamelan performance practice.

The thesis is divided into two parts. Part I establishes the theoretical foundations for the thesis, introducing key concepts from ethnomusicology, gamelan music, and theory developed for electroacoustic music. Central to the thesis is a notion of "idiom" involving constraints, affordances, and individual expression. While the choice of instruments does not always influence musical style, *karawitan* presents examples of established instrumental roles in relation to a central framework.

In the absence of a unified electroacoustic theory, Schaeffer's *musique concrète* provides a starting point for discussion. Further ideas are developed using an adaptation of Simon Emmerson's *language grid* (1986) to identify situations in which musical information is imposed from elsewhere, developed directly from the sound materials, or a combination thereof. This leads to the proposal of a set of strategies for composition and analysis of new works. Three areas are discussed through a set of case studies: the development of syntax and idiomatic discourse, idiomatic references and their interpretation, and the use of cues to establish discourse.

Part II examines the compositions developed during the research. A description of the overall composition framework and technical considerations is presented, in which abstract algorithmic-oriented approaches are compared with a more concrete approach to sound. A general commentary leads into the description and analysis of works in the portfolio based on the methods exposed in the body of the thesis.

v   Typography, language, and notation

In this thesis I use italics for the introduction and emphasis of technical terms, including those borrowed from Indonesian and Javanese, and the titles of compositions and performances. Italicization in section headings is restricted to the titles of pieces. Bold is used for additional emphasis of core concepts and elements of compositions. All other bold and italic typefaces are reproduced from original quotations unless otherwise stated; quotation marks within citations are converted to single inverted commas for consistency.

Internal references to sections are marked in bold with the section character (e.g. **§1.1**); numbering restarts in the second part, and references between the two documents are indicated on an individual basis. Pieces in the portfolio are marked similarly with the prefix "AV" (e.g. **AV2.1.B**); notation is indicated with "N" (e.g. **N1.A**).

This thesis assumes a basic knowledge of electroacoustic terminology; many technical processes are defined in Roads (1996). While I have not attempted to provide a comprehensive introduction to gamelan music, a glossary of gamelan-related terms is provided in **appendix 6**. Where possible I have employed Javanese terms and spelling; some Indonesian variants of words are included when most commonly used. Variations of spelling (including accents) in cited sources may be attributed to appearance of Javanese or Indonesian versions of technical terms.

Words in Indonesian and Javanese do not typically have plural indicators, and they have not been added except in cases where they have been lexicalized in English (e.g. gongs). The "*–an*" suffix is used throughout, which in both Javanese and Indonesian serves the purpose of converting a verb or adjective into a noun. For example, *kendhangan* is a term used to describe the patterns played by the *kendhang* [double headed drum]; *gongan* and *kenongan* refer to cycles marked by strokes of instruments called the *gong* and *kenong* respectively[1].

Gamelan music is often notated with numbers to represent pitches of the *slendro* and *pelog* scales. The examples presented here use the *Kepatihan* system of notation, which has been rendered in font form as *Kepatihan Pro*[2]. Registers are

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[1] The name of the *Mipilan* software developed through this research was based on a mistaken interpretation of this rule, but has been maintained in this document for consistency with the portfolio (my thanks to Lukman Aris for pointing this out).
[2] See <http://www.gamelan.org/library/#fonts>, accessed 19/08/13.

indicated by dots above or below the numbers. However, the actual perceived pitch of any given note is relative to the general pitch of the instrument; e.g. a note "6" played on a *kempul* is one or more "octaves" lower than the equivalent note on a *kenong*. The complete range available for notation, from low to high, is as follows[3]:

Low: 1 2 3 4 5 6 7 1 2 3 4 5 6 7

Middle: 1 2 3 4 5 6 7

High: 1 2 3 4 5 6 7 1 2 3 4 5 6 7

An extension of the previous note (*pin*) is represented by a full stop. Punctuating instruments are represented with diacritic markings as illustrated below:

Kepatihan	Letter	Name/function
①̣	G	*Gong*
1̂	N	*Kenong*
1̆	P	*Kempul*
1̄	p	*Kempyang*
1̟⁺	t	*Kethuk*
‖	-	Marks boundaries of section

Many of the traditional pieces referred to in this thesis exist in several versions. Unless specific sources are cited, examples of notation may be found in collections by Sutarja (2004) and Drummond (2013).

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[3] Since tuning in gamelan ensembles is flexible, example frequencies and ratios have not been included here; see Rahn (1978); Polansky (1985); Carterette & Kendall (1985); Pickvance (2005 p. 50). For examples of *slendro* and *pelog* tuning used in the present research see **Part II: §3.4.2.b**.

vi Preface

Prior to discovering gamelan, my experience as a musician was largely based around electronics. Among my first memories of enjoying sound is the experience of walking into a room as a child while my brother was copying data cassettes, unaware of the more practical function of what I was hearing, captivated. This incredible complex and rich sound formed a benchmark for my later musical aesthetic aspirations.

After a brief spell learning piano and guitar as a teenager, I quickly became more interested in effects pedals and digital editors, enjoying the manipulation of sound for its own sake. Having moved with my family to Japan at the age of twelve this attitude was cemented in later years by attending "noise" performances by the likes of *Merzbow* (see Landy, 2007 p. 127), experiencing spaces engulfed with often painful washes of sound, sometimes with little to no discernable structure. At home I would attempt to recreate these experiences with the limited equipment to which I had access; during this period I developed a basic vocabulary of techniques for sound manipulation that I continue to draw upon in my current work.

Upon returning to the UK and moving to London I became involved with dance music production, where I found that I could reach a wider audience by drawing listeners in through repetitive rhythms and deep bass tones. Although I achieved modest success through this activity, I often felt that my intentions were at odds with what the audience was hearing, and the critical reception of other musicians. In particular I felt my peers spoke of an artificial divide between what was considered "the music" – rhythm, melody and harmony, and "the production" – the manipulation of timbre, texture and virtual space, and the reduction of what I felt were the most interesting parts of a piece to perception as mere "sound effects". I had little interest in the formalized aspects of melody and harmony that they were speaking about, and yet I felt that the equipment I was using, the seemingly ubiquitous keyboard interface and piano roll, was pushing me towards a particular musical discourse.

Through my undergraduate studies in the Sonic Arts department at Middlesex University, I was exposed to electroacoustic music, notions of the abstract and the concrete, and algorithmic processes through the visual programming environment Max/MSP. Here I was able to reconcile the idea of a musical structure without necessarily focusing on the organization of note events. It was with this new open

attitude that I found interest in exploring musical systems with different conceptual groundings and from different parts of the world.

My first conscious engagement with gamelan music took place in 2004 as a result of recording filing cabinets in the university's electroacoustic studio. At the time I was looking for ways to bring some of the processes I was experimenting with through electronics into an acoustic instrumental context: I recorded loops of metallic taps and scraping, finding what I felt were natural subdivisions according to the tessitura of the sounds, that I would later learn loosely fitted with Indonesian gong structures. Upon hearing these experiments a friend suggested that I should look into gamelan, in particular for these structural similarities.

The comparisons between percussion-oriented electronic music and gamelan made sense when I heard recordings of the Balinese *gamelan gong gede*, and post punk band *23 Skidoo*'s albums *Urban Gamelan* (1984) and *Seven Songs* (1983). The latter of these combined gamelan instruments with sound processing techniques associated with dub and industrial music, notably tape echoes and distortion, aiding the aesthetic overlap. Shortly afterwards I signed up to a beginner's class at the Southbank Centre, and subsequently attended other community groups in London. I was immediately struck by the accessibility of the music as someone with limited instrumental experience, and the simplicity of the notation on the occasions it was used. I was told that a lack of experience in other music was not a problem, and could even be advantageous in some respects.

In playing Javanese gamelan I found that it was possible to join in with more advanced players through simple but nonetheless important parts, as the shift between different notes in the underpinning melodic framework represented by the *balungan* took place around me on what felt like an almost subliminal level. The parts played by the *gender* (a keyed instrument played with soft mallets in either hand) and other *panerusan* ("soft-style" elaborating instruments, commonly contrasted with the "loud-style" *saron* and *bonang*) were incomprehensible to me. My initial impression was of a kind of granulated echo or reverberation of other parts, a bubbling texture swelling around key points of the structure. This perception remains integral to my aesthetic, gradually developing alongside my knowledge of how the instruments related to the rest of the ensemble. Over subsequent years, through exposure to recordings, lessons, and eventually visits to Java, I fell in love with the more formal aspects of gamelan music alongside these concrete textures.

The aspects of gamelan that most appealed to me – beyond the general timbre of the instruments – were the notions of elaboration and *irama* [rhythm and levels of density].   I was particularly interested in the idea of establishing musical structure marked by pulses that could be pulled apart, expanded and contracted in real-time as part of a performance. This reminded me of the process of time stretching in digital samplers, in which granular processes were used to maintain the pitched content of audio material while the overall playback rate was modified, and which could be used creatively beyond their intended range to create distinctive grating textures.

The relationship of some elaborating parts to the *balungan* as they were taught to me seemed very suitable for algorithmic composition; my MA dissertation was based on algorithmic representation of a *bonangan* ensemble using a combination of Max/MSP and Java (Matthews, 2009). Around this time I also became aware of the *Virtual Gamelan Graz* project and other educational platforms (Schütz & Rohrhuber, 2008; see **§3.4.3**), which inspired me to move away from attempting to emulate ensembles, towards more experimental composition.

Digital technology has played a significant role in my learning process – I frequently annotated notation in spreadsheets, and generated parts on the computer to play along to – either with MIDI sequences or rudimentary algorithms – where no recording of a teacher was available. Since my first contact with gamelan I have attempted to incorporate its associated sounds and techniques into my own compositions, to varying degrees of satisfaction. The current research began as a combination and expansion of these processes: the creation of a flexible framework based on traditional material that might be expanded for other applications including the organization of sound texture and spectral content, timbre, and spatialization.

Through the development of practical work, and in particular interaction with musicians for the first time in this context, a variety of other questions have been raised that have come to the foreground; in particular, whether it is always appropriate to focus on the abstract information in music (i.e. what can be notated; see **§2.3**). In particular I became concerned that work on an algorithmic system alone, while affording a certain degree of accuracy to real-time part generation, might misrepresent the highly personal and interactive elements of Javanese gamelan performance. Consequently the focus of my work has moved towards an attempt to find an appropriate theoretical and analytical framework within which new compositions can fit, and which can accommodate a variety of approaches.

1   Introduction

Gamelan is widely known as a predominantly percussive ensemble from Indonesia, and forms part of a long-standing musical tradition. Playing gamelan generally relies on interaction and cooperation, and has been adopted in community groups and educational institutions around the world as an inclusive music making activity. The timbre and tuning of these instruments – as well as the complex musical structures with which they are associated – have also formed inspiration for many composers in other areas, including the electroacoustic medium (see **§3.4** and **§5** for examples).

An extensive body of academic discussion exists around the composition of new music involving gamelan and interaction with other disciplines (e.g. Becker, 1983; McDermott (1986); Diamond, 1992; Sorrell, 1992; 2007; Steele, 2013). Due to its integral conventions for interpretation and structuring, *karawitan* (the music played on the central Javanese gamelan) has also formed a basis for algorithmic representation (e.g. Surjodiningrat et al. 1977; Grupe et al. 2008; Worgan, 2009; Matthews, 2009). However, at the time of writing a significant study of the combination of central Javanese gamelan with electroacoustic music composition and performance, with particular reference to traditional playing techniques, has yet to emerge. The research presented in this thesis is based on a combination of theoretical and practical exploration in this area, drawing on existing discussion of both traditional and new music.

1.1 Research questions

The aim of the present thesis is to address the overarching question:

- What kind of results can be obtained through the combination of Central Javanese gamelan and electroacoustic composition and performance?

In order to address this question one must first address what composition and performance mean in either field, not only in terms of resources and parameters available to work with, but on a fundamental conceptual level. This problem may be broken down into the following questions:

- What do the terms "composition", "performance", and "theory" entail in the context of gamelan and electroacoustic music?

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- Can a broader conceptual framework accommodate both fields and their associated compositional parameters?
- What kind of practical considerations should be taken when combining the gamelan with electroacoustic music?
- What happens in cases where musical material and theories are separated from the instruments, voices, and wider cultural context within which they were initially developed?

These questions are developed further through a series of aims and objectives for the practical work in **Appendix 1**.

As the title suggest, the present thesis is biased towards the adaptation and application of theory in one particular direction – using ideas from Javanese gamelan to organize electroacoustic processes. For example, in my own practice stock melodic patterns and playing conventions are adapted to the constraints and affordances of software and controllers, with limited necessity for modification to the common processes they control, such as sine tone generators and granular synthesis (see **Appendix 2**). Wider conceptual considerations are also linked to the possibilities enabled by electroacoustic composition: to the re-contextualization of recorded material, the blurring of sources of gesture, and the ability to work directly with sounds as concrete textures, on a micro-sonic level, or to derive new forms of syntax from them. The implications of applying theory developed for analysis of electroacoustic music to gamelan performance practice based on instruments, as well as more involved collaborative attitudes, will be considered throughout the thesis where appropriate (e.g. **§5.1.1.a**).

1.2 Research methods

This thesis has been developed with equal weighting on practice and research in a feedback relationship. The practical portion of the research is documented in a data DVD attached to the physical copy of the thesis. In addition to the main portfolio this includes a selection of additional recordings from the development process.

Over a period of three years I have worked on a series of original compositions and arrangements of traditional Javanese material for gamelan instruments and electroacoustic processes, with the intention of creating a framework for

composition[4]. The composition process has largely been focused on the development of algorithmic software using the visual programming environment Max/MSP with fragments of JavaScript. The results of this development are represented in the *Mipilan* standalone software in the digital portfolio.

This activity has extended beyond the central research, and has yielded several public performances that form the basis for discussion in the latter part of the thesis (see **§1.5**). In particular the *Augmented Gamelan* concert set performed in the Union Chapel in June 2012 was designed as a focal point for the research output.

During the research I have made several trips to Solo in Central Java, Indonesia, lasting one to two months each. Through these trips I participated in private lessons (focusing on *kendhang* and *bonang*), experience rehearsals and performances first hand, and engage in discussion with composers and musicians on the nature of gamelan music, composition, and performance[5]. This activity culminated in a series of recording and development sessions in ISI Solo during January-March 2012, during which I worked with a group of musicians gathered by composer and teacher Joko Purwanto.

In addition to composition and arrangement I have continued my study of traditional Javanese gamelan music both in the UK and in Indonesia. This process has been vital in the development of the thesis, as I view the works I have developed as part of a more general learning process, a way of finding my way around gamelan instruments and music, and relating them back to my own means of expression and my personal conception of sound and music.

Through the theoretical portion of the research I have developed an analytical framework for examination of my own compositions alongside existing works. In leading up to doing so I have conducted a review of existing literature and practice,

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[4] During this time I have also collaborated with several composers and performers on mixed instrumental and electroacoustic works (notably Aris Daryono and Charlotte Pugh) as well as joining the Southbank Gamelan players as a gamelan musician during their collaboration with Rahayu Supanggah and Plaid. These performances have not been included in the main thesis but are mentioned to provide additional examples where appropriate.

[5] Although these have been important in the development of my ideas and compositions, it has not been possible to include text from the interviews to the extent that I had originally intended. I hope that these may be used in further development of the research beyond the present thesis.

which in turn has necessitated the examination of general musical terminology in order to find an overarching and – where possible – culturally neutral approach.

The focus of analysis presented within the thesis is on the conceptual level, and is based on the nature of syntax and degree of reference to idiomatic conventions. The foundation for this framework has been adapted from the *language grid* developed by Simon Emmerson (1986) for the analysis of electroacoustic composition oriented around timbre, which may lead to analysis based on note-oriented conventions such as melody and rhythm where appropriate. Further analysis based on cues to indicate discourse takes development of Emmerson's ideas by Nye Parry (2000) as a starting point.

1.3 Thesis structure

The written thesis is divided into two parts. **Part I** focuses on theory and context through the development of a conceptual framework; **Part II** serves both as illustration of the concepts developed and documentation of the practical element of the research. Through the course of the thesis I have attempted to move from more abstract ideas to concrete examples, leading to discussion of on my own practice.

The first three chapters represent a review of existing literature and practice, leading into the development of a theoretical framework. In **Chapter 2**: *General musical concepts*, I introduce general musical concepts and terminology as I intend to use them, and attempt to address wider issues of compatibility between different forms of music. In particular I focus on a notion of idiom as often discussed in relation to gamelan, and its relationship to constraints and affordances. Here I also discuss the distinction between abstract musical information and concrete musical experience.

These somewhat abstract ideas are developed further in context in the subsequent two chapters. In **Chapter 3**: *Central Javanese gamelan music theory and practice*, I provide an introduction to the relevant concepts in traditional gamelan composition and performance, and their relationship to idiom. Here I also introduce approaches to new composition in Central Java and abroad, and their relationship to tradition, helping to establish context for the current research. In **Chapter 4**: *Electroacoustic music theory and practice*, I engage in discussion of approaches to the electroacoustic medium and its relationship with idiom, alongside a brief history of the sources used in the construction of my theoretical framework. Schaeffer's

musique concrete provides an example of theory developed for the electroacoustic medium, which is extended with more recent academic discussion. Emmerson's *language grid* is introduced as the foundation for my own analytical framework, which also serves to illustrate the breadth of current approaches to electroacoustic composition. Through discussion of Emmerson's work, a theory of intersecting syntax and discourse is established, with further reference to idiomaticism to complement the notion of aural and mimetic discourse.

In **Chapter 5**: *Strategies for composition and analysis of mixed works*, I examine attitudes to new composition for gamelan and electroacoustic processes alongside issues raised by the introduction of acoustic instruments associated with other disciplines such as orchestral music. This leads to the question of whether it is appropriate to look at gamelan and electroacoustic music in a "bi-musical" relationship, a way of thinking developed through ethnomusicology that has been adopted by many composers seeking to bridge musical disciplines (Hood, 1960). The notions of syntax, discourse, idiomatic reference, and mapping introduced in previous chapters are explored through a selection of existing works involving gamelan and electroacoustic processes alongside examples from my own practice. This discussion culminates in the positing of a framework for conceptual analysis of works using electronics with gamelan, with suggested applications in the composition process.

In **Chapter 6**: *Conclusion*, I present a summary of the thesis and discuss its implications in the context of both relevant disciplines and the wider area of cross-disciplinary collaboration.

The appendices presented in **Part I** are based on description and analysis of my own practice. A general introduction takes place in **Appendix 1**: *Composition process and framework development*, providing the background and chronological order of development. An overview of techniques and parameters for composition is provided, including descriptions of custom software and electronic *cengkok* [melodic patterns] created in the composition process. This section concludes with a critical assessment of the practical work and the identification of opportunities for further development.

The details of software development and implementation, including further explanation of electronic *cengkok* and sources for timing are covered in **Appendix 2**. In **Appendix 3** I examine five key pieces : *Bonang Study*, *Tenuous Links*, *Monggangan*, *Augmented Gamelan*, and *Response to ShoutCry Room*. In each case I provide a

description of the software and instrumental resources used, the individual composition and performance process, and analysis based on the framework proposed in **Chapter 5**.

1.4 Contributions to knowledge

The key contributions to knowledge developed through this thesis are as follows:

- The identification of approaches and expanded possibilities afforded through mixed electroacoustic and gamelan-oriented composition, and their orientation within existing academic discussions in electroacoustic and ethnomusicological contexts.
- A framework for analysis of new works based on the relationship between development of syntax and degrees of idiomaticism in musical discourse, building on the *language grid* introduced by Simon Emmerson (1986) (see **§5**).
- The development of a set of techniques for the integration of pseudo-idiomatic information in gamelan-oriented composition (see **part II**).

1.5 Research outputs

The current research has been developed and disseminated through the following public performances in addition to internal seminars and informal workshops. Events marked with an asterisk took place during the writing-up period and it was therefore not possible to include them in the portfolio or body of the thesis. These performances are listed to illustrate further development of the research and are referred to in note form where appropriate. Additional media is available in an online archive under development at <http://www.augmentedgamelan.com/>.

16/07/11: *Placard Headphone Festival*, **Access Space, Sheffield**
Tenuous Links – solo performance using the *Bonangan* software, with a selection of small gongs, input/output transducers, and analog mixer (**AV1.2.B**).

26/04/12: *Gathering of the Gamelans* **symposium, University of York**
Paper presentation and demonstration: *Searching for an approach to gamelan and electronic music*, including an arrangement of *Ladrang Srikaton* using the *Cengkokan* software (**AV2.5**; **Appendix 2**). The main presentation was followed by a lunchtime

concert of pieces developed in collaboration with Charlotte Pugh, including an arrangement of *ketawang Subakastawa* (**AV2.7.B**).

30/06/12: *Daylight Music* event, Union Chapel, London
Augmented Gamelan performance with a selection of *gender*-type instruments, mixer, *bonang*, and input/output transducers (**AV1.4**).

28/10/12: *Art and Healing* event, The New Diorama Theatre, London
Collaborative performance (music and movement) with Rebecca Woodford-Smith, using pre-recorded electronic material based on processed gamelan instruments and the *Mipilan* software (**AV1.5**).

16/05/13: *Algorave* event, The MS Stubnitz, London*
Improvised solo performance using the *Mipilan* software synchronized with a Roland TB-303 (emulating conventions of *irama*) and processed through various *bonang*, and input/output transducers.

01/06/13: *No Dark Places* festival, The Albert, London*
Further development of the *Augmented Gamelan* performance set in an empty swimming pool, including further improvisation based on acoustic feedback and delays.

07/07/13: *Gamelanathon* event, Queen Elizabeth Hall front room, London*
Further development of the *Augmented Gamelan* performance set in an informal staged area.

2 General musical concepts

This thesis involves the combination of two broad areas; both *electroacoustic music* and *gamelan* can refer not only to styles of music, but also to methods of sound production. The approach to music in an electroacoustic context frequently involves the separation of instruments, materials and techniques from the contexts in which they were developed, occasionally in ways that may be considered to play on the subjective borders of musicality. Thus I feel it is essential to begin by exploring a broader definition of musical concepts, beginning with music itself – one that will accommodate the discussion and output of the current research presented in **Part II** of this thesis. In particular the notion of idiom employed in this thesis has been developed as an interpretation of ethnomusicological discussions where no explicit definition has been provided (e.g. Hood, 1971; Brinner, 1995; Perlman, 2004; Sorrell, 2007). These terms form the basis of discussion in **§5** and **Appendix 3**.

2.1 Music as (humanly) organized sound

In contemporary music circles it is increasingly common to refer to all sound as music, or all sound as potentially being music; a shift often attributed to John Cage's philosophy and writing (1961). In order for the terms *music*, and perhaps more importantly, *musical*, to be useful in the context of the discussion presented here, I feel it is necessary to stipulate the broadest possible definitions as a starting point from which more specific terminology can be developed.

In this thesis I will use the term music to refer to "organized sound", drawing on definitions from ethnomusicology, and experimental and electroacoustic music theory established in the 20th century. I will distinguish between types of musics in terms of *idiom*. In doing so I hope to find an approach to various abstract properties without necessarily resorting to analogy with musical concepts of a specific culture, such as tonal music.

In his study *How Musical Is Man?* John Blacking presents a definition of music for ethnomusicological purposes as "humanly organized sound" (1974). Blacking states that "music is a product of the behaviour of human groups whether formal or informal; it is humanly organized sound . . . musical performance, as distinct from the production of noise is inconceivable without the perception of order in sound" (p10). Blacking's inclusive conception of music forms part of his ongoing discussion of the

differences in emphasis of musical parameters in different cultures, asking: "must the majority be made 'unmusical' so that a few may become more 'musical'?"(p.4). In doing so, he places emphasis on the physical construction of instruments, the physical movement needed to create sounds, and social context. Blacking acknowledges the use of technology and electronic instruments in the production of music but suggests that people of some cultures may find it difficult to focus on abstract musical information (in this case notes and their tuning) without the presence of human production, or find it difficult to relate to new parameters such as timbral modulation as musical if there is no obvious human influence (p. 27).

Blacking, in keeping with the evolving attitudes of the time of his writing, suggests that "No musical style has 'its own terms': its terms are the terms of its society and culture, and of the bodies of the human beings who listen to it, and create and perform it" (p. 25). It follows that changes in culture bring about changes in music; just as the music from other cultures or innovation in composition may become accepted as "musical", shifting from perception as non-musical sound or noise, so might the changing sounds of human and mechanical activity in everyday life. The integration of environmental and electronic sounds in contemporary music is largely linked to shifts in society and culture in post-industrial Europe and America[6].

The term "organized sound" in the context of composition is often attributed to Edgard Varèse (1966) and widely adopted in experimental and electroacoustic music circles to include the new electronically generated sounds that did not appear to fit with conservative definitions of his time and location. The term was also taken up by John Cage (1961 pp. 3-6), suggesting that: "If this word 'music' is sacred and reserved for eighteenth- and nineteenth-century instruments, we can substitute a more meaningful term: organization of sound" (p. 3). Cage and Varèse form part of a wave of composers and theorists in the early 20th Century calling for an integration of noise and so-called "real world sounds" into music; a move that forms the basis of development of *music concrète* and electroacoustic music, and challenges the idea that human influence must be present. This expanded definition allows for non-humanly produced sounds such as bird-song or organization via chance operations and algorithms to be called music if interpreted as such by the listener.

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[6] See Russolo, 2004 p. 12. For further examples of changing attitudes towards noise and music see Cox and Warner (2004 pp. 5-61).

2.1.1 Musical instruments

If all sound can be considered music, it follows that any device capable of making sound has the potential to be a musical instrument. According to Pierre Schaeffer: "Every device from which a varied collection of sound objects - or a variety of sound objects - can be obtained, whilst keeping in the mind the permanence of a cause, is a musical instrument in the traditional sense of an experience common to every civilisation" (Schaeffer in Chion, 2009 p. 53). In some cases the combination of several processes might be described as a "pseudo-instrument", a term developed by Schaeffer to reconcile situations in which the convergence of several distinct sound objects creates the impression of a single virtual source (Dack 2002b).

While these ideas are essential in understanding the broader scope opened by electroacoustic practice, the expansion of a notion of "instrument" can cause difficulties in writing about the combination or comparison of electroacoustic processes with more traditional means of musical sound production. Unless otherwise stated the term "instrument" will henceforth be used to refer to "traditional" acoustic musical devices with a clear human agent (within which I include voices), or their emulation; a situation Smalley refers to as "second-order surrogacy" (1997 p. 112; see **§4.3**).

2.2 Musical idiom

Since various cultures and individuals take different approaches to music and what might be considered musical, it may be more appropriate to find a term for a sort of "relative musicality", which I suggest may be referred to as *musical idiom*[7]. *Musical idiom* as represented in this thesis describes a set of codes, an abstract frame of reference for the creation and perception of discourse in music. In some cases the notion of idiom is comparable to those of style and genre. An idiom represents the conventions drawn upon in composition and performance; the theory of a form of

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[7] In attempts to find culturally neutral language to describe musical activity beyond what might be described "Western musical" terms, it is common to use analogies with linguistics such as phrase, grammar, syntax and idiom. I have adopted these terms throughout this thesis, as despite their connotations they provide a vocabulary common to the pedagogy and academic writing surrounding ethnomusicology, gamelan and electroacoustic music. Unless otherwise stated these references remain notional and should not imply a practical correlation between music-making and linguistics to the extent that their rules can be considered interchangeable.

music in cases in which it has been formalised. Musical idiom may be formed over centuries as part of a tradition, or developed on a more fluid and individual basis in contemporary music. One might speak of *regional idioms*, e.g. *karawitan* (traditional Central Javanese gamelan music), or the *personal idioms* of musicians[8]. The term *instrumental idiom* may be used to describe the conventions associated with an instrument, often in relation to their physical constraints. In practice a musical idiom comprises a complex network of these factors, which interact with the creative input of individual composers and performers[9].

With this in mind, rather than questioning whether sounds or actions are musical in a broader sense, it can often be more useful to examine their appropriateness in a given context: the degree to which they are idiomatic[10]. As with notions of musicality, to be idiomatic in itself does not guarantee quality in the mind of a listener; an artificial emphasis on idiomaticism in composition might bring about a perception of cliché or pastiche (see Sorrell, 2007). In this manner a question of idiomatic integrity does not constitute a value judgement, but rather it allows for examination of the grounds upon which a value judgement might be made, the emphasis of certain abstract parameters (e.g. pitch and rhythm) and the syntaxes that these form, from which musical meaning can be derived. To attempt to apprehend music without knowledge of its intended idiomatic identity might lead to the imposition of knowledge from other idioms, or a shift towards listening on a more concrete level, and the "sonic surface" of the music[11].

Performance and composition are typically mediated by idiom, whether on a personal or regional level, or in the approach to working with an instrument. In his influential text on improvisation, Derek Bailey uses the term *idiomatic improvisation* to describe performance within a framework: "Idiomatic improvisation, much the most widely used, is mainly concerned with the expression of an idiom - such as jazz, flamenco or baroque - and takes its identity and motivation from that idiom" (Bailey,

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[8] Personal idiom might also be described as an *idiolect* (see Nettl, 1983 pp. 52-53).
[9] Huron & Berec provide a comprehensive review of academic writing relating to various forms of idiom (2009 p. 103).
[10] Defined in non-linguistic contexts as "appropriate to or representative of a distinctive style of music, art, architecture etc.; characteristic of the mode of artistic expression of a particular period, place, individual or group" (OED online 2013c).
[11] Michael Tenzer uses the term "sonic surface" in his discussion of various levels of listening to Balinese *gamelan gong kebyar*, noting that in-depth knowledge of the idiom also allows for greater appreciation on this level (2000 p.21-25).

1986 p. xi). Bailey's study highlights that improvisation is common to many forms of music around the world, but that the term improvisation in itself is rarely used; performers often prefer to describe their activities as "just 'playing'" (ibid p. xii). Some degree of idiomatic interpretation takes place in what might otherwise be considered non-improvised music; for example, the interpretation of dynamic marks on a composed orchestral score and the speed chosen by a Javanese drummer in a particular *irama* are generally performed with reference to established conventions.

In contrast, *non-idiomatic* improvisation (or other musical activity) implies the deliberate eschewing of convention, of any frame of reference. *Non-idiomatic* activity might be considered a more extreme form of *un-idiomatic* activity, the latter of which must be considered in relation to an idiom (Bullock, 2010 p. 141). Describing free improvisation, Bailey writes: "Diversity is its most consistent characteristic. It has no stylistic or idiomatic commitment. It has no prescribed idiomatic sound. The characteristics of freely improvised music are established only by the sonic-musical identity of the person or persons playing it" (ibid, p. 83).   This deliberate operation outside an idiomatic framework often leads to the creation of new idioms, or a personal set of conventions that Michael Bullock terms *self-idiom* (2010); an extension of the concept of personal idiom described above. Bullock suggests that *self-idiomatic* musicians strive to work directly with materials as much as possible, that it is an approach "characterized by exploration of the sound possibilities afforded by musical instruments and sounding objects" (ibid, p.1). This describes much electroacoustic composition and performance, which is often characterized by the absence of conventional instruments or recognizable sound sources (see **§4**).

2.2.1 Phrasal idiom

Examples of phrasal idioms in linguistic contexts include the metaphorical "hitting a wall" in English to mean encountering a problem, or "*jam karet*" [lit. *rubber time*] in Bahasa Indonesia to mean that an appointment is flexible[12]. Within this thesis the term *phrasal idiom* will be used in musical contexts to describe phrasing of notes or

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[12] Taking the definition of "idiom" from linguistics: "a form of expression, grammatical construction, phrase etc. used in a distinctive way in a particular language, dialect or language variety" (OED online, 2013b). Further discussion of idiom and its relation to metaphor in linguistic contexts falls outside the scope of this research, but may prove useful in illuminating some musical issues. See Glucksberg (2001) for discussion of the semantic and syntactic properties of linguistic idioms.

structures having specific meaning or function in one context that will be lost if transferred to another. Examples of phrasal idioms in music include abstract devices such as the *picardy third* and *cadence* in tonal music, and entire phrases e.g. 'named *cengkok*' such as *jarik kawung* or *tumurun* in Central Javanese gamelan (see **§3.3.3**). A phrasal idiom might not be transferable to other instruments or ensembles for mechanical reasons, for example the tessitura, mono/polyphony or rhythmic capabilities of an instrument.

2.2.2 Instrumental idiom

An *instrumental idiom* refers to the characteristic techniques and phrasing it is possible to play, combining the physical constraints and an accumulation of conventions for playing in relation to wider stylistic concerns. Instrumental idioms are not always formalized; gamelan music provides a clear example of established roles. An instrument may also be associated with characteristic rhythms, contours or textures, and a set of phrasal idioms – in some cases a specific vocabulary of melodic patterns as in the case of Javanese *cengkok* – which by definition must rely to some extent on the physical constraints of the instrument. In some cases a phrasal idiom originating in a specific part (such as a vocal line) may be subject to distinctive methods of interpretation across several instruments in an ensemble (see **§3.3.3**).

Instrumental idiom provides a model for a composer to ensure that a part is possible to play on an instrument, or the preconception of how an instrument will behave when approached by an improvising musician. In this respect, the degree to which a part is idiomatic does not just affect a critical reaction, but may determine the ease with which a part may be played, or whether it is possible to play at all. A player might complain that a part is unsuitable for their instrument and hence un-idiomatic on mechanical grounds: for example, if its pitch content falls outside the tessitura of the instrument, if it calls for rhythmic density that is impossible or uncomfortable to realize, or in the case of vocal or wind-based parts, does not leave space for the singer or player to breathe. Some instruments have little dynamic range, or might produce undesirable sounds or risk damage when played outside their established range.

It is therefore possible to think of a spectrum of instrumental idiom in terms of difficulty (Huron & Berec, 2009). For a part to be idiomatic at its most basic level, it must first be possible to play at all. At the other extreme, for a part to be truly idiomatic its parts might be impossible to play on other instruments:

un-idiomatic   idiomatic

physically	uncomfortable	undesirable,	playable on this	considered	impossible
impossible	for human	"un-musical"	and other	characteristic	to play on
to play	player(s)	sounds	instruments	of an instrument	other
					instruments
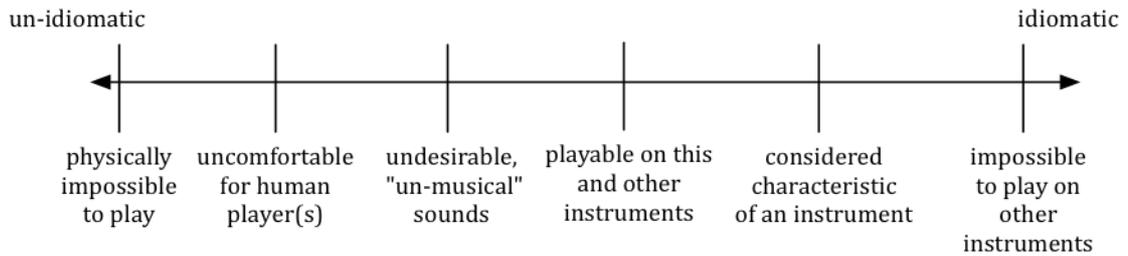
Figure 2-1: A possible spectrum of instrumental idiomaticism based on difficulty.

Equating idiomaticism with performance difficulty is problematic in that a part can be difficult to play due to complexity or expert technique required, and yet still be idiomatic. In this respect, an instrumental idiom may also be discussed in relation to its affordances (Huron & Berec, 2009; see Gibson, 1977, Norman 2002) [13]. Affordances have been adopted in design and subsequently in musical contexts to describe possible actions for an environment or object (see Magnusson, 2006; Mooney 2010). In particular, they may be used to describe the actions that a design can encourage a user to perform, highlighting that the easiest or most intuitive option is not always the most desirable.

Affordances can also be considered in relation to physical and conceptual frameworks such as instruments, styles and idioms (Mooney, 2010). According to Mooney, an idiomatic performance sits around the upper-middle end of a spectrum of affordance, as a set of actions that relies on considerable deliberation and skill[14]. However, the affordances of an instrument can vary according to context, including the stylistic or personal idioms being evoked at the time: the "niche" created by in performance situation. What may be considered arbitrary sounds in a classical context can form the basic vocabulary of a contemporary piece, requiring a comparable degree of skill to reproduce accurately.

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[13] Gibson's original text provides the following definition: "the affordance of anything is a specific combination of the properties of its substance and its surfaces taken with reference to an animal" (1977, p. 67). Gibson highlights that affordances are a combination of properties that may vary depending on the subject; he refers to the particular set of affordances for a given animal as a *niche* (Gibson, 1986 p. 128).
[14] Mooney's spectrum of affordance ranges from easy to difficult possible actions, giving a violin as an example of a physical framework. At the lower end of the spectrum lie what Mooney refers to as arbitrary taps, and scrapes; sounds that are easy to make, perhaps by accident. At the upper end are seemingly impossible tasks, e.g. space travel (ibid pp. 145-146).

2.2.3 Formalizing aspects of idiom

Idiom often describes an established function of part in relation to an instrument's mechanical qualities and the wider musical framework.   While these are considerations that a composer should take when writing for an instrumental performer, they are essential in what Bailey terms as idiomatic improvisation, where players must act spontaneously with other players while working within a framework (1986 p. xi). This is the case in Central Javanese gamelan, in which many parts can be said to follow and expand upon the same central melodic framework (see **§3.3**). Through a process called *garap* [work, interpretation], musicians interpret and elaborate in compliance with instrumental constraints, abstract conventions and the personal idioms of performers. Benjamin Brinner describes knowledge of an idiom in the context of gamelan performance:

> Active knowledge of an idiom begins with basic playing
> technique and appropriate playing style. For the more complex
> idioms, a higher level of competence is evidenced by command
> of all the options inherent to the instrument, including a stock
> of patterns, and knowledge of their proper usage. (Brinner,
> 1995 p. 56)

In gamelan music, alongside various forms of idiomatic improvisation, knowledge of the wider stylistic idiom, mechanical and phrasal idioms, and those of other instruments and players is essential for performance. Players must know their instruments, including methods of sound production, to the point that technique does not interfere with the process of realizing parts and communicating with other exponents in the group (see **§3.3.1**).

Therefore I suggest that ensemble and stylistic idiom have conceptual overlap with a concept of instrumental idiom, and might be broken down as follows:

- **Physical constraints/affordances**: the available sounds and ranges/limitations of various parameters in playing an instrument, such as pitches and their discretion, polyphony, timbre and dynamic range.

- **Basic/conventional techniques**[15]: appropriate sound production (including minimizing risk of damage to an instrument), specialist techniques such as damping and vibrato.
- **Codified aspects**: grammar, syntax, patterns, phrasal idioms, and relation to the rest of the ensemble.

Various levels of idiom may be addressed in terms of these factors, with varying emphasis on the influence of physical constraints. For example, a personal idiom may develop from particular vocal qualities as well as innovation and the abstract codes of a regional style. The affordances presented by instruments may vary in different situations, according to stylistic, regional and personal idioms. As highlighted by Cottrell's example of working musicians in London the same musician may find different uses for an instrument in different situations (2007). What seem like arbitrary noises in a refined classical context may form the basic vocabulary of a contemporary piece; the act of non-idiomatic or self-idiomatic improvisation or other musical activity can redefine its affordances.

2.2.4 Bi-musicality and multi-musicality

Mantle Hood introduced the term "bi-musicality" in the 1960s as he was encouraging ethnomusicology students to learn the instruments involved in their studies (Hood, 1960). Hood places emphasis on developing "an ability to hear", suggesting that the conditioning to perceive equal-tempered intervals was a "prejudice to overcome" in order to appreciate a world of microtonal inflections (ibid p. 56). Other areas Hood highlights include the importance of aural learning and flexibility in rhythmic perception, which he describes in relation to "Western music" practices (ibid).

The appropriateness of the term bi-musicality has long been the subject of debate, resulting in some updated definitions - notably in the logical expansion beyond two "traditions", and in particular moving forward from the original context of Western classical music and its others that Hood himself admits is questionable (ibid p. 59). Bi-musicality and its variants – including multi-musicality (Nettl, 1983) – have more recently been employed in other situations including the context of composition of new music (Diamond 1998; Sorrell 2007; Gluck 2008; see **§5.1.1**).

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[15] In contrast with extended techniques, which might be developed by a performer, idiomatic to another style of playing, or adapted from another instrument.

Steve Cottrell reviews various uses of the term and related concepts (Cottrell, 2007). Developing discussion initiated by the ethnomusicologist John Bailey, Cottrell uses "bi-musicality" to describe relationships between various disciplines on a local level, focusing on professional musicians based in London and highlighting subtle differences that musicians may encounter when playing the same instrument in different settings. Cottrell also draws on Mark Slobin's application of the ideas of code switching, layering and superimposition to music, enabling comparisons with multi-lingualism (Slobin, 1979; 1993 pp. 85-89)[16]. It is possible to speak of moving between idioms in this manner: for example, switching between personal idioms through quotation of various musicians, or moving between regional idioms and more general musical styles. Although the logical interpretation of this idea in music is a movement between characteristic vocabulary and syntax (as in linguistic contexts), Cottrell extends this to include what might be considered "extra-musical" or perhaps more appropriately "extra-sonic" factors, such as dress code and physical gestures and posture on stage (Cottrell 2007 p. 99). Other "codes" to consider include the processes involved in recording or amplifying performance; for example the way a singer may be trained to interact with a microphone, or the mix created by a sound engineer. This layering is happening constantly, as part of a concrete musical activity.

Stanley Hoffman goes further in describing layering of musical conventions as the layering of epistemologies: conceptions of the way the world works, and in particular concepts of time (1978). Hoffman presents the ceremonial *gamelan Monggang* and the sung poetry of *macapat* as representative of cyclical and linear approaches to time respectively, which he suggests combine to represent the *gendhing kemanak* form of composition used in court dances (ibid, p. 81)[17]. Hoffman's approach describes a similar code layering to that presented by Slobin, and reinforces the idea that combinations of music, even from the same culture, imply a relationship between wider cultural values. Even if not consciously intended by the composer or performer, these layers of references may form a significant part of discourse for audience.

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[16] Slobin uses a definition borrowed from socio-linguistics: "moving from one set of co-occurring rules to another" (Labov, 1972 in Slobin 1993 p. 85).
[17] This example may be extended to describe gamelan composition most frequently found in *gendhing*, as the layering of cyclic elements and linear melodic lines.

2.3 Abstraction in music

The meaning of *abstraction* depends on context; it has different connotations in music, visual arts and computer science, as well as particular philosophical implications[18]. In music, abstraction on a low level is the isolation of values, in contrast with concrete characteristics (Schaeffer, 1977; see **§4.1.1**). Abstract values often represent the information that can be notated in a performance. As networks of values are taken away or considered in more general terms, a higher level of abstraction entails the creation of larger scale musical structures or frameworks for composition, ultimately resulting in what I have thus far described as musical idioms. The organization of sound – whether in the mind of the creator or listener – may be considered in terms of abstract qualities, isolated from the concrete whole that comprises both sonic and extra-sonic aspects[19]. Listeners or performers might not consciously engage with abstraction or relate abstract qualities to the way music moves them, but it can form a vital part of analysis and composition.

Working in the domain of the abstract often means a removal from reference to the real world or established cultural contexts. Abstract music in its most extreme form is sometimes equated with *absolute music*; i.e. music with no reference to the real world in the same manner as the visual arts (with perhaps the exception of lyrical content), in contrast with *programme music* (Scruton, 2013)[20]. To a certain extent the term *abstract music* may be used to describe a great deal of instrumental music, including orchestral tonal music and *karawitan*[21]. In some cases the reference to the real world may be to an existing idiom; for example serialism and twelve-tone music are often considered abstract in relation to the more familiar structures of tonal music.

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[18] The Oxford English Dictionary defines the adjective *abstract* as: "Considered or understood without reference to particular instances or concrete examples; representing the intrinsic, general properties of something in isolation from the peculiar properties of any specific instance or example" (OED Online 2013a) and the verb *to abstract* as "[to] consider something theoretically or separately from (something else)" or "[to] extract or remove" (ibid).

[19] See Dack (2002a) for discussion of the terms abstract and concrete as used in other musical contexts; also see **§4**. For wider philosophical implications see Rosen (2012).

[20] For discussion of abstraction in the sense of removal of reference to the real world in electroacoustic music and crossover with the use of the term here see Parry (2000); Evans (1986).

[21] See Humardani (in Roth, 1986, appendix I) for discussion of the use of representational sounds in traditional gamelan music.

2.3.1 Isolation of values and notation

In many musical idioms the most commonly recognized abstract values are pitch and duration, with varying degrees of importance. Alongside loudness or intensity, these often form the values that are written or notated, and combine to form a "note" event in the MIDI specification (see Roads, 1996 pp. 972-1016). Consideration of these values in relative isolation – and in some cases further abstraction to numerical values – allows for processes such as generalized notation for many parts (e.g. staff notation or the numeric *kepatihan* system commonly used to represent gamelan music), remapping (e.g. from one instrument to another) and manipulation (e.g. transposition and inversion). For the purposes of representation, abstraction is often achieved through approximation and the stabilization of other parameters. For example, consideration of pitch in isolation often entails an approximation of a fundamental or pseudo-fundamental frequency, abstracted from more complex spectral content[22].

The *cantus firmus* as used in species counterpoint provides an example of a further melodic abstraction through the stabilization of rhythm and other parameters. According to Felix Salzer, the *cantus firmus* can be defined as: "not a melody . . . but an abstraction from melody in which the linear element is separated from the other aspects of melodic design" (Salzer and Schachter, 1989 p. 3). This isolation affords an approach to sequencing notes on their most basic level, creating a structure that can be manipulated without having to consider other aspects before being re-concretized in the context of a wider composition[23].

2.3.2 Creation of a framework

A set of values can be combined to form an abstract structure, something that might be considered apart from concrete realizations in performance and manipulated to generate musical output. This might take the form of a loose framework, as in the case of musical idioms, or a formal set of rules, such as serialism and various methods

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[22] In some gamelan instruments the impression of a pitch may be formed out of predominantly noise-based spectra or the combination of two close fundamental frequencies, which also cause *ombak* [beating tones] (Schneider & Burmann, 1993).
[23] The *cantus firmus* was used as a reference point for the *balungan* by scholars in the early 20th century (see Perlman, 2004 pp. 123-126; **§3.2**).

of algorithmic composition. Contemporary composers and performers often create their own syntaxes or personal idioms, perhaps abstracted from wider genres, the affordances of their tools, and raw sound material (see Bullock, 2010, Emmerson 1986; **§4.2**). Formal grammars have also been applied to music in analytical and composition contexts, including application to the analysis of *karawitan* (Becker 1972b; Becker & Becker; 1979; Hughes, 1988) and more recently form part of the foundation for the *Virtual Gamelan Graz* framework developed in the *Supercollider* language as a means for simulating a gamelan ensemble in real-time for musicological and performance purposes (Schütz & Rohrhuber, 2008).

Abstraction in computing has crossed over into musical process with the advent of algorithmic and other forms of computer-based music[24]. Object oriented languages such as *HMSL* (Polansky et al. 1990) and *Supercollider* (McCartney, 2002) rely on a hierarchy of abstraction at various levels as virtual objects are implemented by referring to abstract versions of their parents. The boundaries between models of musical abstraction and abstraction in programming contexts are increasingly blurred and manipulated in real-time through the emerging practice of live coding (see Collins et al. 2003; Bown et al. 2009; Mclean, 2011). The manipulation of code in real-time, often projected for the audience, helps improvisers focus on abstract compositional structures rather than individual note events (McLean 2011 p.132)[25].

2.3.3 Mapping

In order to be heard and experienced even the most "abstract" music must be concretized in some manner, whether it is sung, played on instruments, produced through other processes including amplification. The choice of parameters and many subsequent decisions in composition take place through the process of *mapping*[26]. Mapping involves the transference of information between different parameters, and in some cases builds on higher levels of abstraction to enable the movement of information and concepts between domains.

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[24] For examples of types of abstraction in programming see McCartney (2002 p. 62).
[25] This approach is characteristic of what McLean describes as "bricolage programming" in performance, which he describes as "artistic programming as an embodied, creative feedback loop" (McLean, 2011 p. 129).
[26] "A correspondence by which each element of a given set has associated with it one element (occas., one or more elements) of a second set" (OED Online 2013d).

Mapping is an important part of electroacoustic and in particular computer-oriented music, creating an interface between abstract information and the physical world. Mapping is essential in musical interface design, providing a means for physical gestures to be translated into information that may be processed and translated into audio (Hunt & Wanderley, 2002). It is a key process in sonification, the act of representing non-musical information through sound, the applications of which extend beyond musical contexts (Ben-Tal, 2004). In many cases the process of mapping may be considered as important a consideration as the information being mapped, and can form a primary activity in composition (Doornbusch 2002a).

For the purposes of this thesis, mapping of information in a musical context will be divided into two categories: *parameter mapping* and *conceptual mapping*. The relationship between parameters in mapping varies from *one-to-one*, *one-to-many*, *many-to-many*, or *many-to-one* (Hunt & Wanderley, 2002 p. 99; Doornbusch 2002a, p. 37). Conceptual mapping implies transfer of information on a higher level of abstraction, and generally entails a movement across domains. Examples of conceptual mapping can be found in the verbal descriptions of musical concepts such as pitch and height[27]. The ease and frequent necessity of stating explicit parameter mappings in electroacoustic music might lead a composer to seek one-to-one equivalence in the most parameters by default, where it may be more appropriate to consider the wider implication of the conceptual mapping taking place.

A conceptual mapping may be broken down into a set of parameters for the purposes of analysis or actuation, but may require flexibility, and in some cases the substitution of other similar parameters or material. A mediating parameter or conceptual metaphor might be used when mapping between domains rather than attempting to seek direct equivalence of parameters or their values (a role I have assigned to a frequently inaudible *balungan* [skeletal melody] in my own work; see **§5.3**, **§5.7**; **Appendix 3.1.2.a**, **3.3.2.d**).

2.4 Conclusion

Different types of music are not always mutually intelligible; the term "idiom" may be used to differentiate between various styles and traditions while highlighting this problem. In particular, it cannot be assumed that all music shares the same

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[27] See Zbikowski (1997 p.201); also Perlman (2004 pp. 30-35).

parameters, or places equal weighting upon them; to do so assumes relativity to a particular discipline or culture, and may lead to the creation of a circular definition. Instead it may be more beneficial to move to a broader conceptual level.

In this chapter I have highlighted the importance of considering music as a concrete whole, although its interpretation often takes place through an abstract framework. One may speak of the abstract content of a work as being the combination of note events or a similar ordering of sounds (i.e. the material that is typically notated). On a wider scale the abstract framework of an idiom is generally used as a reference point for creating and interpreting a composition or performance, and a means for appreciation without necessarily having to focus on individual events. In this manner idiomatic frameworks may be used to represent the more fluid aspects of improvised and orally transmitted music in lieu of strictly determined sequences and phrases when performing analysis.

In the following discussion of Central Javanese gamelan and electroacoustic music I will focus on types of abstraction and idiom. These two types of music are different in many respects; in particular, the composition and performance of gamelan music relies heavily on established idiomatic identity, whereas composers choosing the electroacoustic medium frequently work outside it.

3 Central Javanese gamelan music theory and practice

In this chapter I will discuss some central aspects of gamelan music theory, in particular those relating to my own composition process, as will be seen in **Part II**. This will range from traditional music to contemporary composition both in Central Java and elsewhere, including the influence of technology on contemporary practice.

The nature of gamelan music theory and the degree to which it can be formalized are subjects of contention. There are few records of formal writing about gamelan music before the early 20th century (see Sumarsam, 1992 pp. 102-160; Tenzer 1997 pp. 170-174). Much academic discussion has been developed in response to concepts developed by the early ethnomusicologists Jaap Kunst and Mantle Hood (e.g. Kunst, 1949; 1968; Hood, 1954; 1972; 1982), in particular regarding the role and form of a central melodic framework (see Perlman 2004).

Representations of gamelan music in this thesis are based on key texts in English by the following authors: Sumarsam (1975; 1992), Perlman (2004), Sutton (1993; 1998), Supanggah (1985; 1988; 2004; 2011), Brinner (1995b), and translated works compiled by Becker & Fenstein (1984, 1987; 1988) including Martopangrawit (1972a; 1975)[28].

3.1 Gamelan music and karawitan

The term *gamelan* is typically used to refer to a family of bronze instruments found throughout Indonesia, and to a lesser extent in other parts of South East Asia. In its broadest sense it can be taken to mean a collection of tuned percussion. Gamelan can be used to describe either the ensemble or the act of playing; as the composer Sapto Raharjo states, "gamelan is a spirit, not an object . . . the instruments are just the medium" (Diamond 1997 p. 92). Gamelan music is often played as part of dance or theatre – in particular *wayang kulit* [shadow-puppetry] – but can also be found independently in ceremonial settings or in performances called *klenengan*.

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[28] Although not cited extensively I also wish to acknowledge Neil Sorrell's *Guide to the Gamelan* (1990) and Richard Pickvance's *Gamelan Manual* (2005). Alongside classes at the Southbank Centre led by Peter Smith these texts formed the foundation for my initial studies.

A gamelan typically contains at least one bossed *gong* used to produce deep pulsating tones. Alongside it sit similarly shaped instruments, mounted vertically and horizontally (*kempul, kenong, kethuk* and *bonang*), and rows of keyed metallophones (*saron* and *gender*). In Central Java these instruments are joined by strings (*rebab* and *siter*), flutes (*suling*), xylophones (*gambang*), double-headed drums (*kendhang*) and singers (*sindhen*, *gerong*, and *koor*). Tuning varies between ensembles, meaning that instruments are not generally portable from one group to another. This flexibility is widely accepted, and has been likened to differences in vocal timbre between singers in other styles of music (Sorrell, 2007; Becker, 1979 p. 7)[29].

Performances of *karawitan*, the music traditionally played on the gamelan[30], are largely based around the interpretation of abstract frameworks through a process called *garap* [work or cultivation], relying on listening and interaction between parts and the idiomatic identity of instruments, which often combine to form a steady, interlocking texture (see **§3.3**). Emphases of meter and structure do not generally take place through individual articulation of accents, but rather through the coincidence of strokes of various instruments. Stresses often fall at the end of each gong cycle and other cycles and phrases that sub-divide it; what Kunst refers to as a *colotomic* structure (1949). This nesting of alternating high and low sounds forms a characteristic phrasal idiom of gamelan music alongside other Southeast Asian idioms (Becker, 1972b p. 5-6).

Further organization in traditional music comes through a conceptual framework called "*pathet*" (sometimes used interchangeably with the term "mode"; see Weiss, 2006 p. 22). The various *pathet* are linked to times of the day and associated sections of shadow puppet theatre (Martopangrawit, 1972a p. 47), and have strong ties with the feeling (*rasa*) of a piece (see Benamou, 2009, pp. 192-195)[31].

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[29] While tuning systems from gamelan are a popular point of interest for electroacoustic composers, further discussion falls outside the scope of the current research (see Carterette & Kendall, 1984; Rahn 1978; Polansky, 1985).
[30] *Karawitan* is sometimes defined as any music played with the five-tone *slendro* and seven-tone *pelog* tuning systems, and can extend beyond gamelan to other ensembles and purely vocal performance (Martopangrawit, 1972 p. 9; Perlman 1991).
[31] *Pathet* can be analyzed in terms of nested structures of *padhang* and *ulihan* phrases - one interpretation of which is "question and answer" (Hastanto, 1985 p. 46; Martopangrawit, 1972 pp. 66-82).

"*Gendhing*" is the generic term for a composition based on a cyclic structure punctuated by gongs, forming the bulk of traditional gamelan music[32]. Traditional *gendhing* are rarely attributed to specific composers, or may be credited to the ruler of a court at the time of creation (Sutton 1978 p. 66 - 67). *Gendhing* are often composed using recombination of existing material, a process sometimes referred to as "centonization" (Sutton 1987; Sumarsam 1992 p. 162). Traditional methods of aural transmission can lead to multiple versions of the same piece existing in different areas. Due to increasing use of notation and recordings, *gendhing* repertoire is becoming more standardized (see Sutton, 1991). The notated element of *gendhing*, a skeletal melody called the *balungan*, is often regarded as the core of a composition[33]. However, according to Supanggah: "It is the sound produced by the garapan of the entire ensemble that is called the gendhing. The gendhing only exists in the moment of performance" (1988, p. 3).

Gamelan performance in Central Java is based as much around songs as it is the percussive elements for which it is most famous. Focus often moves between a solo female singer (*pesindhen*) and male chorus (*gerong*). Vocal parts are often drawn from existing texts called *macapat*, a form of sung poetry (*sekar*) that may also be performed without instrumental accompaniment (see Kartomi, 1973; Hastanto, 1983)[34]. Parts may also be composed specifically for a piece, or borrowed from or other forms of music such as *langgam* or children's songs.

Gamelan ensembles do not exclusively perform traditional *karawitan*; groups may play overlapping repertoires involving popular idioms such as *keroncong* and *langgam, dhangdhut, campur sari,* and *gendhing dolanan*. Compositions such as these have largely been developed in the mid 20th century and reflect increasing external influence (Becker, 1972a; 1972b; see **§3.4**). While these pieces do not necessarily follow traditional conventions, they may be found in *klenengan* and theatre settings in more light-hearted moments of performance (Supanggah, 2011 pp. 201, 213).

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[32] Other forms of pieces that do not rely on cycles include *pathetan*, *bawa*, and various elements of *wayang* repertoire (see Brinner 1981).

[33] Notation of gamelan music is a relatively recent development, gathering popularity in the late 19th Century. Most players in Java prefer to learn pieces aurally and use notation as a reminder, but it is increasingly used in teaching settings and for documentation. The most popular form of notation is called *kepatihan*, and primarily consists of numeric representation of notes (see Sumarsam, 1992; Clark 2008).

[34] The texts and melodies of *macapat* vary, but each form holds a specific number of syllables and the sound of the final vowels in each line (Kartomi, 1973 p. 41).

3.2 Balungan and melodic frameworks

The precise nature of the framework referred to in the course of performance has been the subject of much academic debate. The problem is discussed at length in Marc Perlman's study of implicit or "unplayed" melodies, gathering perspectives from Javanese theorists (2004)[35].

Emphasis was placed on the *balungan* in early ethno-musicological studies of gamelan (Kunst 1949 p. 167, Hood 1959). Kunst and Hood engage with the *balungan* as a nuclear theme or *cantus firmus* (fixed melody); an abstraction of pitch and fairly stable rhythm that may be used to generate the various instrumental parts of the gamelan in combination with various other aspects of performance (Hood 1982 p. 238). Like the *cantus firmus*, the *balungan* is often considered to be a framework (*rangka*) rather than a melody (Perlman 2004 p. 103). There is some overlap between these two functions: the notes of the *balungan* are sometimes played by the *saron* at a pace in which they make sense as a melodic part in their own right[36]. However, it is often slowed down to the point where perception of a coherent melody is challenged, sounding as infrequently as once every ten seconds (Vetter, 1977). Alternative theories have emerged through the positing of more obscure inner melody (what is described in Javanese as a *"lagu batin"* – see Sumarsam 1975; 1992)[37] and a call for the reconceptualization of the *balungan* beyond its associations with the *saron* part or even what is provided in notation (Supanggah, 1998).

The *balungan* as notated and the division between punctuating and elaborating parts remain invaluable reference points, in particular for beginning players who are not accustomed to the phrasal idioms of Javanese song. The development of parts directly from the *balungan* remains the most logical starting point in teaching techniques for a certain subset of instruments, in particular the "loud-style" instruments led by the *bonang* (see **§3.3.2**).   The notated *balungan* can act as a bridge between different approaches, linking the "loud-style" instruments and the

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[35] For recent critique of theories based on implicit melody concepts see Ishida (2008).
[36] According to Supanggah: "the balungan gendhing is the essence, core [*inti*] or distillate [*abstraksi*] of the gendhing. The balungan gendhing is not played or sung by any one instrument or singer" (Supanggah, 1998 p.4). Supanggah refers to the notated *balungan* – which he suggests is often tailored to the *saron* and related instruments – as a *balungan semu* [pseudo-balungan] (ibid p. 9).
[37] Supanggah calls the *lagu batin* "une abstraction un peu floue" [a somewhat fuzzy/fluid/blurred abstraction] (1985 p. 126).

"soft-style" instruments centering on the vocals, *gender* and *rebab*, and enabling players of varying degrees of experience to co-exist in a performance.

3.3 Garap, improvisation, and idiomatic interpretation

The act of *garap* in gamelan music is essentially one of idiomatic interpretation, relying on the established idiom of each instrument or voice and their relationship to the rest of the group, the personal idioms of a performer, and *irama*: the varying relative rhythmic densities of parts in performance. As with other primarily oral or aural musical traditions, performance practice of Javanese gamelan is sometimes (somewhat contentiously) described as improvisation due to the prominence of real-time interpretation and interaction (Sutton, 1988). Musicians are expected to incorporate variation in their parts, but priority lies in realizing the underlying piece (the *gendhing*), communication between players, and the idiomatic integrity of parts. As Sutton notes, Javanese music involves improvisation, but it would not be appropriate to describe it broadly as improvisatory: "the aesthetic emphasis is not on originality, spontaneity, or even planned variability" (Sutton, 1998).

Hood describes gamelan performance as "group improvisation", in interaction between what he calls "deep structures" and individual variation (1971 p. 19)[38]. He presents nine levels for consideration: tuning system, mode (or *pathet*), colotomy, *balungan*, "fixed melody" (a further abstraction of the *balungan*), instrumental idiom, local style, group empathy, and the individuality of the performer (ibid) [39]. Elucidating Hood's observations and creating a distinction from "freedom in the sense of 'doing anything you want'", the musician Hardjo Susilo describes the differences between various forms of improvisation and spontaneity in performance:

> There is no Javanese word that exactly translates as
> 'improvisation.' There is *kembangan* or *sekaran*, which mean
> 'flowery elaboration.' There is the term *isèn-isèn*, which means

[38] Kate Wakeling (2010) highlights structuralism and related problems in the imposition of colonial ideals in the description of Balinese and Javanese music.
[39] Various scholars have explored further influential factors in performance: Supanggah acknowledges acoustics, the quality of a sound system, and the emotional and physical state of musicians alongside *laras*, *irama*, and *pathet* in influencing *garap* (Supanggah, 2011). Brinner explores wider perspectives, including the selection of pieces, through a notion of "cultural matrices" (1995a).

'appropriate filler.' *Ngambang*, literally 'floating,' refers to filling in without knowing where the music is going, while *sambang rapet* means 'reacting to,' i.e. keeping a tight ensemble, covering up, or recovering from mistakes. *Ngawur* is filling in with incongruous or unrelated material; in other words, 'to blunder.' A musician's 'improvisation' preferably is of the sekaran, kembangan or isèn-isèn type; he should know ngambang or sambang rapet if necessary, but never play ngawur! (Susilo, 2010 p. 50)

The degree of freedom afforded to musicians in *karawitan* largely depends on the established role of the instrument. Improvisation often takes place in the realization of details; the concretization of existing patterns, or in response to other players or events. As Susilo highlights, musicians playing without notation must listen to the instruments and singers around them to orient themselves, sometimes relying on a process of "filling in" to ensure a steady pulse is maintained in keeping with the idiomatic integrity of their own part. Players may react to variations played by other musicians, or to external factors such as the accompaniment of theatre and dance. Groups respond to external cues through mediation by individuals; a drummer might signal a dynamic change for dance movements heard throughout ensemble (often retained or imitated if the piece is transferred to a *klenengan* setting), or the *rebab* player may issue a cue to change section, which is also disseminated to other players via the more easily discernable *bonang* part (see Brinner 1995b). The choice of refined or florid patterns is influenced in the course of performance by factors such as the use of different *kendhang* (see Sumarsam, 1974 p. 163). Musicians may even find inspiration in responding to environmental sounds in the course of a performance (Brinner, 1995b p. 226).

3.3.1 Instrumental idiom

Gamelan instruments are often divided into three categories: those that play the *balungan* as notated or a very similar part directly (e.g. *saron* and *slenthem*), those that punctuate it (gongs, *kenong*, *kempyang* and *kethuk*), and instruments that elaborate upon it (e.g. *gender*, *gambang*, *bonang*, and *peking*)[40]. This division generally remains applicable when moved from the *balungan* to reference to vocal parts or more abstract melodic frameworks.

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[40] The term "elaborating instruments" is sometimes used interchangeably with "*garap* instruments" (Supanggah 2011 p. 275).

According to Hood, in the context of gamelan music: "each instrument and the human voice have an idiomatic form of expression that is quite predictable in terms of: available pitches (perhaps including vocal tones), range, density, quality of sound, and method of playing (the hands, a beater, two beaters, plucked, bowed, blown, sung)" (1971 p. 18). Knowledge of an instrumental idiom consists of a basic awareness of the limitations and range of the instrument, extending to grammars and ultimately specific repertoires of melodic and rhythmic patterns (Brinner, 1995b; Perlman, 2004; see **§2.2.3**). Perlman introduces the role of instrumental idiom as follows:

> Each part has one or more strongly defined idioms and is responsible for maintaining the integrity of those idioms. While each part also bears a responsibility to the whole (to match or fit together with other parts), and while the elaborating parts must allow room for variation (through which individual players can express their personal tastes and respond to the exigencies of the performance situation), each part must guard the consistency of its distinctive idiom. Each part should unite with the others . . . but only as long as it can do so and maintain its own life. (Perlman, 2004 p.49)

The types of patterns playable on an instrument are in part determined by its constraints and affordances. For example, the range of pitches available to an instrument affects its expressive potential and the accuracy with which it can be used to reproduce a central melody (ibid p.49). Certain *rebab* melodies may not be transferred to the *saron* due to limitations in pitch range (ibid pp.51-52). The melismata of vocal parts and of the *rebab* must be transferred to discrete pitches if imitated by the *gender* or other instruments.

Performance of *gendhing* tends towards a stable texture. The elaborating instruments include a set of instruments called *panerusan* (from the root *terus*, meaning continuously), which are used to play streams of notes at rates often suited to their physical construction and the physical comfort of players. The relationships between instruments are emphasized through changes of *irama*, in which the punctuating and *balungan* instruments slow down while others double their density in order to maintain their idiomatic pulsation (see Sutton, 1993 pp. 138-165).

Instruments in higher registers generally play at higher rhythmic densities than their counterparts in the same family, in a relationship often described as

stratification[41]. While varying across the ensemble, this is generally true of sub-sets of instruments that include two or three versions of different sizes and corresponding register (*panembung*, *barung* and *panerus*). The decay time of notes also comes into play; for example, the *gambang*, while holding one of the widest pitch ranges, is one of the rhythmically densest instruments in keeping with its short, percussive character (Roth, 1986 p. 16). The physical layout of instruments can afford certain characteristic playing styles. For example, the placement of *bonang pencon* lends itself to stepwise movement and *gembyang* (Roth, 1986 pp. 14-15). These factors lead to characteristic interpretations of the *balungan* or other frameworks, in interaction with other members of the ensemble and the musician's own personal idiom, including influence from regional styles, teachers, and other influential players.

3.3.2 Direct reference to the balungan

Certain instruments are used to play a part identical or very close to the *balungan* as notated. The *balungan*, typically spanning the three registers available to the vocal parts and rebab, must be adapted to match the range of the instrument: first in mechanical terms, by fitting its octave restrictions, and then in phrasal terms, by maintaining a contour appropriate to the *gendhing* and more general conventions when presented with a choice of high or low notes[42]. In the case of punctuating instruments such as the *kempul* and *kenong*, which often do not include a complete *pelog* or *slendro* "octave", players require additional knowledge to substitute idiomatic intervals (*kempyung*) or anticipate shifts in the melody to be reflected in the instrumental part (*plesedan*)[43]. In addition to the default behaviour for instruments such as the *saron* and *slenthem*, playing the *balungan* directly (*mbalung*) takes place on instruments more often considered as taking elaborating roles. This generally occurs when the *irama* is too fast to allow for a more idiomatic interpretation.

Other (predominantly "loud-style"), parts refer to or anticipate the *balungan* in different combinations of ordering and density, through methods I will call *referring patterns*. These techniques tend to play a guiding role for other musicians,

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[41] "Each stratum has a characteristic and predictable density or number of musical events that occur in a given span of time" (Hood, 1971 p. 8; 1982 p. 52).
[42] This results in characteristic leaps in melodic patterning, which Hood saw as intentional (Sumarsam 1992, p. 161).
[43] The pitch ranges of gamelan instruments are illustrated by Kunst (1949:II pp. 479-480); Hastanto (1985, pp. 22-23); Pickvance (2005, pp. 103-105).

in particular those playing an approximation on the *saron*-family[44]. However, even when using methods closely linked to the *balungan*, players of the elaborating instruments such as the *bonang* may choose to play idiomatic phrases based on a more elaborate conception of the melodic framework, causing obfuscation or divergence from practical information.

3.3.2.a Nacah

The *nacah* part played by the *peking* presents a practical example of a referring pattern. The basic form of this technique (*nacah lamba*) involves repetition of the individual *balungan* notes at double rhythmic density, filling the spaces between the basic pulse. For example, the *gatra* 5 3 2 1 is interpreted as 5 5 3 3 2 2 1 1. In *nacah rangkep* – a version of the pattern played in slower but denser *irama* – the notes of the *balungan* are shifted forward in phase and repeated in an alternating configuration, as illustrated in **Figure 3-1**. In generalizing this process, the pairs of notes from the balungan may be represented by abstract values such as "a" and "b" (e.g. Perlman, 2005 pp. 55; Pickvance, 2005, p. 125)[45].

Balungan	5	3	2	1
Peking (*ir. II*)	5 5 3 3	5 5 3 3	2 2 1 1	2 2 1 1

Balungan (abstract)	a	b	c	d
Peking (*ir. II*)	a a b b	a a b b	c c d d	c c d d
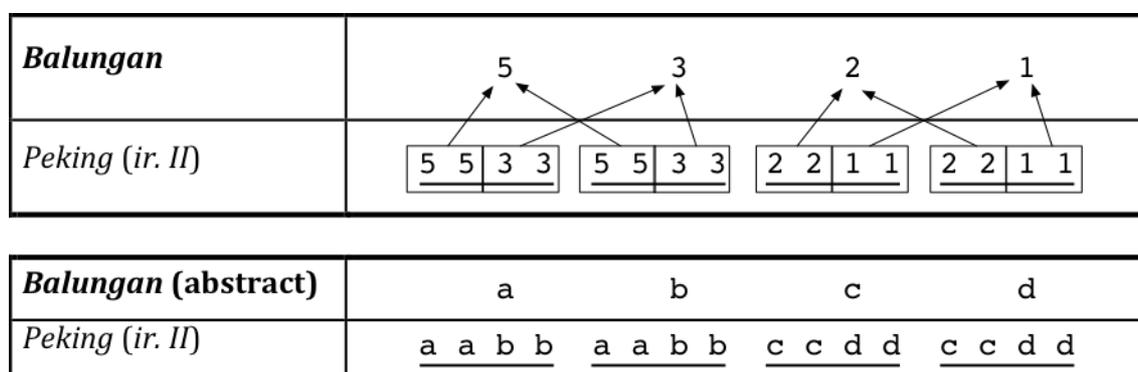
Figure 3-1: *Nacah rangkep* pattern anticipating the *balungan* phrase 5 3 2 1 (after Sutton, 1993 p. 99) and abstract representation.

This patterning relies on *balungan* in which distinct pairs of notes are presented without "rests" [*pin*]. In practice, players accommodate for variations by creating an idiomatic version of the *balungan* appropriate to the instrument. For example, the

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[44] In rare cases the *bonang* can be used to disseminate spontaneous compositions to other players, as Supanggah describes in the context of *gamelan sekaten* (2011 pp. 151-152).
[45] This approach facilitates the creation of a grammar, which forms the basis of loud-style *garap* in the *Virtual Gamelan Graz* (Schütz & Rohrhuber, 2008) and in my own practice (see **Appendix 2**).

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pair of notes: <u>5 5</u> may be interpreted as <u>6 5</u> in order to avoid uncharacteristic repetitions.   In cases where the density of the *balungan* consistently negates a one-to-one interpretation, such as *balungan nibani* (<u>.   a   .   b</u>), *peking* players either call upon knowledge of idiomatic contours to fill the gaps, or for guidance refer to other parts such as the vocal or *rebab* (see Pickvance 2005, 127-128).

3.3.2.b Pipilan

A similar process of interpretation is found in the *pipilan* [lit. picking] technique played by the *bonang* family of instruments. The *bonang barung* player anticipates and repeats the notes of the *balungan* in alternation, often omitting the strongest notes; the *bonang panerus* plays the same essential pattern at twice the density[46].

Balungan (abstract)	a	b	c	d
Bonang barung (*ir. II*)	<u>a b a .</u>	<u>. b a .</u>	<u>c d c .</u>	<u>. d c .</u>
Bonang panerus (*ir. II*)	<u>aba.aba.</u>	<u>aba.aba.</u>	<u>cdc.cdc.</u>	<u>cdc.cdc.</u>

Balungan	5	3	2	1
Bonang barung (*ir. II*)	<u>5 3 5 .</u>	<u>. 3 5 .</u>	<u>2 1 2 .</u>	<u>. 1 2 .</u>
Bonang panerus (*ir. II*)	<u>535.535.</u>	<u>535.535.</u>	<u>212.212.</u>	<u>212.212.</u>

Figure 3-2: Abstract and concrete versions of *pipilan*-style *bonang* parts.

Combined with *gembyangan* (a technique in which repeated notes in the *balungan* are emphasized through simultaneous "octaves"), this forms the basis for interpretation in much *bonang* playing. However, a wider array of techniques must be drawn upon to create an idiomatic *bonang* part. These include specific types of *garap* for different registers and patterns used to complement specific *seleh* notes or figurations of *gatra*, as well as differing behaviour for established *irama* levels[47]. In addition to knowing this core repertoire, experienced players create fluid transitions between patterns and respond to other instrumental and vocal parts.

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[46] Electronic versions of these parts as used in my own practice – including modified versions to control synthesizer parameters – can be found in **Appendix 2.4**.

[47] For examples see Pickvance (2005 pp. 147-167). A selection of patterns may also be heard in the *Bonang Study* (**AV1.1.B**). For simplified algorithmic representation of part selection processes see Appendix **2.3.1**; **2.3.2**.

3.3.3 Cengkok and wiletan

The more elaborate patterns played on gamelan instruments are generally referred to as *cengkok* (a generic term for a melodic unit). Although some prefer a more fluid approach, musicians often draw upon established repertoire of *cengkok* to complement certain vocal passages or figurations of the *balungan*, named after associated lyrics or onomatopoeia (Martopangrawit, 1987 pp. 103-120). **Figure 3-3** shows an excerpt from *ladrang Pangkur* with the conventional sequence of named *cengkok* written beneath the *balungan*[48].

Figure 3-3: *Kepatihan* notation for *ladrang Pangkur laras slendro pathet manyura* with named *cengkok* indicated below.

These patterns often represent moments of convergence within the elaborating parts, where the texture unifies to carry the vocals, and are particularly noticeable in the denser *irama wiled* and *rangkep*. In addition to the selection of named *cengkok*, generic patterns may be used to move between phrases, or "hang" around notes (Perlman, 2004 pp. 58-59). The *balungan*'s capacity for guidance in its notated form depends in part on its density. In the sparsest figuration (*balungan nibani*), players of elaborating instruments are free to create their own elaborations, interact with other musicians, or follow the song or inner melody, whereas in tighter *mlaku* and *ngadhal*

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[48] *Pangkur* is often taught at beginner level as it contains standard *cengkok* that may be used in the interpretation of many other pieces. A variation of this piece can be heard in the *Augmented Gamelan* set (**AV1.4.B**). Notated electronic versions of the *cengkok* can be found in **N4.B**.

versions they may be obliged to join the parts played by the *saron* (Supanggah, 1998 p. 8; Perlman, 2004 pp. 91-96).

       Cengkok in isolation are abstract – at times ambiguous – patterns or contours: a series of structurally important notes remain consistent, while interpolation and more specific phrasing depends on the affordances of the instrument, variations accrued through aural transmission, and personal expression. While simplified *cengkok* may be written in the manner of other parts such as the *balungan* (e.g. Martopangrawit, 1973; Polansky, 1993), it is sometimes difficult to trace a consistent version. Like the *balungan*, *cengkok* must be concretized in performance; these realizations are called *wiled* or *wiletan*. According to Supanggah:

> . . . *cengkok* . . . can signify the "vocabulary" used in playing the *garap* instruments. This is a rather abstract sort of formula that is distinguished by the character of a melodic or rhythmic ensemble rather than a series of precise notes. Every time one plays a *cengkok*, it's not the *cengkok* that's being played, but a *wiled* (a variant, or version). (Supanggah p. 145)[49]

The idioms associated with each instrument may be compared through the characteristic interpretations of named *cengkok*. **Figure 3-4** shows the *cengkok* called *Ayu Kuning*, as sung by the *penggerong* and interpreted or accompanied by players of various elaborating instruments (expanded from Martopangrawit, 1984).

       In this example most of the instruments fit the contour of the vocal part, providing elaboration or filling appropriate their relative density and tessitura. The *peking* and *balungan*-based parts must be adapted to fit the ranges of the instruments spanning just over an octave (see **§3.3.2**). The *bonang* – this time playing a *cengkok*-oriented approach – is used to play a part in the middle register, giving a more accurate outline of the key points in the melody while filling in with characteristic elaborations. The *rebab*, *gender*, and *gambang* players, with the widest ranges, are able to match the vocal register. The *rebab* is capable of playing similar melismata to the vocals, which are echoed in the *gender* part but broken into discrete note events, elaborated upon with interplay between the left and right hand. The *gambang*

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[49] "*céngkok* . . . peut signifier le 'vocabulaire' de jouer les instruments *garap*. C'est une sorte de formule plutôt abstraite qui se distingue par un caractère d'ensemble mélodique ou rhythmique plutôt que par une serie de notes précises. Chaque fois qu'on joue un *céngkok*, ce n'est pas le *céngkok* qu'on joue, mais un *wiled* (varient, version)" (ibid). Also see Sindoesawarno (1986 p. 396); Forrest (1980).

features similar elaborations with characteristic bridging and hanging phrases to match its characteristic fast, dense rhythm.

The instruments ostensibly fill out the notes of the *balungan* in the *slenthem* part in (**B**); however, the *nibani*-style *balungan* (**C**) diverges from the vocals and other parts in accordance with its phrasal idiomatic restrictions[50]. In other *cengkok* the *seleh* notes often fit the *balungan*, but midpoints vary. For example, *gender* renditions of *jarik kawung* indicated in **Figure 3-3** usually take a note "6" for their midpoints despite the *balungan* sometimes indicating a note "3".

Item	Instrument	Source
a	*Gerongan*	Martopangrawit, 1984 p. 113
b	*Slenthem (balungan mlaku)*	Martopangrawit, 1984 p. 113
c	*Slenthem (balungan nibani)*	Martopangrawit, 1984 p. 113
d	*Rebab*	Djumadi, 1986 p. 316
e	*Gender*	Martopangrawit, 1984 p. 113
f	*Bonang (imbal/sekaran)*	Hartono (from lesson, 2012)
g	*Gambang*	Darsono in Scholz, 2004 p. 41
h	*Peking (nacah rangkep)*	N/A (see **§3.3.2.a**)

Figure 3-4: *Ayu kuning* as interpreted through vocals and various instruments.

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[50] This *gatra*, found in the *inggah* section of *gendhing* such as *Widosari*, is typically used to follow . 3 . 2 . Conventions for *balungan nibani* dictate that the previous note "2" cannot be repeated (see Martopangrawit, 1984 p. 113; Perlman, 2004 p. 95).

Choice and creation of *wiletan* are opportunities for individual expression in performance[51]. Beyond the physical constraints of the instruments and formal conventions, players draw upon a variety of factors including the *laras*, *pathet* and *rasa* [feeling] of the piece. Above all the ability to modify parts spontaneously provides opportunities for interaction between instruments, bringing life to the texture of the ensemble and the *gendhing*.

3.4 New composition for gamelan

New compositions for gamelan in Indonesia are typically divided into two main categories: *gendhing kreasi* and *komposisi*. *Gendhing kreasi* (also called *kreasi baru*) are generally based on traditional idioms, structures and techniques, such as the work of composers Martopangrawit, Nartosabdho, and Wasitodiningrat (Becker, 1972; Sorrell, 2007). *Komposisi* (also called *komposisi baru* and *musik kontemporer*), represent a much freer and sometimes deliberately non-idiomatic approach.

Komposisi generally retain an emphasis on group composition processes and reuse of existing material in a manner reminiscent of traditional processes (Roth, 1986; Sutton 1987). The flexible nature of *komposisi*, its re-use of existing material, and relationship to tradition are reflected in the terms used to describe its processes and the role of the composer. One of the most frequently used terms is *penyusun* [arranger, compiler] (Roth, 1986), which leads to the conceptualization of new works as *susunan* [arrangements, compilations]. Other common terms are *ciptaan* [creation/invention] and *garapan* [interpretation] (see Supanggah in Sutton, 1987 p. 58)[52]. *Karawitan* often provides the source material for new composition, but it is uncommon for the experimental approaches developed through *music kontemporer* to feed back into traditional repertoire[53].

The role of composer may be held by one or two musicians who typically take ideas to a group – if parts are not fixed, musicians will typically interpret a set of

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[51] The scope for variation in *wiletan* is exemplified in the parts played on the *gambang*, one of the rhythmically densest instruments in the ensemble. The example in **Figure 3-4** is one of ten transcriptions of the same *cengkok* from an educational text (Scholz, 2004 p. 41).

[52] In situations where a direct equivalent for the English term *composer* is needed, the Indonesian term *komponis* also may be used.

[53] See Sutton (1987 pp. 88-91). Becker (1977) and Roth (1986) discuss the crossover between *karawitan* and new composition.

instructions or melodic framework, either in a traditional manner or using techniques specified by the composer. Sometimes this framework might be referred to as a *balungan* (in its broadest sense) or *abstraksi* [abstraction]. As with traditional *karawitan*, notation is not always part of the performance process; parts are often memorized during creation and notated afterwards for posterity or for examination requirements in academic settings (Roth, 1986 p. 77). Other composers prefer to prescribe parts notated in detail (e.g. Suwardi 2009).

The development of *komposisi* in Indonesia flourished in the 1970s, with the *Pekan Komponis Muda* [Young Composer's Week] festival in Jakarta providing a focus and catalyst for activity (see Hardjana, 1986; Sadra & Diamond, 1991). Alec Roth details the new compositional processes explored during this period in his PhD thesis, which provides a comprehensive introduction to new composition in Solo (1986); further discussion can be found in works by Sutton (1987), Sadra & Diamond (1991), Warde (2002), and Miller (2006)[54].

The works developed around this period frequently involved deliberately non-idiomatic activity, including the use of extended instrumental and vocal techniques and sound effects, and in particular, the breaking away from constraints of tradition towards more active exploration of the affordances of the instruments[55]. Amongst the compositions examined by Roth and others around this period, several make direct reference to traditional *macapat* (e.g. arrangements involving *macapat Dhandhanggula* by Sri Hastanto (1979), and *macapat Gambuh* by Rahayu Supanggah (1979)), while others play on traditional *cengkok* and playing conventions related to specific instruments.   Many pieces were also heavily influenced by what might be extra-musical factors such as theatre and dance choreography (Roth, 1986 p. 62).

These developments form part of the foundation for current approaches to *komposisi* in Solo, which has been part of the curriculum for students of *karawitan* in

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[54] For more diverse examples of Indonesian composers see Diamond (2001).
[55] Attitudes to new composition and traditional material of the time are reflected in collected writing translated by Roth and included as an appendix to his thesis. Humardani reflects on manners in which the performing arts may be expanded without diluting their value as cultural media (ibid pp. 239-279), whereas Supanggah examines ways in which traditional instruments can be expanded with non-traditional techniques, adding sudden shifts in dynamics and tempo, and the exploration of the qualities of sound (pp. 281-288). Hastanto focuses on the importance of using traditional material in new composition, expressing a desire to find new *rasa* [feeling] (pp. 290-298).

ISI since the 1980s (Roth, 1986 p. 65)[56]. New compositions continue to thrive in Central Java, particularly in theatrical and dance contexts. Performances in academic institutions and festivals such as the annual Yogyakarta Gamelan Festival founded by the composer Sapto Raharjo provide platforms for new music (Diamond, 1997).

New compositions may use a blend of traditional gamelan and their associated playing styles, or take advantage of extraneous instruments and other sound generators[57]. Contemporary composers often explore the borders of physical constraints of instruments and their associated mechanical idioms. For example, trills are used extend short percussive sounds (Roth, 1986 pp. 86-191) and glissandi are sometimes produced through filling *bonang* and *kenong* with water (ibid p. 95).

Some musicians commission or create their own instruments; a notable example being the musician, composer and instrument builder Aloysius Suwardi. Along with other musicians, Suwardi has long experimented with extended techniques; his early compositions involve bowing *gender*, blowing over resonators and playing *suling* through a tank of water (see Sadra & Diamond, 1991). More recently Suwardi has developed whole new ensembles, including the *Gamelan Gentha* – a set of bell-type instruments– and *Planet Harmonics*, a gamelan-inspired ensemble based on metal poles capable of producing rich spectra, the fundamental frequencies of which are typically inaudible. These ensembles demand new types of *garap*, which Suwardi determines through experimentation while often maintaining connections with the feeling and phrasal idioms of traditional Javanese music (p.c. 2011).

3.4.1 New composition for gamelan outside Indonesia

Influence from gamelan music is reputed to have played a part in works by the composers Debussy and Messiaen (see Sorrell, 1992). Early compositions for gamelan instruments themselves were developed by Lou Harrison in the 1960s. Harrison augmented the ensemble with other instruments such as piano, violin, and cello to be played by soloists, as well as including a harp player as an integrated part of the gamelan (Miller and Lieberman, 2004 p. 164). Harrison's work plays on the

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[56] During field trips to Solo I observed rehearsals and performances for several new pieces. Performances at an end of term concert at ISI Surakarta ranged from empty water bottles thrown onto stage and played as percussion, to interpretation of *macapat* on a full gamelan with mostly traditional *garap* (2012).
[57] Recent recorded examples of new compositions may be found in *Gamelan of Central Volume 2 (2009)*, *Kurmat Pada Tradisi* (2001), and *Mahambara (2013)*.

border of tradition, employing adaptations of traditional *bentuk* alongside tonality associated with the "Western instruments" brought to the ensemble. Having borrowed directly from traditional structures in his early work, Harrison later took a more integrated approach, maintaining an awareness of essential hierarchical relationships with his own "untraditional" placement (Miller & Lieberman, 2004 p. 165), creating effective layers of tonal systems and instrumental textures.

Harrison and his contemporaries created what came to be called "American Gamelan" (see Miller & Lieberman, 1999; 2004; Adler & Diamond 1985; Perlman 1994) [58]. Generally made of aluminium for its affordability and stability, these instruments are based on Indonesian designs and primarily used for the creation of new music. The development of new instruments allows for the experimentation with tuning systems (often in the form of *just intonation*), alongside instrumental timbre and other constraints, while retaining potential for reference to the idiomatic framework within which they were developed.

With the arrival of sets of gamelan and residencies of Indonesian teachers and musicians alongside creation of new instruments, new composition for and inspired by gamelan has gathered popularity outside Indonesia, and has been the subject of extensive academic discussion (e.g. Becker, 1983; McDermott, 1986; Diamond, 1992; Sorrell, 1992; 2007; Steele, 2013; see **§5**). Composers take a range of approaches, from building on existing conventions (including the interpretation of American folk songs with Javanese *garap*; see Diamond, 1981), to using the instruments as sound generators, as interesting sources of tuning and timbre, without necessarily referring to existing conventions or their cultural context[59].

It is not uncommon for gamelan groups outside Indonesia to devote equal attention to learning traditional repertoire and developing new compositions. The English Gamelan Orchestra (EGO) was the first group to play Javanese gamelan in the UK, which actively combined traditional repertoire with new works mostly composed by members of the group (Mendonça, 2002 pp. 102-114). In contemporary practice compositions continue to be developed as a way to explore or make sense of

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[58] New instruments – some inspired by the *American Gamelan* – have also been developed in the UK, including the *Cragg Vale* and *MetalWorks* gamelan ensembles (Mendonça, 2002 pp. 417 – 428).
[59] A variety of scored works for gamelan by international composers are collected by Diamond & Powell (2000). For further examples see **§5**.

instruments and their playing conventions, as in Robert Campion's recent *Gender Study* series (2007) and Peter Moran's *Bonang Quartets* (2009).

3.4.2 Composition for gamelan and electronics

As early as the 1960s Indonesian gamelan composers have been using electronics; one of the first recorded compositions for gamelan and tape was created by Slamet Abdur Sjukur, who had previously studied in Paris with Messiaen and Schaeffer (Gluck, 2009). Sapto Raharjo created several works for gamelan and synthesizer in the 1980s, in which the tuning was tailored to the gamelan (ibid). The prominent Balinese composer I Wayan Sadra experimented with synthesizers and processed suling in his composition *Snow's Own Dream* (1992). Indonesian composers actively using gamelan and electronics in Europe include Aris Daryono (2006) and Patrick Hartono (2013). However, composition specifically billed as a combination of electroacoustic media and gamelan in Java remains a rarity.

The increasing availability of instruments and recordings outside Indonesia has provided inspiration and sampled source material for electroacoustic music. The placement of gamelan ensembles in educational establishments in particular has led to their inclusion in acousmatic works (see examples in **§5.5.1.b**). As well as being a commonly cited influence in popular electronic music, gamelan has been sampled to form integral parts of numerous beat-oriented works (e.g. Squarepusher, 1999; Fourtet, 2005; Bitwise & Madek, 2011).

The principles of interpretation in gamelan have provided inspiration for algorithmic representation, extending from composition into ethnomusicological applications. As Gerd Grupe states in his introduction to the *Virtual Gamelan Graz Project*: "*karawitan* is often said to be a musical idiom that should be particularly well suited for an attempt at simulating it because of its seemingly obvious regularity" (2008 p. 4). The *Virtual Gamelan Graz* project, developed in Supercollider, represents the most advanced published algorithmic representation of the idiom. Early experiments with computer representation and generation include a project by Surjodiningrat et al. (1977) in which random *balungan* were generated by computer in order to explore the nature of *pathet*.

Several projects have emerged using electronically augmented versions of traditional instruments. A robotic gamelan has been developed by the Casa da Musica in Portugal, which allows sequencing through bespoke software, and control

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designed for disabled participants in workshops via distance sensors (Penha, 2010). The *Gamelatron* developed by Aaron Kuffner with the *League of Electronic Musical Urban Robots* in the USA adds solenoid-based actuation to Balinese and Javanese gamelan instruments. The *Gamelatron* is played through drum pads and pre-programmed sequences, and instruments are often installed spread out to create an immersive experience that would be difficult to achieve with live performers (Kuffner, 2013; Steele 2013 pp. 96-103). While the project continues with great success, Steele relates that it has met with a mixed reaction from gamelan-playing communities, in part due to a perceived removal of the "human element" (ibid).

3.4.3 Other influences of technology

Recordings in the forms of tapes, CDs and more recently MP3s and video on the internet are increasingly used as reference for performance, possibly encouraging the fixing of parts but also influence from a wider geographical catchment (Sutton, 1985). Notation itself remains widely available with the help of electronic media; in addition to books of notation available in academic institutions and as popular publications, *balungan* and collections of *cengkok* are available on the Internet (e.g. Drummond, 2013; Polansky, 1993; Scholz, 2004).

The introduction of recording and amplification has affected the sound of professional gamelan ensembles, shifting the *pesindhen* and other vocal parts to the front of instrumental textures and affecting the overall perceived timbre of the ensemble (see Sutton, 1985). Distortion and overdriven sound have become common elements in the Javanese soundscape, sometimes not only tolerated but actively embraced, reflecting the desire for busy-ness (a state and aesthetic described as *ramai*) (Sutton, 1996; Supanggah, 2011 p. 344). Contemporary *campur sari* performances frequently include commercial synthesizers, which may play the role of gamelan or *keroncong* instruments, sitting alongside them and frequently replacing them. As the majority of commercial synthesizers are tuned to equal temperament by default, the inclusion of electronic instruments often brings about a shift in tuning, either clashing with or replacing existing Javanese *laras* (Supanggah, 2011 p. 13).

Specialist gamelan software has emerged in recent years, including mobile applications, developed both in Indonesia and overseas. Using interfaces based on graphical representations of the instruments themselves, these virtual instruments apparently bypass some of the associations of unsuitable interfaces such as the MIDI

keyboard, but bring with them another set of constraints such as the absence of velocity sensitivity or the restrictions of mouse input. Although applications such as these have yet to see mainstream adoption, they are starting to appear in educational institutions and have been used for public performances[60].

3.5 Conclusion

It is commonly agreed that gamelan music relies on interpretation of an abstract framework of some description, although the nature of such frameworks remains a subject of contention. Musicians draw on various factors in the process of concretization, including conventions established through the constraints and affordances of the instruments, which contribute to groupings of instrumental idioms. The examples of patterns referring to the *balungan* and *garap* involving named *cengkok* illustrate the ways in which this interpretation may take place. While certain elements may be abstracted for description or analysis, as Supanggah states, gamelan music only truly exists while it is being played (1988). The relationships between parts and opportunities for interaction and expression are vital in any representation of *karawitan*.

The scope for interpretation in gamelan may also be observed in new composition in Indonesia, as musicians work with new methods of interpreting traditional structures, and finding ways to break away from established approaches. Although electroacoustic composition has not yet experienced the same degree of activity in the gamelan communities in Indonesia as elsewhere, the manipulation of concepts, sound, and discourse nonetheless form important aspects of new instrumental compositions. Gamelan music also provides a source of inspiration for composition outside Java, both in the use of the instruments and conceptual resources. The more specific situation of new composition for gamelan and electronics will be explored in greater detail in **§5**. In order to do so, it is necessary first to examine electroacoustic music and its relationship with idiom in greater detail.

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[60] Recent examples of projects with downloadable software alongside video of performances online include *Virtual Gamelan* (2013); *Gamelan Pusaka* (2013); *Gamelan iLands* (2012).

4 Electroacoustic music theory and practice

Broadly speaking, *electroacoustic music* is any music in which the electronic recording, processing or amplification of sound plays a significant role. As will be seen below, this includes a great deal of modern music as technology has become more widespread. "Electroacoustic music" is also sometimes used as an umbrella term for a collection of art music genres developed in the mid-20th century that has since become too diffuse to be of practical use (see Emmerson & Smalley, 2001; Dhomont, 1995). The application of the term "idiom" is contentious, as will be discussed later; many electroacoustic composers and musicians can be regarded as working "self-idiomatically" (Bullock, 2010). Therefore it is necessary to examine electroacoustic music's relationship with idiom rather than treating it as an idiom in its own right.

The examples of genres associated with electroacoustic music upon which I will focus here take roots in the *musique concrète* [concrete music] and *elektronische Musik* [electronic music] developed in Europe in the mid-20th century. Contemporary electroacoustic music of this lineage includes *live electronics* and *acousmatic* music, both of which may also be mixed with more conventional instrumentation (Emmerson & Smalley, 2001; for approaches to mixed music see Alvarez, 1993; Emmerson, 1998; Menezes, 1997). In the absence of a unified idiomatic framework I will discuss methods of listening and abstraction introduced by Pierre Schaeffer (1977, 2012; also through Chion, 2009) and subsequently developed for analysis by Simon Emmerson (1986, 2013) and Denis Smalley (1986, 1997)[61]. While not tied to a particular genre, these ideas are useful in identifying the processes and discourse involved in works in the electroacoustic medium, and may be applied to wider musical practice.

4.1 Musique concrète and acousmatic music

Pierre Schaeffer developed *musique concrète* in order to counter what he felt was an "excess of abstraction" that had accumulated in European contemporary classical

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[61] As with other areas in this thesis I feel it is important to acknowledge a bias towards sources available in English. Schaeffer's work has become accessible through John Dack and Christine North's recent translations; I am grateful for access to an unpublished version of *Traité des objets musicaux* (Schaeffer, 1977).

music (Chion, 2009 p. 37). Speaking of the difference between established "abstract music" and his newly proposed approach, Schaeffer states:

> The adjective "abstract" is applied to ordinary music because it is initially conceived in the mind, then notated theoretically, and finally executed in an instrumental performance. As for "concrete" music, it is made up of preexisting elements, taken from any sound material, noise, or musical sound, then composed experimentally by direct montage, the result of a series of approximations, which finally gives form to the will to compose contained in rough drafts, without the help of an ordinary musical notation, which becomes impossible (Schaeffer 2012, p. 25)[62].

Although he also describes the establishment of musical structures and instruments in what might be termed an exploration of the affordances of found objects (Schaeffer, 1967 pp. 43-45), Schaeffer's focus is on recorded sounds and the approaches enabled by the relatively recent development of recording technology. The separation of the listener from sound source enables what Schaeffer calls *écoute reduite* [reduced listening], which "concentrates on the sound for its own sake, as *sound object*, independently of its causes or its meaning" (Chion, 2009 p. 11). Through this process it is possible to bypass the cultural and idiomatic musical associations of a sound, allowing for a more objective assessment of its qualities and isolation of parameters, which may be abstracted and used in composition[63].

Schaeffer describes the disconnection from visual indication of a source as an *acousmatic* listening experience – a term attributed to Pythagoras's practice of teaching from behind a curtain (Schaeffer, 1967 pp. 91-99; see Dack, 2002b p. 3). The term *acousmatic* has been adopted to describe electroacoustic music in which loudspeakers provide the primary or only means of delivery, creating a disconnect that composers can use to their advantage in blurring the perception of a source or agent, and complementing the range of processes available through electroacoustic

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[62] Schaeffer takes his definition of the abstract from André Lalande: "every notion of quality or relationship considered in a more or less general manner without reference to any of its representations. In contrast, the complete representation as it is or could be is called concrete" (Lalande quoted in Chion, 2009 p. 37).
[63] As Dhomont summarizes: "musique concrète . . . asks of its listeners that they un-program their hearing (accustomed to the matrix of pitch, scales, harmonic relations, instrumental timbres, etc) and develop an attitude of active listening based on new criteria of perception" (Dhomont, 1995).

media[64]. Contemporary theory relating to acousmatic music such as Smalley's *spectromorphology* (1986; 1997) often focuses on listening and analysis of work that can feed back into composition, responding to ideas developed in *musique concrète* such as "reduced listening" and classification of sounds (ibid pp. 107, 111; see **§4.3**).

4.1.1 Abstract values and concrete characteristics

Schaeffer divides musical parameters into *valeurs* [values] and *caractères* [characteristics]. The values of a musical work are often considered to be the abstract codes that convey the primary musical discourse and structure, whereas the characteristics are the other aspects that form part of the concrete whole. As Chion explains:

> Values are the *relevant features*, which emerge from several sound objects placed in a structure and form the elements of the *abstract* musical discourse properly speaking; the other aspects of the object which are not relevant in the musical structure but which form its concrete substance, its matter, are grouped together under the name of *characteristic*. (Chion, 2009 p. 74)

The abstract values of a musical work may be mapped to other parameters, or from one instrument to another, taking on the characteristics of the instrument as well as the expressivity of a performer in the act of being concretized. Schaeffer suggests that for values to be perceived, other aspects of a sound must remain stable; a relationship he calls *PCV2*: the "*permanence des caractères*" and *"variations des valeurs"* [permanence of characteristics, variation of values]). He presents pitch as an ideal medium for values in that it can be perceived in absolute terms, in registers. In contrast, timbre, commonly paired as a characteristic of pitch material, is sometimes harder to distinguish to the same subtle degree as pitch without reference to other

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[64] The name "acousmatic music" has been adopted by a group of composers taking *music concrète* as a starting point, and unsatisfied with the contemporary breadth of the term "electroacoustic music". In this case "acousmatic" is used to describe an approach in which the separation of the listener from visual indication of a source is essential, often accompanied by particular techniques and compositional approaches (Dhomont, 1995). Although it is my opinion that this adoption of genre classification should be acknowledged, further definition of the genre requires discussion that falls outside the scope of this thesis. Unless stated otherwise "acousmatic music" is employed in a broad sense – without stylistic implications – with the aim of integrating other genres such as popular electronic music (see **§4.3**).

sounds (a notion that might be challenged by contemporary methods of synthesis and sampling).

One of Schaeffer's aims in establishing *musique concrète* was to find ways in which other parameters may be promoted from sonic characteristics to the status of transmitting musical value. Schaeffer draws on *Klangfarbenmelodie* [lit: sound colour melody] as an example of promoting a characteristic to the status of a value[65]. In addition to problems of register, the perception of timbre-melodies is inhibited by pitch and rhythm, which Schaeffer suggests: "unfailingly dominate when they are used as values" (Chion 2009, p. 43; quoting Schaeffer, 1967 p. 302)[66].

Schaeffer ultimately concedes that composers do not necessarily need to rely on a system of discrete values to convey meaning. According to Schaeffer, music may also take another form of discourse based on variation and texture, which he describes as "*plastique*" [plastic] (Schaeffer 1977 in Dack, 1989 p. 244; see Chion, 2009 p. 79). In contrast to the types of music described thus far, plastic music may be appreciated through fluid changes in parameters that are difficult to perceive as discrete units.

As acousmatic compositions have developed, further types of discourse have been identified; the distinction between "aural" discourse (where sounds are treated as abstract musical objects) and "mimetic" discourse (where sounds are considered in relation to the real world, often with narrative implications) was popularized by Emmerson (1986). In practice, acousmatic and more general electroacoustic musical discourse often exists between these states, contributing to a concrete whole.

4.1.2 Grid-based analysis: syntax and discourse

Emmerson's *language grid* is a tool for analysis of acousmatic music, through which he describes the nature of musical syntax (as will be discussed in **§4.2**) in relation to the type of musical discourse perceived by a listener (1986; 2013)[67]. Emmerson explains the grid through a series case studies based on electroacoustic compositions

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[65] As proposed by Schoenberg and subsequently used by Webern (Schoenberg, 1978).
[66] In his own practice Schaeffer attempted to create values through *allures*, which he considered a characteristic, in his *Etude Aux Allures* (1958; see Dack, 2002b).
[67] Emmerson describes placement on the grid as follows: "I cannot see the origin of the sound, so do I recognize it (as coming from something happening in the material world) or simply appreciate its sound quality alone (x-axis criterion). Do I sense an organizing principle – if so, a 'system' imposed on the soundworld or somehow are the sounds themselves articulating something? (y-axis criterion)" (Emmerson, 2013).

in which he has determined that conscious development of original musical syntax is present. **Figure 4-1** shows a version of the grid adapted to match the format of similar analysis presented in the rest of this thesis, emphasizing the notion of intersecting continua (see **§4.4**). The original presentation features nine boxes (1986 p. 24), which are retained through faint dotted lines.
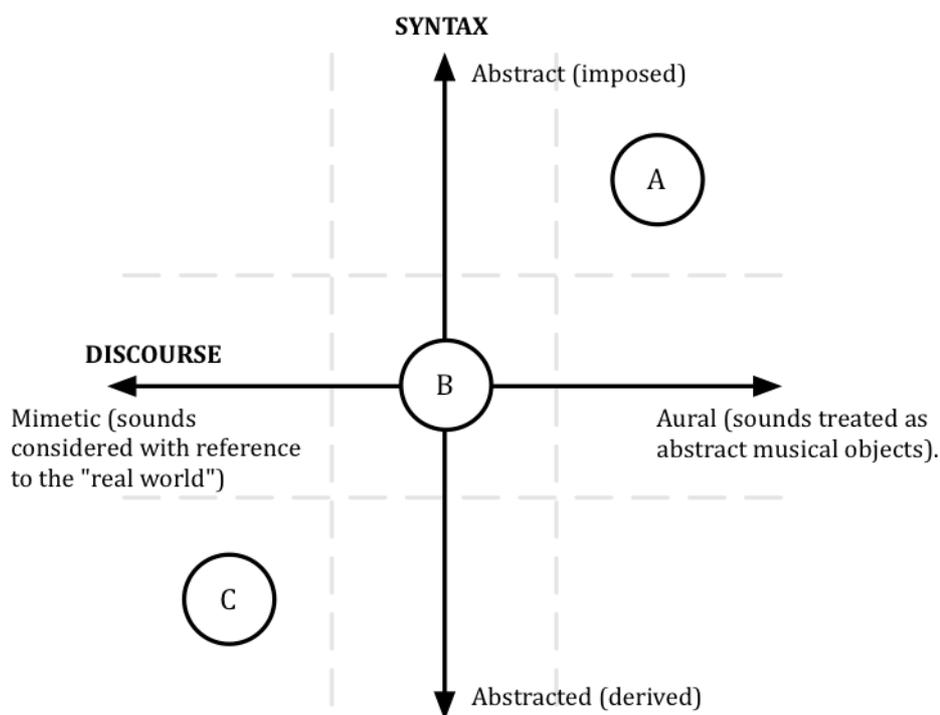
Item	Ref	Year	Composer	Piece
A	p. 27	1954	Stockhausen	*Studie II*
B	pp. 31-33	1978	McNabb	*Dreamsong*
C	p. 38	1970	Ferrari	*Presque Rien*

Figure 4-1: Emmerson's *language grid* with selected examples (1986) represented with intersecting continua.

Through this grid it is possible to observe the breadth of approaches to electroacoustic music in comparison to other disciplines, highlighting situations in which the musical material has been developed as abstract information or narrative, or in response to sound materials. In its original context, this helped elucidate the difference between approaches taken by composers of *musique concrète* and *elektronische Musik* in the mid-20th century (Emmerson, 1986 p.39). More important, however, are the various unusual compositional relationships that the analysis of syntax and discourse can uncover. For example, the type of discourse employed can affect a composer's approach to materials: an aural discourse can lead a composer to manipulate "real-world" sounds in quite a different way to one where a mimetic

discourse is dominant, where their natural ordering might be retained or emphasized. In this manner, existing musical material may also be manipulated according to unrelated abstract principles, as in Stockhausen's *Telemusik* (1966; see Emmerson, 1986 pp. 34-36)[68].

4.2 Creation of syntax

The various manners in which sound can be manipulated entail different types of syntax. For example, pitch-oriented material might be organized according to melodic conventions, serial systems, mapping of extra-musical information, or methods based on chance procedures. Syntax may be thought of on a compositional level as imposed on or derived from the materials. With the ability to work with complex processes in either in real or non-real-time and the absence or marginalization of physical constraints, electroacoustic composers have equal access to both approaches (Mooney, 2006).

Emmerson describes this situation through the process of abstraction, suggesting that syntax may be considered abstract (imposed from existing organizing principles) or abstracted (derived from intrinsic sound relations) (Emmerson, 1982; 1986; 2013)[69]. Although Emmerson's notion of abstraction follows from discussion of Schaeffer's approach (Emmerson, 1982 p. 221) it does not appear to rely on the distinction between values and characteristics. Rather, Emmerson considers syntax in a general sense – ranging from formal serial systems to tonality and more flexible frameworks, enabling examination of various types of activity that have in common the function of the organization of sound.

Emmerson defines abstract syntax as not being based on intrinsic sound relations (1982 p. 235). Taken to its extreme this may appear to suggest a situation in which composers apply patterns without aural feedback (listening to the results to influence the process). As Parry comments:

[68] As Emmerson notes in his recent update, this process can lead to further discourse based on cultural associations (2013, section 2). While this idea is revisited in subsequent discussion, the movement away from Emmerson's original aural/mimetic dichotomy in this thesis inhibits further exploration in this context.

[69] In both cases the syntax itself may be considered abstract. For this reason I will use Emmerson's terms interchangeably with the more easily distinguished "imposed" and "derived" throughout this thesis. These two categories may also be described as "top down" and "bottom up" approaches (Landy, 2007 p. 34; Mooney 2006 p. 84).

> With the exception of a very few radicals, composers are in a
> constant dialogue with themselves as listeners. If the results of
> an abstract process are aurally unsatisfactory, the process is
> modified. On the other hand, even the most aurally biased
> composer will occasionally try out an arbitrary combination of
> sounds to see what happens. There is a constant play of
> conception and perception, playing off an abstract idea against
> a perceived result. (Parry, 2000 p. 36)

Movement between the imposition and derivation of syntax may span a single piece or a wider process of development. For example, a framework derived directly from sound relations may be re-used in composition, requiring a lesser degree of feedback in subsequent work. This relationship is illustrated in **Figure 4-2**.
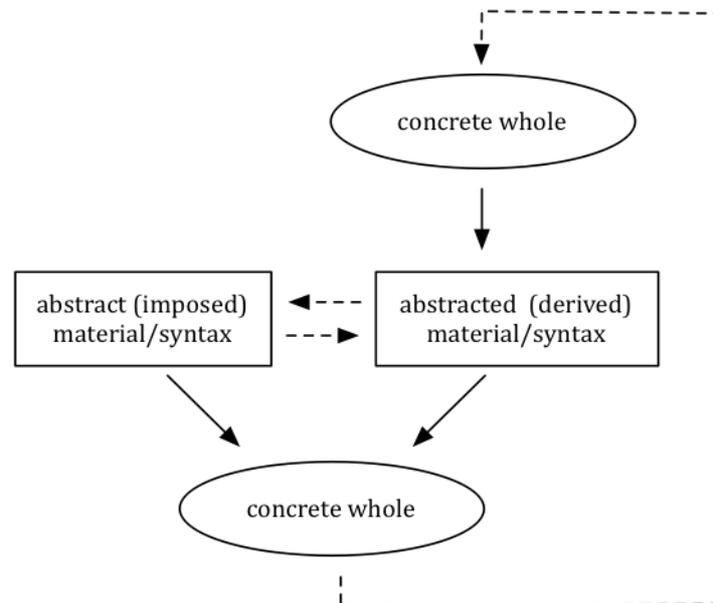
Figure 4-2: Relationship of "abstract" and "abstracted" syntax to materials.

Through a process of formalization, syntax may be passed directly to other composers and performers for re-use. Depending on the level of abstraction and parameters used, this information may also be transferred to other domains, although some degree of mapping must generally take place. Furthermore, concrete material – having been developed through a compositional and performance context – may be treated as raw substance for abstraction. This process may take place in various ways: for example, through self-reflection between development sessions or in the course of performance as a real-time process, or the analysis and reverse engineering of a framework created by a third party.

In cases where an abstract syntax is imposed upon sound materials, some form of mapping must inevitably take place (Parry, 2000 p. 36). This may occur in the selection and modification of parameters in a virtual instrument, or more complex conceptual mappings (see **§2.3.3**). Certain methods of sound production require limited intervention on this front, requiring only a one-to-one mapping and therefore limited modification to syntax in derivation from the materials. However, in the majority of cases some form of adjustment must be made either in the source, target, or both domains, leading to a combined imposed/derived (abstract/abstracted) syntax; a consideration that will be useful in re-integrating Emmerson's ideas to instrumentally dominated situations (**§4.4**).

4.3 Electroacoustic music and idiom

The electroacoustic medium has a complicated relationship with idiom as described thus far in this thesis (**§2.2**). Some genres associated with electroacoustic music move beyond ties to idiom in the instrumental sense (**§2.2.2**). Acousmatic composers frequently abandon orientation with acoustic instruments, and at times attempt to remove traces of a physical source or human agency; a situation described as "remote surrogacy" (Smalley, 1997 p. 112; see below). Composers often play on these borders; a continuum of recognizability can even form the basis for a compositional device along the lines of tension and release (Stockhausen, 1964; Parry, 2000).

The treatment of instrumental output as concrete sound objects can lead to the loss of meaning in an idiomatic context. Electroacoustic composers might also focus on parameters and techniques not commonly associated with the instruments in question, such as deconstruction of their spectral characteristics and the creation and manipulation of an artificial acoustic space[70]. The presence of an instrument may also provide grounding for other, extra-instrumental, movement. As the composer Javier Alvarez states: "the timbral stability of an instrument, working in relation to dynamic electroacoustic sounds provides spectacular textural, spatial, spectral and morphological interactions, which result in unequalled aural perspectives" (Alvarez,

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[70] The exploration of spectral characteristics through further orchestration also forms the basis of *spectral music* (see Anderson, 2000; Evans, 1996 p. 29). Smalley suggests that: "Acousmatic music is the only sonic medium that concentrates on space and spatial experience as aesthetically central" (2007 p. 35). However, acoustic environments may be emulated in instrumental parts, for example, through orchestration, staging, or sequencing of phenomena such as echoes.

1993 p. 148). In these cases idiomatic instrumental parts (e.g. those primarily geared towards transmitting note information) can contribute to a wider discourse, but are not always considered a salient aspect of the work.

Early electroacoustic music was heavily influenced by the affordances of recording technology of the time (see Manning, 2003). Other digital processes such as granular synthesis, FM synthesis, ring modulation or various delay-based effects can imbue a work with a kind of technically-oriented idiom comparable to those of more conventionally recognized instruments. However, by definition composers working acousmatically actively avoid establishment of an audible relationship between gestures and the equipment or processes with which they are created. Failure to do so can lead to "technological listening", potentially distracting from the composer's intentions (Smalley, 1997 p. 109). In other settings this has been embraced, particularly in live electronics and computer music where perception of process can form a vital part of discourse. Failure and dysfunction of sound processing may even take a focus, as exemplified in *glitch* music (Cascone, 2000).

It is not uncommon for an acousmatic composition to go so far as to give the impression of defiance of the law of physics, provided that the listener is able to bracket out the experience of the listening situation and technical processes. In this way electroacoustic music can potentially be considered non-idiomatic in its most extreme sense, in detachment from the real world. However, a base level of reference to reality is often encouraged to aid understanding. In a similar manner to Blacking's emphasis on human production (see **§2.1**), Denis Smalley suggests that "listeners can only apprehend music if they discover a perceptual affinity with its materials and structure" (Smalley, 1986 p. 62), suggesting that the negligence of sound spectra and acoustic space as they relate to naturally occurring acoustic phenomena may account for critical rejection of much electroacoustic music (*ibid* p. 68).

While there is no unified approach to acousmatic music, analysis methods have been created to identify common threads and ways of listening without specifying an idiomatic framework. Building on foundations laid out by Schaeffer (1977), Smalley proposes a framework for analysis that he calls *spectromorphology*. Smalley describes four levels of surrogacy of gestures in relation to human agency: *first-order surrogacy*, in which recorded sounds not intended for musical use are employed, *second-order surrogacy*, in which traditional musical instrumental gestures might be found, *third-order surrogacy*, in which a gesture is inferred but the source is

unclear, and *remote-surrogacy*, in which source and cause become unknown (ibid, p. 112). In the absence of instrumental idiom, frameworks such as this may be used as a reference point for compositional activity and the nature of musical gestures, leading to more precise analysis.

Beyond acousmatic music, the shift from physical and acoustic to digital orientations brings with it fundamental changes in approach, as many musicians move their focus from individual expression and physical constraints to manipulation of various layers of abstraction in real-time (see **§2.3.2**). In this manner an instrumentally oriented model does not always accurately reflect the types of frameworks that live electronic musicians engage with, in particular through the development of live algorithms in performance (Bown et al., 2009). Musicians addressing sound on its most basic level frequently work in such a way that the boundaries between composition and the creation of tools become unclear. As not only the digital processing of sound materials but the development of software frameworks themselves become possible in real-time, performers are increasingly afforded the ability to operate in a feedback loop not only with sound materials, but with the development of their instruments and other tools.

4.3.1 Electroacoustic media in popular and dance music

With technology for electronic sound production becoming more accessible, musicians are increasingly afforded a more direct approach to sound without specialist equipment or training for its maintenance. Processes that were once largely restricted to specialist studios such as complex synthesis and editing on a micro-sound level are now common as part of the basic tools in commercial music software. With this situation comes the potential for equal priority to imposed and derived approaches to musical syntax, as recorded sounds may be combined concretely, layered as bricolage, or deconstructed and manipulated at sample-accurate level.

In more general practice, as recording and amplification play an increasingly common role in music, composers may take different approaches to sounds that might be incompatible in natural acoustic situations. The use of microphones allows what were once quiet sounds to come to the front of performance, and virtual acoustic spaces to be used in the form of artificial reverb for both the practical end of creating a coherent mix, or more creative purposes. Whether conscious or not, the mix and effects processing of a recording can be an important musical code that can

be used to manipulate the listener's experience. Certain genres have been developed around the manipulation of recordings, mixes, and effects (such as *dub*, a characteristic use of effects which started in connection with Jamaican *reggae* but has since become recognized as an independent production technique), which have been re-integrated into wider practice.

These more mainstream applications of electroacoustic media have fed back into acousmatic composition in turn, and are taken increasingly seriously in academic contexts (see Waters, 2000; Emmerson, 2007). As Emmerson notes, contemporary composers or producers do not necessarily make a deliberate genre switch: "Many of today's younger composers do not 'play at a distance with' the styles and musics they hear, it is their primary practice. The world has always been (for them) a mix of musics – if any practices are dominant this is transitory" (Emmerson, 2007 p. 2).

In the absence of dedicated physical instruments for electronic music, instrumental and stylistic idioms and their associated constraints may be borrowed from other contexts. The reasons for this are often based on individual expression or reference to a wider musical or cultural movement; in practice this might manifest through imitation, sampling of concrete sounds, or the affordances presented by virtual instruments. For example, until relatively recently the twelve-tone scale and equal temperament formed the basis for a large proportion of commercial interfaces in the form of keyboard controllers and piano-roll editors. As a result, pitch sequences based on this framework often become a default mode of operation alongside suggested time signatures and tempos (Mooney, 2010). In this manner what is broadly categorized as electronic music often brings with it the tonality and rhythmic conventions from other idioms.

A number of stylistic idioms have also developed in derivation from affordances of more specific music technology, and may be considered loosely equivalent to instrumental idioms. The most immediate examples lie in interfaces for physical interaction, whose designers may seek to mimic existing instruments or find new models for control[71]. Other more abstract methods include the manipulation of filter parameters developed from use of analog synthesizers and popularized through *acid house*, the rapid percussive parts playing on the border between rhythm and

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[71] The development of hardware interfaces is a wider area that I have not covered in depth here due to my initial focus on algorithmic composition (see **Appendix 1**).

pitch through computer sequences in *jungle* and *drill and bass*, and the widespread use digital effects that characterize current trends in electronic dance music.

In most electronic dance music the repetition of rhythmic material dominates, stemming from a combination of cultural setting and available technology. In *house* and *techno* music in particular, repetitive rhythms have developed through the affordances of early drum machines and samplers. These are combined with influence from West African and Cuban rhythms, *funk*, and other forms of contemporary popular music that also provide the basis for much phrasal idiom (Shapiro, 2002). Short cycles are repeated to the extent that instrumental-style phrasing often holds little salience, allowing other parameters to come to the front[72].

These now established idioms based on repetition and textural movement are often combined with more linear composition. This takes place in popular music and a thread of electronic music referred to as *intelligent dance music* (*IDM*) or *experimental electronica* (see Alwakeel, 2009; Emmerson, 2007). Artists working within these genres typically emphasize signal processing alongside development of melodic themes while retaining some of the repetition and various rhythmic and melodic idioms of other forms of dance music. As with Hoffman's example in Javanese gamelan, this combination of approaches might be described in terms of cyclical and linear approaches to time (1978; see **§2.2.4**). Here the crossover between acousmatic approaches (including concrete manipulation of sound) and instrumentally derived idiom is also strong. The intended listening experience can involve combination of the trance state sought in club environments with the more considered attitude and influence from contemporary art music taken by bedroom producers and more recently in academic settings. In such cases, a divide might also be formed between definition of "the music" (which might be described as the abstract values) and "the production" (concrete characteristics), as musicians and audience struggle to find an idiomatic framework within which to operate[73].

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[72] An example of this process may be found in the Chicago house group *Phuture*'s influential *Acid Tracks* (1987). Over twelve minutes a rhythmic pattern played by two drum machines forms the backdrop to an ostinato played on a Roland TB-303 synthesizer, on which the filter cutoff, resonance, and various enveloping parameters are manipulated. The variations in pitch and rhythm are minimal, the main discourse resting firmly in fluid timbral modulation.

[73] This statement is based on personal observation; I frequently noted this distinction in the electronic music community (provoking heated debates between musicians) during my own practice from 2000-2010.

4.3.2 Idiom and manipulation of discourse

Musical discourse is subjective; a composer's intentions do not always match up with what is perceived by the listener as musical values, narrative, or conceptual statements. In reality a listener is likely to bring a mixture of approaches to their perception of the work, which may shift during the experience. This problem is often described in terms of "intention and reception" (Weale, 2006; Landy, 2007)[74]. Issues of appropriate discourse are discussed in relation to the *language grid* by Parry (2000 pp. 31-39), who highlights problems in Emmerson's original chapter, and subsequently by Emmerson himself in revisiting the work (2013).

The absence of a clear style or idiomatic framework for listening can serve to alienate listeners or lead to the imposition of another framework and according value judgements (see **§2.2**). For example, the presence of pitched material that might be considered by a composer to be of lesser importance – or in some cases arbitrary – may distract the listener from an intended texture-based discourse, or dominate where integration is intended. In situations in which sampled material is used, listeners may find themselves addressing a piece on the basis of idiomatic material contained within. Listeners familiar with electroacoustic music may also find themselves engaging in "technological listening", caught up in the processes involved in the composition and production the work that might distract from the composer's intentions (Smalley, 1997 p. 109).

Perceived discourse is influenced by what are sometimes deceptively termed "non-musical" or "extra-musical" factors: the context of the piece, the physical setting, the relationship between the performers, composers and audience, and various other codes and parameters (see Cottrell, 2007 p. 89). Sometimes the title of a work or its placement in a performance may give the audience sufficient information to establish how to listen, which may be reinforced or confounded during the listening experience itself. In the aural realm, according to Parry: "Discourse emerges when the sustained use of a particular listening strategy yields satisfactory aesthetic results in the form of interesting relationships between individual elements" (2000 p. 31). Further considerations for guiding listeners are identified by Janzen (1986) and Landy (1994).

Different forms of discourse may co-exist and complement each other. Once a dominant discourse has been established, the layering and manipulation of discourse

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[74] While falling outside the scope of this research, these issues cross over with discussion of poiesis and esthesis in semiological terms (Nattiez, 1990 p. 17).

types may also be treated as a compositional tool. This might take place in the interaction between electroacoustic and instrumental parts, or in the juxtaposition of pre-existing musical styles, resulting in a "cultural tension" comparable to other forms of tension and release (Emmerson, 2007 p 6).

For example, in Javier Alvarez's *Temazcal* for maraca solo and tape (1984), a textural discourse is established through synthesized and processed sampled material, while the presence of a musician indicates an instrumentally oriented discourse will take place. The textural discourse is juxtaposed with "abstract musical" information in which rhythm dominates, provided by the unprocessed maracas throughout, alongside fragments of other sampled instruments. The final moments unite the instrument with a recording of a traditional ensemble, re-grounding the abstract idiomatic framework in the real world (ibid 7:00).

Smalley's *Pentes* (1974) is based on the manipulation of a set of Northumbrian pipes and percussion as concrete material; what Emmerson terms aural discourse and "abstracted" (derived) syntax (Emmerson, 1986 pp. 28-29). In the climax of the piece (9:00 onwards), the instrumental sources of the sounds emerge, moving the piece from texture towards the tonal system associated with the pipes; the listener's attention is caught between the texture and lingering traces of idiom as the piece dissipates into less recognizable sonic gestures.

In other instances, composers may move between the discourses presented by personal idioms with the same musical parameters, as in the case of Larry Polansky's *Bedhaya Guthrie/ Bedhaya Sadra* (1989). Although instrumental and vocally oriented (in the recorded version of the work the main line is played by a clarinet; see Polansky, 2002), this piece features the processing of note information through computer software using principles shared with digital audio processing. Here the mutation between melodies written by American songwriter Woodie Guthrie and Indonesian composer I Wayan Sadra, each with their own idiomatic style, form an overarching discourse (Polansky, 1996).

4.4 Analyzing syntax and idiom

The notion of employing "abstract syntax" as described by Emmerson – which I have described as "imposition" – might appear to form an unnecessary distance between electroacoustic and traditional instrumental composition. In the context of the *language grid*, the use of entirely abstract syntax represents the somewhat extreme

process of applying organizing principles to sound materials with little to no aural feedback. In instrumental settings this situation may be likened to the "excess of abstraction" to which Schaeffer was responding. But can Emmerson's categorization of abstract syntax be applied to cases in which aural feedback in plays a significant role, such as instrumental composition and idiomatic improvisation?

It is important to note that Emmerson's original example describes abstraction of syntax at the point of composition. Although instrumentally oriented composition typically entails feedback through listening (if not to the instrument in question, then to a surrogate such as vocalization, similar instruments, or synthesis from a MIDI sequence), it does not necessarily involve creation of an entirely new syntax based on the relationships between sound objects. Composition is often mediated by an idiomatic framework, including knowledge of an instrument (acoustic or electronic), and conventions for techniques and interaction between players. Idiom typically provides syntax, in some cases extending to collections of stock phrases (see **§2.2.3**). In instrumental traditions, such as Javanese gamelan, idioms have been developed with direct reference to the instruments in question and vice versa, starting life as derived from the instruments. Once established, the syntax contained within becomes an abstract framework to be imposed, as illustrated in **Figure 4-2**.

The situation is less clear when improvisation or real-time composition is involved. Depending on the degree of freedom granted to a performer, opportunities might arise to refer to direct aural feedback to create a part. In instrumental contexts this activity typically remains within the bounds of an idiomatic framework; even in seemingly non-idiomatic free improvisational settings, some traces of mechanical idiom can manifest through the constraints and affordances of physical instruments (see **§2.2.3**).

With these factors in mind, I suggest that syntax based on an existing idiomatic framework may be placed towards the upper end of a continuum from imposition to derivation, as illustrated in **Figure 4-3**. The positioning of approaches varies according to the degree of mapping required. For example, the sonification of an abstract series of numbers or chance procedure may entail a complex mapping and therefore more involved derivation from the sound materials than an improvisation derived entirely from sound relation consisting of movement between two notes.

Imposed (abstract)

Serial systems

Chance procedures

Sonification of extra-musical information

Application of abstract information with aural feedback

Improvisation or sonic exploration with reference to an idiomatic framework

Relation of syntax to materials

Working with intrinsic sound relations

Derived (abstracted)
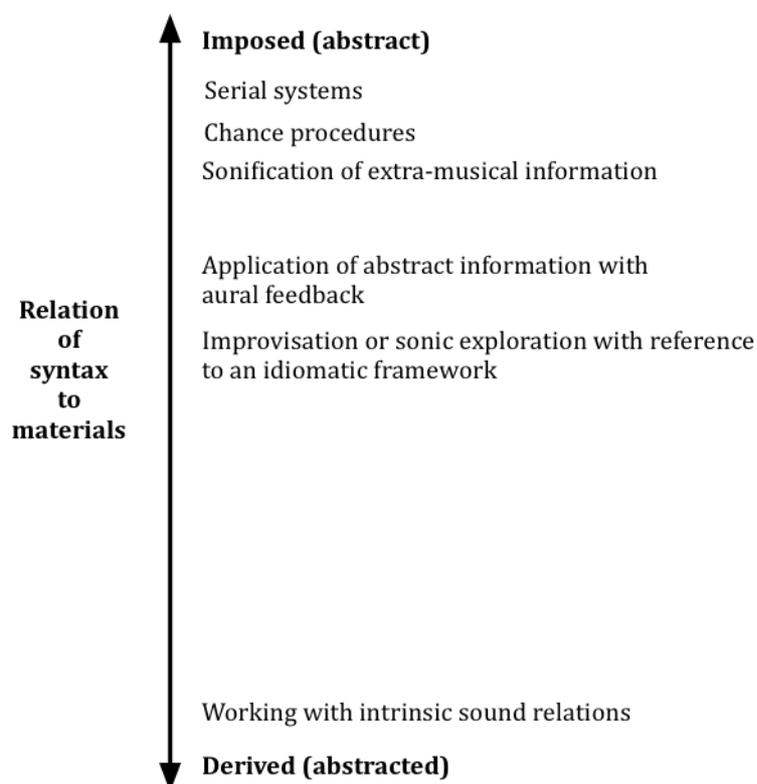
Figure 4-3: A continuum of approaches to abstraction of syntax.

4.4.1 Accommodating alternative discourse types

Emmerson states that his original x-axis continuum is appropriate for "works in which timbre ('colour') composition plays an important part" (1986 p. 39). The generalization of aural discourse is somewhat ambiguous; for example, some textural discourse is conflated with idiomatic pitch-based discourse (ibid pp. 26-29). I suggest that beyond Emmerson's original continuum between aural and mimetic discourse, relationships between various other types of discourse may be examined through addition or substitution of further axes[75]. For the purpose of this thesis I will focus on idiomatic and non-idiomatic discourse in relation to central Javanese gamelan, as demonstrated in **Figure 4-4**.

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[75] In doing so I am not suggesting equivalence between aural/mimetic discourse and degrees of idiomaticism. As Emmerson highlights, his notion of mimesis may accommodate instrumental sounds and phrasing as objects from the "real world", but was not intended in his original conception (2013, section 2). The majority of works discussed within this thesis fit within dominant aural discourse on Emmerson's original grid. Ultimately the two-dimensional grids proposed here suffer from similar ambiguity; development of multi-dimensional grids should provide further illumination.
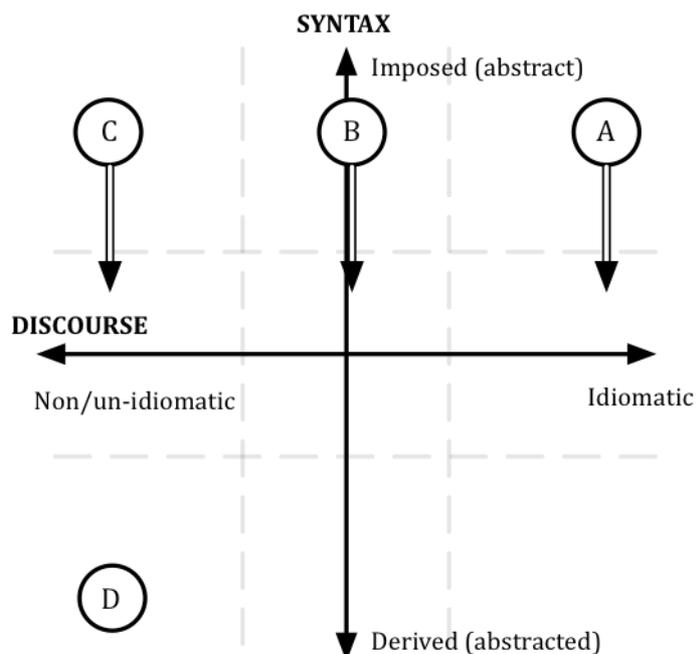
Figure 4-4: A potential grid demonstrating the relationship between syntax and idiomatic discourse for the purposes of analysis.

Point **A** shows a piece of entirely abstract and idiomatic music, which may represent traditional *karawitan*. In this case the syntax is ostensibly imposed on the materials, as belonging to an established idiom. However, according to the level of aural feedback and interaction involved, the degree to which the patterns played may be considered derived from the materials may vary. In the course of performance a more accurate placement may fall somewhere along the arrow indicated below it. Points **B** and **C** represent similar situations, in which abstract syntax is imposed from another idiom with some mutual intelligibility (**B**), or from extra-musical information (**C**). In these cases, the placement on the vertical axis depends on the degree to which modification is necessary through the mapping process. Point **D** represents the extreme situation of un-idiomatic activity derived entirely from intrinsic sound relations, which may be used to describe activity based on processing of instruments outside their idiomatic context. The full range of the grid will be explored further through specific examples in **§5.5.1** and **Appendix 3**.

Although some ambiguity remains as to the source of the syntax itself, these intersecting continua describe the possibilities afforded by electronic media and manipulation in relation to an idiomatic framework, helping determine the nature of mixed works. The model is problematic in that the constituent parts of a performance, whether determined by a central composer or individuals in a group composition or improvisation setting, may operate with varying degrees of

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idiomaticism and derivation of syntax. Placement of entire works on the grid is not only prone to the subjectivity of perceived discourse, but a generalization based on multiple elements. Furthermore, the position of various elements on the grid may vary in time over the course of a work.

Therefore, in addition to the possibility of broad comparison of multiple works, I suggest that several points may be placed on a grid, covering either a single piece or suite of pieces in a performance. These may be used to represent movement in time, and to explore the relationship between various discrete parts within a single piece (e.g. those relating to specific instruments or synthesized elements)[76]. The example presented in **Figure 4-5**, taken from the collective *gender* and *slenthem* parts in my own arrangement of the traditional Javanese piece *macapat Durma*, shows movement of an instrumental part from idiomatic to non-idiomatic discourse, while keeping its abstract syntactic quality intact (see **Appendix 3.4**; **AV1.4.B**, 9:50). In this piece a group of musicians slow down independently of each other while maintaining the same pitch sequence, collectively giving the listener the impression of disintegration and the creation of a new un-idiomatic part.
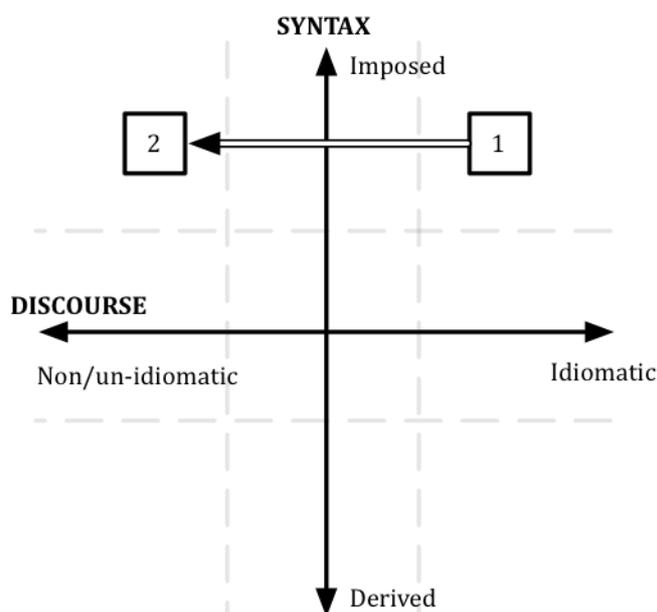
Figure 4-5: Discourse movement in *Durma* (*Augmented Gamelan* set, 2012).

Without the addition of further axes this representation of time is restricted to a general indication of discourse movement. The parameters represented by each

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[76] Further development is presented in **§5.7** (**Figure 5-5**), where shapes representing multiple elements illustrate the scope of several works.

plane may also be examined separately, enabling a more accurate representation of temporal movement (see **Appendix 3.1.3**; **3.2.3**; **3.5.3**).

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textual ←————————————————————————→ pitch-oriented
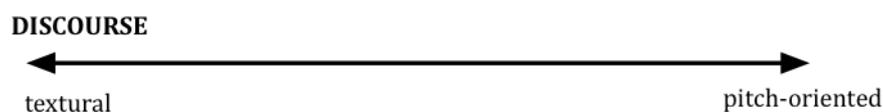
Figure 4-6: A continuum between textural and pitch-oriented discourse.

This type of analysis may in turn be related to other types of discourse. Another axis may be extended to explore the various types of idiomatic or non-idiomatic activity, as in **Figure 4-6**. In contrast to Emmerson's aural/mimetic pairing, this continuum maintains of a focus on abstract relationships between sounds throughout, moving between a discourse based on conventional pitch/rhythm relationships on the right hand side and other less obvious relationships (e.g. granular qualities and spectral characteristics) on the left. This continuum might also be considered equivalent to one of the degree of idiomaticism if the relative idiom is primarily pitch oriented.

4.5 Conclusion

Given the broadness of the medium and that composers working with electroacoustic music do not always operate with ties with reference to acoustic instrumental models or cultural context, it is problematic to attempt to speak of an "electroacoustic idiom". With the appropriate tools and skills, composers are often limited only by their imaginations. In the absence of a dedicated physical means of sound production beyond loudspeakers or headphones, composers might adopt constraints from idioms associated with instruments from other disciplines, from phrasing appropriate to a cultural context, or from the tools with which they are working.

The experiments conducted in *musique concrète* and subsequently in the wider practice of acousmatic music may be described as non-idiomatic or as aspiring to the creation of new idioms, as in the self-idiomatic music described by Bullock (2010). The desire held by many acousmatic composers to minimize perception of sound processing techniques (Smalley, 2009 p. 109) causes difficulties in the identification of a unified idiom based on instruments or equipment. However, distinct aesthetics may be recognized in reference to particular composers or movements.

The abstract values and concrete characteristics of a work potentially differ between types of musical discourse. While most musical idioms apparently share pitch and duration (often integrated with other parameters) as carriers for abstract values, they may be integrated with other parameters, and cannot always be assumed to be of primary importance to the composer or listener. Depending on the composer's focus, a search for abstract values may be misleading; the pitch and rhythm content of a piece, alongside other textural information, may serve part of a wider purpose of creating a sound environment that in itself forms a statement.

To describe the variety of potential approaches I have adopted the *language grid* introduced by Simon Emmerson for analysis on a conceptual level, identifying the type of discourse in relation to the nature of sound production and imposition or derivation of syntax. I suggest that these methods may be applied to the identification of syntax in relation to idiomatic discourse, alongside further modification to accommodate multiple elements in composition and movement in time. These ideas will be developed further in context in the following chapter, in which I will examine the situation of combining gamelan and electroacoustic music and its implications in the wider practice of new music for and inspired by gamelan.

5 Strategies for composition and analysis of mixed works

In the present chapter I will examine some of the expanded possibilities presented by combining electroacoustic music and gamelan, alongside some of the problems that may be encountered. This discussion starts with the use of gamelan instruments as source material, enabling comparison of works with varying degrees of reference to existing performance practice, formal theory, and idiomaticism.

The examples of compositions presented within this chapter have been selected to represent the breadth of existing approaches. I will focus on non-Javanese composers working with what can be described as "gamelan-inspired composition" (Becker, 1983; Sorrell, 2007). This reflects my own background and perspective, which will be the focus of the second part of this thesis; examples from my own work are also discussed in **§5.7**. The scope of electroacoustic composition and performance presented here remains as broad as possible, ranging from acousmatic works (including cases where the instruments are treated as sources for abstract sound objects) to more widespread practice of electroacoustic music retaining a more conventional instrumental orientation (including works combining gamelan with synthesized and sampled pitch sequences).

5.1 Choosing approaches

The discussion in this chapter and subsequent analysis (see **Appendix 3**) will focus on the following levels:

- **A conceptual level** – the gathering of ideas and resources, creation of a sound world, context for the work, and the development of conceptual frameworks.
- **An "abstract musical" level**, concerned with note events or other elements that may be taken to convey values (as opposed to forming concrete characteristics; see **§4.1.1**). This may take the form of building parts note-by-note or building a framework such as a *balungan* or similar part to be elaborated upon by musicians or algorithmic processes.
- **A concrete level** – the whole work encountered by the listener. For a composer, working on this level might involve attempting to derive syntax from sonic relationships (leading back to the "abstract musical" level), or

working directly on sounds without considering their implications in an idiomatic framework.

What kind of results can be obtained through the combination of gamelan and electroacoustic music? In order to answer this question, we must first look at the prominent features of each type of music on a conceptual level. Some important aspects of electroacoustic music as discussed thus far are as follows:

- With widespread use of digital technology, electroacoustic music inhabits a world potentially without physical constraints, which may instead be introduced by the composer. As such, it offers equal opportunities for the imposition of pre-existing syntax and development of syntax directly abstracted from sound materials.
- With this apparent absence of physical constraints, electroacoustic music is potentially free from instrumental models and associated idiomatic obligations. Composers may work on various levels of gestural surrogacy, creating difficulties in perception of a source or agency. Musical discourse is often developed on an individual basis. References to idiomatic material might be employed through the synthesis or sampling of instruments or entire phrases.
- Tools may be developed in real-time during the composition and performance process with greater scale and speed than in traditional acoustic situations, whether through software development (sometimes forming a core process in performance) or the assembly of a virtual studio in a digital audio workstation.

Some prominent features of Central Javanese gamelan music (including *karawitan* and more recent composition) include:

- Established instrumental idiom influenced by the physical construction of instruments in relation to other elements of an ensemble.
- Conventions for real-time idiomatic interpretation and integrity across varying temporal levels, in a manner that sometimes lends itself to algorithmic representation.
- A variety of phrasal idioms that provide interesting source material for composition with an instrumental orientation.

5.1.1 Orientation with tradition: a bi-musical relationship?

The myriad approaches to the combination of gamelan with external idioms and instruments from outside Indonesia (including what are often termed "Western" music and instruments) are the subject of much academic discussion; notably McDermott (1986); Diamond (1992); Sorrell (1992; 2007)[77]. These articles describe different approaches to gamelan instruments and their associated idioms (both in cultural and instrumental contexts), the applications of idiomatic material to other instruments, the construction of new instruments, and cases in which gamelan instruments are used with deliberate disregard for tradition.

When discussing idiomaticism in new composition for gamelan, the issue of "bi-musicality" is frequently raised: the notion that a scholar or composer should aspire to fluency in more than one musical discipline (Hood, 1960; Diamond, 1992 p. 116; Sorrell, 2007 p. 42; see **§2.2.4**). Although other terms such as "polystylism" or "eclecticism" may more accurately describe wider attitudes in contemporary composition, bi-musicality has become embedded in discussion of new music for gamelan in part through its connection to ethnomusicology and Hood's writing.

While the term "bi-musicality" is primarily used to discuss active study of music from another culture, its application also assumes competence in the musician's own culture or tradition. Sorrell explores the popular stance that musicians and composers should draw on the strengths of their own tradition, rather than making superficial attempts to address musical structures in the other discipline. Sorrell explores "bi-musicality" in contrast with what he calls "fusion":

> Fusion music is typically (though of course not always) the result of musicians from different cultures pooling their respective traditions in the hope of a viable synthesis, and often stems from the idealistic but flawed belief in music as a 'universal language'. . . 'bi-musicality', on the other hand, has the more modest aim of bringing from within the individual an awareness of contrasting music's grammars and vocabularies, and – perhaps most crucially of all – idioms. The composer can use this awareness to seek new relationships between musical languages and also discover (as Debussy appears to have done

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[77] Further description of new gamelan music in the UK can be found in writing by Mendonça (2002). I also wish to acknowledge informal conversations with Ginevra House in the development of this chapter, whose forthcoming research on composition for gamelan in the UK provides invaluable insights into a range of approaches including electroacoustic composition.

more than a century ago) how one may reveal new insights into
the other (Sorrell, 2007 p. 42).

In this manner, bi-musicality in the context of new composition may be regarded as enhancing the interaction between the two forms of music and an awareness of where to apply their theory and conventions. It also implies an understanding of when material or processes from one idiom can inadvertently be applied in the other. To work through bi-musicality implies mindfulness when operating across domains: an awareness of how activity in one domain may affect another, or how listeners with different frames of reference may experience what is ostensibly the same musical material. Such decisions may be made by a composer with superficial knowledge of an idiom through research, collaboration, and feedback from musicians. However, to operate with bi-musical awareness suggests a degree of intuition, which may be applied to real-time interaction with musicians and sound-generating materials in a rehearsal and performance context.

The notion of bi-musicality itself has been subject to substantial criticism and debate. In the context of composition there are two significant problems: that bi-musicality might rely on the creation of an artificial distinction between the styles or idioms in question in terms of the composer's own background and attitude, and that to aspire to a bi-musical relationship implies unrealistic expectations in engagement with its wider cultural context – expectations that are not necessarily reflective of the attitudes taken in a music's place of origin.

Many composers find it unnatural to separate aspects of their musical background (which is likely to be a combination of far more than two musical disciplines), instead preferring to view their activity as relating to a more complex personal idiom. While the attempt to study a musical idiom from another culture might be regarded as a conscious effort, what is often assumed to be a composer's home culture is often already a blend of many forms of music (see Cottrell, 2007). This situation is heightened with the widespread availability of digital technology and the Internet. Cultural boundaries increasingly blurred with the possibility of international communication and collaboration, and a range of musical information is available to be heard and sampled as raw material.

Attempted bi-musicality in composition can also raise more complex issues in the cultural placement of a work. In many cases, while musical competency might be

assumed, the deeper implications of the work go unaddressed, as Becker points out in relation to gamelan in America:

> Our students are not Javanese, our culture is not Javanese and although we play Javanese music on Javanese instruments, the meaning and ethos of the music must necessarily be very different here. The concept of bi-musicality has led us initially to a greater appreciation of gamelan music as music, subsequently to a greater appreciation and understanding of Javanese culture, and ultimately to a kind of loss of faith in 'bi-musicality' as a practical aim for most American students. We now know that bi-musicality requires the same commitment (years and years in another culture) as does bi-lingualism. A few years of study will produce neither. (Becker, 1983 p. 85)

Becker suggests that the cultural associations of the instruments and the more general practice of attempting cultural integration are as problematic as the idiomatic expectations. The relatively recent development of American-made gamelan provide a way around this problem (see **§3.4.1**). According to Becker, the instruments "have none of the aura of sacredness of the authentic gamelan and thus are freed for experimental use of all kinds" (ibid p. 87).

The aspiration to bi-musicality can sometimes be an inhibition to creativity, implying what is perceived by some as an unnecessary idiomatic obligation[78]. Many composers prefer to treat gamelan purely as a set of instruments without regard to their idiomatic and cultural associations; perhaps applying their own personal idiom or attempting an entirely non-idiomatic approach. For example, the composer Philip Corner's preferred method was to compose a body of work for the instruments before attempting to learn about the associated idiom; a path Diamond refers to as "bypassing the tradition" (1992 pp. 129-131). Such an approach allows for an uninhibited exploration of the sonic possibilities of the instruments, or for the application of music from other traditions and disciplines without modification occurring through attempted integration. This may generally represent a more honest and respectful attitude, but can sometimes prove problematic if parts intended for players do not exhibit a base level of idiomaticism (see **§2.2.2**).

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[78] As Corner expresses in more provocative terms: "People who learn the traditional music too well often write shit . . . You have to solve the creative problem of what you want to express. But it is not the knowledge that is going to make you creative. It is the creativity that is going to search for knowledge and absorb what it needs" (Corner quoted in Diamond, 1986).

5.1.1.a Bi-musicality and electroacoustic music

How can electroacoustic composition and performance fit into a bi-musical relationship with gamelan, or with other forms of music? May electroacoustic processes be regarded as another set of instruments with similar considerations, or do they entail a fundamentally different approach?

Much contemporary electroacoustic music (within which I include recent crossover with popular electronic music) bridges various instrumentally derived idioms and acousmatic approaches. With each of these directions comes differing emphasis on what might be deemed content and carrier, or in Schaefferian terms, the abstract values and concrete characteristics (see **§4.1.1**). In some cases a composer may not wish to convey meaning through abstract values at all, opting instead to focus on a function (such as the induction of mood or trance), a conceptual statement, or fitting into a wider performance involving other media such as film or dance in which the primary discourse lies.

Hood suggests that in learning to be bi-musical, the bias towards a specific tuning system might be regarded as a "prejudice to overcome" in order to recognize the inflections of other musical cultures (1960, p. 56). Can the assessment of appropriate discourse and alternative sets and weighting of values and characteristics be treated in a similar manner? The parameters holding values for a composer and the concrete characteristics may differ, sometimes within the course of a performance; for example, an instrumental part may be established in order to form the basis of timbral movement. The composer's bi-musicality may come into play in judging what not to use in order to avoid cliché, or avoiding types of phrasing that may prove distracting for a listener in either framework. In some respects the task of working between these domains is easier than working between idioms that ostensibly share the same abstract values, as there is less chance of misunderstanding of material. However, a composer may need to work harder at creating coherent idiomatic references and bridges between domains.

To be bi-musical in relation to an electroacoustic context may be to recognize the effects that movement in one domain has in another. For example, electroacoustic composers working with textures and pitched material – attempting to build a syntax abstracted from the intrinsic sound relations of an instrumental source – may draw upon their knowledge of an idiom to ensure that dissonance or cliché is not being created in an idiomatic context if it is not intended. Conversely, a

composer working from an idiomatic (gamelan oriented) perspective may draw upon an awareness of timbre and acoustic space in choosing instrumentation, or choose to accept the dissonant qualities or clichéd aspects of certain activity with recognition that it creates interesting activity on a concrete, textural level. A composer operating within a balanced bi-musical relationship may seek compromise between the two types of discourse, perhaps finding ways to modify the material accordingly, or may seek ways to move between them in the course of a composition.

5.2 Derivation of syntax

In discussion thus far idiomatic discourse has been associated with abstract (imposed) syntax, as various levels of idiom provide an abstract framework through which the development of material passes. The combination of abstracted (derived) material and idiomatic discourse is a grey area; idiomatic references may be made while drawing on the affordances and intrinsic sound relations, as may be observed in *komposisi* developed in Solo (Roth 1986; see **§3.4**).

It is tempting to categorize a non-idiomatic approach as relying on the creation of material directly derived from sound materials. In particular an acousmatic approach, based on the foundations of reduced listening and treating sounds as abstract objects, might imply a feedback relationship with the sounds themselves. However, as Emmerson's grid highlights, this may also entail the applications of abstract structures such as serial systems, chance procedures, or mapping of extra-musical information. In the case of application of material from another idiom or extra-musical information an abstract syntax might also be applied. In all instances some form of modification may take place in order to make the transfer of information work in practical or aesthetically satisfying terms[79].

Can a part become idiomatic without any deliberate abstract idiomatic reference? At the lowest level of mechanical idiom, instruments and other sound-producing items usually exhibit predictable behaviour in relation to the physical world. Exploration and composition based on the affordances of an instrument tends to entail a base level of mechanical idiomaticism that may not come about if it is treated as a recorded sound object in abstract. If the instrument's role is based on its

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[79] For examples from my own practice see **Appendix 2**; **3.3.2.d**; **3.4.3.a**.

physical constraints, as in the stratified hierarchy of pitch and rhythmic density of gamelan instruments, this idiomatic function may be evoked unintentionally[80].

While the use of instruments might not automatically invoke more complex idiomatic frameworks, a base level of idiom takes place through considerations in using the instruments with players, and through their physical properties, including their timbre and tuning. For example, the use of instruments in *slendro* tuning, while not necessarily conforming to any *pathet*, exhibit a base level of idiomaticism in terms of *laras*. The striking of a physical gong at varying rates and intensity exhibits a base level of idiom in terms of how its timbre is affected.

Through the use of synthesized and sampled instruments these factors sometimes play contrary to the affordances of the tools used to realize them. Revisiting the above examples, in the majority of commercial applications the tuning of a synthesized or resampled part may be set to equal temperament by default, making re-tuning the instrument and selecting the correct pitch ranges a deliberate task. A single sample of a gong may be retriggered or played at various intensities of volume without any practical impact to its spectral qualities: the timbre remains frozen in a single state, and the instrument may effectively be played beyond the frequencies possible to realize both by a human player and according to the laws of physics. Furthermore, these situations often exclude the expression and interaction of performers, who can lend subtle articulation to the realization of a part and may make modifications on a near-automatic basis in order to ensure it can be played.

5.3 Idiomatic reference, interpretation, and mapping

Composers working with a combination of gamelan and electroacoustic processes may make idiomatic references for a variety of reasons, for example:

- To create parts to be played by live musicians or through sampled or synthesized versions of the instruments.
- To provide raw information as a starting point for manipulation or as a carrier for information in another domain.

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[80] For example, discussing his *Gamelan* series, Corner suggested that he had "unconsciously abstracted the colotomic structure of a Javanese gamelan" by working with what he described as "organic" relationships between the length and density of note events in relation to their pitch (Gamelan Composer's Forum event, 2013).

- To find interesting new ways of organizing sounds, perhaps to fill in information (such as melody) where it is lacking in the composer's personal idiom, or to explore more advanced concepts such as *garap* and *irama*.
- To create coherence in electronic and live instrumental and vocal parts.

Electroacoustic-oriented composers wishing to notate parts for integration of a gamelan ensemble may wish to draw on an existing idiomatic framework to understand the constraints and affordances of the instrument so that parts can be played comfortably, particularly if the instruments are not available during the composition process. This may extend to knowledge of conventional techniques, and codified aspects such as syntax and phrasal idioms, which may be adopted wholesale or developed further in the context of the new work. These considerations may relate as much to the avoidance of cliché as the generation of material.

Idiomatic reference may also take place across disciplines and domains; for example, idiomatic syntax may be used to organize non-idiomatic material, and vice versa. The process of idiomatic reference in its most basic form involves the use of material within its original domain; e.g. the use of traditional pieces or garap, the creation of new material within an idiom, or the aspiration to doing so through a pastiche-based approach. Reference to an ensemble idiom may involve the emulation of a general sound – what Harrison calls "aural imitation" (Miller & Lieberman, 1999 p. 149) – or focus on specific information such as melodic patterning[81]. Idiomatic references can involve a hierarchy of abstraction; for example, an instrumental or ensemble idiom might contain a selection of predetermined phrasal idioms such as *cengkok*.

The scope for mapping across domains is expanded by digital technology, as mapping of information and abstract syntax can often be a trivial matter of re-routing data flow or copying and pasting sequences. In some cases what can be considered a simple, literal, reference across parts – such as the movement of pitch values onto a sampler to sequence a set of samples – can represent a more complex conceptual mapping that would require careful consideration if interacting with a musician and the idiomatic constraints of their instrument (see Collins, 2000). Unless the idiomatic qualities of the parts match up, they may be counter-intuitive, or even physically

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[81] Classic examples include Messiaen's *Gamelang* section in *Turangalîla* (1948), Britten's *Prince of the Pagodas* (1957), and Debussy's work (see Sorrell, 1992).

impossible to play. Even if the part is intended to remain in the realm of sample playback, it may have an adverse affect on the audience's critical reaction.

Many idiomatic references rely on more complex conceptual mappings: for example, the emulation of rhythmic concepts in Otondo's *Irama* (2012), or the movement of *seleh* from the pitch domain to the spatial domain in Hughes and Jacobs's *Framework* (2012; see **§5.5.1.d**). In the context of gamelan-inspired composition, a successful conceptual mapping or re-interpretation may be likened to the process of *garap* in its broadest sense; the movement between domains is often accompanied by consideration of the constraints and affordances of the target, and may result in a characteristic interpretation. For example, in my own practice I have attempted to create a set of electronic *cengkok* based on the limitations of a bank of faders, using slow fades to play *pipilan* patterns that were shifted in time and density accordingly (see **Appendix 1.3.3**). Conceptually these parts were intended to move from instrumental patterns towards swelling resonances without a clear source. The accompanying gamelan parts were simplified to create acoustic space for the resulting sounds.

In making a complex conceptual mapping it may be sometimes be more effective to search for equivalent processes in the target domain. Composers wishing to move information from one instrument to another may find it more fruitful to ask a player to provide an idiomatic interpretation of their intentions rather than attempt to transfer the information wholesale. Composers wishing to explore *irama* in an electroacoustic context may wish to draw on existing time-stretching algorithms such as the audio-slicing or granular-based solutions found in early samplers (Roads, 1996 pp. 440-446) or phase vocoding (ibid pp. 566-577), and their potential for colouring sound in the process. In a tonal or post-tonal orchestral context other angles might be found in investigating precedents for notational augmentation, or the notion of metric modulation pioneered by Elliott Carter (see Bernard, 1988).

5.3.1 Concrete references and sampling

A concrete reference involves the appropriation of a chunk of information; the most common example of this is the process of sampling. Concrete references may be performed with the intention of using a set of abstract information; for example, a pitch sequence or rhythm, or to evoke the atmosphere and sound of a performance or ensemble. In doing so, composers must accept that certain aspects of the work such

as tuning and rhythm are likely to become fixed and therefore difficult to port to other ensembles or performance settings. In the sampling or emulation of a piece with the intention of importing "abstract" note information, a composer may involuntarily invoke the personal idioms of a teacher or a player, or the concrete characteristics of a particular set of instruments.

By working with samples a composer may employ idiomatic material without taking the needs of musicians into account. Ensembles from different regions and times may be placed in the same virtual performance, forming complex combinations of note information, style, timbre, acoustic space, and countless other considerations. However, any additional expression beyond that taking place in the original performance must be imposed through manipulation or augmentation of the samples.

5.3.2 Generation of artifacts

The use of idiomatic material can often bring with it the unintentional modification or generation of information. For example, a phrase sampled for its abstract pitch content may bring with it rhythmic or timbral information unnoticed by the composer. The direct mapping of a parameter to the velocity of an instrument or synthesizer may be intended to affect the volume, but also generate differences in spectral content. In some cases these artifacts may prove aesthetically pleasing, perhaps highlighting an idiomatic connection between domains.

Artifacts may also be created or maintained in the use of phrasal information; for example, the wholesale copying of a pattern from the *kendhang* to a computer sequence brings with it characteristic phrasing designed to control the *irama* of the ensemble. The *wiletan* of a *gender* part separated from the other parts it accompanies may maintain traces of interaction, melodic or rhythmic nuances, and divergence from the abstract *cengkok*. Where the original interaction is lost these phrases might become meaningless, the audio equivalent of skeuomorphs[82].

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[82] Skeuomorphism is commonly described in visual terms: "a design feature that is no longer functional in itself but that refers back to a feature that was functional at an earlier time" (Hayles, 1999 p. 17). Application of the concept to musical information might provide further insight into development and influence of idiom in composition.

5.4 Garap and interaction

Real-time interpretation, commonly referred to as *garap*, is integral to the performance of Central Javanese gamelan music. Traditional and new compositions frequently leave the details of parts to the interpretation of musicians – a process that may take place in rehearsal and development sessions to be fixed in communication with musicians or remain open through performance[83]. In many cases the only fixed elements provided by a composer are vocal parts, some form of *balungan*, instrumentation, and structural information. Additionally the resulting parts may be subject to changes in dynamics, *irama*, and general playing style. Composers wishing to work with gamelan musicians may find it useful, if not essential, to gain familiarity with this way of working unless their intention is for parts to be thoroughly pre-composed (Sorrell, 2007 p. 41).

     Opportunities for real-time interpretation may be incorporated into electroacoustic composition through two primary methods: interpretation by musicians (which may include a computer operator), and analysis and elaboration by a computer system through an algorithmic system. In both cases a central framework such as a *balungan* may be shared between both sides. Algorithmic systems may provide a means for a composer to work with idiomatic material where musicians are not available, as computer-aided composition. They may also allow a composer to hear relations between electronic and acoustic parts outside an ensemble, auditioning changes in a *balungan* or other central frameworks. Software along these lines may also be applied an educational setting, allowing users to explore individual parts and experiment with idiomatic responses to their own decisions. In these cases they may complement learning with acoustic instruments, or enable users with limited mobility (see **§3.4.3**).

     Interpretation need not necessarily be idiomatic or associated to any instrumental parts. Electronic parts may also appear to respond or provide cues within their own conceptual domains. For example, a non-instrumentally oriented electronic texture may accompany an *irama* change through granular manipulation, pitch shifting, or other forms of audio time stretching. Certain phrasing may be

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[83] As Roth notes, the goal in new composition in Java is often to find a *mantap* [stable] state rather than that of a "finished work" (1986 p. 77).

highlighted and emphasized through processing or sympathetic movement of textures in electronic parts, as in my own practice (see **Appendix 1.3**).

5.4.1 Timing

The nature of a work for instruments and electroacoustic elements is influenced by the source of timing. Beyond coincidence of events on a base level, synchronization of clocks can affect the character or degree of idiomaticism of a piece. This is particularly apparent in traditions such as Javanese gamelan where fluidity of timing is integral: the presence of a drum machine (as occasionally found in *campur sari*) can bring a mechanical feel to an ensemble as musicians are obliged to follow or fall out of phase. Although this in itself is not always undesirable, certain idiomatic actions such as changes of *irama* and undulating *laya* become difficult or impossible to achieve.

The established convention of works for "instruments and tape" often demands that musicians follow the internal clock of a recording, which may be elucidated further by a headphone click track. This is particularly important where the only audible parts not only do not exhibit a clear rhythmic pulse, but do not fit a traditional instrumental model, and yet still require some degree of synchronicity[84]. The conventional positioning of instruments close to the floor and the delicate sound of instruments such as the *gender* can create difficulties when using fold-back monitoring in larger performance spaces where acoustic signals are lost on stage. The gain needed to amplify these instruments often causes feedback or bleed from electronic parts; this creates a necessity for headphone parts of some description if both amplification and synchronized timing with a computer part is essential[85]. A full gamelan ensemble involving upwards of fifteen players may be confronted with a situation where they are asked to block out the timing of other players so as not to lead each other astray, attempting to lock to a single pulse in contrast to the two-way situation in which a *kendhang* player moderating the group's *irama* may rely on aural feedback. Due to the volume required for a click track to cut through a full gamelan and difficulties in splitting ears between instruments and headphone feeds, players may feel acoustically isolated and unable to respond to other parts, or in some cases,

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[84] The problems of building timing cues into electroacoustic works and their effects on playing style are discussed at length by Alvarez (1993).
[85] The discussion here is based on my own experiences in development of the compositions presented in this thesis alongside other projects including participation in the Southbank Gamelan Players' collaboration with Plaid (2010).

feedback from their own instruments. In these cases, should knowledge of a part and individual rhythmic integrity be given priority, or are the subtleties and *rasa* [feeling] of the performance paramount? Depending on the context, it may even be desirable to evoke a mechanical feel in instrumental parts or explore contrasting rigidity and fluidity (a concept I have explored in my own practice; see **Appendix 3.4**).

These issues may be necessary to consider at the beginning of developing a performance, at a conceptual level. In the development of a piece, a composer might ask the following questions[86]:

- Should the integrity of the electronic parts given priority over the articulation and "feeling" (*rasa*) of the players?
- Would instrumental parts be as effective if pre-recorded, eliminating the need for synchronization of players?
- How much timing information can be built in to the electronic parts?
- Should inherent timing in the sampled material be taken into account?
- Could timing be learned from the electronic parts, perhaps aided by a click track, and subsequently discarded?
- Can rhythmic parts be triggered by a human player or synchronized to an ensemble by other means?
- Is synchronization between computer and players necessary or desirable? Is it acceptable for rhythmic parts to exist independently of each other[87]?
- Could multiple clock sources be used in the electronic parts[88]?

If a click track is to be used it may be tailored to its purpose by providing additional information to musicians. In the case of gamelan, this may take the form of a *balungan* or pre-recorded *kendhang* part. In situations where parts are relatively fixed (e.g. based on MIDI sequences or pre-recorded sounds), the ability to trigger sounds in response to an ensemble can be central in bringing life to a performance.

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[86] Approaches to timing in my own practice are discussed in **Appendix 1.5.2**.
[87] This approach was taken by Malcolm Milner in the composition of *Plinth of Seives* (performed by the Southbank Gamelan players, 2010). A pre-recorded synthesizer part provided the initial pulse for the gamelan, which was allowed to drift, creating an ambiguous relationship that varied between performances.
[88] The *Virtual Gamelan Graz* presents an interesting example in which each part is assigned its own clock with "confidence" and "empathy" parameters used to emulate listening and interaction within an ensemble (Schütz & Rohruber, 2008 pp. 177-182).

5.5 Analytical framework

With the above discussion in mind, I suggest that the relationship between gamelan music theory and electroacoustic processes may be examined in three key areas:

- The relationship between syntax and discourse
- Idiomatic reference, mapping, and modification
- Cues to indicate dominant discourse and appropriate listening strategies

5.5.1 Syntax and idiomatic discourse

Through the examples in this section I will explore the relationship between various approaches to idiomatic material and the syntax involved in composition. This is represented in two-dimensional space through the adaptation of Emmerson's *language grid* presented in **§4.4**.

	Un-idiomatic discourse	Idiomatic discourse
Abstract (imposed) syntax	- External musical systems - Non-musical information	- *Karawitan* (traditional gamelan music) or directly related genres
Abstracted (derived) syntax	- Free and "non-idiomatic" improvisation - Acousmatic music	- Coincidentally idiomatic parts - Traditional instrumental music adapted to other sound generators?

Figure 5-1: Preliminary categorization of syntax and discourse in relation to Central Javanese gamelan.

Figure 5-2 shows a selection of works involving gamelan instruments and electroacoustic processes on a grid for the purposes of comparison; the placement of works was influenced by access to programme notes and other texts, as well as first-hand discussions with the composers where possible.
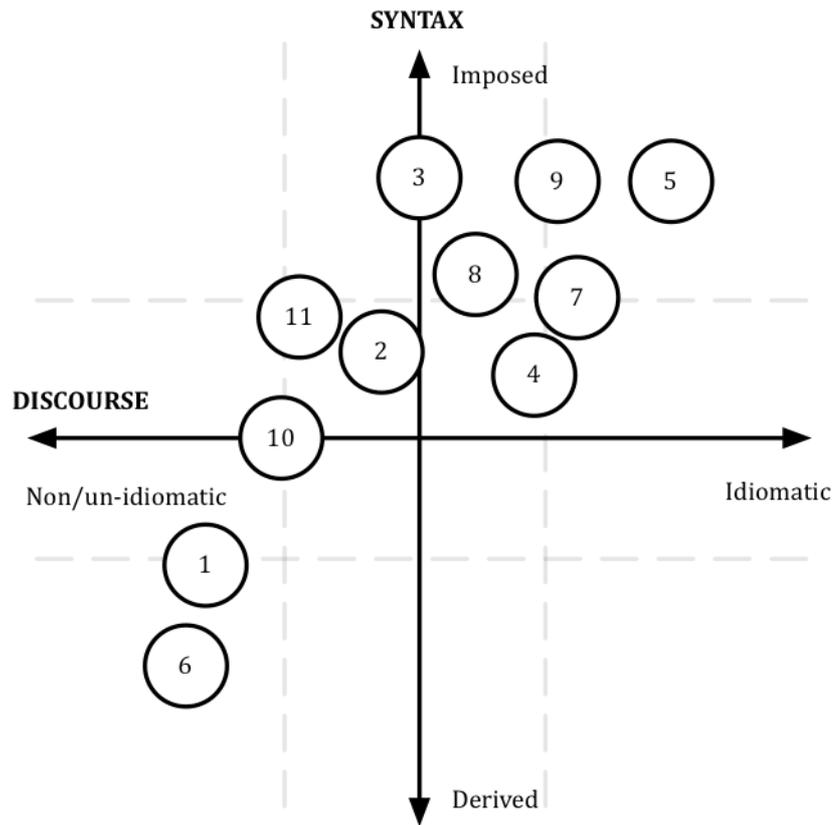
Item	Year	Composer(s)	Piece
1	1994	Lucier	*Music for gamelan instruments…*
2	1996	Ayers	*Merapi*
3	1998	Macht	*String of Pearls*
4	2006	Daryono	*Beautiful Error*
5	2008	Schütz & Rohrhuber	Output of *Virtual Gamelan Graz*
6	2008	Pasoulas	*Arborescences*
7	2009	Plaid & Supanggah	Section from *Rubber Time*
8	2011	Bitwise & Madek	*Gamelan Re-imaginings (track 1)*
9	2011	Worgan	*The Sound Catcher*
10	2012	Otondo	*Irama*
11	2012	Hughes & Jacobs	*Framework*

Figure 5-2: Placement of composition examples on the grid.

5.5.1.a Idiomatic approaches

A base level of idiomaticism can ensure that parts are viable and comfortable to play by performers, or that emulated and sampled parts maintain some air of authenticity. To work idiomatically also suggests recognition of a particular balance of abstract values and concrete characteristics. At a higher level of abstraction, composers may wish to borrow from structures or melodic patterns. Such an approach demands an understanding of the music in question, as superficial imitation of idiomatic material may be perceived as unidiomatic or pastiche (see Sorrell 2007).

Examples of electroacoustic compositions in which a rigorously idiomatic approach is dominant are uncommon, as idiomatic material is generally layered with un-idiomatic material. For example, in *Rubber Time* (a collaboration between *Plaid*, Rahayu Supanggah, and the Southbank Gamelan Players, 2009-2010), a traditional-style *gendhing* composed by Supanggah is layered over synthesizer and drum machine parts influenced by Plaid's own personal idiom and wider influence from conventions from electronic dance music[89].

While not presented as compositions, I suggest that the output of the *Virtual Gamelan Graz* framework and educational software such as the *Wells Cathedral School Gamelan* should be considered in this category, as they are based on the electronic organization of sound. An example of more creative applications of idiomatic material in algorithmic composition can be found in *The Sound Catcher* (2009)*, created by the Feral Theatre Company with music by Max Worgan. This piece uses an amalgam of Javanese and Balinese gamelan music based on Worgan's experiences studying Javanese gamelan and the samples available to him. The algorithmic system is used to respond to the movements of shadow puppets in a flexible manner (Worgan, 2009).

In these latter cases, an abstract (imposed) syntax appears to dominate. The more precise placement on the spectrum of abstraction depends on the degree to which the material has been adapted to the instruments, sound generators, or algorithmic processes. The introduction of other elements or source material for reference – as in the case of Plaid and Supanggah – complicates matters; this will be revisited in regards to combined approaches below.

5.5.1.b Un-idiomatic approaches

Un-idiomatic activity may involve the application of material or conventions from another idiom or non-musical information (abstract/imposed syntax), or exploration based on the affordances of the instrument and intrinsic sound relations (derived syntax). In its most extreme form, an un-idiomatic approach represents aspiration to the lack of idiom, as in the non-idiomatic improvisation described by Derek Bailey

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[89] Although Supanggah's part was developed in dialog with the synthesizer parts, the *gendhing* functioned independently to the extent that the gamelan players were able to keep going seamlessly when the computer crashed during a performance. A *pathetan* in relatively free rhythm provided an opportunity for the electronics to re-enter (performance at Birmingham MAC, 2010).

(1992; see **§2.2**). A deliberately un-idiomatic approach may be likened to treatment of instruments as "found objects", leading to somewhat polarized critical responses (Diamond, 1992 p. 129; Sorrell, 2007 p. 45).

Examples of electroacoustic compositions in which an un-idiomatic approach is dominant include Aki Pasoulas's *Arborescences* (2008) and Felipe Otondo's *Irama* (2012). Both compositions were developed in electroacoustic studios using recordings of gamelan ensembles housed in educational institutions in the UK (the University of York and City University respectively), with the expressed intention of exploring sound organization on various timescales. However, they exhibit markedly different approaches to idiomatic reference and syntax.

In Pasoulas's case the approach is explicitly stated as acousmatic and may be considered abstracted from the materials (which are played with extended techniques including striking, rubbing and scraping), primarily based on intrinsic sound relations: "developing particular gestures and textures based on micro-elements and groups of partials extracted from the recorded events" (Pasoulas, 2011 p. 148), in combination with his stated conceptual framework. The discourse is logically un-idiomatic, but frequently recognizable as oriented around gamelan instruments. At times seemingly arbitrary gestures such as accelerating pulses leading into deep gong tones exhibit compatibility with a base level of idiom from gamelan, hinting at the possibility of an note-oriented discourse that dissolves into the ensuing textures (Pasoulas, 2008 at 2:20-3:00).

Otondo's composition is a mixture of note-oriented and textural approaches, "[exploring] notions of pulse and microrhythmic developments using as timbral framework a set of recordings of a Javanese gamelan orchestra . . . inspired [by] various temporal and timbral relationships between subdividing parts of gamelan music and structured as an aural journey through a rich palette of timbres that contribute to the unique overall sound quality of the gamelan" (Otondo, 2013 p.2). The syntax is predominantly rhythmic, underpinned by gong tones and relying on movement between different rhythmic densities. The discourse might be described as pseudo-idiomatic; the more specific phrasal idioms of the gamelan are seldom used; instead instrumental tones evoke the texture of the ensemble, underpinned by gongs. The rhythms of the gamelan are imitated and augmented by rapid retriggering and looping of samples. While the aesthetic and structuring in *Irama* are audibly influenced by the use of the gamelan instruments, Otondo's work appears to draw on

techniques developed in previous compositions, including *Ciguri*, a piece presented on the same audio CD release featuring processed bell tones[90]. Although this does not compromise the integrity of Otondo's approach, it indicates that an abstract (imposed) syntax based on material previously derived from other similar sources (both gamelan and other bell-type instruments) may be present.

Alvin Lucier's *Music for Gamelan Instruments, Microphones, Amplifiers and Loudspeakers* (1994) provides further contrast. This composition uses traditional instruments in an acoustic feedback setup, asking performers to search for beating tones. The use of instruments in a live setting implies a base level of idiom in terms of physical interaction with the instruments; interactive and interpretive elements of gamelan are also evoked in a general sense as players are asked to listen and respond to the acoustic feedback processes. Lucier's approach uses a combination of abstract and abstracted syntax, as the process is based around the combination of the gamelan instruments and amplifying technology, while a seemingly arbitrary sequence of numbers determines the participation of players at any given moment.

5.5.1.c Electronic parts in instrumental roles

The use of electroacoustic processes to realize idiomatic material generally implies a more complex mapping and a combination of abstract (imposed) and abstracted (derived) syntax. Examples of electroacoustic compositions in which other sound sources adopt the roles of acoustic instruments (i.e. *second-order surrogacy*; see **§2.1.1**) include Lydia Ayers's *Merapi* (1996) and Robert Macht's *Suite for Synthesizer and Javanese Gamelan* (1998).

In *Merapi*, Ayers used algorithms to generate both synthesized parts and notation for live players (Ayers, 1996). Ayers synthesized the computer-generated parts in the *CSound* language, using an adaptation of algorithms created by Jean-Claude Risset intended for the synthesis of bell tones (ibid p. 9). The piece was written using the tuning of the Berkley Gamelan built by Daniel Schmidt, based on a combination of Javanese *laras* and *just intonation*. Many parts were generated using predominantly random processes over a traditional Javanese gong-structure; the

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[90] Otondo previously worked with gamelan in the piece *Clangor*, in which he took a more pitch-oriented approach based on clearly recognizable samples of the instruments and notions derived from Javanese theory (Otondo, 2008 pp. 14-18).

focus appears to move away from Javanese conventions to the development of just-intoned chords and combinations of *slendro* and *pelog* tuning (ibid pp. 12-13).

The tape portion of the *Merapi* appears as a standalone piece in a collection of Ayers's work entitled *Virtual Gamelan* (2006). In this version the chance operations involved in the piece stand out; the development of the piece is most apparent in the contrasting rhythmic density across sections and bending of the tuning of the synthesized sounds. The discourse is also influenced by a narrative based on volcanic eruptions, which may be observed in mimetic aspects of the piece (Ayers, 1996 p. 9).

Macht's *Suite for Gamelan and Synthesizer* uses a Javanese gamelan, mostly multi-tracked by a single player, and augmented with an Ensonic TS 12 synthesizer. The studio recording presented on CD appears to employ mixing techniques and reverb to add emphasis to certain parts as well as blending the synthesizer in a virtual acoustic space with the instruments. Macht adopts an experimental attitude with an awareness of the timbral implications of the synthesizer, the potential for what he terms as "the exploration of new tone colors" (Macht, 1998 p. 1). While the use of the studio and electronic instruments are integral to the recording of the work, the extent to which these processes affect the composition and discourse is unclear.

Macht's approach to the note-oriented aspects of the work appears to be largely based on pastiche, using traditional structures and frequently idiomatic *garap*. In the piece *String of Pearls*, Macht uses a *ladrang* structure, with similarities to the traditional piece *Bubaran Udan Mas*. The synthesizer part is treated instrumentally, drawing on emulation of other instruments such as harp, sitar, and dulcimer (ibid p. 2). Here timbral variation serves an expressive purpose, but appears to be secondary to pitch and rhythmic-oriented material.

In both Ayers's and Macht's works the dominant syntax is abstract – imposed from traditional material and the phrasal idioms associated with other instruments emulated by the synthesizer parts – and a combination of idiomatic and un-idiomatic.

5.5.1.d Combined approaches

Examples of approaches in mixed instrumental and electronic works include elements of *Rubber Time* (Plaid and Supanggah, 2009-2010), *Gamelan Re-imaginings* (a set of pieces using extensive gamelan samples by the Irish duo *Bitwise and Madek*, 2011), *Framework* (a multichannel installation by Jon Hughes and John Jacobs

featuring recordings of contemporary and traditional gamelan performances, 2012), and *Beautiful Error* (a piece for six *gender* and computer by Aris Daryono, 2006).

Both *Rubber Time* and *Gamelan Re-imaginings* use idiomatic material from central Javanese gamelan layered with idioms from electronic dance music. In Bitwise and Madek's case, the note-oriented material is based on their own roots in electronic dance music: "*an attempt at fusing Gamelan instruments, tonality and harmony with our own western groove, song structuring ideas and most notably, electronic elements and technology*" (Bitwise & Madek, 2011). Here, samples of *gender* and vocal parts, isolated from their original context, are accompanied by pseudo-idiomatic phrasing of original material.

Daryono's *Beautiful Error* uses fragments of traditional material played on the *gender* using a combination of conventional and extended techniques. The electronic part is left for the computer operator to determine based on a series of short instructions[91]. This affords flexibility in performance, allowing varying degrees of interpretation and interaction between the instrumental and electronic parts.

In Hughes and Jacobs's *Framework* the content of the piece chiefly consists of recordings of existing works and field recordings of a forge in Java, many of which are played simultaneously across an Ambisonic array of speakers. The piece draws on a narrative concerning the creation of the gamelan *Sekar Petak* residing in York, which also formed the basis for a *wayang* that the piece complemented in its first installation. This narrative is transferred from a temporal discourse to a one oriented around spatial movement, as Jacobs describes:

> The spatial elements in the installation . . . take the wayang out of the passage of time, so you're perceiving all sections of a story simultaneously . . . you have the whole history dangled there as an object, . . . each part of the story represented outside the normal temporal flow. So there is some extra-musical element, playing with and thinking about the structure of music as compared with the structure of a sculpture, and how that relates to the *wayang* (Jacobs quoted in House, 2013 p. 229).

The relationship between musical content in the constituent sampled pieces also plays an important function: the notion of *seleh notes* is interpreted through spatial positioning, as melodic movement towards key points in the recorded pieces converge and coincide with movement in space (Hughes, p.c. 2012).

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[91] E.g. "very rough, medium pitch, and multi layer sound" (Daryono, 2006 p. 1).

These works naturally exhibit a wide range of syntax and discourse. In both the work by Bitwise & Madek and Plaid & Supanggah, the syntax is primarily imposed (abstract) from a combination of established traditional idiom and personal idiom of the composers; however, various sections of the work may involve a greater degree of textural manipulation, which in turn may require derivation from the materials. In *Beautiful Error*, the syntax is a combination of imposed and derived, depending on the approach taken by the computer operator. The discourse is a mix of idiomatic and un-idiomatic, as fragments of traditional phrases serve a wider texture.

The syntax in *Framework* is a mixture of imposed and derived. The narrative and "abstract musical" aspects of the work (the concept of a *seleh* movement in space and the note information contained within the sampled material) provide layers of abstract syntax, whereas the interaction between the recordings demands a process of extraction and aural feedback. The discourse is a mix of idiomatic and un-idiomatic, bringing various idiomatic works together with an overarching structure based on idiomatic notions, but juxtaposed and treated in an un-idiomatic manner.

5.5.2 Idiomatic reference and modification

Analysis on this level involves describing the nature of syntax and the choice of vocabulary in relation to a specific idiom. Whereas musical discourse may be considered subjective, an idiomatic reference typically implies some deliberation on the part of the composer or performer. However, there are some exceptions; for example, where phrasal idioms or concrete samples are integrated from a recording, observed performance, or prior collaboration without awareness of their wider context. The methods presented here are biased towards situations in which the composer's intentions are discernable.

Analysis of idiomatic reference may entail examination of conceptual mapping and interpretation. This process should identify transfer of information within a domain (e.g. the playing of patterns from one pitch-oriented instrument on another) or between domains (e.g. application of pitch information from an instrumental part to the spatial positioning of a sound). Where electronic processes are involved this often leads to establishment of a set of parameter mappings.

Analysis on this level also examines the deliberate modification of an idiomatic reference: for example, the exaggeration of processes or modulation of parameters while maintaining links to traditional parts. The affordances of an instrument or

process should also be considered, including opportunities for expression such as polyphony or glissandi that can feed back into the development of a part.

The examination of re-mapping abstract information and processes also holds potential to identify any additional artifacts generated (see **§5.3.2**). Examples of such activity include associated modulation of parameters such as increasing loudness leading to modulation of timbre, or phrasal idioms orphaned from their interaction with other elements such as *kendhang* parts that would usually play the role of indicating tempo changes to the rest of the ensemble). More abstract cross-domain mappings like movement of information from pitch to spatial positioning may yield further unintended results such as psychoacoustic effects and interaction with acoustic resonance of a performance space.

I suggest that idiomatic references may be examined through the establishment of the following information, which may be placed in a table for the purposes of analysis:

- **Source** represents the idiomatic element being drawn upon. Depending on the depth of the analysis, this may be based on a single abstract parameter (e.g. pitch), or a higher level of abstraction such as the collected playing techniques for an instrument or conceptual frameworks such as *bentuk* and *pathet*.
- **Application** refers to the end result, the purpose of a conceptual mapping. This is likely to be an instrument or sound object that the idiomatic reference contributes to, but may also refer to more general processes, phrasing, or structuring.
- **Interpretation** refers to the process by which the application is achieved: the mapping of abstract parameters used in the application of the reference and the target parameters in the application.
- **Modification** describes any further changes, including practical consequences of a re-mapping or transposition, creative decisions and personal expression, and other factors such as unusual interaction between instrumental parts.

The following table draws on multiple samples from my own compositions represented in **Part II**. So far I have referred to existing works by other composers; the use of my own practice provides insight for more detailed examples.

Source	Application	Interpretation	Modification
Bonang barung: *pipilan* playing techniques (*Bonang Study).*	Synthesized *bonang barung* part (generator A)	Equivalent events on a note-by-note basis. Pitch values retained where possible.	Patterns developed based on slow envelopes and anticipation of *bonang* part. Specific patterns play textural role.
Expansion of structure and note relations through *irama* (*Tenuous Links*).	Synthesized *bonang barung* part (generator A)	Conventional *irama* relationship. Extended / anticipated tones.	Inconsistent density ratio. Extension of envelopes rather than increased note event density.
	Influence on overall structure of piece.	General ensemble parts.	Pulse moves from the pitch domain to conventional *irama*.
Gender cengkok (*Augmented Gamelan* set).	Envelope parts for stretched gender samples.	Selection of generalized envelopes based on subjective perception of strong points.	Details of patterns lost in abstraction. Movements based on affordances of sliders and visual notation. Modification in performance through scrubbing and parameter smoothing.

Figure 5-3: Idiomatic reference table with examples taken from case studies.

As with the grid-based analysis of syntax and discourse, this example exists in relation to a specific idiomatic framework; mapping is described from one direction (gamelan music) to a particular medium. If modification takes place within the original domain then the "interpretation" field may be left blank.

This form of analysis leads towards the more tangible elements of a composition. Attempted application to more complex conceptual mappings may yield limited results; in these cases a detailed verbal exposition may be more appropriate. The table presented above provides an overview for examining references and a means to highlight areas for further discussion. Once established, the details of idiomatic references and mapping may be examined accordingly. Direct mapping of abstract information might be represented in chart form; for example the mapping from one established tuning system to another or to specific frequencies (see Ayers 1996 p. 10; **Appendix 3**), or mapping of note values to sound files in a sampler. In

some cases code or images taken directly from software provide sufficient information for representation and analysis (see **Appendix 2**).

5.5.3 Establishing discourse

This final area is concerned with how a composer establishes discourse with the audience and guides them towards appropriate listening strategies. Establishment of discourse may take place on the basis of an entire piece, section or layer. In cases where multiple types of discourse exist simultaneously, the composer may attempt to establish one as dominant.

Cues to the audience may be given through a combination of aural and visual information. They are not always deliberate, and a composer may rely on established conventions to create an expectation in the listener that the work should be heard in a particular manner. These same assumptions can cause problems in a contemporary performance context, or when operating across cultural boundaries. Furthermore, the act of separating music from a performance context in recording, allowing the audience to choose their own way of listening, causes additional complications in perception of intended cues (some of which may be impossible to transmit through the limitations of audio-only recording), and should be taken into account when analyzing a work.

The act of recording and amplifying works sometimes play a role in guiding an audience member's listening experience. The separation of a sound from its source in itself forms the foundation of acousmatic music. The dominance of certain electroacoustic sound production techniques can provide a cue to the listener that textural discourse will dominate, or may form a backdrop to more instrument-oriented discourse. In some cases the inclusion of a textural introduction may provide a means of opening the listener's mind to the sonorities of a piece even though a note-oriented discourse dominates.

Beyond deliberately acousmatic works, the separation from a performance situation – both in terms of lack of visual input and the presentation of an artificial acoustic space through microphone placement and reverb – can sometimes have subliminal effects. Although this might not necessarily count towards establishment of discourse in relation to electroacoustic sounds, it may guide a listener in other respects: for example, in listening for expressivity and interaction between musicians.

Idiomatic cues based on note events may be the easiest to understand for an experienced listener, and consequently the hardest to ignore if not intended by the composer. Further examination of "abstract musical" content (e.g. note information) helps determine the degree of idiomatic reference. The use of the traditional repertoire of *cengkok* for *gender* might imply to a listener that traditional vocal-oriented repertoire is to be used. A passage identifiable as a *buka*, the traditional opening to a *gendhing*, typically contains a set of practical information, indicating form, *laras* and *pathet*. Conversely, a textural introduction may set the tone for non-idiomatic discourse. For example, *Rubber Time* (Plaid & Supanggah, 2010) opens with an effective passage in which a sparse gong part is accompanied by rich abstract textures and similar sampled electronic parts that bend in pitch, creating a bond between the instrumental and electronic worlds and establishing a combined pitch and texturally-oriented discourse.

In determining whether a piece is to be approached idiomatically, a listener might listen for some of the following qualities:

- Use of traditional or externally sourced instruments
- Use of "non-musical" or "real-world" sounds.
- Choice and blending of tuning systems.
- Vocal parts, including lyrical content and reference to traditional forms.
- Use of established idiomatic conventions and patterning, e.g. a *buka*, traditional *cengkok,* or *kendhang* patterns.
- Instruments taking structural roles, e.g. gongs, *kenong*, *kethuk*, and *kendhang*, and forms indicated in their syntax.
- Layering and juxtaposition of instrumental timbres with textures or environmental sounds.
- Prominent manipulation of spectral content or movement of sounds in space.

The mere presence of these elements does not guarantee establishment of discourse. For example, a textural introduction, background sound, or other material acting as "sound effects" may precede a predominantly idiomatic traditional-style piece. Once potential cues have been identified, discourse must be confirmed through extended listening and identification of persistent domain-specific or cross-domain activity.

5.5.4 Further analysis

The methods described above may be treated as steps towards identifying other appropriate forms of analysis. These may be based on note information or areas specific to electroacoustic composition. For example, if an idiomatic discourse with reference to central Javanese *pathet* and traditional structures has been established, it may be beneficial to examine a piece in terms of relation of parts to a *balungan* or the *padhang/ulihan* qualities of phrasing (Martopangrawit 1972; Hastanto 1985; 2009). In my work presented in **Part II** the strokes of a large gong and their synthesized counterparts provide data for structural analysis, indicating corresponding movement, expansion, and contraction in non-idiomatic parts (see **Appendix 3.4.1**). Further analysis methods may be found in discussions of contemporary Solonese composition, which is often based on combination of idiomatic and non-idiomatic material, with emphasis on organization of timbre (see Roth, 1986; Warde, 2002).

If different systems for organization of pitched material are identified (i.e., tonal or modal frameworks associated with a specific tuning system) then other methods may be more appropriate. If algorithms play a role in composition then code and other digitally stored data may be consulted directly (e.g. Collins, 2008).

If a composer has attempted to create syntax for organization of pitch or other parameters based on intrinsic sound relations (i.e. abstracted/derived syntax, non-idiomatic discourse), then established methods of analysis may yield limited results. Where discourse is based on other parameters, such as movement in timbre or acoustic space, it may be possible to apply analysis methods based on typo-morphology (Schaeffer, 1977; Chion, 2009) or spectromorphology (Smalley, 1986; 1997). It may also be beneficial to consider narrative elements based on non-musical information, or statements made through the presentation of a particular musical set-up (for example, the cultural significance of the presence of a gamelan on stage), especially in cases where no conventional musical discourse is discernable.

5.6 Applications for analysis in composition

The analytical methods explored in this chapter can be employed in the composition to develop awareness of relevant conceptual issues and act accordingly. It may be

beneficial to consider analysis and decisions on a conceptual level as a step in an on-going feedback process, as illustrated in **Figure 5-4**[92].
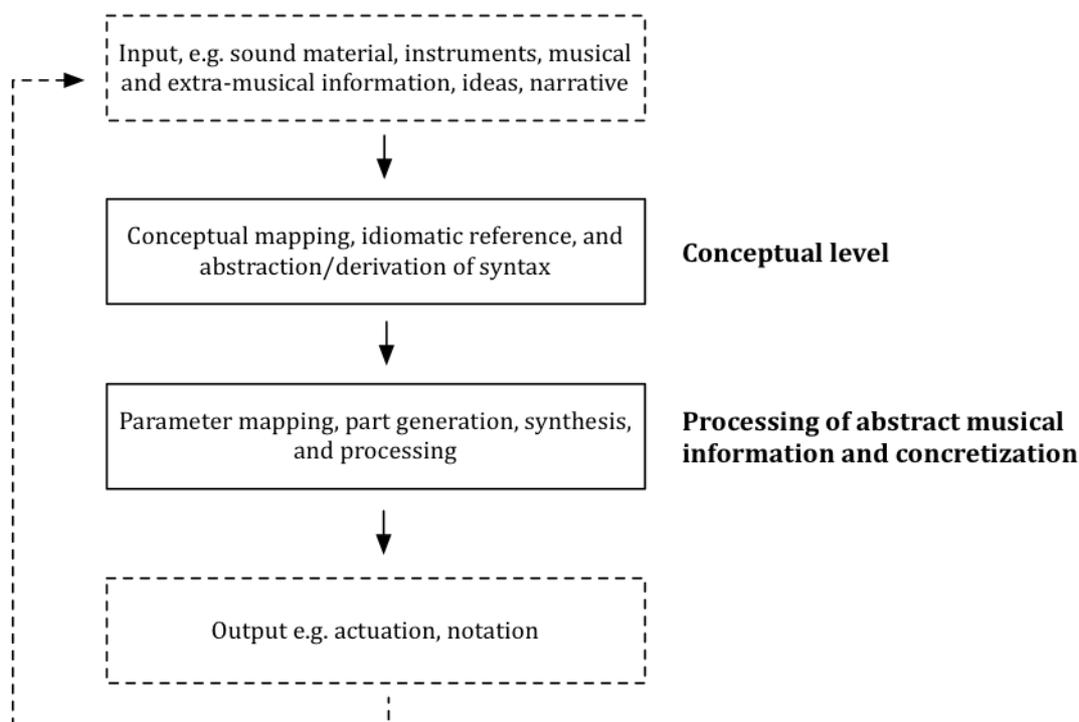
Figure 5-4: Outline of the compositional process, incorporating mapping and idiomatic reference.

Engaging with the analysis of types of syntax and discourse at the point of composition may lead a composer to examine any obligations to operate idiomatically or avoid idiom altogether. The placement of these aspirations at the extreme ends of continua (as in the grids presented here) may illuminate the necessary compromises along the way and lead to a more informed and practical approach. Once an awareness of discourse has been established it may be engaged with consciously as a compositional device, as described in **§4.3.2**.

An array of possibilities is opened up to a composer once awareness of the processes involved in mapping and interpretation have been established. Beyond the transfer of abstract information to different media, awareness of idiomatic reference can be used to influence the selection or development of appropriate digital tools, including interfaces, notation and sequences. Greater compatibility in parts can be established through consideration of the constraints and affordances of a target mapping; this may be established by modification of the source material or the target. This can also lead to the creation of more intuitive parts to be played or interacted

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[92] This model is expanded further in assessment of my own practice; see **Appendix 1**.

with by performers. Creative mapping across domains can form a dynamic part of composition, leading to bonding of otherwise unrelated elements.

Establishing a type of discourse can lead the listener to or from specific ways of interpreting information. An awareness of providing cues can be important not only to actively establish discourse with a listener, but also in order to avoid a conflict in audience expectations. Sometimes this may be a case of avoiding parts that provide clear cues to an experienced listener, such as a traditional *buka* or gong structure, or the inclusion of *pathet* and *bentuk* in the title of a piece (see Sorrell, 2007 p. 42). Cues may also be established across domains; for example, application of an extended technique in a familiar instrumental part, bringing with it an unusual timbre, may point to related movement in electroacoustic parts.

The presentation of a non-idiomatic piece in an idiomatic context can raise a listener's expectations and subsequently to a poor critical reception. Providing clear indications that one particular type of discourse is dominant may relieve the listener of the desire to search for other musical information, such as pitch-oriented material in a primarily textural piece. However, the establishment of discourse may also be used to play contrary to a listener's expectations; a composer may wish to set up an apparently note-oriented discourse before introducing substantial textural movement, leading to what might be experienced as uncanny, subliminal effects.

Finally, the conscious exploration of otherwise subtle cues holds potential for performance and improvisation situations to establish dialog between performers, particularly where attempted response or exchange of information between domains may not be obvious. For example, electroacoustic performers may wish to communicate to other – perhaps instrumentally oriented – players that they are shifting focus from idiomatic "abstract musical" discourse towards concrete manipulation of sounds, perhaps dominated by textural or spatial movement. While practical cueing may be established through verbal communication, a heightened awareness of the relationships between parts can lead to a stronger interplay, allowing players to make contributions that can be taken up and reacted to in other domains in a fluid and intuitive manner.

5.7 Composition in the current research

The analysis methods presented here have been central to the development of a series of original compositions and arrangements of traditional material through the

current research. In particular these works have been developed as an attempt to integrate processes from gamelan and electroacoustic music as closely as possible, extending to the physical presence of the constituent elements in performance. In most cases the gamelan instruments share not only the physical space and acoustics with computer-generated processes, but are connected directly through speakers attached to their bodies, stimulating resonances and playing on the borders of traditional instrumental gestures (see **Appendix 1.4**).

Theoretical integration in these works was achieved through direct reference to structures and playing techniques, while drawing upon the affordances of electroacoustic processes: in particular, the ability to impose syntax or derive it from the instruments, treating them concrete sounds. The idiomatic references involved range from direct parameter mappings (for example, the transference from an abstract *slenthem* part to trigger un-pitched synthesizer parts; see **Appendix 3.1.2.e**) to conceptual mappings involving substitution of other material (such as imitation of *garap* processes through granular crossfades based on convergence and divergence from a central melody; see **Appendix 3.3.2.e**). A custom software framework provided the foundation for idiomatic activity, using adapted *balungan* as mediating parameters to determine the generation and playback of electronic *cengkok* based on the enveloping of synthesized, sampled, and granulated material[93]. Alongside the transducers used in performance, this provided a set of constraints and affordances within which to work, which led to the development of a personal idiomatic framework with reference to both mechanical and phrasal considerations.

These pieces were also characterized by the development of awareness of moving between different types of discourse. Using Central Javanese gamelan as a reference point, contrasting idiomatic and un-idiomatic sections were employed to create movement between coherence and incoherence, which I suggest may be likened to broad notions of consonance and dissonance, tension and release, or the Javanese notion of *padhang* and *ulihan*. Through first-hand engagement as a composer combined with details illuminated through the analysis methods exposed in this chapter, it is possible to show a generalized representation of the areas of syntax and discourse covered (**Figure 5-5**). More detailed discussion and analysis including placement of individual elements on the grid may be found in **Appendix 3**.

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[93] The *balungan* was rarely played as a stand-alone melody, and was used as the starting point for composition in only one piece (*Bonang Study*; see **Appendix 3.1**).
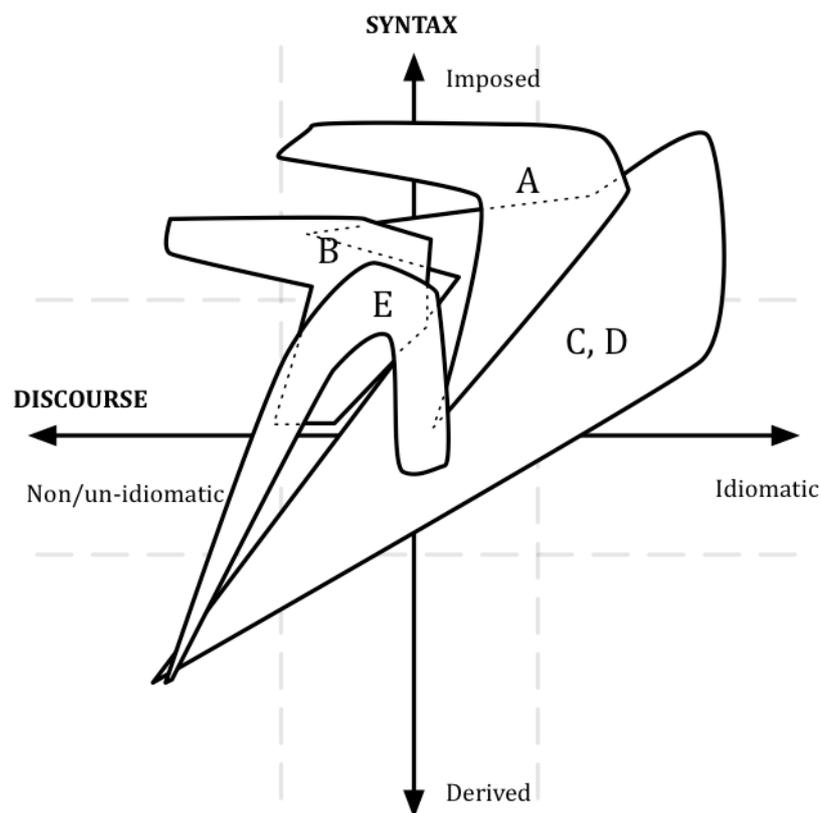
Item	Year	Piece	Reference
A	2011	*Bonang Study*	**AV1.1**
B	2011	*Tenuous Links*	**AV1.2**
C	2012	*Monggangan*	**AV1.3**
D	2012	*Augmented Gamelan* set	**AV1.4**
E	2012	*Response to ShoutCry Room*	**AV1.5**

Figure 5-5: Overview of analysis of works created through the current research.

As with the majority of existing works presented in this chapter, there is little activity in the lower-right-hand corner of the grid. This situation is partly due to the nature of idiom as an abstract framework; as a composer, once becoming aware of activity as idiomatic or idiomatically compatible, I typically found myself responding with reference to musical conventions, and drawing on established syntax. In other cases the manipulation of idiomatic material as concrete sounds has crossed over into the manipulation of discourse on a conceptual level. For example, in *Response to ShoutCry Room*, a synthesized bass tone moves between an indistinct rumble and a recognizable gong tone, shifting roles in the process, and drawing the listener in and out of idiomatic discourse (**AV1.5**). Elsewhere, incidental pitched material generated through textural experimentation becomes integrated into the framework of a traditional structure (see **Appendix 3.5.2.a**).

Throughout this compositional activity I have aspired to adopt an actively "bi-musical" approach, exploring the benefits of my experience as an electroacoustic composer and a student of *karawitan*, and deliberately restricting influence from elsewhere. At times this proved problematic, as I felt restricted by my knowledge of how parts might work traditionally, and more often by the awareness of my lack of practical knowledge. Where possible I attempted to treat my work as a way of exploring the traditional parts, building counterparts in the electroacoustic domain rather than attempting to elaborate on note-based material. This activity allowed me to respond to my initial impressions of gamelan as a group of swelling resonances anticipating and responding to the vocal parts. I attempted to bridge the instrumental and electroacoustic worlds by sharing the same reference point (typically a *balungan*), forming bonds between parts before space was created for the electroacoustic elements using simplified melodies and conventions from *karawitan* (for example, *sirep* and changes in *irama*; see Appendix **1.3.2**, **3.4.4.c**).

During development I worked with aural feedback as well as developing parts based on abstract music theory, and attempted to learn any instrumental parts to ensure that I was fully aware of the implications of activity in both areas. In particular the establishment of a set of electronic *cengkok* and techniques for vocal accompaniment became a focal point for learning to play intuitively across both domains. The benefits of this attitude surfaced in unexpected ways towards the end of the research period. In allowing for work to be incorporated outside strict idiomatic reference it became possible to identify resonances of various apparently unrelated approaches and a shift to working on a conceptual level. With this came an awareness of the importance not only of integration, but of the juxtaposition and manipulation of discourse types as a strength of electroacoustic music.

5.8 Conclusion

In some cases the presence of electroacoustic technology in gamelan-oriented composition has little impact on the conceptualization of the music in itself. Nonetheless the technology can make a powerful contribution to the texture, bringing new opportunities for timbre, tuning and spatial movement. Similarly, the instruments, phrasing and structure of gamelan music may be treated as raw substances in electroacoustic composition. Gamelan provides a wealth of abstract

material in the form of playing conventions, phrasing and structures, or sound material to be sampled and manipulated on a concrete basis.

More involved activity takes place in the cross-domain interpretation and mapping of material, which may take place through transposition and parameter assignment, or on a more complex conceptual level. In both cases some form of modification is typically necessary based on the constraints and affordances of available physical and conceptual resources. In many cases it may be more appropriate to substitute material or processes that prove more idiomatic in the target domain. These processes may be compared to the notions of instrumental idiom and *garap* in gamelan, leading to stronger integration across disciplines.

Composers approaching gamelan – amongst other idioms – may find benefits in the study of traditional music. The term "bi-musicality" is frequently used to describe this approach, but can be problematic for two main reasons: it brings with it an implication of "bi-culturality" that it is not always possible or desirable to reach, and in some cases an unnatural separation between various influences in a composer's personal idiom. However, the attitude behind bi-musicality can also bring a heightened sensitivity of operation between domains, discourses, and associated values and characteristics, sometimes helping uncover deeper conceptual overlaps. In some cases it can cause a composer to explore aspects of their own discipline in order to find compatibility or contrast with others.

Conscious engagement with the relationship between idioms and the electroacoustic medium can help composers find awareness of the idiomatic consequences of activity in relation to gamelan, while maintaining focus on the concrete manipulation of sound or the imposition of abstract processes. The two axes of the grid presented for analysis have been chosen to highlight this duality. Through these methods it is possible to uncover new angles on compositions in which electroacoustic processes ostensibly play an arbitrary role, or in which gamelan instruments are treated as "found objects".

I suggest that in various combinations the approaches explored here can highlight ways of working across domains, and in particular the manipulation of perceived discourse, bringing new possibilities. However, unless a theoretical focus is intended, the ultimate goal of such pursuits may be the re-integration into a more concrete and fluid method of working.

6 Conclusions

Through this thesis my intention has been to uncover some of the results producible through the combination of gamelan and electroacoustic music. In order to do so, it has been necessary to identify some prominent features of the two areas. Although my stated focus has been on music theory, this has necessarily involved incorporating discussions of physical resources such as instruments alongside less clearly defined issues of creativity and expression. Due to essential differences in approach, technology, and cultural contexts, the discussion has been performed from the vantage point of a conceptual level in which all sound and the process of its organization may be considered music (**§2.1**).

Many differences between approaches to composition for electroacoustic and gamelan music may be noted through the level upon which abstraction of phrasing, syntax and other structures takes place. Composers and performers of electroacoustic music often take advantage of the ability to work directly with sound materials, whereas gamelan music depends on an existing hierarchy of abstraction. In particular the traditional form of gamelan music called *karawitan* relies on conventions of pitch intervals (*laras*) and their organisation (*pathet*), rhythm (*irama*) and particular groups of phrases (*cengkok* or referring patterns), in relation to complex notions of structuring (formalized *bentuk* and the consideration of *padhang/ulihan*). As with abstract elements of any music, these are concretized in the course of performance, in interaction with other musicians and various musical factors: a process called *garap*.

Even in cases of new composition where more complex abstract idioms are not actively engaged, it is sometimes difficult to escape the functional associations of the instruments. The specific idioms associated with instruments often come about through their physical constraints, and through the affordances created in the context of their original development. The associated roles of gamelan instruments in relation to their physical construction provide a useful demonstration of this concept in more general practice, helping aid understanding of interaction with instruments and development of constraints for electroacoustic performance.

Electroacoustic musicians and composers often aspire to work non-idiomatically or self-idiomatically (the former frequently leading to the latter). The direct approach to sound that technology affords has the potential to transcend

established idiom, unlocking potential to realise sounds from the composer's imagination, as well as intensive experimentation with immediate feedback. The acousmatic experiments of composers and theorists such as Schaeffer might be regarded as attempts to establish idiom and syntactic conventions beyond traditional instrumental models, and often outside the realms of pitch and rhythm as dominant values. However, many composers display no such aspirations, preferring to take a more experimental approach, or focussing on a concrete experience or conceptual statements.

Within this thesis the possibilities afforded by electroacoustic media have been examined through adaptation of Simon Emmerson's *language grid* (1986), with the extent to which activity can be considered idiomatic in relation to *karawitan* forming an additional axis to complement Emmerson's original dichotomy of aural and mimetic discourse (**§4.4**). This broad method of analysis leads to more specific exploration of idiomatic reference between the two disciplines. Having identified electroacoustic music as a medium potentially separate from traditional instrumental models and therefore instrumental idiom, attempts to identify crossover or substitution with gamelan (e.g. through a melodic or rhythmic material) may be met with limited success. In some cases where collaborations take place between electroacoustic composers and gamelan ensembles, melodic and rhythmic influence may be traced back to other established idioms. Such influence may come from a variety of contributing factors: for example, the cultural context of the work, sampled instrumental timbres and phrases, the affordances of virtual instruments and other software frameworks, or from personal musical experiences.

The influence of the constraints and affordances of technology plays a vital role, whether offering a greater range for a parameter within its own domain, a set of constraints that may be worked with creatively, or interesting artifacts associated with information from one domain that persist in the other. Each of these areas can provide stimuli for creative engagement. The most interesting results often come from conceptual mappings across domains. Composers may find it useful to draw on the notion of *garap* to create parts appropriate to the medium, with appropriate substitution taking place in either domain where necessary. This process has been explored in in the arrangements and original compositions presented in the portfolio, which offer a series of practical case studies.

The restricted scope of this thesis naturally leaves some important areas uncovered. For example, the exploration of new physical interfaces – both in relation to instrumental contexts and otherwise – may offer further insight into the exploration of physical constraints and idiomatic identity. The application of theory derived from gamelan music to algorithmic systems is also a vast area for exploration, as highlighted in existing research (Grupe et al. 2008). It is my hope that the ideas presented here might shed some light onto the potential mappings and applications of these processes.

Owing to the focus on a conceptual level, many of the discussions presented within this thesis may be applied to other areas. In particular the analytical methods developed from Emmerson's ideas have the potential to describe many combinations of electroacoustic music with idioms besides gamelan, including popular and classical music. Alternatively, these methods might also be used to describe new music for gamelan instruments based on unconventional experimentation while maintaining some degree of idiomatic reference. Such activity is commonly found without electronics in contemporary Indonesian *komposisi* (**§3.4**). With some modification it is also possible that these methods may also be applied to cross-idiomatic activity in a broader sense, examining areas of mutual intelligibility. My adaptation of the grid is prone to similar problems to Emmerson's in that material is broadly classified as idiomatic or un-idiomatic; further development should entail the development of new axes and methods for their combination.

Through this thesis I have attempted to find context for new composition involving gamelan and electroacoustic media. As Blacking states, musical style is difficult to separate from society, culture, and individual expression: it cannot exist on "its own terms" (Blacking, 1973 p. 25). The relationship is more obvious in some cases than in others; a clear example lies in the use of gamelan outside its native Indonesia. The strong cultural ties of the instruments, songs, and patterns are difficult to ignore, even in contemporary composition. Composers using these instruments may find themselves treading carefully around appropriation of traditional material, which ultimately may not make sense or be subject to misinterpretation in a new setting. A more honest approach may be to attempt to incorporate elements of personal or local culture, musical or otherwise – as Sorrell suggests, to acknowledge the strengths of a home culture in bi-musical aspirations

(2007; see **§5.1.1**) – or attempting to disregard the idiomatic associations of the instruments altogether.

A more tangible example may be found the creation of new physical resources, as in the sets of American gamelan developed in the 20th Century (**§3.4.1**; **§5.1.1**). While these new instruments do not bypass the problems of cultural appropriation or emulation, they provide acknowledgement alongside grounds for exploration of local developments such as tuning systems. Composers working with instruments such as these may be free to approach their sonorities and physical affordances without concern for idiomatic or cultural obligations. In other cases this may involve incorporating material or processes from an ostensibly similar musical tradition, such as local folk traditions, orchestral tonal or post-tonal music (see Sorrell, 2007). The application of processes from other disciplines and domains may emerge as more appropriate, as I have attempted to illustrate through the development of conceptual and software frameworks in my own practice (see **Appendix 3**).

Throughout this thesis, as well as in my more general practice, I have attempted to engage with electroacoustic music as culturally unbiased. To some extent this may be considered impossible: the most abstract processes still rely on derivation from concrete situations that have been developed in a specific cultural context. Furthermore, the roots of the theory to which I refer have grown directly from a response to particular narratives – in particular what might be referred to as "Western art music". The foundations of Schaeffer's *musique concrète* and *elektronische Musik* are important both in terms of the cultural situations to which they were reacting and the emerging technology of the time. Electroacoustic music composers often aspire to move beyond cultural associations – and in some cases the physical world – to find processes that exist on a neutral level. In this respect, Schaeffer's call for reduced listening (1977) may be likened to Hood's suggestion that musicians and ethnomusicologists overcome their musical prejudices to uncover the values of other idioms (1960). Developed in different contexts, both attitudes may lead to appreciation of existing material, or to the uncovering of new methods for composition.

Tradition does not exist in a vacuum; it often evolves as a society develops around it. Shifts might take place through interactions with other cultures, or with the introduction of new technology: a partnership that predates electronic media in the form of imported instruments and conceptual resources such as notation. In

more recent years a new form of digital culture has emerged, as people in various locations are connected not only through the Internet, but also through the subtle influence of shared technology and software. While in some cases technology may be considered neutral, it often comes conjoined with design applications from other cultures. In turn this provides set of affordances that may produce different default ways of working, perhaps leading to emulation of other idioms or creating unexpected results through apparent misuse in relation to their intended function.

Even in cases where composers and performers are not consciously engaging with electroacoustic processes or instruments, as technology becomes more widespread there is an increased need to take them into consideration. The presence of synthesisers and programmed drum parts can form variations of musical idiom, as can be seen in the shifting tuning and rhythmic stability of *campur sari* (see Supanggah, 2003). The mix, effects and editing of a recording or amplified performance (sometimes collectively referred to as "the production") form a subtle, even subliminal layer to discourse that can alter an audience's perception of music. Even the act of recording in itself separates the listener from a concrete experience – including the performance, social contexts and acoustic space that play significant roles in the development of any music – and is prone to fixing parts that represent the personality of the music and the players. The "production" of a recorded or amplified performance can draw a listener's attention to certain elements (as in the prominence of the *pesindhen*), or smooth out what might be considered imperfections to one person but hold essential musical value and personality to another.

With an increased substitution of electronic instruments and emphasis on editing and integration of effects into popular music, these processes do not always play a passive role. With increased availability of digital technology and the flexibility afforded by new models for software and interfaces, one way to take control of this situation is through direct engagement, experimentation and composition. It is my hope that this thesis will illuminate means for the closer integration of technology in a manner that encourages new directions, while taking care to respect the integrity of a deep and rich musical culture.

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