'Starting with Nothing' and 'Ending up with Something'

Musical Improvisation and Parametric Spatial Design Improvisation

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Musical improvisation is a complex field of the study of creativity wherein the musician - according to jazz pianist Herbie Hancock - improvises by 'starting with nothing' and 'ending up with something'. We explore a 'Musico-Spatial Design' creative practice design research project that uses parametric spatial design tools to research musical improvisation, then takes knowledge gained from this process to illuminate aspects of improvisation within parametric spatial design processes. Our investigation of musical and parametric spatial design improvisation provides insights into how both novices and experts engage in improvisation and how they don't really 'start with nothing' but bring into the design conversation a varying range of referents to inform designerly intent.

Keywords: Parametric Spatial Design, Musical Improvisation, Scripting , Creative process

INTRODUCTION

At the opening concert for the 2015 Melbourne International Jazz Festival, jazz pianist Herbie Hancock introduced his improvised performance with Chick Corea by telling the audience how they would 'start with nothing and hopefully end up with something'. Hancock and Corea are renowned improvisers with a capacity to generate incredibly complex and beautiful music in the moment, with years of performance and practice informing their capacity to make designerly decisions on timing, timbre, attack and duration with split second accuracy and without the need for notation. As researchers operating at the intersection of music and spatial design, this statement serves as the starting point for a conversation on the practice of improvisation within both domains.

In our research we examine a digital drumming generative improvisation exercise and explore how musicians bring into improvisations a complex repertoire of patterns and phrases that have been learnt, copied and adapted over a period of playing experience. We expand the examination of musical im-
provisation to initiate a discussion on the concept of parametric spatial improvisation. This 'Musico-Spatial Design' positioning provides a lens through which to enable further understandings of architectural and spatial creative design processes. The intention of this paper is to generate a conversation on how musicians and spatial designers create through improvisation and to serve as the basis for further research. We question whether musicians and spatial designers 'start with nothing' with the aim of 'ending up with something'.

Parallels between music and architecture (we use the term spatial design to enable a wider discussion) have been widely examined throughout history, and can be conceptualised on three levels: through process- the means of inventing and realising, product- the outcome of these processes and experience- the human interaction with the outcome. Goodman (1974) provides an account of the comparisons between music composition and architecture as 'allographic arts' that require notation in the form of plan or score in order to be realised. We address this by examining improvisation without notation (music) and improvisation through notation (parametric design).

Elizabeth Martin (1994) in 'Architecture as a Translation of Music' describes the 'y-condition' as 'the middle position of music and architecture when translating one to another finding an organic union between the two'. Musico-Spatial Design connections have manifested in many ways over the years: most famously with the collaboration between Iannis Xenakis, Le Corbusier and Edgar Varese for the 1958 Brussels World Fair. This built creative collaboration integrated electroacoustic music and architectural space in the form of a 'poème electronique' (Xenakis and Kanach 2008). Martin's 'y-condition is expressed by Steven Holl (1994) in the Stretto House-a built interpretation of Bela Bartok’s Music for Strings, Percussion and Celeste. These built works provide two contrasting ways in which music and architecture can be combined in built form.

The advent of design computing has enabled computational approaches to facilitate the production of 'architecture' from music through Music Instrument Digital Interface (MIDI). This includes the work of Ferschin et al. (2001), Levy (2003), Fowler (2011), Krawczyk (2012) and Tomara et al. (2011). Extended innovative creative investigations by Novak (2007) explores the translation of 'frozen music into liquid architecture', that emancipates architecture from matter and music from sound. The work of Swiss architect Jan Henrik Hansen (2015) furthers these explorations in a practice context across a wide range of 'musical sculptures' through to building facades over a number of years, providing a comprehensive body of translations from one medium to the other across scales and media.
The authors' own investigations between the disciplines of music and architecture include the development of a model of virtual architecture generated from the music of J. S. Bach (Christensen and Schnabel 2008) and the development of an integrated design-build design studio over several years involving design students composing music, designing a 'Music Room', building these at real scale and retaining work on an on-line Virtual Gallery (Ham 2003, 2005).

The first authors' own house is an outcome of a design process that references musical elements such as polyrhythmic material pattern overlays and metaphorical expressions of instrumentation and golden section geometries whilst operating within the pragmatic constraints of planning and building regulations (Figure 1). Given the significant work undertaken in architectural and spatial manifestations of music, there exists a gap in knowledge in the area of developing understandings of similarities in the creative processes of both domains. This area of 'process' forms the basis of this paper.

MUSICAL IMPROVISATION AND DESIGN PROCESS

Our Musico-Spatial Design theoretical positioning uses parametric spatial design tools to examine musical improvisation and then takes knowledge gained from this process to illuminate aspects of parametric spatial design processes. Focussing on the initial stages of creativity we are interested in how both musicians and spatial designers 'start with nothing' and 'end up with something'. The 'nothing' is the drummer sitting on the drum stool, sticks in hand: the parametric designer on computer with empty screen (perhaps with pencil in hand). The 'something' is an improvised drum solo, or the first iteration and outcome of a parametric script respectively.

Both musicians and spatial designers improvise as part of their creative practice. Improvisation is generally regarded as a process of 'in the moment' extemporisation of musical creativity which is evident in a range of cultures and musical styles including Jazz, Flamenco, Indian Tabla music, Hip Hop, Rock and Blues (Bailey 1993). Composition differs from improvisation in that the outcome is pre-conceived (usually through the language of notation) prior to the performance; however given the many modalities of musical performance (including digital modalities including live coding), the lines between composition and improvisation are often blurred.

Composition and improvisation form a living system whereby chaos and order coexist, with chaos evolving from order through disruptive improvisations, resulting in a reordering of the complex system of musical dialogue. This does not neatly fit into the 'levels of improvisation' as proposed by Benson (2003) but operates within the complex system of Cobussen's Field of Musical Improvisation (Cobussen 2010) founded indeterminism, imperfection and unpredictability Kleidonas (2012).

Brown (2006) connects music and architecture through the study of jazz and improvised music to contribute 'insight regarding the human creative potential that can be enabled in the interplay of dynamic systems: filled with risk, diverse durations, fleeting boundaries and varying qualities of media'. He describes improvisation as, 'borrowing from the language of the biological and the computational, best understood as an emergence- one of human thought and action: that is facilitated by a range of variables, properties and structures'. The degree, and success of compositional and improvisational output is a function of the ability of the creative practitioner to engage in the creative parameters within which they work as defined by the opportunities and constraints of the interface between idea and artefact. Improvisation requires the instantaneous musical response to an internal or external stimulus within the range of musical choices of frequency, time and dynamics Malinowski (2011) as determined by the instrument.
GENERATING COMPLEXITY THROUGH SOLO DRUMMING IMPROVISATION

We base this research on the creative practice of digital drumming within a merged Musico-Spatial Design creative practice PhD by project work at the Spatial Information Architecture Laboratory (SIAL) at RMIT University. Project work involved the performance by the first author (an experienced musician and architect) of a series of 80 drum solos on a Roland TD20 digital drum kit templated to 100 beats per minute for 100 beats (Figure 2). Other improvisations were performed across the contexts of Beat and Fill (playing drum beats) and playing improvisations over a set guitar track. This generative exercise was designed to test the scope, structure, shape, form and details of improvisational capacity, using MIDI format to enable computational analysis. Drumming is perhaps an under-recognised creative art form that is gaining traction in research through, for example, renowned King Crimson and Yes drummer Bill Bruford's PhD on the creative aspects of the western drum kit player (Bruford 2015). Drummers, like architects and spatial designers, each evolve unique approaches to design solutions. The creative approach of drummers like Buddy Rich, Jo Jones, Bill Bruford, Shiela Escovedo, Terry Bozzio and Thomas Prigden to improvisation over a set template will be significantly different. The creative approach of architects such as Mies van der Rohe, Frank Gehry and Zaha Hadid to a set task will also be markedly different. These differences are founded on philosophical and stylistic differences evolved through creative practice over time.

Drum improvisation in a very physical practice that requires percussive striking with hands (sticks) and feet on the interface of the drum kit. The foundation of drumming is the physical production of often complex overlays of polyrhythms over a temporal structure. Using hands and feet, the drummer physically percusses on a resonant surface to produce a sound. Virtuoso drummers such as Terry Bozzio have an advanced capacity to produce 4-way complex polyrhythmic overlays from all limbs - essentially playing four things at once. Although this may operate well as a mathematical exercise, the key to the master drummer is building skill levels to serve a musical intention or purpose. Referring to the opening statement, the expert drummer, in performing improvised drum solos does not really 'start with nothing' but brings into each improvisation a combination of referent patterns and phrases (The 'go-to' riffs invented, learnt, borrowed and adapted that constitute style) which are informed by a range of factors.

Figure 2
Model of Drum solo in Plan, Elevation and Isometric.
environmental conditions, thoughts, feelings and intentions that tacitly inform the drummer’s response. Improvisation is thus founded on Schön (1983) concept of ‘tacit knowing in action’ through the recall and implementation ‘in the moment’ of a repertoire of ‘referent’ (Pressing 1987) patterns and phrases that have evolved through played experience.

In an effort to define this repertoire of ‘referent’ drum patterns and phrases, the collection of drum solo outputs were curated, with a representative set of 100 context-specific referent patterns and phrases extracted in MIDI, then analysed in relation to length, style, beat type, quality of play, complexity and a ‘referent rating’. Using Rhinoceros3D Version 5 with Grasshopper (GH) the ‘ImprovScope’ script was built that enables spatialization of referent drum patterns and phrases in plan, section, elevation and 3D (Figure 3). MIDI data was translated into .csv format, recording tempo, ‘drum note’, ‘velocity’, ‘note on’ and ‘note off’ over time to 1/1000ths of a beat accuracy. These data were read into GH, separated and sorted using standard GH components to result in the generation of a series of points in space for each drum note with velocity and note length data attached.

The principal of this translation is the use of spatial design software to unlock the complexities of the process drum based improvisation and not to reproduce concepts of ‘frozen music’. We propose that by translating these improvisations into the spatial domain, a theoretical ‘musico-perspectival hinge’ is unlocked (referring to Pelletier and Pérez-Gómez (1997) perspectival hinge) thus enabling spatially-dominant people (e.g. architects) insights into understanding the ‘infinite art of improvisation’ (Berliner 2009). The GH script overcomes problems inherent in traditional notation and founds representations on a spiral symbolic representation of the drum kit as viewed from a player’s perspective. The Snare drum forms the centre, with bass drum to the bottom, with arrays of Hi-Hats, and Cymbals on the outer spiral and Tom Toms radiating around the inner spiral. Velocity of hits are represented, in this spatialization, by the radius of mesh spheres. The GH script allows multiple modes of analysis that includes the integration of many forms of spatialized representations with tagged descriptors, culminating in the use of 3D printed representations of referent patterns and phrases (Figures 4 and 5). This drummer’s own representation of improvised drumming allows for the analysis of micro-timing, playing behind and ahead of the beat and the variations in velocity that defines individual style. The wider research project involves using this parametric framework to analyse how different drummer improvise over a set musical piece. Drummers thus have their own signature elements of style that, when brought into the spatial domain, can be compared.
The eighty drum solo improvisations form a generative basis for the creation of a complex data set of multi-layered polyrhythms through the interface of the digital drum kit. When overlaid onto each other in MIDI, patterns emerge regarding clustering of drum notes, combinations of drum patterns including flams, closed and open rolls, combinations and the other elements that constitute drumming style (Figure 6). Each of these improvisations 'started with nothing' and 'ended up with something' in a musical sense, however each solo was in some way preconceived through muscle memory and complex cognitive processes and neural transmission where 'auditory stimulus activity reaches the cerebral cortex 8-9 millisecond after stimulation' (Pressing 1987). The musical intention may well 'start with (close to) nothing' however evolves as a necessity during live play. This is because the urgency of live play requires immediate action and reaction with little or no time for reflection-on-action to inform reflection-in-action. We acknowledge the limitations of this research, however see significant potential in adding to the present framework to include body mapping and the analysis of brain activity in improvisational activity using Emotiv EEG Brainware-apparatus in future project work.

PARAMETRIC SPATIAL DESIGN IMPROVISATION

We preface this conversation by stating some of the key differences between musical improvisation and spatial design improvisation. Fundamentally, improvised music is performed (played) in the moment meaning the time for critical-path decision making is many times quicker than spatial design. From the outset, free improvisation in spatial design appears to be more difficult than music. This domain is centred around the resolution of a design brief founded on an often-complex array of spatial, financial, structural, servicing, temporal and resourcing constraints. Real risks for spatial designers are posed where the outcome of spatial design decisions may cause loss of time, money or even life. This has resulted in many conservative design practices recycling a well-established set of design solutions from project to project that are known to work.

The core intention of many parametric design processes is to push boundaries - as one can see easily from the CumInCAD index, which is full of complex, innovative and difficult projects brought into fruition through parametric design processes. For example the Sagrada Familia project is one that has driven innovation through parametric design by the need to solve complex geometric problems spatially and materially across a geographically dispersed team (Burry 1996). In this paper, we focus on the initial starting point of design, as this starting point is where comparisons with improvisation can be the closest.

Parametric spatial improvisation, unlike musical improvisation, is facilitated through notation in the form of scripting. The research described above outlines an alternative method of notating improvisations so that the notation follows the improvisation. 'Script' is derived from the term for written dialogue in the performing arts, where actors are given directions to speak, perform or interpret. Subsequently, 'scripting' is a creative process that describes the artistic intent of the designer. Scripts can define a set of rules that perform a set of defined operations on a set of parameters. Software applications can be programmed and adjusted by scripts allowing for example repetitive tasks to be automated or to generate solutions that fit to a range of parameters (Biloria 2005). Thus, the lines between composition and improvisation, notation and 'live play' are blurred in parametric design.

Thus notation forms the foundation of parametric design, just as it forms the foundation of musical composition. A descriptor of geometry or a virtual geometric elements - each of these have mathematical relations with a global coordinate system and/or a mathematic function which describes the geometry - just as a note is located within a stave (global coordinate system). The rules between geometric elements that define new elements of relational geometry mir-
ror the relation between one note/drum beat with respect to the next - and so on. These 'rules' or musical relations that link notes/elements of geometry is the 'medium' or 'skeleton' for musico-spatial parametric design - hence - parametric design starts with something - that something is notation.

Instead of using only compositional methods for designing, designers utilise scripts to form their own generative properties and base for their design improvisation. Developing and amending scripts - designers can quickly improvise and control their ideas by amending the parameters or rules to fit their design intent (Celani 2008). Thus, there exists a role reversal between music and parametric spatial design improvisation. The improvising drummer can improvise freely to produce the initial musical output quickly and efficiently, only later to be slowed down in mixing, sampling and processing of sound through the Digital Audio Workstation (DAW) (Figure 6).

The parametric designer however must work through the constraints of analysing parameters and setting up scripts to allow the freedom of improvisation in the production of multiple design outcomes with a minimum of effort. One moves from simplicity of operation to complexity in processing, the other from complexity of parameterisation to simplicity of generation of multiple spatial alternatives. Although parametric improvisation in architecture does not lead directly to a resolved design, yet the interdisciplinary methodology can be accepted as a valuable approach for infusing innovative ideas into overall design process. The computational processes offer the ability to empower designers to delve into other fields. Allowing for a unique interpretation, representation through the improvisation process that generates the resulting artifices (Figure 7) (van Velthooven and Schnabel 2016).

Thus, significant 'embodied effort' (Ham 2004) is required to deliver initial representations and to resolve the complex, wicked and ill-defined problems (Rittel and Webber 1973) inherent in spatial design. This has parallels with the research on representa-
Improvisations using a variety of scripts to generate hyperlocalized architectural forms (van Velthooven and Schnabel 2016).

Figure 7

Tional media by Bermudez and King (2000) wherein they found that 'analogue representations are far more fluid and appropriate than digital media for initial and fast development of ideas, the stimulation of the imagination, free inquiry, the intentional and random cross-reference of diverse sources', whereas 'digital media are stronger for design development as they demand higher levels of geometrical definition and abstraction'. For digital natives and expert users, mediating digital and physical media is natural, however the issue arises as to how novice users can best engage in improvisation. For them, the pencil and sketch pad may be the ideal spatial design improvisation tools— not the computer. Maybe, for novice spatial design improvisers, Tom Kvan was right: the computer is the problem (Kvan 2004) as novice users may well 'start with nothing' but a blank screen and an empty pallet of referents.

The development of a repository of parametric referents acts to enable efficiencies in parametric design processes. These referents, in the form of elements of scripts, patches and code can be saved and recalled digitally, then shared online thus creating hybridized multi-user referents (much in the same way as a band has its trademark 'licks'). Expert scripters, like expert drummers, can recall, cut, copy these with speed, accuracy and precision. The key is, to refer again to Bermudez and King (2000), to develop a hybrid media process wherein each medium facilitates the free flow of design. In both music and spatial design, expert users find this natural and easy to the point of their skill and knowledge limitations,
whereas novices struggle.

A fundamental element of improvisation is the ability to 'play'. The problem is, 'as parametric models exceed levels of complexity that go from toy systems to the real world practice problems, they become increasingly inflexible' Pena de Leon (2014). When 'starting with nothing', this inflexibility (due to complexity) provides barriers for non-expert users to engage in the potentials of parametric design tools and represents a hurdle even for expert designers. Playing with toys is thus different to playing with complex systems and play by novices is different to play by experts. Parametric improvisation subsequently does not solve all issues connected with the process of architectural design and may even cause other issues. It allows however, an alignment of cause and effect and a reflection of the design intent, its processes and to some extent - its outcome (Schnabel 2012).

CONCLUSIONS
The research we have presented explores the idea of improvisation within a Musico-Spatial Design perspective wherein one domain forms a lens through which to examine the other. Founding this paper on a statement by a virtuoso jazz improviser (Herbie Hancock), we find that both drummers and spatial designers do not really 'start with nothing' when they improvise, but bring into the process a repertoire of patterns and phrases that have been learnt, copied and adapted over the period of creative practice. The founding quote by Herbie Hancock was followed by a two-hour concert whereby he and Chick Corea improvised freely and fluently over rehearsed and un-rehearsed material in a highly complex dynamic interplay using a wide range of trademark 'referent' piano riffs as the foundation. This is the domain of the expert, the virtuoso, the 'practiced digital hand' (McCullough 1998) that most creatives aspire to. Reaching the stage of musical and spatial design virtuosity takes years of practice, repetition, learning, copying and adapting and evolving an individual sense of style.

A creative practice project is described that uses the digital drum kit as a means of generating improvisational output that is curated and translated into spatial form using parametric design processes. Insights into the 'infinite art of improvisation' brings forward the issue of how parametric design tools such as GH enhance or obstruct the ability of spatial designers to improvise. The exploration of the gestalt within both environments can enhance the understanding of issues relevant to the field and lead to meaningful and new results (Schnabel 2005).

We find that expert musicians and spatial designers don't 'start with nothing', however they start with something in order to create something else. Expert musicians like Herbie Hancock and Chick Corea, and also expert parametric designers start their improvisation drawing on a rich vein of knowledge centred on their domain that has been learnt, copied and adapted over their creative practice. The key to parametric design, perhaps, is to borrow from musical improvisation and find ways to best enable the free flow of ideas through play.

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