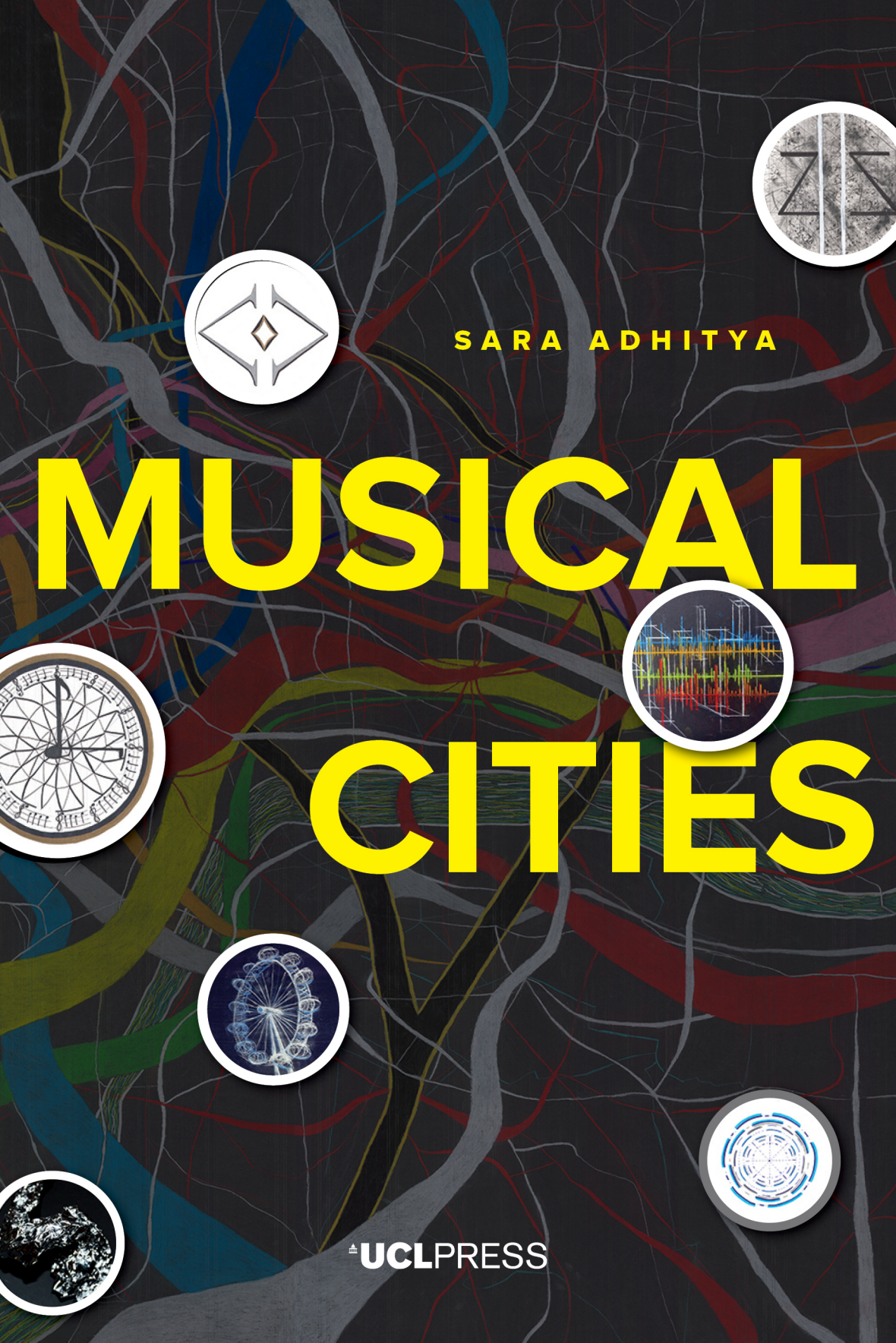

SARA ADHITYA
MUSICAL CITIES
UCLPRESS

Musical Cities

Musical Cities

Sara Adhitya

UCLPRESS

First published in 2017 by
UCL Press
University College London
Gower Street
London WC1E 6BT

Available to download free: http://www.ucl.ac.uk/ucl-press

A CIP catalogue record for this book is available from The British Library.

ISBN: 978-1-911576-56-3 (html)
ISBN: 978-1-911576-51-8 (PDF)
DOI: https://doi.org/10.14324/111.9781911576518

Acknowledgements

Just like in music, this book would not have been possible without the wonderful performances of a number of people, and I would like to thank each of them for the important part they have played.

In particular, to the collaborators of the various musical projects discussed in Part 2:

Patric de Villiers, for supporting the first of my musical explorations in the design of the Perth Foreshore, Iain Grandage for the continued use of his wonderful piece of music *Left Edge*, and the kind permission of the West Australian Symphony Orchestra to include their performance in this work;

Mika Kuuskankare, for his collaboration on the Sonified Urban Masterplan tool, as well as everyone else involved in the doctoral thesis which drove it;

Michela Marino for her heartfelt collaboration in Venice and contribution to Chapter 8, as well as Luca Maestri and Valentina Capraro for performing with us;

the entire Pastor family for participating in the process of entrainment, and especially to Barbara Pastor for her extended contribution to this publication;

Abbie Phillips and Daniel Scott for helping me bring the London *Soundmap* to life with their respective artistic and technical expertise, as well as Ellie Cosgrave, Michele O'Neill, Stefano Pasetto and Tatiano Rathelot for their wonderful performances;

and last but not least, to Angela Lamont, whose film-editing expertise brought many of these projects to life in Part 2.

It was a pleasure to work with you all.

I would also like to thank: Everyone at UCL Press, for their commitment to open access publishing, their willingness to push the boundaries of a 'book' and their support of my proposal for a more interactive mode of communicating knowledge and ideas; Jagjit Singh Rooprai

and Armadillo, for bringing my interactive figures to life; Nick Tyler, for providing me with the space and resources to explore my ideas as a post-doctoral researcher at UCL; my colleagues at UCL, for being ever-helpful; Transport for London, for their support of our alternative approaches to the design of London's urban realm and for sharing their sounds; Ircam's Perception and Sound Design team for hosting me during my doctoral studies: Davide Rocchesso and my colleagues at the University IUAV of Venice, who gave me the space to write in while back in town; and Andii and Jackson, for sharing their special *Soundmap* experience with us all.

And for believing that I could write this book in the short and eventful time given, I give my special thanks to Kornelija Šarkaité, Sara Gaviño Martin, Angela de la Torre and James Harris; and extend it to all other friends, near and far, who sent their encouragement as needed.

Last but not least, I would like to thank *you*, the Listener, for bringing this work to life: I hope that it may help make your experience of the city a more musical one.

About the book

Musical Cities represents an innovative approach to scholarly research and dissemination. A digital and interactive 'book', it explores the rhythms of our cities, and the role they play in our everyday urban lives, through the use of sound and music.

Sara Adhitya first discusses *why* we should listen to urban rhythms in order to design more liveable and sustainable cities, before demonstrating *how* we can do so through various acoustic communication techniques. Using audio-visual examples, *Musical Cities* takes the 'listener' on an interactive journey, revealing how sound and music can be used to represent, compose, perform and interact with the city. Through case studies of urban projects developed in Paris, Perth, Venice and London, Adhitya demonstrates how the power of music, and the practice of listening, can help us to compose more accessible, inclusive, engaging, enjoyable, and ultimately more sustainable cities.

We invite you on a musical journey through these cities. Part 1 sets the theoretical scene for the interactive elements of Part 2. We hope you enjoy the many audio-visual elements in Part 2, including an interactive masterplan of Paris, sonification of Kennington Road, London and a musical score of *Left Edge*. The icon indicates an interactive element – please click on the figure to be taken to the full version on our digital platform https://ucldigitalpress.co.uk/.

Contents

List of Audio-Visual Figures

List of Audio-Visual Credits

CHAPTER 6

Figure 6.1: Thanks to Mika Kuuskankare for his design and implementation of the graphic user interface of the SUM tool.

Figure 6.2: Maps generated from open data provided by the Mairie de Paris, Available from https://opendata.paris.fr; and ile de France, Available from: https://data.iledefrance.fr.

Figure 6.3: Based on the video 'Sonifying Urban Rhythm' in: Adhitya, S., *Sonifying Urban Rhythms*: *towards the spatio-temporal composition of the urban environment*, Doctoral Thesis, University IUAV of Venice; École des Hautes Études en Sciences Sociales, Paris, 2013, p.111.

Figure 6.4: Thanks to Simon Ball, animator, for his assistance in the making of this film, Nick Tyler for the use of UCL's PAMELA bus, and Andy Strachan, our bus driver. Funded by an Urban Research Award in Innovation & Leadership, UK Higher Education Innovation Fund (2016).

CHAPTER 7

Figure 7.1: Background Aerial Map data: Google, DigitalGlobe, Europa Technologies, 2006.

Figure 7.2: Background Aerial Map data: Google, DigitalGlobe, Europa Technologies, 2006.

Figure 7.3: Image based on Iain Grandage's score of *Left Edge*, 2004, used with permission + editing.

Figure 7.4: Image based on Iain Grandage's score of *Left Edge*, 2004, used with permission + editing. Internal images: Sara Adhitya, 2006 Audio: Iain Grandage's *Left Edge*, recorded by the West Australian Symphony Orchestra, conducted by Peter Moore and used with permission.

Figure 7.6: Audio: Iain Grandage's *Left Edge*, recorded by the West Australian Symphony Orchestra, conducted by Peter Moore and used with permission.

Figure 7.7: Audio: Excerpts from Iain Grandage's *Left Edge*, recorded by the West Australian Symphony Orchestra, conducted by Peter Moore and used with permission.

Figure 7.8: Audio: Excerpts from Iain Grandage's *Left Edge*, recorded by the West Australian Symphony Orchestra, conducted by Peter Moore and used with permission.

Figure 7.9: Audio: Iain Grandage's *Left Edge*, recorded by the West Australian Symphony Orchestra, conducted by Peter Moore and used with permission.

CHAPTER 8

Figure 8.2: Image by Studio Pastor Architetti Associati.

Figure 8.3.1: Photo by Sara Adhitya.

Figure 8.3.2: Photo by Daniele Resini.

Figure 8.4: Photos 1-6: Daniele Resini. Photo 7: Sara Adhitya.

Figure 8.5: Video plan of performance.

Video recording by Nicolò Scibilia, Venice, November 2010.

Video editing by Angela Lamont.

Choreography: Michela Marino.

Sound Design: Sara Adhitya.

Dance Interpretation: Luca Maestri, Valentina Capraro, Michela Marino.

Scene 3:
Quizás Quizás Quizás (1947), Music and lyrics by Ovsaldo Farrés, performed by Nat King Cole (1958), used with permission from Peer Publishing and Universal Music.
This scene also uses the following sounds from freesound:

- *Tape measure* by Chris Reierson (https://www.freesound.org/s/383089/).
- *Tape measure* 03 by LG (https://www.freesound.org/s/74352/).
- *Tape measure* retract by Wingcommander1 (https://www.freesound.org/s/366057/).

All other sounds: Self recorded.

Scene 4:

Narration: Barbara Pastor.

Original text: Michelina Pastor.

Photos: Massimo Spada, Daniele Resini, Studio Pastor Architetti Associati, as referenced throughout the film.

Drawings: Elena Bassi, Palazzi di Venezia, La Stamperia di Venezia Editrice, Venezia 1976, 490- 492.

Scene 5:

Scene 5a uses the following sounds from freesound:

- *Writing with Pencil breath* by Jason Elrod (https://www.freesound.org/s/85485/).
- *drawing fast lines with pencil on paper* by 123jorre456 (https://www.freesound.org/s/46624/).

Scene 5b uses the following sounds from freesound:

- *Sirene 06080401* by WIM https://www.freesound.org/s/26173/.
- *Car loud clip 02* by metamorphmuses https://www.freesound.org/s/38685/.
- *roda 2* by melack https://www.freesound.org/s/81555/.
- *ahaha* by yacou https://www.freesound.org/s/36938/.
- *Timbre* by melack https://www.freesound.org/s/9218/.
- *synthsteamengine* by gleeman https://www.freesound.org/s/102002/.
- *Washing Machine Train Loop* by JohnLaVine333 https://www.freesound.org/s/81555/.
- *Church Bells* by Percy Duke https://www.freesound.org/s/23269/.
- *bells ringing church close* by dobroide https://www.freesound.org/s/4243/.

Scene 5c uses the following sounds from freesound:

- *Computerstartup* by guitarguy1985 https://www.freesound.org/s/52050/.
- *Dialup* by Jlew https://www.freesound.org/s/16475/.
- *Computer Keyboard* by Carl Ewart https://www.freesound.org/s/84883/.
- *modem_dial* by Oktober https://www.freesound.org/s/188828/.

- *Machine Jam* by scottyheist https://www.freesound.org/s/35532/.
- *IMPresora* by user melack https://www.freesound.org/s/13809/.
- *Accessed Denied* by suntemple https://www.freesound.org/s/249300/.
- *EMPowerbookG4* by holger schwetter https://www.freesound.org/s/53580/.

Scene 5d uses the following sounds from freesound:

- *Town or suburbs amb - summer night_* by eric5335 https://www.freesound.org/s/52604/.
- *Newspaper* by osivo https://www.freesound.org/s/26477/.

Scene 6:

- Background music: Jóhann Jóhannsson, *Odi et Amo*, 2002, used with permission from Jóhann Jóhannsson and Mute Song Limited. Poem: *La Poetica dello Spazio*, Composed by Michela Marino and Sara Adhitya.

Scene 7:
Audio: Flute and corten steel staircase.

CHAPTER 9: LONDON

Figure 9.2: Film excerpt taken from UCL-squared et al., 'The Bus Stop: London's Agent of Change', available from: https://www.youtube.com/watch?v=Y6lW1kD-o9U [13 November 2014] (awarded *Best Urban Design film*, New Urbanism Film Festival, Los Angeles, 2014). Thanks to Nick Tyler and Liliana Ortega from UCL; Matthias Moos and Alex Brigden from Goldsmiths University.

Figure 9.4: Thanks to Ellie Cosgrave, Michele O'Neill, Stefano Pasetto and Tatiana Rathelot from Scatter Dance Company (The Place, London) for their performances and facilitation on the day.

Figure 9.6: Thanks to all participants who shared their experiences in this film.

Figure 9.8: Thanks to Andii and Jackson for their participation on the day and for sharing their experiences there after.

Figure 9.9: Graphic: Abbie Phillips
Audio: *Big Ben hourly chimes and Big Ben strikes* + editing http://www.parliament.uk/about/living-heritage/building/palace/big-ben/

anniversary-year/downloads/ [Accessed 15 July 2016] and used under the Open Parliament License.

Greenwich: *Ticking clock* by user 150128 https://www.freesound.org/s/326647/ [Accessed 15 July 2016] and used under the Open Parliament License.

London transportation sounds: Transport for London Visual Services Team + editing.

Thanks to Paul Curtis and colleagues.

All other sounds: Self recorded.

Prologue

Musical Cities is based on the theory and practice of *rhythmanalysis*: the understanding of one's environment through the experience of its rhythms. Introduced by French philosopher and urbanist Henri Lefebvre (1901–1991) in the 1980s, the analysis of rhythms was intended as a way of better understanding the relationship between our bodies and the space around them. Shortly before his death, Lefebvre called for the development of an 'analytical science' of rhythm,[1] which was left largely unanswered. However, considering the increasing arrhythmia of our contemporary cities, resulting in large-scale issues such as climate change, the need for such a science is even more relevant, not to mention urgent, today.

Thus this work has grown out of a desire to develop an accessible technique of rhythmanalysis that can help people to listen to these rhythms. It acknowledges that many contemporary urban problems are a result of our failure to listen: to our bodies; our environments; and each other. It also recognises that we are responsible for the urban rhythms we compose: the 'music' of our cities. With its ability to speak to our bodies and minds: to move us, both physically and emotionally; to stimulate us; and to connect us, music can help us to better understand and compose our cities.

Musical Cities is an attempt to harness these powers and help make our cities more musical. And with music being a medium accessible to all, it aims to give this power back to the people who must perform it. Thus through the development of rhythmanalysis into a more 'musical' practice, this book hopes to contribute to the composition of more harmonious environments for us all.

Notes

1 Lefebvre, H., *Éléments de rythmanalyse*. Paris: Éditions Syllepse, 1992 (posthumous). English translation: *Rhythmanalysis: Space, Time and Everyday Life*. London: Continuum, 2004.

Introduction: *Music and Cities*

As complex compositions of sound and rhythm, cities have inspired numerous music compositions around the world: from Italian composer Ottorino Respighi's symphonic descriptions of early 20th century Rome;[1] to American composer Steve Reich's sonic collage of modern-day city life featuring the sounds of New York.[2] Being inherently temporal and polyphonic, the medium of music has shown itself to be well adapted to capturing the multiple urban flows that comprise a city. Unfortunately, contemporary urban life itself is not always as 'musical' as these compositions may present. Thus, we propose the potential of music to inspire the design of more 'musical' cities.

i. Why music?

As the organisation of sound, music is a powerful medium: at once auditory, emotional and motoric, it has the ability to speak directly to our ears and bodies. Neurologist Oliver Sacks was to call human beings a 'musical species'[3] due to our ability to perceive and respond to musical parameters such as tone, timbre and, most elementally, rhythm, claiming that: 'Our auditory systems, our nervous systems, are indeed exquisitely tuned for music'.[4] This intricate connection between music, the body and the mind has been explored by a number of music psychologists and neurologists.[5] It has been noted that music was not only used as a mode of communication and means of expression, but as a way of organising society itself.[6] So if we ourselves are musical beings, why not design environments that better address our musical needs?

ii. Why cities?

As the principal organiser of urban time, our cities can be seen to have an important role to play in composing the rhythms – the *music* – of our

everyday urban lives. The composition of our urban form and the activities it houses dictates when and where we must be. The organisation of our public transport infrastructure, its frequencies and services, determines how we get there and how long it takes. The design of our streets and their urban morphology choreographs our bodily movements, and ultimately informs our internal experiences along the way. And as we perform these rhythms, we simultaneously play our part in the 'musical' soundtrack that is our urban soundscape. The rhythms of the city cannot help but compose the music of our urban lives.

iii. Why cities and music?

The connection between the city and music has so far been drawn on a number of levels: the German writer Johann Wolfgang von Goethe was to describe architecture as frozen music;[7] acoustic ecologist Raymund Murray Schafer referred to the world soundscape as a macrocosmic music composition;[8] and urbanist and philosopher Henri Lefebvre likened the polyphony of urban rhythms to those of a symphony.[9] Both cities and music are compositions of various rhythms: they both structure time; they both produce sound; and they have the ability to move us, both physically and emotionally. We have only to listen – with our ears and with our bodies – to find music embedded in our cities in its various forms:

- *The music that we hear*, as explored by acoustic ecologists;
- *The music that we move to*, as viewed from afar by time geographers;
- *The music that we embody*, as listened to by the rhythmanalyst of Lefebvre;
- *The music that we make*, as we interact with our urban environments.

Musical Cities is thus an exploration of the music composed not by composers, but by urban designers and planners; played not by musicians, but by each and every one of us as we perform our urban activities. It is an investigation into the rhythms that structure our urban environments and our everyday lives. And it is a search for more liveable rhythms in the temporal art of music.

iv. Structure

Musical Cities is structured in two main parts:

Part 1 is an exploration of what the 'music' of a city might be and the different ways in which we can 'listen' to it. In particular, it investigates the role rhythm plays in our everyday urban lives and our urban experiences, how it is composed by the design of our built environment and its significance for urban liveability and environmental sustainability.

Part 2 explores how we can use music to inform the design of the urban environment. With its medium as its message, it demonstrates, using interactive audio-visual examples, how music can be integrated at all levels of the urban design process: from its representation to design, performance and implementation. It discusses how music has been used in various personal projects developed around the world – from cities as diverse as Paris, France; Perth, Australia; Venice, Italy and London, UK – with the intention of improving the quality of our urban environments and our resulting experience.

While Part 1 sets the theoretical scene for the interactive elements of Part 2, the two Parts can also be read in reverse for those more practically inclined. With Part 2 making reference to the concepts discussed in Part 1, the participant of Part 2 is able to access the theoretical concepts at a later stage.

By harnessing the communicative power of sound and music, this book aims to speak to everyone: after all, music has the power to make us all listen. It aims to connect a variety of disciplines and encourage discussion between professionals and the public alike. In light of current issues of urban liveability and sustainability, it is clear that more collaborative approaches to urban development are needed and *Musical Cities* hopes to provide an accessible and engaging alternative that will help us to compose our cities together. Ultimately, this book hopes to make the design of our cities more accessible, understandable, enjoyable and meaningful to the people who must perform their music.

Notes

1 Respighi, O., Fontane di Roma *(Fountains in Rome)*, 1916; Pini di Roma *(Pines of Rome)*, 1924; Feste Romane *(Roman Festivals)*, 1928.
2 Reich, S., *City Life*, 1995.
3 Sacks, O., *Musicophilia: Tales of music and the brain*, Picador, UK, 2008, xi.
4 Sacks, 2008, xii.

5 See Anthony Storr, Daniel Levitin, Oliver Sacks: Storr, A., *Music and the Mind*, Harper Collins, London, 1997; Levitin, D., *This is your brain on music: understanding a human obsession*, Atlantic Books, London, 2006; Sacks, O., *Musicophilia: Tales of music and the brain*, Picador, UK, 2008.
6 Storr, A., *Music and the Mind*, Harper Collins, London, 1997, 19.
7 Johann Wolfgang von Goethe, *Conversation with Eckermann* (letter addressed to Johann Peter Eckermann, March 23, 1829).
8 World Soundscape Project. *The Music of the Environment Series*, R.M. Schafer (ed.), A.R.C. Publications, Vancouver, British Columbia, 1973–8, 3.
9 Lefebvre, H., *Rhythmanalysis: Space, Time and Everyday Life*. Continuum, London, 2004.

Part 1
Why do we need Musical Cities?

Chapter 1
The city as a rhythmic composition

> *I once said that by examining the rhythms of life in detail, by descending from the great rhythms forced upon us by the universe to the finer rhythms that play upon man's most exquisite sensibilities, it would be possible to work out a rhythmanalysis…* (Gaston Bachelard)[1]

The concept of a 'musical city' is based on Henri Lefebvre's philosophy of rhythmanalysis,[2] developed in the 1980s by the French philosopher and urbanist as a way of understanding our cities through the experience of its rhythms. He was to develop philosopher Gaston Bachelard's rhythmic view of life as a composition of rhythms and apply it to everyday urban life in an attempt to understand the rhythmic relationship between our body and our urban environments. To Lefebvre, the city was a *symphony*, with rhythms permeating everywhere[3] and he sought to develop a 'theory, practice and mode of analysis for the understanding of one's environment through the experience of its rhythms'.[4] In this chapter, we explore this concept of an urban symphony of rhythms, identifying the various rhythms that it comprises. But first, we need to understand *what rhythm is*.

1.1 What is rhythm?

Rhythm is defined as 'a regularly recurring sequence of events or processes'.[5] As the principal organiser of sound in time, rhythm is fundamental to music.[6] Professors of music Grosvenor Cooper and Leonard Meyer were to claim that 'To study rhythm is to study all of music. Rhythm both organises, and is itself organised by, all the elements which create and shape musical processes.'[7] However, rhythm is not only limited to its acoustic mode of

expression; it plays a vital role in other temporal arts such as poetry and dance, where it carefully structures words and movement. Furthermore, rhythm rises above its audio or visual representations[8] and can also be identified in disciplines ranging from psychology and psychoanalysis, to urban geography and acoustic ecology, where it manifests itself in the form of thoughts and feelings, movements and interactions. Thus, as well as being an organiser of time, it is also a *means of interpreting time and space.*[9]

1.2 The production of rhythm

Rhythm implies repetition for, as recognised by Lefebvre, 'there is no rhythm without repetition in time and in space'.[10] However, rhythm is more than the theoretical ticking of a clock or metronome, designed to calibrate social or musical time. Whether in music, art, geography or psychology, the production of rhythm is said to arise from the interaction of two types of repetition: the absolute and the variable. The first acts as a measure, allowing the variations of the second to be perceived. Musical rhythm is perceptible to the body and mind through reference to a constant beat.[11] In its performance, a metronome may be used to articulate this objective beat and keep the easily swayed psychological time of the performer in check. In the visual arts, rhythm is made apparent to the eyes through the juxtaposition of a variable element against a more regular one.[12] In time geography, rhythm is also viewed as the 'approximate repetition of a cycle', rather than the 'precise, identical repetition' that is used to measure it.[13] It is the relation between repetition and difference that allows rhythm to be both produced and perceived.

1.3 Urban rhythm

With respect to our cities, an urban rhythm can thus be considered the approximate repetition of any urban interaction at a given spatio-temperal scale.[14] Some of these rhythms occur naturally, such as the environmental rhythms of the seasons and the biological rhythms of our own bodies. Others are man-made, such as the collective organisation of our urban activities or transportation systems, and the social and cultural rhythms that guide them. Some rhythms may take place daily, such as those of the moon and the tides, while others repeat themselves only once a year, such as national holidays and our own individual birthdays. The production of urban rhythm is perhaps only limited to their scale of

perception: even seemingly 'static' elements, such as buildings or objects, have a rhythm if observed over a long enough duration.[15] The simultaneous presence of such a wide spectrum of rhythms at any given point in time renders urban life a complex, polyrhythmic composition.

1.4 Types of urban rhythm

Rhythm has always marked the repetitive nature of human activity but, as recognised by Lefebvre, these rhythmic characteristics were really only revealed through urbanisation.[16] The collective processes of urbanisation, manifest in our buildings and infrastructure systems, serve to house and transport the masses and in turn influence the nature of our individual everyday rhythms. Urban living can thus be seen as the result of the interaction of various types of rhythms: those of our environments, our activities, our mobilities and our bodies;[17] as composed by the design of our built environments.

Environmental rhythms

Our environmental rhythms include those of night and day, as well as our various seasons, which once governed when and where we would sleep, work and play. However, since the industrial revolution and the development of artificial lighting and heating systems, we have been able to override them. Yet environmental and human rhythms cannot be separated from one another, and the detrimental impact of our modern day rhythm of life is now manifesting itself in the form of climate change.[18] It is time to acknowledge that, in order to survive, we must treat human and environmental rhythms as one.

Activity rhythms

The rhythm of our activities includes those of home, work, school and leisure, as well as other services we require, ranging from commerce and health, to sport and entertainment. Some of these activities are governed by the environmental conditions previously described, such as agriculture, while others by social and cultural rhythms, such as national holidays. Some of us have more rigid rhythms than others, depending on our timetables and schedules, as well as the provision of the services we need and their opening hours. For example, the rhythm of an office worker is often much more rigid than that of a student or tourist. We each

perform different activities at different frequencies, whether weekly, monthly or yearly, yet the one with the most impact is arguably the one we repeat most often: the rhythm of our everyday lives.[19]

Rhythms of mobility

Our rhythm of activities is directly connected to how we get there: our rhythm of mobility. These include our various modes of transportation: from the regulated rhythms of public transport; to the private and more independent rhythms of the car and bike; and our own corporeal rhythm of walking. The speed, pace and regularity of these mobility flows are composed by both the physical design of the infrastructure network, as well as by rules and regulations, such as traffic signals and speed limits. However, today, with the ability to perform an increasing number of activities remotely through the internet and wireless technologies, our patterns of mobility are also shifting. While the need to commute to the office may be decreasing, many of us are now more mobile than ever.

Rhythms of the body

The rhythms of our bodies include those of our respiration, pulse, beating heart and blood flow. Lefebvre described our body as a 'metronome' and, just like in music, our own internal pulse serves as the measurement of the rhythms around us. However, unlike a mechanical metronome, our internal rhythms cannot help but be influenced by the external rhythms around them. Their effects also produce secondary rhythms, such as hunger and thirst, and determine our physiological and psychological state, such as when our hearts beat faster under stress. Neuroscientists have observed more complex rhythms occurring in our brains, such as the 'timing circuits' of our cerebellum that allow us to synchronise our bodies with music.[20] Lefebvre likened our bodily rhythms to a *complex chord* which must reunite different tones:[21] when in good health, they are in tune and in equilibrium with each other; when out of tune, illness strikes.[22]

Rhythms of urban design

As the spatial structure within which we live out our everyday activities and mobilities, the physical design of our cities plays an inevitable role in composing our everyday rhythms: its built form houses our activities; its

transport infrastructure guides our movements in time and space, telling us where we can go and how long it will take to get there; and its urban design elements, such as street lights, trees, bins and benches compose our urban experience. As such, each city can be observed to have its own rhythmic characteristics according to its spatial organisation: the grain of the urban fabric; the intensity and diversity of its various activities; the speed and frequency of its transport infrastructure; the composition of its design elements; and the flow of people through it. A number of geographers, sociologists and now urban designers are recognising the rhythmic patterns which characterise a place as 'place temporalities'.[23] Space and time are inherently connected and when we design our urban environments in space, we cannot help but compose its urban rhythms in time as well.

1.5 Summary

Urban life can thus be seen as a dynamic composition: of people, their activities and their mobilities; and the repeated interaction of these urban flows can been seen to produce regular spatio-temporal interactions, i.e. rhythm. As the structuring device of these urban rhythms, our built environment should no longer be viewed as a solid thing, as it is often designed and represented, but rather as 'a becoming, through circulation, combination and recombination of people and things',[24] essentially a dynamic 'composition'. Urban geographer Anne Buttimer was to describe the city as an 'orchestration of various time-space rhythms',[25] similar to the relationship between the individual parts in music. However, in order to appreciate this music, and understand what it is our cities are telling us, we first need to 'capture' it. Thus in the following chapter, we will discover how we can capture urban rhythm through the art of *listening*.

Notes

1 Bachelard, G., *The Poetics of Space*, Beacon Press Books, USA, 1994, p.65.
2 A term first introduced by Brazilian philosopher Lucio Alberto Pinheiro dos Santos, *La Rhythmanalyse*, 1931.
3 'Everywhere where there is interaction between a place, a time and an expenditure of energy, there is rhythm' in Lefebvre, H., *Rhythmanalysis: Space, Time and Everyday Life*, Continuum, London, 2004, 15.
4 Elden S. (ed.), in Lefebvre, H., *Rhythmanalysis: Space, Time and Everyday Life*, Continuum, London, 2004, xiii.
5 Oxford University Press, *Oxford English Dictionary* [Online], http://oxforddictionaries.com/definition/english/rhythm [accessed 31 January 2012].

6 Cooper, G., Meyer, L.B., *The Rhythmic Structures of Music*, The University of Chicago, US, 1960, 3.
7 Cooper & Meyer, 1960, *The Rhythmic Structure of Music*, 7.
8 Deleuze described rhythm as 'a vital power that exceeds every domain and traverses them all… more profound than vision, hearing, etc.' Deleuze, G. *Francis Bacon: The logic of sensation*, Smith, D. (trans.), Continuum, UK, 1989, 42–3.
9 May J. and Thrift N., (eds), *Timespace: geographies of temporality*, Routledge, New York, 2001, 30.
10 Lefebvre, 2004, 16.
11 The basic unit of measurement in a musical piece', Levitin, D., *This is your brain on music: understanding a human obsession*, Atlantic Books, London, 2006, 59.
12 'Described by painter Paul Klee as the juxtaposition of an '*élément individuel*' against an '*élément dividuel*', in Mroczkowski, S., *Paul Klee [temps du peintre]*, L'Harmattan, Paris, 2002, 80.
13 Winkler, J., 'Rhythmicity', in Helmi Järviluoma, Gregg Wagstaff (eds), *Soundscape studies and methods*, Finnish Society for Ethnomusicology Publ. 9, Helsinki 2002, 133–42.
14 Adhitya, S., *Sonifying Urban Rhythms: towards the spatio-temporal composition of the urban environment*. Ph.D Thesis, École des Hautes Études en Sciences Sociales, Ircam-Centre Pompidou, Paris, University IUAV of Venice, 2013, 5.
15 They only seem not to relative to our own bodily time from which we measure the rhythms around us, Lefebvre, 2004, 17 in Edensor, 2010, 7.
16 Felski, R., 'The invention of everyday life', *New Formations* 39, 2000, 16.
17 Edensor, 2010, 4.
18 Explored in further detail in Chapter 3.
19 'Everyday life is above all a temporal term. As such it conveys the fact of repetition; it refers not to the singular or unique but to that which happens "day after day".' Felski, 2000, 18.
20 Levitin, D., *This is your brain on music: understanding a human obsession*, Atlantic Books, London, 2006.
21 Lefebvre, 2004, 89; a chord is a group of 3 or more musical notes.
22 Lefebvre, 2004, 88.
23 Wunderlich, F.M., 'Place-temporality as an aesthetic experience', in Edensor, 2010.
24 Crang, M., 'Rhythms of the City: Temporalised space and motion', 2001. In May, J. and Thrift, N. (eds), *Time/Space: Geographies of Temporality,* 2001, 190.
25 Buttimer, A., 'Exploring the dynamics of lifeworld'. *Annals of the Association of American Geographers*, 1976, 66 (2), 289.

Chapter 2
Listening to urban rhythm

In response to the increasing dynamism of the 'modern' city in the 1970s, the discipline of time geography evolved, concerned with analysing our spatio-temporal movements of activities and their patterns,[1] i.e. urban rhythm. It was no longer enough to map the city on a piece of paper, and Swedish geographer Torsten Hägerstrand of the Institute of Geography at the University of Lund called for the need to '… rise up from the flat map with its static patterns and think in terms of a world on the move'.[2] Realising that we are continually moving in time, even when we are stationary in space,[3] he sought to temporalise a traditionally spatial discipline. However, although geographers began to map the human activity patterns they observed from afar over time as well as space, they were still confined to the static, graphic limitations of the flat piece of paper. Thus the understanding of these rhythms remained largely externalised and its experiential aspect marginalised.[4] Watching the world from afar was not enough to capture its polyphony of rhythms: one needed to *listen* to it.

2.1 Listening with our ears – the music that we hear

We can learn a lot from our cities through listening. Just think of how it alerts us to important events that we cannot see, such as a car coming around a corner before we cross the road. However, listening is more than simply hearing, which refers to our physiological ability to perceive auditory stimuli[5] (something which the majority of us do subconsciously). Rather, listening is the *conscious processing* that follows the perception of a sound; it is the psychological act of understanding and comprehension[6] driven by the motivation to derive meaning from the sounds we hear. Thus we listen with intent, and psychoacousticians, music psychologists and composers have identified a number of different

modes of listening that we utilise in different situations, from enjoying music, to communicating with other people and understanding our surrounding environments.

2.1.1 Ecological Listening – listening for events

Introduced by William Gaver in 1993,[7] ecological listening is based on the theory that we perceive events and sound sources rather than the sounds themselves.[8] Physical interactions within our environments often produce audible sound waves as a by-product of their movement, such as a door slamming shut or a tree falling to the ground. Psychoacoustic research has shown that we can in fact determine a number of physical attributes from such auditory feedback, such as the material, shape and size of the objects involved in an interaction,[9] as well as its location in time and space.[10] This allows us to deduce the cause of the sounds we hear.[11] what Michel Chion referred to as *causal listening*.[12] Applied to the identification of events occurring in our everyday acoustic environments, it is also known as *everyday listening*.[13] We can also apply this ability to listen to the identification of the size and shape of our spaces, as explored in the field of aural architecture: listening to the reverberations of a space renders the walls essentially 'audible'.[14] As Barry Blesser and Linda-Ruth Salter note: 'When our ability to decode spatial attributes is sufficiently developed, we can readily visualise objects and spatial geometry: we can "see" with our ears.'[15] Thus by listening to our urban environments in this 'ecological' way, we can understand to a large degree not only what is happening around us, but the space itself.[16]

2.1.2 Musical Listening – listening for experience

Musical listening refers to the experience of the sounds themselves.[17] It involves paying attention to the perceptual properties of the sounds, such as the melodies, harmonies and rhythms they form,[18] rather than their acoustic parameters, such as their frequency, amplitude and duration.[19] It is not necessarily relevant only to composed music, in the traditional sense of the word. Rather, what is considered 'music' depends on our own capacity for perception. For example, to some birdsong can be considered more musical than many types of composed music. By switching on our aptitude for musical listening, we can find musical excerpts in just about everything, including our cities.

2.1.3 Semantic Listening – listening for meaning

Finally, we can listen in a semantic way, by focussing on the meaning of a sound.[20] In language and music, this semantic relationship is both highly symbolic and culturally dependent, relying on learning and memory. However, the meaning generated by environmental and interaction sounds is recognised to be understood more universally.[21] By listening to all the urban interactions in our cities in a semantic way, we can deduce what is happening within society itself. In the next section, we apply these modes of listening to our cities, in an attempt to better understand what it is we are hearing.

2.2 The music of our cities – our urban soundscape

The musical growth that was observed in our cities during the 1960s earned the term *soundscape*: defined by Raymund Murray Schafer as any sonic environment under study,[22] and now commonly considered as the acoustic equivalent of a landscape. It arose out of a concern for the acoustic quality of our urban environment due to increasing industrialisation and urbanisation: the clang of construction work and the rapid growth of motorisation were drowning out the natural soundscapes of plants and animals at an alarming rate.[23] This was accompanied by growing recognition of its negative impact on both our physical and psychological wellbeing: from stress, to hearing loss and sleep disturbances; leading to the identification of a new urban problem of noise pollution.[24] While many sought to solve this problem through the implementation of noise abatement initiatives, putting a limit on decibel levels did not resolve the core of the problem: the cause of the sounds themselves.

2.2.1 Soundscape as acoustic communication

While responding to the acoustic quality of our increasingly urbanised soundscape, Raymund Murray Schafer and his colleagues at Simon Fraser University were fundamentally concerned with the interactions behind them: they were interested in understanding the underlying societal changes themselves.[25] As noted by Schafer, 'The general acoustic environment of a society can be read as an indicator of social conditions which produce it and may tell us much about the tendency and evolution of society.'[26] Thus they were not just listening in an 'acoustic' way to the

city and its sound levels and qualities. Rather, they were listening to it in a causal and semantic manner, and attempting to understand what it was saying about society: from the honking of car horns, which indicated frustration and possible congestion; to the chiming of a town hall clock telling us the time while reminding us of the authorities who dictate it. By semantically listening to the urban environment, one could deduce the social, cultural and environmental rhythms of the city, making it a useful source of information for the rhythmanalyst as well. The goal for both rhythmanalyst and acoustic ecologist is thus shared: the achievement of harmony between human action and their rhythmic output, however it may be expressed.

To acoustic ecologists, who focussed on the sonic expression of these rhythms, the urban soundscape was a rich source of information regarding the organisation of social and cultural activities in a place over time.[27] They began to record it, measure it, listen to it and interpret it using both qualitative and quantitative techniques: from sound preference questionnaires and sound walks;[28] to sound-pressure-level measurements and periodic recordings. By analysing the acoustic qualities of a place, they could understand its evolution over time: its time profile; overall tonality; and its rhythms;[29] and ultimately identify the impact of these changes.[30] Soundscapes became recognised as manifestations of urban rhythms, just as in time geography: the only difference was that these rhythms fell within our range of hearing, rather than our range of vision.'[31]

2.2.2 Soundscape as a music composition

In their comparative analyses of soundscapes around the world,[32] Schafer and his colleagues identified three types of sounds: keynote sounds, sound signals and soundmarks.[33] *Keynote sounds* were identified as background sounds that contributed to the overall tonality of a place, including the sounds of nature, such as geography and climate, or more urban sounds such as traffic noise. In contrast, *sound signals* were classified as foreground sounds, to which we directed our conscious attention, such as horns and sirens. And just like our cities are characterised by their landmarks, *soundmarks* were defined as the sounds that characterised a community and area, such as a church bell or mosque.[34] This decomposition of the soundscape thus brought attention to the fact that the soundscape was, in fact, a composition which could, and should, be composed. The world soundscape was famously described as a *macrocosmic musical composition.*[35]

2.2.3 Soundscape as an indicator of rhythm

Schafer's approach to composition can be seen as a positive one: rather than the elimination of the sounds we don't want (the motivation behind noise pollution policies), Schafer proposed the identification, preservation and encouragement of the sounds we do want ('the sounds that matter') with the anticipation that this would subsequently lead to the reduction of the sounds we do not want.[36] To do so, a new type of analytical listening was proposed, which Schafer and his colleagues called *ear cleaning:* a programme of ear-training for the discrimination of environmental sounds.[37] Only by listening to the acoustic environment in this 'clear'[38] analytical way, could we then improve its orchestration.[39] Thus, just like their analyses, the proposal for orchestration was driven not only by a concern with the 'acoustic' quality of the city, but with its societal implications; the soundscape could ultimately be considered an indicator of *urban rhythm*.

2.3 Listening to our cities today

Unfortunately, listening to today's urban soundscape is becoming an increasingly difficult exercise. Our urban lives have become so noisy – not just in their intensity but also in their complexity – that it is hard to know what to listen to: many of these sounds we have grown to accept, such as the noise of traffic and construction; many we have invited, such as those of computers and mobile phones; and many more are yet to be determined as new opportunities present themselves, such as the introduction of electric cars, which require their sounds to be designed.[40] To make the practice of listening even more complicated, there are yet more rhythms that cannot even be heard. To perceive them, we must turn to our bodies.[41]

2.4 Listening with our bodies – *rhythmanalysis*

Rhythm is not just a phenomenon that appeals to our ears: it also speaks to our bodies. This is not surprising since we as human beings are comprised of a multitude of rhythms. Through his theory of *rhythmanalysis*, Lefebvre proposed a more embodied practice of listening: 'He listens – and first to his body; he learns rhythms from it, in order consequently to appreciate external rhythms.'[42] He called this type of listener a *rhythmanalyst*: one who uses his or her own body as a reference point from which to

understand the rhythms of the external environment. After all, what rhythm can a human being know more intimately than their own? Thus bodily experience is fundamental to a better understanding of our rhythmic relationship with the space around us.[43]

2.4.1 Body as a metronome

As identified in Chapter 1, a rhythm needs a measure in order to be perceived, and Lefebvre proposed the various rhythms of the human body as our inbuilt metronome: the internal beating of one's heart, pulse, blood flow or breath.[44] These rhythms may not be easily heard,[45] but can nonetheless be felt. They call upon our ability to 'think' rhythmically with one's body: to sense time as well as space, and recognise phases, periods and recurrences.[46] It should be noted, however, that unlike the mechanical metronome often used to keep time in music, our bodily metronome is hardly a constant measure. It varies greatly from person to person due their own biological make-up,[47] as well as within one person over time due to psychological, social and environmental factors.[48] Technological developments, for example, have allowed us to manipulate our bodily rhythms into something nature alone could not have created.[49] Thus it is the role of the rhythmanalyst to understand the influence of these various external rhythms on their own internal rhythms. The rhythmanalyst must be both inside and outside simultaneously: viewing rhythm from the internalised point of view of a participant, as well as from the externalised viewpoint of an observer.[50] And while the rhythmic experience may be deeply internal, its analysis is necessarily external.[51]

2.4.2 Entraining bodily rhythms

Our ability to be influenced by our external rhythms occurs through the process of *entrainment*: the meeting of one rhythm with another. It is what occurs when we find ourselves so readily moving or walking in time to the music that we hear: before we know it, we have absorbed this external rhythm. We can harness this power of entrainment to keep us moving at the gym or on the road. We can also use it to help us learn new movements, adopting new rhythms through repetition and practice until they become second nature. This manipulation of bodily rhythms is what Lefebvre termed *dressage*: just like we can train the way in which we move through repetitive physical training, we can also alter our biological

rhythms, such as hunger or sleep, and train ourselves to become hungry or tired at a certain time. These acquired or learnt rhythms are often the result of social custom or education[52] and they manifest themselves through the act of repetition itself.

2.4.3 Identifying arrhythmia

At their optimum state of wellbeing, our bodies are in a state of *eurythmia*: our internal bodily rhythms unite in a state of equilibrium and harmony.[53] However, our sensitivity to rhythmic manipulation means that we are easily susceptible to rhythmic disturbances, known as *arrhythmia*, often expressed as bodily illness.[54] Rhythmanalysis was thus seen as a form of psychoanalysis and pathology.[55] Listening inwards, like a physician, the rhythmanalyst could diagnose which bodily rhythms were malfunctioning in the event of illness;[56] listening outwards, using our eyes, ears, memory and heart as a measure,[57] one could diagnose our urban rhythms in a similar way. However, to Lefebvre, this meant more than simply listening to the urban soundscape: one had to listen to 'a house, a street, a town as one listens to a symphony, an opera.'[58] Through understanding the rhythmic role each urban element has to play in the overall composition of the city, arrhythmia in our urban environments could also be identified. Thus in Chapter 3, we listen to our contemporary cities in such a way as to understand their arrhythmic impact on the rhythms of our own bodies as well as those of our surrounding environments.

Notes

1 Kwan, M.P., Lee, L., 'Geovisualization of Human Activity Patterns Using 3D GIS. A Time-Geographic Approach' in Goodchild, M.F., Janelle D.G., *Spatially integrated social science*, Oxford University Press, 2004, 48–66.
2 Hägerstrand, T., 'Space, time and human conditions' in Karlqvist A. et al. (ed.) *Dynamic allocation of urban space*, Saxon House Lexington Book, Lexington, 1975, 165.
3 Hägerstrand, 141.
4 Edensor, T., *Geographies of Rhythm: Nature, Place, Mobilities and Bodies*, London, Ashgate, 2010, 2.
5 Eds. J.A. Simpson, E.S.C. Weiner, *The Oxford English Dictionary (Second Edition)*. Volume VII, Oxford University Press, Oxford, 2001 (First published 1989), 56–7.
6 Eds. J.A. Simpson, E.S.C. Weiner, *The Oxford English Dictionary (Second Edition)*. Volume VIII, Oxford University Press, Oxford, 2001 (First published 1989), 1022.
7 Gaver. W., *How do we hear in the world? Explorations in ecological acoustics*, Ecological Psychology, 1993, 5(4), 285–313.
8 Derived from Gibson's ecological theory of visual perception Gibson, J.J., *The Ecological Approach to Visual Perception*. Lawrence Erlbaum Associates Inc. Publishers, Hillsdale, NJ, USA, 10th (1986) edition, 1979.

9 Avanzini, F., 'Interactive Sound', in Polotti, P., Rocchesso, D., (Eds.), *Sound To Sense, Sense To Sound – A State Of The Art in Sound and Music Computing,* Logos Verlag, Berlin, Germany, 2008, 346.
10 'Sound provides information about an interaction of materials at a location in an environment', de Götzen et al. 'Sound Design and Auditory Displays', in Polotti et al., 2008, 407.
11 Avanzini, F. in 'Low-level models: resonators, interactions, surface textures', Rocchesso, D., Fontana, F., *The Sounding Object, Mondo Estremo,* 2003, [Online]. Available from: http://www.soundobject.org 137–8
12 According to Chion, 'When the cause is visible, sound can provide supplementary information about it… When we cannot see the sound's cause, sound can constitute our principal source of information about it.' Chion, M., *Audio-Vision: Sound on Screen*; Columbia University Press, 1994, 25–6.
13 de Götzen, et al. in Polotti et al., 2008, 407.
14 Blesser, B. & Salter, L., *Spaces Speak, Are You Listening? Experiencing Aural Architecture*, MIT Press, 2007, 2.
15 Blesser & Salter, 2007, 2.
16 This is important in the understanding of space for both sighted and visually impaired people.
17 de Götzen, et.al in Polotti et al., 2008, 407.
18 Grassi, M. & Burro, R., 'Impact Sounds', in Fontana, Rocchesso (eds.) *The Sounding Object*, 2003, 48.
19 de Götzen, et.al in Polotti et al., 2008, 406.
20 Barrass, Vickers, in Hermann, T., Hunt, A., Neuhoff, J., (Eds), *The Sonification Handbook,* Logos Verlag, Berlin, Germany, 2011, 146.
21 Hermann, T., Hunt, A., Neuhoff, J., (Eds), *The Sonification Handbook,* Logos Verlag, Berlin, Germany, 2011, 400–1.
22 Including both actual environments or abstract constructions. Schafer, R.M., *The Soundscape: Our Sonic Environment and the Tuning of the World*, Destiny Books, Vermont, 1994 (first published 1977), 274.
23 Due to human actions, half of the wild soundscapes he has on tape no longer exist. Krause B., *The Great Animal Orchestra*, Profile Books Ltd, London, 2012.
24 What Schafer described as what happens 'when man does not listen carefully'. Schafer, 1977, 4.
25 They asked the question: 'What is the relationship between man and the sounds of his environment and what happens when those sounds change?' Schafer, 1997, 3.
26 Schafer, 1977, 7.
27 As noted by Truax, it is essentially a form of acoustic communication: 'Nothing is more revealing to the soundscape analyst than to monitor the changes in an acoustically rich environment over some lengthy period of time.' Truax, B., *Acoustic Communication*, Ablex Publishing, USA, 2001, 73.
28 Walking through one's environment with the sole intention of listening to it, introduced by Hildegard Westerkamp.
29 Mayr, A., *Soundscapes in Cembra 1975–2000*, Estratto da: SM Annali di San Michele – n.15/2002, Museo degli Usi e Costumi della Gente Trentina, 2002, 145.
30 Their primary aim was to 'draw attention to imbalances which may have unhealthy or inimical effects' Schafer, 1977, 271.
31 As recognised by time-geographer Justin Winkler: 'Time and space are essential dimensions in the sonic world. Oscillations of any scale are determined by a time-space ratio, by two quantities that condition each other mutually. Soundscapes are thus essentially manifestations of rhythmic systems, both in the sonic and subsonic realm, in their objective constitution and subjective evaluation.' Winkler, J., *Rhythmicity*, 2002, 3, in Winkler, J., *Space, Sound and Time – A choice of articles in Soundscape Studies and Aesthetics of Environment 1990–2003,* Basel, 2004.
32 Schafer, R.M. (ed.), 'World Soundscape Project'. *The Music of the Environment Series*, A.R.C. Publications, Vancouver, British Columbia, 1973–8.
33 R.M. Schafer, *The Soundscape: Our Sonic Environment and the Tuning of the World*, 1977.
34 Schafer, 1977, 10, 274.
35 Schafer, 1977, 5.
36 Schafer, 1977, 12.
37 'A systematic program for training the ears to listen more discriminatingly to sounds, particularly those of the environment.', Schafer, 1977, 272.

38 Referring to Schafer's objective for the achievement of clairaudience, or 'clear hearing', Schafer, 1977, 272.
39 Orchestration, as defined by Schafer, is the art of arranging sounds 'so that all possible types may be heard to advantage' in Schafer, 1977, 238.
40 Schafer urged that these new sounds be designed and tested through the discipline of acoustic design, which we will address is Part 2.
41 In his epilogue to The Soundscape, entitled *'The Music Beyond',* Schafer speaks of 'the whole body opens out to become an ear' Schafer, 1977, 262.
42 Lefebvre, H., *Rhythmanalysis: Space, Time and Everyday Life*. Continuum, London, 2004, 19.
43 Rhythmanalysis was a practice intended to understand 'the relationship between the body, its rhythms and surrounding space', Lefebvre, Trans. Kofman, *Writings on Cities*, Blackwell Publishers, UK, 1996, 30.
44 Lefebvre, 2004, 19.
45 John Cage famously noted the high-pitched sound of his nervous system while sitting in an anechoic chamber; these internal rhythms also have a sound of their own. Cage, J., *Silence: Lectures and Writings*, Marion Boyars Publishing Ltd., 2009, 13.
46 Lefebvre, 2004, 31
47 Levine, R., *A Geography of Time: The temporal misadventures of a social psychologist*, Oneworld Publications, Oxford, 2006, 28.
48 Hoffman explains that our own rhythms are informed by those close to us from an early age, our environments, as well as the temporal codes of our culture, Hoffman, E., *Time*, Profile Books Ltd, London, 2009, 117.
49 Shiftwork is one example of what is described as the 'dispossession' of biological rhythms due to social conformity.
50 Lefebvre, 2004, 31.
51 'In order to analyse a rhythm, one must get outside it.' In Lefebvre, 2004, 95.
52 Lefebvre, 2004, 47.
53 Lefebvre, 2004, 25.
54 Lefebvre, 2004, 30.
55 Lefebvre, 2004, 30.
56 Lefebvre, 2004, 95.
57 Lefebvre, 2004, 45.
58 Lefebvre, 2004, 94.

Chapter 3
Why rhythm matters

> *The fact is, a person is so far formed by his surroundings, that his state of harmony depends entirely on his harmony with his surroundings.*
> Christopher Alexander[1]

We often don't notice the important role rhythm plays in the functioning of our bodies, cities or natural environments until something goes wrong. Our bodies are inbuilt with warning signals. Stress, for example, is hard to ignore when our hearts are beating faster and our blood pressure is up; and it is often through suffering that we become conscious of the role these rhythms have to play. However, urban problems are often easier to ignore as their impact is often delayed and indirect: rising air pollution levels and depleting fossil fuels are just a few examples of unsustainable rhythms which we have allowed to creep up on us. Unfortunately, as with bodily illness, it often calls for some discomfort before we really start listening: perhaps breathing difficulties due to the pollution levels or unaffordable petrol prices. Today it is climate change that is calling for our attention – from the seasons starting earlier or later than expected to an increasing number of natural disasters – and this arrhythmia is wreaking havoc not only on our bodies, but on our economies, society and nature in general.

In this chapter, we look at contemporary urban issues from a rhythmic point of view. Taking on the role of a psychoanalyst or physician, as suggested by Henri Lefebvre in his practice of rhythmanalysis, we examine how our current problems of health and wellbeing, as well as environmental sustainability, can be considered the result of arrhythmic relationships. In particular, we look at the effect of tempo, pace of life, linearity and polychronicity on our bodies and our environment and, in doing so, reveal *why rhythm matters* in the liveability and sustainability of our cities.

3.1 Urban tempo

The tempo of a city is an important rhythmic quality as it is what attracts us to some cities rather than others. Tempo does not simply refer to speed, although this has an important role to play in it and has led to the tendency to characterise many places in terms of being fast or slow. Rather, tempo is a physiological and psychological phenomenon, determined by 'how time is filled – upon how many patterns arise in a given span of time.'[2] i.e. the more activity happening in a period of time, the faster time appears to pass. It has also been observed that 'The greater the variety, the more rapidly time seems to move'.[3] Thus the tempo of our urban environments is influenced not only by speed, but by the density and diversity of activities. This makes activity-packed cities like Paris appear a lot faster than cities of sprawl like Perth – even though the predominant car-based speed of travel in the second is theoretically much faster than the speed of the pedestrian in the first. Tempo plays an important role in our experience and wellbeing, as will be seen in the following sections.

3.1.1 Pace of life – fast cities

The tempo of a city, together with its rhythms, sequences and synchronies, forms the pace of life of a city, defined by social psychologist Robert Levine as our experience of the flow or movement of time.[4] Pace of life, as discovered by Levine in his study involving 31 countries, plays a critical role in our health and wellbeing, both physical and psychological, and the quality of life of a society as a whole.[5] He found a correlation between a faster-paced city and the occurrence of coronary heart disease,[6] attributing it to both the city and the type of people it attracts: 'Fast places appeal to fast people, and fast people create fast places.' The relationship between the pace of our cities and the pace of our own lives can thus be seen as a vicious cycle of entrainment and of being entrained. Faster cities can also contribute to our increased levels of stress, due to the increased pressure placed on each moment.[7] The increasing demand of our cities on our time has led to what writer and academic Eva Hoffman calls the emergence of 'fast pathologies', with many sociologists identifying new 'temporal diseases' such as time poverty, hurry sickness, and time anxiety.

3.1.2 Pace of life – slow cities

To counteract the increasing speed of many of our cities, a 'Slow Cities Movement'[8] (based on the Slow Food Movement[9]) emerged in 1999 from the Tuscan town of Greve, Italy. It aimed to slow down our pace of life out of a renewed respect for the rhythms of the seasons, the environment, our bodies and society. By retaining the traditional rhythm of life of each city, the movement hopes to preserve its identity and resist the increasing tendency for homogenisation. There are a number of guidelines that attempt to slow things down, one of which is the privileging of the pedestrian, with most things being easily reachable by foot. While the aim is to reduce traffic, noise and crowds,[10] ironically the result is that life flows much faster than in a congested and crowded 'fast' city. Thus it is important to consider tempo as a question of rhythm and connectivity, rather than simply as a speed and mode of travel. The popularity of a decelerating rhythm is reflected by the Slow Cities Movement's growing network of now more than 200 cities.

3.2 Rhythm of boredom

A different type of slow city is one in which time does not seem to go anywhere at all. The experience can be associated with a feeling of boredom: a psychological state that is not only undesirable, but can also be detrimental to our wellbeing. It is associated with a general lack of interest, is often unpleasant and can even be painful.[11] At its worst, as in the case of depression, time can seem to stop completely: perhaps this is the reason why we often call places with no activity at all 'dead' spaces. Unfortunately, boredom is a common characteristic of suburban sprawl, whose homogenous and monotonous rhythms lack activity and variety, and contribute to a sense of going nowhere. Typically disconnected from shops and services, motorised transport becomes the norm, accompanied by socio-economic and environmental implications such as air pollution and social segregation. However, for those without means of escape, such as youths or older people, it is associated with the feeling of being trapped.[12] We need to either bring the activities to the people, or the people to the activities, and one is clearly more environmentally, socially and economically sustainable than the other. Suburban sprawl is a prime example that time needs a direction in order to give meaning to our urban lives.

3.3 Rhythm of congestion

Being stuck in traffic is another kind of tempo – a tempo where we want to go faster but can't – leading to the production of stress hormones. Studies have shown that the worse the traffic, the more adrenaline and cortisol runs through our bodies, causing our heart rates to increase as we become more alert:[13] ultimately, too much adrenaline over a long period of time is detrimental to our health. In order to cope with this stress, our brains have been observed to automatically shut down to external stimuli,[14] resulting in what psychologist David Lewis calls commuter amnesia. Other studies have shown that longer commutes are associated with chronic pain, higher blood pressure, cholesterol and even heart attacks.[15] Thus the slow, painful crawling rhythm of a traffic jam, apart from causing congestion, noise and air pollution, can also be blamed for both physical and emotional arrhythmia.

3.4 Social Interaction Potential

The rhythm of our urban movement – characterised by our speed and mode of travel – also has an important role to play in the rhythms of society as a whole. As observed by Montgomery: 'You cannot separate the social life of urban spaces from the velocity of the activities happening there. Public life begins when we slow down.'[16] Although counterintuitive to the traditional aims of traffic engineering, where speed and efficiency are sought, traffic flows in the city of Copenhagen are considered a success when people are not moving at all.[17] The expectation is that, rather than simply rushing past each other, they are interacting with each other. Unfortunately, in many cities today, we seem to be avoiding social interactions by choosing to drive everywhere.[18] Cars reduce social interaction, due not only to their speed[19] but because they create a barrier between face-to-face interactions.[20] This led geographer Steven Farber and his colleagues at the University of Utah to establish the Social Interaction Potential rating system: a way of calculating the ease of meeting based on city size, population, geography, form and land use; in effect determining the possible space-time meet-up envelopes of a place.[21] Not surprisingly, the most influential factor in reducing this rating was sprawl: with citizens having less access to one another, social interactions decreased dramatically.[22] With the potential to either bring people together or keep them apart, our rhythm of movement in public urban spaces needs to be carefully composed.

3.5 Tempo giusto

Tempo and rhythm also play a defining role in our temporal experience of the city, and how engaged we are with our urban environments. We need time to process our experiences or otherwise risk losing our ability to experience at all: something prone to occur when we try to do too many things at once.[23] At the same time, the reverse can occur, with not enough activities leading to disorientation, disorganisation and a general lack of form.[24] This is often what happens in areas of sprawl, where rhythms are so monotonous that it is easy to get lost. The ideal tempo for human experience is what Hoffman describes as our 'tempo giusto',[25] i.e. not too fast, not too slow. Social psychologist Mihaly Csikszentmihalyi refers to this optimal temporal experience as a state of 'flow',[26] the sense of time moving unforced and at its most natural, without too much resistance or strain. He associates it with the same engaging, enjoyable, focused and satisfying state achieved during the performance of right-brained activities, such as music and art, when we ultimately lose track of time. Thus, with the right balance of activities and tempo, we can compose more engaging and stimulating urban experiences.

3.6 Polychronicity and temperal fragmentation

The increasing polychronicity of our contemporary cities – i.e. the occurrence of multiple tempi and our ability to navigate between them – can also be seen to fragment urban time and produce disjointed tempi rather than rhythms. The digital rhythms of telecommunication technologies are a principal cause of this temporal fragmentation as they weave themselves in and out of our physical lives. The social expectation to juggle multiple activities simultaneously is another rhythmic disrupter, restructuring wider social patterns, such as family relationships and work structures with inevitable consequences. Unfortunately, the fracturing of urban time is now blamed for the increasing occurrence of psychological arrhythmias, such as the development of attention deficit disorder, which is considered to be a neurological response to the temporality of the modern world.[27] The effects of polychronicity are wide-ranging as they permeate all aspects of our physical and mental lives and should be observed by the rhythmanalyst with vigilance.

3.7 Linearity and the circadian body

The increasing linearity of our contemporary urban rhythms is of increasing concern as they override the cyclical rhythms of our bodies: not least in the 24-hour city with its non-stop urban activity. More than 25 years ago Henri Lefebvre observed that 'social practice eats bit by bit into the night'[28] and in many capital cities today, it has succeeded in consuming almost all of it. However, these new technological and socio-economic rhythms of the night are also affecting the circadian rhythms of our bodies. While we once worked to the rhythm of the sun, shift work has meant that we are now out of synchronisation with, and perhaps even in rhythmic syncopation to,[29] the diurnal rhythms of our natural environments. The bodily arrhythmia produced is similar to that caused by jet-lag,[30] and ranges from a decrease in concentration and overall performance, to an increase in stress levels, and a reportedly higher risk of heart disease, ulcers and cancer.[31] Unfortunately it is not enough to simply exchange our sleeping hours for our waking ones, with factors such as body temperature and hormone production playing a key role in our sleep cycle.[32] It is thus important to take into account the cyclical rhythms of our bodies in relationship to their natural environments as we develop our cities, both socially and economically.

3.8 Sustainability and the cycles of nature

Our current rhythm of growth is not only creating arrhythmia in our bodies, but in our natural environments. By overriding the cyclical rhythms of nature, we are essentially undermining their sustainability: not surprising as the term 'sustainability' itself implies renewal, and therefore rhythm.[33] After all, our natural resources have a life cycle of their own, required to replenish them, and ignoring these rhythms inevitability leads to their overconsumption and depletion. Furthermore, failing to acknowledge these environmental rhythms can be attributed to the overwhelming arrhythmia that is climate change: from unexpected weather conditions to an increase in natural disasters. For the sake of our environments and ultimately ourselves, we must learn to listen to the cycles of nature and ensure that our rhythm of urban development stays within these rhythmic constraints.

3.9 Summary: Composing sustainability and wellbeing

The important role rhythm plays in sustaining our health and wellbeing, as well as that of society and our natural environment, is more prominent than ever: cities that are too fast can make us stressed and compromise our health; cities that are too slow may contribute to boredom and the formation of dead spaces; cities with multiple time lines can render our lives disjointed; cities that do not sleep can turn our bodily rhythms upside down; and cities that grow too fast cause havoc with the cyclical rhythms of nature. We have reached a point where it is difficult to ignore the detrimental impact of our current state of arrhythmia: it manifests itself in our urban experiences, our bodies, our minds, our emotions and social interactions, as well as in nature itself, and it is clear that something must be done.

According to Lefebvre's theory of rhythmanalysis, it is the responsibility of each of us to ask ourselves whether our urban environments support our rhythms or work against us, for only we can understand their effect through our bodily experiences. We each have our own internal rhythms, which thrive at different tempi and thus function at their optimum in different environments. Thus in order to achieve a healthy fit between oneself and one's environment, we need to listen to our rhythmic relationship with it. Levine was to describe the achievement of 'Person-Environment Fit'[34] as 'the critical art of all'[35] and, admittedly, it is not an easy art to achieve. While there are many other factors involved – social, cultural, economic and technological – the physical design of our environments clearly has an important role to play in generating the rhythms we desire. Thus in Chapter 4, we explore the role urban design plays in mediating the relationship between our bodies and their environments, and ultimately in our resulting urban rhythms.

Notes

1 Alexander, C. et al., *The Timeless Way of Building*, Quoted in Montgomery, C., *Happy City: Transforming our lives through urban design*, Penguin Books, London, 2013, 10.
2 Cooper, G., Meyer, L.B., *The Rhythmic Structures of Music*, The University of Chicago, US, 1960, 3.
3 Levine, R., *A Geography of Time: The temporal misadventures of a social psychologist*, Oneworld Publications, Oxford, 2006, 44.
4 Levine, 2006, 3.
5 Levine used 3 measures: walking speed, work speed and clock accuracy.
6 Type A behaviour is defined by a sense of time urgency, such as fast walking and multitasking, and in comparison to slower Type B individuals, has been shown to increase heart attack by two-fold and heart disease by seven-fold, in Levine, 2006, 155.

7 Hoffman, E., *Time*, Profile Books Ltd, London, 2009, 180.
8 *Slow Movement,* http://www.slowmovement.com/slow_cities.php [Accessed October 2010].
9 *Slow Food Movement,* http://www.slowfood.com [Accessed October 2010].
10 *Slow Movement,* http://www.slowmovement.com/slow_cities.php [Accessed October 2010].
11 Levine, 2006, 36.
12 For youth stranded in one American suburb, two solutions for happiness were identified: either a corner store, or a car with a tank of fuel. 'When kids pay for distance' in Montgomery, C, *Happy City: Transforming our lives through urban design*, Penguin Books, London, 2013, 59.
13 One study by Hewlett-Packard in England showed through the use of electrode caps that peak-hour travel caused more stress than that experienced by fighter pilots or riot police. Heart rates were observed at more than twice the normal rate at 145 beats/min, and were accompanied by a marked increase in cortisol. Montgomery, 2013, 185.
14 Making a stimulating journey hard to achieve.
15 Montgomery, 2013, 185.
16 Montgomery, 2013, 174.
17 Niels Torslov, traffic director, City of Copenhagen, in Montgomery, 2013, 174.
18 *'Those who wish to experience streets as briefly as possible.'* Montgomery, 2013, 173.
19 Which is not necessarily faster than the speed of walking.
20 Donald Appleyard's 1971 study of the relationship between traffic and social life in San Francisco found a direct relationship – that the more cars passing by, the less social activity there was. Montgomery, 2013, 172–3.
21 Montgomery, 2013, 57.
22 Farber, S. in Montgomery, 2013, 57.
23 'If we try to pack too many experiences into our time, then we lose the ability to experience', Hoffman, 2009, 180.
24 'Time which is insufficiently filled with activity dissolves into disorienting amorphousness' while 'immoderate languor can also lead to a disorganisation of time and loss of temporal form.' Hoffman, 181.
25 Hoffman, 182.
26 Csikszentmihalyi, M., *Flow: The psychology of happiness*, Rider, London, 1992.
27 Neuropsychiatrist Richard Restak has labelled ADD as the 'paradigmatic disorder of our times', in Hoffman, 2009, 156–7.
28 Lefebvre, H. *Rhythmanalysis: Space, Time and Everyday Life*, Continuum, London, 2004, 83.
29 Syncopation is a displacement of beats, whereby the strong become weak and vice versa, Oxford University Press, *Oxford English Dictionary* [Online], https://en.oxforddictionaries.com/definition/syncopate [Accessed: 29 September 2016]
30 Hoffman, 2009, 32.
31 Hoffman, 2009, 31.
32 The release of the hormone melatonin, associated with a normal, restorative sleep state, occurs only at night, Hoffman, 2009, 32.
33 Rhythmic disruption has also been blamed for our current sustainability crisis by a number of urban geographers: Anne Buttimer first recognised that 'issues of sustainable development… inevitably involve nature and its multiple rhythmicities' while Tim Edensor proposed that 'the rapid acceleration of climate change may require a shift in thinking rhythmically' and James Evans stressed the 'urgent imperative to develop new economic and social rhythms which are better attuned to the quickly mutating ecological rhythms that signal impending catastrophe.' Buttimer, A. 'Sustainable development: issues of scale and appropriateness' in Buttimer, A. (ed.), *Sustainable landscapes and lifeways*, Cork University Press, Cork, 2001, 7; Edensor, T., *Geographies of Rhythm: Nature, Place, Mobilities and Bodies*, London, Ashgate, 2010, 7.
34 Person-Environment Fit is 'related to how much pleasure people experience in everything from their leisure, social and work lives to the cities and countries in which they live.' Levine, 2006, p.215.
35 Levine, 2006, p.215.

Chapter 4
A rhythmic approach to urban design

The design of our built environment plays an inevitable role in the urban rhythms that result. Spatial factors such as the morphology of the urban fabric, the distribution of activities housed within it, and the transport infrastructure connecting them impact temporally on the speed and frequency of activity and transport flows, as well as on the rhythms of our bodies and the natural environment. Thus through their design of our built environment, architects, urban designers, planners and traffic engineers are essentially composing our urban rhythms. They define the relationship between urban space and time, both quantitatively and qualitatively determining where, when and how we can move through our cities, and our resulting experiences, opportunities and constraints. As discussed in Chapter 3, the quality of these rhythms is essential to our wellbeing, the liveability of our cities and the sustainability of our environments, making it important for urban designers to directly address their composition. Thus in this fourth chapter, we take a rhythmic look at urban design and examine the role it plays in the production and perception of urban rhythm.

4.1 Rhythm of our daily commute

Every day we have various urban activities to perform – from home life to work or study – and commuting between them is recognised as a fundamental rhythm that marks our urban lives.[1] Unfortunately many transport planners and traffic engineers focus on the quantitative aspect of moving people from A to B, rather than the quality of the rhythms these people experience. This has rendered commuting, for many of us, a rhythm to be conquered, rather than enjoyed. Yet, considering the role our commute plays in the formation of our identity and sense of place,[2]

it is time to give this important ritual the attention it deserves and make urban design as much about the journey as the destination. The rhythm of our commute is characterised by various factors such as our mode(s) of travel, their respective durations, the number of modal changes that must be made, and how long we have to wait between each change. The composition of this rhythm is important as it determines our resulting opportunity and constraints, including how much time we spend travelling, how much time we have left, what we are able to achieve during the day, and how we feel physically and emotionally at the end of it.

4.2 Daily urban rhythms: Paris

Different urban structures offer different types of rhythms based on the spatial distribution of activities and the temporal network connecting them. As an example of the common rhythms generated by a major metropolitan city, we turn to a recent rhythmanalysis conducted in Paris.[3] Here, four main types of daily urban rhythms were experienced by citizens, depending on where they lived, worked and played: metropolitan, inner-city, peripheral and regional.

Metropolitan rhythm

A metropolitan rhythm was used to define the rhythm of citizens who both lived and worked within the 105 sq km area of Paris contained within its Boulevard Périphérique. They had a number of different public transport modes at their disposal, including the underground metropolitan ('metro') rail network, bus and tram. This allowed them to readily access most parts of the city and take advantage of both day and night activities. As a result, their rhythms were much more varied both in terms of the transport modes they took and the activities they could perform, and they expressed an appreciation for the variety of rhythms living within this area provided.

Inner-city rhythm

Living and working at the centre of Paris, within a walkable or cyclable radius of twenty minutes, meant that citizens were relatively in control of their commute. Due to this spatio-temporal proximity, they could even afford to make multiple trips home throughout the day, whether for

lunch or even a siesta. Not having to spend as much time travelling also meant that those with an inner-city rhythm had more leisure time, and their resulting rhythms were characterised by an intensity and frequency of urban activities over commuting time. Their high level of rhythmic satisfaction can be attributed to the rhythmic control retained through being able to walk or cycle everywhere.

Peripheral rhythm

By contrast, the rhythms of citizens who lived in the *banlieue*, or Parisian periphery, in the suburbs outside the Boulevard Périphérique were much more transport-oriented. Due to the centralisation of the Parisian transport system, it was relatively easy to reach the city centre, where the major transport hubs were located. However, if the activities were located elsewhere, it meant having to enter central Paris before leaving it again, often with a number of changes of transport involved. Not surprisingly, the rhythms of this group were dominated by their commute by train or metro, and many expressed their desire to break free from these transport-oriented constraints, either to regain their leisure time or return to the fundamental rhythm of walking.

Regional rhythm

Largely due to the decentralisation of urban activities within the wider Parisian region of Île-de-France,[4] a number of citizens performed a regional rhythm, choosing to live in the city centre while working outside it. To do so, they were obliged to spend up to three hours a day commuting, often with delays. While the duration of this commute was deemed unacceptable, it is interesting to note that all justified their choice to continue living in the city centre by the activity opportunities that the capital could afford, such as its cultural activities and night life. However, when asked how much time they spent profiting from these opportunities, all admitted that they were usually too tired to do so.[5] Thus this regional rhythm was characterised by long periods of commuting and a lack of urban activity, resulting in a monotonous rhythm that was lamented by all.

Inter-regional rhythm

In addition to the four main commuting rhythms, a fifth rhythm was also seen to emerge: the inter-regional rhythm. Due to an increase in the

speed and reliability of transport infrastructure, an increasing number of people were able, for various reasons, to live in one town or city and work in another. For example, the high-speed connection of the TGV allowed one individual to commute to Paris from Besançon, a town outside the Parisian region more than 400km away. However, due to the journey taking three hours one way, he was only able to perform this commute on a weekly rather than daily frequency. Thus while developments in our transport infrastructure systems may be stretching the limitations of our spatio-temporal urban rhythms, the limits of our social and bodily rhythms are still largely the same.

Summary

Relative to this range of everyday urban rhythms, what is the rhythm of your commute and how does it impact on the quality of your life? Does it leave you with enough time to do all the things you would like to do each day or does it leave you feeling utterly exhausted? Given the temporal control and freedom that the spatio-temporal proximity of an inner-city rhythm allows, it is not surprising, as observed by Charles Montgomery in *Happy City*, that the happiest commuters are those who walk, run and ride.[6]

4.3 Rhythm of urban design

In addition to the city-wide composition of activities and transportation, the rhythm of urban design elements also affects our experience of urban space and thus its attractiveness as a place to be. This has much to do with the psychological phenomenon of tempo, discussed in Chapter 3, which has the ability to affect our perception of time and distances through the composition of activities and interactions.

Tempo can make a place seem more lively and attractive, and make distances appear longer or shorter. For example, a purely residential road often seems like a much longer stretch to travel than a mixed-use road of the same length housing a variety of commercial activities. In a study of street façades, urban designer Jan Gehl observed that streets with uniform, inactive façades (i.e. no openings or activities) motivated people to move past as quickly as possible, whereas a street with varied and active façades encouraged them to stop and linger,[7] filling the street with social life. This led him to recommend that shopfronts should be spaced at 5m

apart in order to keep us sufficiently entertained[8] and away from the state of boredom previously discussed.

The frequency and density of urban design elements such as street lights, trees and benches, also need to be considered as they contribute to how safe, comfortable and stimulated we feel. The low density of lights is why a dark, empty alleyway tends to make us want to escape it, yet a higher density can attract us to a piazza and make us want to stop and linger. Rhythm is essentially what makes some urban spaces vibrant and lively, and what keeps others dead and empty; it is what brings people together and in turn affects the life of the spaces themselves. Urban design elements must thus be composed with the resultant rhythm of life in mind.

4.4 Rhythm of waiting

In our everyday lives, there are moments of doing and moments of waiting. Waiting is another rhythmic element with important consequences that we do not adequately design for. We all have to wait at some stage, often for a bus or train, but an uninviting environment often makes the wait seem much longer than it actually is. After all, waiting involves duration, and our perception of duration is a psychological one: time seems to slow down when we are forced to wait. Montgomery observed that 'Inaction has a warping effect on time: a minute spent waiting seems to pass much more slowly than a minute spent moving.'[9] Waiting is one of the main reasons why public transport is often perceived as an unattractive option, particularly if the frequency is low. But what if we could turn waiting into a more pleasant activity, and the places for waiting such as a bus stop or train station, into more interactive and pleasant places to be? If time does indeed fly when you're having fun, then urban designers can design our experience of waiting to appear shorter, more attractive and even a desirable thing to do.

However, for waiting to be acceptable it is not just up to the design of more comfortable places. Time unfortunately seems to slow down when we don't know how long we have to wait for, and even more so when the service we are waiting for is typically infrequent. Frequent services remove the anxiety of waiting since we know that the next service will probably come soon. For example, relatively dense cities such as Paris can afford to provide a metro service every few minutes due to population demand, which makes missing one less of an issue. However, infrequent service intervals of twenty or thirty minutes associated with low-density

cities of sprawl such as Perth, require planning and make waiting a more stressful exercise. Composing anticipation is key to encouraging waiting, and many cities have resolved this problem by integrating real time arrival data into their transport systems. In fact, after the installation of arrival countdown clocks in the London underground, perceived waiting times were reported to be 25 per cent shorter than they actually were.[10] Addressing our perception of time is fundamental to designing services for the rhythms of people.

4.5 Rhythms for walking

Our temporal, as well as spatial, scale must also be considered in the design of rhythms for people and this for most means the rhythm of walking. Unfortunately, many cities that cater for cars are often not conducive to the rhythm of walking,[11] with the theoretical speed of the former rendering distances unachievable for the pedestrian. However, as recognised by Montgomery, it is not only about designing destinations within reach: it is also about making the experience of walking an enjoyable and satisfying one.[12] Thus if we want to encourage people to walk to their destinations, we not only need an urban structure at the appropriate spatio-temporal scale: we also need a sufficiently stimulating composition of urban activities and design elements that renders walking a safe and interesting experience.[13]

The impact of designing walkable environments has many benefits. It encourages us to interact with other people as we navigate each other on the pavement,[14] it puts us in control of how we get to where we have to be and as we perform our activities at our own human speed, it contributes to a feeling of being 'in time' with our environment. The rhythm of walking is associated with wellbeing, as we perform what our bodies were essentially built to do, leading Montgomery to claim that 'We can literally walk ourselves into a state of well-being.'[15]

4.6 Flexible, adaptive rhythms

Of course, it is important to acknowledge that everybody is different and evolving, and that there exists no one ideal person-environment rhythm. Rather, achieving eurhythmia relies on our ability to adapt to our environments: our tendency to calibrate our rhythms to those around us. Essentially a mode of survival, it can be attributed, both biologically

and socially, to the same process of entrainment identified by Lefebvre: 'the process by which one temporal rhythm is captured and modified by another'.[16] In order to achieve the Person-Environment Fit mentioned in the previous chapter, we entrain our rhythms to meet those around us. However, we all have our temporal limits whereby our wellbeing is compromised, and sometimes the rhythms of our urban environments need to entrain to us.[17] This led Robert Levine to pose a most interesting question, which we will attempt to address in Part 2: 'Can we design environments that are capable of adapting themselves to the preferred rhythms of individuals?'.[18]

4.7 Summary: Composing rhythms for people

It is clear that the rhythmic composition of our urban infrastructure is a defining factor in the formation of our own everyday rhythms, our resulting opportunities and constraints, our health and wellbeing, both physiologically and psychologically, and our overall perception of the liveability of our city. This, in turn, cannot help but influence how we behave and the choices we make in our cities, which ultimately impacts on their sustainability. We can design our urban spaces to encourage more sustainable urban rhythms, such as catering for the rhythm of walking to discourage driving, or making waiting a more attractive experience to encourage public transport. As a result, we would not only reduce energy consumption, traffic congestion and air pollution, but also improve our overall health and wellbeing. By composing rhythms for people, we are ultimately composing more sustainable rhythms for our natural environment as well.

We can do so by listening to our bodies and identifying the rhythms that stimulate, engage, entertain and resonate with us. However, as these rhythms vary between people and over time, perhaps the only solution is to design environments that are flexible enough to adapt to multiple tempi and rhythms. This multitemporality was suggested by Lewis Mumford: 'to find the right tempo and measure for every human activity; in short, to keep time in life as we do in music, not by obeying the mechanical beat of the metronome… but by finding the appropriate tempos from passage to passage, modulating the pace according to human need and purpose.'[19] Levine was to describe this need for temporal adaptation as our 'multitemporal challenge'[20] and in Chapter 5, we explore how the temporal art of music composition can help us respond to this challenge.

Notes

1 Montgomery, C., *Happy City: transforming our lives through urban design*, Penguin Books, London 2013. 183
2 'Long or short, every commute is a ritual that can alter our very sense of who we are and what is our place in the world.' Montgomery, C., *Happy City: transforming our lives through urban design.* 2013. 183.
3 Adhitya, S., *Sonifying Urban Rhythms: towards the spatio-temporal composition of the urban environment*. Ph.D Thesis, École des Hautes Études en Sciences Sociales, Ircam-Centre Pompidou, Paris, University IUAV of Venice, 2013.
4 Consisting of an area of 12012 sq km.
5 Adhitya, 2013, *Sonifying Urban Rhythms.*
6 As observed by Charles Montgomery in Montgomery, C., *Happy City: Transforming our lives through urban design*, Penguin Books, London, 2013, 186.
7 Montgomery, 2013, 165.
8 According to Jan Gehl, to make façades more interesting in Danish cities, street frontages on city streets should not be in excess of five meters (15ft). in Gehl, J., *Life Between Buildings – using public space*, Island Press, UK, 2011, 95.
9 Montgomery, 2013, 206.
10 Montgomery, 2013, 207.
11 Colombian mayor Enrique Peñalosa, who famously declared war on cars, stated that 'A city can be friendly to people or it can be friendly to cars, but it can't be friendly to both' in Montgomery, 2013, 7.
12 Criticising the dispersion of many American cities, Montgomery explains that 'most people do not walk in American cities because cities have designed destinations out of reach. But they have also corroded the experience of walking.' Montgomery, 2013, 193–4.
13 As noted by Montgomery, 'We walk farther when streets feel safe and interesting.' Montgomery, 2013, 194.
14 Referred to as street ballets by Jane Jacobs: 'An intricate ballet in which the individual dancers and ensembles all have distinctive parts which miraculously reinforce each other and compose an orderly whole. The ballet of the good city sidewalk never repeats itself from place to place, and in any once place is always replete with new improvisations.' in Jacobs, J., *The Death and Life of Great American Cities,* Random House, NY, 1961.
15 Montgomery, 2013, 188.
16 Levine, R., *A Geography of Time: The temporal misadventures of a social psychologist.* Oneworld Publications, Oxford, 2006, 217.
17 Levine recognised that for synchronicity to occur, 'there must be temporal flexibility on both sides of the person-environment equation', Levine, 2006, 217.
18 Levine, 2006, 217.
19 Quoted in: Levine, 2006, 219.
20 Levine, 2006, 220.

Chapter 5
How can music help?

Urban design, and its predominantly spatial approach to urban experience, can be criticised for inadequately addressing our rhythmic needs. We only have to think of the undesirable rhythmic experience of traffic jams and dead spaces that continue to characterise our urban lives. This calls for more temporal approaches to urban design, such as those utilised in the composition of music. Thus in this fifth chapter, we explore how the temporal and corporeal art of music can help us compose urban rhythms better suited to the rhythms of people.

5.1 Music and movement

The connection between music and movement is deeply rooted in cultural tradition, with music playing an important role in primitive cultures as the accompaniment to dance. Originally made both with and for the body, music can thus be seen to have evolved from our own bodily rhythms. The ability of music to make us move led philosopher, pianist and composer, Friedrich Nietzsche to state that 'We listen to music with our muscles'[1] and this connection has since been shown to exist at a neurological level. Due to the integration of our auditory and motor systems,[2] music has proven to be useful in the coordination and stimulation of locomotor movement.[3] Being both culturally and neurologically linked to bodily movement makes music a useful tool in the composition of urban movement.

5.2 Music as therapy

The ability of music to stimulate movement has also been shown to assist the body in arrhythmic situations. Neurologist Oliver Sacks was

to observe in a number of his post-injury patients (and from first-hand experience),[4] the extraordinary ability of music, and rhythm in particular, to help stimulate movement in times of need: 'Another system must be brought in, and it was clear that music, above all else, can kick-start a damaged or inhibited motor system into action again.'.[5] He noticed how the system of music could 'reawaken' the body, essentially from its state of arrhythmia, and how rhythm could act as an activator and 'de-inhibitor' in the rehabilitation process.[6] Rhythm was in fact recognised to have the ability to restore a sense of movement, embodiment and life at the corporeal level, due to its ability to speak to the fundamental subcortical levels of the brain.[7] In fact, music and dance have proven to be successful forms of therapy in patients with Parkinson's and Huntington's disease, presenting music as a useful tool in restoring the arrhythmic body to a more eurhythmic state.

5.3 Coordinating movement

The ability of music to coordinate such movement is attributed to the same process of entrainment identified by Henri Lefebvre and Robert Levine. Neurological research shows that our bodily entrainment to music – i.e. our ability to synchronise our movements to it – is possible due to the tight coupling between our auditory and motor systems.[8] Music can thus be used to coordinate our movement, both individually and collectively. It can be used as a tool to optimise our performances, as used by professional athletes to synchronise their breathing with movement in physical training.[9] Collectively, it is often called upon to coordinate the movement of large crowds of people in a variety of cultural situations ranging from marching to military music to agricultural work songs, helping us to keep in time with each other as well as to improve the overall efficiency of communal activity.[10]

5.4 Bringing people together

The power of music in bringing society together has been observed across all cultures through communal song and dance.[11] Its ability to coordinate collective movement, both physically as well as emotionally, is thought to help produce a sense of community and said to have played an important role in human evolution.[12] Psychiatrist Anthony Storr was to observe that a 'culturally agreed-upon pattern of rhythm and melody' can in fact

temporarily synchronise a culture's physiology.[13] He attributes this to the ability of music to produce 'similar physical responses in different people at the same time';[14] Sacks describes this as the collective binding of our nervous systems.[15] Music can thus been seen to connect people both at a physiological and societal level and we can use this power to ultimately bring people together in public urban spaces.[16]

5.5 Power to stimulate

Music has also been shown to stimulate both body and mind, with physiological changes observed in listeners, ranging from increased blood pressure and heart rate, to muscular activity and changes in our brain waves. It is associated with a heightened sense of 'alertness, awareness, interest and excitement', described by Storr as 'a generally-enhanced state of being'.[17] This is similar to the state of 'flow' identified by social psychologist Mihaly Csikszentmihalyi in Chapter 3, characterised by the engagement, focus and satisfaction associated with other right-brained activities. Music has also been shown to alleviate boredom in the performance of repetitive actions, with repetitive movements becoming less tedious when synchronised to music.[18] Music could thus be used to compose our urban environments in a more stimulating manner, alleviating the boredom generated by their monotonous design and instead contributing to a more enhanced state of wellbeing.

5.6 Structuring time

Music is often defined as organised sound,[19] but as explained by musician and neuroscientist Daniel Levitin, 'Too much organization may technically still be music, but it would be music that no one wants to listen to.'[20] This statement is also relevant to our cities, not least in areas of suburban sprawl, where the monotonous repetition of residential houses is literally driving people away in search of some other sort of urban activity. Rather, Levitin notes that 'the organization has to involve some element of the unexpected or it is emotionally flat and robotic'.[21] A similar thing can be said of contemporary urban design, whose repetitive processes of standardisation and prefabrication are turning urban development itself into a robotic process. Globalisation has further led to the generation of homogenous rhythmic experiences and an overall sense of placelessness.

Music's ability to structure time in socially and culturally meaningful ways can be harnessed to reactivate the rhythms of a place. In primitive cultures, music is said to have played an important role not only in structuring sound and gesture, but in structuring society itself.[22] This led Storr to suggest that we can use this organisational ability of music to help 'order our actions and make structured sense out of the world around us'.[23] Writer and academic Eva Hoffman also acknowledged the important link between the musical organisation of time and our societal need to 'structure time and fill it with meaning'.[24] This capacity of music to embody social and cultural time provides us with an arguably more meaningful alternative to the composition of urban rhythm than the current drivers of urbanisation.

5.7 Manipulating temporal perception

Of all the arts, music is considered to be the one most dependent on time as its subject and material. It is, as Hoffman describes, 'nothing but the shaping of time, and the constructions of time it is capable of evoking are infinitely varied.'[25] In Chapter 2, we discussed how the perception of time is a psychological phenomenon, and music can be seen as the fine art of its manipulation. Just as identified by social psychologist Levine with respect to the urban environment, music composer Igor Stravinsky also recognised two types of time at play in music: psychological and ontological. The first varies depending on 'the inner dispositions of the subject' i.e. their emotional state, while the second is 'time as it actually is', i.e. measured time.[26] This is similar to the repetition and difference involved in the production of rhythm described in Chapter 1. Music plays on the relationship between these two types of time through its composition of rhythm, manipulating our psychological sense of time to render us more relaxed or excited: our hearts beat faster or slower with the rhythm of the music. Thus if we could apply the compositional techniques of composers to our design of urban time, we could help create more desirable urban experiences, for example by making time pass quicker while waiting, or slowing it down in places of stress.

5.8 Composing emotion and experience

The manipulation of time also affects our emotions, and composers of music are experts in pulling our emotional strings as they take us on a

temporal journey based on expectation and anticipation. Most of us can appreciate how listening to certain types of music can calm us down while listening to others can keep make us feel lively. Furthermore, we do not need a formal knowledge of music in order to enjoy and respond to it, with much of our response being a physiological rather than a mental one.[27] Sacks attributes this corporeal response to rhythm in particular, said to be able to restore our sense of embodiment, movement and life.[28] What if we could harness these corporeal rhythms that drive our music[29] to calm down places of tension or enliven dead public spaces? Urban designers can learn a lot from music composers in the composition of more enjoyable urban experiences.

5.9 Facilitating multitemporailty

Just like the tempo of urban life described in Chapter 3, tempo in music refers to its speed of performance, and according to Levitin 'Music breathes, speeds up, and slows down just as the real world does'.[30] In a similar way to Lefebvre, Levitin drew correlations between music and the human body, with the tempo as its gait, and the measurement of this tempo its beating heart.[31] This interpretation of musical tempo is, just as it is for the human body, subjective. Before the introduction of the metronome in 1816, which allowed specific tempos to be indicated much like the speed limits of urban roads, qualitative terms were used such as *adagio*, meaning slow and steady, *andante*, meaning at an easy walking pace, and *allegro*, signifying fast and lively. However, it is clear that we all walk at different speeds and have different opinions about what is slow and fast and, unlike the rigidity of our cities with its speed limits, music allowed for this. Like our own movement, musical motion can vary greatly in speed and regularity, as well as emotion.[32] In fact, tempo is recognised to play an important role in the generation of emotion in music: hence the 'lively' in fast, and the 'steady' in slow and, most importantly for an accessible city, the 'easy' in walking. However, music also expects tempo to change, with *tempo rubato* (or 'robbed' time) giving the performer the freedom to steal time from one beat and give it to the next depending on how he or she feels. Perhaps we can learn from the rhythmic freedom that tempo rubato permits in music to respond to Lewis Mumford's call for multitemporality and the need to adapt urban time as needed. As recognised by Lefebvre and music composers alike,

the real measure of tempo is ourselves and we must first be able to speak to our internal rhythms in order to generate the urban experiences we desire.

5.10 Summary: Making life more musical

Music is a powerful art form for a number of reasons: it can speak to our bodies and coordinate movement; it can help restore arrhythmia to a state of eurhythmia; it can optimise our performance and increase efficiency; it connects people across society, bringing them together; and it has the power to stimulate our minds and manipulate our emotions. As Storr suggests, 'music can and should be a life-enhancing part of our day-to-day existence'[33] and what a joy everyday life could be if our cities were designed more musically. Thus in Part 2, we explore how music can contribute to urban design, making everyday life a more engaging and enjoyable experience for all its performers.

Notes

1 Sacks, O., *Musicophilia: Tales of music and the brain*, Picador, UK, 2008, xii.
2 Sacks, 2008, 254.
3 Sacks, 2008, 254.
4 Sacks speaks from his personal experience of how listening to Mendelssohn helped him learn to walk again following a mountain climbing accident, claiming that the music brought back 'the natural rhythm and melody of walking'. He attributes this to the ability of rhythm to synchronise movement. Sacks, 2008, 254–5.
5 Sacks, 2008, 257.
6 Sacks, 2008, 255–7.
7 Sacks, 2008, 382.
8 Sacks, 2008, 260.
9 Sacks, 2008, 263.
10 Sacks, 2008, 267–8.
11 Sacks, 2008, 266.
12 Sacks, 2008, 268.
13 Storr, A., *Music and the Mind*, Harper Collins, London, 1997, 7.
14 Storr, 1997, 24.
15 Sacks, 2008, 269.
16 Sacks, 2008, 268.
17 Storr, 1997, 24.
18 Storr, 1997, 32.
19 Term first attributed to composer Edgard Varèse.
20 Levitin, D., *This is your brain on music: understanding a human obsession*, Atlantic Books, London, 2006, 173.
21 Levitin, 2006, 111.
22 Storr, 1977, 19.

23 Storr, 1977, 107.
24 Music is said to be 'most capable of expressing all aspects and dimensions of both measurable external time and subjective lived temporality.' Hoffman, 2009, 184.
25 Hoffman, E., *Time*, Profile Books Ltd, London, 2009, 184.
26 Storr, 1997, 185.
27 Sacks, 2008, 385.
28 Sacks, 2008, 382.
29 Levitin called rhythm 'the engine driving virtually all music… ' Levitin, 2007, 55.
30 Levitin, 2006, 191.
31 Levitin, 2006, 59.
32 Hoffman, 2009, 184.
33 Storr, 1997, 106

Part 1
Summary

Part 1 has been a theoretical exposé of the rhythmic link between music and our cities, and how we can use music – and rhythm in particular – to improve their design. In Chapter 1, we have explored the music of our cities: the multitude of urban rhythms that comprise it, and the role that urban design plays in composing them. We may observe these rhythms from afar, as we watch the world go by. However, in order to truly understand these rhythms and their impact on the human body, we need to experience it for ourselves through their embodiment. As discussed in Chapter 2, we can do this by listening to our urban soundscape with our ears and by sensing the rhythms around us with our bodies. By understanding the relationship of these external rhythms to our own internal bodies, we can better compose urban rhythms for people.

Unfortunately, our current urban composition often generates urban rhythms that are less than desirable, leading to common urban problems such as traffic congestion and dead public spaces; these are discussed in Chapter 3. These urban problems affect our internal rhythms, both physiologically and psychologically, rendering our urban lives more stressful and tiring than they need be. They also affect how we behave and ultimately treat our environments and each other. Thus in order to design more sustainable cities, we need to design not only places for people, but *rhythms for people*, and in Chapter 4, we explored the important role urban design has to play in catering for the human speed as well as the human scale, and especially the rhythms which comprise us.

Due to music's strong connection to the way in which we hear, feel and move, in Chapter 5 we proposed that it could be used to access the rhythmic connection between people and their environments. Drawing on the neurological connection between our auditory and motor systems, and the ability of rhythm to synchronise them both, we can thus use music

to coordinate our urban movement, both individually and collectively. With a powerful ability to move us, music has the potential to help move our cities too. Thus in Part 2, we will explore how music can be used to compose more desirable, enjoyable and meaningful urban experiences for its citizens to perform.

Part 2
How to compose Musical Cities

As discussed in Part 1, we can find music embedded everywhere in our cities, generated by their multitude of urban rhythms. While we can hear the music of our urban soundscape, there is an underlying music which architects, urban designers and planners compose that cannot always be heard: *the music that we move to*. We perform this music as we go about our everyday urban lives and we embody it as we interact with our urban environment. Thus while designers may compose this music on paper, in the form of architectural drawings and urban masterplans, in order to truly understand this music, it must be experienced with our bodies. We can do so through the embodied practice of *listening*.

Part 2 puts the theory of Part 1 into practice using a series of audio-visual case-studies that demonstrate different ways in which music can inform the design of the built environment. Each allows us to better understand the city at different levels: from the composition of our urban experiences to the performance it generates; from the interactions it encourages to the resulting soundscape that we hear. In this part, we attempt to answer the question: *how can the integration of music in the urban design process help improve the quality of our urban rhythms*?

To do so, it draws on the power of acoustic communication and methods of musical composition: from the graphical musical score to image sonification; from soundscape composition to sonic interaction design. Being both temporal and polyphonic, music is a medium well-equipped for both the capturing and representation of urban rhythms. In combination with existing visual modes of communication, such as architectural and urban plans, it can help us to understand the relationship between the spaces we draw, the forms we build and the temporal experiences we compose, i.e. our urban rhythms. By representing the rhythmic outcomes of urban design decisions in a more accessible and

understandable way, we can have not only a more meaningful dialogue concerning their composition, but a more collaborative one as well.

Through the following four case-studies, which vary not only in location (Perth, Venice, Paris and London) but scale (city, building, street and urban design element), we demonstrate how music can assist the urban design process at various stages. By integrating music into the representation, design, implementation and performance of our urban environments, we reveal how it can deepen our understanding of the existing rhythmic relationships between our environments and ourselves. Furthermore, we explore how it can help us compose the urban rhythms we desire in the future.

In Chapter 6, we acknowledge the limitations of the existing graphic representation techniques used in urban design and planning in articulating urban rhythms and its temporalisation using sound. We propose how we can animate the static rhythms of the urban masterplan using the acoustic communication technique of sonification. We discuss the development of a Sonified Urban Masterplan: an audio-visual tool for the representation of the urban masterplan, which allows us to play the composition of the city like a piece of music. By listening to the result, we can embody the rhythms embedded in the urban plan and understand the effect of these rhythms on our urban experience. We apply it to the city of Paris, allowing us to listen to its rhythms and better understand its overall urban composition.

Chapter 7 explores the temporal art of music composition and the notion that architecture can be 'frozen music'. It applies this concept to the field of urban design and planning, and proposes the possibility of 'composing' a city in time, in a similar manner to music. In this chapter, we translate a site-specific piece of music describing Perth, into an urban design project for the city's foreshore. Thus it investigates the potential of music compositional techniques to inform the composition of urban design, developing a methodology for the translation of music notation into built form. The urban masterplan is composed like a graphic musical score,[1] to be played at various tempi of movement, with the aim to generate more musical urban experiences from various temporal viewpoints.

Chapter 8 explores the role of architecture in entraining our everyday rhythms – of movement, emotions and social interactions, both past and present – and articulates these rhythms through the performance of music and dance. It takes a seventeenth-century restored Venetian palazzo as an example of aural architecture, playing it acoustically like a musical instrument in accompaniment to the movement it composes. The result is recorded dynamically through the integration of

sound and moving image in the traditionally static architectural plan. By doing so, it reveals how architecture is far from frozen but is in fact a dynamic being, which must be designed with the composition of sound and movement (i.e. rhythms) in mind.

Last but not least, Chapter 9 acknowledges the need for a more multisensorial approach to urban design, and explores the integration of music in the urban realm. It introduces the emerging field of sonic interaction design (SID), and explores how it can help render our urban environments more musical and interactive. Through the development of an interactive *Soundmap* for the city of London, we respond to R. Murray Schafer's call for the communal need to compose our urban soundscape. In addition to questioning predominantly visual approaches to urban design, it also demonstrates the power of music to bring people together in a more collaborative way.

Thus in Part 2 we explore how music can assist each stage of the urban design process. We use each case study to demonstrate how music can improve both the process and outcome, rendering our urban experiences more accessible, interactive, enjoyable and collaborative. Ultimately, we discover how a more 'musical' approach to urban design can help improve the quality of our urban rhythms.

Notes

1 The notation of music as an image, with rules of performance defined by the composer, rather than traditional western musical notation of notes on a musical stave read from left to right.

Chapter 6
Representation

Key to the design of more sustainable urban rhythms is their representation, and it is often the limits of these representation techniques that result in the generation of undesirable urban rhythms. According to urban designer Peter Bosselmann, there are two types of urban representation: conceptual and experiential.[1] The first is abstract and deals with physical parameters such as form and structure, while the second deals with how we perceive the environment through our senses. In addition to our senses of sight, touch and hearing, this can be seen to include our sense of rhythm. In fact, parallels can be drawn with our abstract and psychological perception of musical and lived time, as discussed in Part 1.

The traditional graphic representation technique of the urban masterplan is inherently static, making it difficult to represent temporal experiences such as rhythm. It is also subject to issues of legibility, placing limitations on the number of datasets that can be synthesised. Furthermore, the disembodied graphic line struggles to represent the corporeality of urban experience. Thus unequipped to represent the multi-dimensional, corporeal and temporal, it is not a surprise that rhythm is not the focus of urban design.

Such technical plans and static drawings further inhibit the communication of these rhythms to the general public and limit their involvement in participatory planning processes. As noted by Bosselmann: 'Few people outside the design and engineering field can read two-dimensional drawings and understand what it would be like to walk alongside a building thus shown. The general public understands the experiential form of representations.'[2] This often leads to misunderstandings regarding the experiential objectives of urban design projects, resulting in the production of rhythms that are not only undesirable, but unsustainable. Thus Bosselmann's call for a more 'experiential form of

representation' was for the benefit of not only design professionals, but for everyone concerned.

6.1 Capturing urban rhythm

With the aim of improving communication in urban decision-making problems, and hopefully reducing the accidental composition of arrhythmia, I began my search for a more accessible technique for representing our urban environments: one that could represent not only the temporality and plurality of urban flow; but also embody their experiential aspect. I was further driven by the lack of attention paid to impending issues of urban sustainability, which made me wonder: *Why don't people listen?* 'Listening' to Henri Lefebvre involved paying attention to the rhythms of one's bodily experience, and Raymund Murray Schafer had already identified a multitude of urban rhythms that we could hear. However, the problem was that many of the rhythms that urban designers were concerned with were silent, such as the urban design elements of trees, lights and benches. As I walked down my street of silent houses, I began to wonder what their composition would sound like if we could only hear them: what sort of music would they make?

So with the aim of helping people to listen to the silent rhythms of urban design, I turned to the medium of sound and the temporal art of music whose powers were revealed in Chapter 5. The ability of music to both capture and embody rhythm, as well as help us embody it, could help us understand the rhythms of our cities by listening;[3] instead of talking in terms of time frames and frequencies, speed and experiences, we could potentially hear these rhythmic relationships for ourselves. In this chapter, I explore how we can use acoustic communication, and in particular the technique of sonification, to capture the rhythms we design.

6.2 The power of sound

Not only temporal and polyphonic, but also corporeal, sound is well adapted to representing the multiple rhythms of the city in a more embodied manner. Being inherently temporal, it can represent the dynamic rhythms that are frozen by the static media of drawings, masterplans and models. Being polyphonic, it can represent these rhythms simultaneously. And being corporeal, it can help us to embody

these rhythms in a more experiential way. With these three qualities, sound has the ability to override the graphical limitations of urban representation previously discussed, and can thus contribute to the development of a more temporal, polyphonic and experiential representation technique for urban design.

6.3 Urban soundmaps

Urban soundmaps have become increasingly popular in recent years largely due to developments in GIS technologies and online collaborative mapping systems.[4] However, these are predominantly concerned with the geo-localised mapping of acoustic data, whether in the form of quantitative noise levels (in dB) or more qualitative soundscape recordings. Although such soundmaps can be useful for acoustic ecologists to use to represent the acoustic environment at a particular point in time, as explored in Chapter 2, not all rhythms can be heard and those that are can often be difficult to distinguish. Rather, as urban designers and planners, we need a way to represent the silent rhythms of urban form and its design elements, as well as to represent the noisier rhythms of our activities and transport systems in a clearer and more understandable way. Here we can articulate these rhythms by literally 'giving' them sound using the acoustic communication technique of *sonification*.

6.4 Introducing sonification

Sonification was first introduced by Geoffery Kramer in 1994 as the process of representing data through auditory means[5] and has since come to be considered the auditory equivalent of data visualisation.[6] However, while it can be difficult for the eye to process information as it evolves in real time, the ear is considered to be more efficient in detecting temporal patterns, with studies showing that '… audition plays a greater role than vision in the processing of temporal information'.[7] Furthermore, the ear is able to perceive and distinguish between multiple sound streams at once,[8] while the eye is limited by issues of visual overloading. Thus listening to a sonification can be a much more effective mode of perceiving and analysing multiple urban rhythms, rather than merely watching them go by.

6.5 Using sonification

Sonification involves the translation, or mapping, of a data source into audio output. This mapping process is by definition both systematic and objective,[9] making it extremely useful in both the physical and social sciences in the representation of a wide range of data.[10] It is particularly suitable for temporal data analysis, including the detection of temporal patterns (such as periodicity) and anomalies not discernible by sight (due to scale or noisy visual displays),[11] as well as the identification of trends and the overall morphology of a dataset. Thus the suitability of sonification in the temporal representation and analysis of rhythm is clear, as well as its potential to help us capture, listen to and understand urban rhythms.

6.6 Sonification and 'music'

While the objective of sonification is the effective communication of a data source, its audio output can often be considered as a form of music.[12] This has led to an increasing number of music composers tapping into the potential of a wide range of datasets as a source of artistic inspiration, for example, climatic data. However, it is important to remember that the aesthetic result is dependent on not only the data source, but on the mapping process responsible for converting the original data parameters into acoustic ones. The value of an aesthetically pleasing sonification is now recognised as an important part of acoustic communication,[13] bringing the science of sonification even closer to the art of music composition.

6.7 Sonifying urban rhythms

So how can we sonify the rhythms of urban design: the rhythms we as urban designers and planners draw on paper? With the data source being a graphic one, we need to sonify the images themselves by translating their graphic parameters into parameters of sound. However, due to the number of urban elements involved – environment, transport, activity and design – we also need to be able to sonify multiple images. Furthermore, we need to be able to read them from multiple directions and speeds, as we do a geographical map or an urban plan. Ultimately,

this calls for an image sonification tool that is both multi-dimensional and spatio-temporal, able to represent the multiple urban rhythms of the urban masterplan in both space and time.

6.8 An urban sonification tool

The journey to create such a tool began while I was a doctoral student wandering through the poster exhibit of a sound and music computer conference in Barcelona: out of all the sonograms, graphs and formulas, something that looked remarkably like an urban plan caught my urban designer eye. It turned out to be a graphic score created by Dr Mika Kuuskankare from the Sibelius Academy, co-developer of the graphical computer-aided composition tool of PWGL.[14] The striking similarities between the graphic score and the urban masterplan brought together the disciplines of computer music programming and urban design in an unexpected way: I could not help but ask myself if this music composition software could be used to 'play' the rhythms of my urban masterplan. The question did not go away and, a year later, we found ourselves exploring the multi-dimensional, spatio-temporal commonalities of graphic scores and urban masterplans at the Ircam-Centre Pompidou[15] in Paris. It was the start of our journey to transform a music composition tool into one capable of sonifying, and ultimately designing, urban rhythms.

6.9 The Sonified Urban Masterplan tool

In order to be relevant to current urban design practice, the tool needed to be able to transform existing graphic techniques of urban representation into sound: that is, we needed to develop a method of image sonification. This meant first being able to sample the image parameters of a graphic masterplan (colour, position or intensity), made possible through the process of rasterisation. These parameters could then be mapped to audio parameters (such as pitch, loudness or timbre) as defined by the urban designer or composer. Crucial to this was the data's distribution over both space and time, and so we incorporated the ability to define both speed and direction using vector paths, which could be drawn by the user. We named the resulting image sonification tool the Sonified Urban Masterplan,[16] or SUM tool.[17]

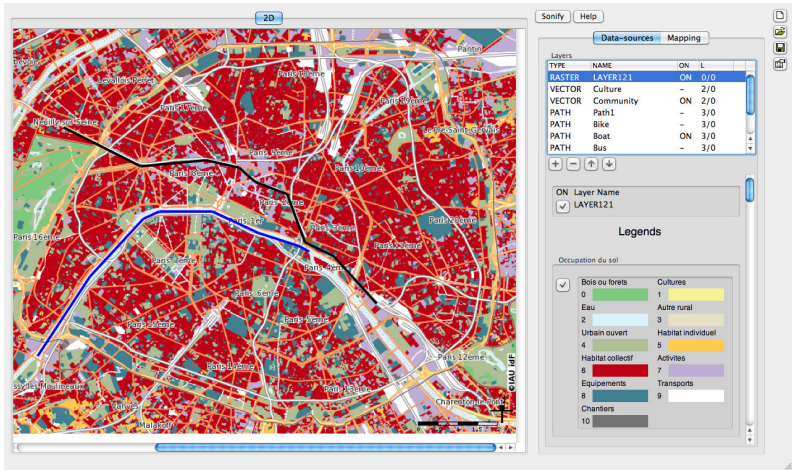


Figure 6.1 The Sonified Urban Masterplan Tool

6.10 An urban sonic code

Once armed with a tool to extract the graphical rhythms embedded in the masterplan, the next step was to define the mapping process that would make them not only audible, but understandable. But what should these rhythms sound like?

The question of effective acoustic communication is critical to the success of any sonification: the data needs to be represented to the listener in a meaningful way, in order to be interpreted and thus understood. In the case of the Sonified Urban Masterplan, this meant representing elements of our urban and natural environment in a way that could be understood as intuitively as possible by the ear: the creation of an *urban sonic code* that could essentially be considered the sonic equivalent of the colour-coded legend traditionally used for maps. However, in order to communicate to a wider audience, in designing this sonic legend we needed to take into account *how we hear*.

Due to our universal sense of ecological perception discussed in Chapter 2, the majority of us can easily identify common environmental and urban interactions from their sounds. This means that we can easily draw the connection between a river and the sound of flowing water, or a tree and the sound of wind blowing through its leaves. It also means that we can readily recognise our transport infrastructure

systems from the interaction sounds they typically generate, such as a train from the sound of its tracks, or a car from the sound of its engine. Iconic sounds, although relying on the cultural references of *semantic listening*, such as those associated with a church or a mosque, are also relatively easy to identify in today's multicultural society and can be used to represent our different cultural activities.[18] However, for those silent rhythms of urban design, such as light poles and benches, the sounds needed to be designed. Sounding objects were created, whose acoustic properties were designed to represent the size, shape and material of each element upon impact.[19] Furthermore, they were tuned in pitch relative to their respective heights, in order to aid their identification, as well as to the same tonality as the other urban systems, in order to render their combined result aesthetically pleasing.[20] The various sonified elements of each urban system, from the ecological interaction sounds of the environment and transport systems, to the iconic sounds of the activity system and the sounding objects of the urban design system, can be heard in the interactive audio-visual masterplan of Figure 6.2.

Figure 6.2 An Interactive Masterplan of Paris featuring its various urban systems: Environment; Transport; Activity; Urban Design
[Maps generated from open data provided by the Mairie de Paris and ile de France]

6.11 An urban orchestra

The problem of the increasing complexity of our contemporary cities is, as evident from listening to our own urban soundscapes, the production of noise. This makes it very difficult for the rhythmanalyst to differentiate between the different urban rhythms. However, when we listen to orchestral music it is still possible, despite the variety of instruments, to tell them apart: this is largely thanks to the ear's ability to differentiate between timbre.[21] For example, we can distinguish the woodwind section from the brass, and even the individual instruments within a section, such as a flute from a clarinet. Each section has its own timbral qualities due to its mode of sound production: the strings produce sound due to the vibration of their chords; the woodwind due to the vibration of air in their different length tubes; and the percussion through the impact of two objects. We can thus utilise these various modes of sound making in order to differentiate between the different urban systems of environment, transport, activity and urban design. To do so I created a series of 'urban instruments'[22] for each urban system which, together, formed an *urban orchestra* that could play the urban symphony that is our city. The different urban instruments allow us to distinguish each of the urban systems in Figure 6.2 from one another.

6.12 A Sonified Urban Masterplan for Paris

Thus, armed with the SUM tool and an urban orchestra to play it, I applied it to the city in which I was living and generated a Sonified Urban Masterplan for Paris. Gathering the urban data of its various urban systems – environment, transport, activity and urban design – I mapped these to the urban sounds I had designed. I could then use this audible masterplan to listen to the rhythmic composition of one path, such as a street, or the various rhythms that flow through one place over a period of time. I could also play different combinations of urban systems together, for example the transport network and activity system, in order to hear the relationships between them. With rhythmanalysis being a personal endeavour, I sonified a well-known boulevard in central Paris which featured in my daily journey from work to home. The eurhythmia of this journey can be heard in my sonification of Boulevard de Sébastopol in Figure 6.3.

Figure 6.3 Sonification of Boulevard de Sébastopol, Paris

6.13 Listening to the rhythms of Paris

My sonification of Boulevard de Sébastopol attracted a range of responses when presented to members of the general public, including its ability to provoke feelings of emotion and recognition; represent temporality and movement; communicate urban data; and increase rhythmic awareness through embodied experience.[23]

Embodiment of temporal movement

The sonification was recognised for its capacity to represent travel and movement in a more experiential way, through its ability to give a sense of timing that was likened to the physical movement itself.[24] Feelings of embodiment were reported, with one cyclist able to associate the rhythms heard with their own experience of travelling at a similar tempo, including the associated rhythmic qualities of density, repetition and variation.[25] Furthermore, the tempo and duration of the sonification was also said to be useful in understanding spatial distances, which are often difficult to understand from spatial representation alone.[26]

Plurality and polyphony

The plurality of the city, and its variety of urban dimensions that comprise the urban dynamic, was also said to be an element not normally revealed in the graphic urban masterplan. Described as the 'life' of the city, the sonification represented both how the city was used by its inhabitants, and the change of activities over time: 'The fact that the city is alive, that there are things that happen and change, that walking in a street you can see many different things from one square to the other and discover things.'[27] Thus, in addition to communicating the rhythms of its physical urban structure, the sonification was able to communicate the social dimensions of the city, providing a 'much deeper experience' than simply looking at a map.[28]

Emotional response

The Sonified Urban Masterplan was recognised as a tool 'capable of triggering powerful emotions'.[29] Those who were familiar with the area claimed to have feelings of recognition,[30] and to have been 'transported' back to the street and able to 'relive' their experiences with greater awareness.[31] Those who were not familiar with it described how the sonification helped them imagine what it would be like to be there.[32] It inspired an interest in listening to other places, the curiosity to interpret more paths, and the desire to learn more about the composition of the city. Several participants also referred to it as a 'musical composition',[33] which can be seen to reflect the relative musicality of the street's urban composition.

Other advantages

Further advantages of incorporating sound in urban representation in general were acknowledged, such as the ability of sound to represent the smaller-scaled details that would make the graphic masterplan 'very noisy and impossible to communicate with'.[34] While largely an issue of scale, it was also due to the polyphonic ability of sound to represent multiple data layers at once: 'While visually you can only focus on one thing, aurally you can have more than one input.'[35] Furthermore, the communication of the data was more immediate, with the ability to avoid '… frequent references to the legend.'[36] Overall, the sonified masterplan can thus be considered to be both an 'informative' and 'enriching' addition to the traditional graphic plan.

6.14 Towards a 'sonified' rhythmanalysis

The Sonified Urban Masterplan of Paris demonstrates the great potential sonification can play in urban representation, and in particular the representation of urban rhythm. These initial responses demonstrate the ability of sound to communicate the rhythms and experience of urban movement on a physiological, emotional and intellectual level. By encouraging the act of listening – not only to our city's soundscape, but to the way in which it makes us move – the Sonified Urban Masterplan highlights the role urban design plays in the composition of our urban experience.

These responses demonstrate the ability of sonification to represent temporality and polyphony, and ultimately, urban rhythm, making it a useful tool in rhythmanalysis. In fact, being a systematic and objective process itself, it lends itself to the advancement of Lefebvre's 'analytical science' of rhythm. By applying the Sonified Urban Masterplan to the sonification of our own everyday urban rhythms, it can help us gain a rhythmic insight into the temporal composition of our own lives, producing what can essentially be seen as a 'sonified rhythmanalysis'.[37] As one participant noted, 'Listening to the transposition in sound of the monuments, offices, markets, trees of Boulevard de Sébastopol opened me up to the possibility that this manner of interpreting the urban dimension may in fact help to develop a deeper understanding of the city in which I live.'[38]

6.15 Rhythmanalysis: a personal experience

As much as we can understand urban rhythms by listening to the experiences of others, rhythmanalysis is inherently a personal experience. Thus we each need to listen to our own rhythms in order to understand the effect of our urban environments on ourselves. So take a moment to think of the rhythm of your street and those of your everyday life: *What would these rhythms sound like if you could sonify them? What would be the music of your life?* Now living in London, the rhythm of my day is completely different as I find myself dependent on the bus system. The tempo of its transport rhythms can vary quite dramatically according to the traffic conditions on the day, with the overall journey ranging from 20 minutes to over an hour. Furthermore, the rhythms of the urban design elements evolve with the changing function of each street. The irregularity of these various transport, activity and urban design rhythms can be heard in my sonification of Kennington Road in Figure 6.4.[39]

Figure 6.4 Sonification of Kennington Road, London

6.16 Summary: Sonifying Paris

This chapter demonstrates the potential for sound and 'music' to represent urban rhythm and thus aid our understanding of a city's rhythmicity. Through the sonification of the graphic urban masterplan in particular, we were able to literally play the urban symphony that we design on paper, just like the graphic music score that inspired it. The Sonified Urban Masterplan tool thus allows us to not only articulate the rhythms we design in time as well as space, but to represent these spatio-temporal urban relationships both quantitatively and qualitatively. The corporeality offered by sound allowed us to listen to them, embody and understand them. Furthermore, it allowed these rhythms to be communicated to a wider audience, creating a common platform for the discussion of urban issues. Thus by applying sonification to Lefebvre's theory of rhythmanalysis, we have essentially transformed it into a practice that can be captured, expressed, embodied and shared: bringing it one step closer to the development of the 'analytical science' he proposed.

Notes

1 Bosselmann, P., Gilson, K., 'Visualizing Urban Form', *proceedings of the 1° European Architectural Endoscopic Association Conference,* Tampere Finland, 1993, 9–30.
2 Bosselmann et al., 1993, 10.

3 '… to capture a rhythm one needs to have been captured by it…Just as in music.', Lefebvre, H., *Writings on Cities*, Kofman E. and Lebas E. (trans. and eds.), Basil Blackwell, Oxford, 1996, 219.
4 Some examples of soundmaps include: NoiseTube http://www.noisetube.net/#&panel1-3 [Accessed May 2013]; and Le Montre Verte http://www.lemonde-des-plantes.com/montre-verte/ [Accessed May 2013].
5 Kramer, G., 'Some organizing principles for representing data with sound.' In Kramer, G. (ed.), *Auditory Display – Sonification, Audification, and Auditory Interfaces*, Addison Wesley, Reading, 1994, 185–221.
6 Kramer, G., 1994, 52–3.
7 Kubovy, M., Schutz, M., *Audio-Visual Objects,* Review of Philosophy and Psychology, March 2010, vol.1, issue 1, 41–61
8 de Götzen, A., Polotti, P., and Rocchesso, D., 'Sound Design and Auditory Displays.' In: Polotti, P., Rocchesso, D., (Eds.), *Sound To Sense, Sense To Sound – A State Of The Art in Sound and Music Computing,* Logos Verlag, Berlin, Germany, 2008, 418.
9 Hermann T., 'Taxonomy and Definitions for Sonification and Auditory Display' in: Susini P, Warusfel O, eds. *Proceedings of the 14th International Conference on Auditory Display (ICAD 2008)*. Paris, France: IRCAM; 2008.
10 Dayé, C., de Campo, 'Sounds sequential: sonification in the social sciences', in *Interdisciplinary Science Reviews*, 2006, vol.31, no.4, 354.
11 Ferguson, S., Martens, W., Cabrera, D., in Hermann, T., Hunt, A., Neuhoff, J., (Eds), *The Sonification Handbook,* Logos Verlag, Berlin, Germany, 2011, 178.
12 Music, as discussed in Chapter 5, is defined as 'organised sound' and in sonification, the sound is inherently organised by the dataset that informs it.
13 As advocated by Tractinsky et al., in Tractinsky N., Katz A., Ikar D. (2000), 'What is beautiful is usable', in *Interact Comput* 13:127–45.
14 Laurson M., Kuuskankare M., Norilo V., *An Overview of PWGL, a Visual Programming Environment for Music*, In: Computer Music Journal, 2009, vol. 33, no.1, 19–31.
15 Ircam: Institut de Recherche et Coordination Acoustique/Musique, www.ircam.fr.
16 Details can be found in my thesis, Adhitya, S., *Sonifying Urban Rhythms: towards the spatio-temporal composition of the urban environment*. Ph.D Thesis, École des Hautes Études en Sciences Sociales, Ircam-Centre Pompidou, Paris, University IUAV of Venice, 2013. Available from: http://discovery.ucl.ac.uk/10027995/ [2 November 2017].
17 Adhitya, S. & Kuuskankare, M., 'The Sonified Urban Masterplan (SUM) tool: Sonification for Urban Planning and Design', *Proceedings of the 17th International Conference on Auditory Display*, Budapest, 2011, Available from: http://hdl.handle.net/1853/51918 [24 Jun 2011].
18 McGookin, D., Brewster, S., Chapter 14: Earcons in Sonification Handbook, 2011, 350, in Adhitya, 2013, 94.
19 Much like hitting a percussion instrument. According to Rocchesso et al., 'ecological acoustic signals tell us a lot about how the objects interact with each other' in Rocchesso, D., Fontana, F. (eds), *The Sounding Object*, Mondo Estremo, 2003, 96 [Online]. Available from: http://www.soundobject.org
20 Recommended to enhance the effectiveness of a sonification by Trantinsky et al., 2000, and Susini et al., in Susini, P., Misdariis N., Lemaitre G., Houix O., 'Naturalness influences the perceived usability and pleasantness of an interface's sonic feedback', JMUI, vol. 5, n° 3, 2012.
21 Timbre is defined as the quality that distinguishes one instrument from another, Levitin, D., *This is your brain on music : understanding a human obsession*, Atlantic Books, London, 2006, 16.
22 Using various techniques of digital sound synthesis.
23 Adhitya, 2013, 112–19.
24 'It was more experiential than just looking at a graphical plan, gave me a sense of timing of a place in a similar way to physical travel.' Subject xxii, Appendix 4: Questionnaire 1: SUM as a representation tool, in Adhitya, 2013, 203–15.
25 'As a biker I did have some awareness that fitted well to the rhythms represented…' Subject iii, Appendix 4: Questionnaire 1, Adhitya, 2013.
26 'The pre-set pace also allows me to have an idea of distances. With a purely graphic map it is often hard to judge how long it would actually take me to walk or bike from one place to another – especially for an unfamiliar city.' Subject vii, Appendix 4: Questionnaire 1, Adhitya, 2013.
27 Subject xviii, Appendix 4: Questionnaire 1, Adhitya, 2013.

28 Subject vii, Appendix 4: Questionnaire 1, Adhitya, 2013.
29 Subject xxi, Appendix 4: Questionnaire 1, Adhitya, 2013.
30 'As the examples in the video are about places I've been to, I feel transported there and biking down Boulevard de Sebastopol but in a more aware fashion than I would normally do.' Subject vii, Appendix 4: Questionnaire 1, Adhitya, 2013.
31 'I lived in the area for 6 years and the analysis of Bld Sebastopol feels very familiar – many of the sounds evoke emotional feelings as they mimic the real sound' Subject xvii, Appendix 4: Questionnaire 1, Adhitya, 2013.
32 'Looking at the map and listening to the music simultaneously provoked visualisation of the journey.' Subject iv, Appendix 4: Questionnaire 1, Adhitya, 2013.
33 'like listening to a piece of music'. Subject i, Appendix 4: Questionnaire 1, Adhitya, 2013.
34 Subject xvii, Appendix 4: Questionnaire 1, Adhitya, 2013.
35 Subject x, Appendix 4: Questionnaire 1, Adhitya, 2013.
36 Subject vii, Appendix 4: Questionnaire 1, Adhitya, 2013.
37 A 'sonified rhythmanalysis' was first conducted for my doctoral thesis, whereby the main daily activities of different participants were mapped temporally, scaled proportionally in duration, and sonified using a simplified set of auditory icons. Adhitya, 2013, 120–9
38 Subject xiii, Appendix 4: Questionnaire 1, Adhitya, 2013.
39 Time-lapse video made in collaboration with animator Simon Ball. Funded by an Urban Research Award in Innovation & Leadership, UK Higher Education Innovation Fund (2016).

Chapter 7
Design

Having revealed the various rhythms embedded in the urban masterplan, we now attempt to compose them. While these rhythms have the potential to produce musical urban experiences, as heard in our Sonified Urban Masterplan of Paris, they are also in danger of producing more arrhythmic ones, such as the traffic jams and dead spaces discussed in Chapters 3 and 4. This can be attributed to the visual focus of architectural and urban design processes,[1] which inherently privilege the design of visual aesthetics and form over temporal and rhythmic experience. This calls for the need to develop our capacity for spatio-temporal design, not only through a more dynamic mode of urban representation, but also by applying more temporal approaches to their design. Thus having played the urban masterplan like a musical score, in Chapter 7 we attempt to compose it like one, and turn to the temporal art of music composition.

Music, as explored in Chapter 5, has both a cultural and biological connection to the way in which we move, being made for and by the human body. Rhythm in particular is said to help coordinate our movement, both individually and collectively,[2] making it a useful tool for the composition of urban movement. Recognising the potential of music to inform the design of our built environment, Goethe referred to architecture as 'frozen music',[3] inspiring works of architecture based on musical structures: from Xenakis's composition of the fenestration of the monastery of *La Tourette*;[4] to Steven Holl's *Stretto House* whose roof was inspired by the musical stretto.[5] While these compositional devices were applied to the buildings themselves, we can also apply them at the scale of the urban fabric to compose our urban movement.

This chapter is an exploration of the potential of music to inform urban design, proposing a new way of planning based on not just dimensions and distances, but also on rhythms and tempi. It explores how the multitemporality of music can help us respond to the challenge

for urban design to cater for our multitemporal needs, as suggested by Robert Levine in Chapter 4. In doing so, it questions the homogenous rhythms of built form produced by standardised processes, and instead suggests an urban design driven by the bodily rhythms embodied by music. Thus in this chapter, we ask: *what if we could compose our cities, just like a piece of music?*

7.1 Music composition and urban design

The connection between music composition and urban design can be drawn on both a functional and representational level: both are responsible for the composition of temporal experiences; and thus both must be able to symbolise temporal processes.[6] While one art form is clearly more successful in this endeavour than the other, common compositional characteristics can be identified in their respective graphic representation techniques. As recognised by urban designer Galia Hanoch-Roe: 'Each conventional score has a graphic dimension, which may indicate, without necessity of prior knowledge, aspects such as regularity of pulse, relative tempo, acceleration and deceleration of the pace, density of texture or instrumentation, and formal organization. Such terms also relate to architectural plans, which incorporate ideas of spatial pulsation, density of textures and inner pace.'[7] In fact, we could hear these musical characteristics of pulse, tempo, density, texture, instrumentation and pace in our Sonified Urban Masterplan of Paris in Chapter 6. However, not all streets are as musical as Boulevard de Sébastopol and the contemporary urban designer can learn a lot from the art of music composition. Thus in order to achieve a more 'fluid' urban design, Hanoch-Roe suggested the 'scoring' of urban design: referring to the symbolisation of its temporal processes, just like in music.[8]

7.2 Scoring urban design

Similarities between the scoring of music and urban design can be seen to have arisen from the development of the open graphic score in the mid-20th century, which opened up the singularity and linearity of conventional musical time and allowed music composition and performance to be approached from multiple temporal perspectives. In composing multiple temporal possibilities for his performer, Pierre Boulez likened his Third Piano Sonata (1958) to an urban plan: 'I have often compared

this work with the plan of a city. One does not change its design, one perceives exactly what it is, and there are different ways of going through it. One can choose one's own way through it, but there are certain traffic regulations.'[9] While Boulez still adhered to the conventions of traditional musical notation, composers such as John Cage brought this temporal freedom to the spatial realm, inventing their own graphic notation techniques, which paralleled the visual arts. This led to the development of the graphic musical score, which could be read spatially from any number of perspectives, causing Cage to compare the performer to a 'traveller trying to catch trains and departures, which have not been announced but are in the process of being announced'.[10]

Thus, strong similarities can be drawn between the role of the composer of the graphic score and the designer of an urban plan, rendering the essentially 'plan-like' open graphic score a useful tool in the composition of urban movement. In the following case study, which takes place in Perth, Western Australia, I develop a methodology for the scoring of urban design. In particular, I attempt to compose an urban masterplan like a graphic musical score, based on an existing piece of music. Thus this project is also an exploration of how music composition techniques can inform the spatio-temporal composition of our urban environment.

7.3 Revitalising the rhythms of Perth

I have the sprawl of Perth to thank for my desire to compose more musical cities. While the city in which I lived was composed for the rhythms of the car rather than the human body, it left me longing for something more interesting, more 'musical'. I found myself trapped between two spatial extremes: the undefined expanse of the suburbs, and the claustrophobic confines of the automobile; as well as the temporal extremes of the high-speed freeway and the traffic jam. Both extremes were not calibrated for the rhythms of the human body, and I got tired of waiting for the infrequent buses to arrive and bored while walking long distances of monotony. Due to its spatial composition, Perth was suffering from a number of the arrhythmic conditions discussed in Chapter 3: a case of boredom due to the lack of urban activity outside the city centre; high levels of traffic congestion, road rage and commuter amnesia due to a dependency on the car to access them; as well as a sense of placelessness generated by its homogenous, low-density sprawling urban fabric. Furthermore, the spatial separation

of activities due to zoning regulations generated a monophonic music, rather than the polyphony of mixed-use functions associated with more vibrant urban developments, and the temporal segregation of day-time and night-time activities left the city centre predominantly 'dead' after hours.[11] These long expanses of waiting, however, gave me time to wonder what life would be like if its rhythms were more *musical*, with a greater density and variety of activities, that would draw more people out of their cars and onto the streets.

These musical musings manifested themselves in my final year architecture project at the University of Western Australia: having succumbed to the spatial dominance of built form, I was left craving the temporality of music, and sought a way to reunite these spatial and temporal practices together. Thus I began to investigate the potential of music and its various compositional techniques to inform urban design, leading to the proposal of an urban design for Perth based on a piece of music. This experimental design project was thus an opportunity to see both what music had to offer my city, as well as how it could contribute to the development of a more spatio-temporal practice of urban design in general.

7.4 Composing Perth foreshore

My chosen site was the Perth foreshore: the large expanse of reclaimed land separating the city centre from its Swan River. At the time, the proposed destiny of the Perth foreshore was still up for debate, with numerous design competitions being held in previous years to no avail. A new Convention Centre had just been built to the west of the site and an adjacent train station was in the pipeline: yet this prime piece of real estate remained empty and lifeless, rendering the waterfront remarkably under-utilised for a culture defined by its strong connection to water. Furthermore, the relatively few riverside developments, such as the Barrack Street Jetty and its various urban activities, were disconnected from each other and undesirable to access on foot, particularly at night. It was clear that an urban revitalisation strategy for this important site was called for: one which could unite the city centre to the north, the river to the south, and the native bushland, Kings Park, to the east, as shown in Figure 7.1.

Figure 7.1 Site plan - 1) existing conditions Landscape (Green), Urban (Red), Water (Blue)

[Map data: Google, Digital Globe, Europa Technologies, 2006]

7.5 A 'musical' urban strategy

Around the same time, there was a separate call for a new performing arts precinct, comprising an opera house, a dance theatre and a home for the West Australian Symphony Orchestra. The prominent location of the iconic Perth Concert Hall, not only central but raised among the sea of office buildings to the north as it overlooked the river to the south, made it an obvious choice for the beginnings of such a musical precinct. Thus my proposed urban strategy adopted both a musical function as well as form: I proposed the creation of a 'musical' pedestrian path along the riverfront, beginning at the Convention Centre and future train station to the west, and leading up to the centralised Concert Hall with its raised podium. Such a path would not only connect the two main attractions, but also the existing disparate riverside activities to each other, and hopefully encourage the generation of urban activity along the waterfront in the future. Furthermore, the day- and night-time activities associated with a performing arts precinct would help activate the city over time. I also chose to respect the natural amenities of the site, retaining the existing landscaped areas as such, while enhancing the connection between landscape and water to the east of the site. While relatively straightforward in principle, as indicated in Figure 7.2, the way in which I would realise this strategy was less so. The intention was to use music to drive the urban design itself, requiring a methodology for translating sound into space.

Figure 7.2 Site plan - 2) proposed strategy Landscape (Green), Urban (Red), Water (Blue)

[Map data: Google, DigitalGlobe, Europa Technologies, 2006]

7.6 Site-specific music: *Left Edge*

My first question, critical to the end result, was *what music to use*? This would inevitably influence the design outcome. I wanted it to be a composition that was specific to Perth, in order to be culturally meaningful. However, it had to be accessible by the everyday listener in order to be understood. More importantly, in order to play a positive role in transforming Perth into the place we wanted it to become, it also had to represent our desires for the city's future.

I was fortunate enough to find these musical requirements in *Left Edge*,[12] a short orchestral piece written by West Australian composer Iain Grandage, performed by the West Australian Symphony Orchestra, and commissioned by the WA Tourism Commission as part of its advertising campaign at the time. The piece was essentially a soundtrack to a visual essay of images of Western Australia, aimed at both a local and international audience. With this in mind, Grandage utilised descriptive compositional techniques that communicate three important aspects of Perth: A) its vast landscape; B) its vibrant (or soon to be vibrant) urban life; and C) its close relationship with the water: the same three themes which were found embodied by the site itself (Figure 7.1). *Left Edge* was acclaimed as having successfully captured the essence of Western Australia in music[13] and, listening to the rhythms of this soundtrack (Figure 7.3), it was not hard to imagine what they were describing.

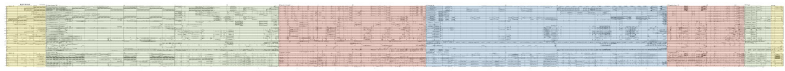


Figure 7.3 Musical score of *Left Edge* showing thematic structure: A. Landscape (green), B. Urban (red), C. Water (blue) [Score: Iain Grandage + editing]

7.7 From sound to space

Inspired by the potential of *Left Edge* to regenerate the site, I first needed to render its temporal organisation of sound visible to the untrained eye, revealing its compositional characteristics of pulse, tempo, density, instrumentation and texture as previously identified by Hanoch-Roe. I began to decompose the music notation conventions utilised by Grandage, consisting of its various musical staves and clefs (Figure 7.3), and map these individual musical parts into one simple graph of pitch over time, which could be understood by both designer and musician.[14]

Through this process of visualisation, the overall distribution of sound over time was revealed: high versus low, short versus long. The differences between the various themes could not only be heard, but seen (see Figure 7.4). Each theme had clearly defined characteristics, making the structure of the piece quite evident. The landscape theme, consisting of long, sustained notes and minimal leaps in pitch, began to resemble the vast West Australian landscape (section A). Three distinct melodies could be heard and seen, each repeated with a slight variation detectable both by eye and ear, and forming three distinct landforms. This was juxtaposed against the urban theme, composed twice as fast and in syncopation to the beat, thus appearing instantly more lively. When visualised, the high-pitched, punctuating chords formed an uncanny resemblance to tall, thin skyscrapers (section B). In contrast, the cyclical rhythms of the water theme generated a more fluid musical line, which reflected the undulating waves of the ocean (section C). Descriptive in nature, the music took on a similar morphology to the forms it was describing, and the compositional similarities between sonic modes of expression and those more visual became apparent.

Figure 7.4 Interactive musical score of Left Edge showing visualisation of each theme with accompanying music A) Landscape B) Urban C) Water [Images: Sara Adhitya; Audio: Iain Grandage's Left Edge recorded by the West Australian Symphony Orchestra conducted by Peter Moore and used with permission]

7.8 Applying the landscape music

Once spatialised, I could then apply the music thematically to the site, according to the urban strategy proposed in Figure 7.2. However, in order to be able to generate a similar rhythmic experience to those heard, maintaining the existing temporal relationships was key. Thus I first created a scaling system based on time rather than space, allowing me to measure the graphical space of the existing masterplan in musical beats rather than metres. The landscape theme, being half the tempo of the urban theme, meant that it had to be applied at twice its spatial scale in order to maintain this temporal relationship. Thus, at the speed of the car (60km/h), this meant that one beat was equal to 6m in length for the landscape tempo, and only 3m for the urban tempo, generating the 'temporal grid' depicted in Figure 7.5.

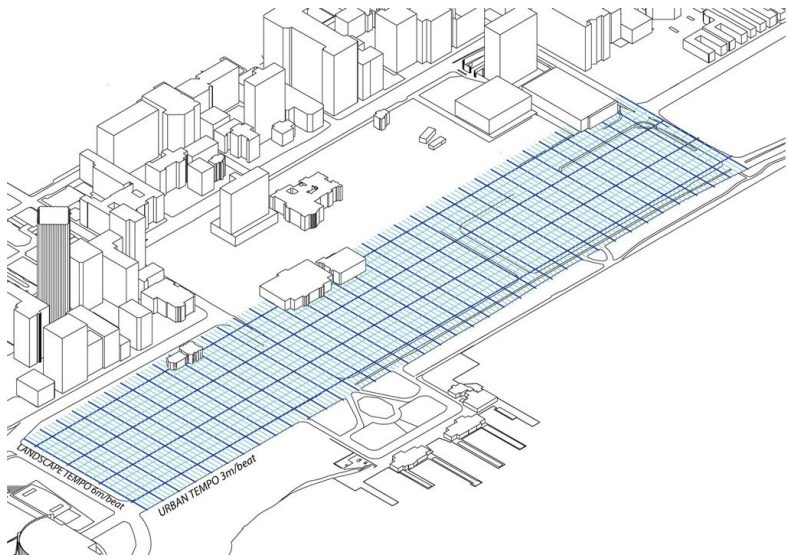


Figure 7.5 Temporal grid indicating urban tempo at twice the landscape tempo (3m x 6m at 60 km/h)

I also had to work with the existing 'traffic regulations' of the site, as suggested by Boulez. These included its road layout and speed limits, which restricted how the site could be moved through and thus how the music could be experienced. The existing one-way roads connecting the city to the river each lent themselves to the experience of each of the three landscape melodies while driving alongside each of the three landscape

areas. The tension generated by each drawn-out melody and its repetition was used to form the contours of each landscaped area, inspired by the songlines of the Australian Aborigines (see Figure 7.6).[15]

These drawn-out landscape melodies contributed to the impressive land formations visible from the road. In contrast, the impressionistic harmonies of the flutes, reflective of the changing light of native trees, became tree-like structures that shaded pedestrians traversing this vast landscape from the hot Australian sun. I also utilised the distinctive sound of the Aboriginal didgeridoo that features in this theme to create an indigenous path which could guide the pedestrian through it.

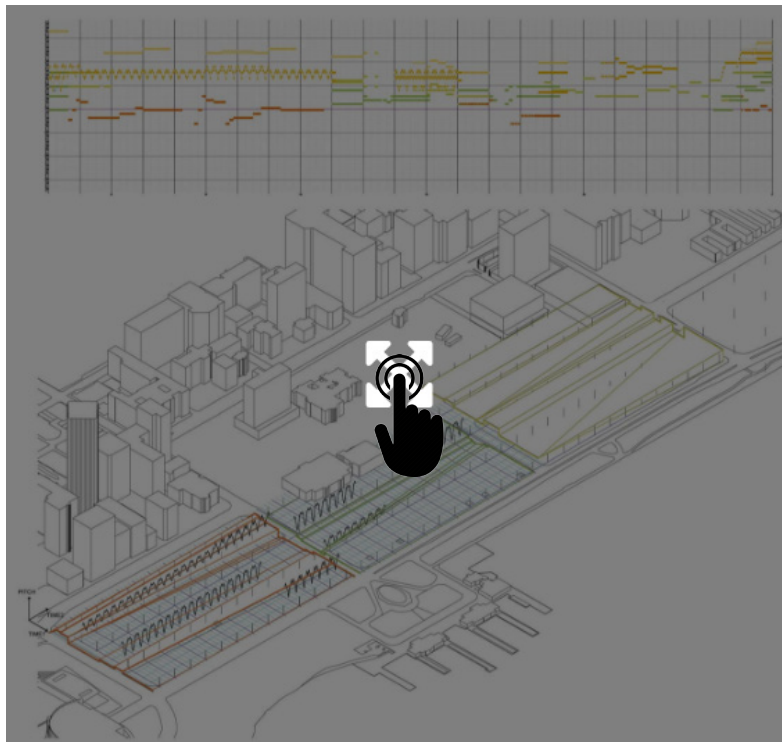


Figure 7.6 Application of landscape theme to site [Audio: Iain Grandage's *Left Edge* recorded by the West Australian Symphony Orchestra conducted by Peter Moore and used with permission]

7.9 Applying the urban music

With the objective being to revitalise the riverfront by linking its disparate urban activities, I then applied the urban music along the existing riverside drive that connected them. Respecting that it was twice the speed of the landscape theme, I applied it according to the temporal grid of Figure 7.5, and at this temporal scale of 3m per beat, the music conveniently spanned from the Convention Centre to the Concert Hall. Conscious of the need to be accessible to the pedestrian, I also applied it at a walkable scale: a semitone became a single step, which allowed the rising violin harmonies to form a gradually climbing walkway. By the time the urban theme had reached its climax, these harmonies had successfully transported the pedestrian from the ground level to the raised level of the Concert Hall. At this same scale, one octave (comprising 12 semitones) could form the space between two floors, and the multiple octaves used by Grandage to reinforce the feeling of urban density manifested themselves as multistorey buildings. The sustained chords of the brass instruments generated more solid building structures along this path, while the short, sharp syncopation of the woodwinds articulated the waterfront with transparent lookout towers (see Figure 7.7).

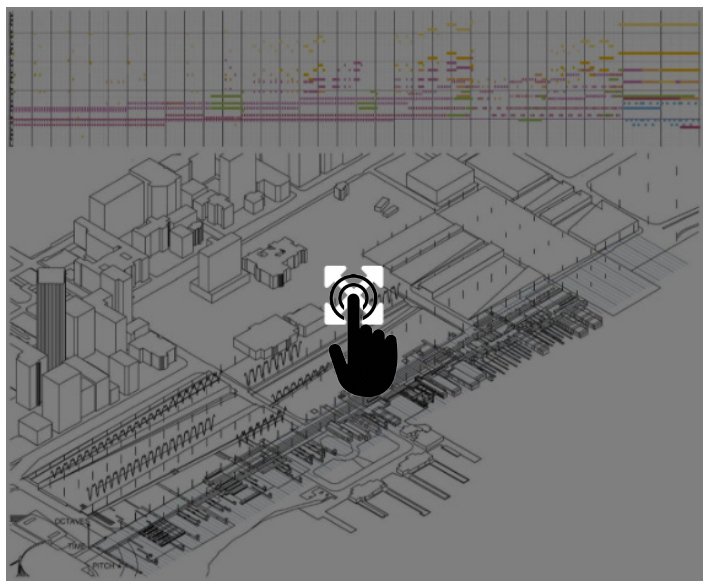


Figure 7.7 Application of urban theme to site [Audio: Iain Grandage's *Left Edge* recorded by the West Australian Symphony Orchestra conducted by Peter Moore and used with permission]

7.10 Applying the water music

The water theme, defined by its cyclical rhythmic motif mimicking the motion of the ocean waves, was intended to activate the water's edge to the east of the Concert Hall and lead both car and pedestrian towards it. Composed at the same tempo as the landscape theme, the music was applied at a similar spatial scale of 6m per beat. The cyclical rhythm of the marimba that was featured throughout dictated the position of the street lights (at the speed of the car), with the objective being to animate the driver experience along the riverside road. At the same time, a similar scaling system was applied to the urban path, with each semitone contributing to the generation of pedestrian walkways leading once again to the raised level of the Concert Hall. The sustained violin melodies were transformed into pedestrian pontoons, which extended into the water as they rose in pitch, and were conveniently shaded by the harmonics hovering an octave above them. They were articulated by the high-pitched piccolo part a few octaves above, forming multi-storey lookout towers providing prime river views, while the lower, sustained harmonies created long pools of water in the adjacent park (see Figure 7.8).

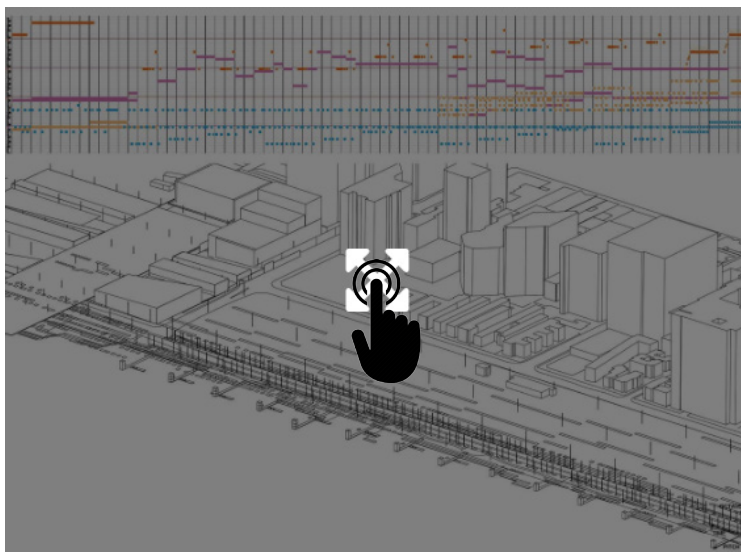


Figure 7.8 Application of water theme to site [Audio: Iain Grandage's *Left Edge* recorded by the West Australian Symphony Orchestra conducted by Peter Moore and used with permission]

7.11 A musical masterplan for Perth

These three musical themes each arrived strategically in front of the existing Perth Concert Hall, where the intersection of their various forms contributed to the urban design of the performing arts precinct: the primary functions were housed within the contours of the landscape theme; the architectural detailing was articulated by the water rhythms; and the various urban design elements were activated by the rhythms of the urban theme.

Explore Figure 7.9 to see how the various musical elements of *Left Edge* were transformed into a musical masterplan for the Perth Foreshore.

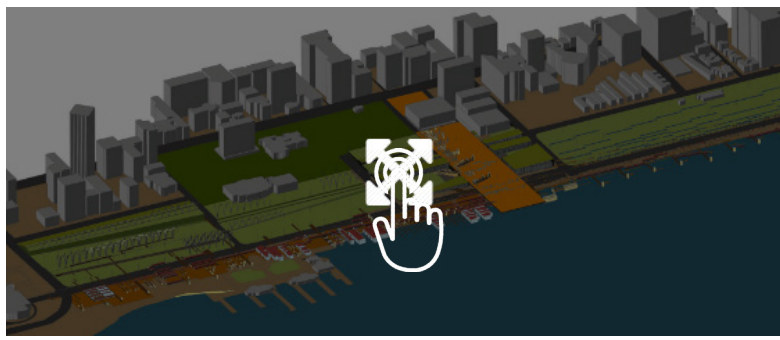


Figure 7.9 Interactive musical masterplan showing urban design interpretation. Click on the numbered hotspots to view design details. [Audio: Iain Grandage's *Left Edge* recorded by the West Australian Symphony Orchestra conducted by Peter Moore and used with permission]

7.12 Summary: Composing Perth

This project began as an exploration of the potential for music to inform urban design, through the representation technique of the graphic score, and Grandage's site-specific composition *Left Edge* showed us that music composition has much to offer. The parallels between sonic and visual compositional techniques were apparent from their initial graphical representation, with striking similarities seen between each musical theme and its object of description. This contributed to the generation of built form composed at an appropriate pulse, rhythm, density, texture and instrumentation for each contrasting site condition: landscape, urban or water.

Furthermore, the various musical tempi of each theme could be applied at multiple spatial scales in order to respond to the multitemporal challenge of catering for the speeds of different travelers. For example, the rhythms of the water were expressed in the form of light poles along the riverside drive at the speed of the car, offering the driver a more musical 'view from the road'.[16] At the same time, they were expressed in the fenestration of the performing arts precinct and the balustrading along the urban path, where it could be used to animate the movement of the pedestrian. By applying these musical rhythms at multiple temporal scales, it became possible to create stimulating urban experiences for all its urban performers.

By scoring the masterplan of the Perth Foreshore, repetitive building standards were broken as new 'musical' rules were established. Rather than succumbing to the processes of standardisation and prefabrication, attributable to the production of homogeneous and unmemorable experiences, we drew on more musical processes that could stimulate and animate the listener. By carefully selecting the site-specific piece of *Left Edge,* acclaimed to have successfully captured the essence of Western Australia in sound, I was able to regenerate the site with rhythms that could also contribute to its sense of place.

Almost ten years after its conception, this project was featured in a retrospective exhibition of the most memorable architectural projects developed at the University of Western Australia.[17] Thus, while the destiny of the site has since been decided,[18] *Left Edge* still leaves us wondering what life could be like if we could *compose* it like a piece of music.

Notes

1 Described as ocularcentrism in Pallasmaa, J., *The Eyes of the Skin – Architecture and the Senses*, John Wiley & Sons Ltd, UK, 2012, 21.
2 Sacks, O., *Musicophilia: Tales of music and the brain*, Picador, UK, 2008, 260–8.
3 Johann Wolfgang von Goethe, *Conversation with Eckermann* (March 23, 1829).
4 Le Corbusier, Sainte Marie de La Tourette, Eveux, France, 1960.
5 Stretto refers to the close succession, or overlapping, of a musical subject.
6 Halperin, L., *The RSVP Cycles: Creative Processes in the Human Environment*, Braziller, Inc., New York, 1969, 1.
7 Hanoch-Roe, G., *Musical Space and Architectural Time: Open Scoring Versus Linear Processes*, IRASM 34, 2003, Vol. 2, 157.
8 Hanoch-Roe, 2003, 157.
9 Boulez, P., *Third Piano Sonata*, 1958.
10 Hanoch-Roe, 2003, 156.
11 Spagnolo, Joe, *Why Perth is 'dying'*, The Sunday Times, 2006, http://www.perthnow.com.au.
12 Programme notes by Iain Grandage: *'Left Edge* was commissioned by the WA Tourism Commission to accompany images of Western Australia. From its vast landscapes and

glistening oceans to the urban attractions of Perth and its orchestra, Western Australia is represented in an aural world that attempts to mix Hollywood with ideas more Australian. Its themes are based on musical lines that contract to a single point – not dissimilar to watching the sun disappear over the horizon – themes which are played over harmonies that make reference to Sculthorpe and utilise the ubiquitous didgeridoo. The ocean plays a large part in the lives of Western Australians, and the soft central section of the work is inspired by some of the beautiful underwater experiences that the western coastline offers. The title not only refers to WA's geographical location but, being music for film, also echoes the "Top, Left Edge" call of the conductor so often heard in recording sessions for the screen.' http://www.iaingrandage.com/works/left-edge/ [Accessed 16 May 2017].

13 Tourism Western Australia, *Original WASO composition helps Western Australia to shine*, 16 September 2004 [Accessed from www.westernaustralia.com 14 July 2006].

14 Also known as a 'piano-roll'.

15 Chatwin, B., *The Songlines*, Franklin Press, UK, 1987.

16 Appleyard, D., Lynch, K., and Myer, J.R., *The View from the Road*, MIT Press, Cambridge MA, 1964.

17 Adhitya, S., 'Music, Architecture & Urbanism: Investigating the relationship', in *UWA Architecture: The First 50 Years 1965–2015,* Retrospective Exhibition, Cullity Gallery, The University of Western Australia, 2015, 162–3.

18 Phase 1 *Elizabeth Quay* was completed in early 2016.

Chapter 8
Performance

In order to hear the music of our cities, it needs to be performed and, as discussed in Part 1, we cannot help but perform it as we go about our everyday lives. In 1623, Shakespeare infamously summarised life as a performance: 'All the world's a stage, And all the men and women merely players';[1] and this description is still just as relevant today as we continue to play our parts in contemporary urban society. Thus in our urban performance, the city is our stage: its architecture, landscaping and urban design elements, as well as the other performers around us, encourage us to perform in a certain way; it influences how we move, how we feel and how we behave. This is because, as discussed in Chapters 2 and 3, our surrounding environments entrain us – physically and emotionally – through their own rhythmic features, just like in music.[2] Through the process of dressage, our cities train our bodily movements, and through the process of entrainment, we cannot help but let it. With the ability to affect the rhythm of our movement and even our emotions, we should not underestimate the role of our built environment in informing our urban performances.

Unfortunately this urban stage is often an uninspiring one, rendering our everyday performances mundane and boring. Imagine if this stage could help us express ourselves – our bodies and our rhythms – to the best of our abilities. The following performance, entitled *Entrainment*, is an exploration of how architecture can help play a more dynamic role in our everyday entrainment. In particular, we attempt to bring to life the everyday rhythms of the Venetian architectural family Pastor through a site-specific performance set in the family's home studio. Through the rhythmic arts of dance and music, we explore the relationship between the external rhythms of the city and its architecture, and the internal rhythms of its inhabitants.

8.1 A 'serendipitous' encounter

I first encountered Studio Pastor serendipitously during my doctoral studies at the Instituto Universitario d'Architettura di Venezia in 2010. Michela Marino, ballerina and friend (and soon-to-be partner-in-crime), was showing me the location of her new apartment. Next to her future front door happened to be another, which enticed us to peer through to what appeared to be an architecture studio, and, almost as if expecting us, the door opened. We found the Pastor family of architects – Valeriano, his wife Michelina, and their daughter Barbara – waiting for us in the adjoining space behind it, almost as if we had a prearranged appointment. And so the connection was made: not through phone calls or emails but, as we were to discover, through much effort in restoring the original urban fabric.

Figure 8.1 The door which enticed us

8.2 A connected urban fabric

We discovered that the studio was a seventeenth-century palazzo initially built for Venetian merchants, and restored in 2007 as the studio and home of the Pastor family by the architects themselves. Due to their strong relationship with the city and commitment to their role as architects and designers of the public domain, the Pastors had taken it upon themselves to reconnect the palazzo with its surrounding urban fabric. They had restored many of the doors and windows that had been walled-up, our own door of entry included, and liberated the internal space of the palazzo to allow a clear line of sight from the campo (a Venetian piazza) to the east, through to the canal to the west (Figure 8.2). This not only allowed the architects to look outwards, towards the rhythms of the urban space (Figure 8.3.1), but invited curious passers-by to look inwards (Figure 8.3.2). Thus it was not by chance that we found ourselves here, at the intersection of inside and out: our journey had been choreographed. More details of the palazzo and the architects' interventions can be watched in Figure 8.5 (Scene 4).

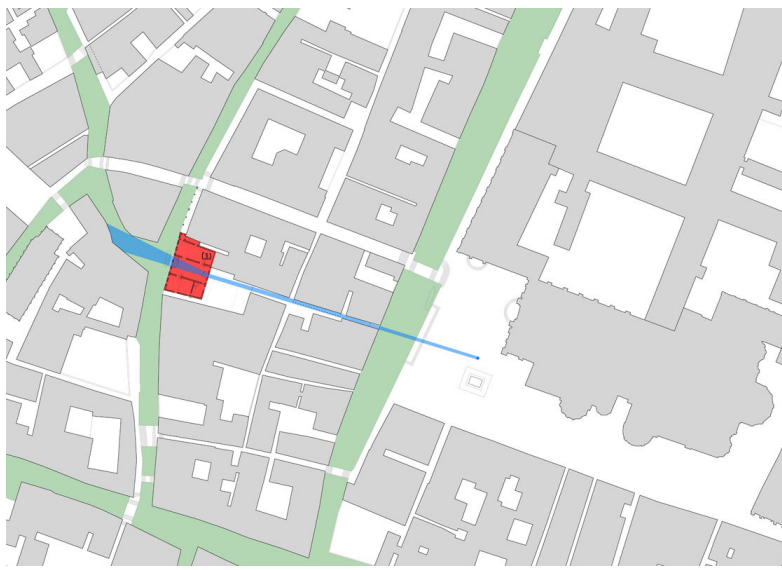


Figure 8.2 Site plan showing the line of sight between the campo (white), the studio (red) and the canal (green) [Image: Studio Pastor Architetti Associati]

Figure 8.3 Connection to site 1) View looking outwards towards campo [Photo: Sara Adhitya] 2) View looking inwards towards studio [Photo: Daniele Resini]

8.3 Architecture as a stage

This connection between the inside world and outside environment was expressed in numerous ways, as can be seen in the interactive plan of Figure 8.4. A glass-enclosed deck brought the outside canal inside (1), and the reflective floor and ceiling brought its watery reflections further in, animating the space with constantly changing light (2). There were spiral staircases which wove together the neighbouring rooms and levels through the great open arches (3); the revolving lamps connected the various drawing tables in the design room (4), while the sliding ladder connected the book-lined wall (5); and the rotating bookshelves encouraged us to activate the space ourselves (6). These dynamic architectural elements animated each of the three naves and connected them with each other (7). As architect Barbara Pastor described how groups of visitors moved through the space as if performing a kind of dance, we both realised that the architecture had in fact become a stage. And so the seed was planted to create a performance using this very stage itself, expressing the rhythms the architecture had composed in the lives of the people who used it. Little did we know it at the time, but *Progetto Entrainment* had already begun.

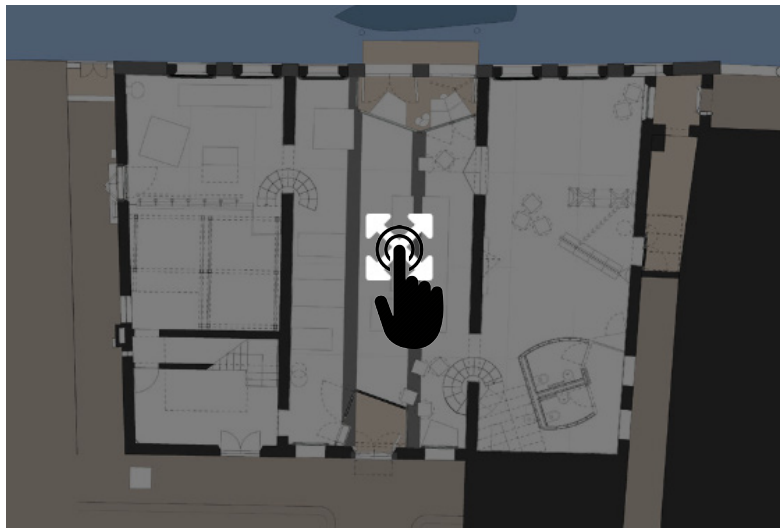


Figure 8.4 Interactive image plan of Studio Pastor showing photos of the architectural renovations. [Photos 1-6: Daniele Resini; Photo 7: Sara Adhitya]

8.4 A rhythmic exploration

The intention of the performance was to express the rhythms of the architectural space and the role it played in the lives of the Pastor family through music and dance, setting in motion its various dynamic elements through sound and movement. With each space having its own character and function, we wanted to highlight how these individual architectural elements worked to shape the rhythms of each space and the characters of the people using it.

We also wanted to explore other urban rhythms that connected with the studio: the internal rhythms of personal experiences, memories and emotions; the external rhythms that define our roles and functions; the rhythms of our natural and urban environments; and the rhythms of the past as well as those of the future. We hoped to express the Atelier's philosophy of listening to and engaging with the past in the design of the future, uniting the rhythms of both in the everyday. Their multitemporal design of the studio facilitated the simultaneous embodiment of the rhythms of past, present and future.[3]

8.5 A process of entrainment

The creative process was a rhythmic one in itself, evolving organically the more we got to know the studio and the studio got to know us. After hours turned into office hours, and the architects found themselves working alongside dancers warming up on the studio floor while I played the stairs like a percussion instrument. Over time, we became absorbed by the space and then by the family itself: Barbara's son Eduardo joined our warm-ups and was to play his role in life's performance, as the future of the family; while his grandmother, Michelina, a wealth of knowledge regarding the history of the place and its transformation over time, was to pass on her memories to the audience. We wanted to involve the family as much as possible in our process of discovery and soon it became a process of mutual exchange. Our will to reach out to one another became in fact a process of entrainment as we extended the range of our own personal rhythms to those around us. Soon we had established a rhythmic relationship with the space itself, using its compositional elements as the generator of our music and movement.

8.6 An embodied performance

We also wanted the audience members themselves to experience the various rhythms of the place, allowing their experience of the performance to be an embodied one: just like in the act of rhythmanalysis.[4] And so, in the composition of our performance, we led them on an itinerant journey through the various spaces of the studio, recreating the rhythms of each space through sound and movement. Wherever possible, we capitalised on the mobile nature of the architectural elements, literally 'playing' with the building and its various elements. We were essentially responding to what Pallasmaa identified as architecture's 'call for action'.[5] through its design, architecture encourages us to enact its rhythms and bring them to life.

8.7 Rhythmic components

There are four aspects involved in the creation of the performance, with each playing a role in the articulation of its rhythmic composition:

- The architecture – the stage of the performance
- The choreography – the movement of the body itself in space and time
- The dramatology – the story of the family and the history of the place
- The music – the resonance and sounds of the space itself.

8.8 The characters – personifying rhythm

There are six characters at play, with each character representing a particular rhythm, expressed in words, gestures, music and dance:

- The young architects, Valeriano[6] and Michelina[7]
- The internal rhythm of Tension[8]
- The external rhythm of Observation[9]
- The rhythm of the Past, represented by Michelina Michelotto Pastor as herself
- The rhythm of the Future, represented by the grandson Eduardo as himself.

8.9 The scenes – choreographing rhythm

The performance consisted of a number of scenes, which can be watched sequentially in the interactive plan of Figure 8.5:

1. The courtyard – Il cortile

The courtyard is the introduction to the studio and the story, setting the scene by presenting the various external threads and putting them into perspective. Due to its outdoor nature, it was subject to the external rhythms of nature and this was reflected in our performance. Our inaugural performance, held in late November 2010, profited from falling snow and provided us with a magical opening scene. However, by February of the following year, the snow had ended and we were left to our own devices to represent these environmental rhythms. In its place, we constructed a network of threads which linked the existing trees: the threads composed the movement of the dancers, and in turn the rhythms of their dance wove them together like the various threads of the story about to unfold.

2. Loss – La mancanza

The glass cage, which separates the studio from the canal, represents loss, abandonment and issues of communication. The separation created by the glass wall solicits a call for help from the rhythm of Tension, who is trapped within it. However, destruction is often necessary before renewal can occur, and she throws herself into the canal to end her misery. Furthermore, her loss becomes the driving force of desire: and so begins the story of a family's love for a place and for each other, and the desire to restore it back to life.

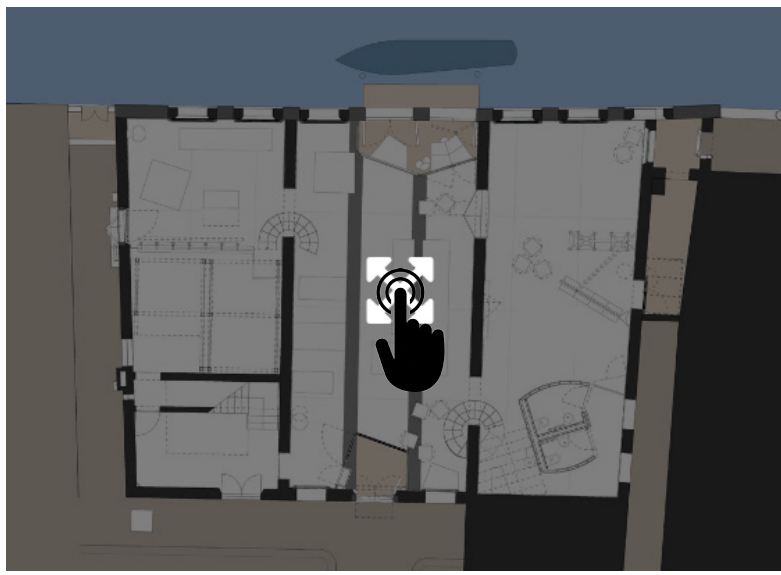


Figure 8.5 Interactive video plan showing video footage of the performance. Click on the numbered hotspots to watch each scene (note: scene 1 was not filmed). [Footage: Nicolò Scibilia; Film editing: Angela Lamont; Audio: various sources – see AV Credits for full details]

3. The meeting – L'incontro

The central space of the studio's 'meeting room' is the space where the young architects first meet and the project for restoration is inspired. The rhythm of the tango, embodied by the music of *Quizás Quizás Quizás*[10] (representative of the time) was used to express the emotional rhythms internalised by the two architects. Simultaneously, we are reminded of the exterior world and its external rhythms through the sounds of the studio space and its various pieces of equipment: a paper cutter, stapler and measuring tape. However, played in time to the rhythms of the music

and dance, they serve to reinforce the rhythm of the tango rather than detract from them, indicating through sound that entrainment has been achieved.

4. The archives – L'archivio

The audience is led up the spiral staircase, which passes through the arch from the meeting room to the mezzanine of the neighbouring design room. The raised level represents not only a different spatial, but temporal, plane, for it is here that the studio archives are stored. To a seated audience, the grandmother Michelina Michelotto Pastor recounts the history of the palazzo and presents the plans and images of its restoration. It is a scene of reflection, filled with the memories of another era.

5. The design process – Il processo di progettazione

The audience is then led back down to the design room, where the four stages of the design process are explained sequentially and in movement by the young architect Valeriano Pastor:

a. Drawing – *Il disegno:* First is the process of drawing, accompanied by the frantic sound of pencil on paper. Just like the two-dimensional piece of paper he draws on, he himself remains predominantly static, seated throughout.
b. Modelisation – *La modellizzazione:* Second is the process of modelisation, whose three dimensions are presented in the form of a break-dance: chosen for its ability to decompose movement. This 'urban' break-dance is used to model urban development over time – from advancements in transport infrastructure to the growth of society itself – and is accompanied by a recorded soundscape evolving from peaceful tranquility to noise and disorder. The architect becomes the embodiment of the urban rhythms he is designing: through the medium of dance, he demonstrates the affect of these rhythms on the human body. Exhausted by his efforts in creating such a world, the dance ends when arrhythmia is reached. Thus this scene also acts as a commentary on the nature of urban development and its physical, as well as acoustic, limitations.
c. Digitisation – *La digitalizzazione:* The computer is inevitably introduced in the design process, with digital technology extending our physical limits. First a new, strange instrument the architect

treats with wonder, it soon becomes the source of his frustration. The effect of the abstract rhythm of the digital computer on that of our physical body and mind increases over time. The prerecorded sounds of the computer, the Internet, printer and scanner, are first used musically and rhythmically, before building up to an arrhythmic disorder, which drives the architect to his limits. The scene ends in a sudden silence.

d. Research – *La ricerca:* In search of eurhythmia, and with his judgement clouded by the infinite possibilities and constraints of technology, the architect turns to the essential, and reminds himself of his original motivations and intentions. He goes to the book-lined wall, looking back in time as he ascends the sliding ladder towards the temporal plane of the archives. And while he searches, he regains his tranquility accompanied by the sounds of books and birds.

6. Inspiration – L'ispirazione

This search for inspiration leads him and the audience towards the rotating bookshelves where the muse is awaiting him with the promise of inspiration, accompanied by the music of *Odi et Amo*[11] (Hate and Love), whose multitemporal mix of digital voice and acoustic strings generates another world, described by the composer as 'the alchemy of total opposites'.[12] As reflected in the title of the book she holds, the role of the muse is to *Transport* us into this new world, and the ethereal rhythms of the music encourage the audience to let go of the rhythms of the present world and instead allow the rhythms of the future to guide them. Books begin to fall almost magically from the bookshelf to the ground, presenting ideas to the architect as he reads out their titles: one by one, a poem emerges: a rhythmic medium in itself.

La Poetica dello Spazio[13] – The poetics of space
Da cose nasce cose[14] – One thing leads to another
Le muse e il naufragio[15] – The muse and the shipwreck
La forma e il disincanto[16] – Form and disenchantment
L'arte del construire[17] – The art of construction
Tra aqua e aria[18] – Between water and air
Nelle città del mondo[19] – In the cities of the world
La città racconta[20] – The city recounts
Dove abitano gli emozioni[21] – Where the emotions live

7. Tension – La tensione

The poem transports us all to a moment of realisation and leads to the maturity of the project. Tension resurfaces in the suffering for one's art, represented by the sounds of grating nails on metal. During the process of realisation and implementation, Tension reaches her physical and psychological limit and arrhythmia sets in, manifest in the increasing urgency of her movements and breath, accompanied by the violent sounds of banging metal, the shrill sound of the flute, and her own gasps of breathlessness. However, after surpassing this limit, a personified unravelling of Tension occurs, accompanied by the music of rebirth played by the flute. Thus the fruits born from this suffering are passed onto the next generation, represented by the architect's grandson, Eduardo.

8. Resolution – La risoluzione

Tension's arrhythmia is resolved by Eduardo embracing Tension. In gathering the books of inspiration, he becomes the guardian of the future, and in carrying them back to the meeting room, he leads the other characters and the members of the audience with him. The cycle of the story comes to its close: physically, emotionally and rhythmically. The performance ends with all the personified rhythms linked in solidarity, with their individual breaths synchronised and accompanied by the soft and steady sound of the flute.

8.10 The music – articulating rhythm

As can be heard throughout the performance, the architecture not only inspired the choreography of the performance, but its soundtrack. I treated the studio as a work of *aural architecture*,[22] exploring the space acoustically, discovering points of resonance and playing the building itself like a musical instrument. Outside in the courtyard was a brick wall, with its own rhythms of materiality and texture, while in the centre was a covered well with the resonance of a timpani drum. Inside, the custom-made corten stairs were the highlight, whose vibrations spoke to me on my way up to the mezzanine, and whose tonality I discovered upon striking with a piece of bamboo. The balustrade and the top stair sang a minor sixth apart and were incorporated into the soundtrack of Scene 6 (Figure 8.6). Then there were the instruments that one finds in an architectural office: the giant paper cutter, the measuring tape and the

stapler all made great percussion instruments to accompany the tango of Scene 3. Listen to some of these sounds in the audio plan of Figure 8.6.

Recorded sounds from various sources were also utilised in Scene 5, which maps the evolution of the design process over time. The soft sound of pencil on paper preferred by architect Valeriano serves as a stark contrast to the digital sounds of the computer utilised by Barbara, whose discordance of loading, dialing, scanning and printing represent the increasing arrhythmia of our digital world. The sounds of urban transportation and activities, juxtaposed against those of the natural environment, also reflect the evolution of urban development. Finally, the traditional acoustic instrument of my flute served as the audible extension of my breath and the metronome of all other rhythms.

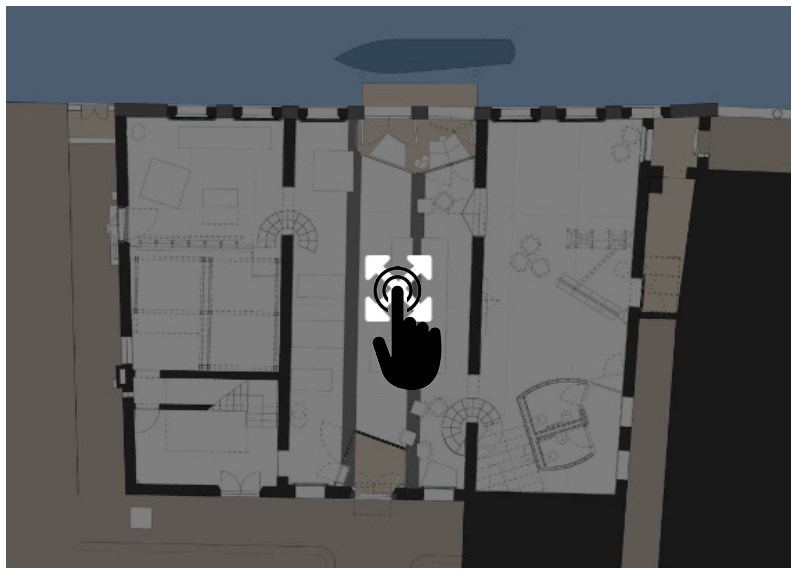


Figure 8.6 Interactive audio plan of Studio Pastor: featuring sounds recorded from the studio and utilised in the performance. Click on each numbered hotspot to listen to each sound.

8.11 The audience - rhythmic reactions

The feedback we received following our performance also indicated the emotional effect of the rhythms we created: one spectator claimed it had succeeded in touching one's most 'internal chords'[23] while another described the performance as 'resounding'.[24] Each member of the

audience was subject to their own internal bodily rhythms and, coincidentally or not, two people fainted on separate occasions during Scene 7. The emotions generated by the performance demonstrate the ability of the rhythms of others to impact on our own as we empathise through the process of entrainment.

8.12 Summary: Choreographing Venice

Progetto Entrainment can thus be seen as a performative response to the poetics of space: an attempt to capture the rhythms of architecture in sound and movement. In the same way that it demonstrates that dance is not made just for a theatre stage, it is also an example of how the production of music is not limited to just musical instruments. Rather, music and dance can become an integral part of our everyday urban lives: we only have to listen to our environments and explore their potential. And while not all buildings may be as 'musical' as Studio Pastor, *Progretto Entrainment* serves as an inspiration to design our future architectural and urban spaces in a more acoustic and dynamic way, with and for all our senses.

Progetto Entrainment is thus an example of how our everyday environment plays a role in our everyday lives; or rather, a demonstration of the potential of our everyday environments to play a greater role in our lives. Being designed by themselves, for themselves, Studio Pastor can thus be considered to have successfully achieved the person-environment fit discussed in Chapter 3. While subject to the rhythms of tension that come with their architectural practice, the space has the capacity to ease this tension through its own capacity to move. It is both dynamic and flexible, responding to the inhabitants' needs as required, and becoming the adaptive environment suggested by Robert Levine in Chapter 4. Furthermore, with each space having its own temporality, it achieves the multitemporality suggested by Lewis Mumford.

However, the architecture is not only concerned with the internal rhythms of the family, but invites those external rhythms of visitors from Venice and abroad, as well as curious passers-by like ourselves. Our 'serendipitous' encounter had been choreographed all along and it was only afterwards that I realised we had benefited from this restored connection between public and private; what architect Valeriano referred to as the Atelier's '*servizio urbano*'.[25]

Thus '*Entrainment*' has proved to be a fitting name for a number of reasons: from the way in which we met; to the creative process; the

performance itself; and our continued relationship with it. Through the process of entrainment, we shared, and continue to share ideas and creative rhythms, feeding the creative flow of the studio. Like a rhythm, it is a pleasure to return and perform the music of the day, the spatial composition just slightly differently each time. *Progetto Entrainment* is a reminder of the multitude of rhythms that compose our lives, and which we (as architects and urban designers) inherently compose. It highlights the role architecture plays in the staging of our urban performances and ultimately reminds us of the need to *listen*.

Notes

1 Shakespeare, W., *As You Like It*, 1623
2 See Chapter 5 for more details.
3 A manifestation of Juhani Pallasmaa's view of architecture as an instrument embodying multiple times: 'Architecture emancipates us from the embrace of the present and allows us to experience the slow, healing flow of time. Buildings and cities are instruments and museums of time. They enable us to see and understand the passing of history, and to participate in time cycles that surpass individual life.' Pallasmaa, J., *The eyes of the skin: Architecture and the senses*, John Wiley & Sons Ltd, UK, 2012, 56.
4 Entrainment Programme Note by Michela Marino and Sara Adhitya (translated from Italian): There is an internal rhythm that outlines our days according to a unique perspective: our own personal experience. It is a sleepwalking rhythm that weaves between memories and emotions. There is an external rhythm that resonates in our surroundings and defines our roles and functions. A rhythm in official evolution that brings with itself real change. There is a natural rhythm that accompanies us for generations. There is an artificial rhythm that draws us towards the future. Entrainment is when one rhythm tries to meet the other, giving birth to our history. We have decided to recount the story of Atelier Pastor, who embodies the will to engage the past in the design of the future. Listening. Here one does not impose a principle but considers the architectural element in its specific environment. In its specific era. Responding to current needs, but not betraying what was the original structure. We have decided to recount the story of the space, intertwining in various locations the history that it retains, emotions that have taken place in the course of the realization of the work and beyond, in the memories of those who lived those moments.
5 'It is this possibility of action that separates architecture from other forms of art. As a consequence of this implied action, a bodily reaction is an inseparable aspect of the experience of architecture. A meaningful architectural experience is not simply a series of retinal images.' Pallasmaa, 2012, 67
6 Performed by Luca Maestri.
7 Performed by Valentina Capraro.
8 Performed by Michela Marino.
9 Performed by the audience and with me as the sound designer.
10 Sung by Nat King Cole, Peer Publishing, 1958, music and lyrics by Osvaldo Farrés (1947).
11 Jóhann Jóhannsson, Odi et Amo, 2002.
12 Jóhann Jóhannsson, Englaborn, http://www.johannjohannsson.com/discography/englaborn/, [Accessed 24 April 2017].
13 Bachelard, Gaston, *La Poetica dello Spazio*.
14 Munari, Bruno, *Da cose nasce cose*.
15 Testa, Luciano, *Le muse e il naufragio*.
16 Zeto, Anfione, *La forma e il disincanto*.
17 di Pasquale, Salvatore, *L'arte del construire*.
18 de Carlo, Giancarlo, *Tra aqua e aria*.

19 de Carlo, Giancarlo, *Nelle città del mondo.*
20 Various authors, *La città racconta.*
21 Botta, Mario; Crepet, Paulo; *Dove abitano gli emozioni.*
22 Aural architecture is defined as 'the properties of a space that can be experienced by listening'. Blesser, B. & Salter, L., *Spaces Speak, Are You Listening? Experiencing Aural Architecture*, MIT Press, 2007, 5.
23 '*Lo spettacolo ci tocca nelle corde piu interne!*': 'The performance touches our most internal chords', Nicoletta.
24 '*É stato uno spettacolo strepitoso – mi ha veramente steso*' 'It was a resounding performance – it really knocked me out', Bianca (one of the audience members who fainted).
25 'urban service'.

Chapter 9
Implementation

In Chapter 8, we saw the potential of architecture as an instrument: an acoustic one that could be played through our physical interactions with it, as well as a dynamic one that guides our bodily motions and emotions. However, in the contemporary city, the 'built environment' no longer means that it is necessarily 'built'. Technological advancements in interaction design have changed the concept of materiality and we can now use the invisible medium of sound to create new types of urban 'spaces'. The soundscape of the contemporary city is no longer just the result of our physical interactions with it, as mechanical interactions give way to electrical and digital ones. This leaves us with new opportunities to design their sounds, such as the introduction of the silent electric car, which raises not only the question of its acoustic design in isolation, but potential contribution to the urban soundscape as a whole.[1] Thus, armed with both the opportunities and tools to compose it, we have a newfound responsibility, as both composers and performers, to render the 'macrocosmic music composition'[2] identified by R. Murray Schafer into something worth listening to. With developments in sound and music technology, we can literally embed our walls and floors with sound and address Chapter 4's call to make them more interactive and responsive to our needs.

9.1 Sonic interaction design

One tool that we can use to both compose and perform our soundscapes is the emerging field of sonic interaction design (SID). An interdisciplinary field at the intersection of sound and music computing (SMC) and interaction design in general, it draws on research concerning the connection between action and sonic feedback, and explores how sound can be used

to convey information, meaning and aesthetic and emotional qualities through interactive means. The overall aim of sonic interaction design is to enhance our everyday interaction with our products and environments.[3]

Applied to our urban environments, SID can thus allow us to embed the contemporary city with a music of its own, using our urban infrastructure as a new interface for musical expression: i.e. we can literally turn our built environment into a musical instrument. Imagine a city which can be played and which therefore makes you want to play in it: an interactive city that entertains itself. We can use it to make our urban experiences more enjoyable and responsive by encouraging interactions with our urban environment. We can also use it to compose our urban soundscape through more participatory means, empowering the public to take responsibility for what they hear.

9.2 Reconnecting society

Unfortunately, contemporary society has largely stopped listening. As explored in Chapter 5, listening to music was once a communal activity, serving to bring society together by coordinating the movements and emotions of the masses. Only recently, due to the development of recording devices and headphones, has it become such a solitary activity.[4] As a result, we now commonly navigate our cities with headphones in our ears, ignoring our soundscapes (perhaps for good reasons) but unfortunately also each other. Thus, by returning music to the public domain, sonic interaction design has the potential to restore music's important social function. Embedding music in public spaces has the potential to bring people together and reconnect society.

9.3 Two sonic urban interventions

In a much more organised fashion than the serendipitous beginnings of *Progetto Entrainment* of Chapter 8, the Universal Composition Laboratory at UCL was commissioned by Transport for London (TfL),[5] the city's integrated transport authority, to design two interactive urban interventions on Regent Street in central London. As part of the yearly Summer Streets festival, this normally heavily trafficked central London street was pedestrianised for the day.[6] The first intervention was in support of the *Year of the Bus* in 2014 and involved the development of

a musical bus stop, which we called the '*Musical Buskstop*'.[7] Through the use of sonic interaction design, it raised the expectations of what our urban infrastructure could, and should, provide: not only in the operation of the transport system itself, but in providing a social service that was interactive, entertaining and participatory. In the same musical and interactive spirit as the *Musical Buskstop*, we developed the *London Soundmap* two years later for the *Transported by Design Festival*, aimed at promoting the role of design in London's public transport system.

Both projects are an example of how sound can be integrated into the physical fabric of the city through the use of sound and music computing technologies, rendering our everyday infrastructure systems and their urban environments more interactive and responsive. The *Musical Buskstop* presents our public transport service in a different light, while the *London Soundmap* questions the role of the street itself. The overall objective of both was to present the public with alternatives to the boring, static infrastructure design they had all grown used to, allowing them to expect more not only from its designers, but from themselves as citizens and performers of the public urban realm.

9.4 A 'musical' bus stop

The *Musical Buskstop* involved the integration of sound into the physical infrastructure of the bus stop, usually a product of marketing and economy. The aim was to use the connecting power of music to encourage interaction between waiting passengers. However, encouraging neighbouring strangers to connect to each other is not an easy feat in a large metropolitan city like London, with the majority of public transport commuters preferring to listen to their headphones or talk on their phones rather than interacting with the person sitting next to them. Thus our aim was to use the power of music to break down this invisible barrier and bring society closer together.

Our tactic involved creating a communal game of musical chairs by embedding music into the existing seating of the shelter.[8] The pressure generated by sitting on one seat activated a musical track, which could then be played together with that of a neighbouring seat. With the motivation to play all the tracks simultaneously in order to hear the whole piece, we encouraged passers-by to take the time to sit down and listen to each other.

As an accompaniment to the musical seats, we also created a series of percussion instruments, which could be played by those standing

outside the shelter. Normally reserved for commercial advertising aimed at passing vehicles, we replaced it with 'musical' signage, which could be played like a percussion instrument. Each bus line was associated with a specific tone that was synchronised with the musical seating, allowing passers-by to accompany these melodies with their own rhythms. It also made the communication of bus information more prominent, interactive and accessible to the pedestrian.

The *Musical Buskstop* can be seen to have encouraged more collaboration, participation and listening in the streets of London, receiving a number of positive comments from participants on the day, as expressed in Figure 9.2. It can be seen to have empowered the everyday user of London's public transport system to view themselves as a participant and performer of their transport system, rather than simply as a passive user. Sonic interaction design helped to transform this typically mundane piece of infrastructure into an enjoyable and interactive instrument, opening up the dialogue to the possibilities of more adaptive and responsive urban infrastructure that is more in time with our rhythmic needs and desires.

Figure 9.1 The Musical Buskstop, Regent Street, London (2014)

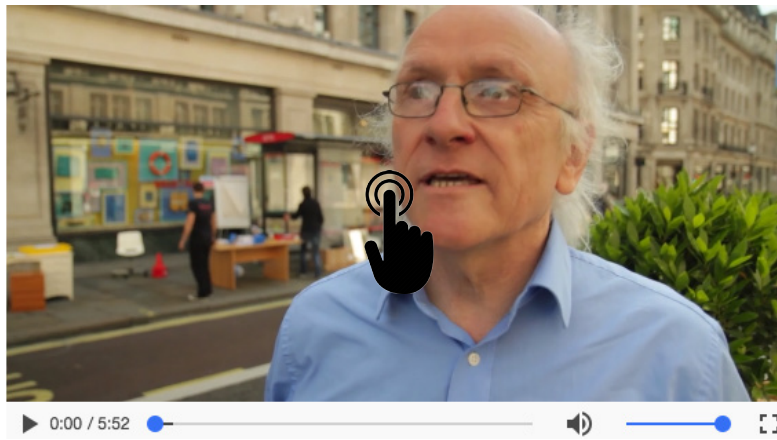


Figure 9.2 Film: *Interactive bus stops* (2014)

9.5 An interactive soundmap of London

The *London Soundmap* intervention aimed to bring public attention to the soundscape of contemporary London: first, through its decomposition; then, through a communal form of 'ear-cleaning';[9] and finally, by encouraging and facilitating its recomposition as first proposed by Schafer. However, by using sonic interaction design, we could allow this process of soundscape composition to be an interactive and collaborative one.

9.6 Platform for acoustic design

Recognising that our soundscape is essentially a product of societal interactions, as explored in Chapter 2, Schafer proposed the interdisciplinary field of acoustic design[10] as an attempt to improve it. However, rather than focusing on the elimination of the sounds we did not want (the usual approach to noise pollution policies), Schafer encouraged us to identify and multiply the sounds we did want to keep: in doing so, he anticipated an inherent reduction in the sounds that we did not.[11] Above all, he was concerned with 'the imaginative placement of sounds to create attractive and stimulating acoustic environments for the future',[12] calling upon the skills of not only musicians and acousticians, but also psychologists and sociologists, and, as proposed in this chapter,

architects, urban designers and planners.[13] Thus the *London Soundmap* can be seen also as a multidisciplinary platform for acoustic design.

9.7 (de)composing London's soundscape

In order to compose the soundscape, I first had to decompose it through my own process of ear-cleaning. I sorted it according to the categories identified by Schafer et al.[14] I identified its *keynote sounds*, which contributed to its overall tonality, such as the buzz of the London Eye (in A) and the natural sounds of the watery River Thames and the wind through the trees of Hyde Park. I recorded its *sound signals*, which include the honks, beeps, bells and whistles of its various modes of transportation, calling out for our attention at various tones. And I could not help but take note of its *soundmarks*, which were dominated by the chime of Big Ben (in F) every quarter of an hour. Schafer asks in the *Tuning of the World* what London would be without Big Ben[15] and it was a difficult thing to imagine. The *Soundmap* was thus a way to find out what makes London tick.

However, during the process of recording and composing these sounds,[16] I discovered many discrepancies between one beep and another that served the same purpose. For example, the honk or bells of the buses often varied from one another. Upon further enquiry, I learnt that there are currently no specifications concerning the sound design of London's transport system: this means that one bus can have a different sounding horn or bell to another, making a coherent sound identity difficult to achieve, not to mention the discordance produced when sounded together. Schafer described car horns as an example of 'a sonic absolute bequeathed anonymously to the world by an inventor who took few music lessons'[17] and he appears to have been right. The majority of London's transport sounds were, in fact, quite out of tune, and there was a clear need for an integrated approach to the city's acoustic design. The potential for sonic interaction design to contribute to the 'tuning' of the city was evident. This did not make for an easy exercise as I attempted to create a composition out of the city's sounds without altering their original frequencies. However, by following Schafer's strategy of eliminating the 'out of tune' sounds by default, the underlying 'music' of London's soundscape emerged.

The end result consisted of 14 soundtracks, which represented a range of well-known London rhythms and, because of their iconic nature, most had the potential to become easily recognisable *auditory*

icons for those familiar with the city. Many were transport-related due to the theme of the festival, such as the sounds of the tube, bus, bicycle and pedestrian crossing. However, transport exists to take us to our urban activities and places and thus several well-known destinations were also represented in sound, including the London Eye, Hyde Park and of course Big Ben. The soundtracks were intentionally composed as synchronisable loops, which allowed the piece to be played continuously throughout the day, allowing people to join in as they pleased. In fact, this cyclical structure was symbolic of the cyclical rhythm of the city itself, as measured by the hourly chime of Big Ben (scaled to the length of the piece). Furthermore, they were composed to complement each other, allowing them to be played simultaneously. With enough hands and feet working together, all the soundtracks could be activated and the whole piece could be completed.

9.8 Physical manifestation

The physical manifestation of the *Soundmap* itself consisted of a giant 3m by 5m non-slip mat that was integrated onto the road surface of Regent Street. It was embedded with pressure pads at 14 points spaced over the mat, which would allow the activation of the 14 different soundtracks.[18] The graphic design[19] of the mat was thus crucial, not only in attracting the public to the *Soundmap* itself, but in visually indicating where to stand and move in order to play each sound. Thus we worked closely together in order to develop both image and sound in tandem, and assist in the formation of audio-visual objects.[20] In doing so, we helped transform the grey asphalt of Regent Street into a more attractive surface for pedestrian interaction, as shown in Figure 9.3.

Figure 9.3 Regent Street 1) on an ordinary day 2) with the *Soundmap*

9.9 Coordinating urban movement

With the music being a direct product of our bodily actions, the *Soundmap* was also a demonstration of the potential of music to coordinate our urban movements, both individually and collectively. Furthermore, in order to simultaneously play its music and dance to it, collaboration between participants was necessary. Thus to coordinate this participatory process and facilitate the public's interaction with the *Soundmap* on the day, we engaged a group of improvisational dancers,[21] skilled in the spontaneous creation of movement. With little explanation or introduction to the *Soundmap*, they quickly and intuitively responded to its sounds and, after only a few hours of rehearsal, had simultaneously composed and choreographed a dance performance. Their process and initial reactions can be watched in Figure 9.4.

On the day of the event itself, the dancers used their choreographed performance to facilitate the participation of the public. First, they demonstrated the potential of the mat to both generate music and inspire movement through their own movements. Then, they encouraged audience participation by inviting members of the public to play a part in this performance, with the end goal being to activate all sound icons in collaboration. Finally, having watched the performance, the rest of the audience were empowered to join in and compose their own music and dance. Through these three stages listeners were transformed into participants; spectators into performers; and strangers into collaborators. This was reflected by the resulting activity generated both on and off the mat, as the street became animated by collective music-making and dance.

Figure 9.4 Film: *Dancing to the sounds of London* (2016)

Figure 9.5 The *Soundmap* public participation process 1) Demonstration by the dancers 2) Invitation of public involvement 3) User empowerment and collaboration

9.10 Public participation and reaction

The *Soundmap* attracted a wide range of participants – from passers-by to transport enthusiasts; children and adults alike; even the railway workers themselves – representing its universal appeal and accessible design. In listening to their reactions, expressed in Figure 9.6, it became evident that while many were already aware of their urban soundscape and its respective noises, they had not realised its rhythmic quality, and the role that this rhythm could play in transforming it into 'music'. As one young girl noted, the soundscape could in fact be considered both as 'noise and music' at once. This realisation is an important one as it reveals that while many of us consider it as noise, the soundscape has the potential to be musical: we just need to be more selective about how we choose to play it. Thus the *Soundmap* highlighted the fact that the soundscape was actually a composition that we had the power to change through our own urban interactions.

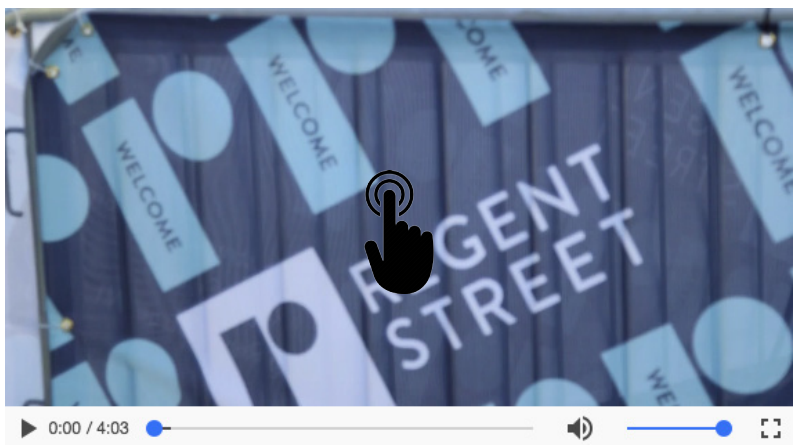


Figure 9.6 Film: *The London Soundmap* (2016)

9.11 Achievement of flow

Perhaps a telling indicator of the power of music to entertain and improve our sense of wellbeing is reflected in the amount of time people spent exploring the mat. Their exploration of its music can be seen to have contributed to the generation of a state of 'flow' attributed to right-brained activities such as music and associated with a state of focus and stimulation in which one easily 'loses track of time'.[22] Even after we had unplugged the speakers, both adults and children stayed on the *Soundmap* and continued to make up their own game. For one little boy in particular, this meant more than one hour on the Jubilee line (see Figure 9.7).

Figure 9.7 Jackson standing on the Jubilee line sound icon

9.12 Jackson's Jubilee line

Three-year-old Jackson was found standing on the *Soundmap*'s Jubilee line almost consistently for more than an hour. While he did leave to explore some of the other nearby sound icons, it was only a few seconds before he returned; he would not budge even during the dancers' hourly performance. Upon speaking to his mother, Andii, we discovered that Jackson had in fact been afraid of this sound for almost the past two years due to a traumatic experience on the line. The loud and distinctive sound of the London tube had become an acoustic warning sign for him, and he had refused to go on it ever since, making navigating London a difficult one for them both. Thus watching him glued to this auditory icon (as seen in Figure 9.8) made us wonder about the sound's impact on his psychological wellbeing. According to his mother, it was his way of processing these memories and recreating more positive associations with the sound: by listening to this sound in a less-threatening environment, surrounded by dancing children in a safe environment, more positive associations could be formed. Furthermore, being able to produce the sounds himself gave him a sense of control. While we can only speculate as to the extent of its psychological impact, the therapeutic role of listening to it would not be surprising: as explored in Chapter 5, music has often demonstrated its ability to stimulate and bring forth emotions and memories.[23]

Before prying Jackson away from the *Soundmap*, Jackson's mother asked me for a copy of the soundtrack as a reminder to Jackson of his positive experience. A few days after this, she informed me that they had successfully caught the Bakerloo line, another line with a similar sound they had also been avoiding. Upon enquiring about Jacksons' progress a few months later, I received news that they had made it onto the once-dreaded Jubilee line and that, furthermore, this little boy had become an enthusiast of the London underground. Jacksons' uplifting story can be watched in Figure 9.8 and enforces how the sound of our urban environment plays an important part in our psychological wellbeing. While the potential of the *Soundmap* to become an instrument of 'urban music therapy' remains to be explored, it is clear that its composition requires our utmost attention.

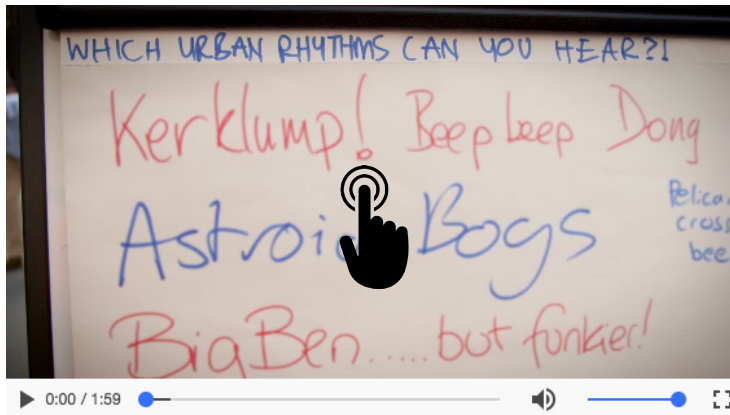


Figure 9.8 Film: *Jackson's Jubilee Line*

9.13 Summary: Embedding London

Both the *Musical Buskstop* and the *London Soundmap* highlight the importance of listening to our urban soundscape as both a composition of sounds as well as the product of our urban rhythms. By using sonic interaction design to draw the connection between physical action and acoustic output, they aim to bring forth the inherent relationship between them and the need to address both. If indeed the soundscape is a reflection of society and the urban interactions we perform, by questioning the composition of our soundscape, we are essentially questioning the way in which we live and behave. According to Schafer: 'When the rhythms of the soundscape become confused or erratic, society sinks to a slovenly and imperiled condition'.[24] London is hopefully not yet at that state, but it does highlight the need for us to acknowledge that our soundscape is the result of our own doing[25] and should thus be taken as a serious warning sign of pending urban arrhythmia. Fortunately, with the potential for sonic interaction design to guide our urban interactions and render today's soundscape literally at our fingertips, we can all be responsible for its future composition.

The *Musical Buskstop* was an initial attempt to observe how sonic interaction design could enhance urban design at a contained scale. Embedding music into the existing bus stop furniture was seen to encourage people to engage more with their urban infrastructure, as well as with each other, quickly transforming this static piece of street furniture into a lively, collaborative performance space. The *London Soundmap* investigated the potential of sonic interaction design further by applying it to the surrounding street surface, which enabled even more people to participate and collaborate. Furthermore, by drawing on the sounds of

the city as the source of its 'music', it introduced a new way of listening and presented London's soundscape as a macrocosmic music composition. Thus, in providing the opportunity to control the urban soundscape, sonic interaction design not only empowered participants, but encouraged them to take responsibility for their acoustic environments.

Both of these projects also hoped to play a greater societal role in influencing the perception of public transport and public space by providing a more interactive and engaging experience. As explored in Chapter 4, positive urban experiences have the potential to encourage positive behavioural change, which can render our cities more sustainable. By making waiting a more enjoyable exercise, the *Musical Buskstop* presented public transport as a more attractive option, while the *Soundmap* was seen to encourage communication, collaboration and social interaction between strangers as they worked to compose their sonic urban environment together. The increase in activity generated on the street due to both sonic interventions is perhaps the best indicator of the power of sound to stimulate interest, interaction and collaboration.[26] Sonic interaction design can thus be seen to have contributed to a dramatic improvement in the social interaction potential[27] of Regent Street by not only bringing people together, but by literally getting them *dancing* in the street.[28]

Explore the various sounds of the *London Soundmap* in Figure 9.9, both separately and together, and compose your own version of London's soundscape.

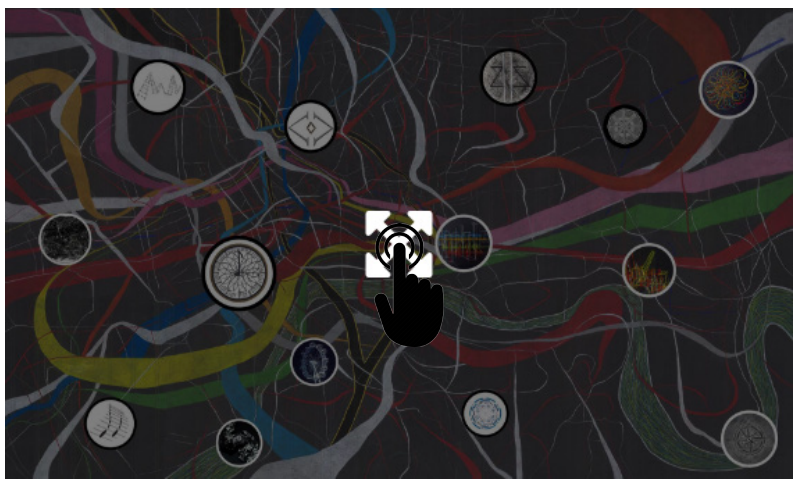


Figure 9.9 Interactive version of the *London Soundmap*. Click on each sound symbol to activate or deactivate its soundtrack. [Graphics by Abbie Phillips; Composition by Sara Adhitya; Sounds: various sources – see AV Credits for further details]

Notes

1 Largely for reasons of safety – the car must be able to still be identified by the pedestrian crossing the road.
2 World Soundscape Project. *The Music of the Environment Series*, R.M. Schafer (ed.), A.R.C. Publications, Vancouver, British Columbia, 1973–8, 3
3 Serafin et al., Chapter 5: Sonic Interaction Design. In *The Sonification Handbook,* Hermann, T., Hunt, A., Neuhoff, J., Eds., Logos Verlag, Berlin, 2011, 87. Available from: http://sonification.de/handbook/index.php/chapters/chapter5/.
4 Storr, A., *Music and the Mind*, Harper Collins, London, 1997, 108.
5 Transport for London, www.tfl.gov.uk.
6 An annual public event in which Regent Street is pedestrianised each Sunday of July, available online: https://www.regentstreetlocal.info/events/summer-streets (accessed on Jul 6, 2017).
7 Developed by UCL-squared, in collaboration with Alex Brigden and Matthias Moos, Goldsmiths University.
8 Sound design and implementation by Alex Brigden and Matthias Moos, Goldsmiths University.
9 The listening program devised by Schafer and colleagues in order to encourage discriminatory environmental listening.
10 'An attempt to discover principles by which the aesthetic quality of the acoustic environment or soundscape may be improved' Schafer, R.M., *The Soundscape: Our Sonic Environment and the Tuning of the World*, Destiny Books, Vermont, 1994 (first published 1977), 271.
11 Schafer, 1994, 12.
12 Schafer, 1994, 271.
13 Schafer, 1994, 4.
14 See Chapter 2 for more details.
15 Schafer, 1994, 239.
16 Some of these recordings were undertaken by myself, others by Transport for London's Visual Services Team, for which thanks go to Paul Curtis and colleagues.
17 Schafer, 1994, 243.
18 The electronic design was by Daniel Scott.
19 The illustration was by Abbie Phillips.
20 Kubovy, M., Schutz, M., 'Audio-Visual Objects', *Review of Philosophy and Psychology*, March 2010, vol.1, issue 1, 41–61.
21 Scatter Dance Company, The Place, London, available from: http://www.theplace.org.uk/scatter-dance-company-0 [Accessed 16 May 2017].
22 See Chapter 4 for more details.
23 Sacks, O., *Musicophilia : Tales of music and the brain*, Picador, UK, 2008, 372–3.
24 Schafer, 1994, 237.
25 'No accidental byproduct of society; rather it is a deliberate construction by its creators.' Schafer, 1977, 237.
26 A footfall of 400,000 for the Year of the Bus and 340,000 for Transported by Design were reported, estimated to be approximately 50% more than on a typical Sunday.
27 See Chapter 3 for more details.
28 Refers to Sergio Porta's book of the same name: Porta, S., *Dancing Streets. Scena pubblica urbana e vita sociale*, Unicopli, Milano, 2004.

Part 2
Summary

Part 2 of *Musical Cities* has been an exploration of the different ways in which we can use music to help make our cities more 'musical'. Through four very different projects, ranging in scale and location, we demonstrated how music could be integrated at various stages of the design process: from its representation and design; to its implementation and performance.

In Chapter 6, we explored how sound and sonification in particular, can be used in the representation of our cities in order to better understand the temporal composition of the rhythms we design and the effect they have on our urban experiences. Through the development of a Sonified Urban Masterplan and an appropriate 'urban orchestra', we were able to capture, articulate and embody the rhythms necessary for the embodied practice of rhythmanalysis, yet both usually escaping traditional methods of urban representation. This gave birth to a 'sonified' form of rhythmanalysis, whereby the rhythms of one's everyday urban experience could be not only understood in time through listening, but recorded and shared with others. While much work still needs to be done, the potential of sonification is clear: being a methodological and 'objective' process, it could allow the development of the analytical science of rhythm proposed by Henri Lefebvre.

In Chapter 7, we used music to design, or rather 'compose' our cities, approaching the urban masterplan like a graphic musical score. Drawing on the compositional techniques of music and the ability of composers to manipulate time, we developed a methodology for translating music into urban form. By applying the site-specific piece of *Left Edge* to the redevelopment of the Perth foreshore, we were able to generate culturally specific and temporally appropriate rhythms. Application at various tempi allowed us to address the multitemporal urban challenge of catering for multiple speeds and scales of urban experience.

In Chapter 8, we saw how we can also make music at the more detailed scale of our architecture, by listening to the sounds it makes as we interact with it. Through the site-specific dance performance of *Entrainment*, we could appreciate both the aural dimension of the architecture as well as its role in choreographing our movement. By viewing architecture as a dynamic, compositional tool that can itself adapt and entrain itself to our needs, we saw how we could make the performance of our everyday lives a more musical and enjoyable experience for all. By designing our urban environments in a more dynamic manner, we could better support both our internal and external rhythms in a more liveable and sustainable way.

Last but not least, we saw in Chapter 9 how we can literally embed our cities with music through the emerging field of sonic interaction design, allowing us to literally embody its rhythms through our urban movements and make our interactions more musical. By treating urban design as a new interface for musical expression, we could create a whole new way of composing our urban soundscape and 'tuning' our world. Furthermore, by using sound to encourage more positive urban interactions with our built environment, as well as between ourselves, we could also encourage more participatory and collaborative city-making necessary for the development of more liveable and sustainable cities.

Through these four projects, I hope to have demonstrated the potential of music to make our urban experiences not only more 'musical', but more accessible, enjoyable, collaborative and interactive. There are of course many more ways in which sound and music can contribute to the design of our cities and help improve our urban lives, such as improving urban navigation or creating a sonic identity for our various urban infrastructure systems. Furthermore, the changing nature of our urban environments itself – through increasing digitisation and real-time connectivity – accompanied by new developments in sonic interaction design, is continually providing new opportunities for sound and music to enhance our urban interactions. Thus this selection of projects hopes to stimulate the imagination towards the composition of more musical cities and the benefits it can bring.

Chapter 10
Conclusions

Musical Cities is essentially a book about rhythm: the multitude of rhythms that comprise our cities from those external rhythms of the environment to those internal to our bodies. In a constant cycle of entrainment, our cities compose the rhythms of our urban experience and we, in turn, perform its 'music' through our interaction with it. As the product of these urban interactions, as identified by both Henri Lefebvre and Raymund Murray Schafer, rhythm can only really be understood through the embodied practice of listening.

Thus *Musical Cities* is equally a book about listening: to our soundscapes, to ourselves, and to each other. As explored in Part 1, not listening can be blamed for our current state of social, environmental and bodily arrhythmia: from traffic jams and dead public spaces; to climate change and noise pollution; as well as bodily illness and temporal disease. Listening to these various urban rhythms is thus key to better understanding and composing more liveable and sustainable cities.

However, the increasing complexity of the contemporary city, with its exponential growth, silent cars and digital devices, has rendered listening an increasingly difficult task to perform. Thus to help us listen to these various urban rhythms, in Part 2 we drew on the power of acoustic communication. Through musical projects of various scales and in various parts of the world, and using techniques such as sonification and sonic interaction design, we demonstrated how music can play a part in representing, understanding, composing and performing our cities. Through interactive audio-visual examples, from architectural plans animated by sound and moving image to interactive urban soundmaps of various scales, our objective was to demonstrate first-hand the power of sound and music to communicate, stimulate, engage and involve. It is these same qualities that music has to offer the process of city-making

itself, potentially rendering our cities more accessible, collaborative, meaningful, adaptable and, ultimately, more sustainable.

10.1 More accessible, understandable cities

First, we saw how music can communicate urban experiences in a way that drawings cannot: it can represent its temporality, plurality and corporeality by speaking to our ears, bodies and hearts. Unfortunately, rhythm is a difficult thing to capture and design, and the limitations of graphic urban representation techniques often lead to the generation of the undesirable rhythms previously described. By enhancing these techniques with sound, as demonstrated by the Sonified Urban Masterplan, we can articulate these urban rhythms in space and time, revealing temporal urban issues often hidden in technical drawings. Listening to these rhythms can help both designers and the general public better understand their roles in urban design and contribute to the composition of more desirable urban rhythms in the future.

10.2 More participatory and collaborative cities

By communicating urban design in a more accessible and understandable manner, music has the ability to involve more citizens in the planning and design of our cities, making city-making a more participatory process. By encouraging people to listen, both to their cities and to each other, acoustic communication can help render urban development more equitable to society as a whole. Music also has the power to bring people together, as revealed by the *London Soundmap*'s ability to dramatically increase the social interaction between strangers on the streets of London. Sound and music technology can further assist this process by allowing for real-time collaboration, as shown in the collaborative composition of the urban soundscape in Chapter 9: by returning the power of composition to the people, the *Soundmap* reminds us of our role in its creation.

10.3 More stimulating and meaningful cities

Music can also help make our cities more stimulating, not only from what we hear but by how we move. We are all familiar with how music

can improve your mood psychologically, as well as affect your rhythms physically, either calming you down or making you want to get up and dance. The *London Soundmap* demonstrated the psychological impact of music by allowing one little boy to overcome his fear of the tube. Through sonic interaction design, we can now integrate musical rhythms into the design of our cities to help create more desirable urban experiences: the *Soundmap* literally got Londoners dancing in the streets.

By choosing our music wisely, we can also use it to inform the physical design of more meaningful places, especially in a time when standardisation and globalisation are rendering our cities all the same. With the ability of music to express the identity of a place and its people, we can draw on these rhythms to inform culturally specific designs that are more meaningful than the homogeneous rhythms driven by economy and ease. As seen in the case of the Perth Foreshore revitalisation project in Chapter 7, musical rhythms can be used to generate more interesting and meaningful urban experiences at various scales. Repetition and boredom can become a thing of the past as we draw on the infinite archive of musical rhythms to compose more stimulating experiences catering for multiple speeds.

10.4 More adaptive, multitemporal cities

As individual rhythmic beings in our own right, we all have our rhythmic and musical preferences, and music can also help us compose cities which are adaptive and responsive to these multitemporal needs. Music can help us achieve this multitemporality due to its ability to manipulate time, both psychologically, physically and now digitally. Embedding music in public transport infrastructure sought to make the wait seem shorter; while Studio Pastor showed us how its dynamic architecture could physically adapt to the family's evolving needs; and the practice of sonic interaction design instantly rendered London's streetscape more responsive. The temporal art of music can thus help us achieve a more eurhythmic Person-Environment Fit for both individuals as well as society.

10.5 More liveable and sustainable cities

Last but not least, musical cities can also contribute to more liveable and sustainable cities through the design of rhythms that speak to our

bodies and encourage them to move in certain ways. Musical rhythms are bodily rhythms, and when the needs of our bodily rhythms are well designed for, our physical and psychological wellbeing increases. We can use music to help create this sense of wellbeing and promote more sustainable rhythms of life. It is not a surprise that we choose to drive if the rhythm of walking is not sufficiently supported – an inescapable phenomenon in most of suburbia. But by composing more enjoyable rhythms for walking, we can discourage the use of the car and encourage the human desire to move, rendering our cities not only better for the environment, but also better for ourselves. By recognising that sustainable cities are also healthy cities, music can help us achieve urban eurhythmia.

10.6 A more musical city for you

Last but not least, while cities and music are for everyone, we must not forget that rhythmanalysis is also a personal endeavour. So take a moment to reflect on your own urban rhythms: would you consider them musical; do they resonate well with your internal bodily rhythms; do they make you feel 'in time' with your city? While we may not be the sole composers of our rhythms of life, there are many ways in which we can make our lives more musical, and the first step is through *listening*.

Chapter 11
Epilogue

Rhythmic Urban Design Guidelines

With a newfound appreciation for the rhythmic composition that is our city, we now have the responsibility to compose them. However, composing the rhythms we desire can present challenges, ranging from limitations in its representation to our changing perception of it over time. A more temporal approach to urban design must therefore be informed as much by psychology and acoustic ecology, as by architecture and urban planning: a new discipline of Urban Composition is called for. Here, we offer a set of Rhythmic Urban Design Guidelines, which may help guide the development of such a discipline towards the achievement of urban eurhythmia.

11.1 Compose temporal experiences

Without time, there is no experience and, in the composition of urban experiences, urban professionals need to give time its due value. We should focus on quality, not just quantity, and aim to improve our temporal experiences rather than trying to simply make them faster and more efficient. Thus in the design of public urban spaces, we need to design places that make us want to slow down, rather than focusing on experiencing them as briefly as possible. Urban design should be as much about the journey as the destination.

11.2 Design responsive environments

We cannot help but be informed by our external environments through the process of entrainment, and we need to acknowledge the role urban

design plays in entraining our rhythms. However, as adaptable as we may be, we each have our own *tempo giusto* that contributes to our wellbeing and we need to celebrate this temporal diversity. In order to maintain a healthy *Person-Environment Fit*, our environments need to be flexible enough to entrain themselves to us. Thus urban designers need to design more adaptive and responsive environments, which cater for different people's changing needs, and which are achievable through both physical[1] and digital[2] means.

11.3 Allow for multitemporality

Rhythms need to be contextualised in time as well as space: acknowledging the rhythms of the past, as is embodied by our existing urban fabric, as well as catering for those we imagine in the future. We need to acknowledge the public rhythms in between our buildings while we cater for the more private rhythms inside them,[3] allowing us to be both inside and outside at once. In order to allow for this constant evolution of rhythm, the role of our built environment should be considered as a *rhythmic mediator*: part of a rhythmic process, rather than a product in itself. In acknowledging this dynamism, it can better support the *flow* of these rhythms at their natural tempi, rather than forcing them to be what they are not.

11.4 Compose rhythms for people

We must not forget that cities are for people, and that in designing *places for people*, we also need to compose for the *rhythms of people*. This includes the internal rhythms of our beating hearts, pulses, breath, circulation and nervous systems, which we are dependent on for our physiological and psychological wellbeing. Thus our ultimate goal in designing places for people should be designing rhythms that support these bodily rhythms rather than undermine them. Musical rhythms can be seen as an extension of our bodily rhythms, made by and for the human body, and can potentially help us compose more appropriate rhythms for the human scale. Composing more musical rhythms can help revive dead urban spaces: with the ability to make us move, they can also help stimulate our bodies.[4]

11.5 Support temporal clarity

Our perception of time has great influence on our psychological state and is imperative to our wellbeing: the rise of temporal diseases such as time anxiety or attention deficit disorder is an indication of the negative impact of our current temporal composition of over-demanding and polychronous rhythms. We need rhythms that provide a supportive temporal structure for our minds rather than fill them with noise and confusion: tempi that are too fast can be over-stimulating; and tempi that are too slow can become boring and depressing; while too many tempi can fracture time beyond comprehensibility, as real-time connections become no-time at all. Such rhythmic confusion often leads to acoustically noisy environments, as reflected by the soundscape of our contemporary cities. In addition to R. Murray Schafer's ear-cleaning, a temporal-cleaning is also called for.

11.6 Encourage sustainable urban behaviours

By composing for the rhythms of our wellbeing, we can in turn encourage more sustainable urban behaviours. Just like we can design rhythms that encourage walking, we can also encourage the use of public transportation by reducing the perception of waiting time and making it a more enjoyable experience. We can help reduce congestion and improve driver comportment by better composing the rhythms of traffic signals to synchronise both driver and pedestrian expectations: mediating traffic jams is as much about psychology as it is about traffic engineering. However, some rhythms are clearly more sustainable than others: for example, the rhythm of the car has more chance of causing congestion, pollution and frustration than the rhythm of walking. We as urban designers have the opportunity to encourage more sustainable urban rhythms and the responsibility to do so.

11.7 Encourage social interactions

While our urban experience is a personal one, it is also a collective one. Thus we need to coordinate the communal rhythms of society as well as those of individuals. Musical rhythms have the power to not only entrain each listener, but a group of listeners with each other. They thus have the

power to synchronise the movements and emotions of crowds of people, contributing to a much-needed sense of community. We can use the connecting power of rhythm to bring people together in our public urban spaces and encourage social interactions.[5]

11.8 Respect the cycles of nature

We need to respect the cyclical external rhythms of our natural environments, as well as the internal bodily rhythms of people. Rather than creating urban rhythms that attempt to override them, we need to allow our bodies and our environments to renew themselves, or else deal with the consequences in the future. This is as much the responsibility of the citizen as it is of the designer. We can help improve our own health and wellbeing, as well as the sustainability of our environments, by respecting these rhythmic cycles in the rhythmic choices that we make.

11.9 Listen collectively

Above all, we need to listen: not only to our cities, but to ourselves and to each other. As the product of our urban interactions, listening to our soundscape can help us understand the rhythms of society. Through listening, we can identify and encourage the rhythms that matter, improve the rhythms that can be improved, and discourage those we would be better off without. By addressing the composition of our soundscape, we can help address the composition of society itself.

Collective listening can also help make the process of city-making a more collaborative one. Both urban professionals and the community need to listen to each other in order to ensure that cities are composed for the people who must perform them. But we need to be hearing the same music in order to have a meaningful discussion. By communicating our cities in sound, we can better articulate the temporal urban experiences we compose for each other and work together towards composing those we actually desire.

11.10 Harness the power of music

Music can help us to listen through its powers of communication and connection. Listening to music has the power to synchronise our urban

movements and our nervous systems. Through its ability to organise time, it can help us make music out of the noise of contemporary urban life. Technological developments, such as sonic interaction design, can help us give this power to the people and render city-making a more participatory process.

Deeply integrated in culture, music can also help make our existence a more meaningful one. Musical rhythms give difference to repetition, and can help create a sense of identity in a globalised world of standardisation. There is a whole archive of rhythms out there embodied by music, which we can draw on to compose more meaningful rhythms for society and make our lives more musical. Schafer was to described music as 'the key to the utopian soundscape'.[6] With the soundscape being a reflection of society itself, music could also be the key to designing a more utopian city.

11.11 Take rhythmic responsibility

It is clearly time to start listening to your city as it entrains your everyday life. Do its rhythms support your wellbeing? If not, feel free to demand more from your urban environment as well as participate in its composition. Anthony Storr suggested that 'Music can and should be a life-enhancing part of our day-to-day existence.'[7] As the physical, and increasingly digital, composer of our everyday lives, we really should not expect any less from our cities. So take responsibility for the composition of your own urban rhythms and make your next urban performance a more musical one.

Notes

1 See *Progetto Entrainment,* Chapter 8.
2 See *London Soundmap,* Chapter 9.
3 As achieved in *Progetto Entrainment*, Chapter 8.
4 As applied to the Perth Foreshore revitalisation project, Chapter 7.
5 As seen in the *London Soundmap*, Chapter 9.
6 Schafer, R.M., *The Soundscape: Our Sonic Environment and the Tuning of the World*, Destiny Books, Vermont, , 1977, 244.
7 Storr, A., *Music and the Mind*, Harper Collins, London, 1997, 106.

Glossary of Terms

Acoustic design (as described by R. Murray Schafer)
'An attempt to discover principles by which the aesthetic quality of the acoustic environment or soundscape may be improved.'[1]

Acoustic ecology (as described by R. Murray Schafer)
'The study of the effects of the acoustic environment or soundscape on the physical responses or behavioural characteristics of creatures living within it.'[2]

Arrhythmia (as described by Henri Lefebvre)
Rhythmic disturbances or discordance, which often lead to suffering.[3]

Aural architecture (as described by Barry Blesser and Linda-Ruth Salter)
'The properties of a space that can be experienced by listening.'[4]

Beat
'The basic unit of measurement in a musical piece.'[5]

Boredom (as described by Robert Levine)
A psychological state associated with a general lack of interest; the effects are often unpleasant and can even be painful.[6]

Commuter amnesia (as termed by psychologist David Lewis)
The tendency of our brains to shut down to external stimuli while commuting.[7]

Computer Assisted Composition (CAC)
The use of computing technology in music composition practices.

Dressage (as described by Henri Lefebvre)
The manipulation of bodily rhythms through repetitive training.[8]

Ear-cleaning (as introduced by Schafer et al.)
A systematic program of ear-training aimed particularly towards the discrimination of environmental sounds.[9]

Entrainment (as described by Robert Levine)

'The process by which one temporal rhythm is captured and modified by another.'[10]

Eurhythmia (as described by Henri Lefebvre)
The unification of rhythms in a state of equilibrium and harmony.[11]

Fast pathologies
The 'temporal diseases' caused by the increasing demand of our cities on our time, such as 'time poverty', 'hurry sickness', and 'time anxiety'.

Flow (as described by Mihaly Csikszentmihalyi)
The sense of time moving unforced and at its most natural.[12] It is associated with an engaging, enjoyable, focused and satisfying experience, and the sense of losing track of time.

Graphic musical score
The representation of music in a graphic form other than traditional music notation, usually as some sort of image to be read according to rules assigned by the composer and interpreted by the performer.

Hearing
Our physiological ability to perceive auditory stimuli.[13]

Listening
The conscious processing of auditory stimuli following its perception; a psychological act of understanding and comprehension, driven by the motivation to derive meaning from the sounds we hear.[14]

> **Causal listening** (as termed by Michel Chion): Our ability to deduce the cause of a sound.[15]
>
> **Ecological listening** (as introduced by William Gaver): Our ability to 'pick up' information about our surrounding environment and the interaction of objects within it.[16] It is based on the theory that we perceive events and sound sources rather than the sounds themselves.[17]
>
> **Everyday listening** (as described by William Gaver): The perception of sound-producing events in our everyday environments.[18]
>
> **Musical listening:**
> The perceptual experience of sound, e.g. listening out for melodies, harmonies and rhythms.
>
> **Semantic listening:**
> Listening for the meaning of a sound; the semantic relationship is usually highly symbolic and culturally dependent and informed by learning and memory.[19]

Metronome
A device used in music performance to keep time at a chosen rate.

Monochronic
The performance of one task or event at a time, in a linear sequence.[20]

Multitemporality (as described by Robert Levine)
The ability to move as fast or slow as is needed.[21]

Music (as described by Edgard Varese)
Organised sound.[22]

Noise
Sound that is unwanted, unmusical or loud.[23]

Noise pollution (as described by R. Murray Schafer)
The acoustic outcome of not listening carefully enough, often resulting in an excessive amount of noise;[24] it is commonly assessed and measured in decibels (dB).

Orchestration (as described by R. Murray Schafer)
The art of arranging sounds 'so that all possible types may be heard to advantage'.[25] In music, it refers to the harmonious combination of the parts or instruments in an orchestra.[26]

Pace of life (as described by Robert Levine)
The flow or movement of time experienced by people, and characterised by rhythms, sequences, synchronies and ultimately tempo.[27]

Person-Environment Fit (as described by Robert Levine)
Related to 'how much pleasure people experience in everything from their leisure, social, and work lives to the cities and countries in which they live.'[28]

Piano-roll
Musical notation in graph form, consisting of the mapping of pitch over time.

Pitch
Our psychological perception of the frequency of a sound, i.e. how high or low it is.

Polychronic
The performance of two or more tasks concurrently.[29]

Polyphony
The co-existence of multiple voices or sounds.

Polyrhythmia
The co-existence of multiple rhythmic lines.

Psychoacoustics
The science of the perception of sound.[30]

Rasterisation
The conversion of an image into pixels; the formation of a raster image.

Rhythm
'A strong, regular repeated pattern of movement or sound… a regularly recurring sequence of events or processes;[31] said to arise from the interaction of absolute and variable repetition.

Rhythmanalysis (as described by Henri Lefebvre)
A 'theory, practice and mode of analysis for the understanding of one's environment through the experience of its rhythms.'[32]

Rhythmanalyst (as described by Henri Lefebvre)
One who uses his or her own body as a reference point in order to measure and understand the rhythms of their external environment.[33]

Rubato
Italian term for 'Robbed' time, a tempo which temporarily speeds up and slows down while maintaining the overall pace.[34]

Score
The symbolisation of temporal processes in general. In music, it refers to the graphical notation of the organisation of sound over time.

Scoring
The act of drawing or engraving lines. In music, it refers to the convention of drawing vertical lines to align sounds which are meant to be heard simultaneously.[35]

Social Interaction Potential (as described by Steven Farber et al.)
A rating system used to calculate the ease of meeting other people within a given space-time envelope, based on city size, population, geography, form and land use.[36]

Sonification (as introduced by Gregory Kramer)
The representation of data in sound.[37]

Sonified Urban Masterplan (as described by Sara Adhitya and Mika Kuuskankare)
A graphic urban masterplan whose image parameters can be represented in sound; an audio-visual tool for urban representation and design.[38]

Sonography (as described by R. Murray Schafer)
The graphic notation of a soundscape.[39]

Sound
Atmospheric oscillations within the audible range of the human ear.[40]

Soundscape (as described by R. Murray Schafer)
Any 'sonic environment' under study, including both actual environments or abstract constructions (derived from the word *Landscape*).[41]

> **Keynote sounds**
> Background sounds which contribute to the overall tonality of a place, such as the sounds of nature, geography and climate, or more urban sounds such as traffic noise.[42]
>
> **Sound signals**
> Foreground sounds, which we consciously listen to, such as horns and sirens.[43]
>
> **Soundmarks**
> Sounds unique to an area, which characterise a community, such as a church bell or mosque.[44] (derived from 'Landmark')

Soundscape studies (as described by R. Murray Schafer)
The analysis and understanding of the soundscape not only for its acoustic quality, but for how it could be understood and interpreted; concerned with the relationship between humans and the sounds of their environment and the effect of sonic changes.[45]

Synchrony
Occurring at the same time; keeping time with; or having coincident periods.[46]

Syncopation
A displacement of beats, whereby the strong become weak and vice versa.[47]

Tempo (plural **Tempi**)
'The rate or speed of motion or activity';[48] In music, it refers to 'the rate or speed at which a piece is performed'.[49] It is both a physical and psychological phenomenon, whose perception is influenced by 'how time is filled… how many patterns arise in a given span of time.'[50]

Tempo giusto (as described by Eva Hoffman)
The concept of an ideal tempo for human experience.[51]

Timbre
The quality of sound which distinguishes one instrument from another.[52]

Time geography
The spatio-temporal analysis of human movement and activity patterns.[53]

Urban masterplan
The conventional graphic representation technique of urban design and planning.

Urban rhythm
The approximate repetition of any urban interaction at a given spatio-temperal scale.

Urban soundscape
The sonic environment of an urban environment.

Notes

1 Schafer, R.M., *The Tuning of the World*, Destiny Books, Vermont, 1994 (First published 1977), 271.
2 Schafer, 1994, 271.
3 Lefebvre, H., *Éléments de rythmanalyse*. Paris: Éditions Syllepse, 1992 (posthumous). English translation: *Rhythmanalysis: Space, Time and Everyday Life*. London: Continuum, 2004, 30.
4 Blesser, B. & Salter, L., *Spaces Speak, Are You Listening? Experiencing Aural Architecture*, MIT Press, 2007, 5.
5 Levitin, D., *This is your brain on music: understanding a human obsession*, Atlantic Books, London, 2006, 59.
6 Levine, R., *A Geography of Time: The temporal misadventures of a social psychologist*, Oneworld Publications, Oxford, 2006, 36–7.
7 Described in Montgomery, C., *Happy City: Transforming our lives through urban design*, Penguin Books, London, 2013, 185.
8 Lefebvre, 2004, 48–9.
9 Schafer, 1994, 272.
10 Levine, 2006, 217.
11 Lefebvre, 2004, 25.
12 Csikszentmihalyi, M., *Flow: The psychology of happiness*, Rider, London, 1992.
13 Eds. J.A. Simpson, E.S.C. Weiner, *The Oxford English Dictionary (Second Edition)*. Volume VII, Oxford University Press, Oxford, 2001 (First published 1989), 56–7.
14 Eds. J.A. Simpson, E.S.C. Weiner, *The Oxford English Dictionary (Second Edition)*. Volume VIII, Oxford University Press, Oxford, 2001 (First published 1989), 1022.
15 Chion, M., *Audio-Vision: Sound on Screen*; Columbia University Press, 1994, 25–6.
16 Avanzini, F., 'Low-level models: resonators, interactions, surface textures', in Rocchesso, D., Fontana, F., *The Sounding Object*, Mondo Estremo, 2003, 137–8.
17 Derived from Gibson's ecological theory of visual perception, Gibson, J.J., *The Ecological Approach to Visual Perception*. Lawrence Erlbaum Associates Inc. Publishers, Hillsdale, NJ, USA, 10th (1986) edition, 1979.
18 Gaver. W.W., *How do we hear in the world? Explorations in ecological acoustics*, Ecological Psychology, 1993, 5(4), 286.
19 Barrass, Vickers, in *The Sonification Handbook*, Logos Verlag, Berlin, Germany, 2011, Hermann, T., Hunt, A., Neuhoff, J., (Eds.), 146.

20 Oxford English Dictionary, available from: https://en.oxforddictionaries.com/definition/monochronic [accessed 11 July, 2017].
21 Levine, 2006, 219.
22 Cox, C., Warner, D., [Eds.], *Audio Culture: Readings in Modern Music*, Continuum, New York, 2004, 17.
23 Schafer, 1994, 273.
24 Schafer, 1994, 4.
25 Schafer, 1994, 238.
26. Eds. J.A. Simpson, E.S.C. Weiner, *The Oxford English Dictionary (Second Edition)*. Volume X, Oxford University Press, Oxford, 2001 (First published 1989), 898.
27 Levine, 2006, 3.
28 Levine, 2006, 215.
29 Oxford English Dictionary, *Oxford English Dictionary* [Online], https://en.oxforddictionaries.com/definition/polychronic [accessed 11 July, 2017].
30 Eds. J.A. Simpson, E.S.C. Weiner, *The Oxford English Dictionary (Second Edition)*. Volume XII, Oxford University Press, Oxford, 2001 (First published 1989), 760.
31 Oxford English Dictionary, available from: http://oxforddictionaries.com/definition/english/rhythm [accessed 31 January 2012].
32 Elden (ed.), in Lefebvre, 2004, xiii.
33 Lefebvre, H., 2004, p.29–30.
34 Oxford English Dictionary, *Oxford English Dictionary* [Online], https://en.oxforddictionaries.com/definition/rubato [accessed 11 July, 2017].
35 Martin, E., *'Architecture as a Translation Music', Pamphlet Architecture 16*, Princeton Architectural Press, Canada, 1994, 60.
36 Montgomery, C., *Happy City: Transforming our lives through urban design*, Penguin Books, London, 2013, 57.
37 Kramer, G. (ed.), Auditory Display – Sonification, Audification, and Auditory Interfaces, Addison Wesley, Reading, 1994.
38 Adhitya, S. & Kuuskankare, M., 'The Sonified Urban Masterplan (SUM) tool: Sonification for Urban Planning and Design', *Proceedings of the 17th International Conference on Auditory Display*, Budapest, 2011, Available from: http://hdl.handle.net/1853/51918 [24 Jun 2011].
39 Schafer, 1994, 274.
40 These vibrations can sometimes be felt with the body, e.g. through our hands, feet and chest, allowing a hearing impaired person to also perceive a sonic event.
41 Schafer, 1994, 274.
42 Schafer, 1994, 9.
43 Schafer, 1994, 10.
44 Schafer, 1994, 10.
45 Schafer, 1994, 3.
46 Eds. J.A. Simpson, E.S.C. Weiner, *The Oxford English Dictionary (Second Edition)*. Volume XVII, Oxford University Press, Oxford, 2001 (First published 1989) 473.
47 Oxford English Dictionary, *Oxford English Dictionary* [Online], https://en.oxforddictionaries.com/definition/syncopate [accessed 29 September 2016].
48 The Oxford English Dictionary, *Oxford English Dictionary* [Online], https://en.oxforddictionaries.com/definition/tempo [accessed 11 July, 2017].
49 Levine, 2006, 3.
50 Cooper, G., Meyer, L.B., *The Rhythmic Structures of Music*, The University of Chicago, US, 1963, 3.
51 Hoffman, E., *Time*, Profile Books Ltd, London, 2009, 182.
52 Levitin, 2008, 16.
53 Kwan, M.P., Lee, L., 'Geovisualization of Human Activity Patterns Using 3D GIS. A time-Geographic Approach'. in Goodchild, M.F., Janelle D.G., *Spatially integrated social science*, Oxford University Press, 2004, 48–66.

Bibliography

Adhitya, S., 'Music, Architecture & Urbanism: Investigating the relationship', in *UWA Architecture: The First 50 Years 1965–2015,* Retrospective Exhibition, Cullity Gallery, The University of Western Australia, 2015, 162–3.

Adhitya, S. & Tyler, N., 'It's the little things that count…', *Proceedings of the 2014 International Symposium for Next Generation Infrastructure*, Vienna, 2014, 179–184, available from: http://discovery.ucl.ac.uk/1469416/ [24 August 2015].

Adhitya, S., 'A Sonified Urban Masterplan for Paris – the use of sonification in urban representation', *Proceedings of Invisible Places Sounding Cities: Sound, Urbanism and Sense of Place*, Viseu, 2014, 168–77, Available from: http://invisibleplaces.org/IP2014.pdf [10 January 2015].

Adhitya, Ortega, Tyler, Redefining the role of the user through experience design for the 'Year of the Bus', Proceedings of Ballerina and the Elephant conference, Hong Kong Baptist University, 2014.

Adhitya, S. & Kuuskankare, M., 'Connecting SUM with computer-assisted composition in PWGL: Recreating the graphic scores of Anestis Logothetis', *Proceedings of the 40th International Computer Music Conference and the 30th Sound and Music Computing Conference*, Athens, 2014

Adhitya, S., 'Musical Cities', (online video), *TEDxUWollongong2013*, 2013, available from: http://tedxtalks.ted.com/video/Musical-cities-Dr-Sara-Adhitya [23 October 2013].

Adhitya, S., *Sonifying Urban Rhythms: towards the spatio-temporal composition of the urban environment*. Ph.D Thesis, École des Hautes Études en Sciences Sociales, Ircam-Centre Pompidou, Paris, University IUAV of Venice, 2013, available from: http://discovery.ucl.ac.uk/10027995/ [2 November 2017].

Adhitya, S. & Kuuskankare, M., 'From Musical Score to Graphic Plan: The Development of SUM as a Design Tool', *Proceedings of the 39th International Computer Music Conference*, Perth, 2013.

Adhitya, S. & Kuuskankare, M., 'The SUM Tool as a Visual Controller for Image-based Sound Synthesis', *Proceedings of the 38th International Computer Music Conference*, Ljubljana, 2012.

Adhitya, S. & Kuuskankare, M., 'Composing Graphic Scores and Sonifying Visual Music with the SUM Tool', *Proceedings of the 9th Sound and Music Computing Conference*, Copenhagen, 2012, 171–5.

Adhitya, S. & Kuuskankare, M., 'SUM: from Image Sonification to Computer-aided Composition', *Proceedings of the 9th International Symposium on Computer Music Modeling and Retrieval*, London, 2012, 94–101, Available from: http://www.cmmr2012.eecs.qmul.ac.uk [22 Jun 2012].

Adhitya, S., 'Audio-assisted Visualisation: Sonification of Complex Urban Systems with the SUM tool', Presented at the *International Meeting in Visualisation of Complex Environments*, Turin, 2011.

Adhitya, S. & Kuuskankare, M., 'The Sonified Urban Masterplan (SUM) tool: Sonification for Urban Planning and Design', *Proceedings of the 17th International Conference on Auditory Display*, Budapest, 2011, available from: http://hdl.handle.net/1853/51918 [24 Jun 2011].

Adhitya, S., *Music, Architecture & Urbanism: Investigating the relationship,* M. Arch design research project, exhibited in Cullity Gallery, University of Western Australia, 2006.

Alexander, C. et al., *The Timeless Way of Building*, Oxford University Press, UK, 1979.

Appleyard, D., 'Understanding Professional Media.' In *Human Behavior and Environment,* Altman and Wohlwill, (eds.), Vol. 2, New York, Plenum Press, 1977.

Appleyard, D., Lynch, K., and Myer, J.R., *The View from the Road*, MIT Press, Cambridge MA, 1964.

Attali, J., *Noise: The political economy of music*, University of Minnesota Press, US, 1985.
Augoyard, J.F., *Sonic Experience - A Guide to Everyday Sounds*, McGill-Queen's University Press, Canada, 2005.
Bachelard, G., *The Poetics of Space*, Beacon Press Books, USA, 1994.
Barrass, S., 'A Perceptual Framework for the Auditory Display of Scientific Data', *ACM Transactions on Applied Perception*, Vol. 2, No. 4, October 2005, 389–402.
Blesser, B. & Salter, L., *Spaces Speak, Are You Listening? Experiencing Aural Architecture*, MIT Press, 2007.
Bosselmann, P., Gilson, K., 'Visualizing Urban Form', *proceedings of the 1° European Architectural Endoscopic Association Conference,* Tampere Finland, 1993, 9–30.
Boulez, P., *Third Piano Sonata,* 1958.
Buttimer, A., 'Exploring the dynamics of lifeworld'. *Annals of the Association of American Geographers*, 1976, 66 (2), 277–92.
Buttimer, A., 'Sustainable development: issues of scale and appropriateness' in Buttimer, A. (ed.) *Sustainable landscapes and lifeways*, Cork University Press, Cork, 2001, 7–34.
Cage, J., *Silence: Lectures and Writings*, Marion Boyars Publishing Ltd., London, 2009 (first published 1968).
Chatwin, B., *The Songlines*, Franklin Press, UK, 1987.
Chion, M., *Audio-Vision: Sound on Screen*; Columbia University Press, 1994.
Clarke, E.F., *Ways of Listening: An ecological approach to the perception of musical meaning*, Oxford University Press, NY, 2005.
Cooper, G., Meyer, L.B., *The Rhythmic Structures of Music*, The University of Chicago, US, 1963. (First published 1960)
Cox, C., Warner, D., [Eds.], *Audio Culture: Readings in Modern Music*, Continuum, New York, 2004
Crang, M. 'Rhythms of the city: Temporalised space and motion', 2001. In J. May and N. Thrift (eds), *Time/Space: Geographies of Temporality*, 2001, 187–207.
Csikszentmihalyi, M., *Flow: The psychology of happiness*, Rider, London, 1992.
Dayé, C., de Campo, 'Sounds sequential: sonification in the social sciences', in *Interdisciplinary Science Reviews*, 2006, vol.31, no.4, 354.
de Götzen, A., Polotti, P., and Rocchesso, D., 'Sound Design and Auditory Displays.' In: Polotti, P., Rocchesso, D., (Eds.), *Sound To Sense, Sense To Sound – A State Of The Art in Sound and Music Computing,* Logos Verlag, Berlin, Germany, 2008.
Deleuze, G., *Différence et repetition*, Paris, PUF, 1969.
Deleuze, G., *Francis Bacon: The logic of sensation*, Smith, D. (trans.), Continuum, UK, 1989.
Edensor, T., *Geographies of Rhythm: Nature, Place, Mobilities and Bodies*, London, Ashgate, 2010.
Farrés, O., *Quizás, quizás, quizás*, 1947.
Felski, R., 'The invention of everyday life', *New Formations* 39, 2000, 13–32.
Gaver, W.W., *What in the world do we hear? An ecological approach to auditory event perception*, in Ecological Psychology, 1993, 5 (1): 1–29.
Gaver. W.W., *How do we hear in the world? Explorations in ecological acoustics*, Ecological Psychology, 1993, 5(4), 285–313.
Gaver, W.W., *Everyday listening and auditory icons*, Phd thesis, Cognitive Science and Psychology, San. Diego, University of California, 1988.
Gehl J., *Cities for People*, Island Press, Washington DC, 2010.
Gehl, J., *Life Between Buildings – using public space*, Island Press, UK, 2011.
Gibson, J.J., *The Ecological Approach to Visual Perception*. Lawrence Erlbaum Associates Inc. Publishers, Hillsdale, NJ, USA, 10th (1986) edition, 1979.
Goethe, J.W. von, *Conversation with Eckermann* (letter addressed to Johann Peter Eckermann, March 23, 1829).
Google, *Aerial map data,* Europa Technologies, DigitalGlobe, 2006.
Grandage, I., *Left Edge*, 2004.
Gren, M., 'Time Geography Matters'. In J. May and N. Thrift (eds), *Time/Space: Geographies of Temporality*, 2001, 187–207.
Hägerstrand, T., 'Space, time and human conditions'. in Karlqvist A. et al. (ed.) *Dynamic allocation of urban space*, Saxon House Lexington Book, Lexington, 1975.
Halperin, L., *The RSVP Cycles: Creative Processes in the Human Environment*, Braziller, Inc., New York, 1969.
Hanoch-Roe, G., *Musical Space and Architectural Time: Open Scoring Versus Linear Processes*, IRASM 34 (2003) Vol. 2, 145–60.

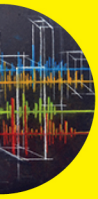
Heidegger, M., *Being and time*, Harper Row, New York, 1962.
Hendy, D., *Noise: A human history of sound and listening*, Profile Books, Great Britain, 2013.
Hermann T., 'Taxonomy and Definitions for Sonification and Auditory Display' in: Susini P, Warusfel O, eds. *Proceedings of the 14th International Conference on Auditory Display (ICAD 2008)*. Paris, France: IRCAM; 2008.
Hermann, T., Hunt, A., 'Guest Editors' Introduction: An Introduction to Interactive Sonification', in *IEEE MultiMedia*, Apr. 2005, vol. 12, no. 2, 20–4.
Hermann, T., Hunt, A., Neuhoff, J., (Eds), *The Sonification Handbook,* Logos Verlag, Berlin, Germany, 2011. Available from: http://sonification.de/handbook/.
Hoffman, E., *Time*, Profile Books Ltd, London, 2009.
ile de France, *La plateforme open data de la Région Île-de-France,* Available from: https://data.iledefrance.fr.
International Community for Auditory Display Editorial Committee, *Sonification Report: Status of the Field and Research Agenda (1999),* National Science Foundation, 1999, [Online].
Ircam – Perception et Design Sonore, *Définition et processus du design sonore - Le design sonore: faire entendre une intention* http://pds.ircam.fr/906.html, [accessed May 2013].
Jacobs, A., *Great Streets*, MIT Press, Cambridge MA, 1995.
Jacobs, J., *The Death and Life of Great American Cities,* Random House, NY, 1961.
Järviluoma H. et al. (eds.), *Acoustic Environments in Change & Five Village Soundscapes,* Tampereen ammattikorkeakoulu, Tampere, 2009.
Järviluoma, H., *Acoustic Environments in Change – Improvement of sustainable qualities and strategies for local action*, MS, Turku, 1999.
Järviluoma H.(ed.), *Soundscapes: Essays on Vroom and Moo*. Tampere University Press, Tampere, 1994.
Jóhannsson, J., *Odi et Amo,* 2002.
Kandinsky, W. *Point to Line and Plane*, Dover Publications, Inc., New York, 1979.
Kramer et al., *Sonification report: Status of the field and research agenda. Technical report*, ICAD/NSF, 1999.
Kramer, G. (ed.), Auditory Display – Sonification, Audification, and Auditory Interfaces, Addison Wesley, Reading, 1994.
Krause, B., *The Great Animal Orchestra*, Profile Books Ltd, London, 2012.
Kubovy, M., Van Valkenburg, D., 'Auditory and Visual Objects', *Cognition*. 2001, vol.80, 97–126.
Kubovy, M., Schutz, M., 'Audio-Visual Objects', *Review of Philosophy and Psychology*, March 2010, vol.1, issue 1, 41–61.
Kwan, M.P., Lee, L., 'Geovisualization of Human Activity Patterns Using 3D GIS. A Time-Geographic Approach' in Goodchild, M.F., Janelle D.G., *Spatially integrated social science*, Oxford University Press, 2004, 48–66.
LaBelle, B., *Acoustic Territories: Sound Culture and Everyday Life*, Bloomsbury Academic, London, 2010.
Laurson M., Kuuskankare M., Norilo V., *An Overview of PWGL, a Visual Programming Environment for Music*, In: Computer Music Journal, 2009, vol. 33, no.1, 19–31.
Laurson M., Kuuskankare M., Norilo V., *'PWGLSynth: A Visual Synthesis Language for Virtual Instrument Design and Control,'* in Computer Music Journal, Fall 2005, vol. 29, no. 3, 29–41.
Le Corbusier, Sainte Marie de La Tourette, Eveux, France, 1960.
Le Montre Verte http://www.lemonde-des-plantes.com/montre-verte/ [Accessed May 2013].
Lefebvre, H., *The Critique of Everyday Life*, Volume 1, Moore J.,(trans.), Verso, London, 1991 (Originally published 1947).
Lefebvre, H., *The production of space*, Blackwell Publishing, Donald Nicholson-Smith, 1991.
Lefebvre, H., *Writings on Cities*, Kofman E. and Lebas E. (trans. and eds.), Basil Blackwell, Oxford, 1996.
Lefebvre, H., *Éléments de rythmanalyse*. Paris: Éditions Syllepse, 1992 (posthumous). English translation: *Rhythmanalysis: Space, Time and Everyday Life*. Continuum, London, 2004.
Levine, R., *A Geography of Time: The temporal misadventures of a social psychologist*, Oneworld Publications, Oxford, 2006.
Levitin, D., *This is your brain on music: understanding a human obsession*, Atlantic Books, London, 2006.
Lynch, K., *What time is this place?*, MIT Press, Boston, 1972.
Lynch, K., *The Image of the City*, MIT Press, Cambridge, MA, 1960.
Mairie de Paris, Paris Open Data, Available from: https://opendata.paris.fr

Martin, E., *'Architecture as a Translation Music', Pamphlet Architecture 16*, Princeton Architectural Press, Canada, 1994.
May J. and Thrift N. (eds.), *Time/Space: Geographies of temporality*, Routledge, New York, 2001.
Mayr, A., 'Temporal Notations: Four Lessons in the Visualization of Time', 281–86, in *Leonardo*, Vol. 23, No. 2/3, New Foundations: Classroom Lessons in Art/Science/Technology for the 1990s, The MIT Press, 1990.
Mayr, A., Colimberti, A., Montagano, G., *L'Ascolto dei Tempo, Musiche inudibili e ambiente ritmico*, (mp)x2, Firenze, luglio 1995.
Mayr, A., *Soundscapes in Cembra 1975-2000*, Estratto da: SM Annali di San Michele – n.15/2002, Museo degli Usi e Costumi della Gente Trentina, 2002.
Mels, T., *Reanimating Places - A Geography of Rhythms (Re-materialising cultural geography)*, Ashgate, UK, 2004.
Mikesch, M., Zach, M. (eds.), *Resonance: Essays on the Intersection of Music and Architecture Vol.1*, Culicidae Architectural Press, US, 2007.
Montgomery, C., *Happy City: Transforming our lives through urban design*, Penguin Books, London, 2013.
Mroczkowski, S. *Paul Klee [temps du peintre]*, L'Harmattan, Paris, 2002.
NoiseTube http://www.noisetube.net/#&panel1-3 [Accessed May 2013].
Oxford University Press, *Oxford English Dictionary* [Online], http://oxforddictionaries.com [Accessed February 2013]
Pallasmaa, J., *The eyes of the skin: Architecture and the senses*, John Wiley & Sons Ltd, UK, 2012.
Polotti, P., Rocchesso, D., (Eds.), *Sound To Sense, Sense To Sound – A State Of The Art in Sound and Music Computing,* Logos Verlag, Berlin, Germany, 2008.
Porta, S., *Dancing Streets. Scena pubblica urbana e vita sociale*, Unicopli, Milano, 2002.
Regent Street, *Summer Streets*, 2016, Available from: https://www.regentstreetlocal.info/events/summer-streets [Accessed July 6, 2017].
Reich, S., *City Life*, 1995.
Relph, 'Temporality and the Rhythms of Sustainable Landscapes', 2004, in Mels T. (ed.), *Reanimating Places - A Geography of Rhythms (Re-materialising cultural geography)*, Aldershot: Ashgate, UK, 2004.
Respighi, O., Fontane di Roma/ *Fountains in Rome*, 1916.
Respighi, O., Pini di Roma/ *Pines of Rome*, 1924.
Respighi, O., Feste Romane/ *Roman Festivals*, 1928.
Rocchesso, D., Fontana, F., *The Sounding Object*, Mondo Estremo, 2003, [Online]. Available from: http://www.soundobject.org/
Sacks, O., *Musicophilia: Tales of music and the brain*, Picador, UK, 2008.
Schaeffer, P., *Traité des objets musicaux*, Éditions du Seuil, 1966.
Schafer, R.M., *The Soundscape: Our Sonic Environment and the Tuning of the World*, Destiny Books, Vermont, 1994 (first published 1977).
Schafer, R.M. *The New Soundscape*, Universal Edition, Vienna, 1969.
Schafer, R.M. (ed.), 'World Soundscape Project'. *The Music of the Environment Series*, A.R.C. Publications, Vancouver, British Columbia, 1973–78.
Serafin et al., Chapter 5: Sonic Interaction Design. In *The Sonification Handbook,* Hermann, T., Hunt, A., Neuhoff, J., Eds., Logos Verlag, Berlin, 2011, available from: http://sonification.de/handbook/index.php/chapters/chapter5/.
Shakespeare, W., *As You Like It*, 1623.
Simpson, J.A., Weiner E.S.C., [Eds.], *The Oxford English Dictionary (Second Edition)*. Oxford University Press, Oxford, 2001 (First published 1989).
Slow Movement, available from: http://www.slowmovement.com/slow_cities.php [accessed October 2010].
Smith, R.J., Heterington, K. (Eds.), *Urban Rhythms: Mobilities, space and interaction in the contemporary city*, John Wiley & Sons, UK, 2013.
Storr, A., *Music and the Mind*, Harper Collins, London, 1997.
Susini, P., Misdariis N., Lemaitre G., Houix O., 'Naturalness influences the perceived usability and pleasantness of an interface's sonic feedback', JMUI, vol. 5, n° 3, 2012.
Transport for London. Available from: https://www.tfl.gov.uk/ (accessed July 6, 2017).
Tractinsky N, Katz A, Ikar D, 'What is beautiful is usable'. *Interact Comput* 2000, 13:127–45.
Truax, B. (ed), *Handbook for Acoustic Ecology*, 2nd edition, 1999, Available from: http://www.sfu.ca/sonic-studio/handbook/.

Truax, B., *Acoustic Communication*, Ablex Publishing, USA, 2001.
UCL-squared, *Universal Composition Laboratory at University College London*, Available from: http://www.cege.ucl.ac.uk/arg/ucl-squared/Pages/home.aspx (accessed July 6, 2017).
UCL-squared et al., 'The Bus Stop: London's Agent of Change' (online video), 2014, Available from: https://www.youtube.com/watch?v=Y6lW1kD-o9U [13 November 2014]
Whyte, W.H., *The Social Life of Small Urban Spaces*, Project for Public Spaces Inc, US, 1980.
Winkler, J., 'Rhythmicity', in Helmi Järviluoma, Gregg Wagstaff (eds), *Soundscape studies and methods*, Finnish Society for Ethnomusicology Publ. 9, Helsinki 2002.
Winkler, J., *Space, Sound and Time–A choice of articles in Soundscape Studies and Aesthetics of Environment1990–2003,* Basel, 2004.
Wunderlich, F. M., 'Place-temporality as an aesthetic experience', in *Geographies of Rhythms,* by Edensor, T., London, Ashgate Publishers, 2009.
Xenakis, I., *Formalized Music: Thought and Mathematics in Composition*, University of Indiana Press, Bloomington, 1971.
Xenakis, I., *Music and Architecture,* Kanach S. (trans.), Pendragon Press, June 30, 2008.

Index

Glossary words are in **bold**.



Musical Cities represents an innovative approach to scholarly research and dissemination. A digital and interactive 'book', it explores the rhythms of our cities, and the role they play in our everyday urban lives, through the use of sound and music.

Sara Adhitya first discusses *why* we should listen to urban rhythms in order to design more liveable and sustainable cities, before demonstrating *how* we can do so through various acoustic communication techniques. Using audio-visual examples, ***Musical Cities*** takes the 'listener' on an interactive journey, revealing how sound and music can be used to represent, compose, perform and interact with the city. Through case studies of urban projects developed in Paris, Perth, Venice and London, Adhitya demonstrates how the power of music, and the practice of listening, can help us to compose more accessible, inclusive, engaging, enjoyable, and ultimately more sustainable cities.

SARA ADHITYA is an urban designer and Research Associate with the Accessibility Research Group at UCL. Awarded a European Doctorate in the 'Quality of Design' of Architecture and Urban Planning by the University IUAV of Venice and the École des Hautes Études en Sciences Sociales, Paris, she draws on her multidisciplinary background in environmental design, architecture, urbanism, music and sound design, in her interactive and multisensorial approach to urban design.

UCLPRESS
Free open access versions available from
www.ucl.ac.uk/ucl-press

FRONT COVER IMAGE:
Based on graphic of
the London Soundmap
designed by Abbie Phillips.

COVER DESIGN:
Jason Anscomb