

**Handbook of Research on**

# **Perception-Driven Approaches to Urban Assessment and Design**



**Francesco Aletta and Jieling Xiao**

**IGI Global**  
DISSEMINATOR OF KNOWLEDGE

## Table of Contents

**Foreword** by Prof Malcolm Tait

**Preface** by the Editors, Dr Francesco Aletta and Dr Jieling Xiao

### **Section 1 - Soundscapes**

#### **Chapter 1**

Urban Sound Planning: An essential component in Urbanism and Landscape Architecture

*Gemma Maria Echevarria Sanchez, Ghent University, Belgium*

*Sonia Alves, Müller-BBM, Germany*

*Dick Botteldooren, Ghent University, Belgium*

#### **Chapter 2**

On the intersection between speaker installations and urban environments: A soundscape design perspective

*Gunnar Cerwén, Swedish University of Agricultural Sciences, Sweden*

#### **Chapter 3**

Assessments of urban soundscape: Case studies in Seoul, Korea

*Joo Young Hong, Nanyang Technological University, Singapore*

*Pyoung Jik Lee, University of Liverpool, United Kingdom*

*Jin Yong Jeon, Hanyang University, South Korea*

#### **Chapter 4**

Non-participant observation methods for soundscape design and urban planning

*Lisa Lavia, Noise Abatement Society, United Kingdom*

*Harry J Witchel, University of Sussex, United Kingdom*

*Francesco Aletta, University of Sheffield, United Kingdom*

*Jochen Steffens, Technische Universität Berlin, Germany*

*André Fiebig, HEAD acoustics, Germany*

*Jian Kang, University of Sheffield, United Kingdom*

*Christine Howes, University of Gothenburg, Germany*

*Patrick G.T. Healey, Queen Mary University of London, United Kingdom*

#### **Chapter 5**

Activity as a Mediator between Users and their Auditory Environment in an Urban Pocket Park: A Case Study of Parc du Portugal (Montreal, CA)

*Edda Bild, University of Amsterdam, Netherlands*

*Daniel Steele, McGill University, Canada*

*Karin Pfeffer, University of Amsterdam, Netherlands*

*Catherine Guastavino, McGill University, Canada*

*Luca Bertolini, University of Amsterdam, Netherlands*

#### **Chapter 6**

Influence of Soundscapes on Perception of Safety and Social Presence in an Open Public Space

*Arianna Astolfi, Politecnico di Torino, Italy*

*Paola Orecchia, Politecnico di Torino, Italy*

*Elena Bo, Politecnico di Torino, Italy*

*Louena Shtrepi, Politecnico di Torino, Italy*

*Cristina Calleri, Politecnico di Torino, Italy*

*Francesco Aletta, University of Sheffield, United Kingdom*

## **Chapter 7**

Identification, Prioritization and Assessment of Urban Quiet Areas

*Aggelos Tsaligopoulos, University of the Aegean, Greece*

*Chris Economou, University of the Aegean, Greece*

*Yiannis G Matsinos, University of the Aegean, Greece*

## **Section 2 - Thermal and Smell Aspects**

### **Chapter 8**

The Doors of Dynamic Thermal Perception: Towards Environmental Quality in Urban Design

*Carolina Vasilikou, University of Reading, United Kingdom*

### **Chapter 9**

Thermal Perception Driven Adaptive Design for Wellbeing in Outdoor Public Spaces: Case Studies in Naples

*Luciano Ambrosini, University of Naples, Italy*

*Eduardo Bassolino, University of Naples, Italy*

*Francesco Scarpati, University of Naples, Italy*

### **Chapter 10**

Smell, Smellscape And Place-making: A Review of Approaches to Study Smellscape

*Jieling Xiao, Birmingham City University, United Kingdom*

## **Section 3 - Arts and Performance for Perception**

### **Chapter 11**

Sensitive Bodies in the cityscape

*Javier Ruiz Sánchez, Universidad Politecnica de Madrid, Spain*

*Maria Jose Martinez Sanchez, Birmingham City University, United Kingdom*

### **Chapter 12**

Changing perception through performance art: Reviewing the Thermopolis Performance

*Pablo Berzal Cruz, Universidad Politecnica de Madrid, Spain*

## **Section 4 - Technology for Perception**

### **Chapter 13**

Visualisation and auralisation for perception-driven decision supports in planning: A comparative review

*Like Jiang, University of Surrey, United Kingdom*

### **Chapter 14**

Towards a Virtual Soundwalk

*Tin Oberman, University of Zagreb, Croatia*

*Kristian Jambrošić, University of Zagreb, Croatia*

*Bojana Bojanić Obad Šćitaroci, University of Zagreb, Croatia*

### **Chapter 15**

Investigations on the Influence of Auditory Perception on Urban Space Design through Virtual Acoustics

*Cristina Calleri, Politecnico di Torino, Italy*

*Louena Shtrepi, Politecnico di Torino, Italy*

*Alessandro Armando, Politecnico di Torino, Italy*

Arianna Astolfi, Politecnico di Torino, Italy

## **Chapter 16**

Eye-tracking in the real world: Insights about the urban environment

*Jim Uttley, University of Sheffield, United Kingdom*

*James Simpson, University of Sheffield, United Kingdom*

*Hussain Qasem, University of Sheffield, United Kingdom*

## **Chapter 17**

Graphical Research Tools for Acoustic Design Training: Capturing Perception in Architectural Settings

*Alessia Milo, Queen Mary University of London, United Kingdom*

*Nick Bryan-Kinns, Queen Mary University of London, United Kingdom*

*Joshua D. Reiss, Queen Mary University of London, United Kingdom*

## **Section 5 - Urban Design for Perception and Social Interactions: Theories and Practice**

### **Chapter 18**

The City as a Mode of Perception: Corporeal Dynamics in Urban Space

*Federico De Matteis, Xi'an Jiaotong - Liverpool University, China*

### **Chapter 19**

Attention, perception and social cognition: bridging the gap between the physical and perceived

*Bobby Nisha, University of Sheffield, United Kingdom*

### **Chapter 20**

Walking as Kinaesthetic Experience of the City: A Historical and Conceptual Approach for Urban Design and Policies

*Edna Hernández González, Université de Bretagne Occidentale, France*

*Jérôme Monnet, Université Paris-Est Marne la Vallée, France*

### **Chapter 21**

Healing space in high density urban contexts: Case studies and design strategies

*Fei Xue, National University of Singapore, Singapore*

*Gou Zhonghua, Griffith University, Australia*

### **Chapter 22**

Indicators of Environmental Comfort Sensitive to Human Perception

*Igone Garcia, Tecnalia Research & Innovation, Spain*

*Karmele Herranz-Pascual, Tecnalia Research & Innovation, Spain*

*Itziar Aspuru, Tecnalia Research & Innovation, Spain*

*Laura Gutierrez, Tecnalia Research & Innovation, Spain*

*Juan Angel Acero, Tecnalia Research & Innovation, Spain*

*Alvaro Santander, Tecnalia Research & Innovation, Spain*

### **Chapter 23**

Reactivating Urban Voids through Sensory and Pop-up Design: Changing Citizen Perceptions of Remaking with Waste

*Cristian Suau, Studio Pop, United Kingdom*

## **About the Contributors**

## **Index**

## Foreword

The need to understand the spaces in which we live, work, socialise, and play is a constant aspect of our urban existence, whether as planners, architects, and designers seeking to shape the built environment, or as residents, visitors, workers using and navigating our cities. It might, however, be argued that the tools we deploy to understand space are rather deficient, often tending towards the functional and the instrumental. Henri Lefebvre in responding to Roland Barthes' semiotic analyses, noted *"When 'Ego' arrives in an unknown country or city, he first experiences it through every part of his body – through his senses of smell and taste, as (provided he does not limit this by remaining in his car) through his legs and feet. His hearing picks up the noises and the quality of the voices; his eyes are assailed by new impressions. For it is by means of the body that space is perceived, lived – and produced."* (1991 p.162) As planners, designers, architects and other professionals engaged in the production of the built environment we might follow Henri Lefebvre's call that we need ways of sensitively and more completely understanding what it is to be in a place, to perceive it and use it.

This book starts from that problem – what does it mean to perceive in the urban environment and how might those tasked with shaping these environments understand perception more fully? In an era in which urban change is produced by systems and processes that concentrate on the quantity and profitability of development rather than its qualities, poor quality environments are the result. One aspect of this is the dominance within these systems of tools that are highly advanced at the measuring of physical or financial aspects of developments, but which are impoverished in the mechanisms and arenas in which to evaluate quality. This has democratic as well as physical implications – we are reduced in these systems to standardised 'users' of space, not complex and diverse people with different interests in and experiences of places. Countering this assumption requires us to generate more nuanced, complex understandings of space and place, recognising us as humans with bodies, all trying to navigate our urban existences. If we understand this, we are more likely to design, plan, and build more fulfilling places.

Knowing how we perceive our environments is, however, not a simple task. It requires us to understand how seemingly immaterial aspects of cities, such as smell and sound, relate not only to the materiality of the city, but also to our own bodies and sensory organs. Beyond this, those perceptions are shaped by our background, history, lifestage, health and culture. This book approaches the phenomenon of perception with a usefully broad perspective, one that recognises its cultural and personal dimensions as well as its psychosocial aspects. It also recognises the interlinked nature of our senses, and draws together our concerns for sound, smell, touch, and vision into a rounded collection. Contributors take a range of approaches, from psychological insights through a concern for the aesthetic and onto critical social science, alerting us to the value of seeing perception as multifarious.

In an era in which many claims are made for the real world impact of academic work, much research in the built environment disciplines continues to be silo'ed with limited interchange of ideas between academics and practitioners. Theoretical work on perception is often divorced from practical concerns for design, or is applied in simplistic ways to actual problems. This book seeks to very usefully address this gap. It is rare for a book on a subject such as this to address two distinct audiences – that of academic researchers and that of practitioners, especially those working in local government. In doing so, it helps to reveal the common concerns that groups in both areas share, and more practically to

reveal how we perceive our environment is influenced and influences how we design it. Not only does this book demonstrate the value of a holistic approach to environmental perception, it will also stimulate a valuable debate about how academics and practitioners might contribute to shaping places more attuned to the diversity of people and bodies who perceive and use them.

*Malcolm Tait*

*Professor of Planning,*

*Department of Urban Studies and Planning,*

*University of Sheffield, UK*

## Preface

Francesco Aletta & Jieling Xiao

One of the first examples of planning driven by ‘perception’ can be found as back as in Roman Laws. The *Lex Iulia Municipalis* (45 BC) prevented ox carts from transiting on the streets of Rome during daytime, in order to avoid congestions, as well as complaints about undesired smells and noises (Hardy, 2012). Ever since ancient times, people have indeed experienced environmental and sensorial issues, which were mainly related to urbanisation. Notwithstanding, such perceptual demands seem to have been largely dismissed over the centuries by those who were responsible for planning and managing the life of organised communities, until very recent times.

In a conventional approach to urban design, the designer would start from a theoretical scheme to introduce a change in the built environment and see how the policy input he received in the first place can fit to it. The feedback from the users only comes at the end of the process, which means that if the change is not accepted, mitigation actions will be needed. On the other hand, the works presented in this book claim that the users’ feedback to the urban environment should be the triggering mechanism for the planning and design process.

The physical urban environment is an essential element of the human experience in modern cities (Cassidy, 1997). Over the years, an increasing number of studies focused on the themes of the city and the urban domain in a number of different scientific fields. Environmental and urban sciences aim at addressing the grand challenges posed by urbanization and globalization. Modern cities are facing ecological issues related to sustainability. Meanwhile, atmosphere and sensorial features are central factors in the debates concerning the quality of public spaces shared and used by people (Gehl, 2011). Therefore, the improvement of the quality of the urban environment at a human scale is becoming an urgent need for urban planners and designers. Perceptual aspects, such as materiality, temperature, sound, light and odour qualities are increasingly considered fundamental to the definition of urban public spaces (Zardini & Schivelbusch, 2005). It is therefore desirable to search how to combine different approaches to urban planning and design, which could provide a broader understanding of the urban realm from the human perceptions’ perspective, leading to an enhanced living experience for local communities.

In the last two decades, we have seen an increase of urban theories focusing on people’ experiences in cities such as the emotional geography (Anderson & Smith, 2001; Davidson, Smith & Bondi, 2012) and sensuous geographies/urbanism (Rodaway, 2002; Zardini & Schivelbusch, 2005). Such approaches set out inquires on how people ‘feel’ and ‘perceive’ the space which then questions strategies applied by urban planners and designers. Inevitably they emphasized the power of human senses on people’s perceptions of places and their lives in cities. Perception, is a key word in all these approaches, which according to Rodaway (2002, p.11) is ‘grounded in sensations which are a series of environmental stimuli and involves cumulative, analytical and synthetic, processes of the brain, each working together to give us a sense of a world.’ The subjectivity brought by people is important in understanding their perceptions, as Rodaway (2002, p.12) said: ‘perception is not just sensation plus cognition since human beings each have a personal history and are socially and culturally situated.’ Perception, according to

Tuan (1979, p.8) links emotions and thoughts which all consist to ones' experiences whilst are grounded in sensations. Thus, such approaches can all be considered as perception driven enquiries of urban spaces.

The exploration of 'perceptions' should draw upon psychophysical, aesthetic and cultural perspectives, considering both objectivity of the physical space and subjectivity of the perceiver. The contributions in this book explore how to assess, characterise and design the quality of urban environments using a perceptual approach. In most of legal and administrative frameworks for the urban realm around the world, sensory elements are addressed as 'pollutants'. In the case of sound, for instance, local authorities treat it as 'noise' and establish threshold levels which should not be exceeded for communities' exposure. On the other hand, the main concept underpinning this work is that the immaterial aspects of the built environment (e.g., sound, smell...) should be treated as a 'resource' rather than as a 'waste' of poorly designed places. In order to do so, it is essential that the individual perception lead the management and design of public spaces. Thus, this book gathers theory and case studies on methods for data collection and analysis of individual responses about the experience of urban environments.

This book is addressed to two main audiences: (1) local authorities' environmental departments, and (2) the architectural and urban planning academic communities. The first group will benefit of immediate knowledge at a strategic level. The contents of the book can inform policy and planning for local and small scale renovation interventions in the urban context. The second group will benefit of the book mostly at an operational level, as it provides practitioners with a deeper understanding of how to design 'intangible' elements of the built environment for more liveable spaces.

The book is organised into five sections; namely: (1) Soundscapes, (2) Thermal and Smell aspects, (3) Arts and Performance for Perception, (4) Technology for Perception; and (5) Urban Design for Perception and Social Interactions: Theories and Practice.

The first section of the book deals with 'soundscapes' and how these are relevant for urban assessment and design. For both its intangible nature and ecological saliency, the sense of audition is possibly the one which has been considered more by planners and designers. The concept of soundscape was brought to Urban Studies by Southworth in the late Sixties, when he raised the point that the sonic identity of cities should be considered in parallel with their visual counterpart (Southworth, 1969). The term was further defined by Schafer, Truax and colleagues, within the World Soundscape Project as 'an environment of sound (or sonic environment) with emphasis on the way it is perceived and understood by the individual, or by a society' (Truax, 1978). This statement was mostly confirmed by the International Organization for Standardization, which in 2014 defined the term as an "acoustic environment as perceived or experienced and/or understood by a person or people, in context" (International Organization for Standardization, 2014). Thus, both definitions point out that soundscape is different from the 'physical' sound environment, as it entails a 'perceptual' construct and claim for further attention on the latter.

In spite of the many efforts to 'standardize' this emerging field (Brown, Kang, & Gjestland, 2011) (Davies, 2013), the knowledge needed to fully include the sound perception domain into urban planning and design is still in an early stage of its development (Payne, Davies, & Adams, 2009) (Kang, et al., 2016). More operational tools are needed to anticipate and design the auditory perception of individuals in urban contexts (Aletta, Kang, & Axelsson, 2016).

Chapter 1 provides a general framework to start including the sound perception domain into urban planning processes and offers some guidelines for planners and architects to address noise issues in urban context to potentially reduce the existing gap between urbanism and acoustics. Likewise, in a design perspective, Chapter 2 describes some active methods (i.e., using loudspeakers) to modify the acoustic using long term active systems in the context of urban design and landscape architecture. The Chapter offers new insights into how active systems can interact with the environment.

From the assessment and characterization point of view, Chapters 3 and 4 describes different methods to gather individual responses about the perception of the acoustic environments, both with participatory (e.g., soundwalks) and non-participatory (e.g., covert behavioural observation) methods. Chapters 5 and 6 deal with the mutual influence that activity, physical acoustic environment (and their interactions) can have on behaviour change and overall perceived comfort and safety in urban environments. Chapter 7 covers the broad topic of 'quiet areas', which has been largely debated, especially in Europe, also due to the normative input provided by the so-called Environmental Noise Directive (European Parliament and Council, 2002).

Moving on from soundscapes, Section 2 discusses emerging methods to assess and design better quality urban spaces considering thermal and smell aspects. Thermal perceptions through touch and convection form the main part of haptic experiences in urban spaces, responding to the climate, materials and urban forms (Pallasma, 2012). Thermal comfort, the satisfaction of body and mind to 'hot' and 'cold', has been widely recognized important to urban planning and design to create comfort urban environments for outdoor activities (e.g., Lin, 2009; Nikolopoulou, 2007). The beginning two chapters in section 2 explored environmental qualities in different urban spaces responding to thermal perceptions in London (Temperate climate), Rome and Naples (Mediterranean climate). Unlike the traditional quantitative approach, Chapter 8 introduces 'thermal walks' as a new tool to investigate people's responses to thermal environments in physical-spatial transitions, using case studies in London and Rome. **The method of walking in this inquiry has addressed the difficulty to study haptic experiences in urban contexts considering the impacts of somatic senses such as kinaesthesia, proprioception and the vestibular sense (Paterson, 2009). Dealing with the difficulty of prediction and verification in a design process, Chapter 9 demonstrates the possibilities of integrating advanced simulation tools (e.g. Rhinoceros, 3DMax, ENVI-met) in the analytical and decision-making process of designing the thermal environments in complex urban context based on field data, through three case studies in Naples.**

The last chapter of Section 2 provides an overview of approaches to smellscapes. Perceptions of smells can enrich people's experiences in urban spaces and create place identities (Henshaw, 2013), revealing ones' past and cultural symbols (Classen, Howes & Synnot, 1994). Tuan (1977, p.11) wrote: 'The modern architectural environment may cater to the eye, but it often lacks the pungent personality that varied and pleasant odours can give. Odors lend character to objects and places, making them distinctive, easier to identify and remember.' The sense of smell is associated with more durable memories and emotions (Engan & Rose, 1976). However, smells are more difficult to record, describe, measure and design with (Porteous, 1985). Based on existing studies, Chapter 10 constructed a toolkit to guide future studies of smellscapes involving the detection and representation of smells, evaluations of smellscape qualities, design and management of smell environment.

Section 3 introduces an artistic approach to explore and design urban spaces through performance arts. Performances developed from the bodily sensations and responses reflect performers' interpretations of spaces, i.e. dimensions, scales, emotions (Crang, 2003; Harding, 2013). Performance arts can bring instant

changes to spaces, engaging people in the space and changing their perceptions. Chapter 11 introduced the concept of 'sensitive bodies' in urban context, to study the bodily-kinaesthetic features of urban spaces. Kinaesthesia is the perception of the body's movements across different perceptual systems (senses) (Gibson, 1966). Authors of the chapter used performance arts as experiments in London and Winchester to gain specific knowledge of urban forms and topologies to inform creations of interactive, playful and communicative urban spaces. Chapter 12 conceptualised performance arts as an investigation tool for urban designers to explore the social relations between people and urban spaces in their everyday routines. The chapter analysed a series of street performance in Athens through observations and reflections of performers. It also offers insights into the creation of performance from urban designers' perspectives to illustrate how the results from such investigations can be used to inform designs of common spaces.

Section 4 deals with how technological tools that support perceptual data gathering can inform the decision and planning process or enhance conventional methods to collect individual responses. Many planners and designers indeed have started to take advantage of laboratory experiments or, more generally, sessions for individual data collection in controlled environments, to better understand how people experience and perceive a real or virtually modified built environment (e.g., (Ruotolo, et al., 2013) (Wang, Kim, Love, & Kang, 2013)). This approach of course raises a point about the 'ecological validity' of the observed results; i.e., whether people would perceive the sensory stimuli in a simulated/reproduced environment as they would in a real one. Nevertheless, there is an increasing trend in using such technologies to inform the design process.

Chapter 13 reviews different techniques to re-create the auditory and visual materials of built environments' scenarios, by exploring different contents and ways to present them, from a 'validity' point of view. Chapters 14 and 15 describe different auralization methods to provide valid representations of (simulated) sound environments in both dynamic and static configurations. Chapter 16 focuses on vision and proposes eye-tracking as a tool for physiological observations. Physiological observations have the advantage that they can overcome potential bias introduced by other methods when the designers have to actually 'ask' people/participants about their perception. Physiological observations, on the other hand, provide useful insights into individuals' feedback to environmental stimuli while they experience them in a more 'unaware' mode. Chapter 17 explores visual tools to represent perceptual data about sound environments, a challenge many designers have to face in their daily practice, as well as a gap that needs to be filled for better policy communication between local authorities and community groups.

Section 5 started with three chapters challenging and interpreting perception related urban theories from alternative perspectives. Chapter 18 investigates the notion of corporeal contraction and expansion, a dialectic that philosopher Hermann Schmitz identifies as the primary movement of the felt-body. Chapter 19 challenges the disciplinary tradition of regarding perception and cognition as being one and establishes that systems of perception and cognition play an equally important role to enable this construct of 'place'. Chapter 20 conceptualises walking as a kinaesthetic experience of cities towards a post-functionalist urbanism. It identifies challenges of walking in cities today based on fieldworks in France and Mexico, which opens up a discussion of elements taken into account for urban planning and design to improve people's perceptions of cities through walking.

Chapter 21 and chapter 22 introduce protocols assessing the overall environmental comfort in complex urban context. Chapter 21 sets in Southeast Asian context where a large population lives and works in metropolis, suffering physical and psychological pressure due to the high-density built environment. It

explores correlations between the specific site configurations, physical environments and human perceptions in the high density urban context, based on which the chapter proposes a series of design strategies and implementations for the cities with comparable climate conditions and urban morphology to create 'healing space' for citizens. Chapter 22 introduces a use-focused protocol to assess people's perceptions of urban spaces and guide for environmental designs, considering place characters and sensory comfort (e.g. light, sounds, thermal). The method is validated through case studies in Spain with future development recommendations. It also introduces informational and computational tools to envisage the desired environmental comfort outcome in simulated scenarios.

The last chapter provides some insights into practice of place-making with sensory cues in live projects. Chapter 23 reviewed three public-engaged projects in Glasgow to regenerate urban voids into community spaces with waste materials, exploring constructive sensibilities embedded in the making process. This chapter draws conclusions on how people from the practice can engage with sensory cues and add value to their designs. On one hand, there are always interests and questions on how one can validate practitioners' knowledge (Anderson & Herr, 1999). In return, it is always worth thinking how results from experiments and empirical studies can be applied for urban planning and design practice.

The overall goal of the book is twofold. On one hand it aims to provide practical examples for 'measuring' perceptual aspects in the urban realm across a broad spectrum of sensory aspects and show how such data can be turned into useful information for both researchers and practitioners; these can potentially be replicated by others in a context of practice, or be used as a learning tool by students. On the other hand the book offers food for thought about theoretical frameworks to take 'perception' into account in the general discourse about cities. Methods and theories proposed in this book will be hopefully validated in the future so to establish a common understanding about how 'perception should drive urban assessment and design'.

## References

- Aletta, F., Kang, J., & Axelsson, Ö. (2016). Soundscape descriptors and a conceptual framework for developing predictive soundscape models. *Landscape and Urban Planning*, 149, 65-74. doi:10.1016/j.landurbplan.2016.02.001
- Anderson, K., & Smith, S. J. (2001). Emotional geographies. *Transactions of the Institute of British Geographers*, 26(1), 7-10.
- Anderson, G. L., & Herr, K. (1999). The new paradigm wars: Is there room for rigorous practitioner knowledge in schools and universities? *Educational Researcher*, 28(5), 12-40.
- Brown, A. L., Kang, J., & Gjestland, T. (2011). Towards standardization in soundscape preference assessment. *Applied Acoustics*, 72, 387-392.
- Cassidy, T. (1997). *Environmental Psychology*. London, UK: Psychology Press.
- Classen, C., Howes, D., & Synnott, A. (1994). *Aroma: The cultural history of smell*. London, UK: Routledge.
- Crang, M. (2003). Qualitative methods: touchy, feely, look-see? *Progress in human geography*, 27(4), 494-504.
- Davies, W. J. (2013). Editorial to the Special issue: Applied soundscapes. *Applied Acoustics*, 74, 223.
- Davidson, J., Smith, M. M., & Bondi, L. (Eds.). (2012). *Emotional geographies*. Ashgate Publishing, Ltd..

- European Parliament and Council. (2002). Directive 2002/49/EC relating to the assessment and management of environmental noise. Brussels: Publications Office of the European Union.
- Gibson, J. J. (1966) *The senses considered as perceptual systems*. Boston, US: Houghton Mifflin.
- Gehl, J. (2011). *Life between buildings: using public space*. Washington, D.C., US: Island Press.
- Harding, F. (2013). *The performance arts in Africa: a reader*. London: Routledge.
- Hardy, E. G. (2012). On the Lex Iulia Municipalis. In H. W. Garrod, A. Platt, & H. Jackson (Eds.), *The Journal of Philology* (Cambridge Library Collection - Classic Journals) (Volume 35). Cambridge: Cambridge University Press.
- Henshaw, V. (2013). *Urban smellscape: Understanding and designing city smell environments*. London, UK: Routledge.
- International Organization for Standardization. (2014). ISO 12913-1:2014 Acoustics — Soundscape — Part 1: Definition and conceptual framework. Geneva: ISO.
- Kang, J., Aletta, F., Gjestland, T. T., Brown, L. A., Botteldooren, D., Schulte-Fortkamp, B., . . . Lavia, L. (2016). Ten questions on the soundscapes of the built environment. *Building and Environment*, 108, 284-294.
- Lin, T. P. (2009). Thermal perception, adaptation and attendance in a public square in hot and humid regions. *Building and environment*, 44(10), 2017-2026.
- Nikolopoulou, M. and Lykoudis, S., (2007). Use of outdoor spaces and microclimate in a Mediterranean urban area. *Building and environment*, 42(10), pp.3691-3707.
- Pallasmaa, J. (2012). *The eyes of the skin: architecture and the senses*. New York, US: John Wiley & Sons.
- Paterson, M. (2009). Haptic geographies: ethnography, haptic knowledges and sensuous dispositions. *Progress in Human Geography*, 33(6), 766-788.
- Payne, S. R., Davies, W. J., & Adams, M. D. (2009). *Research into the Practical and Policy Applications of Soundscape Concepts and Techniques in Urban Areas* (NANR 200). London: Department for Environment Food and Rural Affairs.
- Porteous, J. D. (1985). Smellscape. *Progress in Geography*, 9(3), 356-378.
- Rodaway, P. (2002). *Sensuous geographies: Body, sense and place*. London, UK: Routledge.
- Ruotolo, F., Maffei, L., Di Gabriele, M., Iachini, T., Masullo, M., Ruggiero, G., & Senese, V. P. (2013). Immersive virtual reality and environmental noise assessment: An innovative audio-visual approach. *Environmental Impact Assessment Review*, 41, 10-20.
- Southworth, M. (1969). The sonic environment of cities. *Environment and Behavior*, 1(1), 49-70.
- Truax, B. (1978). *Handbook for Acoustic Ecology*. Vancouver, Canada: ARC Publications.
- Wang, X., Kim, M. J., Love, P. E., & Kang, S.-C. (2013). Augmented Reality in built environment: Classification and implications for future research. *Automation in Construction*, 32, 1-13.
- Zardini, M., & Schivelbusch, W. (2005). *Sense of the city: an alternate approach to urbanism*. Zurich, Switzerland: Lars muller publishers.