

Commentary

What are the Current Priorities and Challenges for (Urban) Soundscape Research?

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Abstract: Soundscape research is attracting an ever-increasing worldwide interest from different disciplines and stakeholders. This brief commentary paper aims at offering some insights into the new directions this research (and practice) field will likely go, in the near future. For this purpose, eleven early-career soundscape researchers and practitioners were approached and asked to provide a response to the question “*What are the current priorities and challenges for soundscape research?*” Five recurring themes were identified in the participants’ statements. A major concern of the interviewed sample is the need to bridge the academic and practice sides of the soundscape community, in order to better position this discipline in the broader framework of (urban) sound planning and design.

Keywords: soundscape; acoustic environment; urban planning; multisensory perception; early-career researchers

1. Introduction

Soundscape studies are a well-established field of research by now, positioned somewhere in the “intersection” (some might even say “union”) among diverse disciplines, such as sociology, environmental psychology, music, acoustic ecology, urban planning, noise control engineering, architecture and more. The concept of soundscape started to increasingly gain importance, particularly for researchers and practitioners of the built environment, thanks to the pioneering work of authors like Southworth [1] and Schafer [2], who significantly contributed to the debate around the urban realm, questioning what modern cities should “sound like” (and not only “look like”). The scope of soundscape research is broad, and it can indeed be applied to any context. However, it becomes particularly important in *urban* contexts (compared to rural or natural ones), because of the many sustainability challenges modern cities are facing around the world, due to an increasing density of people and activities related to urbanization and globalization [3].

Kang et al. [4] showed that the number of soundscape studies (even without considering those strictly dealing with natural and animal sciences) is increasing with time. Looking back at the scientific production of the last 20 years, it is easy to support such a claim. Just as an example, Figure 1 shows the cumulative sum of items retrieved from the Scopus[®] database in the year range 1997–2017, using soundscape as search term (for title, abstract, keyword criteria). Several special issues in academic journals have indeed gathered papers to report on the advancements in the field in the last few years [5–7]. This does not necessarily cover the whole body of soundscape literature, but it shows a consistent trend.

While the publication rate of soundscape studies is increasing stably, urban soundscape research as a whole could still be considered in its beginnings. The discipline is going through a process of harmonization and standardization, supported by the efforts of the international research community [8],

aiming to address both general frameworks and definitions' issues [9,10], as well as more practical and methodological aspects related to "soundscape" [11–13].

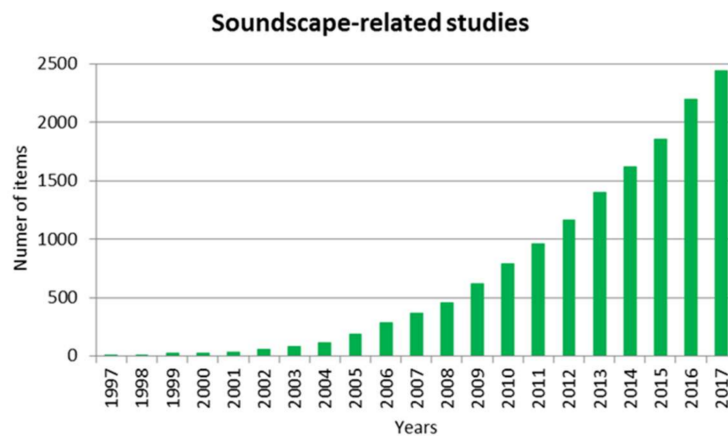


Figure 1. Cumulative sum of documents retrieved in the Scopus® database using “soundscape” as search term: TITLE-ABS-KEY (soundscape).

The aim of this Commentary paper is not to propose a framework for the development of the soundscape discipline, but rather to make an educated guess on where soundscape research will be pointing at, and where it will be, in the near future. For this purpose, a number of soundscape researchers in the early stage of their (academic or professional) careers were invited to express their views on this matter. Data collection was conducted using an interview method. In Section 2, the contributions of the interviewees are reported integrally. In Section 3, some themes are extrapolated from the interviewees' statements to suggest possible paths the soundscape community will be following.

2. The Perspective of Early-Career Soundscape Researchers

In order to gather deeper insights into what issues are perceived as priorities in soundscape research, we selectively invited eleven early-career researchers in the soundscape area to answer the following open-ended question: “*What are the current priorities and challenges for soundscape research?*”

The general criteria for the selection of the participants typically were: having less than 5 years of post-doctoral experience; being younger than 40 years old; having published at least three journal or conference papers with a clear focus on soundscape in the last 5 years. While more researchers/practitioners could have been invited, it was assumed that data gathering would easily be saturated with a relatively small group of participants (which is common in this kind of open-ended methods).

The invitation was circulated via email separately to the selected researchers, together with some basic instructions; i.e., the answer would be relatively short in content (typically 100–500 words, but no explicit word limit was set), and there would be no need to provide definitions and/or justify concepts from soundscape theory.

Ten researchers out of the eleven invited agreed to take part. All responses were received within three weeks, after the first invitation email was sent out. We report below the responses to the abovementioned question, as provided by the participants, in the chronological order as we received them. The content of the statements provided by the interviewees was not revised (they are reported in full); only template-related adjustments were made. This study was granted ethical approval through the Ethical Review of Research Committee of the Faculty of Arts Design and Media at Birmingham City University, UK (confirmation letter on 1 November 2017).

Interviewee #1

Coming from landscape architecture, I see the following five challenges as being the most pertinent.
 (1) *Apprehending variation. There is a need to acknowledge the interdependence and relationship*

between adjacent soundscapes in terms of time-space relationships, contrasts and transition effects. (2) Multisensory experience. There is a need to understand the interaction between sound and other sensory inputs in the environment. For instance, the potential role of inter-sensory coherence could be further investigated. Also, the notion of visual masking is in need of a better understanding. (3) Sound and behaviour. There is a need to further understand the influence of sound on behaviour in various situations; this includes the notion of entrainment. (4) Representations. There is a need to further develop accessible visual and aural representations of soundscapes. (5) Practice-Academia. This challenge relates to all of the four previous points. In order to ensure applicability of the research conducted in the soundscape community, there is a general need to further connect academia with practicing professionals, like acousticians, architects and landscape architects. As part of such undertaking, it could be useful to increase the number of reference projects assessed in research as well as investigate potentials for new market oriented products, like urban soundscape furniture and absorbing materials for outdoor use.

(Gunnar Cerwén—Swedish University of Agricultural Sciences, Sweden)

Interviewee #2

Soundscape research is in a period of meteoric rise with its acceptance in the overall acoustic research arena. For many it has replaced the traditional noise annoyance research scope by its positive approach towards all sounds accepting the sound environment as a resource to appraise. Within its scope, initially ecological and rural soundscapes played the key role, yet urban soundscape studies on major metropolises to small-scale towns followed up by increased demand. Among all that concentration to open and urban-scale sound environments, there is one important research focus which started to get popular in the recent years, indoor soundscaping. Although indoor soundscaping shares many with the urban soundscape research methodology and framework, architectural characteristics, indoor context and space usage are the key differentiated elements to concentrate on. It is no doubt that, in the coming years with increased awareness on the importance of indoor soundscapes on space perception, one major priority of designing indoor environments will be indoor soundscaping, where architects, interior architects and designers start to design by listening to spaces in order to create enhanced user experience.

(Papatya Nur Dokmeci Yorukoglu—Cankaya University, Turkey)

Interviewee #3

The main challenge that I face as an early career soundscape researcher is the difficulty in ‘translating’ my research to insight for practitioners and thus bridging the dreaded academia-practice gap. This is particularly important to me considering my approach, that is focused on the relationship between what people do and what they hear in a public space context, thus very much relevant for e.g., designers and policy makers. In my experience, there is pressure on academics to provide made-to-measure ‘solutions’ that practitioners can integrate in their everyday work, without an understanding of the underlying idea of an actual change in mindset: sound is more than noise and sounds are not something that are only hindering and must be managed or limited, but are an essential part of our everyday urban experiences. We are not only ‘exposed’ to sound, but we also make sound. Furthermore, people are not identical machines that process, label and interpret what they hear in the same way, so the auditory experience is more complex than what noise measurements and even acoustic quality questionnaires can grasp. The valuable knowledge that soundscape researchers can share is more than just on gross simplifications on causal relationships, but rather methods and processes that others can integrate in their everyday work e.g., showing others how to observe, how to ask, how to integrate end-users in the decision-making process in a new way. While this idea is far from revolutionary for anyone in the soundscape community, the message somehow gets lost to the larger audience of practitioners. This change in mindset and putting sound higher on the agenda of practitioners but also pushing it

into the collective consciousness is at the crux of the challenges we are facing in our everyday work. I have thus inadvertently become a sound activist and I “preach” for more sound awareness both among those who design and manage cities but also those who inhabit and use them on a daily basis.

(Edda Bild—University of Amsterdam, The Netherlands)

Interviewee #4

In my opinion, we still need to develop empirically well-founded models on soundscape perception and its contextual factors. This primarily includes the understanding of human activities, behaviors, and associated attention processes. Based on that, we need to create novel ideas to improve soundscapes while taking into account residents’ and users’ perspectives. Here, a challenge is and will be to work together in transdisciplinary teams of soundscape experts and establish a common language when speaking about sound. Lastly, we need to reach broader audiences who make key decisions on urban environments and who can support us in carrying out soundscape interventions and in conducting large-scale participatory and observatory studies.

(Jochen Steffens—Technische Universität Berlin, Germany)

Interviewee #5

One of the challenges for soundscape research is that it is not clear for the designers (e.g., architects, landscape architect or urban planners) how to apply soundscape concept into their practical works because soundscape descriptors and indicators have not been clearly established yet, which are essential for the practical applications. Similar to subjective and objective measures in auditorium design process, the soundscape descriptors and indicators can be used to set the design goals and targets according to the specific context of the place. Thus, I think that efforts on standardization of subjective descriptors (e.g., semantic or linguistic attributes) should be taken for collecting internationally comparable soundscape data regarding soundscape descriptors. Also, soundscape indicators, which can be quantitatively measurable and implementable for designing and managing soundscape, should be established for the application of soundscape approach into practice.

(Joo-Young Hong—Nanyang Technological University, Singapore)

Interviewee #6

The field of soundscape research is an interdisciplinary branch of science of increasing prominence. It seems that the individual findings complement each other, indicating a universal and useful set of underlying soundscape descriptors. Now, the time has come to utilize this knowledge and design soundscapes that are truly beneficial to our physical and mental health. To achieve this, I believe there are three main challenges: (1) We must draw our attention inward and include indoor soundscapes in our studies. Soundscape research has thus far focused mainly on outdoor environments, while the developed methods and discovered findings are very well suited for indoor research as well. For example, many healthcare facilities are designed as highly efficient workplaces and not as pleasurable environments to reside in. There is a lot to be gained here. (2) Synergy must arise between those who study soundscapes and those who actually design soundscapes, these two groups are now worlds apart. Sound-designers rely on their gut feeling for most of their design decision and require a solid scientific paradigm as a foundation for their work, which can be offered by the state-of-the-art in soundscape research. There is much to be gained if these two groups come in contact with each other. Together we could actually design soundscapes that promote health and ensure a high quality of living. (3) Legislation should adopt the soundscape approach to complement the traditional acoustical approach, because as long as regulation and legislation do not properly include (the importance of) the soundscape approach, there will be no pressing need for anybody to act accordingly.

(Kirsten A. van den Bosch—SoundAppraisal Ltd., The Netherlands)

Interviewee #7

One important challenge is to hack deeply into architectural and urban practices to make soundscape concepts not only understandable, but also attractive to all professionals dealing with planning and design of the built environment. Architectural and urban practices are often based on aesthetic values which serve as a motivation for design. Soundscape research, as well as the soundscape concept, has a lot in common with approaches characteristic for these mainly visual disciplines. They concern many similar principles of perception and similar research tools, i.e., virtual reality simulations. The growing accessibility of quality tools for virtual reality simulations is opening many possibilities for soundscape researchers who shall be able to conduct experiments easier with a high degree of “immersiveness”, not necessarily tied to the auralization laboratories. The challenge would be not only to increase a number of soundscape assessments but to achieve a high degree of standardisation and implementation in practice at the stage when affordable tools accomplish satisfactory quality of simulating three-dimensional data for both aural and visual stimuli. New possibilities of data collection are arising intertwined with this, with ethical challenges regarding privacy, as well. I believe these connections could be used for that. Soundscape must not be another boring layer which should be implemented in the final design or plan proposal. It should be one of the design motivations. This educational task goes in hand with a fundamental need to define urban planning and design tasks which require attention of soundscape experts the most - specific land use, specific program that is more soundscape sensitive, type of a place where soundscape planning would have a significant impact on the overall conditions etc. For example, defining site selection criteria for soundscape interventions would be beneficial for this.

(Tin Oberman—University of Zagreb, Croatia)

Interviewee #8

Soundscape research has been drawing increasing attention from researchers with different background, and interdisciplinary approaches are promoting abundant theoretical and practical experiences. I think one of the priorities for soundscape research is to build a common scientific paradigm based on these experiences and knowledge we already have, so soundscape could have further development as an independent discipline. As a soundscape researcher with the landscape planning and design background, the relationships between landscape and soundscape are always my concern, from both physical and perceptive aspects, on different scales, and in different cultural background. It is a challenge not only for soundscape designers in terms of effectively using landscape elements, but also for landscape designers to consider about the soundscape effects in their design.

(Jiang Liu—Fuzhou University, China)

Interviewee #9

In the framework of my current research work on urban soundscape, priorities and challenges for soundscape research revolve around several issues. In this context, I'd like to share 3 of them. (1) Epistemology and disciplinary field definition—Does soundscape belong to art or science? Or is it inherently interdisciplinary, as Schafer argued? In the attempt of defining soundscape as a science and in the implementation of standardization processes (e.g., ISO norms), is there a risk of overlooking that soundscape studies were rooted in art? How can we solve this tension? Perhaps, as Schafer suggested, through “a new generation of artist-scientists”? (2) Knowledge production and social justice in relation to quiet areas—In the framework of the “Beyond the Noise: Open Source Soundscapes” project, empirical evidence has shown that the application of the soundscape approach and the active involvement of people in the identification and evaluation of quiet areas can also have a positive impact on environmental and social justice issues. By using the Hush City app, people have identified an additional network of small, “everyday quiet areas” which does not overlap with the official quiet

areas identified in the Berlin Quiet Areas Plan and which are more equally distributed on the city scale, reflecting real needs and people's preferences. Now that this network is identified, new challenges rise: how can these quiet spots be protected? And furthermore, how can we make sure that these places will not turn into gentrified areas? These challenges will be explored in the final step of the "Beyond the Noise: Open Source Soundscapes" project. (3) Data quality and standardization issues in regard to new technologies—In 2014 the ISO norm on soundscape definition and its conceptual framework was published, and a new ISO norm to standardize soundscape data collection and reporting requirements is under preparation. These ISO norms are fundamental to the achievement of data quality and to the development of consistent and robust comparative studies in soundscape research, and they can contribute to the establishment of the emerging soundscape science. On the other hand, with the increasing development and use of low-cost and open source digital new technologies (e.g., sensors, augmented reality, artificial intelligence, mobile apps), standardization processes face new challenges and open questions, which cannot be overlooked. Is it possible and does it make sense to standardize the implementation of these new technologies in soundscape research? And, eventually, how can this goal be achieved? How can the exponential speed of new technology development be combined with the inherent slowness of ISO norm production?

(Antonella Radicchi—Technische Universität Berlin, Germany)

Interviewee #10

Urban soundscape poses multidisciplinary, multistakeholder, and multisector challenges that require a far more integrated understanding than previous methods for dealing with urban sound environments. On the research side, I believe we need a better understanding of the relationships between sound sources, urban activity, and soundscape appropriateness to understand the role that amenities and interventions play. Though we are far from scientific consensus on many topics (e.g., acoustic indicators, evaluation methodologies), I believe the approach has reached sufficient maturity and the stakes are high enough that we should prioritize a developing a soundscape practice for the "real world". Beyond the purely academic side of research, like many fields, we are faced with a research-to-practice gap. Lately, we have been helping cities move past the legally codified, implicit assumption that all environmental sounds are unwanted. But we need more opportunities to implement and test our approaches that could serve as examples to help build momentum toward the intentional use of soundscape in design, planning, policy, and so on. For that we need the help and support of practitioners and other city representatives. In the long-term, cities would benefit from having tools for manipulating the sound environment to influence experience in the built environment (and vice versa).

(Daniel Steele—McGill University, Canada)

3. Common Themes

A qualitative thematic analysis was performed by the authors on the statements of the ten interviewees to identify common themes perceived as priorities to be addressed in soundscape research or, more generally, by the soundscape community. Table 1 shows a number of smaller Sub-themes used for the analysis that were aggregated into more general topics (Themes), and it briefly describes the perceived "challenges". As a general rule, a Theme was defined when a specific topic recurred at least twice between different interviewees.

Table 2 shows how recurrent each identified theme was among the ten interviewees. It can be seen that the most frequent themes to recur are the "Academia-Practice gap" and the "Applicability of the soundscape framework", which together included questions about the domain of applicability of the soundscape approach, normative framework, operational tools for design and communication, and alike. Themes 1 and 2 are the priorities most frequently mentioned by interviewees, which are both practice-oriented. The other three themes are more related to theoretical and methodological aspects of soundscapes. It is important to point out that the ten interviewees all have different academic

and professional backgrounds; therefore, the theoretical and methodological themes (3–5) are more fragmented. However, in spite of their personal research agenda (almost) all participants convey on the first two themes, mentioning them at least once in their statements. This raises the point that the new generation of the soundscape community is oriented to a transition from the academic to the practice domain.

Table 1. Themes identified in the statements of the ten interviewees.

Theme	Sub-Themes	Perceived Priorities (Challenges)
Academia–Practice gap	<ul style="list-style-type: none"> • Normative context • Design and planning guidelines • Education and training for soundscape professionals 	To bridge soundscape research and practice (architecture, urban planning, landscape design, etc.)
Applicability of the soundscape framework	<ul style="list-style-type: none"> • Indoor environments • Quiet areas • Scale of intervention • Common language to communicate • Techniques for representation • Operational tools (methods) 	To explore how to adapt the current (urban) soundscape frameworks for other contexts/disciplines.
Multisensory interactions in soundscapes	<ul style="list-style-type: none"> • Sound-visual • Sound-smell • Sound-haptic 	To identify impacts of other sensory inputs for soundscape appraisal.
Relationships between soundscape and behaviour	<ul style="list-style-type: none"> • Antisocial behaviours • Use of spaces • Crowd’s movements/flows 	To understand how people react to different types of sounds, behaviourally and psychologically, in specific contexts.
Technology for soundscapes	<ul style="list-style-type: none"> • Sensors and apps • Virtual/ Augmented Reality tools • Data archives and platforms • Repositories of soundscape studies/interventions 	To analyse data collected from emerging technologies, archives and platforms in an ecologically valid way.

Table 2. Occurrence of the identified themes among the ten interviewees.

	Theme	Interviewees									
		#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
1	Academia–Practice gap	•	•	•	•	•	•	•	•	•	•
2	Applicability of the soundscape framework	•	•	•	•	•	•	•	•	•	•
3	Multisensory interactions in soundscapes	•							•		
4	Relationships between soundscapes and behaviours	•		•	•						•
5	Technology for soundscapes							•		•	

Academia–Practice gap—a lot of work has been done in recent years to show solid evidence about quantifiable benefits provided by the soundscape approach to everyday practice for the professionals of the built environment [14–17]. However, there are still very few (properly documented) application cases that practitioners can refer to. The City of Brighton and Hove (UK) set out some examples of soundscape planning, but the inclusion of soundscape recommendations in the final design decisions about a number of urban interventions was sometimes limited [18]. The reason given by the planning authority was the lack of scientific evidence and, most noticeably, the prevalence of other aspects such as mobility, energy efficiency and air pollution control, which seem to be higher on the agenda of local authorities. Undoubtedly, compared to soundscape, these issues have already been framed into legislations (e.g., Directive 2008/50/EC, Directive 2014/94/EU, etc.), which makes a big difference on the decision-making process. Thus, more efforts into soundscape-oriented policies are needed [8,11].

An additional obstacle to fill the academia–practice gap could be the fact that there are no “trained” professionals to cover the broad range of skills and knowledge that the soundscape approach requires [19,20]. With this in mind, new learning and teaching activities should be developed in higher education institutions to train a new generation of professionals that can embed a more holistic view on the design and management of the urban acoustic environments.

Applicability of the soundscape framework—this theme is closely connected to the academia–practice gap, as the lack of clarity on how and where the soundscape approach should be applied is a crucial obstacle to embed it successfully into everyday practice. The international research community has partially reached consensus on the soundscape definition and a number of relevant concepts such as the difference between “soundscapes” and “acoustic environments” and the centrality of people’s experience “in context” [9,10]. However, the debate is still going on around methodological aspects, which caused the recent failed attempt to approve the Soundscape Standard Part 2 [13]. The major concern or uncertainty is indeed about the practical aspects of soundscape science. Furthermore, researchers seem to address soundscape issues at different “scales” of intervention. On one hand, some people deal with soundscape using a more large-scale perspective (i.e., planning-oriented), dealing with soundscape in parallel with landscape [21–25]; on the other hand, some researchers have also questioned that soundscape should be dealt with also at much more local and building scales, recently promoting indoor soundscaping. A number of studies have indeed been conducted in outdoor small-scale spaces (e.g., gardens or “pocket parks”) [15] or indoor (semi)public spaces, such as libraries, nursing homes and transportation hubs [26–31]. In such contexts, challenges for soundscape are even more demanding, because Room and Building Acoustics still dominate the view of most engineering and architectural professionals. However, in the contemporary context where the social functions particularly in public buildings have widely expanded, a shift in approaches to deal with the indoor sonic environment is definitely needed.

Multisensory interactions in soundscapes—multisensory interaction for soundscapes’ appraisal have been recognised since the concept was introduced. Different interviewees have pointed out that further research efforts are needed to better understand the interactions between sound and other sensory inputs in urban environments. While all senses are relevant for the soundscape framework, considering, for instance, the emerging research fields of “smellscapes” [32,33] and “thermalscapes” [34], the main interest seems to be again in the auditory–visual dichotomy [15] and how, more generally, soundscapes and landscapes relate to each other [21]. In particular, in a landscape framework, aural and visual elements interact in the construction of many perceptual dimensions, such as quietness and tranquillity, which have largely been investigated in the past years [3,4,8,9].

Relationships between soundscapes and behaviours—several interviewees acknowledged this gap of knowledge. It is important to understand how soundscapes can affect people’s behaviours in urban public spaces and, in turn, how behaviours will change the activities affecting the acoustic environments (and the soundscapes) [14,35–37]. This is particularly important for urban design at the micro scale. For example, it would be useful to get further insights into how the acoustic environments can modulate the perceived “safety” of a place, or the choice of using (or avoiding) a space. Addressing this challenge will need more interdisciplinary collaborations (e.g., behavioural scientists, psychologists, neurologists, criminologists, etc.) and definitely reliable protocols for data gathering in non-experimental conditions.

Technology for soundscapes—new technologies also bring new challenges into the field of soundscape research. From the point of view of laboratory experimentation, equipment and devices for Virtual Reality (VR) or Augmented Reality (AR) offer new tools and possibilities to investigate in controlled environments the effect of specific factors on sound perception, in potentially multisensory configurations [38]. However, the “ecological validity” of data gathered under such conditions has often been questioned and it is worth exploring further how reliable this information can be considered. Indeed, since soundscape is a perceived acoustic environment, effective auralizations for VR and AR applications are important to increase ecological validity, especially for the soundscape design

process [39]. The recording and reproduction issues are also a topic for discussion of the Soundscape Standard Part 2 (e.g., binaural and ambisonics recordings) [13].

On the other hand, in non-experimental contexts, apps and platforms for crowd-sourced data are attracting increasing attention in soundscape-related studies [40,41]. Also in this case, given the (usually) unsupervised nature of data collection, there might be some issues about the effectiveness of integrating such applications into scientific studies and making strong arguments that can eventually lobby for soundscape-oriented policy making. Furthermore, additional research efforts and awareness campaigns are desirable to help citizens with different socio-cultural backgrounds to understand the soundscape approach and to simplify and standardize concepts and tools [42].

4. Concluding Remarks

Soundscape research in the last decades has changed the historical view of “sounds” in the urban environment. The ISO (International Organization for Standardization) soundscape standards [10,13], as a result, could be seen as a first step towards the recognition of soundscape as a legitimate approach to manage and design the urban sound environments. However, their impact has been often limited so far in attracting stakeholders’ attention in real “practice” situations. From the reflections of researchers in this field (interviewees), the biggest challenge that the soundscape community is facing is the gap between academic research and urban planning and design practice. In responding to this challenge, there might be several ways; for instance: to explore more measurable or quantifiable methods to assess/predict and monitor the impact of sound on people’s perception of the built environments; to promote soundscape education for professionals and students through higher education’s and professional boards’ accredited courses; to lobby policy interventions to define a “soundscape legal framework”; to integrate practice components into academic work (and vice versa).

In the meantime, there are some priorities in responding to interdisciplinary requests and new technologies. More efforts are also needed around multisensory inputs in soundscape appraisals as well as bodily relations. All such initiatives will need support from both the academic and practice side of the soundscape community, in order to better position this discipline in the broader framework of (urban) sound planning and design. The collaboration of these two sides (of the same medal) will help to identify further challenges and points that are pertinent to practice. Moreover, such collaborations can be beneficial to formulate methods and understandings that are “in line” with the mind-set of practitioners.

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