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Two acoustic theories – Blesser and Salter's 'aural architecture' and Truax and Schafer's notion of 'soundscape' – are examined and their impact on architectural design is discussed.

Sounds in space or space in sounds? Architecture as an auditory construct

Michael Fowler

The absolute consideration of the acoustic environment within architectural design praxis has traditionally been reserved only for those specialised listening facilities such as concert halls or recording studios. This is in spite of numerous recent calls from architects and theorists such as Juhani Pallasmaa, Ted Sheriden, Karen Van Lengen, and Björn Hellström[1] that architectural praxis must seek to move beyond what Jeremy Till describes as the vanity of form,[2] and what Rafael Pizarro acknowledges as the seductive immediacy of pure visual articulations of space.[3] That architectural design has traditionally been in a more than willing position to seek out myriad influences, theories, and extra-architectural knowledge has even led Jean-Claude Guédon and Botond Bognar to argue that architecture has ceased to occupy a finite domain – its boundaries have dissipated as the definition of what architecture *is* continues to evolve and expand.[4]

This eagerness to embrace other disciplinary knowledge has, for the most part, neglected the recent theories of 'aural architecture' and 'soundscape' posited by Barry Truax and R. Murray Schafer,[5] and Barry Blesser and Ruth-Linda Salter.[6] This omission may have been insignificant had it not been for the recent studies into population density inversions between rural and urban areas and the increase in potential health and well-being risks from elevated noise levels across Europe. But perhaps the more persuasive aspects of the theories of aural architecture and soundscape lie with their latent power to augment architectural design with a semiotics of sound. Indeed, for architect-semiotician Geoffrey Broadbent, the importance of the field of semiotics lies in its potential application to the design of meaningful form in architecture. As Broadbent sees it, 'architects worldwide have been striving again to *build* meanings into their buildings, yet few seem to know that semiotic principles could help them'.[7] That architecture then might harness the sounding environment as a design construct whose auditory content delivers meaningful experiences which augment a building's narrative also provides a currency for Stephen Holl's long-held notion that architectural design must cater to the multisensory.

But there are fundamental differences separating aural architecture from soundscape that reside in each theory's stance on the connection and relevance between space and sound. Blesser and Salter nominate sound as a device for acoustic illumination; a novel design parameter that is often over looked yet capable of providing an aural compliment to design decisions that may have been biased from a focus on purely visual articulations of space. Thus, sounds are perceived as *in* space, and an aural architect uses sound sources in combination with the material properties, geometry, context, and programme of a design to produce unique multisensory architectural experiences. Barry Truax and R. Murray Schafer's theories differ in that they conceive soundscape as a collection of sounds that *produces* space. Here a soundscape is positioned as 'an environment of sound (or sonic environment) with emphasis on the way it is perceived and understood by an individual or by a society'.[8] In this regard, space is *in* the sounds, at least in a manner perhaps not too far removed from Henri Lefebvre's conception of space as a function of social production.[9] For both acoustic theories though, a semiotics of sound functions through the experience of the auditor, who interprets meaning within their environment through the act of *listening*.

For Schafer and Truax, the very impetus for the theory of soundscape arose from their overwhelming desire for a paradigm shift regarding the manner in which the qualities of a soundscape and its communicative power be considered within the earliest stages of urban or architectural design. This position is similarly reflected in Blesser and Salter's extension of architecture to become an act of spatial composition that synthesises anticipated visual *and* auditory effects. It is outwards from these fundamentals that I will explore in this article the theoretical underpinnings of these complimentary theories on the sounding environment and offer my analysis on their scope, some recent criticisms and design projects, and the possible factors that are inhibiting a more widespread visibility of the auditory within architectural design praxis.

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Aural architecture as an act of spatial composition

When acoustician Barry Blesser and environmental psychologist Ruth-Linda Salter published their 2007 book *Spaces Speak, Are You Listening? Experiencing Aural Architecture,* the United Nations had just released their now infamous report *State of World Population, 2007: Unleashing the Potential of Urban Growth.*[10] Not that Blesser and Salter's book was a direct response to the UN's report that, now for the first time in history, more people lived in urban areas than rural areas, but the deeper implications of their notion of aural architecture seemed destined to become, at least in theory, a catalyst for addressing the threat of a noisy future. The increasing population densities of cities may have many consequences for urban design, not least the impact on local ecological systems, energy usage and waste management. But what is perhaps most overlooked in this complex cocktail of cause and effect is the quality of the auditory experience with ever-greater densities of people as well as the effects of elevated noise levels on health, wellbeing, and social coherence.

Though aural architecture is not a direct means to solve such a complex issue as acoustic sustainability at the urban scale, it does provide an important framework for how architectural praxis might reconsider its disciplinary boundaries. The theory achieves this by questioning the inherent connections between materiality, volume, and sound sources, and what Blesser and Salter argue as a need for an increased 'auditory spatial awareness' among the technologically mediated general population in the Western world. Aural architecture then is a designate of the:

> [...] *properties of a space that can be* experienced *by listening. An* aural architect*, acting as both artist and social engineer, is therefore someone who selects specific aural attributes of a space based on what is desirable in a particular cultural framework. With skill and knowledge, an aural architect can create a space that induces such feelings as exhilaration, contemplative tranquility, heightened arousal, or a harmonious and mystical connection to the cosmos. An aural architect can create a space that encourages or discourages social cohesion among its inhabitants.*[11]

Holl's notion that architecture is an inherently multisensory experience that encompasses all the senses places Blesser and Salter's emphasis on the auditory channel as one that might be considered of limited enterprise; a type of phenomenology only for the blind or visually impaired. But, to counter such accusations, while at the same time noting architecture's fixation with visual forms, two key terms, 'active aural embellishment' and 'passive aural embellishment' are introduced as a means to highlight the fact that architectonic form may encourage particular acoustic behaviours:

> *Architecture includes aural embellishments in the same way that it includes visual embellishments. For example, a space we encounter might contain water sprouting from a fountain, birds singing in a cage, or wind chimes ringing in a summer breeze – active sound sources functioning as active aural embellishments for that space.* [...] *In contrast, passive aural embellishments, such as interleaved reflecting and absorbing panels that produce spatial aural texture, curved surfaces that focus sounds, or resonant alcoves that emphasize some frequencies over others, create distinct and unusual acoustics by passively influencing incident sounds.*[12]



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Here are the most acute aspects of the theory of aural architecture: that the physical articulation of space and the materiality of form have marked effects on the acoustic behaviour of sound sources. Geometry, spatial volume, and materiality combine to create unique acoustic signatures that enable particular auditory experiences given the function of particular sound sources within a site and the site's programme. This is rather elementary for the discipline of room acoustics, whose field is concerned primarily with the measurement and evaluation of architectural designs. Perhaps the innovative nature of active and passive aural embellishments for architectural praxis then is the simplification of acoustic concepts that can be often lost within the scientific language of assessing acoustic parameters such as T-30.[13] The concept of an active aural embellishment as a design parameter that illuminates the auditory qualities of an architectural site is an innovative concept from Blesser and Salter. This is particularly apparent in light of the premise that architectural space can also be a *designed auditory experience*, and thus may include the addition of sound sources, that when acting in concert with passive aural embellishments, provide particularly striking multisensory experiences.

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1 Bernard Leitner's *Wasserspiegel* (water mirror), an architectural installation for the 1997 Donaueschingen Music Festival, Danube temple, Donaueschingen, Germany.

2 Lars Spuybroek and Edwin van der Heide, *Water Pavilion* (1993–7), Neeltje Jans, The Netherlands.

This perhaps describes best the design approach of an early pioneer of aural architecture, Bernard Leitner, in his augmentation of the Danube temple at Donaueschingen, in Baden Württemberg, Germany *[1]*. Here, at the small neoclassical temple, which marks the headwaters of the mighty Danube, a small spring emerges from the base of the temple. The orientation of the temple, though, places the visitor some two metres directly above the hidden source for which a vista of the small pond and watercourse of the river are the primary focus. *Wasserspiegel* (Water mirror), Leitner's temporary architectural intervention commissioned by the 1997 Donaueschingen Music Festival, saw the installation of a reflective acoustic dome positioned under the ceiling of the temple that acted as a parabolic reflector to greatly amplify the sound of the hidden spring at the temple's feet. Suddenly the temple's form and situation gained a deeper meaning as the communicative power of the sound of water springing forth amplified the architectural narrative.

Leitner's synthesis between active and passive aural embellishments at the Danube temple can be read as not only a deeply considered approach to aural architecture but also a technologically minimal one. This becomes an obvious prompt for framing the water pavilion *[2]* of Lars Spuybroek and composer Edwin van der Heide as a technologically maximalist compliment that Marcus Novak might eagerly consider a species of 'archimusic'.[14] The pavilion's programme, generating a multisensory onslaught dedicated to the experience of water, was developed out of the desire to create a communicating architectural environment in which the encounter is one of a sounding building rather than a building of sounds. The interior of the pavilion uses electronically generated sounds, actual moving water, lighting effects, sensors, and video imagery to augment intersecting non-uniform surfaces that immerse, wrap, and revolve around the visitor. The sounds too are designed to behave autonomously, for which the notion of immersion arises as a consequence of the constantly changing acoustic dimensions of the interior. Here then, Spuybroek and van der Heide seem particularly drawn to the concept of an architecture in which space is generated *within* sounds rather than the case of Leitner's *Wasserspiegel* where sounds *articulate* space.

But to argue then, as Blesser and Salter do, that aural architecture is a newly founded field is to partly disown the mid-twentieth-century rise in digital technologies, and in particular, the shift from acoustic space as wholly a function of the physical articulation of space (that is, sounds *in* space), to it becoming independent, or an generator of space (space *in* sounds). This notion extends, and problematises, what the traditional notion of the word 'architecture' means within Blesser and Salter's concept of aural architecture. Given the scope of digital technologies to allow for any number of acoustic spaces to be simulated and experienced via headphone or other multichannel listening formats, aural architecture necessarily becomes a representation of space that moves beyond the

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purely functional notion of an *extant* physical environment. Is spatial music then, in electro-acoustic or acoustic formats a form of aural architecture? For Blesser and Salter, musical space is a subset of the space that aural architecture encompasses, and an important precursor to the appreciation and application of exemplar acoustic qualities to the more tangible articulations within the built environment.

The authors nominate particular exemplars of the unification between spatial electro-acoustic music and architectural form, citing the auditoria of the Pepsi and German pavilions at the Osaka World's Fair 1970 *[3]*, and the Phillips pavilion at the 1958 Brussels World Fair for whom composers Iannis Xenakis, Edgard Varése, and Karlheinz Stockhausen later found worldwide acclaim. That these spaces were capable of producing intense multisensory experiences, including projections and lighting effects, was offset by the capabilities of the spatial projection of sound sources within the pavilions using electronic means, and via multiple loudspeakers – in the case of the German auditorium, over fifty loudspeakers structured in concentric circles below and above the seated audience. The aural architecture of these spaces then seems readily apparent, though one actuated primarily through musically crafted sounds whose spatial projection and compositional form followed the principles of musical aesthetics. The architecture then of these pavilions served or facilitated the delivery of thematic content that was bound to musical narratives. Thus the architectonic dimensions and materiality of the pavilions are not *in themselves* designed to evoke aural architectures. They merely act as conduits, or perhaps instruments for ephemeral electro-acoustic events that are designed by the composers whose works they perform, and subsequently delivered via technological mediation (multichannel loudspeaker diffusion).

This means then that, for aural architecture to gain credence and impact within our daily lives, designers are not only required to consider the ways in which auditory behaviours might be encoded into architectonic form (with, or without technological mediation) but, similarly, that the end-user of a space is a *critical listener*. If aural architecture then is a call for new modes of design praxis, it is simultaneously a call for a new mode of listening:

> *When our ability to decode spatial attributes is sufficiently developed using a wide range of acoustic cues, we can visualize objects and spatial geometry: we can 'see' with our ears.* [...] *The composite of numerous surfaces, objects, and geometries in a complicated environment creates an* aural architecture.[15]

What is required then is what Blesser and Salter identify as an 'auditory spatial awareness', akin perhaps to Pallasmaa's notion of 'heightened awareness'[16] in which a sound source, as carrier of a temporal continuum, partners with the embedded visual impression of architectonic articulation.



3 Karlheinz Stockhausen and the Spherical Auditorium, German Pavilion, Expo 70' Osaka, Japan.

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Blesser and Salter go further by suggesting a tripartite encounter in which sensation (detection), perception (recognition), and effect (meaningfulness) provide a basis for which an external environment becomes an internalised auditory experience.

But, according to Blesser and Salter, this complex set of interactions between sensation, perception, and effect cannot be completely premeditated during the design concept stage as a human-internalised aural image. Perhaps what sets aural architecture apart from other traditions of design is its fundamental reliance on computer modelling as a means for the aural attributes and the aural experience of a space to be predicted and a simulation (or auditory model) consequently constructed. Blesser and Salter document the claim that, before digital computing and mass production, acoustic design was a process of trial and error, an almost Darwinian approach in which the best designs fostered copies and changes for which exemplars emerged over centuries. That there is then a necessary reliance on modern computation for designing aural architectures suggests that there is a potential for a dissipation between those traditional spheres of acoustic modelling and architectural modelling: a situation that Michael Ostwald might nominate as an example of 'hybridisation' between acoustic theory and architectural praxis.[17] The striking direction that architectural computing has taken in the generation of form, and what Mark Burry notes as the computer's ability to foresee forms that could never have been internally visualised by a human mind,[18] seems to offer a platform equally poised for the discovery of unknown auditory experiences and thus new meaningful relationships between architecture and those who inhabit it. But, if the emphasis of aural architecture seems a natural fit to the idea of architecture as an act of spatial composition, whether the materials used are ephemeral or tangible, the question remains about how, and by what means, the traditional materials of the built environment must be combined to achieve an exemplary or meaningful auditory status, and moreover, how will these manifestations address the auditory expectations and listening habits of the intended end-users?

Acoustic ecology and the landscape-soundscape dichotomy

If aural architecture then appears to be a theory of acoustic space that revolves primarily around the concept of spatial composition, or at least the extension of architecture beyond the domain of purely visual articulations of space, then R. Murray Schafer's concept of the *soundscape* of an environment relies on the discreet nature of sound sources to generate a particular semiotic *schema* between source and receiver (that is, active listener). Schafer derived the term soundscape from the word landscape as a provocation against the contention that a landscape constitutes all objects within the visible environment; a soundscape then represents all auditory phenomena within a given environment.[19] But as Blesser and Salter note, 'with a soundscape, the sounds themselves are important in themselves [... whereas] aural architecture emphasizes sound primarily as illumination.'[20] This distinction also gives rise to Schafer's views on the constituent elements of a soundscape as an *acoustic ecology*, and therefore to study the sounds of an environment is to seek to understand that environment's ecological dimensions. But Schafer's focus on sounds of human-made and natural environments as carriers of information and, similarly, as mediators between a listener and an environment leads to the theory's de-emphasis on the spatial context of the sound sources. This particular de-emphasis on the physical context and refocus on the semiotics of sounds, particularly in the urban environment, has meant that the discipline of acoustic ecology has forged a unique methodology for the analysis and classification of sounds as a means to better understand how the soundscape helps construct ideas about place.

The alignment of the discipline of acoustic ecology towards the rigorous analysis of the sounding environment would seem at odds with the creative direction of its founder, R. Murray Schafer, an internationally recognised composer and environmental activist. But the ideas of Schafer were a result of a multidisciplinary investigation into noise within the urban environment, firstly initiated at Simon Fraser University (Vancouver, B.C) in the late 1960s:

> *The home territory of soundscape studies will be the middle ground between science, society and the arts. From acoustics and psychoacoustic we will learn about the physical properties of sound and the way sound is interpreted by the brain. From society we will learn how mankind behaves with sounds and how sounds affect and change this behaviour.*[21]

Barry Truax has argued that a soundscape then represents not merely the presence of an acoustic environment – which could be natural (located) or simulated (dislocated) – but also the potential of such an environment to communicate information to a listener.[22] As the two most prominent theorists active within the field of acoustic ecology, both Truax and Schafer have argued that, in particular, natural environments and their acoustic behaviours produce particularly meaningful experiences to auditors, and thus the sounds within them constitute a type of mediating language between listener and environment. This is perhaps one of the more latent ideas of soundscape theory and the most relevant for the field of architectural design. Given that the ubiquitous and immersive nature of sonic events perpetuates just about every corner of our daily lives, and that discrete meaning is communicated through a plethora of functional and non-functional sounds, means that architecture today is in a particularly influential position. The power of soundscape theory thus lies in its suggestion that new modes of communication for architecture exist and, moreover, that there is a potential for generating new and meaningful relationships between people and the built environment. Indeed Schafer recognised this

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potential too, and used it as leverage to firstly better understand and classify the urban acoustic environment, and secondly as a departure point for which in the future, Schafer reckoned, we will design urban sonic experience anew.

Like the theory of aural architecture then, the study of a soundscape is a phenomenological study of the environment, though cast exclusively via the auditory channel: as Hildegard Westerkamp notes, a listener is situated *within* the soundscape.[23] This immersion then is akin to the world of Martin Heidegger's 'thematic space', for which the resulting encounters between *Dasein* and localised sounding objects become categorised by Schafer via a new terminology that formalises the taxonomy of a soundscape: the terms *soundmark*, *keynote*, and *signal*. This new terminology attempts to document classes of sounds regarding their semiotic structure, and for which these three fundamental classes enable a rather broad investigation into what is being communicated to an acoustic community (that is, those auditors actively listening to sounds).

Soundmarks are those sounds considered culturally significant or deemed by an acoustic community to warrant preservation (such as church or temple bells, town square clocks, and foghorns) while keynote sounds are those which are continuously operable within a site and form a background (traffic, for example, or air conditioner sounds or muzak). Sound signals represent foreground sounds within a soundscape and thus may dynamically change and include local soundmarks, though as Truax[24] and Jean François Augoyard have noted,[25] the increase in the sound pressure level and electronic nature of emergency warning signals in contemporary cities is a direct consequence of the increased noise floor level of urban spaces. Truax also argues that within urban environments, because keynote sounds are overwhelmingly generated through mechanical means (and thus occupy predictable frequency bands), they are contributing to the masking of historical soundmarks and thus producing lo-fi (low fidelity) auditory environments.[26]

The larger goals of Schafer and the acoustic ecology movement have been not only to examine the qualities of a soundscape but also to use this effort as a means to ascertain whether there are recurring patterns that point towards exemplary soundscape designs. The work of Bernie Krause in bioacoustics and his auditory niche theory[27] certainly provides an important pointer towards the composition of pristine natural soundscapes and their qualities, though for Truax and Schafer, there is a greater desire for the soundscape of the urban environment to become an exemplary auditory design space. This desire for urban planners and architects to use soundscape concepts within their design processes has attracted criticisms though, and not only from within the discourses of design theory, but also from the field of anthropology.

For Tim Ingold, the question of soundscape as a design parameter within the built environment is not as much the hairy question as the very notion of soundscape itself.[28] As an anthropologist, Ingold objects to the concept that the landscape should be further divided into 'scapes', contending that the experience of space is a multisensory one for which the very idea of a separate agency awarded to acoustic phenomenon destroys Schafer and Truax's deeply-held notion of the *ecological* importance of soundscape studies. Sound designer and theorist Sophie Arkette similarly cites their misguided assumption on the nature of silence within the city, noting that:

> *Schafer and his colleagues are apt to condemn cities for eroding silence. Their ecological approach appears to treat silence as an endangered species; something that must be preserved by maintaining habitats for its incubation and growth.*[29]

Arkette sees the critique of acoustic ecologists against the elevated sound levels of cities as a complete misreading of the nature of city sounds, the inherent semiotics of city spaces and their dynamics. As such, she read this as a stance based on a romantic idea of the pastoral becoming a stand-in for an auditory utopia in which current technologically mediated space represents a malformed and misshaped entity that requires *tuning*.

But the notion of tuning has already been explored outside the auditory realm of soundscape studies in what may seem like an historical confirmation of the immediacy and importance that architectural design has placed on visual manifestations of form. One of Archigram's more iconic projects 'Tuned suburb' explores what might initially seem in contemporary parlance as the act of 'modding' as applied to the built environment of the suburban dwelling in which material additions, new facade elements, and technologies and signage complement the vernacular. But, as Simon Sadler notes, 'ethically and aesthetically, Archigram regarded strictly modular building systems as a mixed blessing, partly an overstated "demonstration" of prefabrication that might be better combined with other building elements or tacked onto structures already in situ'.[30] Here then, the notion of tuning serves purely an architectonic or aesthetic function, though given the scope of what Blesser and Salter identify as the potential of numerous materials to act as passive aural embellishments and thus change the acoustic identity of a space, it would seem that there was an unseen (or perhaps *unheard*) consequence to Archigram's use of 'kit architecture' to transform a suburb.

Thus the idea of tuning may imply the act of acoustic attenuation or amelioration, an approach that Ursula Franklin advocates through her call for the instigation of 'silent commons' within cities.[31] Contending that the appreciation of silence is at stake within the urban environment leads Franklin to note that the impact of technology has both created new opportunities and hazards for the qualities of the postmodern city soundscape. Indeed there is more than a passing interest in the impact of technology within the discipline of soundscape studies regarding the auditory experience of cities. Many of the arguments against technologically

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mediated sound sources arise in a form that is congruent with Albert Borgmann's theory of the 'device paradigm'.[32] Franklin's desire for the removal of technological sound sources within the city neatly approaches Borgmann's call for a focus not on technological devices themselves, whose only qualities remain their readiness for use, but on 'focal things and practices' (such as gardening, running, and reading for example). For architect and theorist Paul Carter though, the notion of silence, or the natural acoustic environment as a type of auditory Eden, easily attracts the same criticisms as those levelled at Borgmann.[33] Carter notes that:

> *Any research program that takes a notion of harmony or reharmonisation as its ground and goal risks recapitulating the nostalgic trope which, already in the early 17th century according to Francis Bacon, characterized the empirical sciences, and which, in repairing fallen appearances, has as its goal the restoration of Paradise.*[34]

Carter's most compelling observation though on the discipline of soundscape studies lies in the way in which he reads its use of technology, and how its use has created a fracture, essentially splitting the discipline into two camps. The first contains sound activists whose implicit objective is:

> *ameliorative, to draw attention to a neglected dimension of the everyday world, and, by appealing to the listener's musical sensibilities, to enlist support for its preservation and protection. Another camp, mainly represented by anthropologists and historians, regards acoustic ecology primarily as a strategic tool for resisting the visualism of Western analytical thinking. Applied to diverse cultures and historical periods, it unveils dimensions of social and cultural signification that a deaf perusal would inevitably miss.*[35]

Perhaps what Arkette and Carter identify most critically about soundscape studies' apparent readiness to present itself as a utility to urban planning and architecture is the discipline's emphasis, and thus potentially alienating stance, on the aesthetics of sound as consumed wholly within a music-centric discourse. Indeed, the derivation of the idea of keynote from Western art music's notion of the functional harmonics of a home key or base tonality betrays the ease for which the practice of musical soundscape composition arose. Given the seemingly more practical definition of aural architecture for anticipating novel types of tangible spatial design, a soundscape is by contrast, *any* sounding environment. This may include then environments created through piecing together collected field recordings: works also known as 'soundscape compositions'. Many of the electronic soundscape compositions of Truax and Westerkamp[36] thus function as virtual acoustic experiences in that they *suggest* acoustic spaces that may never be completely formed, built or realised outside of the electronic music studio – space then becomes constructed *through* the sounds, and potentially acquiescent to a preconceived musical narrative.

But for Bert de Coensel's recent urban planning project in Antwerp, the theory of soundscape became an ascendent to negate any ulterior reliance on preconceived musical aesthetics that might drive design decisions. By focusing on local residents' perceptions of sound and noise within the project site, de Coensel sought to influence the housing design so as to provide for a future idealised soundscape that meaningfully connects residents to their built environment. Here, soundscape theory became a valuable directive to guide the earliest stages of the project. By using a range of approaches including end-user site questionnaires, noise maps, acoustic modelling, and SWOT analysis (strengths, weaknesses, opportunities, threats), a series of design scenarios were proposed for the housing estate that sought to greatly influence the quality and presence of particular sounds that were important to residents. Other design measures that were suggested included the concept of a quiet side to the housing estate optimised through the geometry of roof shapes and facades covered with climbing plants combined with planted green roofs so as to improve acoustic insulation and limit acoustic diffraction. Similarly, a nearby urban park was earmarked for various types of greenery and ground coverage as well as optimising topography as a means for spectral fine-tuning of the soundscape of nearby transport infrastructures.[37]

The bifurcation between acoustics and architectural design

It still remains surprising though that the fields of acoustics and applied acoustics have, in the last five years, become the main proponents for the usurpation of the theory of soundscape into frameworks intended to guide future urban designs. While the thirty-or-more years since Schafer's development of soundscape studies have seen the discipline focused primarily on soundscape composition and the preservation and documentation of important natural and cultural soundscapes,[38] the recent interest from the field of acoustics has highlighted what Truax correctly anticipated as the necessity for not only assessing the physics of sound (through the 'energy transfer model') within an environment, but also the semiotics of sound (what Truax calls the 'communicational model').

But this newly found interest has moved the field of soundscape studies into a new territory that relies more heavily on the scientific method that Blesser and Salter outline in their tripartite model of sensation, perception, and effect. The most recent work, then, that uses the concepts of Schafer, Truax, and others in the field of acoustic ecology tend towards the deployment of metrics to describe an urban soundscape, and the development of predictors for gauging the perception of ideal soundscapes among users of a site.[39] Traditionally, soundscape research has relied on the concept of an expert aesthetic listener, their documentation of an auditory environment and their mapping and description of its qualities. For acousticians, a methodology that investigates the nature of human perception of sound within the urban realm, and among human participants (who are not necessarily

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4 Warwick Bar, Birmingham, UK (2006).

expert listeners) has been more of a focus, as have large studies that qualify what are engaging or preferred soundscapes for an acoustic community within an urban environment.[40]

Much of this research though has been limited to the scientific discourses of acoustics and applied acoustics even though there is a desire (which is also common to the acoustic ecology movement) for an immediate and rapid uptake of such frameworks and proposals directly into contemporary urban design and architectural praxis.[41] That architectural discourse has yet to fully 'see' these strong postulations from either the field of acoustics or acoustic ecology only seems to highlight deep-felt differences regarding the methods of presentation, the utility of information, and the language of dissemination regarding such diverse fields. That there has been a traditional separation between architectural design and acoustics has been one forged not only through the function of each discipline (acoustic measurement versus spatial composition), but the language and methods by which knowledge is assessed, understood, and disseminated within each field.

But according to acoustician Jian Yang, in spite of such diversity between the disciplines there is still a pressing need for the integration of urban soundscape approaches into design policy. Yang also notes that this goal is currently inhibited by a lack of universal soundscape quality indicators (or metrics) and design guidance tools for the creation of noise maps or new urban design auralisations. Maria Leus similarly identifies that 'planners are lacking an adequate design vocabulary such as aurally evocative concepts and tools to integrate an acoustic consciousness into the design process of urban spaces'.[42] This deficit is also attributed by Mags Adams to the current situation in which 'there is no standard way to include such subjective concepts as sound aesthetics into the planning process'[43] which consequently rejects such aesthetic concerns due the prevailing standard of scientific rationality. Blesser and Salter's identification then of the need for new modes of listening through auditory spatial awareness seems an important hurdle that will be required not only of architects, but equally of urban planners.

However, for Frances Crow and David Prior of the architectural practice Liminal, the urban development of Warwick Bar in Birmingham, UK *[4]* presented itself as just such a chance for investigating how new modes of listening might influence design decisions. Crow and Prior integrated Hildegard Westerkamp's ecological practice of *soundwalking* as a means to embed themselves not only within the acoustic dimensions of the project site, but also to enter into the same type of relationship local residents have with the site. Westerkamp's practice of soundwalking involves a group of technologically unmediated listeners whose pre-planned walk through an environment is enacted in silence and without interpersonal communication so as to foster a heightened auditory awareness and thus allow for a deeper understanding of the connection between listener and place.[44] Crow and Prior used soundwalking as a

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means to investigate aurally the sonic character of Warwick Bar and raise the status of its auditory history to a level that would actively influence the development of the masterplan. Soundwalking also provided a way in which to educate the partner project architects (Kinetic AIU) as well as the general public on the site's current acoustic qualities, soundmarks and signals. Additionally, Crow and Prior used a questionnaire to construct a noise/tranquility indicator from the local soundwalkers and then integrated existing Birmingham City Council noise maps of local traffic patterns to generate a predicative acoustic model that tracks the impact of any new architectural or landscape interventions within the site.[45]

Indeed the current frameworks for urban planning regarding noise issues are well known for their complete reliance on the measurement of SPL (sound pressure levels), for which numerous studies have shown a significant health and well-being risk regarding elevated noise levels.[46] What is innovative then about the proposals of Crow and Prior and de Coensel are their integration of local user soundscape preferences and the notion that sound represents not just a phenomenon of physics, but a semiotic construct too.[47] But even as such guidelines, suggestions, or frameworks for qualitative sound design are proposed, the praxis of architectural design at the urban scale remains a difficult task that must contend with numerous competing agendas. This perhaps represents the real difficulty in interdisciplinary investigations when knowledge that is prepared and disseminated within one discipline is expected to be readily absorbed into a completely different disciplinary language.

Towards a noisy future?

In 2007, a study by Anita Gidlöf-Gunnarsson and Evy Öhrström noted that 'it has been estimated that about 80 million (approximately 20%) of the European Union's population suffer from noise levels considered unacceptable (above 65dB in so-called "black area") and an additional 170 million are living in "grey areas" exposed to noise levels between 55 and 65 dB'.[48] The consequences of such acoustic conditions have been well documented through numerous studies into the link between stress effects manifested in physiological systems and psychosocial behavioural patterns, indicating that the acoustic quality of urban space will remain an important contemporary health issue with increased population densities. Though such studies refer only to pure SPL levels of sound sources rather than user expectations of particular sounds, sound source preferences, the semiotics of sounds, or threshold levels of acceptance within particular urban areas, there is still strong evidence that the acoustic environment of the contemporary city, and in particular, its future sustainability, will need constant redress. That both aural architecture and soundscape studies have nominated themselves as somewhat equipped to tackle, or at least present alternative frameworks for conceptualising sound as a design parameter leaves the processes of architectural design still in need of new ears.

That noise is a particularly contested area for urban design given its wide ranging definition among different sociocultural groups, has led Björn Hellström to describe it as more of a subjective qualitative measure of a sound for a particular auditor, while Charles Gurney hears noise as a sound that is out of place.[49] The emphasis on *critical listening* that is the hallmark of both aural architecture and acoustic ecology may end up becoming their greatest hindrance if designers are to take on and apply aural design into urban spaces. Given both disciplines have arisen from thinkers and practitioners whose *modus operandi* involves a lifelong role in critical listening – whether that be within the context of musical aesthetics or sound engineering – means that to design an urban auditory experience necessarily implies possessing the ability to understand what is currently heard within a site according to its users. Furthermore, what a new design may desirably present to the ecology of such a site. This may quite easily lead to the playback of soundscape compositions over loudspeakers,[50] of course, which would seem to defeat the purpose of Blesser and Salter's contention that the auditory environment is indelibly linked to tangible space, and moreover, that the ability of sound to embody an architectural programme or a project brief is a creative *opportunity* rather than a regulatory constraint.

However, where specific acoustic goals have to be resolutely upheld, such as within concert halls or recording studio environments, the gap in auditory knowledge between the roles of acoustician and architect have been effectively maintained. Here, the complete separation between architectural design and the 'tweaking' of a design through acoustic analysis by a team of room acousticians has meant that the optimisation of the aural qualities of a space have sat in a convenient and respectable relationship to its process of design. But for Pizarro, Sheriden, and Van Lengen, this separation of disciplinary knowledge has left architecture in a state of *acute deafness*. In spite of this assumption, it would seem that for the theories of auditory space explored in this article to become more readily applicable, those disciplinary boundaries and knowledge bases must remain intact given the emphasis by both Blesser and Slater and Truax and Schafer that the designer be in possession of specialist listening skills; a somewhat self-defeating position. Jian Kang, though, suggests an alternate longer-term solution for achieving a greater porosity between disciplinary knowledge areas through his call for new digital design tools for auralising architectural models.[51] If such tools might become integrated into the digital design environments of architectural modelling softwares currently in use, rather than as they are now, as standalone computational engines used only by, and for, acousticians, then the uptake of Blesser and Salter's auditory spatial awareness into the very beginnings of the design process may enable a more tangible impact on design praxis. If available too as a pedagogical supplement, such tools may also have longer-lasting impacts on design training. Such a

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paradigm may also compliment the recent explosion of parametric approaches to design, and the idea of the flexible digital model and the notion of a 'performative design' paradigm.[52]

Kang's proposal for a software solution that communicates the auditory qualities of a design through all stages of the design process closely approaches Blesser and Salter's contention that aural architecture is a design arena that will be enacted *only* through digital tools. It also envisages that listening to a design and the acoustic relationship that it establishes towards its users may become a ubiquitous approach for future urban planning frameworks. Currently, such information about design impact regarding acoustic qualities are still constructed objectively, and communicated through the standard scientific models of plotted data, tabulations, and complex noise mappings. The move away from pure visual representations of acoustic data into the more tangible area of experiencing the intended auditory qualities of an urban design *directly through listening* will certainly be a requirement for any assimilation of either the theory of soundscape or aural architecture. Indeed, the most basic premise of the disciplines of soundscape studies and aural architecture stem from their potential to enable architectural praxis to communicate via the auditory channel, for which the design process then must be one concerned with optimising, adjusting, or morphing architectonic qualities to communicate particular visual *and* acoustic effects. To readily accommodate the acoustic impact of design decisions, particularly within a parametric paradigm, requires an immediacy between hearing the connection that visual form making has on the impact of the design's ability to communicate an intended acoustic signature. In such a framework, architecture gains the potential to become more than what is immediately seen, and moreover, the case of whether sounds inhabit the space or space is produced by the sounds is a question only relevant to how one *hears* the design.

Notes

1. Pallasmaa, Sheriden, and Van Lengen and Hellström have each focused on how auditory experience might be a powerful new direction for shaping architectural praxis. In particular, Sheriden and Van Lengen note that 'aural interpretations provide additional layers of meaning to the architectural experience, and have the potential to influence the evolution of architecture's visual form as well'. See: T. Sheriden and K. Van Lengen, 'Hearing Architecture', in *Journal of Architectural Education*, 57:2 (2003), pp. 37–44. Pallasmaa also explores the power of auditory sensations within architecture in his discussion of 'Acoustic Intimacy', in Juhani Pallasmaa, *Eyes of the Skin* (Chichester: Wiley-Academy, 2005), pp. 49–54, while Björn Hellström has investigated at length the social, cultural, and architectural consequences of sound design in the built environment: Björn Hellström, *Noise Design* (Göteborg: Bo Ejeby Förlag, 2003).
2. Jeremy Till, 'The Vanity of Form', in *The Journal of Architecture*, 4:1 (1999), pp. 47–54.
3. Rafael Pizarro, 'Teaching to Understand the Urban Sensorium in the Digital Age: Lessons from the Studio', in *Design Studies*, 30 (2009), pp. 272–86.
4. Michael Ostwald further explores this proposition with an examination of Guédon and Bognar's argument on architecture's 'proclivity for appropriation' as an indigenous attribute by questioning both authors' avoidance of the 'complex issues of motivation (why do architects appropriate?) and efficacy (whether or not the architect's aims and objectives are consistent?)'. See: Michael Ostwald, 'Architectural Theory Formation through Appropriation', in *Architectural Theory Review*, 4:2 (1999), pp. 52–70.
5. See: Barry Truax, *Acoustic Communication* (Westport: Ablex Publishing, 2001) and R. Murray Schafer, *The Soundscape: Our Sonic Environment and the Tuning of the World* (Rochester: Destiny Books, 1977).
6. Barry Blesser and Ruth-Linda Salter, *Spaces Speak, Are You Listening? Experiencing Aural Architecture* (Cambridge: MIT Press, 2007).
7. Geoffrey Broadbent, 'Recent Developments in Architectural Semiotics', in *Semiotica*, 101:1–2 (1994), pp. 73–101.
8. ISO 12913-1:2014(en), Acoustics - Soundscape - Part 1: Definition and conceptual framework, available online: <https://www.iso.org/obp/ui/#iso:std:iso:12913:-1:ed-1:v1:en> (accessed 1 September 2014).
9. Henri Lefebvre, *The Production of Space*, trans. by Donald Nichols-Smith (Oxford: Blackwell Publishing, 1974).
10. United Nations, *State of World Population, 2007: Unleashing the Potential of Urban Growth* (New York: UNFPA, 2007), available online: <http://www.unfpa.org/swp/2007/presskit/pdf/sowp2007_eng.pdf> (accessed 27 August 2014).
11. Blesser and Salter, *Spaces Speak, Are You Listening?*, p. 5.
12. Ibid., p. 51.
13. T-30 is a measure of reverberation time of a space and gives a broad sense of the general acoustic behaviours of a room due to its geometry and materiality. Technically, T-30 is a measure of the time taken for a sound source to decay by 60dB: it is thus a type of measure of the persistence of a sound within a space.
14. Marcus Novak, 'Computation and Composition', in *Architecture as a Translation of Music*, ed. by Elizabeth Martin (New York: Princeton Architectural Press, 1994), pp. 66–9 (p. 66).
15. Blesser and Salter, *Spaces Speak, Are You Listening?*, p. 2.
16. Pallasmaa, *Eyes of the Skin*, pp. 49–54.
17. According to Ostwald, a hybridisation is 'a transaction that appropriates a body of theory and assimilates that theory into its own discipline [which] results in the formation of a hybrid theory.' See also: Kipnis, and his example of Mozart, who by importing myriad extra-musical exotic influences, aided the creation of an unmistakeably unique and innovative musical style: Jeffrey Kipnis, 'Hybridizations', in *Architecture + Urbanism*, 296:5 (1995), pp. 62–5 (p. 62), cited in Ostwald,

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'Architectural Theory Formation through Appropriation', pp. 52–70 (p. 61).

18. Burry highlights this fact through his project Our World in which an arrangement within a 3-space cube maps both the 10-step transformation from sphere to cube as well as cylinder to pyramid. See: Mark Burry, *Scripting Cultures, Architectural Design and Programming* (London: John Wiley & Sons, 2011), pp. 190–223.
19. M. Raimbault and D. Dubois, 'Urban Soundscapes: Experiences and Knowledge', in *Cities*, 22:5 (2005), pp. 339–50.
20. Blesser and Salter, *Spaces Speak, Are You Listening?*, p. 16.
21. Schafer, *The Soundscape*, p. 4.
22. Here Truax also notes that 'the natural soundscape [...] may be heard and analyzed as a system of interrelated parts whose "acoustic ecology" reflects the natural ecological balance. In order to study such systems, one must experience them and therefore even the natural soundscape must include a listener within it [. . .] Also natural soundscapes [...] usually include human artifacts [...] Therefore, acoustic ecology understands natural soundscapes as being part of human soundscapes, as well as providing a model from which much can be learned.' See: Truax, *Acoustic Communication*, pp. 65–6.
23. Hildegarde Westerkamp, 'Soundwalking', in *Sound Heritage*, 3:4 (1974), pp. 18–24.
24. Barry Truax, *The Handbook for Acoustic Ecology* (Burnaby: Cambridge Street Publishing, 1999).
25. J. F. Augoyard and H. Torgue, *A L'écoute de L'environnement: Répertoire des Effets Sonores* (Marseille: Éditions Parenthéses, 1995).
26. There is also a case for the effect of mechanical and electronic sound sources within the urban environment having an increasing impact on the communication of resident bird species. In 2011, Potvin, Parris, and Mulder found that the species of small bird *Zosterops lateralis* had significantly changed their pitch and tempo calls in urban environments compared to their rural cousins. As a significant evolutionary adaptation, the ambient background noise of traffic and other cities sounds was found to be inhibiting the birds' ability to communicate within their auditory niche, thus requiring them to sing higher and slower to be understood among peers. See: D. Potvin, K. M. Parris, and R. Mulder, 'Geographically Pervasive Effects of Urban Noise on Frequency and Syllable Rate of Songs and calls in Silvereyes (*Zosterops lateralis*)', in *Royal Society of London Philosophical Transactions – Biological Sciences*, 278:1717 (2010), pp. 2464–9.
27. Truax describes Krause's niche hypothesis as one in which the natural soundscape is comprised of 'sounds uttered by various coexisting species occupying discrete frequency bands that do not overlap', Truax, *Acoustic Communication*, p. 82. See also: Bernie Krause, 'Anatomy of a Soundscape: Evolving Perspectives', in *Journal of the Audio Engineering Society*, 56:1–2 (2008), pp. 73–101.
28. Tim Ingold, 'Against Soundscape', in *Autumn Leaves: Sound and the Environment in Artistic Practice*, ed. by Angus Carlyle (Paris: Double-Entendre, 2009), pp. 10–13.
29. Sophie Arkette, 'Sounds like City', in *Theory, Culture & Society*, 21 (2004), pp. 159–68 (p. 166).
30. Simon Sadler, *Archigram: Architecture without Architecture* (Cambridge MA: MIT Press, 2005), p. 103.
31. Ursula Franklin, 'Silence and the Notion of the Commons', in *Soundscape, the Journal of Acoustic Ecology*, 1–2 (2000), pp. 14–17.
32. Albert Borgmann, *Technology and the Character of Contemporary Life* (Chicago: University of Chicago Press, 1984).
33. See for example: Peter-Paul Verbeek, 'Devices of Engagement: On Borgmann's Philosophy of information and Technology', in *Techne*, 6:1 (2001), pp. 69–92.
34. Paul Carter, 'Auditing Acoustic Ecology', in *Soundscape, the Journal of Acoustic Ecology*, 4:2 (2003), pp. 12–13 (p. 12).
35. Ibid., p. 12
36. See for example: Westerkamp's *Into the Labyrinth* (2002) a work generated from field recordings of urban areas in India, Darren Copeland's *Memory* (1997) from recordings of Stockholm and surrounds, and Truax's *Pacific Fanfare* (1996), a number of sound scenes composed from ten soundmarks of Vancouver.
37. B. De Coensel, A. Bockstael, L. Dekoninck, D. Botteldooren, B. Schulte-Fortkamp, J. Kang, and M. E. Nilsson, 'The Soundscape Approach for Early Stage Urban Planning: A Case Study', in *Internoise 2010*, noise and sustainability, Lisbon, Portugal, 13–16 June 2010.
38. One of the first major projects completed by Schafer was the audio CD *The Vancouver Soundscape* (1973), a document of the soundmarks of Vancouver together with spoken word commentary on notions of good and bad acoustic design in the context of the local environment of Vancouver. This project inspired the Japanese Association for Sound Ecology and Japanese Environmental Protection Agency to launch in 1996 a project called *100 Soundscapes of Japan* in which the general public could nominate important soundmarks or soundscapes that deserve preserving, all of which were documented through photographs and sound recordings and made available through a publicly accessible database: (<http://en.wikipedia.org/wiki/100_Soundscapes_of_Japan>). The popularity of this project was the catalyst for The Finnish Society for Acoustic Ecology's 2005 project *One Hundred Finnish Soundscapes* that similarly involved a public consultation and documentation program that became available through the World Wide Web.
39. See: M. Zhang and J. Kang, 'Towards the Evaluation, Description and Creation of Soundscape in Urban Open Spaces', in *Environment and Planning B: Planning and Design*, 34:1 (2007), pp. 68–86; also A. L. Brown, J. Kang, and T. Gjestland, 'Towards Standardisation in Soundscape Preference Assessment', in *Applied Acoustics*, 72 (2011), pp. 387–91; and J. Y. Jeon, P. J. Lee, J. Y. Hong, and D. Cabreara, 'Non-auditory Factors Affecting Urban Soundscape Evaluation', in *Journal of the Acoustical Society of America*, 130 (2011), pp. 3761-3770.
40. See for example: L. Yu and J. Kang, 'Modelling Subjective Evaluation of Soundscape Quality in Urban Open Spaces: An Artificial Neural Network Approach', in *Journal of the Acoustical Society of America*, 126:3 (2009), pp. 1163–74; and Catherine Guastavino, 'The Ideal Urban Soundscape: Investigating the Sound Quality of French Cities', in *Acta Acustica*, 92 (2006), pp. 945–51. Also noteworthy is that several recent studies have reported that natural sounds such as birdsong and water are preferred in urban spaces. See in particular: B. De

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Coensel, S. Vanwetswinkel, and D. Botteldooren, 'Effects of Natural Sounds on the Perception of Road Traffic Noise', in *Journal of the Acoustical Society of America*, 129 (2011), pp. 148–53; also J. Y. Jeon, P. J. Lee, J. You, and J. Kang, 'Acoustical Characteristics of Water Sounds for Soundscape Enhancement in Urban Open Spaces', in *Journal of the Acoustical Society of America*, 131 (2012), pp. 2101–9; and L. Galbrun and T. T. Ali, 'Acoustical and Perceptual Assessment of Water Sounds and their use over Road Traffic Noise', in *Journal of the Acoustical Society of America*, 133 (2013), pp. 227–37.

41. For an overview of this literature see: Jian Kang, 'From Understanding to Designing Soundscapes', in *Frontiers of Architecture and Civil Engineering in China*, 4:4 (2010), pp. 403–17.
42. Maria Leus, 'The Soundscape of Cities: A New Layer in City Renewal', in *Sustainable Development and Planning V*, ed. by C. A Brebbia and E. Beriatos (Southhampton: WIT Press, 2011), pp. 355–70 (p. 356).
43. Mags Adams et al., 'Sustainable Soundscapes: Noise Policy and the Urban Experience', in *Urban Studies*, 43:13 (2006), pp. 2385–98 (p. 2389).
44. See: Hildegard Westerkamp, 'Soundwalking as Ecological Practice', in *The East Meets West in Acoustic Ecology*, ed. by K. Torigoe, T. Imada and K. Hiramatsu (Hirosaki: Hirosaki University, 2006), pp. 84–9. For a detailed account of the methodology see also: J. Y Jeon, J. Y. Hong, and P. J. Lee, 'Soundwalk Approach to Identify Urban Soundscapes Individually', in *Journal of the Acoustical Society of America*, 134 (2013), pp. 803–12.
45. For more details see Liminal's web page, available one: <http://www.liminal.org.uk/portfolio/warwick-bar-masterplan/> (accessed 1 September 2014).
46. See for example: A. Skånberg and E. Öhrström, 'Adverse Health Affects in Relation to Urban Residential Soundscapes', in *Journal of Sound and Vibration*, 250:1 (2002), pp. 151–5'; also C. Clark and S. A. Stansfeld, 'The Effect of Transportation Nosie on Health and Cognitive Development: A Review of Recent Evidence', in *International Journal of Comparative Psychology* 20:2 (2007), pp. 145–58; and World Health Organisation, *Guidelines for Community Noise*, ed. by D. H. Schwela, B. Berglund, and T. Lindvall (Geneva: WHO, 1999).
47. See also: W. Yang and J. Kang, 'Soundscape and Sound Preferences in Urban Squares: a Case Study in Sheffield', in *Journal of Urban Design*, 10:1 (2005), pp. 61–80 and W. Yang and J. Kang, 'A cross-cultural study of soundscape in urban open public spaces', in *Proceedings of the Tenth International Congress on Sound and Vibration* (Stockholm, 2003).
48. A. Gidlöf-Gunnarsson and E. Öhrström, 'Noise and Well-being in Urban Residential Environments: The Potential Role of Perceived Availability to Nearby Green Areas', in *Landscape and Urban Planning*, 83:2–3 (2007), pp. 115–26 (p. 115).
49. Charles Gurney, 'Rattle and Hum: Gendered Accounts of Noise as a Pollutant: An Aural Sociology of Work and Home'. Paper presented to the *Health and Safety Authority Conference*, New York, April 1999.
50. This has been one approach taken by the Melbourne City Council in Australia, in which a public thoroughfare housing multiple loudspeakers plays host to local sound art productions. Referred to as an 'urban soundscape system', its promoters claim its value arises from its ability to reactivate a site through the introduction of soundscape compositions that engage the local community. For details see: Lawrence Harvey, 'Melbourne's Urban Electroacoustic Soundscape Systems, a discussion and strategy paper', available online: <http://www.rmit.edu.au/architecturedesign/sial/soundstudio/projects/urbansoundscape> (accessed 24 August 2014); and also the Signal homepage, <www.melbourne.vic.gov.au/Signal/Pages/AboutSignal.aspx> (accessed 24 August 2014).
51. Kang, 'From Understanding to Designing Soundscapes', p. 412.
52. R. Oxman, 'Performative Design: A Performance-based Model of Digital Architectural Design', in *Environment and Planning B: Planning and Design*, 36:6 (2009), pp. 1026–37.

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