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Listening to Japanese gardens II: expanding the soundscape action design tool

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ABSTRACT

Tools for soundscape design have tended to focus on noise-exposed situations like urban parks and squares. Less attention has been given to multisensory interaction, movement, and other phenomenological aspects. This paper addresses the gap by studying the Japanese garden tradition, where such issues have been given high priority. The paper is the second of two reporting on autoethnographic field studies carried out in 88 Japanese gardens. Ten new Soundscape Actions are introduced and discussed in relation to previous research. Conclusively, the paper addresses the potential for future applications and developments of the tool.

Introduction

The soundscape affects our daily lives and wellbeing in a wide variety of ways. Sound is known to have an impact on environmental aesthetics (Carles, Barrio, and de Lucio 1999; Benfield et al. 2010) and social behaviour (Bild et al. 2018; Cohen and Spacapan 1984), as well as on health (WHO 2018; Aletta, Oberman, and Kang 2018) and cognitive skills (Klatte, Bergström, and Lachmann 2013). Moreover, sound facilitates orientation in the environment (Moore 2012) and gives us feedback when we move (Blesser and Salter 2007). Sound can also provide pleasant experiences and delights, a fact which has led some authors to compare the sonic environment to a musical composition that can be orchestrated by landscape architects and urban designers (c.f. Schafer [1977] 1994).

Despite the possibilities, critique has been brought forward in terms of how sound has been dealt with in these professions (Hedfors 2003; Southworth 1969; Pallasmaa [1996] 2012), particularly during the modernistic tradition. It has been found that, if sound is at all considered, it is mostly when there is a problem with noise (c.f. Steele 2018; Cerwén, Wingren, and Qviström 2017).

In recent years, there has been an increased interest among researchers and practitioners in exploring positive aspects of the acoustic environment (Axelsson 2010; Cerwén, Wingren, and Qviström 2017; Hedfors 2003; Steele 2018). This development has been fuelled by the soundscape movement, which emphasizes the contextual and subjective experience of the sonic environment. Much attention has been given to masking strategies, whereby a 'positive'

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sound is introduced to reduce the impact from noise, most typically using water features to shift focus from traffic sounds in urban situations (Galbrun and Calarco 2014). However, relatively little has been done in terms of understanding soundscape design in relation to movement, behaviour, and/or multisensory interaction with the environment.

The aim of the present paper is to develop the design tool 'Soundscape Actions' (Cerwén 2019, 2017; Cerwén, Kreutzfeldt, and Wingren 2017) to include considerations that correspond to phenomenological experiences, taking account of subjectivity and the relationship between hearing and other senses. The research is based on autoethnographic field studies conducted in Japanese gardens, where sensory experiences traditionally have been given high consideration (Slawson 1987; Fowler 2014).

Studying Japanese gardens

As a renowned tradition, Japanese gardens have inspired designers, artists, and gardeners around the world (Stauskis 2011). The Japanese garden tradition is known to involve visitors actively in the garden (Slawson 1987), where sensory impressions are carefully orchestrated and used to create various experiential effects. For instance, steppingstones, *tobi-ishi*, constitute a recurring feature, forcing the visitor to employ balance and reduce walking speed (Nitschke 1999). Many gardens are laid out on a relatively small area yet made to seem larger by playing with the visitor's perception in intricate ways, involving articulation of forced perspectives (Slawson 1987), as well as manipulation of time-space relationships (Nitschke 1999).

Like so many other aspects of Japanese culture, the garden history is intertwined with influences from China, particularly during its early inception. Japanese gardens also bear a close connection to landscape painting and Buddhism (Nitschke 1999). Even today, some of the most famous gardens are found in conjunction with Buddhist temples. Spanning more than 1000 years of history, several different styles and types of gardens can be discerned, including the dry landscape garden, *karesansui*, the tour (stroll) garden, *Kaiyū-shiki-teien*, and the tea garden, *cha-niwa* (Itō 1972). As such, it is a diverse tradition, yet held together by its Japanese sense of aesthetics and its affinity for natural expressions, symbolism, and geomancy (c.f. Slawson 1987; Takei and Keane 2011).

The role of soundscape in the Japanese garden tradition has previously been spotlighted by Sowa (2012) in his analysis of three Japanese gardens. Torigoe (2009) has described her soundscape design in the garden of Rentaro Takis's Memorial House in Japan. Szanto (2016) has discussed sound and polysensory dynamics in Murin-an, and Fowler (2014, 2013) has highlighted the relationship between sound and design in various ways.

Materials and methods

The study is situated in the intersection between landscape architecture and soundscape research, based on sonic experiences notated during 136 visits to 88 Japanese gardens (Figure 1). Most of the field studies were carried out in Kyoto, known for its many traditional gardens of high esteem. The present paper is the second of two reporting on these experiences, following up on challenges identified during the evaluation of previous work (Cerwén 2019). Further details on the studied gardens and the data collection can be found in the first paper.

The field studies were conducted using an autoethnographic approach (Ellis, Adams, and Bochner 2011). Autoethnography opens up for a deeper understanding of sonic experiences,

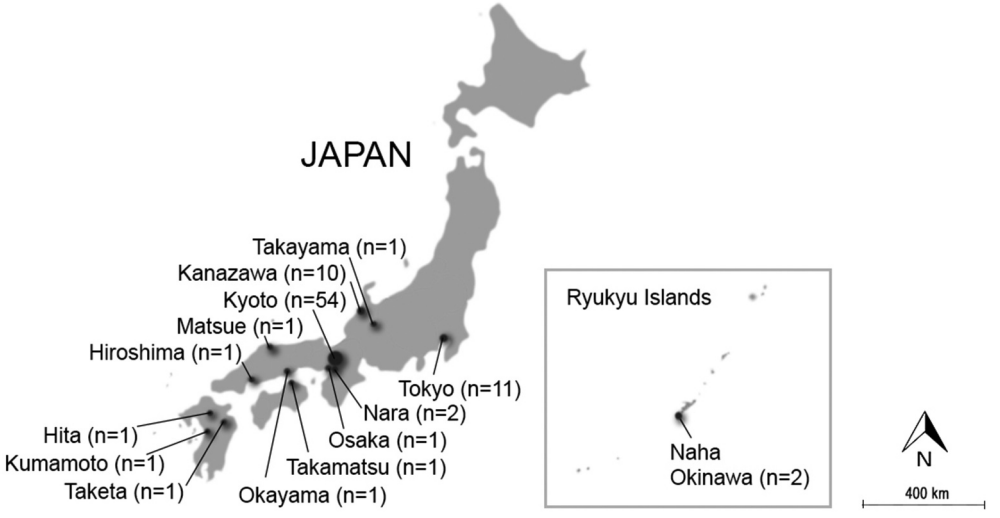

Figure 1. A map illustrating the geographical distribution of the 88 Japanese gardens visited during the study.

making it possible to capture the first-person perspective (c.f. Dahlin and Berglind 2018). A parallel can be drawn to the notion of 'skilled listeners' as proposed by Hedfors and Berg (2003) and used previously to study the relationship between sonic phenomena and landscape architecture.

The field notes, consisting of a document of around 23,000 words, constitute the main research material. Findings presented in the paper are supported by extracts from the notes as well as field recordings, sound level readings, photographs, and video captured in the gardens. For an overview of video files referred to in the paper, see the online supplemental data at https://doi.org/10.1080/13574809.2020.1782183.

Analysis: identifying new design actions

To develop new Soundscape Actions, all field notes from the garden visits were scrutinized, assigning keywords to descriptions considered relevant from a phenomenological perspective (c.f. Cerwén 2019; Cerwén, Kreutzfeldt, and Wingren 2017). The keywords were collected and clustered in a separate document, from which a total of 20 clusters emerged; seven of these corresponded to existing Soundscape Actions already presented in the previous study (Cerwén 2019), while the remaining 13 were used to formulate new Soundscape Actions presented in this paper. Due to reconfiguration and merging of six clusters, a total of 10 new Soundscape Actions are defined.

Each of the new design actions is discussed in relation to previous research on soundscapes and landscape architecture. A particular focus has been given to the notion of 'sonic effect', a framework offered by French researchers Augoyard and Torgue (2005). Based on a total of 82 'sonic effects', the authors compare their approach to an 'instrumentarium' or 'sonic grammar'. The notion of sonic effect is phenomenologically oriented, and thus in line with the purposes of this study.

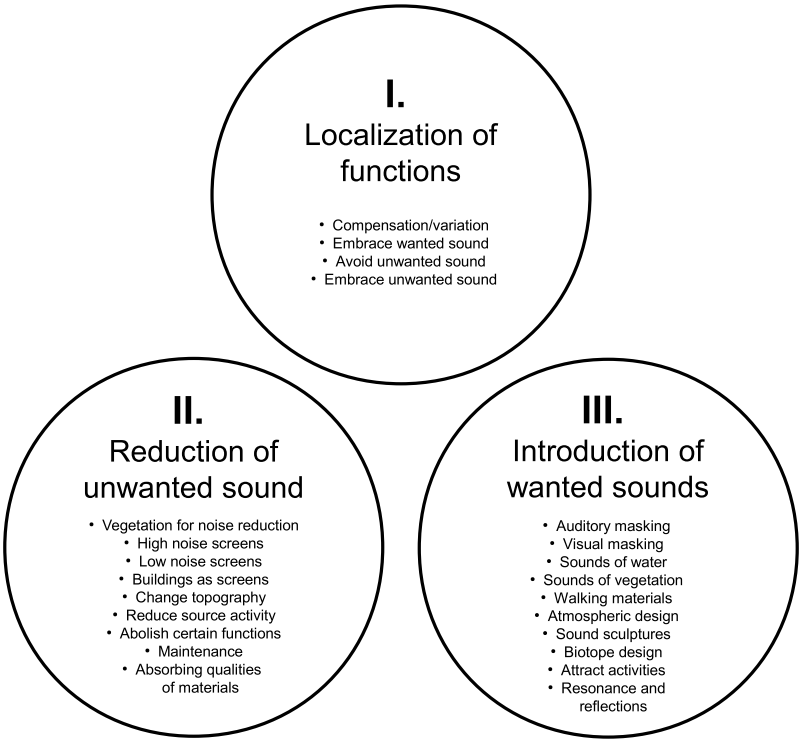

Figure 2. An overview of previously defined Soundscape Actions divided into three main categories: localization of functions, reduction of unwanted sounds, and introduction of wanted sounds.

Soundscape actions: a summary of previous work

The Soundscape Action design tool consists of 23 design actions that landscape architects and urban designers can use to improve a given soundscape (Cerwén 2019, 2017; Cerwén, Kreutzfeldt, and Wingren 2017). They are structured around three main categories: localization of functions, reduction of unwanted sounds and introduction of wanted sounds (Figure 2).

This section summarizes the tool, highlighting some of the 23 existing design actions. Examples are drawn from the Japanese garden tradition and a previous paper on the topic (Cerwén 2019). The 10 new Soundscape Actions are subsequently introduced under a separate heading.

Localization of functions

The first main category is about the strategic localization of functions (in this case: gardens) in relation to surrounding soundscapes.

The majority of the Japanese gardens studied are located in urban settings. Noise from surrounding activities may be disturbing, but escaping from such noise into a quiet garden can make that garden seem all the more tranquil, as in the Soundscape Action 'Compensation/ Variation'. Some gardens are strategically located in the fringes of the urban fabric where the distance allows them to, to some extent, 'Avoid unwanted sounds'. Gardens located close to

natural settings can benefit from the associated soundscapes, including rustling leaves, birds, and water streams, that is, 'Embrace wanted sounds'.

Reduction of unwanted sounds

Soundscape Actions in this second main category are focusing on measures that can be taken to reduce unwanted sounds once the locations of functions have been decided.

There are several aspects of Japanese garden design that have positive effects on noise levels; one of the most typical examples is the use of garden walls, which corresponds to the Soundscape Action 'High noise screens'. The garden walls are often used in combination with vegetation, 'Vegetation for noise reduction', which can improve the performance. The extensive use of moss in the gardens creates a soft and absorbing layer that reduces sound levels, thus corresponding to the Soundscape Action 'Absorbing qualities of materials'. Signs that encourage visitors to be considerate and quiet during their visits exemplify the Soundscape Action 'Reduce source activity'. Much of the maintenance in the gardens is performed by hand, by use of traditional tools. Noise from combustion engines is rare, an example of the Soundscape Action 'Maintenance'.

Introduction of wanted sounds

The third and final main category is about enhancing, stimulating, and/or introducing new sounds into an environment. Sounds of nature are generally conceived of as positive, and they are also commonly found in Japanese gardens where certain design solutions are used to invite them.

To enhance the 'Sounds of water', there is a long tradition to place rocks strategically in streams. Another strategy is to use resonating qualities of cavities to articulate and direct the sound of waterfalls, thus corresponding to the Soundscape Action 'Resonance and reflections'. The rustling of trees in the wind is one of the most typical 'Sounds of vegetation'. Bamboo is a popular species in Japanese gardens, known to respond readily to wind. In some gardens, bamboos are planted on mounds, where the wind is caught more effectively for an increased effect. The abundance of natural features and access to water provide rich habitats for wild and domestic animals, including frogs, carp, turtles, and twittering birds, as discussed in the Soundscape Action 'Biotope design'.

The third main category includes examples of 'Sound sculptures', like the *shishi-odoshi* – deer scarer, or the *suikinkutsu* – a subtle garden instrument. Visitors in the gardens contribute to the soundscape as well; the extensive use of wooden floors on the gardens' verandas constitutes an example of a characteristic 'Walking material'. Religious activities in some gardens add a characteristic atmospheric tint, as the chanting of monks, the sound of bells, and visitors' praying contribute to the soundscape, an example of 'Attract activities'.

Soundscape Actions in the third main category can also reduce the impact of noise through 'Auditory masking'. Auditory masking is a common phenomenon in Japanese gardens, owing largely to the extensive use of streams, waterfalls, and other 'Sounds of water' that cover noise from the outside world, and/or shift focus from it. Influences from other senses should also be considered. For instance, auditory masking is closely related to 'Visual masking', where the focus is shifted by considering visual cues (the source producing the noise is hidden from view,

most typically behind a layer of vegetation). For optimal effect, masking strategies should be combined with measures to reduce noise levels. Such combinations are encouraged in the Soundscape Action design tool through its division in three main categories.

New soundscape actions

Each of the new Soundscape Actions is first defined briefly, and then followed by a description of how they were derived from the context of Japanese gardens, including examples and quotes from notated experiences in the gardens, as well as comparisons with previous research. Categorization of the new actions is discussed in the concluding remarks.

Tranquillity induced by contrast

This Soundscape Action takes advantage of the relative relaxation experienced after a sudden drop in sound level. This is particularly beneficial when used in conjunction with an entrance to provide a sense of tranquillity as a first impression.

'Tranquillity induced by contrast' could be experienced to various extents in most of the studied gardens, but the effect was particularly pronounced in two gardens in Kyoto: Murin-an and Konchi-in.

Murin-an is surprisingly tranquil despite its urban location in the midst of road traffic and other noisy activities. The surrounding city is effectively screened by garden walls combined with vegetation (Figure 3), and the remaining noise is masked by soothing water sound. The contrast effect is most pronounced by the entrance to the garden (Video 1, https://vimeo.com/270888007), where a path leads the visitor through a narrow gate and then immediately to the right for an optimal reduction in noise. This is also the quietest part of the garden with an ambience level of 44 dBA (6 May 2018), which is about 10 dBA lower than by the sidewalk outside the garden. The contrast is further enhanced after rainfall when the sound of a water trench outside the entrance intensifies the 'outside' noise.

Konchi-in is a small and quiet temple garden in the vicinity of the famous Nanzen-ji complex, an area surrounded by intense activities as the following extract from the field notes illustrates:

Figure 3. A contextualization of Murin-an garden. The images were taken 40 metres apart, outside (a) and inside (b) the garden. Mount Higashiyama is included as a reference in both images.

> It is a warm day on April 21 in 2018 when I visit Konchi-in. To enter the temple, I have to cross the crowded main street leading up to Nanzen-ji. As usual, it is filled with tourists, souvenir salesmen, and the occasional taxi or delivery truck. The street is a hubbub, and it is a challenge to zigzag between the many events. Konchi-in is located a stone's throw away. To enter, I have to cross a stone bridge that carries across a loud stream. The garden entrance is located some sixty meters up the alley to the right. It is soothing to arrive. I can still hear some construction work in the distance, but it is soon fading. I hear nothing of the tourists.
>
> Konchi-in, 21 April 2018, Figure 4

The extract illustrates how the sensation of an intense soundscape leading up to the garden can linger in the perceptual apparatus and open up for a contrasting experience of relief and tranquillity. As a result, even though most of the described activities cannot be heard inside Konchi-in, they have a bearing on the experience. This can be taken into consideration when designing gardens and other tranquil spaces. In particular, it is noteworthy that the sound of the stream raises the intensity while crossing the bridge (62 dBA; 21 April 2018), but because of the steep sides of the trench (Figure 4), the sound level drops rather quickly on the other side of the bridge. Inside the garden, some 60 metres from the stream, the sound level is about 20 dBA lower (38–43 dBA, as observed in different areas; 21 April 2018). This contrast is evident as an experiential quality inside the garden, where the relative quietness can be felt.

'Tranquillity induced by contrast' is closely related to the notion of *cut-out* as described by Augoyard and Torgue (2005). *Cut-out* is defined as 'a sudden drop in intensity associated with an abrupt change in the spectral envelope of a sound or a modification of reverberation' (Augoyard and Torgue 2005, 29). The authors emphasize the potential of *cut-out* in architecture and urban planning as a means by which to articulate transition between different kinds of spaces, such as private and public. Tranquillity is not mentioned per se, but it can be inferred from the context, as an emphasis is put on the contrast between intensities. The authors suggest three applications of a *cut-out* in architecture: *sound door* (screening), *sound lock* (quiet transition zone), and *sound marking*

Figure 4. Panorama depicting the main gate of Konchi-in temple area, Kyoto. A stone bridge leads across a water stream, temporarily raising the sound level as the visitor crosses the bridge to the other side of the trench.

(adding sound). The examples from the Japanese gardens described above are essentially a combination of a *sound door* and a *sound marking*, arguably making the contrast particularly pronounced.

Quiet sounds

'Quiet sounds' are sonic features which are subtle. Yet, they may be rich in details and dynamics and thus stimulate a heightened listening. 'Quiet sounds' are typically associated with a low level of ambient noise.

The notion of 'Quiet sounds' was derived from Zen Buddhist temple gardens where they are used in abundance, albeit they can also be experienced occasionally in other gardens. Most quiet sounds relate to water, such as small streams, drops, or miniature waterfalls. Quiet sounds are unassuming and impermanent, thus suggesting a connection to the Japanese aesthetic tradition known as *wabi-sabi*, which is also associated with Buddhism (Koren 2008).

In the study, the effect was first experienced in the garden of the silver pavilion, Ginkaku-ji, in Kyoto where a refined water stream in the northeastern part is barely audible (Video 2a, https://vimeo.com/311079936). It was found that the effort required to listen to the sound could stimulate heightened listening and increased awareness about other things in the environment. The notion of 'Quiet sounds' was later confirmed in several other gardens (Video 2b-f, https://vimeo.com/showcase/5683763). In Funda-in, for instance, water drops from a bamboo pipe are set to fall slowly into a water basin, *chozubachi*, where each drop makes a unique sound:

> A few meters distance separate the *chozubachi* from the veranda from which I am listening to it. Each drop is different from the other, making it interesting to follow the development. As I am sitting there listening, a gust of wind suddenly takes over the sonic space, causing the leaves around the *chozubachi* to rustle and the door behind me to vibrate. A car passes outside the temple and I hear some people talking in the background. The sound of water drops is still present somewhere, but the focus shifts for a while. As the other events have settled, the dropping sound resurfaces.
>
> Funda-in, 13 April 2018, (Figure 5 and Video 2b, https://vimeo.com/270886225)

A similar kind of heightened listening has previously been described in relation to the delicate sound produced by the Japanese *suikinkutsu* (Imada 1994). The *suikinkutsu* is a subtle garden instrument that can be experienced at some *chozubachi*. The sound is generated as excess water from the water basin is led down to a cavity where it is made to drop slowly on a water surface, causing the cavity to resonate with a musical, slightly metallic tone. To be able to hear the *suikinkutsu* over surrounding noise, it is often necessary to use a bamboo tube to amplify the sound.

Many of the 'Quiet sounds' in Japanese gardens could be experienced only occasionally, as they are very sensitive to disturbances, typically requiring an ambience level below around 45 dBA. This is a challenge in many urban settings, but when audible, they seem to enhance the quietness. Interestingly, there seems to be a similar appreciation for quiet sounds in the Chinese garden tradition, as reported by Zhang (2017), who also suggests that such sounds may be used to stimulate a heightened listening.

Figure 5. A single drop of water breaking the surface of a *chozubachi* in Funda-in temple, Kyoto.

Responsive features and materials

This Soundscape Action highlights the inherent quality of some materials and features that produce a sonic response when interacted with. Broadly defined, 'Responsive features and materials' overlap with several other previously defined Soundscape Actions including 'Walking materials' and 'Sounds of water'. 'Responsive features and materials' are social as they communicate the presence of people and activities.

The Soundscape Action was conceived from various social practices and activities that can be experienced in and around Japanese gardens. Several of these are associated with religious rituals such as the water cleansing at the *temizuya*, the offering of coins in the offertory box, *saisen-bako*, or the striking of bells (Figure 6a).

'Responsive features and materials' are closely related to walking materials, and a particularly noteworthy feature in Japanese gardens is the wooden veranda, *engawa*. An *engawa* works as a link connecting garden with building and sometimes also connecting various buildings on the premises (Figure 6b). The tactile wooden floor makes a characteristic thumping sound when walked on. The character of each *engawa's* sound varies and some even make a squeaking sound. These floors are called *uguisubari*, or nightingale floors, so named because the sound they produce is said to resemble that of a Japanese bush warbler, *uguisu*, also known as Japanese nightingale. The sound is produced as a result of the construction of the floor, where nails connecting the floorboards rub against clamps to produce the effect. The most famous example of *uguisubari* can be experienced in Nijō-jō castle:

> Being in Nijō-jō castle reminds me of being on a hanging bridge, sensitive to the touch and responsive with sounds. I can hear the floorboards moving rhythmically, as they are pushed down by the thump of footsteps around me. Each movement is accompanied by a mysterious chirping sound creaking through the dark castle corridors as hordes of tourists slowly pass through the premises. The floor is called a nightingale floor, and indeed, the sound can be likened to the twittering of birds, yet it has more of a mechanical and metallic feel to it.
>
> Nijō-jō castle, 7 April 2018, (Video 3, https://vimeo.com/311380259)

Figure 6. Responsive features and materials. (a) A bell in Shorin-in temple, Ohara, north of Kyoto. (b) Wooden walkways and verandas by the *karesansui* garden of the Abbott's hall in Tōfuku-ji temple in Kyoto.

Legend has it that the sound was used to warn residences of approaching enemies. According to a sign in the castle, however, the sound effect of the nightingale floor was not intentional but rather happened as a result of wear and tear. This does not, of course, exclude its being used as a warning system after the fact. At least two temples in Kyoto, Daisen-in and Daikaku-ji, hand out information that says their nightingale floors were used as a warning system.

Reconnecting to the metaphor of the sonic environment as a musical composition mentioned previously, 'Responsive features and materials' can be taken to illustrate how people are co-creators of the soundscape (c.f. Schafer [1977] 1994) and how architecture can facilitate this (Blesser and Salter 2007). Pallasmaa ([1996] 2012) has highlighted how responsive sounds can be informative about architectural properties, exemplified by the reverberation of footsteps. Augoyard and Torgue (2005) introduced *psychomotor effects* to describe a group of sonic effects dependent on the listener's action to be produced; yet limited attention is given to how such effects could be facilitated in architectural disciplines.

Phantom sounds

'Phantom sounds' are not real in the sense that they exist as a physical entity. Rather, the notion of phantom sounds is an effect that happens when a sound that is expected from a particular context does not materialize. The effect comes from anticipating and/or imagining a sound, thus emphasizing the listener's role in creating their own experience. 'Phantom sounds' can have a religious and symbolic meaning and may stimulate a heightened listening.

The dry landscape garden, *karesansui*, is known for its use of symbolism and stylized representations of nature to reach its innermost essence (Slawson 1987). Some of the most typical features of these gardens suggest the occurrence of sonic events, such as water. Yet they are silent. It is in this tension that the notion of phantom sound occurs. Gravel, for instance, is a basic ground cover element used extensively to hold *karesansui* gardens together (Figure 6b). The gravel is raked in such a way as to suggest waves in a sea. However, the sound of these waves – much like the lake itself – can only be

Figure 7. The dry waterfall, *karetaki*, in Saiho-ji, Kyoto, is one of the first of its kind in Japan dating from the 14th century.

imagined. A garden's name may contribute to the effect, like 'the garden of the sound of the tide' in Kennin-ji temple.

Another common feature in the *karesansui* garden, in which the effect of phantom sound is perhaps most pronounced, is that of the *karetaki*, or dry waterfall (Figure 7). The *karetaki* is built from stones placed carefully to suggest a 'real' waterfall, except there is no water. The missing water can initially create a sense of wonder and/or anti-climax, yet after a while, it can also trigger a sense of extreme silence, or freezing of time (c.f. Slawson 1987, 75).

Fowler (2014, 2013) has previously noted how the absence of expected sound in the *karetaki* may contribute to an enhanced listening, in which other sounds in and around the garden are brought to the visitor's attention (c.f. 'Borrowed sonory'). Such an enhanced listening relates to what Augoyard and Torgue (2005) refer to as *deburau*, that is, the active search for a sound that is inaudible. 'Phantom sounds' also relate to the sonic effects *anticipation* and *phonomnesis*, where *anticipation* is the ability to 'pre-hear' an expected sound before it is actually heard, and *phonomnesis* is an imaginative sound that may be triggered by a situation.

There is something peculiarly Japanese about 'Phantom sounds'. The phenomenon is not restricted to *karesansui* gardens. Imada (1994), for instance, has described how Japanese people used to gather every year to 'listen' to the sound of lotus flowers as they open, even though the sound is technically inaudible. 'Phantom sounds' also relates to the concept of *ma*, which is used in Japanese art and culture to emphasize negative space.

Borrowed sonory

'Borrowed sonory'[1] is about the potential of distant sound objects to be 'drawn in' and used as part of a design. It is particularly relevant in secluded and tranquil spaces like gardens and parks, where there is a relative quietness and a clear distinction between an inside and an outside.

'Borrowed sonory' was derived as a parallel term to borrowed scenery, *shakkei*, which is a well-known concept in the Japanese garden discourse. *Shakkei* refers to the technique

by which distant objects, such as a mountain or a plain, are utilized as a part of a garden design. To qualify as *shakkei*, the object must be framed or 'captured alive' in the garden, and the most common way to do this is by use of vegetation (Itō 1973). *Shakkei* has previously been discussed mostly in terms of visual aspects, although it has been argued that the discourse could be extended to include other senses as well (Kuitert 2002). Hearing should be of particular interest, as it works on longer distances compared to touch, taste, and smell.

Most of the gardens in the study offered a relative quietness that extended the *acoustic horizon* (Blesser and Salter 2007) and provided a beneficial setting for experiencing distant sounds. It was unusual that sounds from the outside materialized as a dominant perceptual feature; they were mostly experienced as atmosphere.

Sounds of nature from the outside, such as the twittering of birds, rustling trees, or water streams were found to merge quite seamlessly with the gardens, being in themselves a representation of nature. In a way, it could be said that natural features in the gardens, such as trees, shrubs, and ponds, work to 'capture' sounds of nature from the outside to become part of the garden (c.f. Itō 1973), thereby also extending the experienced size of space (c.f. Nitschke 1999).

Urban sounds from the outside, including those from traffic and other people, tended to be problematic, especially when prominent and atmospheres rising above around 50 dBA. In quieter gardens, however, even urban sounds could be experienced as an atmospheric and contextualizing quality, emphasizing the distinction between being outside and inside the garden. This kind of experience was particularly pronounced in Entsū-ji, which is famous for its use of (visual) *shakkei* (Figure 8). The main garden in Entsū-ji is designed to open up and 'capture' Mount Hiei in the distance, which is framed between shrubs and trees located at the fringes of the garden. In addition to framing the view, this layout seems to enhance the perception of distant sounds, thus suggesting an intricate relationship between senses in projecting the attention:

> The shadow from the main building has grown long, covering large parts of the rock garden now. The trees in the far back of the rectangular space are elegantly framing the distant

Figure 8. The borrowed scenery, *shakkei*, in Entsū-ji garden, Kyoto.

> mountains. The *shakkei* does something with the attention. It seems to be stimulating a different kind of presence and perspective on life. From the veranda, I can hear sounds from the distant city below. Birds are chirping close, and the occasional wind is blowing in the maple tree to the right. A dog is barking in the distance, where there is also the occasional sound of construction work. Traffic is audible as a faint murmur.
>
> Entsū-ji, 19 April 2018, (Figure 8 and Video 4, https://vimeo.com/311069164)

In a somewhat opposite manner, sound can also be used to articulate attention towards a visual *shakkei*. In the garden of Murin-an, for instance, where the distant mountain Higashiyama is captured to become part of the garden (Figure 3b), a stream is laid out in such way that it seems to be emanating from the mountain. The sounds and sights of the stream thus lead the attention in the direction of the *shakkei*.

The role of multisensory experiences in *shakkei* has previously been discussed by Fowler (2014, 2013). In his analysis of the garden Kyu-Furukawa in Tokyo, he argues that the sound of a specific waterfall can be experienced as a *shakkei* from a point in the garden where a dry waterfall, *karetaki*, is located. Fowler describes how a set of steppingstones located by the *karetaki* reduces walking speed and opens up for an enhanced auditory spatial awareness encouraged by the attempt to listen to the dry waterfall. While the role of the steppingstones in this scenario could be discussed (the concentration demanded from walking on steppingstones may well steal attention from listening), the example of the *karetaki* as a way to open up listening and thus 'to capture' a distant sound is indeed interesting. There are several features in Japanese gardens that may stimulate a heightened listening, potentially producing this effect (c.f. 'Quiet sounds', 'Curiosities', 'Phantom sounds', and 'Shrouded sounds').

Finally, it should be mentioned that the technique of borrowing sound (in addition to visual cues) has also been noted in relation to the Chinese garden tradition (Song et al. 2018), where the concept *shakkei* originated (Itō 1973).

Forced perspective

'Forced perspectives' are typically used to enhance the perceived size of a space and/or distance to another object. For instance, objects of various sizes can be located strategically so as to suggest a greater distance between them. If a large rock is placed in the foreground and a smaller one in the middle or background, the distance to the smaller one seems stretched. For sound, similar effects can be generated if the source is muffled to alter the frequency content and/or if the sound is less loud than expected.

This Soundscape Action was derived from a theoretical discourse on Japanese garden design (see e.g., Slawson 1987) and subsequently examined in the study. Typically laid out on a limited space, Japanese gardens are famous for their ingenuity to enhance the perception of size by manipulating the visual perspective by various means (Slawson 1987; Nitschke 1999). Slawson (1987) suggested that the muffled sound of a waterfall could be used to create an effect of distance, but no specific example was mentioned. The present study found that sound could play a role in creating forced perspectives, as tested by observing waterfalls from different locations (Video 5, https://vimeo.com/311198465). The effect can be experienced in Adachi Museum garden, Rikugi-en, and to some extent, in Ninna-ji.

Figure 9. The Kikaku waterfall in Adachi Museum Garden, outside Matsue. (a) From inside the garden (175 m distance). (b) From outside the garden (50 m distance), revealing the true height of the fall.

The most interesting application of the technique was conceived in Adachi Museum garden (Figure 9 and Video 6, https://vimeo.com/418978868), with the Kikaku Waterfall, built in 1978 as a celebration of the museum's eighth anniversary. The waterfall is actually located almost 100 metres outside the garden borders, but the garden has been designed so that the waterfall is 'drawn in' and experienced inside the garden as a borrowed scenery, *shakkei* (Figure 9a). The waterfall boasts a height of 15 metres, yet it is surprisingly difficult to hear its surge from the garden. This can partly be explained by the long distance to the fall as well as interferences from other sound sources. However, the limited presence of the fall can also be explained by the way it has been constructed. It is much shorter than it seems, interrupted at about half the expected height (Figure 9b); a trick effectively hidden from the garden by vegetation. Moreover, the water lands in a pool surrounded by walls that obstruct the propagation of sound, and especially high frequencies are attenuated. This, together with the distance to the garden, makes the waterfall a rather quiet feature. The quietness adds a kind of subtle power to the experience, suggesting that the fall is further away than it is.

Research in psychoacoustics has identified several cues that influence perceived distance to sound objects, including their sound level, frequency spectrum, and amount of reverberation (Moore 2012). In general, human beings have a limited ability to judge absolute distances based on sound source characteristics, with a tendency to perceive distant objects as closer and close objects as more distant. To a large extent, judgement is based on how the sound's properties change as it progresses through space, a process that Augoyard and Torgue (2005) refer to as *filtration*. To summarize, perceived distance to sound objects can be said to depend on two factors: (a) knowledge about the properties of the original sound source (e.g. strength and frequency spectrum) and (b) the amount of filtration (e.g. reduction in strength and change in frequency spectrum). In the example from the Adachi Museum garden, the intervention focused on (b) filtration (strength and frequency were manipulated at the source in a way that emulated filtration). In addition to this, it should be possible to manipulate (a) knowledge about the original sound source. This could be done

by introducing false reference objects along the visitors' path with enhanced properties in the proximity, which should make distant objects appear further away.

Shrouded sounds

This Soundscape Action is about sound sources that are, to some extent, hidden visually by other objects and/or shadows created by these objects. This may be used to project mystique and depth and stimulate the imagination.

There is a long tradition in Japanese aesthetics of acknowledging the subtle qualities associated with darkness and shadows (Tanizaki [1933] 1977). As early as in the 11th century (Heian era), it is mentioned in the garden manual *Sakuteiki* how it is beneficial to partially hide waterfalls in shadows with the intention to create aesthetic effects, fascination, and surprise. For instance, it is stated that 'waterfalls appear graceful when they flow out unexpectedly from narrow crevices between stones half hidden in shadows.' (Takei and Keane 2011, 169).

This traditional way of locating water features is, as recognized in the present study, still evident in several Japanese gardens, including Shisen-dō, Konchi-in, Nanzen-in, Nezu museum garden, and Kinkaku-ji. The darkness is typically created by vegetation and/or rocks strategically located to block the sun (See e.g. Shisen-dō, where a waterfall is located in a small cave covered with vegetation: Figure 10 and Video 7, https://vimeo.com/311170906). The darkness provides a contrast that brings forward the whiteness of the foam, while at the same time inviting the visitor's imagination to fill in the dark spots. This relates to the aesthetic principle *yohaku no bi*, known from Japanese *sumi-e* painting, where the qualities of the (shrouded) white surfaces of the paper are acknowledged (Nitschke 1999).

The most extreme example of 'Shrouded sounds' was conceived in Konchi-in, where a waterfall flowing out in a pond can be heard, but it is almost impossible to see it as it is shielded by rocks and vegetation from every direction. It is only the sound that articulates that something is hidden there. A similar effect has previously been described in the Chinese garden Yunqin Zhai (Zhang 2017), where a water feature located in the edge of a pond is

Figure 10. A shrouded waterfall in Shisen-dō, Kyoto.

hidden by vegetation. Zhang (2017) argues that, by intentionally hiding the water feature from sight, the designer manages to shift the perceptual focus of the visitor from vision to hearing and that the hidden sound encourages an active exploration if the visitor tries to find the source (c.f. 'Hide and reveal').

Hide and reveal

'Hide and reveal' implies a progression or movement through a path, whereby features are gradually hidden and revealed along the way. A series of changing relationships between sound, vision, and other sensory impressions are used to support a continuous interest by gradually hinting at, hiding, and revealing objects. This may encourage active exploration of the spaces surrounding the path. As a Soundscape Action, 'Hide and reveal' focuses on the role of sound in these kinds of relationships.

In the Japanese garden discourse, the technique is acknowledged as *miegakure* (Slawson 1987). It is typically found in pond and stroll gardens like Katsura Rikyū, Sentō Imperial Palace garden, Shūgaku-in Rikyū, and Koishikawa-Kōrakuen. 'Hide and reveal' has previously mostly been discussed in terms of visual cues, but as illustrated by Szanto (2016), sound may play an important role in these kinds of relationships as well. In her exploration of Murin-an garden, Szanto (2016) describes how the sound of a distant waterfall creates anticipation that encourages visitors to explore a distant 'there' in the far back of the garden (see also Figure 3b). The same waterfall was encountered in the present study, where the interplay between sound and visual cues was explored as a factor to consider in *miegakure*:

> The main waterfall in the garden lies in the easternmost corner; it feeds the system of streams and ponds further down through gravitational force. The fall is mysteriously located in a dark area shaded by trees, and it is only through its rather powerful sound that I first become aware of its presence. The sound together with the occasional glimpse through the vegetation encourages further investigation. To reach it, I have to walk around the pond and through the forest on the right. In the forest now, I am clearly very close, but the fall has become completely hidden from view, as the vegetation straight ahead is dense. Further down, the path turns to the left across the stream on steppingstones. Once on the other side, the view of the fall finally opens up to the right. It actually consists of three falls. The sound comes out as a beautiful pure natural white noise.
>
> Murin-an, 6 May 2018, (Video 8, https://vimeo.com/311434611)

In the example from Murin-an, sonic information from the waterfall was used to provide a suggestion about its existence. The vegetation made it possible to keep the fall hidden from view, but because sound can travel through vegetation, a kind of anticipation was created. This encouraged further exploration to confirm the waterfall's spatial location and visual features.

Generally speaking, sound has a good ability to travel around objects and may also transmit through some materials. This property seems to be useful to consider when designing *miegakure*, particularly as a means to hint at the existence of an artefact further ahead. If the purpose is the opposite, that is, to hide an artefact's sound, it may, however, become necessary to use quite extensive screening (and/or masking, c.f. 'Disorientation').

The notion of *sight line* is useful to emphasize a visual connection to objects of interest. In the case of sound, we may speak of a *sound line* (Cerwén 2017). Both terms can be used to describe a connection between an object of interest and its intended audience (visually and

aurally). A *sound line* is established once the object of interest can be heard. The *sound line* is perhaps most apparent in situations where there is no *sight line* established (such as when a waterfall is hidden by vegetation but can be heard). It is also possible that a *sound line* and *sight line* interact, in which case the connection would be emphasized even further. However, this might not encourage exploration to the same extent.

Curiosities

'Curiosities' are unexpected occurrences that attract visitor attention and curiosity. They can be used for their appealing qualities and also to influence behaviour and movement patterns in a desired way.

This Soundscape Action was derived from the many animals living in and around the gardens, as they make unexpected sounds. In particular, the carp fish that are held in most ponds are prone to make the occasional leap, breaking the surface of the water, as illustrated by the following experience in the moss temple, Saihoji on a spring day:

> The trees are shading the sun effectively, but some rays manage to reach through the dense foliage, adding yet another colour to the saturated, moody palette of moss. Suddenly, a loud splash in the pond attracts my attention. As I look around behind me to identify the source, I see faint ripples fading in the water. Two of my fellow visitors are equally surprised by the loud sound, and we are silently waiting for the event to recur.
>
> Saihoji, 15 April 2018

Similar sounds can be emitted by turtles, frogs, and, in some cases, plunging birds. 'Curiosities' can also be designed in a more controlled manner. An example was noted at the entrance to Shōsei-en garden, where a waterfall is located in the vicinity of the garden gate. The waterfall is not audible outside the gate, as a wall screens it is from that direction, but the sound emerges on the inner side of the gate (Video 9, https://vimeo.com/311452446). Even though the difference is rather subtle (sound level rises from 44 to 47 dBA; 29 April 2018), most visitors seem to choose to walk in the direction of the fall after entering, which could suggest that the *sound line* from the fall has an impact on behaviour (c.f. Cerwén 2017; Szanto 2016).

It is fundamental to 'Curiosities' to attract visitor attention, which can be achieved in different ways. Schafer ([1977] 1994) has argued that attention to specific sound is highly subjective and not so dependent on physical properties, while Hedfors (2003) has found that some physical properties like intensity, repetition, movement, and deviations are relevant. Moore (2012) has highlighted the importance of one specific property, that is, changes (deviations) in the sound field. This relates to the sonic effect *emergence* (Augoyard and Torgue 2005), which may be triggered not only by a change in sound level but also by changes in pitch, timbre, and rhythm. If the emerging sound attracts attention, it is called *attraction*, and if it has an influence on behaviour, it is called *incursion*. In the examples described above, the sound seemed to influence behaviour, that is, an *incursion*.

Disorientation

Sound can aid spatial orientation. Good orientation is beneficial in most cases, but it may also be fruitful to tamper with orientation as a design effect creating tension, mystique, and

disclosure. This Soundscape Action acknowledges the role of environmental sounds in spatial disorientation.

Japanese gardens are known to play with visitors' perception of space by the use of distractions like winding paths and altered perspectives to create anticipation and to change the perception of size (c.f. 'Forced perspective' and 'Hide and reveal'). Related to these effects, the notion of 'Disorientation' is about the experience of 'losing' oneself in an environment. The study indicates that sound may be used actively to stimulate this effect.

In Sentō Imperial Palace garden (Figure 11), for instance, a waterfall can be heard from across the pond while standing on the western shore (Point I). From the same distance towards the north (Point II), the waterfall is shielded by topography and vegetation and cannot, therefore, be located from that position (neither by sight or sound). The soundscape here is dominated by a small stream, which helps to mask out the sound of the fall.

Based on an inherent knowledge about the expected propagation of the sound from the fall, and the fact that it 'should' have been heard from the second position, it may be inferred that the distance to the fall is larger than it is. This sense of ambiguity is reinforced in this case by the meandering path, which increases the travelling distance between the two points.

Sound source localization is a complex process involving several cues and cognitive processes. According to Moore (2012), human beings have their best ability to judge direction in the horizontal plane, quite good in the vertical plane, but not as good for distance. Consequently, distance may be a fruitful starting point to find applications concerning the disorientation effect.

The disability to locate sound sources has previously been discussed by Augoyard and Torgue (2005). They describe *ubiquity* as 'an effect linked to spatio-temporal conditions that expresses the difficulty or impossibility of locating a sound source' (Augoyard and Torgue 2005, 130). While ubiquity implies an active search for an audible sound (among other sounds),

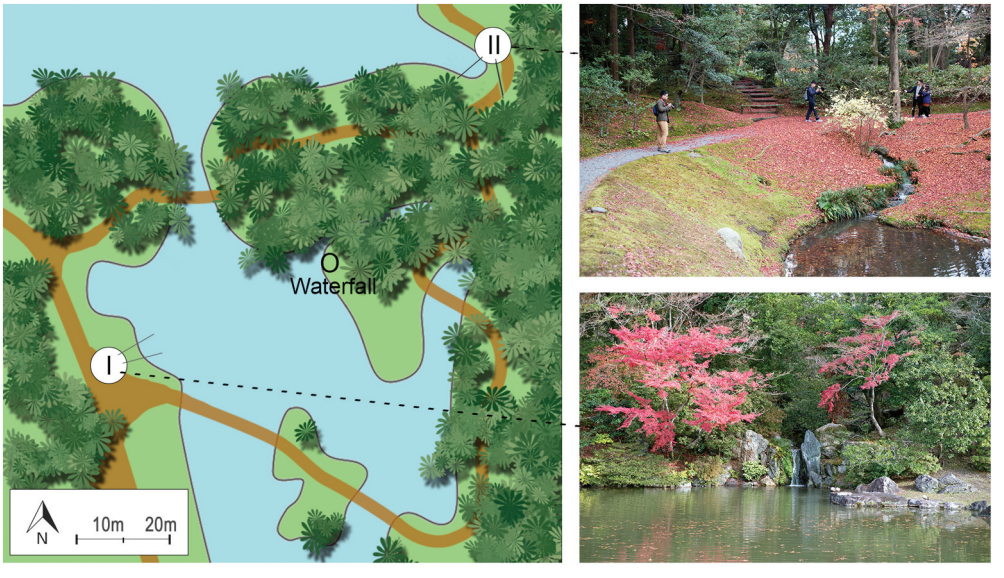

Figure 11. A plan (a) and two views (b, c) illustrating 'Disorientation' in Sentō Imperial Palace garden. Roman numerals indicate (I) A view overlooking a waterfall. (II) Obstructed view towards the same waterfall where a small stream adds masking sounds.

the situation in Sentō Imperial Palace is, in a way, opposite, as the dislocalisation happens unconciously (and as a result of a sound that is inaudible). Similar to the observations in the present study, Augoyard and Torgue argue that changes that happen during the propagation of sound, such as *filtration, masking*, and *distortion*, may make it more difficult to locate the source.

Concluding remarks

This paper is the second of two reporting on sonic experiences in Japanese gardens. The Japanese garden tradition, with its particular sense of aesthetics, contributed with a fruitful context that provided new insights on the design tool 'Soundscape Actions'. In the first paper, the tool was evaluated, pointing to the potential for further development. This was addressed in the present paper, where a set of ten new Soundscape Actions were added to the pre-existing 23.

The new Soundscape Actions tend to be more complex, often involving other sensory impressions, spatial relationships, and active participation in the environment. The paper has thus contributed with an extension of the tool for soundscape design, now covering a wider range of understandings and entry points to soundscape design.

The notion of Soundscape Actions was originally developed as a tool to be used by landscape architects and urban designers in noise-exposed situations, such as urban parks and squares. The actions are structured in three main categories, each of which should be considered in order to stimulate a comprehensive approach to soundscape design: localization of functions, reduction of unwanted sounds, and introduction of wanted sounds. All of the newly introduced soundscape actions fit in the third category of this system, provided that its title is adjusted to 'Introduction of wanted sounds and effects'. However, future work should look into the most proper categorization as it may vary depending on the situation. One possibility is to use a flexible and web-based solution,[2] where categorization could be adjusted to take account for different scenarios (e.g. gardens, urban squares, and traffic planning).

The borders between different Soundscape Actions are sometimes overlapping. This is true for both previous and new ones. Some subcategories are related because they are similar, such as 'Hide and reveal' and 'Shrouded sounds'. Other categories are related by the fact that they can be combined. Taken together, the Soundscape Actions can be regarded as a 'palette' for designers, who can use different combinations to accommodate a wide variety of situations.

The study was based on sonic experiences in 88 Japanese gardens, captured through an autoethnographic approach. The method is subjective in nature, and the defined Soundscape Actions are inevitably a result of personal interests and experiences. In future works, it would be fruitful to involve other participants to test and evaluate the applicability of the findings, possibly identifying new Soundscape Actions and/or categories. Moreover, while the present study is based on existing garden designs, the findings should also be applied to new development projects. A suitable platform for this purpose might, for instance, be a set of workshops to identify strengths and weaknesses in relation to various design tasks, as well as identifying the potential for future developments.

Many gardens in the study were located in densified urban areas with potential noise disturbance. Providing a refuge from the hectic city around them, some of these gardens could be taken to exemplify 'quiet areas' in urban environments, highlighting design ideas that could be used in other contexts as well. The juxtaposition of 'urban' and 'quiet' might be considered

a potential quality in its own right, a prerequisite being that noise emissions are controlled within quiet areas. The previous study on the Soundscape Action design tool in Japanese gardens illustrated how impact from noise could be reduced by considering aspects such as locations, garden walls, and masking strategies. Noise reduction opens up for other sounds and experiences to come forward, and this second study extended the knowledge on such experiences.

It has been argued repeatedly that urban design disciplines should give increased attention to sound. This paper has illustrated some of the possibilities that could be gained by thinking about the sound environment beyond problems with noise. Ten examples were drawn from the Japanese garden tradition and formulated as part of the Soundscape Action design tool.

Notes

1. From latin *sono*, 'relating to sound' and -ry, suffix 'denoting a collection of things'.
2. A digital version of the tool has previously been developed and presented on a webpage aimed for soundscape design in landscape architecture (Cerwén 2018).

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