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Soundscape and Restoration: observations from planning case studies

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ABSTRACT

There is increasing demand for innovative approaches to decrease the negative impact of noise by sound-conscious design. But how far are we and what do we know about the health effects? While the health effects of environmental noise are well mapped, little is still known about the effectivity of interventions on health. This is one of our conclusions in the WHO-Review on health impacts of noise interventions. More and better interventions studies are needed, in particular for sources other than road traffic, and for health outcomes other than annoyance. Soundscape interventions were classified under the category "Other physical interventions" and three out of four studies in this domain demonstrated potential efficacy. . Against this background an inventory of planning soundscape projects in the Netherlands and elsewhere was made, commissioned by the NL Ministry of Infrastucture and Water Management. Interviews with researchers, policy makers, acoustic engineers, and sound designers, were combined with a literature review. This paper reconsiders these cases by placing them in the context of restoration theory and by studying the key elements that could turn sound conscious design into healthy design.

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1. INTRODUCTION

In a review prepared in the framework of the WHO Guidelines for environmental noise (Brown, van Kamp, 2017) we discerned five types of interventions: A Source interventions B Path interventions C New/closed infrastructure D Other physical interventions and E Education/ communication interventions.

Figure 1 presents the different types of interventions

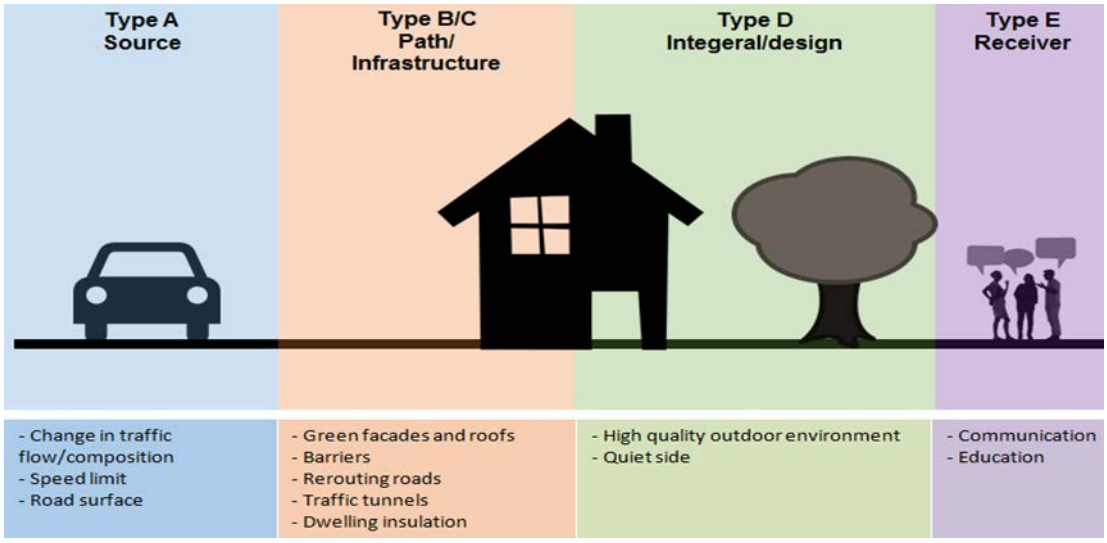

Figure 1: Five different types of noise intervention potentially acting along different parts of the pathway between environmental noise and health.

The studies aimed at the effectiveness of type D interventions provided, by comparing responses from groups with and without the particular physical dimension of interest, indirect evidence on the magnitude of the likely effect of certain physical "soundscape/planning" interventions (Brown, van Kamp, 2017). This type of intervention could be achieved, for example, as part of comprehensive housing/roadway redesign activities over some area. The physical dimensions considered in this group of studies included: availability of a quiet side; whether bedroom or living room windows faced a quiet street (effectively a variation on the existence of a quiet side to the dwelling); the non-acoustic 'quality' of the space that constituted the quiet side of the dwelling (such as a courtyard); and the existence of nearby green areas. All studies found the presence of the particular dimension being investigated had an effect on the (annoyance) responses of the study group, and all but one demonstrated that this was statistically significant (for example, the difference in the percentage of at least moderately annoyed participants between homes with and without a quiet side was statistically significant). Several of the studies adjusted for a large number of different confounders in their analyses but others only for age, noise sensitivity, or window-closing behaviour.

This current paper is also at least partly focused on type D interventions and in particular on soundscape types of interventions in the physical environment including elemnts of tyope E (communication). In 2017 the Netherlands Ministry for Infrastructure and Water Management commissioned RIVM to inventory examples of architectural interventions aimed at improving the soundscape in urban areas. The actual work was performed by Soundappraisal (Derksen, van den Bosch, 2019). The main aim

of this exercise was to collect a set of good practices in the field of soundscape interventions, preferably in the Netherlands but if needed also from other countries. In this paper we take the examples as a starting point and reanalyse them in view of restoration and try to describe the key indicators of healthy sound design.

2. METHODS

2.1 Soundscape project inventory

The projects had to meet the following criteria:

- The reduction of sound levels to below a (statutory) limit was not a primary aim of the project;
- The project is in the public domain;
- Some physical modification has been made;
- Improvement of acoustic quality must be an explicit aim of the project and identified beforehand.

The method of desktop research and interviews with experts were combined in preparation of the inventory. Representatives of diverse disciplines were interviewed in order to obtain a broad overview of different visions of acoustic quality to ensure that the subject matter is approached from as many perspectives as possible. Also the aim was to explore the terminology used within each of the disciplines in order to identify interventions which qualify as soundscaping projects, even though the word itself may not be used. Four main groups of experts were thus identified: 1) Researchers 2) Government authorities and their staff 3) Acoustic engineers and consultancies 4) Sound designers and sound artists

Overall, the interviews confirmed that the importance of soundscape design is widely acknowledged within the field, but that it remains difficult to 'sell' the concept to clients and project principals. The boundary line between theory and practice is proving very hard to cross. Practical experimentation is needed to determine which ideas will work and which should be quietly abandoned.

Four Dutch soundscape projects were identified which met the criteria in three municipalities of Assen, Hoofddorp, Wijchen and Ypenburg. In addition three international projects were added to the list. Below these projects are shortly described. For a full description we refer to

For a full description (available in Dutch as well as English) we refer to https://www.slimmeengezondestad.nl/Kennisnetwerk/publicaties/default.aspx (under "Engelstalige publicaties").

3. RESULTS

3.1 Cases

Case 1: Hoofddorp – Buitenschot Land Art Park

This project was launched in 2011 and aimed at improving the environmental quality in the area around Schiphol Airport which had deteriorated considerably since the opening of a fifth runway in 2004? The park, has two sections of angular surfaces lying at an angle of eighteen degrees. Between them are various areas for recreation, sport and games, as well as a large open space suitable for public events. This intervention has had the desired effect (measured) of deflecting and dispersing low-frequency noise, thus decreasing overall noise levels and the associated annoyance. Nearby are various public artworks which are based on the concept of sound. At two points in the park, visitors can find a 'Listening Ear': a large metal structure which amplifies ambient sound. Standing at the focal point of the reflector dish, one can hear all environmental sounds, including the engine noise from aircraft on the nearby runway, combined to form a single 'auditory experience'. This increases the listener's awareness of sound and noise. In one of the quietest sections of the park is the 'Chladni Lake', a diamond-shaped water feature which includes a vibration mechanism that generates waves similar to sound waves.

Visitors are able to adjust the frequency of the waves, thus generating various geometric patterns.

Case 2: Motor cross circuit (TT Circuit Assen).

The motor circuit in Assen (NE of the Netherlands) attracts yearly many visitors (over 100.000 people). However residents are less happy with the events which is accompanied with noise and noise annoyance. In 2011, a covenant was signed by the provincial authority, the TT Circuit management, local businesses and residents' groups, setting out agreements intended to reduce noise annoyance. It also announced that soundscape study would be performed.
Based on the covenant, stakeholders were invited to produce a 'vision document' for the future of TT Circuit Assen. This document includes both recommendations based on the traditional approach to reducing noise levels, and recommendations made by soundscape researchers from the University of Groningen who propose:

- Tackling unpleasant noise at source.
- Ensuring that unpleasant noise is produced (and thus heard) less frequently, with 'quiet periods' included in the annual programme.
- Adding pleasant sounds, e.g. music, moving water or birdsong. This would serve to mask unpleasant noise or divert attention from its source.
- Improve the general quality of the human environment, making it more visually attractive. This would create a more attractive atmosphere in which unpleasant noise is less prominent.
- Improve communication between TT Circuit Assen and local residents. Better planning of events and activities would ensure that residents know what to expect and can prepare themselves. Moreover, it is important that anyone with complaints about noise feels that they are being taken seriously.

This highly participatory project has not been implemented yet, but its key ingredient is participation. Moreover several other interventions were suggested such as introducing the so called green days, with guaranteed low levels of noise, adjusted race schedules and interventions on wind turbines positively affecting propaogation of sound.

Case 3: Historic, sustainable solution for traffic noise reduction in Alverna

It concerns a traffic route which runs through the village of Alverna, in the Dutch province of Gelderland. Due to significant growth the traffic volume has increased significantly in recent decades. The provincial authority realized that a solution must be found. The original plan of erecting a four meter high noise barrier was dismissed by the residents, and in close consultation with them and other stakeholders the following measures were taken

- Both carriageways are now sited directly alongside each other, with no central reservation, and the road surface has been lowered by fifty centimetres.
- Noise barriers of just one metre in height have been installed along both sides of the road. Being very much smaller than the four-metre structures originally proposed, they have a much lesser impact on the appearance and aesthetic quality of the village. Moreover, their design is inspired by the Roman road that once ran through this region.
- Much new greenery has been planted. It not only makes the area more attractive but emphasizes the cultural-historic significance of the dry-stone walls. Once fully grown, the new trees will partially hide the road from view.
- Street lighting has been fitted with low-energy LED bulbs which cast a warm light, creating a pleasant atmosphere after dark.
- The speed limit has been reduced from 80 to 50 km/h. This reduces both noise levels and emissions.
- New cycle paths have been constructed to connect the village with the outer areas.

The project was received well by the residents and in 2011, the project won the European Soundscape Award, an international prize presented by the European Environment Agency.

Case 4: Ypenburg – 'Plan District 20'

The last case concerns a neighbourhood in the Hague with extensive residential development in recent years. The area is located near the intersection of two main highways and the maximum permissible noise levels are regularly exceeded. A study has revealed that traditional acoustic measures will not be enough to resolve this situation. To ensure that development plans can go ahead, efforts are being made to improve acoustic quality by alternative means. During a participative process, various stakeholders were invited to devise a package of measures. Soundscaping plays a prominent part in their proposals. Some measures are intended to reduce traffic noise from a nearby trunk road, Ypenburgse Boslaan. They include a low wall alongside the road and a low-noise asphalt road, possibly in combination with perforated concrete sections (known as diffraction plates) to deflect tyre noise upwards. A number of soundscaping interventions have also been proposed:

- 'Rustling' greenery such as reeds, willows and poplars to mask traffic noise.
- Greenery which will attract birds. Birdsong will add a positive element to the overall soundscape.
- An urban farm, which will not only add animal noises to the mix but will encourage citizen participation.
- A 'soft' design for the public areas, using acoustically friendly materials and perhaps including an orchard as a 'quiet area'. Areas likely to account for noise, such as children's playgrounds, will be strategically sited.
- A miniature 'green belt' encircling Plan District 20, with bat-friendly lighting.

Additional measures include sound insulation of individual homes, with an emphasis on exterior and interior design such as the use of floating screed floors, a layout which places bedrooms on the quieter side of the house, or 'introverted' design which ensures that there is at least one extremely quiet room with no exterior walls. The overall aim of the project is to create a green and attractive residential setting in which acoustic quality

is high despite the proximity of major traffic routes, but these plans have not been implemented yet.

International cases

Montreal – Musikiosk The bandstand in Parc du Portugal in central Montreal housed a temporary installation which allowed visitors to play their own music through the speakers provided. This multidisciplinary project was intended to test whether the music would improve visitors' enjoyment and appreciation of the park. Most people found the music to be a pleasant addition to the soundscape. People tended to spend more time in the park and were more likely to interact with others. This, is explained by a sense of temporary 'ownership', and because it enhanced social cohesion.

Bern – Singing waters at Freudenbergerplatz

Freudenbergerplatz in Bern is generally avoided due to traffic nosie Urban Identity, a specialist consultancy, devised a plan which would give the square its own unique soundscape and hence make it more attractive. The emphasis was not on reducing traffic noise but on the addition of recognizable sounds to give Freudenbergerplatz its own 'voice'. Designers, urban planners, architects, artists and students were asked to assess the current acoustic environment and city was concluded that traffic noise was not the only issue but also the poor design and layout of the physical domain. Fountains and 'water curtains' were proposed as means to mask the traffic noise, thus improving both the acoustic quality as well as improving the aesthetic appeal of Freudenbergerplatz.

St. Knuts Torg Square in Malmö

In 2016, St. Knuts Torg Square in Malmö became the scene of a soundscaping intervention in which ivy-clad sound screens were placed around a cluster of benches to form a small gazebo. Visitors could sit inside, shielded from the noise of the nearby road. The project also experimented with the addition of recorded nature
sounds, such as birdsong and the gentle murmur of flowing water. The volume of these sounds was automatically adjusted according to the noise level of the traffic on the nearby road. A survey was held among some two hundred visitors. The general opinion was that the combination of techniques did indeed enhance the acoustic quality of the setting. One interesting finding was that the quietest soundscape is not necessarily the most pleasing. The addition of sounds from nature was shown to have a positive effect on sound perception.

3.2 Restoration associated with soundscapes.

The soundscape case studies which we presented above all have in common that a noise reduction per se was not the key aim. While two of the cases have not been implemented yet, and thus their effects have not been studied, there are two feature which makes further discussion of the interventions worthwhile. All projects had the following in common 1) participation of several stakeholders 2) creating a sense of **ownership** or in other words a sense of control over the situation.

Those features do not immediately fit into the definition of restoration in the attention restoration theory (Hartig et al, 1991)(Staats et al, 2003) (Van den Berg et al, 2003) (Brosschot et al, 1998), which distinguishes four necessary components of restoration:

1. being away: psychological distance from the demands and routines in which people use the directed attention capacity
2. fascination: attention is captured by aspects of flora and fauna
3. extent: degree and scope of exploration on the environment
4. compatibility: match between what the person wants to do and must do

They also do not fit available evidence on restoration associated with the acoustic environment, and literature on green areas which suggest, at least tentatively, the following two contexts and mechanisms (van Kamp et al, 2017):

Type 1 restoration in which a high quality acoustic environment intrinsically provides restoration by an immediate pathway – in the same way as green or natural areas/wilderness/ or urban environments with natural elements are assumed to do. There might be immediate Type 1restorative effects of spending time in such places
Type 2 restoration refers to the effect of availability (knowledge) of a high (better) quality acoustic environment to a person who otherwise is subject to adverse effects of noise.

In evaluating the health impact of soundscape related interventions it has been advised to consider health benefits, not just health risks, especially when making decisions about investments on the built environment. Involving stakeholders in outcomes and follow-up activities is recommended.

4. CONCLUSIONS

An inventory of Dutch and international examples of soundscape approaches in urban planning came up with several interesting approaches. The approaches all had in common that a reduction of sound levels was not the main aim, but the improvement of the acoustic quality was. The projects also have in common that they involved stakeholders and that a sense of ownership was created by the interventions. It might be worthwhile studying the effect of these two aspects further by including them in the protocol which was developed for intervention studies by Brown (2015) and also outlined in the framework of the WHO review on interventions (Brown, van Kamp, 2017). The latter are likely to be important in comprehensive evaluation of the human health effects of transport noise interventions.

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