

## Soundscape approaches in urban planning: implications for an intervention framework

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### ABSTRACT

There is increasing demand for innovative approaches to decrease the negative impact of noise by sound-conscious design. While the health effects of environmental noise are well mapped, little is known about the effectivity of interventions on health. This is one of the 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. Some soundscape intervention studies were included in the WHO review, classified under the category "Other physical interventions". Three out of four studies in this domain demonstrated potential efficacy. Although consideration of soundscapes seems essential for urban planning, guidelines on how to implement and assess improvements are not available. Against this background an inventory of architectural soundscape projects in the Netherlands and elsewhere was made, combining interviews with experts and planners with a literature review. The inventory of Dutch and international examples of soundscape approaches in urban planning led to the conclusion that well-documented approaches all aimed at the improvement of the acoustic quality, rather than a mere reduction of sound levels. The projects also combined changes in the physical environment with stakeholder involvement and in that way created a sense of ownership of the interventions. Based on these findings this paper extends the examples of the typology of interventions.

Keywords: Sound, Soundscape, Interventions, Social Interventions

### 1. INTRODUCTION

In a review prepared in the framework of the WHO Guidelines for environmental noise<sup>1</sup> 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.

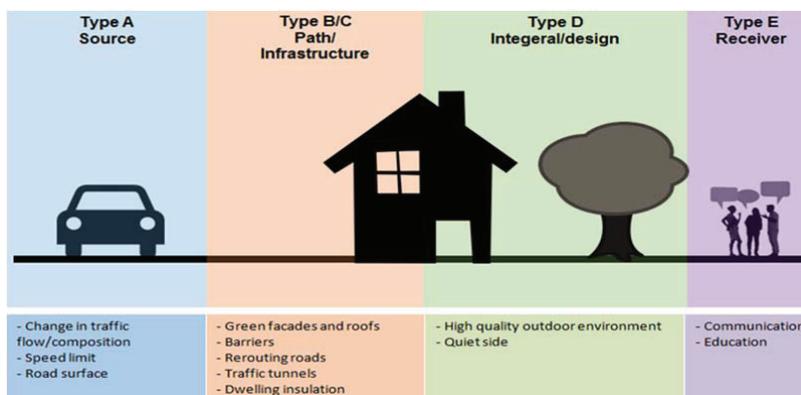


Figure 1: Five types of noise intervention along the pathways between environmental noise and health.

The studies included in assessing 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 the physical interventions<sup>1</sup>. 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. This type of intervention could be achieved, for example, as part of comprehensive housing/roadway redesign activities over some area. All studies found the presence of the particular dimension being investigated had a favorable effect on the (annoyance) responses of the study group, and all but one study 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 confounders in their analyses, but others only for age, noise sensitivity, or window-closing behavior.

## 2. INVENTORY OF EXAMPLES OF ARCHITECTURAL INTERVENTIONS

A recent inventory of projects<sup>2</sup> aimed at improving the soundscape in urban areas in the Netherlands focused on type D interventions: changes in the physical environment. To be included in the overview the intervention 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.

Only four Dutch soundscape projects were identified which met the criteria and these included only two projects which had been implemented. In addition, three international projects were added to the list. For a full description of the projects see <sup>2,3</sup>.

### 2.1 Key features of interventions in the inventory

This inventory<sup>2</sup> 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 had in common that they involved stakeholders and that a sense of ownership or control was created by the interventions, although this was not necessarily an explicit aim of the intervention. Ownership had (in these examples) many different faces, varying from participating in the decision-making regarding the design, creating solutions with a strong (visual) link with the history of the area, giving people actually temporary ownership of the soundscape of a park and so on. We note that, in discussion of annoyance reducing measures around airports, wind turbine parks etc. the concepts of participation, personal control and ownership, have also often been mentioned.

In a recent review paper of Asensio et al.<sup>4</sup> a wheel of participation was described of which the segment in Figure 2 below is closely related to the approaches in projects reported in the inventory. This approach also is a vital part of the Horizon2020 project ANIMA<sup>5</sup>.

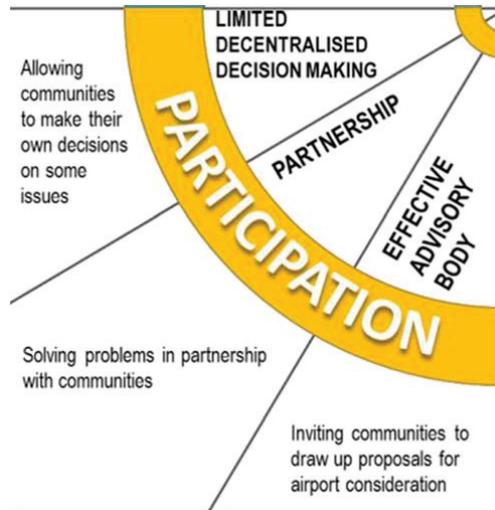


Figure 2: Segment of the wheel of participation<sup>6</sup>

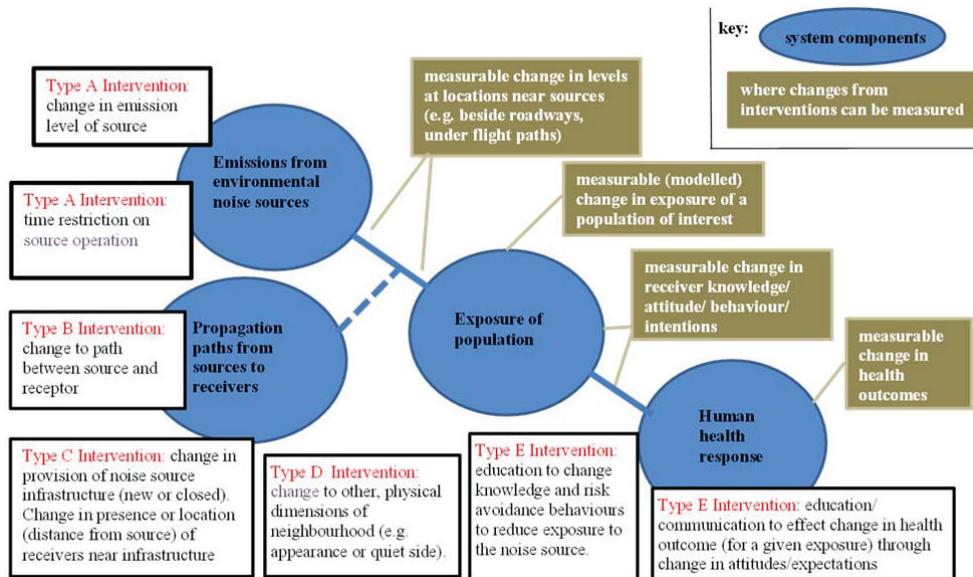
The segment clearly shows that there are different levels of participation and ownership: 'real' ownership (of the airport/noise source, of measures/devices that reduce exposure, i.e. sound proof windows, house with good sound insulation, quiet façade, etc.) and 'symbolic' ownership which might also be understood as 'real' ownership of decisions or of the power to decide (and thus ownership of control). or ownership in the sense as described above: the solutions in itself create a sense of belonging/ownership. The pathway by which these types of intervention can lead to a reduction in annoyance is well summarized by the concept of personal control

Control beliefs (“perceived presence of factors that may facilitate or impede performance of a behavior” become manifest in residents’ perceived behavioral control. Ajzen<sup>7,8</sup> distinguishes perceived behavioral controllability (“belief about the extent to which performing behavior is up to the actor”) and self-efficacy (“ease or difficulty of performing a behavior”). The more a resident assumes to know about objective environmental quality and environmental rights, the greater her or his engagement-specific controllability<sup>6</sup>. Equally, the more she or he feels confident and capable of civic engagement, the more self-efficacy regarding civic engagement is present. The stronger engagement-specific controllability and self-efficacy are, the higher the chance that a resident will adopt an institutional (read active) coping strategy.

Although the role of personal control in the relationship between environmental exposures and acute stress responses and long-term health effects has been well documented in the past<sup>9</sup>, we do not know much yet about the health effects of soundscape types of interventions including participative elements. Also, there is a limit to how much one can intervene in chronic high levels of noise exposure: creating a sense of ownership or literal ownership might have stress- and annoyance- reducing effect at lower levels, they do not prevent long term health effects of exposures to noise levels above the health-related limit values. In other words: these interventions are not meant, and cannot be used, as a way for paying off the acceptance of unhealthy living conditions.

### 3. The noise intervention Framework

The original framework<sup>1</sup> for considering noise interventions and related health effects is presented in Figure 3. It shows where different categories of interventions fit along the system pathway between noise sources and human outcomes. It also shows different measurement points along the pathway where changes relevant to human outcomes can be measured. This framework provides a systematic and comprehensive basis for this, and any future work with respect to the effects of interventions in environmental noise of all source types.



**Figure 3.** Intervention framework showing: system components of the path between environmental noise and human health, where different types of noise intervention potentially act along that path, and points along the pathway where changes resulting from interventions can be measured.

Table 1 expands on these interventions by adding subcategories and examples

**Table 1.** Categorization of Noise Interventions.

Type	Intervention Category	Intervention Sub-Category	Examples
A	Source interventions	change in emission levels of sources	motor vehicle emission regulation; rail grinding; road surface change; change in traffic flow on existing roadways/railways; change in number of aircraft flights
		time restrictions on source operations	airport curfew, heavy vehicle curfew
B	Path interventions	change in the path between source and receiver	noise barrier
		path control through insulation of receiver's dwelling	insulation of building envelope
C	New/closed infrastructure	opening of a new infrastructure noise source, or closure of an existing one planning controls between (new) receivers and sources	new flight path; new railway line; new road bypass; or closure of any of these urban planning control; 'buffer' requirements
D	Other physical interventions	change in other physical dimensions of dwelling/neighborhood	availability of a quiet side; appearance of the neighborhood; availability of green space
E	Education/communication interventions	change in behavior to reduce exposures; avoidance or duration of exposure	Educating people on how to change their exposure
		community education, communication	Informing people to influence their perceptions regarding sources, or explaining reason for noise changes

### 3.1 Implications of the findings of the inventory for the intervention framework

We surmise that the examination of urban planning interventions in Section 2 above has several implications for future work on interventions, and specifically for further comprehensive development of the intervention framework as originally proposed<sup>1</sup>. Two of these are illustrated in Tables 2 and 3 below.

Firstly, Intervention type D, “Other physical interventions” was defined as changes to physical dimensions of dwelling/neighborhood, including; availability of a quiet side; appearance of the neighborhood; availability of green space. It is suggested that the examples of applicable interventions for this category should be extended to explicitly include “varied soundscape design”.

Table 2: Type D Interventions *extended*

D	Other physical interventions	change in other physical dimensions of dwelling/neighborhood	availability of a quiet side; appearance of the neighborhood; availability of green space; <i>varied soundscape design.</i>
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Secondly, what was first labeled as “education/communication” interventions (Type E) should be defined much more broadly, and categorized as “Social Interventions”, They represent a very broad range of participatory interventions as discussed above, including public involvement in a physical/soundscape intervention creation, (a sense of) ownership or responsibility for the intervention - as in Table 3 below.

Table 3: Type E interventions, *extended*

E	<i>Social interventions</i>	change in behavior to reduce exposures; avoidance or duration of exposure	educating people on how to change their exposure
		community education, communication	informing people to influence their perceptions regarding sources, or explaining reason for noise changes
		<i>participation/stakeholder involvement enhancing a sense of ownership and /or responsibility</i>	<i>proving literal ownership, proving ownership of solutions such as a collaborative plan of insulation, owning a quiet façade, etc. – or co-create areas, soundscapes which create a sense of ownership, giving control over a soundscape</i>

Thirdly, it is suggested that it might be worthwhile studying the effect of a combination of interventions together. Examination of the effects of interventions that involve a physical change should be extended to also include assessment of involvement and ownership of both process and outcome of the Type D interventions, directed at improvements in the local environment (and those that involve Interventions Types A to C as well). These dimensions need to be appropriately incorporated within the protocol for the study of change which was developed by Brown and van Kamp<sup>10</sup> for intervention studies, as utilized by Brown<sup>11</sup> and included in the WHO review on interventions<sup>1</sup>. They are likely to be important in comprehensive evaluation of the human health effects of noise interventions.

#### 4. CONCLUSIONS

There is wide and increasing demand for innovative approaches to decrease the negative impact of noise by sound-conscious design. However, evidence on the effectiveness of these interventions is still very limited. In order to stimulate the evaluation of noise-related interventions the typology of interventions should be as concrete as possible. We propose an extension of the Type E category of interventions and name it Social Intervention. Also we suggest to include soundscape planning interventions as a specific subcategory of Type D interventions. It is also concluded that interventions

related to changes in the physical environment combined with stakeholder involvement might create a sense of ownership and personal control. Via that pathway this might lead to a reduction of annoyance and other aversive consequences..

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