Urban soundscapes:  
A quasi-experiment in landscape architecture

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ABSTRACT

Soundscapes are becoming increasingly recognised as significant for sustainable  
development, since they involve issues of health and quality of life. With this in mind, the  
present study aims to further our understanding of how urban soundscapes can be altered  
through design of outdoor space. The study took the form of a quasi-experiment on an urban  
square, involving sound screens covered with ivy to form a small arbour. Assessment was  
effected using a mixed-method approach that included measurements of sound pressure  
levels as well as self-reports from (in total) 205 visitors (198 questionnaires and 9 semi-  
structured interviews were used for analysis). The findings reveal that the arbour improved  
the soundscape. This effect was further enhanced when forest sounds were added through  
loudspeakers, underlining the importance of qualitative considerations. The study  
additionally highlights potential applications of soundscape design, by examining a number  
of issues encountered during the project in relation to landscape architecture.

KEY WORDS

Landscape architecture: Soundscape: Design: Noise screen: Speaker installation: quasi-  
experiment: Square: Urban
1. Introduction

The term soundscape as described by Schafer (1994/1977) is relatively broad and has been used to refer to everything from field recordings and musical compositions to descriptions of acoustic environments. In this paper, the concept is used to refer to the sonic aspects of the outdoor environment, with particular focus on the overall experience of sound (ISO, 2014). Soundscape, in this context, has also been referred to as an auditory counterpart to the more visual term landscape (Botteldooren, De Coensel, Van Renterghem, Dekoninck, & Gillis, 2008; Brown, 2012).

It should be emphasised that in this study the examination of soundscape was not considered an end in itself; rather, this angle of approach was chosen with the intention of contributing to a general understanding of the experience and design of outdoor environments. Furthermore, while the focus of this paper is on the sonic world, relationships between other aspects of the environment are considered as well.

According to Hedfors and Berg (2003), a sustainable environmental design requires that consideration is given to all the human senses, including sound. A growing body of research on the effect and role of environmental sounds supports this standpoint. Sound can, for example, be related to health, both in terms of negative aspects (WHO, 2000), and also, as has been shown recently, with regard to positive effects (Alvarsson, Wiens, & Nilsson, 2010; Annerstedt et al., 2013; Saadatmand et al., 2013). Furthermore, studies in environmental preference have pointed out, in addition to visual factors, the importance of sound (Anderson, Mulligan, Goodman, & Regen, 1983; Carles, Bernáldez, & Lucio, 1992).

It has previously been argued that environmental design has neglected experiential qualities of the sonic world. An increased focus on this perspective in landscape architecture (and related) disciplines has been called for by, among others, Hedfors (2003), Hellström (2003) and Botteldooren et al. (2008). A general concern has been that, while quite a lot of attention has been given to noise abatement, and protection from negative sounds, little has been done in terms of understanding the overall perspective, including the experiential potentialities inherent in the sound environment. In recent years, soundscape as a component of environmental design has progressed to become a field in its own right (see e.g. Brown, 2012), but much remains to be done.

The aim of this study is to gain increased understanding of how the urban soundscape can be altered through the design and construction of outdoor space. The study centres on a quasi-experiment that was conducted at a central square in southern Sweden. The experiment was evaluated through a mixed-method approach (Bryman, 2008) which, as well as considering the visitors’ experience, took account of design issues.
1.1. Soundscape design
Following Amphoux’s (1993) work on sonic identity, Hellström (2003) describes three different general attitudes towards the management of the sonic environment—defensive, offensive and creative. The defensive strategy focuses on the protection of people from sounds that are considered undesirable or dangerous. This has been the dominant strategy (Brown & Muhar, 2004; Hellström, 2003) and includes much of the quantitative work pertaining to noise abatement, such as measurements of sound pressure levels (SPL). The offensive strategy, on the other hand, is more focused on identifying the qualities of the sonic environment in order that these can be accorded their due importance. The offensive strategy is thus about exposure rather than protection, and focuses on what people want to hear. The creative strategy, finally, includes the introduction of new sounds, through interventions such as loudspeaker installations.

An assumption and starting point of the present project is that the most propitious approach to creating a suitable sound environment is to consider the use of these three strategies concurrently, so that their respective strengths may complement each other. This kind of broad approach to the soundscape includes the addition or enhancement of wanted sounds, as well as the reduction or elimination of unwanted sounds (Brown & Muhar, 2004).

The orchestration of the soundscape can be achieved in many ways and on different levels, such as through the positioning of different functions in public space (Hedfors, 2003; Southworth, 1969); the use of acoustically appropriate materials (Nilsson, Bengtsson, & Klæboe, 2015); the introduction of a water feature (Brown & Rutherford, 1994); rustling vegetation (Cerwén, 2010; Hedfors, 2003); the construction of suitable biotopes for songbirds and other animals (Dawson, 1988); or the use of speaker sounds (Hellström, 2003; Hellström, Nilsson, Axelsson, & Lundén, 2014).

By adding wanted sounds, it is possible to mask unwanted sounds so that they are no longer heard at all, or not heard to the same extent (Nilsson, Alvarsson, Rađsten-Ekman, & Bolin, 2010). However, the introduction of new and/or masking sounds is not necessarily advantageous in all situations; in urban open spaces, Zhang and Kang (2007) suggest that it is only meaningful to introduce sounds if the pre-existing SPL does not exceed 65–70 dBA. From this level up, Zhang and Kang say, all sounds are disturbing, while below 65–70 dBA it is the quality of the sound that is most important—the authors arguing, on the basis of previous studies, that at these lower SPL readings there is no relation between acoustic comfort and sound levels. While this could be debated, the division is interesting as it is potentially useful as an aid for design considerations.

Whereas much of the previous work related to soundscape design has been theoretical, hypothetical and/or executed in laboratory settings, less research has focused on practical on-site application. Specifically lacking are studies that could be said to incorporate more than
one of the strategic approaches described above: defensive, offensive and creative. The present study incorporates all three approaches in practice through the construction of a design intervention.

2. Methods

2.1. A quasi-experiment
The research was designed as a quasi-experiment (Deming & Swaffield, 2011). A design intervention (Figures 1–4) was built on a central square in the city of Malmö in southern Sweden. The intervention could be described as an arbour, and was designed with the specific intention of altering the soundscape inside the space it enclosed. The idea was that the arbour would provide a fruitful platform for investigating the relationship between soundscape and landscape architecture.

The arbour was evaluated using a mixed-method approach (Bryman, 2008). This approach was chosen since it makes it possible to outline potential general patterns while at the same time illuminating more specific nuances and explanations. The experienced change in soundscape was measured by way of self-reports from visitors recruited on site. Data were collected through a questionnaire based on a five-point bipolar scale (see Nilsson & Berglund, 2006), as well as through semi-structured interviews. Additional information was gathered through conversations and observations on site. To obtain acoustic data, SPL measurements were conducted inside, as well as outside of the space.
2.2. Designing an arbour at St. Knuts Torg

The site that was chosen for the intervention, St. Knuts Torg (Figure 2), is situated in a lively and eventful district of Malmö called Möllevången. The square is, among other things, a popular place to dine and drink coffee at. A heavily trafficked street, Amiralsgatan, passes the square on its south-west side, and on this edge of the square there is a fast-food kiosk. Further in, away from the street, there are pavement cafés in the warmer parts of the year.

The intention was for the arbour to change the soundscape in two ways: by screening noise from (especially) Amiralsgatan; and by adding forest sounds through loudspeakers. The idea was that the speaker sounds would produce a pleasant soundscape, while at the same time masking some of the traffic noise that was not filtered out by the screens. The arbour was placed with its rear side as close to Amiralsgatan as was practically possible, about 12 m. This was done in order to achieve the strongest possible contrast between being inside the arbour and being outside. This location meant that the arbour could potentially work as a tranquil space and/or auditory refuge (Hedfors, 2003)—especially in relation to and as a contrast to Amiralsgatan.

![Figure 2. Aerial view of St. Knuts Torg in Malmö. The circle at the southwest side of the square marks the arbour. Photo by permission of Lars GB Andersson in agreement with Malmö municipal authority.](image-url)
As well as being conceived as a soundscaping feature, the structure was built in a way that incorporated other elements of landscape architecture and site design: the screens, instead of being readily recognisable as noise screens, were ‘dressed’ as an arbour which harmonised well with the square as a whole. The core of the screens consisted of NoiStop® Green, a market-oriented product based on mineral wool. These screens (1.8 m high) were then covered with pre-fabricated walls of ivy. The ivy was planted in troughs constructed specifically for the project. The enclosed area measured about $5 \times 8$ m (see Figure 3 for construction).

Inside the arbour, recorded forest sounds were played through six small (4” coaxial) speakers. These were mounted in the wooden frames of the construction at around 1.6 m height (see Figure 3). The playback was effected in crosswise stereo. The playback volume was adjusted in real time in relation to the SPL of the surrounding environment through a setup that included the processor DBX ZonePro 641, the software Ambient Noise Compensation and a condensator microphone, facing towards the street.

The choice was made to use forest sounds for the site because it was felt they would correspond best with the overall experience it was hoped the arbour would communicate—forest sounds being concordant with the visual expression of the arbour, and vice versa. Previous studies have pointed up the significance of a correlation between vision and sound (see e.g. Anderson et al., 1983; Carles, Barrio, & de Lucio, 1999; Pheasant, Fisher, Watts, Whitaker, & Horoshenkov, 2010). The sound that was played back consisted of a collage of several different sounds typically found in forests: the sound of wind in trees, the sound of a brook in the mid-distance, and birds (predominantly nightingale and blackbird). The collage was composed so as to offer variations over shorter periods of time as well as longer periods of time. The total playback time was approximately 20 min, which was looped with a subtle fade-in and a subtle fade-out.

Figure 3. Construction drawings of the arbour. Left panel: plan view. Right panel: section (A1–A2).
2.3. Questionnaires

2.3.1. Participants
A total of 205 visitors to the square were recruited to fill in a questionnaire. Seven of these questionnaires were considered to have been filled out in an unsatisfactory manner, leaving a total of 198. Of the 198 respondents, 97 were not exposed to any added sound in the arbour (Group A), while 101 were exposed to forest sounds added through speakers inside the arbour (Group B). See Table 1 for the breakdown of study groups.

2.3.2. The questionnaire
The questionnaire was developed following previous work by Nilsson and Berglund (2006), but adapted to the specific experimental design that included two different locations (see below). The questionnaire consisted of (in total) 16 questions, as well as a field left for ‘Other comments’ (two additional questions was posted to Group B concerning sounds from speakers). The questionnaire covered aspects ranging from (a) personal cues (habits, age, sex etc.), (b) the general environment and (c) the acoustic environment. The answers were analysed using the statistical software SAS (2010).

2.3.3. Experimental design
The experiment was designed in two different stages. The first stage was carried out outside the arbour (Location I in Figure 4), while the second stage was completed after having entered the arbour (Location II in Figure 4). Having a two-stage questionnaire made it possible to compare perceptions outside and inside the arbour. In each stage, the participant was asked to sit down on one of the benches which were provided as part of the structure.

Half of the evaluations were made with no added sound in the arbour (Group A), while for the second group (Group B), forest sounds were played through speakers built into the arbour. (These sounds were not audible from the spot being used outside the arbour, but only from within).

Table 1. Breakdown of study groups. There were no significant differences in age (t-test, t = .78, df = 190, p = .434) or sex (Chi-square-test, χ² = .98, df = 1, p = .322) between the groups.

<table>
<thead>
<tr>
<th>Group A (97 respondents)</th>
<th>Group B (101 respondents)</th>
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<tbody>
<tr>
<td>Started the experiment outside the arbour (Location I) and finished inside (Location II). No additional sound was added in any of the locations. The 97 respondents in Group A were 51 women and 46 men, aged 16–70 years (M&lt;sub&gt;age&lt;/sub&gt;=35.4 years, SD=13.4, n=94).</td>
<td>Started the experiment outside the arbour (Location I) and finished inside (Location II). Forest sounds were played through speakers in Location II. The 101 respondents in Group B were 59 women and 40 men (2 missing values), aged 14–71 years (M&lt;sub&gt;age&lt;/sub&gt;=36.8 years, SD=12.7, n=98).</td>
</tr>
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</table>
2.3.4. Procedure

Data collection was conducted at different times of day and on different weekdays during the late summer and autumn of 2011. At any given time, one or two research assistants were working. Visitors who passed in the proximity of the arbour were approached, informed about the research project and asked to participate. The study was described as being about environmental experience where sound was mentioned as an example. Respondents who agreed to participate were informed about the basic research procedure. The completion of each questionnaire typically varied between 7 and 15 min.

2.4. Semi-structured interviews

Some of the people who filled in the questionnaire were asked to participate in a follow-up interview on a different occasion. The selection of these was based on a general intention of trying to achieve a broad representation of questionnaire respondents. In total, nine semi-structured interviews were carried out. The interviews varied in length between 20 minutes and an hour and a half, and were recorded.

The interviews were analysed in relation to other findings in the project, in order to gain complementary angles of approach. The analysis included aspects ranging from design considerations and users’ experience of the arbour to methodological issues.

The questionnaire contained a field left for ‘Other comments’. This data was treated following the same principles for analysis as the semi-structured interviews. In the following, participants will be denoted as either respondents (referring to the answers in the questionnaire) or interviewees (referring to answers in the semi-structured interviews).
2.5. Conversations and observations
Conversations with participants in the study, as well as with people who worked in businesses around the square or were passing by, were held continually as the project evolved. These findings, together with general observations, were recorded in a notebook.

2.6. Measurements of SPL
Measurements were carried out by the engineering consultancy firm Ramböll. Decibel levels were recorded using a RION NL-52 sound analyser for periods of 10 min, from which equivalent (A-weighted) levels were established (L_Aeq10 min). Measurements were carried out on 1 and 2 September 2011. On the second occasion, measurements were recorded both outside and inside the arbour simultaneously.

3. Findings and discussion
The first part of this section is based on the questionnaire and the quantitative evaluation of the arbour. In the second part, qualitative aspects are brought in for a deeper understanding. Here, the users’ experiences of the arbour as well as design considerations are dealt with. Aspects related to the design of the arbour can be regarded as a methodological reflection, as well as findings in their own right.

3.1. Soundscape ratings
The ratings of the soundscape is based on the following (five-step bipolar) question (asked in Location I and Location II); On the whole, how would you describe the surrounding sound environment right now? By comparing the ratings given outside (Location I) to those given inside the arbour (Location II), it was determined (for each respondent) whether the experience of the sound environment had improved, was unchanged or had deteriorated after they entered the arbour. Each respondent was put in one of these three categories.

The findings reveal that the intervention put in place on the square (i.e. the arbour) generally influenced the experience of the sound environment in a positive manner (see Table 2).

<table>
<thead>
<tr>
<th></th>
<th>Sound environment improved</th>
<th>Sound environment unchanged</th>
<th>Sound environment deteriorated</th>
<th>Total</th>
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<tbody>
<tr>
<td>Group A. No sound added</td>
<td>41 (42%)</td>
<td>49 (51%)</td>
<td>7 (7%)</td>
<td>97 (100%)</td>
</tr>
<tr>
<td>Group B. Forest sounds added</td>
<td>72 (71%)</td>
<td>26 (26%)</td>
<td>3 (3%)</td>
<td>101 (100%)</td>
</tr>
<tr>
<td>Total: Groups A and B</td>
<td>113 (57%)</td>
<td>75 (38%)</td>
<td>10 (5%)</td>
<td>198 (100%)</td>
</tr>
</tbody>
</table>

*Table 2. Contingency table presenting the number of participants who experienced an improved, unchanged or deteriorated soundscape quality in Location II compared to Location I (see Figure 4), divided on the two groups (A and B) of participants.*
3.2. Experience encompasses more than SPL

It is noteworthy that a considerably higher proportion of respondents in Group B (71%) rated the arbour as producing an improved sound environment than in Group A (42%). When Group B took part in the experiment and filled in the questionnaire, forest sounds were played back inside the arbour, and Group B was thus in practice presented with a stronger SPL in the arbour than Group A (see Box 1), but rated the sound environment as being better.

To make a model for the preferences in Group A and Group B, an ordinal logistic regression was used (PROC GENMOD in SAS [2010]). The effect of age and sex were excluded from the model since these variables did not improve the model significantly (p = .534 and p = .666, respectively). The final ordinal logistic regression model without age and sex is based on the data in Table 2 and confirms a significant difference between the groups ($\chi^2 = 17.18$, df = 1, p < .001). The model had an estimated odds ratio of 3.32 (95% CI = (1.86, 5.94)), meaning that the odds for participants in Group B to consider an improved soundscape inside the arbour were around three times larger than Group A.

The findings here support the standpoint, described at the beginning of this paper, that a more qualitatively oriented approach is called for with regard to sound in landscape architecture. It can be argued that even though measurements of SPL are important as tools for describing the sonic environment, they are insufficient for describing the experience of a situation such as that in the present study. The SPL inside the arbour was measured to be approximately 56 dBA (58 dBA with the forest sound installation active). In both situations,

<table>
<thead>
<tr>
<th>Box 1. Sound Pressure Levels</th>
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<tr>
<td><strong>The SPL on the square</strong> was measured just outside the arbour (Location I*) on a total of five different occasions with the mean value being 62 dBA** (Standard Deviation, SD = 2.2).</td>
</tr>
<tr>
<td><strong>The reduction effect of the arbour</strong> (as presented for Group A, no added sound) was measured on three different occasions on 1 September 2011. The mean difference between outside (Location I*) and inside the arbour (Location II*) was measured to be 6.2 dBA** (SD = 2.9***). Approximate SPL inside the arbour (Group A): 56 dBA**</td>
</tr>
<tr>
<td><strong>The reduction effect of the arbour</strong> (as presented for Group B, with forest sounds added) was measured outside (Location I*) and inside (Location II*) the arbour simultaneously on two different occasions. The mean difference between outside and inside the arbour was measured to be 4.3 dBA** (SD = .5). Approximate SPL inside the arbour (Group B): 58 dBA**</td>
</tr>
<tr>
<td>From the measurements described above, it was estimated that when the forest sounds were added through the speakers they led to an increased sound level of around 1.5-2 dBA. Measurements were also effected at different heights (simultaneously) in the arbour. A total of two measurements indicate that a further reduction effect of 1.8 dBA** (SD = .0) would have been achieved had the walls been .4 m higher, i.e. had they been 2.2 m in total.</td>
</tr>
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</table>

*Height: 1.1 m (estimated average listening position).
**Arithmetic mean value established from a series of equivalent (A-weighted) measurements (L_Aeq10 min).
***The measurements inside and outside the arbour were not carried out simultaneously, a fact which contributes to the rather high standard deviation.
the level is below the 65–70 dBA suggested by Zhang and Kang (2007) as an upper limit for considering the introduction of new sounds. While the present study thus provides some corroboration for Zhang and Kang’s suggestion, it only does so at the given SPL level: 56 dBA (and up to 58 dBA). The findings here do, however, provide support for the incorporation of offensive and creative strategies (Amphoux, 1993; Hellström, 2003) at this level. The study also supports the use of defensive strategies at 62 dBA.

3.3. Tranquil qualities
One idea behind the project was that the arbour could potentially work as a tranquil space. The study of the arbour, as described above, is however based on a rather broad approach to the sound environment, which does not necessarily say anything specifically about tranquility; what constitutes a good or bad sound environment may encompass many different aspects at different times and for different people. In the qualitative part of the study, several people found the arbour to be ‘fairly tranquil’—especially in relation to the surrounding environment. One interviewee commented on the arbour thus:

[…] It does what it sets out to do, it’s like an oasis. And what’s more, the listening experience makes you feel that Amiralsgatan has faded into the distance a bit.

One other interviewee mentioned, while discussing the general sound environment in the city, how traffic and other strong sounds can be annoying, while sounds of nature, on the other hand, are pleasing:

Basically it’s the fact that they’re natural sounds. It’s nice. Wind and water, and things like that.

Several participants talked about how important it is to find places in the city which have a tranquil sound environment. This particular aspect of the soundscape—tranquility—can be seen to tally with recent findings of positive stress recovery connected with exposure to nature sounds (Alvarsson et al., 2010; Annerstedt et al., 2013; Saadatmand et al., 2013). Even though these studies had a different and more specific approach than the present study, there is a possible connection. The concept of the arbour could potentially be developed as an aid to stress recovery in a relatively small space. This would however require research directed more specifically towards this aspect.

3.4. Variation and contrast
In what might be seen as the opposite pole to tranquility, another role of the city is to offer stimulation and a range of activities, some of which are related to noisy environments such as a busy city centre or a market square. Aspects such as these could not be recorded in the quantitative study, but were raised by some people in the qualitative part. Some respondents noted that a city should include a certain amount of noise, and that if a natural environment was their ideal, they would choose to live in the countryside. One respondent commented thus:
We live in a city. If I want to enjoy the birds singing and all that, I go back to my home in the north of Sweden.

One of the interviewees similarly expressed that:

Sure, it’s a lively city and can sometimes have one or two rough edges, but I kind of like that.

It could be argued that an ideal city soundscape would in fact consist of a range of different soundscapes, so that people had access to tranquil spaces as well as other kinds of environments. One interviewee commented:

It’s nice to be able to feel that you can take a step away from it all, that you can choose to say to yourself, ‘No, I’m tired of this now, I’m going to go and sit somewhere calm instead.’ So it’s like getting away from it all, while you’re still in the middle of the city. You can come and sit in a place like this instead of actually having to get out of town.

A city has the potential to offer a multitude of environments, corresponding to the multitude of people, moods, wants and needs that occupy it. If such a variety is achieved, it becomes possible for each inhabitant to seek out their own favourite environment. Furthermore, with a variety in the soundscape, the different modes of expression can potentially reinforce each other through the effect of contrast. Mapping the city from a soundscape perspective could potentially add valuable information in this respect, something that was recognised by the city of Oslo in their mapping of calmer central areas (Bymiljøetaten, 2013).

3.5. Aesthetics for all senses

Even though the arbour that was built offered an improvement of the soundscape, certain aspects might benefit from further improvements. In the qualitative part of the study, the visual aspects of the arbour were sometimes commented on as inferior—for example:

It looks boring. It could do with being made a lot more romantic, with flowers, and so on.

The ivy makes it dark, it’s too featureless. Maybe water would give it a lift?

To sum up, the most frequent suggestions were that the arbour should include flowers or plants to look at, that it was too dark, and that it should include a water feature.

Aspects such as these, particularly the water feature (as an alternative to speaker sounds), were discussed for the project prior to installation, but it was not possible to realise them within the project boundaries. Further, it was argued that a relatively neutral aesthetic in terms of how the other senses were addressed would aid the study of the soundscape. It would however be an interesting subject for future studies to incorporate aspects such as those described above, not least as they include other kinds of sensory input such as the fragrance of flowers, and the possibility of touching plants and feeling water, feeling the sun. The role of sensory inputs in restorative contexts has been recognised in previous studies (see e.g. Adevi & Lieberg, 2012).
3.6. Sound and expectations
Several participants expressed the view that they had expected the arbour to offer more reduction of traffic sounds than was actually achieved. One interviewee explained her experience as follows:

I thought before I went in [the arbour] that I would find it quieter than it turned out to be. What I found was a different kind of noise, which I experienced as more pleasant—but still quite loud.

Another interviewee, when asked to reflect on this phenomenon, explained:

I would say that when I sat down the first time, I felt: well, it’s not doing such a great job of screening out noise … And maybe that first impression had an effect on my evaluation.

The noise-reducing walls were built to a height of 1.8 m, and the theoretical reduction effect was calculated to be around 10 dBA (i.e. that the noise level would be felt to have been roughly halved). In practice, the measurements indicate that the walls reduced the noise by around 6 dBA (when the listener was seated). It is unclear what the reasons for this discrepancy might be, but there is clearly scope for further exploration. Furthermore, the vegetation walls, due to construction technicalities, were around 40 cm higher than the actual insulating core. The expectation when entering the arbour may therefore have been somewhat higher than what was actually experienced having entered—meaning that there was a possibility of disappointment. Measurements at the site showed that there would have been a further reduction of 1.8 dBA, had the height of the insulation corresponded to that of the ivy.

3.7. Sound, spatiality and masking
Through the intervention, sonic as well as visual contact with the street was changed. The visual contact was interrupted entirely, while the sounds of traffic could still be heard, but to a lesser extent. Several participants mentioned how especially the visual screening was beneficial; one interviewee said:

Even though I kind of feel that it doesn’t take away that much noise, you still feel that you’ve got away from the traffic. […] I’d say that’s because of the visual aspect, the fact that the traffic is out of sight.

The sounds played through the loudspeakers seem to have worked well in diverting focus from the traffic, and making it seem further away. For example, one interviewee described how the speaker sounds created a sort of sonic screen against the traffic which, although still audible, now resided in the background:

On the one hand, you have this screen of leaves, a visual screen. But you also get a kind of sonic screen, coming between your ears and the traffic. A more pleasant sound with birds chirping and rippling water. […] So even if you hear the noise, the music [speaker sounds] is closer to your ears, and this screens some of the unpleasant sound.
This effect can be described as informational masking (see e.g. Nilsson et al., 2010; Watson, 2005), meaning the detraction of attention from one sound source to another. The informational masking, in this context, seems to have been aided by the relative proximity of the speaker sounds (masker) compared to the traffic sounds (target). This finding relates to Gestalt psychology and the notion of figure and ground as described by Schafer (1994/1977), Truax (2001/1984) and Hedfors (2003). The study also indicated that the relative directions of the masker/target sounds in relation to the listener may be a factor to consider. Observations confirmed that the masking effect seemed stronger in positions where the speaker and traffic sounds were coming from the same direction.

The core of the noise-abatement walls was constructed from an absorbant material, i.e. mineral wool. The absorbing capabilities of this material were deemed useful as it interrupts noise without reflecting it, thus offering increased control with a minimised risk of unwanted reflections. However, inside the arbour the walls also absorbed all sounds being produced there; had the internal walls been reflective (as discussed by Southworth, 1969), the locally produced sounds would have been emphasised, and this would probably have made a desirable contribution to the creation of a pleasant atmosphere.

A useful feature of the walls, apart from keeping the sound of traffic outside the arbour, was that they kept the sounds emanating from the speakers inside the arbour. The speaker sounds might otherwise perhaps have been disturbing to the surrounding environment.

3.8. Speakers and added sounds

The introduction of speaker sounds constitutes a new element in the environment which could potentially be experienced as artificial and/or irrelevant. One of the reasons for this is the fact that the original sound source is not present and therefore cannot be seen—an effect often referred to as acousmatics (Hellström, 2003; Schaeffer, 1966). Another reason could be that the sound environment is to some extent rendered private when speakers are used (Hellström, 2010).

One of the interviewees said that the injection of sound made her feel as though someone was trying to control the way she felt, and that this experience was related to the fact that the municipality was one of the originators. The interviewee generally liked the artificiality of sound art installations, but thought that here the addition of the forest sounds represented a top-down perspective, which for her was a negative association. The connection between sensory impressions and the politics of urban life has previously been spotlighted by Degen (2008).

The use of speaker sounds also stimulated reflections concerning the relationship between environmental design and the soundscape. One respondent suggested, for example, that habitats for real birds should be prioritised rather than the introduction of artificial sound.
Other participants enjoyed the speaker sounds in their own right. For example, one interviewee was impressed at the effect that the installation had:

\[
\text{It's amazing how just such a tiny snippet of birdsong can affect you. It lifts your mood ... you feel better when you hear the birds. And the fact that the little birds singing can blur out the rest of the traffic is terrific.}
\]

The design and construction of the arbour meant that the speaker sounds were mainly audible inside the arbour and right in front of it, but not from the sides. This meant that visitors could fairly easily choose whether to be exposed to the speaker sounds or not. The visitor’s choice has previously been raised as an important issue to consider when incorporating speaker sounds in public spaces, as there is otherwise a risk of annoyance connected with undesired or frequent exposure (Hellström, 2010). Furthermore, in this manner, the auditory space produced by the speakers was made to correspond with the physical space of the arbour. This might have reduced disturbance due to the acousmatic effect, as the speaker sounds were potentially given a new meaning and context in this way (Cerwén, 2010).

The quantitative study reveals that nearly all (95%) of the participants who were exposed to speaker sounds in the study also noticed the speakers. Furthermore, 57% of participants said that the speaker sounds were an interesting and/or positive feature, while 31% expressed some sort of annoyance. The environmental psychologists Kaplan and Kaplan (1989) suggest that fascination is an important element in recuperation. It is not unlikely that, in some cases, sounds emanating from speakers could present such a fascinating situation. An observation that could substantiate this is the fact that children in particular who visited the intervention examined the space thoroughly, and tried for example to locate where the sounds came from. Several visitors mentioned how much children enjoyed the arbour, and one respondent commented:

\[
\text{The kids and us really like to stop by here every time we walk past. More places like this, please!}
\]

Had the intervention consisted of a natural setting with, for example, a fountain to provide the masking sound, the findings of the study might have been very different. Aspects such as those discussed here further suggest the importance of exploring the soundscape through a qualitative approach which looks at different meanings, variations and connotations of the sonic world. The present study has shown that the soundscape is more complex than being merely about SPL; quantitative measurements are important, but they should not be allowed to overshadow the overall picture and the actual experience of the sonic world.
4. Conclusion

This study has shown that there is scope for changing the soundscape through the design of urban space, and that the perception of soundscape can be enhanced through the incorporation of different strategies—offensive, defensive and creative strategies—simultaneously. The findings also support the standpoint that the construction of good sound environments involves aspects that go beyond what can be measured through SPL. In the arbour structure created for the study, the quietest environment was not perceived of as being the best one. In fact, an average increase of 1.5–2 dBA, arising from forest sounds played through loudspeakers, was associated with a significantly improved experience as compared to when no sounds were added. This supports the postulate put forward by Zhang and Kang (2007), that the introduction of new sound may be a relevant step to take, provided the sound pressure level is below 65–70 dBA. In addition, the present study has contributed to increasing our understanding of how the experience of soundscape relates to the design and construction of outdoor spaces.

The research was designed as a quasi-experiment that was evaluated through a mixed-method approach. As always in quasi-experiments, there are confounding factors that may influence the result. The recruitment of respondents is not done randomly, which may result in a one-sided representation of the population. Furthermore, the experience of the sonic environment is influenced by several interrelated aspects, such as other sensory inputs, mood, weather and the reason for visiting. The project was designed to reduce the impact of confounding factors through the incorporation and comparison between two different groups (A and B), as well as two different locations (I and II).

It should be emphasised that in focusing on the sonic world and the subject of soundscape, the study has to a certain extent (although not entirely) passed over other aspects of landscape architecture. That being said, limiting a study to the consideration of a single particular aspect is sometimes needed in order to increase the understanding of the whole. As was also noted by Fowler (2013) in connection with a soundscape workshop in landscape architecture, new insights and general opportunities may arise through such a strictly defined focus.

While the project’s main focus was on issues of design detail, it also dealt with overall city planning. The study mentions the importance of variations in the city soundscape, and looks at the value of being able to choose between soundscapes of different character. Tranquility was identified as one such character that is generally considered good or desirable—which suggests that there is scope for further investigation of the concept of tranquil space. It is likely that the need for small-scale tranquil spaces may increase in the future as cities become more densely populated. This calls for increased research into different solutions and applications.
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