The effect of added sounds on urban soundscape evaluation and listening activity

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Abstract. Understanding the relationship between what people hear in public spaces and what activities they perform there has been a question at the core of soundscape studies for decades. The role of specific sound sources on how public space users evaluate their soundscapes in relation to their activities has been of particular interest to academics and urban practitioners alike. In this context, our study addresses the addition of common urban sound sources, human voices, bird sounds and water sounds, to the urban soundscape, investigating their effect on public space users' soundscape evaluations while performing different pre-defined activities. A binaural auditory experiment was conducted at Mercatorplein, a public space in Amsterdam, where we asked people to put on open headphones playing one of the three sources and perform one of two activities related to Barry Truax' states of listening. For the state of 'listening in search' participants were asked to focus on and count the sounds of trams passing by. For the state of 'background listening' participants were asked to participate in a conversation in which they had to answer a number of questions about themselves. Using surveys, we documented participants' evaluation of their soundscapes and their perceived appropriateness for the corresponding activity. Our research shows a significant difference in appreciation of the soundscape between the two activities while water sounds are added. The addition of bird sounds was evaluated as pleasant, appropriate for both activities and most stimulating for the counting activity related to listening in search. The addition of human voices was perceived as most chaotic, most eventful and disruptive for both activities.

1 Introduction

Cities are growing. More than half of all people on earth are living in the city.[1]. All those people bring their own sounds, cultures, habits and lifestyles into the cityscape through the activities they perform ranging from the sound of industry and traffic to those of music and spoken language [2]. This environment of sound, with a focus on the way in which it is perceived, refers to the concept of soundscape [3]. A soundscape is defined as “the acoustic environment as experienced, perceived and understood by a person or people, in context” [4]. The soundscape is an important factor in the comfort of urban public spaces. Beyond music, sounds in our environments – referred to as “environmental sounds” [25] – have a proven effect on our moods and behaviors. They can affect the expressions and emotions of people in the city, as well as how they use the city [5] [6]. The way we use sounds in everyday life and how we engage and listen to them is different from listening to music [7] [25]. Listening to music focuses more on the experience of the sound itself, and more attention is paid to features such as loudness and pitch. Listening to environmental sounds focuses more on the sound source. The focus is not on the sound itself but more on the source that produces the sound, such as a passing train, a ticking traffic light or a starting car.

However, it is not just the source, but also what the source represents, the cues it brings to whether we can perform our activities and thus live our lives.

For one person an everyday sound can be experienced as nice, for the other annoying [8]. Despite this complexity in perception, policy and public discourse are centered on the negative aspects of sound associated with busy urban living. “noise pollution” [9] [10], focusing mostly on sound levels. The general logic behind this approach – besides justified public health considerations – is that the lower the sound levels, the higher the acoustic comfort in urban spaces. The approach to lower sound levels might be limiting and not address the complexities of the urban experience in relation to how soundscape and behavior are related. This is particularly relevant in the context of noise abatement policies and the approach taken in planning and design. [11][12][13]. These noise reduction strategies can sometimes work, but are not always realistic or achievable, for example in public spaces, where there is limited control on the presence and level of sound sources. Most common are architectural strategies, for example reducing traffic noise by bordering roads with continuous residential buildings to provide noise reduction to the areas in the backyard of these buildings [14]. Another common option is masking sounds usually evaluated as unpleasant (like traffic) by introducing nature sounds to the public soundscape. Evidence shows that added sounds such as placing a water fountain in urban open spaces can mask unpleasant sounds [15]. Nonetheless, the adding of sounds to the environment raises the overall sound levels in a space, thus going against the aforementioned logic of “quieting” spaces.

In this paper, we aim to address this apparent paradox by researching the addition of different sound sources to the urban soundscape and its effect on soundscape evaluation and appropriateness for two types of activities. We will look into how the addition of different sound sources can affect the evaluation of soundscape in general and in particular in terms of appropriateness for different types of activities performed. Answering this will contribute both to academic debates as well as planning and design practice concerns.

We will look into literature on how to evaluate a soundscape (section 2). Literature will be given related to experiments in which sounds were added to the urban environment. A model with which the experiment can be designed is explained. The main goal of this study is to test if participants are evaluating their soundscape differently according to different added sounds while performing specific tasks [20]. We will also present a discussion on what can be important for future research related to urban planning and soundscape research.

2 Motivation and literature review

In order to answer the research question, we will be first looking into strategies of evaluating soundscapes and factors that can influence that evaluation. We will look into which model can be used to create an experiment and give examples of how to add sounds to the urban environment.

2.1 Quality of urban experience: soundscape evaluation and appropriateness

There is a recent study from Steele et al. (2019) that has tested the addition of specific sounds in public space [16]. The study investigated the role of added sounds to the urban environment, documenting the effects of an installation called the Musikiosk. This installation allowed public space users to play audio content from their own devices over publicly provided speakers. The model they used to analyze the effect of Musikiosk on the urban environment is called QUPE (Quality of the urban public experience). They used this model to test if Musikiosk changed the evaluation of the soundscape. They found that, when the Musikiosk installation was in use (so when was added to the environment), the urban environment was perceived as more pleasant and social for both installation users and non-users, and the perceived soundscape calmness and appropriateness were not affected.

The QUPE model consists of 3 main components, namely sound-related evaluation, public space engagement and psychological outcomes. For our research the focus will be only on the first component, namely the evaluation of sounds in the urban soundscape (see figure 1). This includes the soundscape evaluation part and the specific sounds part. The soundscape evaluation is based on using soundscape descriptors, informed by the Swedish Soundscape-Quality Protocol (SSQP). This is a useful tool to compare and characterize soundscapes and their affective perceived quality along the following axes: pleasantness and eventfulness [17]. See the method

for more information. In addition to using a soundscape descriptor, the activity of the participant must also be taken into account.
Increasing academic literature (including Steele et al. (2019)), argue that activity can play an important role of how participants evaluate their soundscape [18]. Nielbo et al. (2013) found that different soundscapes can affect the evaluation of appropriateness of an activity [19]. For evaluating the soundscape it is therefore necessary to take into account the appropriateness for an activity.

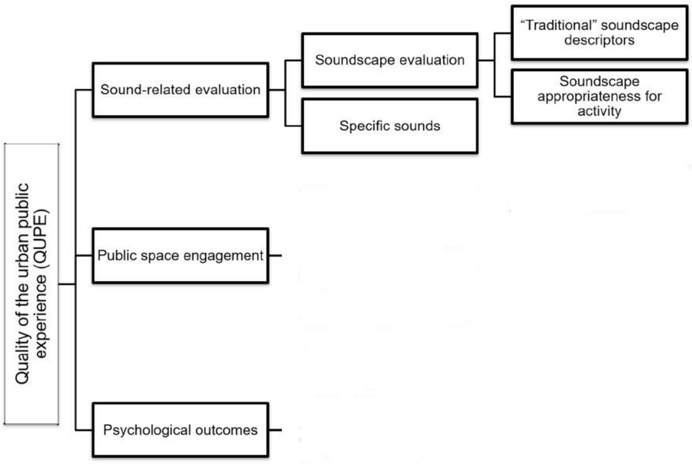

Figure 1: The QUPE (quality of the urban public experience) model

This argument is also suggested by Jennings & Cain (2013), arguing that the factors that can be influencing the perception of the urban soundscape include: activity and demographics [20]. According to [20], activity refers to how they're using the space, and their "state of listening". According to Truax (2001) there are 3 states of listening behavior [21], differentiated according to the level of attention they require and what we argue can be linked directly to activities.

1. **Listening in search, or analytical listening**
   A conscious act where one is listening in search of the environment for a particular sound of importance. It is an analytical type of listening, where the sound itself is searched for information. The detail of the specific sound is of greatest importance. One can detect information about the environment through these specific details. This analytical listening process gives the ability to focus on one sound to the exclusion of others. This can also be linked to the "cocktail party effect" [22], where one is able to focus on one conversation or voice in the midst of many.

2. **Listening in readiness**
   An in-between type of listening in which the attention is in readiness to receive significant information, but where the focus of one's attention is probably directed elsewhere. This intermediate type of listening depends on associations being built up over time, so that the sounds one hear are familiar and can be readily identified even by "background" processing in the brain. Subtle differences in familiar sounds can already be enough to convey information that is more important in judging the sound than simple identification. For example a mother being wakened by her baby's cry and not by a passing car or other noise. Another example is the recognition of your own phone sound, when other phones are ringing around you.

3. **Background listening**
   A sort of distracted listening behavior where the listener is engaged in another activity. It occurs when one is not listening to a particular sound, and when its occurrence has no special or immediate significance to a listener. In this distracted type of listening, the listener is tuned out of all the sounds around him. For example concentrating on having a conversation or reading a book.

The second factor mentioned by Jennings & Cain (2013) that can influence the perception of the soundscape is related to demographics. According to Kang et al., (2010), age can determine the experience of an urban sonic environment [23]. Sounds related to nature, culture or human activities are more likeable for people with a higher age. Young people are more accepting noises such as mechanical sounds. Also, the educational level ca influence the perception of the soundscape. Kang (ibid.) found out that with the increasing of educational level people preferred more natural sounds and where more annoyed by mechanical noise.
Activity and demographics are factors that can have influence on the perception of sound. Therefore it is important to take these two factors into account in this research.

2.2 Added sounds

Various field surveys have been carried out on which natural sounds have positive effects on our perception of the urban soundscape. Most of the time, the sound of water was the most favorably sound to hear in the urban soundscape [24].
Another field survey done by Guastavino (2006) confirmed the relationship between natural sounds and the positive perception of the urban soundscape in French cities [25]. Especially the sound of wind was more often perceived as pleasant compared to the sound of water. This study also found that urban soundscapes, consisting primarily of traffic noise, were described as unpleasant, whereas soundscapes in which human voices were dominated were appreciated. Also nature sounds (birds and water) were perceived as more pleasant and less unpleasant in comparison with the human voices.

Some laboratory tests conducted binaural auditory experiments to test the masking effect of natural sounds on traffic noises. They added different kinds of water sounds to the sounds of traffic and construction noise. Jeon et al. (2010) found out that that the sound of streaming water had the most effect on masking traffic noises [26]. They discovered that the level of the water sounds should be similar to or not less than 3 dB below the level of the urban noises. De Coensel et al. (2011) conducted binaural auditory experiments by adding bird and fountain sounds to road traffic noise to see the effect of masking. Loudness, pleasantness, and eventfulness were tested to see which sounds were most effective. The sound of a water fountain had the most effect in reducing the loudness of road traffic noise, while bird sounds significantly improved pleasantness and eventfulness [27].

Another study from 2013 investigated the design and effect of audio-visual components on environmental quality to improve urban soundscapes [28]. The scientists selected natural sounds and noises from road traffic. The visual components were selected out of urban streets. Other natural sounds, such as the sound of a waterfall, streaming water sounds and bird sounds were selected to enhance the soundscape. The results showed that bird sounds were the most preferred among the natural sounds. The sound of falling water was found to degrade the soundscape quality when the road traffic noise level was high. Moreover, the sounds of falling water were introduced as the best sound for masking road traffic noise.

The latter binaural auditory studies have only been applied to test masking effects on traffic noise. However, no auditory studies have yet been performed related to how different sounds can affect the evaluation of the urban soundscape by public space users in relation to particular activities.

It is why this study proposed a binaural auditory test with participants located in the urban open environment with added sounds based on the findings of Guastavino (2006) [25]. We specifically ran experiments with public space users to test if the sounds of human voices, water and birds affect the evaluation of the urban sound environment.

To test if those sounds affect the evaluation of the urban sound environment, one has also take into account the listening attention. Therefore it is interesting to test the effect of the added sounds on soundscape evaluation while performing activities based on the listening behaviors of Truax (2001). Therefore we came up with the following research question:

- Does the addition of different sound sources to the urban soundscape influence public space users evaluation of their soundscapes related to two types of listening activities?

Building on literature, to answer the research question, we test separate 4 hypotheses on activity and added sounds.

1. Based on Truax (2001) and Jennings & Cain (2013): The state of listening affects the evaluation of the soundscape; additionally, based on Steele et al. (2015), activity can have a significant effect on different soundscape descriptors (for example pleasantness)

2. The addition of different sound sources to the urban soundscape can differently affect how public space users evaluate their soundscape in terms of appropriateness for different types of activities performed (based on Nielbo et al. (2013)).

3. The addition of different sound sources to the urban soundscape will have different effect how public space users evaluate their soundscape

- Addition of bird sounds
  Bird sounds can make the urban soundscape more pleasant, less eventful , more vibrant, less monotonous, more calm, less chaotic and less unpleasant in comparison with background sound, while evaluating the urban soundscape (based on findings from De Coensel (2011), Guastavino (2006))
- Addition of human voices
  Human voices can make the urban soundscape more pleasant, more eventful, more vibrant, less monotonous, more calm, more chaotic and less unpleasant in comparison with background soundscape (based on findings from Guastavino (2006))
- Addition of water sounds
  Water sounds can make the urban soundscape more pleasant, less eventful, less chaotic, more calm and less unpleasant in comparison with background soundscape. (based on Yang & Kang (2005). Jeon et al. (2010), Guastavino (2006))

4. Demographics such as age and educational level can have an influence on how people evaluate their soundscape

- Age: According to Kang (2010), older people tend to evaluate nature sounds such as birds and water as more pleasant and less unpleasant in comparison with human voices.
- Educational level: According to J,Kang (2010), sounds related to nature, such as bird and water sounds, are being perceived as more pleasant and less unpleasant with the increase of education level in comparison with human voices

To test these hypotheses, we proposed an urban public space setting.

To test if the sounds of human voices, water and birds are affecting the appropriateness of a specific activity and influencing the evaluation of a soundscape, all the factors mentioned above have to be taken into account. An auditory experiment was conducted at a specifically selected urban open environment, described below. The main goal of this research is to test if the 3 selected sounds are affecting the appropriateness of various activities in public space and the influence on the evaluation of the soundscape. The next section in this paper is focusing on how to achieve the main goal related to the method of the experiment.

3 Method

We developed a quasi-experimental setup where we invited participants to conduct 2 listening activities based on the listening behaviors of Truax (1983), namely listening in search (analytical listening) and background listening (distracted listening). It was decided not to include listening in readiness in this study. This is because this listening activity consists of unconscious behavior, which makes it difficult to test in public space.

Each participant listened to sound fragments of human voices, streaming water and bird sounds during a specific listening activity. During the experiments, every participant listened to the sound recordings through open headphones, so that they can still clearly perceive the rest of the environmental sounds. The sound fragments must sound as realistic as possible to see if they have an effect on the evaluation of a specific activity and soundscape. The aim is to let the sounds that are played through the open headphones mix as good as possible in the already present sonic environment of the participant in order to create the most realistic soundscape. To achieve this, it was decided to record the sound fragments binaurally. The use of binaural recording technique ensures that the recorded sound is reproduced as realistically as possible [29].

3.1 Location

One location in Amsterdam was chosen to run the binaural auditive experiment. The locations has to be representative for an urban public space, providing amenities that can satisfy the social, physical and environmental needs of city users [30]. The chosen location to run the experiments is a public open city square in Amsterdam called Mercatorplein. The square has both catering establishments and a busy traffic route including tram tracks (see figure 2). There are also trees for shade and benches for people to sit on. The area surrounding the square consists of taller buildings with residential or commercial use on two sides, and roads for different transportation modes (cycling, car, tram).

Figure 2: Mercatorplein

3.2 Data collection

3.2.1 Added sources

To test the hypotheses, binaural sound recordings of water, birds and human voices are required. All the sounds were recorded with the Zoom H6 recorder. The DPA SMK-SC4060 binaural headset microphone was used to capture all the sounds.
Binaural recordings of streaming water were made at a fountain in the Vondelpark. The recording distance from the fountain was 3 meters away. The fountain was located in the Vondelpark in a quiet area without traffic surroundings. The recordings were done early the morning, so that no other daily sounds from people could interfere. The fountain consisted of water falling along all sides of multiple rectangular stone columns with different heights from 1 to 2 meters above the ground. It was located in a pool and produced a constant water sound.
The binaural sound recordings of birds are done in the early morning to prevent any background noise such as traffic. They were made in Vondelpark around 5:00 in the

morning, just before sunrise to capture all different bird species on their most active time. The sound recordings were made on an empty lawn surrounded by trees. Because there were trees around the entire lawn, you can hear the bird sounds coming from every angle in the binaural recordings.
The binaural sound recordings of human voices is done at a crowded lawn located in the Vondelpark. It was decided to record the human voices here because there is hardly any audible traffic in the vicinity. The recordings were taken on a sunny day in the Vondelpark where many people were enjoying the sun in the park.
Another important thing that has to be taken into account to run the experiment is the environment where the experiments will take place.
The binaural recordings were analyzed to see which one is best to use for the experiments. In addition, the volume and pitch of the selected fragments were examined at Mercatorplein. The aim was to let the sounds overflow in the environment as realistically as possible so that all participants experience the added sounds as if the sounds belong to the urban soundscape of the location. With the sound fragments of human voices, attention has been paid to the pitch of the voices. When analyzing the human voices, attention is paid to the prevention of predominance of the voices. The voices had to sound like people actually reside in the environment of the participant. The bird sounds have been analyzed for the number of birds that can be heard in a fragment. The birds should not sound too predominant. The aim was to make the birds sound as realistic as possible on the relevant environment. The sound fragment of running water has been analyzed for the number of decibels. Attention has been paid to the degree to which the running water in the area overflows without it becoming too conspicuous.

3.2.2 Data collection tasks

To test the soundscape appropriateness related to a specific activity, the experiment was designed based on the 2 states of listening behavior of Truax (1983), namely listening in search (analytical listening) and background listening (distracted listening). One of the activities a participant had to do was based on listening in search. Participants were asked to focus on the sound of a tram that could be passing by. They had to count the sounds of a tram that was passing by within the experiment. For example those sounds could be the ringing of a tram or the screeching sound of the wheels. By letting the participant focus on the sound of a tram, a conscious activity is created where the participant is listening in search of the environment for a particular sound of importance.

The other activity was based on background listening. Participants were asked to start a conversation in which they had to answer a couple of questions about themselves. In this way the participants created a distracted listening behavior where the listener is engaged in another activity. The questions that could be asked to the participants during the experiment included:

- Describe in detail what you did today
- Describe in detail what you are going to eat this evening
- Describe in detail your favorite artwork

3.2.3 Data collection instrument

The soundscape evaluation within the experiment was done through a two-part questionnaire that is based on the Swedish Soundscape Quality-Protocol (SSQP). The first part focused on the following things related to the quality of the perceived urban soundscape: pleasantness, unpleasantness, eventfulness, uneventfulness, vibrancy, monotony, calmness and chaoticness. The participants were asked if the soundscape was appropriate, stimulating or disruptive related to the performed listening activity. All the measurements were based on a 5-point Likert scale: strongly disagree, disagree, neutral, agree, strongly agree.

The second part of the questionnaire focused on demographics such as age, educational background and how many times the participant visits the place of experiment. The last thing asked to the participants was to rank the 4 different soundscape situations according to its appreciation (one without added sounds, one with the added bird sounds, one with the added water sounds and one with the added human voices). See the full schema of all the questions from the two questionnaires inside appendix 1. The two questionnaires were made with the online Qualtrics survey software.

3.2.4 Data collection procedure / experimental setup

Every experiment was performed on a sunny day during the week, without rain between 12 and 4 pm to attempt to maintain a somewhat constant background urban sonic environment the same within every experiment. In total, 20 days were needed to collect data and perform experiments. The temperature ranged between 17 °C and 31 °C. During this experiment, randomly selected Dutch speaking public space users were asked to do one of the 2 tasks, leading to a total of 60 participants. Of these, 31 were male and 29 were female. The mean age was 33 years old. The youngest person was 16 years old, the oldest was 82 years old. The average visit of the Mercatorplein by all participants was a few times a week, so they were well accustomed to the space.

First, the participants were asked if they wanted to participate in the study. It was said that the research was focusing on sounds in public space. The total duration of the experiment of 20 minutes was told. If they agreed on participating in the experiment they were told what to do. Every participant got headphones which they had to put on during the experiment. During every experiment, a participant listened to the sounds of water, birds and human voices in a particular order with an open headphone (Beyer Dynamic DT 990 PRO open studio headphone). To avoid prejudice while listening to the 3 sounds, a participant could only do one of the 2 activities. During the listening experiment, every participant listened to the binaural sound fragments of birds, human voices and streaming water. A laptop was used to play the sounds. The duration of every sound fragment was 2 minutes to allow each participant to listen to all 3 sounds for the same amount of time. Every fragment was played in a specific order. In total, 6 different combinations were used. Based on Pollack (1964), The order of audio stimuli can differently affect their rating. Because of this, the 6 combinations were necessary to avoid the same sequence for all participants. Within every experiment, the 3 binaural sounds were heard by the participants through an open headphone.

There were 4 rounds in total, where participants were told to perform a specific listening experiment during all the 4 rounds. After every round, participants had to fill in a questionnaire on a laptop to evaluate the quality of the perceived soundscape according to the added sound on the open headphone. In the 1st round the participant had to listen to the environmental sounds with the headphones on. No sounds were added on the headphones. This was necessary to obtain a baseline for the experiment. In the other 3 rounds, additional sounds were played on the headphone. After completing the 4 rounds, the participants had to fill in the final questionnaire related to demographics and evaluation of the 4 different soundscape situations.

3.2.5 Data processing and analysis

The collected data was exported in an Excel table and analyzed after all the experiments. First, the derived Likert-scale data from the questionnaires were converted to numbers to derive descriptive statistics (strongly disagree = 1; disagree = 2; neutral = 3; agree = 4; strongly agree = 5). We first report on means per activity and soundscape. Pearson's correlation test was used to see if there were any significant correlations between the SSQP questions. For each activity it was examined whether there was a correlation between the SSQP questions.
Finally, to investigate the effect of activity on the 4 soundscapes, MANOVA and ANOVA analysis were applied to see if there were significant differences between activity and every soundscape situation. Each question from the SSQP of all the 4 soundscapes were used as dependent variables, and activity as the fixed factor. The MANOVA was applied to investigate differences between activity and the 4 soundscapes. The ANOVA was applied to investigate differences between the two activities within every soundscape.
All statistical analyses were performed using JASP version 0.14.1.0.

4 Results

The total means of all the results can be seen in appendix 2. A bar-chart of the total means between every soundscape and means per activity and soundscape can be seen in appendix 3. All the correlations can be seen in appendix 4.
For ease of reporting below, we use the following abbreviations:
Soundscape 1- background sounds = SBg (for Soundscape Background)
Soundscape 2- birds = SB
Soundscape 3 – voices = SV
Soundscape 4 – water = SW
Activity 1 – conversation = AC
Activity 2 – counting tram = AT

4.1 Listening activity

We will first report how participants performing the same activity evaluated their different soundscapes across the scales. We afterwards describe how evaluations for the "same" soundscape differed between the two activities. Both these analyses will help us further explain the relationship between activity and particular sound sources.
In table 1, one can notice differences between how participants engaging in each of the two activities evaluated their four different soundscapes

	Soundscape	**Activity 1: Conversation (N=30)**	**Activity 2: Counting tram (N=30)**
Pleasantness	SBg	*3.43 neutral*	*3.10 neutral*
	SV	*2.53 neutral*	*2.80 neutral*
	SV	*3.10 neutral*	*3.78 agree*
Eventfulness	SV	*3.23 neutral*	*2.80 neutral*
Vibrancy	SB	*3.90 agree*	*3.67 agree*
	SW	*3.76 agree*	*3.47 disagree*
Monotonous	SB	*2.13 disagree*	*2.47 disagree*
Calmness	SW	*2.80 neutral*	*3.40 neutral*
Chaoticness	SW	*2.77 neutral*	*2.23 disagree*
Unpleasantness	SBg	*2.13 disagree*	*2.43 disagree*
Appropriateness	SV	*2.63 neutral*	*2.90 neutral*
	SW	*3.07 neutral*	*3.47 neutral*
Stimulating	SBg	*2.77 neutral*	*3.17 neutral*
	SW	*2.77 neutral*	*3.30 neutral*
Disruptiveness	SW	*2.93 neutral*	*2.23 disagree*

Table 1: Differences in means between activity per soundscape. Only the questions with a mean difference of 0.3 and higher between activity and soundscape are shown.

Below, we report on differences per soundscape between the 2 activities, as well as differences in evaluations per activity between the soundscapes
For AC, the evaluations with a higher mean in comparison with AT are:
Pleasantness (SBg), eventfulness (SW), vibrancy (SB, SW), chaoticness (SW), disruptiveness (SW).

For AT, the evaluations with a higher mean in comparison with AC are:
Pleasantness (SV, SW), monotonous (SB), calmness (SW), unpleasantness (SBg), appropriateness (SV, SW), stimulating (SBg, SW).

If one looks into the state of listening behavior and its effect on appropriateness, we can say that there is only a difference between activity within soundscape 3 (SV) and 4 (SW), although quite small.

Looking at the stimulation, the difference between activity occurs within soundscape 1 (SBg) and 4 (SW). For the disruptiveness, there is a visible difference within soundscape 4 (SW).

If we look all the means per soundscape of the SSQP questions per activity (Appendix 2), one can say that for

- Pleasantness:
  - SB was perceived as pleasant for both activities.
  - SW was only perceived as pleasant for AT
- Eventful:
  - SBg and SV were perceived as eventful for both activities
- Vibrancy:
  - The first 3 soundscapes (SBg, SB, SV) were perceived as vibrant for both activities
  - SW was only perceived as vibrant for AC
- Monotonous:
  - None of the 4 soundscapes was perceived as monotonous
- Calmness:
  - None of the 4 soundscapes was perceived as calm
- Chaoticness:
  - Only SV was perceived as chaotic for both activities
- Unpleasantness:
  - None of the 4 soundscapes where perceived as unpleasant
- Appropriateness:
  - SBg and SB were perceived as appropriate for both activities
- Stimulating:
  - Only SB was perceived as stimulative for AC
- Disruptiveness:
  - Only SV was perceived as disruptive for both activities

4.2 The addition of different sound sources

The addition of different sound sources to the urban soundscape can affect how public space users evaluate their soundscape in comparison with background sounds

Bird sounds
If one looks at appendix 2, one can see that for both activities, bird sounds can make the urban soundscape more pleasant, less eventful, less vibrant, more monotonous, more calm, less chaotic and less unpleasant.

Human voices.
If one looks at appendix 2, one can see that for both activities, human voices can make the urban soundscape less pleasant, more eventful, less monotonous, more chaotic and more unpleasant.

During both activities the vibrancy level is not perceived as different in comparison with background sounds
The level of calmness is staying the same during activity 1 in comparison with background sounds whereas for activity 2 human voices can make the urban soundscape less calm.

Water sounds
If one looks at appendix 2, one can see that for both activities, water sounds can make the urban soundscape less eventful, less vibrant, more monotonous, more calm and less chaotic.
For activity 1, water sounds can make the soundscape less pleasant, whereas for activity 2, water sounds make the urban soundscape more pleasant
Speaking about the unpleasantness, during activity 1 water sounds can make the urban soundscape more unpleasant, whereas during activity 2 the addition of water sounds can make the urban soundscape less unpleasant.

	Pleasantness	**Unpleasantness**
Total means Soundscape 2: Birds	*3.91 agree*	*1.95 disagree*
Total means Soundscape 4: Water	*3.45 neutral*	*2.31 disagree*
Total means Soundscape 3: Human voices	*2.667 neutral*	*3.6 agree*

Table 2: Total means between pleasantness and unpleasantness.

Taken into account the Biophilia Hypothesis stated In the paper of guastavino, The two nature sounds (birds and water) would be perceived as more pleasant and less unpleasant in comparison with the human voices
If one looks at table 2, one can say that indeed the two nature sounds are perceived as more pleasant and less unpleasant in comparison with the human voices.

Correlation

Correlations	SBg		SB		SV		SW	
	AC		AC		AC		AC	
	Pearson's r	P-Value	Pearson's r	P-Value	Pearson's r	P-Value	Pearson's r	P-Value
Pleasant - Calm	*0.48*	*0.007*	*0.53*	*0.003*	***0.69***	*<0.001*	***0.62***	*<0.001*
Pleasant - Unpleasant	*-0.57*	*0.001*	***-0.86***	*<0.001*	***-0.72***	*<0.001*	***-0.60***	*<0.001*
Pleasant - Appropriate	***0.61***	*<0.001*	*0.59*	*<0.001*	***0.68***	*<0.001*	***0.70***	*<0.001*
Pleasant - Stimulating	*0.59*	*<0.001*	*0.57*	*0.001*	***0.62***	*<0.001*	***0.74***	*<0.001*
Unpleasant - Disruptive	*0.46*	*0.010*	***0.79***	*<0.001*	***0.76***	*<0.001*	*0.52*	*0.003*
Appropriate - Disruptive	*-0.43*	*0.019*	*-0.53*	*0.002*	*-0.42*	*0.022*	*-0.52*	*0.002*
Stimulating-Disruptive			*-0.54*	*0.002*	*-0.43*	*0.019*	***-0.66***	*<0.001*
Eventful - Chaotic			*0.58*	*<0.001*	*0.53*	*0.003*	*0.44*	*0.016*
Calm - Stimulating			*0.44*	*0.014*	***0.63***	*<0.001*	***0.63***	*<0.001*
Calm- Disruptive			*-0.52*	*0.003*	*-0.51*	*0.004*	*-0.57*	*<0.001*
Unpleasant - Stimulating			***0.60***	*<0.001*	*-0.57*	*0.001*	*-0.46*	*0.010*
Appropriate - Stimulating			***0.66***	*<0.001*	***0.60***	*<0.001*	***0.79***	*<0.001*
	AT		AT		AT		AT	
	Pearson's r	P-Value	Pearson's r	P-Value	Pearson's r	P-Value	Pearson's r	P-Value
Eventful - Calm	***-0.66***	*<0.001*	*-0.43*	*0.018*	***-0.77***	*<0.001*	*-0.43*	*0.017*
Pleasant - Calm			*0.54*	*0.002*	*0.54*	*0.002*	*0.43*	*0.018*

Table 3: Correlations within every soundscape per listening activity

Within every activity, similarities in correlation will happen between every soundscape. During AC, there are in total 6 significant correlations happening within every soundscape (table 3). The positive correlations are happening between: pleasant – calm, pleasant – appropriate, pleasant – stimulating and unpleasant – disruptive.
Significant negative correlations are happening between:
pleasant – unpleasant and appropriate – disruptive.
Focusing only on the soundscapes with added sounds, 6 correlations are happening within every soundscape. The positive correlations are happening between: eventful – chaotic, calm – stimulating, unpleasant – stimulating and appropriate – stimulating.
The negative correlations are happening between: stimulating- disruptive and calm-disruptive

During AT there is only one negative correlation happening within every soundscape (table 3) between eventful - calm.
Focusing only on the soundscapes with added sounds, one positive correlation is happening within every soundscape, namely between pleasant – calm

We will be describing in depth relationships between evaluations within every soundscape.

Correlation soundscape 1: background sounds

SBg						
AC				**AT**		
Variable	**Pearson's r**	**P-Value**		**Variable**	**Pearson's r**	**P-Value**
Pleasant - Appropriate	*0.61*	*<0.001*		Pleasant - Unpleasant	*- 0.75*	*<0.001*
Pleasant - Stimulating	*0.59*	*<0.001*		Eventful - Calm	*- 0.66*	*<0.001*
Pleasant - Unpleasant	*- 0.57*	*0.001*		Vibrant - monotonous	*- 0.62*	*<0.001*
Pleasant - Disruptive	*- 0.56*	*0.001*				

Table 4: Correlations within soundscape 1. Only significant correlations were reported (p <0.001).

Within every soundscape, similarities and/or differences in correlation will happen between the two listening activities.
If one looks at table 4, one can say that the only shared negative correlation within soundscape 1 for both activities is between pleasant - unpleasant.

If we look at the differences between the two listening activities, one can say that for conversation the highest positive correlations are happening between pleasant – appropriate and pleasant – stimulating. That means that the higher the pleasantness, the higher the evaluation of the soundscape as appropriate for their activity and more stimulating for it. Conversely, the highest negative correlation is happening between pleasant – disruptive, meaning that the lower the pleasantness, the higher the disruption .
For counting tram the highest negative correlations are happening between eventful – calm and vibrant – monotonous.

Correlation soundscape 2: Birds

SB						
AC				AT		
Variable	**Pearson's r**	**P-Value**		**Variable**	**Pearson's r**	**P-Value**
Unpleasant - Disruptive	*0.79*	*<0.001*		Chaotic - Disruptive	*0.69*	*<0.001*
Chaotic - Disruptive	*0.72*	*<0.001*		Unpleasant - Disruptive	*0.55*	*0.002*
Appropriate - Stimulating	*0.66*	*<0.001*		Eventful - Monotonous	*- 0.65*	*<0.001*
Chaotic - Unpleasant	*0.66*	*<0.001*		Pleasant - Disruptive	*- 0.57*	*0.001*
Unpleasant - Stimulating	*0.60*	*<0.001*		Vibrant - Monotonous	*- 0.57*	*0.001*
Pleasant - Appropriate	*0.59*	*<0.001*				
Eventful - Chaotic	*0.58*	*<0.001*				
Pleasant - Stimulating	*0.57*	*0.001*				
Pleasant - Unpleasant	*- 0.86*	*<0.001*				
Pleasant - Disruptive	*- 0.71*	*<0.001*				
Calm - Chaotic	*- 0.65*	*<0.001*				
Eventful - Calm	*- 0.64*	*<0.001*				
Pleasant - Chaotic	*- 0.67*	*<0.001*				
Unpleasant - Appropriate	*- 0.58*	*<0.001*				
Chaotic - Appropriate	*- 0.57*	*0.001*				

Table 5: Correlations within soundscape 2. Only significant correlations were reported ($p < 0.001$).

If one looks at table 5, one can say that the only shared positive correlation within soundscape 2 between the two listening activities is between:
unpleasant – disruptive and chaotic – disruptive. Look even further: Pearson's R is higher for AC between unpleasant - disruptive than for AC (0.79 vs 0.55). We could speculate that perhaps something about having a conversation could be making the disruptiveness higher when they find the environment unpleasant, than for counting. More tests need to be performed to establish that, but it opens an interesting avenue for research .
The negative shared correlation is between: pleasant – disruptive.

If we look at the differences between the two listening activities, one can say that for AC the highest positive correlations are happening between:
appropriate – stimulating, chaotic – unpleasant, unpleasant – stimulating, pleasant – appropriate, eventful – chaotic and pleasant – stimulating.

The highest negative correlations are happening between: pleasant – unpleasant, calm – chaotic, eventful – calm, pleasant – chaotic, unpleasant – appropriate and chaotic – appropriate.

For AT the highest negative correlations are happening between
eventful – monotonous and vibrant – monotonous.

Correlation soundscape 3: Voices

SV						
AC				**AC**		
Variable	**Pearson's r**	**P-Value**		**Variable**	**Pearson's r**	**P-Value**
Unpleasant - Disruptive	*0.76*	*<0.001*		Eventful - Disruptive	*0.66*	*<0.001*
Pleasant - Calm	*0.69*	*<0.001*		Eventful - Calm	*- 0.77*	*<0.001*
Pleasant - Appropriate	*0.68*	*<0.001*		Pleasant - Unpleasant	*- 0.68*	*<0.001*
Eventful - Disruptive	*0.67*	*<0.001*		Calm - Unpleasant	*- 0.56*	*0.001*
Calm - Stimulating	*0.63*	*<0.001*				
Pleasant - Stimulating	*0.62*	*<0.001*				
Appropriate - Stimulating	*0.60*	*<0.001*				
Eventful - Unpleasant	*0.57*	*<0.001*				
Pleasant - Chaotic	*- 0.72*	*<0.001*				
Pleasant - Unpleasant	*- 0.72*	*<0.001*				
Pleasant - Eventful	*- 0.62*	*<0.001*				
Calm - Chaotic	*- 0.60*	*<0.001*				
Calm - Unpleasant	*- 0.60*	*<0.001*				
Eventful - Calm	*- 0.60*	*<0.001*				
Eventful - Appropriate	*- 0.57*	*0.001*				
Unpleasant - Stimulating	*- 0.57*	*0.001*				

Table 6: Correlations within soundscape 3 per listening activity. Only significant correlations were reported (p <0.001).

If one looks at table 6, one can say that the only shared positive correlation within soundscape 3 between the two listening activities is between eventful – disruptive. The shared negative correlations are happening between eventful – calm, pleasant – unpleasant and calm – unpleasant.

If we look at the differences between the two listening activities, one can say that for AC the highest positive correlations are happening between:
unpleasant – disruptive, pleasant – calm, pleasant - appropriate, calm – stimulating, pleasant – stimulating, appropriate – stimulating and eventful – unpleasant.

The highest negative correlations are happening between: pleasant – chaotic, pleasant – eventful, calm – chaotic, eventful – appropriate and unpleasant – stimulating.

For AT there is no difference between the other activity.

Correlation soundscape 4: Water

SW						
AC				AT		
Variable	**Pearson's r**	**P-Value**		**Variable**	**Pearson's r**	**P-Value**
Appropriate - Stimulating	*0.79*	*<0.001*		Calm - Unpleasant	*- 0.64*	*<0.001*
Pleasant - Stimulating	*0.74*	*<0.001*				
Pleasant - Appropriate	*0.70*	*<0.001*				
Pleasant - Calm	*0.64*	*<0.001*				
Calm - Stimulating	*0.63*	*<0.001*				
Pleasant - Disruptive	*- 0.72*	*<0.001*				
Stimulating-Disruptive	*- 0.66*	*<0.001*				
Pleasant - Unpleasant	*- 0.60*	*<0.001*				
Calm - Disruptive	*- 0.57*	*<0.001*				

Table 7: Correlations within soundscape 4 per listening activity. Only significant correlations were reported (p <0.001).

If one looks at table 7, one can say that there are no shared correlation within soundscape 4 between the two listening activities is

If we look at the differences between the two listening activities, one can say that for AC the highest positive correlations are happening between: appropriate – stimulating, pleasant – stimulating, pleasant – appropriate, pleasant – calm and calm – stimulating.
The highest negative correlations are happening between: pleasant – disruptive, stimulating - disruptive, pleasant – unpleasant and between calm - disruptive

For AT there is only one difference between the other activity and that is the negative correlation between calm – unpleasant.

4.3 Demographics

Age: according to J, Kang (2010), sounds related to nature such as birds and water sounds are being perceived as more pleasant and less unpleasant for people with a higher age in comparison with human voices.

	Pleasantness		**Unpleasantness**	
	Age <30	**Age >30**	**Age <30**	**Age >30**
Total means Soundscape 2: Birds	*4.13 agree*	*3.69 agree*	*1.77 disagree*	*2.12 disagree*
Total means Soundscape 4: Water	*3.58 agree*	*3.31 neutral*	*2.42 disagree*	*2.21 disagree*
Total means Soundscape 3: Human voices	*2.97 neutral*	*2.35 disagree*	*2.74 neutral*	*3.17 neutral*

Table 8: Total means for pleasantness and unpleasantness, divided by age and soundscape.

If one looks at table 8, one can say that young people with the age under 30 years old are perceiving the nature sounds (birds and water) as more pleasant than the older group above 30. If one looks back to the hypothesis of J.Kang (2010), it is indeed correct that the human voices are perceived as more pleasant within the younger group.
If one looks at unpleasantness, one can say that only water sounds are being perceived as less unpleasant for people with a higher age. Bird sounds are perceived as less unpleasant for people with a younger age. Human voices are indeed being perceived as less unpleasant for people with a younger age.

Educational level: according to J,Kang (2010), sounds related to nature, such as bird and water sounds, are being perceived as more pleasant and less unpleasant with the increase of education level in comparison with human voices.
During this study, no significant differences were found between people with different education levels for different soundscape evaluations

4.4 Differences between activity and soundscape

Within this research, there are significant differences found between activity and soundscape for pleasantness, calmness, chaoticness, unpleasantness and disruptiveness. Based on Steele et al. (2015), Activity can have a significant effect on pleasantness. Comparing the activity with the pleasantness of all the 4 soundscapes within this research, there is a significant difference. Looking at the MANOVA test, there is a significant difference between every activity and the 4 soundscapes for pleasantness with a P-value of 0.012. If we look at the differences between activity within every soundscape, the ANOVA test shows a significant difference only appearing at SW with a P-value of 0.018.
Here the participants that did AC, evaluated the 4th soundscape related to pleasantness as neutral (3.1). Participant that did AT evaluated the 4th soundscape as indeed pleasant (3.767).
Comparing the activity with all the SSQP questions of all the 4 soundscapes within this research, there is a significant difference for unpleasantness. Looking at the MANOVA test, there is a significant difference with a P-value of 0.047. If we look at the differences between activity within every soundscape for unpleasantness, the ANOVA test only shows a significant differences for SW with a P-value of 0.015. Here the participants that did AC evaluated the 4th soundscape related to unpleasantness as neutral (2.63), whereas participant that AT disagreed on the unpleasantness of the 4th soundscape (2.0).

For calmness only the ANOVA test showed a significant differences for SW with a P-value of 0.031. Here the participants that did AC evaluated the 4th soundscape related to calmness as neutral (2.8), whereas participant that did AT evaluated the soundscape with a slightly higher mean (3.4).

For chaoticness only the ANOVA test showed a significant differences for SW with a P-value of 0.052. Here the participants that did AC evaluated the 4th soundscape related to chaoticness as neutral (2.767), whereas participant that did the AT activity disagreed on the chaoticness of the 4th soundscape (2.23)

For evaluations specifically related to the evaluation in relation to activity, for disruptiveness only the ANOVA test showed a significant differences for SW with a P-value of 0.011. Here the participants that did the AC evaluated the 4th soundscape related to disruptiveness as neutral (2.93), whereas participant that did the AT disagreed on the disruptiveness of the 4th soundscape (2.23)
No other significant differences were found between activity and soundscape.

5 Discussion

Due the small number of participants within this research, the findings can be used as a preliminary study, opening many avenues for future, more in-depth research.. In order to provide meaningful advice to urban planners and designers, it is necessary to study more into the effects of different soundscapes on listening activity. We focus the discussion around the hypotheses discussed above.

5.1 State of listening behavior

The state of listening behavior based from Truax can differently affect the evaluation of the soundscape. If one looks at the ANOVA results, one can notice that activity can indeed have a significant effect on the evaluation of a soundscape. There are only significant difference between activity within SW for pleasantness, calmness, chaoticness, unpleasantness and disruptiveness. Participants that did AT evaluated the 4th soundscape as more pleasant, more calm, less chaotic, less unpleasant and less disruptive in comparison with AC. One can speculate that water sounds are working better for activities based on listening in search in comparison with background listening. If one looks at table 7, one can conclude that there are no shared correlations between the two activities within SW. Future studies are needed to find out what the exact relation is between water sounds and activity.

If one looks at the appropriateness of every soundscape for the two listening activities, one can say that only SBg and SB are perceived as appropriate for both activities. There is a possibility that this can be linked to the biophilia hypothesis. Future research is needed to confirm this.
If one looks at the stimulative effect of the soundscape on the listening activity, one can say that only SB was perceived as stimulative for AC. Future research is needed to see if bird sounds are indeed having a stimulative effect on having a conversation
If one looks at the disruptive effect of the soundscape on the listening activity, one can say that only SV was perceived as disruptive for both activities. Other research supports this argument that human voices can indeed have a disruptive effect on activity [31].

5.2 The addition of different sound sources

Addition of bird sounds.
Based on findings from De Coensel (2011) and Guastavino (2006), bird sounds could make the urban soundscape more pleasant, less eventful, more vibrant, less monotonous, more calm, less chaotic and less unpleasant in comparison with background sound. Within this study, for both activities, the addition of bird sounds can indeed make the urban soundscape more pleasant, less eventful , more calm, less chaotic and less unpleasant, confirming the findings of De Coensel (2011) and Guastavino (2006). However, going against the findings of the same studies, we had different findings related to monotonous and vibrant. Within this study addition of bird sounds can make the urban soundscape more monotonous and less vibrant.

Addition of human voices

Based on findings from Guastavino (2006), human voices could make the urban soundscape more pleasant, more eventful, more vibrant, less monotonous, more calm, more chaotic and less unpleasant in comparison with background soundscape. Within this study, for both activities, human voices can indeed make the urban soundscape more eventful, less monotonous and more chaotic.

During both activities the vibrancy level is not perceived as different in comparison with background sounds.

The things that are different related to the findings of Guastavino is that within this study addition of human voices can make the urban soundscape less pleasant, and more unpleasant. Also the level of calmness is staying the same during activity 1 in comparison with background sounds whereas for activity 2 human voices can make the urban soundscape less calm. It is possible that this can be linked to the fact that background speech can distract someone during the performance of a task. The research of Marsh & Jones (2010) can support this and the unpleasant effect of hearing human voices. For future research, one can test whether less human voices would be perceived as more pleasant and less disruptive for a particular listening activity. One can record several binaural sound files with an increasing number of people talking. In this way one can test whether the increase in human speech can also lead to more distraction during a specific listening activity.

Addition of water sounds

Based on Yang, W., & Kang, J. (2005). Jeon, J. Y., Lee, P. J., You, J., & Kang, J. (2010) and Guastavino (2006), water sounds would make the urban soundscape more pleasant, more eventful, less chaotic, less vibrant, less monotonous, more calm and less unpleasant. Within this study, for both activities, water sounds can indeed make the urban soundscape less eventful, less vibrant, more calm and less chaotic. For activity 1, water sounds can make the soundscape less pleasant, whereas for activity 2, water sounds make the urban soundscape more pleasant

Speaking about the unpleasantness, during activity 1 water sounds can make the urban soundscape more unpleasant, whereas during activity 2 the addition of water sounds can make the urban soundscape less unpleasant. Future studies are needed to find out what the exact relation is between water sounds and activity.

The things that are different related to the findings of Guastavino is that within this study addition of water sounds can make the urban soundscape more monotone for both activities. Maybe this can be linked to the fact that the water recordings used in this study consisted of a continuous sound. Future studies are needed to find out if water sounds indeed make the urban soundscape more monotone.

6 Conclusion and further research

This study addresses the effect of addition of human voices, bird sounds and water sounds to the urban soundscape and how participants evaluate their soundscape while doing a specific listening activity. This research shows that there is a significant difference for soundscape evaluations between two different between two different listening activities (conversation and counting trams) while hearing water sounds. Participants that did the listening activity based on listening in search were perceiving the soundscape with added water sounds as more pleasant, more calm, less chaotic, less unpleasant and less disruptive in comparison with the first listening activity based on background listening. Future research is required to test the exact relationship between listening activity and hearing water sounds.

If one looks at the soundscape without added sounds, one can conclude that within this study background sounds were perceived as vibrant and appropriate for both activities. The addition of bird sounds to the urban sonic environment can make the soundscape pleasant, vibrant and appropriate for both activities and stimulative for the conversation activity related to background listening. The addition of human voices were perceived as eventful, vibrant and disruptive for both activities. The soundscape with added water sounds was perceived as vibrant for the conversation activity and pleasant for the counting tram activity.

During this study, all participants performed the two listening activities while sitting on a bench at Mercatorplein. If one looks into testing the effect of listening activity on the perception of our soundscape, one can design a new experiment where one can add an extra physical dimension to the two listening activities. During observations on Mercatorplein, it appeared that some of the visitors of Mercatorplein crosses the square on foot. For future research, it would be interesting to test the two listening activities with adding an extra physical dimension. One can do the experiment again but then with two extra groups. One group will perform the two listening activities while sitting, and the other group will perform the two listening activities while walking. By doing this one can test if physicality can have an effect on the perception of our sound environment.

If one looks back to the introduction and takes into account the context of noise abatement policies and the approach taken in planning and design, one can conclude that this study could be a starting point for finding alternative solutions to make the urban open soundscape more pleasant. One can do more study into the effect of adding bird sounds to the sonic environment. Besides this it is questionable if placing water fountains to urban open environments really benefits with making the sonic environment more pleasant. If one looks at the addition of water sounds and activity, this study shows that these 2 factors may have an effect on the perception of our sound environment. For future research, one can opt for a public square including a fountain. This time, no sounds are added to the public space. Only the listening activities are tested. By doing this, one can test whether water sounds and activity do indeed have an effect on soundscape evaluation.

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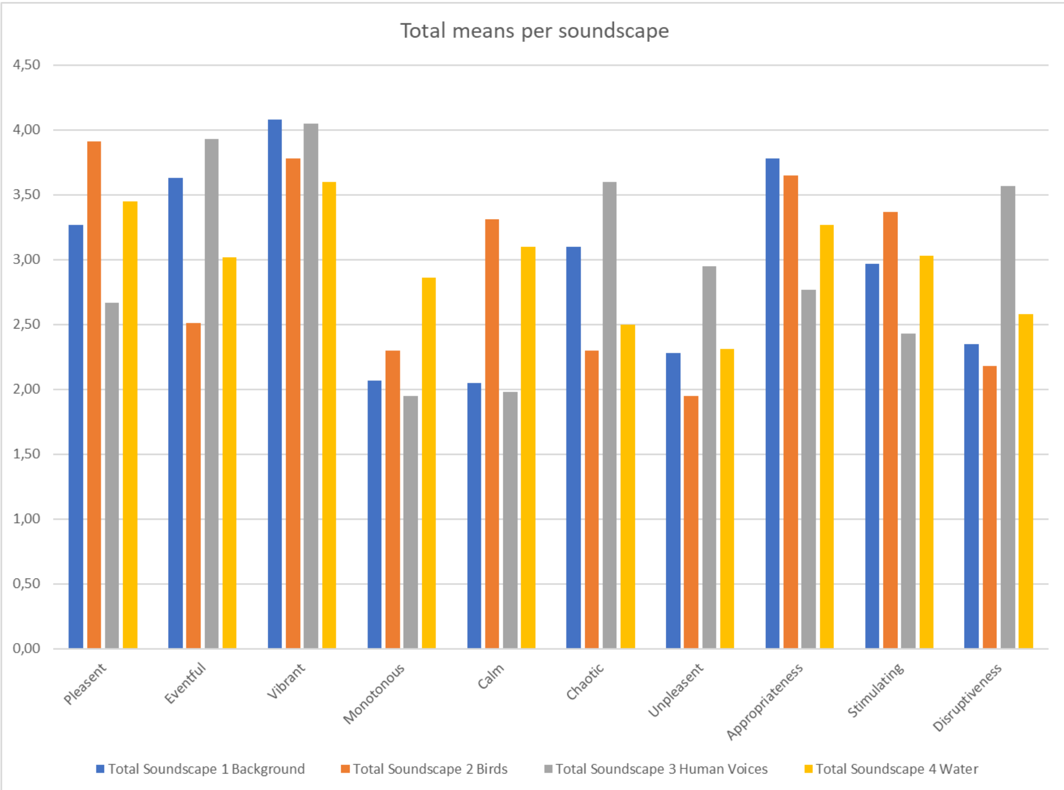
Appendix 1

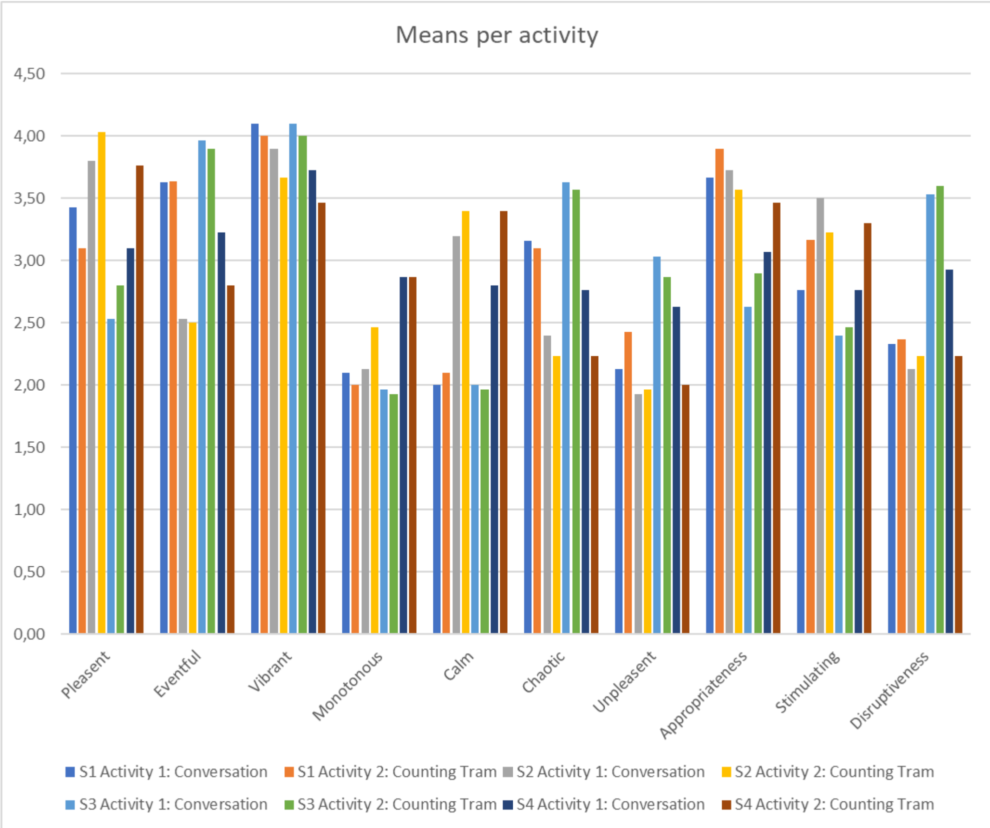
Question number	Question / Statement	*Answer type*	Answer options		Concept
Section 1	This section is about the soundscape on Mercatorplein A Soundscape describes your sound/sonic environment as you perceive it. The soundscape includes all of the sounds around you.				
1	I find the soundscape around the Mercatorplein	*Scale (5-point)*	Strongly disagree	Strongly agree	SSQP
	Pleasant	*Scale (5-point)*	Strongly disagree	Strongly agree	
	Eventful	*Scale (5-point)*	Strongly disagree	Strongly agree	
	Vibrant	*Scale (5-point)*	Strongly disagree	Strongly agree	
	Monotonous	*Scale (5-point)*	Strongly disagree	Strongly agree	
	Calm	*Scale (5-point)*	Strongly disagree	Strongly agree	
	Chaotic	*Scale (5-point)*	Strongly disagree	Strongly agree	
	Unpleasant	*Scale (5-point)*	Strongly disagree	Strongly agree	
2	The soundscape was appropriate for the task I performed.	*Scale (5-point)*	Strongly disagree	Strongly agree	Soundscape appropriatness
3	The soundscape was stimulating for the task I performed.	*Scale (5-point)*	Strongly disagree	Strongly agree	
4	The soundscape was disruptive for the task I performed.	*Scale (5-point)*	Strongly disagree	Strongly agree	
Section 2	This section is about demographics and preference of soundscape				
1	What is your gender?	*Multiple choice*	A man / A woman / Other / Prefer not to say	Just one choice possible	Gender
2	What is your age?	*Free response*			Age
3	What is your educational background?	*Multiple choice*	Less then highschool / High school graduate / Some college credit, no degree / Bachelor's degree / Master's degree / Professional degree / Doctorate degree	Just one choice possible	Educational background
4	On average, how often do you visit Mercatorplein ?	*Multiple choice*	Daily / A few times a week / A few times a month / A few times a year / Once a year or less	Just one choice possible	Frequency of use
5	Rank the 4 sounscape-situations you heard in order of appreciation during the experiment (without added sounds/ with added bird sounds/ with added water sounds/ with added human voices	*Rank order*	Most appreciated (1)	Least appreciated (4)	Appreciation of soundscape

Appendix 2: Total means per soundscape

Means	Soundscape 1: Background sounds				Soundscape 2: Birds				Soundscape 3: Human Voices				Soundscape 4: Water				Manova of difference between activity and the 4 soundscapes (vallue P)
	Totaal	Activity 1: Conversation	Activity 2: Counting Tram	Anova between Activity S1	Totaal	Activity 1: Conversation	Activity 2: Counting Tram	Anova between activity S2	Totaal	Activity 1: Conversation	Activity 2: Counting Tram	Anova between Activity S3	Totaal	Activity 1: Conversation	Activity 2: Counting Tram	Anova between Activity S4	
Pleasent	Neutral 3.27	Neutral 3.43	Neutral 3.103	0.136	Agree 3.91	Agree 3.8	Agree 4.03	0.379	Neutral 2.667	Neutral 2.53	Neutral 2.8	0.227	Neutral 3.45	Neutral 3.1	Agree 3.767	0.018	0.012
Eventful	Agree 3.633	Agree 3.633	Agree 3.634	1.0	Neutral 2.51	Neutral 2.53	Neutral 2.5	0.906	Agree 3.93	Agree 3.967	Agree 3.9	0.772	Neutral 3.017	Neutral 3.23	Neutral 2.8	0.110	0.587
Vibrant	Agree 4.08	Agree 4.1	Agree 4.0	0.517	Agree 3.78	Agree 3.9	Agree 3.667	0.277	Agree 4.05	Agree 4.1	Agree 4.0	0.618	Agree 3.6	Agree 3.73	Neutral 3.467	0.258	0.765
Monotonous	Disagree 2.067	Disagree 2.1	Disagree 2.0	0.728	Disagree 2.3	Disagree 2.13	Disagree 2.467	0.148	Disagree 1.95	Disagree 1.967	Disagree 1.93	0.884	Neutral 2.86	Neutral 2.867	Neutral 2.867	1.0	0.527
Calm	Disagree 2.05	Disagree 2.0	Disagree 2.1	0.727	Neutral 3.31	Neutral 3.2	Neutral 3.4	0.581	Disagree 1.98	Disagree 2.0	Disagree 1.967	0.895	Neutral 3.1	Neutral 2.8	Neutral 3.4	0.031	0.229
Chaotic	Neutral 3.1	Neutral 3.16	Neutral 3.1	0.784	Disagree 2.3	Disagree 2.4	Disagree 2.23	0.576	Agree 3.6	Agree 3.63	Agree 3.567	0.815	Neutral 2.50	Neutral 2.767	Disagree 2.23	0.052	0.411
Unpleasent	Disagree 2.28	Disagree 2.13	Disagree 2.43	0.220	Disagree 1.95	Disagree 1.93	Disagree 1.967	0.893	Neutral 2.95	Neutral 3.03	Neutral 2.867	0.523	Disagree 2.31	Neutral 2.63	Disagree 2.0	0.015	0.047
Appropriate for the task	Agree 3.78	Agree 3.667	Agree 3.9	0.265	Agree 3.65	Agree 3.73	Agree 3.567	0.485	Neutral 2.767	Neutral 2.633	Neutral 2.9	0.313	Neutral 3.267	Neutral 3.067	Neutral 3.467	0.078	0.216
Stimulative for the task	Neutral 2.967	Neutral 2.767	Neutral 3.167	0.066	Neutral 3.367	Agree 3.5	Neutral 3.23	0.293	Disagree 2.43	Disagree 2.4	Disagree 2.467	0.770	Neutral 3.03	Neutral 2.767	Neutral 3.3	0.057	0.093
Disruptive for the task	Disagree 2.35	Disagree 2.33	Disagree 2.367	0.879	Disagree 2.183	Disagree 2.13	Disagree 2.23	0.681	Agree 3.567	Agree 3.53	Agree 3.6	0.798	Neutral 2.583	Neutral 2.93	Disagree 2.23	0.011	0.083

Appendix 3: Total means per soundscape




Means per activity
4,50
4,00
3,50
3,00
2,50
2,00
1,50
1,00
0,50
0,00
Pleasent
Eventful
Vibrant
Monotonous
Calm
Chaotic
Unpleasent
Appropriateness
Stimulating
Disruptiveness
S1 Activity 1: Conversation
S1 Activity 2: Counting Tram
S2 Activity 1: Conversation
S2 Activity 2: Counting Tram
S3 Activity 1: Conversation
S3 Activity 2: Counting Tram
S4 Activity 1: Conversation
S4 Activity 2: Counting Tram

Appendix 4: Total Correlations

Correlations	Soundscape 1: Background Sounds						Soundscape 2: Birds						Soundscape 3: Voices						Soundscape 4: Water					
	Total		Conversation		Counting tram		Total		Conversation		Counting tram		Total		Conversation		Counting tram		Total		Conversation		Counting tram	
	Pearson's	P-Vallue	Pearson's r	P-Vallue	Pearson's	P-Vallue	Pearson's	P-Vallue	Pearson's	P-Vallue	Pearson's	P-Vallue	Pearson's	P-Vallue	Pearson's	P-Vallue	Pearson's	P-Vallue	Pearson's	P-Vallue	Pearson's	P-Vallue	Pearson's	P-Vallue
Pleasent - Eventful	- 0.418	<0.001	- 0.404	0.027					- 0.536	0.002			- 0.518	<0.001	**- 0.669**	**<0.001**	- 0.407	0.026						
Pleasent - Vibrant																	0.409	0.025						
Pleasent - Monotonous			0.509	0.004																				
Pleasent - Calm	0.425	<0.001	0.482	0.007			0.532	<0.001	0.525	0.003	0.535	0.002	0.595	<0.001	**0.687**	**<0.001**	0.540	0.002	0.562	<0.001	**0.635**	**<0.001**	0.429	0.018
Pleasent - Chaotic							- 0.451	<0.001	**- 0.670**	**<0.001**			- 0.546	<0.001	**- 0.721**	**<0.001**	- 0.406	0.026						
Pleasent - Unpleasent	**- 0.664**	**<0.001**	- 0.569	0.001	**- 0.749**	**<0.001**	**- 0.644**	**<0.001**	**- 0.863**	**<0.001**	- 0.486	0.006	**- 0.693**	**<0.001**	**- 0.716**	**<0.001**	**- 0.677**	**<0.001**	- 0.536	<0.001	**- 0.604**	**<0.001**		
Pleasent - Appropriate for the task			**0.606**	**<0.001**			0.527	<0.001	0.591	<0.001	0.515	0.004			**0.676**	**<0.001**			0.467	<0.001	**0.701**	**<0.001**		
Pleasent - Stimulating for the task			0.594	<0.001					0.567	0.001					**0.615**	**<0.001**			0.509	<0.001	**0.740**	**<0.001**		
Pleasent - Disruptive for the task	- 0.425	<0.001	- 0.560	0.001			**- 0.610**	**<0.001**	**- 0.706**	**<0.001**	- 0.568	0.001	- 0.463	<0.001	- 0.531	0.003	- 0.429	0.018	- 0.460	<0.001				
Eventful - Vibrant											0.541	0.002									**- 0.716**	**<0.001**		
Eventful - Monotonous							- 0.464	<0.001			**- 0.652**	**<0.001**			- 0.453	0.012							- 0.415	0.023
Eventful - Calm	- 0.506	<0.001			**- 0.657**	**<0.001**	- 0.512	<0.001	**- 0.638**	**<0.001**	- 0.429	0.018	**- 0.679**	**<0.001**	- 0.598	<0.001	**- 0.769**	**<0.001**					- 0.433	0.017
Eventful - Chaotic							0.524	<0.001	0.583	<0.001	0.483	0.007	0.483	<0.001	0.526	0.003	0.442	0.014			0.435	0.016		
Eventful - Unpleasent	0.443	<0.001			0.488	0.006			0.452	0.012					0.574	<0.001	0.414	0.023						
Eventful - Appropriate for the task															- 0.570	0.001	0.432	0.017						
Eventful - Stimulating for the task																								
Eventful - Disruptive for the task									0.470	0.009			**0.661**	**<0.001**	**0.672**	**<0.001**	**0.657**	**<0.001**						
Vibrant - Monotonous	- 0.443	<0.001			**- 0.623**	**<0.001**					- 0.567	0.001	- 0.451	<0.001			- 0.538	0.002						
Vibrant - Calm																								
Vibrant - Chaotic																								
Vibrant - Unpleasent																								
Vibrant - Appropriate for the task																								
Vibrant - Stimulating for the task																								
Vibrant - Disruptive for the task																								
Monotonous - Calm															0.472	0.008								
Monotonous - Chaotic																								
Monotonous - Unpleasent																								
Monotonous - Appropriate for the task																								
Monotonous - Stimulating for the task																								
Monotonous - Disruptive for the task																								
Calm - Chaotic							- 0.577	<0.001	**- 0.645**	**<0.001**	- 0.526	0.003	- 0.569	<0.001	**- 0.601**	**<0.001**	- 0.535	0.002						
Calm - Unpleasent					- 0.514	0.004			- 0.517	0.003					- 0.598	<0.001	- 0.560	0.001	- 0.536	<0.001			**- 0.637**	**<0.001**
Calm - Appropriate for the task													- 0.563	<0.001	0.545	0.002					0.503	0.005		
Kam - Stimulating for the task									0.443	0.014					**0.625**	**<0.001**					**0.627**	**<0.001**		
Calm - Disruptive for the task							- 0.528	<0.001	- 0.523	0.003	- 0.541	0.002	- 0.518	<0.001	- 0.507	0.004	- 0.535	0.002	- 0.471	<0.001	- 0.574	<0.001		
Chaotic - Unpleasent	0.519	<0.001	0.521	0.003	0.542	0.002	0.485	<0.001	**0.661**	**<0.001**			0.416	<0.001	0.516	0.004								
Chaotic - Appropriate for the task									- 0.567	0.001														
Chaotic - Stimulating for the task									- 0.524	0.003					- 0.473	0.008								
Chaotic - Disruptive for the task							**0.695**	**<0.001**	**0.724**	**<0.001**	**0.688**	**<0.001**	0.414	<0.001	0.452	0.012			0.434	<0.001			0.543	0.002
Unpleasent - Appropriate for the task									- 0.584	<0.001					- 0.533	0.002								
Unpleasent - Stimulating for the task									**0.600**	**<0.001**			- 0.462	<0.001	- 0.569	0.001					- 0.463	0.010		
Unpleasent - Disruptive for the task			0.462	0.010			**0.646**	**<0.001**	**0.788**	**<0.001**	0.553	0.002	0.505	<0.001	**0.756**	**<0.001**			0.447	<0.001	0.521	0.003		
Appropriate for the task - Stimulating for the task	0.464	<0.001			0.535	0.002	0.581	<0.001	**0.663**	**<0.001**	0.517	0.003			0.597	<0.001			**0.609**	**<0.001**	**0.790**	**<0.001**		
Appropriate for the task - Disruptive for the task			- 0.426	0.019			- 0.427	<0.001	- 0.533	0.002					- 0.416	0.022			- 0.524	<0.001	- 0.539	0.002		
Stimulating for the task - Disruptive for the task					- 0.441	0.015	- 0.413	<0.002	- 0.538	0.002					- 0.425	0.019			- 0.551	<0.001	**- 0.659**	**<0.001**		