The influence of traffic visibility and greenery appreciation on soundscape appraisal in urban areas:

Case study in Prinsentuin and Guyotplein in Groningen

Olivier Bruinen | S3519619
University of Groningen
Faculty of Spatial Sciences
Supervisor Margaritis, E.

Summary

In this study, a socio-acoustic survey is performed to investigate a relationship between traffic visibility and greenery appreciation on affective quality in urban areas in Groningen. A combination of noise mapping techniques to explore the current acoustic environment and an online survey on the perception of the environment is presented using the Swedish Soundscape-Quality Protocol (SSQP) as adopted by the ISO. This study validates a Dutch translation of the SSQP. From the survey, the Prinsentuin is considered as a pleasant soundscape, with characteristics of being calm and vibrant. The Guyotplein does not have a distinct soundscape type, but is inclined to be perceived as more annoying and chaotic compared to the Prinsentuin, even though they are of similar size and similar exposure to traffic noise. It is clear there are other factors at stake. Natural sound sources tend to have a positive effect on the soundscape quality, as well as human sounds such as conversations on the eventfulness. There is also a negative correlation between reported traffic sounds and the perceived pleasantness of a place. This correlation tends to be stronger when there is reported to be more traffic sounds. This is also the case when respondents were asked how much traffic hindrance they experienced. Even though it is known several visual aspects influence the soundscape perception, this study did not find a direct association between traffic visibility and perceived affective quality. Nature dominance and nature quality however is associated with higher pleasantness and overall quality of the soundscape, but this was only the case at the Guyotplein where there is higher perceived traffic nuisance. This suggests the presence of green has the potential to mitigate traffic nuisance and improve soundscape quality. More standardised research on more sites or in laboratory setting in advised.

Keywords

Soundscape - audio-visual stimuli - experiment - affective quality - soundscape appraisal - traffic visibility – urban parks - Swedish Soundscape-Quality Protocol

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1. Introduction

1.1 Topic

Sound is everywhere around us and affects humans in positive and negative ways. This is addressed in the European Environmental Noise Directive (Directive 2002/49/EC) to protect citizens from excessive noise exposure. Especially urban areas are prone to high noise exposures and pressure on healthy environments is increasing due to globalisation. Currently more than half of the world's population lives in urban areas and is expected to increase to 68% by 2050 (UN, 2018). Urban parks are one of the few spots within the public urban realm which may provide a place of peace and tranquillity. These places needs to be taken care of and protected from noise nuisance. Rather than merely looking at the objective noise levels expressed as decibels (dB), the soundscape approach deals with the perceptual attributes of the acoustic environment. Studies have been done on the effect of different socio-, acoustic-, visual factors. However, there is still much debate among academia how the visibility of negative sound sources and green appreciation affects soundscape perception. In this study I will apply and validate Swedish Soundscape-Quality Protocol (SSQP) as adopted by the on a case study in Groningen to verify the tool in a different language and context and add to the existing body of literature. Furthermore, hypothesis on the influence of traffic visibility and greenery appreciation are tested.

1.2 Aim and research questions

Therefore, this study is going to adress the following research question: To what extent is there a relationship between traffic visibility and greenery appreciation, and on soundscape appraisal in urban parks in Groningen? To investigate this, two urban parks in Groningen are selected to do a comparative case study. The accompanying sub-questions are:

- Which socio-, acoustic-, visual factors affects the affective sound appraisal?
- What are the differences in the noise level distribution in the urban parks of Groningen?
- How does the sound appraisal and the explanatory variables differ between the two green spaces?
- What type of soundscape can be assigned to the two parks?
- What is the association between the identified sound sources and sound appraisal?
- What is the association between perceived visuals and sound appraisal?
- What is the association between perceived visuals and sound appraisal

The first sub question deals with the objective sound levels of the acoustic environment, while the other sub questions take a deeper look on how the acoustic environment is perceived by the respondents.

Hypotheses

A comparison of the two spaces with the help of noise mapping and surveys should make it possible to test the following hypotheses:

- The visibility of the sound source of the perceived noise affects the soundscape appraisal and thus the affective quality negatively
- Difference in the dominance in greenery, and the associated appreciation of the quality of the greenery, affects the affective sound appraisal and thus the soundscape quality

Structure

The thesis is divided in five main chapters. After this introduction, a literature review is done on international literature on the topic. The third chapter is concerned with the methodology used for this study. Then, the results are presented and discussed. In the last chapter conclusions are drawn and recommendations for future research are presented.

2. Theoretical framework

2.1 Soundscape

The ISO (2014) developed standards on the definitions of the most important aspect to do research in soundscapes. Soundscape are defined as the "acoustic environment as perceived or experienced and/or understood by a person or people, in context". Here, the acoustic environment comprises all sounds from sound sources generated by nature or human activity. Acoustic environments can be actual or simulated. This section investigates soundscape studies.

2.2 Identifying soundscapes

Given the explanation the term soundscape still remains a fuzzy term. In order to identify soundscapes better, efforts have been made to come up with descriptors to determine the type of soundscape. Axelsson et al. (2012) developed a tool called the Swedish Soundscape-Quality Protocol to assess the appraisal of the environment. This is done with eight attribute scales that altogether reflect the perceived affective quality. This data can later be analysed and projected on a two-dimensional scale (*Pleasantness – Eventfulness*) which gives insight in the type of soundscape and its characteristics (fig. 1) (Axelsson et al., 2012) (Van den Bosch et al., 2014).

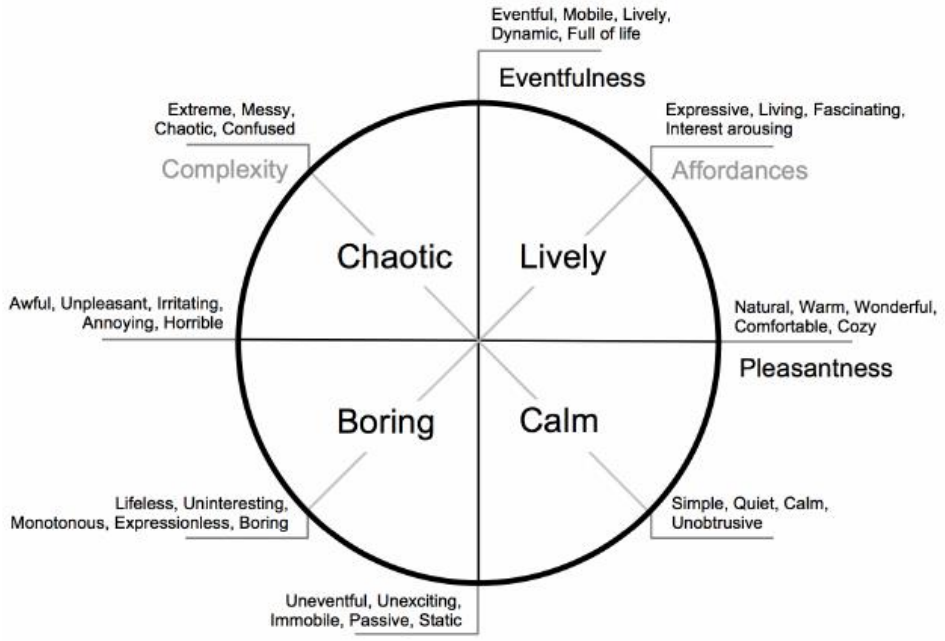


Figure 1: The Swedish Soundscape-Quality Protocol, complemented by Van den Bosch et al. (2014) depicting the four types of soundscapes (Chaotic, Lively, Boring and Calm) and their basic dimensions (Eventfulness vs. Pleasantness and Affordances vs. Complexity)

2.3 Factors influencing soundscape

Perception is one the most important aspects soundscape studies. It is know that not merely the sound levels determines the soundscape. Several other variables such as visual cues influence how the acoustic environment is perceived. Jeon et al. (2011) found in a study on the influence of non-auditory factor on soundscape perception that a combination of person factors, acoustic factors and environmental is responsible for differentiations in research outcomes. An overview is given of a set of determinants and their state of affairs within research.

Socio-demographic
A large-scale study by Langdon (1976) found that noise annoyance is influenced by differences in age, gender and socio-economic class. This relates to the level of sensitivity for noise nuisance contributing to the overall perception of the acoustic environment. It showed that female respondents were more prone to noise nuisance that male respondents.

Perceived sounds
Kogan et al. (2018) investigated in their research on the Experienced Environment the effects of different sound sources (being traffic noise, sounds from human beings, natural sounds and other sounds). Natural sounds are considered to have a positive impact on the soundscape perception by experiencing the environment as more pleasant. Also research on a physiological level showed the positive effects on well-being and stress recovery.
Next to the actual sound sources, Axelsson (2015) recommended to add another dimension to assess the affective quality of a soundscape by introducing the aspect of appropriateness of the acoustic environment. Appropriateness reflect as an addition to the affective quality the extent to which the perceived sounds are expected, given the context.

Perceived visuals
However, factors that influence the perception of sound sources need to be considered as well. A study by Zhang et al. (2003) showed that the visibility of the sound source has an influence on the soundscape perception. From the perspective of noise annoyance. However, a study on the visual characteristics of railway noise barriers show that when the sound source can be seen through a transparent noise barrier, the perceived loudness and annoyance was lower compared to opaque noise barriers. However, sound source visibility refers in this case to direct visibility without intervention of the physical environment such as transparent sound barriers.

2.3 Noise mapping tool

Noise maps integrated in soundscape studies. A combination of noise mapping techniques in GIS is combined with soundscape features to produce a so-called sound map or soundscape map (Aletta & Kang, 2015). For this study, noise maps are produced with the help of a calibrated measurement device to map the current acoustic environment. It provides background information on the distribution of noise levels as well as identifying roughly the influence of different sound sources. Due to a switch from in-situ to digital survey methods, it is unfortunately not possible to produce a soundscape map.

2.4 Conceptual model

The conceptual model in figure 2 addresses all the different concepts and their relation to each other. The soundscape appraisal is measured through the affective quality expressed in pleasantness P and eventfulness E. Another additional dimension is the appropriateness and the overall quality.
The soundscape appraisal is influenced by different factors that can be categorised as socio-demographic factor, physical factors and acoustic factors. Socio-demographic factors that can not be influenced by urban planning, but solely relies on the perception of the individual. The individual perceives the physical environment and the acoustic environment. But the perception of the acoustic environment is influenced by the perceived visuals. In addition to the perceived acoustic environment, this study also provides a noise map using objective noise measurements as background information.

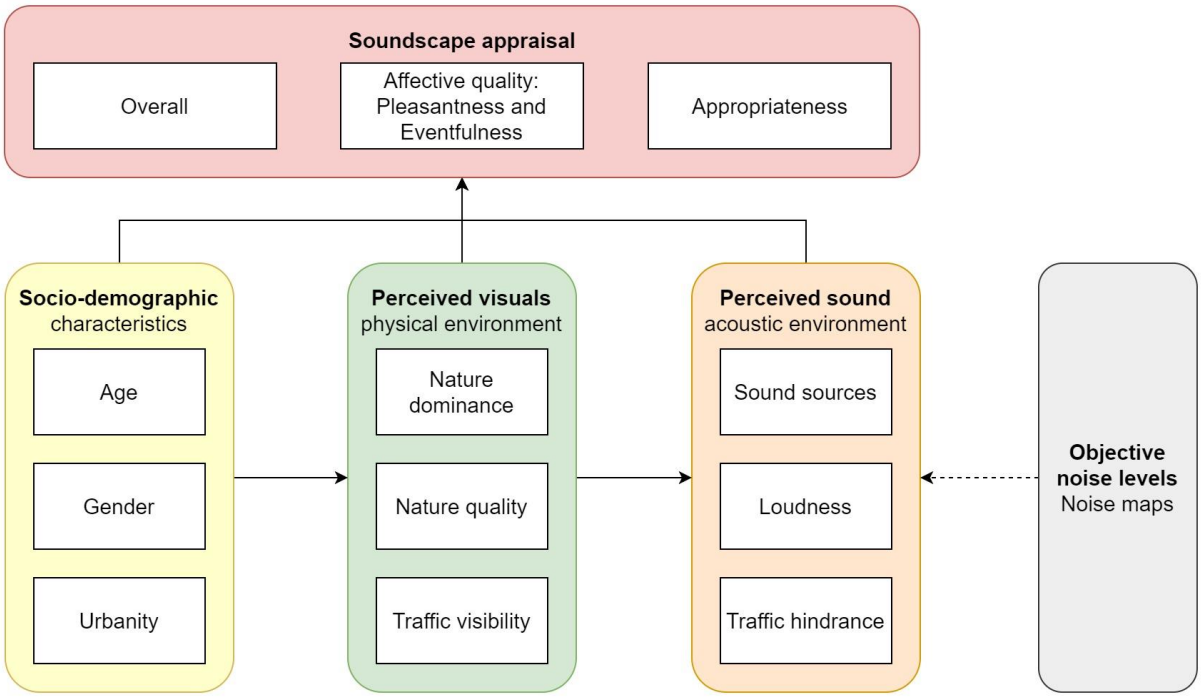


Figure 2: Soundscape concepts in relation to each other

3. Methodology

For the data collection a socio-acoustic survey will be performed. This means that on the one hand objective sound measurements of the research site will be collected and on the other hand subjective aspects will be surveyed among the users of the green space concerning both visual and auditory qualities on-site. The objective sound measurements will provide background information on the acoustic environment by giving insight in the sound levels and the distribution of sound across the two sites.

3.1 Site selection

A preliminary analysis has been done to identify possible problematic urban green spaces concerning noise nuisance in Groningen. Overlap of green spaces in the inner city of Groningen with the municipal noise exposure maps of Icinity (2016) showed two potential sites that may experience excessive noise as a result from traffic (figure 3). The two sites are located along the same traffic artery, which makes it an interesting case to study the differences in outcomes. In terms of size and surface area, the two parks Guyotplein and Prinsentuin are more or less the same, and they are both located directly along the canal ring of Groningen.

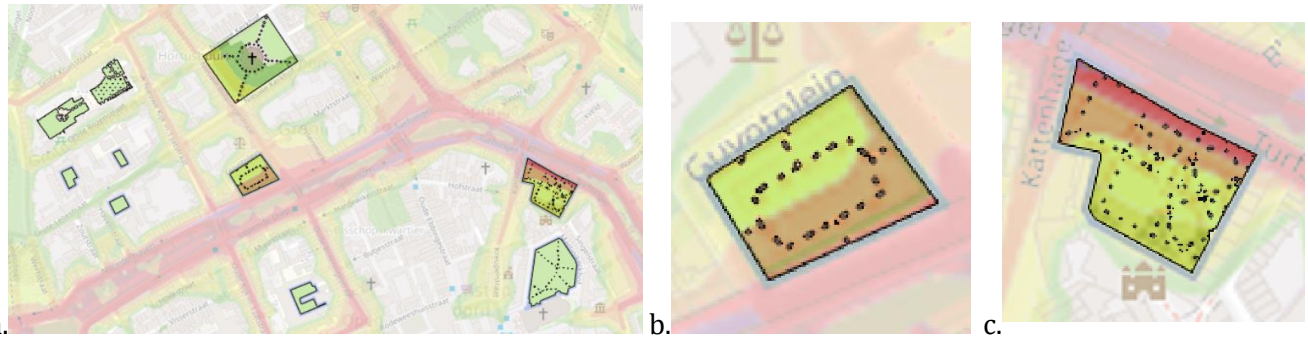


Figure 3: identifying possible problematic urban parks concerning noise nuisance in Groningen (a.) and a close-up from Guyotplein (b.) and Prinsentuin (c.)

However, there are differences in appearance and overall look of the two places (figure 4). Guyotplein is officially a square, planted with trees and grass, with in the middle a monument. The Prinsentuin is a garden of the Prinsenhof, including a rose garden and a herb garden, which is on two sides surrounded by buildings and closed off with a brick wall. The garden is open to the public, accessible through two gates, which are closed off during evening and night. Therefore, the Prinsentuin could be considered as a semi-public space.
The main differences between the two is on the one hand visual quality and aesthetic (public green space vs garden) and on the hand the direct relation with the traffic; at the Guyotplein you can actually see traffic passing by, while at the Prinsentuin there is a 2 meter high brick wall separating the garden from the road.

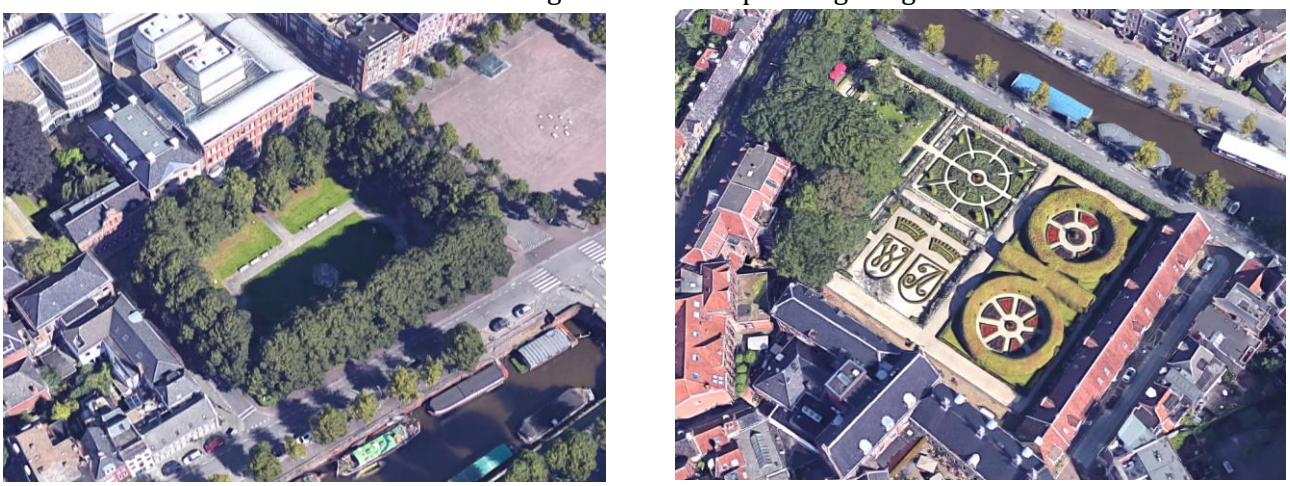


Figure 4: aerial photos of the two parks; Guyotplein (left) and Prinsentuin (right)

3.2 Noise map

In order to gain insight in the current acoustic environment, I will do several measurements of the sound levels on location with a smartphone device, using the mobile app NoiseCapture. Data gathered using this app can then be imported in GIS software, in which a noise map can be established. The noise map gives insight in the objective sound level distribution in both green areas. This serves as one of the control variables of the soundscape, to find the relationship between actual sound levels and the perceived noise.

3.2.1 Sampling strategy

There are several sampling strategies to consider for mapping the acoustic environment (fig. 5). In order to properly interpolate the data and minimize irregularities, a systematic centric sampling is the most appropriate strategy. Considering the size of both green spaces, a grid of 15x15 meters is applied to both areas (fig. 6). Since the sound measurement is bound to only a very small moment in time, the audio recordings will be carried out three times sequentially and the average will be taken for it to be representative for the analysis.

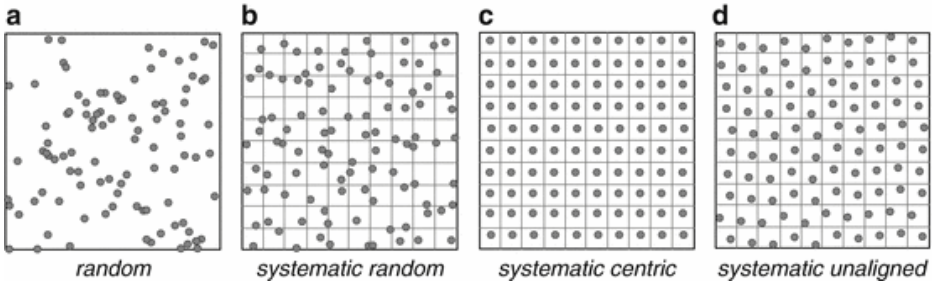


Figure 5: Spatial sampling strategies (Delmelle et al. 2014)

Figure 6: Systematic centric sampling grid (15x15m) applied to Guyotplein (left) and Prinsentuin (right)

3.2.2 Data management

The data is collected and stored on the smartphone, and afterwards uploaded on the local network of the computers at the University of Groningen. Every collection point will get a unique ID to which the audio data can be linked. The data includes additional information on the data collection, such as the date and time of measurement.

Figure 7 depicts the flowchart for the spatial analysis. First, the average of the sound levels needs to be linked to geo points. This is done through the Link tool in Arcmap. Then, by interpolating the point data, a noise map is created. Kriging interpolation proves to be the most accurate method for predicting the interpolation of noise.

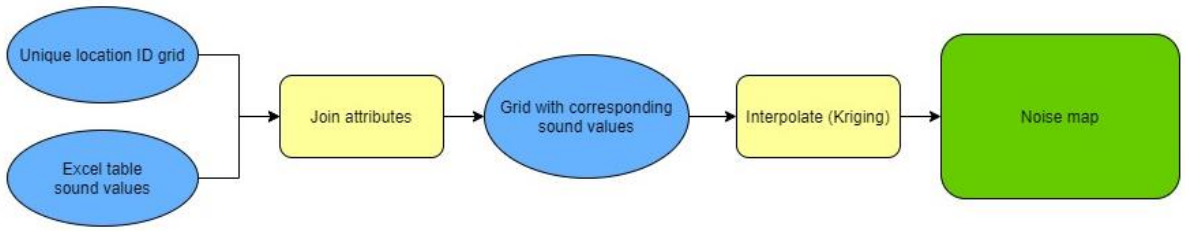


Figure 7. Flowchart of the GIS analysis

3.3 Survey

In order to get an insight in how the soundscape is perceived, a digital survey has been made in the survey software Qualtrics (see appendix). The several aspects identified in the conceptual model are related to each survey question. For it to be a representative sample, the test population needs to consist of at least 30 people as a rule of thumb.

The main goal of this research is to find out whether visual incentives, measured as the visibility of traffic and the appreciation of the green space, has an influence on the affective quality. But there might be other variables at stake that may be of influence as well. Therefore, several other questions are asked in the questionnaire that function as control variables (fig. 8). These control variables are also vital in the discussion of the results and the overall credibility of the research. The influence of each variable is tested with the help of statistics using SPSS.

Independent	**Dependent**
Visual stimuli	• **Sound source**
• **Nature dominance**	Natural sounds
• **Nature quality**	Sounds from human beings
• **Traffic visiblility**	Traffic noise
	Other noise
Control	• **Sound appraisal**
Demographics	Pleasant
• **Gender**	Chaotic
• **Age**	Vibrant
• **Degree of urbanity**	Uneventful
	Calm
Sound levels	Annoying
	Eventful
	Monotonous
	• **Traffic noise hindrance**
	• **Overall sound environment**
	• **Appropriateness**
	• **Loudness**

Figure 8: Overview of the variables

First, a statistical test is performed to find out what the correlation is between the different variables in each of the two green spaces. Considering only a few of the variables asked in the questionnaire are ratio variables, I have to rely on a non-parametric test to determine the correlation. Since all the data is at least ordinal (such as the Likert scales), a Spearman's correlation test can be applied. For the comparison, a Wilcoxon Signed rank test can be applied.

3.3.1 Data collection instrument

For the audio-visual stimuli, I went to both sites on a sunny day in spring between 15.00 and 16.30. Within this time slot, it is most likely to have sufficient visitors to the parks, as well as enough traffic movement, just before rush hour (fig. 9). The panorama video was recorded on a Nikon Z7 full-frame DSLR camera with a 24mm lens mounted on a tripod (fig. 10). The camera has a built-in microphone, but in case of audio failure, I attached an external microphone to the tripod connected to my smartphone. A screenshot of the panorama recordings can be seen in figure 11.

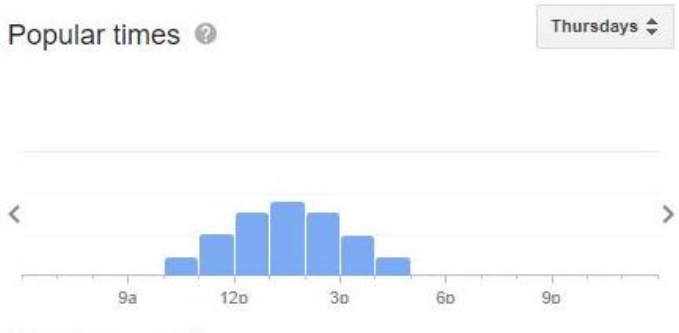


Figure 9: average amount of visitors throughout the day on Thursdays in the Prinsentuin (Google, sd.)

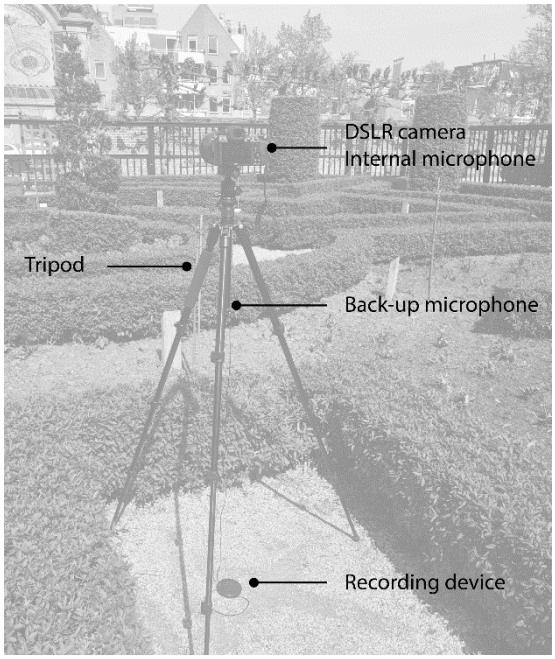


Figure 10: Data collection instrument setup at location

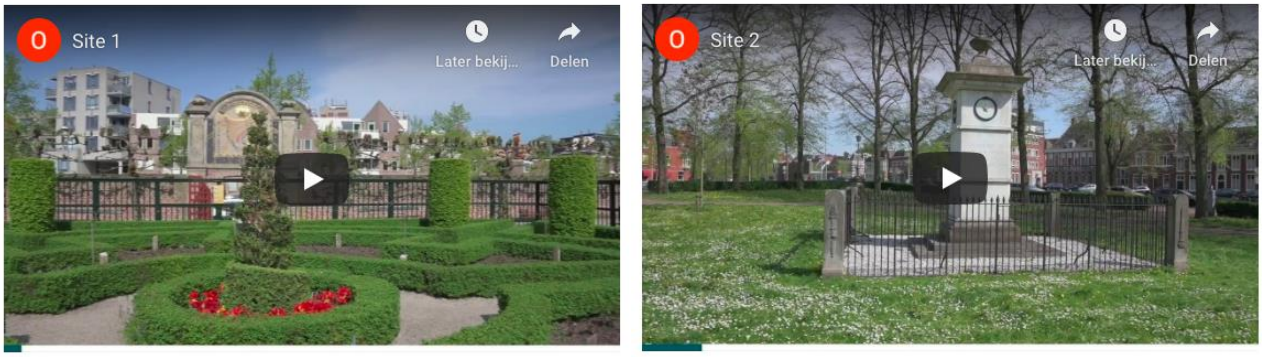


Figure 11: panorama recording included in the online survey; Prinsentuin (left) and Guyotplein (right)

3.3.2 Distribution of the survey

In order to recruit respondents for the online survey, I have sent out the link to friends and family through Whatsapp and published a post on my personal Instagram and Linked-in account. Furthermore, I got permission from the Faculty of Spatial Sciences from the University of Groningen to post a short promotional video on their Instagram account. Next to this, the link is further distributed among the networks of friends and family.

3.3.3 Ethical considerations

Since people will be involved in the research, the participants of this research need to be informed what the research is about and how the information they provide will be processed. Before the participants can proceed to fill in the survey a short summary of the research is provided and an informed consent with a box to confirm they have read the information, participate voluntarily and have the right to withdraw at any moment. My contact information is also provided in case of a question of a comment regarding the study.

4. Results

4.1 What are the differences in the noise level distribution in the urban parks of Groningen?

After collection of the data, the numbers of the measurements are processed to a table in Excel (see Appendix). The data is then imported in ArcGIS to make a noise map (fig. 12). The sound levels in the Prinsentuin are quite evenly distributed with small deviations. The higher noise levels are to be seen on the north side of the site, due to traffic passing by. High peaks in noise levels are likely flattened by the brick wall separating the park from the road.
On the other hand, there are large deviations in the sound distribution among the Guyotplein. Higher peaks of noise are found along the roads on the east and south side, and a few hotspots near benches with people chatting in the middle of the site.

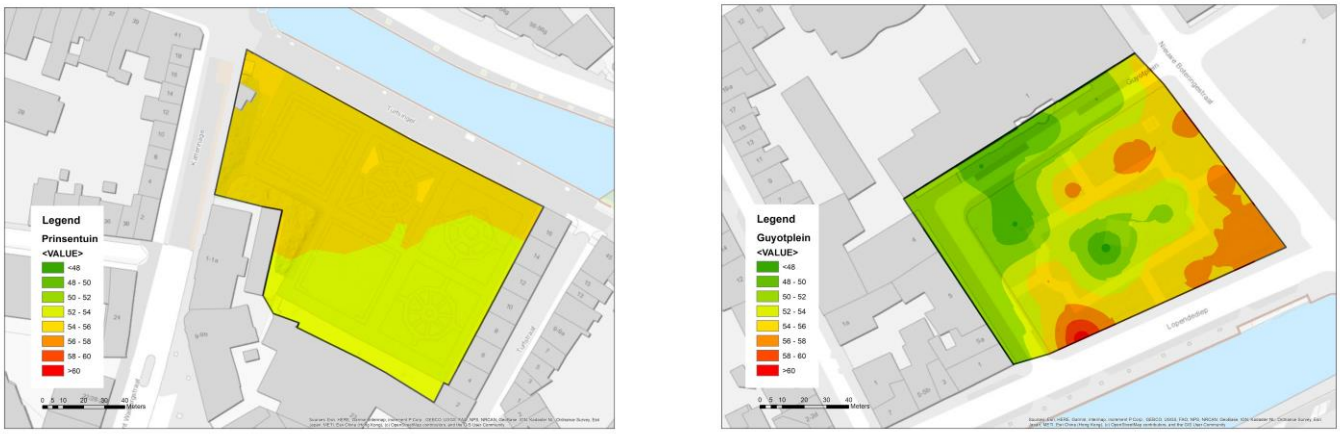


Figure 12: Noise map from the average sound levels of the three measurements; a. Prinsentuin ; b. Guyotplein (illustration by the author, 2020)

Comparison Icinity

A comparison between the produced noise maps and the Icinity can be made (figure 13). We can see that the influence of the brick wall is not taken into the consideration in the noise map of the model, with high noise levels directly behind the wall along the traffic road. What we see on the Guyotplein, however, is more or less the same pattern in sound distribution with higher noise levels along the road and lower levels near the buildings. Variations – and especially resulting from peaks in traffic noise – are not seen in the model. This has also to do with the amount of traffic per time slot.

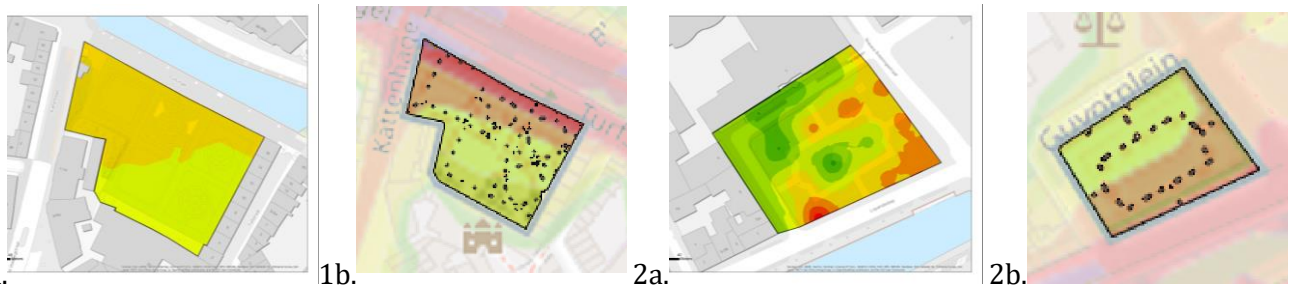


Figure 13: comparison of Prinsentuin (1a) with the Icinity model (1b) and of the Guyotplein (2a) with the Icinity model (2b)

4.2 Sample

For the survey I gathered a total of 114 respondents. After manually processing the data and removing unfinished respondents, a total of N=83 remained. Most of the respondents are between the 20 and 30 years old (most likely students), a small peak around 60 years ((grand-)parents) and some evenly distributed in between (fig. 14). The proportion of male respondents is almost the same as female respondents (fig. 15). The majority of the respondents are residents of cities (50.000+ inhabitants) and a few from a town (10.000 – 50.000 inhabitants) or a village (<10.000 inhabitants) (fig. 16). Since the survey is distributed among my own network and the network of friends and family, the survey also reached other continents, with 19 respondents in Oceania, two in North-/South-America and in Europe (fig. 17). With a couple respondents in Belgium and Iceland, the majority is from the Netherlands.

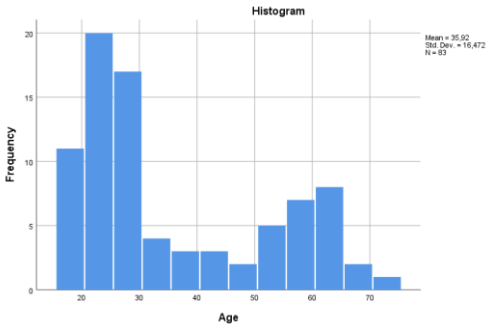


Figure 14: Distribution of age

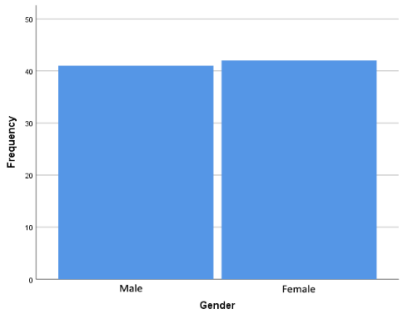


Figure 15: Gender

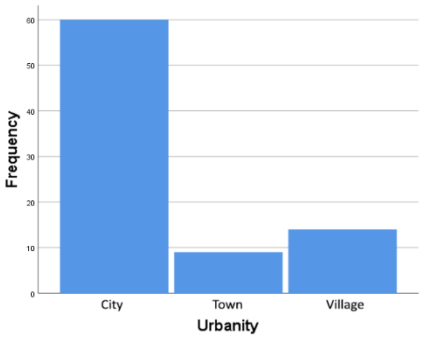


Figure 16: Degree of urbanity

Figure 17: Location of respondents

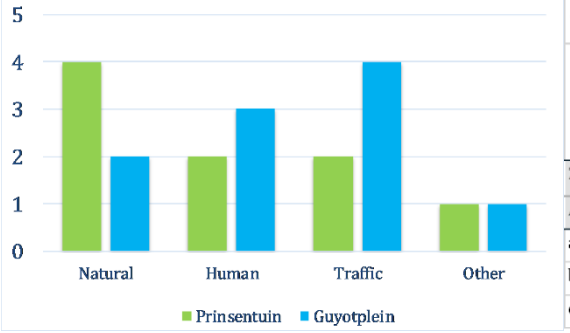
4.3 Descriptive

4.3.1 How does the sound appraisal and the explanatory variables differ between the two green spaces?

All the variables are compared to each other between the two parks in order to find out whether there are differences and similarities in responses. By running a Wilcoxon signed Ranks Test, it will tell if the parameters are significantly different from each other. As it turns out, only the variable 'eventful' is insignificant, all the other variables are significant. Next to the significance, also a direction can be assigned. Green boxes on the Z-score indicates the indicator is reported more in the Prinsentuin, while a red box is more on the Guyotplein.

Sound sources

For the sound sources, the presence of natural sounds is significant based on positive ranks, meaning that natural sounds were more reported in the Prinsentuin (fig. 18). The human, traffic and other sounds are reported more to be heard on the Guyotplein compared to the Prinsentuin (fig. 19).



Test Statistics[a]

	Natural_sounds Guyotplein - Natural_sounds Prinsentuin	Human_sounds Guyotplein - Human_sounds Prinsentuin	Traffic_sounds Guyotplein - Traffic_sounds Prinsentuin	Other_sounds Guyotplein - Other_sounds Prinsentuin
Z	-7,802[b]	-6,408[c]	-7,632[c]	-4,459[c]
Asymp. Sig. (2-tailed)	0.000	0.000	0.000	0.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. Based on negative ranks.

Figure 18: Median of the reported sound sources Figure 19: Wilcoxon signed Ranks Test on sound sources

Perceived acoustic environment

In the survey, various parameters were addressed that tries to capture the richness of the description and classification of the soundscape (fig. 20). Almost all variables differ significantly from each other, except for the eventfulness. All of the more positive attributes such as pleasant, vibrant and calm are more reported in the Prinsentuin, while most of the negative attributes such as chaotic, uneventful and annoying are more heard on the Guyotplein (fig. 21).

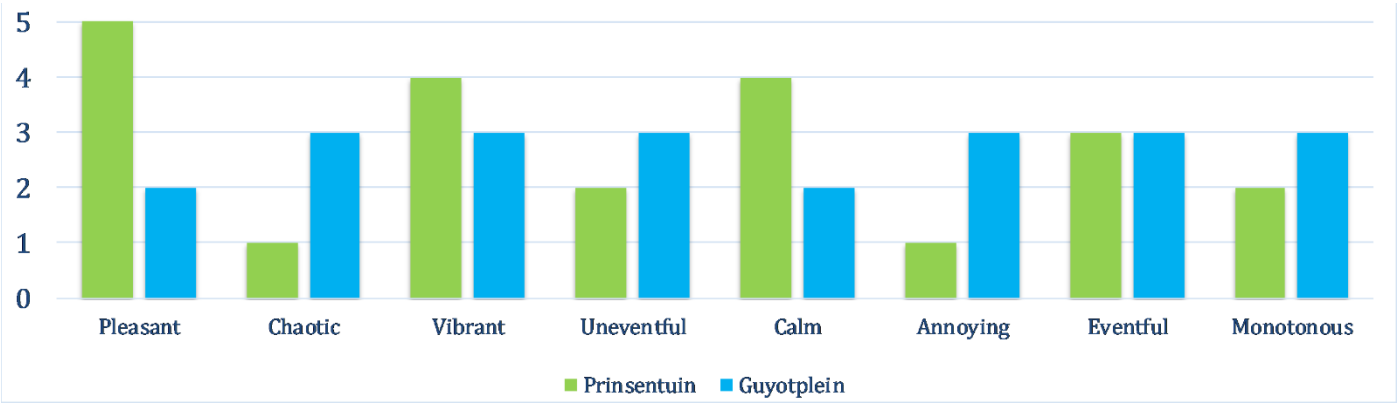


Figure 20: Median of the perceived acoustic environment parameters

Test Statistics[a]

	Pleasant Guyotplein - Pleasant Prinsentuin	Chaotic Guyotplein - Chaotic Prinsentuin	Vibrant Guyotplein - Vibrant Prinsentuin	Uneventful Guyotplein - Uneventful Prinsentuin	Calm Guyotplein - Calm Prinsentuin	Annoying Guyotplein - Annoying Prinsentuin	Eventful Guyotplein - Eventful Prinsentuin	Monotonous Guyotplein - Monotonous Prinsentuin
Z	-7,578[b]	-6,930[c]	-2,828[b]	-2,035[c]	-7,202[b]	-7,389[c]	-,327[c]	-4,913[c]
Asymp. Sig. (2-tailed)	0.000	0.000	0.005	0.042	0.000	0.000	0.744	0.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. Based on negative ranks.

Figure 21: Wilcoxon signed Ranks Test on acoustic environment parameters

Visuals and appraisal

Furthermore, a comparison has been made on several other parameters describing the acoustic environment in its entirety such as overall quality, appropriateness and perceived loudness, as well as visual aspects such as traffic visibility and nature visual dominance (fig. 22). Also here all the variables differ significantly from each other, with more the negative aspects as traffic hindrance, traffic visibility and loudness more reported at the Guyotplein, while positive aspects such as the overall quality, the appropriateness and nature visual dominance assigned to the Prinsentuin (fig. 23).

Figure 22: Median of the measured variables

Test Statistics[a]

	Overall Guyotplein - Overall Prinsentuin	Appropriateness Guyotplein - Appropriateness Prinsentuin	Loudness Guyotplein - Loudness Prinsentuin	Traffic_hindrance Guyotplein - Traffic_hindrance Prinsentuin	Nature_dominance Guyotplein - Nature_dominance Prinsentuin	Traffic_visibility Guyotplein - Traffic_visibility Prinsentuin
Z	-7,667[b]	-5,458[b]	-6,494[c]	-6,793[c]	-5,415[b]	-8,134[c]
Asymp. Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. Based on negative ranks.

Figure 23: Wilcoxon signed Ranks Test on measured variables

Differences in gender

To find out whether the soundscape perception differs between group based on gender, an independent T-test is performed (fig. 24). A significant difference is found between male and female respondents on both the eventfulness of the Prinsentuin as well as the eventfulness of the Guyotplein. In both cases, female respondents perceive the sites more eventful compared to the perception of male respondents. This differences can be explained by a difference in noise sensitivity. Further analysis is carried out with groups based on sex combined.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Pleasantness Prinsentuin	Equal variances assumed	0.100	0.753	-0.926	81	0.357	-0.49141	0.53051	-1.54696	0.56414
	Equal variances not assumed			-0.924	77.994	0.358	-0.49141	0.53163	-1.54980	0.56698
Eventfulness Prinsentuin	Equal variances assumed	0.304	0.583	-2.105	81	0.038	-1.10354	0.52425	-2.14663	-0.06044
	Equal variances not assumed			-2.105	80.987	0.038	-1.10354	0.52418	-2.14649	-0.06059
Pleasantness Guyotplein	Equal variances assumed	1.232	0.270	-0.279	81	0.781	-0.20400	0.73179	-1.66003	1.25203
	Equal variances not assumed			-0.278	75.867	0.782	-0.20400	0.73390	-1.66574	1.25773
Eventfulness Guyotplein	Equal variances assumed	0.259	0.612	-2.723	81	0.008	-1.52084	0.55845	-2.63199	-0.40970
	Equal variances not assumed			-2.728	80.024	0.008	-1.52084	0.55754	-2.63037	-0.41132

Figure 24: Independent T-test on the difference between male and female respondents

4.4 Sound appraisal

Based on the perceived acoustic environment parameters, the coordinate for pleasantness P and for eventfulness E can be calculated (ISO, 2019):

“

The coordinate for pleasantness P is calculated by means of Formula (A.1):

$$P=(p-a)+\cos 45°\cdot(ca-ch)+\cos 45°\cdot(v-m)$$

The coordinate for eventfulness E is calculated by means of Formula (A.2):

$$E=(e-u)+\cos 45°\cdot(ch-ca)+\cos 45°\cdot(v-m)$$

”

Figure 25 depicts the individual assessments projected on the *Pleasantness – Eventfulness* spectrum. The Prinsentuin is considered as a pleasant soundscape, with characteristics of being calm and vibrant. Only a few respondents assess the soundscape towards the annoying side of the spectrum. The soundscape of the Guyotplein is less distinct: the points are scattered across the spectrum. However, most of the points are located on the left side on the spectrum, with even a few extreme towards annoying and slightly shifted towards chaotic.

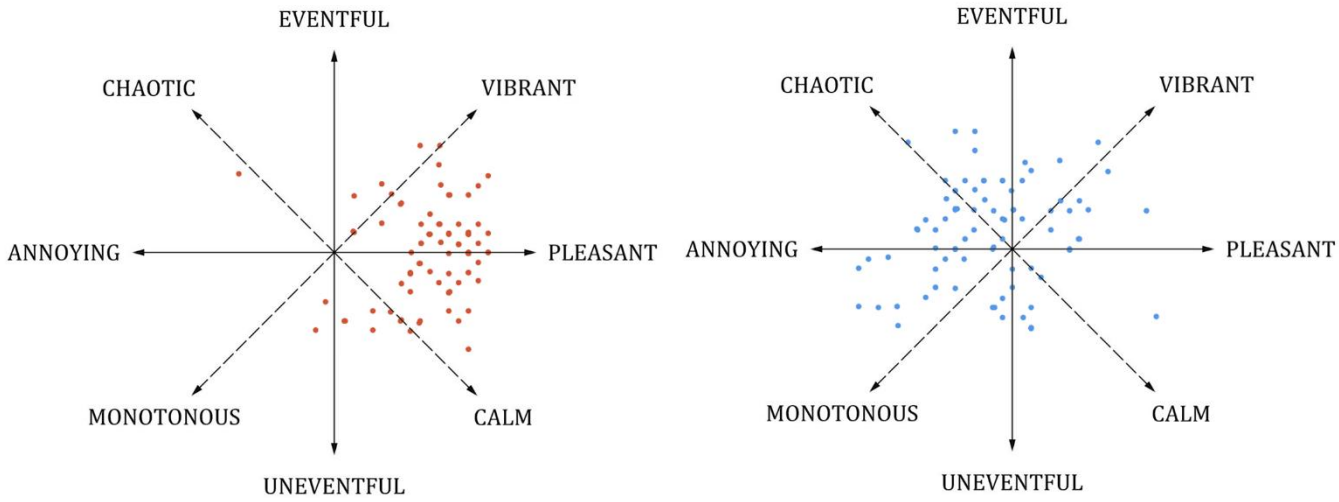


Figure 25: visualisation of the spectrum of pleasantness (x-axis) and eventfulness (y-axis) of the Prinsentuin (left) and the Guyotplein (right)

4.5 Correlations

4.5.1 What is the association between identified sound sources and sound appraisal

In both sites, the natural sound positively influences the pleasantness and eventfulness of the acoustic environment (fig. 26) (fig. 27). This is in accordance with the literature, stating that the presence of natural sounds is often perceived as being pleasant. In the case of the Guyotplein, there is also a small negative correlation with uneventful and annoying.

The presence of human sound positively influences the eventfulness. International literature identified sounds from people making up a vibrant soundscape where things are happening. This is especially true for the Guyotplein where there is a small negative correlation with uneventful and a small positive correlation with eventful. In the Prinsentuin human sounds are also associated with eventfulness, but it is also responsible for making the acoustic environment perceive as less calm and more chaotic.

On the other hand, traffic sounds negatively affect the pleasantness. At the Guyotplein, the correlation coefficient indicates there is a moderate negative association of -0,6 of traffic sounds on pleasantness. This is also seen in the individual parameters.

Correlations

			Pleasant Prinsentuin	Chaotic Prinsentuin	Vibrant Prinsentuin	Uneventful Prinsentuin	Calm Prinsentuin	Annoying Prinsentuin	Eventful Prinsentuin	Monotonous Prinsentuin	Pleasantness Prinsentuin	Eventfulness Prinsentuin
Spearman's rho	**Natural** sounds Prinsentuin	Correlation Coefficient	,243*	-0.046	0.139	-0.203	0.080	-0.135	0.118	-,371**	,276*	,256*
		Sig. (2-tailed)	0.027	0.680	0.210	0.066	0.474	0.225	0.288	0.001	0.011	0.020
		N	83	83	83	83	83	83	83	83	83	83
	Human sounds Prinsentuin	Correlation Coefficient	-0.108	,342**	0.154	-0.106	-,286**	0.094	,219*	-0.119	-0.136	,372**
		Sig. (2-tailed)	0.329	0.002	0.166	0.341	0.009	0.400	0.046	0.282	0.219	0.001
		N	83	83	83	83	83	83	83	83	83	83
	Traffic sounds Prinsentuin	Correlation Coefficient	-,222*	,248*	-0.080	0.084	-0.154	0.191	-0.024	0.033	-,238*	0.006
		Sig. (2-tailed)	0.044	0.024	0.470	0.451	0.165	0.084	0.830	0.765	0.030	0.958
		N	83	83	83	83	83	83	83	83	83	83
	Other sounds Prinsentuin	Correlation Coefficient	-0.103	,219*	0.054	0.055	-0.141	0.093	0.162	-0.009	-0.110	0.143
		Sig. (2-tailed)	0.356	0.046	0.629	0.621	0.204	0.401	0.143	0.939	0.323	0.198
		N	83	83	83	83	83	83	83	83	83	83

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 26: correlation between sound sources and soundscape appraisal in the Prinsentuin

Correlations

			Pleasant Guyotplein	Chaotic Guyotplein	Vibrant Guyotplein	Uneventful Guyotplein	Calm Guyotplein	Annoying Guyotplein	Eventful Guyotplein	Monotonous Guyotplein	Pleasantness Guyotplein	Eventfulness Guyotplein
Spearman's rho	**Natural** sounds Guyotplein	Correlation Coefficient	,344**	0.039	0.176	-,308**	0.149	-,221*	0.117	-0.151	,222*	,218*
		Sig. (2-tailed)	0.001	0.724	0.110	0.005	0.178	0.045	0.291	0.172	0.044	0.048
		N	83	83	83	83	83	83	83	83	83	83
	Human sounds Guyotplein	Correlation Coefficient	0.160	-0.148	0.164	-,242*	0.070	-0.103	,235*	-0.202	0.143	,232*
		Sig. (2-tailed)	0.148	0.181	0.139	0.028	0.529	0.354	0.032	0.067	0.196	0.035
		N	83	83	83	83	83	83	83	83	83	83
	Traffic sounds Guyotplein	Correlation Coefficient	-,530**	,367**	-0.099	0.057	-,594**	,594**	0.027	,242*	-,602**	0.099
		Sig. (2-tailed)	0.000	0.001	0.372	0.606	0.000	0.000	0.806	0.028	0.000	0.374
		N	83	83	83	83	83	83	83	83	83	83
	Other sounds Guyotplein	Correlation Coefficient	-0.077	0.136	-0.074	-0.097	-0.196	0.044	0.080	-0.038	-0.119	0.131
		Sig. (2-tailed)	0.490	0.219	0.508	0.382	0.076	0.696	0.472	0.730	0.283	0.240
		N	83	83	83	83	83	83	83	83	83	83

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 27: correlation between sound sources and soundscape appraisal on the Guyotplein

4.5.2 What is the association between perceived visuals and sound appraisal

Different sound sources have different impacts on the sound appraisal, but there might also other mechanisms that influence the perception of sound sources. Even though visual aspects influence the soundscape perception, this study did not find a direct association between traffic visibility and affective sound appraisal (fig. 28). Nature dominance and nature quality is associated with higher pleasantness and overall quality of the soundscape, but only at the Guyotplein where there is a case of high traffic nuisance (fig. 29). This suggests the presence of green has the potential to mitigate traffic nuisance and improve soundscape quality.

Correlations

			Traffic_hindrance_Prinsentuin	Nature_dominance_Prinsentuin	Nature_quality_Prinsentuin	Traffic_visibility_Prinsentuin
Spearman's rho	Pleasantness_Prinsentuin	Correlation Coefficient	-,518**	0.039	0.167	0.062
		Sig. (2-tailed)	0.000	0.724	0.132	0.578
		N	83	83	83	83
	Eventfulness_Prinsentuin	Correlation Coefficient	0.045	-0.029	-0.057	0.000
		Sig. (2-tailed)	0.685	0.792	0.607	1.000
		N	83	83	83	83

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 28: *correlation between perceived visuals and soundscape appraisal on the Guyotplein*

Correlations

			Traffic_hindrance_Guyotplein	Nature_dominance_Guyotplein	Nature_quality_Guyotplein	Traffic_visibility_Guyotplein
Spearman's rho	Pleasantness_Guyotplein	Correlation Coefficient	-,693**	,360**	,259*	-0.114
		Sig. (2-tailed)	0.000	0.001	0.018	0.304
		N	83	83	83	83
	Eventfulness_Guyotplein	Correlation Coefficient	-0.055	0.053	-0.030	0.024
		Sig. (2-tailed)	0.619	0.632	0.788	0.830
		N	83	83	83	83

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 29: *correlation between perceived visuals and soundscape appraisal in the Prinsentuin*

4.5.3 What is the association between perceived visuals and identified sound sources?

When the perceived sound sources are correlated with the identified sound sources, we can see that there is no association found in the Prinsentuin (fig. 30). On the Guyotplein, there is however a correlation with nature dominance and nature quality on natural sounds (fig. 31). When we connect this to the previous section, this implies that the dominance of nature and the quality of nature is indirectly responsible for a pleasant soundscape. Also the negative association of nature dominance on traffic noise is expected to be seen.

Correlations

			Nature dominance Prinsentuin	Nature quality Prinsentuin	Traffic visibility Prinsentuin
Spearman's rho	Natural_sounds_Prinsentuin	Correlation Coefficient	0.129	-0.100	-0.066
		Sig. (2-tailed)	0.244	0.368	0.554
		N	83	83	83
	Human_sounds_Prinsentuin	Correlation Coefficient	-0.080	-0.147	-0.148
		Sig. (2-tailed)	0.472	0.183	0.183
		N	83	83	83
	Traffic_sounds_Prinsentuin	Correlation Coefficient	-0.060	-0.159	-0.146
		Sig. (2-tailed)	0.590	0.152	0.188
		N	83	83	83
	Other_sounds_Prinsentuin	Correlation Coefficient	0.062	-0.126	-0.003
		Sig. (2-tailed)	0.578	0.258	0.982
		N	83	83	83

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 30: *correlation between perceived visuals and identified sound sources in the Prinsentuin*

Correlations

			Nature dominance Guyotplein	Nature quality Guyotplein	Traffic visibility Guyotplein
Spearman's rho	Natural_sounds_Guyotplein	Correlation Coefficient	,231*	,253*	0.039
		Sig. (2-tailed)	0.036	0.021	0.724
		N	83	83	83
	Human_sounds_Guyotplein	Correlation Coefficient	0.133	-0.005	-0.133
		Sig. (2-tailed)	0.232	0.966	0.230
		N	83	83	83
	Traffic_sounds_Guyotplein	Correlation Coefficient	-,245*	-0.179	0.201
		Sig. (2-tailed)	0.026	0.106	0.069
		N	83	83	83
	Other_sounds_Guyotplein	Correlation Coefficient	-0.057	0.002	0.034
		Sig. (2-tailed)	0.611	0.985	0.763
		N	83	83	83

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 31: *correlation between perceived visuals and identified sound sources on the Guyotplein*

5. Discussion

Conclusions

In this study, a socio-acoustic survey is performed to find a relationship between traffic visibility and green appreciation on the soundscape appraisal in urban parks in Groningen. Respondents were presented two audio-visual stimuli to assess the soundscape perception. The key findings in this study are:

- The Prinsentuin is considered as a pleasant soundscape, with characteristics of being calm and vibrant;
- The Guyotplein does not have a distinct soundscape type, but is inclined to be more annoying and chaotic compared to the Prinsentuin, even though they are of similar size and similar exposure to traffic noise;
- Natural sound sources tend to have a positive effect on the soundscape quality;
- Human sounds - such as conversations – have a positive effect on the eventfulness. However, in some cases it might also contribute to less calm and more chaotic soundscapes;
- A negative correlation between reported traffic sounds and the perceived pleasantness of a place. This correlation tends to be stronger when there is reported to be more traffic sounds. This is also the case when respondents were asked how much traffic hindrance they experienced;
- Even though visual aspects influence the soundscape perception, this study did not find a direct association between traffic visibility and affective sound appraisal;
- Nature dominance and nature quality is associated with higher pleasantness and overall quality of the soundscape, but only at the Guyotplein where there is a case of high traffic nuisance. This suggests the presence of green has the potential to mitigate traffic nuisance and improve soundscape quality

Limitations and future research

This study tried to address several parameters as a descriptor of soundscape quality, but is limited to only a few. There might be other variables that influence the perception of soundscapes. On the hand, variables are closely interlinked, meaning that a difference in a non-measured variable affects directly or indirectly the outcome of an other variable. Future studies are invited to address all the different attributes that add up to the magnitude of soundscape studies.

Unlike other studies that include audio-visual stimuli in an experimental setting, I didn't have the opportunity to control the conditions in which the surveys were conducted. It would be most ideal to have the respondents watch the video on the same monitor and listen to the audio stimuli on the same headphones, but unfortunately the respondents had to provide their own equipment. To tackle this problem, I included in the survey a short audio fragment in which a voice is heard and asks the participants to make sure the audio volume is not set too loud nor too soft, and are instructed to not adjust the audio during the survey anymore. Nevertheless, slight differences in volume levels and the quality of the headphones might represent the audio fragment differently and therefore result in different outcomes.

As a consequence of more people working from home, the amount of traffic for commuting reduced drastically. The noise maps and the fragments might therefore not coincide with the situation under normal conditions.

However, this study does not aim to report and describe the two sites in detail, but rather more focused on how the sites are perceived in context. Furthermore, the sites are investigated on the same day in the afternoon, so a reduction in traffic movement in one site, would also mean the same reduction in the other. In this way, a fair comparison can be made given the fact it is under the same conditions.

Also, the respondents were asked to assess two parks on their audio-visual aspects, but the assessment of one place might unconsciously influence the assessment of the second place. This also called the sequential effect. One way to tackle this problem is to have different sample populations per site. Time constraints and lack of sufficient respondents did not make it possible to a carry out this method, but is highly advised in order to draw conclusions from unbiased results.

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Appendix

Questionnaire

Soundscape study 2020

This study is on sound in public spaces in the city of Groningen and how this is perceived by the users of the space. You will be shown two short videos of two urban green parks in Groningen. After watching the video you are asked to fill in multiple-choice questions regarding the visuals and the sound environment. There are no wrong answers, it is about how you perceive it. For the most reliable results, you are asked to use headphones or earphones.

The study should take you around 5-10 minutes to complete.

By clicking the button below, you acknowledge that:

- You have read and understood the information sheet explaining the experiment
- You are aware the survey is conducted anonymously and the results of the questionnaire will only be used for this study
- You are aware that you may choose to terminate your participation at any time for any reason

o I consent, begin the study
o I do not consent, I do not wish to participate

Comments and questions:
OIivier Bruinen: o.h.d.bruinen@student.rug.nl

General

Q15 What is your gender?
o Male (1)
o Female (2)
o Other / rather not say (3)

Q16 What is your age?

_____

Q26 Choose what applies to you
I live in:
o a city (50.000+ inhabitants) (1)
o a town (10.000 - 50.000 inhabitants) (2)
o a village ((3)

Q50 Calibration
Put on your headphones or earphones and listen to the audio fragment down below

Fragment 1/2

This is the first video of the total two

Watch the 360° video and listen carefully, and try to imagine as if you were there.
After the video, please fill in the questions down below.

About the sound
The following questions are about the sound environment

Q20 To what extent did your presently hear the following type of sounds in the fragment

	Not at all (1)	A little (2)	Moderately (3)	A lot (4)	Dominates completely (5)
Natural sounds (1)	o	o	o	o	o
Sounds from humans (2)	o	o	o	o	o
Traffic noise (3)	o	o	o	o	o
Other noise (4)	o	o	o	o	o

Q38 To what extent do you agree or disagree that the sound environment is

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
Pleasant (1)	o	o	o	o	o
Chaotic (2)	o	o	o	o	o
Vibrant (3)	o	o	o	o	o
Uneventful (4)	o	o	o	o	o
Calm (5)	o	o	o	o	o
Annoying (6)	o	o	o	o	o
Eventful (7)	o	o	o	o	o
Monotonous (8)	o	o	o	o	o

Q30 Overall, how would you describe the present sound environment
o Very bad (1)
o Bad (2)
o Neither good, nor bad (3)
o Good (4)
o Very good (5)

Q31 Overall, to what extent is the sound environment appropriate to the place
o Not at all (1)
o Slightly (2)
o Fine (3)
o Very well (4)
o Perfectly (5)

Q52 How loud would you say the sound environment is
o Not at all (1)
o Slightly (2)
o Moderately (3)
o Very (4)
o Extremely (5)

Q34 Did you experience hindrance from traffic noise
o Not at all (1)
o Sometimes (2)
o About half the time (3)
o Most of the time (4)
o All the time (5)

About the visuals

The following questions are about what you saw

Q39 How much would you say the nature dominates your view
o Not at all (1)
o Sometimes (2)
o About half the time (3)
o Most of the time (4)
o Always (5)

Q37 What would you consider the quality of the nature
o Very bad (1)
o Bad (2)
o Neither good, nor bad (3)
o Good (4)
o Very good (5)

Q36 Was traffic visible from the green space

- o Never (1)
- o Sometimes (2)
- o About half the time (3)
- o Most of the time (4)
- o All the time (5)

Fragment 2/2

This is the last video

First watch and listen to the video and fill in the questions down below.

About the sound

The following questions are about the sound environment

Q30 To what extent did your presently hear the following type of sounds in the fragment

	Not at all (1)	A little (2)	Moderately (3)	A lot (4)	Dominates completely (5)
Natural sounds (1)	o	o	o	o	o
Sounds from humans (2)	o	o	o	o	o
Traffic noise (3)	o	o	o	o	o
Other noise (4)	o	o	o	o	o

Q41 To what extent do you agree or disagree that the sound environment is

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
Pleasant (1)	o	o	o	o	o
Chaotic (2)	o	o	o	o	o
Vibrant (3)	o	o	o	o	o
Uneventful (4)	o	o	o	o	o
Calm (5)	o	o	o	o	o
Annoying (6)	o	o	o	o	o
Eventful (7)	o	o	o	o	o
Monotonous (8)	o	o	o	o	o

Q42 Overall, how would you describe the present sound environment

- o Very bad (1)
- o Bad (2)
- o Neither good, nor bad (3)
- o Good (4)
- o Very good (5)

Q43 Overall, to what extent is the sound environment appropriate to the place

- o Not at all (1)
- o Slightly (2)
- o Fine (3)
- o Very well (4)
- o Perfectly (5)

Q53 How loud would you say the sound environment is
o Not at all (1)
o Slightly (2)
o Moderately (3)
o Very (4)
o Extremely (5)

Q44 Did you experience hindrance from traffic noise
o Not at all (1)
o Sometimes (2)
o About half the time (3)
o Most of the time (4)
o All the time (5)

About the visuals

The following questions are about what you saw

Q47 How much would you say the nature dominates your view
o Not at all (1)
o Sometimes (2)
o About half the time (3)
o Most of the time (4)
o Always (5)

Q48 What would you consider the quality of the nature
o Very bad (1)
o Bad (2)
o Neither good, nor bad (3)
o Good (4)
o Very good (5)

Q46 Was traffic visible from the green space
o Not at all (1)
o Sometimes (2)
o About half the time (3)
o Most of the time (4)
o All the time (5)

Measurements

Table x. Noise measurements and the average value of three measurements at both locations

Prinsentuin

Location_ID	1	2	3	Average
P1	73.9	52.1	50.8	58.9
P2	73.0	59.5	44.0	58.8
P3	41.6	51.5	47.6	46.9
P4	46.6	42.6	47.6	45.6
P5	45.6	43.1	43.6	44.1
P6	37.2	42.1	38.1	39.1
P7	40.4	43.6	41.4	41.8
P8	59.5	43.1	44.2	48.9
P9	45.9	72.2	44.9	54.3
P10	43.0	44.3	52.2	46.5
P11	54.9	43.3	51.5	49.9
P12	39.7	43.0	41.9	41.5
P13	49.3	42.5	42.7	44.8
P14	42.6	47.5	39.7	43.3
P15	39.4	50.8	42.5	44.2
P16	39.7	43.0	44.6	42.4

Guyotplein

Location_ID	1	2	3	Average
G1	58.0	50.2	63.7	57.3
G2	52.5	61.4	55.3	56.4
G3	60.3	46.6	58.3	55.1
G4	58.0	52.9	73.9	61.6
G5	55.7	51.3	46.8	51.3
G6	51.2	50.8	50.2	50.7
G7	49.0	44.6	74.8	56.1
G8	47.9	47.1	46.9	47.3
G9	54.6	53.5	45.2	51.1
G10	51.1	54.6	65.2	57.0
G11	56.9	55.5	58.2	56.9
G12	58.0	63.2	52.6	57.9
G13	50.5	56.6	63.6	56.9
G14	52.7	47.6	42.8	47.7
G15	49.3	57.8	44.7	50.6
G16	48.8	49.9	56.6	51.8
G17	47.3	48.0	48.1	47.8
G18	47.6	51.8	44.6	48.0
G19	48.8	51.4	49.5	49.9
G20	50.8	58.1	58.2	55.7

Statistics

Ranks

		N	Mean Rank	Sum of Ranks
Natural_sounds_Guyotplein - Natural_sounds_Prinsentuin	Negative Ranks	78[a]	40.39	3150.50
	Positive Ranks	1[b]	9.50	9.50
	Ties	6[c]		
	Total	85		
Human_sounds_Guyotplein - Human_sounds_Prinsentuin	Negative Ranks	6[d]	21.00	126.00
	Positive Ranks	59[e]	34.22	2019.00
	Ties	22[f]		
	Total	87		
Traffic_sounds_Guyotplein - Traffic_sounds_Prinsentuin	Negative Ranks	3[g]	9.50	28.50
	Positive Ranks	74[h]	40.20	2974.50
	Ties	9[i]		
	Total	86		
Other_sounds_Guyotplein - Other_sounds_Prinsentuin	Negative Ranks	6[j]	14.00	84.00
	Positive Ranks	33[k]	21.09	696.00
	Ties	48[l]		
	Total	87		
Pleasant_Guyotplein - Pleasant_Prinsentuin	Negative Ranks	75[m]	42.43	3182.50
	Positive Ranks	5[n]	11.50	57.50
	Ties	7[o]		
	Total	87		
Chaotic_Guyotplein - Chaotic_Prinsentuin	Negative Ranks	5[p]	14.70	73.50
	Positive Ranks	65[q]	37.10	2411.50
	Ties	17[r]		
	Total	87		
Vibrant_Guyotplein - Vibrant_Prinsentuin	Negative Ranks	41[s]	33.43	1370.50
	Positive Ranks	21[t]	27.74	582.50
	Ties	25[u]		
	Total	87		
Uneventful_Guyotplein - Uneventful_Prinsentuin	Negative Ranks	19[v]	25.76	489.50
	Positive Ranks	34[w]	27.69	941.50
	Ties	34[x]		
	Total	87		

Annoying_Guyotplein - Annoying_Prinsentuin	Negative Ranks	3[ab]	17.33	52.00
	Positive Ranks	73[ac]	39.37	2874.00
	Ties	11[ad]		
	Total	87		
Eventful_Guyotplein - Eventful_Prinsentuin	Negative Ranks	21[ae]	20.29	426.00
	Positive Ranks	21[af]	22.71	477.00
	Ties	45[ag]		
	Total	87		
Monotonous_Guyotplein - Monotonous_Prinsentuin	Negative Ranks	13[ah]	21.08	274.00
	Positive Ranks	48[ai]	33.69	1617.00
	Ties	26[aj]		
	Total	87		
Overall_Guyotplein - Overall_Prinsentuin	Negative Ranks	74[ak]	37.50	2775.00
	Positive Ranks	0[al]	0.00	0.00
	Ties	13[am]		
	Total	87		
Appropriateness_Guyotplein - Appropriateness_Prinsentuin	Negative Ranks	58[an]	36.10	2094.00
	Positive Ranks	11[ao]	29.18	321.00
	Ties	18[ap]		
	Total	87		
Loudness_Guyotplein - Loudness_Prinsentuin	Negative Ranks	7[aq]	23.00	161.00
	Positive Ranks	62[ar]	36.35	2254.00
	Ties	17[as]		
	Total	86		
Traffic_hindrance_Guyotplein - Traffic_hindrance_Prinsentuin	Negative Ranks	3[at]	38.50	115.50
	Positive Ranks	69[au]	36.41	2512.50
	Ties	15[av]		
	Total	87		
Nature_dominance_Guyotplein - Nature_domincance_Prinsentuin	Negative Ranks	58[aw]	36.05	2091.00
	Positive Ranks	11[ax]	29.45	324.00
	Ties	18[ay]		
	Total	87		
Traffic_visibility_Guyotplein - Traffic_visibility_Prinsentuin	Negative Ranks	0[az]	0.00	0.00
	Positive Ranks	86[ba]	43.50	3741.00
	Ties	1[bb]		
	Total	87		

Figure x: Wilcoxon Signed ranks test

ResponseId	Q38_7	Q38_3	Q38_1	Q38_5	Q38_4	Q38_8	Q38_6	Q38_2
Respons	Eventful	Vibrant	Pleasant	Calm	Uneve	Monotc	Annoyin	Chaoti
R_1	4	4	4	4	2	2	2	2
R_2	3	4	4	5	4	2	1	1
R_3	5	5	4	4	1	1	1	3
R_4	4	5	5	4	2	3	1	1
R_5	2	2	4	4	4	3	1	1
R_6	4	2	5	5	2	1	1	1
R_7	4	4	5	5	2	1	1	1
R_8	4	4	4	3	2	3	1	3
R_9	2	5	5	5	1	3	1	3
R_10	4	4	4	4	2	2	1	1
R_11	2	4	5	4	2	1	1	1
R_12	5	4	2	1	3	4	5	5
R_13	2	2	4	5	1	3	2	1
R_14	4	4	5	5	4	3	1	1
R_15	2	2	4	3	4	3	1	1
R_16	3	3	5	4	2	4	1	2
R_17	2	3	4	4	2	3	1	2
R_18	1	1	5	5	1	4	1	1
R_19	5	4	4	4	1	1	1	4
R_20	4	4	5	5	2	2	1	1
R_21	4	5	4	4	1	1	2	1
R_22	4	4	5	5	2	3	1	1
R_23	3	4	5	5	2	2	1	1
R_24	3	4	5	4	3	1	1	1
R_25	3	4	3	4	3	1	1	1
R_26	1	5	5	4	3	1	1	1
R_27	3	3	4	4	4	3	1	2
R_28	4	2	4	4	3	2	1	1
R_29	2	4	4	4	5	3	2	2
R_30	4	4	4	5	3	2	2	2
R_31	2	4	5	5	1	1	1	1
R_32	4	3	5	4	2	2	1	2
R_33	3	4	5	5	3	2	1	1
R_34	1	4	3	3	4	4	2	1
R_35	4	3	5	4	2	2	1	1
R_36	3	3	3	3	4	4	4	1
R_37	3	4	5	5	3	2	1	1
R_38	3	5	4	4	4	3	1	2
R_39	3	4	4	4	3	2	2	2
R_40	3	4	4	4	1	2	1	2
R_41	1	1	5	5	1	1	1	1
R_42	3	3	5	5	1	2	1	1
R_43	4	4	5	1	1	1	1	1
R_44	3	4	5	4	2	3	1	1
R_45	3	5	5	5	3	1	1	1
R_46	2	3	5	5	1	1	1	1
R_47	3	5	1	4	5	5	2	1
R_48	2	4	5	4	3	1	1	1
R_49	3	5	5	5	1	3	1	1
R_50	1	4	5	5	5	2	1	1
R_51	3	4	5	5	3	1	1	1
R_52	2	2	5	5	2	2	1	1
R_53	5	5	5	5	1	1	1	1
R_54	4	4	4	5	1	1	1	2
R_55	3	5	5	5	3	1	1	1
R_56	1	2	4	4	2	4	1	2
R_57	1	3	5	5	3	1	1	1
R_58	4	5	4	3	3	2	2	3
R_59	2	2	4	4	4	3	4	2
R_60	3	4	4	2	2	3	2	2
R_61	3	3	4	3	5	3	3	1
R_62	3	4	4	2	1	2	2	3
R_63	4	4	4	4	3	2	2	1
R_64	2	5	5	5	1	1	1	1
R_65	3	4	5	3	1	4	1	1
R_66	3	4	4	4	1	2	2	4
R_67	2	2	4	4	1	3	1	1
R_68	1	3	4	1	2	1	3	3
R_69	3	3	4	4	2	4	1	1
R_70	4	5	4	4	4	1	2	1
R_71	4	4	5	4	1	2	1	2
R_72	3	4	4	3	3	2	4	3
R_73	1	2	3	3	4	3	4	2
R_74	3	5	5	3	3	1	1	1
R_75	3	3	5	5	2	3	1	1
R_76	5	4	5	5	1	1	1	1
R_77	2	4	5	4	1	1	1	1
R_78	4	4	5	5	1	1	1	2
R_79	2	4	5	5	4	3	1	1
R_80	2	3	4	4	4	3	1	1
R_81	3	1	4	5	2	2	1	2
R_82	3	4	4	2	2	2	2	4
R_83	2	4	5	4	4	3	1	1
R_84	5	1	1	4	1	1	1	2
R_85	3	3	5	4	3	3	1	1
R_86	3	3	4	5	1	2	1	2
	2.97	3.62	4.36	4.09	2.38	2.17	1.41	1.55

	Q41_7	Q41_3	Q41_1	Q41_5	Q41_4	Q41_8	Q41_6	Q41_2
	Eventful	Vibrant	Pleasar	Calm	Unever	Monotc	Annoying	Chaotic
	4	4	3	2	2	3	3	4
	3	4	4	3	2	2	1	3
	4	4	2	1	1	1	4	4
	4	4	4	4	2	2	2	3
	3	3	2	1	1	2	4	3
	2	4	3	2	4	2	4	4
	2	2	2	4	4	4	2	4
	3	2	2	1	2	4	4	3
	2	3	2	1	3	4	4	4
	4	4	2	2	2	3	3	4
	4	4	4	1	2	1	2	3
	3	3	2	1	3	4	5	4
	3	2	2	2	3	3	4	3
	4	2	2	2	4	4	4	3
	4	5	4	3	1	2	1	2
	4	4	2	2	3	5	3	3
	2	4	2	3	2	4	4	4
	2	3	3	2	4	2	2	2
	4	4	3	3	2	2	3	4
	4	5	1	2	4	3	4	5
	2	4	2	4	4	4	4	2
	4	5	2	1	1	3	4	5
	3	4	2	2	2	2	4	4
	3	2	2	3	3	4	3	4
	3	3	1	3	3	5	4	3
	5	5	2	1	3	2	4	4
	3	4	2	2	2	2	3	2
	3	3	2	2	5	5	4	4
	2	2	3	3	3	4	3	2
	3	4	3	2	3	2	3	3
	4	4	4	2	2	2	3	1
	4	4	2	2	2	4	4	4
	1	4	5	5	4	1	1	1
	2	2	2	2	3	4	4	2
	4	4	2	2	3	2	4	3
	2	2	4	3	3	2	3	3
	2	2	3	4	3	5	2	1
	1	1	1	1	4	5	5	5
	3	4	2	2	2	2	4	1
	4	4	5	4	2	1	1	1
	1	3	1	1	5	5	5	3
	3	2	2	2	3	5	4	3
	3	1	1	1	4	5	5	5
	4	4	2	2	2	3	3	4
	3	3	2	1	3	3	4	4
	4	3	2	1	2	3	4	4
	2	4	2	4	4	4	3	1
	2	3	4	4	2	2	1	1
	3	4	4	3	2	3	3	2
	2	2	4	4	4	4	3	2
	3	2	4	2	3	1	1	2
	2	2	3	3	4	4	3	2
	5	5	1	4	1	1	4	1
	4	2	2	1	3	4	4	4
	3	3	3	2	3	3	3	3
	1	1	2	2	3	4	4	4
	1	3	1	1	3	4	5	5
	4	4	2	2	3	2	3	2
	4	3	4	2	2	3	3	4
	3	4	2	2	2	4	3	4
	3	3	2	2	2	3	4	4
	3	2	2	2	3	3	4	3
	2	1	1	2	4	5	5	4
	2	4	1	1	1	5	5	2
	3	2	1	2	3	3	1	1
	1	1	1	1	1	5	5	4
	4	4	1	2	4	1	5	3
	5	5	1	1	1	5	5	4
	4	3	2	3	2	3	3	3
	4	4	3	2	2	2	2	4
	4	4	4	3	2	3	3	2
	3	3	2	1	3	2	4	4
	4	4	4	3	2	3	2	2
	3	3	3	4	3	1	1	3
	3	4	4	4	3	3	2	3
	5	5	5	4	1	2	2	4
	4	4	3	2	2	3	3	4
	2	4	3	2	4	4	3	2
	4	2	2	2	2	2	4	4
	2	3	3	4	4	4	2	3
	3	2	4	4	2	2	2	2
	2	2	3	4	3	4	4	2
	3	2	3	3	3	3	3	4
	4	5	2	2	4	4	2	4
	3	2	2	2	3	3	4	3
	1	1	1	1	4	4	4	4
	3.03	3.19	2.48	2.31	2.72	3.10	3.28	3.09

Table x. Overview of respondents on soundscape indicators; a. Prinsentuin, b. Guyotplein (table by the author, 2020)