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Iceland Academy of the Arts

Department of Design and Architecture

Master of Design

REYKJAVIK SOUND SCAPE

Thesis submitted in partial fulfillment of the requirements for the degree of Master of Design

Anna Giudice

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REYKJAVIK SOUND SCAPE

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Goddur, my mentor.

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ABSTRACT

The aim of my project is to explore the connections between sound and perception through the decoding of physics rules, cultural aspects, and parameters contained within sound.

This research is about looking for something in a focused and systematic way, to create new knowledge through active social experimentation and also interpretation of new sound sensations.

The Reykjavik Soundscape is a board game created in order to help designers to come up with ideas. It is a tool designed to understand and transform the city soundscape. This project explores listening to "noise" to develop a new attitude to understanding sounds and music in order to arrive at a new way of thinking that helps the listeners understand the shapes of sound through analytic investigation.

This approach can help designers, city planners, architects, understand how sounds are created, inviting them to play together, to create their own "city landscape" in a big musical ensemble. When people play all together, it is possible to compose a story using sound and memory in cooperation, to connect to one another and to have a sense of ownership of space due to the sound they create. The storytelling is a great way to understand how the single unit can be part of a larger composition.

ACKNOWLEDGEMENTS

I would like to sincerely thank my supervisor Guðbjörg Rannveig Jóhannesdóttir (Gugga) and my mentor Guðmundur Oddur Magnússon (Goddur), for their guidance, support and for their friendship, which gave me the possibility to learn and grow personally and professionally during my Master studies.

I would like to thanks my colleages and friends Shuyi, Eusun, Sinead, Ma and Maria and teachers Johannes, Dora, Halldor, Thomas, Massimo, Hlin at LHI, for their friendship and support in the academic world and every-day life.

A big thanks goes to Fabio, Valeria, Nicola and Kyriaki.

Sound experiment.

INTRODUCTION

The Reykjavik Soundscape is a board game created in order to help designers to come up with ideas. It is a journey throughout the city and its sound. The aim of this project is to explore the connections between sound and perception through the decoding of physics rules, cultural aspects, and parameters contained within sound.

This game was inspired by The Game of the Goose, a race game of unknown origins in Europe in the 16th century. Like The Game of the Goose , players will move their tokens on a virtual walk through the board, which is printed with a cityscape. The tokens will be shaped like cats!

The Reykjavik Soundscape is a tool designed to understand and transform the city soundscape. It is about looking specifically at sound to create an experience, examining one´s reactions and perceptions. It enhances creativity, and also promotes idea generation and design thinking, while raising awareness about environmental and social issues.

Begin by choosing a particular group issue that you are currently dealing with, one that you would like to resolve by playing at The Reykjavik Soundscape. Using the 120 cards, representing sounds and actions, walking throughout the city, players have to tell a story.

The city of Reykjavik provides an excellent study typology because the entire city environment is condensed into a small, densely populated space.

This approach can help designers, city planners, architects, understand how sounds are created, inviting them to play together, to create their own “city landscape” in a big musical ensemble. When people play all together, it is possible to compose a story using sound and memory in cooperation, to connect to one another and to have a sense of ownership of space due to the sound they create. Storytelling is a great way to understand how the single unit can be part of a larger composition.

Put into practice, the theory of the soundscape as I describe here represented as an experience journey can inspire a new approach to the creation of city guides, urban solutions, installations and new creative solutions to define a standard of quality of the life of citizens. The journey proposes a new approach for understanding city development projects, through an investigation into the relationships between soundscape and city. I define my research as research through design, of which the aim is to communicate new knowledge through a methodological process.

My objective is to change the perception of sound as an element of a given environ-

ment to those who imagine sound as being invisible and intangible (Figure 1); because of this, it is often overlooked and people are seldom aware of the soundscape surrounding them. Our sense of vision often seems more dominant than our sense of hearing, yet sound plays a fundamental role in our everyday lives, especially in detecting danger, making communication and providing orientation in a physical space.

Each individual organizes sound in their own way (Figure 2); the thing that most fascinates me is the perception of sound in the brain. At the beginning, the sound of environment around me is like a background buzz, but slowly becomes something that can be reimagined as an orchestra playing a symphony. It is a sound that I cannot control, but I can perceive in a different way: in the active voice and the passive voice. In its passive form, it is possible to be lulled by the sound or it is possible to become really annoyed; in the active form, it is possible to isolate individual sounds without identifying the source; in effect, letting the melody make up its own mind.

New tools are necessary to further explore the complexities of perception of sound.

In the first part of this analysis, I will introduce the research field. In the second part, I will analyze my design approach from the methodological point of view; finally, I will describe the parameters and rules that led to the final result.

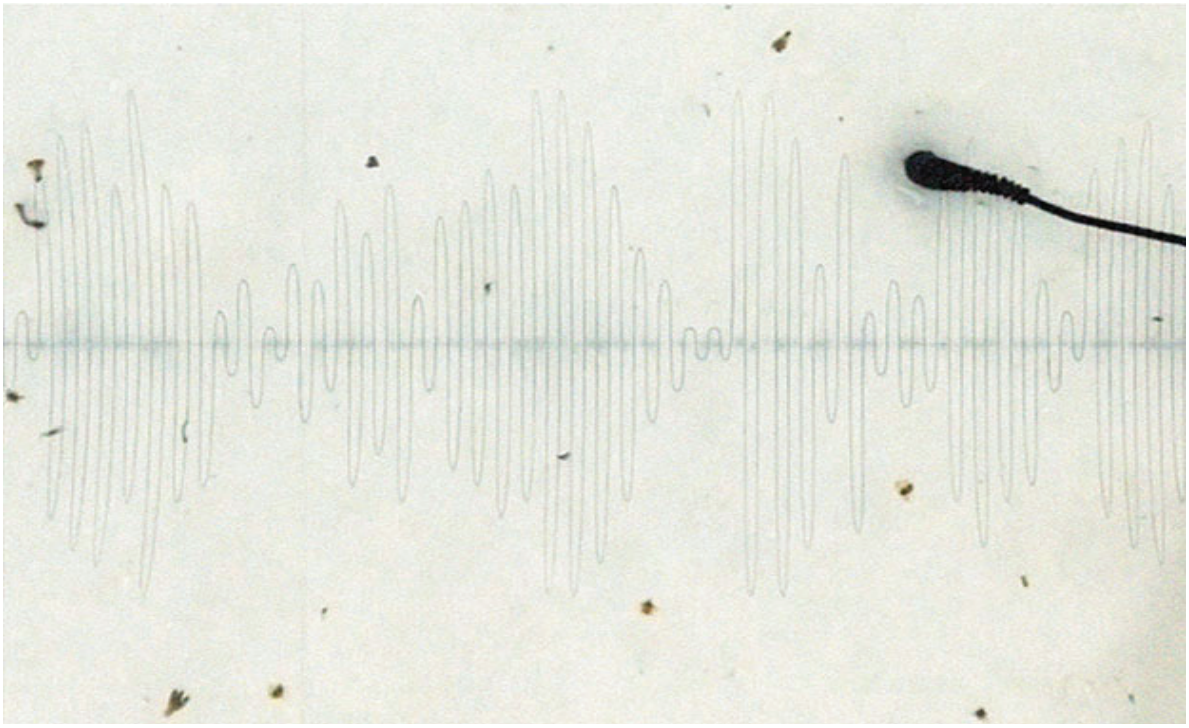


Figure 1. Sound is invisible and intangible.

Figure 2. Individual organizes sound in their own way.

FIELD OF STUDY

Our daily experience is produced by perception. In architecture and design context, sight has been historically privileged over the other senses. In the early sixties, Jane Jacobs stressed the importance of visual order in the city[1], and Kevin Lynch focused on the visual dimensions of urban design.[2] The senses of hearing and smell, for instance, are regarded negatively in contemporary urban research, as something that disturbs our lives: a pungent odor, a deafening noise. A first positive reference is found in studies by Juhani Pallasmaa, wherein he notes:

> Sight isolates, whereas sound incorporates; vision is directional, whereas sound is omni-directional. The sense of sight implies exteriority, but sound creates an experience of interiority. I regard an object, but sound approaches me; the eye reaches, but the ear receives. Buildings do not react to our gaze, but they do return our sounds back to our ears. (…) Hearing structures and articulates the experience and understanding of space. We are not normally aware of the significance of hearing in spatial experience, although sound often provides the temporal continuum in which visual impressions are embedded. When the soundtrack is removed from a film, for instance, the scene loses its plasticity and sense of continuity and life. [3]

According to Pallasmaa, sound is, therefore, essential in human sensory awareness. Urban Studies reveal how the exploration of the city is affected by our ability to store images. Kevin Lynch observes,

> Environmental images are the result of a two-way process between the observer and his environment. The environment suggests distinctions and relations, and the observer – with great adaptability and in the light of his own purposes – selects, organizes, and endows with meaning what he sees. The image so developed now limits and emphasizes what is seen, while the image itself is being tested against the filtered perceptual input in a constant interacting process, thus the image of a given reality may vary significantly between different observers.[4]

1 Jane Jacobs, *The Death and Life of Great American Cities*. (Harmondsworth, Middx., Engl: Penguin Books, 1972).
2 Kevin Lynch, *Good City Form.* (Cambridge, MA: MIT Press, 1984).
3 Juhani Pallasmaa, *The Eyes of the Skin: Architecture and the Senses*. (Chichester: Wiley-Academy, 2005). 49 - 50.
4 Kevin Lynch, *The image of the city.* (Cambridge, MA: MIT Press, 1960). 6.

However, our memory is not only influenced by our visual memory but also by others senses. Sound and memory are closely linked, as well as smell or taste. Research on the perception of urban spaces has neglected for years the significant role that sound plays, for better or for worse, in the urban context, as Emily Brady wrote in "Sniffing and Savouring: The Aesthetics of Smells and Tastes". She notes that *"*one general reason why smells and tastes have been neglected in philosophical aesthetics stems from their association with that which is base. They are associated with the body and with non human animals and relegated to the realm of the crude, so called lower pleasure". [5]

Sounds contribute, along with images and smells, to the recognition of an identity of a place. Sounds and smells are often ignored by city planners, or even treated as something to be resisted and annihilated. Sounds contribute to the construction of a place. The combination of natural sounds to those induced by human activities, create a unique synergy.

The goal of this project is, as I have already described, to encourage people to listen and become aware of their surrounding soundscape. This project began by asking: In what ways can sound be used to perceive the city (Figure 3)? Research *en plein air* and development of a prototyping process was key to exploring these questions (Figure 4). Sounds can be perceived in different ways, sometimes too strong, sometimes annoying, sometimes simply "out of place." How can sound be reframed in contexts which are pleasant and acceptable to the human ear? It is not just a matter of positively accepting what is happening and listening to the sounds with better preparation; I think it's more a matter of how to interpret what we feel.

The idea is to learn how to isolate sounds that are considered unpleasant and to perceive them as a stimulus that can be part of something not necessarily unpleasant through interpretation and knowledge. From psychiatrist Hans Berger, the inventor of electroencephalography, I have learned to interpret sound physically and we have considered how it affects the brain. From arts and music, I know now how to create an ideal sound around us that allows us to reflect both creatively and psychologically.

5 Andrew Light and Jonathan M. Smith, *The Aesthetics of Everyday Life*. (New York: Columbia University Press, 2005). 179.

Using the framework put forth by Raymond Murray Schafer, a composer, writer, music educator and environmentalist, this work will show that it is possible to perceive the world as a great macrocosmic musical composition.[6]

Besides the sensory data, there is the work of recognition and classification of sounds, which occurs according to predetermined categories, suggested by Schafer: continuous sounds, repetitive sounds, those which appear only once; natural sounds, human, or technological; loud sounds or weak; pleasant or unpleasant; internal or external; sounds that are still, in motion, or moving with us. The attention given to the sounds and their perception is the basis of my research.

The way to interpret the environment is determined by the interaction of the biological structure of the brain and its ability to develop. Knowledge of the physical structure of the sound adds information that the body can not perceive. In the book *Art of Noises* in 1916, the futurist Luigi Russolo turned sound into an extraordinary musical experience. In his compositions all sounds have the same aesthetic dignity:

> Let us cross a great modern capital with our ears more alert than our eyes, and we will get enjoyment from distinguishing the eddying of water, air and gas in metal pipes, the grumbling of noises that breathe and pulse with indisputable animality, the palpitation of valves, the coming and going of pistons, the howl of mechanical saws, the jolting of a tram on its rails, the cracking of whips, the flapping of curtains and flags. We enjoy creating mental orchestrations of the crashing down of metal shop blinds, slamming doors, the hubbub and shuffling of crowds, the variety of din, from stations, railways, iron foundries, spinning wheels, printing works, electric power stations and underground railways. We want to attune and regulate this tremendous variety of noises harmonically and rhythmically. To attune noises does not mean to detract from all their irregular movements and vibrations in time and intensity, but rather to give gradation and tone to the most strongly predominant of these vibrations. Noise in fact can be differentiated from sound only in so far as the vibrations which produce it are confused and irregular, both in time and intensity. Every noise has a tone, and sometimes also a harmony that predominates over the body of its irregular vibrations. [7]

The sounds that surround us, following the teachings of Luigi Russolo, are to be considered an asset to our knowledge. The environment around us is a great symphony that becomes an important part of our being.

6 Murray Schafer. *The Soundscape.* (Rochester: Destiny Books, 1977).
7 Luigi Russolo. *The Art of Noises.* (New York: Pendragon Press, 1986.) 5.

Figure 3. Perception of the city.

Figure 4. Research *en plein air*.

METHODOLOGY

I started my research reading about sound and perception doing soundwalks around the 101 district of Reykjavik, bringing with me a sound recorder and a camera. I recorded 237 different sounds, following my sound walk in the Reykjavik city map. I recorded a variety of typical soundmarks in the Reykjavik soundscape, focusing my research on 12 different typological areas: Airport, Bus Station, Harbor, National Hospital, Concert Hall, Park, the Pond, Residential District, Shopping District, Stadium, Swimming Pool and University (Figure 5). While walking, I recorded sounds and took notes and pictures of the areas explored. I identified my path using open source software OpenStreetMap3. This process helped me to classify the sounds I collected at each location. In my soundwalk, I detected that some pleasant sounds are produced by sources which are visually unpleasant, as well as the fact that unpleasant sounds can be produced from visually pleasant sources. Visual and mental perception can affect data generated by the brain positively or negatively, thus distorting the aesthetic perception of reality.

During the soundwalk, I increasingly focused upon tasks of attentive listening. Urban soundscapes are similarly designed. These twelve Reykjavik environments are a mix of overlapping natural and human sounds.

I followed Schafer's sound classification: nature, music, indoor, transport, mechanical and society. [8] (Figure 6).

When I analyzed the sounds collected, and I tried to find an analogy between the sounds of the city and music sound of nature or musical instruments.

I used Praat software to compare the sound spectrogram and to find strong analogies between sounds in order to classify and compare music spectograms and soundwaves to the sounds of the city. This was done in order to discover the essence of the sound, indentifying similarities and differences, and analyzing shapes, data and patterns.

I classified sounds according to physical characteristics (figure 7). The first parameter I examined is that of pitch. According to the physics work of Campbell and Greated, pitch is used to define the quality of a sound that to understand if the sound is "high" or "low." Sound, in acoustics field, is a property of the vibration of particles in a medium.

8 Schafer, R. Murray. *The Soundscape.* Rochester: Destiny Books, 1977.

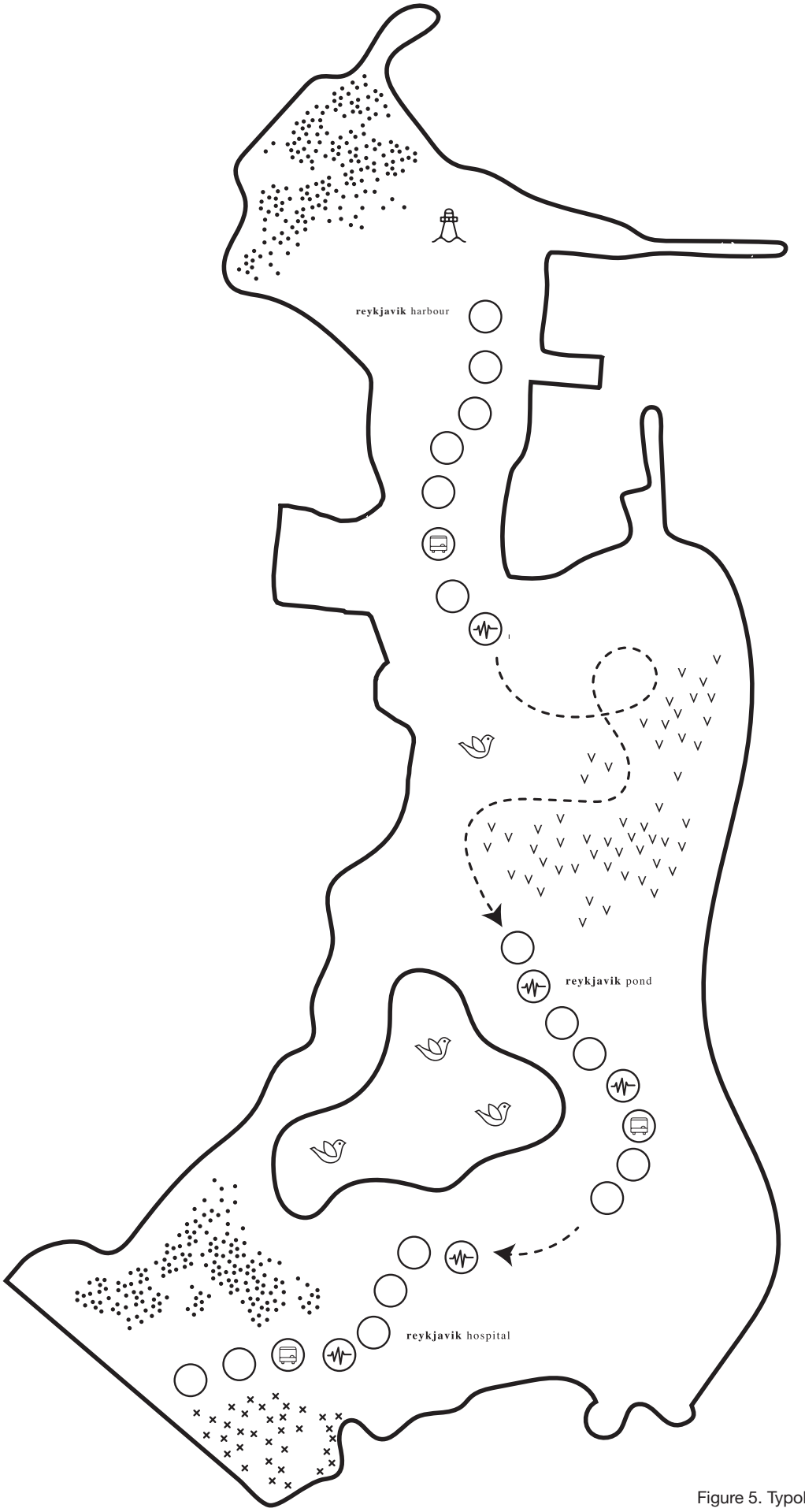


Figure 5. Typological areas.

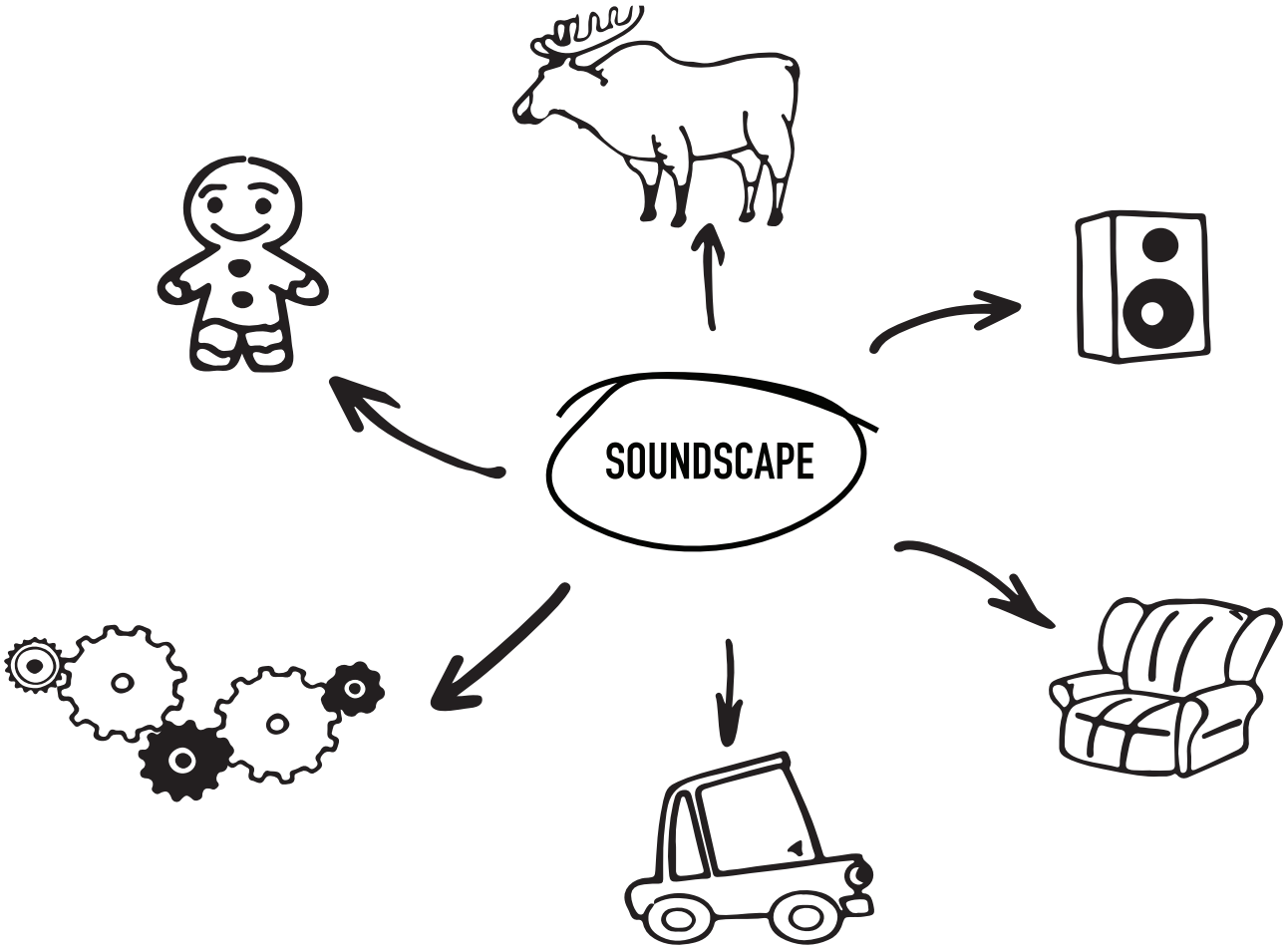


Figure 6. Schafer's sound classification: nature, music, indoor, transport, mechanical and society.

Jeremy Starpoli observes,

> A sound created in air is a vibration of the air particles themselves, acted on by the expenditure of energy. This energy displaces the air particles immediately around it, causing them to crowd the adjacent particles, thereby increasing the pressure. When the original particles return to their position, this causes the second set of particles to follow, which decreases the pressure in that area. This alternation of compression and rarefaction causes a wave, much like the ripples of a stone thrown into a pond. The sound wave expands out into air in all directions, and loses energy by being absorbed by surfaces, eventually dying out unless more energy is expended at the source. If we graph the displacement of energy over time, we can view the waveform of a sound, which is one of many useful visual representations in sound analysis. For a sound to be heard as a pitch, it must consist of many cycles of a sound wave, and one cycle of the wave is the return of a particle to its origin after being displaced in both positive and negative directions. The number of these cycles per second determines the frequency of the wave. The standard unit of measurement of frequency is the Hertz (Hz), a term synonymous with cycles per second. If a cycle repeats itself exactly over a specific time interval, known as the period, then the resulting wave is called a periodic wave. Mathematically, the simplest

> example of a periodic wave is a sine wave, which theoretically repeats indefinitely over time, therefore having a constant frequency. A sine wave that has a frequency of 440 Hz, for example, causes the air particles around it to be displaced from their original positions (in both directions) 440 times in one second.[9]

The intensity of a sound is represented visually on the spectogramme. The horizontal axis (x) represent the time (t), the ordinate axis (y) represent the frequency (Hz). The intensity of the sound, in my anlysis, is represented in gray scale. Higher intensities of color correspond to a higher intensity of sound. Using soundwaves and spectrograms, it is possible to find similarities and differences between two sounds. I used this analytical method to find similarities between sounds that may appear very different on a superficial level.

In my research I was looking for something related to the brain activities. I would like to understand if the brain reacts to sound in different way when we know what sound is and if we are prepared to receive knowledge from that.

Engineer and researcher Kyriaki Kalimeri is studying how brain waves change for the blind during a walk through the city of Reykjavik.

I analyzed her research to understand the user experience of the virtually impaired when navigating in unfamiliar outdoor environments assisted by mobility technologies. She proposed a framework for assessing their cognitive-emotional experience based on ambulatory monitoring and multimodal fusion of electroencephalography, electrodermal activity, and blood volume pulse signals. [10]

I decided to use the same instrument (a Scientific Contestual EEG) to detect how the brain works in the presence of city sound.

To understand the reactions of sensors to sounds, I traced the path I soundwalked with a Brain Computer Interface and Scientific Contextual EEG to map my brain activity and its changes to the onset of a noise. Given the practical constraints involved in an outdoor mobility study, EPOC+ was chosen because it provides a good compromise between performance (i.e. number of channels and scientific validity of the acquired EEG signals) and usability (i.e. outdoor portability, preparation time and user comfort) with respect to other commercial wireless EEG systems (Figure 8).

9 Jeremy Starpoli. *A method of musical composition based on sound analysis.* (Amherst: Hampshire College, 2002). 12-13.
10 Saitis Charalampos and Kyriaki Kalimeri. *Identifying Urban Mobility Challenges for the Visually Impaired with Mobile Monitoring of Multimodal Biosignals.* (Turin: ISI Foundation, 2016.)

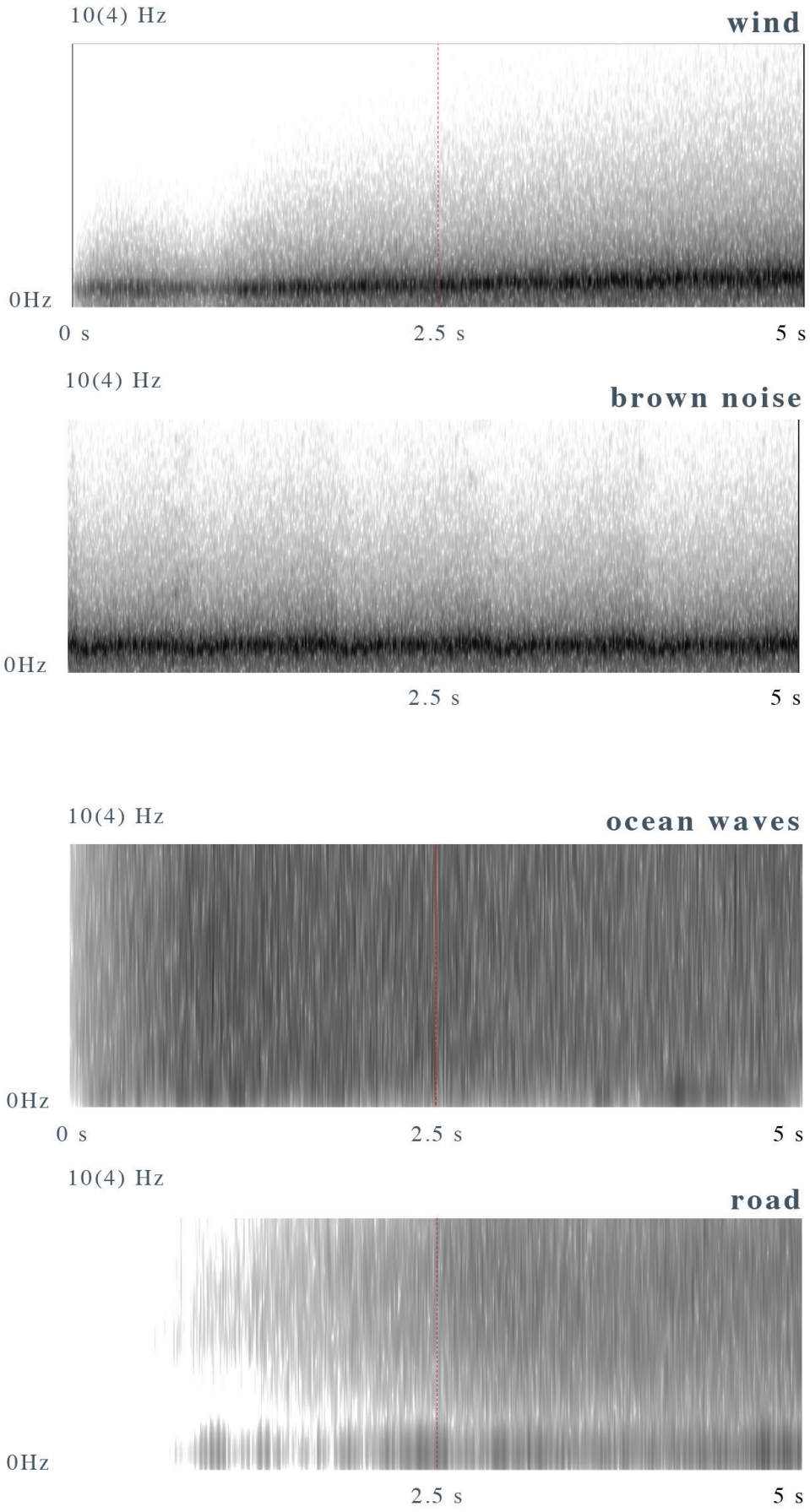


Figure 7. Sound analysis.

The results have been amazing for me. A known sound, although strong or sudden, creates a minor reaction, and therefore less stress, compared to an unknown sound.

At this point, I began to translate the data at my disposal into the journey rules.

As explained by Darren Copeland and Nadene Thériault-Copeland,

People can shape ideas about the world and themselves just by listening to the associations triggered by sounds. Here is one example:Is it true that the blind live in their bodies rather than in the world? I am aware of my body just as I am aware of the rain. My body is similarly made up of many patterns, many different regularities and irregularities, extended in space from down there to up here. These dimensions and details reveal them- selves more and more as I concentrate my attention upon them. Nothing corresponds visually to this realization. Instead of having an image of my body, as being in what we call the "human form," I apprehend it now as these arrangements of sensitivities, a conscious space comparable to the patterns of falling rain.(…) On the basis of such listening, can one ever approach the enormous task of reading the acoustic environment as a record of social experience? [11]

Following Copeland´s work, and by analyzing the data I collected, I understood how the perception of sounds is strictly linked with knowledge: two sounds can be regarded as similar in their structure and, heard in a neutral environment, they can be considered very closely. Yet the same ear may perceive sounds as good or bad depending on their context. Once you understand the sounds and recontextualise them

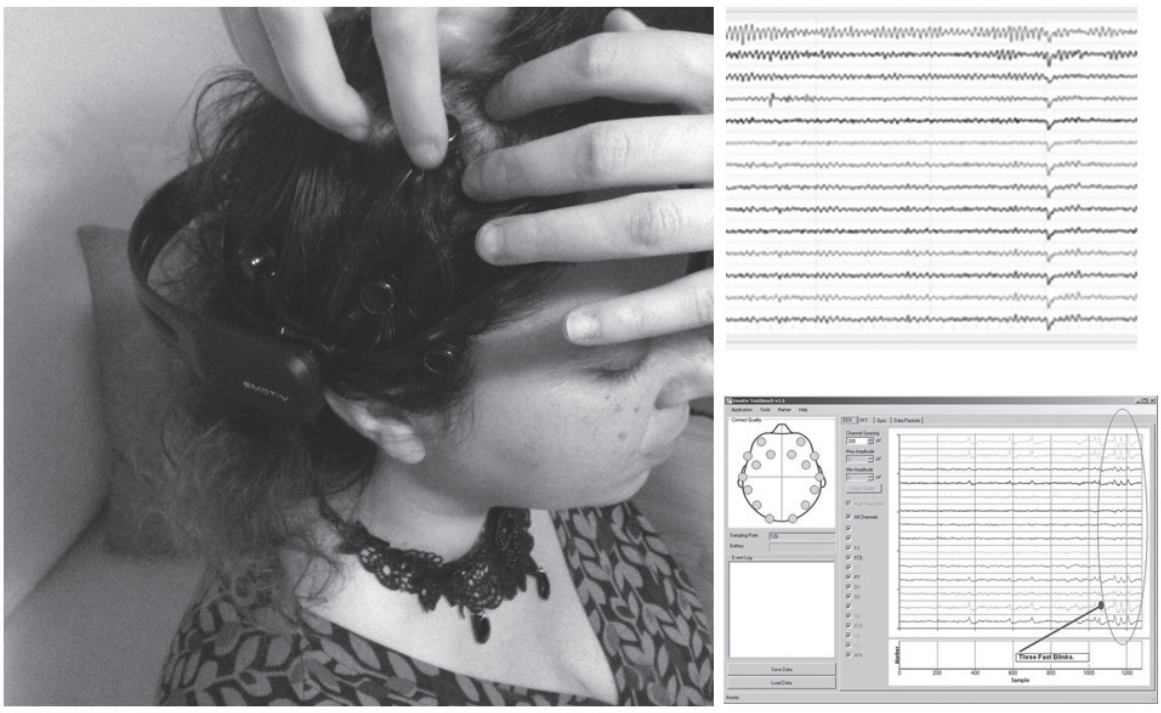


Figure 8. EPOC+. *(Ph. Fabio Del Percio)*

11 Darren Copeland, *http://www.darrencopeland.net*. (retrieved 2/03/2016).

in a new environment, their perception will be different again.

I began to understand how to tell a story using sounds as protagonists, placing them in different contexts and comparing them to each other, which can be a valid exercise of understanding and reworking the soundscape. Players of the Journey I have designed will be able to understand the problems of the city and find solutions through the similarities between sounds, using their comprehension of sound.

Originating as an investigation into the soundscape, this Journey, called Reykjavik

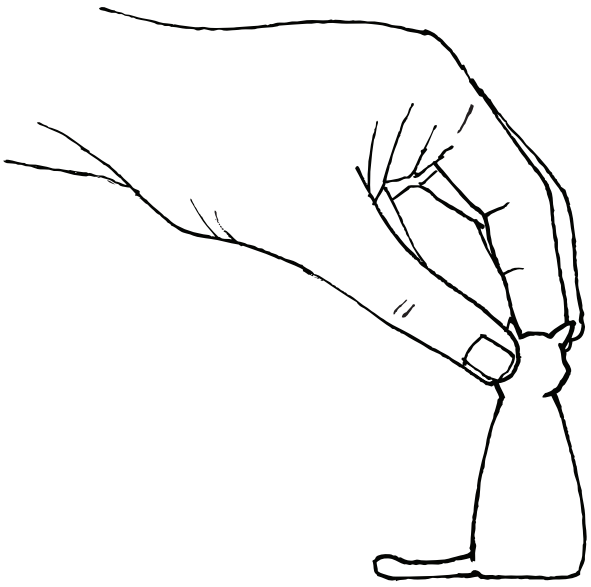
Soundscape, is a joyful way to understand and transform the soundscape of the city. It is a vehicle for creative expression.

The Journey through sound offers a stimulating context which encourages open-mindedness, cooperation and creativity. It is a fun educational tool for creative people. It enhances creativity, and also promotes idea generation and design thinking, while raising awareness of environmental and social issues.

The experience is developed through the use of storytelling. The storytelling methodology is the use of narrative procedures in order to better promote human values and ideas, and focuses on influencing social dynamics. Through the narration, it is possible to create a reflective tool for interpreting reality.

Storytelling is a tool used to penetrate deep into the causes and reasons of events, details of which are recounted build a story, become real and determine the story itself. Sound can be used to perceive the world, the city and the environment. It can be used for design, using improvised mental association and ideas. This project illustrates that sound is a good way to provide users tools for making decisions, judgments and interventions. Many tests were done for the first prototypes. I played with some designers and some sensory and visual data engineers. The designers helped me to improve the rules of storytelling. The engineers helped me to compare in better way the sound and data to arrive at the final result.

RULES



THE JOURNEY INCLUDES:

1 playing board
6 markers
60 SOUND cards
60 SITUATION cards
1 hourglass
1 die
1 guidebook

INTRODUCTION:

The *Reykjavik Soundscape* is a joyful way to understand and transform the Soundscape of the city. It is about looking at the sound and create experience, seeing reaction and perception. The *Reykjavik Soundscape* is appropriate for players age 14 and older. It can be played by two to six players. The *Reykjavik Soundscape* encourages openness, cooperation and sharing. It is a fun educational tool for creative people. It enhances creativity, and also promotes idea generation and design thinking, while raising awareness of environmental and social issues.

PREPARATION:

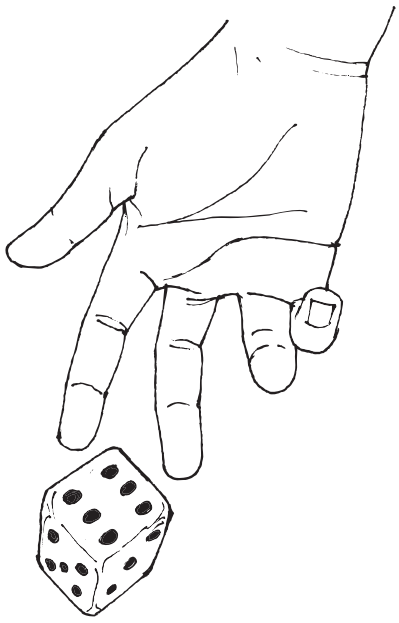
Players each need a pen and paper.

- Set the board so that each player is seated in front of one city walking path.
- Shuffle each cards deck: Sound cards and Situation cards, face down, on the appropriate location on the Journey Board.

GROUP PLAYING FOCUS:

Begin by choosing a particular group issue that you are currently dealing with, one that you would like to resolve by playing the *Reykjavik Soundscape*.

Your experience in the *Reykjavik Soundscape* will provide clarity, understanding, feedback and new direction on your specific issue. The *Reykjavik Soundscape* will reach to the heart of your issue and move you as deeply as you are willing to experience.

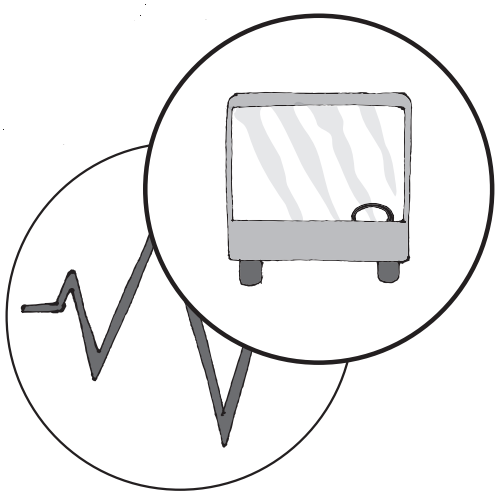


START

Players roll the die to see who gets the highest number. Whoever rolls the highest number will take the first turn. Roll the die and move forward that number of spaces with your marker. Example: If you roll a four, move your piece forward four squares. Read the symbol on the square you land on and follow the instructions for that symbol.

- NORMAL SQUARE: take one SOUND card and one SITUATION card. The player has one minute to tell a story set in the city situation where the marker on the board is located, using the reality described by the SITUATION card. The player must tell a story using the word and and a sound he considers synonymous to the one found on the SOUND card. That means sounds the player thinks are similar.
  Example: Thunder = Car Engine
  Navy sirens = Trumpet
  Ship ropes = Potato Chips Pack

At the end of the minute, all opponents must take note of the word associations made by the storytelling player. In turn, the opponents name the two words that seemed to them most suspect in the history. Then, the storytelling player reveals the words she put into the story. If no one has discovered the words, the player can immediately replay. If not, the next player will roll the die and move.



- WAVES SQUARE: Team meeting. It is time to rethink the group issue for 3 minutes.
- BUS SQUARE: The player will take a bus to go to the area indicated on the playing board.

Note: Every story has to be related in some way to the group focus.

PURPOSE OF THE Journey:

The aim of the Journey is to get to the end of the path.

CONCLUSION

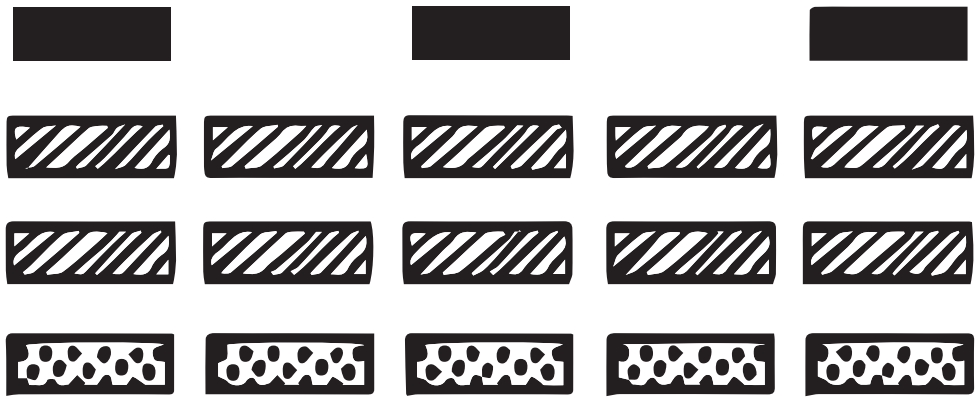
My research contributes to the growing body of literature on how people can experience the environment and, in this particular case, the city. I have researched how we can perceive sound and how we can hear the soundscape. I have tested the relationship between sound and visual representation, sound and the brain, sound and intuitive mental association and finally, I designed a tool to experience sound using intuition, design method and team work. This work examines the themes of the urban soundscape through a journey to allow others to experience it, using the design process.

A narrative journey, as I have already mentioned, that through the sound offers a stimulating context which encourages openmindedness, cooperation and creativity. A narration can create a reflective tool for interpreting reality, to penetrate deep into the causes and reasons of events.

I hope this work can empower designers, researchers, urban planners or just anyone who wants to become more aware of their experience of sound, by offering them methodological tools to rethink the role of sound. Different urban scenarios were compared, aiming to understand the soundscape, exploring the connections between sounds and perception through the cultural aspects and the rules of physics contained within sound.

APPENDIX

In the exhibition room, it is possible to hear a looped musical composition created using all the sounds that I recorded in the city and, at the same time, the bodily impulses that were recorded through the analysis of brain waves. The aim of this symphony is to represent the data I collected in the city soundscape and the human perception data and turn them into a "sound language."



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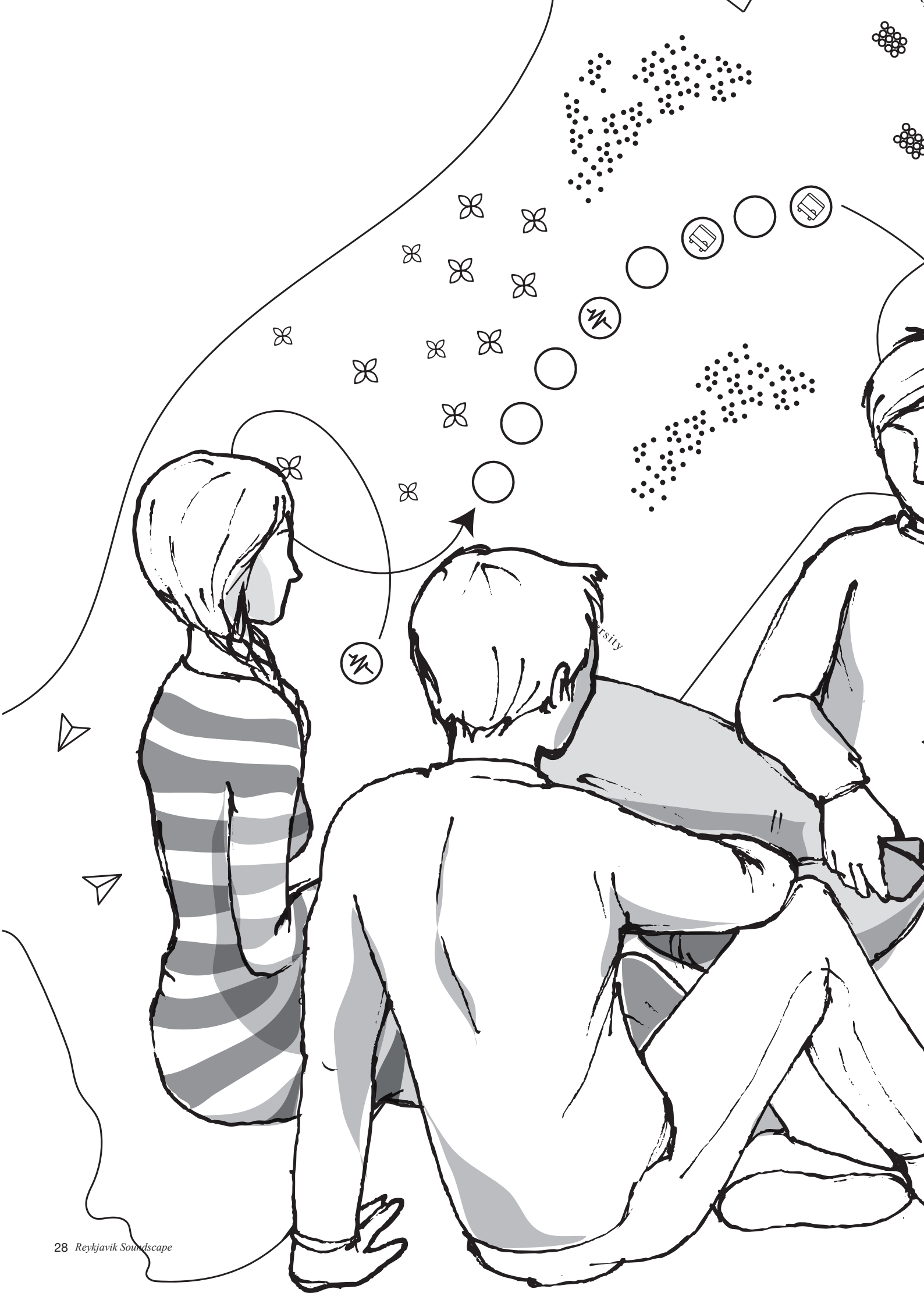


ykjavik residential district

Reykjavik Soundscape.