Soundscape Sensibility:

Developing A Sound Training Activity To Heighten Beginners' Environmental Sound Awareness

Master Thesis
Shourui Zou

TUDelft

Critical Alarms Lab

Acknowledgment

Here, I would like to express my sincere gratitude to all the people who helped me complete this project. My two supervisors, Professor Elif and Professor Stefano, gave me timely help and corrections, as well as pertinent suggestions. Without them, my project would not have reached its current level.

I would also like to thank other researchers in the field of soundscape who have helped me. Their enthusiasm has given me great motivation. I have benefited a lot from communicating with them.

As a beginner in the field of soundscape, it was more difficult for me to advance the project, especially in the early stage, compared with my previous projects, because I needed to constantly learn new knowledge and tools. This is indeed a big challenge. Although my final output (in my opinion) is not outstanding, I am still happy with my progress.

In addition, this project has greatly improved my research rigor. I realized that I was very careless and arbitrary before, and I am doing my best to correct this mistake. "Everything has its basis" is not only an important criterion in academics, but also in future work. I would like to thank my two supervisors again for pointing out my shortcomings directly and clearly.

Finally, I would like to thank my friends, classmates, and my parents for their support no matter mentally and financially.

With Heartfelt Gratitude

Shourui Zou

TUDelft   Critical Alarms Lab

Summary

This thesis mainly describes the research, design and evaluation of an activity for improving soundscape beginners' sound awareness -- Sound Detective.

For new students who are just beginning to learn about soundscape, or researchers who have just entered this field, in addition to mastering basic soundscape knowledge, it is equally important to improve their sound awareness. Sound Awareness, to be specific, is Listening to sound (hearing sounds in the soundscape), Experiencing sound (knowing what feelings the soundscape will cause and how to describe it), Understanding sound (knowing the characteristics of sounds and how we use/react to different sounds), and finally Organize sound (adjusting the sound for a better experience).

However, the current learning methods have limitations. To be specific, the limitations are lack of practice (lectures), lack of flexibility (workshop), lack of guidance (research studying), and heavy use of teaching resources (workshop). It is worth mentioning that Sound Walk, as a very pioneering soundscape learning activity, can indeed enhance sound awareness, but it is limited to the first part "listening to sounds" and ignores other parts.

Thus, Sound Detective, which is the main outcome of this thesis, is designed to act as a supplement and improvement that focusing on training beginners' awareness of sound during their studies of soundscape, in combination with other learning methods.

The thesis starts with a survey of soundscape, serious gaming, and existing soundscape-related activities and educational methods. Subsequently, the thesis conducted one-on-one online interviews with four different soundscape experts to gather information on current soundscape education practices and methodologies. Following these interviews, the results, along with previous research findings, were used to develop a design outline for future reference. Based on the design outline, the thesis proposed three different conceptual directions. These concepts were compared and evaluated using benchmarks, leading to the selection of the Sound Detective concept for further detailed design. The Sound Detective concept underwent three iterations: the first focused on refining the process, the second on visual and usability improvements, and the third on fixing detailed issues. Two rounds of user testing were conducted between the iterations. The final activity design was produced after the last iteration.

All activity props were created at a 1:1 scale and used for the final evaluation test. The evaluation invited a total of 24 participants, divided into an experimental group and a control group (12 participants each). Using the designed "Sound Awareness Test," the results indicated that through the Sound Detective activity, participants were more inclined to use various soundscape terms to describe soundscapes compared to traditional lectures or self-study. However, there was no improvement in global listening skills. Additionally, the activity enhanced participants' understanding of the specific sound environments used in the activity. Of course, the evaluation had several limitations, such as an insufficient number of participants and uncontrolled variables (test environments). While the results offer some insights, further exploration is needed in the future.

Abbreviations

ISD - International Soundscape Database

SOUND SOURCE VIDEO 56

TALKING CHATTING 35

SOUND SOURCE TABLEWARE 52

USER — ACTIVE

NAME: #J Effie 2km
AGE: 22
HOBBY: Reading
OCCUPATION: Student

MY MOOD TODAY: Happy

MY ACTIVITY

ACTIVITY

PERFECT

Watch videos on your phone

BAD

FOREGROUND — PASSIVE — BACKGROUND
BACKGROUND — PRODUCER — BACKGROUND

Character Board

FOREGROUND — PRODUCER — BACKGROUND

SOUND SOURCE MUSIC (SPEAKER) 45

Sound Token

SOUND SOURCE FANS/AC 30

Sound Token

SOUND SOURCE EATING/DRINKING 30

SOUND SOURCE

Sound Token

RATE - SOUND DESCRIPTORS
Eventful
Exciting
Chaotic

POSITIVE
NEUTRAL

PROCESS

UNIVERSAL SOUNDSCAPE

ACTIVITY

...isit and ...preciate the ...exhibits

...requiremen...
...in a mus...

— Activity Token —

SOUND SOURCE

HORNS

33

— Sound Token —

SOUND TYPE
NATURE

FEELING

I feel... POSITIVE ☐

I feel... NEUTRAL ☐

I feel... NEGATIVE ☐

RATE - SOUND DESCRIPTORS

Pleasant
Calm
Exciting
Eventful
Uneventful
Monotonous
Chaotic
Unpleasant

...OCESS

...ape, pick out and
...oken you heard.

...te down your
...Background.

...ns' Sound
...ound, using
...ard, and

...e soundscape.
...will actively look
...ll will not.

...about

...very
...the more

— Rate Board —

BACKGROUND

FOREGROUND — ACTIVE — BACKGROUND

ACTIVITY — ACTIVE

BACKGROUND

FOREGROUND — PRODUCER — BACKGROUND

— Character Board —

...TION

Table of Contents

01

Project Introduction

This chapter discusses the project's background and the definition of main problems, as well as the design approach used.

Project Introduction

1.1 PROJECT BACKGROUND

Soundscape, is the acoustic environment as perceived or experienced and understood by a person or people in context (ISO, 2014). It is a perceptual construct of our experience of a place or setting. With the development of modern cities, soundscapes are getting more and more complex, no matter in outdoor urban spaces like train stations and public parks, or indoor spaces like museums and offices (Davies et al., 2013). The idea of soundscape design was generated when people found that simply blocking noise or "negative sound" is not enough for people to feel better in those contexts (Cain et al., 2013). "Positive" sounds should be used and appropriateness should be considered. A well-designed soundscape can significantly influence the experience of people inside that environment, but yet, it is still a challenging task because rather than simply evaluating different acoustical qualities of sounds, the context of the soundscape, which can be different from one to another, is also necessary to consider (Cain et al., 2008).

Kang (2010) proposed a framework for soundscape exploration in his research, which includes both research and practice, as shown in Figure 1. It can be seen that to better design soundscape, in addition to learning necessary
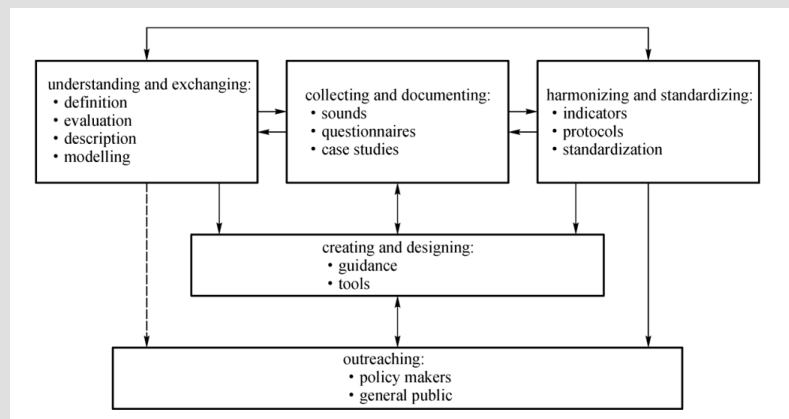

Figure 1
Kang's soundscape framework

theoretical knowledge, designers need to cultivate their sensitivity to sound and interpret sounds in different environments and perspectives, or in other words, their "awareness of sound", through continuous practice and training to help them better cope with soundscape design in different contexts.

For new sound designers, especially those who have no experience in sound design but want to start their journey in exploring sound and soundscape, traditional learning methods such as offline/online lectures and research study can be sufficient for them to learn basic theoretical knowledge of soundscape, but at the same time lacks the cultivation of perception and practice (Khalaf & Zin, 2018), which to some extend have more weight in the context of learning soundscape design. Workshops and interactive classes, on the other hand, can provide better scenario simulation and practical training to a certain extent, but it requires sufficient planning and financial budget, and is closely related to the ability of the organizer. In addition, from a macro perspective, participants follow a well-established process and do not have a lot of freedom to explore. (Baysinger, n.d.)

Serious gaming is a new way of learning. It is a relatively new discipline that couples learning design with game mechanics and logic and can cultivate areas that are difficult to reach with traditional learning methods while costing less effort for educators, providing more freedom and maintaining interests (Lameras et al., 2016). Currently, there are several researches on sound games concentrated in the field of music education, and these studies have confirmed that sound games can significantly improve an individual's perception of sound (Bégel et al., 2018; Mandanici et al., 2018). Although there are limitations to these studies, as Bégel's studies focus on blind children, Mandanici's "Rhythm Worker" (shown in Figure 2) is a long digital game that takes over three hours for one round, and both of the studies are in the field of music education, it is still exciting to explore how

a sound game design can be used for new designers during their learning of soundscape.

1.2 PROBLEM DEFINITION

The problem lies in the limitation of training designers' awareness of sound using traditional learning methods like lectures, research studying and workshops. To be specific, the limitations are lack of practice (lectures), lack of flexibility (workshop), lack of guidance (research studying), and heavy use of teaching resources (workshop).

This project goal is To explore the opportunity of a sound training activity, not as a replacement, but as a supplement and improvement, that focusing on training beginners' awareness of sound during their studies of soundscape, in combination with other learning methods.

1.3 PROJECT APPROACH

In order to reach the project goal, the following design approaches were used throughout the project in the frame of the double diamond design model.

Context Research: The context research relies on research studies and professional consulting in three domains: soundscape, serious game design, and teaching context. The framework of each domain will be explored and re-organized to determine the content of the activity and design criteria later on.

User Research: The two main groups of stakeholders, the fresh soundscape design learner and the teacher will be investigated through questionnaires and interviews. The goal of user research is to further explore the learning patterns of students with different backgrounds and the requirements of teachers to help determine the structure and general frame of the activity. The research will be mainly carried out inside the IDE faculty, but external resources will also be used if necessary.

Design Criteria: This step is of great significance before generating concepts. All the requirements and properties of the activity design will be determined to give the right direction for the next steps.

Concepts & Evaluation: Different from the original framework, concept generation and evaluation will be combined in this project, as the only way to test the concept is by playing it among testers. Then, feedback will be collected and iterations will be made. This procedure will be repeated several times before the outcome of the final concept. Prototypes for each version will be recorded (either digitally or physically) for analysis.

Refine & Reflection: The final prototype will be refined into a more mature product. Then self-reflection will be on this project to discover its advantages, limitations, and future opportunities.

02

Context: Soundscape & Serious Gaming

This chapter primarily introduces background research in three different directions: Soundscape, Serious Gaming, and existing sound field practices. Valuable insights were derived from the research in each direction, which determined the subsequent design framework.

Context Research

2.1 SOUNDSCAPE

The concept of 'soundscape' became popular in the 1970s within the field of contemporary music, advocated by Canadian composer R. M. Schafer at Simon Fraser University in Vancouver. (Aletta et al., 2016) Schafer and his associates defined 'soundscape' as "a sonic environment, prioritising its perception and comprehension by individuals or societies" (Truax, 1978). In 2014 ISO introduced Part 1 of ISO 12913, defining soundscape as "the acoustic environment perceived or understood by individuals or groups within a context" (International Organization for Standardization, 2014). Both definitions illustrate that soundscape is not only the accumulation of objective facts (sounds), but also includes different people's cognition and feedback of sounds in different contexts.

In Chapter 2 of the Book "Soundscapes: Humans and Their Acoustic Environment" (Fiebig, 2023), the author proposes a framework of three basic elements that make up a soundscape: **Context**, **Acoustic Environment**, and **People**. Among them, People are subjective factors, Acoustic Environments are objective factors, and Context provides the background and situation where the first two are located. These three exist at the same time and influence each other, forming a soundscape.

To know about People in soundscape, we need to know how listening functions in complexity. In the research of Acoustic Biotopes, Listeners and Sound-Induced Action by Özcan Vieira (2022), listening is divided into three categories: Sound oriented listening (focusing on the acoustic phenomenon and components), source-oriented listening (discovering the object as sound source), and meaning-oriented listening (how the identified sound represents certain socio-cultural and emotive concepts). This research also dives into the field of Acoustic Biotopes, which considers the general aspects of the behaviour of the species (e.g., position, locomotion,
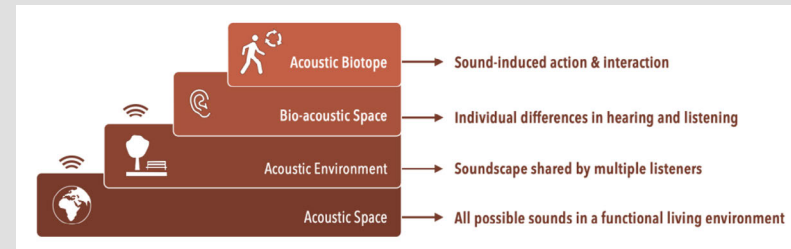
interaction possibilities) and how their sound-induced behaviour influences their actions within a specific environment, and the relationship between it and Acoustic Space (Shown in Figure 3) through an investigation inside an orthopaedic surgery room, and draws a conclusion:

> *"Listening in highly functional environments is an individual experience and is influenced by hearing function, physical position and role in an environment, and the task at hand."*

Based on these research, People, or listeners, are divided into five types: "exposed listening" by inactive listeners, "background listening" by passive listeners, "listening-in-readiness" by active listeners, "listening-in-search" by sound users and "listening-in-action" by sound producers (Özcan et al., 2022). This classification plays a key role in the design of the sound activity mechanics.

For the Acoustic Environment, there is no definite classification for objective sounds. In the book "Innovative Approaches to Noise Reduction" by Suhanek and Grubeša (2021), sounds are classified as Geophony, Biophony and Anthrophony, while in Schafer's book "A Sound Education: 100 Exercises in Listening and Sound-making" (1992) sounds are classified as Human, Nature and Machine. Sound can also be classified according to its 4 basic physical characterises: Pitch, Intensity, Harmonic/Overtone, and Duration (Feigen, 1971). Which classification method or methods to choose requires further research at a later stage.

In the research "Soundscape descriptors and a conceptual framework for developing predictive soundscape models" (Aletta et al., 2016), the author introduced the concept of soundscape descriptors to help evaluate the quality of soundscape. 8 different descriptors were given in this research and were improved and reduced to Pleasantness, Eventfulness, and Familiarity/Appropriateness dimensions in later studies. For indoor soundscape specifically, there are also Comfort, Content, and Familiarity (Torresin et al., 2020), and Engagement/Privacy and Control (Özcan et al., 2022). In the study carried out by Han et al. (2022), sound, or the Acoustic Environment mentioned above can be subjectively divided into Foreground and Background by People (listeners). Background sound (or ambient sound) tends to be quieter, easier to ignore, more continuous, less variable, and broader in the spectrum, while foreground sound tends to be louder, more intrusive, composed of recognisable events, changeable, located in particular frequencies. And each elements of sound in these two categories are rated as Positive, Neutral, and Negative, based on soundscape descriptors (shown in Figure 4). These studies show the influence of subjective factors on the classification of Acoustic Environment and provide evaluation methods for soundscape.

Figure 4
Study by Han et al.

In Part 1 of ISO 12913, ISO defined the Conceptual Framework of Soundscapes (shown in Figure 5), which explains the relationship between People, Acoustic Environment and Context in soundscape.

Figure 5
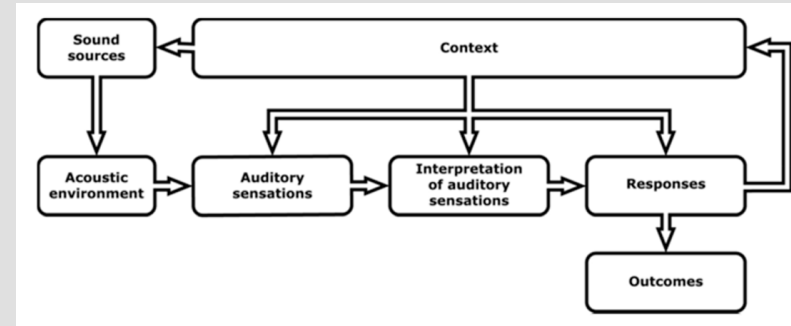*Soundscape framework by ISO*

Based on this framework, and all the studies and research done, a more detailed framework of soundscape, focusing on the logic and relationship between each factor in the soundscape, as well as the potential elements in the activity design, is made (shown in Figure 6). This framework will be the core of the sound activity design.

Figure 6
Detailed soundscape framework

2.2 SERIOUS GAMING

Laamarti et al. (2014) define serious gaming after combining several previous research and arguments as an application with three components: experience, entertainment, and multimedia, as shown in the diagram of Figure 7.
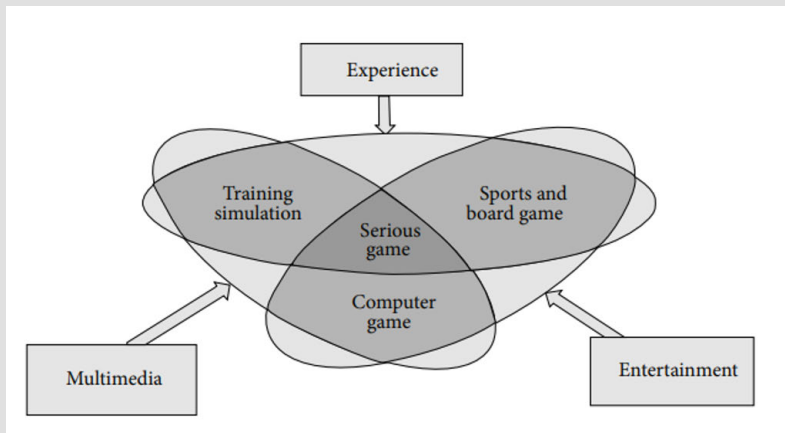
This model well explains the relationship between entertainment and education in serious gaming, and does not limit serious gaming to the category of video games like other studies (Zyda, 2005).

Laamarti also classifies serious gaming based on five characteristics: Application area, Activity, Modality, Interaction Style, and Environment. The detailed taxonomy is shown in Figure 8. Laamarti also explained each of the classifications in the study, but no further details will be given here.

According to the goal of this project, some characteristics can already be determined. The Application area will be Education and Training, the Activity will be Mental, and the Modality will include Visual and Auditory. Other aspects remain to be discussed.
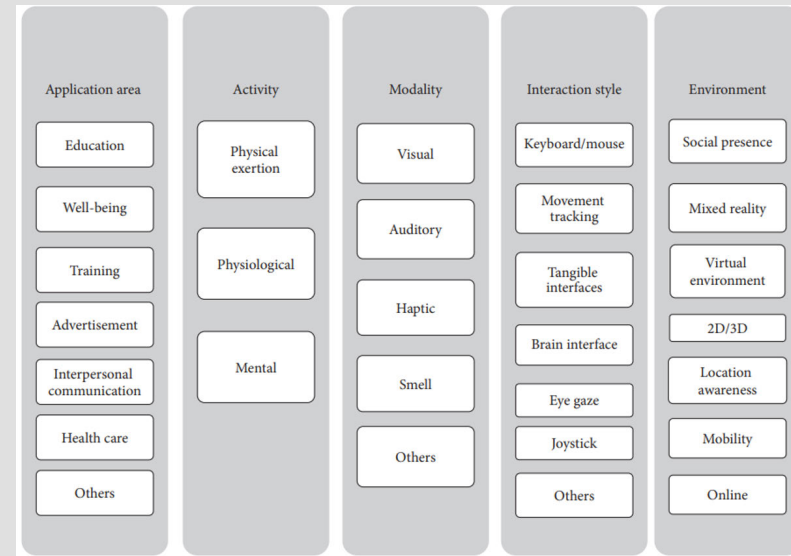
Based on this research, a deeper study on Educational Serious Game has been carried out. In the study "A Model-Driven Framework for Educational Game Design" (Roungas & Dalpiaz, 2016), the author introduces a framework focusing on the relationship between education and gaming based on computer games (Shown in Figure 9). This framework explains the logic of educational games and how it can influence the player.

Xue and Desmet (2019) explored the role of introspection in learning and design in their study. Introspection is an ongoing process of tracking, experiencing, and reflecting on one's own thoughts, mental images, feelings, sensations, and behaviours. Let designers take the first-person perspective as the observer position and collect their own subjective experiences as rich and accessible data for analysis can significantly improve their design. The author divides introspection into five types, among which Researcher Introspection (the researcher serves as the sole introspector) and Interactive Introspection (both researchers and subjects

Figure 9
Serious game
framework by
Roungas

engage in introspection and actively share introspective data and insights) have development potential in this project.

Based on the above research, I summarized it into a framework for the activity design of this project (shown in Figure 10). It simplifies the relationships between each objective, but enumerates the key elements required to complete the design.
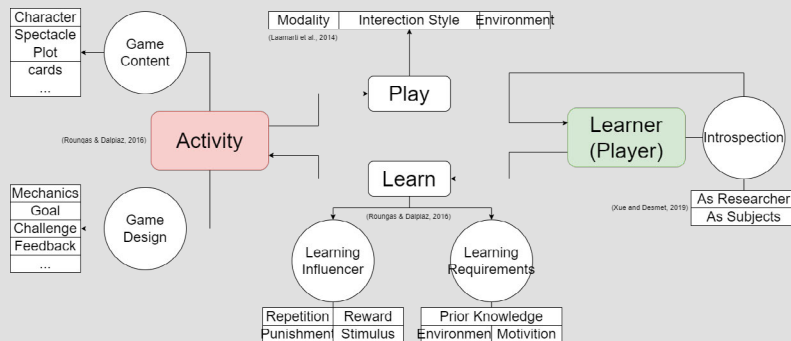
Figure 10
Activity
design
framework

2.3 SOUNDSCAPE TEACHING

In 1992, R.Murray Schafer, who is also the one who first defined the concept of soundscape, published a book named "A Sound Education: 100 Exercises in Listening and Sound-Making" to help beginners get acquainted with sound and practice their listening. Below is a summary of each exercise.

- *1-5 Sound classification, objectively and subjectively. Moving sound simulation.*
- *6-10 Outdoor busy street listening. Focus on one category of sounds and count. Then footsteps. Then walk around and listen.*
- *11-12 Indoor, listen to people walk up and downstairs. 13 A Listening Walk with 20 questions.*
- *14-16 Write a Sound Diary.*
- *17 Silence practice (while writing the diary). Do not talk for ideally 24h.*
- *18-20 Special sounds for identifying persons/things.*
- *21 Concentration exercise.*
- *22-23 "See" by listening. Cover your eyes and listen. Better talk with real blind people.*
- *24-25 Hearing and Seeing: Things you can hear but can't see and vice versa.*
- *26-28 Hearing and Seeing: sounds that are attractive but come from visually unattractive sources and vice versa.*
- *29-35 Imagine exercise. Try to imagine a sound under a scenario and the scenario itself.*
- *36-39 Find a sound that meets the requirements. From easy (1-2 requirements) to hard (4-5 requirements).*
- *40-42 Match sounds with images. What it will "look like"? What would be the colour? Then think of sounds using images.*
- *43-45 Nature concerts. Use our own voice to reconstruct the sounds in a scenario.*
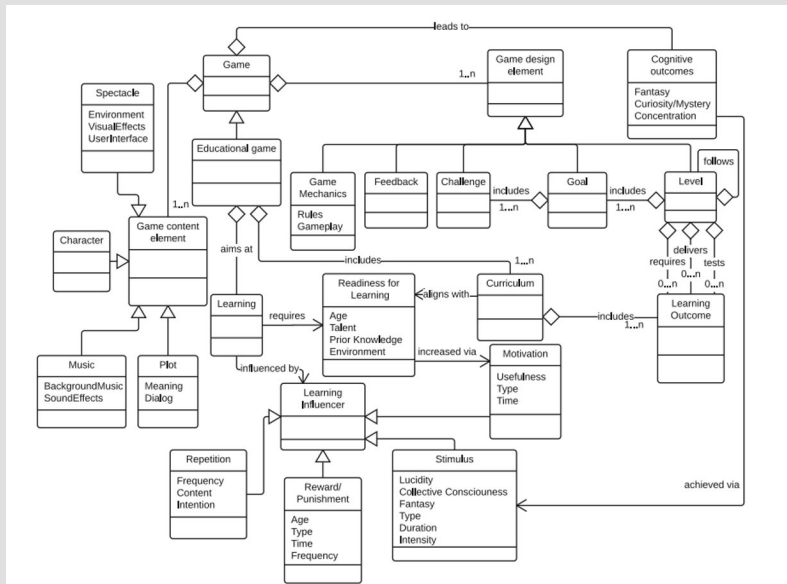
- *46-48 Onomatopoeia theory. Invent your own words to describe a thing/sound.*
- *49 Use the voice to give directions without using words.*
- *50-51 Name game. Use sounds to call someone's name.*
- *53-54 Group up game. Each group must locate all the other members of their own group by making the appropriate animal sounds and listening for those that correspond.*
- *55-59 Sound imitation.*
- *60 Tell a well-known story without words, with sounds alone.*
- *61-63 Aural illusions and ghost sounds, sound paradoxes.*
- *64-69 Locations where the environment modifies sound in an exceptional way either by reinforcing it or cancelling it. How a soundscape designer could shape environments to produce desired acoustic effects. Use a recorder. (Record the same voice speaking the same text in a dozen different environments).*
- *70-73 Silence exercise. Complete tasks without making sounds.*
- *75-77 Aural memory training.*
- *78-81 Soundscape in the past. The old sounds that don't exist now but are still in one's memory.*
- *82 New sounds nowadays.*
- *83-86 Noise: Law investigation, come up with your laws.*
- *87 Sound marks.*
- *88-91 Soundscape design: Add a pleasant sound and delete an unpleasant sound from your own perspective.*
- *92-95 Soundscape design: Parks.*
- *96-97 Soundscape design: Street.*
- *98-100 3 games to involve as many people as possible in considering the community soundscape: Sound Treasure Hunt, Sound Walk, Sound Mobile.*

In the book, Schafer pointed out three stages of sound training: "First. we learn to listen; then we learn to think about sounds; and finally we begin to organise them in more satisfying patterns." So the 100 exercises in the book can be divided according to these three stages: 1-39 Listen, 40-82 Think, 83-100 Organize. Below are the insights gained from these exercises:

1. *This book provides a detailed definition of "awareness" in this project: Listening to sound (capturing all the sounds in the soundscape), Experiencing sound (describing the soundscape based on our own or others' perception of it), Understanding sound (knowing the characteristics of sounds and how we use/react to different sounds), (plus) Organize sound (adjusting the sound for a better experience).*

2. *The classification of sound sources can be very general, but at the same time, it can be very detailed. The classification in the framework above is broad. The specific degree and method of classification need to be judged based on the size of the activity.*

3. *Blocking other senses, especially vision, can improve auditory sensitivity and concentration.*

4. *Each individual experiences the same objective sound differently. But as far as groups are concerned, some subjective feelings that a sound can cause are universal. (This has also been confirmed in previous research on sound descriptors). It will be crucial in future design to familiarize beginners with the universal feelings, while also knowing about other different feelings of themselves or other individuals.*

14

5. *In the above framework, due to the complexity and diversity, there is no classification or summary of Context. However, selecting a few representative contexts can better plan the activity process and mechanism. (Like the two major examples in the book: park and street corner)*

But at the same time, this book also has certain limitations. The biggest point is that this book focuses more on intuitive judgment rather than systematic judgment on hearing training and on understanding and designing sounds, as it hopes readers can design the soundscape based on their own feelings at the end of the book. These two ways of judging need to be better balanced and neutralized. Secondly, due to age and technology, most of the exercises in this book need to be carried out in the real field, or involve a large number of people, or last for a long time. How to use modern technology to optimize activity venues and processes requires in-depth exploration after further investigation of the classroom environment and teacher needs.

03

Interview: Soundscape Experts

This chapter primarily presents interviews with four experts in the field of soundscape. It includes the purpose of the interviews, the interviewees, the interview results, and the insights gained.

Interview

3.1 RESEARCH AIM

After preliminary research and summarizing a series of frameworks, I have certain ideas and references for the logic and composition of this design. However, I still need a more specific understanding of **how sound awareness is practised today and what to pay attention to during training** to further determine the mechanism and details of my design. This is the goal of this interview.

3.2 TARGETS & METHODS

This interview is aimed at researchers, designers and lecturers in the field of soundscape. The interview method is online video interview. Eventually, the following four people accepted the invitation and agreed to be interviewed:

ELA FASLLIJA

Postdoctoral Acoustic Researcher
Interior Architecture Environment
6 years exp.

FRANCESCO ALETTA

Soundscape Researcher, Lecturer
Building Physics & Urban Soundscape
11 years exp.
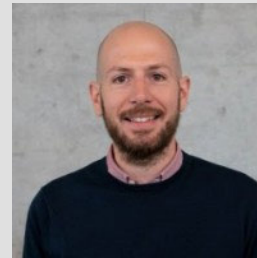
SIMONE TORRESIN

Assistant Professor
Indoor Environment & Soundscape
11 years exp.
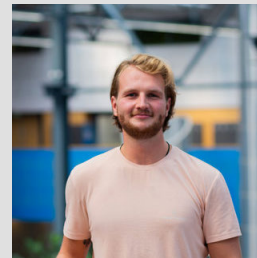
GIJS LOUWERS

Soundscape Researcher
Acoustic Environment
4 years exp.

Based on the four people's different fields, research directions, and published articles, I divided the four people's different interview focuses and wrote corresponding interview outlines:

- *Ela Fasllija: Training in listening to sounds. (Öztürk & Fasllija, 2024)*

- *Francesco Aletta: Process of soundscape design and human perception of sound. (Aletta et al., 2016)*

- *Simone Torresin: Simulation of sound. (Torresin et al., 2020b)*

- *Gijs Louwers: The investigation of the soundscape from a researcher's perspective. (Louwers, 2022)*

The interview consent form can be found in Appendix B, and the interview outline for each expert can be found in Appendix C.

3.3 RESULTS & INSIGHTS

The interview script of each expert can also be found in Appendix C.

The interviews were successful. The four experts provided diverse perspectives and very constructive feedback based on their experiences. Since the questions varied for each interview, the following sections will summarize each interview individually.

In the interview with Ela Fasllija, following conclusions are summarized:

- *Listening training for multiple people can help students learn to help each other and point out deficiencies in group learning.*

- *Sound recording can be used to restore the real soundscape, but it will cause the trouble of being unable to identify the sound source.*

- *Allowing learners to go to places they are unfamiliar with can better practice their listening skills.*

"...recordings are used, but there will be one issue: if it's a recording, that means we cannot see, and sometimes there will be different outcomes of the sound resource for the same sound."

In the interview with Francesco Aletta, he made some very interesting points during the interview and concluded as follows:

- *Sound awareness is not limited to listening to sounds, how people perceive sounds is equally important. To understand people's perception of sound requires access to a large amount of data.*

- *Recordings can only give relative results (A is better or worse than B), but cannot give people's absolute perception of a soundscape.*

- *In soundscape design, what we need to care more about is not a person's demographic, but the role they play in the context.*

- *The research results on the interpretation of the same sound descriptor by different people are only of reference value, and cannot be completely believed because the methods and questions of different studies are different, and different standards create inconsistency in the results.*
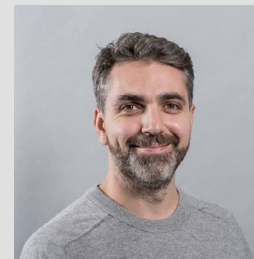
"It is impossible to fulfil everyone's needs in an open public area. So it is very important to think about the role of people in the soundscape, (for example residents and visitors) and their needs."

In the interview with Simone Torresin, the conclusion is as follows:

- *VR can be used to simulate sound fields that currently do not exist to assist design, but there are requirements for quality, and participants cannot test for a long time.*

- *Although the context of the soundscape is different, if we classify it by the activities of people in the scene, we can find the connection. People with the same behaviour often have roughly the same expectations for the soundscape.*

- *Soundwalks are a great way to train your listening skills. And it can also be done indoors.*

"...there will be some common points, at least in residential soundscape. Because even though people are in different contexts, sometimes their activities are the same."

In the interview with Gijs Louwers, his point of view is consistent with the point above, which can be regarded as a kind of confirmation, and has new and valuable points, as follows:

- *There is a database (ISD) that can be used as a reference for different people's perception of different sound fields, but the results still need to be tested by yourself.*

- *Whether different contexts are connected depends on the person's intention. This is consistent with the point from Torresin above.*

- *If researchers can stand in the perspective of the people involved and listen to the sound field with their behavioural purposes in mind, they can better understand the different perceptions of different people.*

"User research can help you find out what other people think about a soundscape, but going and listening by myself might gonna provide some new insights... people listen to sounds intentionally. It's need-driven."

These four interviews provided direction and a framework for the subsequent design. Based on the interview results, additional requirements and constraints for the activity design are summarized as follows:

- *Although the VR model is a good simulation method, it has strict requirements on simulation quality and usage time, otherwise it will be counterproductive. Based on the time schedule and resources of this project, the use of VR technology will not be considered. And because of this, going on-site to the real field is a must, because for the understanding of sound, just relying on recording without being immersive will have a completely different effect. (Fischbeck, 2022)*

- *There are many methods and means for sound design, and there are different design methods according to different situations. Therefore, it is unrealistic for beginners to learn how to design through an activity. Rather than putting all the processes into the activity, it is better to focus on training their ability to listen and perceive sounds.*

- *The entire activity will be divided into two parts: Sensitivity training and Comprehension training. These two parts cover the previous definition of awareness: Listening to sound, Understanding sound and Experiencing sound.*

- *Role-playing (let participants listen to the soundscape from the perspectives of others) is the most critical mechanic in this design.*

- *The activity will be a multi-participant event, whether conducted online or offline.*

- *The activity needs to provide participants with as much data as possible, no matter it's data collected on-site or data from the ISD.*

- *The activity needs to make participants aware of how behavioral intentions affect listening. Engaging in different behaviors within the same activity provides a method for participants to compare their experiences.*

20

04

Design Criteria: Activity Essentials

This chapter primarily introduces the criteria that the design adheres to and the benchmark for evaluating concepts. Both of these elements play a crucial role in providing overall direction for the subsequent generation, selection, and improvement of concepts.

Design Criteria

4.1 ACTIVITY BASIC FRAMEWORK

According to the research findings and the insights of the interview, a detailed framework for the design of this project is made. This framework is mainly divided into two parts: activity contents and activity settings, as shown below.

Activity Contents:
As mentioned above, the activity generally needs to be divided into two parts: Sensitivity training and Comprehension training.

The goal of Sensitivity training is to develop the ability to distinguish sounds and experience how different roles (intentions) will affect one's listening, while the goal of comprehension training is to develop an understanding of sounds and the perspectives of others, shown below in Figure 11:

The framework also identified two very important factors: Role-play and Data, and proposed two different activity formats. Among these, to go on site is mandatory, while the simulated soundscape serves as an alternative.

Activity settings:
The activity settings mainly list some basic attributes of the activity, as follows:

- **Number of Participants: 1+**
- **Pre-activity preparation/knowledge requirements: None**
- **Activity flow: Loop**
- **Activity duration: Less than 2h (Compared to Sound Walk)**
- **Participant Age: 16+**
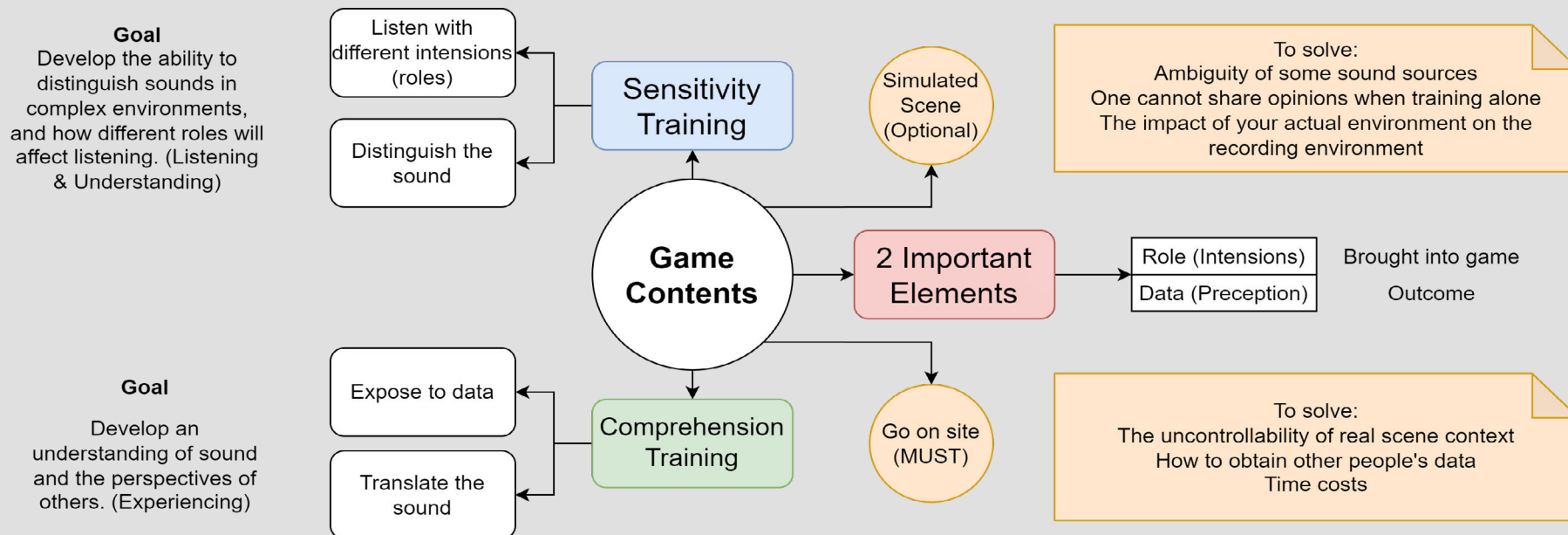
Figure 11
Activity basic framework

4.2 EVALUATION BENCHMARKS

Additionally, 5 benchmarks are purposed. These benchmarks are useful for selecting concepts and comparing them with existing solutions in the later stage, and they all have the same measure: The higher the degree the better. The benchmarks and basis are as follows:

Authenticity:
Soundscape (analogue) realism. To go on-site is the most real. (The interview with F. Aletta and S.Torresin)

Diversity:
Diversity of data acquired (scenes, demographic of people). The more diverse the data participants can access, the deeper their understanding of the soundscape will be. (Idowu & McCalla, 2018).

Accessibility:
If it is possible to discuss and communicate with other participants at any time and get mistakes fixed and questions answered in time. Quickly addressing participants' questions helps them form accurate memories from the outset. (The interview with Ela) (Ganyaupfu, 2013)

Adaptability:
Whether the final quality of learning is affected by the player's personality (introversion vs. extroversion). Extroverted individuals often can accept introverted learning styles, but introverted individuals may resist or reject extroverted learning styles. (Eysenck, 1996)

Flexibility:
If the restrictions or requirements on time, location and number of players will affect the final quality of the event. The ease of conducting the activity and achieving good outcomes are positively correlated with this benchmark.

All the benchmarks will contribute to the consolidation of knowledge after the activity, which is the main focus point of this activity design.

It is worth mentioning that I did not count the attribute "fun" as a benchmark because it is too early to consider fun before determining the activity form.

Moreover, all benchmarks can be regarded as quantitative benchmarks, scale from 1 to 5.

05

Concept: Three Directions

This chapter mainly discusses three design concepts derived from the earlier research findings. Each concept has its own characteristics and strengths. The chapter concludes with an evaluation of the three concepts and the selection of one concept (or a combination) for further refinement.

Concept Directions

5.1 THREE CONCEPT DIRECTIONS

Based on the design criteria provided earlier, three different activity concepts have been proposed. The main differences among these three directions lie in the form and process of the activities. Each concept has its own strengths and weaknesses, which will be detailed in the following sections.

In addition, the process of each concept will be compared with the Soundscape Framework summarized in Chapter 2 to clarify the significance and purpose of each step in the process.

Concept: Sound Role-play

This activity is designed based on soundwalk, but compared to soundwalk, it focuses more on comprehension training.

The activity is divided into 6 phases, including role-playing and field interviews. The flow of the activity is quite linear, and the time it takes varies depending on the organizer. The detiled process is shown in Figure 12.

Concept: Sound Role-play
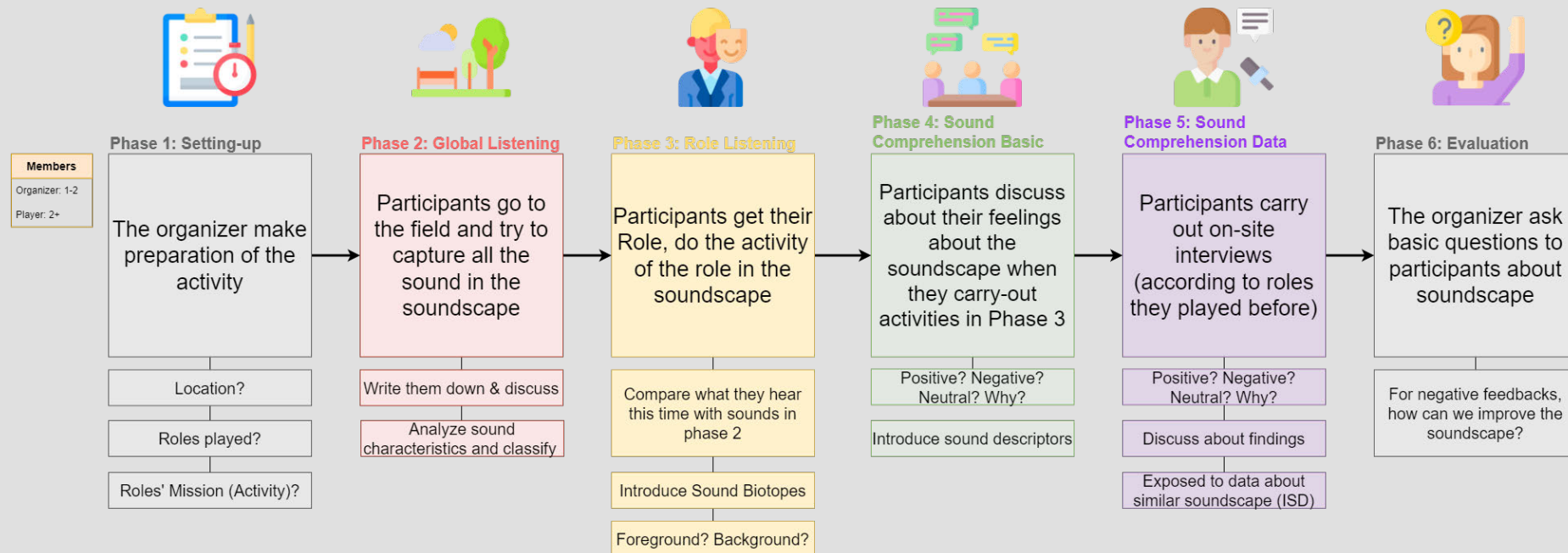
Figure 12
Concept: Sound Role-play

The relationship of this concept with the soundscape framework is shown below in Figure 13. In this concept, each step corresponds to different content.

Main Pro:
- *The scene is completely realistic.*
- *Free to ask questions and discuss at any time.*
- *Can get first-hand data.*

Main Con:
- *Not suitable for introverted participants.*
- *Because of the uncertainty of the scene, it takes repeated activities to experience a diverse soundscape.*
- *The level of organizers is closely related to the quality of events.*
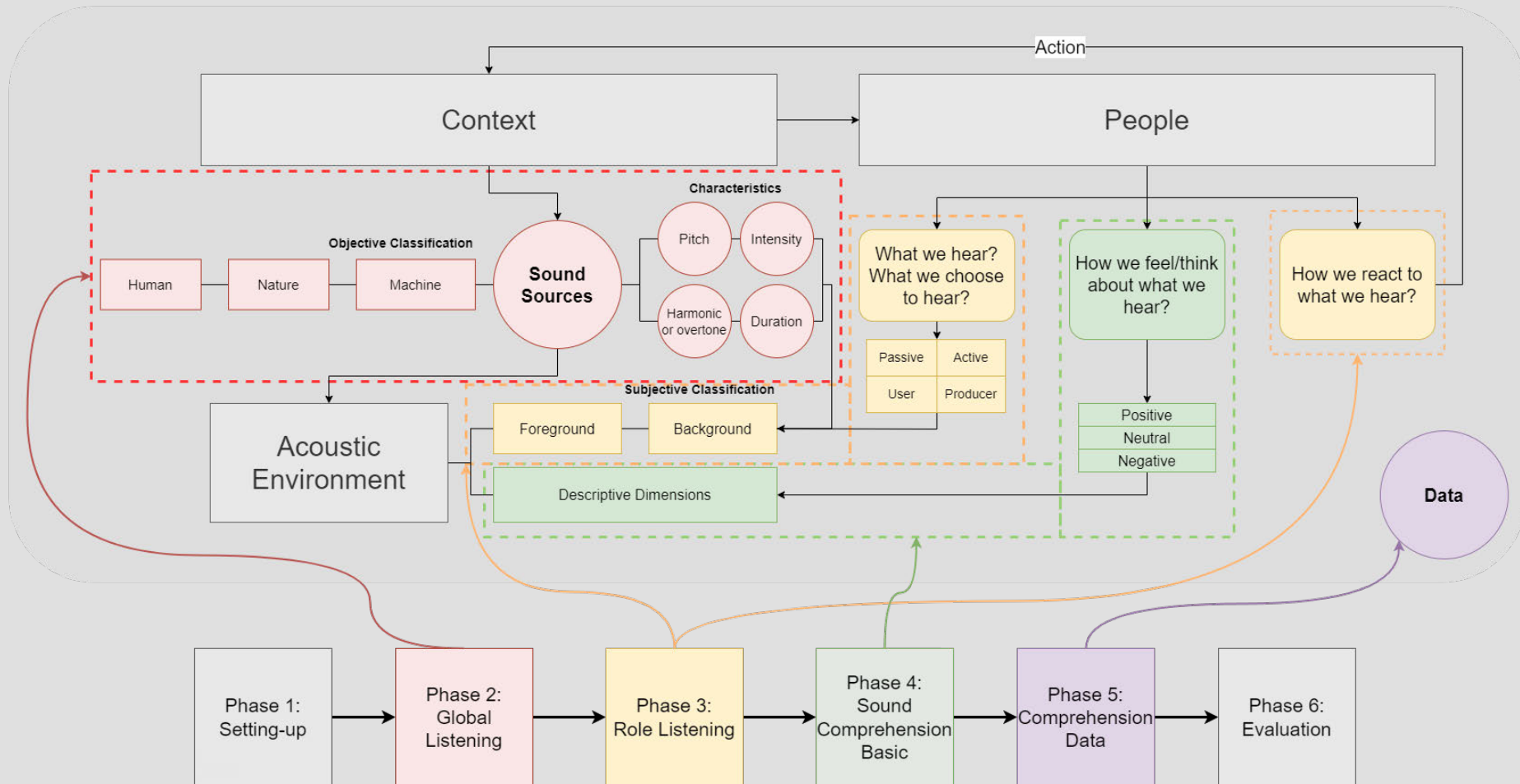
Figure 13
Sound Role-play relationship

Concept: Soundscape Forum

In this concept, the active platform is transplanted to an online platform to obtain maximum data diversity. At the same time, users can log in anytime, anywhere and perform different exercises at will according to the system's instructions. But it sacrifices some of the authenticity of the scene. The process is shown in Figure 14.

The relationship of this activity with the soundscape framework is shown below in Figure 15 (next page).

In this concept, there is some overlap between the content of the third section and the fourth section.

Main Pro:
- **A more diverse soundscape database can be obtained.**
- **Information about how people in different cultural situations feel about the soundscape.**
- **Very flexible in time and space, all depends on a personal plan.**

Concept: Soundscape Forum

Get ready	Section: Global Listening	Section: Role Listening - practice	Section: Role Listening - feedback	Section: Sound Comprehension Data	Section: Evaluation
Members / Participants: 1 — Participant open the platform and choose the practice he want to do	Participant watch the video of the scene he selected (listen to recordings) and try to capture all the sound in the soundscape	Participant go to the real scene, complete tasts within a role given by the system	Participant enter his feeling (in the system) about the soundscape that they carry-out activities in last step	Participants check other people's feedbacks and reasons on platform(same role/same scene)	System give quiz about soundscape
	Check the answer	Carry out activities, note down what they hear, record a video	Positive? Negative? Neutral? Why?	What's the difference?	
	Analyze sound characteristics and classify	Answer question given by the system on the platform (Instructed by system)	Sound descriptors	Why the difference?	
	Check the answer		Upload video as reference	Exposed to data about similar soundscape (ISD)	
	(Recordings)	(On-site)	(On-site)		

Figure 14
Concept: Soundscape Forum

27

Main Con:
- **Requires a certain base of participants.**
- **Part of the reality is sacrificed for flexibility.**
- **questions cannot be answered promptly.**
- **Backend maintenance is required to ensure the accuracy and freshness of data.**
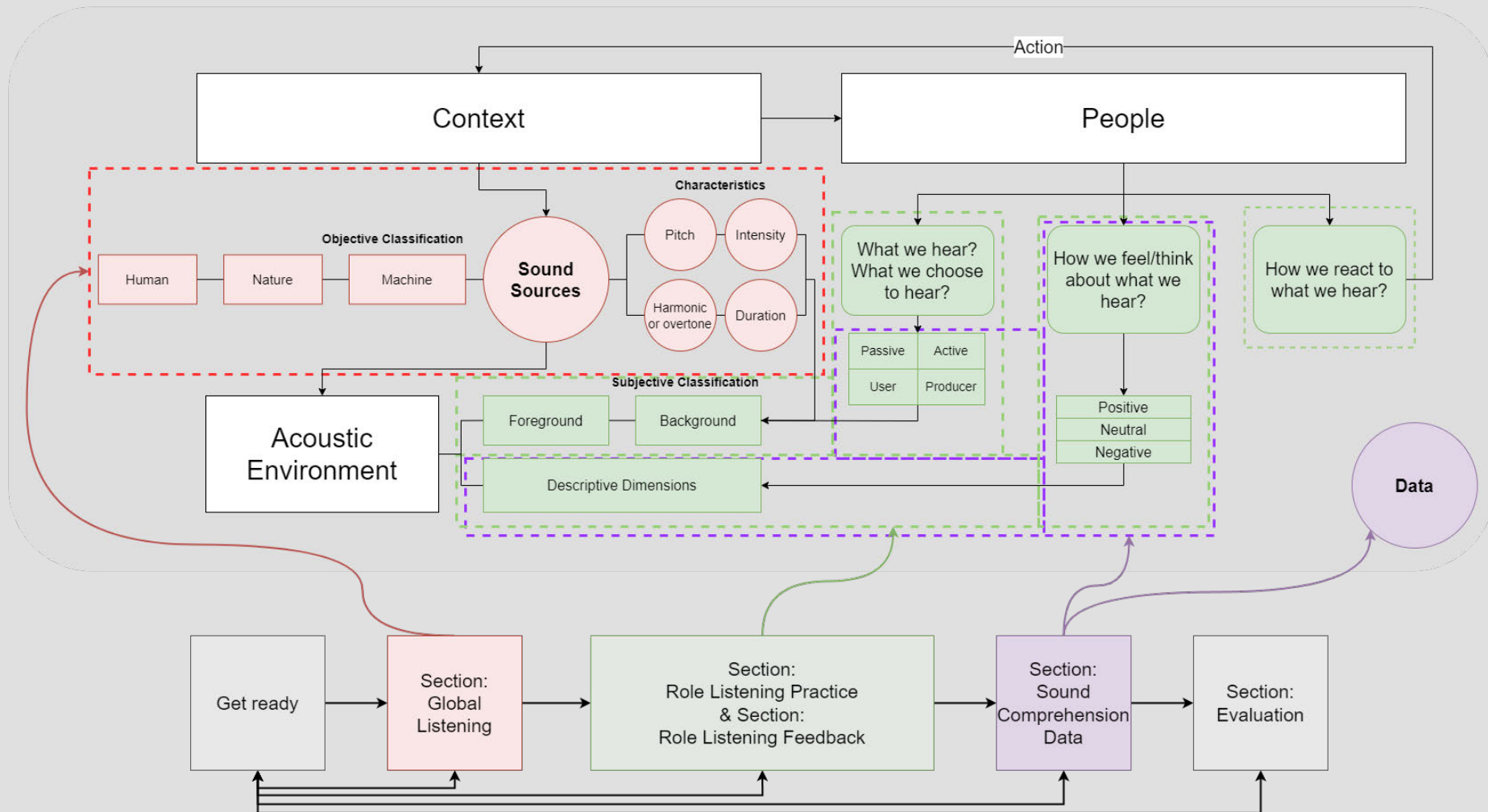
Figure 15
Soundscape Forum relationship

28

Concept: Sound Detective

The core of this concept is the Introspection (Xue, 2019) investigated in the previous chapter. Participants listen and indicate other participants' feelings within the soundscape. Each participant is both the researcher and the subject. The process is shown in Figure 16.

The relationship of this activity with the soundscape framework is shown below in Figure 17 (next page).

In this concept, there is complete overlap between the content of the fourth step and the fifth step, making it more integrated. Additionally, this concept has control over the factors related to people.

Main Pro:
- **The scene is completely realistic & can get first-hand data**
- **Players can experience multiple different roles in one event**
- **The activity process is more integrated, which helps participants sort out the relationships in the soundscape.**

Concept: Sound Detective

Step 1: Setting-up	**Step 2: Global Listening**	**Step 3: Get Demo & Activity**	**Step 4: Carry out activity**	**Step 5: Role-play**	**Step 6: Evaluation**

Members
Organizer: 0-1
Player: 4-6

Participants decide on the scene to go to

Participants go to the field and try to capture all the sound in the soundscape

Participants describe their demographic, and then randomly draw an activity

Participants carry out the activity, and note down their feelings, description of the soundscape, and sound biotopes

Participants exchange the Demo and Activity with other participants, and carry out role play

Check indication with other participants to see if it's correct

Get ready all the props

Pick out all the sound they heard

Analyze sound characteristics and classify

Age, hobby, characteristic, environment they like

Positive? Negative? Neutral? Why?

Sound descriptors

Sound Biotopes

Try to find out other participants' feelings, description of the soundscape, and sound biotopes

Discuss together

If first time, organizer can ask more questions about soundscape

Figure 16
Concept: Sound Detective

29

Main Con:
- **There is a certain limit on the number of players. (Too few – insufficient data. Too many -chaotic.)**
- **Participants need to conduct activities with different people every time as much as possible to ensure the diversity of data.**
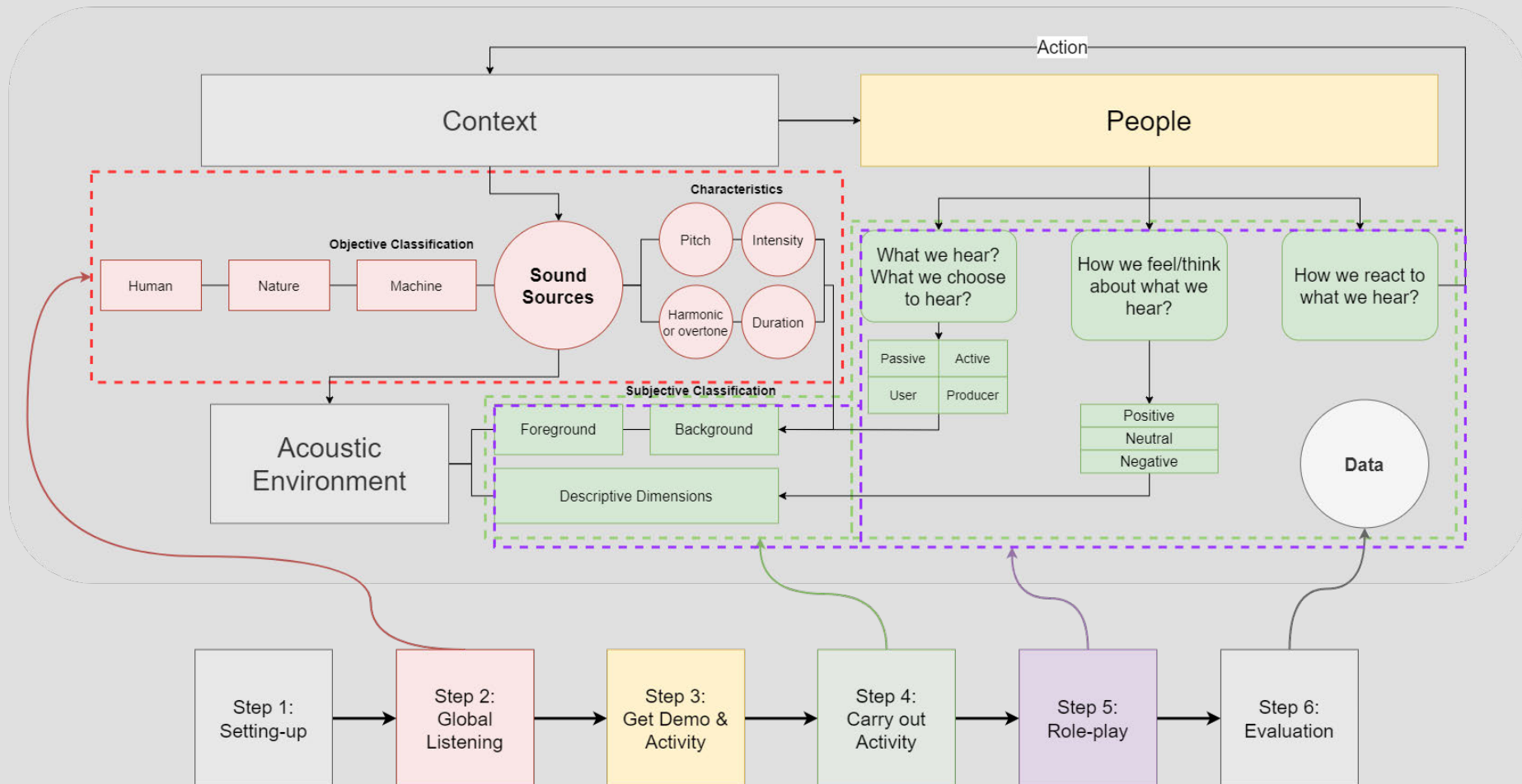
Figure 17
Sound Detective relationship

5.2 CONCEPT SELECTION

The concept selection process utilizes five benchmarks proposed in Chapter 4, each carrying equal weight. The specific ratings for each concept are shown in Table 1.

For the Concept "Sound Roleplay," Authenticity and Accessibility are its main strengths, earning it a score of 5. However, Diversity scores 2 because participants can only portray one role per session. Street interviews within the activity are unfriendly to introverted participants, so it scores 2 for Diversity. The involvement of an Organizer is necessary, and the activity quality correlates with the organizer's skill level, which imposes some limitations, hence a score of 3.

For the Concept "Soundscape Forum," Authenticity scores 1 because it cannot achieve a 100% authentic soundscape

due to the use of recordings. Diversity and Adaptability are strengths as the internet allows access to a broader range of participants and soundscapes, earning it 5 points. However, the internet's diversity poses challenges such as uncontrollable data authenticity and lack of real-time Q&A for participants, resulting in a score of 1 for Accessibility. Although the activity's process is entirely controlled by the system, participants need to record videos which may vary in quality, hence Flexibility scores 4 points.

For the Concept "Sound Detective," Authenticity is its main strength, earning it 5 points. The activity encourages but does not r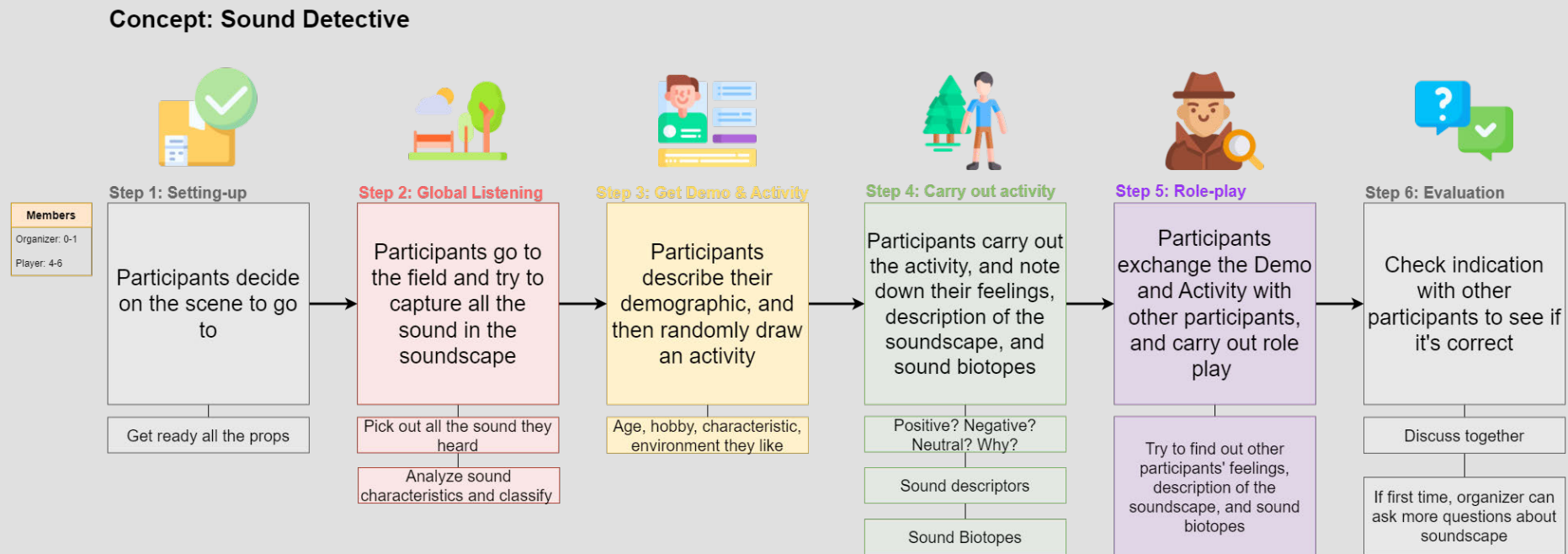equire participant interaction, so Adaptability scores 4 points. For Diversity, Accessibility, and Flexibility, this concept is average. It allows a participant to play multiple roles within the same interaction but only within the team, and it can proceed without an organizer, though the quality

	Authenticity	Diversity	Adaptability	Accessibility	Flexibility	Final Score
Concept 1 Sound Roleplay	5 (Main advantage)	2 (1 participant, 1 role, 1 interviewee)	2 (Introvert people will feel awkward)	5 (Main advantage)	3 (requirement on organizer)	17
Concept 2 Soundscape Forum	1 (Videos used)	5 (Main advantage)	5 (Main advantage)	1 (discuss and answering question are not timely and uncertain)	4 (requirements on quality of videos)	16
Concept 3 Sound Detective	5 (Main advantage)	3 (1 participant, multiple roles)	4 (Public speaking is good, but not necessary for this activity)	3 (Have people to discuss but with no organizer around questions can not be answered timely)	3 (requirement on the number of Participants)	18

Table 1
Concept scores

may decline. Due to its uniqueness, it has specific requirements for the number of participants. Therefore, each of these criteria scores 3 points.

Therefore, the final scores for the three concepts are 17, 16, and 18, respectively. To provide a more intuitive comparison of the three concepts, radar charts have been created, as shown in Figure 18.

comprehension for participants and the ability to clearly delineate relationships.

Furthermore, adjustments can be made in the subsequent design details to enhance its attributes of Diversity and Accessibility.
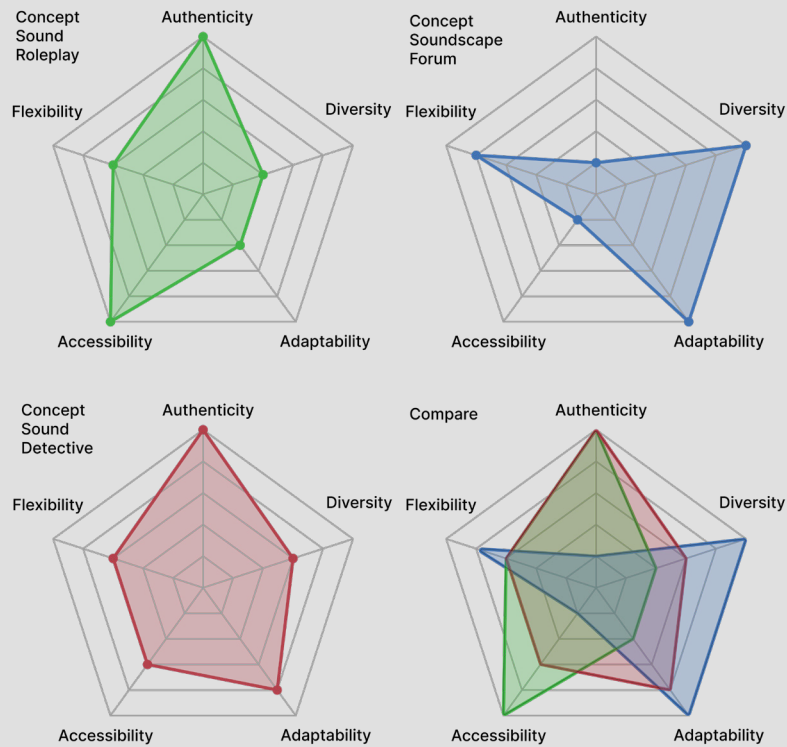
Figure 18
Concept radar chart

The final selection is the concept "Sound Detective." This concept incorporates the advantages of both "Sound Roleplay" and "Soundscape Forum" to some extent, while also possessing its unique strengths, such as ease of

06

Concept Development

This chapter primarily discusses the design, refinement, and iteration of the selected "Sound Detective" concept. It provides a detailed explanation of the design process, two user tests, and how the final design outcome was achieved.

Concept Development

6.1 CONCEPT DETAILIZATION

After selecting the "Sound Detective" concept, I refined it as illustrated in Figure 19. The figure provides detailed information on the participants, props, process, and knowledge references involved in the activity.

Activity Members

Organizer	To have an organizer will be the best for the activity, but still it's optional. The organizer can be teachers or experienced participants. The organizer can also join the game as a participant.
Participant	People who are interested in Soundscape and willing to join the activity

References

Sound Characteristics	Pitch, Intensity, Duration
Rate (Sound Descriptor)	Calm, Monotonous, Vibrant, Chaotic
Sound Type	Human, Nature, Machine
Sound Role	Passive, Active, User, Producer
Feelings	Positive, Netural, Negetive

Activity Props

Instruction Board	Provide participants with instructions for necessary activity procedures and knowledge
Rate Board	A board that allows participants to speculate on Character's Ratings and Feelings. (Based on Sound Descriptors)
Sound Token	A token representing the sound heard by the participant. It has the sound source on the front and the Sound Type on the back.
Character Board	A board that allows participant to fill in their basic information. Also, there will be space for Sound Role around the board (4 edges)
Activity Token	A token that indicate the participant what to do in the scene

Activity Process

Participant reads the Instruction Board

Organizer explain the activity process to the Participant

Participant & Organizer choose a scene to go to ← Another scene

Get ready the Props

Participant & Organizer go to the Scene

Participants listen to all the sounds in at scene

Participants pick out the sounds they heard from the Sound Token

Participants write down the sounds that are not incouded in Sound Token on the Blank Sound Token

Participants classified the Sound Token according to Sound Type, and describe their Sound Characteristics

Participants check the answer about their classification and discuss.

Organizer explain the result and give insights

Each Participant get a Character Board

Each Participant fill in the content of the Character Board acoording to themselves

Each Participant draws an Activity Token

SOUND DETECTIVE

An activity to improve soundscape awareness

Participant & Organizer decides on to go another round or change a different scene

Organizer ask questions to check the consolidation of knowledge, and answer questions

Till all the participants are selected

The selected Participant tell other participant about thier indication

Other Participant put the Sound Token they selected in last section around the Character Board according to Sound Role and Fore/Background (Indicate Sound Role, Back/Foreground) Remember to use Sound Characteristic

The selected Participant reveal his Feelings and Rate on the Rate board

One Participant put his/her Character Board and Activity Token in the middle of all the participants

Another round

Participants notedown/remember thier Feelings, Rate, Sound Role, Fore/Background

Participants carry out activity in the scene

Each Participant introduce themselves according to the Character Board, and about the activity they will carry out in the scene. This can be asked again at any time in later process

Figure 19
Sound Detective details

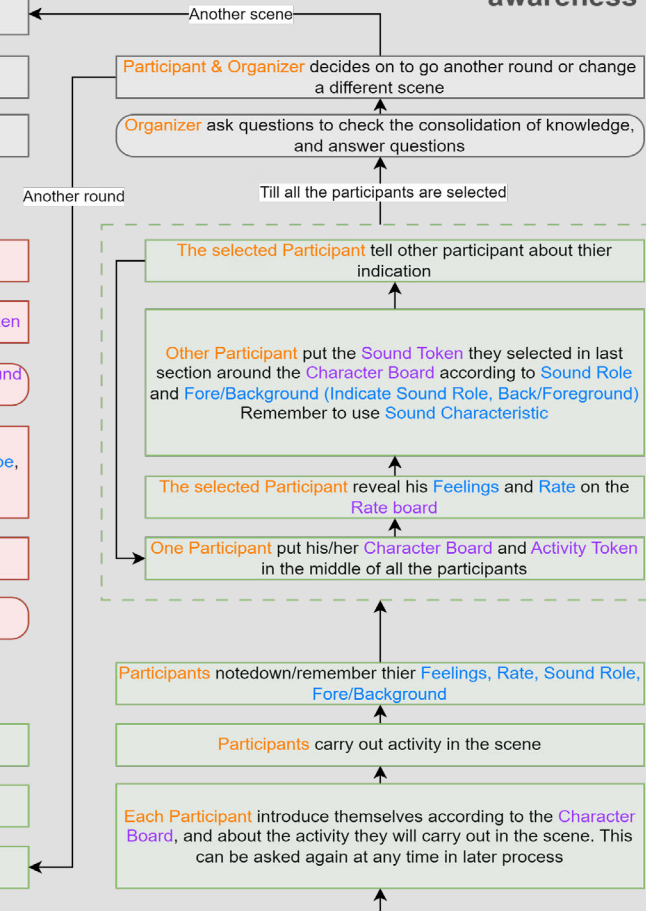Before introducing the process, it is crucial to define Sound Awareness clearly. As mentioned earlier, Sound Awareness is primarily divided into three components (the fourth component is not the focus of this activity and thus will not be highlighted):

- *Listening to sound (capturing all the sounds in the soundscape)*

- *Experiencing sound (describing the soundscape based on our own or others' perception of it)*

- *Understanding sound (knowing the characteristics of sounds and how we use/react to different sounds)*

The entire activity is divided into four main parts: **the Preparation phase, the Global Listening phase, the Action phase, and the Detect phase**. In summary, the Preparation phase involves organizing all pre-activity matters, such as setting up the scene, participants, props, etc. The Global Listening phase requires participants to try and listen to all sound sources in the environment, aiming to train participants' **Listening to sound**. During the Action phase, participants complete designated actions within the soundscape (assuming roles) while simultaneously recording and categorizing the sounds they hear (Biotopes). In the Detect phase, participants attempt to infer the sound classifications (Biotopes) heard by other participants through their descriptions and perceptions of the soundscape. Both the Action and Detect phases aim to train participants' **Experiencing sound** and **Understanding sound**.

It is worth mentioning that, in the previously discussed concept, the task of inferring participants' perceptions and descriptions of the soundscape based on known sound Biotopes Roles has been modified. Now, participants will use known perceptions and descriptions to infer the sound

Biotopes Roles. This is because individual perceptions and descriptions are highly subjective, blindly asking participants to predict unpredictable subjective feelings does not effectively enhance Sound Awareness. Conversely, after understanding subjective feelings, it is reasonable and relevant to deduce the Biotopes Roles of sounds for individuals.

6.2 PROPS DESIGN

After completing the design of the activity's process, this paper proceeds to elaborate on the design of its 5 key activity props.

Sound Token

For sound tokens, the most important thing is the choice of sound source. It must include the sound sources as much as possible when performing on-site activities. It also needs to provide interference items to provide challenges.

For the classification of sounds, I chose the categories Human, Nature, and Machine, as this method is easier for beginners to remember and understand. Recordings given in ISD are listened and the sounds that appeared in recordings are listed and categorized, as shown in Appendix D. Also, the sound sources used in Axelsson et al. (2010) experiment of exploring soundscape perception are also listed in Appendix D. Finally, I the following sound sources are selected as sound tokens:

- *Human:*
  Laughing, Shouting, Snoring, Chewing, Talking/chatting, Footsteps, Children at play, Crying, Singing, Applauding

- *Nature:*
  Thunder, Tide, Fire camp, Bird flying, Bird song, Wind whispering, Rustling leaves, Rain, Water, Pet, Non-pet animals

- *Machine:*
  Individual cars, Motorcycles, Train/tram, Bus, Music (speaker), Instrument, Construction, Siren, Luggage dragging, Ventilation fans, Cans, Airplane, Horns, Bells, Paper/Books, Bicycle, Tableware, Camera, Video, Broadcast

Although the scenes given in ISD are all outdoor scenes, this set of sound tokens also contains sound sources from indoor scenes and can be used in indoor soundscapes.

The basic layout for Sound Token is shown below in Figure 20. This layout (also the following layout for other props) is just a preliminary layout for testing purposes. Further design will be done after testing and confirming the details of the activity.
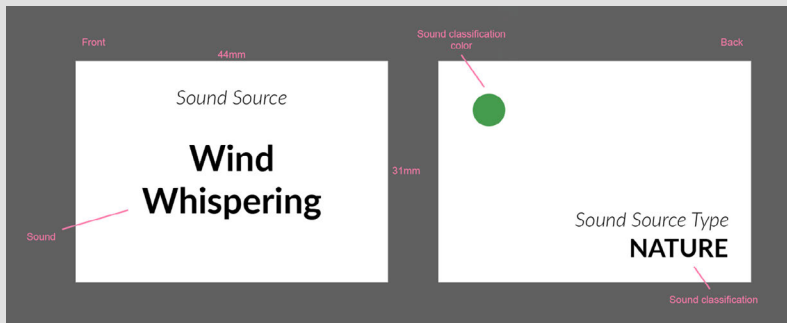
Figure 20
Sound Token Ver 1

Character Board

The character board is set according to the ISD and the interview outline of ISO. In ISD, the acquisition of personal information is as follows: Age, Gender, Ethnicity, Occupation,

Status (local/tourist/other) and Optimism.

According to the process designed for this activity, since the participants need to role-play each other and discuss, I added some attributes to help the participants understand each other better. The final result is as follows:

- *Name*
- *Gender (Optional)*
- *Age*
- *Ethnicity*
- *Occupation*
- *Hobby*
- *Optimism Score: The five questions in the ISO interview outline are used for scoring, and participants finally added up the scores for each question.*

These personal attributes will be listed on the character board for participants to fill in. At the same time, the board also needs to be printed with the four sound-using characters
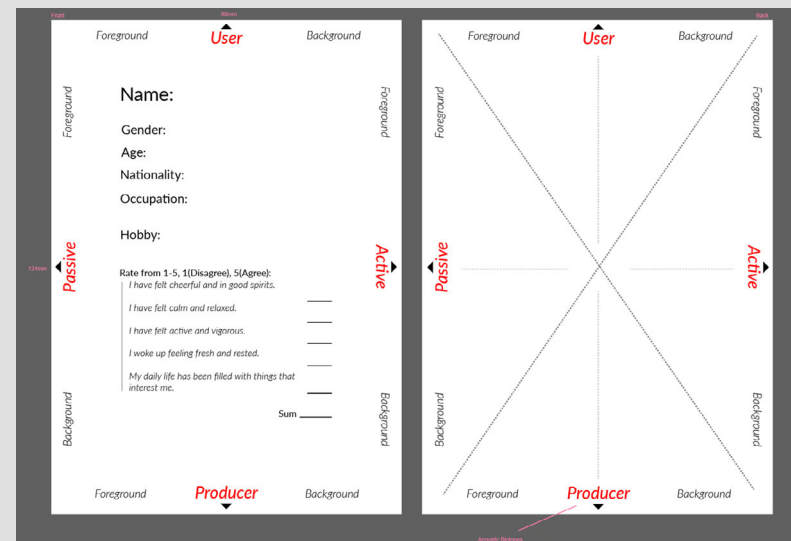
Figure 21
Character Board Ver 1

of the Sound Biotopes on the four edges.

The back of the board will be printed with the participants' feeling of the soundscape and their rate based on the sound descriptor. The basic layout for Character Board is shown below in Figure 21(previous page).

Activity Token

ISD provided relatively limited options regarding the activities performed by participants, as most of its respondents were tourists. The planning of Activity Tokens needs to consider their diversity (covering as many behaviours as possible that will actually occur), adaptability (whether it is consistent with the characteristics of the participants themselves), and comprehensiveness (considerations of acoustic biotopes).

At the same time, the setting of activity is closely related to scene, and it is difficult to directly formulate activity without scene as a reference. Thus, the scenes given in ISD and some indoor scenes are classified and summarized, and activities based on these demos are listed (see Appendix E).

After sorting, the activities for Activity Token are initially set as follows:

- *As a tourist, look around the scenery and find angles to take photos.*
- *Sit on the bench and have a rest*
- *Feed the pigeons*
- *Call someone on a mobile phone*
- *Watch videos on your phone*
- *Buy snacks at street stalls*
- *Watch street performances (Special Occasion)*
- *Go shopping, pay attention to the shops on the street*
- *Waiting to cross the street*

- *Try to call a taxi*
- *Waiting for the bus/tram/uber*
- *Walking/jogging*
- *Watch parades/public presentations (Special Occasion)*
- *Read books/newspapers*
- *Drink and eat*
- *Working on a computer*
- *Chat with friends (Multi-participants)*

The basic layout for Activity Token is shown below in Figure 22.

Front   44mm   Back

Activity

You want to go home, and you are waiting for the bus/tram/uber at the stop.

62mm

Single Person

Universal Activity

Task   Activity limitations (Applicable scenes)
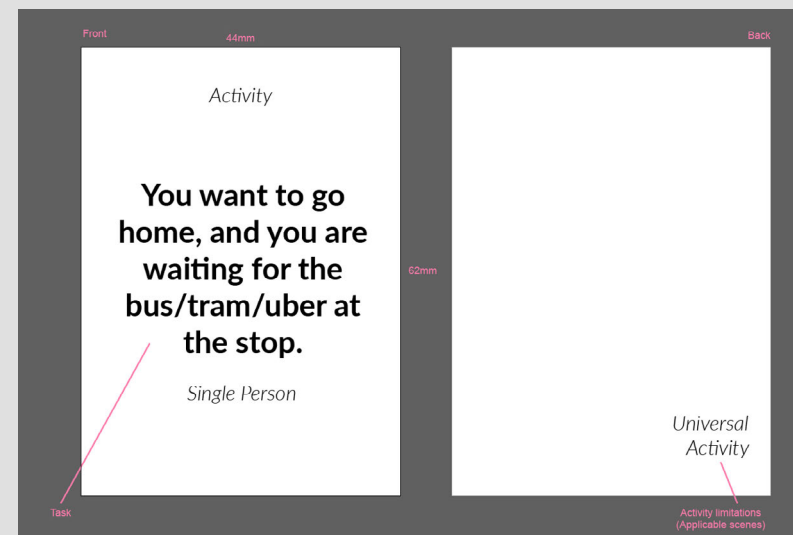
Figure 22
Activity Token Ver 1

Rate Board

For Rate Board, it only serves as a reminder in the activity flow and fully refers to the rate standard of the sound descriptor. The basic layout for it is shown below in Figure 23 (next page).
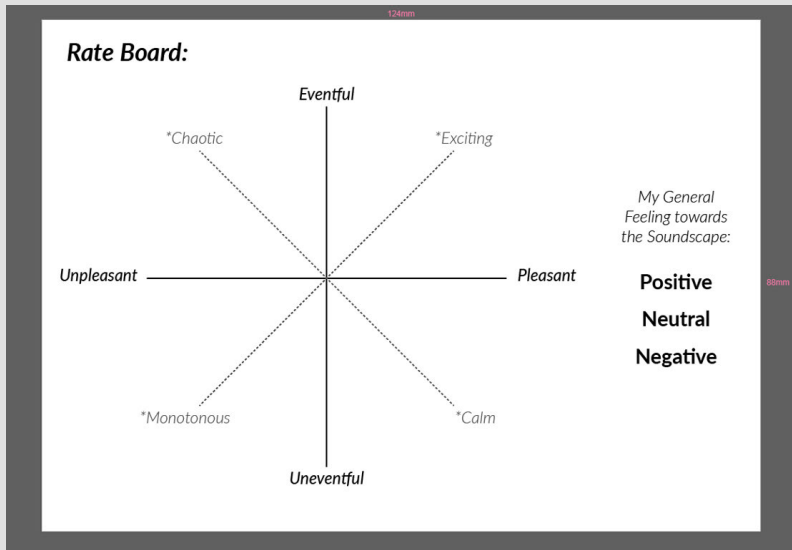
Figure 23
Rate Board
Ver 1

Instruction Board

The instruction board is used to provide explanations and references when there is no organizer or when players forget the activity process. It needs to have detailed explanations of the game process and terms, and needs to be presented to participants in an intuitive and concise manner.

The details for the Instruction Board can be seen in Appendix F.

6.3 USER TEST I

After finalizing the size, format, and content, all the props were printed and cut out for use in the first user test.
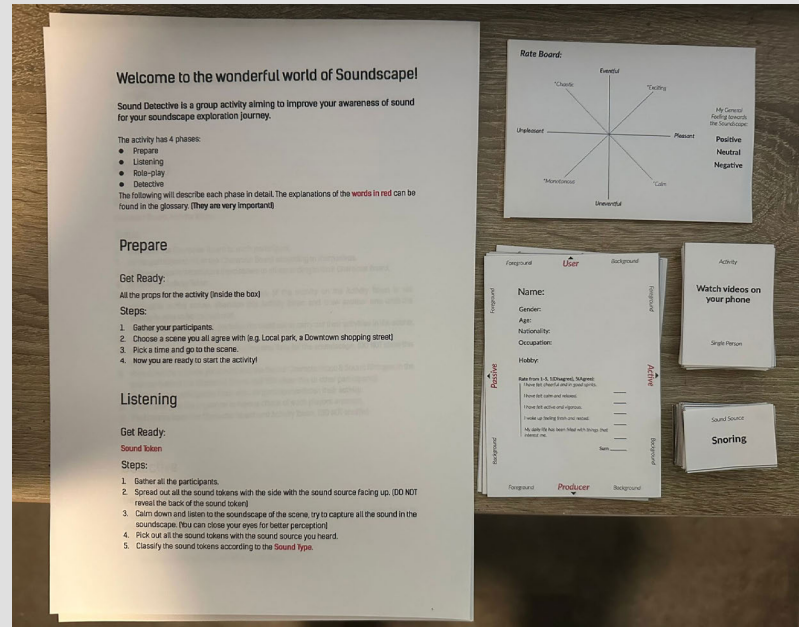
Figure 24
Activity props for user test I

There are **3 main goal** of this user test: analyzing whether the activity flow was smooth and reasonable, whether the knowledge was effectively conveyed, and whether the activity guidance was direct and clear.

The test consists of two parts. The first part is the activity process test, which allows testers to directly participate in and complete the entire activity. The second part is the survey, which collects test information through questionnaires. The first part was conducted in two different scenarios: IDE lobby (indoor) and Delft Church Square (outdoor).

The questionnaire also consists of two sections. The first section is a quiz on basic soundscape knowledge to assess the level of knowledge acquisition. The second section contains an evaluation of the activity process. See Appendix G for consent form and the specific questionnaire can be found in Appendix H.
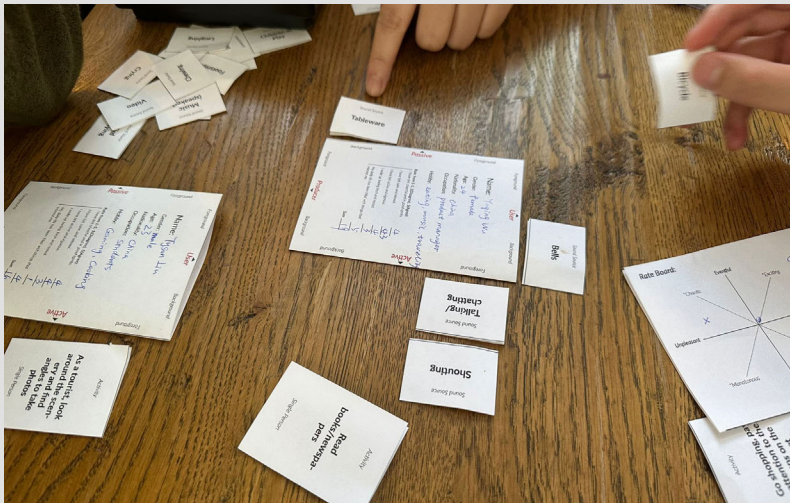
Figure 25
User Test I

Figure 26
Quiz Result

Test Result

The correct rate of the quiz in the questionnaire (first section) is shown in Figure 26 below.

As shown in the figure, the accuracy rates for the seven questions are 100%, 94%, 100%, 100%, 77.8%, 61.1%, 55.5%. Following insights are gained from the data.

- *In general, the activity successfully imparted knowledge about soundscape to newcomers (the correct rate of the first four questions was very high)*
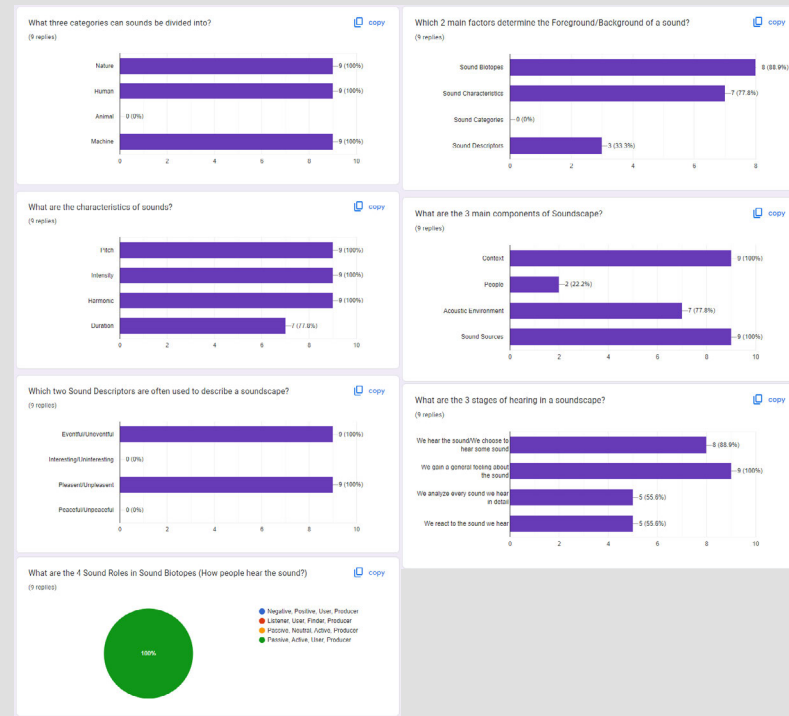
- *The last three questions are not directly mentioned in the game. The correct rate of these three questions is relatively low, which means that only one time of this activity cannot provide a comprehensive understanding of the soundscape.*

- *The quiz contains fewer questions that test participants' sound awareness.*

It should be noted that this quiz is informal and serves only to verify whether the activity has conveyed some key soundscape terms to the participants, and to provide a reference for further improvement of the activity. It does not indicate whether the participants' Sound Awareness has been enhanced.

39

The data from the second section of the questionnaire are shown as follows in Figure 27.
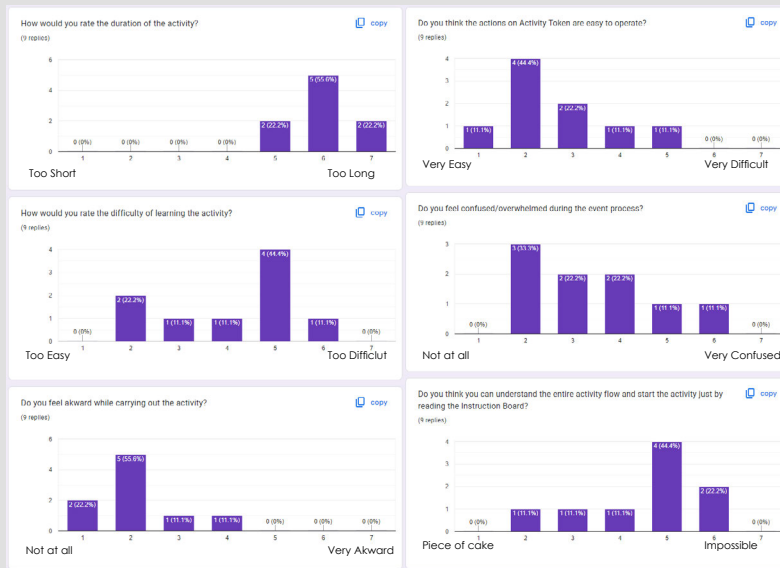
Figure 27
Evaluation Result

Following insights are gained from the data:

- *Participants think the activity is relatively long.*

- *Participants believed that the learning level of this activity was somewhat difficult, but within an acceptable range.*

- *The design of the activity is relatively substantial and will not cause awkwardness or dullness.*

- *The content of Activity Token is relatively reasonable, but some activities require activity props (such as books, computers, etc.)*

- *The contents of the activity may be difficult/ complex for some people to absorb (too many*

special nouns).

- *Simply reading the Instruction Board will not allow participants to understand all the details of the activity.*

Additionally, from the observation and personnel feedback, following insights are gained:

- *The effect of indoor activities is not as good as that of outdoor activities. (The indoor sound is relatively monotonous, and the enthusiasm of indoor testers is not as good as that of outdoor activities)*

- *Sound Token cannot cover all sounds.*

- *The same sound source can be classified again (such as the speech of different characters), and sometimes multiple identical sound tokens are needed.*

- *When participants execute the Activity and write their own Sound Biotopes, they forget the sound sources that have been selected in the previous stage.*

- *When doing outdoor activities, props will be affected by environmental factors (such as wind and rain)*

Based on the results of this round of testing, the following actions need to be made to improve the activity:

- *Add test questions related to sound awareness to the quiz.*
- *Activity Token will be divided into Indoor, Outdoor and Universal according to the applicable scenarios, and more types of activities will be added.*

40

- *Add more Sound Tokens, mainly targeting indoor sound sources.*

- *Added copies of Sound Tokens that may require more than one (such as Human Talking).*

- *Add new Blank Sound Tokens (Sound Token with customizable sound source) to deal with situations where there are special sound sources in the scene.*

- *Add numbers to each Sound Token for easy noting and quick checking.*

- *Add an activity prop: Quick Check Board. This prop can help participants quickly check all the Sound Tokens and provide some explanations and hints.*

- *Redesigned the materials of event props.*

- *The process of the event has been determined, thus the main visual of the event props should be redesigned.*

- *Write a better Instruction Board with proper images.*

6.4 DESIGN OPTIMIZATION

Based on the research results, I adjusted all the activity props and optimized the activity process. The revised version of the activity process is shown in Figure 28 (next page), and the changes to the props will be described in detail in the following sections.

Sound Token

The first is the re-set of the sound source in Sound Token. More sound sources(focusing on indoor sounds), new blank Sound Tokens are added.

Also, a new Supplement Sound Token is added, which have sound sources would be required more than one.

The specific content is as follows:

- *Human:*
  Applauding, Children at play, Crying, Eating/ Drinking, Footsteps, Laughing, Moaning, Shouting, Singing, Snoring, Talking/chatting

- *Nature:*
  Bird flying, Bird song, Firecamp, Fireplace, Fly/ Mosquito, Fountain, Insects, Non-pet animals, Pet, Rain, Rustling leaves, Stream, Thunder, Tide, Trees, Water dripping, Waterfall, Wind whispering

- *Machine:*
  Bells, Bicycle, Broadcast, Building creaking, Bus, Camera, Coffee machine, Construction, Cookers, Fans/AC, Horns, Individual cars, Instrument, Interior furnishing, Luggage dragging, Motorcycles, Music (speaker), Paper/Books, Pen/Pencil, Printing machine, Siren, Stove, Tableware, Train/tram, Typing/Clicking, Ventilation, Video, Writing

- *Supplement:*
  *Custom*6, Echoes*3, Talking/chatting*2, Crying*1, Typing*1, Non-pet animals*2, Pet*2, Footsteps*1, Video*1, Music (speaker)*1, Construction*2, Individual Cars*1, Writing*1, Paper/Books*1, Instrument*3, Eating/Drinking*1, Children at play*1, Blank*3*
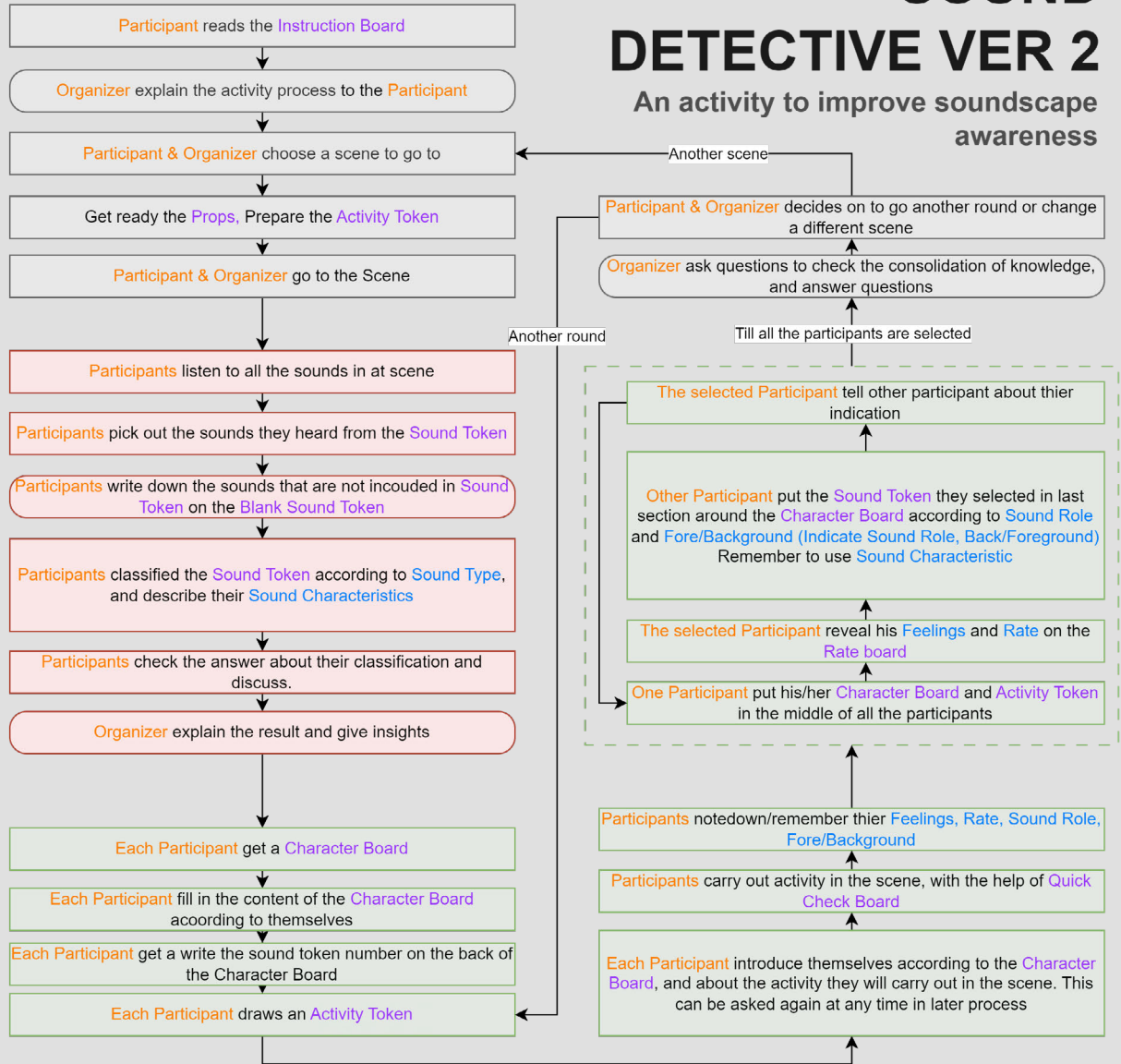
SOUND DETECTIVE VER 2

An activity to improve soundscape awareness

Activity Members

Organizer	To have an organizer will be the best for the activity, but still it's optional. The organizer can be teachers or experienced participants. The organizer can also join the game as a participant.
Participant	People who are interested in Soundscape and willing to join the activity

References

Sound Characteristics	Pitch, Intensity, Duration
Rate (Sound Descriptor)	Calm, Monotonous, Vibrant, Chaotic
Sound Type	Human, Nature, Machine
Sound Role	Passive, Active, User, Producer
Feelings	Positive, Netural, Negetive

Activity Props

Instruction Board	Provide participants with instructions for necessary activity procedures and knowledge
Rate Board	A board that allows participants to speculate on Character's Ratings and Feelings. (Based on Sound Descriptors)
Sound Token	A token representing the sound heard by the participant. It has the sound source on the front and the Sound Type on the back.
Character Board	A board that allows participant to fill in their basic information. Also, there will be space for Sound Role around the board (4 edges)
Activity Token	A token that indicate the participant what to do in the scene
Quick Check Board	A board that can let participant see the brief procedure of the activity, and all the sound token numbers.

Activity Process

- Participant reads the Instruction Board
- Organizer explain the activity process to the Participant
- Participant & Organizer choose a scene to go to
- Get ready the Props, Prepare the Activity Token
- Participant & Organizer go to the Scene
- Participants listen to all the sounds in at scene
- Participants pick out the sounds they heard from the Sound Token
- Participants write down the sounds that are not incouded in Sound Token on the Blank Sound Token
- Participants classified the Sound Token according to Sound Type, and describe their Sound Characteristics
- Participants check the answer about their classification and discuss.
- Organizer explain the result and give insights

- Each Participant get a Character Board
- Each Participant fill in the content of the Character Board acoording to themselves
- Each Participant get a write the sound token number on the back of the Character Board
- Each Participant draws an Activity Token

- Each Participant introduce themselves according to the Character Board, and about the activity they will carry out in the scene. This can be asked again at any time in later process
- Participants carry out activity in the scene, with the help of Quick Check Board
- Participants notedown/remember thier Feelings, Rate, Sound Role, Fore/Background

- One Participant put his/her Character Board and Activity Token in the middle of all the participants
- The selected Participant reveal his Feelings and Rate on the Rate board
- Other Participant put the Sound Token they selected in last section around the Character Board according to Sound Role and Fore/Background (Indicate Sound Role, Back/Foreground) Remember to use Sound Characteristic
- The selected Participant tell other participant about thier indication

(Till all the participants are selected)

- Organizer ask questions to check the consolidation of knowledge, and answer questions
- Participant & Organizer decides on to go another round or change a different scene

(Another round) *(Another scene)*

Figure 28
Activity Process Ver 2

42

Additionally, the main visual design of the Sound Token (and all subsequent props) has been redesigned, as shown in Figure 29.

Figure 29
Sound Token
Ver 2

Activity Token

Next is the update of the Activity Token. Different activities are divided into three categories: Indoor, Outdoor, and Universal. Also some activities that were difficult to implement are removed, and new activities are added:

- • **Universal:**
  1. Sit and have a rest (On a bench/sofa etc.)
  2. Call someone on a mobile phone
  3. Watch videos on your phone
  4. Read books/newspapers (Readings needed)
  5. Drink and eat (Food needed)
  6. Chat with someone
  7. Do meditation
  8. Listen and identify the music in the soundscape (Music needed)
  9. Thinking about something (Pick your own topic)

- • **Indoor:**
  1. Working on a computer (Computer needed)
  2. Visit and appreciate the exhibits (Museum needed)
  3. Go shopping (Mall needed)
  4. Do photography
  5. Take a nap

- • **Outdoor:**
  1. As a tourist, look around the scenery and find angles to take photos.
  2. Feed the pigeons/ducks etc.
  3. Buy snacks at street stalls
  4. Watch street performances
  5. Go shopping, pay attention to the shops on the street
  6. Waiting to cross the street
  7. Waiting for the bus/tram/uber
  8. Walking/jogging
  9. Watch parades/public presentations

Also, 6 customizable Activity Tokens are added for scene-related special activities or organizer's research purposes.
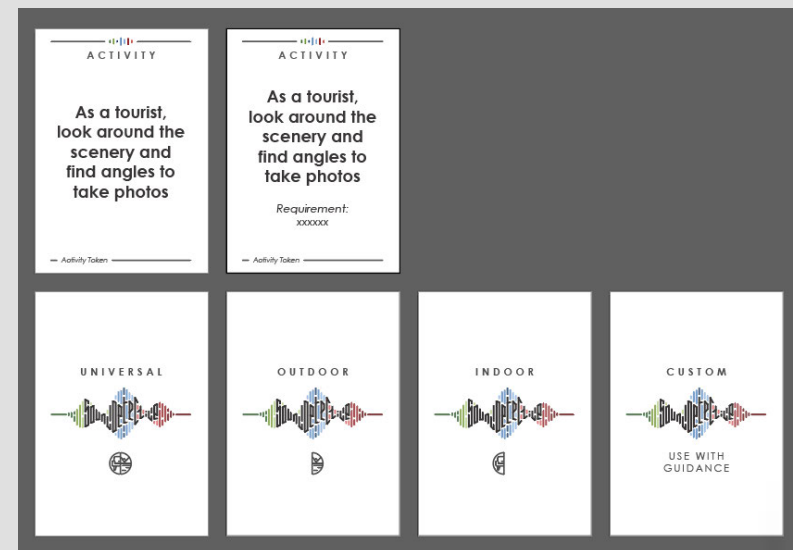
Figure 30
Activity Token
Ver 2

The visual for Activity Token is shown in Figure 30 (previous page).

Character Board

For the Character Board, since participants need to write on it, it is designed to be disposable. To avoid repeated printing, an outer frame has been designed that can replace the inner filling. Participants simply need to pull out the paper with the text and replace it with a new blank A4 sheet after the activity. Models can be seen in Figure 31.
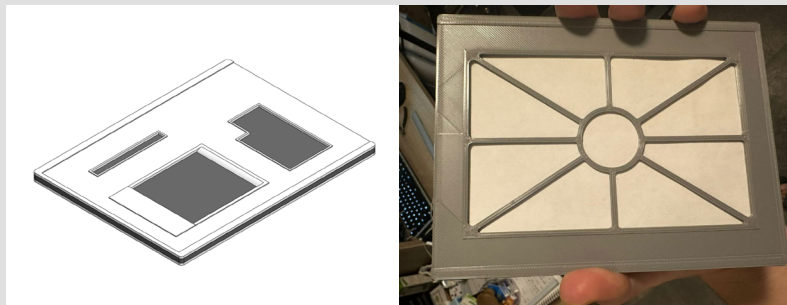
Figure 31
Character Board frame

The content of the Character Board has also been restructured. The previous scoring assessment has been simplified to reflect the participant's current mood, and references to ethnicity and gender have been removed, as they are rarely mentioned during the activity. Shown in Figure 32.

Quick Check Board

Additionally, a new Quick Check Board is added to the activity props. The front side contains a brief description of the activity process and answers and tips to common confusions (difficulties), while the back side contains all the Sound Tokens and their corresponding numbers.
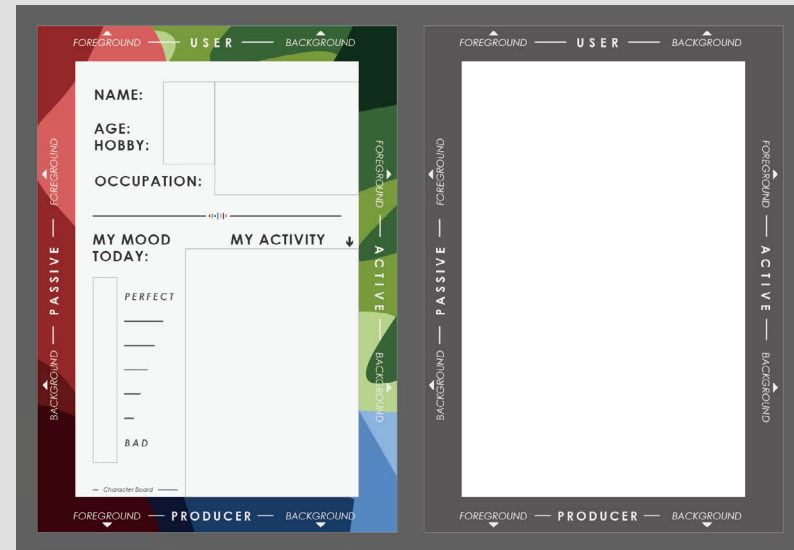
Figure 32
Character Board Ver 2
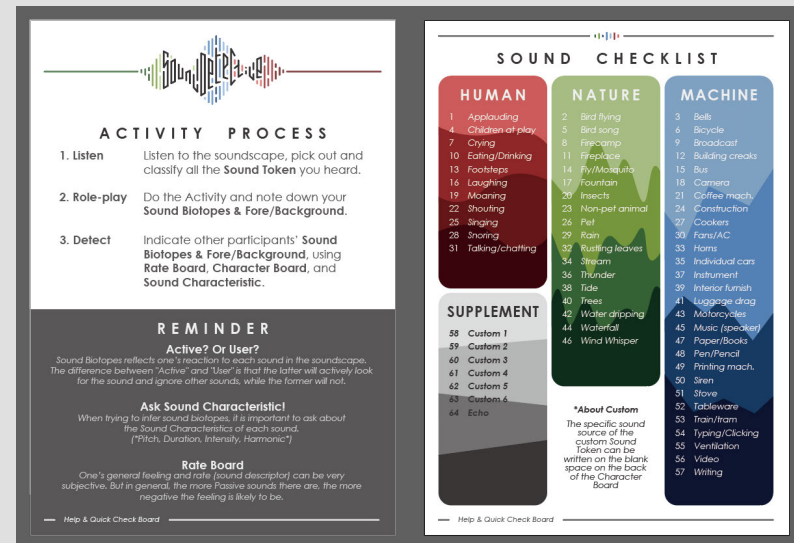
Figure 33
Quick Check Board

Contents of Quick Check Board can be seen in Figure 33.

Instruction Book

The Instruction Board has the biggest change. It has been redesigned into an Instruction Book. Compared to the previous A4 paper format, this time the Instruction is a booklet that includes a detailed explanation of the activity process (with illustrations) and explanations of all the specific terms. At the end, there is also a diagram of the soundscape relationship to provide a better understanding, and a glossary for participants to quick check all the terms. Figure 34 showcases some of the pages.

Figure 34
Instrcution Book page 7-8

Figure 35
Rate Board Ver 2

Logo

Additionally, the activity's logo has been designed for use on the cover and packaging. Inspired by sound waves, the logo is depicted in Figure 36.

Figure 36
Logo

Rate Board

The Rate Board has not undergone significant changes. It has been visually redesigned and the term "Sound Descriptor" has been added. Additionally, multiple sets of transparent indicators (two per set) have been prepared for participants to indicate their Feelings and Descriptions. See Figure 35.
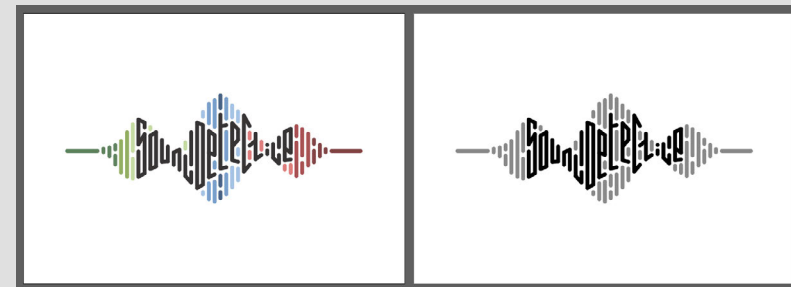
6.5 USER TEST II

To further refine the design, I conducted a second user test, which was in the form of a questionnaire, focusing on **visuals, layout, usability, and most importantly, the Instruction Book**.

This test is rather a small test, but takes quite a long time (about an hour, to read the instruction book). Some of the

testers were people who had participated in the first user test, and some were newcomers who had no experience with sound detective.

See Appendix G for Consent Form and Appendix I for questionnarie script.

Figure 37
Props for user test II

8 people participated in this test, 4 of whom participated in the first round of user test, and the remaining 4 were new to Sound Detective.

Due to the large number of questions in the questionnaire, they are not listed individually here. Detailed test result data can be found in Appendix J. The insights from this test are as follows:

- *The visual design of the props is relatively simple and in line with expectations.*

- *The size of the props is moderate, but the Sound*

Token is small, which can easily lead to loss.

- *The instruction book is a big improvement over the first version. The test subjects can read and understand the game flow just by reading the instruction book, but the control of details is questionable.*

- *Most people don't like reading instructions.*

- *Logic Diagram are helpful, but they need further explanation. But at the same time, some people don't like to look at logic diagrams.*

Based on the insights, the activity underwent another round of optimization.

First, the organizer for all activity props was designed. Initially, a cardboard box was planned for packaging the activity props (similar to the packaging of various board games today). However, considering that this activity will not be mass-produced, 3D printing was chosen for the organizer solution instead. If needed in the future, the packaging can be switched to cardboard boxes. The organizer model is shown in Figure 38.
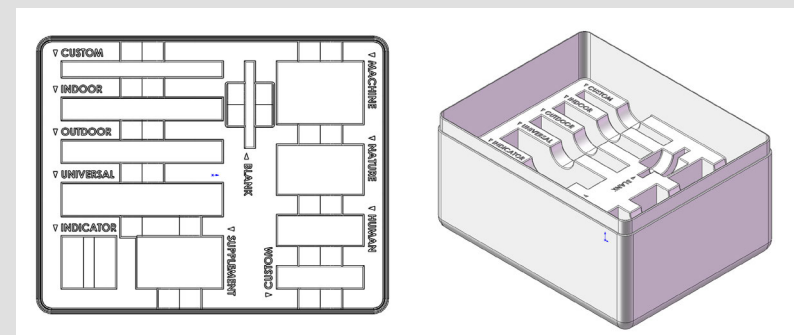
Figure 38
Organizer

Next, the Instruction Book was updated. Some terms were

modified to avoid ambiguity, and an explanation of the Relationship Diagram was added at the end.
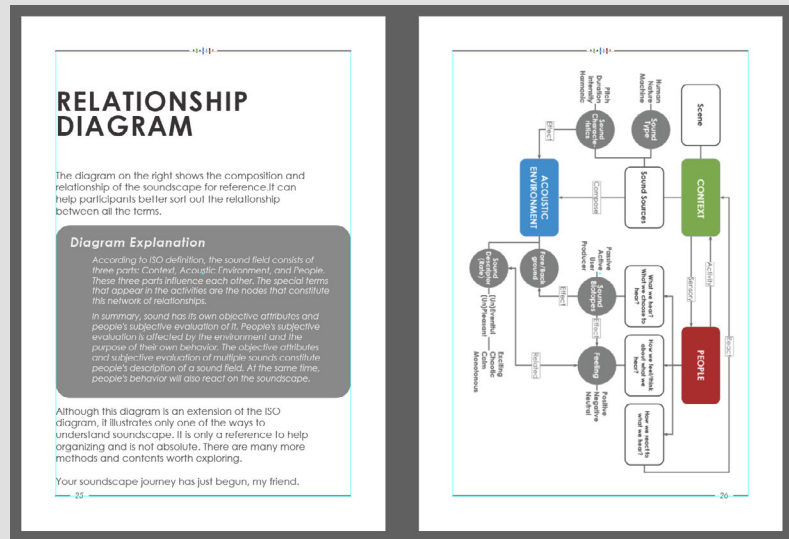
For Sound Token, considering its usage and adaptation to other props, the size will not be adjusted.

The back layout of the Character Board was redesigned. Sufficient space was allocated to write down Custom Sounds, and the central area was divided into two parts to provide participants with more customization options. See Figure 40.
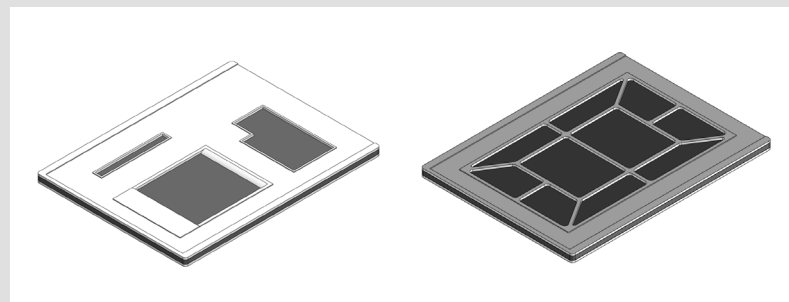
Figure 40
Character Board Ver 3

In addition, to make it easier for participants to reference and memorize soundscape terms, a separate Terms Board was created. See Figure 41.
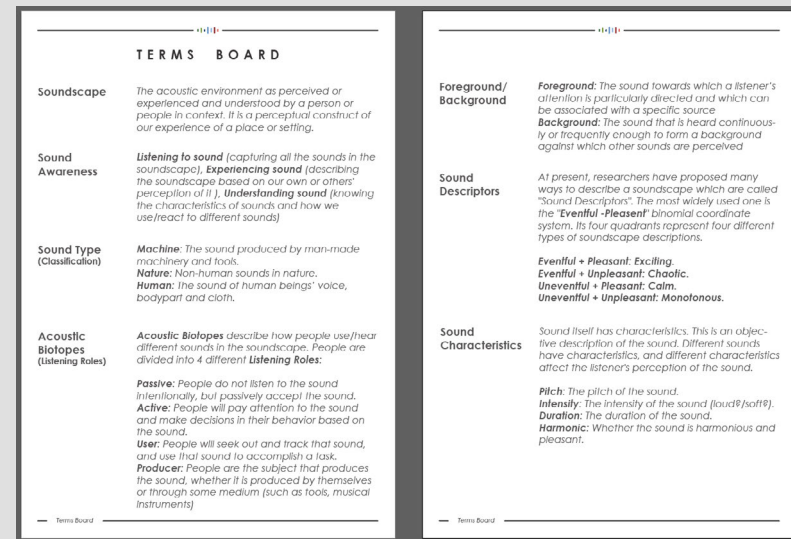
Figure 41
Terms Board

07

Final Activity Design

This chapter primarily introduces the final design of the Sound Detective activity, encompassing descriptions of all activity props and explanations of the activity process.

Final Design

7.1 SOUND DETECTIVE OVERVIEW

Sound Detective is a group activity designed to help soundscape beginners enhance their sound awareness. The activity requires the use of specialized props exclusive to Sound Detective. It can be conducted with 1-5 participants, with the option of including an organizer. The activity typically lasts about one hour and does not impose any special requirements on the participants.

This activity can also be used by researchers as a means of conducting studies. However, it would require researchers to select the activity setting and plan certain game elements in advance.

Contents:

> *Sound token*90, Activity token*30, Character board*5, Quick check board*5, Rate board*1, Terms board*1, Instruction book*1, Indicator*10.*

Figure 42 shows its overall rendering.

Figure 42
Sound Detective Rendering

Photos of all the props used in the activity are shown in Figure 43-51.

Figure 43
Character Board

Figure 44
Quick Check Board

Figure 45
Rate Board
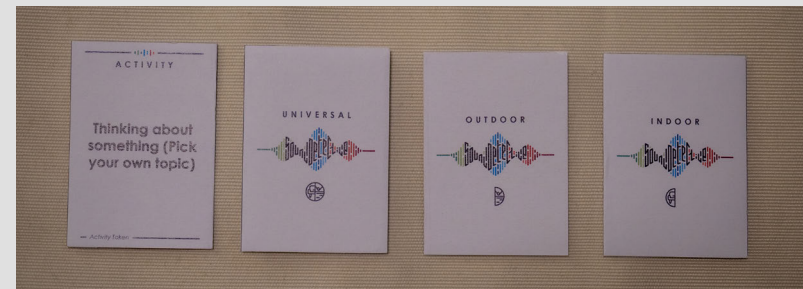
Figure 46
Activity Token

Figure 47
Activity Token (reserach purpose)

50

Figure 48
Sound Token
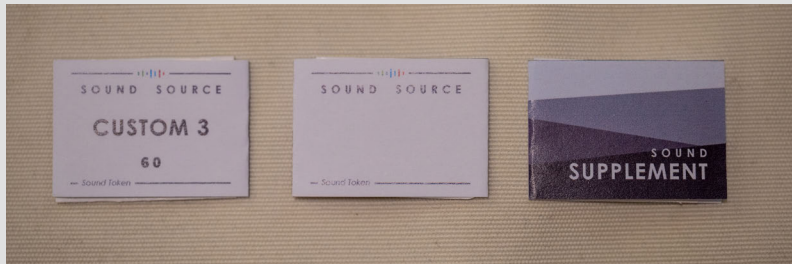
Figure 49
Sound Token (custom and blank)
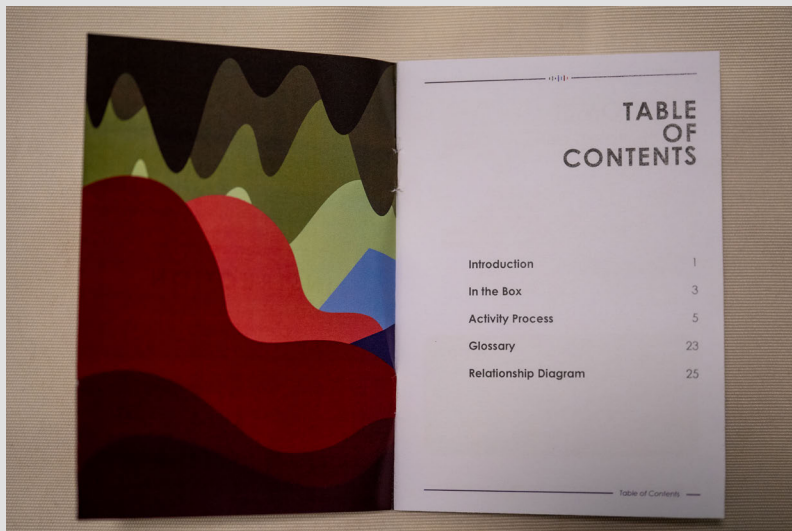
Figure 50
Instruction Book (page 1)

The organizer box for all the activity props is shown in Figure 52-54.
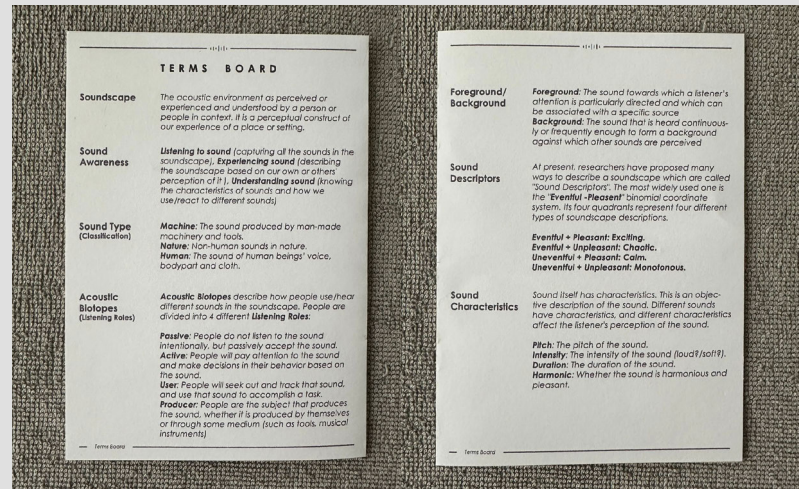
Figure 51
Terms Board

To store the activity props, first place all the small cards and indicators into the box according to the instructions on the storage box (Figure 52). Then, place the instruction book and other large cards inside (Figure 53). Finally, put in the Character Board and close the lid.(Figure 54).
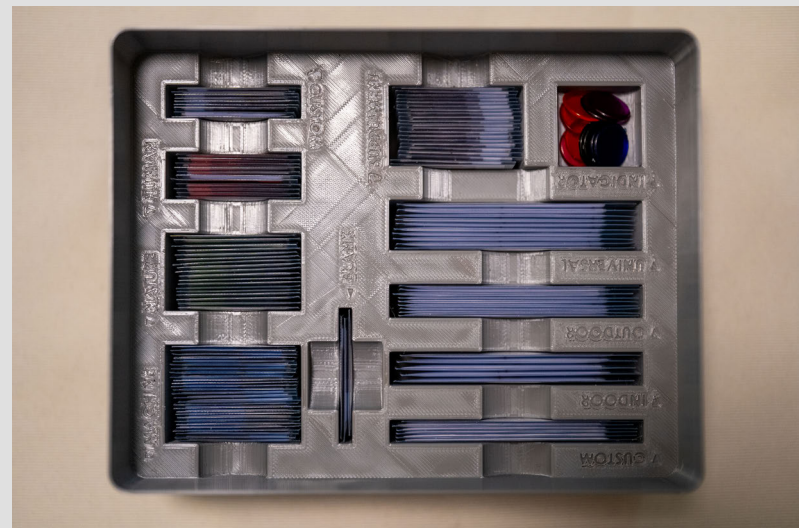
Figure 52
Organizer (step 1)

Figure 53
Organizer
(step 2)

Figure 54
Organizer
(step 3)

7.2 ACTIVITY PROCESS

The process of the activity process can be seen in Figure 55 (next page).

Figure 55 provides only the key steps of the activity without detailing specific nuances. For the complete activity process and details, please refer to the full Instruction Book, as shown in Appendix K.

Due to the low demand, the activity props and storage box are all 3D printed. If there is a need for mass production in the future, cardboard can be used as a substitute.

START
Choose a scene, get all the items prepared and go to the scene.

END
End the activity/reselect Activity Token

Select and spread the Sound Token on a flat surface/ground.

Listen and try to capture (pick out) all the sound in the scene, then classify them.

Flip the Sound Tokens to see the classification and sound type.

Sort out the Sound Tokens and distribute the items for the next phase.

All participants come back to gather.

Select one participant to start with. The participant show other people his/her character board, activity token and indicate his/her feeling and description on rate board.

Start indicating the selected participant's Sound Biotopes and Fore/Background.

Repeat the process until all participants are selected.

Flip the Character Board to reveal answer.

Classify the sounds you heard after finishing your activity.

Note down the sounds you heard during the activity process.

Carry out the activity in the scene.

Fill in the Character Board and introduce yourself.

Shuffle and draw the Activity Token.

Note down Sound Token Numbers.

Figure 55
Activity process

53

08

Activity Evaluation

This chapter primarily discusses the evaluation of the activity design. It focuses on the question, "Can the activity improve participants' sound awareness?" and includes evaluation goals, evaluation procedures, results, and analysis.

Evaluation

8.1 EVALUATION GOAL

The design objective of this project (as outlined in Chapter 1) is to explore the opportunity of a sound training activity, not as a replacement, but as a supplement and improvement, that focusing on training beginners' awareness of sound during their studies of soundscape.

Therefore, the goal of this evaluation is to verify **whether participation in the Sound Detective activity can enhance the participants' sound awareness**.

At this point, it is necessary to reiterate the following definition of sound awareness:

- *Listening to sound (capturing all the sounds in the soundscape)*

- *Experiencing sound (describing the soundscape based on our own or others' perception of it)*

- *Understanding sound (knowing the characteristics of sounds and how we use/react to different sounds)*

The publication of Taxonomy of Educational Objectives followed a series of conferences from 1949 to 1953, which were designed to improve communication between educators on the design of curricula and examinations. And Bloom's taxonomy is a set of three hierarchical models used for classification of educational learning objectives into levels of complexity and specificity (Wikipedia contributors, 2024).

Bloom's taxonomy is an excellent reference for planning the evaluation process. Given the numerous versions, this paper primarily adopts the verbs and classifications shown in Figure 53 and 54.

Figure 56
Bloom's Taxonomy Verbs
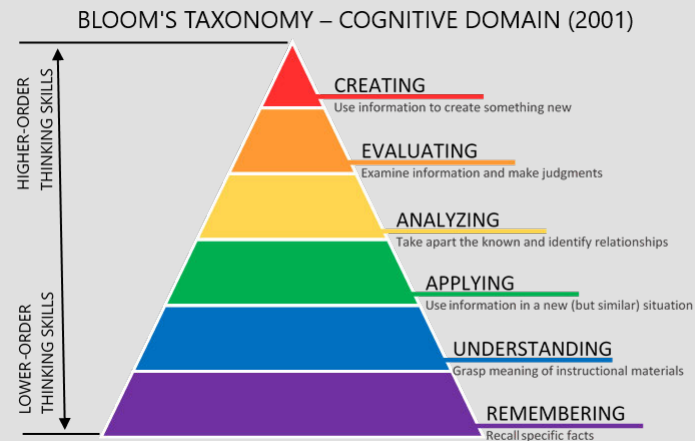
Figure 57
Bloom's Taxonomy

According to Bloom's Taxonomy Chart and Verbs, and the definition of Sound Awareness, the goal for this evaluation can be divided into the following 10 sub-goals:

1. If the participant can memorize all the soundscape terms appear in the activity.

2. If the participant can list the sound sources within a soundscape.
3. If the participant can classify the sound sources they heard.
4. If the participant can distinguish the roles of listener to sounds according to Acoustic Biotopes.
5. If the participant can use soundscape terms to describe sounds and soundscape.
6. If the participant can relate the listener's activity/intention & roles of listener (acoustic biotopes) to Fore/Background sound.
7. If the participant can apply the knowledge they gain to another different soundscape. (different from the soundscape they carried out the activity in)
8. If the participant can infer and point out the reason for one's feeling & description of a soundscape.
9. If the participant can modify the soundscape to make it better/more appropriate.
10. If the participant can argue if a soundscape is appropriate for an activity/action.

G1 are about Knowledge phase, G2, G3 & G4 are about Understanding phase, G5, G6 & G7 are about Application phase, G8 is about Analysis phase, G9 is about Create phase and G10 is about Evaluation phase.

8.2 EVALUATION METHOD & PROCESS

The evaluation will involve an experimental group and a control group, rather than having the same participants take the test first, then participate in the activity, and take the test again for comparison. This is because the initial test could leave a memory with the participants, thereby biasing the results of the subsequent test. (Charness, 2012)

Based on these 10 Evaluation sub-goals, a specialized test for this evaluation has been designed, which will hereafter be referred to as the **Sound Awareness Test**.

The purpose of this test is to verify whether participants have achieved the 10 sub-goals mentioned above and to what extent. Detials of this text will be explained in next section.

After developing the Sound Awareness Test, the entire evaluation process is illustrated in Figure 55. By comparing Result 2 with Result 1, we can determine whether Sound Detective can enhance participants' Sound Awareness.

It is worth mentioning that the experimental group's Sound Detective will be conducted in the context of a Restaurant. The reason for this is to gain additional insights about the selection of activity scenarios through further horizontal comparison (self-comparison of Result 2).
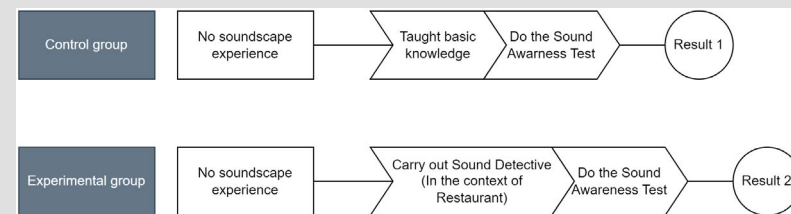
Figure 55
Evaluation process

Evaluation consent form can be found in Appendix L.

8.3 SOUND AWARENESS TEST

The test is divided into five sections, containing 3, 4, 6, 4, and 2 questions respectively, for a total of 19 questions. The question types include multiple-select, fill-in-the-blank, and short-answer questions. The five sections of the test correspond to the six learning stages of Bloom's

Taxonomy (with section 4 encompassing two stages). The 19 questions align with the 10 sub-goals summarized earlier. The type of each question, its summary, score, corresponding sub-goals, and the learning stage each chapter addresses are illustrated in Figure 56.

The test questions are primarily designed based on three different sound environments: **shopping street**, **restaurant**, and **office**. During the test, participants are required to watch and listen to the provided videos and answer the questions. To more specifically assess the participants' Sound Awareness, some examples in the questions include special events. Additionally, the duration of the videos needs to be controlled to ensure the efficiency of the test, so the videos used are artificially synthesized. The sound recordings in the videos were synthesized using myNoise (shown in Figure 57) and Adobe AU, and the images shown in the videos are AI-generated.
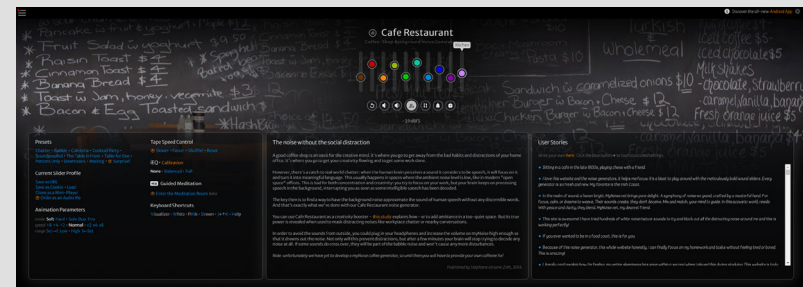
The detailed descriptions and reference answers for each question can be found in Appendix M. The test is conducted online, and each video recording and question can be accessed directly using the following URL: https://ivlv.me/wY0oX

The test has a maximum score of 72 points; higher scores indicate a higher level of sound awareness among participants. By analyzing the scoring rate for each question, we can identify specific strengths and weaknesses of the participants. Detailed scores for each question are shown in Figure 55. The scoring criteria for each type of question are as follows:

Multiple-select questions (2.1-2.4, 3.3, 3.5):
One point is awarded for each correct option selected, no

Figure 56
Questions Relationship

points are awarded for missing a correct option, and 0.5 points are deducted for incorrect options selected.

Fill-in-the-blank questions (1.1-1.3, 3.1-3.2, 3.4, 3.6):
One point is awarded for a correct answer, and no points are awarded for an incorrect answer or no answer.

Short-answer questions:
For questions 4.1 and 4.3, which are worth a total of 5 points, one point is awarded for each valid reason provided, up to a maximum of 3 points. An additional point is awarded for using a Sound Descriptor, and another point is awarded for using Acoustic Biotopes and Fore/Background.

For questions 4.2 and 4.4, which are worth a total of 3 points, one point is awarded for each solution provided to block/avoid the sound source, up to a maximum of 2 points. An additional point is awarded for providing other types of solutions.

For questions 5.1 and 5.2, which are worth a total of 3 points each, one point is awarded for a correct Yes or No answer, one point for providing a reason, and one point for using Soundscape Terms.

Additionally, for the answers to questions 2.1-2.4 (Global Listening), I convened with three other individuals to listen, discuss, and determine the answers collaboratively. During the process of setting the options, we aimed to minimize ambiguity as much as possible.

8.4 EVALUATION RESULT

A total of 24 individuals participated in this evaluation, with 12 assigned to the control group and 12 to the experimental group. Among the participants, 16 took the initial version of the test, while the remaining 8 took the revised version. Although the second version included some modifications to the recordings and question descriptions, the overall structure remained the same, making both sets of results valuable for reference. None of the participants had prior exposure to any soundscape learning or training.

Each evaluation lasts around 2 hours. During the test, communication with others is prohibited. However, participants are allowed to ask the organizers for clarification on any questions they may have.

The detailed scores of the evaluation can be found in Appendix N.

Remembering (Section 1):
This section corresponds to questions 1.1-1.3. The scores of the two groups are shown in Figure 58.
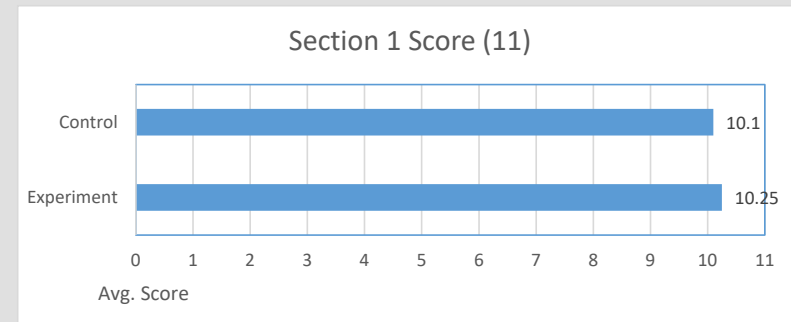
Figure 58
Section 1 score

The difference between the two groups is only 0.25 points, with both groups nearly achieving full marks. Therefore, both groups show relatively optimistic results at the knowledge level.

However, it is noteworthy that in the control group, the Sound Descriptor knowledge was conveyed more effectively,

whereas in the experimental group, the Sound Biotopes knowledge had a better effect. Shown in Figure 59.

Sound Biotopes & Descriptor Compare
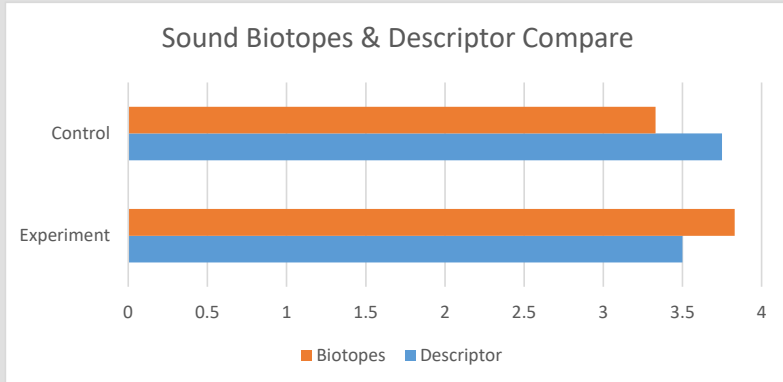
Figure 59
Descriptor & Biotopes

Understanding (Section 2):
This section corresponds to questions 2.1-2.4. The scores of the two groups are shown in Figure 60.
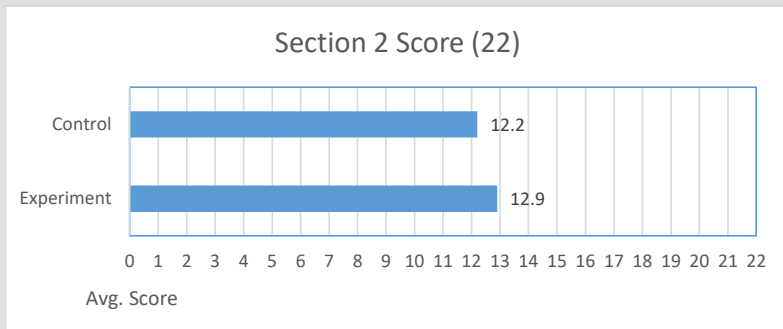
Section 2 Score (22)

Figure 60
Section 2 score

The difference between the two groups is 1.25 points. However, both groups achieved less than 60% accuracy (53% for the control group and 59% for the experimental group). Notably, the experimental group scored similarly to the control group in the Global Listening section (Q2.1 and Q2.2), with Q2.1 even scoring lower than the control group. (Shown in Figure 61) The advantage in the experimental group's score lies in the sound classification section.
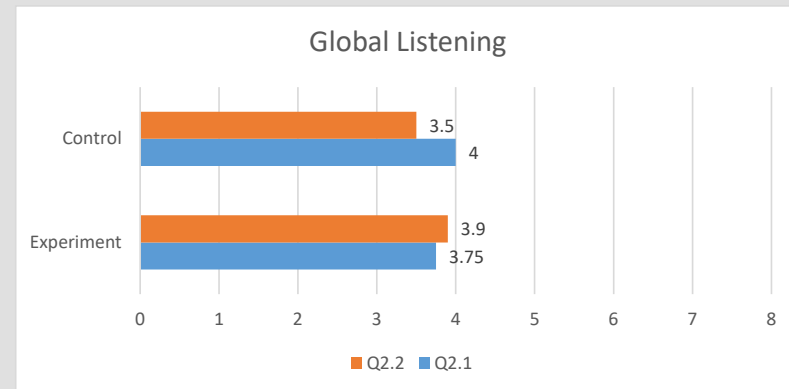
Global Listening

Figure61
Global Listening Compare

Applying (Section 3):
This section corresponds to questions 3.1-3.6. The scores of the two groups are shown in Figure 62.
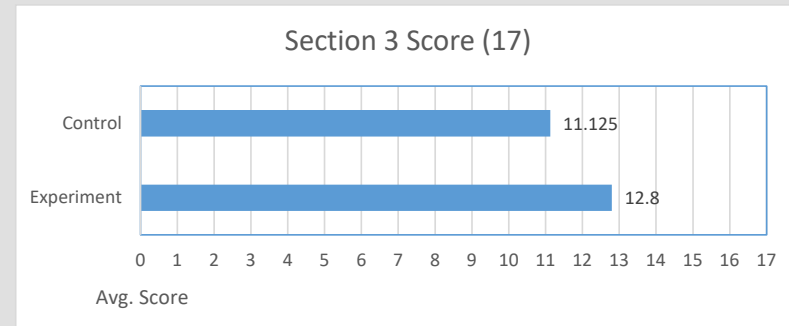
Section 3 Score (17)

Figure 62
Section 3 score

The difference between the two groups is 2.375 points. In terms of the application of Sound Descriptor (Q3.1 and Q3.2), both groups performed similarly and almost achieved full marks. However, in the application of Sound Biotopes and Fore/Background Sound (Q3.3-Q3.6), the experimental group showed better performance compared to the control group. Furthermore, it is evident that the control group is notably weaker in the Fore/Background Sound aspect. Shown below in Figur 63.
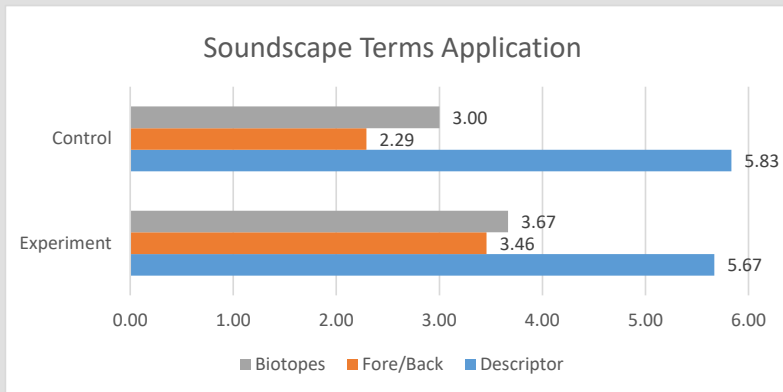
Figure 63
Soundscape terms application

Analysing & Creating (Section 4):
This section corresponds to questions 4.1-4.4. The scores of the two groups are shown in Figure 64.
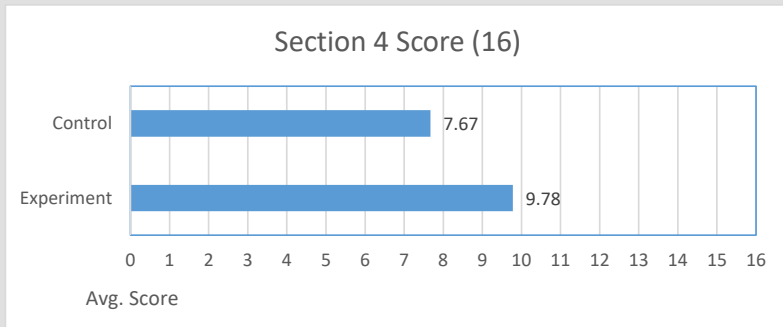
Figure 64
Section 4 score

The difference between the two groups is 2.6 points. Questions Q4.1 and Q4.3 pertain to Analysis, while Q4.2 and Q4.4 relate to Creation. It is observed that both groups performed similarly in Creation, but there is a significant difference in Analysis. The reason is that only 1 of the 8 participants in the control group used the learned Soundscape Terms during analysis, whereas in the experimental group, 5 out of 8 did use Soundscape Terms. Therefore, according to the scoring criteria, they scored higher in this aspect. Shown in Fugure 65.

Figure 65
Analysing & Creating compare

Evaluating (Section 5):
This section corresponds to questions 5.1-5.2. The scores of the two groups are shown in Figure 66.
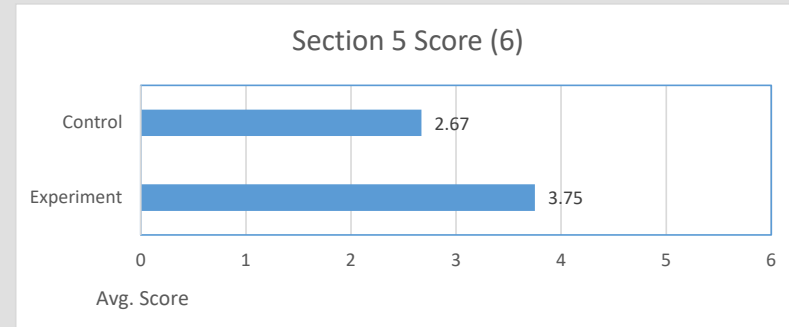
Figure 66
Section 5 score

The reason for the higher scores in the experimental group is that more individuals correctly assessed the appropriateness of the sound environment and applied soundscape terms.

Additionally, a comparison was made between the accuracy of the experimental group's responses to questions related to "restaurant soundscapes" and other soundscapes, as shown in Figure 67.

Restaurant & Other scene Score Rate
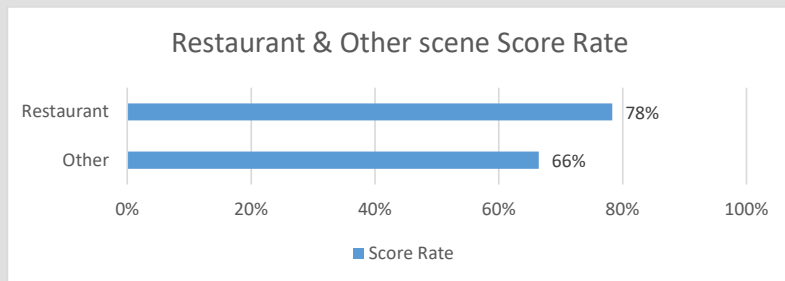
Figure 67
Score rate
for different
scenes

The scoring rate for questions related to restaurant soundscapes is 8 percentage points higher compared to questions related to other soundscapes.

Conclusion:
In summary, through the Sound Detective activity, compared to traditional knowledge lectures (without practical application), participants' Sound Awareness can be enhanced to some extent.

Specifically, the activity effectively imparts foundational knowledge of soundscapes to participants. However, there is room for improvement in the memorization of the four types of Sound Descriptors, as their exposure time during the activity was relatively short compared to other terms. The activity has limited impact on the first aspect of Sound Awareness—Listening to sounds—but it does enhance participants' abilities in Experiencing Sound and Understanding Sound. Participants demonstrate improved comprehension of various Soundscape Terms and are somewhat capable of applying these terms in the analysis of other soundscapes or case studies. However, the activity does not significantly improve participants' ability to design and innovate appropriate soundscapes.

Certainly, this evaluation has its limitations.

For instance, the sample size of participants was small (making it difficult to rule out outliers, Paulus, 2000),

participants were acquainted with each other before the test (potentially enhancing interaction but affecting outcomes, Sawyer, 2010), varying environments during the Sound Awareness test (resulting in different levels of interference), limited scenario examples provided during the test (limiting the comprehensiveness of the assessment), and potential shortcomings in my own ability to impart knowledge compared to a professional instructor (a disadvantage for the control group). These factors may have led to more optimistic evaluation results compared to real-world applications.

Figure 68
During
evaluation

09

Summary of Design

This chapter primarily summarizes the project design, identifies design flaws and limitations, and provides suggestions for further improvement. It also includes personal reflections throught out the project process.

Summary

9.1 CONCLUSIONS

This project successfully produced an activity called Sound Detective, aimed at helping beginners enhance their sound awareness of soundscapes. Participants, either led by an organizer or self-directed, engage in the activity by observing and inferring the roles of other participants based on their behaviors and experiences within a chosen sound environment. Throughout the activity, participants can continually reinforce their understanding and memory of soundscape terms while also collecting a substantial amount of firsthand sound environment data.

The design of the activity process and props was based on multiple studies related to soundscapes and International Soundscape Database (ISD). The props for the activity were made into full-scale physical models for testing purposes. The validation showed that the activity could improve participants' sound awareness to a certain extent, mainly reflected in their increased tendency to use soundscape terms to describe sound environments and analyze human behavior when conducting sound environment research.

Figure 69
Activity in a restaurant

9.2 LIMITATIONS

Sound Token:
The sound sources on the Sound Tokens mainly come from ISD and Axelsson et al. (2010) experiment on exploring soundscape perception. However, since most of the sound environments in ISD are outdoor settings, the determination of indoor sound sources on the Sound Tokens relies on Axelsson's research and the indoor sounds heard during testing. Although this approach can cover most indoor sound sources, there are still rare instances where not all sound sources can be included, even with the use of Custom Sound Tokens. While this does not affect the game flow, it increases the recording burden on participants.

Activity Token:
The design of the Activity Tokens adheres to the principle of requiring minimal additional props. However, this greatly limits their richness and quantity. The content on the Activity Tokens mostly comprises very basic and simple behaviors, which can affect the richness of the sound environment data obtained by participants and their overall experience. Therefore, when an organizer is present, using Custom Activity Tokens to set specific behaviors and prepare in advance can achieve the best results.

Learning the Activity:
Although the activity kit includes an Instruction Book, testing showed that it takes over an hour to read through it, and reading alone does not guarantee the quality of the activity. Therefore, while the activity can be self-directed, the presence of an organizer has a significant impact on the effectiveness of the activity.

Number of Evaluation Participants:
In the final evaluation, only 16 people participated, and all of them knew each other before the activity. Therefore, the evaluation results may be biased (more optimistic) due

to the inability to exclude outliers and the improved group dynamics. (Paulus, 2000; Sawyer, 2010)

Scene Adaptability:
In this project, the activity was conducted in only four scenarios (restaurant, square, IDE lobby, shopping street). Its smooth execution in other scenes remains unknown, and therefore, the scene adaptability of the activity has not been validated.

9.3 RECOMMANDATIONS

Based on the limitations of this design and its future development, the following recommendations are proposed:

1. Increase the number and diversity of participants for further activity evaluation and testing to obtain more realistic data and results.

2. Review and update the sound sources on the Sound Tokens.

3. Design more varied and engaging actions for the Activity Tokens.

4. Expand the activity to more scenes and explore the strengths and weaknesses of the activity in each scene.

5. Introduce the activity to other soundscape experts to gather feedback and suggestions. Collaborate with them if possible to redesign and improve the activity together.

It is important to reiterate that Sound Detective is just one form of learning about soundscapes, with its primary focus on enhancing Sound Awareness. It cannot replace other learning forms or activities (like Sound Walk). In the future, exploring how Sound Detective can be integrated into and complement the overall process of learning about soundscapes is essential.

9.4 PERSONAL REFLECTION

Through my master's thesis project, I have gained significant insights into my strengths and weaknesses.

One of the most profound realizations—and also my major weakness—is the need for me to strengthen my rigor and systematic approach. I tend to be very intuitive in my work. This intuitiveness does not mean I lack logic; on the contrary, I consider various aspects related to research methodology and outcomes. However, I often overlook the necessity of ensuring the validity and truthfulness of conclusions drawn during research. In other words, I sometimes treat certain conclusions as "common knowledge" without adequately substantiating them. This tendency is highly problematic, as it lacks rigor and can lead to serious consequences both in academia and future professional roles.

Even when my supervisors pointed out this issue and I began to consciously prioritize evidence for conclusions, I still occasionally neglected the rigorous and systematic processes of research. Rectifying this habit will be a long process, but I am grateful to my supervisors for bringing it to my attention in a direct manner.

In addition, this design represents my first endeavor in using game props as a presentation format since studying design,

and it is also my first project related to the field of sound. Despite requiring extensive research and learning new knowledge in the early stages, I am pleased with the activity I ultimately produced and the knowledge I gained during the design process. My interest in sound and soundscapes has deepened, and I am now inclined towards pursuing positions related to the field of sound in my future career endeavors.

Overall, this has been a profoundly meaningful experience, despite the late nights and occasional headaches. I feel fortunate to have had the guidance of my two supervisors and the assistance of both experts and beginners throughout the design process. I am committed to further honing my skills and addressing my shortcomings as I continue to grow professionally.

10
References

References

Aletta, F., Kang, J., & Axelsson, Ö. (2016). Soundscape descriptors and a conceptual framework for developing predictive soundscape models. Landscape and Urban Planning, 149, 65–74. https://doi.org/10.1016/j.landurbplan.2016.02.001

Axelsson, Ö., Nilsson, M. E., & Berglund, B. (2010). A principal components model of soundscape perception. the Journal of the Acoustical Society of America/the Journal of the Acoustical Society of America, 128(5), 2836–2846. https://doi.org/10.1121/1.3493436

Ballas, J. A., & Howard, J. H. (1987). Interpreting the language of environmental sounds. Environment and Behavior, 19(1), 91–114. https://doi.org/10.1177/0013916587191005

Ban, Q., Chen, B., Kang, J., Zhang, Y., Li, J., & Yao, J. (2020). Noise in Maternity Wards: A research on its contributors and sources. HERD: Health Environments Research & Design Journal, 14(2), 192–203. https://doi.org/10.1177/1937586720961311

Baysinger, G. (n.d.). Workshops: Advantages, Disadvantages and Considerations: Teaching Chemical Information 3/98: ACS CINF: Projects and hosted sites archive: Swain Library. https://web.stanford.edu/group/swain/cinf/workshop98mar/wrkshpadvdis.html

Bégel, V., Seilles, A., & Bella, S. D. (2018). Rhythm Workers. Music & Science, 1. https://doi.org/10.1177/2059204318794369

Bellini, E., Macchi, A., Setola, N., & Lindahl, G. (2023). Sensory Design in the Birth Environment: Learning from Existing Case Studies. Buildings, 13(3), 604. https://doi.org/10.3390/buildings13030604

Cain, R., Jennings, P., Adams, M. D., Bruce, N., Davies, W., Carlyle, A., Cusack, P., Hume, K., & Plack, C. (2008). An activity-centric conceptual framework for assessing and creating positive urban soundscapes. Proceedings of the Institute of Acoustics Spring Conference. https://usir.salford.ac.uk/2463/

Cain, R., Jennings, P., & Poxon, J. E. W. (2013). The development and application of the emotional dimensions of a soundscape. Applied Acoustics, 74(2), 232–239. https://doi.org/10.1016/j.apacoust.2011.11.006

Darvishi, A., Munteanu, E., Guggiana, V., Schauer, H., Motavalli, M., & Rauterberg, M. (1995). Designing environmental sounds based on the results of interaction between objects in the real world. In IFIP advances in information and communication technology (pp. 38–42). https://doi.org/10.1007/978-1-5041-2896-4_6

Davies, W. J., Adams, M. D., Bruce, N., Cain, R., Carlyle, A., Cusack, P., Hall, D. A., Hume, K., Irwin, A., Jennings, P., Marselle, M. R., Plack, C. J., & Poxon, J. E. W. (2013). Perception of soundscapes: An interdisciplinary approach. Applied Acoustics, 74(2), 224–231. https://doi.org/10.1016/j.apacoust.2012.05.010

Eysenck, H. J. (1996). Personality and the experimental study of education. European Journal of Personality, 10(5), 427–439. https://doi.org/10.1002/(sici)1099-0984(199612)10:5

Feigen, L. P. (1971). Physical characteristics of sound and hearing. The American Journal of Cardiology, 28(2), 130–133. https://doi.org/10.1016/0002-9149(71)90360-2

Fiebig, A. (2023). Soundscape: a construct of human perception. In Springer handbook of auditory research (pp. 23–48). https://doi.org/10.1007/978-3-031-22779-0_2

Fischbeck, L. (2022). Listening studies.

Ganyaupfu, E. M. (2013). Teaching methods and students' academic performance. In International Journal of Humanities and Social Science Invention (Issue 9, pp. 29–35).

Goldhor, R. (1993). Recognition of environmental sounds. IEEE International Conference on Acoustics Speech and Signal Processing. https://doi.org/10.1109/icassp.1993.319077

Guastavino, C. (2007). Categorization of environmental sounds. Canadian Journal of Experimental Psychology, 61(1), 54–63. https://doi.org/10.1037/cjep2007006

Gygi, B., Kidd, G. R., & Watson, C. S. (2007). Similarity and categorization of environmental sounds. Attention Perception & Psychophysics, 69(6), 839–855. https://doi.org/10.3758/bf03193921

Han, Z., Kang, J., & Meng, Q. (2022). The effect of foreground and background of soundscape sequence on emotion in urban open spaces. Applied Acoustics, 199, 109039. https://doi.org/10.1016/j.apacoust.2022.109039

Hargreaves, S., Young, S., Prior, S., & Ayton, J. (2022). Exploring Women's experiences of maternity service delivery in Regional Tasmania: a descriptive qualitative study. Healthcare, 10(10), 1883. https://doi.org/10.3390/healthcare10101883

Idowu, O. M., & McCalla, G. I. (2018). Better late than never but never late is better: towards reducing the answer response time to questions in an online learning community. In Lecture notes in computer science (pp. 184–197). https://doi.org/10.1007/978-3-319-93843-1_14

Kang, J. (2010). From understanding to designing soundscapes. Frontiers of Architecture and Civil Engineering in China, 4(4), 403–417. https://doi.org/10.1007/s11709-010-0091-5

Khalaf, B. K., & Zin, Z. B. M. (2018). Traditional and Inquiry-Based Learning Pedagogy: A Systematic Critical Review. International Journal of Instruction, 11(4), 545–564. https://doi.org/10.12973/iji.2018.11434a

Laamarti, F., Eid, M., & Saddik, A. E. (2014). An overview of serious games. International Journal of Computer Games Technology, 2014, 1–15. https://doi.org/10.1155/2014/358152

Lameras, P., Arnab, S., Dunwell, I., Stewart, C., Clarke, S., & Petridis, P. (2016). Essential features of serious games design in higher education: Linking learning attributes to game mechanics. British Journal of Educational Technology, 48(4), 972–994. https://doi.org/10.1111/bjet.12467

Llorca-Bofí, J., Dreier, C., Heck, J., & Vorländer, M. (2022). Urban Sound Auralization and Visualization Framework—CASE Study at IHTAPark. Sustainability, 14(4), 2026. https://doi.org/10.3390/su14042026

Louwers, G. (2022). Sounds that satisfy: Describing the relationship between sound and need fulfilment. Proceedings of DRS. https://doi.org/10.21606/drs.2022.730

Mallon, M. (2013). Gaming and gamification. Public Services Quarterly, 9(3), 210–221. https://doi.org/10.1080/15228959.2013.815502

Mandanici, M., Altieri, F., Rodà, A., & Canazza, S. (2018). Inclusive sound and music serious games in a large scale responsive environment. British Journal of Educational Technology, 49(4), 620–635. https://doi.org/10.1111/bjet.12630

Morley, M. S., Khoury, M., & Savić, D. (2017). Serious game approach to water distribution system design and rehabilitation problems. Procedia Engineering, 186, 76–83. https://doi.org/10.1016/j.proeng.2017.03.213

Özcan, E., Broekmeulen, C. L. H., Luck, Z. A., Van Velzen, M., Stappers, P. J., & Edworthy, J. (2022). Acoustic Biotopes, Listeners and Sound-Induced Action: A case study of Operating rooms. International Journal of Environmental Research and Public Health, 19(24), 16674. https://doi.org/10.3390/ijerph192416674

Öztürk, Z., & Fasllija, E. (2024, January 17). Assessing soundscape in public libraries: The case study of Yildiz Technical University Şevket Sabancı Library. https://doi.org/10.61782/fa.2023.1012

Potel, M. (2019). Les bienfaits du chant prénatal pour la mère et l'enfant. Soins. PéDiatrie, PuéRiculture, 40(307), 19–20. https://doi.org/10.1016/j.spp.2019.01.005

Rondon, S., Sassi, F. C., & De Andrade, C. R. F. (2013). Computer game-based and traditional learning method: a comparison regarding students' knowledge retention. BMC Medical Education, 13(1). https://doi.org/10.1186/1472-6920-13-30

Roungas, B., & Dalpiaz, F. (2016). A Model-Driven framework for educational game design. In Lecture Notes in Computer Science (pp. 1–11). https://doi.org/10.1007/978-3-319-40216-1_1

Schafer, R. M. (1992). A sound education: 100 Exercises in Listening and Sound-making. Indian River, Ont. : Arcana Editions.

Schafer, R. M. (1993). The soundscape: our sonic environment and the tuning of the world. http://ci.nii.ac.jp/ncid/BA51274040

Suhanek, M., & Grubeša, S. (2021). Innovative approaches to noise reduction. In IntechOpen eBooks. https://doi.org/10.5772/intechopen.93056

Susini, P., Houix, O., & Misdariis, N. (2014). Sound design: an applied, experimental framework to study the perception of everyday sounds. The New Soundtrack, 4(2), 103–121. https://doi.org/10.3366/sound.2014.0057

Torresin, S., Albatici, R., Aletta, F., Babich, F., Oberman, T., Siboni, S., & Kang, J. (2020a). Indoor soundscape assessment: A principal components model of acoustic perception in residential buildings. Building and Environment, 182, 107152. https://doi.org/10.1016/j.buildenv.2020.107152

Torresin, S., Albatici, R., Aletta, F., Babich, F., Oberman, T., Siboni, S., & Kang, J. (2020b). Indoor soundscape assessment: A principal components model of acoustic perception in residential buildings. Building and Environment, 182, 107152. https://doi.org/10.1016/j.buildenv.2020.107152

Visch, V., Vegt, N., Anderiesen, H., & Van Der Kooij, K. (2013). Persuasive Game Design: A Model and its Definitions. N/A. http://repository.tudelft.nl/islandora/object/uuid%3A23ad5ef4-fbf3-4e9c-8815-1edf9da40456/datastream/OBJ/download

Xue, H., & Desmet, P. (2019). Researcher introspection for experience-driven design research. Design Studies, 63, 37–64. https://doi.org/10.1016/j.destud.2019.03.001

Zyda, M. (2005). From visual simulation to virtual reality to games. IEEE Computer, 38(9), 25–32. https://doi.org/10.1109/mc.2005.297

11

Appendix

IDE Master Graduation Project

TUDelft

Project team, procedural checks and Personal Project Brief

In this document the agreements made between student and supervisory team about the student's IDE Master Graduation Project are set out. This document may also include involvement of an external client, however does not cover any legal matters student and client (might) agree upon. Next to that, this document facilitates the required procedural checks:
- Student defines the team, what the student is going to do/deliver and how that will come about
- Chair of the supervisory team signs, to formally approve the project's setup / Project brief
- SSC E&SA (Shared Service Centre, Education & Student Affairs) report on the student's registration and study progress
- IDE's Board of Examiners confirms the proposed supervisory team on their eligibility, and whether the student is allowed to start the Graduation Project

STUDENT DATA & MASTER PROGRAMME
Complete all fields and indicate which master(s) you are in

Family name	Zou	IDE master(s)	IPD ✓	Dfl ☐	SPD ☐
Initials	S.Z	2nd non-IDE master			
Given name	Shourui	Individual programme (date of approval)			
Student number	▉▉▉▉▉▉	Medisign	☐		
		HPM	☐		

SUPERVISORY TEAM
Fill in he required information of supervisory team members. If applicable, company mentor is added as 2nd mentor

Chair	Elif Ozcan Vieira	dept./section	Design Aesthetics, HCD
mentor	Stefano Delle Monache	dept./section	Design Aesthetics, HCD
2nd mentor			
client:			
city:		country:	
optional comments			

! Ensure a heterogeneous team. In case you wish to include team members from the same section, explain why.

! Chair should request the IDE Board of Examiners for approval when a non-IDE mentor is proposed. Include CV and motivation letter.

! 2nd mentor only applies when a client is involved.

APPROVAL OF CHAIR on PROJECT PROPOSAL / PROJECT BRIEF -> to be filled in **by the Chair** of the supervisory team

Sign for approval (Chair)

Name Elif Ozcan Vieira   Date 25 March 2024   Signature *EÖzcan*

CHECK ON STUDY PROGRESS
To be filled in **by SSC E&SA** (Shared Service Centre, Education & Student Affairs), after approval of the project brief by the chair. The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total	_____ EC	
Of which, taking conditional requirements into account, can be part of the exam programme	_____ EC	

☐	YES	all 1st year master courses passed
☐	NO	missing 1st year courses

Comments:

Sign for approval (SSC E&SA)

Name _____   Date _____   Signature _____

APPROVAL OF BOARD OF EXAMINERS IDE on SUPERVISORY TEAM -> to be checked and filled in by IDE's Board of Examiners

Does the composition of the Supervisory Team comply with regulations?

YES	☐	Supervisory Team approved
NO	☐	Supervisory Team not approved

Comments:

Based on study progress, students is …

☐	**ALLOWED** to start the graduation project
☐	**NOT** allowed to start the graduation project

Comments:

Sign for approval (BoEx)

Name _____   Date _____   Signature _____

![Design for our future logo]

TUDelft

Personal Project Brief – IDE Master Graduation Project

Name student Shourui Zou

Student number ████████

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT
Complete all fields, keep information clear, specific and concise

Project title
Soundscape Sensibility: Developing A Sound Game To Heighten Designers' Environmental Sound Awareness

Please state the title of your graduation project (above). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

Introduction

Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)

Soundscape, is the acoustic environment as perceived or experienced and understood by a person or people in context (ISO, 2014). It is a perceptual construct of our experience of a place or setting. That is, in addition to objective sound characteristics, the quality and feel of a soundscape are closely related to context and the person's role and purpose. (Özcan et al., 2022) Understanding soundscape is essential for sound designers' further development, but yet new designers need to know the principle of soundscape and improve their awareness of environmental sounds. Although traditional education like lectures can impart theoretical knowledge more efficiently, it lacks the cultivation of perception and practice, which are essential for soundscape learning. (Khalaf & Zin, 2018) Therefore, an improved learning method is needed to better improve awareness.

Serious gaming is a new way of learning. It can cultivate areas that are difficult to reach with traditional learning methods while maintaining interest. Currently, several researches on sound games is concentrated in the field of music education, and these studies have confirmed that sound games can significantly improve individual's perception of sound. (Bégel et al., 2018; Mandanici et al., 2018) This project is based on these studies to design a sound game that can be used to train designers' awareness of soundscapes in indoor contexts.

The main stakeholders in this context are designers with varies backgrounds who are new to and interested in sound design and educational institutions offering design courses. The project presents an opportunity to create an engaging learning experience for designers to enhance their soundscape awareness. The diversity of soundscape context and the mechanism of the game design are big challenges. Designing the game to appeal to a diverse range of designers with varying backgrounds is also a challenge.

Critical Alarms Lab has been involved in soundscape design in the past years and is willing to hekp support the design student community in their sound-driven educational endevours.

---
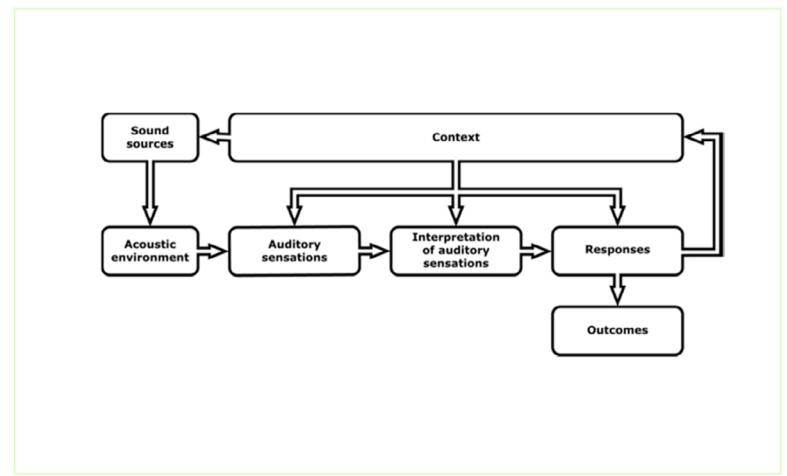
image / figure 1 Basic Framework of Context, People, and Acoustic Environment in Soundscape
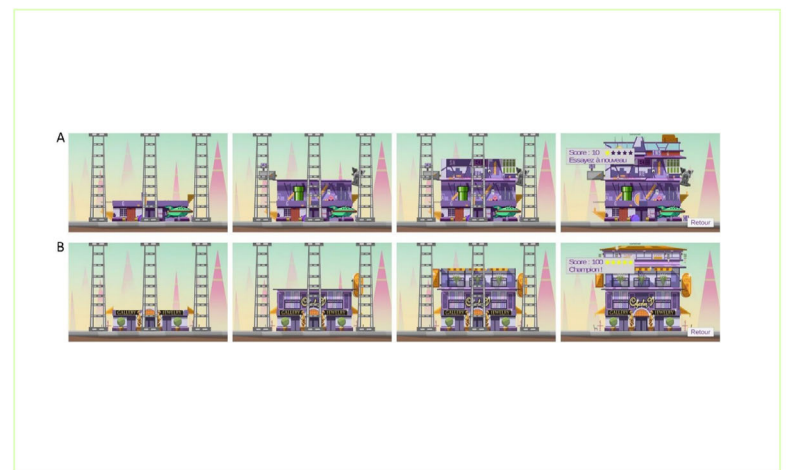
image / figure 2 Sound Game: Rhythm Workers by Mandanici

TUDelft

Personal Project Brief – IDE Master Graduation Project

Problem Definition

What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice.
(max 200 words)

Traditional learning methods can be effective in gaining theoretical knowledge with less distraction. However, for soundscape design learning, theoretical knowledge only occupies a part of it. The problem lies in the limitation of training designers' awareness of sound using traditional learning methods like lectures, research studying and workshops. To be specific, the limitations are lack of practice (lectures), lack of flexibility (workshop), lack of guidance (research studying), and heavy use of teaching resources (workshop).

By addressing this problem, we aim to create added value for the stakeholders involved. For designers, the sound game offers hands-on learning experiences that closely resembles real-world scenarios, providing immediate feedback and facilitating a deeper understanding of environmental sounds. For educators, they benefit from innovative training methods that enhance teaching effectiveness and quality.

Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for.
Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence)
As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:

Design an engaging sound game as an improvement, as well as an addition to traditional learning methods, to better practise one's awareness and sensitivity to environmental sounds, and interpretation of sounds in different contexts for designers with different backgrounds who are new to and interested in learning soundscape design.

Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)

In this project, the double diamond design model will be used. First, context research will be carried out to get a deep understanding of soundscape and soundscape design, and the basic frame and essentials of serious gaming design. The context of when, where, and how this game will be implemented will also be investigated and determined. Then, user research will be done, focusing on the designers who learn soundscape, and the teachers who teach soundscape, to determine the form, mechanism, and details of the game design. A clear design goal with requirements and game elements will be generated after this step. The next step will be concept development, with an outcome of an interactable and fully functioning game prototype for testing in the next step. Then, testers will be found to evaluate the game based on the criteria determined by the design goal, and several iterations will be made throughout several loops of development and testing. Finally a qualified game design will be generated and self reflection of this project will be made.

Project planning and key moments

*To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a **kick-off meeting**, **mid-term evaluation meeting**, **green light meeting** and **graduation ceremony**. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).*

Make sure to attach the full plan to this project brief.
The four key moment dates must be filled in below

Kick off meeting	12/3/2024
Mid-term evaluation	7/5/2024
Green light meeting	2/7/2024
Graduation ceremony	30/7/2024

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	
For how many project weeks	
Number of project days per week	

Comments:

Motivation and personal ambitions

Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five.
(200 words max)

I have an enthusiasm on using my ideas and knowledge to design something meaningful and interesting. My musical talent and personal interests gives me a great interest in exploring sound and gaming design, and this project provides me a precious opportunity to step into these field. I am excited to face the new knowledge as well as new challenges on discovering how sounds and games can be intergrated.

On the other hand, as an IPD student with a mechanic engineering background, I also believe that design, especially for tangible products, has to be base on certain technologies. This topic will integrate technologies from different fields like ME, EE, AI, 3D Printing, etc., and though challenging, it is a good chance for me to develop more on these technologies.

Additionally, I want to further develop my prototyping skills. Through the AED course, my prototyping skills have already been cultivated into a high level, but I want it to be more professional. This includes a further consideration on the strength of the product, the mass production method, modular, inclusiveness to electronic components, sustainability, and many more aspects. I know it is hard for me to reach this level within just one project, but at least I can be one step closer to my ambition.

73

Appendix B: Interview Consent Form

Consent form: Interview

You are being invited to participate in a research study titled "Soundscape Sensibility: Developing A Sound Training Activity To Heighten Beginners' Environmental Sound Awareness". This study is being done by Shourui Zou from the TU Delft for a master graduation project. The purpose of this research study is to design a new educational activity for training one's sound awareness.

In this interview, I will ask you some opening questions according to your experience in Soundscape. This semi-structured interview will take you approximately 30 minutes to complete. The data will be used for analysis.

We assure you that your answers in this study will remain confidential. We will collect your job title, job sector, one of your social media avatars, and your opinion and experience on several soundscape-related questions. To minimize any risks, we will ensure that the analysis result of this survey is entirely anonymous, and no IP addresses or other Personal Data will appear. All the data collected will be stored safely, and confidentiality will be secured by anonymising the data.

Your participation in this is entirely voluntary, and you can withdraw at any time. You are free to omit any questions. If you have any questions or concerns regarding this study, please feel free to contact the corresponding and Responsible Researcher, Shourui Zou at S.Zou-1@student.tudelft.nl. Thank you for your participation in this study!

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information dated [ ], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
3. I understand that taking part in the study involves a 30-minute online interview. I also understand that what I said in the interview will be noted down and transferred into a script.	☐	☐
4. I understand that I will be compensated for my participation in this study.	☐	☐
5. I understand that the study will end in 30min.		
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
6. I understand that taking part in the study involves collecting specific personally identifiable	☐	☐

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
information(PII), such as my name, email address, avatar, and associated personally identifiable research data(PIRD), such as job title and sector.		
10. I understand that personal information collected about me that can identify me, such as my name, my title and my study field, will not be shared beyond the study team.	☐	☐
11. I understand that the (identifiable) personal data I provide will be destroyed after the study.	☐	☐
C: RESEARCH PUBLICATION, DISSEMINATION AND APPLICATION		
12. I understand that after the research study the de-identified information I provide will be used for design reference and thesis output.	☐	☐
13. I agree that my responses, views or other input can be quoted anonymously in research outputs	☐	☐
14. I agree that my real name can be used for quotes in research outputs	☐	☐

Signatures

Shourui Zou

_____   _____   _____
Name of participant   Signature   Date

I, as researcher, have accurately read out the information sheet to the potential participa[nt] to the best of my ability, ensured that the participant understands to what they are freel[y] consenting.

_____   _____   _____
Researcher name [printed]   Signature   Date

Study contact details for further information: S.Zou-1@student.tudelft.nl

Appendix C: Interview Outline

First, thank you again for your participation in this interview. Before we start to discuss, I would like to give a brief introduction to my project so we can both better understand the topic and be more efficient during the interview.

For those who want to learn about soundscape design or dive into this field, the first important thing is to improve their sound awareness. To be specific, sound awareness means: Listening to sound (to hear the sound), Understanding sound (knowing the characteristics of sound), Experiencing sound (knowing what feelings the sound will cause under a context), Organize sound (adjusting the sound for a better experience). The method for training one's sound awareness now is somehow not well-instructed or needs too many resources. So in this project, I would like to design a playful way for individuals to better improve their sound awareness.

The aim of this interview is to learn more about the process of sound awareness training, the important elements, examples, etc. to determine the form and mechanism of the final design.

1. Sometimes "sound awareness" is not improved deliberately, but through projects and experiences. With your expertise in the indoor soundscape, **I would like to ask about the procedure** of designing an indoor soundscape (For example a library)?

Not design but to do research.
Record the sound, then listen to the sound, then categorize the sound (in a excel sheet).

2. And in which part do you think that can best practise sound awareness?

By listening to the sound. Inside a room, with no other sensory except listening. 6-8 people together so that they can discuss about the result.

3. Is it possible not to go on site, but use recordings? What would be the drawback if do so?

As mentioned before, recordings are used, but there will be one issue: if it's a recording, that means we cannot see, and sometimes there will be different outcomes of the sound resource for the same sound. (As it might sound pretty familiar). But if we are on-site and can see, the answer will be single.

4. For listening, do I have to listen and tell every sound in the environment (excel you mentioned), or just catch certain sounds? What would that sound be? How to determine if it's worth capturing?

Depends on the goal of the project. But there will be cases that we need to hear all the sounds.

5. As a designer, we should not only know about our own feelings about the sound but also how other people/the majority feel about the sound. (In this case), how can we know how other people feel about the current soundscape? (Any existing criteria? Or does user research have to be done every time?)

There are ISO standards. 8 sound descriptors. But different people will have different definitions of these descriptors. The best way is to use a questionnaire asking about their opinion of those descriptors.

6. And how can we test our design? (How to implement our soundscape design? Any simulation?) (What if the result is not ideal?)

Design: Use a sound to avoid another sound. Soundscape Interventions. F.Aletta

7. Each different case has a different context. It is impossible to find two places and have the same soundscape. According to your research experience, are there any common things between different contexts? (For example, can the analysis of a library soundscape be used on a project about a café soundscape?)

Not quite. Soundscape is very different from one another. And it really depends on the context. But in indoor soundscape, human sounds (speech) in most of the time are prominent.

8. Now if we want to train one's soundscape deliberately, (according to the last question) would it be useful to set some "typical context" for training? Any examples?

It would make no difference, but it is suggested to go to somewhere that he\she is not familiar with.

9. Have you got any experience in sound awareness training that you want to share? (If have, method, duration, number of people, place of the training)

30s recording with 80 different sounds. 80 sound cards to pick. Rate the sound according to the ISO standard.

10. Add: (Will there be any case that we need to simulate a context in another context? What is need to do that?)

It's not a good idea to simulate another context by programme in a room. It will be completely different.

This would be the end of this interview, again thank you very much for your participation and your answers are truly insightful for this project. Bye and have a nice day!

First, thank you again for your participation in this interview. Before we start to discuss, I would like to give a brief introduction to my project so we can both better understand the topic and be more efficient during the interview.

For those who want to learn about soundscape design or dive into this field, the first important thing is to improve their sound awareness. To be specific, sound awareness means: Listening to sound (to hear the sound), Understanding sound (knowing the characteristics of sound), Experiencing sound (knowing what feelings the sound will cause under a context), Organize sound (adjusting the sound for a better experience). The method for training one's sound awareness now is somehow not well-instructed or needs too many resources. So in this project, I would like to design a playful way for individuals to better improve their sound awareness.

The aim of this interview is to learn more about the process of sound awareness training, the important elements, examples, etc. to determine the form and mechanism of the final design.

1. Sometimes "sound awareness" is not improved deliberately, but through projects and experiences. With your expertise in outdoor soundscape, I would like to ask about the procedure for designing an outdoor soundscape (For example a park)?

The first thing is to figure out the goal. To design a new soundscape? To improve an existing soundscape? Or to protect a soundscape?

2. For example improving?

First, to collect data. About how people feel about the soundscape. (survey, questionnaires) Then I will figure out the target of the improvement, in most cases has a matrix to achieve. (Also discuss with stakeholders). Then I'll carry out the design, give solutions, and test.

3. Will you go to the site and listen to the soundscape yourself?

Yes, but the emphasis is not on how I listen to the soundscape. It's more about the data that I collect, from other participants.

4. And how can we test our design? (How to implement our soundscape design? Any simulation?) (What if the result is not ideal?)

Using recording is a very common method because using technology we can modify the recording and give a final result simulation. Like industrial design rendering.

5. What is the difference between using recordings and go on site?

Recordings can only give the result of a comparison. Like an A/B text. We can make the decision, and tell which one is better using recordings because both subjects are in the lab

environment. But recordings can not give an absolute conclusion, like how people will react in a context because people can tell if it's a simulation and they will act differently.

VR is a very important way of testing, but highly depends on the quality of the simulation. NO simulation can 100% simulate the real case.

6. As a designer, we should not only know about our own feelings about the sound but also how other people/the majority feel about the sound. **how can we know how other people feel about the current soundscape?** (Any existing criteria? Or does user research have to be done every time?)

It's the most difficult question nowadays. And it also depends on the scale of your research/design. Individual? Community? It is impossible to fulfil everyone's needs in an open public area. So it is very important to think about the role/users of sounds in the soundscape, (For example residents and visitors) and their needs.

There are researches about how certain groups of people will feel about different sounds, but the researches are irrelevant and the questions asked are not standardized. Thus the result of these researches are to some extend not reliable. We DO need a standard like this.

7. Each different case has a different context. It is impossible to find two places and have the same soundscape. According to your research experience, are there any common things between different contexts? (For example, can the analysis of a park soundscape be used on a project about an urban walk street soundscape?)

No. Each context is different and will require a different framework. In these frameworks different descriptors are used.

8. Have you got any experience in sound awareness training that you want to share? (If have, method, duration, number of people, place of the training)

There are summer schools and conferences for soundscape design and awareness. IOA is actually publishing CPD for professionals to gain credits and certificates in soundscape design. In 2023 Sep, we have a workshop for students to listen to recordings and give feelings about the soundscape. After that, they will be provided with data on how other people feel about a soundscape.

Sometimes, soundscape awareness is not trained simply by listening, but also by diving into data and information. We can tell why a soundscape is less pleasant than another one by analysing data.

This would be the end of this interview, again thank you very much for your participation and your answers are truly insightful for this project. Bye and have a nice day!

First, thank you again for your participation in this interview. Before we start to discuss, I would like to give a brief introduction to my project so we can both better understand the topic and be more efficient during the interview.

For those who want to learn about soundscape design or dive into this field, the first important thing is to improve their sound awareness. To be specific, sound awareness means: Listening to sound (to hear the sound), Understanding sound (knowing the characteristics of sound), Experiencing sound (knowing what feelings the sound will cause under a context), Organize sound (adjusting the sound for a better experience). The method for training one's sound awareness now is somehow not well-instructed or needs too many resources. So in this project, I would like to design a playful way for individuals to better improve their sound awareness.

The aim of this interview is to learn more about the process of sound awareness training, the important elements, examples, etc. to determine the form and mechanism of the final design.

1. What do you think that can best practise sound awareness?

Soundwalks. We do that outdoor in most of the cases, but we can also do that indoor. And soundwalks do not have to include "walking".

2. Will covering up eyes benefit for soundwalk?

Can be useful so we can focus more on the sound, but we still have other sences like touch and smell.

3. **Is it possible not to go on site, but use recordings? What would be the drawback if do so? (Your study on VR)**

The good thing is VR can be used to simulate non-existent soundscapes for design testing. And if the simulation is good enough the result will be meaningful. But the drawback is the simulation cannot be 100% real, and people can not be in the simulation for too long.

4. As a designer, we should not only know about our own feelings about the sound but also how other people/the majority feel about the sound. (In this case), how can we know how other people feel about the current soundscape? (Any existing criteria? Or does user research have to be done every time?)

Sometimes we don't have the data, so it's gonna be pretty difficult as soundscape have to rely on people. Even if we are doing soundscape for a specific group there will still be diversity in this group. So yes, user research should be carried out.

5. Each different case has a different context. It is impossible to find two places and have the same soundscape. According to your research experience, are there any common things between different contexts? (For example, can the analysis of an office soundscape be used on a project about a museum, or a cafe soundscape?)

To some extent yes, there will be some common points, at least in residential soundscape. Because even though people are in different contexts, sometimes their activity is the same. For example when people are in a library and when people are inside an office, they tend to be quiet and focus on their work, while in a restaurant or café, they are more likely to talk to their friends. If people have the same activity, their expectation of soundscapes can somehow be familiar.

6. Now if we want to train one's soundscape deliberately, (according to the last question) would it be useful to set some "typical context" for training? Any examples?

Yes. But remember to classify them by activities.

7. Will there be any case that we need to simulate a context in another context? What is need to do that?

It's weird, but there will be cases like this. During lockdown people are trying to simulate office sounds in home.

8. The method of simulation soundscape?

There are two main methods. One is to use recordings of real sounds. The second is to use simulated sounds by programme.

This would be the end of this interview, again thank you very much for your participation and your answers are truly insightful for this project. Bye and have a nice day!

First, thank you again for your participation in this interview. Before we start to discuss, I would like to give a brief introduction to my project so we can both better understand the topic and be more efficient during the interview.

For those who want to learn about soundscape design or dive into this field, the first important thing is to improve their sound awareness. To be specific, sound awareness means: Listening to sound (to hear the sound), Understanding sound (knowing the characteristics of sound), Experiencing sound (knowing what feelings the sound will cause under a context), Organize sound (adjusting the sound for a better experience). The method for training one's sound awareness now is somehow not well-instructed or needs too many resources. So in this project, I would like to design a playful way for individuals to better improve their sound awareness.

The aim of this interview is to learn more about the process of sound awareness training, the important elements, examples, etc. to determine the form and mechanism of the final design.

1. Sometimes "sound awareness" is not improved deliberately, but through projects and experiences. With your expertise in the indoor soundscape, **I would like to ask about the procedure** of designing an indoor soundscape (For example a library)?

I am more like a researcher than a designer, so I would like to dive into the perceptual construct of a soundscape. So there is only one step that is to find out people's perception of a soundscape.

2. Will you go listen by yourself of you'll do user researches?

I will say both. User research can help you find out what other people think about a soundscape, but going and listening by myself might gonna provide some new insights.

3. For listening, do I have to listen and tell every sound in the environment (excel you mentioned), or just catch certain sounds? What would that sound be? How to determine if it's worth capturing?

Depend on the role that you want to play, because people listen to sounds intentionally. It's need-driven.

4. As a designer, we should not only know about our own feelings about the sound but also how other people/the majority feel about the sound. (In this case), how can we know how other people feel about the current soundscape? (Any existing criteria? Or does user research have to be done every time?)

There is a database called "International Soundscape Database" that can be used as a

reference. But the results and conclusions from any other research have to be tested in your research.

5. Each different case has a different context. It is impossible to find two places and have the same soundscape. According to your research experience, are there any common things between different contexts? (For example, can the analysis of a library soundscape be used on a project about a café soundscape?)

Sometimes in an indoor area, like a living room and a classroom. But what matters is the intention of the listener.

6. Have you got any experience in sound awareness training that you want to share? (If have, method, duration, number of people, place of the training)

Nope.

7. Will there be any case that we need to simulate a context in another context? What is need to do that?

Sure, and I think that's based on people's preference.

This would be the end of this interview, again thank you very much for your participation and your answers are truly insightful for this project. Bye and have a nice day!

Appendix D: Sound Source List

Place	Location	Sounds	
Venice	SanMarco (Busy Square)	Human Talking (Adult)	Human
		Human Talking (Kids)	Human
		Music (Piano)	Machine
		Music (Symphony)	Machine
		Engine	Machine
		Bells Jiggling	Machine
		Footsteps (Pavement)	Human
		Construction (Hit of metal)	Machine
		Music (chorus)	Human
		Echo	Human
	Monumento G Attractions (Park)	Footstep (Gravel Road)	Human
		Human Talking (Adult)	Human
		Human Talking (Kids)	Human
		Animals	Nature
		Birds (Flying away)	Nature
		Dog (Bark)	Nature
		Bicycles (Wheels)	Machine
Grenada	Carlo V Attractions (architect)	Human Talking (Adult)	Human
		Human Talking (Kids)	Human
		Infants (Crying)	Human
		Footsteps (Pavement)	Human
		Bicycle	Machine
		Bird (Chirping)	Nature
		Trees (Blowed by the wind)	Nature
		Vehicle (Door closing)	Machine
		Paper (Folding/opening)	Machine
	Campo Principe	Echo (Talking)	Human
		Bird (Chirping)	Nature
		Human Talking (Adult)	Human
		Human Talking (Kids)	Human
		Water (Fountain)	Nature
		Footsteps (Pavement)	Human
		Construction	Machine
	MiraddorSanNicolas Attractions	Human Talking (Adult)	Human
		Human Talking (Kids)	Human
		Instruments (Guitar)	Machine
		Singing	Human
		Applausing	Human
		Instruments (Percussion)	Machine
		Coins in bottle	Machine
		Zipping	Machine
Groningen	Noorderplantsoen Park (less people)	Bicycle (wheel)	Machine
		Bird (Chirping)	Nature
		Water (Flowing)	Nature
		Footstep (Gravel Road)	Human
		Trees (Blowed by the wind)	Nature
		Engine	Machine
		Bus	Machine
		Human Talkling	Human
London	Euston Tap/Camden T Street	Human Talking (Adult)	Human
		Human Talking (Kids)	Human
		Engine	Machine
		Music	Machine
		Honk	Machine
		Footsteps (Pavement)	Human
		Horse	Nature
		Siren	Machine
		Luggage draging	Machine
		Bus	Machine
	Marchmont Garden Park	Footsteps (Wood)	Human
		Engine	Machine
		Honk	Machine
		Human Talking	Human
		Bird (Chirping)	Nature
		Alloy Can rolling on the ground	Machine
	RegentsParkFields Park (Many people)	Human Talking (Adult)	Human
		Human Talking (Kids)	Human
		Bird (Chirping)	Nature
		Footstep (Gravel Road)	Human
		Trees (Blowed by the wind)	Nature
		Engine	Machine
		Duck	Nature
		Luggage draging	Machine
		Airplane	Machine
		Construction (Drill)	Machine

Resource	Location Selection	Sounds Selection	
(Axelsson et al., 2010)	urban court-yards	airplanes	Machine
	motorways	individual cars	Machine
	pedestrian street	motorcycles	Machine
	school yards	car alarms	Machine
	suburban parks	car horns	Machine
	suburban recreational areas	chainsaw	Machine
	suburban residential areas	rock drill	Machine
	urban parks	street sweeper	Machine
	an urban square market	construction work	Machine
	urban streets	trains	Machine
		ventilation fans	Machine
		sirens	Machine
		bird song	Nature
		wind whispering	Nature
		rustling leafs	Nature
		rain	Nature
		fountain jets	Nature
		waterfall	Nature
		purling water spring	Nature
		children at play	Human
		footsteps	Human
		human voices	Human

final choice		
individual cars	Laughing	thunder
motorcycles	Shouting	Tide
train/tram	snoring	Fire camp
bus	Chewing	Bird flying
Music (speaker)	Talking/chating	bird song
Instrument	Footsteps	wind whispering
Construction	children at play	rustling leaves
Siren	Crying	rain
Luggage draging	Singing	water
ventilation fans	Applauding	Pet
Alloy Can rolling on the ground		Non-pet animals
Airplane		
Horns		
Bells		
Paper/Books		
Bicycle		
tableware		
camera		
video		
broadcast		

Appendix E: Scene & Activity

For the scene in ISD, a total of 18 different locations are given in the database, 11 from London, 4 from Grenada, 2 from Venice and 1 from Groningen. Among the 18 locations, some are close together and have almost identical soundscape:

- Urban Street: Camden Town (London), Euston Tap (London), Tate Modern (London), San Marco (Venice)
- Small Park: Marchmont Garden (London), StPaulsCross & StPaulsRow (London)
- Big Park: RegentsParkFields & RegentsParkJapan (London), Noorderplantsoen (Groningen), Monumento Garibaldi (Venice)
- Square: PancrasLock (London), RusselSq (London), TorringtonSq (London), PlazeBibRambla (Grenada)
- Attraction: Carlo V (Grenada), MiradorSanNicolas (Grenada)
- Patio: CampoPrincipe (Grenada)

In the experiment by Axelsson et al. (2010) of exploring soundscape perception, the locations are classified as urban courtyards, motorways, pedestrian streets, school yards, suburban parks, suburban recreational areas, suburban residential areas, urban parks, urban square markets, and urban streets. Using it as a reference, I finally selected the following 3 locations as the Preset Scene for the first version of Sound Detective. In these three scenes, three different sound types dominate and have representative functions.

- Downtown Street (machine): Taking Camden Town & Euston Tap as the main sample, an entertainment and shopping street with busy traffic and people is described.
- Busy Square (human): Taking SanMarco, Carlo V & MiraddorSanNicolas as the main sample, it describes a city square with crowds of people and numerous activities.
- Urban Park (Nature): Taking Noorderplantsoen & RegentsParkFields as the main sample, a large park located inside the urban area is described.
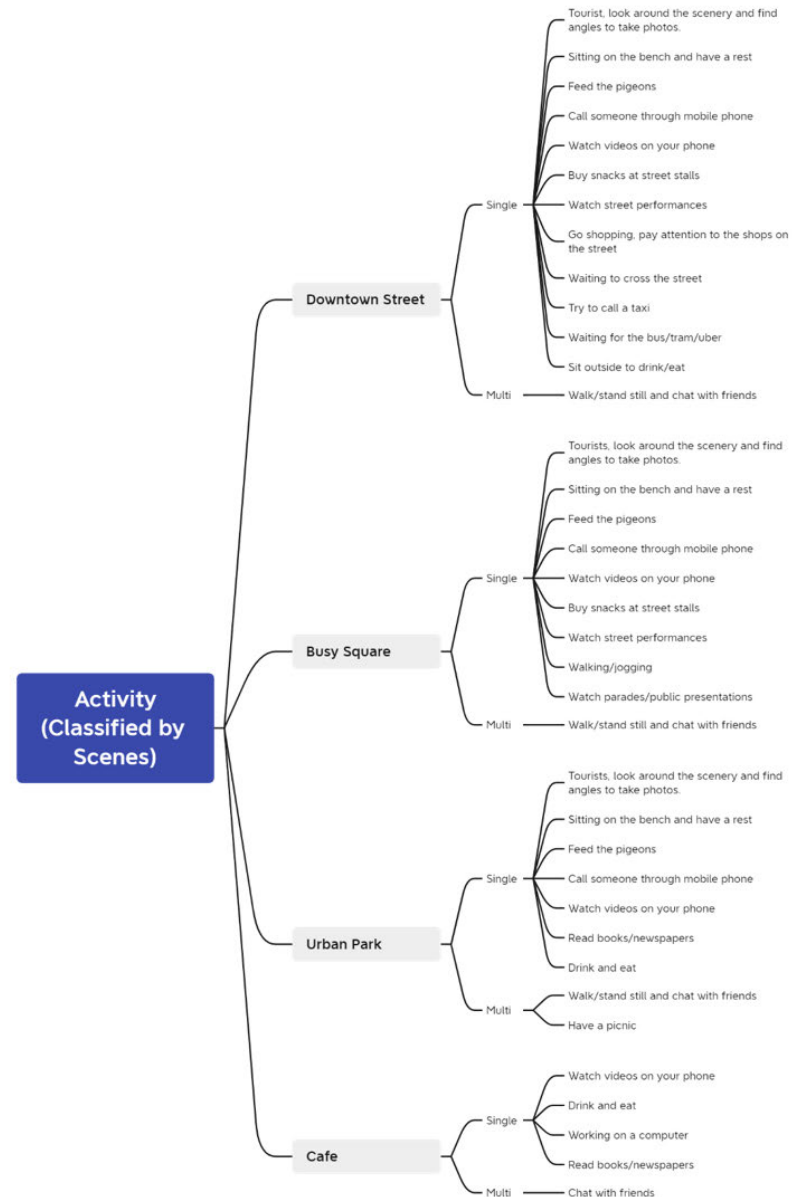
Appendix F: Instruction Board Ver 1

Welcome to the wonderful world of Soundscape!

Sound Detective is a group activity aiming to improve your awareness of sound for your soundscape exploration journey.

The activity has 4 phases:
- Prepare
- Listening
- Role-play
- Detective

The following will describe each phase in detail. The explanations of the words in red can be found in the glossary. **(They are very important!)**

Prepare

Get Ready:

All the props for the activity (Inside the box)

Steps:

1. Gather your participants.
2. Choose a scene you all agree with (e.g. Local park, a Downtown shopping street)
3. Pick a time and go to the scene.
4. Now you are ready to start the activity!

Listening

Get Ready:

Sound Token

Steps:

1. Gather all the participants.
2. Spread out all the sound tokens with the side with the sound source facing up. (DO NOT reveal the back of the sound token)
3. Calm down and listen to the soundscape of the scene, try to capture all the sound in the soundscape. (You can close your eyes for better perception)
4. Pick out all the sound tokens with the sound source you heard.
5. Classify the sound tokens according to the Sound Type.

6. After confirmation with all the participants, flip the sound token to see if the classification is right.
7. Fix the mistake, flip the sound token back (with the sound source side up), keep it aside and DO NOT shuffle.

Role-play

Get Ready:

Character Board, Activity Token

Steps:

1. Distribute the Character Board to each participant.
2. All the participants fill in the Character Board according to themselves.
3. Each participant introduces themselves to all according to their Character Board.
4. Shuffle the Activity Token.
5. Each participant draws an Activity Token. (If the activity on the Activity Token is not applicable in the scene, abandon this Activity Token and draw another one until the activity is able to be carried out)
6. After confirmation with all, participants head out to carry out their activities in the scene.
7. The duration is around 5-10minutes.
8. After the activity, note down the Feeling and Rate for the soundscape. (DO NOT show this to other participants)
9. Note down the sounds you heard and the Sound Characteristics & Sound Biotopes in the process behind the Character Board. (DO NOT show this to other participants)
10. Gather all the participants back after all participants finish their activity.
11. If necessary, let the organizer to have a check of each players answers.
12. Participants keep the Character Board and Activity Token. (DO NOT shuffle)

Detective

Get Ready:

Sound Token (In phase Listening), Character Board (In phase Role-play), Activity Token (In phase Role-play), Rate Board

Steps:

1. Select one participant as the first respondent.

2. The selected participant puts his/her Character Board (with the personal info side up) in between all the participants, together with the Activity Token he/her draws.
3. The selected participant briefly introduces his/her activity to all. (Also his/her personal info again if necessary)
4. The selected participant tells other people about his/her Feeling and Rate of the soundscape during his/her activity using the Rate Board.
5. Other participant start to standing on the view of the selected participant, and pick out the sound he/her heard (indicated) during his/her activity from the Sound Token.
6. Other participants put the Sound Token around the Character Board according to Sound Biotopes and Sound Characteristics.
7. After reaching an agreement, the selected participant flips the Character Board and reveals the answer. Also explain his/her Sound Biotopes.
8. Select another participant and repeat the process from step 2, until all the participant are selected.

Glossary

Sound Token:

An activity prop. There are many different sounds in the soundscape, and these sounds come from different sound sources. The front of the Sound Token is the sound source, and the back is the Sound Type of the sound.

Sound Type:

There are many different ways to categorize sound sources, but the most widely used and easy to understand ones are "Machine", "Nature" and "Human".
● Machine: The sound produced by man-made machinery.
● Nature: Non-human sounds in nature.
● Human: The sound of human beings.
Different types of sounds will dominate in different soundscapes.

Character Board:

How people feel about a soundscape is mainly determined by the person himself and his intension. The Character Board is an activity prop that provides information about the participant's personal characteristics. The front side has the participant's basic information, while the back side shows the participant's Sound Biotopes and Sound Characteristics of the sound they heard in the soundscape.

Activity Token:

An activity prop. People's intention is another factor that determines people's perception of the soundscape, and this prop determines the "intention" of the participant in the scene. It has the activities that participants need to perform in this activity.

Feeling:

People's perception of sound fields can be divided into three types: Positive, Neutral, and Negative.

Rate:

At present, researchers have proposed many ways to describe a sound field, which are called "Sound Descriptors". The most widely used one is the "Eventful-Pleasent" binomial coordinate system. Its four quadrants represent four different types of soundscape descriptions. See Rate Board for details.

Sound Characteristics:

Sound itself has sound attributes. Its attributes can be divided into Pitch, Intensity, Duration, and Harmonic. Different sounds have attributes, and different attributes affect the listener's perception of the sound.
- Pitch: The pitch of the sound.
- Intensity: The intensity of the sound (loud?/soft?).
- Duration: The duration of the sound.
- Harmonic: Whether the sound is harmonious and pleasant.

At the same time, according to the different behaviors of the listener, the sound can also be divided into Foreground and Background.
- Foreground: The sound that dominates the listener.
- Background: Sounds that are easy for the listener to ignore or take for granted.

Analyzing the characteristics of the sound itself and combining it with the listener's behavior to determine the Foreground/Background of the sound plays an important role in understanding the soundscape and subsequently improving the soundscape.

Sound Biotopes:

Depending on the different activities of people in the sound field, the same sound will be perceived differently by people with different intentions. Sound Biotopes describe how people use/hear different sounds in the soundscape. People are divided into four different roles:
- Passive: People do not listen to the sound intentionally, but passively accept the sound.
- Active: People will pay attention to the sound and make changes in their behavior based on the sound.
- User: People will seek out and track that sound, and will block out other sounds to better focus on it.
- Producer: People are the subject that produces the sound, whether it is produced by themselves or through some medium (such as tools, musical instruments)

Distinguishing different sounds from a research subject's Sound Biotopes is very helpful in judging his or her perception of the soundscape.

Rate Board:

An activity prop. It has an eventful-pleasant (sound descriptor) coordinate system and four types of soundscape corresponding to the four quadrants. A person's feeling for a sound field is often related to his or her description of the sound field. The selected participant uses this board to show other participants his/her Feeling and Rate towards the soundscape.

Appendix G: User Test Consent Form

Consent form: User Test

You are being invited to participate in a research study titled "Soundscape Sensibility: Developing A Sound Training Activity To Heighten Beginners' Environmental Sound Awareness". This study is being done by Shourui Zou from the TU Delft for a master graduation project. The purpose of this research study is to design a new educational activity for training one's sound awareness.

In this user test, I will ask you to participate in the activity Sound Detective and fill in a questionnaire survey. This will take you approximately 1.5-2h to complete. The data will be used for analysis.

We assure you that your answers in this study will remain confidential. We will collect your personal demographic, your behaviour during the activity, and your questionnaire answers. To minimise any risks, we will ensure that the analysis result of this survey is entirely anonymous, and no IP addresses or other Personal Data will appear. All the data collected will be stored safely, and confidentiality will be secured by anonymising the data.

Your participation in this is entirely voluntary, and you can withdraw at any time. You are free to omit any questions. If you have any questions or concerns regarding this study, please feel free to contact the corresponding and Responsible Researcher, Shourui Zou at S.Zou 1@student.tudelft.nl. Thank you for your participation in this study!

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information dated [ ], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
3. I understand that taking part in the study involves a Sound Detective activity and a questionnaire survey (1.5-2h). I also understand that what I did during the activity will be noted down.	☐	☐
4. I understand that I will be compensated for my participation in this study.	☐	☐
5. I understand that the study will end in 1.5-2h.		
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
6. I understand that taking part in the study involves collecting specific personally identifiable	☐	☐

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
information(PII), such as my name, gender, occupation, and associated personally identifiable research data(PIRD), such as job title and sector.		
10. I understand that personal information collected about me that can identify me, such as my name, my title and my study field, will not be shared beyond the study team.	☐	☐
11. I understand that the (identifiable) personal data I provide will be destroyed after the study.	☐	☐
C: RESEARCH PUBLICATION, DISSEMINATION AND APPLICATION		
12. I understand that after the research study the de-identified information I provide will be used for design reference and thesis output.	☐	☐
13. I agree that my responses, views or other input can be quoted anonymously in research outputs	☐	☐
14. I agree that my real name can be used for quotes in research outputs	☐	☐

Signatures

Shourui Zou

_____   _____   _____
Name of participant   Signature   Date

I, as researcher, have accurately read out the information sheet to the potential participa to the best of my ability, ensured that the participant understands to what they are freel consenting.

_____   _____   _____
Researcher name [printed]   Signature   Date

Study contact details for further information: S.Zou-1@student.tudelft.nl

Appendix H: User Test I Script

Investigation After Activity

B *I* U 🔗 🅧

This questionnaire is intended to investigate participants' level of knowledge mastery and their feelings about the mechanism of the activity after the activity. Please be sure to answer truthfully.

Thank you very much for agreeing to participate in this survey. *

By selecting agree, you are fully awared that the information provided by you in this questionnaire will be used for research purposes. It will not be used in a manner which would allow identification of your individual responses.

○ Agree
○ Disagree

Section 1: Small Quiz
Description (optional)

What three categories can sounds be divided into? *
☐ Nature
☐ Human
☐ Animal
☐ Machine

What are the characteristics of sounds? *
☐ Pitch
☐ Intensity
☐ Harmonic

Which two Sound Descriptors are often used to describe a soundscape? *
☐ Eventful/Uneventful
☐ Interesting/Uninteresting
☐ Pleasant/Unpleasent
☐ Peaceful/Unpeaceful

What are the 4 Sound Roles in Sound Biotopes (How people hear the sound?) *
○ Negative, Positive, User, Producer
○ Listener, User, Finder, Producer
○ Passive, Neutral, Active, Producer
○ Passive, Active, User, Producer

Which 2 main factors determine the Foreground/Background of a sound? *
☐ Sound Biotopes
☐ Sound Characteristics
☐ Sound Categories
☐ Sound Descriptors

What are the 3 main components of Soundscape? *
☐ Context
☐ People
☐ Acoustic Environment
☐ Sound Sources

What are the 3 stages of hearing in a soundscape? *
☐ We hear the sound/We choose to hear some sound
☐ We gain a general feeling about the sound
☐ We analyze every sound we hear in detail
☐ We react to the sound we hear

Section 2: Activity Feedback
Description (optional)

How would you rate the duration of the activity? *

	1	2	3	4	5	6	7	
Too Short	○	○	○	○	○	○	○	Too Long

How would you rate the difficulty of learning the activity? *

	1	2	3	4	5	6	7	
Very Easy	○	○	○	○	○	○	○	Very Difficult

Do you feel akward while carrying out the activity? *

	1	2	3	4	5	6	7	
Not at all	○	○	○	○	○	○	○	Very awkward

Do you think the actions on Activity Token are easy to operate? *

	1	2	3	4	5	6	7	
Very Easy	○	○	○	○	○	○	○	Very Difficult

Do you feel confused/overwhelmed during the event process? *

	1	2	3	4	5	6	7	
Not at all	○	○	○	○	○	○	○	Very Chaotic

Do you think you can understand the entire activity flow and start the activity just by reading the Instruction Board? *

	1	2	3	4	5	6	7	
Piece of cake	○	○	○	○	○	○	○	Impossible

Do you have any other confusion or discomfort during the event?
Detailed answer text

Thanks for your participant!
Description (optional)

Appendix I: User Test II Script

Feedback: Visuals and Usability for Sound Detective activity items

B *I* U 🔗 X̶

表单说明

Thank you very much for agreeing to participate in this survey. *

By selecting agree, you are fully awared that the information provided by you in this questionnaire will be used for research purposes. It will not be used in a manner which would allow identification of your individual responses.

○ Agree
○ Disagree

Your name please? (For distinguish purpose) *

简短回答文本

What do you think of the size of Sound Token? *

	1	2	3	4	5	6	7	
Too small	○	○	○	○	○	○	○	Too big

What do you think of the size of Activity Token? *

	1	2	3	4	5	6	7	
Too small	○	○	○	○	○	○	○	Too big

What do you think of the size of Character Board? *

	1	2	3	4	5	6	7	
Too small	○	○	○	○	○	○	○	Too big

Are there enough space to write on the Character Board? *

	1	2	3	4	5	6	7	
There is very little space	○	○	○	○	○	○	○	There is plenty of space

---

What do you think of the size of Quick-check Board? *

	1	2	3	4	5	6	7	
Too small	○	○	○	○	○	○	○	Too big

Are the sound sourse (number) easy to find and match? *

	1	2	3	4	5	6	7	
Very easy	○	○	○	○	○	○	○	Very hard

Is the font size on the prop appropriate? *

	1	2	3	4	5	6	7	
Too small	○	○	○	○	○	○	○	Too big

What do you think of the main visual design of the prop? *

	1	2	3	4	5	6	7	
Too monotonous	○	○	○	○	○	○	○	Too complicated

Is the instruction book well structured? *

	1	2	3	4	5	6	7	
The structure is confusing	○	○	○	○	○	○	○	The structure is clear

---

Do the images in the book provide effective help? *

	1	2	3	4	5	6	7	
Not helpful at all	○	○	○	○	○	○	○	Very helpful

Does the logic diagram in the book provide effective help? *

	1	2	3	4	5	6	7	
Not helpful at all	○	○	○	○	○	○	○	Very helpful

Do you have a clear knowledge of the activity process and the special terms used in the activity? *

	1	2	3	4	5	6	7	
No I'm very confused	○	○	○	○	○	○	○	Yes I'm very clear

Can you carry out the activity after reading this instruction book? (Without other's help) *

	1	2	3	4	5	6	7	
That's impossible	○	○	○	○	○	○	○	Yes sure thing

How willing are you to read the instructions? *

	1	2	3	4	5	6	7	
Very reluctant	○	○	○	○	○	○	○	Very willing

Any other comments? *

详答文本

What do you think of the size of Sound Token?
(8 条回复)

- 1: 0 (0%)
- 2: 1 (12.5%)
- 3: 4 (50%)
- 4: 3 (37.5%)
- 5: 0 (0%)
- 6: 0 (0%)
- 7: 0 (0%)

What do you think of the size of Quick-check Board?
(8 条回复)

- 1: 0 (0%)
- 2: 0 (0%)
- 3: 2 (25%)
- 4: 6 (75%)
- 5: 0 (0%)
- 6: 0 (0%)
- 7: 0 (0%)

Is the instruction book well structured?
(8 条回复)

- 1: 0 (0%)
- 2: 0 (0%)
- 3: 0 (0%)
- 4: 0 (0%)
- 5: 2 (25%)
- 6: 5 (62.5%)
- 7: 1 (12.5%)

Can you carry out the activity after reading this instruction book? (Without other's help)
(8 条回复)

- 1: 0 (0%)
- 2: 0 (0%)
- 3: 0 (0%)
- 4: 1 (12.5%)
- 5: 4 (50%)
- 6: 1 (12.5%)
- 7: 2 (25%)

What do you think of the size of Activity Token?
(8 条回复)

- 1: 0 (0%)
- 2: 0 (0%)
- 3: 2 (25%)
- 4: 6 (75%)
- 5: 0 (0%)
- 6: 0 (0%)
- 7: 0 (0%)

Are the sound sourse (number) easy to find and match?
(8 条回复)

- 1: 1 (12.5%)
- 2: 3 (37.5%)
- 3: 4 (50%)
- 4: 0 (0%)
- 5: 0 (0%)
- 6: 0 (0%)
- 7: 0 (0%)

Do the images in the book provide effective help?
(8 条回复)

- 1: 0 (0%)
- 2: 0 (0%)
- 3: 0 (0%)
- 4: 0 (0%)
- 5: 0 (0%)
- 6: 5 (62.5%)
- 7: 3 (37.5%)

How willing are you to read the instructions?
(8 条回复)

- 1: 1 (12.5%)
- 2: 3 (37.5%)
- 3: 4 (50%)
- 4: 0 (0%)
- 5: 0 (0%)
- 6: 0 (0%)
- 7: 0 (0%)

What do you think of the size of Character Board?
(8 条回复)

- 1: 0 (0%)
- 2: 0 (0%)
- 3: 1 (12.5%)
- 4: 6 (75%)
- 5: 1 (12.5%)
- 6: 0 (0%)
- 7: 0 (0%)

Is the font size on the prop appropriate?
(8 条回复)

- 1: 0 (0%)
- 2: 0 (0%)
- 3: 3 (37.5%)
- 4: 5 (62.5%)
- 5: 0 (0%)
- 6: 0 (0%)
- 7: 0 (0%)

Does the logic diagram in the book provide effective help?
(8 条回复)

- 1: 0 (0%)
- 2: 0 (0%)
- 3: 1 (12.5%)
- 4: 2 (25%)
- 5: 3 (37.5%)
- 6: 1 (12.5%)
- 7: 1 (12.5%)

Any other comments?
(8 条回复)

I hate reading logic map

There are too many Sound tokens, and it's not convenient to spread them all out on the desktop.

The instruction are way better than last time. But the logic diagram can be confusing without explanation.

I hate reading instructions. But this instruction is helpful. Can be overwhelming to learn the activity by myself but it is meant to be hard. There are many items and cards. Maybe a organizer?

The activity is interesting, but also a bit hard to learn as there r so many terms. I can carry out the activity after reading instruction but not confident. Pretty sure I will encounter questions during the process so it's good to have a organizer.

The character board is too big to carry while doing activities.

It took me a long time reading instructions. It is helpful to give a logic diagram telling me the relationship of all the terms I learn. Maybe an example for the explanation of Sound Biotopes.

Are there enough space to write on the Character Board?
(8 条回复)

- 1: 0 (0%)
- 2: 0 (0%)
- 3: 2 (25%)
- 4: 5 (62.5%)
- 5: 0 (0%)
- 6: 0 (0%)
- 7: 1 (12.5%)

What do you think of the main visual design of the prop?
(8 条回复)

- 1: 0 (0%)
- 2: 0 (0%)
- 3: 4 (50%)
- 4: 3 (37.5%)
- 5: 1 (12.5%)
- 6: 0 (0%)
- 7: 0 (0%)

Do you have a clear knowledge of the activity process and the special terms used in the activity?
(8 条回复)

- 1: 0 (0%)
- 2: 0 (0%)
- 3: 0 (0%)
- 4: 1 (12.5%)
- 5: 3 (37.5%)
- 6: 2 (25%)
- 7: 2 (25%)

Appendix K: Instruction Book

INSTRUCTION
— Activity Process & Glossary —

TABLE OF CONTENTS

WELCOME!
TO THE WORLD OF SOUNDSCAPE.

Soundscape, according to ISO, is the acoustic environment as perceived or experienced and understood by a person or people in context. It is a perceptual construct of our experience of a place or setting.

The study of Soundscape plays an important role in various fields (e.g. healthcare, architecture, urban environment). To have a more thorough understanding of the Soundscape, one will have improve *Sound Awareness.

What is Sound Awareness?
Sound Awareness can be divided into 3 aspects:
- Listening to sound (capturing all the sounds in the soundscape)
- Experiencing sound (describing the soundscape based on our own or others' perception of it)
- Understanding sound (knowing the characteristics of sounds and how we use/react to different sounds)

Sound Detective is an educational activity designed to enhance participants' Sound Awareness. Beginners can learn the basics of Soundscape and explore the relationship between sound and people. Researchers can also use this activity as a research tool to obtain data and information.

"When you listen carefully to the soundscape it becomes quite miraculous."

—— R. Murray Schafer

Activity Token

Rate Board
(with colored indicators)

Quick-check Board

Important Notice
- The Character Board in the box is just a frame, so you need to bring your own infill (normal A4 paper).
- You need to bring your own writing pen (fine ballpoint pen/oil pen is recommended).

IN THE BOX

Inside the box you will find 6 items:
- Sound Token
- Character Board
- Activity Token
- Rate Board with colored indicators
- Quick-check Board
- Instruction (What you're reading now)

These are necessary props for the activity, please be sure to check if they are missing before starting the activity.

Sound Token   *Character Board

ACTIVITY PROCESS

The entire activity can be divided into 4 phases. (Please make sure all the items are well prepared. For item list, check Pg. 3)

- Phase 1: Set-up
- Phase 2: Global Listening
- Phase 3: Role-play
- Phase 4: Detecting

In the description, there will be special terms in bold and marked with an asterisk (like **This**). Their explanations can be found in the gray box (below) and are also summarized in the Glossary (see Pg. 22).

I'm the grey box! (example)

These special terms are very important for understand this activity and soundscape.

PHASE 1
SET-UP

1. Gather your participants.

You can choose to gather your friends or beginners who are also interested in soundscape to participate in the activity. However, the participants of each activity should be different as much as possible to ensure the diversity of data. If you are a researcher, you can select participants according to your research purpose.

2. Choose a scene you all agree with.

*You can choose an indoor scene (such as a restaurant) or an outdoor scene (such as a park). The richer the sound in the scene, the more significant the effect of the activity. This choice can be made by the ***organizer**.*

(See next page for explanation)

4. Go to the scene.

After completing the preparations, you can go to the scene with all the participants.

PHASE 2
GLOBAL LISTENING

1. Select and spread the Sound Token on a flat surface/ground.

You can see four different back colors of Sound Tokens:
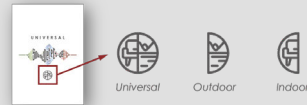
Red	Green	Blue	Grey
SOUND TYPE **HUMAN**	SOUND TYPE **NATURE**	SOUND TYPE **MACHINE**	**SUPPLEMENT**

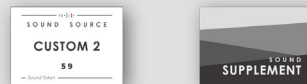*Please select all Sound Tokens except the Grey one and place them with the side printed with Sound Source facing up.*

DO NOT REVEAL THE BACK (COLORED) OF THE TOKEN!

---

3. Select Activity Token according to the scene.

There are three types of Activity Token: Universal, Indoor, and Ourdoor.

*Universal is applicable to multiple scenes, Indoor is for indoor scenes, and Outdoor is for outdoor scenes. Please mix Universal with one of the other two according to the selected scene. **Organizers** can also select Activity Tokens according to the scene.*

Universal	Outdoor	Indoor

*In addition, the box also provides 6 blank customizable Activity Tokens. Participants can use them to create their own special Activities, and researchers can also use them to plan Activities that need to be investigated.

2. Listen and try to capture all the sound in the scene.

Calm down, concentrate, and try to hear all the sounds in the scene. Participants can choose to close their eyes for better hearing amplification.

During the listening process, participants can find the source of the sound they hear from the spread-out Sound Tokens and assign it to the other side.

In some cases, participants were unable to find the sound sources they heard in the Sound Token. At this point, you can select a Custom Sound Token and use it to refer to something. There are 6 Custom Sound Tokens in the box. Please be sure to tell other participants which sound source it refers to and note it.

SOUND SOURCE **CUSTOM 2** S9	SOUND **SUPPLEMENT**
Custom Sound Token	Front & Back

3. Classify the picked Sound Tokens.

*After confirming that all sound sources have been selected, participants categorize all Sound Tokens according to ***Sound Type**.*

---

*After confirming the classification, participants can turn the Sound Token over and see the corresponding **Sound Type**. At the same time, participants can have a general understanding of the Soundscape based on the color distribution (which type of sound is the majority/dominant).*

4. Sort out the Sound Tokens and distribute the items for the next phase.

Sort the categorized Sound Tokens and put them aside (DO NOT shuffle them with the unselected Sound Tokens), and distribute Character Board, Quick-check Board and a pen to each participant.

2. Shuffle and draw the Activity Token.

Shuffle all the Activity Tokens selected in Phase 1: Set-up and each participant draws one. The activity written on the token is the action that the participant will perform in the scene.

After the participant is familiar with the action, he or she can insert the Activity Token into the slot on the lower right side of the Character Board.

*If the action described in the token cannot be executed or does not meet its requirements, it is discarded and re-extracted until it can be executed.

3. Note down Sound Token Numbers.

When the user turns the Character Board over, they will find two blank spaces in the middle. Please write the numbers of all the Sound Tokens selected in Phase 2: Global Listening in the upper blank space. If there is a Custom Sound Token, please write the sound it refers to in the blank space below.
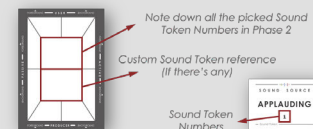
Note down all the picked Sound Token Numbers in Phase 2

Custom Sound Token reference (If there's any)

SOUND SOURCE **APPLAUDING** 1

Sound Token Numbers

PHASE 3
ROLE-PLAY

1. Fill in the Character Board and introduce yourself.

First, please make sure that the Character Board has a new refill (you can make a new refill by dividing a normal A4 paper into 4 equal parts).

Participants fill in their basic personal information according to the instructions on the front of the Character Board. After filling in, participants take turns to briefly introduce themselves so that they can get to know each other better. The self-introduction can be directly read from their Character Board, or it can be appropriately enriched.

Your Name, Age, Hobby, and Occupation

Your mood today (Better explain a little bit to other participant)

Participants can find the numbers corresponding to all Sound Tokens on the Quick-check Board. Sound Token Numbers can help participants record sounds in subsequent steps and save space.

SOUND CHECKLIST
HUMAN	**NATURE**	**MACHINE**
SUPPLEMENT		
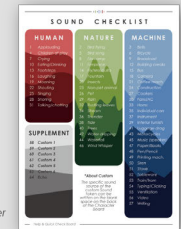
Sound Token Number Quick-check

4¹. Carry out the activity in the scene.

Participants choose a suitable location based on the Activity Token to start the action. Participants can move to other locations, but try to stay in the same scene.

*One's behavior can greatly affect the sound field and feelings he hears. So when performing actions, please be sure to put yourself in the role to get the best activity experience and effect. Please imagine that you are really doing this activity in this scene.

4². Classify the sounds you heard during the activity process.

*When/after performing the activity, participants need to classify the sounds they hear according to ***Acoustic Biotopes** and the ***Fore/Background** of the sound. The main process is as follows:*

- *For the middle part, cross out the sounds (Sound Token Number) that you didn't hear during the process and write the new sounds you heard. If the new sound can't be found in the Quick-check Board, classify it as a Custom Sound Token and write the specific sound.*

- *After that, categorize the uncrossed and newly added sounds (all the sounds you heard while performing the action) according to **Acoustic Biotopes** and **Fore/Background**, and write them in the 8 surrounding blank spaces. (Only write the Number)*

Surrounding 8 blanks   Middle Part

---
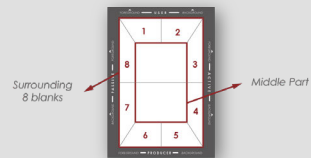
*Acoustic Biotopes (Listening Roles)

Depending on the different activities of people in the soundscape, the same sound will be perceived differently by people with different intentions.

Acoustic Biotopes describe how people use/hear different sounds in the soundscape. People are divided into four different Listening Roles:

- *Passive: People do not listen to the sound intentionally, but passively accept the sound.*
- *Active: People will pay attention to the sound and make decisions in their behavior based on the sound.*
- *User: People will seek out and track that sound, and use that sound to accomplish a task.*
- *Producer: People are the subject that produces the sound, whether it is produced by themselves or through some medium (such as tools, musical instruments)*

Distinguishing different Listening Roles from one's Acoustic Biotopes is very helpful in judging his or her perception of the soundscape.

*Fore/Background

According to the behaviors of the listener, sounds can be divided into Foreground and Background (ISO).

- *Foreground: The sound towards which a listener's attention is particularly directed and which can be associated with a specific source*
- *Background: The sound that is heard continuously or frequently enough to form a background against which other sounds are perceived*

---

2. Select one participant to start with.

*Participants select one of them as the first respondent. The selection can be completely random. The respondent needs to do the following:*

- *Select all the Sound Tokens based on the sounds (numbers) noted on the back of his/her Character Board.*
- *Place his/her Character Board and Activity Token among all participants.*
- *Tell others about his/her activity and where he/she carried out this activity.*
- *Place his/her indicators on the Rate Board and tell other participants his/her **Feeling** and **Rate**.*

3. Start indicating the selected participant's Sound Biotopes and Fore/Background.

Other participants will act as detectives to make inferences. Their main actions are as follows:

- *Take a selected Sound Token and ask the respondent the ***Sound Characteristics** of the sound.*

- *Indicate the **Sound Biotopes** and **Fore/Background** of the sound and place it in the corresponding areas around the Character Board.*

*Detectives can step into the shoes of the person being investigated and carry out the actions themselves. Although the results may be different, this is the embodiment of the diversity of Soundscape.

Example

4³. Note down your Rate and Feeling towards the soundscape.

*You can find a Rate Board in the box. It is divided into two parts, the left side is ***Rate (Sound Descriptor)**, and the right side is Feeling.*

Rate   Feeling
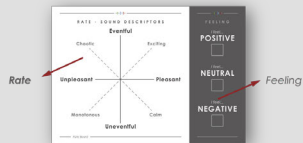
*Rate (Sound Descriptors)

At present, researchers have proposed many ways to describe a soundscape which are called "Sound Descriptors". The most widely used one is the "Eventful-Pleasant" binomial coordinate system. Its four quadrants represent four different types of soundscape descriptions.

- *Eventful + Pleasant: Exciting.*
- *Eventful + Unpleasant: Chaotic.*
- *Uneventful + Pleasant: Calm.*
- *Uneventful + Unpleasant: Monotonous.*

One's feeling for a soundscape is often related to his or her description of the soundscape.

There is only one Rate Board and participants will not carry it with them when performing actions.

Participants are required to give Feeing and Rate after performing actions. Participants can write down any blank space on the back of the Character Board to remind themselves.

DO NOT SHOW THE BACK OF THE CHARACTER BOARD TO OTHER PARTICIPANTS.

*It would be very overwhelming to record and classify sounds while taking action. So it is recommended to separate the two. Focus on taking action first, and then record and classify sounds based on your impressions during the action. There is no need to worry about missing sounds, because this is the most real impact of the soundscape on the listener.

PHASE 4
DETECTING

1. All participants come back to gather.

Don't forget to bring your items with you. (Character Board, Activity Token, Quick-check board, pen)

---

*Sound Characteristics

Sound itself has characteristics. This is an objective description of the sound. Its characteristics can be divided into Pitch, Intensity, Duration, and Harmonic. Different sounds have characteristics, and different characteristics affect the listener's perception of the sound.

- *Pitch: The pitch of the sound.*
- *Intensity: The intensity of the sound (loud?/soft?).*
- *Duration: The duration of the sound.*
- *Harmonic: Whether the sound is harmonious and pleasant.*

*Analyzing the characteristics of the sound and combining it with the listener's behavior to determine the **Fore/Background** of the sound plays an important role in understanding the soundscape and subsequently improving the soundscape.*

During the process, you may encounter the same sound (Sound Token) appearing in multiple different Sound Biotopes. At this time, you can use the Sound Token Supplement (gray Sound Token).

The Supplement has been given a copy of some Sound Tokens, but also provides three blank Supplements for participants to customize.

Supplement   Normal

---
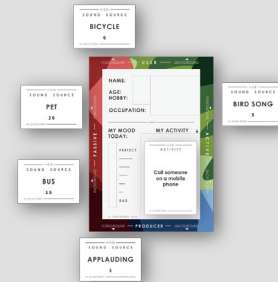
4. Flip the Character Board to reveal answer.

After confirming the guessed result, the respondent turns over his Character Board and reveals the result. If the guessed result is different, both parties explain their own ideas and discuss.

*The correctness of the result is not very important. What is important is the communication of feelings and understanding between both parties. This is the embodiment of the diversity of the sound field.

5. Repeat the process until all participants are selected.

6. End the activity/reselect Activity Token

Participants can choose to end the activity according to the situation, or re-draw Activity Tokens and carry out the second round of activities.

90

GLOSSARY

Sound Awareness (Pg.1)

Listening to sound, Experiencing sound, Understanding sound.

Sound Type (Classification) (Pg.10)

Human sounds, Nature sounds, Machine sounds.

Acoustic Biotopes (Pg.15)

How people use/hear different sounds in the soundscape. Listening Roles: Passive, Active, User, Producer.

Fore/Background (Pg.15)

According to the behaviors of the listener, sounds can be divided into Foreground and Background.

Rate (Sound Descriptors) (Pg.16)

Way to describe a soundscape . The most widely used one is the "Eventful -Pleasent" binomial coordinate system. (Exciting, Chaotic, Calm, Monotonous.)

Sound Characteristics (Pg.20)

An objective description of the sound. (Pitch, Intensity, Duration, Harmonic.)

RELATIONSHIP DIAGRAM

The diagram on the right shows the composition and relationship of the soundscape for reference.It can help participants better sort out the relationship between all the terms.

Diagram Explanation

According to ISO definition, the sound field consists of three parts: Context, Acoustic Environment, and People, These three parts influence each other. The special terms that appear in the activities are the nodes that constitute this network of relationships.

In summary, sound has its own objective attributes and people's subjective evaluation of it. People's subjective evaluation is affected by the environment and the purpose of their own behavior. The objective attributes and subjective evaluation of multiple sounds constitute people's description of a sound field. At the same time, people's behavior will also react on the soundscape.

Although this diagram is an extension of the ISO diagram, it illustrates only one of the ways to understand soundscape. It is only a reference to help organizing and is not absolute. There are many more methods and contents worth exploring.

Your soundscape journey has just begun, my friend.

Appendix L: Evaluation Consent Form

Consent form: Sound Awareness Evaluation

You are being invited to participate in a research study titled "Soundscape Sensibility: Developing A Sound Training Activity To Heighten Beginners' Environmental Sound Awareness". This study is being done by Shourui Zou from the TU Delft for a master graduation project. The purpose of this research study is to design a new educational activity for training one's sound awareness.

In this evaluation session, I will ask you to participate in the activity Sound Detective/teaching session (depending on your group) and finish a Sound Awareness Test. This will take you approximately 1.5-2h to complete. The data will be used for analysis.

We assure you that your answers in this study will remain confidential. We will collect your personal demographic, your behaviour during the activity, and your test answers. To minimise any risks, we will ensure that the analysis result of this survey is entirely anonymous, and no IP addresses or other Personal Data will appear. All the data collected will be stored safely, and confidentiality will be secured by anonymising the data.

Your participation in this is entirely voluntary, and you can withdraw at any time. You are free to omit any questions. If you have any questions or concerns regarding this study, please feel free to contact the corresponding and Responsible Researcher, Shourui Zou at S.Zou-1@student.tudelft.nl. Thank you for your participation in this study!

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information dated [ ], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
3. I understand that taking part in the study involves a activity/teaching session and a test (1.5-2h). I also understand that what I did during the activity will be noted down.	☐	☐
4. I understand that I will be compensated for my participation in this study.	☐	☐
5. I understand that the study will end in 1.5-2h.		
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
6. I understand that taking part in the study involves collecting specific personally identifiable	☐	☐

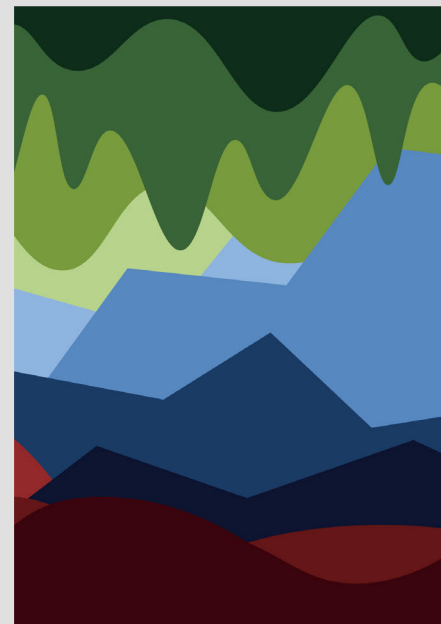| PLEASE TICK THE APPROPRIATE BOXES	Yes	No
information(PII), such as my name, gender, occupation, and associated personally identifiable research data(PIRD), such as job title and sector.		
10. I understand that personal information collected about me that can identify me, such as my name, my title and my study field, will not be shared beyond the study team.	☐	☐
11. I understand that the (identifiable) personal data I provide will be destroyed after the study.	☐	☐
C: RESEARCH PUBLICATION, DISSEMINATION AND APPLICATION		
12. I understand that after the research study the de-identified information I provide will be used for design reference and thesis output.	☐	☐
13. I agree that my responses, views or other input can be quoted anonymously in research outputs	☐	☐
14. I agree that my real name can be used for quotes in research outputs	☐	☐

Signatures

Shourui Zou

_____   _____   _____
Name of participant   Signature   Date

I, as researcher, have accurately read out the information sheet to the potential participa to the best of my ability, ensured that the participant understands to what they are freel consenting.

_____   _____   _____
Researcher name [printed]   Signature   Date

Study contact details for further information: S.Zou-1@student.tudelft.nl

Appendix *M*: Sound Awareness Test

0.1 What's your name? (initials)

0.2 You agree to all the terms.

Section 1
Soundscape basic knowledge

1.1 What are the 3 types of sound that you can use to classify different sound sources?   G1
_____ , _____ , ____
   Human, Nature, Machine

1.2. Please filling the blank according to sound descriptors.   G1
Eventful + Pleasant = ____
Uneventful + Pleasant = ____
Eventful + Unpleasant = ____
Uneventful + Unpleasant = ____
   Exciting, calm, chaotic, monotonous

1.3. What are the four Listening Roles according to Acoustic Biotopes?   G1
_ ' _ ' _ ' _
   Passive, active, user, producer

Volume test: Please listen to this recording of a park's soundscape with your headphones on. Adjust the volume to an appropriate level to ensure you can clearly hear the soundscape. Also make sure you are in a quiet environment.

Section 2
Next you will be provided with some different soundscapes.

2.1   Here is a soundscape inside an office during work time. Please listen to the recording and list all the sound sources you can identify.   G2
   Typing, clicking, Clock, Ventilation, Talking, Printer, writing, walking

2.2   Here is a soundscape inside a crowded Restaurant. Please listen to the recording and list all the sound sources you can identify.   G2
   People talking, tableware, bells, footsteps, Legs hitting the table/chair, kitchen,

2.3   Here is a soundscape of a busy shopping street in Tokyo. The choices below include sound sources that appear in the soundscape, as well as some that do not.
Please select all the HUMAN sounds that appear in the soundscape.   G2,G3
   people talking, footsteps,

2.4   Now, select all the MACHINE sounds appear in the soundscape.   G2,G3
   Luggage dragging, train, car reversing, Iron shelves, plastic bag, Broadcast (speaker)

Section 3
Next you will be introduced to some people inside the soundscape and what they hear in the soundscape. The picture in the video provides a first-person perspective and can be used as a reference.

Here is a recording from Lisa's perspective of what she heard in the soundscape.

She was sitting near the aisle and was working on a complex document. She said she couldn't concentrate because she was always interrupted and distracted by the sound.

3.1 How can she describe the soundscape using Sound Descriptors? (Enter NA if you don't know the answer)   G5
_____ + _____ = ____
   Eventful Unpleasant   Chaotic

Here is a recording from Diana's perspective of what she heard in the soundscape.

She dined alone and sat at a small table at the back of the restaurant where there were fewer people. She thought the atmosphere of the restaurant was very nice, not noisy, and whetted her appetite.

3.2 How can she describe the soundscape using Sound Descriptors? (Enter NA if you don't know the answer)   G5
_____ + _____ = ____
   Uneventful Pleasant   Calm

Here is a recording from Rob's perspective of what he heard in the soundscape.

His is a waiter in the restaurant. He is watching a football game on TV at the front counter and going to serve the dish when he hears the bell.

3.3 What sounds do you think he listens to as Foreground Sounds?   G6
   TV sound, bells,

Listen to the recording again.

You can find Rob heard **the bell** so he reached out to help. He also heard the **sound from the TV** (he was watching a football game before someone called him), and **cutlery stacked together** waiting to be washed in the soundscape.

3.4 For these three sounds, what Listening Roles does Rob play according to Acoustic Biotopes?

(Enter NA if you don't know the answer)   G4

_____ , _____ , ____
        Active, User, Passive

Here is a recording from Jack's perspective of what he heard in the soundscape.

He is a tourist. His travelling plan for today is to look around this famous shopping street in this city, take some photos, and maybe get some souvenirs. He paid much attention to the shops and the music.

3.5 What sounds do you think he listens to as Foreground Sounds?   G6
        Selling sound, Camera sound, music.

Listen to the recording again.

You can find Jack heard **someone playing the saxophone**, he is a saxophone lover and wanted to find out where the player was. He also heard **people selling goods** in front of the shops, and **motorcycle engines** in the soundscape.

3.6 For these three sounds, what Listening Roles does Jack play according to Acoustic Biotopes? (Enter NA if you don't know the answer)   G4

_____ , _____ , ____
        User, Passive, Passive

Section 4
The next few people are not very satisfied with the sound field they are in. Can you help them find out the reason and improve the sound field?

Here is a recording from Vijay's perspective of what he heard in the soundscape. He sat in temporary seating near the ventilation because the original area was being renovated. He is a programmer and is fixing bugs.

Vijay claims that he cannot carry out and finish his activity comfortably in the soundscape.

4.1 Please listen to the recording and find out what can be the reason?   G8
        The ventilation sound is too loud
        Construction sound is disturbing
        The roll of chair is disturbing
        The creaking sound of the chair, etc. Passive, Chaotic

4.2 What can you do to help Vijay to have a better soundscape?   G9
        Earplug

        Sit far from the ventilation and the construction
        Carpeting the office floor Or put cushions on the chairs.
        Put on music, etc.

Here is a recording from Beth's perspective of what he heard in the soundscape.She was dining and chatting with her friends, sitting near the kitchen.

Beth claims that she cannot carry out her activity comfortably in the soundscape.

4.3 Please listen to the recording and find out what can be the reason?   G8
        The cutlery stacked together sound is very disturbing.
        Talking form other tables are too loud.
        The music makes it harder to listen to what her friends are talking.etc. Passive, Chaotic

4.4 What can you do to help Beth to have a better soundscape?   G9
        Switch sit to a less crowded place and far from the kitchen.
        Increase the distance between tables.
        Turn the volume of the music down a bit.etc.

Section 5
Finally, listen to the two recordings with different soundscape and decide whether the soundscape is appropriate for the listener.

Here is a recording from Tim's perspective of what he heard in the soundscape.

It's lunch time in office. He was writing on paper while eating a snack and waiting for a call back from a client.

5.1 Do you think the soundscape is appropriate for him? Why? G10
        Yes
        Lunch time is allowed to talk and he can clearly hear his phone ring.

Here is a recording from Subaru's perspective of what she heard in the soundscape.

She is an old lady in her 70s who lives alone. She is sitting on a chair outside the shop and drinking tea (to have a rest after walking in the street).

5.2 Do you think the soundscape is appropriate for her? Why?   G10
        No
        The intensity of the sound is too loud for her to rest, and the soundscape is chaotic as she is an old lady and lives alone.

Appendix N: Evaluation Result Data

Group	Name	Q1.1-3	Q1.2-4	Q1.3-4	S1 SUM-11
Control	K.B	3	4	4	11
Control	E.Z	3	4	3	10
Control	Y.X	3	4	3	10
Control	V.C	3	3	2	8
Control	S.T	3	3	4	10
Control	Y.H.	3	4	4	11
Control	X.L.	3	4	3	10
Control	K.C.	3	4	3	10
Control	J.H.	3	4	4	11
Control	W.B.	3	4	3	10
Control	Y.X.	3	4	4	11
Control	S.Z.	3	3	3	9
Avg		3	3.75	3.333333	10.0833333
Experiment	X.Y.	3	4	4	11
Experiment	Y.M.	3	4	4	11
Experiment	C.W.	3	4	4	11
Experiment	H.H.	3	2	3	8
Experiment	C.T.	3	3	4	10
Experiment	L.H.	3	4	3	10
Experiment	S.W.	3	4	4	11
Experiment	H.L	3	3	4	10
Experiment	M.C	3	4	4	11
Experiment	T.X.	3	3	4	10
Experiment	X.G.	3	3	4	10
Experiment	S.C.	3	4	4	11
Avg		3	3.5	3.833333	10.25

Group	Name	Q2.1-8	Q2.2-6	Q2.3-2	Q2.4-6	S2 SUM-22
Control	K.B	5	3	1	2	11
Control	E.Z	4	3	1	3	11
Control	Y.X	3	3	1.5	4	11.5
Control	V.C	2	3	2	2	9
Control	S.T	3	4	1.5	4	12.5
Control	Y.H.	4	3	1	3	11
Control	X.L.	5	4	1.5	5	15.5
Control	K.C.	4	4	1.5	3	12.5
Control	J.H.	6	4	1.5	4	15.5
Control	W.B.	4	5	1.5	3	13.5
Control	Y.X.	4	3	2	3	12
Control	S.Z.	4	3	1.5	3	11.5
Avg		4	3.5	1.458333	3.25	12.2083333
Experiment	X.Y.	3	4	1.5	5	13.5
Experiment	Y.M.	5	5	1.5	3	14.5
Experiment	C.W.	4	4	1.5	2	11.5
Experiment	H.H.	3	3	2	5	13
Experiment	C.T.	4	5	1.5	3	13.5
Experiment	L.H.	3	4	2	3	12
Experiment	S.W.	3	4	2	4	13
Experiment	H.L	4	3	2	4	13
Experiment	M.C	4	4	2	3	13
Experiment	T.X.	4	5	1.5	3	13.5
Experiment	X.G.	4	3	1.5	4	12.5
Experiment	S.C.	4	3	2	3	12
Avg		3.75	3.916667	1.75	3.5	12.9166667

Group	Name	Q3.1-3	Q3.2-4	Q3.3-2	Q3.4-3	Q3.5-3	Q3.6-3	S3 SUM-17
Control	K.B	3	3	0	1	0	2	9
Control	E.Z	3	3	0.5	1	2	2	11.5
Control	Y.X	3	3	0	2	0.5	2	10.5
Control	V.C	3	3	0.5	1	1	1	9.5
Control	S.T	2	3	2	2	3	1	13
Control	Y.H.	3	3	1.5	1	2	1	11.5
Control	X.L.	3	3	0.5	2	0.5	1	10
Control	K.C.	3	3	1	2	1	2	12
Control	J.H.	3	3	1.5	3	3	2	15.5
Control	W.B.	3	3	1	1	1	1	10
Control	Y.X.	3	3	1	2	2	1	12
Control	S.Z.	3	2	0.5	1	1.5	1	9
Avg		2.916667	2.916667	0.833333	1.583333	1.458333	1.416667	11.125
Experiment	X.Y.	3	3	1.5	1	2	1	11.5
Experiment	Y.M.	3	3	2	3	3	1	15
Experiment	C.W.	3	3	2	3	2	2	15
Experiment	H.H.	2	3	2	2	2	2	13
Experiment	C.T.	3	2	1	1	2	1	10
Experiment	L.H.	3	3	1.5	2	2	1	12.5
Experiment	S.W.	3	3	1.5	3	3	2	15.5
Experiment	H.L	3	2	1.5	2	2	3	13.5
Experiment	M.C	3	3	1	2	2	2	13
Experiment	T.X.	3	3	1.5	2	1	2	12.5
Experiment	X.G.	3	2	1	1	1.5	1	9.5
Experiment	S.C.	3	3	0.5	2	2	2	12.5
Avg		2.916667	2.75	1.416667	2	2.041667	1.666667	12.7916667

Group	Name	Q4.1-5	Q4.2-3	Q4.3-5	Q4.4-3	S4 SUM-16	Q5.1-3	Q5.2-3	S5 SUM-6
Control	K.B	1	2	1	2	6	2	0	2
Control	E.Z	2	2	3	2	9	1.5	2	3.5
Control	Y.X	2	2	2	2	8	0	2	2
Control	V.C	1	2	2	2	7	0	0	0
Control	S.T	3	1	3	2	9	1.5	2	3.5
Control	Y.H.	2	2	1	1	6	0	2	2
Control	X.L.	1	2	2	2	7	2	2	4
Control	K.C.	2	2	1	2	7	1.5	2	3.5
Control	J.H.	3	2	2	2	9	2	2	4
Control	W.B.	2	2	2	1	7	2	0	2
Control	Y.X.	2	2	3	2	9	1.5	2	3.5
Control	S.Z.	2	2	2	2	8	0	2	2
Avg		1.916667	1.916667	2	1.833333	7.6666667	1.166667	1.5	2.666667
Experiment	X.Y.	2	2	3	2	9	2	2	4
Experiment	Y.M.	3	2	2	1	8	1.5	2	3.5
Experiment	C.W.	4	2	4	3	13	3	3	6
Experiment	H.H.	3	2	2	2	9	1.5	2	3.5
Experiment	C.T.	2	2	3	2	9	0	2	2
Experiment	L.H.	3	3	2	1	9	1.5	2	3.5
Experiment	S.W.	5	2	4	2	13	3	3	6
Experiment	H.L	3	2	2	2	9	1.5	2	3.5
Experiment	M.C	3	2	2	2	9	0	2	2
Experiment	T.X.	4	2	4	2	12	2	3	5
Experiment	X.G.	3	2	2	1	8	2	0	2
Experiment	S.C.	2	2	3	2	9	2	2	4
Avg		3.083333	2.083333	2.75	1.833333	9.7777778	1.75	2	3.75