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FROM SOUNDS TO ARCHITECTURAL DESIGN: ACOUSMATIC SPACES

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ABSTRACT

Acousmatic sounds are those that one hears without identifying their origin. Originating from musique concrète of Pierre Schaeffer, acousmatic music detaches the sounds from the individuals, instruments, and visual elements, to focus on the act of 'pure listening'. Implementing this notion on architecture, one can generate acousmatic spaces by detaching sounds from visual references of a space and re-compose them to design an experience.
A 10-day workshop was conducted that questioned the sound environment's potential in design by introducing it as the main element for design ideation while introducing acoustics as a building physics subject. 20 students of Faculty of Architecture in Istanbul Bilgi University participated in this workshop. Through a sequence of listening exercises, soundwalks, seminars and discussions, the students were trained about the main concepts of acoustics, structure-form-sound-perception continuum. A re-design problem was given that started with a blind walk for enabling 'pure listening' and data was collected with soundscape assessment questionnaires and voice recordings. A spatial narrative was created by 'sketching' sounds (sound-editing) and used in the regeneration of the spatial structures. The study showed that introducing systematic steps and experience-based teaching can encourage students to utilize auditory information in design and enable active learning in acoustics.

Keywords: *Acoustic education, Design education, Soundscape, Acousmatic music, Architecture*

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1. INTRODUCTION

The word "acousmatic" roots back to the ancient Greek word "acousma" which means "the object of hearing" and "akousmatikoi" which described the pupils of Pythagoras who listened the class while a curtain hindered the sound originator to avoid distraction. In 20th century the term "acousmatic" was adopted (initially by Jérôme Peignot and Pierre Schaeffer, later evolved by François Bayle) to describe the sounds that one hears without identifying its origin [1]. The framework for acousmatics comes from "musique concrète" and "reduced listening" pioneered by Pierre Schaeffer - *not to be confused with R. Murray Schafer, known for his contributions to soundscape studies.*

Musique concrète emerged as an experimental composing method using recorded sound "objects" and organizing them by implementing 3 main techniques: (1) transformation of time, (2) transformation of texture and timbre and, (3) spatialisation [2]. Fascinated by the recording technologies, Schaeffer believed that there existed a domain "beyond the sounds" through recording "the noises of things" [2]. This approach emphasized the abstraction of sound, thus enabling its use as a raw material for musical and spatial composition.

Recording technology not just offered the new method of music making but also allowed a new definition of listening. The sounds were disengaged from the origin, striped from indicative and communicative signs and they were no longer a "placeholder for some other thing" which Schaffer theorized as "reduced listening" [3]. By adopting this approach, one could focus on the musical characteristics of a sound or combination of sounds within a composition rather than identifying their source or the action that produced them [4].

Stemming from these fundaments, acousmatic music detaches the sounds from the individuals, instruments, and visual elements, to focus on the act of "pure listening". "Often taken by surprise, sometimes uncertain, we discover that much of what we thought we could hear was in reality merely seen, and explained, by the context." [1; p.66]. Acousmatic sound directs attention to sound characteristics that are typically overlooked when sight is present, as these visual cues tend to emphasize certain elements while masking others [5]. One challenge is that invisibility of the source initially evokes curiosity and intensifies causal listening, although this can be overcome through repetitive hearing [1, 5]. Therefore, acousmatic sounds challenge the listener to shift from conventional listening habits and requires them to focus on the sonic properties rather than their origin or cause.

Inspired by these notions, this study explores application of "acousmatics" in acoustic education as a way to stimulate spatial and soundscape design. In a workshop, students were engaged in a blind walk. They navigated in a building with their eyes closed, took recordings of sounds and defined their perception through a set of questions. This exercise in acousmatic perception aimed to detach the sounds from the space and allow them to reimagine the built environment as a composition of auditory elements rather than predefined spatial functions. The collected sounds were then used to compose new soundscapes, which were later translated into structural and spatial forms—creating a visual entity that emerged from a designed sound experience. In this sense this study aims to introduce a reverse design method to acoustics and spatial design. This paper presents the methodology and the results of this workshop.

2. METHODS

2.1 Preparation and development of the workshop methodology

A 10-days workshop was organized in 2019 summer in Istanbul Bilgi University. The workshop was planned with "learning-by-doing" approach and separated into three parts: (a) novice soundwalk, (b) training and (c) trained (blind) soundwalk.

The initial part of the study benefited from the methods and experiences of a former workshop study which investigated design methods for soundscape interventions [6]. In this previous workshop, students got engaged in a soundwalk, listened the acoustic response of the environment to the spatial sounds as well as self-generated sounds, and analysed their perception through the soundscape assessment forms. The assessment form and reading cards were prepared in line with ISO 12913-2:2018 and ISO 12913-3:2019 [7, 8] and benefited from [9 - 14]. Reading cards were used to evaluate the effect of acoustics during ensemble readings. Acknowledging the role of visual representation in design thinking, the study proposed techniques for audio-visual representation, namely: sound infogram, sound collage with recordings, and abstract sound-model with audio and visual elements. After this representation stage, students were encouraged to work with sound files, as well as sketches, texts and diagram for proposing a design intervention (further explained in [6]).

The current study used the sound evaluation form for the first soundwalk and an adjusted version for the second, i.e. blind walk (Figure 1). A challenge associated with acousmatic sounds was mentioned as the likelihood of the listener's attention shifting to the source due to curiosity. Instead of conflicting with this curiosity, we allowed students to first question the space characteristics through rating items of (a) socio-spatial environment, (b) spatial configuration, and (c) localisation inside the space, before moving to the questions related to soundscape quality.

Audio-visual representation techniques were applied although simplified for the purpose of the current study. An infogram consisting of only the radar chart of studied zone, sound collage with recordings, and sound-model with only visual representation was aimed for the first stage while students were intended to work with sound files, physical models and a videoclip in the second stage.

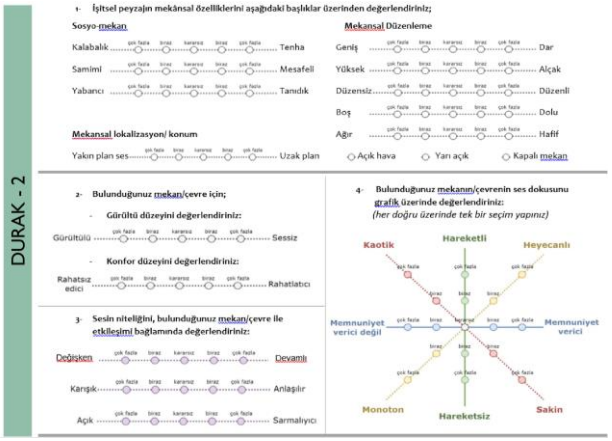


Figure 1. Assessment forms for blind walk

2.2 Workshop process

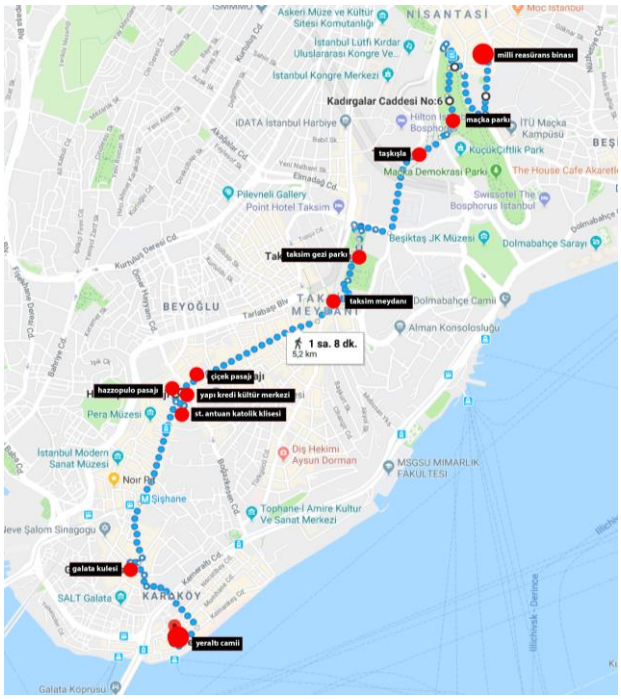
20 students participated to this workshop (15 female and 5 male). The majority had completed first year and had little or no knowledge on acoustics.

2.2.1 Novice soundwalk

Route: The novice soundwalk route was a central 5,2 km long walking route in Istanbul in the axis of Maçka – Taksim – Karaköy (Figure 2). 11 evaluation stops were predefined which would offer variety in terms of spatial, architectural and sound attributes. 4 open areas included both natural and urban soundscapes (Maçka Park, Gezi Park, Taksim Square, Galata Square). 3 passages constituted narrow urban corridors and courtyards which hosted both transit and leisure (café) activities (Milli Reasürans Passage, Çiçek [Flower] Passage, Hazzapulo Passage). 4 indoor spaces represented different architectural periods and had different spatial ratios (Taşkışla - ITU Architecture Faculty, Yapı Kredi Culture and Arts Centre, Church of St. Anthony of Padua, Yeraltı [Underground] Mosque).

Soundwalk procedure: A group walk was conducted on the route lead by instructors. Students were instructed to listen to the sounds and take recordings. In each stop they listened to their environment for approximately 3 minutes and filled the soundscape evaluation form. To understand the acoustic environment, they were instructed to use self-generated sounds (claps, footsteps) and do ensemble readings (4 students read the given texts while others listened). Afterwards instructors explained the historical background, architectural form and its effect on acoustics.

Audio-visual representation: On the following day, students discussed their experiences and the affective quality responses of all participants were averaged for each stop. Later the students were separated in 4 groups and assigned with one of the stops on the route. They were guided to experiment with the audio-visual representation techniques by preparing (1) a sound collage of maximum 1-minute using Adobe Premiere, (2) a graphical expression (poster) and (3) a physical model of sound-structure interaction. The students had little acoustical knowledge at this point and the aim of this study was to initiate questioning rather than proposing design solutions, while mastering representation techniques and tools. This activity continued for one and a half day.



(a)

(b)

(c)

Figure 2. Novice soundwalk; (a) route map, (b) ensemble reading at Yapi Kredi Culture and Arts Centre, (c) ensemble reading at passage

2.2.2 Training soundwalks and teaching

Theoretical knowledge was developed with seminars on basics of architectural acoustics, spatial design for sounds and interactive structures. An emphasize was given on on-foot learning. Two training soundwalks were conducted with approximately 1 hour duration.

- A soundwalk took place within the Istanbul Bilgi University campus, featuring multiple indoor and outdoor stops. This route encouraged students to perceive their familiar surroundings from a fresh perspective. Along the way, they were introduced to fundamental acoustical concepts and engaged in discussions on the relationship between sound, space, and human interaction.
- The second soundwalk involved a visit to Dialogue in the Dark [15], an exhibition where visually impaired guides lead visitors through a completely dark environment. The experience allowed participants to navigate solely through non-visual senses, deepening their awareness of sound and spatial perception.

2.2.3 Trained soundwalk – blind walk

Route: The trained soundwalk was conducted inside Istanbul Naval Museum in Besiktas (Figure 3). This building consisted of a heritage wing from 1897 and a newly built modern wing from 2013 [16]. Two separate routes were defined in two wings. The route in new wing was characterized by volumetric spaces and ended in a narrower glass bridge that connected the two wings. The route in heritage wing consisted of small- and moderate-size rooms distributed in 3 floors and an installation with water sound. Each route included 4 evaluation stops.

Procedure: Students were separated in groups of two. In each route one completed the walk blind (with eyes-covered) while the other acted as their guide and asked the affective quality assessment questions. They implemented the methods they practiced during the novice soundwalk (self-generated sounds, listening). They simultaneously took recording of the whole route.

Reverse design: Students were given the task of redesigning the route that they walked blindly. They were asked to design an "aural experience" and the form, structure and elements for it.

Students worked individually in this phase. They were encouraged to start with a sound collage of the route by using Adobe Premiere and go through the sound recordings, and their responses to affective quality questions. After familiarization process, they started to "design + compose" the spatial sounds by manipulating the sound texture and adding / subtracting sound elements. These were converted into a physical model where this sonic experience would occur. Students were asked to think about the acoustic principles and sound elements in relation to architectural form and socio-spatial environment.

The method for model making was defined as infilling within a 30x30 wooden frame, and students were free to use multiple frames if needed. For the submission students made a stop-motion video that combined the sound file with the corresponding vistas of their model.

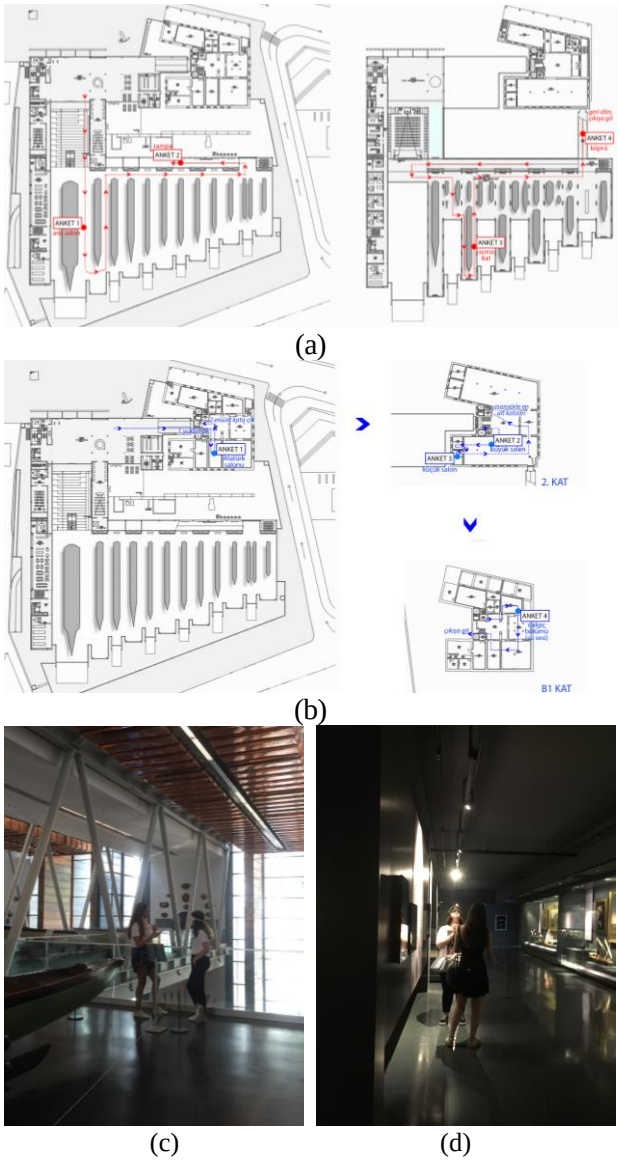


Figure 3. Trained soundwalk; (a,c) route in the new wing, (b,d) route in the heritage wing

3. RESULTS

3.1 Representation of acoustic environments (novice walk)

The first study involved a representation task, and the outcomes included a short sound collage, a poster and a model for four selected spaces.

All four-student-works reflected alterations and contrasts that emerged in the sound environment. When the contrast was not evident, students chose to extend the frame of the study. This was the case for two spaces (2nd and 3rd group) where students included street in addition to the assigned space. Both of them shared similar affective qualities rated as monotonous, uneventful and calm.

1. Çiçek [Flower] Passage
Affective quality: Eventful, exciting, chaotic
Represented elements: The alteration in strength of emotions (colourful spheres), user density (red line), sound level (blue line), reverberation time (green line), location of echo (arrow) (Fig. 4).

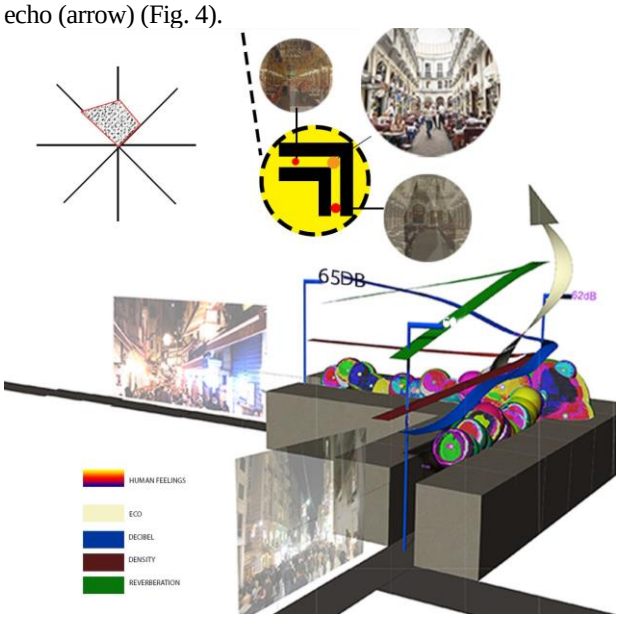


Figure 4. Graphic expression of sound environment in Çiçek [Flower] Passage

This work shows the perception of gradual alteration in sound environment in response to this transition space. The midpoint (corner) corresponds to largest volume which is depicted as climax for emotions along with the reverberation and echo perception (based on hand claps).

2. Church of St. Anthony of Padua
Affective quality: Uneventful, calm, (a little) monotonous
Represented elements: Sound levels (bar heights), variety (colourful vs. blue), envelopment (tangled forms vs. straight forms), transmissibility (forms bending over courtyard boundaries but not over church boundaries) (Fig. 5)

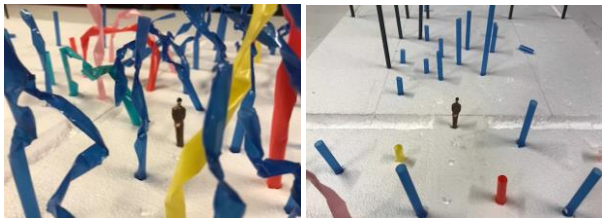


Figure 5. Physical model of sound environment in Church of St. Anthony of Padua

This work shows three different sound zones separated by borders. The two graving on ground shows borders of courtyard (Fig. 5 left) and church (Fig. 5 right). While preparing this work students commented on their observation that although the sound environment was very calm, any single event sounded "bigger" (long reverberation time) and they expressed these events with tall blue bars separated from each other.

3. Yeraltı [Underground] Mosque
Affective quality: Monotonous, uneventful, calm, (a little) pleasant
Represented elements: Temporal and level characteristics (outdoor sounds: rhythmic red line at top vs indoor sounds: continuous beige line at bottom with few movements), sound texture (onomatopoeic words) (Fig. 6)

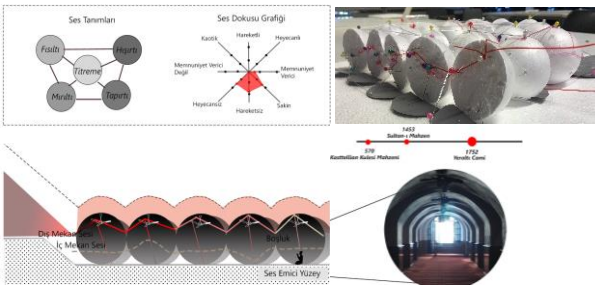


Figure 6. Graphic expression and physical model of sound environment in Yeraltı[Underground] Mosque

Originally built as an underground cellar, this is an unusual space consisting of repetitive domes, low ceiling, massive load bearing columns that create visual and acoustic barrier,

and absorption due to carpet. Students' physical model shows the negative space (void as mass). Their choice of onomatopoeic words (*fısıltı*: whisper, *hışırtı*: rustle, *tapırtı*: tapping, *mırıltı*: murmur) implies perception of soft, subtle and continuous sounds and a non-intrusive environment.

4. Yapı Kredi Culture and Arts Centre
Affective quality: Pleasant, calm, (a little) uneventful
Represented elements: Reflection and absorption of sound by different materials (lines) (Fig. 7)

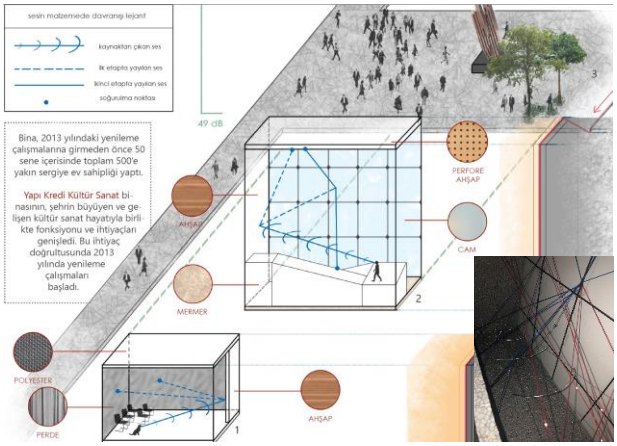


Figure 7. Graphic expression and physical model of sound environment in Yapı Kredi

This group focused on sound reflection from surfaces. They compared circulation area which was characterised by its high ceiling, glass and stone surfaces, with the seminar room which contained absorptive surfaces.

3.2 Reverse design (trained / blind walk)

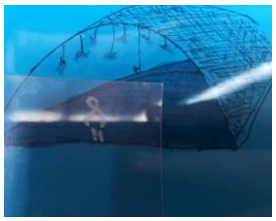
The second study involved a reverse design task, and the outcome was a stop-motion video which combined the sound file and the physical model prepared by the students. 15 of the students submitted their final work. 11 of them were able to complete the final video in time, two students submitted a sound file and a photo of the model, and two students submitted only a sound file.

Students presented their work to the instructors and their peers at the end of the workshop. Due to the absence of students' own verbal descriptions at this stage (contrary to the first study where students' intentions were explicit in posters), the results presented in this chapter include mainly our observations on outcomes and process.

3.2.1 Observations on the design works

Students' instinct of searching for contrasts and comparisons was also evident in the second study (design works) as many of the works offered richness in designed sound experience. Students adjusted the sound characteristics (temporal, frequency, levels), added directivity and spatialization (using left-right channels, dynamic levels, reverb and echo), and through introducing new sounds (spatial, environmental, self-generated, musical and other "effect" sounds). This was reflected in the architectural geometry with changing size, ratio, form and sound elements as well as open / semi-open areas to enable city, and/or nature sounds. This shows that designing "experience" output as a starting point, encourages students to form dynamic spaces (Fig. 8 and 9).

(a)



(b)

(c)

Figure 8. Screenshots from one of the videos with a rich space and sound configuration

Figure 9. A study in which a parallel was drawn between the visually reflective tubular form and sounds distorted through delayed repetition

Most designs also included movement at Z axis (stairs / ramps) (Fig. 10). This might be an attempt of creating different "sound vista"s. However, it is also possible that this was induced by the vestibular sense of the movement pattern during the blind walk, or by the model-making method which involved filling in a wooden frame.

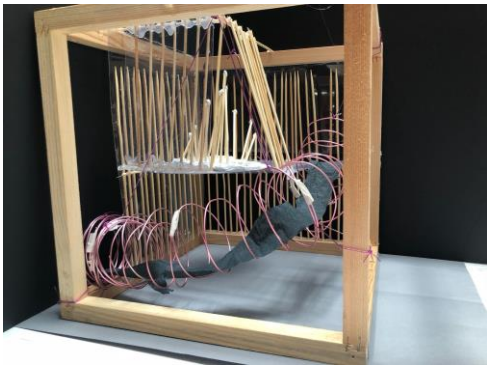
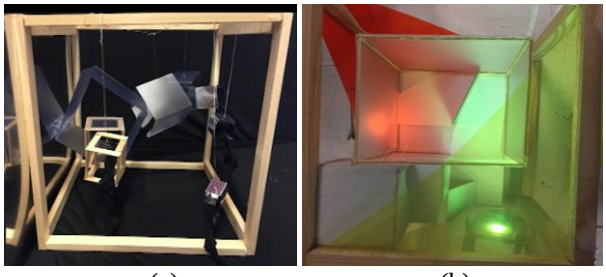


Figure 10. A route where a ramp forms a transition zone between the outdoor sounds and indoor sounds as well as between street level and upper level. The large and reverberant indoor space hosts an inner structure with contrasting sound characteristics

When the studies are analyzed together, a distinction emerges between two approaches to user movement within designed spaces. Some allow for free navigation, enabling users to explore the space openly, while others establish a continuous, predetermined route that guides movement in a specific direction. The intentionality behind these choices needs further examination in future studies (Fig. 11).



(a) (b)

Figure 11. Two approaches to user movement. (a) restricted, (b) free navigation *(the image shows top view)*

There was a clear tendency to include music, even though it was not the main element in most studies. Musical elements can serve as immediate cues for conveying emotion. This should be critically examined in future studies to encourage students to explore alternative means of emotional expression and search spatial sounds.

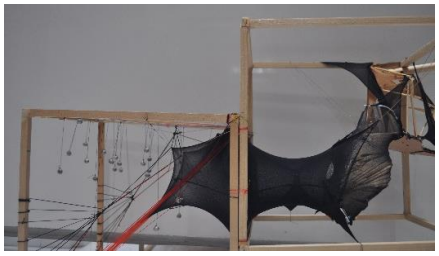


Figure 12. A study where student used spatial sounds very minimally and created a more-deliberately designed sound file composed with sound effects

3.2.2 Observations on the blind walk process

The blind walk received strong interest, and students were generally positive about this experience. The training soundwalk in "Dialogue in the Dark" was helpful for preparing students to navigate in space in the lack of their visual sense (with a guide) and focus on their audio environment. Nevertheless, one student reported being uncomfortable of walking while eyes were covered and that this sense influenced their final work (Fig. 13). This comment and the observed tendency of movement at Z axis (see section 3.2.1) suggest that while blind walk helps to omit visual input, vestibular sense might continue to intervene with the perception.

Figure 13. Student work that reflected discomfort during the blind walk. The sound file included eerie elements such as squeaks and screams, while the spatial model featured vertiginous, torsional surfaces

The implementation of the soundscape assessment forms not only systematized the evaluation but also it directed the

attention to the experience of acousmatic sounds. Furthermore, the voice record of the guide who read the questions on the form and the reading texts was used as a "sound object" in many of the sound collages.

Many students expressed their curiosity about the space. This confirms the challenge associated with acousmatic sounds, as the listener's attention is likely to shift away from the sound upon first contact. Repetitive listening of recordings is found useful for reframing sounds as objects of redesign.

3.2.3 Observations on the design process

The physical model fed from the sound file, demonstrating an example of reverse design, where students first crafted the sound environment and then derived the spatial form from it. This approach highlights the potential of sound as a generative tool in design, encouraging a deeper understanding of the relationship between auditory and spatial experiences. Additionally, it offers a method of acoustic learning where students not only analyse their own perceptions but also design a soundscape and search for forms elements to materialise it.

The two-stage study (novice + trained) helped students to familiarize with listening to spaces, discovering acoustics through self-produced sounds and assessment of soundscape quality as well as representation tools and techniques. This helped the students to focus less on mastering the techniques and more on the activity itself in this second part of the study.

4. CONCLUSION

Inspired by the acousmatic music, this workshop explored its implementation in a design study. Acousmatics suggests renouncing the instrument and traditional musical frameworks, focusing instead on sound itself and its inherent musical "potential" [1]. In this workshop study, students listened to the space without visual cues, stripped the sounds of their origins and spatial context, and explored their potential in designing an aural experience. This provided an alternative way of engaging with sound, moving beyond traditional acoustic design. The designed/composed sound was converted into a spatial form thus exemplifying a reverse design method for architecture and soundscape.

During the 10-day workshop, students were trained in attentive listening and developed a deeper understanding of the acoustic environment. The acoustic training primarily occurred through on-foot experiences and learning-by-doing. This approach fostered an intuitive understanding of how sound interacts with space, offering insights for architectural and acoustic education.

5. ACKNOWLEDGMENTS

This study was conducted in Istanbul Bilgi University.

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