Identifying undesirable space through sensorial experience towards sustainability

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Abstract. Humans need space to live, and also a space becomes livable when used by humans. They role as a user will interact with space as a product of designing through their sensorimotor system. This paper is trying to exploring space in terms of negative things that make the space undesirable, by using hearing sensory as a tool. The observation takes place on the pedestrian route around Jatinegara Station, East Jakarta. The primary method of this research is to sound walking. Some aspects that were observed were the decibel ratings, the number of people who were in the area, the types of sound sources, and the levels of traffic crowdedness. Observations are carried out on weekdays and the weekends, each in 4 periods; in the morning (08:00 am), noon (12:00 pm), afternoon (4:00 pm) and evening (8:00 pm). The results of the observations indicate that not all areas that have a busy sound intensity and diverse sound sources can necessarily be identified as undesirable spaces. Other influential factors are the attractiveness of activities that occur in the space, the users or the people who are there, visual considerations such as darkness and light, and human perception of security.

1. Introduction
There is a very close relationship between humans and space [1]. Humans need space to live, and also a space becomes livable when used by humans. Space itself is an extent or area, a distance between two or more points. It has height, width, and depth, cluttered up with objects/substances such as solid, void, or liquid [2]. A space that has values and activities becomes a place [3]. Donovan [4] explained more about nurturing place and neglectful place. Nurturing place is a place that can help people to meet their needs and fulfill their potentials, while the neglectful place is a place that isolates people from opportunities. Since neglectful space imposes multiple barriers on people, they become disadvantaged by their surroundings and the behaviors of environments that encourage such barriers. This paper tries to explore more about the neglectful place, but in a different term, which is undesirable space.

Undesirable space is the main topic of this paper. Etymologically, desire is a feeling that humans have that leads to the desire or ambition for an object that usually has a positive impact on meeting human needs. One theory that addresses this issue is Maslow’s theory, which describes human needs in the form of a pyramid with three levels: (1) Basic Needs, namely human needs for physiological needs and security; (2) Psychological Needs, namely human needs for belonging and appreciation; and (3) Self-
fulfillment needs, namely the human need for self-actualization, the highest level in the hierarchy of human needs [4]. Similar to a neglectful place, being in an undesirable space negatively affects human well-being — hence, an undesirable space is such a threat that it needs to be anticipated and avoided while designing a place. Referring to this theory, the word ‘desire’ as abstracted in this paper refers to a robust human feeling of wanting to have something or wishing for something to happen, namely to fulfill these three basic needs. Meanwhile, undesire is a form of negation of desire, which has a negative impact and cannot meet human needs.

As mentioned before, there is a close relationship between humans and space. Human as a user will interact with space as a product of designing through their sensorimotor system [5]. Furthermore, the sense of self, strengthened by art and architecture, also permits mental dimensions of dreams, imagination, and desire [6]. Sense becomes an instrument of ‘navigation’ for humans to determine the perception or assessment of an object regarding whether it has a positive or negative impact on them. Sensory experience can also provide a strong sense of place and belonging [7].

The primary method of this research is to sense of walking. It is focused on everyday experiences of the environment gained through one sensory mode, such as sound walking [8], or smell walking [9]. The observation takes place on the pedestrian route around Jatinegara Station, East Jakarta. Observer as a soundwalker is trying to identify and detect the sources of the sound by walking on the sidewalk. By focusing on sound, the information will be captured without any apparent visual boundaries, emphasizing the space itself [10] and bringing out the emotions of the listener more richly. After the sound sources are mapped, the observer will also explore the condition of human crowds and traffic, to find out which spaces tend to be desirable. All of those explorations will be draw on one map so that it can be analyzed the relationship between undesirable spaces and the conditions of the sound that is heard.

Some research related to sensorial experience in public spaces concerned about multisensory approach to understanding human walking behavior [11], kinesthetic sensory [12], and the relationship between sensory and social dimensions [13]. This paper will identify and map undesirable spaces in a public place using sensory experience, which is an integral physiological element of the human body, primarily as derived from the sense of hearing. A space is classified as undesirable in this paper if it produces high-intensity sounds that tend to be noisy [8], trigger a terribly emotional experience, and give a detrimental influence to humans [4]. The understanding of undesirable characteristics of urban space on a human scale will become a new approach and input in planning a sustainable and humanistic city.

2. Methodology
The study was carried out on foot in the pedestrian path, starting from the western section of the northern lane to the west of the south lane. Some aspects that were observed were the decibel ratings, the number of people who were in the area, the types of sound sources, and the levels of traffic crowdedness. Observations were made on weekdays and weekends, with four time periods for each session, namely in the morning (around 8.00 am), afternoon (around 12.00 pm), evening (around 4.00 pm), and at night (around 8.00 pm). To facilitate observation, the observation area was divided into several parts based on the character of activities taking place there and the spatial configuration as follows:
Figure 1. Map of observation location and route on foot.

| Part | Building Functions & Activities | Stories | Setback | Sidewalk |
|------|--------------------------------|---------|---------|----------|
| a-b  | Shophouse (electronic, optic, home appliances), food hawkers | 2-3     | 2-3 m   | 3-4 m    |
| b-c  | Shophouse (electronic, optic, home appliances), food hawkers | 2-3     | No setback | Parking on street |
| c-d  | No buildings                          |         | 4-5 m   | 1-2 m    |
| d-e  | Jatinegara Station, bus stop          | 1-2     | 2-4 m   | 2 m with fences |
| e-f  | No buildings                          |         | 3-4 m   | 2-4 m    |
| g-h  | Shophouse (clothes, shoes)            | 2-3     | 1-2 m   | Use for parking |
| h-i  | Praying area, Police station, Jakarta Gems Center | 2-5     | 4 – 10 m | 2.5 m |
| i-j  | Shophouse (printing center, massage service, convenience store) | 2-3     | 1.5 m   | Parking on street |
| j-k  | Betawi Art Center, shophouse          | 2-3     | 2-10 m  | Fenced off by trees |

3. Observation results
3.1 General brief about the whole observation result
Based on the results of the observations, the sources of sounds differ in the four time periods, which lead to the identification of undesirable spaces whose locations vary depending on these periods. In weekdays, only a small portion of the space is identified as undesirable in the morning. The only section that feels disturbing is found in the northern pedestrian lane east of the station, where an animal market resides. During daytime, the undesirable spaces that are identified increase in number, namely in the junction area where people are crossing bridges, street vendors are conducting their business, and public transportation drivers are looking for passengers. Entering the afternoon, the bus stop on the western side of the station and the franchise shop opposite the station become quite disturbing because of the crowded public transportation waiting for passengers, from which uncomfortable utterances can sometimes be heard. Finally, when the night arrives, the undesirable space that is identified refers to quiet spaces that cause a feeling of insecurity, namely in the store area.

The crowd seems to increase in density during weekends compared to weekdays. The area around the station has a higher crowd density than during weekdays. During the day on the weekend, quite a lot of noise can be identified in various spots, namely the street vendor area along the storefront, the station area, and the bus stop area. In the afternoon, crowds still occur around the same storefront as during the daytime, along with the bus stop and the opposite sides of the station. This crowdedness can be explained by the hectic public transportation drivers that offer a ride in a forceful manner. At night, the resulting
undesirable space is the same as the one on a typical day, namely the quiet shop area where homeless people spend their nights.

3.2 Specific explanation on weekend observation result

In the morning, observations begin at 8.00 am. In addition to vehicle noise, observers can hear the voice of a public transportation driver offering a ride to passersby. The sounds of street vendors preparing their stalls are also audible. Walking to the east, the observer hears a slightly disturbing noise from a broom used for sweeping the street. Passing the storefront, the observer arrives at a wide, empty sidewalk devoid of any street vendor activities, roofs, and barriers on the roads. From there, the observer hears the sound of the train and the station announcer from about 175 m eastward. Arriving at the front of the station, the observer notices the sound of public vehicles lined up with each other as they offer rides. Across the pedestrian lane in the south, the observer passes the first 300 m without significant sound intensity other than the noise of the vehicles. This is due to a lack of activity and the presence of barriers in the form of trees and plants between the sidewalks and highways. Finally, the observer arrives at a franchise shop, which also serves as a base for online motorcycle taxi drivers.

Figure 2. Superimposed image of sound sources mapping, traffic mapping, and crowdedness mapping at 8.00 am.
Table 2. Survey results at 8.00 am

| Part | Sound Sources                                                                 | Decibel Ratings | Amount of People | Duration of Settling |
|------|-------------------------------------------------------------------------------|-----------------|------------------|----------------------|
| a-b  | Goods being moved, vehicle horns, footsteps                                     | 49.1 dB         | 62               | 5-15 minutes         |
| b-c  | Goods being moved, pop music, sound of brooms, television, crowing poultry     | 49.5 dB         | 166              | 5-30 minutes         |
| c-d  | Station announcer, hawkers cooking                                             | 50.5 dB         | 22               | 2-15 minutes         |
| d-e  | Station announcer, trains passing by, vehicle horns  Footsteps                  | 50.2 dB         | 83               | 5-15 minutes         |
| e-f  | Pop music, parking whistle, goods being moved                                  | 51.3 dB         | 29               | 2-15 minutes         |
| g-h  | Ambient speech/conversation, dangdut music                                     | 48.9 dB         | 50               | 5-30 minutes         |
| h-i  | Ambient speech, catcalling, dangdut music                                      | 48.1 dB         | 43               | 5-30 minutes         |
| i-j  | Sewing machines, automotive tools, sound of brooms                             | 46 dB           | 22               | 2-15 minutes         |
| j-k  | Sewing machines, automotive tools, sound of brooms                             | 46 dB           | 22               | 2-15 minutes         |

The next period is the afternoon. The condition at this time is quite hot, and observation begins at 12.10 pm. The condition during the day on weekends is much more crowded than during weekdays. The voices heard on the storefront are increasingly diverse in terms of intonation, accent, and language. There are noises heard overhead, such as sounds of human footsteps treading the crossing bridge and the constant sound of honking from the horn of a public minivan slows down to attract passengers. At the same point, there are also sounds of chatting between street vendors and their customers as they make transactions. Observers also hear sounds of a parking whistle. About ten steps later, the observer hears the squawk of a chicken from the animal market area, dangdut music (an ethnic genre in Indonesia), and a conversation among several people inside the shop. After passing through shops, observers do not hear other voices other than heavy vehicles such as buses, trucks, and old transportation as well as human footsteps. Shortly after, the announcement of a train’s arrival can be heard, followed by the sound of the train's passing. A few steps later, the public minivan horn is heard, accompanied by human voices and the faint sound of a driver offering a ride. Past the station, not too much noise is audible except that of passing vehicles. After crossing, the observer listens to the faint sound of a sewing machine. A few steps after, not too much noise is noticeable, as it becomes slightly muffled when the observer passes a sidewalk lined with plants and trees in front of the Betawi art building. Afterwards, a variety of sounds such as workshop tools and car wash machines begins to emerge from a distance of about 20 to 30 steps. Subsequently, the dominant sound consists of vehicle noise, followed by the occasional sound of chatting and goods being moved.
Figure 3. Superimposed image of sound sources mapping, traffic mapping, and crowdedness mapping at 12.00 pm

Table 3. Survey results at 12.00 pm

| Part | Sound Sources                                                                 | Decibel Ratings | Amount of People | Duration of Settling |
|------|------------------------------------------------------------------------------|-----------------|------------------|---------------------|
| a-b  | Footsteps on the bridge, conversation, old car engines, vehicle horns       | 50.7 dB         | 150              | 5-30 minutes        |
| b-c  | Goods being moved, parking whistle, crowing poultry, pop music              | 50.8 dB         | 133              | 5-30 minutes        |
| c-d  | Station announcer, trains passing by                                         | 49.3 dB         | 14               | 2-5 minutes         |
| d-e  | Vehicle engines, vehicle horns, conversation, station announcer, trains passing by, footsteps on the bridge | 51.3 dB         | 78               | 5-15 minutes        |
| e-f  | Busy roads                                                                  | 51.1 dB         | 28               | 2-10 minutes        |
| g-h  | Pop music, parking whistle, conversation, busy roads                        | 50.8 dB         | 105              | 5-30 minutes        |
| h-i  | Ambient speech/conversation, dangdut music                                  | 49.1 dB         | 65               | 5-20 minutes        |
| i-j  | Conversation, dangdut music, ear wash machines                              | 48.7 dB         | 122              | 5-30 minutes        |
| j-k  | Busy roads, automotive tools, sewing machines                               | 46.3 dB         | 26               | 2-10 minutes        |

In the evening, observation begins at 4.00 pm on the same route from west to east in the northern lane, followed by the east to west route in the southern road. The noise conditions that occur at this time are not too different from those that arise during the day. Some apparent differences are more children's voices can be heard in the western part of the northern lane, which is enlivened by the presence of street vendors in front of the stores. In addition, observers also hear many instances of the sound of goods loaded from the shops to cars. While passing a franchise shop in the southern lane, the observer also hears conversations among online motorcycle taxi drivers who gather in the evening. The observer also hears the sound of brooms at several points, which can be traced to street food stalls that are being prepared for opening.
Figure 4. Superimposed image of sound sources mapping, traffic mapping, and crowdedness mapping at 4.00 pm.

Table 4. Survey results at 4.00 pm.

| Part | Sound Sources                                                                 | Decibel Ratings | Amount of People | Duration of Settling |
|------|-------------------------------------------------------------------------------|-----------------|------------------|----------------------|
| a-b  | Footsteps on the bridge, conversation, old car engines, vehicle horns         | 50.3 dB         | 158              | 5-30 minutes         |
| b-c  | Goods being moved, parking whistle, crowing poultry, pop music                | 50.5 dB         | 150              | 5-30 minutes         |
| c-d  | Station announcer, trains passing by                                           | 50.2 dB         | 34               | 2-5 minutes          |
| d-e  | Vehicle engines, vehicle horns, conversation, station announcer, trains passing by, footsteps on the bridge | 51.2 dB         | 98               | 5-15 minutes         |
| e-f  | Busy roads, conversation, vehicle horns, old car engines                      | 50.9 dB         | 55               | 2-10 minutes         |
| g-h  | Pop music, parking whistle, conversation                                       | 50.1 dB         | 100              | 5-30 minutes         |
| h-i  | Busy roads, ambient speech/conversation, dangdut music                        | 51.0 dB         | 50               | 2-20 minutes         |
| i-j  | Conversation, dangdut music, car wash machines                               | 49.2 dB         | 90               | 5-30 minutes         |
| j-k  | Busy roads, automotive tools, sewing machines                                 | 46.7 dB         | 26               | 2-10 minutes         |

The crowd at night, specifically at 8.00 pm, is much quieter than during the day. In the beginning of the route, observers do not hear excessive instances of human voices, but rather the sound of brooms from janitors, old public vehicles, and human footsteps passing the observers. Because it is not too crowded, observers can hear the station announcer's voice and the train's passing even from a farther distance than during the day. Past the station, precisely at the easternmost point of the observation area, observers do not hear human noise at night. In the southern lane, it tends to be quiet until a sound is heard after passing the Betawi art building, specifically the sound of music from one of the shops. In front of the franchise shop opposite the station, there are increasingly crowded human voices because of the greater number of online motorcycle taxi drivers taking a break. In the evening, there is also the sound of frying and cooking in the tent stalls that only open at night. In the western part of the shop, the sound of cardboard being stepped on is heard, coming from homeless people spend the night there.
Table 5. Survey results at 8.00 pm

| Part | Sound Sources                                                                 | Decibel Ratings | Amount of People | Duration of Settling |
|------|--------------------------------------------------------------------------------|-----------------|------------------|---------------------|
| a-b  | Goods being moved, vehicle horns, footsteps, rolling door closing             | 32.1 dB         | 23               | 5-15 minutes        |
| b-c  | Goods being moved, pop music, sound of brooms, television, crowing poultry, kids playing | 32.5 dB         | 91               | 5-30 minutes        |
| c-d  | Station announcer, hawkers cooking                                           | 40.9 dB         | 39               | 2-15 minutes        |
| d-e  | Station announcer, trains passing by, vehicle horns                          | 44.5 dB         | 115              | 5-15 minutes        |
| e-f  | Pop music, parking whistle, goods being moved                                 | 41.3 dB         | 65               | 2-5 minutes         |
| g-h  | Ambient speech/conversation, dangdut music                                   | 40.1 dB         | 63               | 5-30 minutes        |
| h-i  | Ambient speech, dangdut music                                                | 45.0 dB         | 60               | 5-30 minutes        |
| i-j  | Sewing machine, automotive tools                                             | 39.6 dB         | 75               | 5-30 minutes        |
| j-k  | Sewing machine, automotive tools                                             | 41 dB           | 16               | 2-15 minutes        |

3.3. Analysis of results

3.3.1. Undesirable spaces with high intensity of noise. The hypothesis of this research is that higher intensity of noise and diversity of sound sources lower the desirability of a space. The results of the observations show the corresponding results in several parts, specifically in the areas between the shops and the station, including (1) Part c-d at 8.00 am, (2) Part c-d at 12.00 pm, and (3) Part c-d at 4.00 pm. The area is a 4m-wide pedestrian path, with no buildings and no roofs. In the north, there is an ongoing development project for the station, but the noise resulting from its activities is not significant in the morning in comparison to the afternoon. Most people use this area to enter and exit the station with duration of only 2-5 minutes. Not many other sound sources are identified, but road noise is more dominant because there are no barriers in the area.
In addition, the same condition was identified in the western part of Jatinegara Station. Among them are (1) Part e-f in the morning with 51.3 dB, (2) Part e-f in the afternoon with 51.1 dB, and (3) Part e-f in the evening with 50.9 dB. The only dominant sound is road noise, although it has a fairly high decibel rating. This cutoff is in the form of a sidewalk with a width of 3-4 meters without buildings and roofs, located near the T-junction, which is a public transportation point to drop passengers. This area is used to enter and exit the station, so people tend to stay in it for duration of only about 2-5 minutes.

3.3.2. Desirable spaces with high intensity of noise. However, not all areas that have a high intensity of noise or diverse sound sources automatically become undesirable. Some areas in the observation area have a high sound intensity, yet they also retain a high density of human crowds, as evidenced in (1) Part a-b in the afternoon with 50.7 dB and (2) Part a-b in the evening with 50.3 dB. The two parts have the highest number of sound sources and high decibel levels, but nevertheless manage to achieve the highest crowd density. The cutoff of this area is in the form of a three-storey shophouse that sells books, clothing, and electronic devices among others, with a storefront that has a roof as wide as 2 meters and a pedestrian sidewalk as wide as 3 meters. From the afternoon until the evening, storefronts and sidewalks are used by street vendors. This cutoff is also close to the crossing bridge and the T-junction point, so it becomes a stopping point for public transportation vehicles to find passengers. Some shops try to attract visitors by turning on music, running televisions, and using loudspeakers. This cutoff becomes a crowded area with many sources of noise because of business activities. Furthermore, it is quite noisy because it is situated at an intersection, but it also becomes a very crowded area because of its high number of visitors. This finding, therefore, contrasts with the initial assumption that a high level of noise and number of sound sources are factors that contribute to the undesirability of a space.

The same situation arose in the station area, precisely at (1) Part d-e in the morning with 50.2 dB, (2) Part d-e at night with 44.5 dB, and (3) Part g-h at night with 45 dB. The cutoff of Part d-e is in the form of Jatinegara Station with a building setback of around 2-4 m, without a roof and with a fenced pedestrian sidewalk as wide as 2 meters, while Part g-h is opposite the station and is enlivened by street vendors who have just opened their businesses at night. The three parts possess the highest noise levels in each time period, but at the same time, their crowd density remains high. This is due to the frequent transit activities...
that occur at Jatinegara Station, drawing an ample number of visitors in the morning and evening. Long-distance trains generally follow a schedule of arriving and departing in the morning and evening. Moreover, the activities of street food vendors are also a quite striking attraction at night in Part g-h. Therefore, even though it emits the highest level of noise, it remains a desirable space because of the activities that enrich the liveliness of its atmosphere.

3.3.3. Undesirable spaces with low intensity of noise. The results of observations in some parts stated that the sound intensity was low there, but they were also empty of visitors at the same time. In this case, undesirable spaces are influenced by factors other than sound. Among them are (1) Part j-k in the morning with 46 dB, (2) Part j-k in the afternoon with 46.3 dB, and (3) Part j-k in the evening with 46.7 dB. The three parts have the lowest decibels but are also the quietest areas. In fact, there is a fairly iconic building in the section, namely the two-floored Betawi Cultural Center, and a setback of around 6-8 meters. In front of it is a pedestrian sidewalk of 1.5 meters with trees as a boundary to the road. The area is quite comfortable for walking because the trees filter the noise that occurs on the road while also producing the natural sound of rustling leaves in the wind and giving a relaxing effect. Because they are lacking in activity, there are no attractions to entice visitors into staying in these parts.

Other undesirable spaces with a low intensity of noise can also be found at night in Part a-b and g-h, which have a low average decibel rating of 32.1-32.5 dB and a low crowd density. The parts are in the form of a three-story shophouse that sells books, clothing, electronic devices, etc. with a storefront that is two meters wide and a three-meter sidewalk. Overhang shop and sidewalks are used by street vendors. In the morning, afternoon, and evening, this cutoff is the busiest area, in stark contrast to what happens at night. When the shops start to close at 8 pm, street vendors begin to pack one by one, and activities that attract crowds decrease. In addition, at night, the area has poor lighting, and many homeless people use the space in the area as their resting place. In this case, the quiet noise actually indicates that the cutoff is an area that causes inconvenience to humans, especially in relation to security issues. However, sound is not
the only factor of relevance here, as visual factors related to darkness also play a role in lowering the desirability of a space.

Another finding that is not in accordance with the initial hypothesis is Part i-j in the morning. This part is in the form of shophouses ranging from two to three floors that function as convenience stores, printing centers, massage services, and key duplication services. In front of it, there is a pedestrian path that is 2-3 meters wide, bordered by trees that form a fence against the road. There are several activities that take place on the sidewalk, such as those of street food vendors, street vendors running key duplication services, and motorcyclists parking. In addition, this area is also a gathering point for online motorcycle taxi drivers. Through these gatherings, the observer feels discomfort upon hearing human voices that seem to call and tease, often referred to as catcalling. As such, this research has found that the undesirability of a space is not only caused by noise, but also sounds that lead to negative effects.

![Figure 10. Section of Part i-j](image)

### 4. Conclusion

Not all areas that have a busy sound intensity and diverse sound sources can necessarily be identified as undesirable spaces. This happens because there is attractiveness that is manifested due to the concentration of humans, who carry out certain activities such as buying things in commercial buildings, waiting for public transportation around the station, or buying food at street vendors. There is a shade or shadow that gives shade to pedestrians, and also the proximity of pedestrians to commercial buildings that have setback zero. These spaces become positive spaces, becoming desirable spaces. On the other hand, the space becomes an undesirable space because of the noise from various sound sources and the space has no human concentration. From the observations, the undesirable space that occurs is not the space between buildings, but the empty space formed from the road space and empty land. Undesirable space occurs because of noise, empty space without buildings, and without shadow. Resulting in the absence of human concentration, the attractiveness of the space is low, and becomes a negative space. Negative space encourages the formation of undesirable space.

From the research we can conclude sound sources cannot be the only factor in assessing the desirability of a space. Other influential factors are the attractiveness of activities that occur in the space, the users or the people who are there, visual considerations such as darkness and light, and human perception of security. However, comfortable and soothing sounds also remain considerations that have a positive impact on humans, by considering spatial configuration such as the placement of natural attributes such as trees and barriers such as walls or roofs that can muffle noise.

### Acknowledgments

Grant PIT9 year of 2019 from Universitas Indonesia through Directorate of Research and Community Engagement UI.
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