

Cairo, A Possible Aural Comfort: Factors Affecting the Cairene Perception of Soundscape

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Abstract

An urban open public space represents the most complex element of any city, due to its multitude of embedded sounds, and noises. Public spaces impose a great influence on people's comfort and consequently the general well being. During planning and design process, Architects generally and especially in Egypt cast more attention to the visual aspects rather than the sensual dimensions of public spaces. Since Cairo represents one of the most overcrowded and largest capitals worldwide; its soundscape resembles the richest and most diverse that could be experienced. Its importance is fueled up by the multitude of activities, and the cultural demographic diversity. An analysis of the Cairo soundscape was conducted; a questionnaire targeting Cairene inhabitants was carried out revealing factors affecting their soundscape and aural experience, as well as psychological and physical parameters affecting the perceptual experience. The paper outlines a mitigation matrix and measures that are not only physical but also related to the spiritual perception of the soundscape for Cairene inhabitants.

Keywords: Cairo Soundscape, Aural comfort, Noise

1. Introduction

Life in the city can be a very stressful experience. Urban soundscape is one of many aspects of a city's urban environment that affect the lives of citizens. The problem is, urban planners and urban designers seldom take into consideration the aural aspect of a city planning and design, which leads to the creation of uncomfortable urban open public spaces that hinder the well-being of the inhabitants.

There are various factors that affect soundscape perception in urban settings. P. Jennings and R. Cain defined four factors that affect soundscape perception, which are 'Activity', carried out by the listener, 'Demographics', 'Time' and 'Space' (Jennings & Cain, 2012). These four factors will be used for general guidance upon analyzing the case studies presented in this paper. Moreover, D. Glass and J. Singer defined seven factors that effect soundscape perception and the degree of annoyance caused by the heard soundscape. These factors are (Glass & Singer, 1972):

- Volume: sounds that are higher than 90dB psychologically disturbing (long-term exposure might lead to hearing loss).
- Predictability: sounds that have low predictability levels are frustrating.
- Perceived Control: if a person feels that he/she can control a specific sound, it becomes less irritating.
- Necessity: if a sound is perceived as unnecessary, annoyance level increases
- Concern: annoyance is increases if a person believes that the people generating the sound are not concerned about the well being of others.
- Perceived Health Risks: the fear of the occurrence of damage to one's health due to the generated noise increases annoyance.
- Satisfaction: a general discontent with the neighborhood or place will increase noise annoyance.

These seven factors are the base upon which a questionnaire study is built to assess the Cairene soundscape quality and perception.

In an old metropolitan city like Cairo the soundscape problem has become increasingly annoying and its negative effects on the lives of Cairenes have become prominent. Consequently, a Soundwalk exercise and an online questionnaire have been carried out to assess the quality and the degree of annoyance of the Cairene soundscape from the perspective of Cairo's residents, and to establish rules and mitigation strategies to enhance the soundscape of the city.

2. Methodology and Analysis

The assessment of Cairo's soundscape was carried out in two parts. First, a pilot case study, which consists of a Soundwalk exercise, carried out by a group of 63 architecture students in four major squares in Cairo. Second, an online questionnaire that assesses the Cairene soundscape targeting the residents of Cairo.

2.1. Soundwalk Exercise

The students were divided into 18 groups of 3-4 students. The four squares are El-Tahrir Square, Talaat Harb Square, El-Gomhoreya Squares and El-Opera Squares (Figures 1 and 2). The selection of the squares was based on their location in Cairo's central business district (CBD), the diversity of noise levels present in the four squares and the fact that they are in close proximity to each other, which makes them suitable for a Soundwalk. The students were asked to fill a simple questionnaire after walking in the squares.

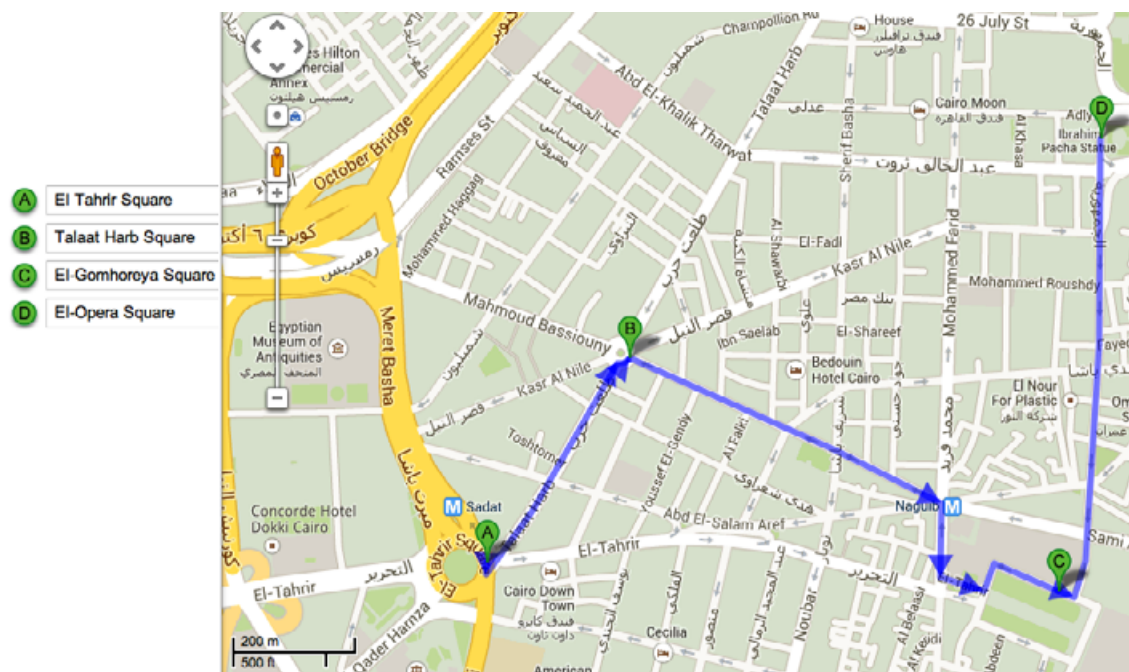


Figure 1. Soundwalk Route.



Figure 2. Soundwalk Squares.
a) El-Tahrir b) El-Opera c) EL-Gomhoreya d) Talaat Harb

According to the results of the Soundwalk, the soundscapes in three of the four Squares created a problem and hindered social activities. These three squares are El-Tahrir, Talaat Harb and El-Opera, which, are very busy squares characterized by heavy traffic and mixed use buildings. The only sound people can hear in three of the four Squares is 'noise', except in El-Gomhoreya Square where it is 'quite'. The term 'Overlapping Sounds' was also expressed several times. This clearly confirms that the setting of the soundscape is a low information lo-fi setting (Wrightson, 2000) where the user's experience of the space is hindered by its soundscape except in El Gomhoreya Square. Upon reflecting on the land use types in each square, it was found that:

- El-Tahrir Square (Fig. 3.) is a vital highly mixed-use square where very large crowds of pedestrians and vehicles navigate in and out of the square. The main buildings found there are El Tahrir Complex which is a very important governmental building that serves thousands of users daily and reached through underground transportation, The League of Arab Countries Headquarters, hotels, the Egyptian Museum, the old American University in Cairo Campus and some residential commercial building.



Figure 3. El-Tahrir Square Map.

- Talaat Harb Square (fig. 4.) is also a vital highly mixed-use squares where there are residential commercial buildings, hotels and motels, cafes, a library and a hospital. These buildings attract a lot of people in addition to those who merely navigate through the square.



Figure 4. Talaat Harb Square Map.

- In El-Gomhoreya Square (fig. 5.) there are governmental buildings such as the Cairo Governorate building, the Headquarters of the Presidential Guards which is an Armed Forces institute, Abdeen Palace and Museum which is currently closed and used as a governmental building, and mixed use residential commercial buildings (Figure 3.6). As compared to the previous Squares, fewer uses are present in the square yet they are important buildings and less traffic navigate through the square. Moreover, the presence of public gardens in front of the Palace encourages people and children to sit and play there and encourages social activities.

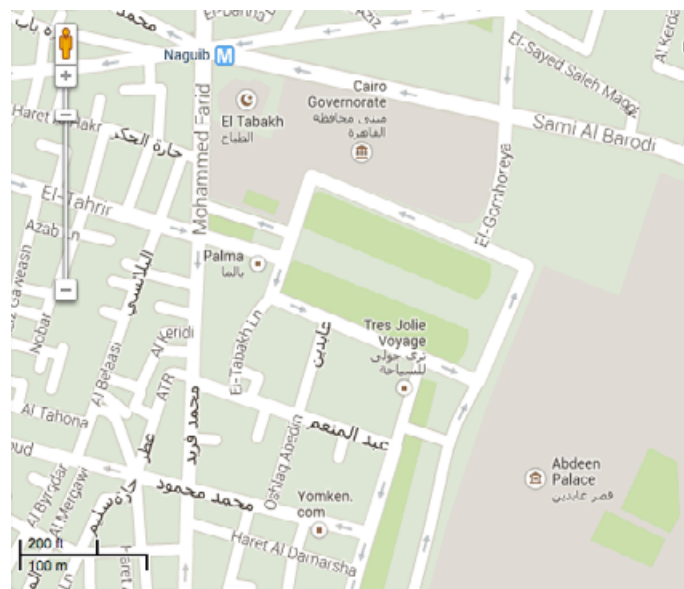


Figure 5. El-Gomhoreya Square Map.

- In El-Opera Square (Fig. 6.) there is a busy vertical parking building, an underground metro station, mixed use residential commercial buildings, a sports club and a garden. There is also an illegal microbus stop that causes high congestion. It is clear that this square contains fewer uses than El Tahrir and Talaat Harb yet most of the soundscape descriptions were ‘Unbearable Loud Noise’ and ‘Overlapping Sounds’.



Figure 6. El-Opera Square Map.

There are various sounds that could be heard in each square as shown in figure 7. Upon relating these sounds to the general description of the soundscape in each square it was noticed that:

- In the three Squares where ‘Loud Noise’ and ‘Unbearable Loud Noise’ are heard (El-Tahrir, Talaat Harb and El-Opera), the most dominant sounds are ‘Traffic’ and ‘Car Horns’.
- Upon Comparing ‘Traffic’ and ‘Car Horns’ in El Tahrir, Talaat Harb and El-Opera Squares, it is found that in El-Tahrir and Talaat Harb Squares ‘Traffic’ is mentioned more than ‘Car Horns’ where the opposite is found in El-Opera Square. This difference could be related to the different urban designs of the Squares where El-Tahrir and Talaat Harb are radial squares where traffic flow is easier while El Opera is a square shaped square where traffic does not flow as smooth as in a radial squares (Please refer to figures 3, 4 and 6).
- If the presence of ‘Loud people, Children and Crowds’ in El-Tahrir, Talaat Harb and El-Gomhoreya Squares is compared, it is noticed that in El-Tahrir and Talaat Harb it causes annoyance and in El-Gomhoreya it does not. This shows that the type of activity of the people present in the space affect the degree of annoyance. To make

it more clear, the types of activity in El-Tahrir and Talaat Harb would be people yelling over each other, people engaging in fights or people talking loudly so they could hear one another, while in El-Gomhoreya it would be people chatting while sitting in gardens and children running and playing.

- In El Opera Square the most mentioned sound is ‘public transportation drivers’ due to the presence of an illegal microbus stop.

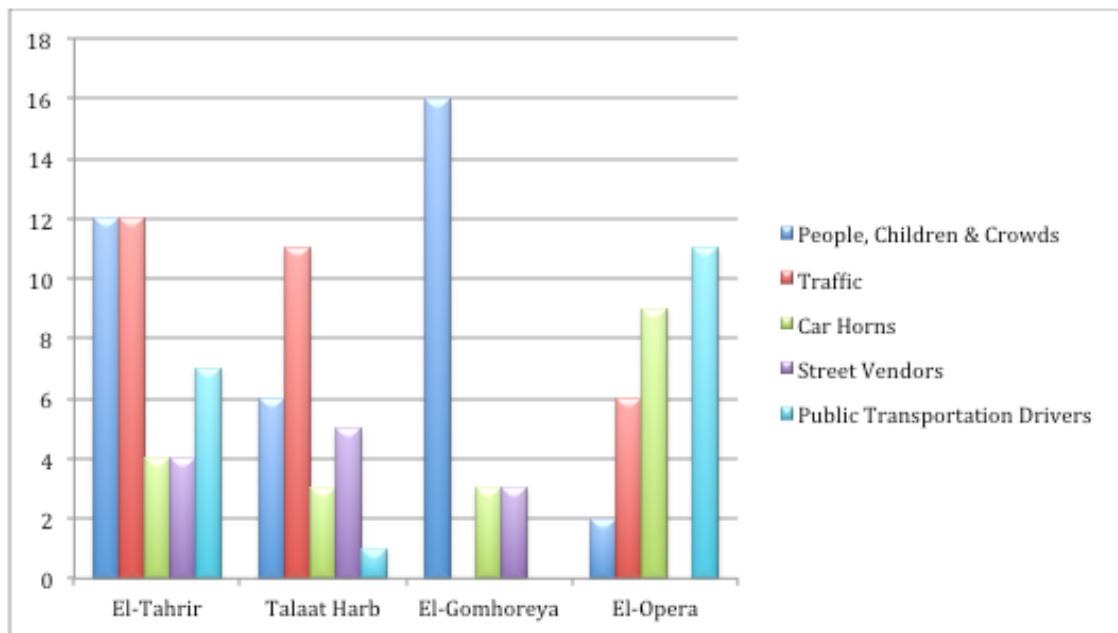


Figure 7. The specific sounds heard in each square.

Upon being asked about the sounds they like, the most mentioned sound were either natural sounds such as birds, wind and trees or religious sounds such as the call for Islamic prayer (Azan) or the sounds of people’s presence. However, some respondents did not find any sounds that they liked and responded by ‘None’, which shows that as noise levels and sound sources increase and overlap, the sounds of nature are masked and lost (Fig. 8.).

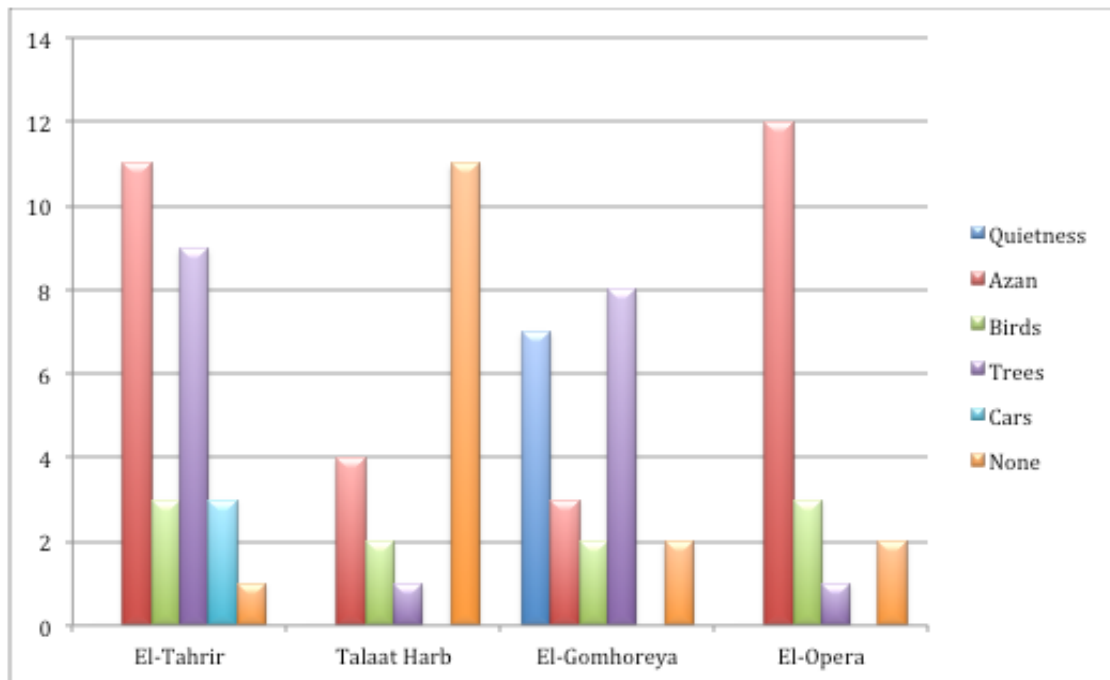


Figure 8. The liked sounds in each square.

The participants were asked about the sounds they dislike which were almost the same in all squares with minor differences (Fig. 9.). The most mentioned sounds in this exercise were employed in the second part of the assessment, which is the questionnaire design.

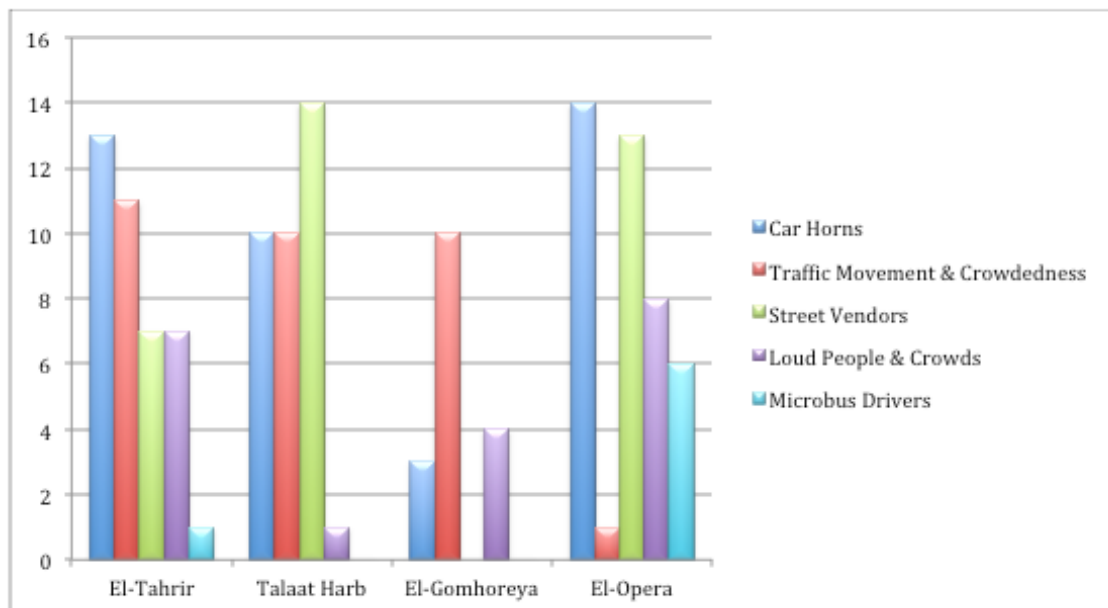


Figure 9. The disliked sounds in each square.

The results of the Soundscape exercise show the eclectic, noisy nature of the Cairene soundscape due to the presence of various overlapping sound sources with different sound levels. It is also found that the soundscapes in El Tahrir, Talaat Harb and El Opera Squares, create problems, hinder social activities and social communication and negatively affect the public health. Upon reflecting on the activities and sound sources found in each of these three squares it is found that they share similar descriptions, sound sources and activities. The soundscape in each of the three squares is described as 'Loud Noise' or 'Unbearable Loud Noise'. 'Traffic' is a dominant characteristic of the three squares with a significant rise in the sound of 'Car Horns' in El Opera Square and in 'People and Crowds' in El Tahrir Square. The most disliked sounds in the three squares are 'Car Horns', 'Traffic and Congestion' and 'Street Vendors'. El Opera Square has an exceptionally unacceptable soundscape if compared to El Tahrir and Talaat Harb Squares as participants were not able to hear each other, felt the urge to leave and would not want to go for a walk in this Square again. This result could be justified by the presence of an illegal microbus stop in El Opera Square, which causes unbearable noise and traffic congestion, the presence of a crowded vertical parking building and the rectangular shape of the Square. These results show that the most annoying sounds are either mechanical sounds of traffic and car horns or remarkably high sounds caused by crowds, street vendors or public transportation drivers.

The only acceptable soundscape was found in El Gomhoreya Square. The soundscape was described as being 'Quite and Relatively Quite' and the most dominant sounds were of 'People, Children and Crowds'. The participants enjoyed walking through this square as they felt 'Relaxed and Calm'. Upon comparing the presence of people and crowds in El Tahrir and El Gomhoreya Squares, it was found that in El Tahrir Square People's presence is annoying due to their loudness while it is calming in El Gomhoreya because people present there are enjoying their time in the gardens present in the Square. This result shows that different activities caused by people have different impacts on the soundscape generated. Moreover, the absence of traffic congestion in El Gomhoreya Square is an important feature of the Square's soundscape. Upon comparing the shape of the squares, it is found that El Gomhoreya Square and El Opera Square are both rectangular shaped squares yet both Squares have entirely different soundscapes. This difference could be traced back to the difference in traffic densities in both squares.

The participants were asked to give solutions for the soundscape problem and the most significant answers were better traffic regulation to avoid traffic congestion, enforcing laws on the use of car horns and noise generation above the acceptable limit and providing parking spaces. A significant number of participants suggested the dedication of a special place

for street vendors to stop them from wandering the streets and controlling the use of minibuses in the capital. Moreover, participants believe that awareness campaigns should be done to raise awareness about the negative effects of noise on the citizens of Cairo.

2.2. Questionnaire Study

An online questionnaire was conducted. The questionnaire was divided into four parts. The first part consists of general questions about the respondent such as age, gender and education. The second part consists of general questions about Cairo's soundscape such as the acceptability of the soundscape, the quietest and noisiest streets and squares in Cairo and the sounds they like or dislike. The third part consists of the assessment of seven annoying sounds found in Cairo's streets and squares based on the seven factors of annoyance perception discussed previously. The fourth and final part consists of questions that examine the reaction of Cairenes to Cairo's soundscape as well as giving them the opportunity to suggest solutions for the soundscape problem.

The questionnaire was answered by a reasonable number of Cairenes living in different districts in Cairo as well as in new cities outside the Capital, 48% males and 52% females. 87.5% of the respondents fall in the age range of 20-29 consequently the questionnaire will be assessing the perception of Cairo's young adults. 93% of respondents have completed or are pursuing their higher education level, which shows that they have the capabilities to understand and answer the questionnaire accurately. Moreover, 57% of the respondents are architects and architecture students who might have a fair background about urban design and soundscape. 64.9% of the respondents spend more than two hours per day on the streets and squares of Cairo, which is too much given the tight fabric of Cairo. However, the main activity carried out by the respondents is driving (42%) which justifies the long durations spent on the streets and squares since Cairo is a very crowded city with a lot of slow traffic.

When asked about the acceptability of Cairo's soundscape 80% responded that it is unacceptable which shows the poor quality of the soundscape. The respondents were asked to describe Cairo's soundscape in three words or less (Table 1), the most used words to describe Cairo's soundscape are negative words, which show the negative effect of the soundscape on Cairenes due to its poor quality and the mix of various overlapping sounds. Among the most remarkable answers were answers number 1, 2 and 3. Answer number 1 describes the soundscape as annoying and unbearable yet 'safe', which shows that an active soundscape, although intolerable, gives the inhabitants the feeling of safety. However, the Cairene soundscape is too active to the extent of becoming noisy and uncomfortable. Answer number 2 describes the soundscape as noisy and continuous yet 'remarkable', which shows that the

Cairene soundscape has a certain identity, which is a positive aspect. However, it is a negative identity as it affects its inhabitants negatively. Answer number 3 describes the soundscape as being noisy and chaotic yet ‘fun’, which shows that the diversity of sounds is exciting from the point of view of some people.

Table 1. “Describe Cairo’s soundscape in 3 words or less” Selected Answers.

Most Used Descriptive Words	Answer No.	Selected answers
Chaotic	1	Annoying, Unbearable and Safe.
Loud/Noisy	2	Noisy, Continuous and Remarkable
Irritating/Disturbing/Annoying/Uncomfortable	3	Noisy, Chaotic and Fun
Tiring/Unhealthy/Stressful/Negative	4	Noisy, Uncomfortable and Fast
Pollution	5	Noisy, Incoherent and Toxic
Provocative	6	Chaotic, Violent and Negative

Upon being asked about the liked and disliked sounds in Cairo’s streets and squares the results were similar to that of the Soundwalk exercise with minor differences and new sounds were mentioned. The results of the liked and disliked sounds are illustrated in figure 10.

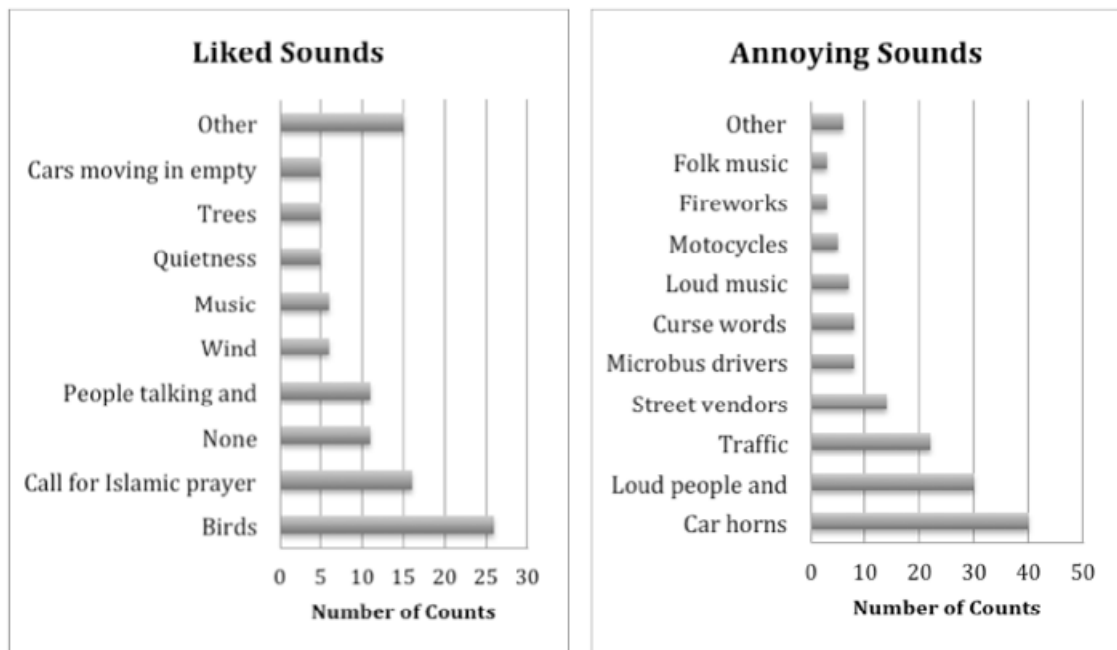


Figure 10. Liked and Annoying Sounds on Cairo’s streets and squares.

The respondents were asked to name the streets and squares that they find noisy and others that they find quite in Cairo. In the question of noisy streets and squares several streets and squares were mentioned and are illustrated in table 2.

Table 2. Noisy Streets and Squares.

Street/Square Name	District	Street Width (m)/ Square Design	Number of Lanes
Salah Salem St.	Heliopolis	40	10
Gamet El Dowal St.	Mohandeseen	60	9
El Nasr St.	Nasr City	30	6
Ramsis St.	Qasr al Nile	30	8
Sudan St.	Mohandeseen	16	4
Roxy Sq.	Heliopolis	Quadrilateral	6
Abbasya Sq.	El-Zaher	Quadrilateral	5
Ramsees Sq.	Al-Azbakeyah	Radial	2
El Galaa' Sq.	Dokki	Radial	3

According to the information in table 2, two of the four squares are radial while two take the shape of a quadrilateral. Which shows that the shape of the square might not affect the intensity of noise if the squares have high traffic densities. Most of these squares are close to 6th of October Bridge or other main vital streets. Most of the mentioned streets are large streets with high traffic density except for Sudan Street, which is only 16 meters wide however it has a high traffic density. As for the quite streets and squares, respondents mentioned certain districts and new cities far away from Cairo where most of the streets and squares are quite, districts such as Zamalek and Maadi and new cities such as New Cairo and 6th of October city. Maadi is a district located east of the River Nile. The most dominant land uses are residential, commercial and leisure. The urban planning shape is a mix between radial and grid systems. Zamalek is an island in the middle of the River Nile. The most dominant land uses are residential, commercial, leisure and Embassies. The urban planning shape is an irregular grid system. Moreover, secondary streets in general are perceived as quite streets. One of the respondents answer was "All of Cairo late at night or very early in the morning" which are the times of day when there is no or very few traffic and very few people are present on the streets and squares. Another answer was "Any street without commercial activity or pure residential zone", which shows that a mixed-use area can be a very noisy area. However, mixed-use zones are known to give a feeling of safety to inhabitants.

In part 3 of the questionnaire seven different sounds that are found in the streets and squares of Cairo were assessed based on the seven factors that affect perception of annoyance of sounds discussed previously in the introduction(Glass & Singer, 1972). The seven sounds were chosen based on the results of the Soundwalk exercise and are: Car horns, Traffic, Street vendors, Loud people and crowds, Motorbikes, Construction/Renovation works and Microbus drivers. The data will be analyzed in two different ways. First, the total number of counts of each factor will be compared to the total number of counts of the seven factors. Second, each sound will be assessed based on the number of counts it scored for each factor of annoyance.

Table 3. Number of counts for each factor compared to the total number counts.

Perception Factor	Number of Counts	Percentage of Counts (%)
Volume	215	18.34
Predictability	137	11.69
Perceived Control	169	14.42
Necessity	169	14.42
Concern	218	18.60
Perceived Health Risks	121	10.32
Satisfaction	143	12.20

According to the data in table 3 and figure 11, all seven factors contribute to the general annoyance of negative sounds occurring in Cairo's soundscape. However the highest contributing factors are 'volume' and 'concern', which might indicate a problem in the sound level control in the streets and squares and a behavioral problem as people are not concerned with the public welfare. While the lowest contributing factors are 'predictability' and 'perceived health risks' which might shows that the soundscape has been a problem for quite a long time that it became part of the city experience, Cairenes got used to it and they no longer think of it as a threat to their health or well being. Moreover, 'necessity' and 'perceived control' scored equal number of counts, which might show that respondents believe that the assessed negative sounds are unnecessary yet they do not have the ability to control them which increases the level of annoyance.

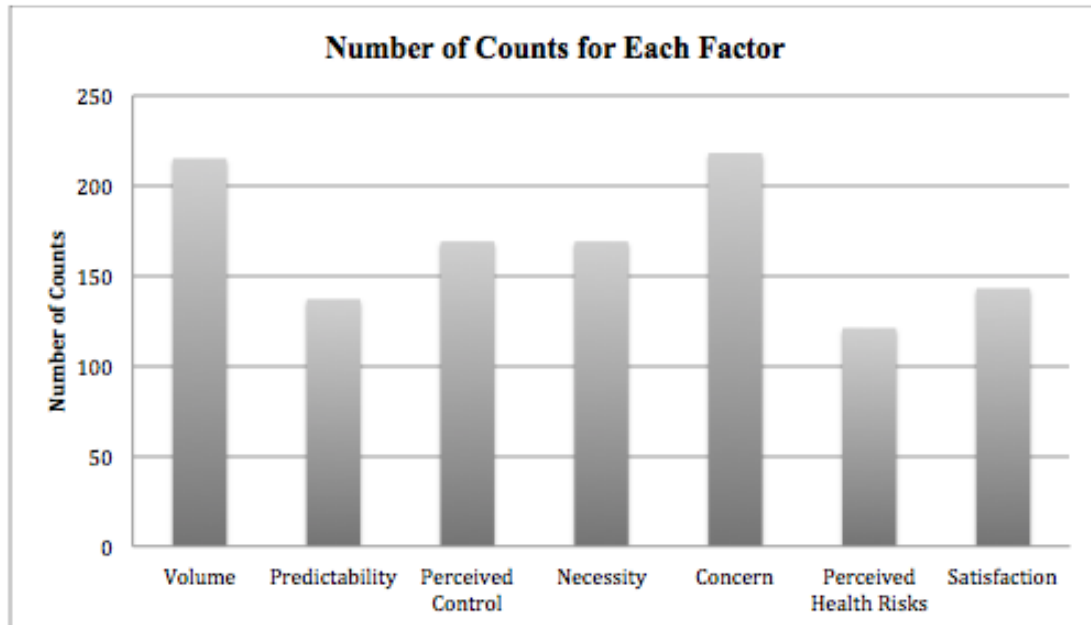


Figure 11. Number of counts for each factor.

Upon comparing the results of the scores of each annoying sound (Fig. 12.) it was noticed that some of the sounds have similar graph shapes. The graphs of 'Loud People and Crowds', 'Street Vendors' and 'Microbus Drivers' share similar topologies where there is a significant drop in the factor of 'Perceived Health Risks' and a rise in the factor of 'Concern'. The similarity between the three sounds could be related to the presence of the human factor. This might show that respondents believe that human sounds do not affect their health negatively and the main factor of annoyance is the unconcern of the individuals creating these sounds.

A noticeable similarity was found between the graphs of 'Car Horns', 'Motorbikes' and 'Microbus Drivers'. The similarity could be related to the presence of the mechanical factor in the generated sounds. The highest factors in all three sounds are 'Volume' and 'Concern', which shows the unconcern of the users of these vehicles and appliances in regards to the volume of the sound generated and the public well being. A similar drop in the score of the factors of 'Perceived Health Risks' and 'Satisfaction', which might show that respondents believe that the perceived health risks of the generated sounds are not the main cause of annoyance neither is the general satisfaction of the community. The similarity between the graphs of 'Motorbikes' and 'Microbus Drivers' is also visible in the score of the factors of 'Predictability', 'Perceived Control' and 'Necessity'. A connection could be made between the factors of 'Predictability' and 'Necessity' as respondents may believe that the sound is unpredictable due to its unnecessary. As for the factor of 'Perceived Control', respondents believe

that the sounds are annoying since they do not have the power to control them, which might show a problem in the enforcement of laws.

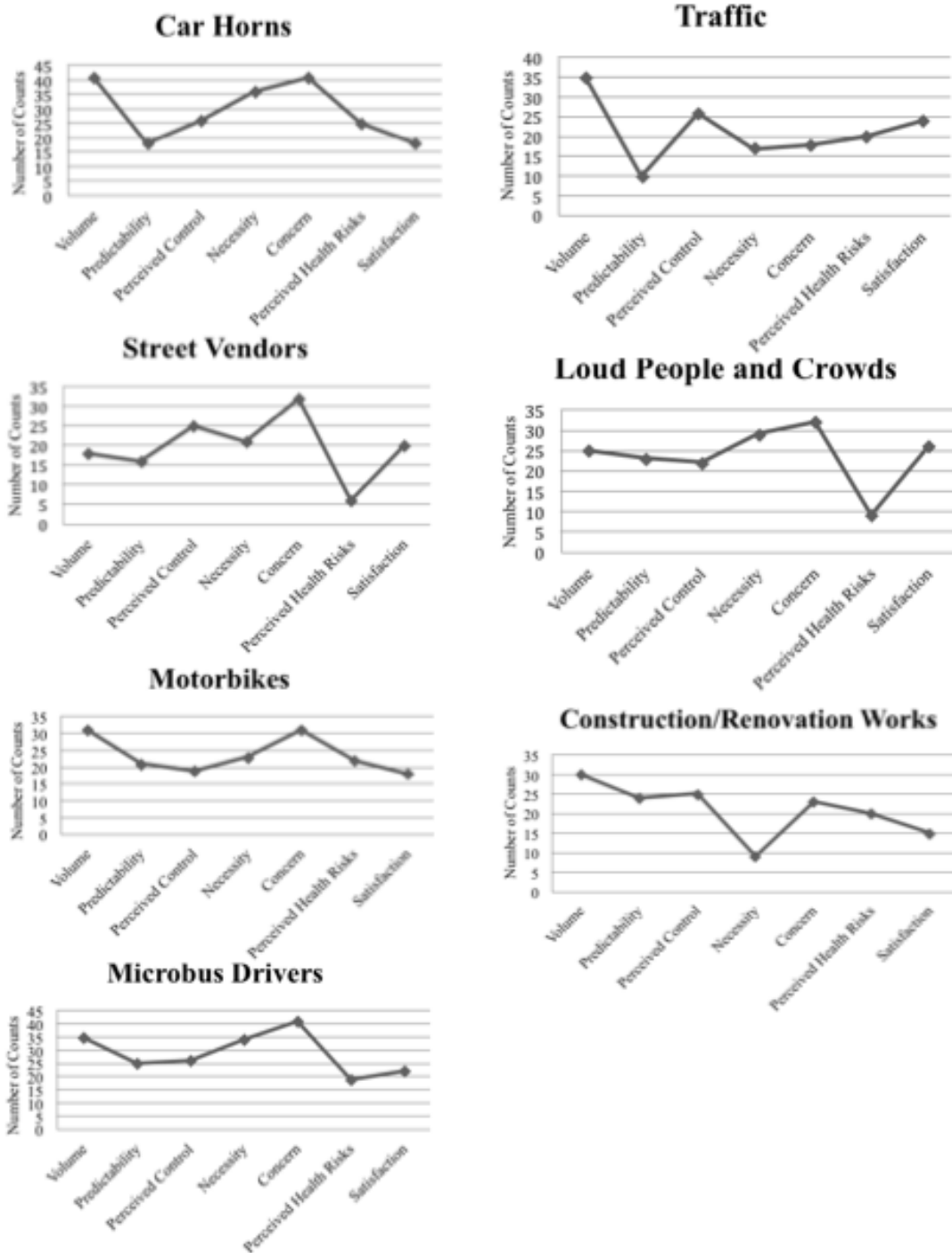


Figure 12. Comparison between the scores of the seven annoying sounds.

The results of part 4 show that 95% of respondents believe that Cairo's soundscape is a problem. 78% have thought about the soundscape problem before answering the questionnaire, which might show that the soundscape problem is noticeably affecting the lives of Cairenes. 76% believe that Cairenes are unaware of the high noise levels and the negative effects of the soundscape they are generating on their lives and the general public welfare. 50% of respondents would not go for a walk in Cairo's streets and squares while 35% would, both for various reasons illustrated in table 4.

Table 4. Reasons for going/not going for a walk in Cairo's Streets and Squares.

Yes	No
Shopping purposes.	Too polluted (Smoke, dust, garbage, bad smells).
Only in Zamalek or Compounds.	Unsafe and sexual harassment.
Got used to the Cairene Environment / There is no other place to go.	Uninviting atmosphere / Uninteresting / Not a good experience.
Late at night or very early in the morning.	Too noisy / Unbearably disturbing / Stressful.
In secondary streets.	Inadequate streetscape / No respect for pedestrians.
I like to walk.	Unpleasant sights.
Streets of Cairo are amusing.	Annoying people / Too crowded.

The reasons for walking in Cairo's streets and squares, stated in table 4, show that people would go for a walk in the streets for different reasons (shopping or enjoying the Cairene environment), during certain period of the day (late at night or very early in the morning) and in specific places (Zamalek or inside compounds / Secondary streets). Which shows that there are various restrictions on walking in the streets of the capital. Other people got used to the Cairene environment and are not bothered by it anymore while others have no option but to walk through the streets and squares. On the contrary, other respondents would never go for a walk in Cairo's streets and square due to the pollution, the social behavior of some Cairenes, the absence of adequate streetscape and the feeling of being unsafe which is a new characteristic of Cairo's streets introduced in the year 2010 after the revolution.

The respondents were asked to suggest solutions for the soundscape problem in Cairo and the results are illustrated in figure 13. The main two solutions suggested by the respondents are enforcing laws, regulations and punishment and Awareness campaigns, which shows a defect in the enforcement of laws and punishment and a lack of awareness among Cairenes regarding soundscape and its effect on human beings.

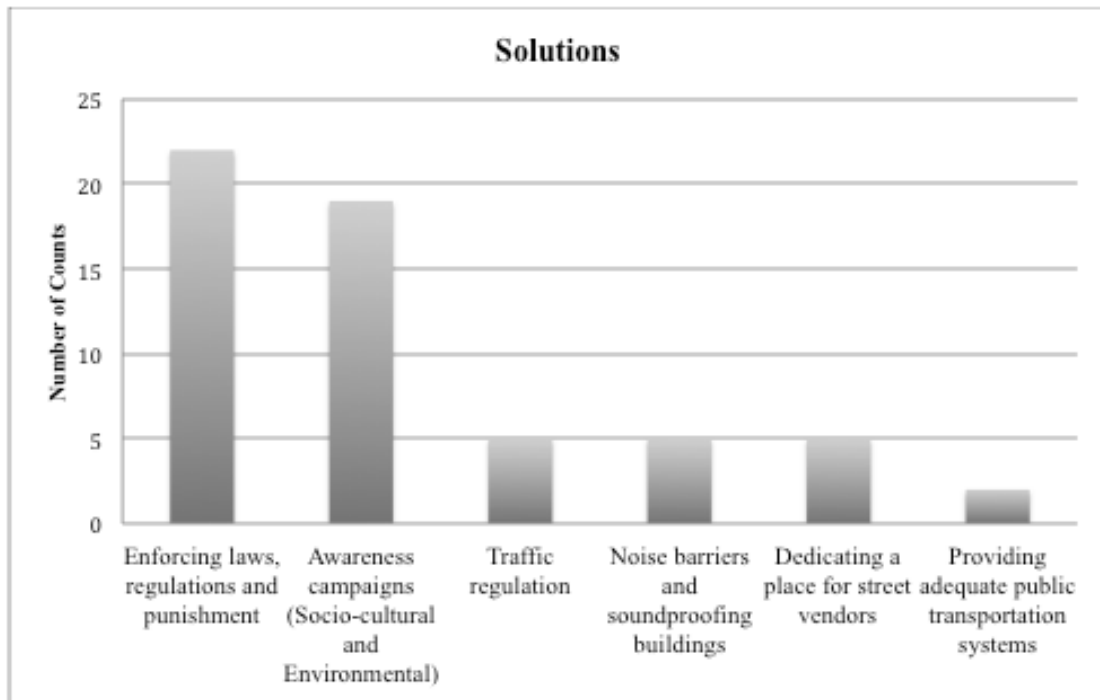


Figure 13. Solutions for the soundscape problem.

3. Conclusion

There are different factors that contribute to the soundscape problem however; the soundscape problem in Cairo is the result of other bigger problems that require solving so that the Cairene soundscape can be enhanced. According to the analysis of the case studies, the soundscape problem is a socio-cultural behavioral problem that requires active solutions and awareness campaigns that target different social levels in the community. Furthermore, a traffic problem also contributes to the soundscape problem, as traffic congestion is a significant problem in Cairo that needs to be solved. Moreover, the lack of law enforcement and governmental control on traffic and behavior of drivers in streets and squares are major contributors to the soundscape problem. Consequently solutions for the previously discussed problems are as follows:

- For the high traffic densities and congestion problem the following solutions are suggested:
 1. Better public transportation quality and connectivity.
 2. Decrease the population of Cairo through new desert settlements.
 3. Decentralization of Governmental authorities. i.e. having other branches all over the country not just in the capital.
 4. Enforcement of laws, regulations and punishment.
 5. Changing activity distribution in noisy districts such as Downtown.
 6. Respecting pedestrians by providing adequate streetscape.
- For the Socio-cultural behaviour problem awareness campaigns targeting different social levels regarding soundscape and its effect on the public welfare are suggested.
- For the poor soundscape quality the following solutions are suggested:
 7. More green urban public spaces in the city
 8. More pedestrian areas and plazas.

The perception of annoyance of urban soundscape is an essential aspect in urban soundscape design. Upon comparing the shapes of the graphs of the assessment of the seven annoying sounds using the factors that affect perception of annoyance, it was noticed that some sounds have similar shapes such as 'Loud People and Crowds' and 'Street Vendors'. This similarity might be a result of the presence of the human factor in the generated sound. Moreover, a similarity was noticed in the graphs of 'Car Horns', 'Motorbikes' and 'Microbus Drivers', which might be a result of the presence of the mechanical factor in the generated sounds. Soundscape designers in collaboration with Urban designer should focus on the factors that affect perception of annoyance of the soundscape as well as the different aspects of the sounds present in the urban soundscape such as human aspects, natural aspects and mechanical aspects of sounds. Based on the analysis, the presence of the natural aspect in the generated sounds is the most preferable while the presence of the mechanical aspect is the least preferable.

For further research it is recommended to study the urban planning and roads network of Cairo to try and find a more effective solution for the traffic problem. Furthermore, studies could be carried out on the soundscape quality inside Cairo's urban parks and gardens to investigate the acceptability of the soundscape. Moreover, comparative Soundwalk exercises could be carried out in different districts in Cairo that have different soundscape qualities and composition such as Zamalek, Maadi, Nasr City and Mohandeseen. Additionally, deeper analysis of the aspects of annoying urban sounds could be carried out to reach a mitigation technique to decrease annoyance.

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