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RESEARCH ARTICLE

Sound preferences of the dense urban environment: Soundscape of Cairo

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Acoustics;
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Abstract
A questionnaire study was conducted to investigate the soundscape preferences of the sonic environment in Cairo. Participants, who were Cairo residents, were questioned about their appraisal of familiar urban soundscapes in a close- and open-ended format questionnaire.
Psycholinguistic data analysis of verbal descriptions expressed by respondents was conducted to identify the relevance of semantic categories of environmental sounds and quantitative soundscape aspects for the urban sonic environment of Cairo. Results confirmed a direct relevance of the linguistic semantic auditory judgment and of the outputs of the quantitative close-ended questions. Cairenes were also found to express their sonic environment linguistically based on physical properties rather than semantic features and values.
Analyzing the relative annoyance increase (*RAI*) of the close-ended part, overall positive *RAI* values for all sound categories reveal how sensitive to noise Cairo residents are. Results further showed that at an *RAI* value of approximately 27%, sound category perception transforms from positive to negative.
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1. Introduction

Parallel to the random increase in population densities and the lack of adequate strategic city planning, the rethinking of urban spaces from an ecological viewpoint is necessary (Selle, 1992). Noise poses a multitude of health and safety concerns on such aspects as productivity, comfort, and functionality. Sound quality is considered a key contributor to the development and enhancement of the ecological/sustainable quality of open urban spaces (Mostafa Refat, 2013; Kang, 2006; Brown and Muhar, 2004).

The quality of our surrounding sound environment, that is, the soundscape, is largely dependent on the social circumstances and perception of listeners, which determine who gets to hear what (Schaudinischky, 1976; Thompson, 2002; Corbin, 1999; Truax, 2001; Dubois, 2000a; Gaver, 1993).

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Soundscape, also called acoustic landscape, is a combination of the physical environment, which is represented in terms of acoustical scientific characteristics of sound waves, and a social environment dimension, which is represented by human perception of sound. Soundscape occurs when one perceives the surrounding sonic environment with his/her hearing, where a sound is a basic element in the "scape" (Schafer, 1994). The human perception of sound is a subjective process that relies on cognitive processes, in which sound and noise are the determining factors (Dubois et al., 2006). Numerous studies have been conducted to assess the subjective evaluation of background noise (Berglund et al., 2001; Schulte-Fortkamp, 2002; Schultz, 1978, 1982a; Botteldooren and Verkeyn, 2002; Job, 1988). These studies evaluate soundscape elements in terms of sound levels. Conversely, considerable work was developed to assess the aural esthetic qualities that reflect listener satisfaction (Yang and Kang, 2005a, 2005b) as well as to assess individual sounds (Westerkamp, 2000). The physical effect of sound on human health has also attracted the attention of numerous researchers (Berglund et al., 1999; Schulte-Fortkamp, 2002; Schultz, 1982b), who assessed the dependence of noise and other physical health factors, particularly considering the ever-increasing community noise since the industrial revolution.

Studies related to sound preferences in urban areas are rather limited. However, related research shows that sound preferences from the perspective of listeners is affected by factors related to physical and social aspects (Southworth, 1969; Berglund et al., 2001; Sémidor, 2006). Environmental psychologists revealed that the attributes of social/cultural factors and the second group of explicit attributes of physical surroundings are related to and directly affect human perception of sound (Robert, 1997; Bell et al., 1996).

In this study, the sound preference of the inhabitants of Cairo, Egypt was systematically examined based on a series of large-scale surveys. Factors influencing inhabitant preference evaluation were also examined. Results are expected to be useful for suitable soundscape design and for enhancing sonic perception in urban public spaces. In the future, the data will be used to formulate input variables for a soundscape prediction model based on artificial neural networks (Yu and Kang, 2005a, 2005b, 2006).

2. Current noise annoyance in Greater Cairo

This study examines the noise preference of residents of Greater Cairo, the capital of Egypt and the fourth largest city in the world. Noise problems arose in Egypt in the late 1970s because of population increase stemming from internal immigration, accelerated growth, and the increasing number of vehicles, which added to the overcrowded streets (Ali and Tamura, 2001a, 2001b, 2002; Reports of Minster of Egyptian Transportation about road traffic in Greater Cairo, 2001) 996 population was estimated to be 18 million. The urban built-up areas are used as tourist centers; commercial, administrative, cultural, and educational institutions; business establishments; governmental offices; and hotels. These areas consequently create dense and mixed work patterns. The old districts in Cairo exhibit a high density of population, estimated to be approximately 150,000 persons/km^2.

In previous studies (Ali and Tamura, 2001a), the annoyance of greater Cairo populations was compared among 11 surveys,

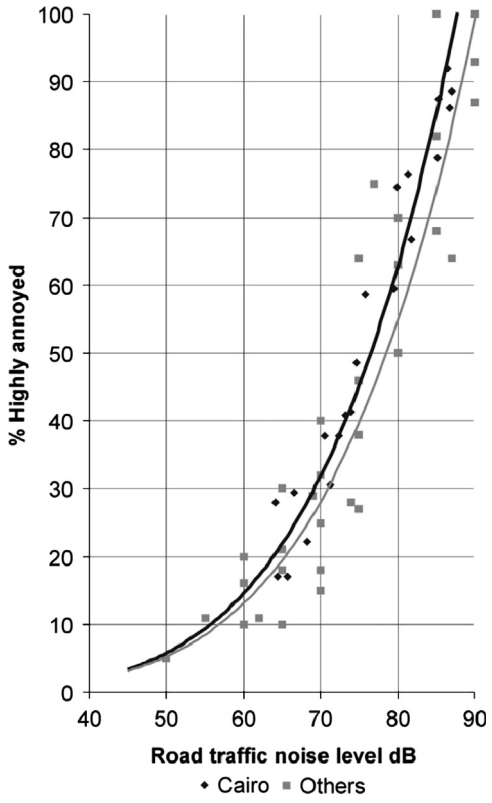

Figure 1 Comparison of annoyance in Cairo with annoyance found in other studies including the Schultz study (in London Street, Paris Street, U.S. Street, Swiss road, and others) and in Pamplona, Spain.

including London Streets, Paris Streets, U.S. Streets, Swiss Roads, and others (Schultz, 1982a; Miguel and Garcia, 1998). Annoyance in Cairo was found to be slightly higher than that in other cities. Patterns extracted from the surveys in Greater Cairo generally agree with annoyance in other surveys conducted in other cities. A strong relationship was observed between the percentage of respondents who felt "highly annoyed" and the increase in road traffic noise level, as shown in Figure 1.

Results from Figure 1 show that people living in Greater Cairo became more sensitive to nuisance than those living in any other city. A sound preference study is revealed to be important in such a dense, crowded, and highly active environment.

3. Methodology

Recent research outlines how soundscape can have an improved effect at the local level (Tjeerd et al., 2013) and how urban planners can design for health and pleasant experiences. The effect of audiovisual components merged with street urban sounds was recently examined by Jeon et al. (2013a). An experiment was conducted to investigate the effect of water features and vegetation on preferences and environmental qualities. The effect was evaluated using a numerical scale and 12 pairs of adjectives. The experiment showed that bird sound was the most preferred among the natural sounds, whereas the sound of water features

NOISE ABATEMENT QUESTIONNAIRE

Use a soft pencil in filling out questionnaire. Under "Location" give the address of the source of the noises most annoying to you, and under "Hour of Day" state the time at which these noises are noticed by you.

SOURCE OF NOISE	LOCATION	HOUR OF DAY
Loud Speakers in Home		
Automobile Horns		
Trucks—Horse-Drawn		
Trucks—Motor		
Buses—Noisy Mechanism or Tires		
Automobile Cut-Outs		
Noisy Brakes on Automobiles		
Riveting		
Pneumatic Drills on Streets		
Pneumatic Drills on Excavations		
Loud Speakers Outside of Stores		
Airplanes		
Noisy Parties		
Locomotive Whistles and Bells		
Tug and Steamship Whistles		
Elevated Trains		
Subway Trains		
Subway Turnstiles		
Street Cars		
Ash and Garbage Collections		
Newsboys' Cries		
Unmuffled Motorboats		
Traffic Whistles		
Fire Department Sirens and Trucks		
Milkmen		
Factories		
What ONE noise is MOST annoying?		

If you have suggestions to offer, write a letter and attach it to your questionnaire.

Signed .....

Address .....

NOTE: Your name and address will not be used publicly in any way or at any time.

Mail this questionnaire to: NOISE ABATEMENT COMMISSION
505 Pearl Street, New York City

TABULATION OF NOISE COMPLAINTS—March 1, 1930

SOURCE	NUMBER	PERCENT
Trucks—Motor	1,125	10.16
Automobile Horns	1,087	9.81
Radios—Homes	774	7.00
Elevated Trains	731	6.62
Radios—Street & Stores	593	5.36
Automobile Brakes	583	5.27
Ash & Garbage Collections	572	5.17
Street Cars	570	5.16
Automobile Cut-Outs	504	4.55
Fire Department Sirens and Trucks	455	4.12
Noisy Parties and Entertainments	453	4.10
Milk and Ice Deliveries	451	4.07
Riveting	373	3.37
Subway Turnstiles	317	2.86
Buses	271	2.45
Trucks—Horse Drawn	268	2.41
Locomotive Whistles and Bells	238	2.15
Pneumatic Drills—Excavations	233	2.11
Tug and Steamship Whistles	223	2.01
Pneumatic Drills—Streets	213	1.93
Newsboys and Peddlers	212	1.91
Subway Trains	183	1.65
Dogs and Cats	140	1.26
Traffic Whistles	137	1.24
Factories	117	1.06
Airplanes	113	1.02
Motor Boats	66	0.59
Motorcycles	41	0.37
Restaurant Dishwashing	25	0.22
	11,068	100.00

CLASSIFICATION

SOURCE	NUMBER	PERCENT
TRAFFIC (Trucks, Automobile Horns, Cut-Outs, Brakes, Buses, Traffic Whistles, Motorcycles)	4,016	36.28
TRANSPORTATION (Elevated, Street Cars, Subway)	1,801	16.29
RADIOS (Homes, Streets & Stores)	1,367	12.34
COLLECTIONS & DELIVERIES (Ash, Garbage, Milk, Ice)	1,023	9.25
WHISTLES & BELLS (Fire Dept., Locomotives & Tugs & Steamships)	916	8.28
CONSTRUCTION (Riveting, Pneumatic Drills)	819	7.40
VOCAL, ETC. (Newsboys, Peddlers, Dogs, Cats, Noisy Parties)	805	7.27
OTHERS	321	2.89
	11,068	100.00

Figure 2 Questionnaire distributed in 1930 via the metropolitan newspaper.

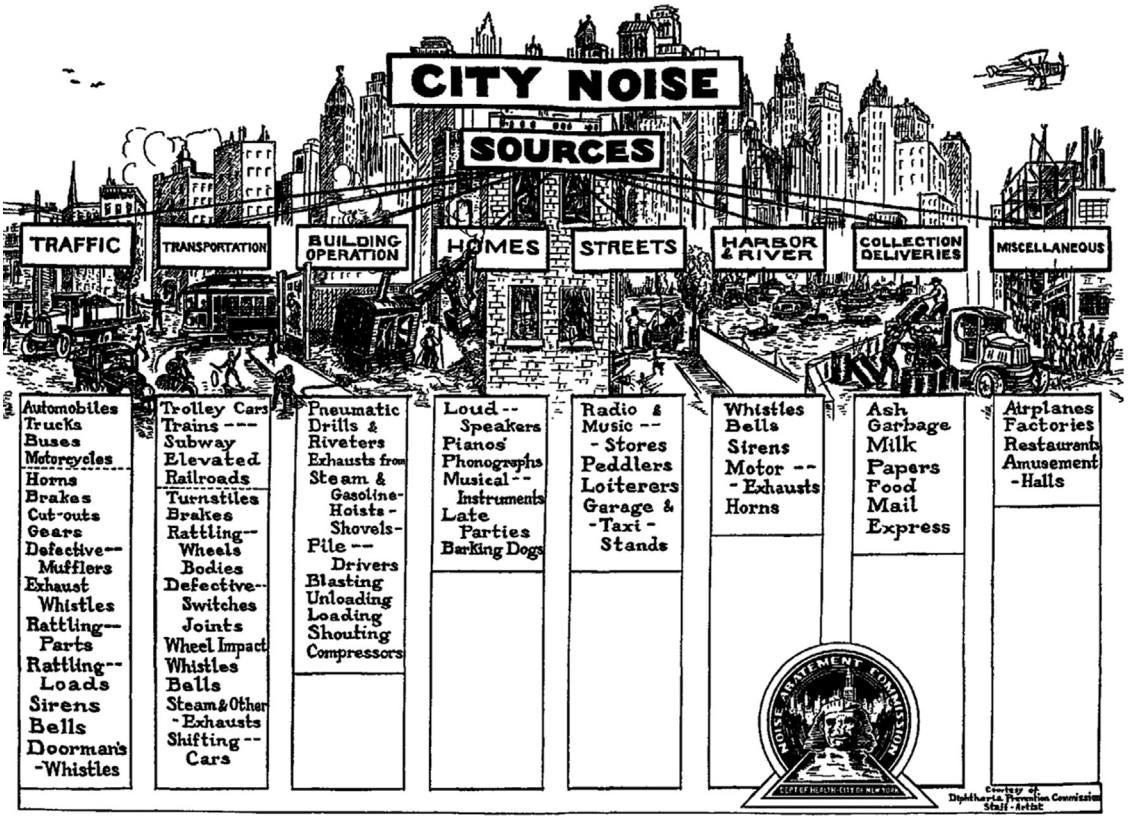

Figure 3 Edward Brown et al., Soundscape of the modern city, New York Department of Health 1930.

was found to degrade the soundscape quality. A soundwalk procedure (Jeon et al., 2013a, 2013b) was conducted on a group of 30 [15 architects and 15 acousticians] participants. Results revealed that soundscape perceptions and preference were dominated by openness, visual images, and acoustic comfort.

Soundscape research started early. In 1930, the Noise Abatement Commission of New York made clear that the soundscape of the city is no longer dominated by sounds of animals and humans but by noise from new modern technology sources (Brown et al. (1930)). Edward Brown et al. conducted a noise survey in 1930. This survey was distributed via the metropolitan newspaper. Responses submitted by readers confirmed that the vast majority of noises that plagued New Yorkers were caused by modern technological inventions. The survey results are shown in Figure 2.

Edward Brown et al. (1930) categorized city noise sources according to the presence and location of the noise source, as well as activity performed. Thus, the categories came in the form of traffic, transportation, building operation, homes, streets, harbor and river, collection and deliveries, as well as miscellaneous sources. In 1930, Brown presented in his work a pictorial presentation of noise sources, as shown in Figure 3.

In 1977, Murray Schafer (1994) introduced a card catalog of noise sources presented through a framework in which information was gathered about past soundscapes through ear witness accounts by some volunteers. Schafer then constructed an extended card catalog that describes the soundscape in terms of literary, anthropological, and historical aspects. This categorization is shown in Table 1.

Table 1 A rough structure of Schafer's catalog of classification of sounds according to referential aspects.

Natural sounds	Sounds of water	Oceans, seas and lakes
		Rain
		Rivers and brooks
		Steam
		Ice and snow
	Sounds of air	Wind
	Sounds of earth	Trees
	Sounds of birds	Sparrow
	Sounds of insects	Flies
	Sounds of seasons	Spring
Human sounds	Sounds of voices, body	Speaking
Sounds and societies	Town, urban, factories, domestic sounds, parks	-
Mechanical sounds	Machine, aircraft, constructions	-
Silence and quiet	-	-
Sound as indicators	Bell, horns, telephones	

In addition to its physical characteristics, noise may also be classified in several other ways, which leads us to reflect on some perceptual relations and gives rise to several questions. Why do people feel more annoyed when they hear the ringing of a telephone compared with the sound of a flute at the same volume and frequency spectrum? Why do people feel calm and relaxed when they hear the sound of birds in comparison with the sound of a siren with similar physical properties? Why do people appreciate sea sound more than mechanical noise even while they have similar physical properties?

These questions outline the considerable importance of the semantic properties of sound. These properties refer to the function of sound and its meaning and impact. These sounds are translated through channels of perceptual awareness accumulated by people over years of experience. In considering the various opinions and feelings held by different individuals toward similar sounds, classifying sounds according to esthetic qualities is essential.

Human perception of sounds can be easily affected by their personal experiences, working environments, and regional background. Thus, giving a definite suggestion on the esthetic classification of soundscapes is difficult. Although the study of this problem is considered to be too subjective to yield meaningful results, evaluating the effect of this problem on local inhabitants in various regions is necessary in this case. However, the present study is mainly focused on people living in Cairo, which is considered one of the noisiest and most overcrowded capitals worldwide.

The formulation of the questionnaires implemented in this study is adapted to this situation. Most questionnaires are closed on a number of specific known adjectives, which makes the differences difficult to assess.

Open-ended questionnaires were used in the psycholinguistic approach developed by the French National Railways Company. Such questionnaires were developed to address subjective appreciation. Results were then based on an analysis of words and free comments made by travelers (Mzali et al., 2000).

Verbal description analysis was conducted by Catherine Guastavino (2006). The work included a psycholinguistic analysis to identify semantic categories of environmental sounds and relevant sound quality criteria for urban soundscapes. The analysis of the open-ended questionnaire revealed the salience of human sounds interpreted as indicators of human activities and are therefore meaningful constituents of urban soundscapes. Thus, the questionnaire used in this study will constitute two parts: a close-ended question part and an open-ended question part.

3.1. Questionnaire construction and analysis

Cairene residents who participated in the study cover a multitude of professionals with different experiences. As directly approaching the people involved is not a requirement, the questionnaires are administered online.

Questionnaires were completed anonymously and comprised two parts. The first part with closed questions intended to identify the population and preferences for Cairo urban noises as well as to assess the global sonic environmental comfort.

The participants approached with the questionnaire were from a range of social groups in terms of age, gender, occupation, educational level, and residential status (local or non-local with living experience in Cairo). A database was consequently established, with social attribute variables, including age ranges (1:18 to 24, 2:25 to 34, 3:35 to 44, 4:45 to 54, 5:55 to 64, and 6:65+), gender (*male and female*), education (1, *school;* 2, *under graduate;* 3, *post-graduate;* 4, *Master's;* and 5, *Ph.D.*), place of residence (1, *on a main busy road* and 2, *inside a calm residential neighborhood*), living on which floor (1:0 to 2, 2:3 to 5, 3:6 to 8, 4:9 to 11, and 5, *above* 11), and living in which Cairo district (*category according to district names*). A summary of the database is shown in Table 2.

In the first close-ended part, the participants were invited to select the factors or criteria that, in their opinion, needed particular improvement or are mostly causing nuisance. The noise sources are divided according to the categorization of city noise sources by Edward Browns et al. (1930). The various noise sources examined in the questionnaire are listed in Table 3.

Table 2 Information of data variables collected.

Factors	Classification and scale
Age	(1) 18-24; (2) 25-34; (3) 35-44; (4) 45-54; (5) 55-64; (6) 65+
Gender	(1) Male (2) Female
Education Level	(1) School; (2) Under graduate; (3) Graduate; (4) Postgraduate; (5) Master; (6) Ph.D.
Years living in Cairo	(1) 0-5; (2) 6-10; (3) 11-15; (4) above 15
Living where	(1) On a main busy road; (2) Inside a calm residential neighborhood
Living on which floor	(1) 0-2; (2) 3-5; (3) 6-8; (4) 9-11; (5) above 11
Living in which Cairo district	Category according to district names

Noise sources are classified under six main categories according to the nature, type, and activity. The six categories are people, nature, traffic, transportation, collective deliveries, and construction sites.

The subjective loudness of the noise activity is also examined. The questions are laid out such that the participant can discriminate whether the type of noise is acceptable at both low and high intensities, at low intensities only, or of both scenarios are unacceptable. Thus, some sounds can be acceptable if the level is low. In some cases where the type of sound is semantically perceived, sounds can be acceptable at both high and low levels. The selection process is shown in Figure 4.

According to the above criteria, the participants were asked to select their choices based on their experience and perception of different noises categorized in the first part of the questionnaire. Results are expected to reflect the opinion of Cairo residents about their own soundscape based on their perception and on the effect of the local sonic environment.

The second part of the questionnaire addressed acoustic comfort and adopts open-ended questions (i.e., to be answered with a written sentence or short statement). The participants were invited to express their opinion on the preferable nature of their sonic environment and origin

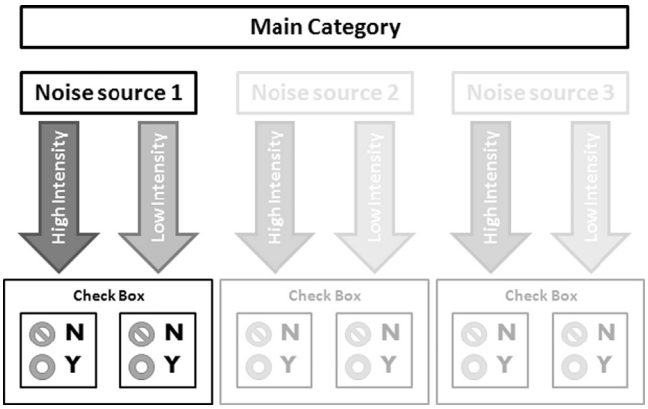

Figure 4 Decision flow in the closed ended question of the questionnaire.

Table 3 Types of noise sources tested in the questionnaire.

Cairo urban noise classification					
People	Nature	Traffic	Transportation	Collective deliveries	Construction sites
Voices	Wind	Automobiles	Airplanes	Garbage	Pneumatic drills
Children	Water	Trucks	Trains	Food	
Footsteps	Natural	Buses	Subways	Mail	Mechanical operations
Human sounds	Elements	Motorcycles	Elevated bridges		
Neighbors	Rain	Horns			Shouting
Pedestrians	Parks	Brakes			Compressors
Cellular phones	Birds				
Angry people					
Market					
Cafe					

of perceived noises, as well as to enumerate the most uncomfortable noise sources. The following questions were asked:

What would be the ideal urban soundscape from your point of view?
What do you find pleasant/unpleasant in your urban sonic environment?
In your urban environment, are there high-pitched [treble]/low-pitched [bass] sounds? If so, describe these sounds.
Do you perceive background noise in urban environments? If so, under which circumstances? How would you describe such noise?
In urban areas, are you sensitive to transportation noise? Describe the characteristics of such noise.
How would you describe the future of Cairo's soundscape? Describe the characteristics of this soundscape.

Two lines for free comment were provided for the participants to express acoustic comfort and discomfort issues linguistically. A psycholinguistic analysis of spontaneous verbal descriptions was conducted to identify semantic categories of environmental sounds and relevant sound quality criteria for urban soundscapes.

The questionnaire was hosted by a survey engine over the internet and distributed through social networks. A large number of responses were collected and analyzed.

4. Results

4.1. First part: Close-ended questions

The statistical analysis of participants is shown in Table 4.

The sample of participants is in the middle age groups, and more than 70% of the sample is between 18 and 34 years old, which indicate that the respondents possess sufficient intellectuality and maturity to judge and rarely suffer from any hearing losses that can affect the study. The participant sample is equally distributed between males and females. Moreover, 100% of the people answering the questions are educated, which enables them to understand, analyze, and judge their surrounding sound environment. The districts in which more than 70.36% of the participants live are located on the east banks of the Nile River, which runs through the middle of Cairo. The east part houses the main Cairo airport and thus has higher densities of air traffic volumes, such that people can judge aircraft noise.

The following question was asked about the various noise sources listed in Table 3.

Please indicate whether you perceive the following sounds if heard in your environment:
If sound is loud positive or negative
If sound is barely audible positive or negative

The questionnaire results are shown in Figures 5–10 for all the six sound groups.

For loud categories, most sound groups were perceived as negative, except for sounds associated with nature. This result shows that all artificially generated sounds are not preferred by Cairo residents. An important finding is that sounds associated with human stimulations or those that facilitate the recall of visual interaction and allocation of position had a positive preference when barely audible at low sound intensities. Groups of sounds generated by people, nature, transportation, and collectives and deliveries show that people in Cairo tend to feel safer when such types of sounds can be heard and allocated without annoyance. The reason for this effect is either to allocate nearby human activities or to detect patterns of transportation and early arrival of deliveries, which is part of the Egyptian semantics and character.

Table 4 Population classification of the persons having filled in the questionnaire files according to criteria.

Factors	Classification and scale	Percentage (%)
Age	(1) 18-24;	48.89
	(2) 25-34;	20.74
	(3) 35-44;	14.81
	(4) 45-54;	6.67
	(5) 55-64;	6.67
	(6) 65+	2.22
Gender	(1) Male	52.59
	(2) Female	47.41
Education level	(1) School;	0.00
	(2) Under graduate;	38.52
	(3) Graduate;	11.11
	(4) Postgraduate;	14.81
	(5) Master;	11.85
	(6) Ph.D.	23.70
Years living in Cairo	(1) 0-5;	10.37
	(2) 6-10;	8.15
	(3) 11-15;	1.48
	(4) above 15	80.00
Living where	(1) On a main busy road;	41.48
	(2) Inside a calm residential neighborhood	58.52
Living on which floor	(1) 0-2;	39.26
	(2) 3-5;	42.22
	(3) 6-8;	13.33
	(4) 9-11;	2.96
	(5) above 11	2.22
District		Percentage of people living
Nasr City, Heliopolis		44.44
New Urban Developments [i.e. New Cairo, 6 of October, El Sherouk, etc.]		17.04
Mohandeseen, Dokki		8.15
West Elbalad		4.44
Maadi		5.18
Shoubra		2.96
Ain Shams AlSharqia (Gesr El Sues)		2.22
Mokattam		1.48
Other districts		14.06

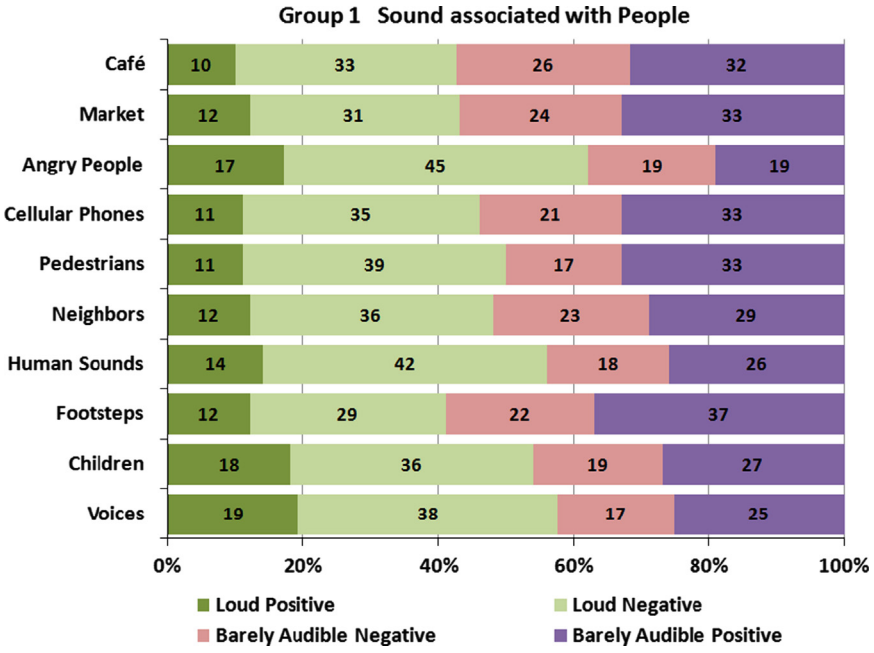

Figure 5 Questionnaire results for sound associated with peoples.

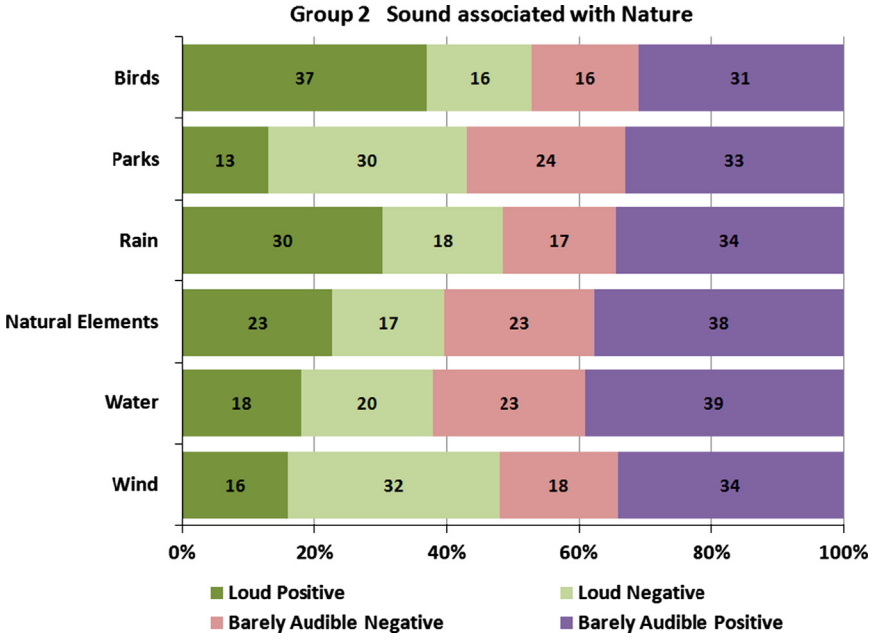

Figure 6 Questionnaire results for sound associated with nature.

The goal behind examining the effect of the noise level on the perception of Cairo residents is to assess to which extent the desirable sound is transformed to noise (undesirable sound), and vice versa. This assessment will reveal some important characteristics of various sounds within the sonic environment of Cairo and consequently reflect the perception of local people.

Figure 11 shows the relative annoyance increase (*RAI*). The *RAI* represents the percentage increase of annoyed people with increasing intensity, normalized to the percentage of people annoyed by the same sound when barely audible.

The overall positive *RAI* indicates the sensitivity of Cairo residents, as shown in Figure 1, where the percentage of highly annoyed people in Cairo is always greater than that in other cities. Thus, a higher percentage of people perceive higher sound intensities as a negative response, even for sounds for which barely audible intensity was regarded as positive.

Figure 12 shows the *RAI* in increasing order for all types of urban sounds. The figure on top indicates sounds that had a positive effect on Cairo residents. These sounds are clearly stimulated by natural elements, such as rain, birds, and so on.

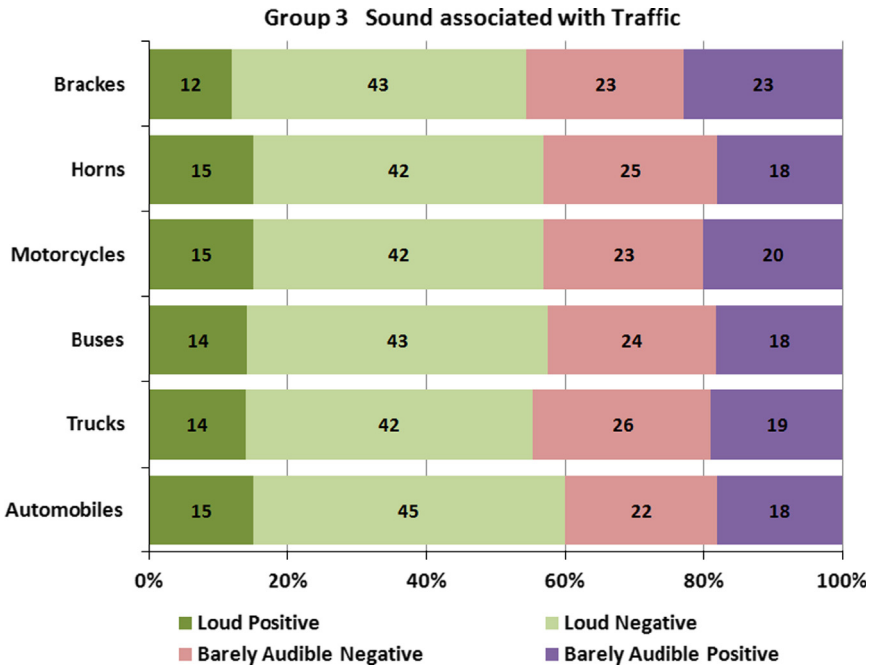

Figure 7 Questionnaire results for sound associated with traffic.

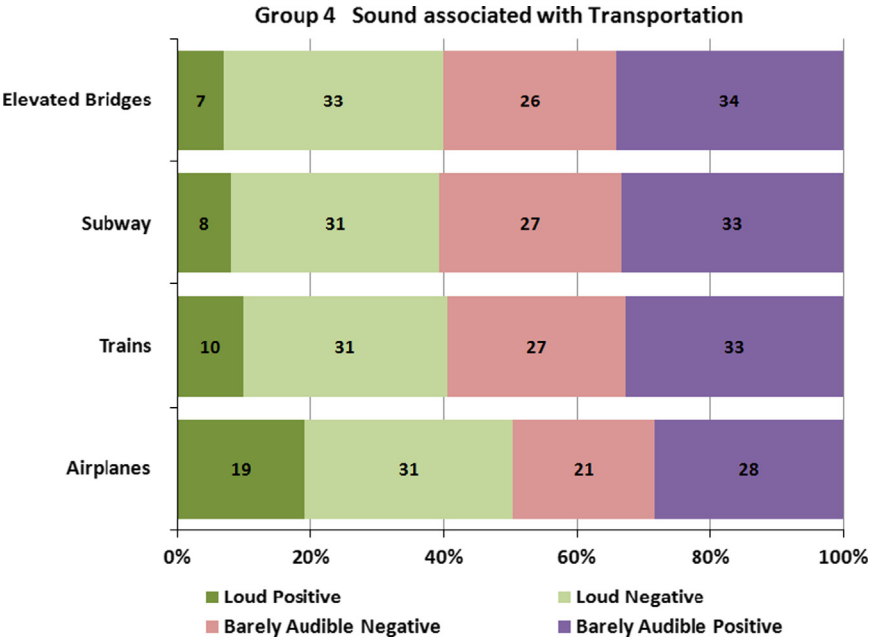

Figure 8 Questionnaire results for sound associated with transportation.

Based on the analysis, Cairenes perceive nature sounds as friendly and in rhythmic harmony. Higher values of the *RAI* can be found for sound sources with a barely audible positive perception, which is in accordance with the changing nature of perception or the switching from positive to negative perception. The trend line in the figure on the bottom shows that an *RAI* of approximately 27% and higher, which represents a perception change from positive to negative. This assumption depends on the number of samples analyzed and the accuracy of the questionnaire data. Thus, further work is needed to justify this finding.

4.2. Second part: Open-ended psycholinguistic analysis

In this part, the participant responses to the open-ended questions are analyzed in terms of the linguistic representation of the soundscape of Cairo residents. Mental representations of urban soundscapes cannot be easily analyzed quantitatively. One way to study these aspects is through analyzing verbal reports, which enables the assessment of how people express their sensory experiences. However, the lack of basic lexicalized terms, particularly for non-native

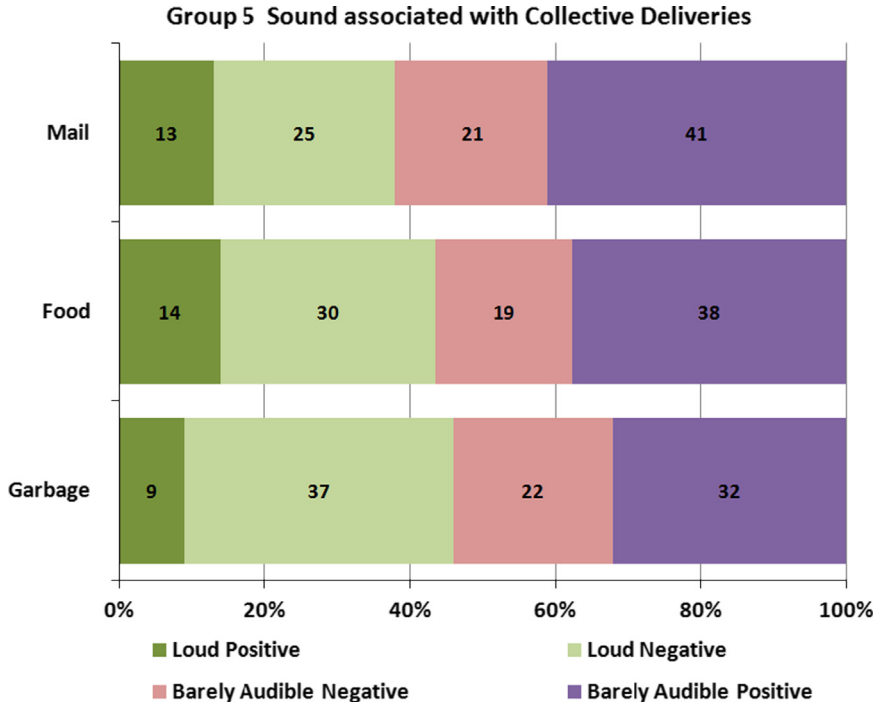

Figure 9 Questionnaire results for sound associated with collective deliveries.

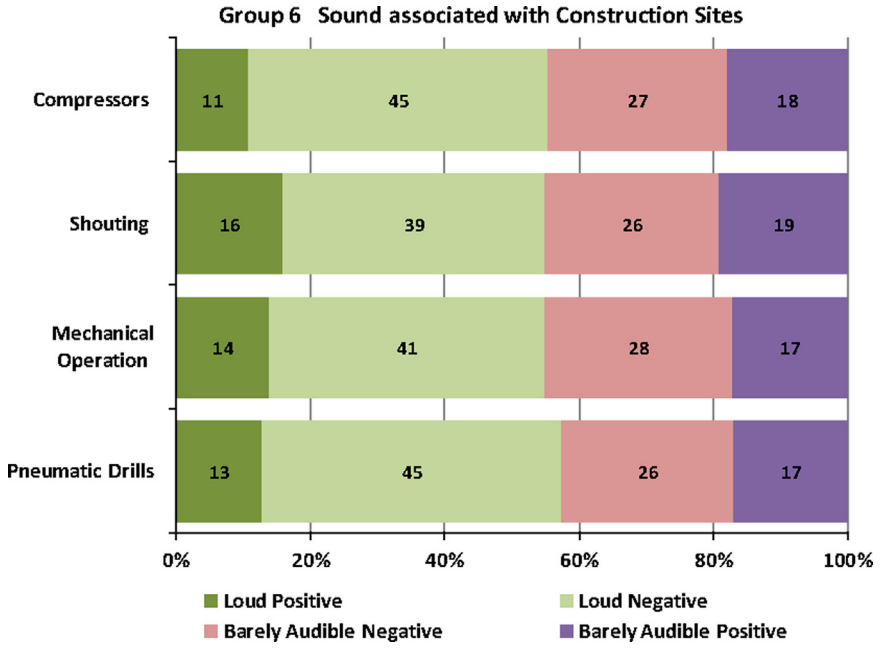

Figure 10 Questionnaire results for sound associated with construction sites.

English speakers, and a priori established categories for acoustic phenomena, leaves the relationship between cognitive representations and linguistic expressions unclear. Thus, language descriptors are agreed to be a spontaneous descriptor of sound and noises (Dubois, 2000b). An objective linguistic analysis of complex words and statements, rather than a mere lexical analysis of isolated words, will be employed by the author to identify positive and negative effects as well as to identify whether linguistic statements in open-ended questions are in accordance with quantitative close-ended question part of the questionnaire.

The most outstanding responses will be categorized in terms of source and soundscape-related answers. Some of the answers are shown in Table 5.

The ideal soundscape was primarily described in terms of technical solutions, based on people's knowledge, such as sound-proof structures, noise-oriented planning, or moving away to quieter outskirts. This result reflects the Cairene

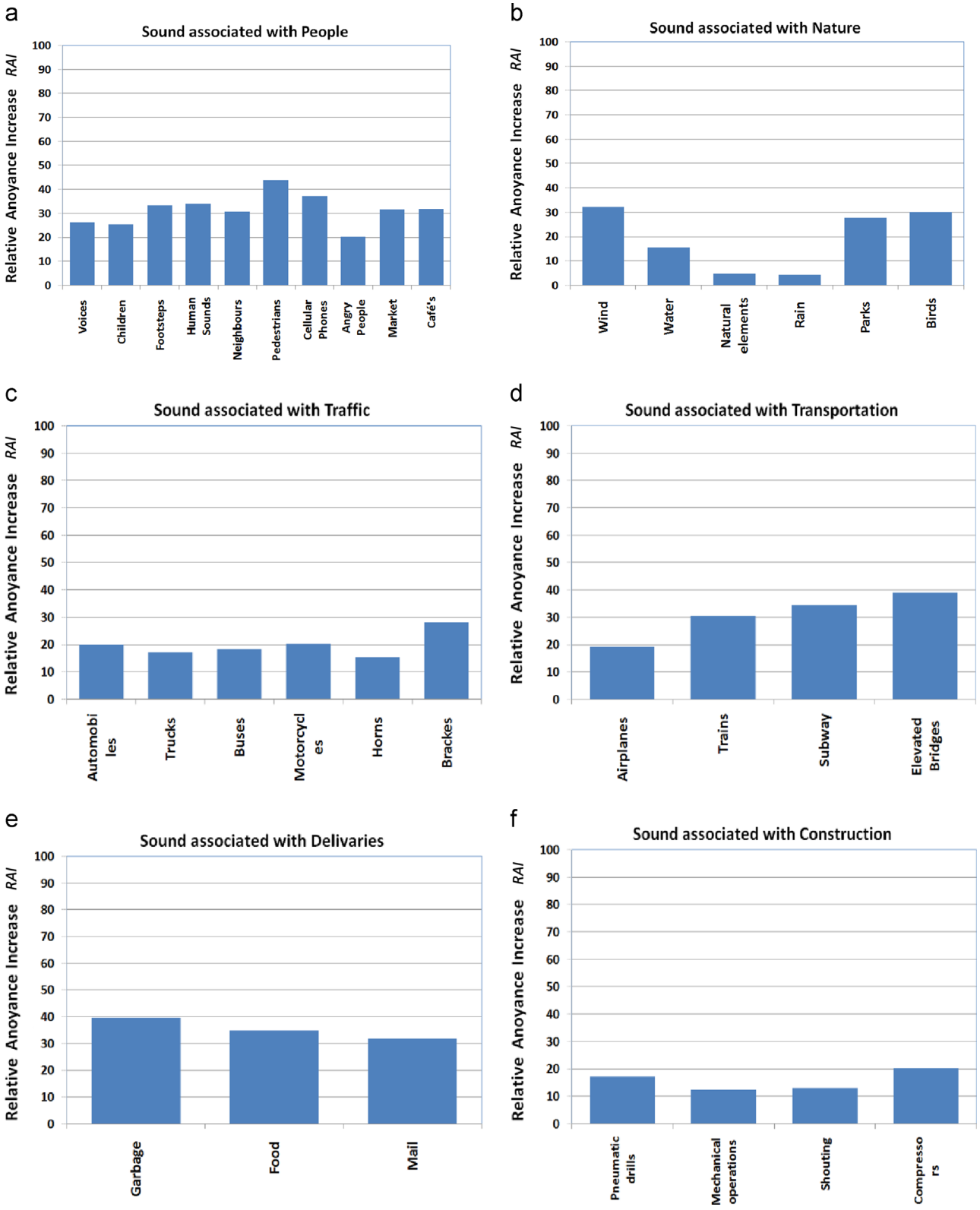

Figure 11 Relative annoyance increase for various sound sources.

awareness of the acts and remedies that should be considered to mitigate high noise levels in the great capital. The representation is rather based on perceptual abstracts than on the semantic properties of sounds. The most common linguistic devices in the transportation category were denominations of the sources ("cars, motorcycles, and horns"), nominal groups constructed on sources ("sound of a car"), or the generic term "traffic" ("traffic noise"). Source descriptor lexicalized terms

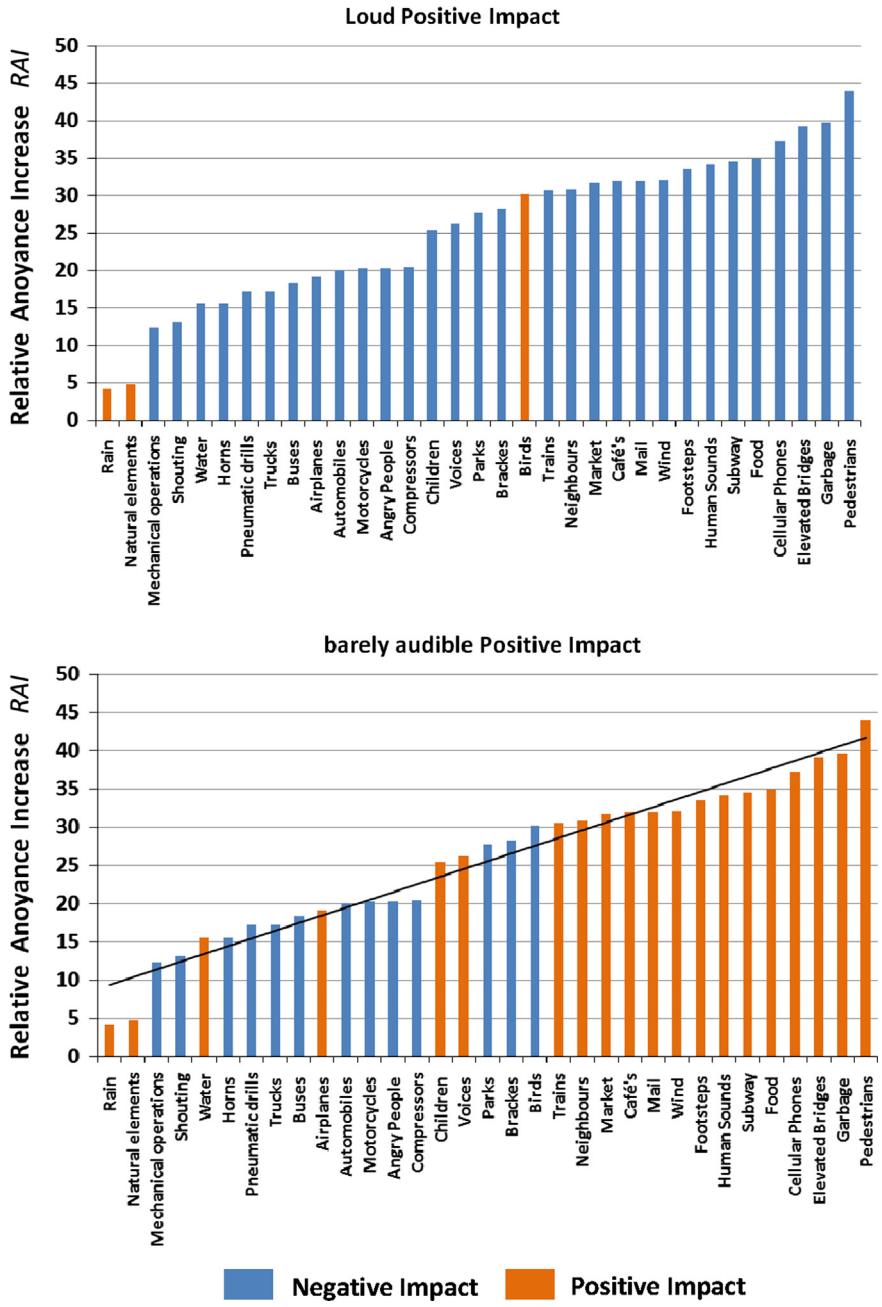

Figure 12 The examined sound in increasing *RAI* order, in terms of positive impact for loud and barely audible intensities.

were used to describe human sounds ("voices" and "children playing"); this source confirms the lack of basic terms for expressing environmental sounds.

In the appraisal process of sound sources from the participant answers, linguistic expression was analyzed by considering enunciation and syntactic devices and not directly inferred from an intrinsic value of lexical items, such as when a negative construction was used ("without cars" or "less traffic").

People do perceive background noise and can characterize the noise content and components. However, most responses are related to the contextual aspects or soundscape, such as when participants get accustomed to the continuing rhythm of background noise. Some people can ignore this soundscape. Negative judgments concerning the sources were inferred using descriptors of negative impact, such as the use of "*pressing the horn in your ear*" as an expression of a high volume of undesirable sound. Similarly, the use of positive terms of phrases was interpreted as pleasantness and positive judgments.

Agreement was found between negative and positive responses in the linguistic expressions of the open- and close-ended parts of the questionnaire, which supports the accuracy of participant responses in part one.

5. Conclusions

The analysis of the first close-ended questionnaire revealed that sources related to natural elements and not artificially generated are given a positive effect score by Cairo residents.

Table 5 Selected answers of the open ended questions categorized in terms of source and soundscape related.

Source related	Soundscape related
What would be the ideal Urban Sound-scape from your point of view?	
• *Greenery, sound of birds, sea*	• *Barely audible (positive) traffic noises , with environmental masking of trees or water elements*
• *Soft wind, rustling of leaves, occasionally car passing by Generally quiet*	• *We must take a leave from Cairo to decrease the noise background. Any industrial areas in the city must be moved to a far place from the citizens.*
• *The Sound of Nature , or Birds , or even The Sound of Wave Silence*	• *The one in which no external (street) noise is interfering with the internal "calm" environment*
• *The sound of nature and natural elements, such as birds and rain*	• *Sound proof structure*
• *NO use of car horns except if seriously needed*	• *Maybe designing areas for cafes and markets in randomly planned districts. and areas for workshops away from residential areas*
• *Natural sounds*	
• *Any sound created from nature only with the odd whisper sound from people*	
What do you find pleasant/unpleasant in your urban sonic environment	
• *Birds is pleasant Traffic is the unpleasant especially with horns used all the time*	• *Pleasant: as it is a calm neighborhood unpleasant: because there is a school so the cars sound is barely heard but negatively, also there is an orphanage which sometimes makes like celebrations and the sound is loud*
• *Garden is pleasant traffic, and car noise unpleasant garden is pleasant neighbors noise unpleasant Pleasant: Music and Rain Unpleasant: Traffic sound (including: trucks, and motorcycles)*	• *Unpleasant is that um on the 8th floor and still I hear every single sound in the streets as if I am down in them.*
• *Pleasant: it is that it is vivid sonic environment during the day unpleasant: it is noisy in the evening (cafes, traffic)*	• *Pleasant: Quietness and calm environment Unpleasant: Much Background noise*
In your urban environment, are there high-pitched [treble]/low-pitched [bass] sounds? If so, describe them	
• *High pitched, are cars, and people shouting and fighting in the street low pitched are pedestrians, and birds, and animals (cats and dogs)*	• *High pitched- calling for prayer, sometimes too high*
• *Treble is the sound of car horns and the bass is the sound of construction drilling sites*	• *Not exactly but some brakes breaks the environment and also some events like (marriage festivals) and (Moral events) that are been held in street*
Do you perceive background noise in urban environments? If so, under which circumstances? How would you describe it?	
• *Yes, the noise of cars, motorcycles and pedestrians on the street*	• *Yes, I receive. From a generator beside my building, but i think this is individual case*
• *Windy climate, lately! Maybe because we are in winter and sometimes the weather changes suddenly. It's too scary. but not as bad as the traffic sound*	• *Coming from the main busy road leading to outside Cairo cities such as Al Oubour. It is very loudly in negative sense*
• *Yes, I perceive background noise from some construction sites which are close to me. Their drilling machines noise and mechanical instruments cause this noise.*	• *Unfortunately, I have grown accustomed to background noise that simply I ignore it*
• *It is a mix of traffic noise, car horns and children shouting.*	• *Yes. When I travel to North cost or Ain soukhna (complete quietness) I got ear ach. It seems that we get used to the background noise.*
In urban areas, are you sensitive to transportation noise? Describe its characteristics?	
• *Motorcycles is very noisy specifically when the motorcycle starts to move*	• *Sleepless nights are my major problem. I cannot sleep in the afternoon after working, because of the noises outside. I became anxiously irritated lately.*
• *Yes. It feels like they are in your and pressing the horn in your ear.*	• *Yes. Since I am near the airport runway, the plane noise is very high (unpleasant)*
• *Yes the planes are disturbing*	• *Yes, it is the persistence of the drivers to rush, shout, block the traffic increases stress and lack of comfort even inside the living space*
How would you describe the future of Cairo's Soundscape? Describe its characteristics?	
• *By the number of vehicles increasing every day, and with the Egyptian people constructing more buildings in already crowded places. Noises are going to kill people very soon. Unbelievable!!*	• *With more expected crowds and less efficient solution I expect in the future the sound scape is going to be worse.*
• *It will remain very noisy as long as there are traffic jams and the excessive use of horns*	• *I assume it will become louder especially main roads and bustling zones of the cities, however, pure residential areas without any commercial activities will remain as is!*
• *Horns are terrible people need to stop using their car horn*	• *The future is not good. It is noisy. The airport should be moved to a distant place and drivers should learn not to use sirens.*
	• *Will continue to be noisy regardless of laws, it is a culture of decades.*
	• *I think new cities has more chance in urban planning of sounds and proper distribution of industrial workshops , cafes and busy roads from residential places unlike randomly planned districts*

This positive scoring is generally observed for sounds at low intensity and for selected natural sounds at high intensity, such as rain, birds, and other natural elements. Natural sounds that are related to negative semantic and emotional experiences, such as wind, were found to score negative results.

The *RAI* for sources that scored negative and positive effects at barely audible intensities was analyzed at high intensities. Results revealed that for all categories of sources, a positive *RAI* value was given. This positive scoring reflects the high sensitivity to annoyance that the Cairo residents have, particularly in relation to other cities. This finding is in accordance with previous work conducted in this area.

As regards the transfer of status from positive to negative response, a *RAI* value of 27% was given. Further investigations should be conducted to verify the aforementioned finding because of dependencies on questionnaire accuracy.

The analysis of the open-ended questions showed that auditory events and soundscapes are linguistically expressed through people's memory of events and semantic experiences. These linguistic expressions are used to describe sounds reflecting interactions between people and their surrounding environments and how these events shape people's perception.

Furthermore, the data on the verbal statements collected outline the fact that sounds are processed based on perceptual abstracted ones (physical properties), rather than semantic features, which suggests a shift from cognitive representations to physical descriptions of sounds for Cairo residents.

The second part of the questionnaire focuses on the linguistic representation of perceptual memory, rather than the processing of soundscapes. Results from the second part of the questionnaire are consistent with those of the first part. This condition outlines the importance and accuracy of semantic features associated with sound sources.

Moreover, results suggest that sounds reflecting human presence and activities related to natural elements are preferable and intimate components of the urban soundscape of Cairo. Thus, the ideal urban soundscape reflects natural life.

These subjective attributes of the soundscape serve a determining function in qualitative and quantitative judgments. Therefore, further investigation is needed to identify cognitive categories of sounds and relevant semantic features within each of the source categories.

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