The influence of the soundscape on the tourists' environmental quality perception

Virginia Puyana Romero
Department of Architecture and Industrial Design, Seconda Università di Napoli, Aversa, Italy.

Giovanni Brambilla
CNR, Institute of Acoustics and Sensors "O.M. Corbino", Rome, Italy.

Maria Di Gabriele
Department of Architecture and Industrial Design, Seconda Università di Napoli, Aversa, Italy.

Veronica Gallo
CNR, Institute of Acoustics and Sensors "O.M. Corbino", Rome, Italy.

Luigi Maffei
Department of Architecture and Industrial Design, Seconda Università di Napoli, Aversa, Italy.

Summary
The tourism plays an important role on the economy of many cities around the world. The environmental quality improvement can be one of the aspects used by stakeholders to make these places more attractive for tourists, despite their stay is usually limited in time.
Different factors can influence the subjective evaluation of the environmental quality in an urban context, like the security, the cleanliness and the soundscape. High variability in the environmental quality appraisals are usually observed, as they depend on several aspects like the motivation of the visit, the provenance or the expectation of the subjects.
A methodology for the classification of areas and the definition of models for the evaluation of the environmental and the soundscape perceived quality was proposed in a previous study carried out along the seafront of Naples. The aim of this paper is to go deeper into the study of this methodology, offering an approach to the environmental and soundscape perceived quality from the point of view of tourists and compare it with the one of daily users. The data collected in a survey performed along the seafront of Naples have been added to the previous dataset in order to compare and analyse them.

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1. Introduction

Historical, cultural, geographical and environmental differences are a source of wealth and one of the main factors in attracting tourists to the European regions. Tourism can provide local economies with a source of sustainable income and employment, and can also contribute towards enhancing the cultural and environmental features of the cities. Identifying and promoting the potentialities of each tourism destination, as natural resources, cultural heritage or particular features can foster a sustainable tourism.
The impact of tourism on the coastal areas threats the environmental imbalance and sustainable development of such sensitive places. However, an appropriate management (of the tourism) can advance to their natural restoration, and promote simultaneously the urban improvement.
The analysis of the potential and gaps of the waterfront environments within a holistic approach can be the key to the success of future urban interventions. New tools are needed to aware stakeholders of the benefits of improving the environmental quality of the coastal areas [1-4].
A previous research study underlined the influence of the sonic environment perceived quality on the overall environmental quality [5] and proposed a methodology for the classification of areas and models for the evaluation of the environmental and the soundscape quality.
The aim of this paper is to look deeper into the study of this methodology, offering an approach to the environmental and soundscape quality perception from the point of view of tourists and its comparison with the one of daily users. The

data collected in a survey performed along the seafront of Naples during July and September 2014 have been added to the previous dataset in order to compare and analyse them.

2. Materials and methods

2.1. The study area

The surveys campaign was performed along the waterfront of Naples, which is a major tourist destination for those who visit the city, and has an intense activity during the whole year. It is full of natural, historical and cultural information about the urban development and way of living of their inhabitants, As a result, the atmosphere of the waterfront uniquely describes the particularities and identity of the place. Some proposals have been undertaken in order to restrict the road traffic, reinforce the pedestrian walkway role and improve the liveability of the waterfront. However, one of the most ambitious one, the pedestrianization of the stretch between Victoria's square and the intersection of Caracciolo and Dohrn street has not been successfully put in practice. As a result, the waterfront of Naples shows a high heterogeneity along its route. The selection of sites was done to take the most of this heterogeneity, regarding aspects as historic values, kinds of traffic or potentiality to attract people of the places. With a length of 1.66 km, the sites under study belong to Francesco Caracciolo, Partenope and Nazario Sauro streets (Fig. 1).

Figure 1. The waterfront of Naples under investigation and the 5 sites where the field survey was carried out.

2.2. Field survey

A previous study was undertaken during January and February 2014, consisting in face to face interviews and sound recordings [5]. Considering the results of the previous research, 5 sites were selected, and a new study was carried out in order to analyse the differences between tourists and local people in the perception of the waterfront environment.

On the basis of the previous survey campaign, a new questionnaire was developed during July and September 2014, made up of 40 questions, and designed to be provided to the interviewees through a tablet. Interviews to people present in each site during the survey were carried out during simultaneous 4-10 minutes of audio recordings; photos were also collected to relate acoustic and subjective perceptual data.

The questionnaire contained questions about personal data of the interviewees, frequency and duration of their visit, perceived quality of different aspects of the waterfront (namely cleanliness, security, maintenance, expectation, benefits for health) and appraisals on sensorial stimuli (sound, eyesight and smells). The questions on quality were rated in a 7 points Likert's scale, ranging from very poor (1) to excellent (7).

Regarding the sonic environment, interviewees were asked to recognize the sound sources heard from a list of 14 items. Afterwards, they were request to select the sound source that mostly attracts their attention, as well as the most frequent, the most intense, the most expected, the most pleasant and the most annoying one. Sonic environment features, namely pleasant-unpleasant, uneventful-eventful, boring-exiting, chaotic-calm, insignificant-stimulant, were also rated on 7 points bipolar scales with neutral appraisal in the middle.

Similar questions were asked to rate the visual and the smelling environment (recognize the visual elements from a list of 12 items, and select the one that attracts more the attention, the most frequent, the most intense, the most expected, the most pleasant and the most annoying one), including features rating collected on 7 points bipolar scales.

2.3. Participants

One hundred and thirty subjects were interviewed (67 women, 63 men) in the 5 sites selected along the waterfront. Among them, 27.7% were tourists (36.1% from South Italy, 33.3%, from North Italy and from other countries: South Europe 8.3%, North Europe 19.4%, South America 2.8%). The inhabitants of the city or commuters from nearby cities were 72.3%. Age and educational levels were distributed in the sample as shown in Table I. Participants were randomly selected among the users of the waterfront.

Table I. Characteristics of the population sample.

		Tourists (%)	Residents (%)
Age	18-24	13.9	28.7
	25-29	33.3	19.1
	30-39	30.6	33.0
	40-49	16.7	13.8
	50-59	5.6	1.1
	≥ 60	0	4.3
Education	Primary school	2.8	2.1
	Secondary school	8.3	5.3
	High school	22.2	30.8
	University degree	66.7	61.7

2.4. Audio recordings

The sonic environment during the surveys was digitally and binaural recorded (16 bits/44.1 kHz) by a portable device "M-Audio Microtrack 24/96" and headphones "Sennheiser HDC 451". The recordings were calibrated by a 94 dB/1 kHz pure tone produced by the 01dB-Metravib acoustic calibrator "CAL21".
The acoustic parameters were determined from the recordings and they will be useful for further play-back in laboratory to perform listening tests and for creating virtual audio scenarios by their processing.

2.5. Statistical analysis

The objective of the statistical analysis, carried out by the open source software R [6], was to evaluate differences in rating the environmental quality, and its other factors, between tourist and residents. Thus, two subsets of data were analysed, namely those of tourists (36 subjects) and residents (94 subjects). The variables considered in this study were environmental quality (ENVQ), soundscape quality (SQ), landscape quality (VQ), smell quality (SMQ), cleanliness (CLN), security (SEC), maintenance (MAN), expectation (EXP) and benefits for health (HLT).
For most of these variables the lowest and uppest scores on the scale were given much less often than that in the middle, corresponding to neutral appraisal. Thus, the responses were coded into three classes, that is negative (scores from 1 to 3), neutral (score 4) and positive (scores from 5 to 7).
The Mann-Whitney test was applied to check the statistical significance of the differences between the two subsets. To measure the association between the variables, as they were ordinal, Kendall's correlation was calculated.

3. Results and discussion

The outcome of Mann-Whitney test applied to the above variables showed that significant differences (at 95% confidence level) occurred between tourists and residents only for the appraisals of cleanliness (CLN) and maintenance (MAN), as reported in Table II where p values < 0.05 are highlighted in grey.

Table II. Significance of the differences between ratings given by residents and tourists tested by Mann-Whitney.

Feature	p value
Environmental quality (ENVQ)	0.0761
Soundscape quality (SQ)	0.953
Landscape quality (VQ)	0.851
Smelling quality (SMQ)	0.715
Cleanliness (CLN)	0.00259
Security (SEC)	0.351
Maintenance (MAN)	0.0275
Expectation (EXP)	0.117
Benefits for health (HLT)	0.694

The bar plots in Fig. 2 clearly show the differences in rating from tourists and residents for CLN and MAN, whereas for soundscape quality (SQ) no significant differences are observed for all the three categories of scores which are more evenly distributed.
The ratings by tourists are more positive than those given by residents for cleanliness (CLN) and environmental quality (ENVQ), whereas the neutral ratings on maintenance are observed more often for tourists.

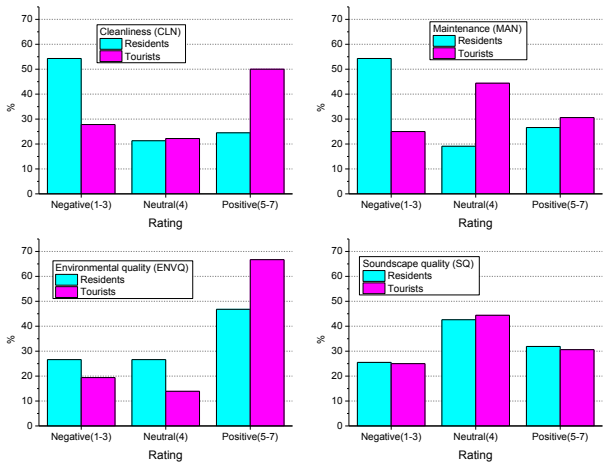

Figure 2. Differences in ratings between tourists and residents.

Dealing with the association between the variables, the correlation matrix computed by Kendall algorithm is reported in Table III, showing that cleanliness (CLN), security (SEC) and maintenance (MAN) have the highest correlation with the environmental quality (ENVQ), whereas soundscape quality (SQ) has low correlation with all the other features.

Table III. Kendall's correlation matrix.

	ENVQ	SQ	VQ	SMQ
ENVQ	1			
SQ	0.04	1		
VQ	0.29	0.14	1	
SMQ	0.32	0.21	0.35	1
CLN	0.58	0.11	0.19	0.31
SEC	0.51	0.09	0.19	0.31
MAN	0.49	0.10	0.19	0.18
EXP	0.39	0.15	0.30	0.38
HLT	0.42	0.10	0.28	0.44

	CLN	SEC	MAN	EXP	HLT
CLN	1				
SEC	0.55	1			
MAN	0.63	0.50	1		
EXP	0.36	0.33	0.24	1	
HLT	0.35	0.40	0.22	0.52	1

As expected, the highest correlation is observed between cleanliness (CLN) and maintenance (MAN).

3.1. Comparison with previous survey

The previous survey [5] was carried out on January and February 2014 in the same area of the waterfront. Thus, a comparison with the current survey is meaningful. All the data together consists of 226 subjects, 174 out of them were residents (77%) and 52 were tourists (23%).

The outcome of Mann-Whitney test applied to the above nine variables showed that significant differences (at 95% confidence level) occur between the two surveys for the landscape quality (VQ), security (SEC) and benefits for health (HLT), as shown in Table IV, where p values < 0.05 are highlighted in grey. These differences between surveys can be also appreciated in the bar plots in Fig. 3.

Table IV. Significance of the differences between ratings collected in the two surveys.

Feature	p value
Environmental quality (ENVQ)	0.92
Soundscape quality (SQ)	0.15
Landscape quality (VQ)	0.0109
Smelling quality (SMQ)	0.201
Cleanliness (CLN)	0.0941
Security (SEC)	0.00178
Maintenance (MAN)	0.153
Expectation (EXP)	0.495
Benefits for health (HLT)	0.00212

The significant difference observed for landscape quality (VQ) might be due to the different season when the surveys were carried out (winter and summer).

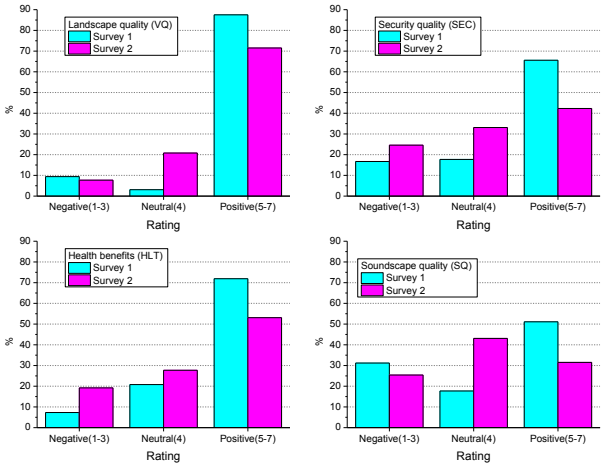

Figure 3. Differences in ratings between previous and current surveys.

Considering the positive ratings (scores from 5 to 7 on the Likert's scale), it is worth to point out that those given in the previous survey occur more often than the corresponding ones in the current survey.

Regarding the data subsets of residents and tourists, Table V reports the outcome of the Mann-Whitney test applied to identify significant differences (at 95% confidence level) between the ratings collected in the two surveys for all the 9 variables.

Table V. Significance of the differences between ratings collected in the two surveys.

Feature	p value	
	R1 vs. R2	T1 vs. T2
Environmental quality (ENVQ)	0.771	0.953
Soundscape quality (SQ)	0.137	0.95
Landscape quality (VQ)	0.00387	0.848
Smelling quality (SMQ)	0.206	0.75
Cleanliness (CLN)	0.0134	0.588
Security (SEC)	0.00773	0.0502
Maintenance (MAN)	0.185	0.0887
Expectation (EXP)	0.594	0.25
Benefits for health (HLT)	0.00268	0.522

No significant differences are observed for tourists between the two surveys (T1 vs. T2), whereas they occur for some features (p values < 0.05 highlighted in grey) when considering the ratings by residents (R1 vs. R2). This trend might be due to the greater familiarity that residents have of the sites.

3.2. Regression

Modelling the perception of the quality of the various features of the environment is appealing to get a reliable prediction of the reaction of people. Thus, it is a fundamental tool to assist in improving the design of the environment more oriented towards sustainability and health promotion.

Although the nine variables under study met most of the requirements of a multivariate linear regression analysis, the ordinal logistic regression analysis was preferred as it is more appropriate to evaluate ordinal data, and yields the probability of obtaining a certain output.

Two different models with the same variables were determined for tourists and residents based on the data collected in the survey carried out during July and September 2014. The variables were already used in the model developed in the previous study [5], namely perceived quality of environment (ENVQ) as dependent variable, and as independent variables soundscape quality (SQ), landscape quality (VQ), cleanliness (CLN), security (SEC), maintenance (MAN) and benefits for health (HLT). The variables SQ and VQ were included in the model even if their correlations with ENVQ was low because several studies showed the influence of the sensorial stimuli on the environmental quality perception [5, 7-8].

The models were determined by maximum likelihood function available in the R-package "ordinal" [9]. To evaluate the goodness of fit of the models, the Nagelkerke pseudo R^2 test was applied [10]. The contribution of each variable to the models was evaluated by the function "add1" of the package "ordinal" [9, 11]. This function computes all the single variables that can be added to the simplest model, the one with the intercept only, and fit the combinations of models comparing the values of the Akaikon information criterion (AIC) through likelihood ratio tests [12].

The interpretation of Nagelkerke pseudo R^2 is different to the one of the determination coefficient in multivariate linear regressions; although the values are still in the range 0 to 1, in ordinal regressions it is more difficult to obtain values near 1 [13]. The Nagelkerke pseudo R^2 obtained show that the predictors of the environmental quality appraisal explain a lower amount of the variance in the model of residents (pseudo $R^2 = 0.49$), than in the one tourists (pseudo $R^2 = 0.62$). Thus, the model of residents has a worse goodness of fit than the one of tourists.

Table VI and Table VII show the Akaikon information criterion and the level of significance calculated to compare the simplest model with the

Table VI. Likelihood ratio tests performed on the variables of the environmental quality model of residents. (Add1 function). Signif. codes: 0 '***'; 0.001 '**'; 0.01 '*'; 0.05 'X'; 0.1 '+'.

Feature	AIC	Pr(>Chi)
<none>	366.05	
Soundscape quality (SQ)	364.89	0.0757 X
Landscape quality (VQ)	353.98	0.0003 ***
Cleanliness (CLN)	320.95	2.1e-11 ***
Security (SEC)	339.90	2.8e-07 ***
Maintenance (MAN)	332.94	8.7e-09 ***
Health (HLT)	340.70	4.2e-07 ***

Table VII. Likelihood ratio tests performed on the variables of the environmental quality model of tourists. (Add1 function). Signif. codes: 0 '***'; 0.001 '**'; 0.01 '*';0.05 'X';0.1 '+'.

Feature	AIC	Pr(>Chi)
<none>	95.81	
Soundscape quality (SQ)	98.53	0.525
Landscape quality (VQ)	96.96	0.240
Cleanliness (CLN)	69.11	2.177e-7 ***
Security (SEC)	86.97	0.0016 **
Maintenance (MAN)	83.45	2.177e-4***
Health (HLT)	86.02	0.0010**

models resulting from adding each specific variable reported in the table [9,11]. The analysis of the influence of each variable shows that while all the variables contribute to the model of the environmental quality for residents (with at least a 90% confidence level), only the variables cleanliness (CLN), security (SEC), maintenance (MAN) and benefits for health (HLT) contribute to the model of tourists.

4. Conclusions

The outcomes of the comparison of both surveys show differences between tourists' and residents' ratings on some of the features under study. Moreover, there are also statistical significant differences on the residents' appraisals of the landscape quality, cleanliness, security and benefits for health between both campaigns. Several aspects can have determined them, as the weather conditions, the affluence of people, the illumination levels or socio-cultural factors. However these differences cannot be explained with the variables under study and the methodology used.

The high variety of factors that can influence the environmental quality perception makes difficult to define it through a mathematical model based only on measurements. This complexity demands hybrid methodologies that explain the gaps that measurements based models leave open. An example of these methodologies are the structural equation models, that test a network of relationships between observed (measured) and unobserved variables (latent constructs) in order to verify the hypothesis of a theoretical model. [14]

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