

Recreational noise: Impact and costs for annoyed residents in Milan and Turin[☆]

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ABSTRACT

European cities are experiencing a particular type of noise pollution originated by recreational activities located in the city centers, both anthropic noise, created by the presence of hundreds of people in the “movida” streets at night, and outdoor music due to events or simply related to public places. In spite of the annoyance experienced by the people living in these areas, the phenomenon has been poorly investigated so far. The paper presents in the first part the results of a self-selected Italian sample obtained through a web based questionnaire aimed at threading some light on the nature of the problem, in particular: identification of the most concerned areas, characteristics of the people complaining and evaluation of economic, health and everyday life consequences. In the second part it shows the results of sound level measurements for environmental noise evaluation which have been carried out in critical areas of Turin and Milan in order to give a technical basis to the subjectively reported annoyance and for a numerical evaluation of the problem.

1. Introduction

Noise pollution adversely affects the lives of millions of people with serious consequences on their health. According to the World Health Organization in the Report “Burden of disease from environmental noise” [22]: “One in three individuals is annoyed during the daytime and one in five has disturbed sleep at night because of traffic noise. Epidemiological evidence indicates that those chronically exposed to high levels of environmental noise have an increased risk of cardiovascular diseases such as myocardial infarction. Thus, noise pollution is considered not only an environmental nuisance but also a threat to public health. The results indicate that at least one million healthy life years are lost every year from traffic related noise in the western part of Europe. Sleep disturbance and annoyance, mostly related to road traffic noise, comprise the main burden of environmental noise”.

The most common sources of noise pollution, and consequently those which have been mainly investigated, are related to traffic and industrial activities [17]. However, in the last three decades European cities have been affected by a particular type of noise pollution stemming from recreational activities generally located in the city centers,

the so-called “movida”,¹ which is the heart of the night time economy, considered by the local authorities as a means of revitalizing urban areas. It is a very complex phenomenon carrying high potentials in terms of social and economic benefits, but also problems related to the impact of alcohol on crime and disorders, coupled with public nuisance caused by recreational noise pollution. See [1,8,23].

In spite of its importance, the phenomenon has been poorly investigated so far [15]: recreational noise is not even mentioned in the EEA Report, Noise in Europe 2014 [2], where environmental noise is defined as “unwanted or harmful outdoor sound created by human activities, including noise emitted by means of transport, road traffic, rail traffic, air traffic and from sites of industrial activity”.

The paper intends to address the issue studying the impact on people living in the affected areas by using two different means of analysis.

The first one presents the preliminary results of an on-line questionnaire whose aim was to describe characteristics and problems experienced by the residents referring to be disturbed by recreational noise in Italian “movida” districts, especially in Milan and Turin. It consists of questions on living conditions, life quality in the area,

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¹ “Movida” is a Spanish term originally identifying the social and cultural climate that took place first in Madrid, and then in other Spanish cities, during the transition after Francisco Franco's death in 1975. This hedonistic cultural wave was characterized by freedom of expression, transgression of the taboos imposed by the Franco regime and a new spirit of freedom on the streets. By extension it is now used to refer to recreational night activities.

characteristics of noise annoyance (sources, time slots, intensity and frequency), self-reported health effects due to sleep disturbance, costs sustained by people in the attempt to mitigate or solve the problem, estate devaluation, attitudes, reactions and general information on the respondents.

The second part of the paper is aimed at giving a technical basis and a first numerical evaluation to the subjective annoyance reported by the questionnaire. Sound pressure level (SPL) measurements for environmental noise evaluation have been carried out in central areas resulting as particularly critical from the questionnaire, three in Milan (Navigli, Città Studi and Brera) and three in Turin (San Salvario, Vanchiglia, Piazza Vittorio).

A final section discusses some achievable urban planning actions to deal with the “movida” challenge.

2. Methodology

2.1. The structure of the questionnaire

The target population of this work is the group of residents annoyed by recreational noise. The paper presents the results of an unrestricted, self-selected survey, which gave rise to a convenience sample, obtained through an on-line questionnaire [5]. This methodology was used as the problem of “movida” annoyed residents is an example of hidden population: recreational noise presents, in fact, a very scattered situation which is difficult for researchers to access and the disturbance experienced by two neighbors may be very different [6].

The results highlighted in this paper do not, then, describe the overall situation in “movida” districts, but are intended to explore the relevant issues for annoyed residents. The questionnaire, promoted through Anti-Noise sites, associations of residents and word of mouth advertising, is available in Italian at <https://is.gd/rumore>.

It is divided in seven sections:

- (1) basic demographic information;
- (2) respondents' houses characteristics and district conditions in terms of safety, sanitary conditions, facilities, transportation, leisure as referred by interviewees;
- (3) night environmental noise annoyance explored through questions investigating the most frequent causes, the frequency and intensity of the phenomenon;
- (4) every-day life consequences such as forced week-ends or house renovation;
- (5) self-reported health consequences of sleep deprivation;
- (6) economic and social consequences;
- (7) solutions' attempts.

In the paper the following data were utilized from the questionnaire.

Data stemming from Sections 1 and 2 constitute the socio-demographic variables including gender, age, education level, working activity, geographical distribution, as well as the presence of bedrooms exposed to, either street or courtyard, noise at night and the number of late night bars and pubs (closing time after two o' clock a.m.) around the residents' home within 20, 50 and 100 m, which are suitable indicators of recreational noise impact.

In Section 3 data were filtered by an item of the questionnaire asking: “In the last twelve months your night rest has been disturbed by recreational noise?” If the respondent answered “No”, the questionnaire was over: the “yes” answers gave access to the subsequent sections. Noise annoyance in the previous twelve months has been investigated for four different time slots: daytime, (07–19 h), evening, (19–23 h), night, (23–03 h) and late night, (03–07 h). The annoyance scale ranges from 1 to 5, where 1 means no disturbance and 5 maximum disturbance, which heavily interferes with current activities.

Section 5² has been devoted to the relationship between sleep deprivation due to night noise pollution and perceived health effects. In particular, the consequences on cardiovascular diseases are considered by asking if the respondent or some other member of the family were affected by tachycardia and hypertension. In the same way stress related problems are inquired by asking if somebody in the family had experienced concentration problems such as insomnia, irritability or anxiety. In case of affirmative answer a question checked for prescriptions by a doctor.

In Section 6 the feeling of a negative impact of a depreciation of real-estate value has been investigated by asking if the respondent considered the possibility to move house, requested an appraisal or tried to list it.

Costs sustained by respondents, such as soundproofing, double-glazing, house renovation, forced week-ends, legal actions and sound level measurements, are then analyzed. Sound proofing and double-glazing are rather self-explanatory; renovation usually refers to the attempt to mitigate the problem by moving the bedroom in the quietest part of the apartment, usually in the kitchen. The climax gained by movida on Friday and Saturday nights justifies the item concerning the need for forced weekends. Sound level measurements are a means to prove noise disturbance in case of legal actions.

The negative impact of recreational noise on residents' welfare has been tested³ in terms of willingness to pay by asking: “if the local authorities proposed a credible and costly plan to reduce “movida” noise, would you agree to contribute?”

All items of Section 7 enumerating the various strategies used by residents to react to the noise disturbance have been reported. They concern: contacts with customers, managers, local police, police, local authorities, media, legal actions and citizens' Associations.

2.2. The noise paths in the buildings

Three typical noise paths can be picked out: noise entering through the building façade from the street, noise coming directly through the building structure because of poor sound insulation and poor limitation of the audio system and noise coming from the back of the building where often the service machinery is installed. In the case of “movida” or outdoor music, the first case is the most frequent and has been worsened by smoking prohibition inside the premises. The other two paths are also present depending on many factors (geometry, local noise permit rules, type and age of building, etc.); low frequencies diffusion through the building structure is particularly serious when discos or late night pubs are located in the building itself.

2.3. The sound measurement settings

Sound pressure level (SPL) sample measurements for environmental noise evaluation have been carried out between 2015 and 2016 in the apartments of a few families who had answered the questionnaire. The apartments are located in central areas resulting as particularly affected by recreational noise, three in Milan (Navigli, Città Studi and Brera) and three in Turin (San Salvario, Vanchiglia, Piazza Vittorio).

The SPL measurements started at 23.30 up to late night in order to

² Section 4 has not been used in the paper

³ The negative impact of recreational noise on residents' welfare, both on physic and psychological wellbeing, is quantified by the means of two approaches: the revealed preferences and stated preferences. In particular, to evaluate the impact of noise in monetary terms, the starting point in environmental economics is the notion that welfare variations may be interpreted as utility variations. Two measures to read utility variations in monetary terms are used in economics: compensatory and equivalent variations. Quantitative variations may be expressed as the willingness to pay (WTP) or as the willingness to accept compensation (WTA). The WTP is the highest price an individual is willing to pay for some good or service, which, in our case could be represented by a marginal reduction in decibel level. The WTA is the lowest sum an individual is willing to accept in order to bear a cost, in our case an increase in the noise level [9,18].

check the noise levels really experienced by people reporting a night-time noise disturbance in the questionnaire. The sample measurements had duration of 15 min and were performed with open and closed windows on the street side of the building to characterize both the sound pressure level introduced in the apartment and the windows' insertion loss. The microphone position was 1 m. inside the room in front of the windows both in open and close windows case, 1.5 m. high upon the floor.

In all the situations, one or more bar or club were present in proximity (within 30 m) of the building where the measurement was carried out.

For the outdoor music noise, many sound level measurements were carried in Turin and Milan in apartments of people disturbed by this noise events.

The LAeq equivalent sound pressure indicator and the LA90 percentile level are measured. The LAeq indicator gives the average energetic level in the measurement time; the LA90 percentile (level exceeded in the 90% of the time) gives the level of the background noise.

3. Results

3.1. Data from online questionnaires

3.1.1. Socio-demographic variables

The questionnaire launched in January 2015 reached 1083 households all over Italy: the paper focuses attention on Milan and Turin with 159 and 132 questionnaires respectively, where the most important “movida” districts are well represented: in particular Navigli, Città Studi and Brera for Milan; San Salvario, Piazza Vittorio and Vanchiglia for Turin.

Respondents are 56% women and 44% men. Average age is 53. The average household size is 2.42.⁴ As for age distribution, 63% are in working-age between 30 and 65 years, whereas retired people account for 16% of the respondents. Questions on working activity show a substantial equilibrium between employees and freelance, around 38% each. The education level of the sample is far above the average Italian education level: nearly 70% of graduate people without relevant differences for gender or city. This may be explained by the following reasons: the digital divide caused by the online questionnaire and social and economic factors due to the location of “movida” in city centers. Respondents are longtime residents as 36% have been living in the same house for up to 20 years, witnessing the transformation of the areas.

The average number of late night bars and pubs around the residents' home is: 3 within 20 m, 10 within 50 m and 14 within 100 m, giving a clear idea of the recreational districts' density, which does not differ according to cities' size or in the comparison Turin- Milan.

A relevant discriminating question to evaluate annoyance due to recreational noise and to understand why some residents report annoyance and others don't, appears to be the presence of bedrooms exposed to noise at night, either street or courtyard noise. In fact, 85% of respondents who declare to be annoyed are in such a situation.

3.1.2. Noise annoyance

Some respondents in Milan and Turin started to answer the questionnaire as they complained about the recreational noise pollution in the neighborhood, although they were not personally annoyed by noise at home at night. They have been excluded from subsequent questions so that the following results, concerning the nature and consequences of recreational noise perceived at home, only concern people who answered affirmatively to the question: “in the last twelve months your sleep or your night's rest have been disturbed by recreational noise?”

⁴ The mean family size of the sample is slightly higher than the population mean according to the ISTAT census data: Milan (2.10) and Turin (2.17) [14].

Table 1A

Average noise disturbance levels (1–5) for gender.

Gender	Mean	Median	Standard dev
Female	4.10	4.00	0.919
Male	4.28	5.00	0.869
Total	4.16	4, 00	0.910

Table 1B

Average noise disturbance levels (1–5) for age group.

Age group	Mean	Median	Standard dev
19–30	4.22	4.00	0.833
31–50	4.35	4.00	0.744
51–65	4.10	4.00	1.016
Over 66	3.97	4.00	0.947
Total	4.17	4.00	0.904

Table 1C

Average noise disturbance levels (1–5) for working activity.

Working condition	Mean	Median	Standard dev
Housewife	4.25	4.50	0.866
Employed	4.15	4.00	0.902
Retired	4.18	5.00	0.950
Student	4.33	5.00	1.155
Total	4.16	4.00	0.910

which represented nearly 84% of respondents.

Tables 1A–1C show the average sleep disturbance level due to night recreational noise (scale 1–5) for gender, working conditions and age group. Reported noise annoyance levels, in Tables 1A–1C, don't differ significantly by gender, working activity or age group, (test Anova, p -value > .05).

The following tables are singled out for Milan and Turin, separately, in order to analyze significant possible differences in attitudes towards “movida” of these two cities' residents.

Table 2 provides average disturbance levels in four time slots in Milan and Turin, referring to the five levels annoyance scale. Noise disturbance starts with the happy hour (19–23 h), (average: 3.59 in Milan and 3.36 in Turin), is really problematic between 23 p.m. and 3 a.m. (average: 4.52 in Milan and 4.34 in Turin), decreases, but it is still higher than daytime, late in the night from 3 to 7 a.m. (average: 2.89 in Milan and 3.2 in Turin).

Reported noise annoyance levels are not significantly different in the two cities (test Anova, p -value > .05).

Table 3 provides for the annoyance perceived levels in Milan and Turin for four time slots showing the percentages in each class. The results of the annoyance scale, which ranged from one to five in the preceding tables, have been reduced to three levels, in order to make them clearer: annoyance level 1: neutral/slight; level 2: moderate; level 3: considerable/extreme.

In the evening, between 19 and 23, 55.3% of interviewees in Milan and 48% in Turin declare a considerable/extreme level of annoyance. Between 23 p.m. and 3 a.m. the situation worsens so that 91.9% of respondents in Milan and 81% in Turin refer a considerable/extreme level of annoyance, which, then, decreases, but remains a serious problem even later in the night (35% in Milan and 46% in Turin keep declaring considerable/extreme level of annoyance between 3 and 7 a.m.).

In order to assess if an association between disturbance levels and city exists a χ^2 test has been executed. For each time slot a p -value > .05 was obtained, showing there isn't a significant association.

Respondents state that recreational noise annoyance is mainly due to customers' shouts (91.1% Milan, 96.5% Turin), loud music coming from pubs, restaurants, clubs and discos (33% Milan, 36% Turin) and

Table 2
Average noise disturbance levels (1–5) for four time slots in Milan and Turin.

		07–19	19–23	23–03	03–07
Milan	Mean	2.25	3.59	4.52	2.89
	Median	2.00	4.00	5.00	3.00
	Standard dev	1.149	1.123	0.728	1.294
Turin	Mean	2.13	3.36	4.34	3.20
	Median	2.00	3.00	5.00	3.00
	Standard dev	0.991	0.931	0.962	1.276

Table 3
Noise annoyance levels for different time slots (% for each annoyance level).

Time slot		07–19	19–23	23–03	03–07
Milan	1. Neutral/Slight Annoyance	63.4	18.7	1.6	42.3
	2. Moderate	22.8	26.0	6.5	22.8
	3. Considerable/Extreme	13.8	55.3	91.9	35.0
	Total	100.0	100.0	100.0	100.0
Turin	1. Neutral/Slight Annoyance	70.2	20.7	6.6	32.2
	2. Moderate	21.5	30.6	12.4	21.5
	3. Considerable/Extreme	8.3	48.8	81.0	46.3
	Total	100.0	100.0	100.0	100.0

low frequencies diffusion through the building structure (36% Milan, 38% Turin).⁵ It is experienced in Milan by 22.3% in the weekend and by 59.3% nearly every night; in Turin by 28.9% in the weekend and by 55.4% nearly every night. In order to evaluate the association between city and disturbance frequency χ^2 tests has been executed: a p -value $> .05$ was obtained.

According to the data, noise pollution heavily interferes with sleeping hours, causing weariness and loss of concentration in daytime activities. Behavior at home is altered in various ways: people, in order to rest, go to sleep in the quietest part of the flat, usually the kitchen (Milan 54.9%, Turin 57%). They are forced to go away for the weekend, if they can afford it, (Milan 45.8%, Turin 60.6%) and have to wear earplugs (Milan 55.8%, Turin 62.1%). In order to evaluate the association between city and behaviors χ^2 tests have been executed: for all a p -value $> .05$ was obtained.

3.1.3. Reported health effects

As the European Commission, 2004 [3] states: “Prolonged exposure to noise can lead to serious health effects mediated by the human endocrine system and by the brain, such as sleep disturbance, cardiovascular diseases, annoyance (a feeling of discomfort affecting general well-being), cognitive impairment and mental health problems. It can also cause direct effects such as tinnitus.”

Section 5 of the questionnaire has been devoted to investigate the relationship between sleep deprivation due to night noise pollution and health effects. In particular, the consequences on cardiovascular and stress related diseases are considered by asking if the respondent or some other member of the family were affected [7,10,13].

The differences in the two cities are significant (p -values $< .05$) for insomnia and anxiety as Table 4B shows.

The answers in Table 4A show a rather high prevalence of cardiovascular diseases such as tachycardia and hypertension.

The prevalence of stress related diseases is high: in Milan 88.7% of the families are affected by insomnia, 80.2% by irritability and 78.3% by anxiety; things seem to be worse in Turin where 95.5% of the families are affected by insomnia, 87.4% by irritability and 86.5% by anxiety.

It is worth noticing that stress related diseases do concern more than

⁵ Disturbances caused by broken bottles, traffic at late night, concerts, are mentioned, but appear less frequently.

one of the family members in nearly 48.1% of cases in Milan and 38.7% in Turin. Also reported by nearly 50% of those who declare such diseases are the prescriptions of anxiolytic, sedatives and hypnotics medications, which is higher than the Italian figure equal to 12.8% for 2011. See [12].

3.1.4. Costs

The European Commission states that: “The effects of exposure to noise impact EU economies. They lead to a loss of productivity of workers whose health and well-being are affected by noise, put a burden on health care systems and cause a substantial depreciation of real-estate value.”

The adverse environment for an apartment located in a “movida” district will result in a lower market value as compared to an apartment with similar characteristics, except for recreational noise. This occurs because potential buyers reduce their demand, as they discount present value of the costs of annoyance, loss of tranquility, and possible health effects. A measure of the noise-induced damages is the difference between the market-determined values of the two apartments.

On the contrary, some claim that the price per square metre of properties has increased after “movida” developed, at least in certain districts, which were previously dilapidated and where nighttime economy was seen as a means to restart an area. On the other hand, Patrigest, an Italian company specialized in Valuation and Advisory for real estate, conducted in 2011 a research in Rome and Milan reaching the conclusion that excessive noise, in particular because of nearby pubs and discos, depreciates the real estate’s value by 10 and 20% [19].

The two statements are not necessarily contradictory because we face a fragmented situation where two neighbors may report very distant night experiences, according, for instance, to the location of bedrooms. If bedrooms overlook a protected courtyard, the estate is rather quiet and inhabitants may not suffer from noise pollution, but enjoy the lively atmosphere at no environmental costs.

Respondents seem aware of the risk as 82% of respondent in Milan and 85% in Turin think that noise is responsible for a depreciation of their apartment. Even if nearly 78% of respondents in Milan and 71% in Turin considered to sell the house, only 10.7% in Milan and 25% in Turin tried to list it, possibly because appraisal of the house, requested by 34% in Milan and 37% in Turin, highlighted the depreciation.

The median expenditure, calculated on those who declared at least 1 euro, is 5000 euros in Milan and 6400 in Turin.

Expenditures classes in Table 5 show that 45.7% of respondents in Milan and 56.2% in Turin incurred expenses between 2100 and 15,000 euros; 25.7% in Milan and 20.9% in Turin higher than 25,000 euros.

Specific costs incurred by disturbed residents in order to mitigate or solve the recreational noise problem are presented in Table 6: sound proofing, double-glazing, renovation, forced weekends, legal actions and sound level measurements. The reported mean and median expenditure for each item take into account only the households who really incurred the costs whose percentage is indicated.

Double glazing represent the most widespread spending (44.7% of respondents in Milan, and 50.4% in Turin), followed by soundproofing (20.3% and 19.8%, respectively) and forced weekends (22.7% and 33.8%, respectively). Renovation is less common (5.7% and 8.3%, respectively), but rather expensive too. Civil or criminal lawsuits (11.3% and 14.4%, respectively) are a solution of last resort and are correlated to sound level measurements (9.7% and 6.6%, respectively), as they are a means to prove noise disturbance in case of legal actions.

In order to test the negative impact of recreational noise on residents’ welfare willingness to pay of residents has been checked by asking: “if the local authorities proposed a credible and costly plan to reduce “movida” noise, would you agree to contribute?”

Answers seem to confirm the view that citizens consider as fundamental and non-negotiable the right to sleep at night with refusals to contribute of 54.5% in Milan and 64.2% in Turin; 25.3% and 19.8%, respectively, to contribute only if all citizens, even those non suffering the problem, would participate. There aren’t significant differences

Table 4A
Prevalence of cardiovascular and stress related diseases (% in each class).

		Tachycardia	Hypertension	Insomnia	Irritability	Anxiety
Milan	No one in the family	62.3	61.3	11.3	19.8	21.7
	One member in the family	29.2	29.2	40.6	39.6	38.7
	More than one in the family	8.5	9.4	48.1	40.6	39.6
	Total	100.0	100.0	100.0	100.0	100.0
Turin	No one in the family	50.5	58.6	4.5	12.6	13.5
	One member in the family	39.6	31.5	56.8	47.7	55.9
	More than one in the family	9.9	9.9	38.7	39.6	30.5
	Total	100.0	100.0	100.0	100.0	100.0

Table 4B
p-values.

Pathology	p-value
Tachycardia	0.206
Hypertension	0.092
Insomnia	0.027
Irritability	0.276
Anxiety	0.035

Table 5
Expenditure classes.

Expenditures (euros)	Milan %	Turin %
≤2100	28.6	22.4
2101–6000	25.7	23.9
6,001–15,000	20.0	32.8
15,001 +	25.7	20.9
Total	100.0	100.0

between the two groups (p-values < .05).

There was also a question testing the willingness to accept: “in case you were willing to file a civil suit for the compensation of physical, moral and material damages suffered because of recreational noise, what would be the amount of damages requested?” Unfortunately, the answers were very emotional, declaring extremely high amounts, coherent with the position that the right to sleep at night is invaluable, as also expressed in the WTA question.

3.1.5. Solution strategies

People try to react to a problem: 75% of respondents in Milan and 71% in Turin tried one or several ways to face recreational noise pollution. Strategies are enumerated in Table 8.

Contacts with customers and managers appear to be the first action carried out by residents. Then local police, who reports that noise problems are the first cause of citizens’ complaints, is contacted.

Civil and criminal lawsuits are undertaken by respondents either personally or in-group, for instance the members of an apartment building. Media are involved to publicize the problem. Interesting is the spontaneous creation of associations of disturbed resident against the excess of “movida” nights, at district and town level, which recently

Table 6
Reported households’ expenditures.

Expenses	Milan % of reporting expenditure	Mean (euros)	Median (euros)	Standard Dev	Turin % of reporting expenditures	Mean (euros)	Median (euros)	Standard Dev
Sound proofing	20.3	6193.64	2500.00	8.222.456	19.8	3906.62	1750.00	5.941.785
Double-glazing	44.7	6979.00	4000.00	7.773.990	50.4	5591.06	4000.00	6.152.096
House Renovation	5.7	6600.71	2000.00	9.192.878	8.3	8030.00	3400.00	11.238.233
Forced weekends	22.7	3335.96	2000.00	3.669.078	33.8	1797.93	800.00	2.448.958
Legal actions	11.3	3357.36	1000.00	4.934.760	14.4	2182.94	500.00	4.849.755
Sound level measures	9.7	945.13	945.00	725.225	6.6	1631.25	750.00	2.038.721

Table 7

“If the local authorities proposed a credible and costly plan to reduce “movida” noise, would you agree to contribute?”.

	Milan %	Turin %
No, peace at night is a fundamental right	54.5	64.2
Yes, even if only annoyed people would be taxed	20.2	16.0
Yes, only if annoyed and non annoyed people would be taxed	25.3	19.8
Total	100.0	100.0

Table 8
Adopted solution strategies (% in the sample).

	Milan	Turin
Contacts with customers	26.2	35.4
Contacts with managers	46.4	54.2
Local Police	84.5	89.6
Carabinieri or Police	40.4	51.0
Local authorities	44.0	51.0
Media	28.6	28.1
Legal Action	24.0	26.0
Citizens’ Associations	67.0	74.0

joined together in an Italian network. A European network has been developed in 2016, “Réseau européen vivre la ville”, which gathers citizens’ associations developed for the same reasons in Italy, France, Spain, Portugal, Holland and Belgium.

Finally asked about a reasonable closing hour of clubs, 82% of the respondents recommend midnight during the week, whereas during weekend nights 43% indicate 1 a.m.

3.2. “Movida” noise - SPL measurement results

Tables 9 and 10 provide the results of sound level measurements; “p.p”. means “public place”, “o.w.” means “open windows” and “c.w.” means “closed windows”.

The division between old windows and new windows, in the left column, depends of the age of the window: more than ten years is considered old, ten years or less is new.

Table 9
Milan noise measurement results.

Measurement description	Floor	Week day	Location	Nearest p.p. (m)	LAeq o.w. dB(A)	LA90 o.w. dB(A)	LAeq c.w. dB(A)	LA90 c.w. dB (A)
Bedroom, old window, new windows glasses	First	Friday	“Navigli” area, pedestrian street. People walking and talking and car far away	5	58.5	54.8	34.4	31
Bedroom, old windows	Ground	Wednesday	“Città Studi”, flat next to p.p., no sound insulation	2	–	–	38.8	34.5
Living room, old windows	First	Thursday	Brera pedestrian street. People walking and talking	5	59.9	56.5	40.9	37.2

Table 10
Turin noise measurement results. (Saturday night).

Measurement description	Floor	Location	Nearest p.p. (m)	LAeq o.w. dB (A)	LA90 o.w. dB (A)	LAeq c.w. dB (A)	LA90 c.w. dB (A)
Bedroom, new windows, old rolling shutter box	Fourth	Pedestrian area in “Vanchiglia”. About 80 people talking, cars far away	50	60.7	57.8	38.6	36.2
Bedroom, double windows	Second	Narrow street “Vittorio Square” area. About 60 people talking and cars	15	66	61.6	23.6	20.3
Bedroom, old windows with new windows glasses.	Third	“San Salvario”. A100 people in a little square and few cars	35	64.1	60.9	43.1	49.3
Bedroom, old windows.	First	Vittorio Square	5	70.2	n.a.	53.4	n.a.

3.2.1. Sound pressure level analysis with open windows

The measured SPL with open windows are very high, especially considering that they refer to areas with low or no car traffic and to a time period between 11 p.m. and 02 a.m. Some measurements were carried out outside the weekend days to make possible a comparison with the peak days (Friday and Saturday).

Registered values show sound pressure levels at the first floor varying from 58.5 up to 70.2 dB (A). The inhabitants specify that noise level grows between 10 and 12 p.m., then stabilization follows until 02 a.m., followed by a slow decrease up to 04 a.m.

The areas interested by the measurements in Milan and Turin, according to the municipality noise plan, belong to the classes III (mixed type areas) and IV (intense human activity areas) of the acoustic zoning. The nighttime absolute limits by the Italian administrative law DPCM 14/11/97 are 50 dB (A) for the 3rd and 55 dB (A) for the 4th, meaning that the measurements always exceed the allowed levels, even by considering sound energy on the entire night reference time (8 h). Many of them even exceed the levels of a 5th class (predominantly industrial Area) equal to 60 dB (A) on the nighttime period. The administrative decree also requires that, inside the receiver buildings, the noise level during the night period must not be higher than 3 dB as compared to the residual noise (LAeq background level without the annoying noise). The open windows measurements easily show that both criteria are disregarded: “movida” districts “de facto” do not comply with the acoustic zones they are set in.

Anthropic induced noise is very annoying, especially in areas where it is the main source of noise. In fact in these cases the traffic component is absent and only the human noise is present in the street. In the open window measurements the sound spectrum of the SPL 1/3 octave band minima has always the maximum energy between 500 Hz and the 4 KHz, as shown in Fig. 1, band in which the human hearing has maximum sensitivity. It is quite interesting that the minima spectrum of this measurements shape fits the ANSI reference (Ansi S3.5) spectrum of loud voice (green⁶ line in Fig. 1, where for a better shape comparison a +15 dB gain was applied to the minima level – this spectrum refers to an SPL measurement at an open windows at 6 m from the street on a busy night).

⁶ For interpretation of color in Fig. 1, the reader is referred to the web version of this article.

Observing the percentile levels we can notice that the difference between LAeq and the LA90 (the sound pressure level exceeded for the 90% of the measurement time), even in a short measurement time of 15 min, is no more than 4 dB: this confirms the presence of very stable noise energy and defines that the mix of voices creates an almost constant noise level.

3.2.2. Considerations about sound pressure levels with closed windows

Such high external sound levels create problems with traditional façade insulation technologies. The windows normally present in old residences in Italy today have been often retrained in the last 20 years by changing the glass: such windows have an insertion loss ΔL that varies between 20 and 24 dB (see Tables 6 and 7). Such values of ΔL lead, inside the flats, LAeq levels with closed windows varying between 35 and 50 dB (A), as confirmed by our sample measurements.

These SPLs are still very high, especially because they are caused by human noise.

A thorough medical study is needed on recreational noise induced annoyance, but it is important to remember that traffic noise annoyance studies set a $L_{ASmax} > 35$ dBA limit for noise induced awakenings caused by a single drive-by [11]. It is obvious that these values prevent sleep, forcing many people to undertake renovation, moving the bedroom to the inside of the house or, at least, as far as possible from the noise source.

This means that costly actions are necessary, devoting sufficient attention to the laying and the selection of the windows and to all the connected technologies (i.e. rolling shutter box, double windows).

In a previous paper [20] an average Italian nighttime background level with closed windows was calculated in LAeq = 29 dB (A), in situations of light traffic and recent (less than ten years) windows without acoustic certification (with a window insertion loss close to what was observed in this investigation). Comparing such average level with the results of this short measurement campaign, it is possible to estimate a differential level above the ‘normal’ Italian urban situation in the absence of ‘movida’ for the closed window state, between 6 and 21 dB, confirming an annoyance.

As a side note, we remind that when the disturbing public place is situated in the same building of the receiver, such façade insulation works always cause an increase in the perception of the noise propagating from the p.p. through the building structure. The only solution that can be adopted in this case is designing and carrying out important

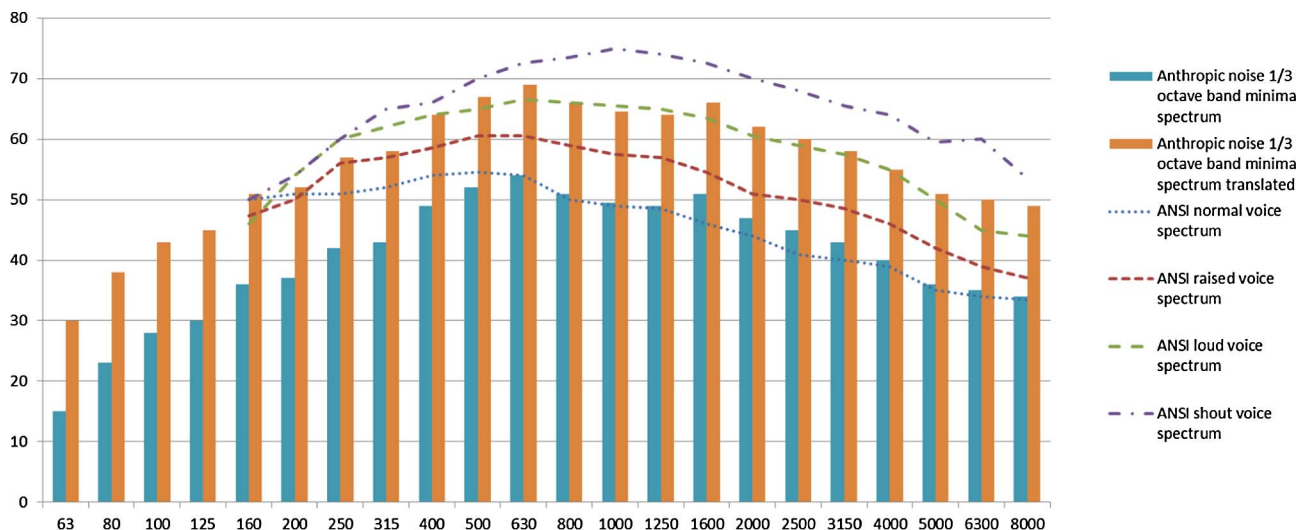


Fig. 1. Anthropoc noise 1/3 octave band minima spectrum.

Table 11
Outdoors music measurements.

Event type	Number of events	Residual LAeq	Maximum noise allowed/LAeq of the measured noise dB(A)	Difference between noise LAeq and residual LAeq dB(A)
Jazz Festival, large town (Turin)	Five consecutive evenings from 22 to 00.30	61	73/73–81	12–20
Street artists (music) in a high frequented street of a large town (high residual noise) (Milan)	In the weekend for many hours	56.8	70/67.7 at the 4th floor	10.9

insulation works in the public place property and limiting thoroughly the audio system emission.

3.3. Noise from outdoor music

Referring to recreational noise the impact of music is to be stressed: it represents a complex topic that will deserve further studies. In case of outdoor music, the noise energy at low frequencies is always higher than in the typical cases of “movida” we discussed, when the noise is mostly produced by numerous people speaking.

In these cases, façade problems give even higher closed windows levels because of a common poor insulation capacity of the windows at low frequencies.

Single spot events are seldom a problem but in case of events performed twice or three times a week for two, three months in the same place during summer period (i.e. music festivals or in case of street artists that daily perform in the same streets with amplified music), this could be a serious problem for the inhabitants’ welfare.

Many measurements were performed by the authors in noise litigations caused by public places with external music. In such cases, with open windows the differences between LAeq of the noise and LAeq of the background noise easily exceed 15 dB.

Table 11 shows some results of measurements we performed in the last three years using the LAeq differential. Different situations are represented: street artists with loudspeakers, big concerts, music festivals.

In the frequency domain, we notice how amplified music always has a very strong low frequency content, which worsens the annoyance and makes noise control more difficult.

In Fig. 2 the 1/3 octave band minima spectrum of music at a 20 m distance is compared with that of the anthropic noise measured in a pedestrian street and shown in Fig. 1: all the values under 250 Hz are higher; these are much harder to stop even with modern windows.

4. Urban planning actions to deal with the recreational noise challenge

As the 2014 EEA Report states “Noise pollution has long been recognized as affecting quality of life and well-being. Over past decades it has, in addition, increasingly been recognized as an important public health issue.” Municipalities have to decide how to protect their own citizens’ well-being, including sleep. Various choices, already practiced in major cities in Europe, can be envisaged. [21].

The first drastic solution is that, beginning from 11 to 12 p.m., night recreational activities compulsorily move from the central-residential areas to peripheral ones with completely different characteristics: offices areas, ex handicraft or industrial zones, ex railway yards. Tax breaks and facilitations should be available to the p.p. opening new businesses in those zones; simplified conditions for live music and free shuttles would create a virtuous circle for everybody: a win-win solution for the stakeholders of the movida game: managers of the p.p., participants of the movida, and residents of the involved districts. This solution would decrease the global social costs related with the movida-generated noise, by diminishing the impact of negative externalities, so giving rise to relevant economic and social opportunities.

However, if the local authorities are willing to maintain numerous p.p. in the residential areas, the choice is forced and already successfully experienced in many European cities: allowing openings of new p.p. in not inhabited buildings and forcing all the p.p. (new and already existing) to conform with precise noise-control evaluations, compulsory acoustic testing, heavy use of real electronic SPL limiters on the audio systems, obligation to the residents to allow access for insulation studies. Unexpected controls from the township acousticians should be the norm, not necessarily following petitions for noise annoyance.

Proactive solutions should always tend to limit this complex problem and create an advantage to the p.p. owners: heavy insulations should be de-taxed, the use of smart technologies and low-cost SPL

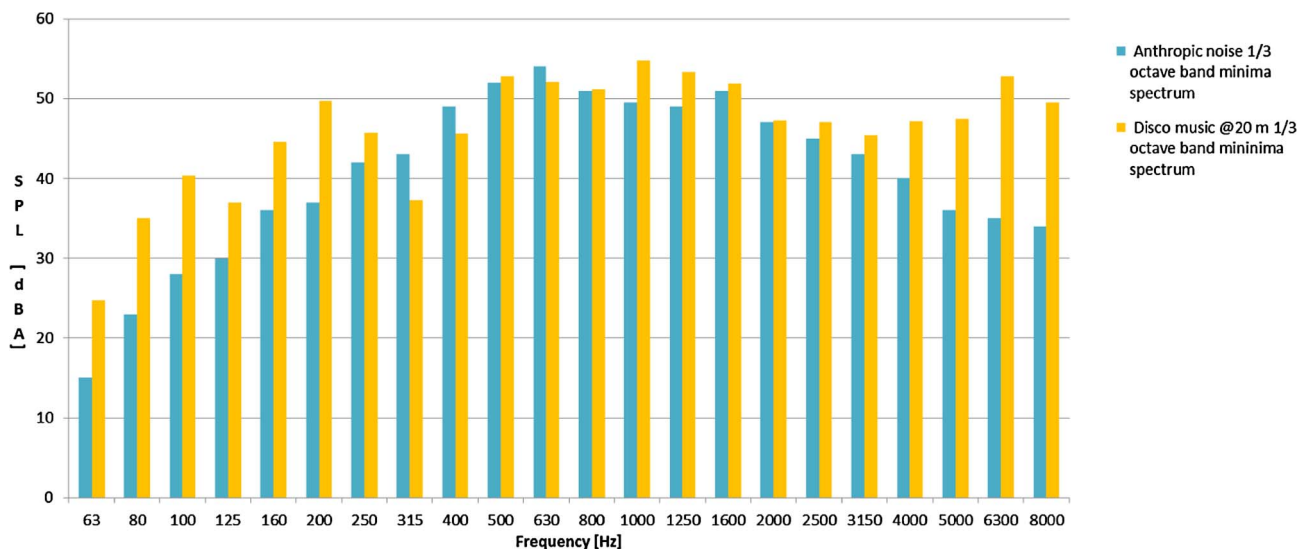


Fig. 2. Anthropic noise vs dance music 1/3 octave band minima spectrum.

measurement devices encouraged, so allowing a rapid control to the p.p. owner himself and giving a register of the situation.

A problem, which is present in Italy, is that noise control studies are asked right at the time of the premise opening, and only on an estimated basis: it is important to also ask a trial with SPL measurements after the premise has worked for a few weeks, better if accessing the flat of a close-by resident. An awareness campaign should be addressed to the movida population and the p.p. owners implying clear solution-oriented guidelines.

Outdoor musical events should be carefully planned: authorizing very few events in each location, requiring a specific time scheduling or selecting special locations very distant from residential areas [16].

5. Conclusions

The recreational noise has become a constant in European cities' evenings and nights, as city centers are increasingly transformed in night leisure zones. It has also become number one night complain with local police.

The negative effect suffered by passive “movida” users, that is to say by the residents, has been analyzed in its environmental, economic and health effects.

The online questionnaire sheds a first light on the nature of the problem by examining the situation in two important Italian cities: Milan and Turin. The answers report a picture of really troubled nights in “movida” districts. Respondents report that noise affects sleep, everyday life and health. Estate depreciation and expenses to mitigate the problem are rather consistent.

Sample sound level measurements were carried out in Milan and Turin “movida” districts, in order to provide a first technical basis to the subjectively reported annoyance. The results confirm what declared by interviewees: very high SPL in the residents' homes between 11 p.m. and 02 a.m., both with open and closed windows, especially considering that involved areas are characterized by low or no car traffic. Noise comes from shouts and music due to outdoor events or simply related to public places.

Significant differences between the two groups of respondent, in Milan and Turin, didn't emerge: neither in the questionnaire answers, nor in SPL measurements. This is interesting as it shows that recreational noise annoyance, suffered by residents in different urban contexts, seems to depend on an objective and constant cross boundaries territorial factor that leads different people to similar behaviors concerning everyday strategies or incurred expenses.

“Movida” can be described as a game where players are: managers

of bars and clubs, customers as active participants and residents of the involved districts, as passive users. It is a market characterized by negative externalities giving rise to a market failure: unrestricted recreational noise is then too high and has to be regulated.

Local authorities should face the subject in a systematic way: an active city planning is needed with solution-oriented guidelines, aiming at a win-win solution for all the “movida” stakeholders, by rethinking the role of city centers, which are often reduced to a sort of urban holiday resorts, as it already happens in certain European cities.

Cost-benefit analyses utilizing economic evaluations concerning the external costs of noise pollution, required by the European Environmental Noise Directive [4], should apply to recreational noise as well.

As the recreational noise situation is a widespread phenomenon in Europe, as a further research it would be interesting to translate the questionnaire in different languages.

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