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Walk Safe Project

Urban safety perception related to light, sound and architectural decay

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ABSTRACT

Nowadays there is a deep separation between phenomena and perception of them due the influences that medias have over human information method. The attention is focalized on problems like **immigration** and **crime facts** by leveraging people's fear or preoccupation, other factors that influence are certainly **crime rate**, **environmental conditions** and **social conditions**.
Also for these reasons, **urban safety perception** suffers a crisis, especially during night-time, in isolated areas of city that didn't joy of design attention over artificial lighting, soundscape or urban and architectural quality of public spaces. People feels insecure themselves walking in these places even if there's no reasons to feels so.
Starting from these premises, some questions spontaneously come to mind. The **urban and architectural conditions** can influence the perception of people that live in urban areas? The differences in answer change with occasionally or habitually **use of places**? Which **light or sound characteristics** of the environment that surround the responders mainly influence their perception? **Presence of other people** help to feel more comfortable or, in opposite way, make the walker more worried? The safety perception can influence **psychological wellbeing** of people that live in particular critical sites?
To answer to this kind of questions, the project of this thesis analyzed the perception of safety related to the conditions of light, sound and urban and architectural decay of places considered particularly critical inside the city. The study was based on analysis of **four neighborhoods** of the city of Turin (Italy) reported by municipality, such as Vanchiglia, Parco Dora, Lingotto and San Salvario and in addition two areas in Barriera di Milano.
Because the necessity to understanding the importance of **big data in social strategies** it was started a collaboration with investigation office of Municipal Police Department that helped the research giving analysis tools for measuring people fluxes and social sentiments of neighborhood. The perceptions were collected through **three different types of questionnaires**, one of these in collaboration with University of Turin, developed keeping in mind the implications that they report, or the distribution channels and the reasons for each questionnaire. Contemporarily, it was collected light, sound and urban and architectural decay condition data. Data coming from people were analyzed using **statistical tools** to find correlation and regression model in order to estimate the safety perception on repetition of the same condition.
Another interesting part of the strategy was the opening of social channels, with PhD in semioti-

cs collaboration, with the purpose of communicate the results and giving communication the most scientifically possible information. Under the name of *Walk Safe Project* it has started an **engagement campaign** aim to propose a focused survey on social channels and to spread the topic of urban safety among citizens. The last portion of the work has represented by the analysis of data obtained from another questionnaire developed in collaboration with PhD in psychology, that confirm the result of previous searching.
At the end, the results were presented in **guideline form**, hoping they could be the first step toward a prediction model for perception and pleasantness helpful to urban and architectural design strategies.

WALK SAFE PROJECT

Walk Safe Project is an interdisciplinary research work for the master's thesis in Architecture of Alfredo Pietro Bresci and Rosanna Siragusa, with respectively supervisors Anna Pellegrino and Arianna Astolfi, professors of the Energy Department of the Polytechnic of Turin and co-supervisors Louena Shtrepi of the Energy Department of the Polytechnic of Turin and Vincenzo Idone Cassone of IC4KI Interdepartmental Center for Knowledge Interchange.

The project analyzed the **perception of safety** related to the conditions of **light**, **sound** and **urban and architectural decay** of places considered particularly critical of the City of Turin. These places are: Campus Luigi Einaudi in Vanchiglia, Parco Dora in San Donato, Passerella Olimpica in Lingotto, Largo Saluzzo in San Salvario and two supplemented sites, Giardini Montanaro and Piazza Bottesini, in Barriera di Milano.
The study assumes the finality to **provide a framework** through the levels of urban and architectural decay and on the levels of acoustics and lighting environment of the selected areas. The goals of this research are focused on the drafting of a **perceived safety assessment protocol** based on the perception of noise disturbance, urban light quality and urban and architectural decay. The main aim is to to provide a **structure of a preliminary analysis method** for urban planner professional figures that is based on the correlation of objective and subjective aspects. This correlation could be the basis of a conscious and participatory urban planning, an urban design that places the citizen at the center.

The interdisciplinarity approach of WSP allows, not only to involve technical aspects such as acoustics or lighting from the Energy Department DENERG “Galileo Ferraris” of Polytechnic of Turin, but it also incorporates the Department of Technological Investigations of the City of Turin, the University of Turin with the Departments of Psychology and the Departments of Semiotics and Mass Media.

The research was considered worthy by the city of Turin and it is sponsored by the **City of Turin**, the **Polytechnic of Turin**, **Iren S.p.A.**, the **Italian Lighting Association AIDI**, the **Circumscriptions** 5, 6, 7 and 8 of the City of Turin and it is supported by the **Italian Association of Acoustics AIA**. This research was the subject of a talk about urban safety at the first **TEDx Polytechnic of Turin** conference on the topic of Safe&Sound.

Walk Safe Project

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AIDI Associazione Italiana di Illuminazione

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AIA Associazione Italiana di Acustica

A

INTRODUCTION

SEMIOTICS

human behaviors and physical dimensions in order to explain urban safety perception

Definitions

The behaviors and relationships between people are changeable on the basis of many factors. Is the environment in which they are inserted involved in this process? Do it exist a method that suggests how to interpret the conventional gestures that humans constantly exchange one another? The researchers of this thesis considered useful to briefly introduce the field of study in argument. Semiotics is the discipline that study

> "*the capacity to create and use signs such as words and symbols for thinking, communicating, reflecting, transmitting and preserving knowledge*" (Danesi, 2017)

It can be considered the science that let us to associate one or more meanings for every sign. Let's start with introducing what it means by sign. **Sign** is 'something' that have a structure, called text, and could be perceived by people not as objects in themselves, but as standing for something other than themselves, distinctive, recognizable, and recurring one. This is something indissolubly linked to history and culture because conventional uses of certain sign or historical reason behind a sign. For example the 'V' for victory shape formed by fingers was introduced after the end of second world war.

But there are also practical uses of sign, for example those two fingers previously cited have practically meaning for the number two. The production of human meaning is composed by recurrent models and one of the purposes of semiotics is to give shape those ones.
Explaining how semiotics occurs, **two models** can be introduced in order to associate **signification**, supported by as many theorists. The first one is Ferdinand de Saussure, that in 1916 define semiotics as the science that studies the life of signs in the context of social life. He also suggests the subdivision of meaning into **signifier**, such as the sounds that make up a word, and **signified**, the concept that the sign elicits. To him it also owes the interdisciplinary orientation of semiotics because the claiming that semiology should be considered a part of psychology and linguistics a part of semiology.
In other hand, a second interpretation model has represented by Charles Sanders Peirce and his interpretative semiotics. According to this theory, meaning is attributed to the world, reading everything as signs (not only artificial languages such as writing and icons). In these terms a certain perception of light, color, sounds, architecture can contain interpretable elements. He divided the meaning into three components: the physical sign, called **representamen**, the thing to which it refers, the **object**, and the interpretation of it in real-world **interpretant**. The semiotics have also to face with two functions that make meaning or signification: **denotation** and **connotation**, both derived by Latin word *notàre* that means *to note*. The denotative function is that which links a given signifier (word, design, sound) to an objective meaning, which is recognized as a sign. For example, the letters / l e a f / indicate that part of the plants, usually in the form of lamina and green, which has above all the function of organizing the carbon and eliminating, through transpiration, the excess water. The connotation uses an existing sign as a signifier to which it attributes a further meaning; for example, the leaf (as a sign) connotes nature or the environment or life, depending on the context.
In 1975, Umberto Eco treat semiotics as a traditional science evidencing autonomy of the discipline, the presence of standardized methodological tools, the capacity to generate hypotheses about semiosis, the possibility of making predictions and can lead to a modification of the actual state of the objective world. The signs learned in social contexts are selective of what must be known among the world. Marcel Danesi highlights the paradox in the fact that the human kind changes, expands, elaborates and discards the habits of thought impressed on sign systems, constantly creating new signs to codify new knowledge and modify previous ones. (Danesi, 2007)
All these informations indicates that the meaning of a sign is **not linear and always pre-established**, but may be subject to several connotations. It is easy to deduce that some characteristics of light, sound, architecture or personal distance can therefore transmit security or insecurity effects. Moreover, these effects depend on the interaction of the signs between them, and therefore according to the context in which it is found. As was introduced in the definition of a sign, in semiotics context is indicated with the text, or the boundaries within which a set of signs produces sense together. Books, movies and songs are texts, but also a space (like a square) or smaller units, like a book chapter or a street can be.

Proxemics

The Proxemics is the semiological discipline that studies gestures, behavior, space and distances within a communication, both verbal and non-verbal. Thanks to these studies it is possible to understand how the perception of safety develops in human beings and how the design process can remedy this negative perception. In sociology and psychology, the proxemics is "*the study of the spatial requirements of humans and animals and the effects of population density on behavior, communication, and social interaction*".
The term was coined by Edward Hall when explained "*the interrelated observations and theories of man's use of space as a specialized elaboration of culture*". (Hall, 1966) He theorized that space was generally used in different way due the **interpersonal type of interaction**. He discretized four different space zones (as public, social, personal and intimate space) that changing for distance between the subject and people that interact with him. In chapter X it was explained that intimate is space for lovers, touching and whispering goes from zero to six to eighteen inches. From one and half to four feet of distance it is called personal distance and it is limited to interaction between good friends or family. Social space, between four to twelve feet, is dedicated to acquaintances. Finally, from twelve to twenty-five feet and more is public space used for public speaking.
Every interaction between man and space use two **type of receptors**, divided into distance ones (eyes, ears, and nose) and immediate ones (skin and muscle). Each zones has peculiar use of receptors. For example in **vision** change the way in which people look each other into the eyes or not, or in **sound** change the tone of voice used. The haptic interactions are different, the habit of touch one another during interaction and the way in which this contact sussist, and so on. (Hall 1963) It is also evident that this **structure of space** that surround every person is something related to culture. Hall developed his hypothesis starting from the theory of Edward Sapir and Benjamin Lee Whorf that the **language structure** of every culture influence so much the human mind that people from different culture has different way to perceive and conceptualize the world i.e. they perceive colors differently. (Kay and Kempton 1984) Consequently, people behaviors are something that not depends only by experiences in which everyone is in because that are borrowed from a perceptive filter. Hall studies was applied mainly to American culture, but he also studied animal behaviors and last part of the book was dedicated to differences in other cultures comparisons. Heini Hediger, a Swiss biologist from the 1900s,

has studied animals and explained other important distance of interaction between species. He called it the flight distance and it is the space that the individual must hold between himself and a potential enemy that allows him to escape in case of danger. (Hediger 1955) It is generally directly proportioned with animal size and humans are no exceptions. At page four "*both man and his environment participate in molding each other*" is a clear affirmation that also the **world surrounding** affect people's spatial behaviors and vice versa. The Hidden Dimension close with some **open questions** and suggestions, like the necessity to measure human scale dimensions, finding a method to transpose constructively the ethical enunciations, conserving open outdoor spaces in cities and preserving old building and neighborhood from urban renewal. This category of semiotics relies heavily on ethnography, "*the scientific description of peoples and cultures with their customs, habits, and mutual differences*", and ecology, "*the branch of biology that deals with the relations of organisms to one another and to their physical surroundings*", trying to find a sense of them. The theoretical and philosophical contribution of the source is undoubted, but the author did not give scientific information useful to be used stand alone because lack of results. (Fabbri, Hall, and Eco 2005)

It is important to understand in which phase to **design process** is possible to insert proxemics considerations, without however making the mistake prevail form over function. Configuring spaces for the same functions in France or Japan should requires the identification of totally different meaning values, but if this were so architecture would be something subject to obsolescence depending on cultural changes in progress. Umberto Eco tried to free the architecture responding that design process will have to realize that its problem is not to build forms with a more precise and clearer but on the contrary, forms as available as possible to different meanings. (Eco 2016)

However, rather than focusing on dimensions and morphology, the aim of this thesis is to act on the **environmental characteristics** like artificial lighting and sound of urban areas and to understand how the studies carried out on proxemics can explain the feeling of insecurity in the cities on the basis of human behavior and cities spaces.

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LIVINGSCAPE

principal characteristics for citizens quality of life in order to explain the importance of surrounding environment in urban safety perception

The life quality of people that live in urban areas depending, as well as countless other factors, by physical characteristics of the environment that surround them, thanks to these it is possible to understand how the perception of safety develops in a specific community and how the **surrounding environment** is important for this perception.
The term *livingscape* comes from previous studies on *livability*, in fact while the latter deals with all aspects of living, the first focuses mainly on aspects of the environment (just from landscape). Partners for Livable Communities defines Livability as

> "*the sum of the factors that add up to a community's quality of life—including the built and natural environments, economic prosperity, social stability and equity, educational opportunity, and cultural, entertainment and recreation possibilities.*" (Partners for Livable Communities, 2019)

The term livability has many meanings, in fact in its the multiple definition the significance varies according to geography, to resident perception, to region or to community. The theme of livable cities is very important in US in fact the main definitions are all American.
Secretary LaHood argues that "*Livability means being able to take your kids to school, go to*

work, see a doctor, drop by the grocery or post office, go out to dinner and a movie, and play with your kids in a park, all without having to get in your car" (Gehl Svarre, 2013) , while American Institute of Architects defines that "*Livability is best defined at the local level. Broadly speaking, a livable community recognizes its own unique identity and places a high value on the planning processes that help manage growth and change to maintain and enhance its community character*". (The American Istitute of Architecths, 2005)
Strategic plan of U.S. Department of Transportation talks about communities saying that "*livable communities are places where transportation, housing and commercial development investments have been coordinated so that people have access to adequate, affordable and environmentally sustainable travel options*" (U.S. DOT Strategic Plan, 2010) while Secretary Osborne says that "*livable communities have transportation options, housing options, destinations nearby, and save money for families and taxpayers*". In America, as mentioned before, livability is a critical topic, in fact FHWA Federal Highway Administration, FTA Federal Transit Administration, HUD U.S. Department of Housing and Urban Development and the EPA U.S. Environmental Protection Agency creates a Partnership for this theme. In June 2009, Secretary LaHood, Secretary Donovan, and Agency Administrator Jackson announced the Interagency Partnership for Sustainable Communities. The interagency have **six principles to act for livability** and it aims to help America's neighborhoods to become safer, healthier, and vibrant.

The six Livability Principles are:
"*1. Provide more transportation choices. Develop safe, reliable, and economical transportation choices to decrease household transportation costs, reduce our nation's dependence on foreign oil, improve air quality, reduce greenhouse gas emissions, and promote public health.*
2. Promote equitable, affordable housing. Expand location and energy efficient housing choices for people of all ages, incomes, races, and ethnicities to increase mobility and lower the combined cost of housing and transportation.
3. Enhance economic competitiveness. Improve economic competitiveness through reliable and timely access to employment centers, educational opportunities, services, and other basic needs by workers, as well as expanded business access to markets.
4. Support existing communities. Target Federal funding toward existing communities through strategies like transit oriented, mixed use development, and land recycling to increase community revitalization and the efficiency of public works investments and safeguard rural landscapes.
5. Coordinate and leverage Federal policies and investment. Align Federal policies and funding to remove barriers to collaboration, leverage funding, and increase the accountability and effectiveness of all levels of government to plan for future growth, including making smart energy choices such as locally generated renewable energy.
6. Value communities and neighborhoods. Enhance the unique characteristics of all communities by investing in healthy, safe, and walkable neighborhoods rural, urban, or suburban."

(HUD, 2019) After this it is possibile to say that livability is a a set of aspects and skills and, in order to this, is essential to **design the city** incorporating **livability planning** to create more efficient land and to improve the quality of urban life.
Quality of life is one of the most important theme for those who live in a city, in fact we talk about improving urban quality more and more often. This is possible by improving the quality of the **physical elements** (air, light, noise, etc.), **social elements** (accessibility and travel, public and private services, etc.), **psychological elements** (security, landscape, etc.); indeed we talk about **urban and architectural decay**, **soundscape**, **lightscape** or **thermicscape**.
The evaluation of environmental aspects includes objective and subjective parts, while the first are the **physical aspects of city**, the second one are the **perceived aspects from citizens**. Perception is fundamental to study cities' environment and it is also important to contribute to the future planning of urban areas. Urban life quality is also measured in terms of sustainability, energy and water savings, and of construction of residential and tertiary-commercial buildings.
To investigate livingscape an important work is the one of La Malva that consist of analyzing three aspects of urban quality in a Turin district: urban architectural blight, psychometric tools and environmental quality (sound, light, thermic and indoor air quality). This research investigate urban quality with in-field survey and in-field measurements in San Salvario, a historical district in Turin; in this districts thirteen key spaces (node, paths and edges) were selected and the area includes ten streets, two squares and an arcade. The in-field survey consists in 51 items in two different sections: general information as age or gender and judgments on perceptions of environment (light, acoustic, thermal and air quality). (La Malva, 2011) In the basis of these datas collected, a factorial analysis singled thirteen factors: *1. Architectural and urban features - visualized space, 2. Security - Social features, 3. Social services - Functional features, 4. Maintenance and care - Setting features, 5. Transports - Functional features, 6. Practiced space - Architectural and urban features, 7. Psychological state - Setting features, 8. Commercial services - Functional features, 9. Affection for the district and urban identity, 10. Urban cleanliness - Setting features, 12. Education and behavior - social features, 13. Decoration - Social features.* (La Malva, 2011) The result of the study shows that some of the blight factor are correlated with sound and light environment and partially with thermal environment.
So livingscape is composed by **physical and objective aspects of city** and by **perceived and subjective aspects of citizens**. For this last it is important the residential environment, in fact according to Bonaiuto and Fornara, "*The quality of the urban environment (and of the residential environment in particular) is a key factor influencing people's overall quality of life, although it tends to rank lower (in terms of importance in the overall quality of life) than do items such as leisure activities, economic conditions, work,*

friendships, and marriage/family life". (Bonaiuto Fornara, 2017) It is necessary to investigate the residential satisfaction, that is the evaluation of the residential environment that "*can be defined as the experience of pleasure or gratification deriving from living in a specific place, that is, the global assessment that inhabitants give of their housing that can be considered at various levels of scale (eg, house, building, neighborhood)*". (Bonaiuto Fornara, 2017) This research is based on the psychological construct of attitude with the components of cognition, behavior and affect and it measures residential satisfaction with two important constructs that are place attachment and perceived residential environment quality (PREQ). The first refers to the people's feeling about their homes or their neighborhoods, while perceived residential environment quality PREQ refers to evaluation of people of the range of quality and it can be investigate with answers as *Buildings have unpleasant colors* and *The air is clean*. So, in order to design cities on the basis of livability, it is useful to take into account the objective aspects and the subjective aspects, in fact Liveable Cities five-year program was created with the view of "*designing and engineering UK cities that take cognizance of one planet living, one world resources and individual and societal wellbeing*". (Liveable Cities, 2019) This program creates a decision-making method for architects, planners and engineers called the **Liveable Cities Method (LCM)**; this last has four principal criteria: individual and societal wellbeing, resource security, resource efficiency, and carbon emissions. A study about this LCM is the work of Leach, Sanchez, Rogers and Tyler that illustrates the application of this method to the city of Birmingham in UK through the nine-step of LCM. (Leach et all, 2019) According to scholars, "*the Liveable Cities research programme (liveablecities.org) set out to transform the engineering of cities by ensuring that radical engineering solutions to the problem of engineering future sustainable and liveable cities take into account the human dimensions of living and working in a city including quality of life, wellbeing and citizen aspirations*". (Leach et all, 2019)

Finally it is possible to say that livingscape is significant to understand how the perception of insecurity develops in citizens, in fact to design livable cities is essential create an **integrated and multi-disciplinary methodology**. So the aim of this thesis is to investigate the environmental characteristics of the selezionate portions of city and the subjective characteristics of citizens, in order to understand how the quality of life can influence the feeling of insecurity.

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URBAN SAFETY

definitions, perception, regulations and its relationship with the design process

Definitions

Today one of the main psychological engine that moves crowd has represented by worry and fear. This can have strong effects on the lives of citizens who inhabit urban environments and it is important to understand the impact of this worry on people's perceptions of security.
In opposition to that feelings of fear, we all looking for the condition that makes to be free from danger and gives the chance to prevent, eliminate or reduce serious damage.

> *'Secure' is derived from Latin securus, that is freedom from care: se is without and cura is care.*
> *'Safety' is from Old French sauvete, from medieval Latin salvitas and from Latin salvus that is safe.*

Globally, there are three terms to express all these concepts: *safety, security and emergency*.
Into Italian language, *sicurezza* is the term that brings together two different concepts expressed by English words *security* and *safety*.
Security corresponds to protection from acts that could harm things or people, it is more a matter of study and management of preventive measures. It comes from the Latin *sine cura*: a composed word with sine that means without, no or absence, and cura that is the idea of worry,

concern or care. Literally it can be defined as the knowledge that any action will not be harmful to ourselves and others. Instead **safety** is more related to human conditions; it is understood not only by physical harm, but also by moral and spiritual damage. Finally, the word **emergency** is a set of social security activities put in place when the task of security is not enough to protect people, so the emergency concerns the protection and containment of the danger with the support of law enforcement, fire department, civil protection and so on.

Another security definition is the subdivision of the concept into: *safety, insecurity* and *uncertainty*. "*Uncertainty concerns the future, insecurity concerns the fact of knowing how hard and fast is your life and also your identity: you can be challenged, you can be forced to change, but safety, concerns the very integrity of your own body*." (Bauman, 2002) The total security is the absence of danger but obviously it would be unthinkable not taking account it into urban strategies. The application of standard guidelines and norms make this context easier and also the occurrence of harmful events difficult. This always translates into a better quality of life.

Within this research the terms *security* and *safety* are used, the first for for terminologies related to regulations, while the second for perception, or all the feelings related to the human being on this specific topic. The perception of safety is the main theme, so it is useful to understand the mechanism of perception.

Perception of safety

Especially in this historical period, objective security condition and perception of it, safety condition, are two different concept that rarely coincide. "*Perception is generally defined as the knowledge gained by perceiving or becoming aware of something via the senses. Obviously, perception is not just about seeing or hearing something; perception involves making sense of the information.*" (Thakur, 2019) According to Thakur, it is a mental process that is not easy to explain because it is not only a purely physical and mechanics condition.

The **perceptive process** is a neural activities, so neurons "*get into excited state when they absorb energy received from the sense organs in the form of electrochemical signals. This is all that happens in the brain. However, experiments in neuroscience have shown that this activity is not enough to project the information in the physical form. Information is projected in the form of images, sound, touch, taste, and smell only in the state of mental alertness.*" (Thakur, 2019) So the perception includes all the characteristics of an individual through different mental processes. In fact the **mental representations** underlie the perceived reality of users; it is a cognitive representation and a cognitive symbol that represents external reality. So reality can be objective, that is the scientifically demonstrable datum, or subjective, that is the perception of the first one. The Technological Age allows a different perception of the objective reality because the user responds to an uncountable quantity of stimuli and therefore provides a re-elaboration of the **objective reality**, that is transformed into a **subjective reality**. According to Ricci the perception of individual, ie subjective reality, is not necessarily congruent with the real fact, ie objective reality, in fact this is the **perceptive dissociation process**. (Ricci, 2019) Indeed the representation is the activity of represent with symbols or other processes some aspects f reality. (Ricci, 2019) The representations are strongly connected to the inputs received from the users, so in this society full of inputs, there are multiple aspect of reality by each one.

Mental representations are the basis of human perception and, according to McCarthy, all the images that individuals collect and incorporate through direct or indirect processes are nothing more than mental representations. (McCarthy and Wright, 2004)

Human perception does not depend only on mental representations, actually the perception in conditioned by the mental representation about spatial, social or cultural context. (Ricci, 2019) These go through two fundamental processes, described by Moscovici: *anchorage* and *objectification*. (Moscovici, 2005)

While the former plans to assimilate the stimuli, to put them in the same circle of already known stimuli and to overcome fear of the unknown, instead the second one provides for the concretization of these in order to be able to bring them to a more concrete reality. Human beings need to make stimulus familiar in order to feel safe from any risk, so the mental representations produced are closely related to the everyday world and are often the result of human socialization.

Starting from childhood, the social sphere is the first place in which an individual meets the regulation processes of mental representations. The link between mental processes, the representation of these processes, and the social environment is indissoluble. It was object of study by two French psychologist, Latané and Darley, that gave a test to Columbia University students to compile with the aim to demonstrate the social influence in perceived reality. (Latané and Darley, 1968) The changes in the answers or the social influence can be in part explained by the *priming effect*; it is the implicit memory effect whereby the exposure to a stimulus influences the answer to a later stimulus: in this way people can influence the response to a stimulus because they had similar input in the past and they remember the mental mechanisms of the past.

Therefore on the basis of all the studies carried out to understand the process of perception, it is possible to affirm that the perception is dependent on **people individualization**, **social environment** and **historic process of the stimuli**. All these personal and social factors are not the only players in the perception process; in fact perception is also influenced by **mental mechanism of perceptive dissociation** mentioned before. It can be defined as the phenomenon that causes a gap between what the individual assimilates and what it encodes, consequently there is a separation between objective reality and subjective process.

This estrangement dissociation is present in nowadays society indeed more and more peo-

ple have a distort image of contemporary world in which live in powered by social medias that interpose between reality and perception of it. Another well-known phenomenon linked by social medias is called **object transfiguration**. According to Ricci the event has not a relevant statistic significance in a larger context such as the globe, so the process of media can amplificate the form and consequently the perception. (Ricci, 2019) Differently from before, the information about reality is no more direct but there is a decontextualzzated from spatial areas. This aspect is the basis for perceptive dissociation because informations can quickly reach each everyone with media and can expand mental representation.

This contemporary media policy lays the foundation for perceived insecurity in the population. The perception of safety is a mental representation of the reality gives by media. The mental image can be objective as fear of virus or can be subjective as hypothetical facts based on the media. These kind of imagined conditions contribute to aggravate the perception of safety.

Mass media effect on safety

The mass media's interest in security and safety topics is quite evident, in fact the dynamics between news and security or safety emphasize the perception of this last one. The media message is that the places where we live are dangerous, they talk about offenses, attacks, thefts and they focus our attention on words like decay, criminality, crime and so on. Therefore the result is that public opinion focused on crimes but don't look into statistic: for a common citizen, it is more likely to have a car accident than to fall a victim of a violent action. (Istat, 2004) It is reasonable to think that mass media or social media in the last few years play a role in the construction of perceived safety.

Communication research has always focused on how the media can influence the public and their mental representations, the *hypodermic needle model* explain this: the theory, knows as magic bullet theory, is a model of communication that considers the mass media as powerful persuasive tools that act directly on a mass; this sees communication as a direct process of stimulus and response. (Lasswell, 2013)

With mass media and social media, the big data analytics based customization uses this notion to influence the crowd. Nowadays we focus on the consequences of prolonged exposure to medias, indeed their messages are able to alter the perception of reality; that brings us back to the mental representation and the perceptive dissociation mentioned before.

Studies about perceived safety

The perceptive dissociation is object of study by University of Milan that, with a sociological research, want to investigate perceived safety in the Municipality of Pregnana Milanese. (Ingrascì, 2017) The methods used in Pregnana include interviews with administrations and citizens, who have identified the **fear of criminal acts**, specifically thefts, and the **characteristics of the environment** as the main cause of the perception of unsafety. Pregnana administrations are very active for citizen, in fact they have implemented numerous initiatives in order to combat the sense of unsafety, such as promotion and encouragement of urban murales in default city zone. This last solution is important because it states how **urban and architectural decay** can influence the perception of the citizens; another factor that proves it is the mark of smash-and-grab that have not been repaired and have a negative impact to citizens. The sense of unsafety and the fear are well faced by the Municipality, but, as evidences by interviews, the citizens lost faith in the institutions. This loss of confidence is also due to the role of social media, in fact the administrations have noticed that social post comments encourage people to be more scared and, therefore, to be more prejudiced against others.

To investigate the perception of security against the actual security situation, Istat has documented a research paper into *La sicurezza dei cittadini* from 2015 to 2016 on a sample of 50.351 citizens. (Istat, 2018) The research shows that sentiment of unsafety is influenced by not only crime levels, but also by the fear of falling victim of a crime that could have serious consequences for themselves and their families. Istat, on the basis of this, divides security into macro-groups: **street safety** (walking alone in the street when it's dark), **perception of crime risk**, **evaluation of the police control**, **systems or behaviors adopted for defense**. The citizens characteristics that influence the perception of safety are the **gender**, **age** and **educational qualifications**. Indeed women are 35.3% more afraid of going out alone at night, compared to 19.3% of men. Unsafety also increases with age, in fact the elderly declare that they do not go out alone at night because of the fear of crime. The qualification enables to acquire greater security, those who have a higher educational qualification feel safer. The socio-environmental decay is identified through factors such as the presence of vagabonds, prostitution and people who use or sell drugs. It is also added the presence of degraded areas and the absence of lighting. The answer about police controls is negative because there is a **loss of confidence in the authority**, in fact 46.4% of the respondents gave a negative response; all citizens are asked how many times they have seen patrols of control or the presence of police in their street. During the analysis, the protection behaviors adopted by the interviewees are also investigated and, than in previous years, there is an higher use of **security technologies** such as alarm system or video security, against the old behaviors such as light during absence or control of neighbors. Finally the research claims that nowadays the feeling of unsafety is greater, despite the fact that the crime statistics remained almost unchanged. (Istat, 2018)

The perceived safety is a very important topic in recent years and it is a sentiment that varies, as said before, on the basis of gender, age and qualification. On this last, Moschi carried out his research. The aim is to identify the differences in safety and its perception among students of different degree courses, in fact **university**

education affects the perception of reality and changes students' problem solving about the situation investigated. (Moschi, 2013) The study found that the degree course, the years of the course and the type of studies influenced the sentiment of safety. The students proposed various solutions to the problem of unsafety that can be divided into two groups: **repression solutions**, such as "*the possibility of possessing weapons to defend oneself privately and to organize rounds of armed citizens*" (Moschi, 2013) and **prevention solutions**, such as "*the importance of promoting figures such as the neighborhood avenue [...] on aid to victims, on the recovery of people at risk, on education to legality, on enhancing the safety culture*". (Moschi, 2013)
The urban and architectural decay theme is identified by many respondents, especially in the Sociology and Criminological Sciences degree courses, as an element that feeds the unsafety of citizens and in fact, they propose among the solutions, the redevelopment of neighborhoods and buildings. The research finally claims that in a context with many different spaces and multiply relationships, the **sense of fragmentation** is higher and therefore the consequences are deleterious, not only in terms of morphology and urban structure, but also on the social and human level. (Moschi, 2013) So the identity of individuals tends to waver in the modern era as we go from *We* understood as collective identity, family, community to an *I* as individual with their own mental representations. Institutions represent a reference for this last but, the lack of confidence in these, brings society into an **ambivalent reality**: on one hand there is the desire to identify with something such as a community, on the other hand there is a society that promotes individual life based on estrangement. (Ricci, 2019) For this reason it is important to define how the state can support citizens.

The role of the State in urban safety

Nevertheless to understand this theme it is crucial to take a step back and look to the picture of security. According to Robert Castel, the historical configurations of the sense of safety start from pre-modern times, when it was seen as belonging to a community capable of protecting members through bonds of dependence. (Castel, 2011) Thomas Hobbes, author of the work *Leviathan*, firstly spoke about them which he defines as *society of total insecurity* because the members of society live a permanent threat due to the inability to protect themselves. (Hobbes, 2011) According to Hobbes, power is the source of protection, security and safety, these aspects with effective power is the State; but when individuals are no longer connected to community, they place value on property. (Hobbes, 2011) Public security is in conflict with the type of State, in fact the more a State moves away from Leviathan and the more it loses protection; all this happens because in a democratic state the bureaucratic procedures do not fully guarantee the protection of individuals. As Rousseau said, all citizens should be virtuous, so a democratic state can protect individuals and their assets, but this is not possible so the safety and security question became e request for authority. This leads to the contradiction of modern world, that search for **total protection** and at the same time justice in all fields. The protection sought by men are divided into two groups: **civil protection**, that have the task of ensuring essential freedoms and **social protection**, that have the task of protecting from the risks that could cause social degradation.
Insecurity or unsafety is not necessarily in opposition to protection, in fact the perception of unsafety in modern society is not the absence of defenses but the life with it; protections therefore produce, according to Castel, *security frustration* that is the frustration perceived because the defenses are not fully efficient. (Castel, 2011) The re-emergence of unsafety depends on the individualization of citizens excluded from social dynamics, increasing unsafety is therefore due to this feeling of abandonment perceived by non-dominant social groups. According to Castel, in order to find a solution it is fundamental to denounce the **inflation of safety** and to affirm the **importance of protection**. (Castel, 2011) The first one is about the absolute protection and how it is impossible to have, while the second one is the importance of protection for individuals.
Protection, social isolation, urban violence and lost of confidence in authority are some of the many safety topics that are often discussed in our society, indeed the issue of public security has undergone a lot of transformations in modern society, so it tried to adapt to contemporary threats. Insecurity and unsafety are mainly an urban problem because in cities there are social expulsion, drug addiction, disintegration of social relations and so on. According to Lourenco, the concept of urban violence it is the passage from an action of incivility to a crime. (Lourenco, 2012) At the end unsafety construction is based on two different factors: **individual reality** and **community reality** and, based on these, there are two insecurity reactions: **fear of a violent crime** and **concern for social order**. (Lourenco, 2012)
The city and the State have a role in identifying insecurity and unsafety in urban reality because they can eliminate social exclusion and can prevent violent crime. Precisely because the theme is increasingly present in recent years, the state has committed itself to standardizing many aspects that contribute to the feeling of insecurity and that are part of urban security.

Urban security

The issue of security or safety in the urban context is called *Urban Security*, which in this case does not include the part of perception.
It is a human good and a human right to protect and to guarantee the **well-being** of citizens and the **livability** of the urban context. The United Nations Human Settlements Program UN Habitat incorporates into urban security concept all questions about **primary needs** and **collective needs**; the basic needs are food, health and housing, while the collective needs relate to protection from crime, corruption, risk of eviction and calamities. (UN Habitat, 2007)

The urban security, according to UN Habitat, are based on three different factor: **criminality and violence**, **protection from eviction** and **protection from calamities**. Criminality and violence are related to cultural and social component such as poverty or the high rate of urbanization, protection from eviction is the deprivation of the security of tenure right and lastly calamities are sudden events that generate dangerous consequences for economy, politics, culture. (UN Habitat, 2007)

WHO-5 protocol for safety

Urban security, as mentioned before, is important to guarantee the **well-being of citizens**; in fact it is precisely for this reason that it is important to deepen the WHO-5 protocol that deals with the topic of well-being.
WHO Regional Office in 1998 presented in Europe the WHO-5 Well-being Index with five items. These aims to measure the **quality of life**, are only positive sentences questions and are based on the respondent's feelings over the last two weeks before. The items are: *I have felt cheerful and in a good spirits, I have felt calm and relaxed, I have felt active and vigorous, I woke up feeling fresh and rested and My daily life has been filled with things that interest me*.
The raw score is calculated by adding the numbers of the five answers, it varies from 0 to 25, where 0 represents the worst possible quality of life and 25 represents the best possible. The **Well-Being Index**, to obtain a percentage score ranging from 0 to 100, is calculated by taking the sum of the scores (the raw score) of each item and multiplying it by four to obtain indices ranging from 0 to 100. A percentage score of 0 represents the worst possible quality of life, while a score of 100 represents the best possible quality of life.(Psychiatric Research Unit, 1998)
For this research it is very important to consider the wellbeing of individuals as this could negatively or positively influence their perception of the surrounding environment and their relative perception of safety.

Urban security laws in Italy

In order to get an urban environment with a low perception of unsafety and with the decrease of dangerous events, must be defined a regulatory framework that is able to regulate behavior and implement useful strategies.
Urban security topic is landed in Italy about twenty years ago, while in Europe the United Nations has a program for security in the cities since 1996, UN-Habitat's Safer Cities Programme.
In Italy the **first definition of urban security** is in the Minister of the Interior's Decree of 5 August 2008 D.L. 92/2008, where urban security is "*un bene pubblico da tutelare attraverso attività poste a difesa, nell'ambito delle comunità locali, del rispetto delle norme che regolano la vita civile, per migliorare le condizioni di vivibilità nei centri urbani, la convivenza civile e la coesione sociale*" ("*a public good to be protected through activities aimed at defending, within the local communities, respect for the norms that regulate civil life, to improve living conditions in urban centers, civil coexistence and social cohesion*").
From the nineties onwards in Italy there is the theme of urban security as result of the inhabitants revolt of the historic Genoa center in 1993 and of the revolt in the San Salvario district of Turin in 1995: citizens forms spontaneous committees with the aim of denouncing the degradation conditions and shake local Institutions.
The issue of security is not only linked to the growth of micro-crime or organized crime, public policies indeed have to consider the feeling of unsafety of the population.
From the 1990s onwards there is the **season of collaboration** between local authorities and the state; in fact in 1994 the Emilia Romagna Region made the first national security project, called *Safe City*.
In 1996 the *Italian Forum for Urban Security FISU* (*Forum Italiano per la Sicurezza Urbana FISU*) was born in Rome and in 1998 there was a Protocol between the Municipality and the Prefecture of the city of Modena, the first of Italian *Protocolli di Intesa*. Sixty protocols will be stipulated in Italian cities in the following years, all of these based on the main aspects of Modena protocol: these aspects shall provide that the security right is guaranteed, that security is the responsibility of State and that representing the citizens' security demand is the responsibility of the municipality. The collaborations between the various cities and the State provide for a collaboration between the police and the municipal police, an annual report about security, an analysis of emerging manifestations, introduction of the *vigile di quartiere* figure, various initiatives about safety and integration of immigrants.
In the D.Lgs. n. 279/99 *Disposizioni integrative del decreto legislativo 31 marzo 1998, n. 112, in materia di composizione e funzionamento del comitato provinciale per l'ordine e la sicurezza pubblica* there is a Committee that deals with the coordination of the different subjects about the security theme; while in D.P.C.M. of 12 September 2000 *Individuazione delle risorse finanziarie, umane, strumentali e organizzative da trasferire alle regioni ed agli enti locali per l'esercizio delle funzioni e dei compiti amministrativi in materia di polizia amministrativa* defines a regulatory framework for the inter-institutional collaborations so that it encourages dialogue between different administrations.
The State thanks to the *Bassanini Laws* introduces a **decentralization of skills**; in fact the administrative functions went from the State to the Regions and consequently to the local authorities.
From 2001 to 2005 the regulatory framework had a lot of changes, there was a **period of reforms** and collaboration between the public bodies. The *Protocolli di Intesa* between the Prefect and the Mayor are very important, in fact in Italy there are 124 protocols; on the basis of this, are introduced institutional program between Regions and State and also between Provinces and State. At the municipal level, it is established the *neighborhood Policeman* (*poliziotto di quartiere*) to ensure control in the cities' areas and to prevent citizens' insecurities.

In 2003 there was a proposal for a national law about the coordination between the State and the local authorities with *Disposizioni per il coordinamento in materia di sicurezza pubblica e polizia amministrativa locale, e per la realizzazione di politiche integrate per la sicurezza*. During this period two regulatory measures are also drafted: constitutional law October 18 of 2001, n. 3 proposes solutions for the increase of social alarm and Law 128 of 2001 *Interventi legislativi in materia di tutela della sicurezza dei cittadini* proposes the plans and the activities related to security are responsibility of the Minister of the Interior.

From 2006 onwards the government of local authorities are put above everything, in fact there is a **new political tool**: the *Pacts for Security*, art.1, co. 439 of financial law for 2007 that aims to eliminate degraded urban areas, respecting the competences of local authorities and integrating the security policies. In Turin the *Pact for safe Turin* (*Patto per Torino sicura*) is stipulated on May 22nd 2007.

Since 2008 greater powers of ordinance have been conferred on the figure of the Mayor thanks to article 6 of the decree-law of 23 May 2008, n.92 *Misure urgenti in materia di sicurezza pubblica* or *Security Package*.

Finally, in 2009, the collaboration of unarmed citizen associations, called *ronde*, was confirmed by paragraph 40 of the law of 15 July 1009 n.94 *Disposizioni in materia di sicurezza pubblica*.

The legislative decree 14/2017 defines for the first time the difference of the terms of **integrated security** and **urban security**: "*si intende per sicurezza integrata l'insieme degli interventi assicurati dallo Stato, dalle Regioni, dalle Province autonome di Trento e Bolzano e dagli enti locali, nonché da altri soggetti istituzionali, al fine di concorrere, ciascuno nell'ambito delle proprie competenze e responsabilità, alla promozione e all'attuazione di un sistema unitario e integrato di sicurezza per il benessere delle comunità territoriali.*" (Decreto Legge n.14, 2017)

"*si intende per sicurezza urbana il bene pubblico che afferisce alla vivibilità e al decoro delle città, da perseguire anche attraverso interventi di riqualificazione e recupero delle aree o dei siti più degradati, l'eliminazione dei fattori di marginalità e di esclusione sociale, la prevenzione della criminalità, in particolare di tipo predatorio, la promozione del rispetto della legalità e l'affermazione di più elevati livelli di coesione sociale e convivenza civile, cui concorrono prioritariamente, anche con interventi integrati, lo Stato, le Regioni e Province autonome di Trento e di Bolzano e gli enti locali, nel rispetto delle rispettive competenze e funzioni.*" (Decreto Legge n.14, 2017)

The issue of urban security has always been an issue of urgency in the last ten years, in fact the major measures are **urgent regulatory measures**, the most important of these are:

- D.L. 92/2008 Security package
- D.L. 94/2009 Provisions on public safety
- D.L. 187/2010 Urgent safety measures
- D.L. 14/2017 Urban safety
- D.L. 113/2018 Legislature on security and immigration

(D.L. 92/2008 Pacchetto sicurezza, D.L. 94/2009 Disposizioni in materia di sicurezza pubblica, D.L. 187/2010 Misure urgenti in materia di sicurezza, D.L. 14/2017 Sicurezza urbana, D.L. 113/2018 Legislatura in materia di sicurezza e immigrazione).

The legislative decree n.14/2017 comes through ten years from the decree n.92/2008 which reported the first security package and it identifies the limits in integrated security management measures based on **three basic lines of intervention**: the first is a series of preventive measures for integrated security, the second defines new union powers and finally the third introduces personal prevention measures. The first is based on the importance of the Pacts and the coordination of the various institutions; in fact this legislative decree regulates methods and tools for coordination between State, Regions and Local Authorities on public policies for the promotion of integrated security.

Already before the law n.121/1981 introduced the importance of the collaboration between the local administrations, while the law n.65/1986 established a collaboration between police of state and local police; other previous laws are the Ministerial Decree of 12 September 2000 and Law 296/2006 that introduced the collaboration of the State, Regions and Local Authorities and the increase in police services for urban security.

The Decree 14/2017 introduces the coordination tools for integrated security and for collaboration between the state and police forces; it also provides for the creation of the Metropolitan Committee for Urban Security. The second intervention is the reform of the union power for urban security; the decree proposes to define areas of intervention to avoid the doubts of the previous 2008 security package. On the basis of this, the areas of intervention of the Mayor are delimited. The third intervention introduces two personal prevention measures: the removal measure which is the responsibility of Mayor and the access prohibition measure which is the responsibility of Commissioner. These aspects of personal prevention have been condemned by the European Court of Human Rights through the De Tommaso case c. Italy. The well-known ruling De Tommaso of the Grand Chamber of the EDU Court in Strasbourg has ignited the technical-legal debate on the compatibility with the constitutional and supranational principles of the preventive measures; above all regarding the cases of c.d. *Generic danger*, that is the danger based on the probabilistic judgment that the subject can actually carry out criminal actions in the future.

In summary, **guidelines for integrated security** includes collaboration between police forces and local police as information exchanges and interconnections of the operating rooms. They also include direct agreements for integrated security initiatives and integrated *Security Pacts* (*Patti per la sicurezza*); the latter provide for introduction of territorial volunteers to protect the street and installation of video surveillance systems. The interventions for urban security instead include the redevelopment of the degraded territory, the elimination of social exclusion and the promotion of legality interventions.

Thanks to the Decree, greater powers are conferred on the Mayor, who can decide to adopt direct orders in situations of degradation or urban livability.
The Decree also proposes measures against the arbitrary occupations of buildings and the sale of drugs and measures against disfigurement of public buildings or public property.
One of the last safety decrees is the D.L. 113/2018 which has numerous modifications regarding the local police, in fact it authorizes the municipalities to recruit personnel in 2019 and provides for further measures for the municipal police force. The decree established an urban security fund to finance urgent security initiatives, it also introduced provisions of a criminal nature and the increase in resources for video surveillance systems by the municipalities. It introduces the use of electronic devices for crimes such as abuse and stalking and introduces provisions on vehicle rental contracts for the prevention of terrorist events; it increases penalties for cases of arbitrary property occupations. A special provision is presented to allow even municipal police officers to use, on an experimental basis, common electrical impulse weapons. The Decree intervenes in order to eliminate the disproportion between the number of recognitions of international protection such as refugee status or subsidiary protection and the number of residence permits issued for humanitarian reasons. It increases the number of crimes which, in the event of a final conviction or in the hypothesis of a defendant considered socially dangerous, involve the revocation of international protection.
The recent legislative proposals followed to numerous provisions on urban security in the last ten years; now the Committee on Constitutional Affairs is considering parliamentary initiative proposals, which are willing to reorganize the local police and to introduce integrated urban security policies. The proposals A.C. 242 Fiano, A.C. 255 Guidesi, A.C. 451 Bordonali, A.C. 705 Polverini e A.C. 837 Savino are based on the reorganization of the local police, while the proposals A.C. 318 Rampelli e A.C. 1121 Vito aims to achieve integrated urban security policies.
In addition to the laws in Italy, the regulations of the Italian standardization certification body UNI have been adopted; one of these is precisely *reference practice UNI/PdR 48:2018 Urban security - Legislative and standardisation framework, terminology and application models to plan, design, implement and manage urban security solutions* (*Prassi di riferimento UNI/PdR 48:2018*). This document can be used by operators in the sector such as public administration, law enforcement, security managers, product managers, engineers, designers, urban planners, lawyers, lawyers, consultants, installers and citizens, when they are confronted with Urban Security issues in public and private areas and it comes from the collaboration between UNI and FOIM - Milan Province Order Engineers Foundation. The document analyzes the issue of safety comparing it with sustainability, with technology and so on and looks like as an excellent tool for the theme of security. All this panorama of laws is useful to understand well how the issue of urban security is still developing and how, despite all the laws and regulations, there is still no clear picture that brings together urban security and the perception of urban safety. For this research it is important to consider the regulations developed for urban security in order to estimate which phenomena are considered for cities' security and, consequently, how these indicators can influence the perception of individuals.

Design for urban safety

The theme of security or safety, terms explained in part A section 3, in cities is increasingly known: the city of these years presents models of life that are no longer traditional but tend to individualize the citizens as mentioned before, this leads the city to fortify itself through barriers. This last, according to Mazza, are **physical barriers** such as the construction of private elite spaces, or they are also **mental barriers** such as limit of freedom of some public spaces through the generation of negative feelings. (Mazza, 2010) Metropolitan cities from the 1960s onwards have problems *"of social marginalization and urban and building degradation; problems related to their peripheral position, to the lack and poor quality of open spaces and collective equipment, to the insufficient integration between the services to the inhabitants*" ("*sia di marginalizzazione sociale, sia di degrado urbanistico ed edilizio; problemi legati alla loro posizione periferica, alla carenza e scarsa qualità di spazi aperti e attrezzature collettive, all'insufficiente integrazione tra i servizi agli abitanti*"). (Mazza, 2010)
The demand for safety is therefore increasingly in modern cities and consequently requires a greater contribution to the planning of actions aimed at guaranteeing the **right to the city** and the **right to safety and security**. The first one, according to Mazza, is to want to experience the city at any time of day or night, to consider a city *around the clock*; this use of the city implies a bigger demand for the right to safety and security.
The planning of new urban safety and security management policies is based on **multidisciplinary approaches** to involve local administrations, in fact *"social inclusion policies come up against complex problems, they are transversal, multidisciplinary and multidimensional policies of: urban planning [...], culture [...], socio-economic and educational actions [...], political innovation and legality [...]*" ("*Le politiche di inserimento sociale si scontrano con problematiche complesse, si tratta di politiche trasversali, multidisciplinari e multidimensionali di: urbanistica [...], cultura [...], azioni socio-economiche ed educative [...], innovazione politica e legalità [...]*"). (Mazza, 2010)
City has a fundamental role in identifying insecurity and unsafety and in urban security because **urbanization factors** can confirm or eliminate social exclusion. According to Lourenco, *"cities, as spaces of strong social and cultural differentiation markedly multi-ethnic and multicultural, in which wealth and social exclusion are narrow, require new forms of governance, exclusively in terms of security*" ("*le città, come*

spazi di forte differenziazione sociale e culturale marcatamente multietnici e multiculturali, in cui la ricchezza e l'esclusione sociale si stringono, richiedono nuove forme di governance, esclusivamente in termini di sicurezza"). (Lourenco, 2012) Urban space represents one of the main environments for criminal phenomena, for this reason the **role of urban space planning** is very important, in fact cities and urban planning are a field of investigation for criminological research and methodologies about these have changed over the years.

Perception of safety can be influenced by three different factor: **personal factor** such as gender, age, socio-economic status, healthy condition; **socio-relational factors** that depend on social communities and finally **situational factors** affecting urban territory or residential district. (Bianchini, 2012) Individuals perception can be influenced by urban places, indeed more or less accurate management or planning of spaces can affect the sense of protection of citizens.

The science of criminology studies the **connection between city and crime**, starting from the twentieth century, in fact in the United States a branch of criminology is born and it relates the environment to the criminal event, *Environmental Criminology*.

Chicago School in 1900 carried out the first studies on **human behavior** and on **urban environment**; they investigated how human behavior changes according to the physical-spatial and social environment of the city: this relationship is emphasized through the *Ecological Approach*, or rather the idea that man and environment are interdependent and are transformed one according to the other. Scholars that investigate spaces and crime are Burgess, McKenzie and Park that in 1938 expose an *Ecological Theory of Crime* that is based on the identified relationships between crime and space in different districts of Chicago.

One of the most important contributions of the Chicago School is that of Robert Park, in fact in his works it is possible to see the study of the urban and social composition of the city. He maps the city as a series of concentric circles that start from the center, or business district, and he associates sociological reasoning with each circle: the outermost circles are those of new settlement, where the population is heterogeneous and there are high crime rates. Park's theory says that there are different dominant use in each of cities concentric zone and that social problems depends on a precise model. Robert Park and his students are founders of modern crime-related research into the urban context called *Crime Mapping*.

Shaw and McKay, on the basis of the study of Park, investigated the relation between **spatial structure** of Chicago and the different types of settlement in the city as **occupancy rate** and **crime rate**; so Shaw's theory says that there are five concentric zone that starts from the commercial area of the city and subsequently transition zone, workers' houses zone, residential zone and commuters zone. This theory has changed over the years, up to the final work *Juvenile Delinquency and Urban Areas* in 1942 where, in order to compare the levels of delinquency in the areas, Shaw used the *deliquence rate* or the ratio of the number resident delinquents in the area and the population of the same area with the same features. He proved the theory with four maps: cases map where each point is the residence of a delinquent, crime rate's map in the different *square miles area*, radial map with the crime rate in the five concentric zone and zonal map that consider a larger zone of the city. These maps show that the **physical deterioration** of the urban and architectural environment is linked to areas with high crime rate, so this confirms *the law of the gradient* of Shaw and MacKay: the crime rate is inversely proportional to the distance from the city center.

In 1961 Wood developed a theory supporting racial integration, the *Social Design Theory*, that is based on the idea that urban planning can contribute to the livability of popular districts and social relations.

In the same year Jacobs published a book *Death and Life of Great American Cities* about the importance of sociology for urban planning; she introduces new concepts based on sociological sciences and she says that the city must be conceived on the basis of being human. Jacobs focuses on the **importance of the roads**, in fact she claims that they are vital organs of the city and that ensuring the safety of the roads makes the city safer. According to Jacobs, the roads must have: *vitality, diversity, permeability, density, natural surveillance* and *clear separation between public and private*. Vitality is that streets must be frequented continuously and must be provided with points of interest that attract people, while diversity is the presence of many functions in order to attract people at all hours of the day and to make the road dynamic and safe. Permeability is to have a space without architectural barriers that allows the continuous flow of people, while the density is to have a very populated neighborhood in order to guarantee presence of people. Natural surveillance is the continuous control of the street by those who live and work in buildings; the separation between public spaces and private spaces is instead useful to create a clear boundary and to not have the *no man's land*, or those spaces of relevance never controlled by citizens.

Another study about crime in urban places is the *Crime Pattern Theory* of Paul and Patricia Brantingham that in 1970 affirms that *Environmental Criminology* is the study of social, economica, legal and physical factors in criminal events. The Brantingham analyzes the characteristics of the **urban pattern** and how this last can create **criminal opportunities**, in fact their theory claims that people interact both in space and in time and that the city influences this. According to them the city is broken down into *nodes*, *paths* and *known areas* and all of these depend on people's daily lives. The nodes are all the activities that attract people, like home, school, work, while paths are the way that people choose to reach the nodes. The areas known, called *awareness areas* instead are the areas where the citizens live and are on the border with the *little known areas*. So the patterns are based on environmental factors and therefore the characteristics of the place influence the criminal action, in fact

the design must focus on nodes, paths, boundaries and other elements that derive from the studies of K. Lynch in 1960. Criminals instead have their own area where they move and the criminal event occurs when the victims move, through the paths, to reach a node and so he enter into the space known to the criminal, called *Crime Template*.
All these theories are a key point of the *Environmental Criminology* based on the *Crime Pattern Theory* of Brantingham, according to which people move into **routine patterns** that are repeated every day and that define the context where the criminal finds the victims. (Chiodi, 2013) The Brantingham also conducted a research in Florida in 1975 where they divided the city of Tallahassee into areas, according to the value of the rents, and calculated the crime rate for each area. The result showed that the blocks on the border have higher crime rate than those located in the city center and, on the basis of results, the Brantingham proposed the structure of cities districts, in fact in order to to minimize crimes the structure of the city must be *a mosaic* where the streets create blind with a view to reduce crimes.
The Brantingham theory is taken up by Newman in 1972 which develops the *Theory of Defensible Space*, in his book *Defensible Space, Crime prevention trough Environmental Design*. Newman identifies the **urban spaces that favor crime** in order to block the growth of *deviance* and he defines the concept of *Defensible Space* as a space that can be more easily monitored thanks to correct physical characteristics. Based on this latest concept he claims that criminal opportunities are influenced by the urban and architectural environment. At the base of Newman's theory is the concept of *territoriality*, that is when the inhabitants of a certain place feel the need to monitor it; in fact a single citizen can monitor a space particle, a group of citizens can monitor an entire street and a community can monitor an entire neighborhood. Newman's theory has some points in contrast with Jacobs's theory: in fact he maintains that a permeable space allows the entrance of strangers and therefore also ill-intentioned and that a dense neighborhood prevents the relationship between neighbors and generates anonymity. Another important concept of the theory is the *stigmatisation* or when public districts are considered ugly and dangerous so therefore have a reputation that affects the inhabitants.
So Newman said that some urban spaces favor crime, this last point is taken up in 1982 by the *Broken Windows Theory* of Wilson and Kelling, the theory suggests that any broken and unrepaired glass can be considered an **encouragement to degradation**. The theory states that it is not the social class that causes degradation but the presence of neglect, in fact disorder can cause a vicious circle, any neglected damage can encourage vandalism and crimes. This study proved to be successful, in fact it was the basis of numerous policies, such as the *zero tolerance* of the ex-mayor of New York Rudolph Giuliani.
Based on Newman's work, geographer Coleman conducts research on the outskirts of London with the use of **criminal statistics**, interviews with residents and physical degradation indicators; in 1985 she included her work in the book *Utopia on Trial. Vision and Reality in Planned Housing*.
After these numerous studies about crime, it is important to say that the **design of urban environments** plays an essential role in reducing the feeling of unsafety, in fact Ray Jeffery in 1971 deepened the study of the deterrent effect of urban space through the *CPTED Crime Prevention Through Environmental Design*; this theory is born as a critique of the criminal justice system based on punishment and not on prevention. CPTED is based on the the *Behaviorist Theory* of the psychologist Skinner, who in 1938 claims that every human behavior originate from **environmental stimuli**, therefore modifying the environment it is possible to modify human behaviors. So CPTED was born as an **urban planning methodology to reduce criminal episodes and vandalism**, it is based on four variables: territoriality, natural surveillance, natural access control, maintenance and use of space. Territoriality is the sense of belonging to the area, that is a prerequisite in order that citizens can take care of space. Natural surveillance is the control of the area by those who live in there every day and it is possible with a good design, while natural access control happens through the planning that prevents the opportunities of criminals action. Maintenance and use of space is that environments are well kept and can discourage criminals.
The concept of CPTED that we know today is not only the theory of Jeffery, in fact it there were numerous changes over the years. Saville and Cleveland in 1997 created a *Second Generation of CPTED*, while the first is based on the potential place of crime, the second studies environmental, socio-cultural and political context and aspects of perception.
Many criminological theories have been developed from the 80s onwards, such us the *Rational Choice Model* of Becker in 1968: he argues that crime is a behavior of those who want to **satisfy their needs**, such as need for money, sex or prestige.
On the basis of this model, Clarke studied the *Situational Crime Prevention* and he argues that criminal behavior is conditioned by **opportunities that can promote action**. The greatest opportunity is when there are together a motivated aggressor, an easy victim and the absence of a guard, all in the same space and time.
A recent contribution to criminology is the study by B. Hiller and his book *Space is the machine* in 2004 in which there is an entire chapter *Can Architecture cause social malaise?* with the theme of urban security. Hiller explains **Space Syntax** that is a methodology used by researchers to define urban space as a function of social activities; this methodology claims that public space is described by a value called *integration*, ie how much space is accessible and how much is connected to all the other points of the context. On the basis of integration of public space, the *virtual community* is created, that is a community of people who use the same space: these people do not interact with each other but are aware of the presence of other users. The

design of the urban space defines the degree of integration and the virtual community instead guarantees natural surveillance; in this case, natural surveillance is dynamic because users are on the move, in contrast to the theories of Jacobs and Newman. According to Hiller, criminal actions do not take place in remote areas of the city, but in areas with high integration but with lack in natural surveillance; the author concludes his book claims that the bad design of public space and low integration creates the possibility of criminal actions. For this research it is important to consider the urban space for safety and, consequently, how this cities' space can influence the perception of individuals, as previously explained also through proxemics in part A section 1.

Prevention for urban safety

Currently there are various security and safety applications in many countries like United States or Great Britain, for example, in the UK there is a police certification system called *Secure By Design SBD* that identifies the city's safe buildings while also ensuring a real estate value. There are also systems useful for urban planning, such as *Safer Places* or *The Planning System and Crime Prevention* that help the government and counties during urban planning.
Police Label Safe Housing is the Dutch tool of the Ministry of the Interior that issues a certification to buildings or settlements that respect certain architectural safety parameters, while in France a safety study called *Étude de sûreté et de sécurité publique ESSP* is required to greater urban transformation projects. In Germany, on the other hand, protection technologies such as video surveillance are widely used. The European Union in 2007, based on the norm of the European Standardization Committee, adopted the CEN/ TR 1438-2 which then in Italy is the UNI 2010. All these theories initiated operational perspectives by government bodies, in fact the European technical standard CEN-ENV 14383 *Crime prevention through urban planning and architectural design* was made. This standard proposes **detailed indications for urban planning** and **guidelines** that can be grouped into three categories: urban planning strategies, urban strategies and management strategies. (Bianchini, 2012) The European standardization committee CEN has also included the aspects of crime, in fact the *Standard and Technical Reports made about the prevention of crime through planning* was made and later in 2006 Technical Reports TC 14383-2 was made. All these new standards start from the study of an important tool, *Crime Mapping,* as mentioned before. **Crime mapping** is a tool *"for the prevention of victimization processes connected to urban crime, and for the functions that is able to perform: geo-referenced analysis of urban crime and antisocial behavior analysis; analysis of time frequencies related to the commission of offenses and antisocial behavior in the urban context; decision-making support tool for the individualization of strategies and operational measures to combat and prevent urban crime; verification tool for the effectiveness of the strategies and measures adopted"* ("*per la prevenzione dei processi di vittimizzazione connessi alla criminalità urbana, per via delle funzioni che è in grado di svolgere: analisi georeferenziata della criminalità urbana e dei comportamenti antisociali; analisi delle frequenze temporali relative alla commissione di illeciti e dei comportamenti antisociali nel contesto urbano; strumento di supporto al decision making per l'individualizzazione di strategie e misure operative di contrasto e di prevenzione della criminalità urbana; strumento di verifica in ordine all'efficacia delle strategie e delle misure adottate*"). (Bravo, 2014)
The mapping of crimes is a strategy used since the 1800s, starting from the study of Guerry who produced a **socio-cultural cartography of criminality** that brings together crime and inequality in development. Another contribution is the study of Quetelet who applies **statistical science to crime**, in fact he uses a statistical analysis that studies crime as a social phenomenon. These two contributions are both important for the birth of *Sociological Criminology* and for crime mapping as a tool to know in advance, with the analysis of the probabilities and the progress of the offenses. Quetelet and Guerry have found a relationship between the **number and quality of offenses and civilization**; this relationship demonstrate how the level of education, climate, seasons, sex and age influence the *penchant au crime*. (Bravo, 2014) In the following years the crime mapping is also used by the scholars of Chicago Schools. Park and his students are founders of modern crime-related research into the urban context. Among the students of the school emerge the theories of Burges, very close to the urban context, which divide the city into five concentric circles as mentioned before: the city, the transaction area, the workers' zone, the residential districts and the commuter area. These maps, among the first of crime mapping, represented: "*case maps in which each point represents in the space the residence of a single offender, the maps of the delinquency rates obtained in the individual square mile areas, the radial maps on which the delinquency rates calculated for each of the five concentric zones elaborated by Burgess, the zonal maps*" ("*le mappe dei casi, nelle quali ogni punto rappresenta nello spazio la residenza di un singolo autore di reato, le mappe dei tassi di delinquenza ottenuti nelle singole square mile areas, le mappe radiali su cui sono stati rappresentati i tassi di delinquenza calcolati per ciascuna delle cinque zone concentriche elaborate da Burgess, le mappe zonali*"). (Bravo, 2014) So the Chicago School has not only identified maps that can identify the natural or environmental factors, it has also proposed **prevention programs** called the *Chicago Area Program*.
All these researches are the basis of **modern crime mapping**, which however differs for one thing: while the first experiments considered the residence of delinquent in the placement of the crimes on the map who committed the crimes, the modern crime mapping instead considers the *locus commissi delicti*, or the geographical area where the crime was committed.
Scholar Lind correlated both the data of the residence of the offender and the data of the

place of the crime, thus he found two patterns called *neighborhood triangle of delinquency* and *triangulation of mobility (mobility triangle of delinquency)*. (Lind, 1930) From the studies of Lind, other scholars like Morris and Lottier have analyzed the places that characterize a crime and have introduced the concept of *opportunities present in the area*, or the importance of the urban and social context in the commission of a crime. (Lottier, 1938) (Morris, 2013) Subsequently Boggs has given more correct and precise measurements by identifying rates for these opportunities by studying the phenomena from the mathematical point of view. (Boggs, 1965)

At the end of these theory there is the importance of the urban, economic and social context. In order to analyze the **social context** was born the *Social Area Analysis*, based on the studies of Bell and Shevky, which claims three different statuses: the family status, or the characteristics of the resident families of the area, the economic status, or the economic levels of the area and finally the family and ethnic status, or the types of families and the percentages of ethnic minorities. In order to analyze the **urban context**, *Environmental Criminology* was born which is proposed as a decision making tool for prevention theories; environmental design is one of the branches of the criminology proposing urban and architectural solutions to reduce crime in at-risk neighborhoods.

Modern crime mapping is defined as "*an analysis tool, currently based on the use of computerized and telematic systems, able to mark and detect on geographical maps the geographical distribution and the time frequency of the distribution of crimes [...] in the urban context , together with other data of interest*" ("*uno strumento di analisi, attualmente basato sull'uso di sistemi informatici e telematici, in grado di segnare e rilevare su mappe digitali la distribuzione geografica e la frequenza temporale della distribuzione dei reati [...] nel contesto urbano, unitamente ad altri dati di interesse*"). (Bravo, 2014)

The crime mapping data are useful because they are able to give information about the place of the crime, the when of the crime, the motive of the crime, the information about the victim and about the aggressor. According to Bravo "*crime mapping can be defined as a process and not as an analysis tool because, thanks to different tools, it is able to support decision making for the policies to be adopted, verify the strategies subsequently adopted and prevent the crime displacement phenomena*" ("*il crime mapping può essere definito come un processo e non come uno strumento di analisi" perché, grazie a diversi strumenti, è in grado di supportare il decision making per le politiche da adottare, verificare le strategie successivamente adottate e prevenire i fenomeni di crime displacement*"). (Bravo, 2014) On the basis of all these proposed methodologies and theories it is possible to identify that the study of space is necessaire for optimal crime prevention and that knowledge of methods for Crime Mapping can be useful to combat the feeling of unsafety. For this research it is important to consider how the urban space of cities can influence the perception of individuals and how these spaces can attenuate the negative perception.

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LIGHTING PERCEPTION

artificial environmental lighting characterizing urban settings, can light influence perception of safety?

After the mentioned changes in human behaviors related to the environment that surround it, part A section 1, the attention will be focused in **physical characteristics of that environment**. According to Hall dimensions of space were one of the characteristics to be considered, and in urban safety section it was explained how the night-time is the most problematic part of the day relative to perception of crime.
This thesis research continues the literature review in field of artificial lighting and soundscapes of urban areas, starting from the first argument.

> *"To play with light is to play with magic-it demands (1) a trained eye to recognize real and relative values (2) experience and knowledge of the cultural and psychological effects of light on people (3) experience and knowledge of physical techniques."* (Kelly, 1952)

Light design and human needs

Lighting design is regulated by at least to three principal aims: **guarantee human needs**, **avoid energetic and economic waste** and **valorize architectural forms**. In first place, urban lighting project has needed to offer adequate visual conditions for people that is in cer-

tain environment, whose goal is provide a good visual settlement to perform the visual task with adequate accuracy. *Visual task* is the term given to the totality of the objects and areas in field of view that the observers must distinguish correctly for complete his work or activity.
Three factors mainly affect the correct performing of visual task: **illuminance of object faces**, **contrasts of luminance** of elements in the lit scene and the **direction** from which the light comes. In photometry, **illuminance** (E) is the total luminous flux incident on a surface per unit area. For the International System it is measured in lux [*lx*], that is equivalent of one lumen per square meters or one candela for steradian per meter. It is considered both for the design of the interior environments, in which it is used to verify the adequacy of light on work plan, but also for outdoor lighting, that is important to consider the ill. of street surface, the ill. of vertical surface surrounds the walk direction and semicylindrical ill. that is the measure of light that incident on semicylindrical surface, considered as a simplification of the human face shape. The second photometric parameter is called **luminance** (L) and indicate the apparent surface or light source luminosity. It is defined as the ratio between the luminous flux emitted or reflected by a luminous surface per unit of solid angle in a given direction and the emitting surface projected on a plane perpendicular to the direction itself. It is also important to consider **reflection index of materials** because two surfaces, illuminated by the same light source, will have different luminance value depending on the value that this index assumes or what percentage of the light that insides them is reflected. It is measured in *candela per square meter* [*cd/m²*]. Human vision is based on **luminance contrast**, that derived from physical characteristic of surfaces including, among other things, also the color. For this reason, reading a black text on a white paper is a simpler visual task than reading the same text written in yellow on a white background; contrast of luminance.
In second time, lighting design also must be careful of visual comfort and wellbeing worrying about human heath in terms of pathologies. It is related also with non-visible effect of light. According with some nineties studies the blue component of the spectrum of some sources, typically LED one, could be responsible for the inhibition of melatonin, a hormone produced by the hypothalamus which has the function of regulating the circadian cycle that regulate wake-sleep rhythms. (R. Küller & Wetterberg, 1993).
Nowadays the principal investment in outdoor lighting design as represented by **street lighting**, which in 2015 saw the start of the modernization project of the public light facilities in Turin with LED sources (Iren2015). It is because the previous high-pressure sodium lamp has a huge impact on energetic consume, and consequently economic balance of cities. Most of the vehicular streets have sidewalks area that is served by the same luminaires used illuminating vehicular lane. The lighting systems are developer principally to respond to security of cars and pedestrian avoiding incidents, but in general have the necessity to respond to the purpose of identify obstacles on the line, helping the visual guide in the direction of travel and limit glare for different road users. In particular, the identification of the obstacle depends on the direction of light. For example, in absence of street lighting, the headlamps of a vehicle that illuminate the outline of a pedestrian, vertical surface, crossing the street cause a luminance contrast in the scene that appear like a light object on dark background; differently in presence of luminaires the condition is oppose because the street surface appear illuminate and the pedestrian not illuminated dark on a light background. Also from the **pedestrian path** point of view, lighting has the purpose to facilitate the detention of obstacle along the way but in this case the goal is delegated solely to lighting system. The **illuminance of horizontal surface** (E_h) could be measured at the ground level and indicate the ability of the user to see the footpath he is walking on. However, it is not enough, the user has the necessity to better recognize the surrounding environment and notice, for example, the intention of person walking towards him from his facial expression. **Semicylindrical illuminance** (E_{sc}) give the designer an indication of this aspect because measure the light that reach the cylindrical surface of human face. Finally, it is important to consider the **illuminance of vertical surfaces** (E_v) in the settlement because the necessity to oriented in the space; commercial banner, house numbers or roads name label are positioned on vertical surfaces. (Commission Internationale de l'Eclairage, 2010)

Norms and legislation about lighting

In Italy there are principally two norms that regulate street lighting: **UNI 11248** and **UNI EN 13201**. The first one defined the lighting categories of street starting from Traffic Urban Plan (PUT). The PUT, established by art. 36 of the new Italian Highway Code, is mandatory for municipalities with more than 30.000 inhabitants and consists in coordinated set of measures to improve road traffic conditions in the urban area. It divided streets and road based on maximum speed travel and complexity of the environment. For example, highways are considered separately by neighborhood street and local roads and so on. UNI 11248 assign for every street category a lighting categories based on speed and visual complexity, that is the complexity of the visual field, introduced in UNI EN 12665 and indicate how much the observer could be confused by the several light elements in the field of view like non correctly oriented street luminaires, buildings or showcase too much illuminated, light advertising signs or shops. Starting from this substrate, UNI EN 13201 introduced the typology of standards for each lighting system, street lighting or pedestrian lighting, and different value for each street. For example, foot walk paths are identified by P letter, or category, and further subdivided into P1, P2, P3 based on complexity of the environment with increasing values of the parameters to be respected. The minimum horizontal illuminance manteined (E_{min}) is the measure of minimum illuminance on the street surface, the higher its

value, better the walker will be able to see the surface where he puts his feet. It is however necessary to avoid lighting too much the surface because it is not very useful in terms of visual task and energetic consume. The average level of horizontal illuminance it was calculated based on all illuminance values collected, it gives an overall approximative value of light that landing on the surface. The vertical illuminance (E_v) is necessary to consider for the observer's need to see obstacles or uneven floor along the path. Finally, the semicylindrical illuminance (E_{sc}) which provides an indication of how adequately the face of a person is illuminated by the lighting system. In the previous pedestrian path example, the norm provides an average level of horizontal illuminance to respect that goes from 2 to 15 lux, a minimum value of horizontal illuminance that the lighting system must maintain over time (from 0.4 to 3 lux), vertical level of illuminance measured at 1.5 meters from the ground along the path directions (from 0.6 to 5 lux) and a value of semi cylindrical illuminance (from 0.2 to 5 lux). Another category is SC where public lighting is necessary for the identification of people and objects in areas with a high crime rate, it is based on semi cylindrical illuminance (from 0.5 to 10 lux). Last pedestrian category is EV when there are vertical surfaces that need to be seen due to the simultaneous presence of people and vehicles, it is based on vertical lighting whose value goes from 0.5 to 50 lux.

Lighting perception

As mentioned before the vision is based on luminance contrasts in the field of view. Mechanically the human eye sees higher luminance surfaces before then other ones, and more illuminated surfaces have priority attention in the mind of the observer. This phenomenon affects the **perception of the physical space**. That means that lighting designer has the power to make it seems the space bigger or smaller changing the intensity and the positioning of light sources in the settlement. Therefore, light is a powerful expressive tool that responds not only to functional mechanisms. The perception of lit scene is therefore something complex that goes beyond the mathematical analysis of the standards values previously explained, visual task and accuracy of vision but involves culture. (Rikard Küller, Ballal, Laike, Mikellides, & Tonello, 2006) (Calvillo Cortés & Falcón Morales, 2016) Researchers looked for indicators to quantify the perception of bright environments. To reach this purpose it was largely used **survey tool** based on questionnaires that measured bipolar semantic Likert scale answer. This technique consists in proposing several statements, called items, that express a positive and negative attitude, for each item there is a scale of *agree/disagree*, generally a five, on which to indicate a continuous value. (Likert, 1932)

In 1977 Flynn used a questionnaire composed by four scales, such as *overhead/peripherical*, *bright/dim*, *uniform/ununiform* and *warm/cold*, to measure the perception of lighting of each individual. (Flynn, 1977) Starting from the scales of the previous article, Kuller and Wetterberg proposed in 1993 a model based on **ten bipolar adjective** for quantifying the perception of lighting assessment: *unpleasant/pleasant*, *natural/unnatural*, *warm/cool*, *strong/weak*, *bright/dark*. (R. Küller & Wetterberg, 1993) They studied the impact of two different spectrum fluorescent lamp on subjective indices of wellbeing and stress. In this case, the result of the work proposed two overarching dimensions representing hedonic tone and brightness.

In 1994 another study tried to measure the relationship between the subjective response to a lit environment and its luminance distribution in a conference room. (Loe, Mansfield, & Rowlands, 1994) Having the necessity to evaluate the perception of eighteen configuration of the same office, none of the traditional measure (spot luminance and horizontal, vertical, cylindrical and scalar illuminances) produced high correlation with personal valuation. For that reason, the measurement was conducted with a conventional illuminance meter with a cosine-corrected photocell and screen that limit the *field of view* in several configurations; the one with best correlations seemed to be 40° in altitude and 90° in azimuth because it includes the front wall but also part of the ceiling and floor. Consequently to the precedent experiment the study continued in 2001 and led to the definition of two subjective factors by principal component analysis, that were called *visual lightness* and *visual interest*. (Loe, Mansfield, & Rowlands, 2001) The first one is related with bright/dim scale and shows how much the lit scene was perceived luminous; the last one is best related with interesting/uninteresting scale and the value increase if the assessment presents light pattern and in general non-uniform distribution of luminance. It seems that the average luminance and the standard deviation in 40/90 band are significatively accurate to describe these two factors.

Another researchers' team worked in 2014 on outdoor lighting settlement and extrapolated other two factors called *perceived strength quality* and *perceived comfort quality*. (Johansson, Pedersen, Maleetipwan-Mattsson, Kuhn, & Laike, 2014) They compare ten different assessment of LED outdoor lighting systemin three studied in different location in order to expand as much as possible the socio-economic diversity with one hundred and thirty answers. First factor was called Perceived Strength Quality PSQ and capture the bright perception from answers like strong, light and sparkling, it also takes into account the direction of light. The second one is the Perceived Comfort Quality PCQ and it is more relative to hedonic aspect of light, pleasantness and softness, it captures the naturality and warmness extent of perceived light. They explained the phenomenon of more than sixty percent of statistical variance. Unfortunately, the results of correlations with technical environmental assessment values showed the perceived qualities don't fully correspond to single photometric values.

In the same way experiment over office settlement was conducted by Duff and colleagues. (Duff, Kelly, & Cuttle, 2017) The test was con-

ducted by two questions survey. Participants were asked to respond to adequacy of three different settings (differing for reflectance of walls) that produce the same results. They stated that "*a clear relationship existed between mean room surface existence and both perceived adequacy of illumination and spatial brightness, but not between horizontal illuminance and either item*". (Duff, Kelly, & Cuttle, 2017)

From the studies conducted until today, however, the perception of light seems to have mainly two components: one is attributable to the **apparent intensity** of the environment, related with brightness and power, and one related to the **hedonic aspect**, that correspond to pleasantness and interest of light. In general, from 1977 scientific articles highlight the presence of indices that statistically explained the light perception of environment but, nowadays no strong correlation was founded with any photometric metrics. Loe suggest that further steps must be done in lighting discipline to better understand subjective perception, consisting in multi-disciplinary approach with ophthalmology, neurology an psychology. (Loe, 2016) It includes the necessity to understand more precisely conscious human mechanisms, but more important, unconscious implications of vision and, starting from these, developed a proper metric.

Lighting and perceived safety

Until now the perception of safety in human mind was studied from the first of sixty years. In 2008 Welsh and Farrington published a literature review that tried to shed light on the issue. (Welsh & Farrington, 2008) Starting in 1960, North Americans sought a method to cope with a dramatic rise of crime studied the effects of street lighting on people behaviors. This could be the moment of start of the interest of this relationship to verify a major lighting improvement in United States cities to reduce crime wave mentioned before. The review continues with some literature hypothetical possible ways in which improved lighting might reduce crime that is could be summarized into morphological changeset to improve visibility, acting situation that improve the usage of space and in general better appearance. They conclude that "*improved lighting should be included as one element of a situational crime reduction programs*" because after analyzed thirteen studies on improvements in road lighting with before-and-after measurements of crime, the overall reduction in crime after lighting improvements was estimated to be about 20%.

In 2000, Boyce and colleagues asked themselves how is the **amount of light needed to perceived safety urban areas** and how important is the **light source spectrum** to understand this question. (Boyce, Eklund, Hamilton, & Bruno, 2000) The experiment was conducted into a parking in March 1996, the tool was the survey and fifteen subjects took part of it. The result shows that between 0 to 10 lux of horizontal illuminance, just a small increase in illuminance produce a significative increase in perceived safety; the trend overturns over 50 lux. In 10-50 lux range, an illuminance of 30 lux seems to be good for safety lighting. Light spectrum has a minor impact on perception but anyway it could be important to consider particularly at mesopic light levels and in conditions where there are many color differences present. Linked to the theme of light spectrum, in 2015 Peña-García at al. studied, with the large-scale advent of LED technology, the different impact that sodium and LED technology street lighting have in perceived safety of pedestrians and wellbeing. (Peña-García, Hurtado, & Aguilar-Luzón, 2015) They focalize into different street lighting system in Granada collecting more than half two hundred questionnaires. They affirmed that average scores value of every question increasing to increase of average luminance, and in general white light induces a greater sense of safety in people. Moreover, cold light also has an impact on accuracy facial recognition, increasing the sense of wellbeing and nightlife because of its better chromatic render than sodium source.

In 2011, a Sweden study focalized the attention into three groups of people that are likely to be extra sensitive like visual impaired ones, elderly and young woman. (Johansson, Rosén, & Küller, 2011) They have more problems to walk along during night and the researchers need to more precise information on their perceptions to improve outdoor lighting design. The study was located into a park in Orebro and, besides the questionnaire, they have measured illuminance along different paths. The objective was providing equal access for all people to urban environment, but in general identify the personal factors that can influence the perception of safety. The results showed that there is a strong correlation between safety and hedonic tone of light. About perception, scales as *pleasant/unpleasant*, *natural/unnatural* or *monotonous/stimulant* are the main influent on safety.

In 2014 as explained in the paragraph above, the subjective factors extrapolated by Johansson and colleagues, perceived strength quality and perceived comfort quality, was used to tried to explained the perceived safety. The results showed that "*no association was found between PSQ and perceived danger. PCQ predicted perceived danger inversely, i.e. high ratings of PCQ correspond to not perceiving danger*". (Johansson et al., 2014)

Reassurance is the term defined by Fotios, Uwin and Farrall to encompass perceived safety and fear of crime. (Fotios, Unwin, & Farrall, 2015) The method developed for their experiment on pedestrian path lighting started from the possibility that the procedures used in the studies previously analyzed had led to find positively correlation between light and safety. Participants were asked to provide two photos of two road where they have no problem to walk alone during night-time and two in which they did not feel confident of it. Them they underwent interview consisting in description of the characteristic of the streets in photos, subsequently associated with quantitative measuring of light. In this way the approach avoided any direct emphasis on lighting or on fear. The result confirmed the association between light and reassurance also if the procedure was not closely focus

on lighting. Two years after reassurance study, Fotios, Castleton, Cheal, & Yang studied the performance of pedestrian to **recognize other person intentions by facial expressions** that, as seen above, is one of the main needs of people walking the city. (Fotios, Castleton, Cheal, & Yang, 2017) The experiment was carried out on twenty-eight participants who had to recognize facial expressions using photos positioned at four and fifteen meters. Intuitively, the face recognition was done more accurately when the brightness of the lamps increased. But this is true only for the low brightness, from 0.3 to 1 cd/m². Over this value "*performance reaches a plateau above which increasing luminance gives diminishing returns in terms of increased probability of correct identification*". Moreover, it seems that the performances are not particularly influenced by the chromaticism of light. It is however important to consider that often a lamp with a different color temperature carries other characteristics that must be considered, like color rendering, different light spectrum and photometric solid because the production technology.

In general, in all these articles it has been demonstrated that **improvement of lighting condition** affect, directly or indirectly, on reassurance. It is mean that **lighting design** can reduces the fear of crime in citizen, also indirectly because better recognition of people intentions, and increases the perception of safety in people that walking in urban areas because the effective increasing of light characteristics like intensity or spectrum.

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SOUND PERCEPTION

soundscape characteristics of urban settings, can sound influence perception of safety?

The soundscape, introduced some forty years ago by Raymond Murray Schafer, in the last few years has a growing interest on the part of scientific community for the support that it can provide for the protection of good acoustic quality areas and for the restoration of those exposed to noise pollution. Schafer promoted the **World Soundscape Project**, including field investigations with phono-metric measurements and recordings of sound environments, these analysis led him to classify the soundscape into two types, *hi-fi* and *low-fi*.
Thanks to this project, research has been carried out on acoustic perception in different geographical contexts, on the symbolic value of sounds, on acoustic pollution, and thanks to this, a defined disciplinary and ethical orientation of *Acoustic Ecology* was born.
According to Schafer the term Soundscape originates from Landscape, shifting the focus from the visual to the sound, he defines:

> *"soundscapes are the totality of all sounds within a location with emphasis on individual relationship with society with the sonic environment"*
> (Schafer, 1994)

This definition says that sounds are linked to the the **perceptions of individuals** and to the **context**, so in contrast to the acoustic environ-

ment, the soundscape chooses to place the listener at its center and therefore can be considered a subjective model.
There are other definitions of soundscape such as Schulte-Fortkamp and Lercher one that describe the sound environment "*In the original soundscape approach Schafer was worried about the dominance of the 'visual culture' and the parallel loss of 'sonological competence' in the modern society. He was able to take care of himself in a series of hearing exercises which he was able to maintain in a high level of sonic awareness. musical composition for which we own the responsibility*" (Schulte-Fortkamp and Lercher , 2003) or the definition of the Handbook for Acoustic Ecology "*The definition of soundscape: The environment of sound with emphasis on the way it is perceived and understood by the individual, or by a society. the term may refer to actual environments, or to abstract constructions such as musical compositions and tape montages, particularly when considered as an artificial environment*". (Truax, 1978) The soundscape is also defined by International Organization of Standardization ISO "*The acoustic environment as perceived or experienced and\or understood by a person or people, in context*". (ISO 12913-1:2004).
Research about soundscape was born about in 1930 when the Noise Abatement Commission of New York noticed that the city of New York was dominated by technological sounds, that had come with the industrial age, and the natural or human sounds of the past, such us animal or people, were no longer present. Brown et al. in 1930 introduced the **noise survey** for the city, in fact questionnaires were distributed through the metropolitan newspaper and results shown that noise in the city of New York were caused by the technologies. (Brown et al., 1930) In this report Brown identified **sound sources** and categorized city noise and in 1977 he introduced his work with a card catalog of noise. He classified the sounds according to their origin: **natural sounds**, **human sounds**, **sounds and societies**, **mechanical sounds**, **silence and quiet**, **sound as indicators**. While the natural sounds contained the sounds of water, air, earth, birds, insects and seasons, human sounds instead contained the sound of voice or body. Obviously, silence and quiet did not involve any sound, while the sounds and societies included the sounds of the town, factories, parks and domestic or urban sounds, mechanical sounds included the sound of machines, aircraft and constructions. Finally the sounds as indicators were sounds like bells, horns, phones. Noise sources can be classified in different other ways but it is important to identificate the main groups of sources that are **technological**, **human** and **natural**, as used in part B section 10. (Brown et al., 1930)
Another scholar, which we talked about before, dealing with the soundscape in the 1990s is Schafer, who identificate soundscape when someone perceives the sonic environment that surround it with her/his hearing and in this case the sound is a basic element in the scape. (Schafer, 1994)Thanks to the work on Schafer's acoustics, the orientation and practice of *Acoustic Design* was born and following its indications in 1993 the World Forum for Acoustic Ecology was founded, that is an international organization that associates a large number of experts, artists and professionals in the field of **acoustic design**. According to Schafer any places have their own peculiar sound identity, linked to their morphology, the specific configurations, the forms of settlement and the cultural dimension. The landscape is not only what is external to us, but also includes our emotional perception. (Schafer, 1994) The soundscape is therefore strongly influenced by the subjectivity and by the process of interpretation and experiential signification of the listener, as mentioned in part A section 1 and 3. Precisely for this reason the *Acoustic Design* is born, which seeks to discover those principles by which the aesthetic quality of an acoustic environment (or soundscape) can be improved. The **human perception** of sound waves is a subjective process that is based on cognitive processes and mental processes as mentioned in part A, section 3, in which sound and noise are the factors that depend on the users' background and that can be influenced by this or other factors of the subjective reality. On the basis of this, many studies have been conducted to evaluate the subjective reality of noise and perception. Noise is one of the causes of multiple health and safety problems affecting aspects such as productivity, comfort and functionality. The **quality of the sound environment** is considered as a key point for the sustainability of open urban spaces and for the right design of these. Indeed it has been shown that social, demographic and behavioral factors influence the sound experience in the long term and the consequent subjective evaluation of the sound level in the open urban space. (Meng and Kang, 2017) So the soundscape quality is related to social context and the perception of users is determinate by their background. In summary for this research, as explained in part A section 5, it is important to consider the perception of the soundscape to be able to understand consequently if this influences the unsafety perception of the individual.

Soundscape factors

Thanks to Schafer's soundscape concept, the sound environment has been increasingly studied, indeed the same Schafer proposed interdisciplinary approach to analyze environment. He also proposed a new tool for controlling the environment and the noise pollution, expressed also the need to inform citizens about their **surrounding sound environment** in order to prevent pollution and to educate citizens to a non-disturbing environment. In fact, according to Schafer, the places in which we live have their own **sound identity** that is linked to many things, such as morphology, natural configurations, forms of settlement and so on; therefore the landscape is not only what is external to us or the context, but also includes our **perception of sound**. Schafer identified and analyzed the characteristics of the soundscape, in fact he defined four main categories of soundscape: *archetypal sounds*, *keytone sounds*, *soundmarks* and *signals*. The first, **archetypal sounds**, are

those ancient and mysterious sounds that have symbolic meanings since ancient times. Each person has a series of sounds that represent the environment in which he lives and his personality; these sounds influence a company's behavior and lifestyle. The **keytone** is defined as the fundamental sound of a composition, while in the soundscape it is that sound which is continuously perceived and therefore becomes like a background of all other sounds. It is a basic sound and often not consciously perceived because it becomes a listening habit. For Schafer the key tones are *background* and some key tones are also archetypal sounds. The **soundmark** is a term derived from landmark or reference point and are those sounds that can be recognized by the inhabitants of a community. They are therefore significant sounds for the place and are also on the verge of extinction in large urban centers. Finally the **signal sounds** are the sounds that are able to attract our attention and be clearly perceived. These signals are distinguished from the keytone because they are the sounds opposed to the background. (Schafer, 1994)

Human perception is therefore the key to the sound environment, in fact there are many factors that identify and describe it; these factors are organized into four main categories: *physiological and biological factors*, *physical and psychoacoustical factors*, *psychological factors* and *contextual factors*. The first factor **physiological and biological factors** is the human perception of a soundscape based on cultural background, well-being, living conditions and hearing abilities. The second factor **physical and psychoacoustical factors** is related to physical parameters, in fact the acoustic environment is directly measurable through these data, or physical and objective physical factors. It is not yet easy to find a direct relationship between perception and the acoustic environment. The third factor, **psychological factors**, is related to people and their feelings, in fact it is related to the psychological attitude during the evaluation of the acoustic environment. Finally, the last factor, **contextual factors**, is obviously linked to the context and characteristics of this; in fact the presence of vegetation or the adequacy of the context and the acoustic environment is important. (Biocca et al, 2003) Therefore on the basis of these studies it is possible to say that the evaluation of an acoustic environment is influenced by **different factors of the interviewee and of the context** and that among these factors the sound is really important. The acoustic environment is therefore perceived as a set of different sounds, as identified by Schafer, and for this reason we must consider every sound to evaluate the acoustic environment. So it is important to identify different **sound sources** to define the human perception of a soundscape, but it is also important to identify a **dominant sound** to investigate the soundscape. Many authors have in fact written that the evaluation of the soundscape is related to the evaluation of a single dominant sound perceived by the interviewee in the area. On the basis of these research, the first step to identify the human perception is to define the different sound sources that are present and perceived by the interviewee, as explained in part B.

Soundscape indicators

In order to analyze the perceived affective quality of a sound environment there are several indicators; some of these descriptors are related to psychoacoustic indexes, such as the physical and psychoacoustical factors identified by Schafer and mentioned before.

These indicators are **Loudness**, **Sharpness**, **Roughness** and **Tonality** that are related to acoustic indices such as the sound level. The psychoacoustic indicators are therefore important for the analysis of a sound environment, in fact they are the dimensions that allow us to know how people perceive an acoustic stimulus. These indicators not only represent the **physical value of the sound**, but also represent the **perceptive value of the sound** and are calculated through a combination of different acoustic parameters. In dealing with the perceptive aspect, which is the object of study of psychoacoustics, the definition of new quantities is required, through which it is possible to quantify the subjective attributes of a sound. The fundamental subjective characteristics of a sound are: the subjective intensity or **Loudness** that expresses the volume of a sound and is identified with expressions such as *weak sound* or *strong sound*, the tonal height or **Pitch**, which makes it possible to distinguish a low-pitched sound from a high-pitched one, the **Timbre** which allows to distinguish the same note played by different instruments, **Roughness**, **Fluctuation strength** and **Sharpness**. (Fastl and Zwicker, 2007)

In addition to these indicators there are also other descriptors of soundscapes used to describe the human perception of an acoustic environment; these are connected to an acoustic index. These most commonly used descriptors are **Noise Annoyance**, **Quietness**, **Pleasantness**, **Restorativeness**, **Perceived Affective Quality**, **Soundscape Quality** and **Appropriateness of Soundscape**. (Medvedev et al, 2015) (Meng and Kang, 2017)

In addition to these identified parameters, the **equivalent sound level A-weignhted L_{Aeq}** was calculated. The disturbing effect of a variable level sound can be assessed through the continuous equivalent level L_{eq}, so the equivalent level therefore has the meaning of average energy level of the signal. In other words, it represents the sound pressure level of a constant sound which, in the pre-established time interval, exposes the disturbed individual to the same acoustic energy. The purpose of introducing the equivalent level is to be able to characterize with a single measure a variable noise, for a pre-established time interval. L_{Aeq} is the sound level in decibels equivalent to the total A-weighted sound energy measured over started period of time. The equivalent sound level can be measured directly with the sound level meters.

The perception of the surrounding environment is an important topic for this research, which has as its objective the evaluation of the perception of urban safety related to the conditions of light, sound and decay. So in order to investigate the acoustic environment, the parameters above were considered indicated, of which a more detailed explanation is given below.

Soundscape psychoacoustics metrics

ARTICULATION INDEX

The Articulation Index (AI) was formulated by French and Steinberg as a means of quantifying speech intelligibility over telephone transmission systems where noise was the primary cause of intelligibility loss, in fact Articulation Index is a sound metric that indicate how much background sound levels can interfere with human speech. Articulation Index is a multiband evaluation based on measurements in octave bands: 250, 500, 1000, 2000, and 4000 Hz. This evaluation has a value that ranges between 0% or no speech understood to 100% or all speech understood. Nowadays Articulation Index is used to rate the quietness of white goods, and more. (Siemens, 2019)

FLUCTUATION STRENGHT

The two metrics of Fluctuation Strengtht and Roughness quantify the amount of modulation present in a sound, in fact a sound level is called modulated when it rises and falls over time. The sensation of fluctuation strenght is generated when there are low modulation frequencies up to around 15-20 Hz and the volume slowly changes up and down. The unit of measure for this is *Vacil* but there is still no standardization for this calculation. Fluctuation Strength can be used to quantify low frequency modulations, like the droning of propeller planes. (Fastl and Zwicker, 2007) (Siemens, 2017)

ROUGHNESS

The two metrics of Fluctuation Strengtht and Roughness quantify the amount of modulation present in a sound, in fact temporal variations of sounds can lead to two different perceptions: Fluctuation at low frequencies of variation and Roughness at high frequencies. The boundary between the two sensations is not clear: for frequency modulations higher than 20 Hz, the phenomenon of fluctuation tends to fade and turns into Roughness; so roughness begins to be perceived at a modulation frequency of 20 Hz and reaches a maximum peak at a modulation of 70 Hz. Zwicker identificate three important parameters for roughness mesure: degree of modulation and modulation frequency are important for amplitude modulation, while the frequency modulation index and modulation frequency are important for frequency modulation. So the roughness indicator is influenced by carrier frequency, modulation frequency of the sound pressure level, and degree of modulation. The unit of measure is *Asper* and it refers to a 1 KHz frequency tone with a sound power of 60 dB at 100% amplitude modulation and at a modulation frequency of 70 Hz. (Fastl and Zwicker, 2007)

LOUDNESS

Loudness is an index belonging to the category of sensations of intensity, in fact the measurement of a sound environment cannot be constructed only by the evident intensity variations, but must also be obtained from other types of measurement, such as the estimation of the magnitude. Precisely for this reason the measurement of loudness is important, because it is not just a value that expresses a sensation but a value between perception and physical values. Loudness is the subjective intensity that expresses the volume of a sound and is identified with expressions such as weak sound or loud sound. (Fastl and Zwicker, 2007) Loudness of complex sounds cannot be determined by adding valid values for pure tones. In fact the masking is the phenomenon for which the perception of a certain acoustic signal is more difficult.
The unit of measurement of Loudness is *Sone* and the evaluation of the loudness is standardized in DIN 45631, ISO 532-1:2017, ISO 532-2:2017 and ANSI/ASA S 3.4. The ISO 532 standards describe two methods to calculate the loudness volume, called method A (**of Stevens**) and method B (**of Zwicker**). The first method is for stationary sounds and is based on DIN 45631:1991while the second is for arbitrary non-stationary sounds, including stationary sounds as a special case and is based on DIN 45631/A1:2010. (Fastl and Zwicker, 2007)

NOISE CRITERION AND NOISE RATING

Noise curves are uniform measurement standards and are regulated by various noise standards, but there are five main methods for noise curves: Noise Criterion Curves (NC), Noise Rating Curves (NR), Preferred Noise Criterion Curves (PNC), Room Criteria Curves (RC), Room Noise Criteria (RNC). There are still no regulations that analyze these in external environments, in fact all refer to the noise from indoor environments.
The Noise Criterion and Noise Rating values are used to describe a measured noise level that takes into account the frequency content of the noise. They are often used in the measurement of noise from mechanical sources. Noise Criterion were established in the United State for evaluate indoor noise, while in Europe it is possible to use the alternative Noise Rating, in fact this last were developed by the ISO International Organization for Standardization in order to determine the acceptable indoor environment for speech communication, hearing preservation, and annoyance.
The method to evaluate Noise Criterion is based on a measurement of sound pressures levels. The criteria curves defines the limits of the octave band spectra: this limits must not be overcome in order to meet the occupants acceptance in the spaces; while the method to evaluate Noise Rating can be determined by plotting at each octave band the measured sound pressure.

SHARPNESS

Sharpness indicator represents the sensation value caused by the high frequency components of a noise. Sharpness can be related to the sensations of *density* and *timbre*. The major factors of sound that influence sharpness are the central frequency of the sound band and the spectral contents.
The unit of measure for sharpness is *Acum* and

the unit of measure of 1 acum is a narrow-band noise one critical-band wide at a centre frequency of 1 kHz having a level of 60 dB. (Fastl and Zwicker, 2007) There are several method to evaluate Sharpness: Aures, DIN45692 (German Institute for Standardization) and von Bismark. **Von Bismarck method** is a procedure based on the distribution of the specific loudness throughout the critical band rate, while the **DIN45692 method** is based Widmann research and this method is similar to the von Bismarck one. The **Aures method** instead calculates the sharpness considering the absolute volume of the signal. The most used method among all is the standardized DIN45692.

SPEECH INTERFERENCE LEVEL

Speech interference level also known as SIL was created to give an estimate of how much a given noise spectrum will interfere with effective speech communication; in fact it is used to characterize a noise in the frequency range in which the ear of human has its maximum sensitivity. SIL is an acoustic parameter calculated from the sound pressure levels measured in octave bands. The SIL was born after the Second World War because several studies were conducted to understand the level of communication and to quantify the effectiveness of human communication for a given background noise. In fact before the SIL the Articulation Index was born for the same reason and subsequently the SIL was born to study the effectiveness of conversation in aircraft during flight.

Speech Interference Levels are arithmetic average sound pressure levels at 500 Hz, 1 kHz, 2 kHz and 4 kHz octave band level.
ANSI (American National Standards Institute) in 1977 standardized speech interference level with 4 octave bands and this **ANSI SIL** is the only standardized form of SIL. The four octave bands are 500, 1000, 2000, 4000 Hz but some industries in the SIL calculation do not use the same bands: this calculation method is not standardized and is known as **SIL3**. So there are several ways to calculate this parameter: PSIL, SIL3 and SIL4. PSIL is an Arithmetic mean of 500 Hz, 1 kHz and 2 kHz octave bands, while SIL3 is an arithmetic mean of 1 kHz, 2 kHz and 4 kHz octave bands and SIL4 is an arithmetic mean of 500 Hz, 1 kHz, 2 kHz and 4 kHz octave bands. The unit of measure for speech interference level is *decibel* (*dB*). (Siemens, 2019)

TONALITY

Tonality is a metric that explain as the human ear is very sensible to the pure harmonic sounds, in fact it measures the number of pure tones in the spectrum of noise. So this psychoacoustic parameter was introduced to quantify the perception of tonal content, it explain the sensation of the timbre of a sound and it defines the composition of a perceived sound, if it consists of tonal components or broadband sounds.
The unit of measure for this parameter is *Ratio* and and its calculation was regulated by the DIN 45681 and ANSI/ASA S 1.13 regulations. There are several methods for calculating the tonality that are still used: Tone-to-Noise Ratio (ECMA-74), Prominence Ratio (ECMA-74), **DIN 45681 Tonality** and Tonality vs. time (*Aures/Terhardt*). Some of these show problems when applied to technical sounds, so recently there is a new tonality calculation based on a hearing model presented by Sottek, Kamp, and Fiebig. (HEADacoustics, 2018)

After the description of all these important acoustic parameters for the soundscape identification, the same indicators were identified in this study to evaluate the soundscape of the selected areas, as mentioned in part B, section 10.

Soundscape and perceived safety

So far the study of soundscape has identified that the sound environment is related to social context and the perception of users is determined by their background, as mentioned before. The soundscape can increase the feeling of unsafety, in fact when people cannot hear any sound the perceived unsafety grows. (Sayin et al, 2015) The feeling of fear and unsafety is closely related to the **feeling of loneliness** or absence of people. (Sayin et al, 2015) The strong relationship between the acoustic environment and the perceived sound is very important and above all how the **human perception of sound** can influence their behavior. The soundscape can influence people's behavior in many ways, in fact since 1980 economic studies have been carried out to understand the relationship between background music and customer behavior or between background music and the behavior of the worker in the store. (Lesiuk, 2005) Based on this idea, Ronald E. Milliman has shown that **background music** can increase the aesthetic perception of the mall, increase the number of purchases and create a better quality of work. It has also shown that people move according to music, in fact they go slower with slower music in a commercial environment and therefore spend more time there and buy more. (Milliman, 1982) All these studies demonstrate the **strong relationship between soundscape and people's behavior**, so it is possible to hypothesize that the soundscape influences people's perception of safety. Only in recent years studies about soundscape moved to the **outdoor environment**, such as the search of Kang about the sound preferences in urban squares. (Yang and Kang, 2005)
A pilot study in outdoor public space conducted in Brighton and Hove by Lavia et al. showed that different type of soundscape can reduce tension and aggressive behavior. (Lavia et al, 2012) Aletta et al conducted a similar in situ study in a pedestrian passage in the University campus of Sheffield; in this passage background music was played creating different soundscape (no music, classical music, jazz music) and the number of people and the time they spent in the passage were monitored. The results showed that the presence of music did lead to an increase in the average time spent in the passageway. (Aletta et al, 2016)
Schafer et al showed that musical scenarios are considered more reassuring, in fact he used an

extract of the soundscape reproduced in a laboratory environment and the participants evaluated the musical scenarios as more reassuring than natural sounds or silence. (Schäfer et al, 2015)
While the soundscape is a theme that has been known for some years, the relationship between human perception of soundscape and sound environment is not yet an in-depth theme and in fact it is quite difficult to study this relationship. The soundscape is often described, on the basis of previous studies, by the most important parameters, namely *noise annoyance*, *pleasantness*, *quietness*, *music likeness*, *perceived affective quality*, *restorativness*, *soundscape quality* and *appropriatness*. (Aletta et al, 2016) Instead, there are no parameters based on the feeling of unsafety, in fact recent studies have been carried out on this topic. In these studies, questionnaires are used to investigate safety and sound and three main indexes are used, namely **perceived safety**, **social presence** and **adequacy**. (Sayin et al, 2015) All these questionnaires also deal with the relationship between lighting and perceived security, because the **soundscape** and the **lightscape** are closely related.
An important study that analyzed the perceived safety and perceived social presence related to soundscape and lightscape is that of Calleri et al, who in the research involved thirty participants to whom were presented nine different scenarios of an underpass with different soundscape and lightscape conditions. Participants were asked to describe each scenario with ten items based on perceived safety and perceived social presence. The results of the research showed that the soundscape has an effect both on perceived safety and on the perceived social presence, while the variations of the lightscape had an effect on the perceived social presence. (Calleri et al, 2019) For the purposes of this research it is therefore important to further investigate how individuals' perception of soundscape can influence the perception of safety, considering that numerous studies have shown how the sound environment can influence people's behavior.

Studies about soundscape with survey

Soundscape evaluation is an important theme that, since the nineties, has been studied and analyzed by many scholars. Moving on to more recent studies concerning the soundscape and, above all, the soundscape investigated with the questionnaires it is possible to analyze Swedish Protocol. The Swedish Soundscape-Quality Protocol SSQP is a tool for assessing the quality of soundscape on the basis of a scale from *good* to *bad* and a set of scale related to *pleasant, unpleasant, eventful, uneventful, vibrant, monotonous, calm* and *chaotic*. (Axelsson et all, 2012)
The method to collect the people's perceptions of the sound environment is the **questionnaire** bus most of the studies on the sound environment examined through questionnaires have developed about interior environments.
One of the studies dealing with the perception of noise is the one carried out by Masullo and Maffei in the offices of the University of Naples. They have shown how the noise inside workplaces, such as offices, is the cause of negative perception of the environment. To do this they used two subjective questionnaires: one to measure noise sensitivity and the other to evaluate noise. (Maffei and Masullo, 2012)
In another context, that is a large urban park in Montreal, instead Steele compares the different methods of evaluating the soundscape, in fact he uses behavioral mapping, questionnaires and sound recordings. The questionnaires are divided into four sections: situational factors, soundscape evaluation, psychological factors and demographics. The soundscape section evaluate sound environment on the basis of the description of the soundscape with scale of *pleasant, unpleasant, eventful, vibrant, monotonous, calm* and *chaotic*. It also includes the evaluate of perceived sound level and of perceived appropriateness level of the place. (Steele et al, 2016)
Aletta et al evaluate the soundscape confirm the need for appropriateness, they have studied the differences in the appreciation of the soundscape on the basis of the different materials used in the paths of urban parks. (Aletta et al, 2016)
Brambilla et all instead compared the parameters of the measurements in the field with the answers to the questionnaires. As for the questionnaires it is important to know how the sound sources were identified by the interviewees: *road traffic*, *anthropic (produced by humans)* and *other natural sources*. When the questionnaire indicated pleasant sounds then the interviewees indicated the music or the water, but when it indicated annoying sounds the interviewees always indicated the traffic noise. (Brambilla et al, 2012)
The Ismail's research was conducted by a questionnaire to investigate soundscape preferences of residents in Cairo. A survey study was conducted to analyze the sound annoyance and to identificate how sensitive to noise Cairenes are; there were two different surveys, one close-ended and other open-ended. Results of this study showed that when Relative Annoyance Increase RAI was about 27% the sound category perceived by Cairo residents transforms from positive to negative. (Ismail, 2013) While Ismail studied soundscape in Cairo, Kaymaz analyzed the perceived soundscape of Ankara, an urban historical place in Ankara. His study investigated the soundscape and the visual landscape in order to evaluate historical urban environments during a renewal transformation. Research aimed to analyze the noise management during an urban transformation, in fact Kaymaz examined acoustic environment perception by the users through three elements: sound level measurements, in field surveys and questionnaire surveys. These surveys included open-ended and close-ended questions and it is divided into three sections: demographic factors, use-pattern and soundscape evaluation. Results of this research shown that gentrification process influenced wellbeing and quality of soundscape and that holistic approach is an useful tool to preserve the historical places. (Kaymaz et al., 2016) In the case of this research, questionnaires were adopted to investigate the subjective conditions of the soundscape, as explained in part B section 10.

Studies about soundscape with walks

In recent years a number of models, approaches and methodologies related to the description and evaluation of soundscapes have been developed. This study aims to investigate the subjective reality and the relative influence factors with a **sound and light walk procedure** (Jeon et al., 2013) with surveys was conducted on the analyzed areas. Another study with sound walk is the one of Schulte-Fortkamp and Fiebig that in 2006 have developed a model for evaluating the soundscape based on the experimental study in the field through sound walks, identifying five elements involved in the evaluation process. (Schulte-Fortkamp and Fiebig, 2006)

In the case of this research, however, some sound and light walks have been defined but single points of measurement defined within the same walks have also been considered, as mentioned in part B.

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MULTIDISCIPLINARY RESEARCH

strategies and solutions of metropolis for the critical issue of urban safety

Today speaking of urban security or urban safety, terms explained in part A section 3, means talking about protecting a public good that concerns the livability and decorum of cities. In a context of globalization, sustainable growth and digitalization, the theme is particularly current and feeds a debate that focuses on the concerns and quality of life of the citizen, but also smart, sustainable and integrated solutions for urban security planning, design and management. The theme of urban security becomes a vision that cannot be ignored when everything is delegated to the technologist and when the central system of cities government passes to the elements of Internet of Things (IoT).

> *"with the dominant domain of IoT devices, it is more than ever necessary to associate the smart adjective with that of safe for an effective overview of governance useful to emergency management processes, which involves the various actors who go from the public security forces to the infrastructure managers involved in the processes thus obtaining coordinated actions supported by technologies that allow interoperability and interchange of joint information between the various forces."*

("*con il preponderante dominio dei device IoT, è più che mai necessario associare all'aggettivo*

smart anche quello di safe per una efficace visione d'insieme della governance utile ai processi di gestione dell'emergenza, che vede coinvolti i vari attori che vanno dalle forze di pubblica sicurezza fino ai gestori delle infrastrutture coinvolte nei processi ottenendo, così, azioni coordinate e supportate da tecnologie che permettano interoperabilità e interscambio di informazioni congiunte tra le varie forze"). (Villarosa, 2019)
The socio-technological nowadays evolution of an urban center has changed the structure of a city, both from the innovative point of view and from the management side, in fact a modern city is the product of the many changes and are called **Smart Cities**. These last are digital city that includes all economic activities, public mobility, transport system, environmental resources, interrelations between people, urban planning policies and the model of public administration. Smart City is a set of: *Smart Transport, Smart Energy, Smart Technology, Smart Living, Smart Environment, Smart Citizens and Education, Smart Economy, Smart Government and Safe City*. (Lacinák and Ristvej, 2017)
The topics of security and safety are crucial components of life quality in every city, in fact it is important that every smart city must be a **Safe City** as well. An important tool to understand this technology-safety relationship is the *Safe Cities Index* that is a report from The Economist Intelligence Unit sponsored by NEC based on the second iteration of the index, which ranks sixty cities with fourty nine indicators about digital, health, infrastructure and personal security. (Economist, 2017) The Economist has numerous case studies for the development of urban security strategies, one of these is *Integrated Urban Safety Solutions - Tigre City*. **Tigre** is a city in Argentina that was facing problems related to theft, drug trafficking, car accidents and episodes of violence. The city in 2011 decided to deploy NEC public safety platform in order to make the city safer and enhance the quality of life of its citizens. The solutions proposed are: *"implementation of public safety platform in order to monitore the whole city 24 hours a day, collaboration between citizen for security, License Plate Analyzer, Behavior Detection, Crime Map and Evidence, Machine Learning Technologies, Service Level Agreement for analyzing and improving the images"*. (NEC, 2016)
Another case study of Safe City is **Surat** *City Police*, a port city on the west coast of India; the government decides to deploy safer city technologies in order to provide security and safety to resident and prevent crime. In this case the solutions proposed are: *"NeoFace facial recognition solution, NeoFace Watch to match faces in real-time with police, NeoFace Reveal for forensic investigation, Face recognition solution at Command and Control and center setup to provide actionable intelligence"*. (NEC, 2018) It is useful to better understand the issue of urban security to cite some examples of cities that have adopted different strategies to enjoy spaces in safety. (UNI, 2018) One of these cities is **Venice** that has signed *Pact for secure Venice*, an agreement between mayor and prefect to improve the control of the territory of the Municipality, fight degradation and lawlessness, and favor the urban decor. The municipality, to obtain these results, focused on the increase of local police officers, on the request for personnel involved in the *Safe Roads Project*, on the fight against illegal trade and on the control of neighborhood and technology. One of the main points of the protocol is the construction of an unified metropolitan operating center of local police; this can favor synergies with the police forces of the state from the point of view of the concentration of video surveillance, that can be easily consulted by the police forces themselves. On this last aspect is important the role of Venis Venezia Informatica e Sistemi S.p.A. that received the award *Safe Venice* because it has designed and built a sophisticated urban video surveillance system based on high-resolution cameras with centralized control and recording, and for the wave control system and water traffic monitoring. (UNI, 2018)
Deputy General Manager Marco Bettini stated that "*This is the recognition of teamwork between the Municipal Administration, Municipal Police Command of Venice and Venis, who strongly believe in the importance of protecting even with the use of the most advanced technologies - a unique artistic and landscape heritage*" ("*Questo è il riconoscimento di un lavoro di squadra tra Amministrazione Comunale, Comando della Polizia Municipale di Venezia e Venis, che fortemente credono nell'importanza di proteggere anche con l'uso delle tecnologie più avanzate - un patrimonio artistico e paesaggistico unico al mondo*"). (UNI, 2018)
Another Italian reality that begins to move towards security is the city of **Bergamo** that in 2017 with the University of Bergamo and Harvard Graduate School of Design presented the projects of the students of the course *Responsive environments: City Emotion* about the issue of urban safety. The students analyzed the case of the city of Bergamo in order to make the city safer and the proposals are drones for personal assistance, apps that help communities, but also road regulation and promotion of activities on the territory. (Unibg, 2017)
A city sensitive to the subject of security is **Nice**, called the most video-monitored city in France. In fact it has 1.257 cameras in the streets, one for every 273 inhabitants, against one in every 1000 in Paris. The cameras' software are based on algorithms able to identify anomalous behavior of people or cars moving along city streets. Then images captured by these arrive at the headquarters on a secure fiber-optic network: Nice is the only city in France to be equipped with a network so technologically advanced and so powerful. In the Center De Supervision frames are controlled by 70 active H24 policemen; in this control room called *war room* there are 14 maxi screens, subdivided into other screens that constantly investigate the city: cars lined up at traffic lights, people shopping, building facades, inside of a tram and so on. This city control with intelligent video surveillance has allowed in recent years to reduce attacks on trams from 0.53 cases for every million travelers to 0.37 episodes. (Mincuzzi, 2019) Even though the technological and organizational cameras, the *big eye* of Nice was not able to stop the scene of the massacre in the night of 14 July 2016 on

the Promenade des Anglais. About of this tragic event, the former Nice chief prosecutor, Eric de Montgolfier, was skeptical about the effectiveness of video cameras *"When you are the victim of an aggression, whether there is a camera or not, you are still the victim of a 'aggression'"*. (Mincuzzi, 2019)

Another city that dealt with security is **Eindhoven**, while Nice is based on integrated policies, Eindhoven focuses on technology: Eindhoven features in the top of most technology and innovation rankings worldwide. An important step for technology and safety in Eindhoven is the *CityPulse pilot* that aimed to help the city to manage the street in the center, particularly the Stratumseind street with a lot of bars and nightclubs. The pilot uses big data intelligence and it is able to provide information to the authorities about what they have to do for safety night. (HSF, 2015) Vice mayor the City of Eindhoven Bianca van Kaathoven states that "*the CityPulse pilot project is important to us since Eindhoven is an innovative city. We use public spaces to develop new, innovative ideas. CityPulse is helping us to make Stratumseind a safer and more enjoyable place for everyone.*" (HSD, 2015) This pilot is part of the initiatives of the Dutch Institute for Technology, Safety & Security DITSS, that is a non-profit start-up founded in 2012 by several governmental and research organizations. Further initiatives of the same are TRILLION (H2020-FCT-2014), ANITA (H2020-FCT), PRoTECT (ISFP 2017 AG) and finally JADS CrimeRoom. (Brainport Development, 2018)

The city of Eindhoven has given particular attention to lighting environment, in fact it is part of *Lighthouse City* for the *European Union's Horizon 2020 Triangulum Project* together with UK and Norway. This project has the task of demonstrate solutions for smart city that are also sustainable and inclusive. (Smith, 2018) In order to investigate the urban environment, a team of researchers composed of Kati Brock and Elke Den Ouden (Eindhoven University of Technology) and Ralf Voncken and Kees Van Der Klauw (Philips Lighting) look at how public lighting in Eindhoven city provides a case of how to use light infrastructure in a smarter way. (Newsroom, 2017) In conclusion with the dominant presence of technologies, it is really important for the city to have the safe adjective with the smart one because this theme is complex and articulated and it is one of the main areas of future research. The concept of smart cities is changing the reality of a places, in fact so many complex technologies are integrated with the infrastructure of the city and there is significant interest in the security of the cities; anyway there is a lot of work need to be done to ensure safety in smart cities and so that the citizens can completely realize the benefits of the smart city. (Kumar et all. 2016) On the basis of all this research on the topic of security it is possible to understand that, in smart cities, different aspects that can influence the perception of safety are analyzed, but the objective aspects are not always correlated with the subjective ones. This thesis aims to integrate all the various objective aspects of the environment into a single research and to compare them with subjective perception.

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DECLARATION OF INTENTS

research implications and purposes

The research analyzes the **safety perception** correlated to the **conditions of light, sound** and **urban and architectural decay** of places considered particularly critical in the City of Turin. The study starts from the assumption that the interaction between light, sound and surrounding environment is an important factor for the evaluation of the urban space quality, as explained in part A section 2. In particular, the urban quality is in contiguity with the theme of urban safety and it is influenced by the policies of redevelopment of the space. The perception of urban safety, that change in relation to the objective environment and to subjective perception of the latter, is investigated because it influences the life quality of the inhabitants of the places under analysis.

This research aims to **provide a framework** on the levels of urban and architectural decay and on the levels of lighting and acoustic environment of the selected areas, based on objective and subjective analyzes.

In fact the research aims to link all aspects of analysis to frame the phenomenon as a whole, the possibility to find a correlation between **subjective analyzes** and **objective analyzes**; in order to do this, the various aspects of an area relevant to the topic of safety have been investigated and have been related to the safety perceived by the users. Concern and fear are certainly influenced by crime levels, but they can be also closely related to levels of brightness and noise environment, to the architectural conditions and to urban degradation of places; in fact it is proved that urban and architectural decay is closely related to social degradation, as mentioned in part A, section 3.

The goals of this research are focused on the drafting of a **perceived safety assessment protocol** based on the perception of noise disturbance, urban light quality and urban and architectural decay; it is important that this protocol can be scalable and applicable in other urban realities.

In order to make citizens aware to the delicate security-city dynamics and in order to adopt proactive behavior in urban life, the research aims to **disseminate urban safety issues**.

In conclusion this research propose solutions to identified safety problems and to improve the acoustic and lighting characteristics.

The principal aim of the research is to provide a **structure of a preliminary analysis method** for urban planning that is based on the correlation of objective aspects and subjective aspects, in fact this correlation could be the basis of a conscious and participatory urban planning, an urban design that places the citizen at the center.

RESEARCH QUESTIONS

research implications and purposes

The research questions are focused on the topic of **perception of urban safety**. In order to analyze this perceived condition, the topics analyzed such us lighting conditions, acoustic conditions, urban and architectural conditions and well-being are related to the central theme of urban safety. The hypothesis of the research is that the perception of urban safety can be influenced by numerous factors that can be divided into factors that concern the citizen himself and factors that concern the perceived surrounding environment. Therefore, by connecting to these theme, the first research questions concern the **characteristics of the citizens**. This study want to investigate how the type of user influences the perception of safety or if the age or gender can affect the perception of safety; in fact the identification of common characteristics of citizens (age group, level of education, etc.) could be reflected in the variation of the answers or in the correlations themselves. Another theme linked to the characteristics of the users is the reason why the participants frequent the place, this thesis want to understand how the **frequentation of the place** influences the perception of safety. Another topic of analysis is the **psychological well-being** of the citizens, the research want to investigate how it affects the perception of safety. After founding the relationships between the users of the area and the perception of safety the research goes on with the analysis of the relationship between urban and architectural degradation and urban security. Starting from the *Theory of Broken Windows*, as mentioned in part A section 3, the study want to investigate how **urban quality** influences the perception of safety. Actually the perceived urban and architectural decay and consequently its relationship with perceived safety can also be related to the **presence of people** in the place of analysis, in fact the degradation can be physical (or an architectural or contextual decay) or a social decay due to the presence of people. The presence of people can be positively, that is aggregation of friends, etc., or negatively as an excessive quantity of people and different types of people. In fact the average hourly presence of people could positively influence compared to walking in a deserted place and vice versa could negatively influence in case of overcrowding.
After the analysis of the subjective characteristics of the participants, it is important to find a correlation with the objective characteristics to understand how the characteristics of the perceived light and perceived sound influence the perception of safety. On the basis of these statements the research questions of the thesis are the following:

	TOPIC	QUESTIONS
1	Area	How does the perception of safety change in the analyzed areas?
2	Characteristics of users	Is the perception of safety influenced by the type of user (residence, gender, level of education, age, level of recurrence)?
3	Characteristics of users	Is the perception of safety influenced by the psychological well-being of the users?
4	Decay	Is the perception of safety influenced by the perceived urban and architectural quality?
5	Decay	Is the perception of safety influenced by the square meter price?
6	Social presence	Is the perception of safety influenced by the perceived social presence?
7	Social presence	Is the perception of safety influenced by the average hourly presence of people?
8	Light	Is the perception of safety influenced by the perceived characteristics of light?
9	Sound	Is the perception of safety influenced by the perceived characteristics of sound?
10	Other factors	Can the perceived safety be estimated starting by other perceived factors?
11	Light	Which objective characteristic of light is more correlated with the subjective characteristics perceived of light?
12	Sound	Which objective characteristic of sound is more correlated with the perceived subjective characteristics of sound?

Table A1. Walk Safe Project Research Questions

B

METHODOLOGY

ENVIRONMENTAL ANALYSIS

the importance of the environment analysis in order to understand the objective and subjective realities of the analysis' areas

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In the 1952 book *A sound of Thunder*, Ray Bradbury deals with a science fiction paradox about how an environmental disaster is the result of local action. (Bradbury, 2000) The environment is a topic that is often talked about in the last years andand is defined as

> *"The surroundings or conditions in which a person, animal, or plant lives or operates."*
> (Oxford, 2019)

> *"The natural world, as a whole or in a particular geographical area, especially as affected by human activity."*
> (Oxford, 2019)

There are numerous actors with different skills in protecting the environment, in fact it is possible to compare everything to a *Game of Go*, an ancient Chinese strategy game. The goal of the Go game is to build and dominate governments by delimiting their board areas with their own pieces; the skill is in **integrating the strength of each pawn** so that they can be able to optimize the other pawns in possession. Each player with the growth of his experience is able to identify more systematic actions on his own territory. (Kunkle, 2002) From this it is possible to understand that at a local level competent people must know how to perform their job, even

more so when they have effective tools such as new technologies, social media, legislative power and available capital. The implementation of policies for monitoring and environmental protection requires increasingly advanced technologies and data produced and collected with the growth of the potential of these technologies; at the local level the situation is reversed because the interpretation of the phenomena loses meaning. Therefore it is necessary to observe always the context in which the phenomenon is inserted and to evaluate its interactions with the entire society. The **context analysis** must be based on the **objective observations** of the place and on the **social**, **cultural** and **economic dynamics**, that are **subjective observations**.

The times of this environmental degradation must also be considered: a damage can be quickly destructive and generate an immediate fear or unsafety (eg final champion in Piazza San Carlo) or it may be the impact that produces damage after prolonged periods (eg nightlife/movida). The solution to environmental degradation is everyone's responsibility: the technician must extrapolate and analyze the data, the politician must use them for a strategy of actions in the short and long term and the citizens must defend their right to quality by demanding information.

In several studies is evident the different in collecting data from environmental setting by two approaches based on different assumption: Technical Environmental Assessment TEA and Observer-Based Environmental Assessment OBEA. (Johansson et al. 2014) First method has the purpose to **characterize objectively the environmental reality** based on measure of physical quantities, such as luminance, illuminance or sound pressure level. That kind of strategy respond to necessity of drawing a model adherent to reality as more as possible. In opposite way, the results obtained from the second method are hard to very because they are based on **subjective sensations**. The tool used from collecting them is the **survey** and the respondents are asked to give opinions that reflect their own perception. In this specific research it was considered necessaire using both in multi scalar approach. This study is based on an experimental research that investigates the human safety perception in spaces of Turin; in this research the data collected are provided by objective analyzes such as **acoustic measurements**, **lighting measurements** and **average people density** and by subjective analyzes such as **three different type of survey** and **sentiment analysis**. All these data are subsequently analyzed with the necessary statistical analysis in part E section 23. Then subsequently, in part B section 9, the methodologies for the analysis of the objective realities are explained, while, in part B section 10, the methodologies for the analysis of the subjective realities are explained. For this research sound-light walks have been adopted, as mentioned in part A section 5. For each station a walk was defined with measurement points, where acoustic and lightinh measurements were carried out.

OBJECTIVE ENVIRONMENTAL CONDITIONS

objective conditions of light, sound and average people density analysis

Lighting objective analysis

In the introductory part relating to light, part A section 4, the concepts of luminance and illuminance were explained in photometric terms, the aims of outdoor lighting project were introduced as well as the binding lighting norms and legislation in the areas of research. It was introduced the necessity to verification of some standards parameters. In this chapter, instead, the methodology used to collect objectively measurable lighting data will be introduced with particular attention to **standard required values** and **luminance distribution of the observed scenes**. The main purpose of the valuation was to document lighting settlement during the submission of on-site survey, introduced in the previous chapter and explained in the next section dedicated to the collection of observer-based data, in order to have the most objectively possible environmental conditions to correlate with subjective perception values.

According with norms UNI 11248 and UNI EN 13201, each measure point was sectioned in three by three-meter horizontal grid between two consequent luminaires; vertices were numerated and on its data were collected. If pedestrian path surface had been less than three meters wide, the grid was reduced to a single line of points. For each vertices the *minimum horizontal illuminance* has been measured at 0.2 m from the ground level, the *vertical illuminance* was measured at 1.5 meters along the two path directions. Finally, the *semicylindrical illuminance* was oriented estimated by vertical illuminance because lack of proper technical instrumentations. Before the proposes of the survey to walking people, every illuminance value was collected using luxmeter kindly offered by LAMSA office of Energy Department DENERG "Galileo Ferraris", to which a heartfelt thanks go.

Because the human vision has based on contrasts of luminance and in the focus of the research is perception, it is important to consider that **illuminance values**, necessary to respect because the norms, are not sufficient parameters to take into account. Considering this, in the same point of vertical illuminance data collection, the researchers took photos using tripod and Canon camera EOS 650 D model with 17-50mm lens positioned to 1.65 meters from the ground level. It was inclined by one degree down from the horizon level to simulate human head position during walking section. For each measure point were collected two photos, one each walking directions (focal length 17 mm f 4 ISO 100) for a total of forty raw high dynamic range images,

using auto bracketing features, in .cr2 extension. Before starting the shooting, camera was previously calibrated in specific laboratories using technique that associate for every pixel value a luminance value, turning the instrument into a photometer. It is possible using several techniques, one of those use MATLAB software and a proper testing room (Suway & Suway, 2017). Analyzing a lit scene in luminance distribution terms means photographing it in photometric way. Finally, finished subjective data collection, the researchers filmed a sound-light walk passing through every measuring point using Go Pro Silver model 4 in UHD standard video. That further document the environmental condition during each specific night.

Three different method was used for **collecting luminance value** of each scene starting from the same photography. All the document passed by LMK lab soft 4, 17.10.10 version that, using the luminance calibration file mentioned before, it was able to extrapolate luminance value and provide descriptive statistical informations. All of these consist in identification of regions of the image in which the values were extrapolated. They are:

- Luminance of horizontal 40° band
- Luminance of physical elements
- Luminance of fixed image regions

The first method is based on the experiments conducted by Loe, Mansfield and Rowlands explained in part A section 4. (Loe, Mansfield, & Rowlands, 2001) In order to reproduce the same field of view, it was important identified the angle of the photos shooted on site. According with the information found on the manufacturer's website, the camera mounts 18.0 MP APS-C CMOS sensor; with 17-50 mm lens applied this sensor is equivalent to 1.6 times the focal length applied to full frame sensor. The region of space in the photographs are between 67° horizontal, 48° vertical and 78° diagonal of radial angle from the point in which is positioned the photographer. (Hollows, 2011) In the Loe's article quoted above, the field of view of the luminance meter instrument was limited positioning physical barriers at 40° in altitude and 90° in azimuth. In the current experiment it was impossible to act on physical barriers because the gap in time from the taking of the photos and the analysis. It was considered appropriate reproduce it using virtual geometry construction in SketchUp software, the same shooting environment was recreated and positioning virtual barriers at 40° in altitude and 90° in azimuth and after it sectioned them in the photos plan. The photo's area into 40° band was identified and reported in the scheme visible in colored part of Fig. B1. The statistical values extracted by the software are: the **average luminance**, **dispersion in luminance value**, **maximum luminance**, **minimum luminance**, **maximum to minimum ratio** (when minimum value was not zero) and **maximum to average ratio**. Every luminance values are misused inside 40° band and expressed in candela per square meter. One of the critic that can be moved to this method is the fact that the 40° band inclu-

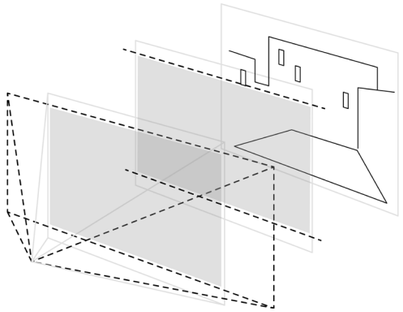

Fig. B1a. horizontal 40° band construction

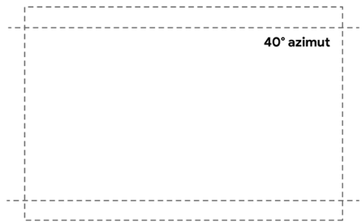

Fig. B1d. horizontal 40° band construction

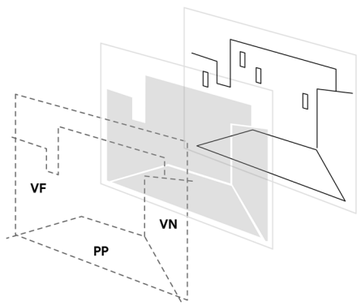

Fig. B1b. physical elements identification

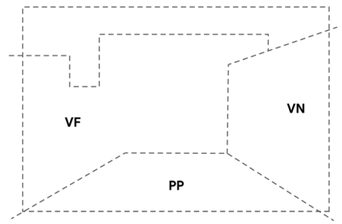

Fig. B1e. physical elements identification

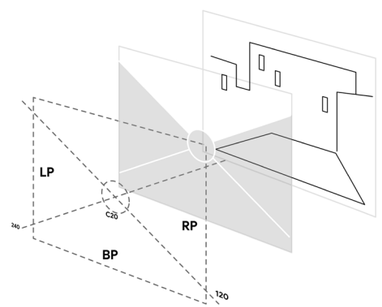

Fig. B1c fixed image regions identification

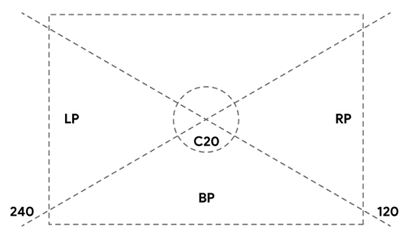

Fig. B1f. fixed image regions identification

ded various elements with very different luminance characteristics such as road pavement and the sky, or light vertical partitions and the vegetable cover; in very different way compared to indoor experiment in which the area included front wall and small part of ceiling and floor.
To solve this question, the second method involves measuring started from the **environmental elements** (like path, near buildings, far vertical element etc..) visible in the frame. As you can see in FigB1b., from them it was identified areas, changing photos by photos, and consequently regions to measuring. The lower region included pedestrian path, or the element in which the individual walks. Near vertical ones is composed by walls, fences or opaque glass façades in proximity of the observer, and vertical far region contain element far from the observers, typically buildings or trees. For each one the statistical values extrapolated by the software are the **average**, **maximum**, **minimum luminance** and the **dispersion**. A limit of this second strategy was the sky. If the photo is mainly composed by the sky or no element is present directly in front of the observers' path, there is no element to consider, and consequently there is no overall luminance value that could give a general information of sight natural calibration that human eyes automatically operate based on luminance of lit scene.
To compensate for this lack, the last method was developed based of central circular region and in general on the **analysis of fixed region** of the photo, FigB1c. The frame considers a centered circular region of 20 radial degree (C20); 120 and 240 degree from vertical line are the limit for lateral regions left and right, and the walk area is considered in the bottom one. Also in this case, for each regions the statistical values extrapolated by the software are the **average**, **maximum**, **minimum luminance** and the **dispersion**.
Pros and cons can be considered for each strategy, this means the impossibility to identify a priori the better strategy of image analysis. The research continues by pursuing all three methods for estimate subjective perception phenomena, the one that will explain it in the most accurate way it will be taken into consideration (comparing variance R and R^2). It is possible to vision all collected values in a **web file** that it possible to download.

Acoustic objective analysis

In the introductory part relating to sound, part A section 5, the concepts of soundscape was explained and the indicators and factors of this were introduced as well as the sound norms and legislation in the areas of research. It was introduced the necessity to verification of some standards parameters, explained in detail in the indicated part. In this chapter, instead, the methodology used to collect objectively measurable sound data will be introduced. The main purpose of the valuation was to document soundscape settlement during the submission of on-site survey, introduced in the previous chapter and explained in the next section, part B sections 9 and 10, in order to have the most objectively possible environmental conditions to correlate with subjective perception values.
The analysis methodology of the sound environment derives from previous studies analyzed in part A section 5. This methodology consists of an objective and a subjective part, the objective part is the in field **acoustic measurements**. Measurements took place on five weeks from November 2018 to December 2018, a week for each examined site, for three days a week (Monday, Thursday, Saturday) in the evening between 08:00 pm to 00:00pm. The acoustic measures were carried out through a **sound-light walk**, as defined in part A section 5, with predefined measurement points, as defined in part C, sections 13, 14, 15, 16, 17: a measurement was made from station number one at station number five without any stops, while the other measures, those used mainly for analysis, were made for each station with a duration of 5 minutes each. Therefore for each station a 30-minute stop for questionnaires and a 5-minute stop for soundscape measurements was provided.
Acoustic measurement were performed using a **binaural recording system** kindly offered by Applied Acoustics Laboratory LAA of the department of Energy DENERG "Galileo Ferraris", to which a heartfelt thanks go. It is composed of a portable audio recorder SCASAS XS connected to earphones with a pair of omnidirectional microphones; this system is controlled via android app Siemens Testlab Scope 7 and Simcenter Testlab Apps for Scadas XS.
The microphones were positioned at the level of the ear as they were included in the earphones, one on the left and the other on the right of the operator that performing the records, in order to simulate how the participant perceived the surrounding sound environment; in fact a five minutes audio file was created to analyze the objective physics levels that describe the soundscape of each station and each area, as defined in part C, sections 13, 14, 15, 16, 17. Every night, before starting the registration, microphone calibrations were performed via tablet app Siemens Testlab Scope 7. All the audio files were directly saved in a memory card in the SCADAS XS itself and in a micro SD memory card in the Huawei tablet. The measurements were then moved into a personal computer protected by a password where the data are analysed using the Siemens software. The audio files collected are analyzed using the Simcenter LMS Testlab (Siemens PLM Software, v.17). The values computer from the acoustic recording were those explained in part A section 5, or the following: A-weighted equivalent sound level **L_{Aeq}** and **Psychoacoustic Metrics** (Articulation Index, Fluctuation Strength, Loudness ISO532A VI, Loudness Stevens VII, Noise Criterion, Noise Rating, Roughness, Sharpness Aures, Sharpness DIN45692, ANSI Speech interference level, Speech interference level SIL3, Specific Loudness ISO532B FF and Tonality). All measured data are collected as raw data in the Appendix reported and it is possible to vision all collected values in a **web file** that it possible to download. Subsequently, in order to analyze the data collected, statistical analysis were used, as defined in part B section 11 and the results of these analyzes are reported in part E section.

Average people density analysis

The analysis of the average hourly presence of people in the different places was carried out through the TIM Big Data Value platform in collaboration with the Technological Investigation Department of the Municipal Police Corps of the City of Turin. TIM Big Data is the Olivetti solution that offers advanced tools for **qualitative and quantitative territorial analysis** in the cloud through the valorization of data collected by the **TIM network using SIM card**. A SIM (Subscriber Identity Module or Subscriber Identification Module) card is a subscriber identification card for a mobile connectivity service (GSM or UMTS) and it has a microprocessor in which there are the essential data about the holder and the type of operator contract. (Singh et all, 2015) The potential of big data impact is used in a lot of sectors such as healthcare, media, energy or retail; an example of these is the media one which obviously includes the data obtained from the SIM cards. Big data analysis of telecom, media and entertainment can enable the discovery and delivery of media content through dynamic interact and across multiple platforms. (Cavanillas et al, 2016) In a reality in which big data are increasingly important, it is also important to be able to use them correctly, even if some technologies are already available in ever wider fields. In fact, for instance, the offer of TIM is only for the Public Administration and Tourism services, and in full respect of privacy, the service is designed to provide presence and mobility information to Public Administrations (City Forecast profile) and to companies (Data Retail Analysis). Indeed through the Tim Big Data solution, Public Administrations will be able to develop a series of initiatives for the transformation of cities into smart cities, where at the center of innovation there is man understood as a citizen with the right to live in an environment. (Olivetti, 2019) Tim Big Data is a service developed with Big Data technology that, through a web interface, represents in the form of dashboard and heat-map the **concentration of the crowd present on the national territory** according to the use of the TIM network. So through this service it is possible to know a whole range of information over time (15 minutes, hour, day, week and month) with a historical depth of one year. It is thus possible to know the characteristics of the interviewee such as **sex**, **age group, nationality** and type of **sim client**. It is also possible to know which areas are most crowded (presences estimate) and which are the areas of greatest origin or destination in a given place or event. (Bonato et al, 2018)

In the case study all this information was extracted for each area analyzed; the selected areas were:

- 0.29 km^2 for the Campus Einaudi with six FSAs used;
- 0.15 km^2 for the Vitali area in Parco Dora with two FSAs used;
- 0.21 km^2 for the Passerella Olimpica with three FSAs used;
- 0.11 km^2 the San Salvario district with two FSAs used.

For all these areas the anonymous data of the SIM were extracted and these latter were used later for the statistical analyzes as defined in part B section 11. For this research it is important to know these data they are necessary to understand that there are different aspects to the perception of unsafety, as in this case the objective ones. This thesis aims to integrate all the various objective aspects of the environment into a single research and to compare them with subjective perception, explained in the following section, part B section 11.

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SUBJECTIVE ENVIRONMENTAL CONDITIONS

subjective environmental conditions analysis through three different questionnaires

It is already defined that the livingscape is an important element for the quality of the environment and consequently for the perception of that environment, as mentioned in part A section 2. In fact the harmony between livingscape or landscape and soundscape or lightscape is a key point, because these elements are related to the perception of environmental quality, therefore also to soundscape perception and to lightscape perception. (Kang et al, 2016) A soundscape is closely related to the perception of a visual environment of an urban space, in fact there are different factors of lightscape that can influence the soundscape, such as spatial impression, aesthetic quality or maintenance of public space. (Kang et al, 2018) On the basis of this, it is therefore important to understand the **perception of these two environments**, soundscape and lightscape.

There are different methods to collect data about **human perception** of the surrounding **acoustic** and **light environment** and physical and psychoacoustical data about the sound and the light environment. The soundscape and lightscape analysis requires particular attention because it is not only an objective measurement of defined parameters measurable in situ, but it is also a subjective assessment of people who live and visit the analyzed places; it is therefore essential to define and understand their perceptions and expectations about what surrounds them. Starting from this last it is important to investigate the social and cultural background of the interviewed, it is also important to understand how their background characteristic influence their perception; in order to do this we use the methodology of the **questionnaires** based on the researches studied, as explained in part A sections 4 and 5.

Survey structure

The method used in this research to collect people's perceptions of safety, sound environment, lighting environment and urban quality is the **questionnaire**; in the study carried out on the areas analyzed three different questionnaires were defined: **on-site survey**, **double-check survey** and **social survey**.

In the first two cases the questionnaires were given via tablet through a *Google Form* document, in a way that prevent the relationship between interviewed and researcher because this could influence the individual assessment, while the third was given through the same *Google Form* document but on the internet.

All the questionnaires are based on a series of questions, the latter are closed for the on-site

survey and for the social survey, while the double-check survey has also open questions. The surveys are always the three same so it is possible to compare the answers of each participant based on the different questionnaire to which they responded.
All the surveys are structured in paragraph form to giving to researchers the opportunity to investigate the different themes about human **perception of unsafety**, **sound conditions**, **light conditions** and **urban quality** (architectural and urban decay). In order to understand the social and cultural background of the interviewed and how these background characteristics influence their perception, at the end of the on-site survey and double-check, there are different questions about the **social and cultural data of interviewed**.
All the data collected such as information relating to the participants, the answers to the questionnaires and the measures are safely stored on a personal computer; the **privacy of the interviewed people** is guaranteed because it is impossible to identify the profile of each interviewed who participate in the questionnaire.
On-site survey took place on five weeks from November 2018 to December 2018, a week for each examined site, for three days a week (Monday, Thursday, Saturday) in the evening between 08:00 pm to 00:00 pm; while double-check survey took place on one week in December 2018 for examined site of Passerelle Olimpica, for three days (Monday, Thursday, Saturday) in the evening between 08:00 pm to 00:00 pm. Finally social survey took place online through the social pages of the project and did not have a precise temporal division, but it was distributed at the end of the other two.
The acoustic and lighting measures were carried out through a **sound-light walk** with predefined measurement points, as mentioned in part C sections 13, 14, 15, 16, 17, simultaneously with the administration of the questionnaires: the researchers was in each point for about 30 minutes, recruiting the participants or the users of the area (residents, in transit, etc.).
The **inclusion or exclusion criteria** of the research participants provide that the participants in the research through the administration of the on-site survey and double-check survey were randomly included among the users of the selected areas. Instead it is not possible to determine the criteria of the participants inclusion or exclusion for the social survey because it is a questionnaire with a compilation via internet.
The **types of participants** who took part in the research are adults over 18 years of age able to express their consent, elderly people over 65 years of age and able to express their consent and people who are non-native speakers of Italian. The participants did not include children, people with cognitive or mental deficiency who could not express their consent or people with cognitive or mental deficits unable to express their consent and other people whose capacity to express consent may be compromised for some reason. Institutionalized persons (eg detainees, hospitalized patients etc.) and patients or clients reported by doctors, psychologists or other categories of professionals, were not included either.

It was also checked that none of the participants was in any form of 'addiction' towards the researcher or one of his collaborators, for which that the expression of consent to participate in the study is completely unconditional, free from any kind of pressure (eg, student/professor, patient/doctor, employee/employer).
Information and invitation to participate were disseminated through the social media channels and through distributed teaser cards; while the participants involved on site had the same *information sheet* and *participant consent form* available in Google Form document and the social media channels of the research were communicated to them with the teaser cards. If the interviewee had shown any discomfort, he would have been free to withdraw from the research without providing any explanation or justification; in any case the participants of all the surveys were informed of an email created specifically for the search (*walksafetorino@gmail.com*) to which they could forward doubts and request clarifications. It is also possible to write messages directly from the social media channels of the project. No rewards of any kind have been provided for participation in the research except for the awareness of having supported a is to provide a structure of a preliminary analysis method.
The **information sheet** and the **participant consent form** by the participant, written on pages 133 and 135, were introduced at the beginning of each questionnaire and provide a detailed description of the research and of the return of the data. After reading the information sheet and the informed consent, the participants started compiling survey; in fact the Google Form was already set in the tablet.
The questionnaires, before the administration, were approved by the *Comitato di Biotetica dell'Ateno CBA* of the University of Turin, as mentioned on page 137.
All three questionnaires were subjected to the *validation procedure*, ie possible interpretation errors, superfluous questions, missing questions, confused or inappropriate answers were identified and corrected. (Corica et al, 2004)
Linguistic validation is the process of investigating reliability, conceptual equivalence and validity of translation contents. The process ensures the multilingual harmonization of translations, making sure that the questionnaire is understood in the same way by different populations.
The questionnaires were subjected to translation and adaptation for the versions presented according to a **translation** and **retranslation process** (*forward/backward translation*) and through a **pre-test of administration**, ie the pilot. (Ranieri et al, 2016) In fact in this phase a **research pilot** was carried out, as mentioned in part B section 12, and the interviewees were encouraged to comment on questions and answers. Therefore all the questionnaires present **two versions**, namely Italian version and English version, the same for the information sheet and the participant consent form.
On the basis of this common structure of surveys, it is useful to understand how these were used to study in depth the unsafety perception.

On-site survey

The on-site survey took place on **five weeks** from November 2018 to December 2018, a week for each examined site, for three days a week (Monday, Thursday, Saturday) in the evening between 08:00 pm to 00:00 pm. The survey is designed to take approximately **6 minutes to complete**. The acoustic and lighting measures were carried out through a s**ound-light walk** with predefined measurement points, as mentioned in part C sections 13, 14, 15, 16, 17, simultaneously with the administration of the questionnaires: the researchers was in each point for about 30 minutes, recruiting the participants.

The questionnaire was divided into four sections: **Perceived Safety** within which there is the **Perceived Urban Quality**, **Lighting Environment**, **Sound Environment** and **Characteristics of the interviewee**, within which there is the **Wellbeing**.

In the first section all the questions were asked from the point of view of the **perceived safety of the interviewee** and it was requested to evaluate the environment that at that moment surrounded the interviewee. One of the aims of the research is to investigate how the perception of safety is influenced by the use of the place, as mentiond in part A section 3, in fact the first two questions investigated the frequency of the visits (such us *this is the first time I visit this place* or *I visit this place every day*) and the reason of visits (such us *walk*, *work*, *study*).

An important source consulted before starting to developed the questionnaire is inherent to social research (Kenneth D. Bailey 1978), in fact the second part of this book was entirely dedicated to the questionnaires. For example, about the persona information questions, it is good practice put them in the last part of the questionnaire for avoid that people could be discouraged from them and stop the compilation.

The following questions instead deal with the issue of perceived safety and it is composed of two parts: first part consists of five items (question 3), from one to five, that investigate **participant's perceived safety**; while the second part consist of two questions (question 4 and 5), with five items from one to five, that investigate the feeling of **social presence**. The items like *I would walk along this path unaccompanied* or *I prefer to be accompanied when it is dark outside* are an important contribute of the scholars Rosén and Hunecke. (Johansson, Rosén, and Küller, 2011) (Blöbaum and Hunecke, 2005)

The last question (question 6) is about the **perceived urban quality** and aims to investigate how architectural and urban decay influences the perception of security, based on the *Theory of Broken Windows* as mentioned in part A section 3.

In the second section the **light environment** was investigated. Question 7 said "*In lighting environmental setting, how much do you see the light source surround you?*": the questionnaire shows three sentences: *street lighting*, or all the luminaires that has the purpose to illuminate streets and road, both vehicular or pedestrian purpose, a*rchitectural lighting*, destinate to illuminate building façades, walls, *indoor lighting*, lighting system installed indoor like commercial lighting settings on at night or lighting in showcase that is indirectly visible from the outside. For each one the answers are in form of Likert scale that goes from one to five with labels as *I don't see, I see, I see moderately, I see a lot, completely dominant*. In this case perception is something that can discount to reality. All the areas were analyzed before developing the questionnaire and with them also the condition of existing luminaires. The questions start from the assumption that the perception of the various sources may differ from the real condition of the light scene (Boyce et al. 2000).

"*How much do you agree or not with the following sentences about lighting environmental setting characteristics?*" is the question 8 and for each one it is possible to answer *totally disagree, disagree, moderately, agree, or totally agree*. The respondent is called to judge for *pleasant, chaotic, stimulant, gloomy, warm, cold, glaring, monotonous, relaxant* and *uniform*.

The question 10 is correlated with the previous one "*In general, how do you seem bright the lighting environmental settings?*" and the respondent can answer in Likert scale from *nothing* or one to *extremely* or five. As in the articles taken for example, the researchers has choose the sentence for reproduce the semantic dichotomic scales found in literature: *pleasant/unpleasant, chaotic/calm, stimulant/monotonous, gloomy/glary, warm/cold, uniform/ununiform and bright/dim*. In this questionnaire someone has repeated in separate sentence, some others like pleasant it was considered enough one. (Küller and Wetterberg 1993) (Johansson et al. 2014) (Johansson, Rosén, and Küller 2011)

Question 9 is "*In general, how do you describe the lighting environmental setting?*" and this time the respondent is called to give an opinion on the hedonic character of the lit scene that surrounds him. The interest of the luminous environment is evaluated in this question in its overall factor. The answer may vary from *very bad*, if the respondent believes that it is not adherent to his aesthetic taste, to *very good*, in the opposite case. Also, in this case the value of this question is Likert scale from one to five.

The last light question said "T*o what extent the light environmental setting is adequate for the use you make of this place?*" (Aletta et al. 2015) and differently from the previous one, the focus is on the adequacy of light in the area, something correlated with performance and the possibility of performing the visual task in best possible way. For this reason, the use you make of this place is fundamental because to every activity carried out corresponds different need and, consequently, a different performance that the lighting system will be required to respect. The light condition of sidewalks or paths could be for example enough for a pedestrian who was just passing but not to another one who goes the for ludic activities. A scene that looks us visibly great to us may not be adequate for the use. The value is Likert scale from one or *not adequate*, to five or *extremely adequate.*

In the third section the **soundscape** was investigated, that was the sound environment that

surrounded the interviewee at the completion point of the questionnaire.
The section includes from question 12 to 16 and starts from the question about the perceived dominant sound source in the analyzed area, question 12 said "*To what extent do you presently hear the following three types of sounds?*" And the questionnaire shows three sentences: *traffic or technological sound* or car, industry, sirens, construction, *sound from human beings* or conversation, laughter, footsteps, children at play and *natural sound* or singing birds, flowing water, wid in vegetation. In fact the interviewed had to listen to surrounding soundscape and had to identify the dominant sound source. For each one the answers are in form of Likert scale that goes from one to five with labels as *I don't hear, I hear, I hear moderatele, I hear a lot* and *Dominates completely*. In this case the subdivision of the sound sources was carried out based on the studies in the background, as mentioned in part A section 5, in particular the one of Brown in 1930.
Question 13 is "*To what extent do you agree or disagree with the following sentences about soundscape characteristics?*" and for each one it is possible to answer *totally disagree, disagree, moderately, agree,* or *totally agree*. This first group of question contains eight items about the characteristic of sound environment, in fact interviewees are asked to define the sound environment as *annoying, eventful, uneventful, calm, chaotic, vibrant* or *monotonous*.
The second group of questions, questions 14 and 15, indeed contains items about the general assessment of sound environment quality and the perceived noisiness of the environment. Questions 14 said "*Overall, how loud is it here?*" and the respondent can answer in Likert scale from *not a lot loud* or one to *extremely loud* or five. Question 15 indeed said "*Overall, how do you describe the present sound environment*?" and the respondent can answer in Likert scale from *very bad* or one to *very good* or five.
The last question contains item about the appropriateness of the soundscape, in fact is about to define how much the soundscape is appropriate to the general environment: question 16 said "*To what extent the sound environment is adequate for the use you make of this place?*" and the respondent can answer in Likert scale from *not adequate* or one to *extremely adequate* or five. The questionnaires are based on the Draft Technical Specification 12913-2 for the acoustic questions, that is about the perception of soundscape, quality of life and human perception.
In the fourth section of the on-site survey there are questions about **wellbeing** (question 17) and about the **characteristics of the interviewee** (questions 18, 19, 20, 21). The question on wellbeing is composed of five items, with a five-point Likert scale, from *strongly disagree* to *strongly agree*; this items are developed by a WHO-5 protocol, as mentiond in part A section 3. The items of this question are: *I have felt cheerful and in a good spirits, I have felt calm and relaxed, I have felt active and vigorous, I woke up feeling fresh and rested* and *My daily life has been filled with things that interest me*.

The raw score is calculated by adding the numbers of the five answers, it varies from 0 to 25, where 0 represents the worst possible quality of life and 25 represents the best possible quality of life. The Well-Being Index, to obtain a percentage score ranging from 0 to 100, is calculated by taking the sum of the scores (the raw score) of each item and multiplying it by four to obtain indices ranging from 0 to 100. A percentage score of 0 represents the worst possible quality of life, while a score of 100 represents the best possible quality of life. (Psychiatric Research Unit, 1998) The final questions are about the **characteristics of the interviewee**, such us personal data; the scope of this items is to demonstrate how the characteristics are linked to the perception of safety, soundscape, lightscape and urban quality.
Also for this questionnaire the information sheet and the participant consent form were introduced at the beginning of the Google Forms document, so the participants were able to make informed choices to consent to participate.

On-site survey structure

	QUESTIONS	ITEMS	SCALE RESPONSE TYPE
Q1	On average, how often do you visit this place?		this is the first time (1); at least once a year (2); at least once a month (3); at least once a week (4); everyday (5);
Q2	What activities do you do in this place?	passage; work/study; leisure (eg sports, pub, free time); other;	
Q3	To what extent do you agree or disagree with the following sentences? I feel...	worried; restless; comfortable; safe; alone;	strongly disagree (1); disagree (2); neither agree or disagree (3); agree (4); strongly agree (5);
Q4	To what extent do you agree or disagree with the following sentences?	I would walk alone along this place; I would extend my route to avoid walking in this place; I am feeling uncomfortable along this route; I would quickly cross this place to get away from here; I have an unpleasant feeling in this place;	strongly disagree (1); disagree (2); neither agree or disagree (3); agree (4); strongly agree (5);

Table B1. On-site survey structure

	QUESTIONS	ITEMS	SCALE RESPONSE TYPE
Q5	To what extent do you agree or disagree with the following sentences?	this place is attractive; this place seems full of life; this place looks like a cozy environment; I feel like there is someone else in this place; this place seems to me designed for users;	strongly disagree (1); disagree (2); neither agree or disagree (3); agree (4); strongly agree (5);
Q6	How do you describe the elements of the urban context that surround you?	maintenance of buildings (decay conditions); maintenance of public spaces; cleaning of public space;	very bad (1); bad (2); neither good or bad (3); good (4); bery good (5);
Q7	In lighting environmental setting, how much do you see the light source that surround you?	street lighting (eg vehicle seat, sidewalks, cycle paths); architectural lighting (eg building facades and monuments); indoor lighting (eg signs, shop windows, pubs);	I don't see (1); I see (2); I see moderately (3); I see a lot (4); Dominates completely (5);
Q8	To what extent do you agree or disagree with the following sentences about lighting environmental setting characteristics?	pleasant; chaotic; stimulant; gloomy; warm; cold; glaring; monotonous; relaxant; uniform;	strongly disagree (1); disagree (2); neither agree or disagree (3); agree (4); strongly agree (5);
Q9	In general, how do you seem bright the lighting environmental settings?		not bright (1); extremely bright (5);
Q10	In general, how do you describe the lighting environmental settings?		very bad (1); bad (2); neither good or bad (3); good (4); bery good (5);
Q11	To what extent the light environmental setting is adequate for the use you make of this place?		not adequate (1); extremely adequate (5);
Q12	To what extent do you presently hear the following three types of sounds?	traffic or technological sound (eg car, industry, sirens, construction); sound from human beings (eg conversation, laughter, footsteps, children at play); natural sound (eg singing birds, flowing water, wid in vegetation);	I don't hear (1); I hear (2); I hear moderatele (3); I hear a lot (4); Dominates completely (5);

Table B1. On-site survey structure

Table B1. On-site survey structure

	QUESTIONS	ITEMS	SCALE RESPONSE TYPE
Q13	To what extent do you agree or disagree with the following sentences about soundscape characteristics?	pleasant; annoying; eventful; uneventful; calm; chaotic; vibrant; monotonous;	strongly disagree (1); disagree (2); neither agree or disagree (3); agree (4); strongly agree (5);
Q14	Overall, how loud is it here?		not a lot loud (1); extremely loud (5);
Q15	Overall, how do you describe the present sound environment?		very bad (1); bad (2); neither good or bad (3); good (4); bery good (5);
Q16	To what extent the sound environment is adequate for the use you make of this place?		not adequate (1); extremely adequate (5);
Q17	Please indicate for each statements which is closet to how you have been feeling over the past two weeks	I have felt cheerful and in good spirits; I have felt calm and relaxed; I have felt active and vigorous; I woke up feeling fresh and rested; my daily life has been filled with things that interest me	strongly disagree (1); disagree (2); neither agree or disagree (3); agree (4); strongly agree (5);
Q18	Age		< 18 (1); 18 - 30 (2); 31 - 40 (3); 41 - 50 (4); 51 - 60 (5); >60 (6);
Q19	Gender	male; female; I'd rather not say;	
Q20	Level of education	no formal education; middle School diploma; higher Diploma; three-year degree; master degree; master - doctorate;	
Q21	Place of residence	turin; piedmont; italy; europe; extra europe;	

Double-check survey

The double-check survey was developed by the *Department of Psychology of the University of Turin*, in particular by the Associate Professor PhD Francesca M. Bosco and by the PhD student Dize Hilviu. This questionnaire was used for the purpose of **confirming the data** and, precisely for this reason, a place was selected, the Passerella Olimpica in which to use this questionnaire.

The double-check survey took place on **one week** in December 2018 for the Passerella Olimpica site, for three days (Monday, Thursday, Saturday) in the evening between 08:00 pm to 00:00 pm. The survey is designed to take approximately **15 minutes to complete**. The questionnaire, as previously explained in the survey structure section, has open-ended questions and closed-ended questions.

The questionnaire is divided into seven sections: **Interviewed**, **Sound Perception of the area**, **Lighting Perception of the area**, **Perception of the Ambient Air**, **Perception of Safety**, **Urban quality** and **Thermal Comfort of the environment**.

In the first section questions are about the **characteristics of the interviewee** and in fact personal data are requested such as *gender*, *year of birth*, *occupation* and the possible *problems of hearing, breathing and sight* are asked.

The following questions instead deal with the frequentation of the place, in fact it is very important to understand how the frequentation of place (*shopping, friends, errands, work, home, other* ..) and the period of attendance (*every day, 2/3 times a week, 1/2 times a month, rarely during the year, less than once a year*) affects the perception of safety.

In the second section questions are about **sound perception** of surrounding environment and the questions are about the intensity of the sounds and the evaluation of the characteristics of the sound (*unpleasant/pleasant, chaotic/calm, lively/quiet, stressful/relaxing*). The last questions of this section are about the identification of noise sources (*road traffic, air traffic, rail traffic, music, commercial activities, building sites and construction works, outdoor animals, outdoor people, natural elements*) and on the influence of sound on the quality of life.

In the third section questions are about **light perception** of surrounding environment, in fact the questions are about the intensity of the area lighting and brightness of area. The following question is about the evaluation of the characteristics of the lightscape such as area brightness and light intensity (*inadequate/adequate, unpleasant/pleasant, dark/clear*). The last questions are about temperature and brightness (*warm/cold*) and the influence of light on the quality of life.

In the fourth section the questions are about the **perception of the air** of the surrounding environment; this topic was not analyzed in the other two questionnaires, on-site and social, but it is an important theme for the perception of the area and it is a topic to consider for future research.

In the fifth section the questions are about **perceived safety** of surrounding environment and the questions are on the level of security of the area (*adequate/inadequate*) and on the safety perceived by the interviewee (*insecure/safe, worried/calm*); subsequently the question is about the elements of concern for the interviewees and the subsequent questions try to understand what are the elements that make an area safe for users. The last question is about the influence of safety on the quality of life.

In the sixthy section the questions are about **urban and architectural quality** of surrounding environment, in fact the questions are based on the evaluation of the aspects that define the quality, such as the verbal comprehension.

Finally in the last seventh section the questions are about the **perceived thermal comfort** of the surrounding environment and the questions are based on the evaluation of the thermal comfort of the area (*cold/hot, wet/dry, unpleasant/pleasant*) and on the influence of thermal comfort on the quality of life.

Also for this questionnaire the information sheet and the participant consent form were introduced at the beginning of the Google Forms document, so the participants were able to make informed choices to consent to participate.

This questionnaire was a valuable contribution to the research by the *Department of Psychology of the University of Turin*, to which a heartfelt thanks go and, as explained later in part E, it allowed us to compare the data collected about the perception of unsafety in one area; it is an useful tool to be expanded to the remaining areas in future research.

Double-check survey structure

	QUESTIONS	ITEMS	SCALE RESPONSE TYPE
D1	Gender	male, female, I'd rather not say	
D2	Year of birth	_____	
D3	Level of education	middle school diploma; higher diploma; three-year degree; master degree; master - doctorate;	
D4	Employment situation	jobless; student; employee; freelance; other;	
D5	Do you have hearing problem?		no; yes;
D6	Do you have respiratory problems?		no; yes;
D7	Do you have vision problems?		no; yes;
D8	If so; what visual problems do you suffer from?	myopia; astigmatism; presbyopia; other;	
D9	Area of domicilie:	_____	
D10	For how many years?	_____	
D11	Why are you in this area right now=	shopping; friends, commissions; work; i'm near my home; other;	
D12	How often do you frequent this area?		everyday (1); 2/3 times a week (2); 1/2 times a month (3); rarely during the year (4); less than once a year (5);
D13	How do you assess the intensity of the sounds present at this time?		very high (1); very low (5)
D14	Why?	_____	
D15	Make an assessment of each of the following features related to the sound of this zone at this time:		very unpleasant (1); very pleasant (5);
D16	Why?	_____	
D17	Make an assessment of each of the following features related to the sound of this zone at this time:		very chaotic (1); very calm (5);
D18	Why?	_____	
D19	Make an assessment of each of the following features related to the sound of this zone at this time:		very animated (1); very quiet (5);
D20	Why?	_____	
D21	Make an assessment of each of the following features related to the sound of this zone at this time:		very stressful (1); very relaxing (5);
D22	Why?	_____	

Table B2. Double-check survey structure

Table B2. Double-check survey structure

	QUESTIONS	ITEMS	SCALE RESPONSE TYPE
D23	What are the sources of noise that you perceive most and how do you assess their presence?	road traffic; air traffic; railway traffic; music; business activities; construction sites and construction works; outdoor animals; people outdoors; natural elements (wind, water);	completely present (1); moderately present (2); neither present neither absent (3); moderately absent (4); completely absent (5);
D24	Do you think the sound quality of this area has an influence on your quality of life?		no (1); yes (2);
D25	If so; which one?	_____	
D26	To what extent?		very negative (1); very positive (5);
D27	How do you assess the brightness of this area (eg possibility to distinguish elements, sharpness, brilliance)?		very inadequate (1); very adequate (5);
D28	Why?	_____	
D29	How do you assess the brightness of this area?		very unpleasant (1); very pleasant (5);
D30	Make an assessment of each of the following features related to the light of this zone at this time:		very dark (1); very bright (5);
D31	Why?	_____	
D32	Make an assessment of each of the following features related to the light of this zone at this time:		very unpleasant (1); very pleasant (5):

Table B2. Double-check survey structure

Table B2. Double-check survey structure

	QUESTIONS	ITEMS	SCALE RESPONSE TYPE
D33	Why?	_____	
D34	How do you rate the temperature and the hue of the brightness?		warm (1); cold (2);
D35	Why?	_____	
D36	Do you think that the quality of the brightness of this area has an influence on your quality of life?		yes (1); no (2)
D37	If so; which one?	_____	
D38	To what extent?		very negative (1); very positive (5);
D39	How do you assess the purity of the air that characterizes this area?		very adequate (1); very inadequate (5);
D40	Why?	_____	
D41	What are the sources of odor that you perceive most and how do you assess their intensity?	tobacco; cosmetics or fragrances; waste,excrement, mold; chemicals (solvents, paints); food; pollution;	completely present (1); moderately present (2); neither present neither absent (3); moderately absent (4); completely absent (5);
D42	Do you think that the quality of the air of this area has an influence on your quality of life?		yes (1); no (2);
D43	If so; which one?	_____	

	QUESTIONS	ITEMS	SCALE RESPONSE TYPE
D44	To what extent?		very negative (1); very positive (5):
D45	How do you assess the level of security in the area?		very adequate (1); very inadequate (5);
D46	Why?	_____	
D47	How do you feel about the safety that characterizes this environment right now?		very insicure (1); very safe (5);
D48	Why?	_____	
D49	How do you feel about the safety that characterizes this environment right now?		very worried (1); very calm (5);
D50	Why?	_____	
D51	What are the elements that worry you?	_____	
D52	What are the elements that allow you to feel comfortable?	_____	
D53	Are there any changes to make the environment safer?		yes (1); no (2);
D54	Which?	_____	
D55	Do you think that the safety of this area has an influence on your quality of life?		yes (1); no (2);

Table B2. Double-check survey structure

Table B2. Double-check survey structure

	QUESTIONS	ITEMS	SCALE RESPONSE TYPE
D56	If so; which one?	_____	
D57	To what extent?		very negative (1); very positive (5);
D58	Evaluate each of the following:	quality of the place (architectural, environmental ...); verbal comprehension (hearing voices of others); understanding urban signage (visual, sound ...); services (hospitals, pharmacies, schools ...); public transport and frequency; commercial exercises; street cleaning and pavement cleaning;	completely present (1); moderately present (2); neither present neither absent (3); moderately absent (4); completely absent (5);
D59	Why?	_____	
D60	How do you assess the adequacy of thermal comfort in this area?		very inadequate (1); very adequate (5);
D61	Why?	_____	
D62	Make an assessment of each of the following features related to the thermal comfort of this zone at this time:		very cold (1); very warm (5);
D63	Why?	_____	
D64	Make an assessment of each of the following features related to the thermal comfort of this zone at this time:		very wet (1); very dry (5);
D65	Why?	_____	

	QUESTIONS	ITEMS	SCALE RESPONSE TYPE
D66	Make an assessment of each of the following features related to the thermal comfort of this zone at this time:		very unpleasant (1); very pleasant (5);
D67	Why?	_____	
D68	Do you think that the thermal comfort of this area has an influence on your quality of life?		yes (1); no (2);
D69	If so, which one?	_____	
D70	To what extent?		very negative (1); very positive (5);

Table B2. Double-check survey structure

Social survey

The social survey is a questionnaire administered online through the social pages of the project, ie Facebook and Instagram, with appropriate strategies as mentioned in part D and through institutional emails to the students of the Polytechnic of Turin and to the students of the University of Turin.
The questionnaire, in order to have greater possible adhesions, was reduced to just four questions based on the analyzed topics, ie **safety perception**, **sound perception**, **lighting perception** and **urban quality perception**. Consequently the sections about the characteristics of the interviewee and the well being have been eliminated. The survey is designed to take approximately **3 minutes to complete** and it is not possible to determine the criteria of the participants inclusion or exclusion because it is a questionnaire with a compilation via internet. Online questionnaires have different advantages in contrast to traditional survey methods in terms of cost, speed, appearance, flexibility, functionality, and usability, so with the coming of easy-to-use online survey, the Internet has the potential to revolutionize the survey process. (Lumsden, 2006) The researchers believe that the online questionnaire encourages participants to read carefully and reduce distortion and strengthen rigor. However, it is important to warn researchers about online survey pitfalls and it is important to provide them with knowledge of how to critically evaluate online surveys. According to Nayak, there are three different methods to collecting data from survey: *administered surveys*, *email surveys* and *web surveys*. (Nayak, 2019) Nayak in this paper discusses the advantages and disadvantage of electronic data collection in general and web surveys method in particular. The first method analyzed by Nayak is *Computer Administered Surveys* that use a written program for the questions; the benefits of this method are 1) *lowered levels of social desirability responding*; 2) *shorter and more to respondents*; 3) *elimination of data entry* and 4) *use of complex branching and prompting of question* and the disadvantages are 1) *expensive for small numbers of people*; 2) *incompatibility of software across systems*; 3) *discomfort in using computers for non- office workers*; 4) *people want a way to know how much time is left* and 5) *resentment to being surveyed in a nonsocial manner*. (Nayak, 2019)
The second analyzed method is the *Electronic Mail Surveys* that are sent to a email address of persons. The advantages are the ease of sending the questionnaire and the response to it and the presence of answers from people with different characteristics. The disadvantages are the non-use of the email by the users or the incompatibility with the software of the questionnaire.
The last method is the *Web Survey*, that in the case of this research is the one used for Social Survey. The web survey include three different tools: **design**, **distribution** and **reporting**. Simple surveys are already into social media like Facebook and Twitter, but these are usually one question polls, while Google Forms is a useful tool for sending short questionnaires. (Nayak,

2019) In fact Google Form is the solution adopted for the social survey of this research; with it is possibile to charts the results, export data for analysis and it provides a variety of questions formats and it is possibile to custom navigate through questions based on answers.
The Social Survey consists of four questions that address four different topics: **Perceived Security**, **Architectural and Urban Decay**, **Lightscape** and **Soundscape**.
It was built following the construction of the on-site and double-check surveys, in fact it takes up the most important questions, that represent the themes, to be able to correlate the answers.
The first question is obviously the choice of place "*Which of these areas did you visit mainly in the last two weeks?*", it is in fact possible to choose the area visited in the last two weeks on which to leave one's opinion among *Largo Saluzzo* (San Salvario), *Tettoia Vitali* (Parco Dora), *Viale O.Mai* (Campus Einaudi), *Passerella Olimpica* (Lingotto), *Piazza G.Bottesini* (Barriera di Milano) and *Giardini Montanaro* (Barriera di Milano). In the social questionnaire, in addition to the four areas analyzed, two particular areas of Barriera di Milano were inserted recommended by the Technological Investigation Department of the Municipal Police Corps of the City of Turin. For each area a direct link to Google Maps has been added for visual identification of the area. This maps position corresponds to a predetermined sound-light walk station.
The following question is about perceived safety *"To what extent do you agree or disagree with the following statement? I felt safe..."* and the respondent can answer in Likert scale from *strongly disagree* or one to *strongly agree* or five.
For the urban decay indee the question is "*Overall, how would you describe the state of conservation and cleanliness of the public spaces and the conservation of the buildings?"* and the respondent can answer in Likert scale from *very bad* or one to *very good* or five. The following question is about the the luminous environment conditions "*Overall, how would you describe the light environment that surrounds you?"* and the respondent can answer in Likert scale from *very bad* or one to *very good* or five, and the same answers for the sound environmental conditions "*Overall, how would you describe the sound environment that surrounds you?"*.
Also for this questionnaire, as for the first two, the information sheet and participant consent form were introduced at the beginning of the Google Forms document, so the participants were able to make informed choices to consent to participate.
Based on this social survey experience, it is possible to state that online surveys can be conducted at a low cost and in a short period of time and that it is a survey tool with advantages and disadvantages at every stage of the survey. However, in this case, the researchers decided to use the online survey tool based on their study setting, study population and study methodology; in fact the social survey methodology was associated with two more complete questionnaires, as seen in the previous paragraphs, therefore this has been used as a support tool and as a useful tool to know the opinions on a larger scale.

Social survey structure

	QUESTIONS	ITEMS	SCALE RESPONSE TYPE
S1	Which of these areas did you visit mainly in the last two weeks?	largo saluzzo (san salvario); tettoia vitali (parco dora); viale o. mai (campus luigi einaudi); passerella olimpica (lingotto); piazza g. bottesini (barriera di milano); giardini montanaro (barriera di milano)	
S2	To what extent do you agree or disagree with the following statement? I felt safe...		strongly disagree (1); disagree (2); neither agree or disagree (3); agree (4); strongly agree (5);
S3	Overall, how would you describe the state of conservation and cleanliness of the public spaces and conservation of the buildings?		very bad (1); very good (5);
S4	Overall, how would you describe the light environment that surrounds you?		very bad (1); very good (5);
S5	Overall, how would you describe the sound environment that surrounds you?		very bad (1); very good (5);

Table B3. Social survey structure

Sentiment analysis

In everyday life the opinions of people constitute the central point of human activities, in fact they are able to influence our behavior. The perceptions of reality and the choices that people make always depend on how they see and evaluate the world. For this reason, the sentiment analysis was born in the last few years when people have the possibility to **comunicate opinions through social media**, Chaudhuri said that "*Sentiment analysis analyses people's viewpoints, feelings, assessments, behaviour and psychology towards living and abstract entities. It highlights viewpoints which present positively or negatively biased sentiments. It is very much closely related to the linguistics and natural language processing research.*" (Chaudhuri, 2019) The sentiment analysis, also called social media analysis or web sentiment analysis, consists in the extraction and analysis of the opinions that users express about different products or services on the web and consists to measure their perception about these latter. This method is a **qualitative analysis** or **semantic analysis** of users reactions and conversations that aims to understand users' propensity towards a particular brand, product, theme, service; in fact the analysis is a collection of data from social networks and from different platforms (Facebook, Twitter, LinkedIn, Youtube, classifieds sites, reviews, blogs & forums, online newspapers).

Sentiments are nothing more than the processing of language and the subsequent analysis of the text in order to identify subjective information in the sources. The perfect application of sentiment analysis occurs above all on social media, for this reason sentiment analysis is often called **social media analysis**.

The main objective of sentiment analysis is to **determine the general polarity** of a web document, in order to classify a sentence as **positive**, **negative** or **neutral**. (Mellea, 2017) The techniques used by sentiment analysis can be divided into four macro-categories: *keyword detection, lexical affinity, statistical methods,* and *conceptual techniques*. While **keyword detection** classifies text using emotional categories, based on unambiguous words, such as happy, sad and bored, **lexical affinity** not only detects emotional keywords, but also assigns an affinity to particular emotions to arbitrary words. Compared to the first keyword detection, the lexical method allows to refine the selection and attribution of polarity. The **statistical methods** are based on the elements of machine learning, some elements try to identify the owner of a feeling, or who is the subject that feels it and also the object towards which that feeling is felt. In this case is important the context of the sentence, in fact in order to measure this grammatical relations of the sentences words are used. The grammatical relationship analysis are made with text scanning through learning process of the machine, also called machine learning. This last one is not so simple to carry out because it is necessary to build models that associate a polarity to different types of comments and topics. Another difficulty in this case is the interpretation of the Italian language, because it shall be subject to errors and with a low level of reliability. (Mellea, 2017) The **techniques at the conceptual level** are based on elements coming from the representation of data such as semantic networks. In this way they are able to detect semantics that are expressed subtly, for example through the analysis of concepts that do not have relevant information, but which are implicitly linked to other concepts that instead have relevant information. (Giga, 2019)

Sentiment analysis has many strengths but is still lacking on some information, in fact the accuracy of the search is not very high. The **limit of automatic analysis** is that any tool or platform that records and attributes polarity to posts or comments is not able to records complex emotional concepts. Based on this, when an analysis of this type is made, the human component is essential because the automated systems are not able to analyze complex concepts such as irony. For example: "*My flight is delayed. Fantastic!*" is an ironic sentence, but without a contextual understanding, a software could identify the word "*Fantastic*" and classify the social post as positive. So the accuracy of the sentiment analysis system depends on the themes, the topics and the complexity; in a lexical context full of irony the reliability will be lower than a scientific document with objective information. (Giga, 2019)

In recent years with the advent of social media, the analysis has developed and is increasingly in demand. In fact, it is required to analyze the online reputation of certain brands, products or public figures. It is also required by city administrations to get a picture of political opinions, of success of certain strategies and so on. The analysis of user opinions is a central theme that, starting from 2000s, has also been studied and tested. One of these studies is that of Sultana et al, who tried a new technique to refine the accuracy of the analysis based on combinations of different adjectives, adverbs and verbs. This study shows that this new technique tested part of speech with benchmark Standford Dataset and with six well-known supervised classifiers. So they show that the best combination of speech is the adjective, adverb and verb. (Sultana et al., 2019)

The following pages show the information sheet, the participant consent form and the approval protocol form of the University of Turin bioethical committee, mentioned in the previous pages.

The **information sheet** is the document prepared to publicize and to make known the characteristics and conditions of the research. The information sheet were introduced at the beginning of each questionnaire and after reading the this, the participants started compiling survey; in fact the Google Form was already set in the tablet. The questionnaires, before the administration, were approved by CBA of the University of Turin, as mentioned on page 137.

INFORMATION SHEET

Title of the project: **WALK SAFE PROJECT**
Good evening, we are Alfredo and Rosanna, two Architecture students of the Polytechnic of Turin. We are working on a project about **safety**, **sound**, **light** and **urban quality**.
You are being invited to take part in this research project.
Before you decide to take part in, it is **important understand** why this research is being done and what your participation will involve, so please take your time to read this information sheet carefully.
The project you are about to take part in is focused on understanding the feeling of unsafety that can be felt visiting certain places in the city. This questionnaire aims to collect data on the feeling of unsafety, acoustic and lighting environment and urban and architectural quality and investigate the causes that can cause it.
It is important to participate because **your help can be useful** to support the work of urban researchers and planners in the development of new strategies concerning urban security.
Participants like you will be randomly approached on site among people and will be invited to take part in the survey. **Participation is entirely voluntary** and remember that you are free to withdraw at any time without providing any explanation or justification. It is important to know that **there are no right or wrong answers**, feel free to respond based on your feelings. The survey is designed to take approximately 7 minutes to complete. All information that we collect during the course of the research will be strictly confidential, **you will not be identified** in any report or publication. All the collected data will be stored in a personal computer with a password and at the end of the project they will be kept in a safe way. The data will be used for research purposes and may be used in the future for research related to safety, light, sound and degradation.
This study has been approved by the Ethics Review Procedure of University of Turin.
The research is sponsored by the **City of Turin**, **District 5**, **District 6**, **District 7**, **District 8**, **Polytechnic of Turin**, **Iren SpA**, **AIDI Italian Lighting Association** and supported by **AIA Italian Association of Acoustics**.
The data provided will be processed by the team in accordance with the EU European Regulation 2016/679 (Protection of individuals with regard to the processing of personal data, as well as the free circulation of data).
If you need further information, **contact us by e-mail** at walksafetorino@gmail.com
Thank you for your cooperation!
Walk Safe Project Team, Alfredo Pietro Bresci and Rosanna Siragusa

Let's do it!

Participant Consent Form is the expression of will that the citizen, previously informed by the researchers through the information sheet, gives consent to be part of the research. The participant consent form were introduced at the beginning of each questionnaire. After reading the informed consent, the participants started compiling survey. The questionnaires, before the administration, were approved by CBA of the University of Turin, as mentioned on page 137.

PARTICIPANT CONSET FORM

Title of the project: **WALK SAFE PROJECT**

By clicking this "Confirm", I attest that:

1. I have read and I understand the **Information Sheet** for this study and have had details of the study explained to me.

2. My questions about the study have been answered to my satisfaction and I understand that **I may ask further questions** at any point.

3. I understand that my **participation is voluntary** and I am free to withdraw at any time from the study without giving a reason for my withdrawal or to decline to answer any particular questions in the study without any consequences.

4. I agree to **provide information to the researchers** under the conditions set out in the Information Sheet and I understand that my **responses will be strictly confidential**.

5. I consent to the **information collected** for the purposes of this research study and to be used for any other research purposes, I understand that **I will not be identifiable in any report**.

6. I am **over 18 years old** and under 80 years old.

Now you can click "Inizia".
If you need further information, **contact us by e-mail** at walksafetorino@gmail.com
Thank you for your cooperation!
Walk Safe Project Team, Alfredo Pietro Bresci and Rosanna Siragusa

Let's do it!

PROTOCOLLO DI PRESENTAZIONE

Università degli Studi di Torino - Comitato di Bioetica dell'Ateneo CBA

Il documento è ispirato a quelli in uso presso altri Comitati Etici nazionali e internazionali per la ricerca che vede coinvolti partecipanti umani: University of Cambridge – UK; Università degli Studi di Milano Bicocca; Università degli Studi di Bologna; Università degli Studi di Milano Statale Università degli Studi di Trento.

SEZIONE A: CARATTERISTICHE GENERALI DEL PROGETTO DI RICERCA

A.1 Titolo del progetto di ricerca

Nota: Il titolo del progetto deve essere sintetico e mirato. Una singola frase.

WALK SAFE PROJECT

A.2 Responsabile del progetto di ricerca (Allegare curriculum)

Arianna Astolfi
Professore Associato Dipartimento Energia - Politecnico di Torino
Responsabile scientifica

A.3 Altri ricercatori coinvolti, qualifica, enti di appartenenza, attività svolta

Nota: Qui devono essere indicati tutti i ricercatori che saranno coinvolti nell'attività di ricerca, riportando ruolo e specificità dell'attività svolta.

Arianna Astolfi
Professore Associato Dipartimento Energia - Politecnico di Torino
Responsabile scientifica

Anna Pellegrino
Professore Associato Dipartimento Energia - Politecnico di Torino
Co-responsabile scientifica

Francesca M. Bosco
Professore Associato Dipartimento di Psicologia - Università degli Studi di Torino
Co-responsabile scientifica

A.3 Altri ricercatori coinvolti, qualifica, enti di appartenenza, attività svolta

Nota: Qui devono essere indicati tutti i ricercatori che saranno coinvolti nell'attività di ricerca, riportando ruolo e specificità dell'attività svolta.

Vincenzo Giuseppe Idone Cassone
PhD in Semiotics e Media - Università degli Studi di Torino
Collaboratore Semiotica e Engagement

Louena Shtrepi
Dipartimento Energia - Politecnico di Torino
Collaboratore scientifico

Rosanna Siragusa
Studente - Politecnico di Torino
Ricercatore

Alfredo Pietro Bresci
Studente - Politecnico di Torino
Ricercatore

Dize Hilvu
PhD in Neuroscienze - Università degli Studi di Torino
Collaboratore analisi ambientali soggettive

Gianfranco Todesco
Direttivo Corpo di polizia municipale - Città di Torino
Collaboratore analisi ambientali oggettive

A.4 Sede/i della ricerca

Politecnico di Torino, Università di Torino
Viale Ottavio Mai (Campus Einaudi)
Largo Saluzzo (San Salvario)
Tettoia Vitali (Parco Dora)
Passerella Olimpica (Lingotto)

A.5 È necessaria l'autorizzazione di altri Enti (ad es., ospedali, scuole, carceri) per l'accesso ai dati o il coinvolgimento di partecipanti?

No, non è necessaria

A.6 È necessario il consenso di un rappresentante legale (genitore, tutore, titolare della potestà)? Se sì, allegare copia della lettera di consenso

No, non è necessario

A.7 Durata prevista della ricerca (in mesi)

Ventiquattro mesi

A.8 Data prevista di inizio della ricerca (GG.MM.AAAA)

Ottenimento consenso comitato etico CBA

A.9 Il progetto di ricerca è sostenuto da uno sponsor?

No, solamente Patrocini: Città di Torino, Politecnico di Torino, Iren SpA, Associazione Italiana di Illuminazione AIDI, Circoscrizione 5, Circoscrizione 6, Circoscrizione 7, Circoscrizione 8 e supporto di Associazione Italiana di Acustica AIA

A.10 Descrivere sinteticamente la tipologia e i termini del sostegno da parte dello sponsor.

Nessun tipo di sostegno economico.
Solamente il supporto e il patrocinio che consiste nella pubblicizzazione dell'iniziativa sui siti ufficiali, pagine social e newsletter.
Fornitura occasionale di dati per la ricerca.

A.11 In caso di risposta affermativa al punto A.10, indicare se, e secondo quali criteri e modalità, lo sponsor avrà accesso ai dati che riguardano i partecipanti coinvolti nella ricerca (o anche solo a parte di essi).

Nessuno dei patrocinanti e supporter avrà accesso a dati che riguardano i partecipanti coinvolti.

A.12 Quali accorgimenti sono previsti per garantire da parte dello sponsor la confidenzialità e/o l'anonimato dei dati raccolti?

Nessuno dei patrocinanti e supporter avrà accesso a dati che riguardano i partecipanti coinvolti.

SEZIONE B: DATI SULLA RICERCA

B.1 Abstract del progetto di ricerca (250 parole)

Il progetto analizza la percezione di sicurezza correlata alle condizioni di luce, suono e degrado architettonico e urbano di luoghi ritenuti particolarmente critici della Città di Torino. Quali: la Passerella Olimpica (Lingotto), Largo Saluzzo (San Salvario), Tettoia Vitali (Parco Dora) e Viale O. Mai (Campus Einaudi).

B.2 Parole chiavi (almeno 3) identificative della ricerca

Sicurezza Urbana
Lightscape
Soundscape
Livingscape
Degrado architettonico e urbano
Percezione

B.3 Base di partenza e giustificazione teorica della ricerca

La ricerca parte dal presupposto che l'interazione tra suono, luce e contesto sia un fattore per la valutazione della qualità dello spazio urbano [1]. In particolare, quest'ultimo è in contiguità con il tema della sicurezza urbana ed è influenzato dalle politiche di riqualificazione dello spazio [2]. Si indaga la percezione della sicurezza urbana, mutevole in relazione all'ambiente [3-4] e alla percezione soggettiva [5].
Infine, questi fattori influenzano la qualità della vita degli abitanti dei luoghi in analisi [6-7].

B.4 Scopi e Obiettivi

Lo scopo della ricerca è quello di fornire uno strumento per la progettazione urbana che si basi sulla correlazione degli aspetti oggettivi e degli aspetti soggettivi.
Gli obiettivi sono quelli di stilare un protocollo di valutazione della sicurezza percepita basata sulla percezione del disturbo da rumore, della qualità dell'illuminazione urbana e del degrado architettonico, individuare le correlazioni fra i tre diversi aspetti indagati e la presenza media di persone nei diversi luoghi, individuare in che modo gli aspetti indagati influenzino la sua qualità della vita delle persone, proporre soluzioni ai problemi di sicurezza indagati e diffondere le tematiche di sicurezza urbana con lo scopo di sensibilizzare i cittadini a comportamenti proattivi.

B.5 Metodologia impiegata

La metodologia impiegata si suddivide in analisi oggettive, analisi soggettive e analisi statistiche: Le analisi oggettive inerenti al campo dell'illuminotecnica e dell'acustica prevedono lo studio delle condizioni di luce tramite livelli illuminotecnici e acustici sul campo e tramite dati forniti da IREN. [8-9]
Le analisi soggettive inerenti alla percezione di sicurezza, dell'ambiente luminoso,
dell'ambiente sonoro e del degrado architettonico avverranno tramite somministrazioni di questionari in loco e tramite somministrazioni di questionari online [10]
Sono previste anche analisi della presenza media oraria delle persone in collaborazione con il reparto investigazioni tecnologiche della Città di Torino e analisi delle opinioni espresse sui social rispetto alle zone della città indagate.
Infine, è stata ideata una pubblicizzazione della ricerca e una successiva fidelizzazione dei cittadini tramite strategie di Social Media Marketing e coinvolgimento in collaborazionecon l'Università di Torino (PhD Vincenzo Giuseppe Idone Cassone) [11-12]

B.6 Risultati attesi

Ci aspettiamo di trovare una correlazione significativa delle analisi oggettive e soggettive, di conseguenza una correlazione tra i dati di luce, suono, sicurezza e degrado. Ci aspettiamo di trovare una correlazione significativa tra i dati oggetivi e soggettivi rilevati e la qualità della vita percepita dalle persone intervistate.

B.7 Rilevanza scientifica

La possibilità di trovare una correlazione tra analisi soggettive e analisi oggettive.
Fino ad oggi sono stati indagati i diversi aspetti (suono, luce, degrado) di un'area e sono stati messi in relazione alla sicurezza percepita dai fruitori; la ricerca si propone però di collegare tutti gli aspetti per inquadrare complessivamente il fenomeno.
Questa correlazione potrebbe essere alla base di una progettazione urbana consapevole e partecipata, una progettazione urbana che pone al centro il cittadino.

B.8 Riferimenti bibliografici (essenziali)

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SEZIONE C: INFORMAZIONI RELATIVE AI PARTECIPANTI

C.1 Indicare i criteri di inclusione/esclusione dei partecipanti alla ricerca

I partecipanti alla ricerca e alla somministrazione dei questionari in loco verranno inclusi casualmente tra i fruitori delle zone selezionate.
Non verranno inclusi però individui minorenni, persone con deficit cognitivi e mentali e persone non in grado di esprimere il proprio consenso.

C.2 Come verranno reclutati i partecipanti

Nota: Indicare modalità, tempi, luogo del reclutamento e numerosità.

La somministrazione del questionario in loco prevede cinque punti di stazione, in allegato i percorsi e le stazioni, per ogni area selezionata.
La somministrazione inizierà alle ore 20:30 di ogni lunedì, giovedì e sabato proseguendo per quattro settimane (una per ogni area analizzata).
I ricercatori stazioneranno nei punti per 30 minuti circa, reclutando i partecipanti ovvero i fruitori della zona (residenti, di passaggio, etc.)
La somministrazione del secondo questionario in loco prevede cinque punti di stazione per la sola area del Lingotto, la somministrazione inizierà alle ore 20:30 di lunedì, giovedì e sabato per una sola settimana.
I ricercatori stazioneranno nei punti per 30 minuti circa, reclutando i partecipanti ovvero i fruitori della zona (residenti, di passaggio, etc.)
Il questionario social verrà distribuito via internet attraverso le piattaforme social.

C.3 Quali tipologie di partecipanti prenderanno parte alla ricerca?

- Adulti (età superiore a 18 anni e in grado di esprimere il loro consenso)
- Anziani (età superiore ai 65 anni e in grado di esprimere il loro consenso)
- Persone di madrelingua non italiana
- Non è possibile determinare la tipologia dei partecipanti (ad es., compilazione via internet)

C.4 È possibile che alcuni dei partecipanti coinvolti nella ricerca si trovino in una qualunque forma di 'dipendenza' nei confronti del ricercatore o di uno dei suoi collaboratori, tale per cui si possa supporre che l'espressione del consenso a partecipare allo studio non sia del tutto incondizionata, libera e priva da ogni tipo di pressione (ad es., studente/professore, paziente/medico, dipendente datore di lavoro)? Se sì, indicare come si intende provvedere per prevenire la possibilità che il partecipante si senta obbligato a prendere parte alla ricerca.

No, non è possibile

C.5 Motivare la scelta del campione coinvolto.

I partecipanti alla ricerca e alla somministrazione dei questionari in loco verranno inclusi casualmente tra i fruitori delle zone selezionate.
Non verranno inclusi però individui minorenni, persone con deficit cognitivi e mentali e persone non in grado di esprimere il proprio consenso.
Fruitori e utenti delle aree in analisi: passaggio, lavoro, studio, svago, residenti.

C.6 Come verranno diffusi le informazioni e l'invito a partecipare alla ricerca?

Nota: Allegare copia di eventuali locandine o lettere da inviare.

L'informazione e l'invito a partecipare verranno diffusi attraverso i canali social della ricerca. I partecipanti coinvolti in loco avranno a disposizione le medesime informazioni e verranno comunicati loro i canali social della ricerca.

SEZIONE D: RISCHIO E GESTIONE DEL RISCHIO

D.1 La ricerca prevede:

- Utilizzo di questionari (vedere allegato)
- Registrazioni audio o video dei partecipanti
- Somministrazione di test, questionari o protocolli sperimentali attraverso internet (web, posta elettronica)

D.2 Sintesi del percorso informativo previsto

Nota: Indicare modalità di presentazione della ricerca, foglio illustrativo firma del consenso, restituzione dei risultati.

Il percorso informativo prevede una descrizione dettagliata della ricerca e della restituzione dei dati all'inizio del questionario da somministrare attraverso un modulo di INFORMATION SHEET e un PARTICIPANT CONSENT FORM.

D.3 Foglio illustrativo/informativo e Dichiarazione di Consenso (allegare una copia)

D.4 Nel caso si coinvolgano partecipanti non in grado di esprimere il consenso, indicare a chi si chiederà di acconsentire alla partecipazione precisandone il ruolo e i motivi.

Non vengono coinvolti partecipanti non in grado di esprimere il consenso.

D.5 Nella ricerca saranno coinvolti individui minorenni?

No, non saranno coinvolti individui minorenni.

D.6 **Quali modalità saranno adottate per la comunicazione di dubbi e precisazioni da parte dei partecipanti nel corso della ricerca e quali modalità verranno messe in atto per le relative risposte?**

Ai partecipanti viene fornita una mail walksafetorino@gmail.com (creata appositamente per la ricerca) a cui poter inoltrare dubbi e richiedere precisazioni. È inoltre possibile scrivere messaggi direttamente dai canali social del progetto. In base a dubbi o precisazioni avanzate il team deciderà le opportune modalità di risposta (e-mail, incontro).

D.7 **Qualora, per la realizzazione della ricerca, non fosse metodologicamente possibile informare i partecipanti prima dell'inizio della sperimentazione sull'obiettivo della stessa, specificare quali saranno le modalità del successivo incontro di chiarificazione e dell'espressione del consenso all'utilizzo dei dati.**

Qualora non fosse possibile, ai partecipanti viene fornita una casella mail per contattare direttamente il team di ricerca ed effettuare un incontro in cui verranno esplicitati gli obbiettivi e le metodologie del progetto.

D.8 **Come i partecipanti verranno informati circa la possibilità di recedere dal partecipare allo studio o alla sperimentazione in un qualunque momento senza dover dare spiegazioni e giustificazioni della loro scelta al responsabile della ricerca?**

Nota: Questo aspetto dovrà essere reso esplicito nel modello del consenso informato. Se il modello del consenso informato lo prevede chiaramente, si può rimandare ad esso.

Il testo introduttivo fornito con i moduli Information Sheet e Participant Consent Form prevede chiaramente questo aspetto.

D.9 **Descrivere la natura degli eventuali rischi o disagi che le procedure utilizzate potrebbero generare.**

Non vengono previsti rischi o disagi in base alle procedure utilizzate.

D.10 **Come si prevede di affrontare gli eventuali rischio o disagi.**

Qualora l'intervistato manifestasse disagio o esprimesse la volontà di ritirarsi sarebbe libero di farlo senza fornire alcuna spiegazione o giustificazione. Viene in ogni caso fornita una casella mail a cui poter scrivere per contattare direttamente il team della ricerca.

D.11 **Si prevede che vi possano essere benefici per chi prende parte alla ricerca? Se sì quali?**

Non sono previste ricompense di alcun tipo per la partecipazione alla ricerca se non la consapevolezza di aver supportato uno strumento per la pianificazione urbana e di aver aiutato la ricerca nel definire la correlazione tra luce, suono, degrado e sicurezza.

D.12 **Allegare l'informativa relativa al trattamento dei dati personali ai sensi del D.Lgs. del 30 giugno2003, n. 196 (Codice in materia di protezione dei dati personali).**

D.12 a **Come verrà garantito ai partecipanti l'anonimato?**

Non sono previste domande circa l'identificazione dell'individuo rispondente. In ogni caso i dati raccolti non verranno divulgati e verranno conservati in sicurezza.

D.12 b **Quali sono le misure di sicurezza che si intendono adottate per assicurarsi che venga rispettata la riservatezza dei dati?**

I dati verranno conservati in un personal computer protetto da password e l'accesso ai dati sarà effettuato solo dai ricercatori presenti nel team; inoltre i dati verranno conservati nella rete protetta Big Data Analysis Lab della Città di Torino.

D.13 **Conservazione e sicurezza dei dati raccolti e dei risultati della ricerca.**

D.13 a **Chi avrà accesso ai dati raccolti e ai risultati (ancorché intermedi) della ricerca?**

I ricercatori coinvolti attivamente nella ricerca, nonché i membri del team della ricerca.

D.13 b **Per quanti anni i dati raccolti verranno conservati dalla conclusione della ricerca?**

Tre anni

D.13 c **Indicare le modalità di conservazione dei dati sensibili specificando la conservazione e il luogo dove verranno conservati.**

I dati sensibili verranno conservati in un personal computer protetto da password e nella rete protetta Big Data Analysis Lab della Città di Torino.

D.13 d **Indicare se i dati raccolti potranno essere utilizzati anche da altri gruppi di ricerca, specificando anche le eventuali modalità di acquisizione del consenso informato a tale fine.**

I dati raccolti potranno essere utilizzati dai gruppi di ricerca che si occupano dei medesimi temi di ricerca. Nel testo introduttivo viene specificato questo aspetto.

In relazione allo svolgimento del progetto WALK SAFE PROJECT, per cui si chiede l'espressione del parere da parte del Comitato Etico d'Ateneo, la sottoscritta Arianna Astolfi, responsabile del progetto, dichiara di non avere conflitti di interessi.

Luogo e data

Torino, 09/04/2019

Firma del responsabile

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STATISTICS ANALYSIS

Statistical analysis was carried out with *SPSS Statistical Package for Social Sciences* (IBM Statistic20, IBM, Armonk, NY, USA) in order to investigate and to answer to the research questions posed in part A, section 9. In the case of this research the analyzes were divided on the basis of the three different questionnaires: *on-site survey*, *double-check survey* and *social survey*.
In fact for the on-site survey the data collected in the weeks from November 2018 to December 2018, a week for each examined site, for three days a week (Monday, Thursday, Saturday) and the measurements of the same weeks were used, while for the double-check survey, the data collected during one week in December 2018 for examined site of Passerelle Olimpica, for three days (Monday, Thursday, Saturday) and the measurements taken in the same weeks were used.
For the social questionnaire all the data collected online were used instead. For the on-site questionnaire, **factorial reductions (PCA)** were made in order to simplify a complex set of data and be able to group a large set of variables into macro-categories, without losing initial information; in this case the factors of safety, urban quality, lighting, soundscape and wellbeing were obtained. These factors were subsequently used to answer the ten research questions.
For each question a different statistical methodology was chosen, however the following methods were used:

- **Linear regression model**, which represents a method of estimating the conditional expected value of a dependent variable Y given the values of other independent variables x.

$$Y = \alpha + \alpha 1x1 + \alpha 2x2 + ... + \alpha nxn$$

- **Bivariate analysis**, that shows if there are any correlations or any relationship between two or more distinct random variables; the correlation method was used, which is a relationship between two variables such that each value of the first corresponds to a value of the second, following a certain regularity.

-**Mann- Whitney U Test (MWU)**, that is a non-parametric test to verify, in the presence of ordinal values from a continuous distribution, if two statistical samples come from the same population; this test is used for two group of independent observations.

-**Kruskal-Wallis (KW) test**, that is a non-parametric test to verify the equality of the medians of different groups, ie to verify that these groups come from the same population; this test is used for more than two groups of inde-

The methods explained in this section and applied to obtain the results in part E were possible thanks to the kind help of professor Franco Pellerey of the Department of Mathematical Sciences DISMA of the Polytechnic of Turin.

pendent observations.

-**Cluster Analysis** has as objective to build some subgroups or clusters of individuals or to group a set of individuals or objects in the same group (claster). This is done by grouping individuals that are similar according to some predefinite criterion.

For the double-check questionnaire instead questions were directly used to obtain a **bivariate correlation analysis** (part E sections 21); therefore double-check survey results was compared to on-site survey results selecting only the answers related to the Passerella Olimpica. The analyzes were done with a **bivariate correlation** of safety questions and light, sound and decay questions.
For the social survey instead, having only four questions, those were directly correlated though **bivariate correlation analysis** (part E section 21). Therefore social survey results was compared to onsite survey results about the same **correlation** in order to investigare differences between these two surveys. The application of these methods can be seen in part E of the results.

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PILOT

Pilot for two university sites: Polytechnic of Turin and University of Turin

The pilot of the research is nothing more than the application of the previously explained methodology. In fact the questionnaires were subjected to translation and adaptation for the versions presented according to a **translation** and **retranslation process** (*forward/backward translation*) and through a **pre-test of administration**, ie the pilot. (Ranieri et al, 2016) This pilot was carried out during the *InsideOutside* design workshop within the master's degree program in *Architecture for Sustainable Design*. The areas analyzed are the **Cittadella Politecnica**, one of the headquarters of the Polytechnic of Turin and **Campus Luigi Einaudi** one of the headquarters of the University of Turin. The first area starts from Corso Duca degli Abruzzi and includes the entire settlement of Corso Castelfidardo and Via Boggio, while the second one starts from Corso Verona and crosses the Franco Mellano footbridge to reach the Campus and continues around the Campus. The acoustic and lighting measures were carried out through a **sound-light walk** with predefined measurement points. This latter evaluation stations were six for each site, Polytechnic: entrance to the Campus (Corso Castelfidardo), underground entrance (classrooms I), area between the avenue and the ex-classrooms R, entrance to the Campus (via Borsellino), internal parking and entrance to the Campus (residence Mollino), while Campus: Corso Verona - Via Cagliari, entrance to the Campus (Viale O.Mai - Lungo Dora), tree-lined avenue (Corso L. Farini), pubs and and associations (Via G. Pallavicino) and Largo Berardi (Corso Farini).
First a normative definition of the area under analysis was made. The **acoustic classification** consists in the territory subdivision into homogeneous areas, according to six acoustic classes. The purpose of this subdivision is to attribute the proper limits for each space. The area of Cittadella Politecnica is identified as mixed type area, such as an urban area affected by vehicular traffic, average population density, commercial activities and offices. Therefore, during the day it is possible to issue up to 55dB (A), while at night it is possible to issue 45dB (A). The area of Campus Einaudi is identified as mixed type area, such as an urban area affected by vehicular traffic, average population density, commercial activities and offices and it is close to an area of type four or areas of intense human activity. Also in this case, during the day it is possible to issue up to 55dB (A), while at night it is possible to issue 45dB (A). The **acoustic mapping** of the City of Turin is the cartographic representation of the noise levels produced by road infrastructures considering the contribution

of private traffic and of public transport. The mapping shows, for each circoscrizioni, the estimated noise levels expressed according to the national indicators daytime level (6-22) and night time (22-6).

The **lighting classification** divides the categories of routes based on the intensity of the traffic. The Polytechnic area is delimited north-west and south by two high-capacity inter-district urban roads (Corso Peschiera and Corso Ferrucci) and by an urban district street (via Borsellino). To the south-east it is bounded by a high-capacity inter-district road (Corso Castelfidardo). The University area indeed is delimited to the north by the Dora river and by a neighborhood urban road (Lungo Dora Siena), while to the south and east it is delimited by a high-capacity inter-city urban road (Corso Regina and Corso Novara).

Measurements took place on October 17th 2018 in the evening between 06:00 pm to 08:00 pm. **Acoustic measurement** were performed using a binaural recording system, composed of a portable audio recorder SCASAS XS connected to a earphone of omnidirectional microphones; this system is controled via android app Siemens Testlab Scope 7 and Simcenter Testlab Apps for Scadas XS. **Lighting measurement** indeed were performed using luxmeter to determinate lighting values of horizontal and vertical illuminance for each area. The acoustic recording time was a five-minute interval for each station, which was record simultaneously while the participant done the survey. After the measurements the acoustic and lighting data were extracted: for the acoustic data **L_{Aeq}**, **Fluctuation Strenght**, **Loudness**, **Roughness** and **Sharpness** as shown in tables B4a and B4b, for the lighting

STATIONS	L_{Aeq}	FLUCTUATION STRENGHT	LOUDNESS	ROUGHNESS	SHARPNESS
Cittadella	*dBA*	*vacil*	*sone*	*asper*	*acum*
1	58.2	1.34	10.13	0.17	1.20
2	45.9	1.10	4.50	0.14	1.11
3	66.5	1.21	14.71	0.21	1.38
4	53.3	1.03	6.51	0.15	1.10
5	59.7	1.13	10.20	0.16	1.16

Table B4a. Acoustic data Pilot for Polytechnic *Simcenter LMS Testlab (Siemens PLM Software 17)*

STATIONS	L_{Aeq}	FLUCTUATION STRENGHT	LOUDNESS	ROUGHNESS	SHARPNESS
Campus	*dBA*	*vacil*	*sone*	*asper*	*acum*
1	57.8	1.26	10.01	0.17	1.57
2	49.9	1.15	6.13	0.13	1.41
3	45.4	1.10	4.18	0.12	1.27
4	44.5	1.06	3.80	0.12	1.31
5	63.2	1.13	13.02	0.22	1.27

Table B4b. Acoustic data Pilot for University *Simcenter LMS Testlab (Siemens PLM Software 17)*

STATIONS	E_h	E_v
Cittadella	*lux*	*lux*
1	2.20	2.20
2	71.87	38.55
3	12.88	11.18
4	0.90	1.50
5	28.98	28.80

Table B5a left. Lighting data Pilot for Polytechnic *Luxmeter (LAMSA)*

STATIONS	E_h	E_v
Campus	*lux*	*lux*
1	13.96	5.15
2	2.40	3.20
3	17.61	7.45
4	8.28	5.37
5	34.9	14.45

Table B5b right. Lighting data Pilot for University *Luxmeter (LAMSA)*

	TOTAL	MALES	FEMALES	AGE	EDUCATION
STUDENTS	15	7	8	18-30	3y-degree

Table B6. Survey data Pilot for two universiy

data horizontal illuminance $\mathbf{E_h}$ measured at 5 cm from the road surface and vertical illuminance $\mathbf{E_v}$ measured at 150 cm from the road surface, as shown in tables B5a and B5b. During the acoustic and lighting measurement in each station on-site survey was submitted to students and it was presented using a Google form document, showed to participants via link on their tablet. This is the first version of on-site survey and was subjected to translation and adaptation for the according to a *forward/backward translation* as mentiond before. The survey used in this pilot consisted of four main themes: **Perceived Safety**, **Light Environment** and **Sound Environment**; the questionnaire used in this pre-test is reported in Appendix.

The participants of survey are 15 students of master degree, 7 males and 8 females, aged between 18 and 30 years, as shown in table B6. Their level of education is three-years degree because they are all of the same course of master degree. Places of residence are Turin (n = 6), Piedmont (n = 4) and Italy (n = 5). The analysis of the questionnaire showed that most of the interviewees in Cittadella Politecnica visit the place every month or every week doing work or study activities or as a path of changeover, while in Campus Einaudi showed that most of the interviewees never visit the place and the main activity is the transition from one area to another. After the first **identification of the interviewees**, the themes of the questionnaire were analyzed for the two different sites.

As for the Turin Polytechnic site, the **perception of safety** varies depending on the stations

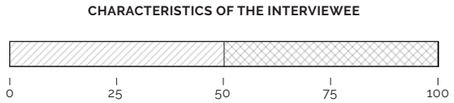


Fig. B2a. gender of respondents

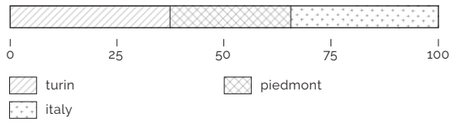


Fig B2b. place of residence of respondents

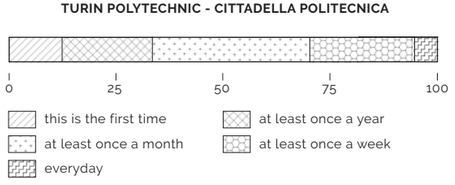


Fig. B2c. frequency of visits

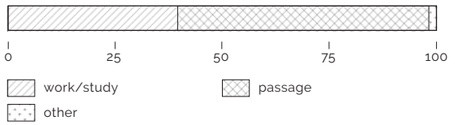


Fig. B2d. activity of respondents

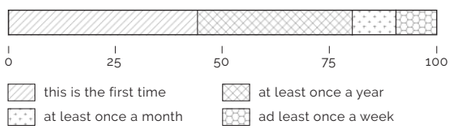


Fig. B2e. frequency of visits

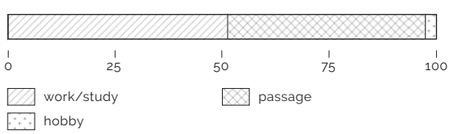


Fig. B2f. activity of respondents

in fact there is a high perception as *I feel safe* in stations one and two, while a low perception in station for and there is a strong perception of loneliness *I feel alone* in almost all stations, with higher value in the four and in the five. The perception of safety associated to the routes as *I feel uncomfortable along this path* has a high value in stations three and four, instead it has a low value in station two; instead *I would stretch the route to avoid walking on this path* has fairly low values, especially in station two. The perception of safety associated to the vitality or livability of the place as *This place is inviting* or has a very similar value in all statements, showing that station three has very negative values compared to station two, which it is perceived as the best. The **perception of urban and architectural decay** with the preservation of buildings or public spaces and the cleaning and maintenance of public area shows station two as closer to excellent followed by station five. After the perception of safety and decay, the **sound environment** and the **light environment** were investigated. The lighting environment is mainly characterized by street lighting in all stations, while architectural and building lighting have a higher value in station two and lower value in station four. The lighting environment tending to bad for all stations, with greater value in station four, the sound environment instead has low values in station five and greater value in station two. The perceived brightness is extremely high in all stations except the four, while the noise level is high for station five and then has levels just above the average value. In both cases, bright and sound, the environment are considered inadequate for the use of the place, especially for the four station.

As for the Turin Univeristy site, the **perception of safety** varies depending on the stations in fact *I feel safe* has a low value in almost all stations, especially in station four and there is a strong perception of loneliness *I feel alone* in almost all stations, with higher value in the one and in the five. The perception of safety associated to the routes as *I would walk alone along this place* has a low value almost for almost all stations, with a very low value in station four, while *I would quickly cross this place to get away from here* has high values, especially in stations four and five. The perception of safety associated to the vitality or livability of the place as *This place looks like a cozy environment* has very low values in stations one and four, perceived as not very cozy. The **perception of urban and architectural decay** with the preservation of buildings or public spaces and the cleaning and maintenance of public area shows station two as closer to excellent followed by station three. After these perception the **sound environment** and the **light environment** were investigated. The lighting environment is mainly characterized by *street lighting* in all stations, while *architectural lighting* have a higher value in station two, in front of Campus entrance. The most heard sounds are *Traffic and technological sounds* in all stations, while *natural sounds* have almost the same value in all stations except the four (bass) and the *anthropic sounds* have a low value in stations one and five. The lighting environ-

ment tending to bad for all stations, with greater value in station four, the sound environment instead has low values in stations three and four and greater value in station five even if the values are all tending to bad. The perceived brightness is high in station three, while the noise level is high for station four and then has levels just above bad. The lighting environment is considered inadequate for stations three and four and almost neutral for stations one and two, while the sound environment is considered adequate for stations one, three and five and inadequate for the others.

In conclusion, objective and subjective data were compared in a qualitative way, in fact in the pilot no statistical analyzes were performed.

C

CASES STUDIES

CASE STUDIES

definitions of the analyzed areas

The areas identified for this research on the perception of safety influenced by the conditions of light, sound and urban and architectural decay are the following: Campus Luigi Einaudi, Parco Dora, Passerella Olimpica and Largo Saluzzo for field measurements, while Giardini Montanaro and Piazza Giovanni Bottesini for social media surveys only, the areas are defined in detail in part A sections 7 and 8.

Each area was selected with the support of the municipal police force of the City of Turin, so as to correspond to certain criteria which were then investigated; this criteria are bad or excellent lighting conditions, bad or excellent sound conditions and bad or excellent conditions of physical and social decay. Field investigations, as previously stated in part B sections 9 and 10, were conducted with an objective and a subjective part. The first was carried out through a sound-light walk inside the analysis area, with predefined station points (five for area), for each point the measurements and also the subjective analyzes were carried out, ie the surveys.

These procedures were carried out for the first four areas, while the last two areas were subject only to investigation through the social survey, explained in part B section 10. Below for each area and each station is defined a framework and the acoustic and lighting characteristics.

CASE STUDIES

definitions of the areas analyzed

Area	Street/Square	Neighborhood	District
Campus L. Einaudi	Corso Verona Passerella F. Mellano Viale O. Mai Corso C. L. Farini	Borgo Vanchiglia	Circoscrizione 7
Parco Dora	Area Vitali	San Donato	Circoscrizione 4 e 5
Passerella Olimpica	Piazza Galimberti ex-MOI, via Pio VII Passerella	Lingotto	Circoscrizione 8
Largo Saluzzo	Corso G. Marconi via Saluzzo via Giuseppe Beretti	San Salvario	Circoscrizione 8
Giardini Montanaro	Corso Giulio Cesare via G. Spontini via Montanaro	Barriera di Milano	Circoscrizione 6
Piazza G. Bottesini	via G. Paisiello via M. Clementi via Mercadante	Barriera di Milano	Circoscrizione 6

Table C1. Identification of areas

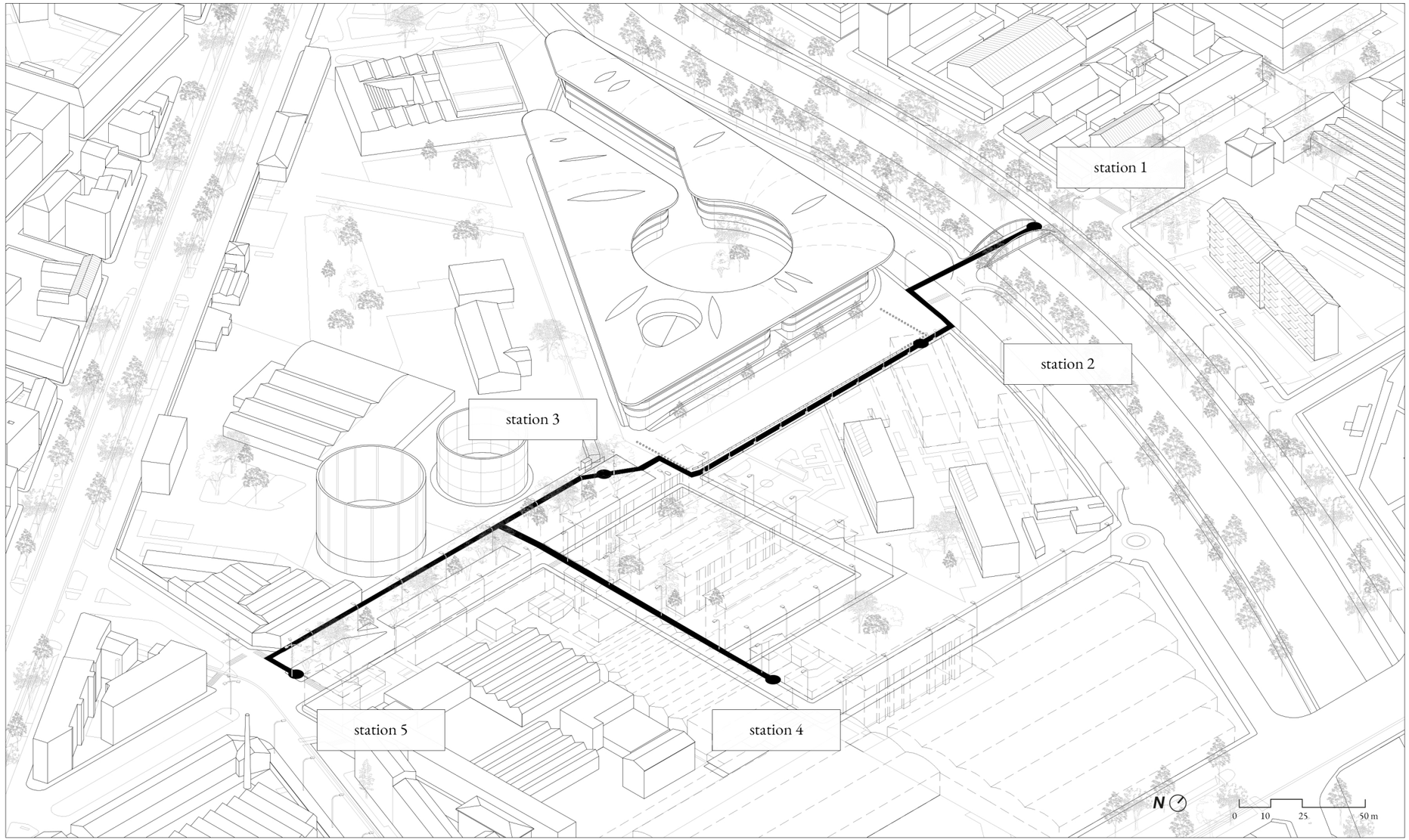
CAMPUS LUIGI EINAUDI

definition of the analyzed area

The Campus Luigi Einaudi is a university area of the University of Turin; it is located in the north-east area of the city of Turin, in particular into Circoscrizione 7, Borgo Vanchiglia sub-area. The Campus is located along the banks of the Dora river, in the ex Italgas industrial area and it is seat of the Schools of Legal, Political and Economic sciences with the departments of Culture, Politics and Society, Economics and Statistics and Law. The campus building was designed by Norman Foster and was built with innovative criteria of environmental sustainability, energy saving, solar design and bioclimatic strategies. (Di Marzo, 2012)

Circoscrizione 7 includes the areas of Aurora, Vanchiglia, Sassi and Madonna del Pilone; the area where the Campus is located and the area analyzed is **Vanchiglia**. The Campus area is located exactly in the **Vanchiglietta area**, which is an area of the Borgo Vanchiglia district and it is a more recent area of urbanization. Inside the area there is the Colletta Park and the Crescenzio Park, the area of the ex Goods Station and the Luigi Einaudi Campus area. The whole neighborhood, Vanchiglia e Vanchiglietta, has an area of about 4 km^2 and the central location and proximity to the University of Turin led to a transformation into residential districts, in fact this recent transformation from a popular

Fig. C1. Luigi Einaudi Campus Area - Franco Mellano runway
Seeing Torino blog



neighborhood to a prestigious one has changed the number of residents and the university has increased the number of houses rented to students away from home.
In recent years Vanchiglia has established itself as one of the artistic and commercial poles of Turin, but in the last years it has become theater of economic crisis and of new recreational activities dedicated to youth nightlife.
The analysis area starts from Corso Verona, on the bank of the Lungo Dora Firenze, and continues along the Franco Mellano footbridge, until Viale Ottavio Mai, which is located east of the Campus structure. The area continues for Corso Carlo Luigi Farini until the intersection with Corso Belgio. Another analyzed street is Via Giorgio Pallavicino that is near to places like Cubo Teatro or Off Topic.
This area was chosen mainly for the conditions in which Viale Ottavio Mai is concerned, that is the **poor lighting conditions**. It has also been chosen as it appears as one of the **new areas of the Turin nightlife**, in fact it is close to Piazza Santa Giulia. It appears as a very populated area during the day by university students and workers, but at night it is a transition zone from public transport stops to the nearby areas of Turin nightlife.
In the following pages, to better investigate the areas of analysis, the open data by the Open Data in 2017 *aperTO* Dataset of the Municipality of Turin have been reported.

Fig. C2. Identification of areas Campus Einaudi

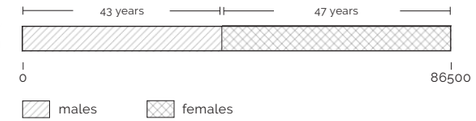


Fig. C3a. population resident in the distric 7 divided by gender with average age.

Fig. C3b. percentage of foreigners in the total population resident in the district 7.

Fig. C3c. foreign residents in the distric 7 divided by gender.

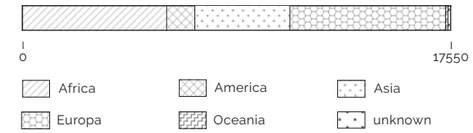


Fig. C3d. foreign residents in the distric 7 divided by nationality.

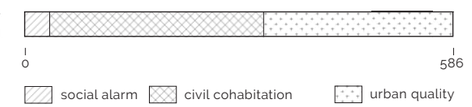


Fig. C3e. complaints of 2017 to the Municipal Police divided by category in district 7.

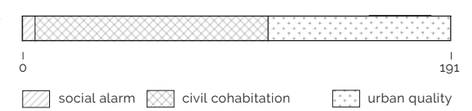


Fig. C3f. complaints of 2017 to the Municipal Police divided by category analyzed microzones of the district 7.

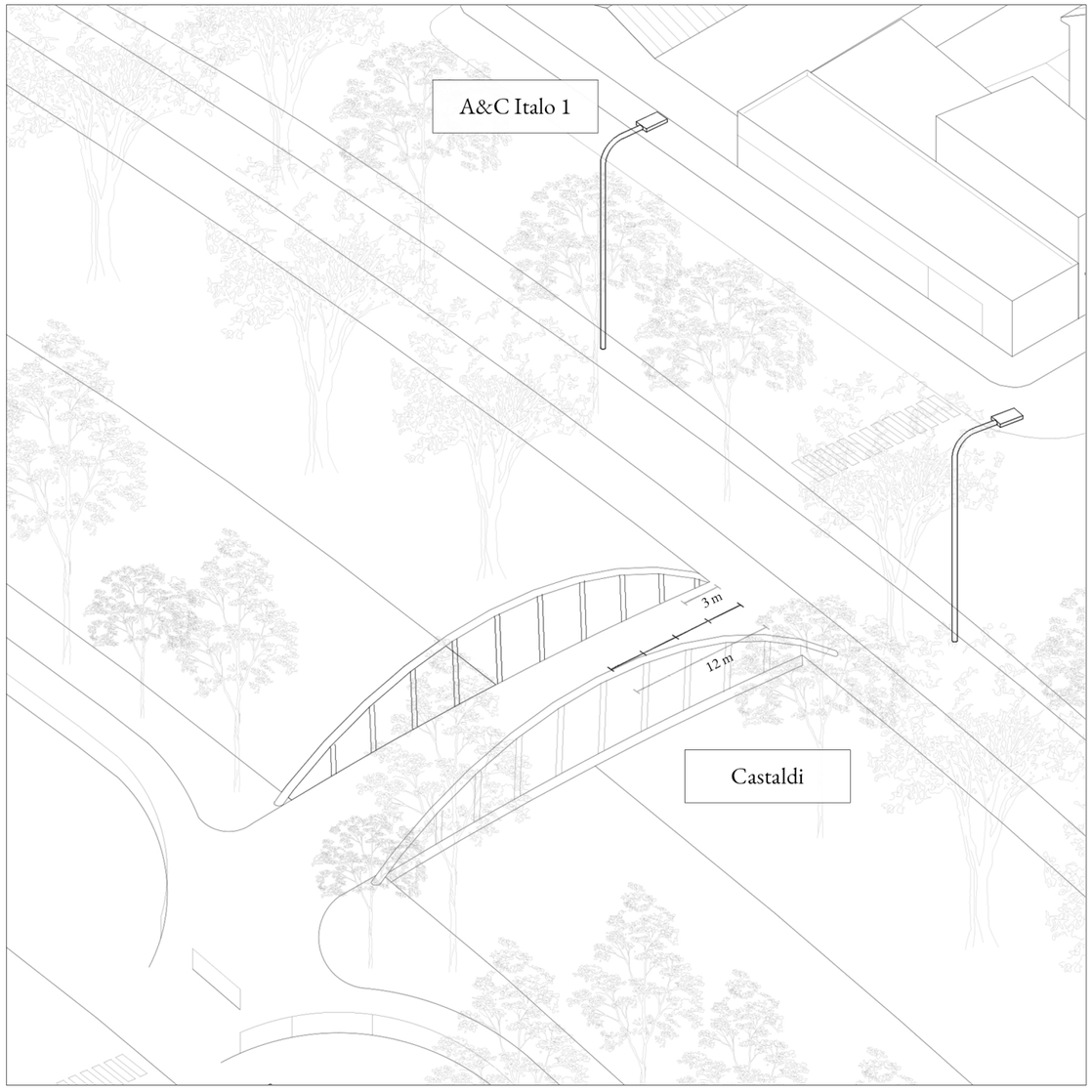
The analysis of the areas was also carried out through the open data by the Open Data in 2017 *aperTO* Dataset of the Municipality of Turin. These data refer to the year 2017 and concern the **demographic data** of the districts analyzed. Specifically, they refer to the resident population of the area divided by gender and age, as we see in FigC3a, or the percentage of foreigners as in FigC3b; the latter are also divided by gender and nationality.

Finally, data relating to **complaints of 2017** to the Municipal Police divided by category and by districts were analyzed.

In the following pages, the lighting and acoustic data relating to the state of affairs for each station in the area are shown.

The **acoustic mapping** of the City of Turin is the cartographic representation of the noise levels produced by road infrastructures considering the contribution of private traffic and of public transport. The mapping shows for each districts the estimated levels of noise in daytime (6am - 10pm) and night time (10pm - 6am). The area of Campus Einaudi in district 7 is identified by high noise levels during the day, that is from 55 to 70 dB(A), with some points of 75-79 dB(A) and lower levels during the night, or around 50 dB(A). The area of the Viale O. Mai in the specific varies from 75-79 dB(A) during the day to 65-69 dB(A) during the night.

The **acoustic zoning** divides the territory of Turin into six acoustic classes to attribute the limits based on the use of the territory. The area of the Campus Einaudi is a *mixed type* area, bordering *areas of intense human activity*.

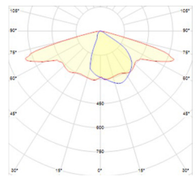


CAMPUS LUIGI EINAUDI

station 1

Castaldi
Fluorescent source, reflector optic, TCC ~ 3000K, inside mounting, luminous flux n.d., power 24 W, IRC n.d.

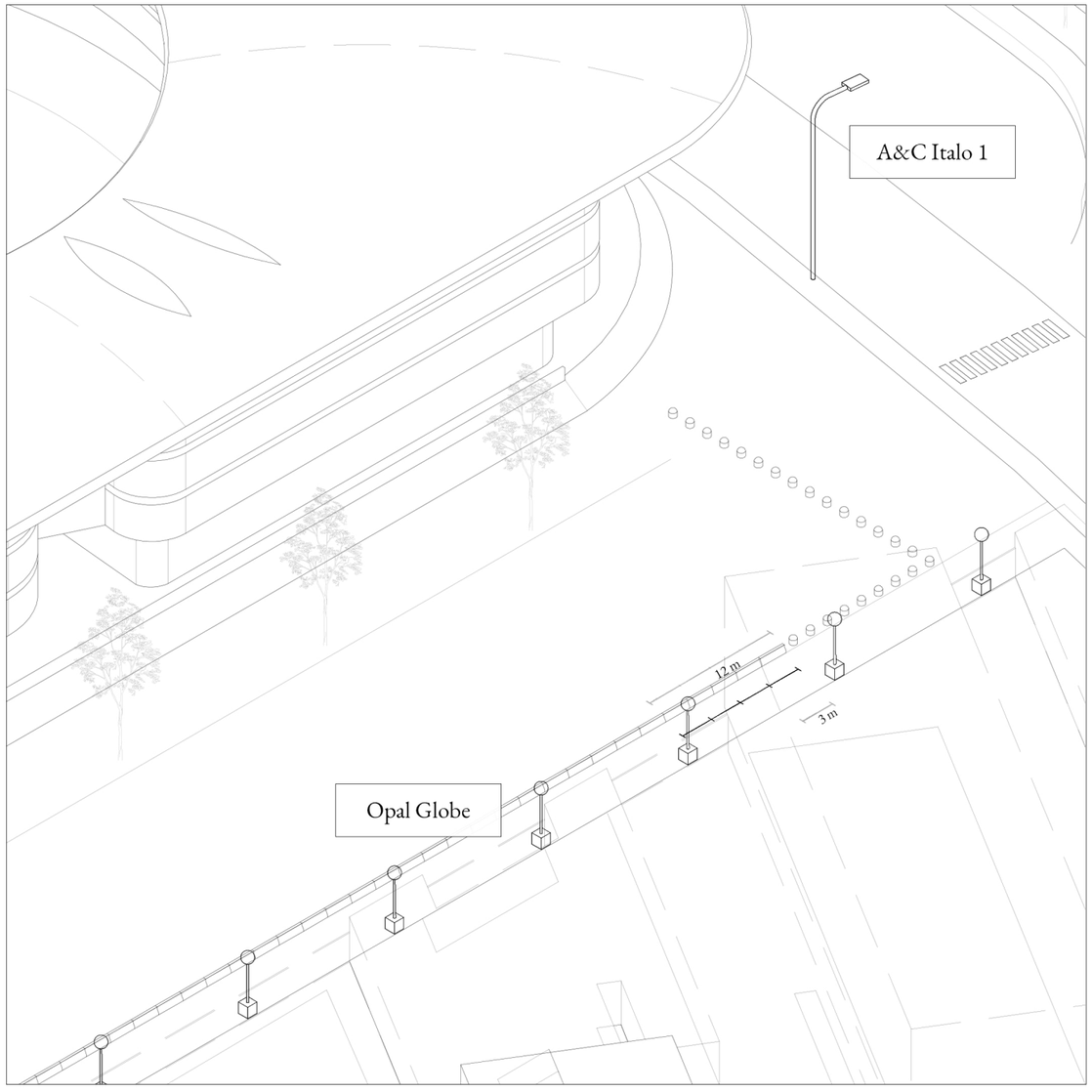
A&C Italo 1



LED source, street projector optics, TCC ~ 4000 K, pole-top mounting, luminous flux 8291 lm, power 72W, IRC ≥ 70

For **acoustic zoning** station one is a *mixed type area* and the limits for these areas are: day entry of 60 dB(A) and night of 50 dB(A), day emission of 55 dB(A) and night emission of 45 dB(A).

Fig. C4a. station 1 of Campus Einaudi.



CAMPUS LUIGI EINAUDI

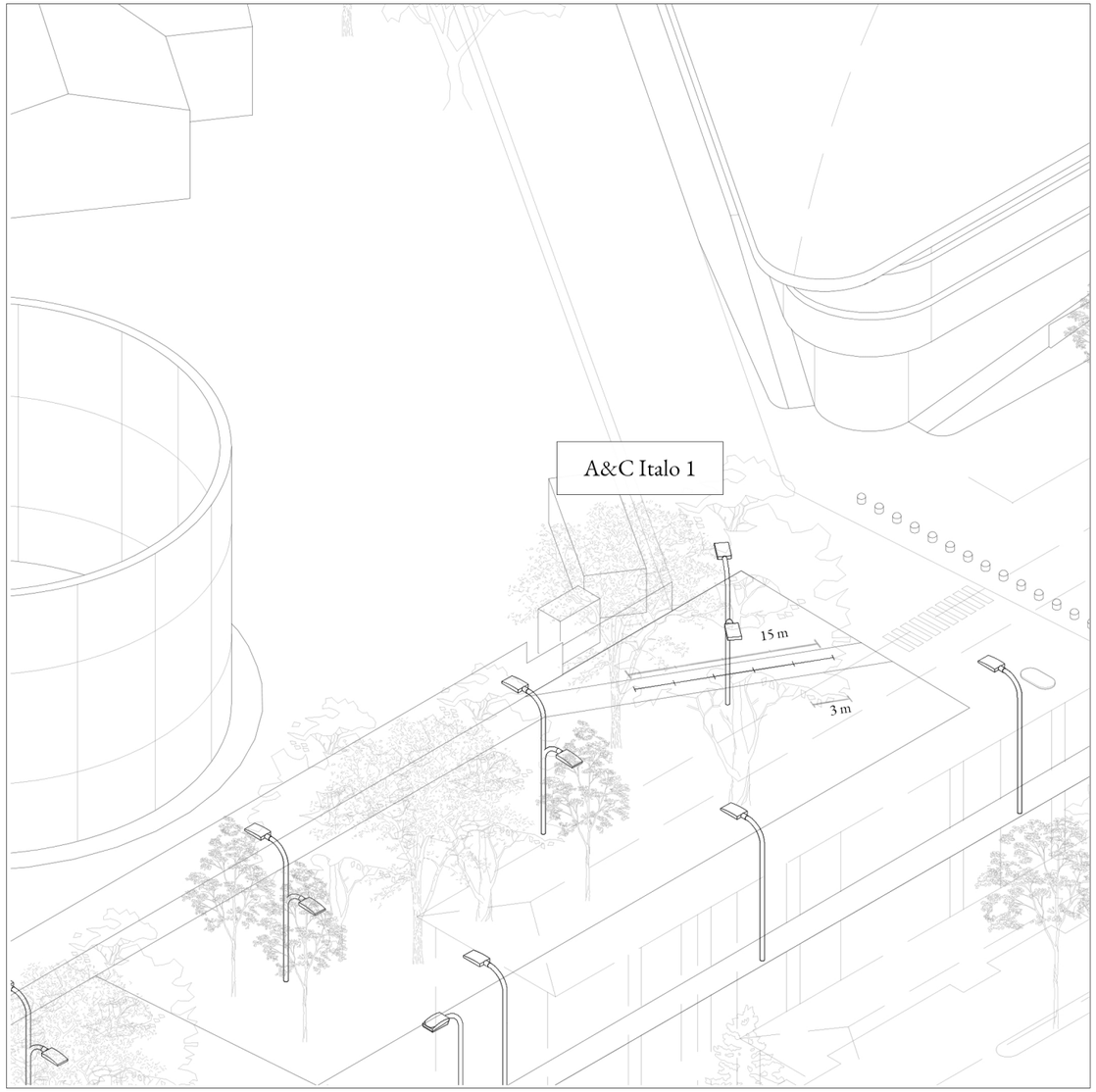
station 2

Opal Globe
High pressure sodium source, diffusing optics, 1900 K < TCC < 2100 K, pole-top mounting, luminous flux n.d., power 25W, IRC n.d.

A&C Italo 1
LED source, street projector optics, TCC ~ 4000 K, pole-top mounting, luminous flux 8291 lm, power 72W, IRC ≥ 70

For **acoustic zoning** station two is on a *mixed type area* and the limits for these areas are: day entry of 60 dB(A) and night of 50 dB(A), day emission of 55 dB(A) and night emission of 45 dB(A).

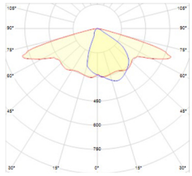
Fig. C4b. station 2 of Campus Einaudi.



CAMPUS LUIGI EINAUDI

station 3

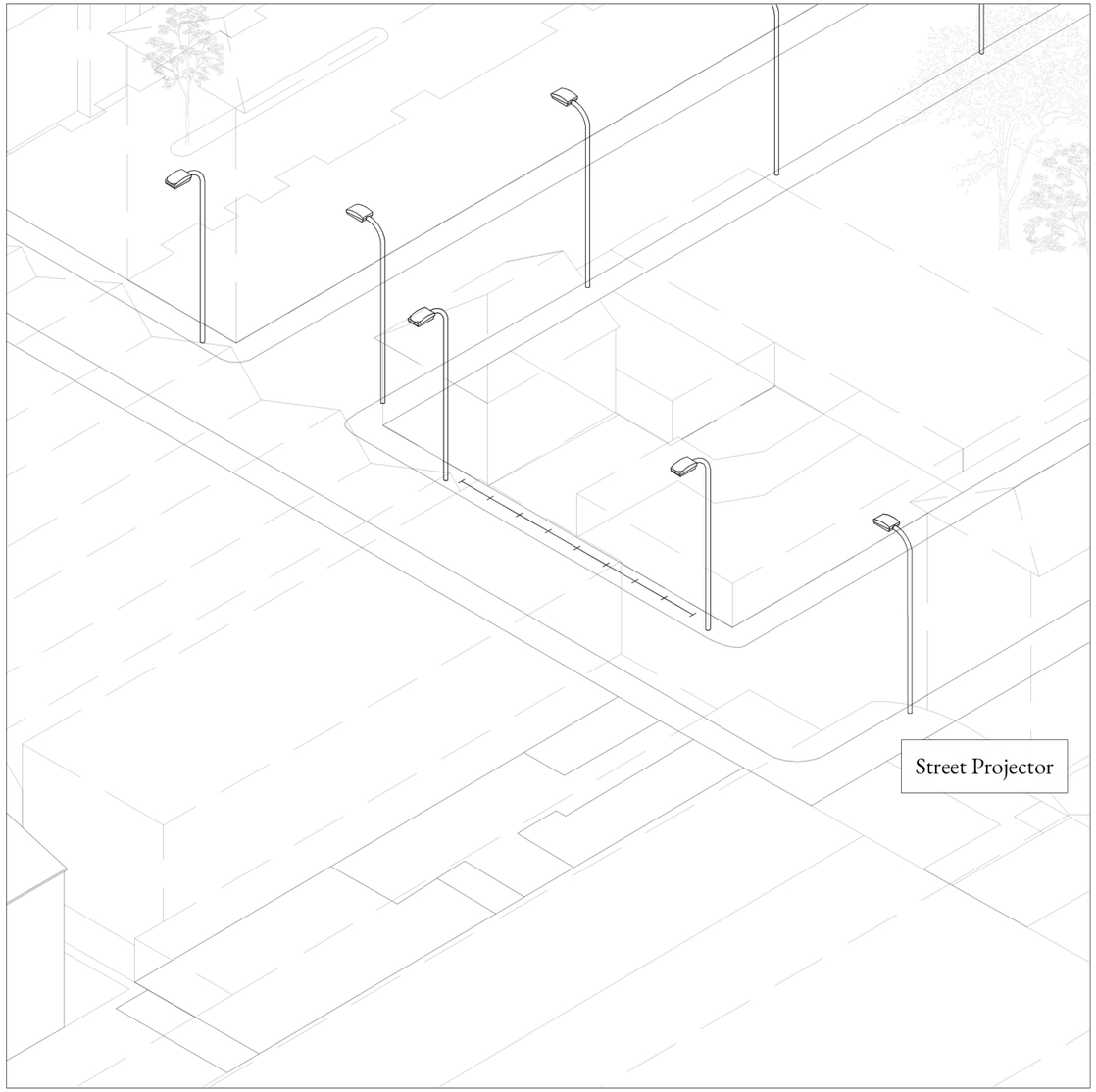
A&C Italo 1



LED source,
street projector optics,
TCC ~ 4000 K,
pole-top mounting,
luminous flux 8291 lm,
power 72W, IRC ≥ 70

For **acoustic zoning** station three is on an *area of intense human activity* and the limits for these areas are: day entry of 65dB(A) and night of 55 dB(A), day emission 60 of dB(A) and night emission of 50 dB(A).

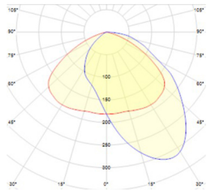
Fig. C4c. station 3 of Campus Einaudi.



CAMPUS LUIGI EINAUDI

station 4

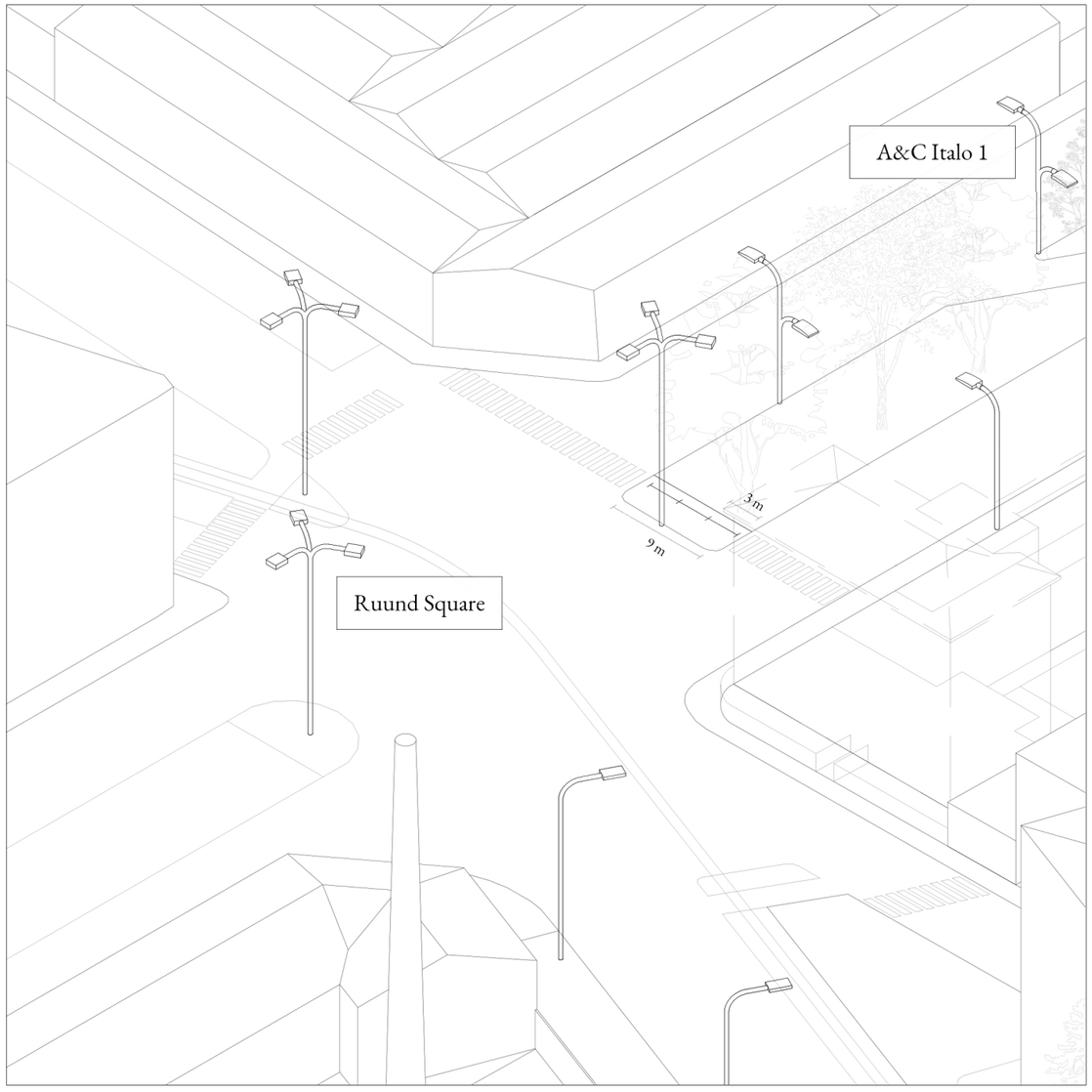
Street Projector



High pressure sodium source, street projector optics, 1900 K < TCC < 2100 K, pole-top mounting, luminous flux n.d., power n.d., IRC n.d.

For **acoustic zoning** station four is on a *mixed type area* bordering *exclusively industrial area* and the limits for these areas are: day entry of 60 dB(A) and night of 50 dB(A), day emission of 55 dB(A) and night emission of 45 dB(A).

Fig C4d. station 4 of Campus Einaudi..

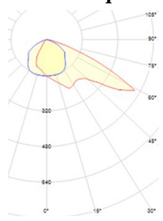


CAMPUS LUIGI EINAUDI

station 5

A&C Italo 1
LED source, street projector optics, TCC ~ 4000 K, pole-top mounting, luminous flux 8291 lm, power 72W, IRC ≥ 70

Ruund Square



High pressure sodium source, street projector optics, 1900 K < TCC < 2100 K, triple pole-top mounting, luminous flux 36000 lm, power 400W, IRC < 25.

For **acoustic zoning** station five is on an *area of intense human activity* and the limits for these areas are: day entry of 65dB(A) and night of 55 dB(A), day emission of 60 dB(A) and night emission of 50 dB(A).

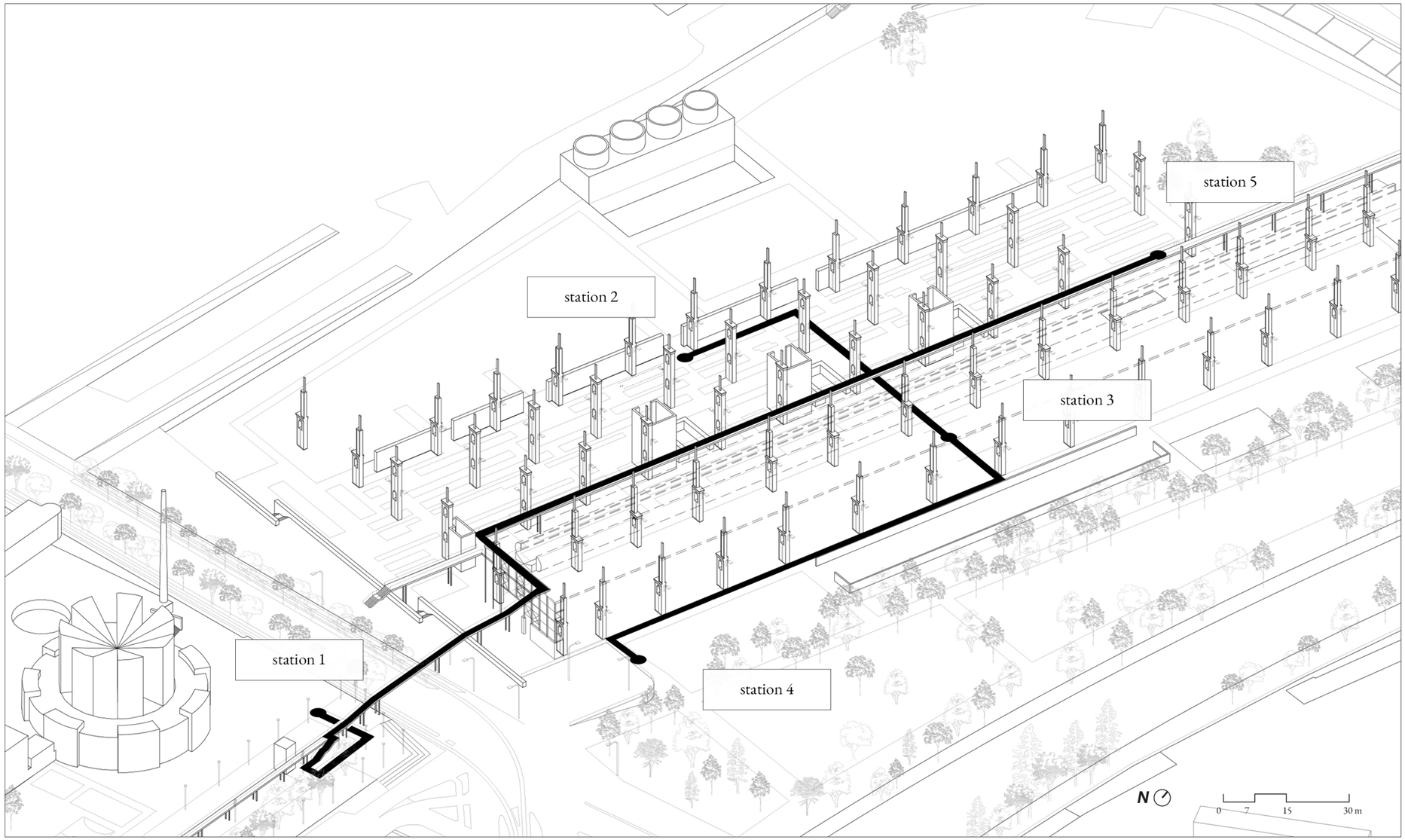
Fig. C4e. station 5 of Campus Einaudi.

PARCO DORA

definition of the analyzed area

The Parco Dora is a post-industrial park in the city of Turin located north-west of the city, in the area of Spina 3, where the Fiat and Michelin production area were located until the 1990s. The park is called like the river that crosses it, Dora Riparia, and it is among the Circoscrizione 4 and 5. The area of the park is **characterized by industrialization**, in fact some historical factories in Turin had been here since the late nineteenth century: the Ferriere Fiat, the Michelin, the Savigliano and the Paracchi.
The park is built on areas once occupied by large production plants and consists of five lots that have the same name: Vitali, Ingest, Valdocco, Michelin and Mortara. Each sector has naturalistic and pre-existing industrial environments: these include the Michelin cooling tower, the large stripping structure and the thermal plant of the Fiat. Another element for the park is the Dora river, which is enhanced by the redevelopment of the banks. (Museotorino, 2019)
The idea of a new green lung already appears in the 1995 PRG and the *Urban Spina 3 Redevelopment Program* develops this indication in 2003. The park project is the result of an international competition announced by the City of Turin in the 2004 and the winner was the group consisting of Servizi Tecnologie, Latz + Partner, Studio Cappato, Gerd Pfarrè, Ugo Marano,

Fig. C5. Parco Dora Area - Tettoia Vitali runway and Chiesa del Santo Volto - *italyformovies blog:A.M.V. Belotti photo*



Studio Pession Associaton. In autumn 2007 the park project is included among the works to be carried out for the celebration of the 150th anniversary of the Unification of Italy. The first construction sites start in summer 2008 and the work is completed in the spring of 2011. (Museotorino, 2019)

Circoscrizioni 4 and 5 includes the areas of San Donato, Campidoglio, Parella into 4 while Borgo Vittoria, Madonna di Campagna, Lucento e Vallette into 5. The analyzed area is located in the north of the park and it starts from the Church of *Santo Volto* to the west of the park and continues through the Vitali area, first on the walkway and then under the roof.

The **Vitali area** is the largest in the park and is characterized by the industrial structures. The area of the stripping shed has been transformed into a garden with play areas, paths and an elevated walkway connecting with the Ingest area. The large canopy is a multifunctional space equipped with pitches for free play and dedicated to hosting events, such as the famous *Kappa FuturFestival*. (Comitato Parco Dora, 2019)

This area was chosen because it is a **very attractive center** of the city of Turin and it is the site of numerous events that require the r**ight design of light and sound** and that require an **adequate level of urban safety**.

In the following pages, to better investigate the areas of analysis, the open data by the Open Data in 2017 *aperTO* Dataset of the Municipality of Turin have been reported.

Fig. C6. Identification of areas Parco Dora

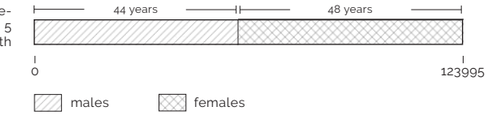


Fig. C7a. population resident in the distric 5 divided by gender with average age.

Fig. C7b. percentage of foreigners in the total population resident in the district 5.

Fig. C7c. foreign residents in the distric 5 divided by gender.

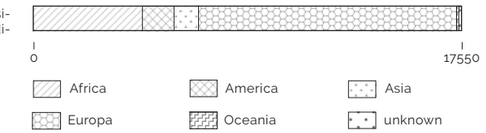


Fig. C7d. foreign residents in the distric 5 divided by nationality.

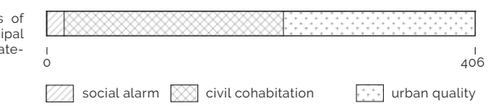


Fig. C7e. complaints of 2017 to the Municipal Police divided by category in district 5.

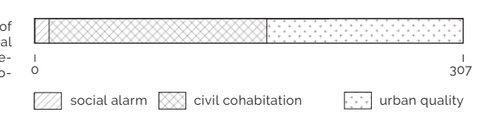


Fig. C7f. complaints of 2017 to the Municipal Police divided by category analyzed microzones of the district 5.

The analysis of the areas was also carried out through the open data by the Open Data in 2017 *aperTO* Dataset of the Municipality of Turin. These data refer to the year 2017 and concern the **demographic data** of the districts analyzed. Specifically, they refer to the resident population of the area divided by gender and age, as we see in FigC7a, or the percentage of foreigners as in FigC7b; the latter are also divided by gender and nationality.

Finally, data relating to **complaints of 2017** to the Municipal Police divided by category and by districts were analyzed.

In the following pages, the lighting and acoustic data relating to the state of affairs for each station in the area are shown.

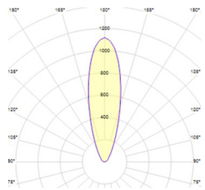
The **acoustic mapping** of the City of Turin is the cartographic representation of the noise levels produced by road infrastructures considering the contribution of private traffic and of public transport. The mapping shows for each districts the estimated levels of noise in daytime (6am - 10pm) and night time (10pm - 6am). The area of Parco Dora in district 5 is identified by 55-59 dB(A) during the day, with some points of 50-54 dB(A) and lower levels during the night, or around 50 dB(A). The area of the Tettoia Vitali in the specific varies from 50-54 dB(A) during the day to 45-49 dB(A) during the night.

The **acoustic zoning** divides the territory of Turin into six acoustic classes to attribute the limits based on the use of the territory. The area of the Parco Dora is a *mixed type* area, bordering on *areas mainly for residential use*.

PARCO DORA

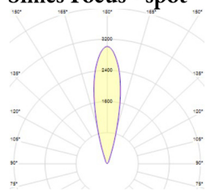
station 1

Simes Focus - wide



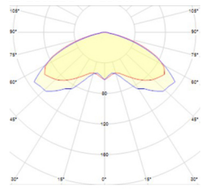
Halide source source, diffusing optics, TCC ~ 3000 K, pole-top mounting, luminous flux 6000 lm, power 70W, IRC ≥ 80

Simes Focus - spot



Halide source source, spot optics, TCC ~ 3000 K, pole-top mounting, luminous flux 6000 lm, power 70W, IRC ≥ 80

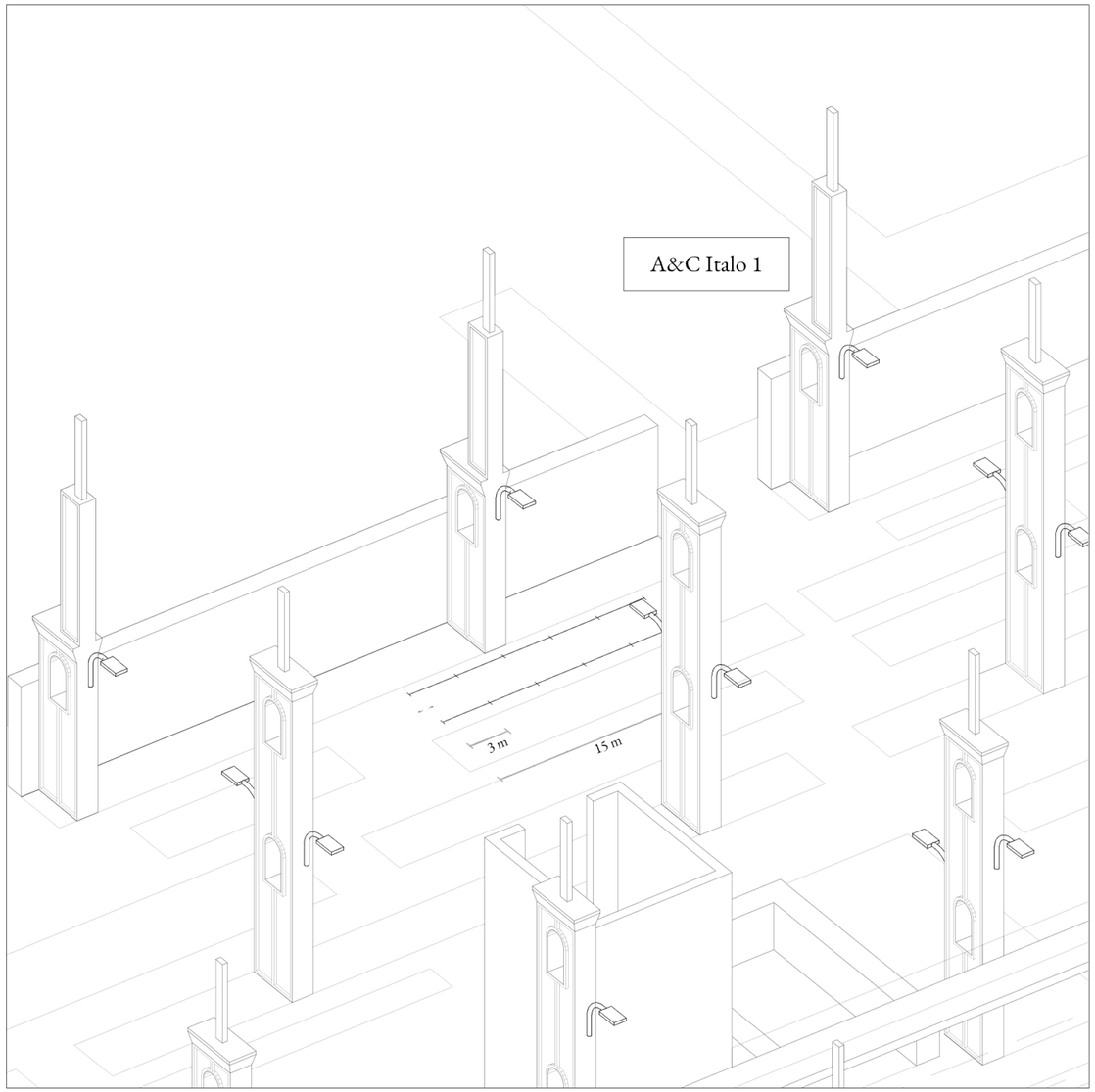
Disano Vista



Halide source source, spot optics, TCC ~ 3000 K, pole-top mounting, luminous flux 14000 lm, power 150W, IRC ≥ 80

For **acoustic zoning** station one is on a *mixed type* area and the limits for these areas are: day entry of 60 dB(A) and night of 50 dB(A), day emission of 55 dB(A) and night emission of 45 dB(A).

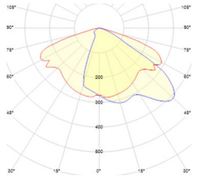
Fig. C8a. station 1 of Parco Dora.



PARCO DORA

station 2

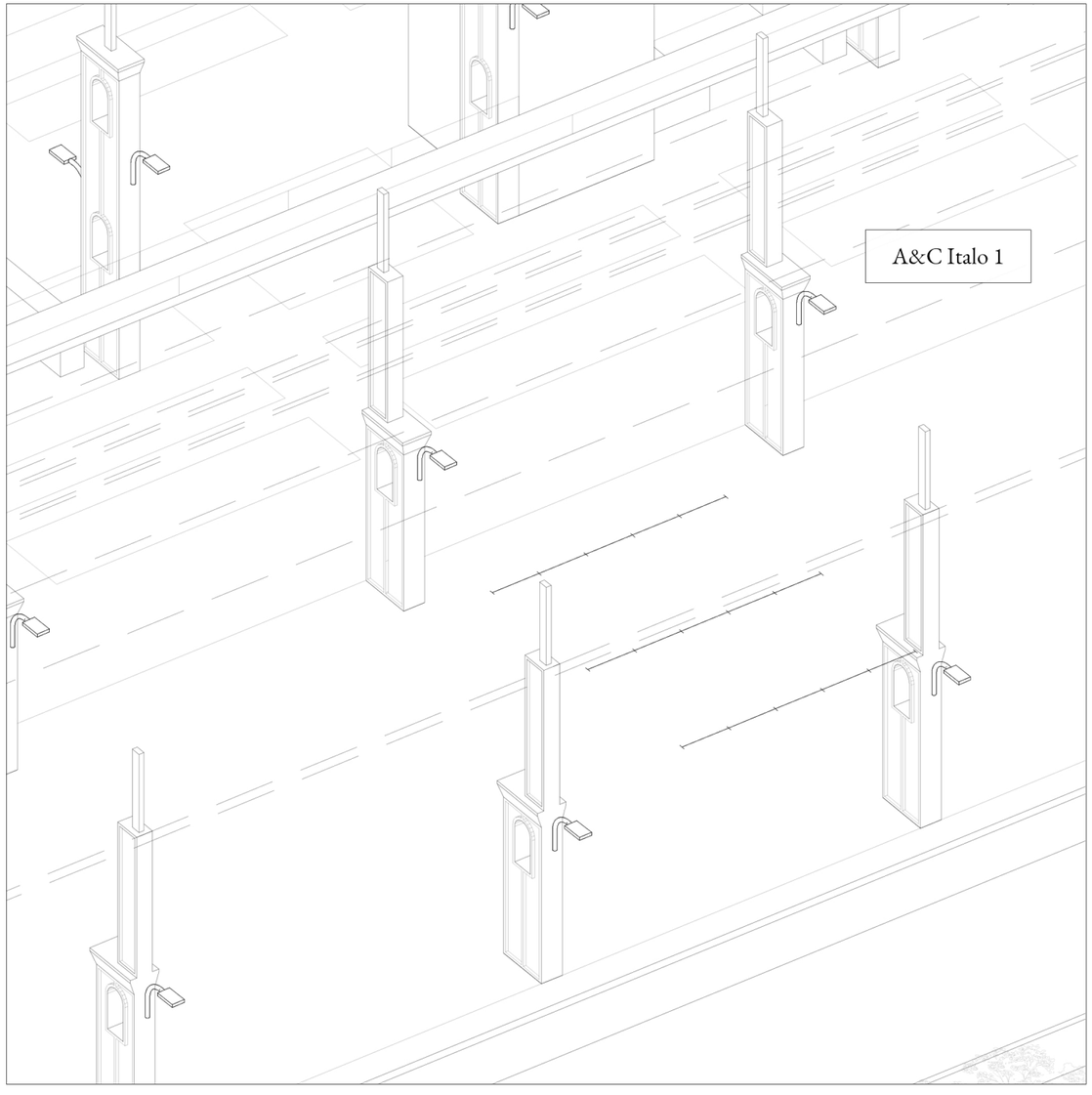
A&C Italo 1



LED source, pedestrian projector optics, TCC ~ 4000 K, pole-top mounting, luminous flux 9500 lm, power 84W, IRC ≥ 70

For **acoustic zoning** station two is on a *mixed type* area and the limits for these areas are: day entry of 60 dB(A) and night of 50 dB(A), day emission of 55 dB(A) and night emission of 45 dB(A).

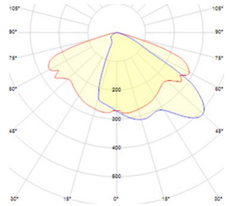
Fig. C8b. station 2 of Parco Dora.



PARCO DORA

station 3

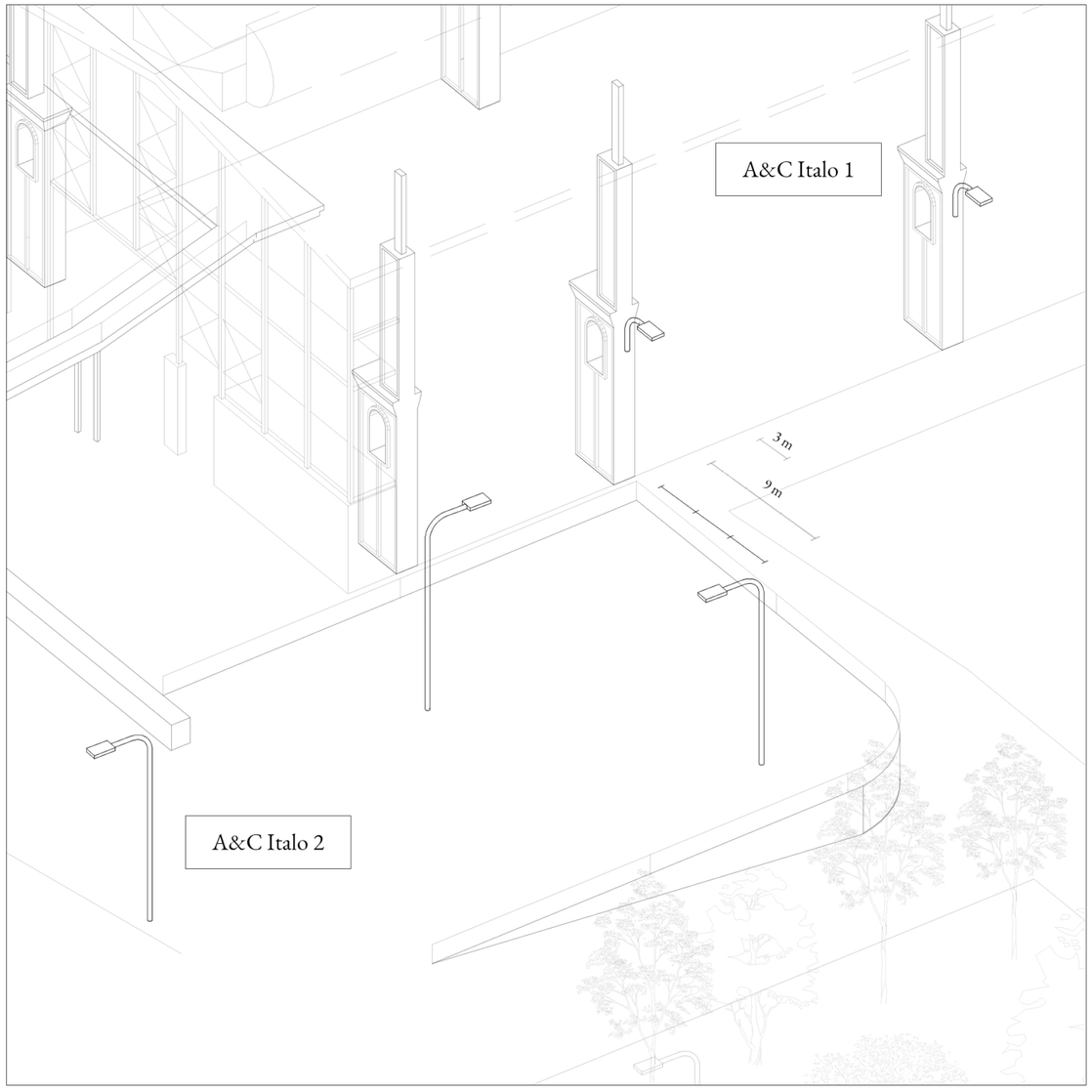
A&C Italo 1



LED source, pedestrian projector optics, TCC ~ 4000 K, pole-top mounting, luminous flux 9500 lm, power 84W, IRC ≥ 70

For **acoustic zoning** station three is on a *mixed type area* and the limits for these areas are: day entry of 60 dB(A) and night of 50 dB(A), day emission of 55 dB(A) and night emission of 45 dB(A).

Fig. C8c. station 3 of Parco Dora.

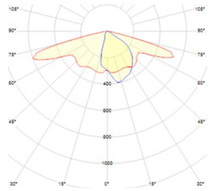


PARCO DORA

station 4

A&C Italo 1
LED source, pedestrian projector optics, TCC ~ 4000 K, pole-top mounting, luminous flux 9500 lm, power 84W, IRC ≥ 70

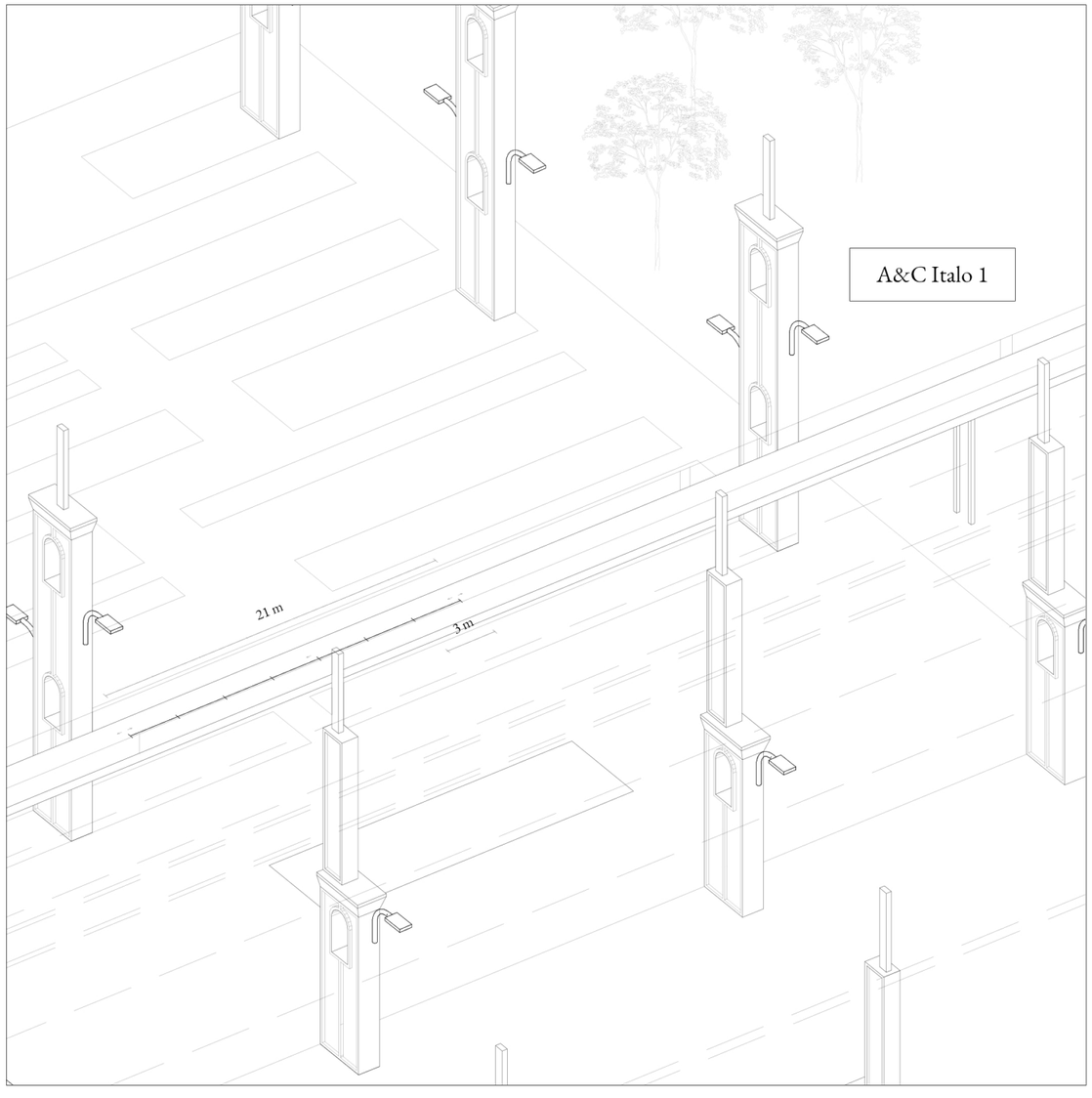
A&C Italo 2



LED source, street projector optics, TCC ~ 4000 K, pole-top mounting, luminous flux 13672 lm, power 126W, IRC ≥ 70

For **acoustic zoning** station four is on a *mixed type area* and the limits for these areas are: day entry of 60 dB(A) and night of 50 dB(A), day emission of 55 dB(A) and night emission of 45 dB(A).

Fig. C8d. station 4 of Parco Dora.



PARCO DORA

station 5

A&C Italo 1
LED source, pedestrian projector optics, TCC ~ 4000 K, pole-top mounting, luminous flux 9500 lm, power 84W, IRC ≥ 70

For **acoustic zoning** station five is on a *mixed type area* and the limits for these areas are: day entry of 60 dB(A) and night of 50 dB(A), day emission of 55 dB(A) and night emission of 45 dB(A).

Fig. C8e. station 5 of Parco Dora.

PASSERELLA OLIMPICA

definition of the analyzed area

Passerella Olimpica with its arch is one of the urban architectural symbols of the Olympic Winter Games in Turin and it is part of the Turino Olympic Park, that is the structure created by the City of Turin, the Province, the Piedmont Region and CONI to manage all the systems used for the XX Olympic Winter Games.
The walkway is located in south Turin and consists of a 400m long pedestrian walkway that unites the ex Olympic village with the Lingotto complex. The whole area is part of the **Circoscrizione 8** which includes San Salvario, Cavoretto, Borgo Po, **Nizza Millefonti**, **Lingotto**, **Filadelfia**, in particular the pedestrian walkway is located in the last three sub-zones.
The project of the walkway was carried out by a team led by Hugh Dutton, creator of the arch of support. The construction took place in various phases: the steel plates were first welded into intermediate blocks, these were sent back to Savona by ship and finally joined together directly on site in Turin. The bow was totally raised in September 2005 and the walkway opened to the public in October 2006. The pedestrian bridge is open every day of the week from 6 am to midnight while the restructured area of MOI (Wholesale Fruit and Vegetable Markets) at the basis of the walkway was no longer used.
The analysis area starts from the gardens in front

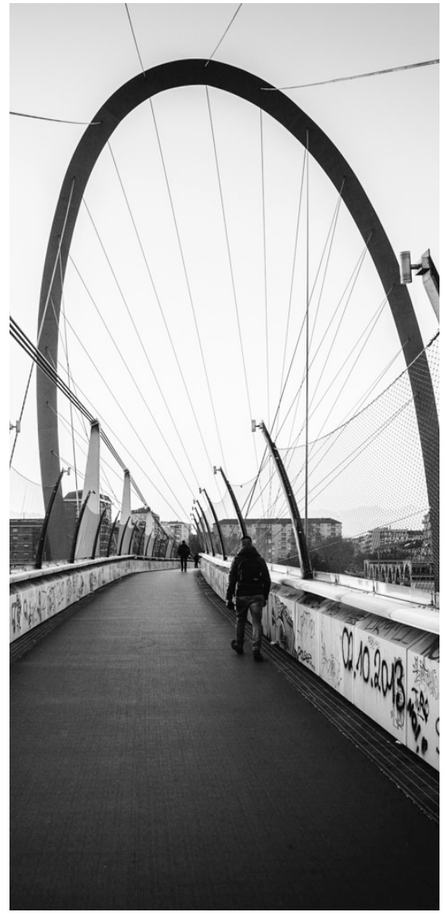
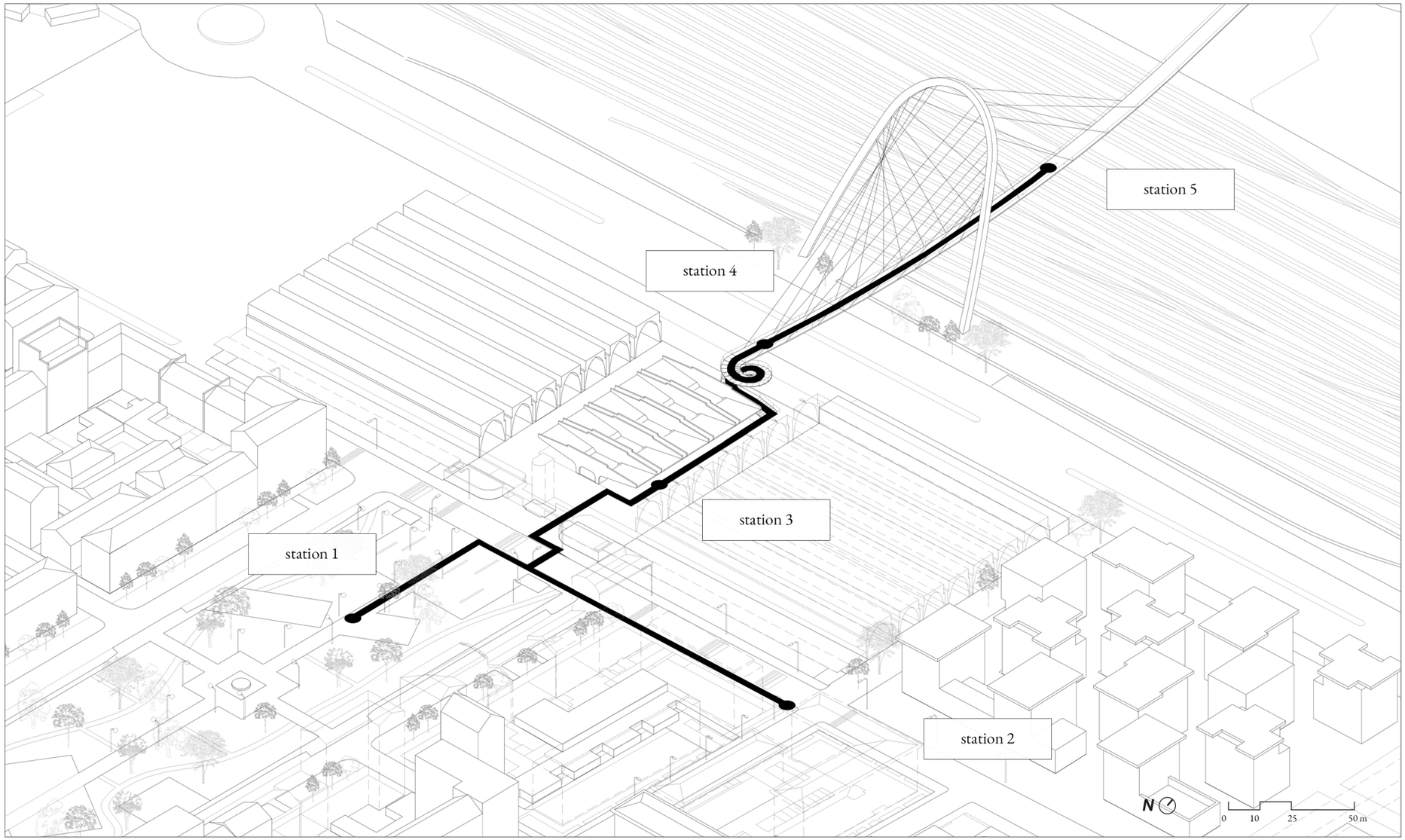


Fig. C9. Passerella Olimpica Area
ikhals - Edoardo Lavagno photo



of the footbridge, Piazza Galimberti, continues south towards the ex-MOI buildings on via Pio VII and finally continues on the walkway, from the internal entrance to the structure up to the 8 Gallery complex of the Lingotto, passing over the railway.

This area was chosen because it is the **center of numerous debates** on the city of Turin, mainly due to the feeling of unsafety deriving from the **occupation of ex-MOI buildings** by immigrants; it was in fact defined as the largest illegal occupation of Europe. In recent years more than 1500 refugees live there and occupied ex-MOI since 2013, in fact it is considered as a city within the city, where commercial activities were born and everyone puts his experience at the disposal of others. (Battistini, 2019) In recent months, evictions have been made of the ex-Moi buildings and the public administration will take care of relocating guests to other facilities already identified by the competent institutions. (Fatto Quotidiano, 2019)

Other reasons for the choice of this area are the **lighting conditions**, in fact the passarella has a lighting system that is partly completely switched off, the **inadequacy of the sound environment** and the **low level of safety** that led to introduction of video cameras in only half path of walkway.

In the following pages, to better investigate the areas of analysis, the open data by the Open Data in 2017 *aperTO* Dataset of the Municipality of Turin have been reported.

Fig. C10. Identification of areas Passerella Olimpica.

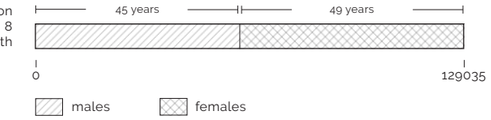


Fig. C11a. population resident in the distric 8 divided by gender with average age.

Fig. C11b. percentage of foreigners in the total population resident in the district 8.

Fig. C11c. foreign residents in the distric 8 divided by gender.

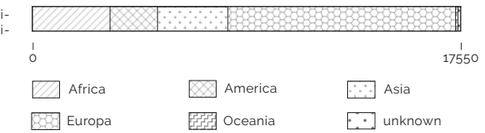


Fig. C11d. foreign residents in the distric 8 divided by nationality.

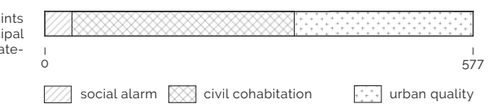


Fig. C11e. complaints of 2017 to the Municipal Police divided by category in district 8.

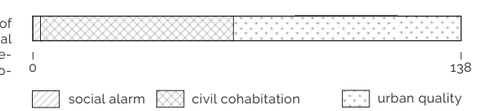


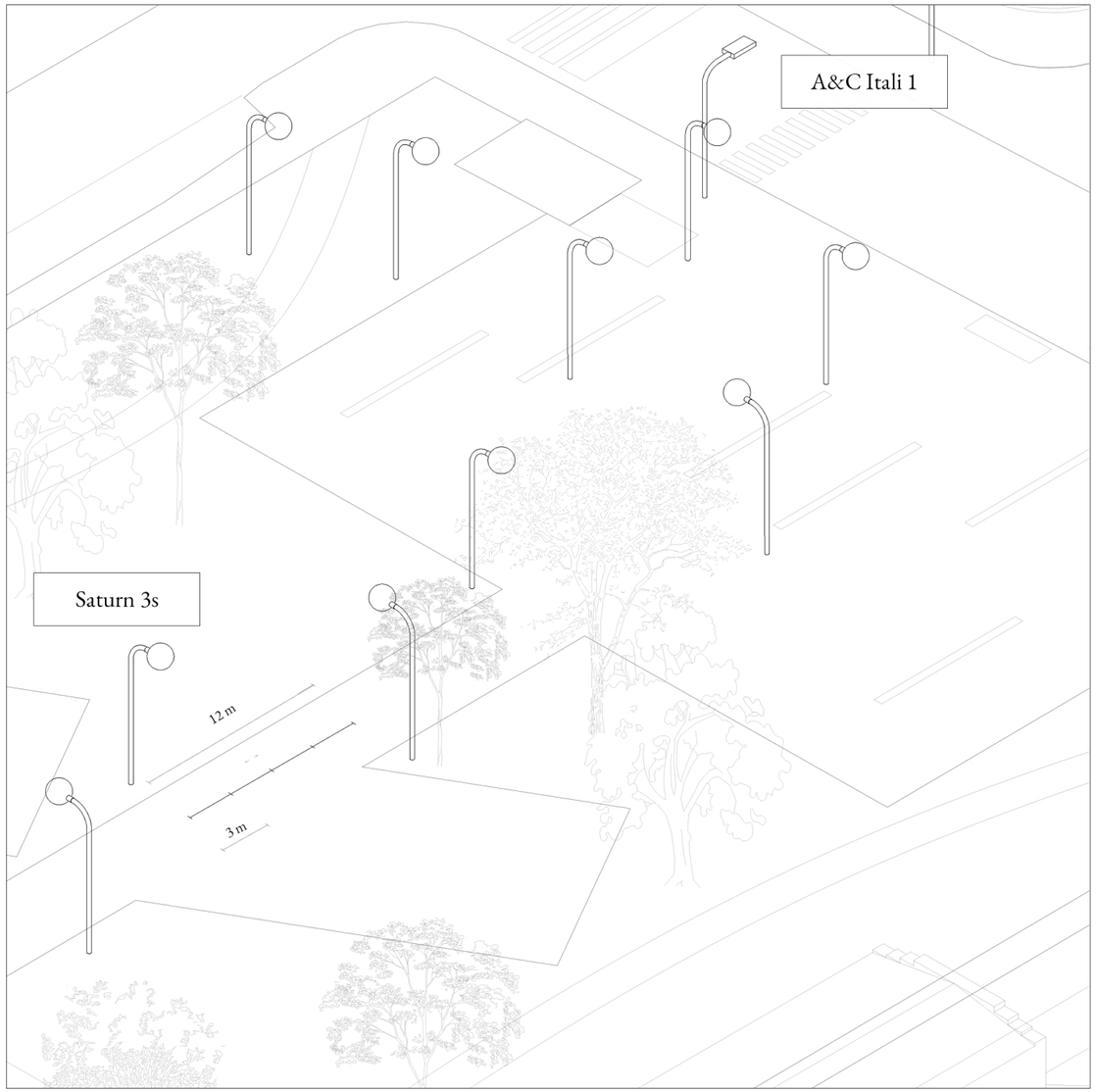
Fig. C11f. complaints of 2017 to the Municipal Police divided by category analyzed microzones of the district 8.

The analysis of the areas was also carried out through the open data by the Open Data in 2017 *aperTO* Dataset of the Municipality of Turin. These data refer to the year 2017 and concern the **demographic data** of the districts analyzed. Specifically, they refer to the resident population of the area divided by gender and age, as we see in FigC11a, or the percentage of foreigners as in FigC11b; the latter are also divided by gender and nationality.

Finally, data relating to **complaints of 2017** to the Municipal Police divided by category and by districts were analyzed.

In the following pages, the lighting and acoustic data relating to the state of affairs for each station in the area are shown.

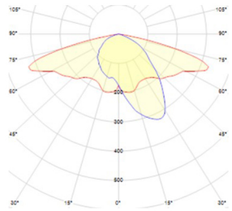
The **acoustic mapping** of the City of Turin is the cartographic representation of the noise levels produced by road infrastructures considering the contribution of private traffic and of public transport. The mapping shows for each districts the estimated levels of noise in daytime (6am - 10pm) and night time (10pm - 6am). The area of Passerella Olimpica in district 8 is defined by high values in areas such as Piazza Galimberti or near the entrance of the Passerella, with values from 60-64 dB(A) to 70-74 dB(A) during the day and lower values during the night, such as 50-54 dB(A) and 55-59 dB(A). Values of 35-39 dB(A) are recorded in certain areas of the ex Olympic village. The **acoustic zoning** divides the territory of Turin into six acoustic classes to attribute the limits based on the use of the territory. The Passerella area is divided between *mixed type* and *intense human activity area*.



PASSERELLA OLIMPICA

station 1

Shreder Saturn 3s



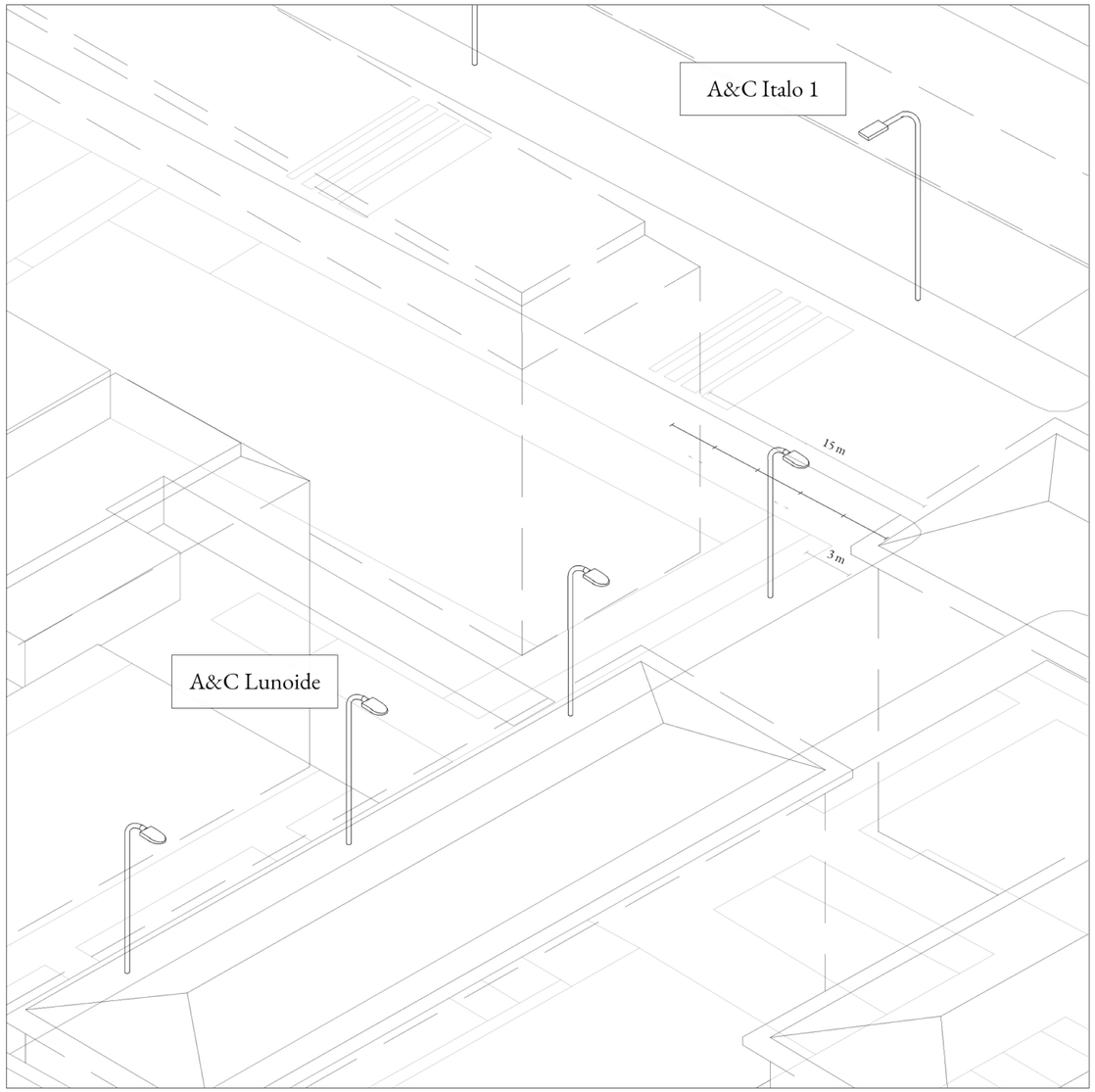
Halide source, diffusing optics, TCC ~ 3000 K, pole-top mounting, luminous flux 9200 lm, power 100W, IRC ≥ 80

A&C Italo 1

LED source, street projector optics, TCC ~ 4000 K, pole-top mounting, luminous flux 7483 lm, power 62.5W, IRC ≥ 70

For **acoustic zoning** station one is on a *mixed type* area and the limits for these areas are: day entry of 60 dB(A) and night of 50 dB(A), day emission of 55 dB(A) and night emission of 45 dB(A).

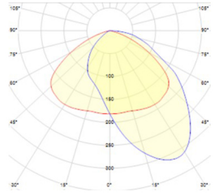
Fig. C12a. station 1 of Passerella Olimpica.



PASSERELLA OLIMPICA

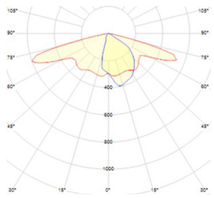
station 2

A&C Lunoide



Halide source, diffusing optics, TCC ~ 3000 K, pole-top mounting, luminous flux 14000 lm, power 150W, IRC ≥ 80

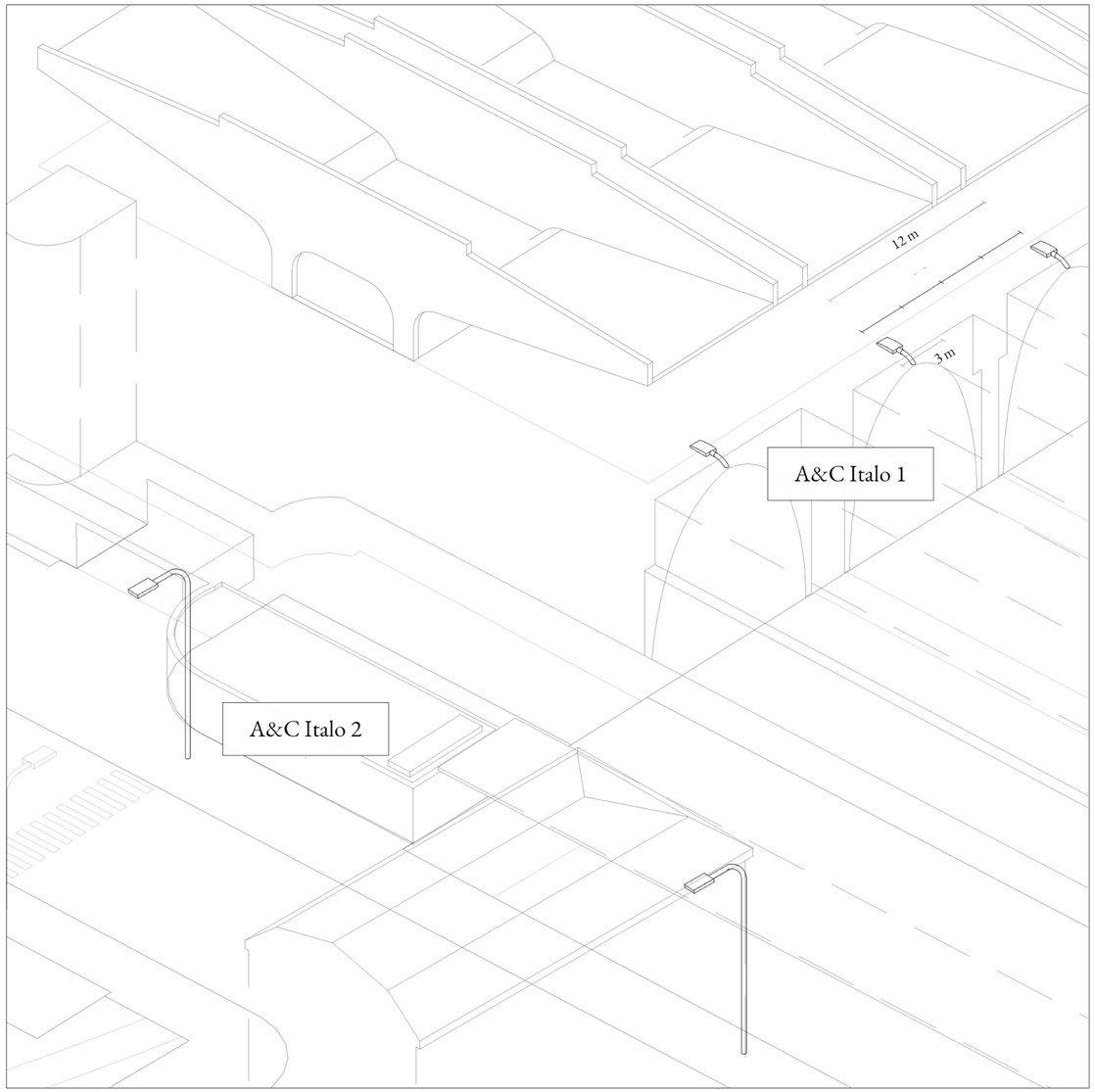
A&C Italo 2



LED source, street projector optics, TCC ~ 4000 K, pole-top mounting, luminous flux 13672 lm, power 126W, IRC ≥ 70

For **acoustic zoning** station two is on a *mixed type* area and the limits for these areas are: day entry of 60 dB(A) and night of 50 dB(A), day emission of 55 dB(A) and night emission of 45 dB(A); but at the same time it borders on a *mainly residential area* and the limits for these areas are: day entry of 55 dB(A) and night of 45 dB(A), day emission of 50 dB(A) and night emission of 40 dB(A).

Fig. C12b. station 2 of Passerella Olimpica.

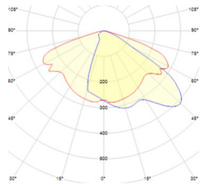


PASSERELLA OLIMPICA

station 3

A&C Italo 2
LED source, street projector optics, TCC ~ 4000 K, pole-top mounting, luminous flux 13672 lm, power 126W, IRC ≥ 70

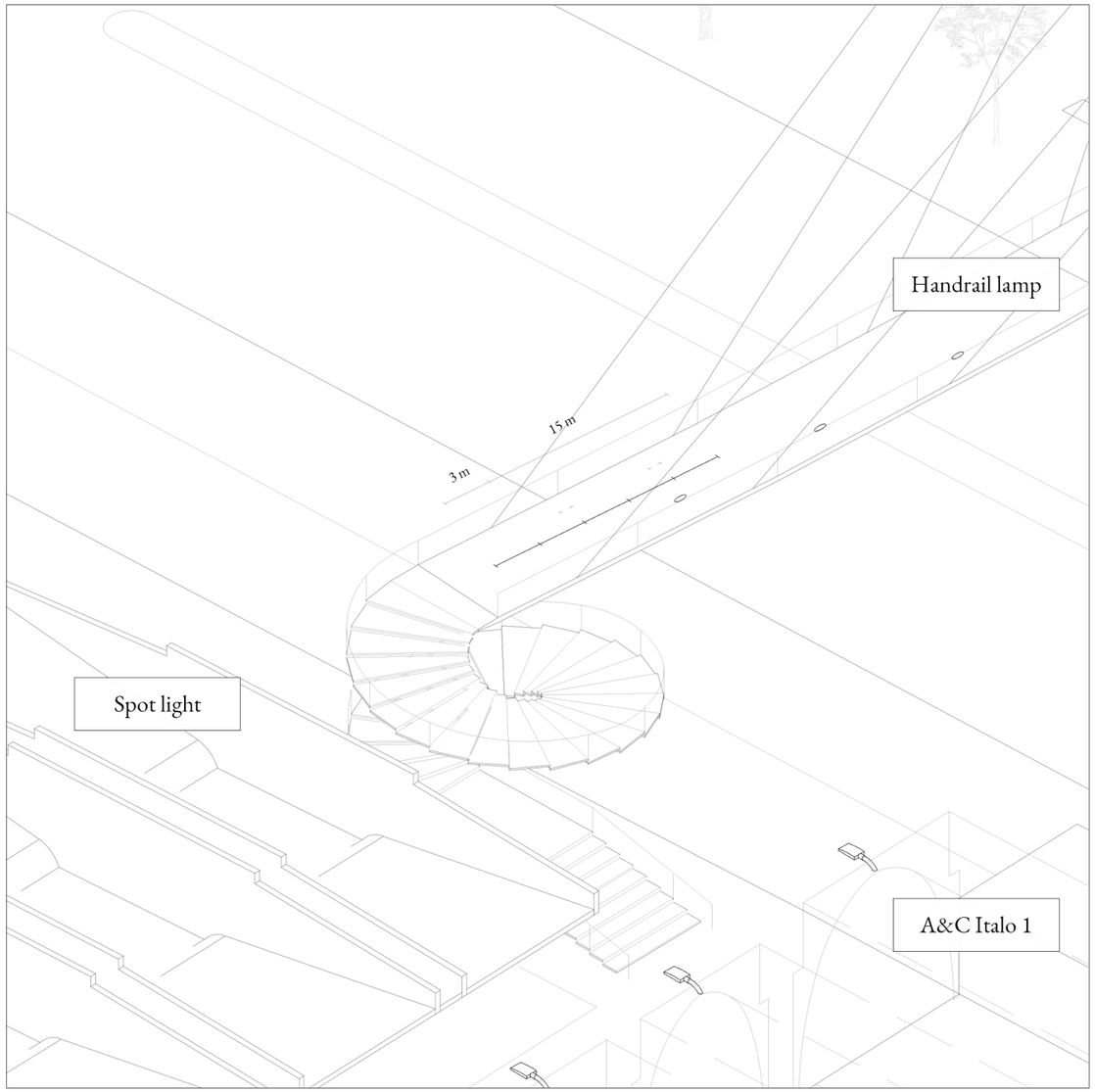
A&C Italo 1



LED source, street projector optics, TCC ~ 4000 K, pole-top mounting, luminous flux 7483 lm, power 62.5W, IRC ≥ 70

For **acoustic zoning** station three is on a *mixed type* area and the limits for these areas are: day entry of 60 dB(A) and night of 50 dB(A), day emission of 55 dB(A) and night emission of 45 dB(A).

Fig. C12c. station 3 of Passerella Olimpica.



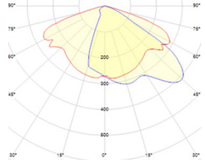
PASSERELLA OLIMPICA

station 4

Spot light
LED source, spot optics, TCC ~ 3000 K, wall mounting, luminous flux n.d., power n.d., IRC n.d.

Handrail lamp
Fluorescent source, washer optics, TCC ~ 5000 K, in handrail mounting, luminous flux n.d., power 14W, IRC n.d.

A&C Italo 1



LED source, street projector optics, TCC ~ 4000 K, pole-top mounting, luminous flux 7483 lm, power 62.5W, IRC ≥ 70

For **acoustic zoning** station four is on a *mixed type* area and the limits for these areas are: day entry of 60 dB(A) and night of 50 dB(A), day emission of 55 dB(A) and night emission of 45 dB(A).

Fig. C12d. station 4 of Passerella Olimpica.

PASSERELLA OLIMPICA

station 5

Handrail lamp
Fluorescent source, washer optics, TCC ~ 5000 K, in handrail mounting, luminous flux n.d., power 14W, IRC n.d.

Simes Slot
Halide source, spot optics, TCC ~ 3000 K, wall mounting, luminous flux 6000 lm, power 70W, IRC ≥ 80

For **acoustic zoning** station five is on an *area of intense human activity* and the limits for these areas are: day entry of 65 dB(A) and night of 55 dB(A), day emission of 60 dB(A) and night emission of 50 dB(A).

Fig. C12e. station 5 of Passerella Olimpica.

SAN SALVARIO

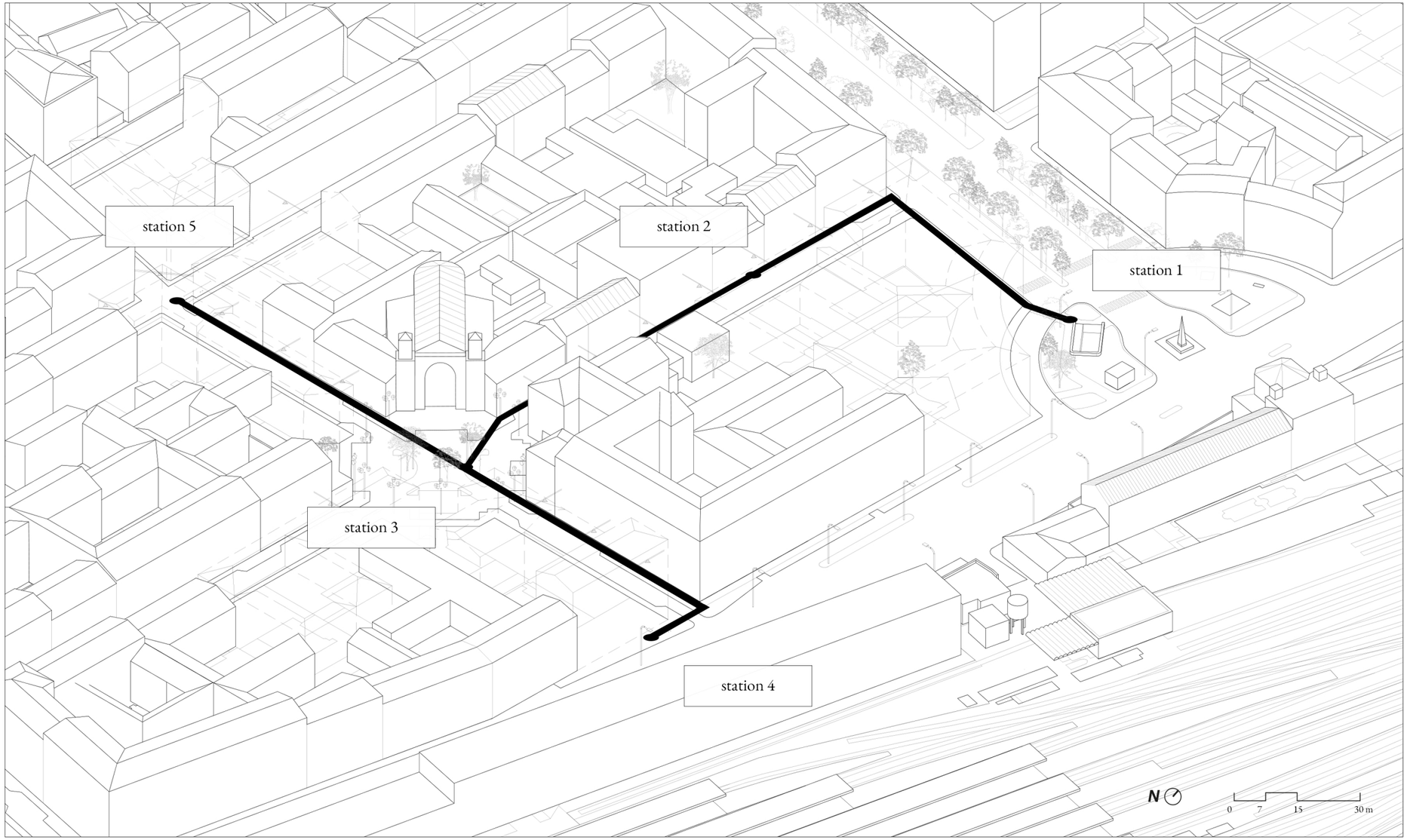
definition of the analyzed area

San Salvario is a historic district located south-east of the historic center, into **Circoscrizione 8** which includes San Salvario, Cavoretto, Borgo Po, Nizza Millefonti, Lingotto, Filadelfia; in particular Largo Saluzzo is located in **San Salvario zone**.

The San Salvario district was born in the second half of the nineteenth century in conjunction with the Porta Nuova railway station and continues to develop until the twentieth century. The building is mainly residential and develops with blocks considered closed, the entire neighborhood has a checkerboard structure. (La Malva, 2012) San Salvario due to its proximity to the Porta Nuova station and to the social transformations derivate to immigration becomes a rich **multi-ethnic** and **multi-cultural neighborhood**; it has an associative reality, in fact there are four religions and their places of worship. Many multi-ethnic socio-cultural associations were born in the neighborhood that were unified into a single non-profit agency for local development called *Casa del Quartiere*.

San Salvario is a very populated district and has a high presence of commercial and craft activities, hotels and restaurants. In general San Salvario, especially in the area of the quadrilateral in analysis, Largo Saluzzo, has aspects of economic, social and cultural liveliness. (La Malva, 2012)

Fig. C13. Parrocchia dei Santi Pietro e Paolo Apostoli, symbol of Largo Saluzzo, an area of Turin nightlife - *mole24 blog*.



The phenomena considered most problematic for the area have been identified in the **nightlife**. In fact, at the end of the 20th century, a lively nightlife developed, especially in the area between Via Madama Cristina and Via Nizza. There are multi-ethnic clubs, pubs, bistros and so on of all kinds and from all ethnic groups. The presence of all these recreational activities has led to **excessive noise**, causing discontent among residents and many users. The city of Turin, Arpa Piemonte, has begun to analyze the situation and the noise monitoring network activated in the area since May 2016 has highlighted a situation of marked criticality. In order to resolve the problem, the City of Turin issued two administrative measures to limit the sale and administration of beverages during the summer of 2017. (Fogola et al, 2018) In reality these solutions were only temporary because they did not achieve the desired results. So the neighborhood is therefore affected by this **bad sound environment** caused by the nightlife and this situation has created a media case and has received many comments on social media, in fact both for this and for noise pollution, it has been chosen as an analysis area. This area starts from the metro stop on Corso Guglielmo Marconi and entirely includes Largo Saluzzo passing through Corso Marconi, via Saluzzo and via Giuseppe Beretti. In the following pages, to better investigate the areas of analysis, the open data by the Open Data in 2017 *aperTO* Dataset of the Municipality of Turin have been reported.

Fig. C14. Identification of areas San Salvario

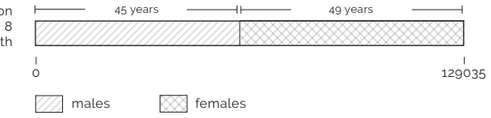


Fig. C15a. population resident in the distric 8 divided by gender with average age.

Fig. C15b. percentage of foreigners in the total population resident in the district 8.

Fig. C15c. foreign residents in the distric 8 divided by gender.

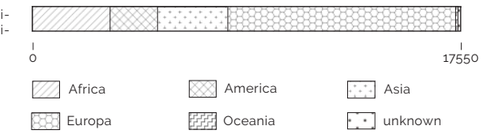


Fig. C15d. foreign residents in the distric 8 divided by nationality.

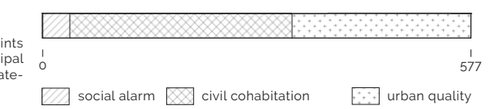


Fig. C15e. complaints of 2017 to the Municipal Police divided by category in district 8.

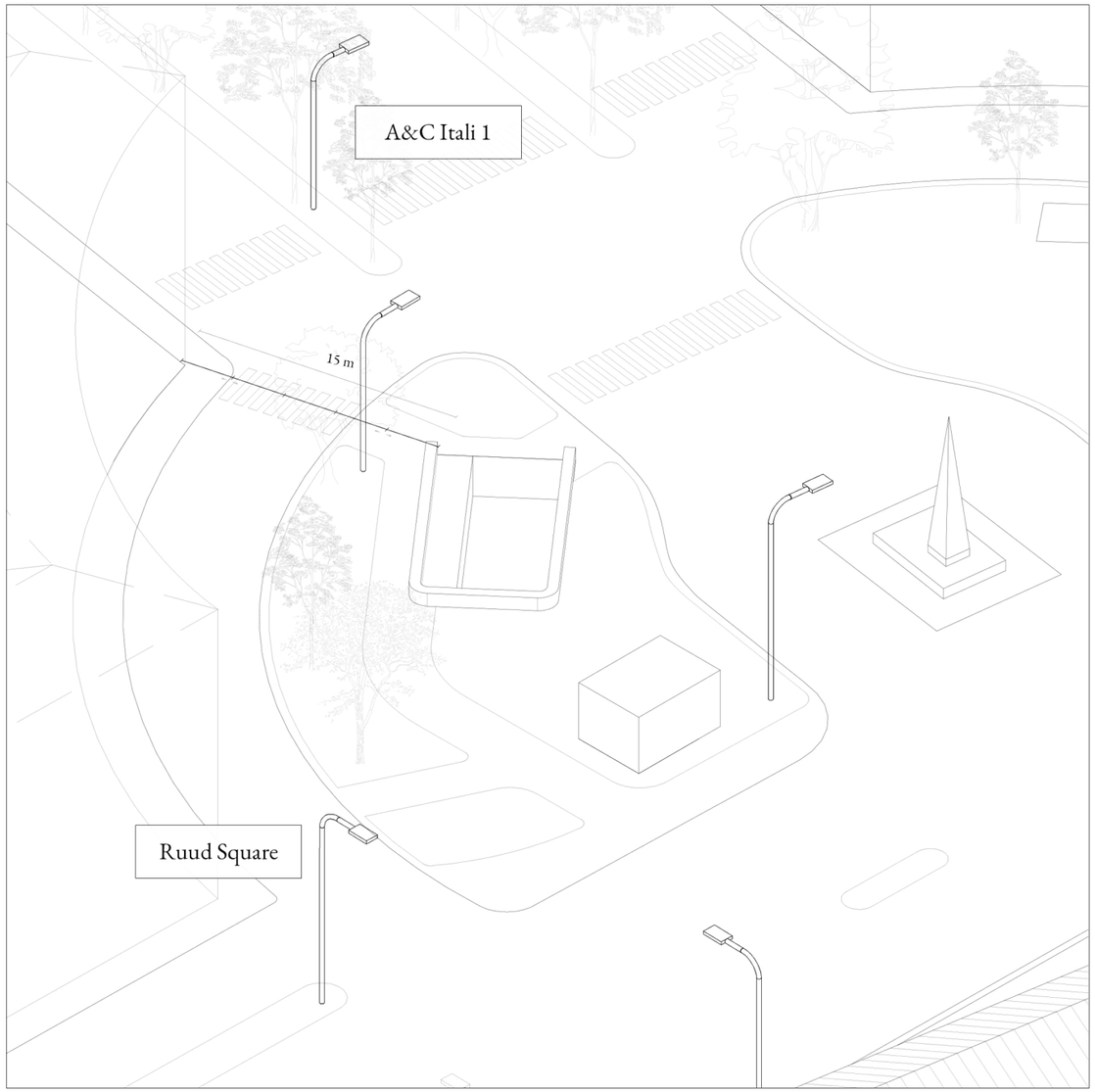
Fig. C15f. complaints of 2017 to the Municipal Police divided by category analyzed microzones of the district 8.

The analysis of the areas was also carried out through the open data by the Open Data in 2017 *aperTO* Dataset of the Municipality of Turin. These data refer to the year 2017 and concern the **demographic data** of the districts analyzed. Specifically, they refer to the resident population of the area divided by gender and age, as we see in FigC15a, or the percentage of foreigners as in FigC15b; the latter are also divided by gender and nationality.

Finally, data relating to **complaints of 2017** to the Municipal Police divided by category and by districts were analyzed.

In the following pages, the lighting and acoustic data relating to the state of affairs for each station in the area are shown.

The **acoustic mapping** of the City of Turin is the cartographic representation of the noise levels produced by road infrastructures considering the contribution of private traffic and of public transport. The mapping shows for each districts the estimated levels of noise in daytime (6am - 10pm) and night time (10pm - 6am). The area of San Salvario in district 8 is defined by high values with values from 60-64 dB(A) to 65-69 dB(A) during the day and the night. Values of 35-39 dB(A) are recorded in the inner areas of the neighborhood courtyards. While in the boundaries, or where there are the main roads, the values are higher with values of 70-74 dB(A). The **acoustic zoning** divides the territory of Turin into six acoustic classes to attribute the limits based on the use of the territory. The San Salvario area is divided between *mixed type area* and *intense human activity area*.

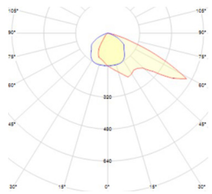


SAN SALVARIO

station 1

A&C Italo 1
LED source, street projector optics, TCC ~ 4000 K, pole-top mounting, luminous flux 8291 lm, power 72 W, IRC ≥ 70

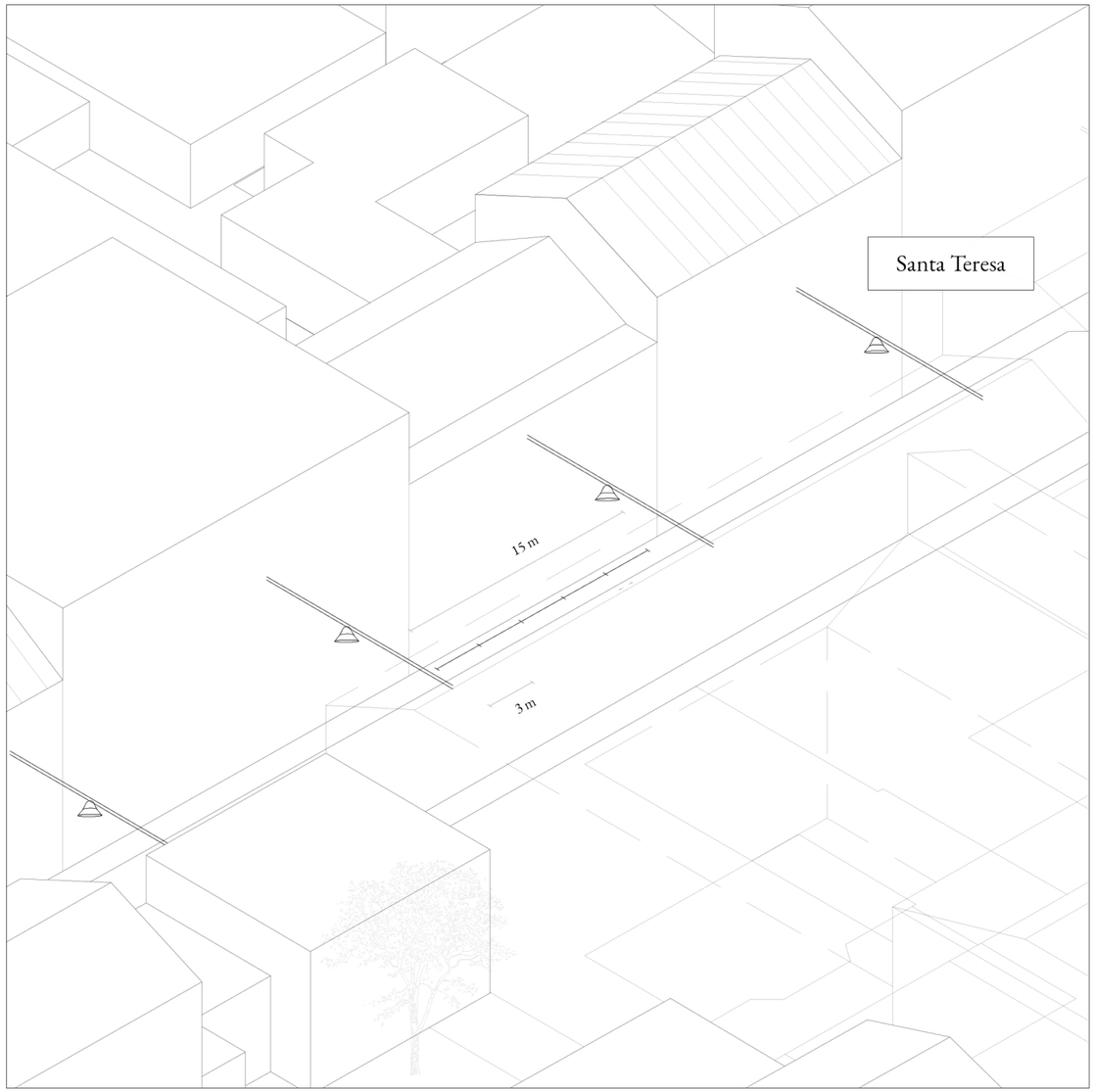
Ruud Square



High pressure sodium source, no optics, TCC ~ 3000 K, pole-top mounting, luminous flux 36000 lm, power 400 W, IRC < 25

For **acoustic zoning** station one is on an *area of intense human activity* and the limits for these areas are: day entry of 65 dB(A) and night of 55 dB(A), day emission of 60 dB(A) and night emission of 50 dB(A).

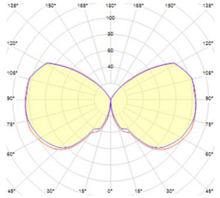
Fig. C16a. station 1 of San Salvario.



SAN SALVARIO

station 2

Santa Teresa



High pressure sodium source, no optics, TCC ~ 2000 K, rope mounting, luminous flux 16500 lm, power 150W, IRC < 25

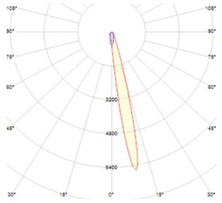
For **acoustic zoning** station two is on an *area of intense human activity* and the limits for these areas are: day entry of 65 dB(A) and night of 55 dB(A), day emission of 60 dB(A) and night emission of 50 dB(A). At the same time it borders on a *mixed type* area and the limits for these areas are: day entry of 60 dB(A) and night of 50 dB(A), day emission of 55 dB(A) and night emission of 45 dB(A).

Fig. C16b. station 2 of San Salvario.

SAN SALVARIO

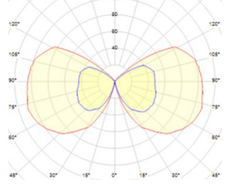
station 3

iGuzzini Lingotto



Halide source, diffusing optics, TCC ~ 3000 K, wall mounting, luminous flux 2800 lm, power 400 W, IRC ≥ 80

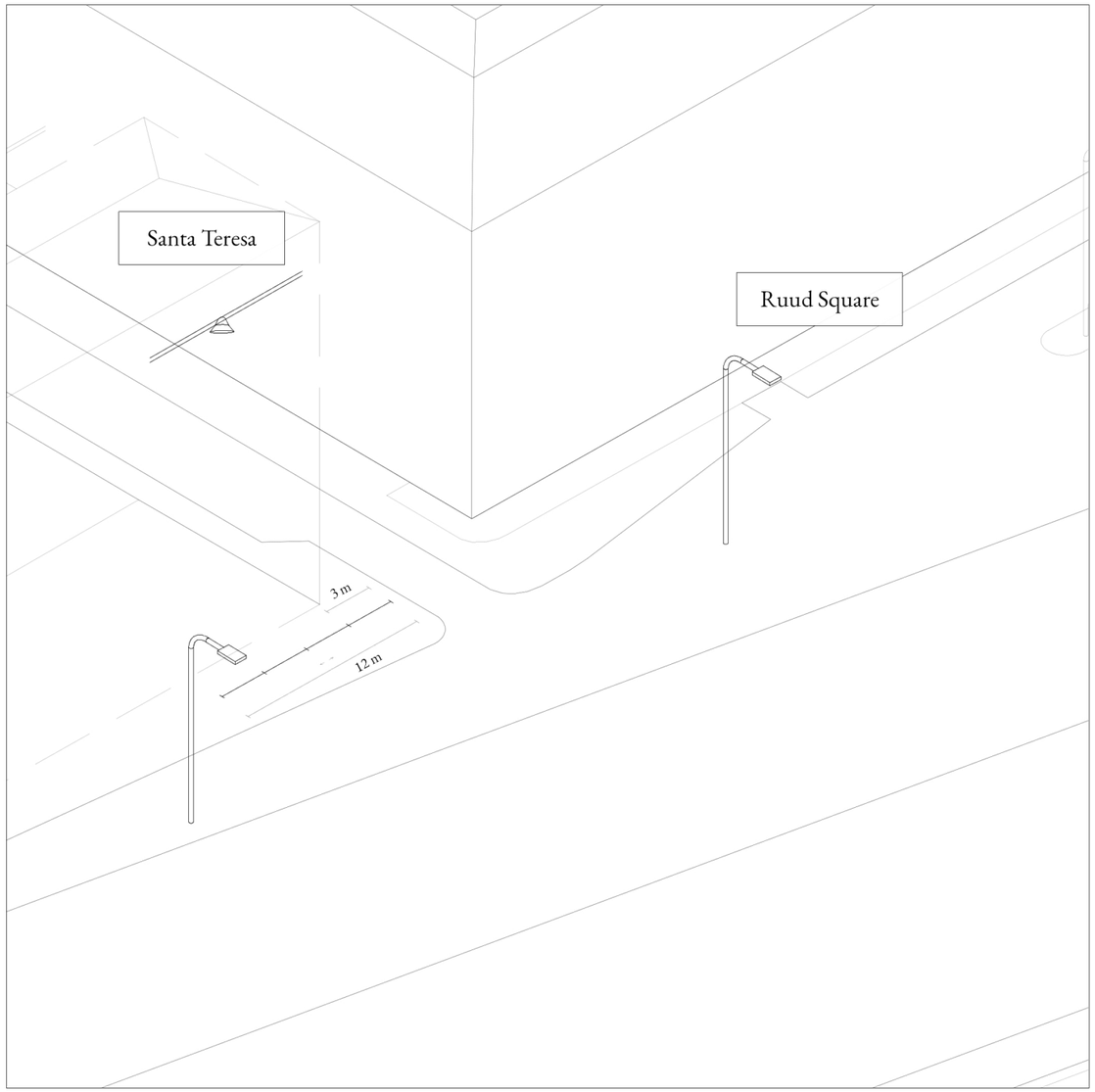
Ex Gas Esagonale



Halide source, no optics, TCC ~ 3000 K, multiple pole-top mounting, luminous flux 6000 lm, power 75 W, IRC ≥ 70

For **acoustic zoning** station three is on an *area of intense human activity* and the limits for these areas are: day entry of 65 dB(A) and night of 55 dB(A), day emission of 60 dB(A) and night emission of 50 dB(A). At the same time it borders on a *mixed type* area and the limits for these areas are: day entry of 60 dB(A) and night of 50 dB(A), day emission of 55 dB(A) and night emission of 45 dB(A).

Fig. C16c. station 3 of San Salvario.



SAN SALVARIO

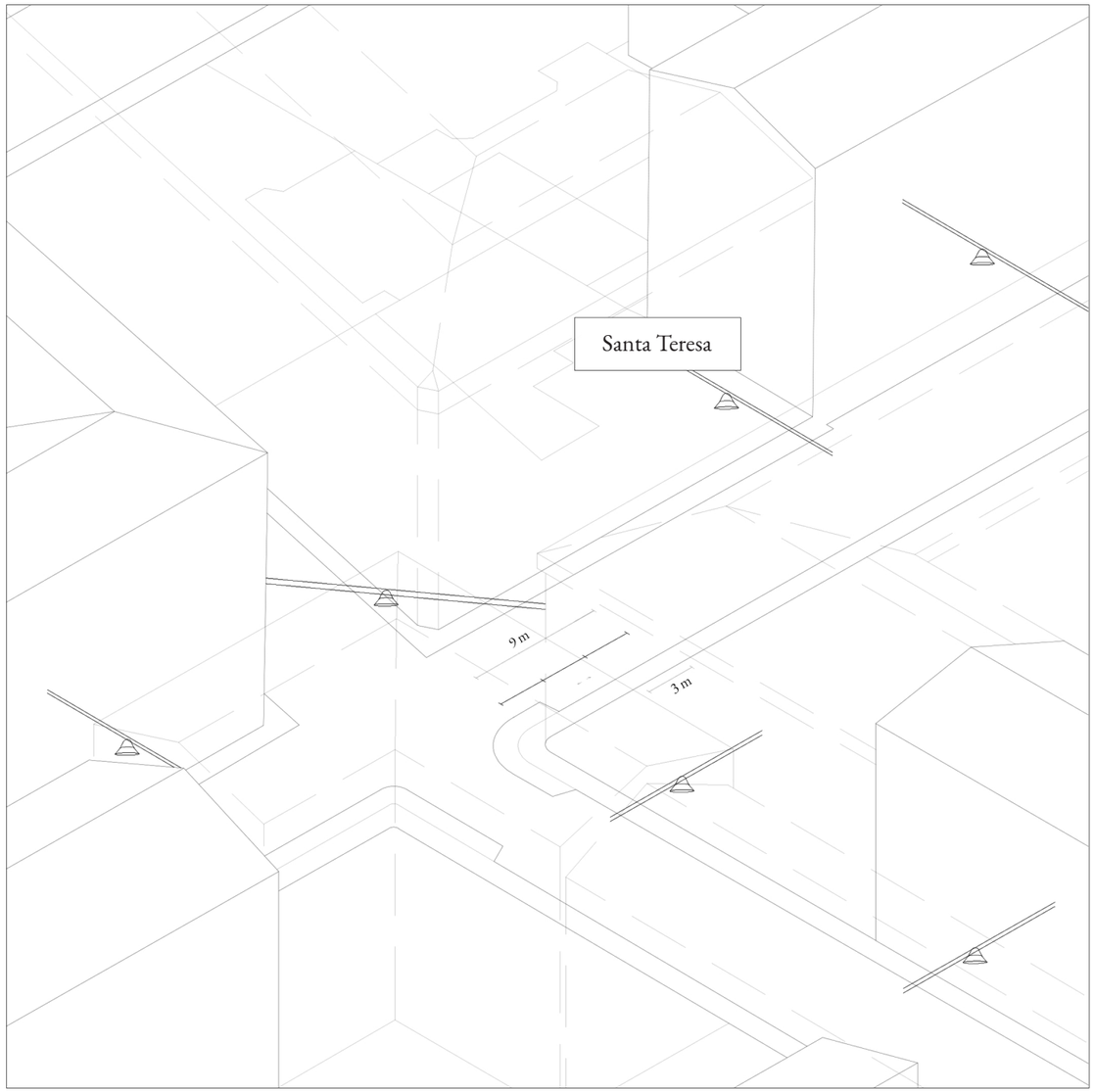
station 4

Santa Teresa
High pressure sodium source, no optics, TCC ~ 2000 K, rope mounting, luminous flux 16500 lm, power 150W, IRC < 25

Ruud Square
High pressure sodium source, no optics, TCC ~ 3000 K, pole-top mounting, luminous flux 36000 lm, power 400 W, IRC < 25

For **acoustic zoning** station four is on an *area of intense human activity* and the limits for these areas are: day entry of 65 dB(A) and night of 55 dB(A), day emission of 60 dB(A) and night emission of 50 dB(A).

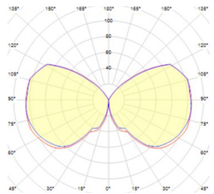
Fig. C16d. station 4 of San Salvario.



SAN SALVARIO

station 5

Santa Teresa



High pressure sodium source, no optics, TCC ~ 2000 K, rope mounting, luminous flux 16500 lm, power 150W, IRC < 25

For **acoustic zoning** station three is on an *mixed type area* and the limits for these areas are: day entry of 60 dB(A) and night of 50 dB(A), day emission of 55 dB(A) and night emission of 45 dB(A).

Fig. C16e. station 5 of San Salvario.

BARRIERA DI MILANO

definition of the analyzed areas: Piazza G. Bottesini and Giardini Montanaro

Barriera di Milano is an ancient district of Turin of the **Circoscrizione 6**. It was built as a proletarian and worker village and its borders are to the south with the Aurora district, to the west with Corso Venezia, to the north and east with the Rebaudengo district. Barriera was founded in 1853 as a cluster of houses and shops and is part of the first town wall. It was created with the aim of ensuring the control of incoming goods, in fact takes its name from one of the gates that allowed entry into the city, called barriere. Circoscrizione 6 includes Barriera di Milano, Regio Parco, Bertolla, Falchera, Rebaudengo, Villaretto; in particular the two places of analysis are located in the sub-area of Barriera Milano: piazza Giovanni Bottesini is located near Corso Novara, in the southern part of Barriera, while the Montanaro Gardens are located on Corso Giulio Cesare, in the northern part of Barriera.
Already in 2014 the areas of San Salvario and Barriera di Milano are associated with the feeling of unsafety and in the area of Barriera there is also a **feeling of abandonment by the authorities**. (Falconieri, 2014) The main problems identified by the community are those of violence and drug. The perception of unsafety increases from 2016 onwards, following the acts of violence in Piazza Bottesini including an assault that becomes murder. (RedazioneTT, 2016) After this event Piazza Bottesini is part of the unsafe areas of Turin and the **issue of security and degradation** put the neighborhood that was trying to redevelop itself in a bad light. (TT Editorial, 2016) The Piazza Bottesini area continues to be the subject of debate, especially on social media, due to all the news spread by the mass media. for this very reason it was chosen as an analysis area. The gardens of Via Montanaro, on the other hand, have always been the subject of debates on security on the part of social media and the mass media, however the main theme is that of the sale of drugs. The most critical area is the one around the ASL in Via Montanaro, including the front gardens. (Redazione TT, 2018) In fact there are numerous **reports of citizens** on the degradation conditions of the area, in particular for the area of the gardens that are right next to a children's playground. (Dardha, 2017) Also this area was chosen for the high media attention and for the numerous mentions on social. Both areas were chosen for a survey on social networks, explained in part B section 10, so no in field measurements were carried out. The areas could therefore be investigations of future research. In the following pages, to better investigate the areas of analysis, the open data by the Open Data in 2017 *aperTO* Dataset of the Municipality of Turin have been reported.

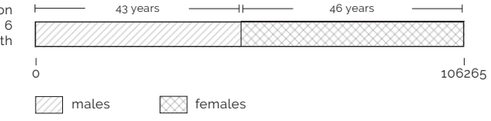


Fig. C17a. population resident in the distric 6 divided by gender with average age.

Fig. C17b. percentage of foreigners in the total population resident in the district 6.

Fig. C17c. foreign residents in the distric 6 divided by gender.

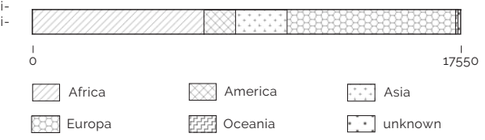


Fig. C17d. foreign residents in the distric 6 divided by nationality.

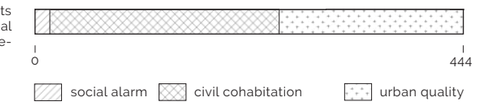


Fig. C17e. complaints of 2017 to the Municipal Police divided by category in district 6.

Fig. C17f. complaints of 2017 to the Municipal Police divided by category analyzed microzones of the district 6.

The analysis of the areas was also carried out through the open data by the Open Data in 2017 *aperTO* Dataset of the Municipality of Turin. These data refer to the year 2017 and concern the **demographic data** of the districts analyzed. Specifically, they refer to the resident population of the area divided by gender and age, as we see in FigC17a, or the percentage of foreigners as in FigC17b; the latter are also divided by gender and nationality.
Finally, data relating to **complaints of 2017** to the Municipal Police divided by category and by districts were analyzed.

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D

SOCIAL MEDIA

SOCIAL MEDIA STRATEGY

the importance of social media and engagement theory for human and social life

Social media revolution

The social networks sites are available to almost everyone in the world and is a eradicated part of the everyday life. Also known as social media, like Facebook, Instagram and Twitter are increasingly popular, especially among young people. The social media are really at the center of the users' everyday life, so much so that the thought of Leadbeater in We Think book is ever more current:

> *"You are what you share. If you are not perplexed, you should be. As the web becomes ever more widespread, infiltrating our lives and shaping what we think is possible, we are increasingly unnerved about what we might have unleashed."*
> (Leadbeater, 2009)

Nowadays, they have definitely bypassed media like television, newspapers or radio, because they have the possibility of getting information to an ever wider audience with relatively low investments. Social networks were born mainly with the intention of keeping in touch old friendships and subsequently also with the intent to create new ones. They based on three perspectives: build public and semi-public profiles, articulate a list of friends who share a connection and view and traverse lists of friends.

(Ahn, 2011) It is possible to share photos, thoughts, sites and much more, for this reason they have become increasingly present.
A brief evolution of the media is useful to retrace their growth reasons. The first social media launched was *classmate.com* in 1995 which was used for educational purposes, especially to keep students in touch after school years. Subsequently many social networks were born, such as *SixDegree.com* in 1997 which was based on the idea that users are united by six degrees of separation, or such as *Cyworld* in 2001, *Friendster* in 2002, *Skyblog* in 2002, *Orkut* in 2004, *Myspace* in 2005, *Yahoo 360* in 2005, *Twitter* in 2006 and *Facebook* in 2006. From 2006 onwards many other social media were born, such as *Instagram* in 2010, *Snapchat* in 2011 or *TikTok* in 2016, in fact now there are more than 100 social media that connect millions of people. (Abu-Shanab et Frehat, 2015)
In particular in recent years, the use of social networks has been the subject of study by an increasing number of researchers, in particular in recent years because they have created new work sectors. The use of social networks is identified with **four indexes**. The first is the **measure of time spent on social media**, while the second is the **average of time of social media login**. The third indicator is **users' profile used to identify their own identity**, while the fourth indicator is the **friends' number on a user profile**. (Abu-Shanab et Frehat, 2015)
It is crucial to understand what drives users to use social networks. Numerous studies have been carried out to understand what are the main reasons for the birth and development of social networks. As explained before one is keeping friendships, but the real reasons are more intrinsic. A study conducted by Kim and Nam show that **individual factors** like age, gender, were less important than **social factors** in motivating usage (Kim et al., 2010). The major motivations are indeed the possibility to access many contents with the minimum cost, the sharing of activities and thoughts with friends and the desire to know new realities of people who are not directly connected to users.
However, it is very important to consider that social networks have not only advantages, in fact in the last few years there is more and more talk about disadvantages such as apparently condtraddictorius **social isolation**, **dependence on social media** and more. The theme that is most debated is the first one: social isolation is related to people's failure to maintain contact with other friends. On the basis of this isolation, however, two conflicting opinions on social media have been identified: in fact on the one hand the social networks provide the possibility of user interactions and wellbeing, on the other hand the social networks reduce face-to-face interaction and increase isolation. (Lampe et al., 2008)
The studies carried out on these issues are therefore conflicting in fact they highlight both the advantages and the disadvantages without giving a positive or negative judgment to the use of social media. According to Abu-Shanab, social networks are an important **source for civil participation**, in fact they have the ability to create groups of people with the same behavior and with the same solution to problems of the community. (Abu-Shanab et Frehat, 2015)
Precisely for this reason social networks were chosen as an integral part of this research: in fact, research through social media gives the possibility of acting on one's own society to face a problem such as the perception of safety, the perception of urban and architectural decay, the acoustic and lighting characteristics or the wellbeing of citizens. All this is enabled because it is important to **build interaction relationships** in social networks, in fact the closeness and quality of personal relationships develop through shared activities and discussion of shared interests. On the other hand the need for these interactions was also theorized by Aristotle in Politics.
He explained that "*Man is by nature a social animal; an individual who is unsocial naturally and not accidentally is either beneath our notice or more than human. Society is something that precedes the individual. Anyone who either cannot lead the common life or is so self-sufficient as not to need to, and therefore does not partake of society, is either a beast or a god*". (Aristotele, 2007)
So it is possible to create these interactions between users of social networks through a good participation strategy, called Social Media Engagement Theory or Strategy.
Before talking about Social Media Engagement Theory it is important to understand what engagement really is.

The definitions and methods explained in *Engagement and human life* chapter refer to the publication *L'arte del coinvolgimento. Emozioni e stimoli per cambiare il mondo* of Vincenzo Idone Cassone and Fabio Viola.

Engagement in human life

Technology puts us in front of too many stimuli, which put users in front of too many choices during all day. This new reality is therefore full of stimuli and choices and has been analyzed through the *Disengagement Theory by of Cumming and Henry*, their initial idea was that it was normal and positive for the elderly to break away from everyday life. This theory in *L'arte del coinvolgimento. Emozioni e stimoli per cambiare il mondo* instead explains how users, faced with too many choices, decide not to choose with consequent inefficiency of stimuli and also argues that increasingly intelligent people reach very high boredom rates because they do not choose too many stimuli. It was precisely in this era that the concept of engagement is very important, it had the task of overcoming the high rate of boredom through new methods, as happens on social networks in which users themselves dedicate their time and their skills to enrich a third-party platform set off. "*From its terminological origins in the Latin language, the dichotomy that accompanies it clearly emerges. The compound verb convolvo presents mainly two different meanings. On the one hand, to wrap ourselves, to envelop, to cover up, on the other to upset*" ("*Sin dalle sue origini terminologiche nella lingua latina, emerge chiaramente la dicotomia che lo accompagna. Il verbo composto convolvo presenta principalmente due accezioni di significato. Da una parte avvolgersi, avviluppare, ricoprire, dall'altra sconvolgere*"). (Idone Cassone and Viola, 2017)

It is possible and positive to think about the design of engagement.It is possible and positive to think about engagement planning, as this is linked to a whole series of changes in habit, increase in motivation, ability to achieve goals, tolerance of stress etc; precisely for this reason it is important to design and study engagement. In fact the engagement can make a person change their behavior, without any obvious motivation, simply involving person in an activity or product or subject. The attention threshold, known as *sustained attention*, is an individual's ability to stay focused on content, people or objects; this concept shows the inability of the mind to maintain the same level of attention for a long period of time. Based on this, numerous studies have been carried out and have shown how men perform behaviors that activate the reward circuit. According to Cassone and Viola, the engagement manifests itself in **different forms**: attraction, interaction and experience. The first, **attraction**, is linked to the aesthetic aspect, such as a particular graphic, and has the goal of stimulating the human senses. The second, **interaction**, is based on a special relationship or an interaction with an object or situation, while the third, **experience**, is when involvement occurs with something that causes reflection or memory.

Engagement also occurs through repeated actions or habits, in fact it is called *Circular Engagement or Engagement Loop* and it is the possibility to repeat the same actions over and over again in a scheme that adds rewards and unforeseen. *The Moar! scheme* should serve to indicate the structure of an efficient engagement loop. It is based on a sequence of repeating elements: Motivation, Occasion, Action and Answer. The **motivation** is at the base of the scheme because it serves precisely to motivate a person to undertake the activity, while the **occasion** is the suitable condition to undertake the activity, that is the right moment. The **action** on the other hand is the act itself, or the undertaken action and usually the actions are repeated over and over again; finally the **answer** is an immediate feedback after the action. This cycle of actions seems to be based on simple actions but in reality it is very engaging. However, engagement is not always the same because it depends on the age group, personal experiences, social context and much more; for this reason an *Engagement Framework* is defined consisting of development, sustained and retrospective. The **development engagement** is the first phase where there is the surprise effect, the novelty, the attraction. When this phase creates a stable engagement then turns into **sustained engagement**, a phase in which boredom can take over. Finally there is **retrospective engagement**, that is when habits disappear and therefore involvement remains in memories and experiences.

Engagement is therefore one of the key points of our society and, according to Cassone and Viola, it is also based on **reward systems** and on the **social context**, ie competition and collaboration with others. Important concepts for a good engagement mechanism are the possibility of **participation** and **personalization**. The concept of engagement is important for this research because one of the research part consist into involving the citizens and visitors of the city of Turin, first of all for the on-site survey and secondly for interaction on social media and for the social survey.

The social media created for the research can be found on the Facebook platform with the **Walk Safe Project profile** (@walksafeproject) and on the Instagram platform with the **walksafeproject profile** (@walksafeproject).

FACEBOOK
https://www.facebook.com/WalkSafeProject/
INSTAGRAM
https://www.instagram.com/walksafeproject/

Engagement in social media life

After understanding how the engagement mechanisms work within human life, we can understand how these work within social media. Social Engagement is the participation of an individual within a **social community**. The objective is to capture the interest of the curious and the users, stimulate their involvement with questions, listen to their answers and needs in order to orient the activities towards the requests of the public. It is a theory that develops mainly for web marketing by companies. So it is essential to know what factors shape user engagement in social media, in fact numerous studies have been carried out in this regard, for example Di Gangi et al have developed the *Social Media Engagement Theory* (SMET). (Di Ganci and Wasko, 2016) This research is developed based on the user's experience, in order to understand the social interactions between users and the technical characteristics of social media, so it is possible to influence user involvement.

The research model of this SMET theory is based on **Social Interactions** and **Technical Features**, the first is formed by personalization, access to social resources, critical mass, risk and transparency, while the second is formed by completeness, flexibility, evolvability and integration. These two influence individual involvement and personal meaning, which are part of *User Engagement*. Thus user engagement is influenced by technical features and social interactions, in addition to these two depends on variables such as age, gender, habit, expertise and tenure and also on frequency of use.

According to Deterding, Dixon and Khaled, there are many **gamification strategies** that are used by social networks to engage people. Relatively quickly, it was assisted to development in field of human-computer interaction with product like serious game, pervasive games, playful design, and alternative reality. We call gamification "*the idea of using game design elements in non-game contexts to motivate and increase user activity and retention has rapidly gained traction in interaction design and digital marketing*". (Deterding, Dixon, Khaled and Nacke, 2011) It presents many of the socio-technical structures that has based social media sites. Firstly, they represent both a limited environmental space in which people can socially interact from each other, secondly, they are both designed by a developer that made choices and build an artificial environment in which the user can move inside certain borders.

One of the functional tactics at the base of social media is called by Wash and Lampe the **power of ask theory**. (Wash and Lampe, 2012) Most

of social media are based on users-generated contents that everyone upload on platform. They suggest that the attention of the people is more vivid asking them to contribute in first person producing contents for the site. This asking of interaction is typical of gamification tools.
Based on all these features the research used surveys, where it was requested to provide information on the use of social media in the last two weeks, to understand which of the features are most influential. The research shows that the greatest engagement is given by users who make greater social interaction with other users and by actions that keep an active audience. (Di Ganci and Wasko, 2016)
On the basis of these theories have been developed **engagement strategies** for Facebook and Instagram platform with two different public profile. In fact the social media created for the research are **Walk Safe Project facebook profile** (@walksafeproject) and **walksafeproject instagram profile** (@walksafeproject) as mentioned before. All the strategies used within the social channels are based on one of **authenticity strategy**, in fact the research wants to present itself in a direct and transparent way. It is very important for us to have an open communication process set at the same level as the citizens, or to really create a dialogue that is natural and genuine. To get this result, we have adopted various methods, such as sharing content created directly by us or sharing the process of our work. The presentation of the work process or the publication of the results are combined with strategies of **direct mention** or **social mention**, that is trying to involve the interested users, also through questions in the posts
Sharing of the chosen contents, as seen in the detailed part of Facebook and Instagram, has a different contents, such as the creation of ironic or funny posts, through a strategy of **playfulness or play-like approach** and the consequent production of **shareable content**, but also of educational and informative posts.
Another strategy used, especially in the Facebook social network, is the sharing of all the city groups concerning the areas we have analyzed: this follows an analysis based on **local geotargeting**, that is designed to target an audience within a specific area.
The strategies used are multiple, as indicated below, such as **newsjacking**, ie creating content based on relevant temporal events, or using color in posts or in creating the logo.

Colors design in social media

The theme of color was very important, always with a view to designing the social pages of the research. This is because the research has tried to make itself recognizable also through the right design of color and logo, as we will see in the final part D. Color is a very studied topic, starting from the world of art as studied by Goethe in 1810 in his book *The theory of colors* up to the new era of virtual design. An in-depth study of color and how color has changed the way we see the world is that of Fancinelli in the book *Cromorama*, in fact he claims that: "*In today's society, therefore, color is not just a sensation or a mere attribute of things. Color is often an idea or an expectation.*" ("*Nella società attuale dunque il colore non è solo una sensazione né un mero attributo delle cose. Il colore è spesso un'idea o un'aspettativa.*") (Falcinelli, 2017)
In fact, to explain this concept he speaks of the pencil that is identified with the yellow color, although obviously there are multiple colors of pencils. The yellow pencil is an example of how color is an archetype or a mental process, as seen in part A section 5. The reasoning of Falcinelli therefore associates the color to an object and to the idea of that object, in fact "*the chromatic imaginary is constructed: making an object of a certain color - a choice among so many possibilities - may or may not meet the public's consent; but if it meets it, it begins to live in our imagination, until, within a few decades, that color becomes a category with which we judge everything else. Like the yellow of a pencil. It is that particular color that makes it an archetype [...]*" ("*si costruisce l'immaginario cromatico: fare un oggetto di un certo colore - una scelta fra tante possibili- può incontrare o meno il consenso del pubblico; ma se lo incontra, inizia a vivere nella nostra fantasia, finché, nel giro di qualche decennio, quel colore diventa una categoria con cui giudichiamo tutto il resto. Come il giallo di una matita. È quella particolare tinta che ne fa un archetipo [...]*") (Falcinelli, 2017)
According to Falcinelli all this is possible mainly because of the mass society in which we find ourselves, in fact just for this the solid color is preferred over the colors full of variations. We are more pleased with something obvious and clear to interpret as the solid color, or "*the uniform appearance of a surface in which we recognize the same color in every point*." ("*l'aspetto uniforme di una superficie in cui riconosciamo lo stesso colore in ogni suo punto.*") (Falcinelli, 2017)
Modernity is therefore marked by uniform colors, contrary to Expressionism or Renaissance.
In his work Falcinelli wants to explain that color has become a **means of information** and that it is even possible to compare it to maps. This is because it is able to convey an **adjective**, such as blue combined with the adjective *expensive* because in the renaissance the color blue overseas did not have the same price as the others and therefore consequently in our days it is associated with nobility. Or the color is combined with the **perception** of a certain temperature, such as red for hot and blue for cold.
All these researches in the past show that every age has its own perception of color and that the ideas and feelings present in our age allow us to identify and associate millions of colors with our mental processes, thus creating **our own perception of color**. "*Color is now a filter with which we think of reality*" ("*Il colore è adesso un filtro attraverso il quale pensiamo alla realtà*") says Falcinelli and it is therefore important to understand how to use this filter for the benefit of the topic of this research, such as for example a correct perception of the research logo as seen in section 19 or through proper urban planning.

WALK SAFE PROJECT

Walk Safe Project as social media project

Walk Safe Project is an interdisciplinary research work that had positive results through social channels. It was initially born as a social media project through the Facebook and Instagram platforms. As explained in the initial paragraphs of this thesis this interdisciplinary project

> *"analyzed the perception of safety related to the conditions of light, sound and urban and architectural decay of places considered particularly critical of the City of Turin."*

The goal of this social research are focused on the subjective aspects of safety, based on the perception of noise disturbance, urban light quality and urban and architectural decay. This is important in order to put the citizen at the center of urban decisions that are based on objective and subjective aspects. The project also aims to raise awareness of urban security and of perception of safety; in fact social media channels have been chosen precisely to reach the largest possible number of citizens and users of the city of Turin. The research was considered worthy by the city of Turin and it is sponsored by the **City of Turin**, the **Polytechnic of Turin**, **Iren S.p.A.**, the **Italian Lighting Association AIDI**, the **Circumscriptions** 5, 6, 7 and 8 of the City of Turin and it is supported by the **Italian Association of Acoustics AIA**.

SEMIOTICS ANALYSIS OF WALK SAFE PROJECT

the design of Walk Safe Project logo

As it was explained in the engagement chapter, the first form of engagement is the attraction and it is linked to the aesthetic aspect. It is interesting analyzing how, in order to set this process in motion, a brand identity has been developed, passing also through graphic.
It is so important to understand what a logo really is and why it is so important to identify a project. According to C.L. Morgan:

> *"the logo represents the graphic foundation of a company and, together with the name itself, expresses its intrinsic value. Try to say 'International Business Machines' and few people will understand what you are talking about. Say IBM and everyone will understand you whatever your language."* (C.L. Morgan, 2000)

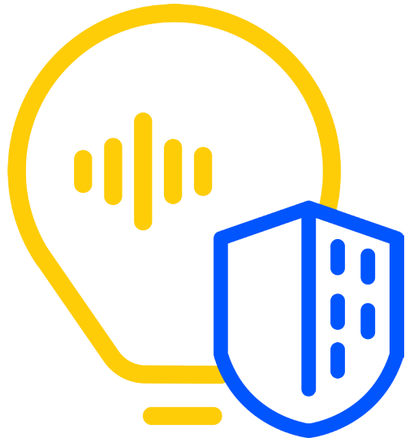
The logo is therefore important to define the identity of a company, a project, an activity.
According to Olins

> *"the identity of the corporation must be so clear that is becomes the yardstick against which its products, dehaviour and actions are measured. This means that identity cannot simply be a slogan, a collection of phrases: it must be visible, tangible and all-embracing. Everything that the organization does must be an affirmation of its identity."* (Olins, 1989)

The design of a logo must have predefined parts, defined by Olins as *products*, *building*, *communication material* and *behaves*. (Olins, 1989) The product is the part of the logo that communicates the actual heart of the project, buildings is the localization of the project, communication material consists in "*quality and character that accurately and honestly reflect the whole organization and aims*", finally behaves is the possibility to include customers.

The **Walk Safe Project logo** was also designed based on Olins and Morgan research. The logo is formed by several elements, some of that explicitly recognizable and others implicit. Two main forms compose the scene: an **incandescent light bulb** with **sound waves** as tungsten filament, and a **shield** form in front of the first one. Inside the latter one line could evoque tower apartment building with some windows illuminated.

Unlike the Instagram logo for example, the **colors** used are discreet and not shaded in order to emphasize the professionalism of the communication campaign, differently the playfulness of the previous cited platform logo. The yellow of the lamp is the color of attention, mental activity but, more obviously, also related of light itself. To underline the medesim importance that sound and light have for the research, that together represent the totality of the environmental condition analyzed, the same yellow is used for both the concept. For the shield was decided the blue ocean that suggests institutional communication but also the health and peace concept, strength and affidability. In its totality



the logo is not bordered by a geometric shape because the will not to link research to a specific context of influence, which by itself nature borned to the idea to be scalable to different contexts and realities. The name is composed by two item. The fist one, walk, bring in the identity of people in motion, the implicit image of subject in walking action, that is also the target of the project. Apart from this, safe is the adjective associated to the first word which denounces in its completion the ultimate goal of the walker aspiration, i.e. walking safe. In the completeness of its name, the research stands as the auxiliary figure of the helper that supports the positive action indicated above. From what has been explained before, it come the project's desire to present itself in a professional way of a contact figure between people who want to walk the city during nighttime, helping them to reach the safety goal.

Fig. D1. Walk Safe Project Logo

FACEBOOK ENGAGEMENT

engagement methodology for Facebook platform: Walk Safe Project profile @walksafeproject

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The presence of Facebook social media has become increasingly important in recent years. Numerous studies have been carried out to effectively understand the *Facebook phenomenon* and it has been estimated that almost all age groups under the age of fifty regularly access Facebook several times a day and spend between ten minutes to three hours a day. Positive association or negative association have been identified for each activity carried out on Facebook: for example, for the FB Friends activity, there are Social Connectedness as a positive association, while Self-Esteem is a negative association.

The principal aim of Facebook is to maintain old friendships and make new ones, as the founder Mark Zuckerberg states, against accusations of social isolation mentioned before:

> *"Facebook has not replaced real relationships, but added opportunities to stay in touch that otherwise would not exist."*

Another goal of social networks like Facebook is the enhancement of everyday life and the possibility of overcoming the boundary between private sphere and public sphere. In particular Facebook allows different **types of actions**: it is possible to enter and acquire information on others, interact through private chats or through public messages on the wall, creating groups

and public pages. So every user in Facebook is a subject that interacts with others, in fact facebook has a **basic narrative scheme** that starts from the narrative program of the *Global Intimacy/Sociality*, that activates a strategy of enunciation of second level *Interest/Reserve*, within which the narrative program of the enunciated enunciated *Normality/Otherness* is developed and each phase of *Competence and Performance* of the previous level is realized in the activation of the next level. This procedure is a recurrence in addiction regimes that are in turn dependent on the overall narrative scheme. (Ghidoli, 2010) Based on the engagement proposed by numerous studies, this research has opened a Facebook page called Walk Safe Project (@walksafeproject).

"*A Facebook page is a central 'hub' for a business or non-profit organization to establish a social media presence on Facebook. It's basically like having a web page or web site of your own, but "within" Facebook, and following its format.*" (Kelsey, 2017) The page created for the search was identified as *Site related to the education sector* and was created on 1 October 2018 with the mission *Help us make Turin safe!*. First of all a small explanation of the research was inserted and the basic graphics were loaded, that is the logo of the research as a profile picture and the cover. Subsequently, the engagement strategies for post creation were adopted. All the choices made for the management of social media concern an **authenticity strategy**, or the research wants to propose itself directly and transparently.

The goal of the Facebook page is to communicate with the citizens and visitors of the city of Turin, but above all to inform them about the topics of urban safety, lighting, sound and decay conditions. In order to do this, posts were scheduled during the week, based on favorable days and time for publication. The best times to post to Facebook in 2018 are **Wednesday at 11 a.m.** and **1 p.m** and this is the best day to post on Facebook. So for the day on Wednesday the posts with the most important contents were reserved, that is those that concerned the information of urban safety, light, sound and decay. The safest times to post are **weekdays from 9 a.m. to 3 p.m**, so for the weekends the posts with lighter content were reserved, such as **short videos** summarizing the progress of the week or some sound and light graphics. **Sunday** has the least effort possible for Facebook during the week, so for the Sunday were chosen **funny posts**, such as a collection of historical photographs with the theme of **walking safely** which includes the photo *Walking safely even on bottles* depicting Bianca Passarge disguised as cat dancing on some wine bottles. These data are general for a Facebook users, in fact the data relating to the best times to post on Facebook for education and to the best times to post on Facebook for media have also been chosen. Some days and some times coincide, that is Wednesday at 11 a.m. while Thursday at 5 p.m. and Friday at 11 a.m. are added. So the weekly contents published on the facebook page included an **informative** post on environmental conditions, a **goal achieved during the week** such as a sponsorship or a conference, a **funny post** and a **summary video**. For each of these posts the graphics and the caption have been carefully chosen while users were involved through surveys or short questions. Another way to engage users was sharing posts on the numerous **social groups** related to the topics studied by the research; while during the period of the social survey, for the publication of the Facebook page and the link to the questionnaire, teaser cards were distributed with a direct link to the page or to the social survey.

The Facebook page has not grown considerably, but sharing on other groups the search obtained numerous comments and numerous likes. In conclusion it is possible to affirm that the greatest involvement took place in those groups where the posts were re-share because many users were waiting for the re-sharing of the Walk Safe Project posts, as stated by some users. So we can therefore say that there is a **small virtual community** interested in research.

INSTAGRAM ENGAGEMENT

engagement methodology for Instagram platform: walksafeproject profile
@walksafeproject

Instagram is a social network like Facebook or Google Plus, but unlike those, it focuses on photos, in fact it is called *photographic social network* and only photos, videos and stories can be published. The increasing use of Instagram has occurred in recent years, mainly following the acquisition of the social media by Mark Zuckerberg, CEO of Facebook. Following this acquisition and the changes made, Instagram has become one of the most used social networks; It is even estimated that in the last year Instagram is more used than Facebook and that the latter has had a down. This is also because recent social media focus much more on visual communication.

> *"The intensified production and consumption of images by the digital public has been followed by an increased interest in and utilization of visual content in corporate social media communications."*
> (Valentini, 2018)

Most of the studies conducted on the Instagram platform mainly concern the analysis of the engagement of a sports brand or a musical band. The first research on digital engagement has identified that to increase *likeability* the main factors are first of all specific of the content, of the proposed and specific media of the person. (Valentini, 2018)

Based on the engagement proposed by these studies, this research has opened a Instagram account called walksafeproject (@walksafeproject). The account created for the search was identified as *Scientific Website* and was created on 1 October 2018. First of all, a small biography with the main information that are place, short sentence explaining the search and link to the Facebook page, was inserted and the basic graphics were loaded, that is the logo of the research as a profile picture. Subsequently, the engagement strategies for post creation were adopted. In this case, unlike Facebook, the goal is mainly to make the research known and, secondly, to forward the link to the social survey; this is because creating a virtual community on Instagram is not as simple as on the Facebook platform. In fact, while for the Walk Safe Project page on Facebook there is a small virtual community interested in research, on the Instagram account there are followers of the page.

Even in this case though posts were scheduled during the week, based on favorable days and time for publication. Best times to post on Instagram are **Wednesday at 11 a.m.** and **Friday at 10** or **11 a.m** and Wednesday is the overall best day to post to Instagram. **Tuesday through Friday 10 a.m to 3 p.m** instead is the most consistent engagement, while **Sunday** is the worst day and receives the least amount of engagement on Instagram. Based on these days and these times, posts have been assigned, as was the case for Facebook and for each of these posts the graphics, the caption and the hashtag have been carefully chosen. Also in this case teaser cards were distributed with a direct link to the Instagram account and the social survey. So the weekly contents published on the Instagram page included an **informative post** on environmental conditions, a **funny post** and a series of **funny** or **catchy graphics** to keep the profile always active.

The instagram page has not grown considerably, but it was an excellent resource for sharing the social survey, in fact many answers come from the instagram link.

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E

RESULTS AND EVIDENCES

RESULTS

objective and subjective environmental analysis

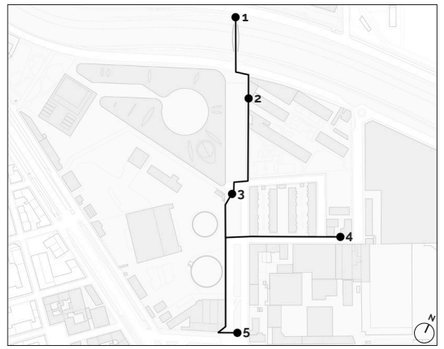
In this section was reported the results related to data analysis, mentioned in part B section 11, from both the objective data method collection by technical measures, such as acoustic and lighting measurements explained in part B section 9, and the method to collect people's perceptions of the safety, sound environment, lighting environment and urban and architectural quality or the questionnaire explained in part B section 10. All three different questionnaires produced are considered in the result: **on-site survey**, **double-check survey** and **social survey**. Because the deep study of perception literature reviewed in part A, the hypothesis of this research is that the perception of urban safety can be influenced by several factors that can be divided into categories that concern the **people's perceptions** and others that concern the **perceived surrounding environment**.

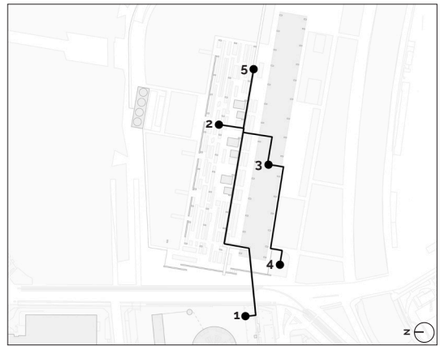
All the research questions of this thesis, that are visible in part A section 8, are focused on perception of urban safety topic. To find an answer to them the starting point was represented by the sample of on-site survey. After individually looking of questionnaire and after comparing them, the final part of the section includes some global considerations that will lead to the elaboration of evidences and guidelines for future projects.

OBJECTIVE ENVIRONMENTAL ANALYSIS

objective conditions of light and sound analysis

In this first section was reported the results related to the objective data by technical measures or **acoustic** and **lighting measurements** explained in part B section 9. The acoustic and lighting measures were carried out through a **sound-light walk** with predefined measurement points, as mentioned in part C sections 13, 14, 15, 16, 17, simultaneously with the administration of the questionnaires: the researchers was in each point for about 30 minutes.
From the lighting point of view, for each questionnaire, a photograph was taken in HDR: the researchers took photos using tripod and camera and for each station every illuminance value was collected using luxmeter. The researchers also filmed a sound-light walk passing through every measuring stations.
From the acoustic point of view the measurements were made with one measurement from station number one at station number five without any stops, while the other measures, those used mainly for analysis, were made for each station with a duration of 5 minutes each. Acoustic measurement were performed using a binaural recording system and and the data, reported in the following pages, have been processed through the Siemens software.
All the data presented here in reduced form are are reported entirely in the Appendix.





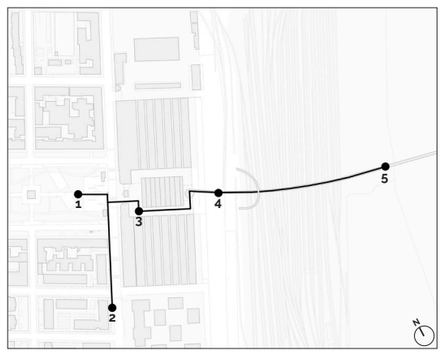


Fig. E1a, b, c, d. Sound-Light walk of analyzed areas: Campus Einaudi, Parco Dora, Passerella Olimpica, San Salvario.

Before answering the research question, explained in part E section 23, a correlation was made between the **objective factors themselves**, or the factors extrapolated from objective measurements, so as to eliminate the factors that explain the phenomenon in the same way.
This got for lighting data: Average Horizontal Illuminance $\mathbf{E_{m,h}}$, Vertical Illuminance min $\mathbf{E_{min,v}}$, Overall uniformity $\mathbf{U_o}$, Average 40° Luminance $\mathbf{L_{m,40}}$, Luminance 40 min $\mathbf{L_{min,40}}$, Pedestrian Path Dispersion $\mathbf{D_{pp}}$, Vertical near Dispersion $\mathbf{D_{VN}}$, Vertical Near Illuminance min $\mathbf{L_{min,VN}}$, Central 20 degree average luminance $\mathbf{L_{m,20c}}$, Central 20 degree dispersion $\mathbf{D_{20c}}$, Bottom max illuminance $\mathbf{L_{maxBT}}$, Right Peripheral min $\mathbf{L_{minSD}}$, which are all explained in detail in part B section 9.
For acoustics data this correlation made it possible to obtain: $\mathbf{L_{Aeq}}$, Fluctuation Strength **FS**, Roughness **RO**, Sharpness Aures $\mathbf{SH_{AURES}}$, Sharpness DIN $\mathbf{SH_{DIN}}$, Tonality **TO** and Tonality DIN $\mathbf{TO_{DIN}}$ which are all explained in detail in part A section 5.

Campus Einaudi area

The analysis area starts from station 1 in Corso Verona (fig.E2a) and continues along the Franco Mellano footbridge (fig.E2b), until Viale Ottavio Mai (fig.E2c, E2d) or station 2. The area continues for Corso Carlo Luigi Farini, where there is the station 3 in a small green area (fig. E2e, E2f). Another analyzed street is Via Giorgio Pallavicino (fig. E2g, E2h) that are station 4.
The sound-walk ends at the intersection with with Corso Belgio (fig. E2i, E2j) in the station 5. The following pages contain LMK LabSoft elaborated images, two for each measuring station, in which there are element regions of light scenes. After those are reported a table of light and sound values. All other values instead are contained in the appendix.

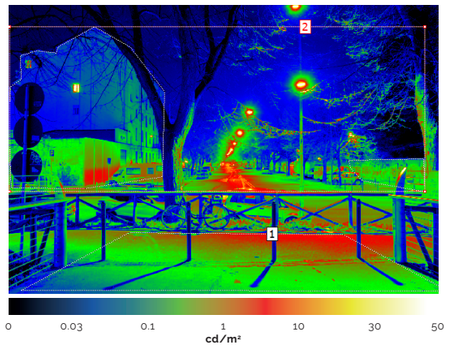


Fig. E2a. Shooting position on station 1 toward north.

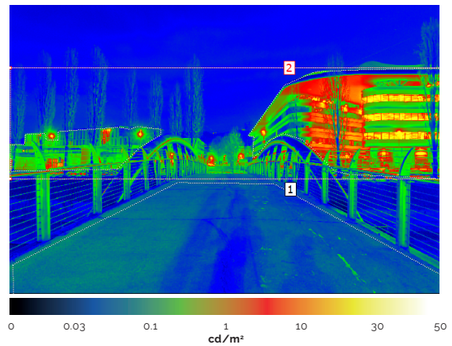


Fig. E2b. Shooting position on station 1 toward south.

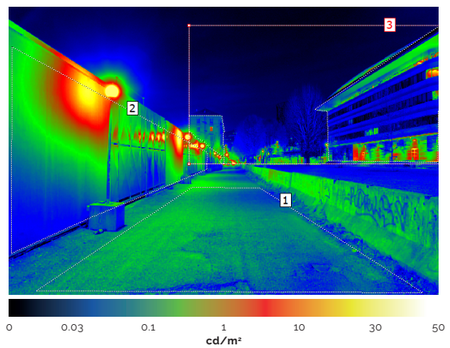


Fig. E2c. Shooting position on station 2 toward south.

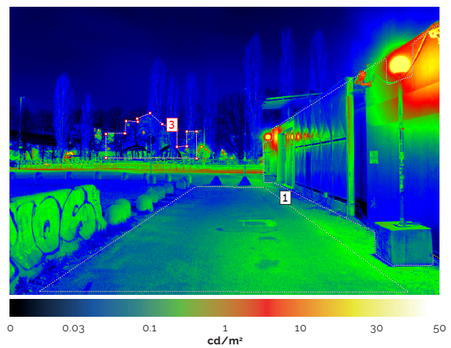
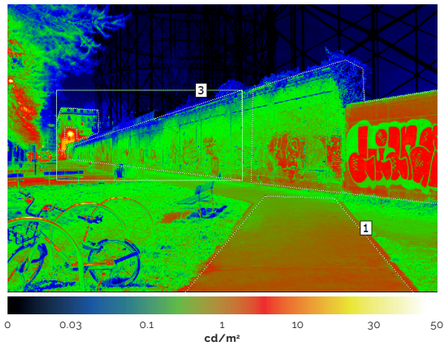


Fig. E2d. Shooting position on station 2 toward north.



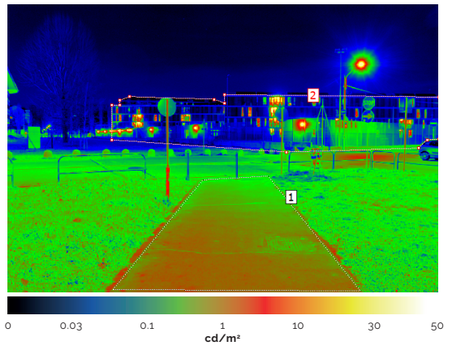
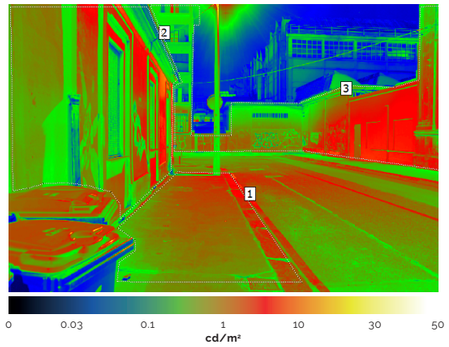


Fig. E2e. Shooting position on station 3 toward south.

Fig. E2f. Shooting position on station 3 toward north.



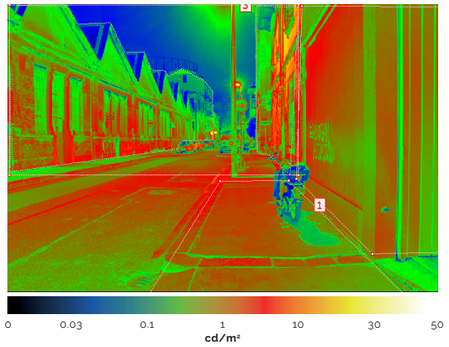
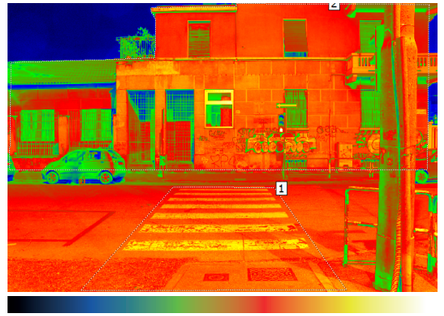


Fig. E2g. Shooting position on station 4 toward west.

Fig. E2h. Shooting position on station 4 toward east.



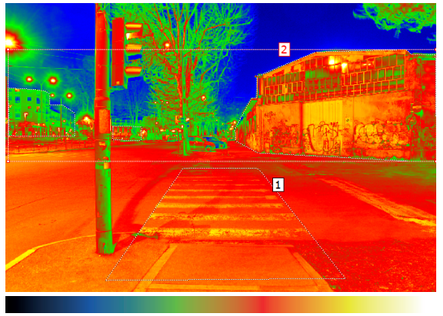


Fig. E2i. Shooting position on station 4 toward east.

Fig. E2j. Shooting position on station 4 toward west.

Table E1. On the next page, luminous data of the sound-light walk with 5 stations of the Campus Einaudi area.

Lighting data in Campus Einaudi area

			st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
			north	south	south	north	south	north	west	east	east	west
ILLUMINANCE	E_m	*lx*	2.35	2.35	2.63	2.63	18.24	18.24	11.58	11.58	81.82	81.82
	$E_{v,\,min}$	*lx*	1.31	0.33	2.41	2.54	1.73	1.76	1.50	4.21	15.31	12.42
	U_o	-	0.00	0.00	0.56	0.56	0.70	0.70	0.42	0.42	0.84	0.84
H. 40° BAND	L_m	*cd/m²*	0.41	0.22	0.42	0.38	0.56	0.39	0.58	0.51	2.58	2.39
	L_{min}	*cd/m²*	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.00
PEDESTRIAN PATH	D_{PP}	-	0.48	0.01	0.07	0.06	0.17	0.19	0.23	0.20	1.62	1.08
NEAR VERTICAL	D_{VN}	-	n.a.	n.a.	1.97	1.86	0.62	n.a.	0.23	0.39	1.95	n.a.
NEAR FAR	L_{min}	*cd/m²*	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	n.a.	0.00
CIRCOLAR CENTRAL 20°	L_m	*cd/m²*	0.85	0.13	0.57	0.27	0.73	0.26	0.64	0.48	2.94	1.74
	D_{20c}	-	2.75	0.47	2.16	0.93	0.32	0.72	0.74	0.33	2.53	3.05
BOTTOM REGION	L_{max}	*cd/m²*	44.00	0.24	2.07	0.85	7.26	3.46	3.55	15.50	14.92	13.18
RIGHT REGION (RP)	L_{min}	*cd/m²*	0.03	0.00	0.01	0.01	0.00	0.01	0.02	0.01	0.03	0.04
LEFT REGION (LP)	L_{min}	*cd/m²*	0.00	0.00	0.01	0.00	0.00	0.01	0.03	0.02	0.02	0.00

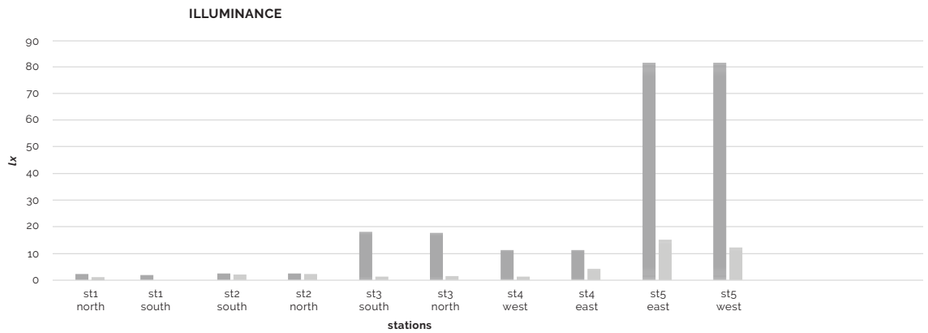


Fig. E3a. Illuminance data measured during the sound-light walk with 5 stations in Campus Einaudi area.

E_m
$E_{v,\,min}$

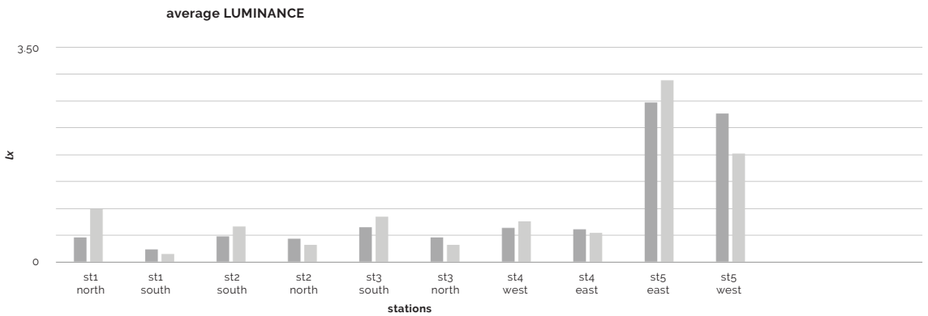


Fig. E3b. Luminance data measured during the sound-light walk with 5 stations in Campus Einaudi area.

$L_{m.40}$
$L_{m.20'c}$

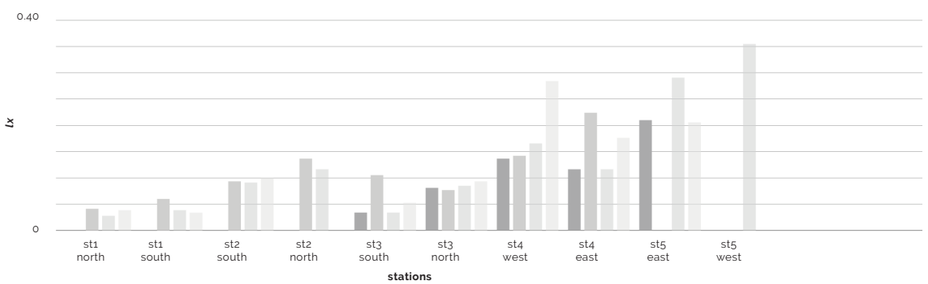


Fig. E3c. Luminance data measured during the sound-light walk in the Campus Einaudi area.

$L_{min.40}$
$L_{min.vf}$
$L_{min.rp}$
$L_{min.lp}$

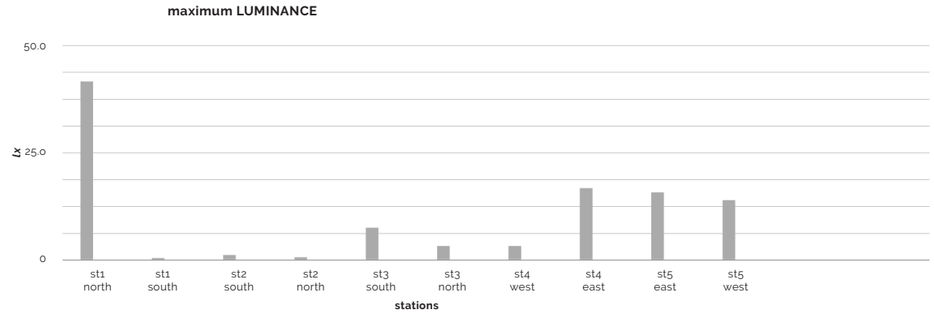


Fig. E3d. Luminance data measured during the sound-light walk with 5 stations in Campus Einaudi area.

$L_{max.bt}$

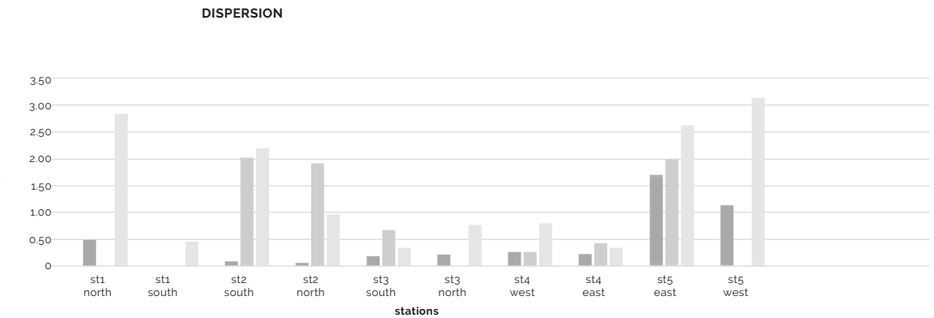


Fig. E3e. Dispersion data measured during the sound-light walk with 5 stations in Campus Einaudi area.

D_{pp}
D_{vn}
D_{c20}

Acoustic data in Campus Einaudi area

A-WEIGHTED SOUND PRESSURE LEVEL

		st.1	st.2	st.3	st.4	st.5
05.11	*dB(A)*	54.10	51.40	45.90	51.00	58.50
08.11	*dB(A)*	61.50	49.20	48.30	47.50	58.30
11.11	*dB(A)*	54.70	48.80	42.80	43.70	55.70

Table E2a. A-weighted sound pressure level data measured during the sound-light walk with 5 stations in Campus Einaudi area on three different measurement days.

PSYCHOACOUSTICS METRICS

		st.1	st.2	st.3	st.4	st.5
FLUCTUATION STRENGHT	*vacil*	1.185	1.131	1.181	1.176	1.112
ROUGHNESS	*asper*	0.198	0.151	0.179	0.213	0.157
SHARPNESS AURES	*acum*	1.545	1.289	1.275	1.251	1.380
SHARPNESS DIN45692	*acum*	1.485	1.229	1.221	1.211	1.324
TONALITY	*t.u.*	0.019	0.018	0.015	0.014	0.015
TONALITY DIN45681	*t.u.*	0.668	1.032	1.189	1.008	1.004

Table E2b. Psychoacoustics data measured during the sound-light walk with 5 stations in Campus Einaudi area.

Fig. E4a. Acoustics data measured during the sound-light walk with 5 stations in Campus Einaudi area on three different measurement days - Average of three days of measures.

Fig. E4b. Acoustics data measured during the sound-light walk with 5 stations in Campus Einaudi area on three different measurement days.
05.11.18
08.11.18
11.11.18

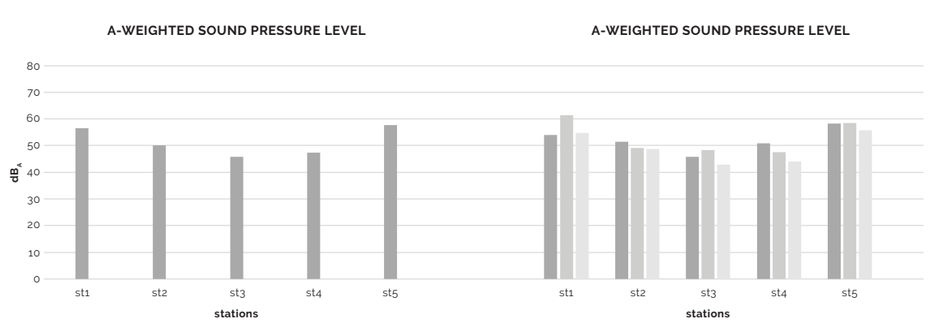


Fig. E4c, E4d. Psychoacoustics metrics measured during the sound-light walk with 5 stations in Campus Einaudi area on three different measurement days.

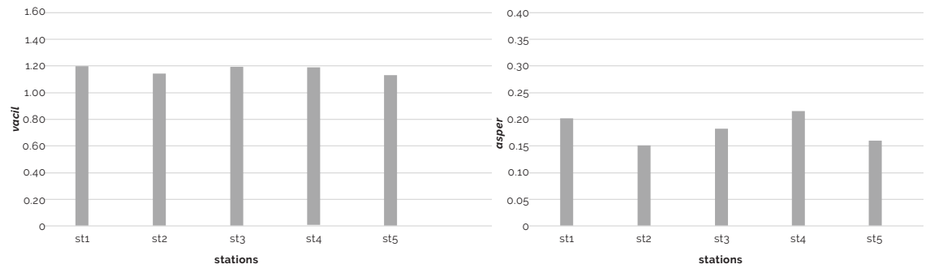
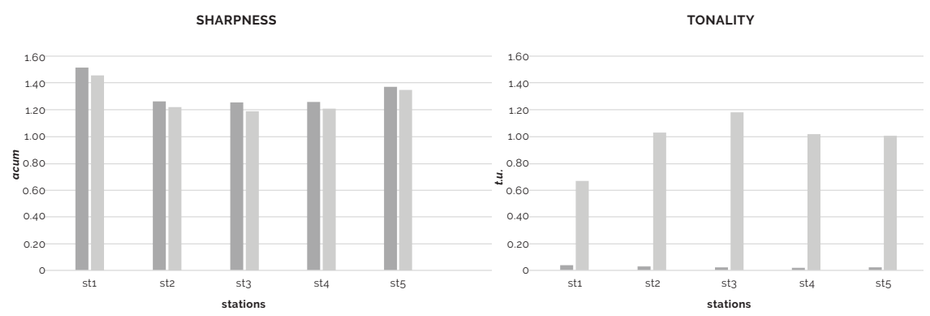


Fig. E4e. Psycoacoustics metrics measured during the sound-light walk with 5 stations in Campus Einaudi area on three different measurement days.
Sharpness$_{AURES}$
Sharpness$_{DIN}$

Fig. E4f. Psycoacoustics metrics measured during the sound-light walk with 5 stations in Campus Einaudi area on three different measurement days.
Tonality
Tonality$_{DIN}$



Parco Dora area

The analysis area starts from station 1 in front of Chiesa del Santo Volto (Fig E5a) and continues under the elevated walkway (Fig E5b). Station 2 is north of the Vitali area (Fig E5c E5d) while station 3 is under the roof of the same area (Fig E5e E5f). The next station 4 is in the parking near Largo Piero della Francesca (Fig E5g E5h). The sound-walk ends in the elevated walkway at the perimeter of the vital area (Fig E5i E5j) in the station 5.

The following pages contain LMK LabSoft elaborated images, two for each measuring station, in which there are element regions of light scenes. After those are reported a table of light and sound values. All other values instead are contained in the appendix.

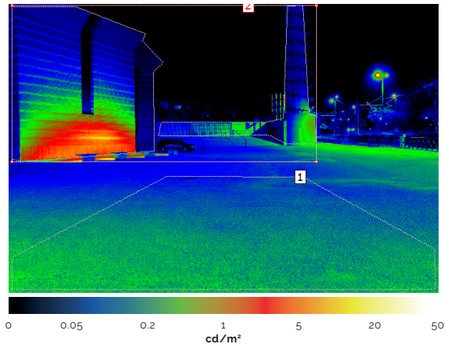


Fig. E5a. Shooting position on station 1 toward west.

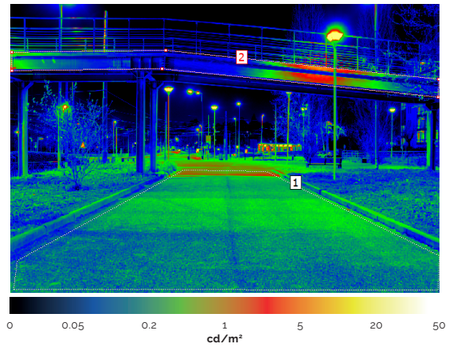


Fig. E5b. Shooting position on station 1 toward east.

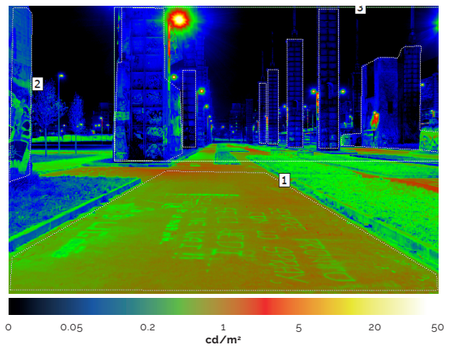


Fig. E5c. Shooting position on station 2 toward north.

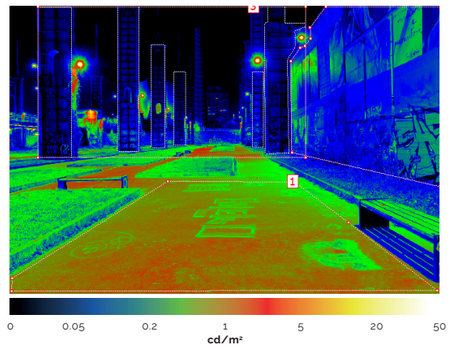
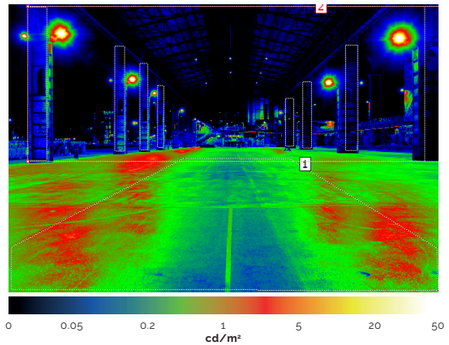


Fig. E5d. Shooting position on station 2 toward south.



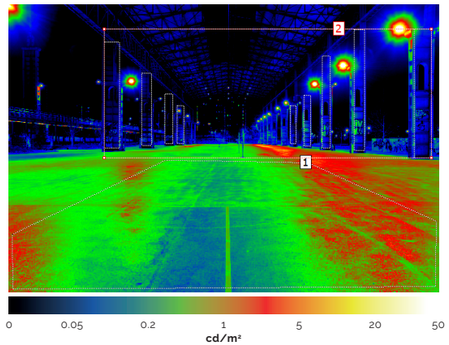
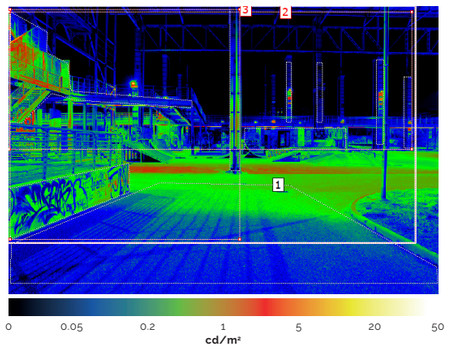


Fig. E5e. Shooting position on station 3 toward south.

Fig. E5f. Shooting position on station 3 toward north.



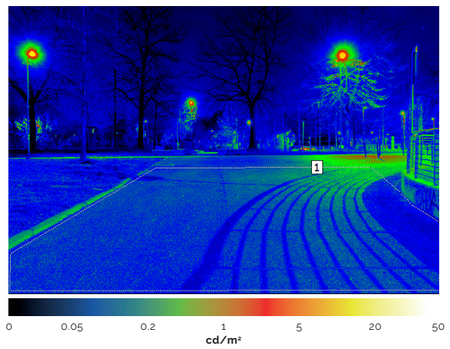
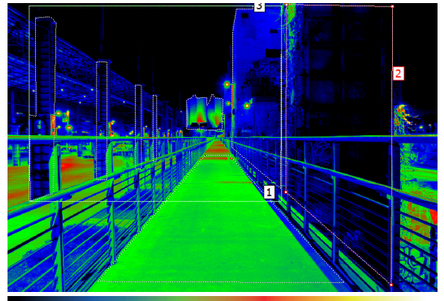


Fig. E5g. Shooting position on station 4 toward west.

Fig. E5h. Shooting position on station 4 toward east.



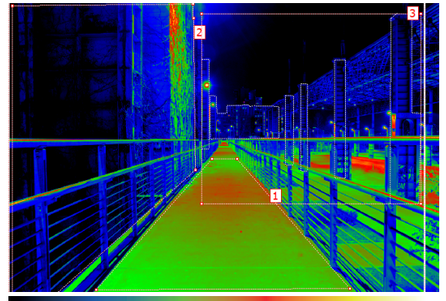


Fig. E5i. Shooting position on station 4 toward south.

Fig. E5j. Shooting position on station 4 toward north.

Table E3. On the next page, luminous data of the sound-light walk with 5 stations of the Parco Dora area.

Lighting data in Parco Dora area

			st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
			west	east	north	south	south	north	west	east	south	north
ILLUMINANCE	E_m	*lx*	20.02	20.02	27.45	27.45	92.57	92.57	11.79	11.79	22.48	22.48
	$E_{v,min}$	*lx*	13.22	2.29	15.25	5.86	11.56	12.47	3.02	2.43	3.74	2.56
	U_o	-	0.78	0.78	0.60	0.60	0.80	0.80	0.24	0.24	0.45	0.45
H. 40° BAND	L_m	*cd/m²*	0.78	0.76	1.20	1.19	2.48	2.43	0.81	0.21	0.63	0.86
	L_{min}	*cd/m²*	0.01	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00
PEDESTRIAN PATH	D_{pp}	-	0.21	0.35	0.38	0.60	1.89	1.99	0.39	0.08	0.26	0.56
NEAR VERTICAL	D_{VN}	-	n.a.	1.89	0.27	0.27	n.a.	n.a.	0.71	n.a.	0.23	0.93
NEAR FAR	L_{min}	*cd/m²*	0.01	n.a.	0.00	0.09	0.09	0.11	0.04	n.a.	0.02	0.00
CIRCOLAR CENTRAL 20°	L_m	*cd/m²*	0.44	1.23	1.49	1.22	1.80	1.83	1.14	0.19	1.00	1.27
	D_{zoc}	-	0.37	2.94	1.79	1.54	4.04	2.29	1.43	0.29	1.30	1.68
BOTTOM REGION	L_{max}	*cd/m²*	4.00	5.01	7.57	17.38	19.94	21.08	5.38	1.05	3.47	6.45
RIGHT REGION (RP)	L_{min}	*cd/m²*	0.03	0.03	0.00	0.03	0.00	0.00	0.03	0.02	0.01	0.03
LEFT REGION (LP)	L_{min}	*cd/m²*	0.01	0.03	0.04	0.03	0.00	0.08	0.03	0.02	0.02	0.03

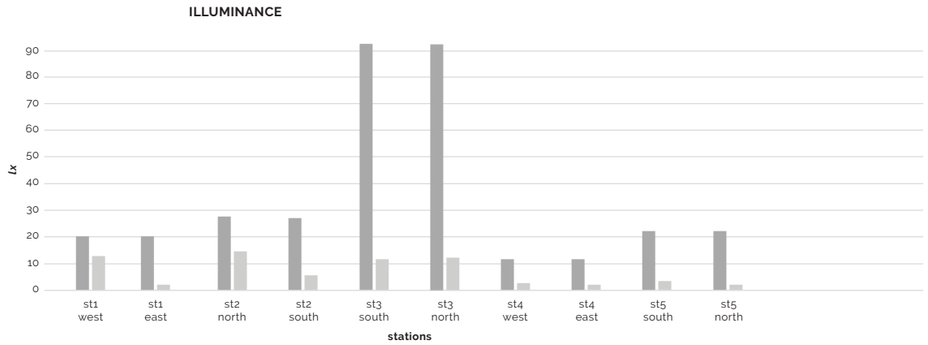


Fig. E6a. Illuminance data measured during the sound-light walk with 5 stations in Parco Dora area.

E_m
$E_{v,\ min}$

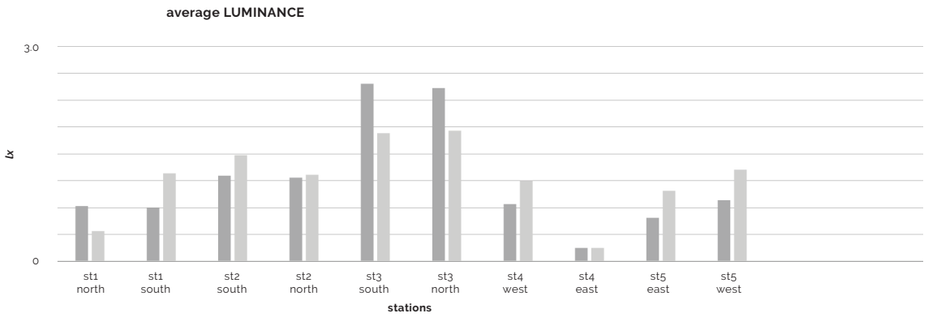


Fig. E6b. Luminance data measured during the sound-light walk with 5 stations in Parco Dora area.

$L_{m.40}$
$L_{m.20'c}$

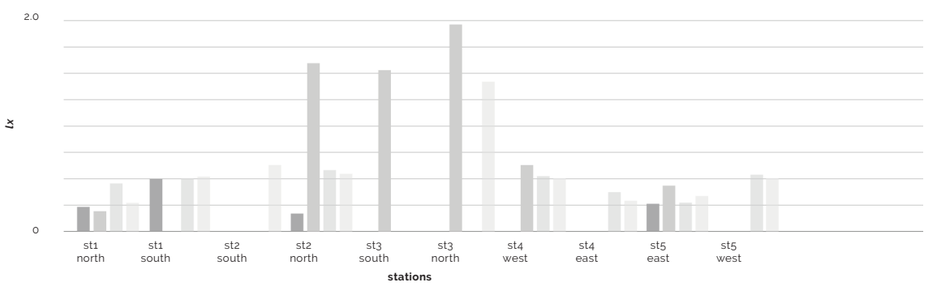


Fig. E6c. Luminance data measured during the sound-light walk with 5 stations in Parco Dora area.

$L_{min.40}$
$L_{min.vf}$
$L_{min.rp}$
$L_{min.lp}$

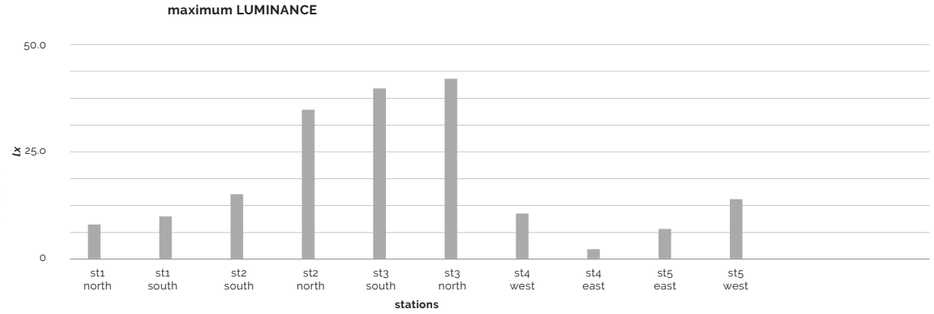


Fig. E6d. Luminance data measured during the sound-light walk with 5 stations in Parco Dora area.

$L_{max.bt}$

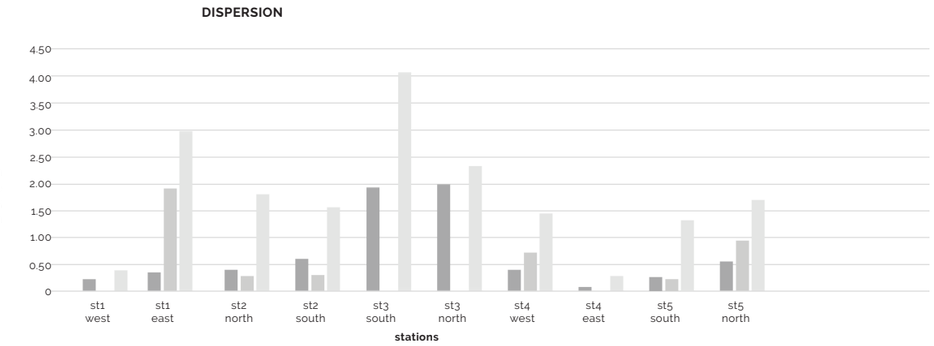


Fig. E6e. Dispersion data measured during the sound-light walk with 5 stations in Parco Dora area.

D_{pp}
D_{vn}
D_{c20}

Acoustic data in Parco Dora area

A-WEIGHTED SOUND PRESSURE LEVEL

		st.1	st.2	st.3	st.4	st.5
12.11	*dB(A)*	46.70	47.00	50.00	49.00	47.00
15.11	*dB(A)*	62.00	49.00	53.00	73.40	45.20
17.11	*dB(A)*	52.50	47.30	48.00	58.00	52.00

Table E4a. A-weighted sound pressure level data measured during the sound-light walk with 5 stations in Parco Dora area on three different measurement days.

PSYCHOACOUSTICS METRICS

		st.1	st.2	st.3	st.4	st.5
FLUCTUATION STRENGHT	*vacil*	1.089	1.086	1.154	1.352	1.135
ROUGHNESS	*asper*	0.151	0.134	0.162	0.283	0.156
SHARPNESS AURES	*acum*	1.393	1.538	1.469	1.810	1.317
SHARPNESS DIN45692	*acum*	0.980	1.135	1.104	1.119	1.027
TONALITY	*t.u.*	0.011	0.019	0.006	0.017	0.020
TONALITY DIN45681	*t.u.*	1.296	1.341	1.312	1.541	1.296

Table E4b. Psychoacoustics data measured during the sound-light walk with 5 stations in Parco Dora area.

Fig. E7a. Acoustics data measured during the sound-light walk with 5 stations in Parco Dora area on three different measurement days - Average of three days of measures.

Fig. E7b. Acoustics data measured during the sound-light walk with 5 stations in Parco Dora area on three different measurement days.

12.11.18
15.11.18
17.11.18

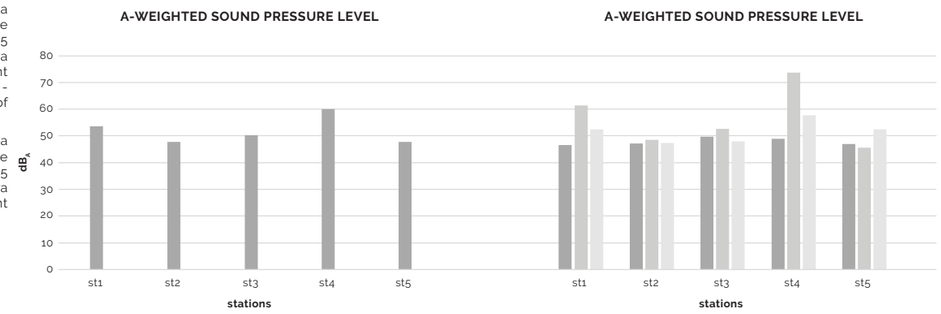


Fig. E7c, E7d. Psychoacoustics metrics measured during the sound-light walk with 5 stations in Parco Dora area on three different measurement days.

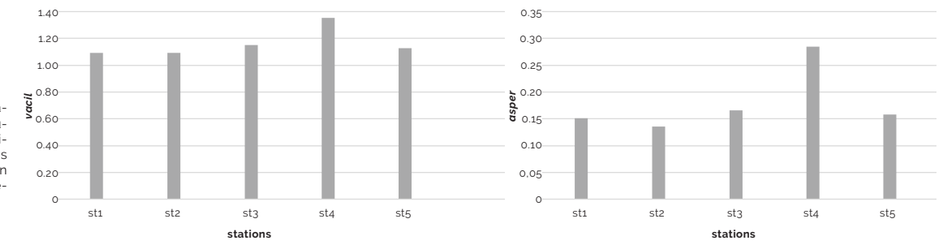
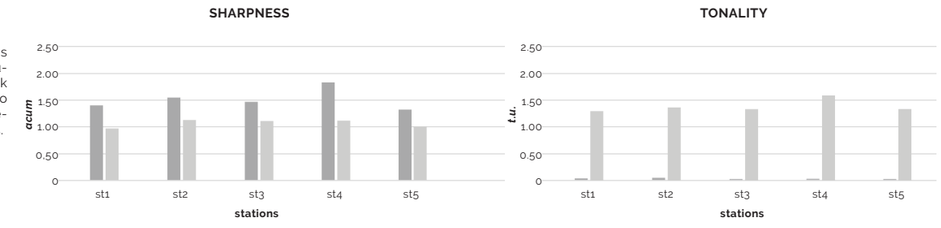


Fig. E7e. Psycoacoustics metrics measured during the sound-light walk with 5 stations in Parco Dora area on three different measurement days.

Sharpness$_{AURES}$
Sharpness$_{DIN}$

Fig. E7f. Psycoacoustics metrics measured during the sound-light walk with 5 stations in Parco Dora area on three different measurement days.

Tonality
Tonality$_{DIN}$



Passerella Olimpica area

The analysis area starts from station 1 in the gardens in front of the footbridge, Piazza Galimberti (Fig E8a E8b), continues south in station 2 in front of the ex-MOI buildings (Fig E8c E8d) on via Pio VII. Station 3 is in the building in front of the walkway entrance (Fig E8e E8f), sound-light walk finally continues on the Passerella Olimpica, from the station 4 (Fig E8g E8h) to the station 5 (Fig E8i E8j) in 8 Gallery complex of the Lingotto, passing over the railway. The following pages contain LMK LabSoft elaborated images, two for each measuring station, in which there are element regions of light scenes. After those are reported a table of light and sound values. All other values instead are contained in the appendix.

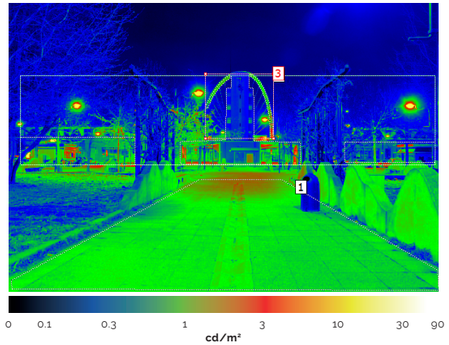


Fig. E8a. Shooting position on station 1 toward north.

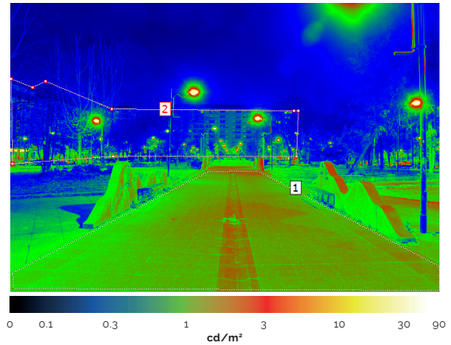


Fig. E8b. Shooting position on station 1 toward south.

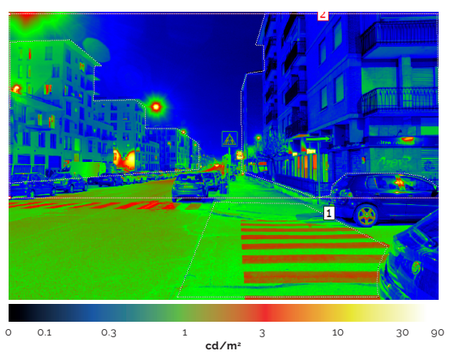


Fig. E8c. Shooting position on station 2 toward east.

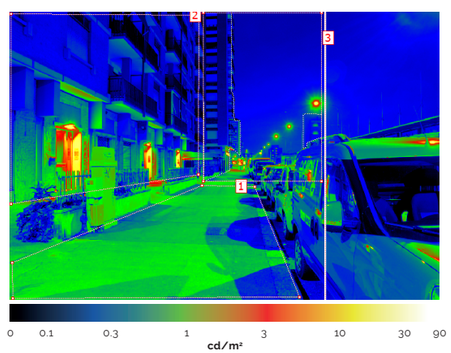
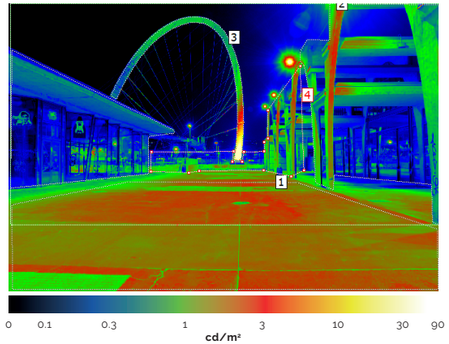


Fig. E8d. Shooting position on station 2 toward west.



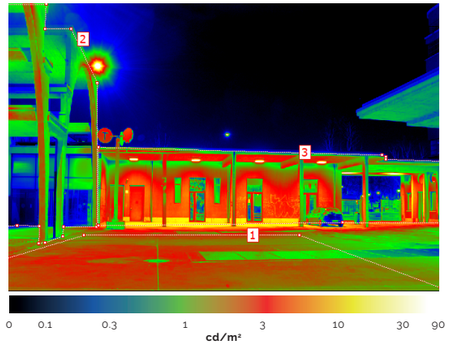
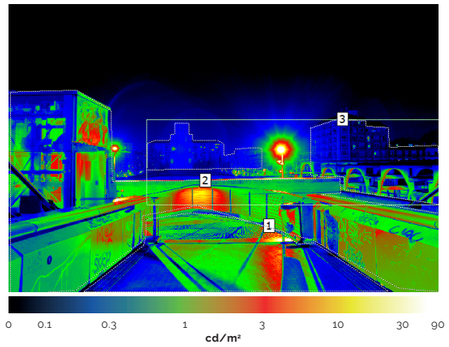


Fig. E8e. Shooting position on station 3 toward north.

Fig. E8f. Shooting position on station 3 toward south.



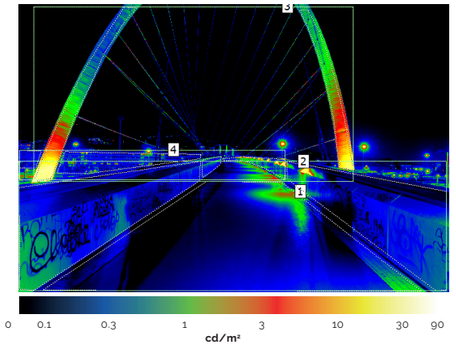
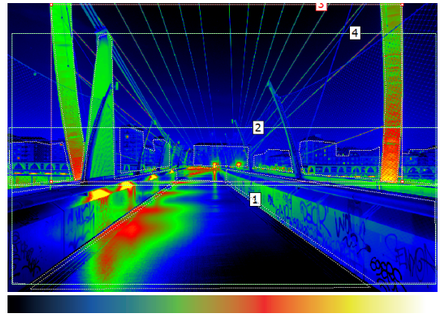


Fig. E8g. Shooting position on station 4 toward south.

Fig. E8h. Shooting position on station 4 toward north.



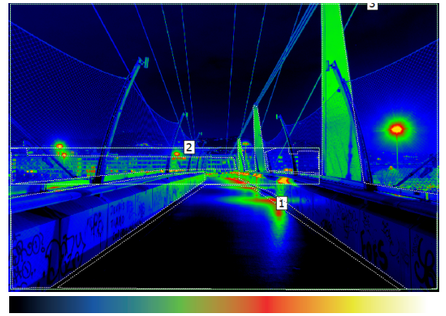


Fig. E8i. Shooting position on station 4 toward south.

Fig. E8j. Shooting position on station 4 toward north.

Table E5. On the next page, luminous data of the sound-light walk with 5 stations of the Passerella Olimpica area.

Lighting data in Passerella Olimpica area

			st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
			north	south	east	west	north	south	south	north	south	north
ILLUMINANCE	E_m	*lx*	12.51	12.51	8.44	8.44	40.17	40.17	2.29	2.29	2.14	2.14
	$E_{v,min}$	*lx*	11.56	5.77	3.04	3.79	21.80	23.26	6.31	2.42	2.17	0.31
	U_o	-	0.70	0.70	0.84	0.84	0.77	0.77	0.20	0.20	0.01	0.01
H. 40° BAND	L_m	*cd/m²*	0.47	0.68	0.65	0.52	1.63	2.52	1.18	0.68	0.44	0.18
	L_{min}	*cd/m²*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PEDESTRIAN PATH	D_{pp}	-	0.21	0.35	0.38	0.60	1.89	1.99	0.39	0.08	0.26	0.56
NEAR VERTICAL	D_{VN}	-	n.a.	1.89	0.27	0.27	n.a.	n.a.	0.71	n.a.	0.23	0.93
NEAR FAR	L_{min}	*cd/m²*	0.01	n.a.	0.00	0.09	0.09	0.11	0.04	n.a.	0.02	0.00
CIRCOLAR CENTRAL 20°	L_m	*cd/m²*	0.44	1.23	1.49	1.22	1.80	1.83	1.14	0.19	1.00	1.27
	D_{20c}	-	0.37	2.94	1.79	1.54	4.04	2.29	1.43	0.29	1.30	1.68
BOTTOM REGION	L_{max}	*cd/m²*	4.00	5.01	7.57	17.38	19.94	21.08	5.38	1.05	3.47	6.45
RIGHT REGION (RP)	L_{min}	*cd/m²*	0.03	0.03	0.00	0.03	0.00	0.00	0.03	0.02	0.01	0.03
LEFT REGION (LP)	L_{min}	*cd/m²*	0.01	0.03	0.04	0.03	0.00	0.08	0.03	0.02	0.02	0.03

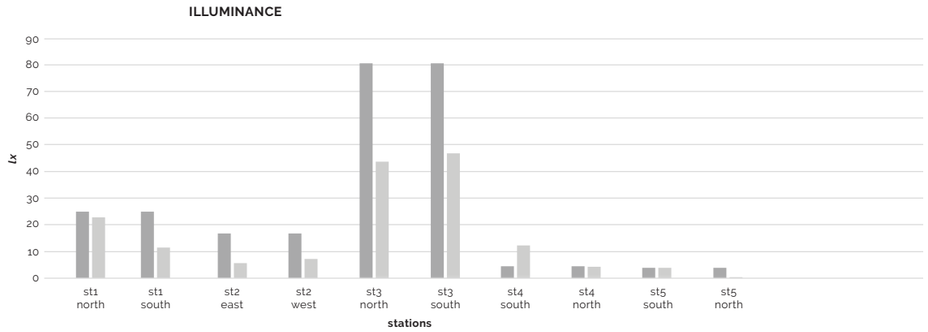


Fig. Ega. Illuminance data measured during the sound-light walk with 5 stations in Passerella Olimpica area.

E_m
$E_{v,\ min}$

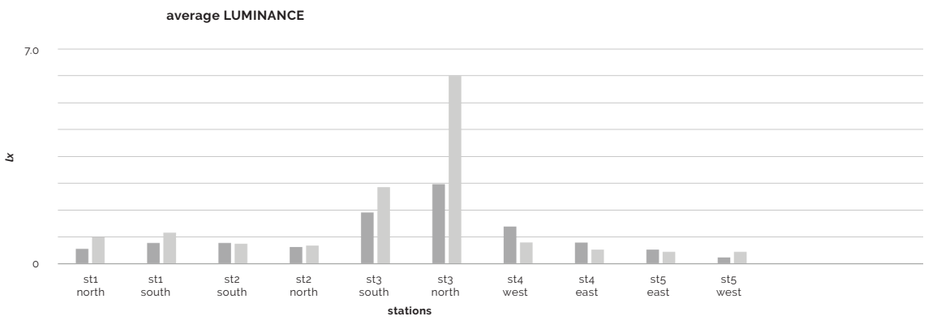


Fig. Egb. Luminance data measured during the sound-light walk with 5 stations in Passerella Olimpica area.

$L_{m.40}$
$L_{m.20'c}$

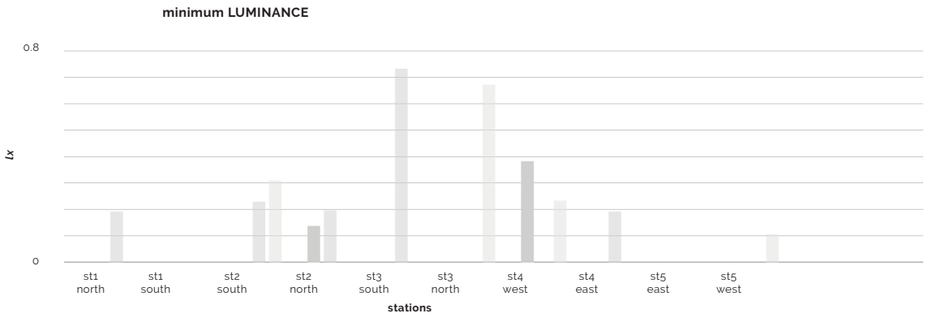


Fig. Egc. Luminance data measured during the sound-light walk with 5 stations in Passerella Olimpica area.

$L_{min.40}$
$L_{min.vf}$
$L_{min.rp}$
$L_{min.lp}$

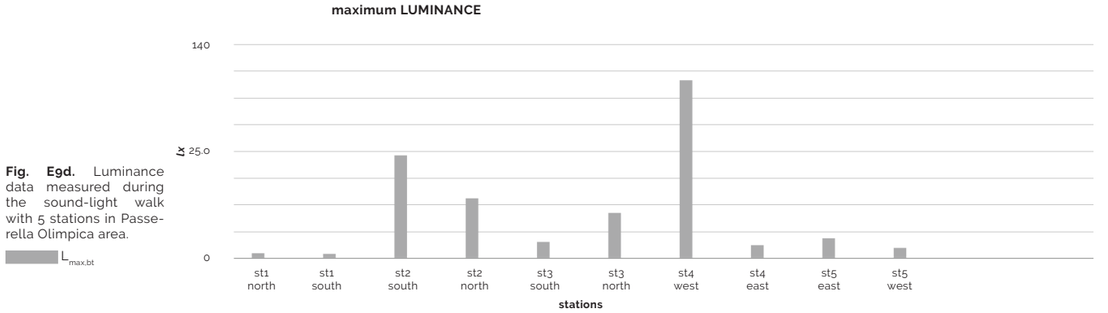


Fig. Egd. Luminance data measured during the sound-light walk with 5 stations in Passerella Olimpica area.

$L_{max.bt}$

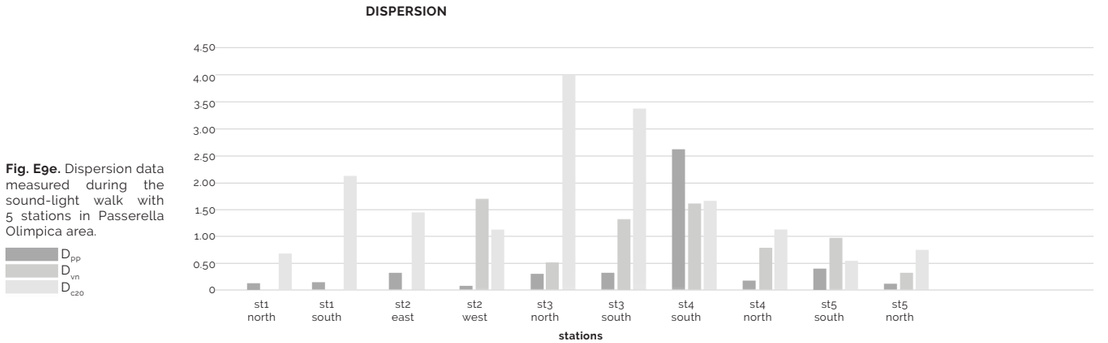


Fig. Ege. Dispersion data measured during the sound-light walk with 5 stations in Passerella Olimpica area.

D_{pp}
D_{vn}
D_{c20}

Acoustic data in Passerella Olimpica area

A-WEIGHTED SOUND PRESSURE LEVEL

		st.1	st.2	st.3	st.4	st.5
21.11	*dB(A)*	53.20	66.30	49.00	57.40	48.00
22.11	*dB(A)*	48.20	54.20	58.30	51.30	46.00
24.11	*dB(A)*	55.00	52.10	58.00	50.00	46.00
10.12	*dB(A)*	63.50	46.30	56.00	40.40	46.00

Table E6a. A-weighted sound pressure level data measured during the sound-light walk with 5 stations in Passerella Olimpica area on three different measurement days.

PSYCHOACOUSTICS METRICS

		st.1	st.2	st.3	st.4	st.5
FLUCTUATION STRENGHT	*vacil*	1,270	1,284	1,241	1,147	1,185
ROUGHNESS	*asper*	0,182	0,825	0,212	0,161	0,183
SHARPNESS AURES	*acum*	1,728	1,661	1,629	1,403	1,208
SHARPNESS DIN45692	*acum*	1,135	1,208	1,162	1,027	0,929
TONALITY	*t.u.*	0,019	0,011	0,014	0,018	0,011
TONALITY DIN45681	*t.u.*	1,160	1,210	1,008	1,015	1,049

Table E6b. Psychoacoustics data measured during the sound-light walk with 5 stations in Passerella Olimpica area.

Fig. E10a. Acoustics data measured during the sound-light walk with 5 stations in Passerella Olimpica area on three different measurement days - Average of three days of measures.

Fig. E10b. Acoustics data measured during the sound-light walk with 5 stations in Passerella Olimpica area on three different measurement days.

21.11.18
22.11.18
24.11.18
10.12.18

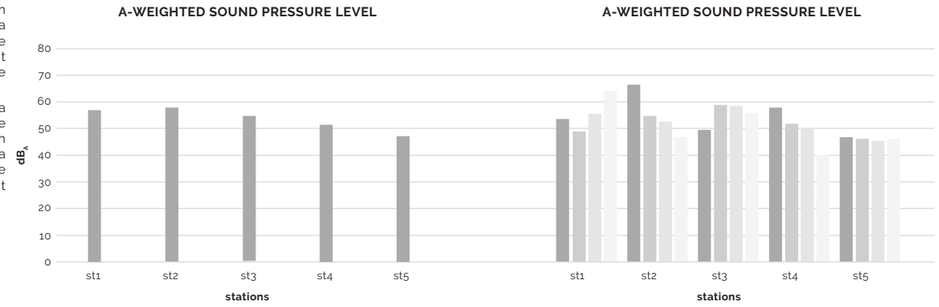


Fig. E10c, E10d. Psychoacoustics metrics measured during the sound-light walk with 5 stations in Passerella Olimpica area on three different measurement days.

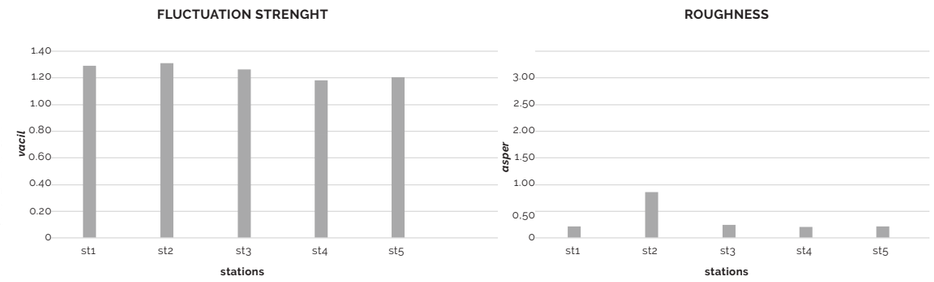
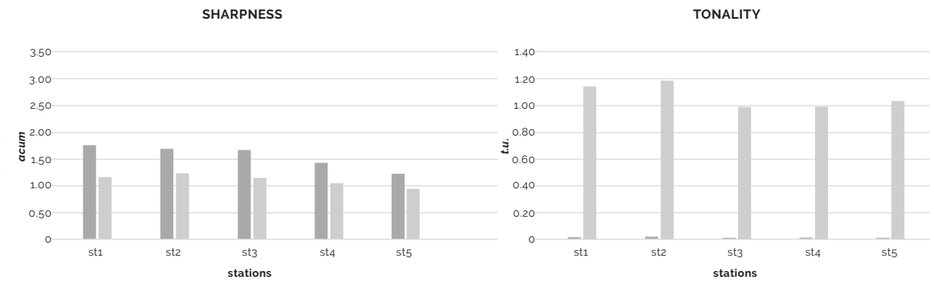


Fig. E10e. Psycoacoustics metrics measured during the sound-light walk with 5 stations in Passerella Olimpica area on three different measurement days.

Sharpness$_{AURES}$
Sharpness$_{DIN}$

Fig. E10f. Psycoacoustics metrics measured during the sound-light walk with 5 stations in Passerella Olimpica area on three different measurement days.

Tonality
Tonality$_{DIN}$



San Salvario area

This area starts from the metro stop on Corso Guglielmo Marconi (Fig E11a E11b) and entirely includes Largo Saluzzo. Sound-light walks passing through Corso Marconi and station 2 is in via Saluzzo (Fig E11c E11d). The walk crosses Largo Saluzzo where is station 3 (Fig E11e E11f) and station 4 is at the intersection of Via Baretti and Via Nizza (Fig E11g E11h). The final station 5 is at the intersection between Via Baretti and Via Belfiore (Fig E11i E11j).
The following pages contain LMK LabSoft elaborated images, two for each measuring station, in which there are element regions of light scenes. After those are reported a table of light and sound values. All other values instead are contained in the appendix.

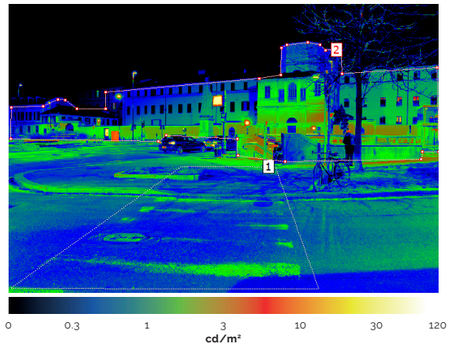


Fig. E11a. Shooting position on station 1 toward west.

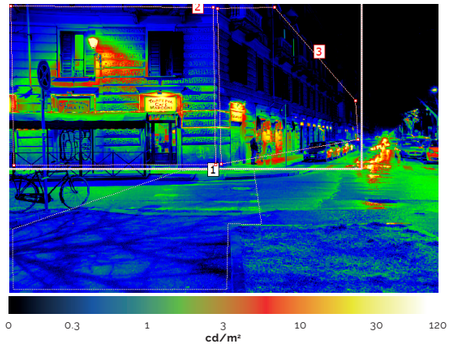


Fig. E11b. Shooting position on station 1 toward east.

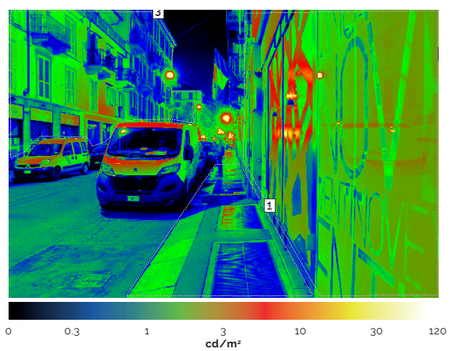


Fig. E11c. Shooting position on station 2 toward north.

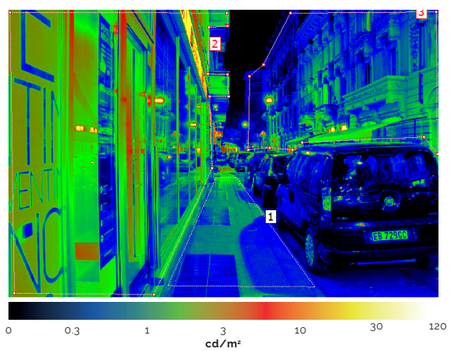
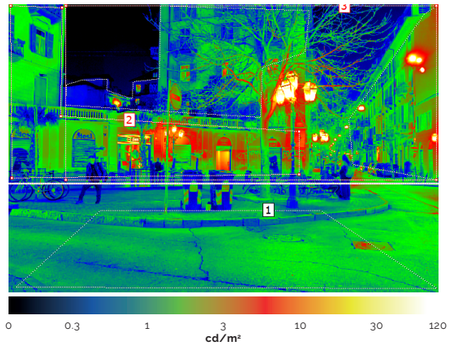


Fig. E11d. Shooting position on station 2 toward south.



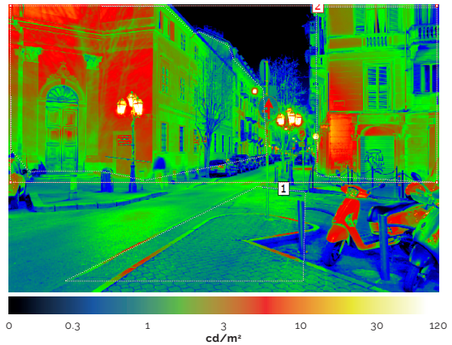
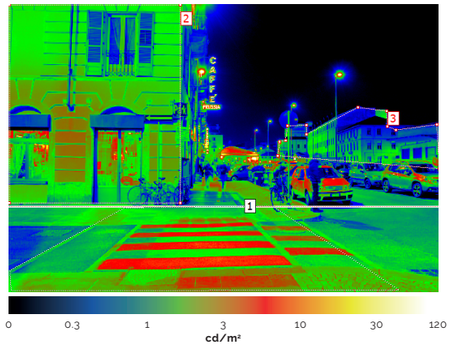


Fig. E11e. Shooting position on station 3 toward north.

Fig. E11f. Shooting position on station 3 toward south.



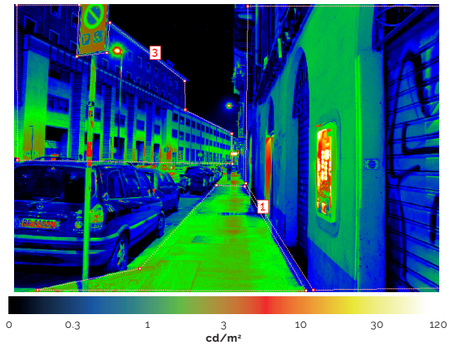
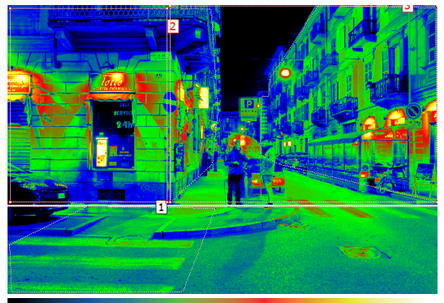


Fig. E11g. Shooting position on station 4 toward south.

Fig. E11h. Shooting position on station 4 toward north.



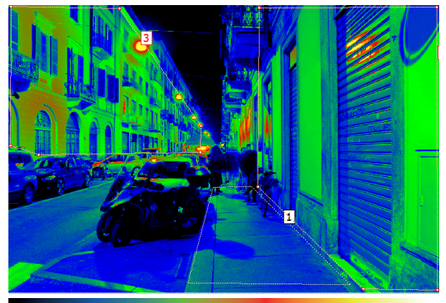


Fig. E11i. Shooting position on station 4 toward north.

Fig. E11j. Shooting position on station 4 toward south.

Table E7. On the next page, luminous data of the sound-light walk with 5 stations of the San Salvario area.

Lighting data in San Salvario area

			st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
			west	east	north	south	north	south	south	north	north	south
ILLUMINANCE	E_m	*lx*	30.41	30.41	20.34	20.34	12.33	12.33	52.85	52.85	12.92	12.92
	$E_{v,min}$	*lx*	13.36	9.44	12.69	11.33	39.17	15.50	10.13	22.60	16.50	5.29
	U_o	-	0.42	0.42	0.63	0.63	0.67	0.67	0.85	0.85	0.71	0.71
H. 40° BAND	L_m	*cd/m²*	2.06	2.89	2.04	1.49	3.03	2.98	1.99	1.46	2.52	1.21
	L_{min}	*cd/m²*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PEDESTRIAN PATH	D_{PP}	-	0.65	0.65	0.83	0.94	0.42	0.83	2.57	0.63	0.50	0.23
NEAR VERTICAL	D_{VN}	-	n.a.	9.48	2.76	3.88	9.41	n.a.	2.28	10.57	10.63	2.22
NEAR FAR (VF)	L_{min}	*cd/m²*	0.09	0.00	0.06	0.04	0.05	0.08	0.05	0.00	0.00	0.05
CIRCOLAR CENTRAL 20°	L_m	*cd/m²*	3.51	4.73	2.36	1.76	0.53	1.65	3.42	1.71	2.45	1.62
	D_{20c}	-	6.26	9.49	6.95	4.13	7.98	2.43	14.53	9.44	7.68	4.16
BOTTOM REGION	L_{max}	*cd/m²*	6.33	23.77	35.31	58.25	30.27	53.32	47.28	219.10	30.61	17.16
RIGHT REGION (RP)	L_{min}	*cd/m²*	0.07	0.00	0.15	0.02	0.00	0.05	0.01	0.00	0.01	0.04
LEFT REGION (LP)	L_{min}	*cd/m²*	0.00	0.07	0.09	0.14	0.16	0.04	0.00	0.00	0.06	0.02

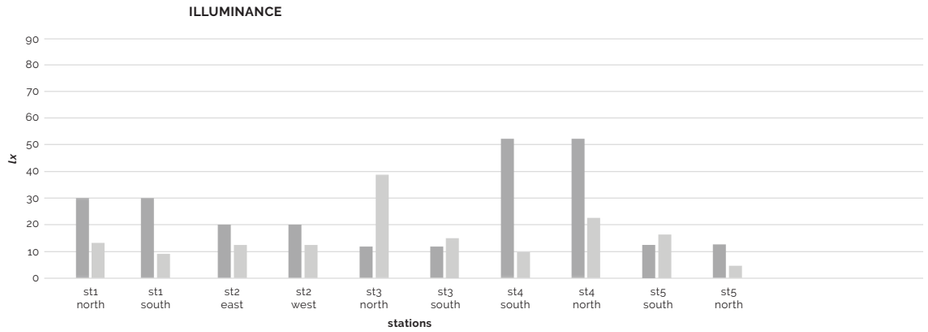


Fig. E12a. Illuminance data measured during the sound-light walk with 5 stations in San Salvario area.

E_m
$E_{v,\,min}$

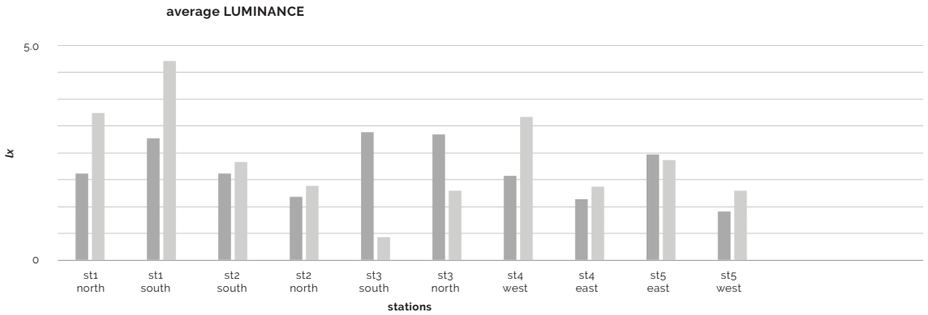


Fig. E12b. Luminance data measured during the sound-light walk with 5 stations in San Salvario area.

$L_{m.40}$
$L_{m.20°c}$

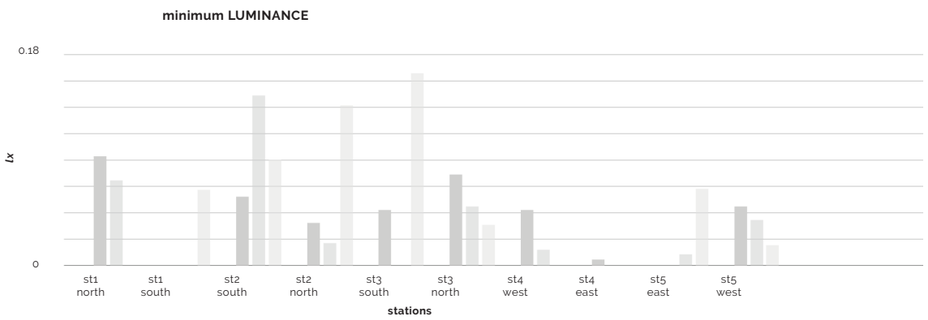


Fig. E12c. Luminance data measured during the sound-light walk with 5 stations in San Salvario area.

$L_{min.40}$
$L_{min.vf}$
$L_{min.rp}$
$L_{min.lp}$

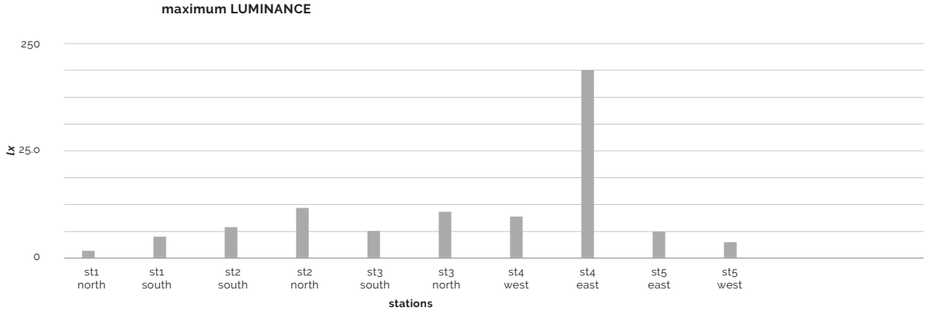


Fig. E12d. Luminance data measured during the sound-light walk with 5 stations in San Salvario area.

$L_{max.bt}$

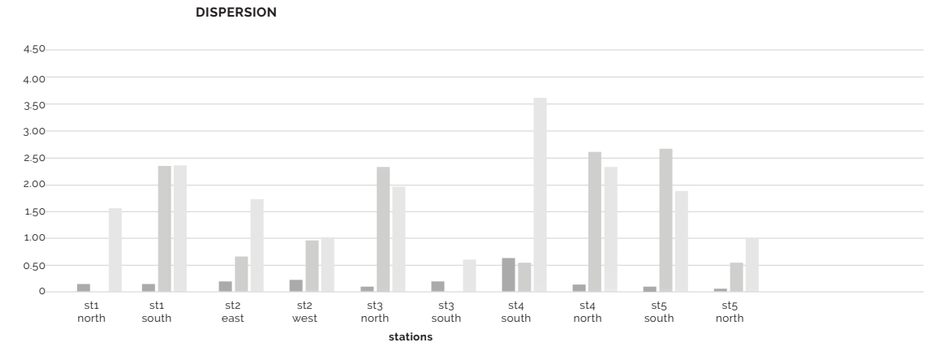


Fig. E12e. Dispersion data measured during the sound-light walk with 5 stations in San Salvario area.

D_{pp}
D_{vn}
D_{czo}

Acoustic data in the San Salvario area

A-WEIGHTED SOUND PRESSURE LEVEL

		st.1	st.2	st.3	st.4	st.5
29.11	*dB(A)*	59.00	60.30	61.00	55.00	58.40
01.12	*dB(A)*	59.00	61.10	61.00	64.00	61.00
08.12	*dB(A)*	59.00	62.00	62.10	63.00	60.00

Table E8a. A-weighted sound pressure level data measured during the sound-light walk with 5 stations in San Salvario area on three different measurement days.

PSYCHOACOUSTICS METRICS

		st.1	st.2	st.3	st.4	st.5
FLUCTUATION STRENGHT	*vacil*	1.202	1.206	1.231	1.471	1.332
ROUGHNESS	*asper*	0.167	0.190	0.212	0.203	0.192
SHARPNESS AURES	*acum*	1.686	1.845	1.988	1.940	1.752
SHARPNESS DIN45692	*acum*	1.125	1.223	1.266	1.283	1.201
TONALITY	*t.u.*	0.012	0.065	0.022	0.037	0.062
TONALITY DIN45681	*t.u.*	1.057	1.164	1.085	1.037	1.127

Table E8b. Psychoacoustics data measured during the sound-light walk with 5 stations in San Salvario area.

Fig. E13a. Acoustics data measured during the sound-light walk with 5 stations in San Salvario area on three different measurement days - Average of three days of measures.

Fig. E13b. Acoustics data measured during the sound-light walk with 5 stations in San Salvario area on three different measurement days.
29.11.18
01.12.19
08.12.19

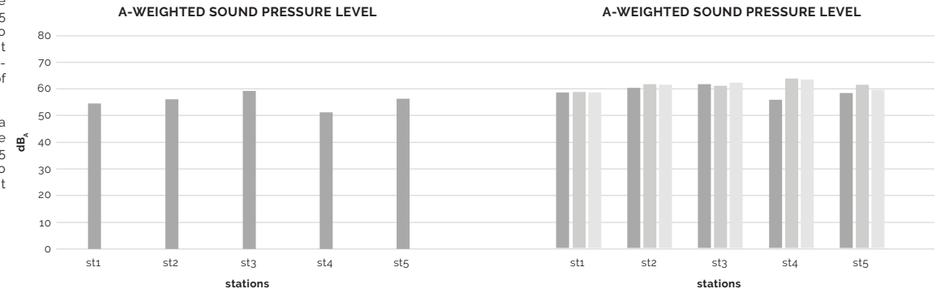


Fig. E13c, E13d. Psychoacoustics metrics measured during the sound-light walk with 5 stations in San Salvario area on three different measurement days.

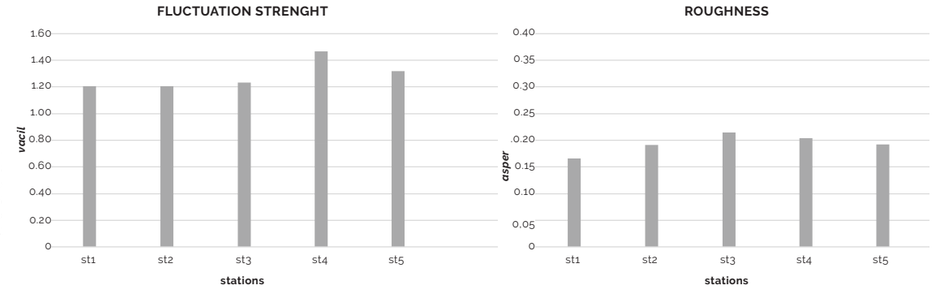
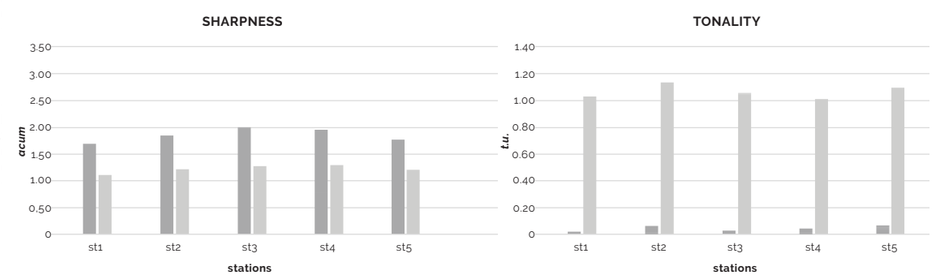


Fig. E13e. Psycoacoustics metrics measured during the sound-light walk with 5 stations in San Salvario area on three different measurement days.
Sharpness$_{AURES}$
Sharpness$_{DIN}$

Fig. E13f. Psycoacoustics metrics measured during the sound-light walk with 5 stations in San Salvario area on three different measurement days.
Tonality
Tonality$_{DIN}$



SUBJECTIVE ENVIRONMENTAL ANALYSIS

results of research questions on subjective conditions of light, sound and sentiment analysis

This section answers the research questions in part A section 8 related to the subjective aspects investigated. To understand that it was considered both subjective and objective evidences, as explained in part B section 9 and 10. The results were carried out using the statistics tools explained in part B section 11.

Surveys' results

Before the answer to the research questions about the perception of the surrounding environment, graphs were drawn up to clearly explain the answers of the interviewees to the questionnaire. These therefore concern the on-site questionnaire and the relative sections, already mentioned in part B section 10: the questionnaire was divided into four different sections or **Perceived Safety** within which there is the **Perceived Urban Quality**, **Lighting Environment**, **Sound Environment** and **Characteristics of the interviewee**, within which there is the **Wellbeing**. After analyzing these results and answering the research questions about the objective and subjective conditions, the following questionnaires, double-check and social, were analyzed with the aim of comparing them with the first one.

ON-SITE SURVEY RESULTS

Starting from on-site sampling of the questionnaires (n = 124), the gender was divided between 52 females and 72 males, as shown in fig. E15b. More than 48% of people had high level of instruction with bachelor degree certification and 7% had terminated master degree course. The 70% of respondents live in Turin while the remaining population lives outside of the city; the main part are there just passing through (n = 37), other lived in areas where submitted the questionnaire (n = 25), some are there for pleasure reasons (n = 24), for working or studying reasons (n = 30) and the restant for other motivation. Data could also be subdivided into areas Campus Einaudi (n = 34), Passerella Olimpica (n = 16), Parco Dora (n = 39) and San Salvario (n = 35).

After this identification, the individual questions in each section, Perceived Safety with Perceived Urban Quality, Lighting Environment, Sound Environment, Wellbeing and Characteristics of the interviewee, were analyzed to get a clearer picture of the answers. The first two questions, Q1 and Q2, with the last ones from Q18 to A21, are important to identify the characteristics of the interviewee. These include the age (fig. E14a), gender (fig. E14b), level of education (fig. E14c) and place of residences (fig. E14d) of people and also the questions concerning the frequency of use of the place (fig. E14e) which has a majority of people that visit everyday these places and the activities (fig.E14f) whose majority is other or residence.

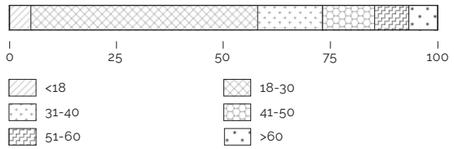


Fig. E14a. age of respondents - Q19 *Gender*

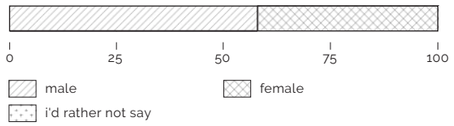


Fig. E14b. gender of respondents - Q18 *Age*

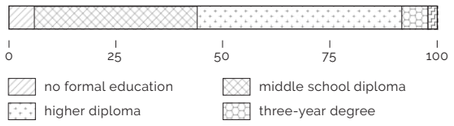


Fig. E14c. education level of respondents - Q20 *Level of education*

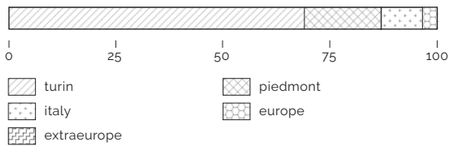


Fig. E14d. place of residence of respondents - Q21 *Place of residence*

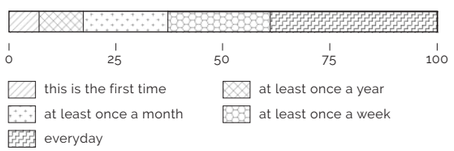


Fig. E14e. frequency of space use of respondents - Q1 *On average, how often do you visit this place?*

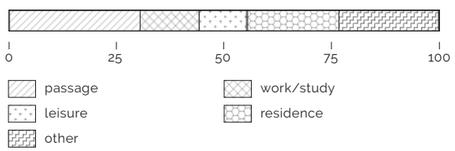
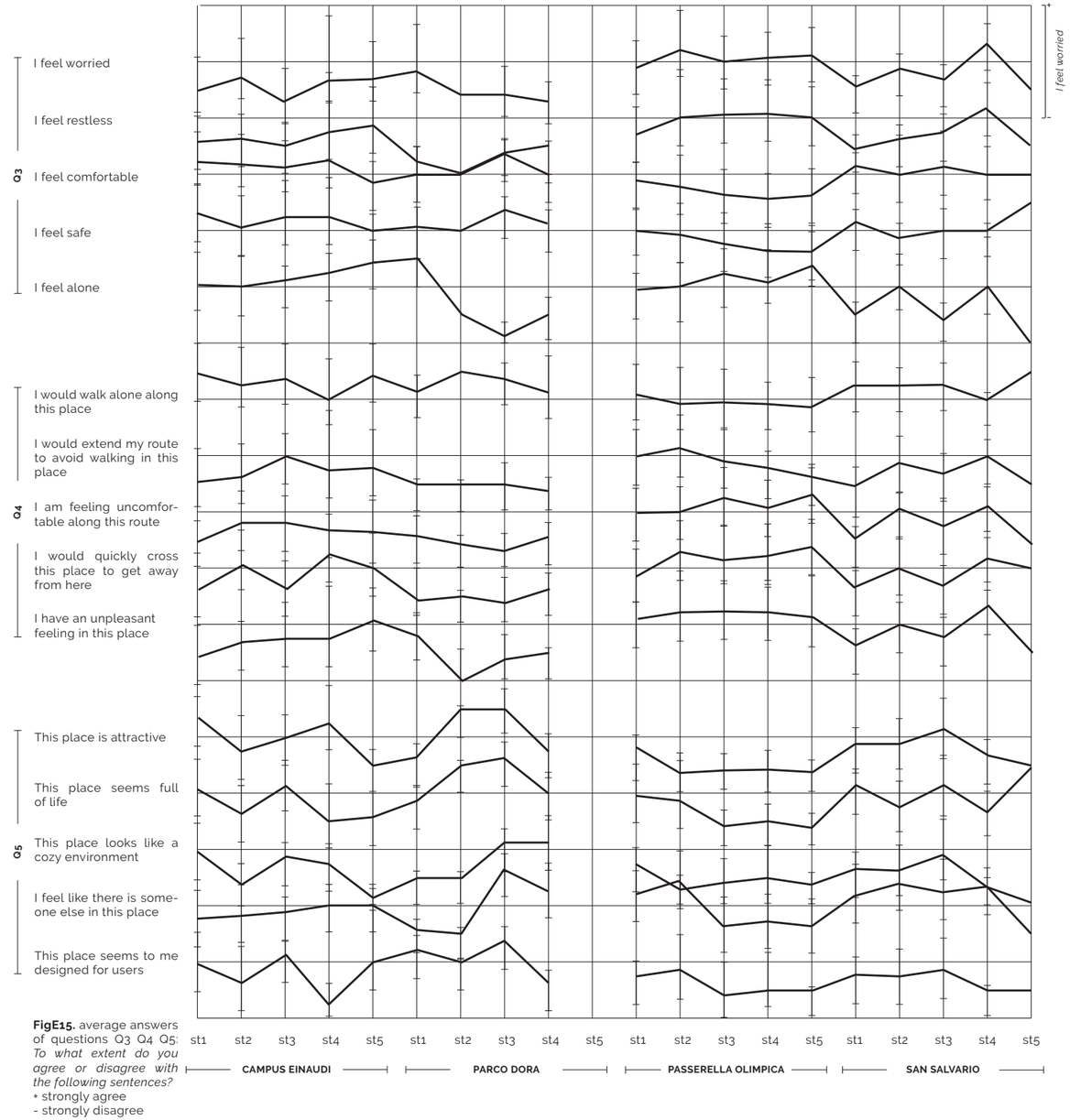


Fig. E14f. activity of respondents - Q2 *What activities do you do in this place?*



FigE15. average answers of questions Q3 Q4 Q5: *To what extent do you agree or disagree with the following sentences?*
+ strongly agree
- strongly disagree

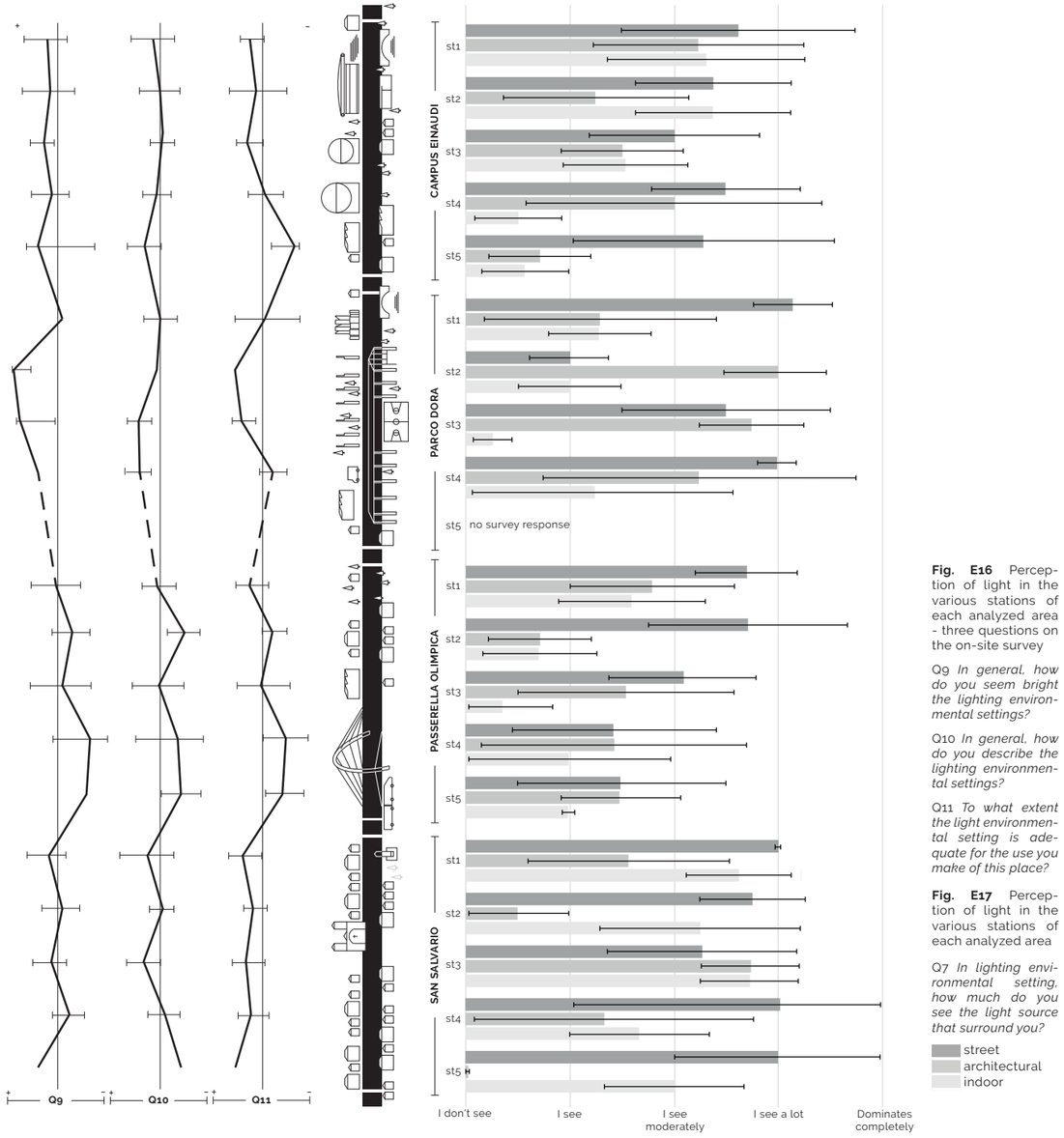


Fig. E16 Perception of light in the various stations of each analyzed area - three questions on the on-site survey

Q9 *In general, how do you seem bright the lighting environmental settings?*

Q10 *In general, how do you describe the lighting environmental settings?*

Q11 *To what extent the light environmental setting is adequate for the use you make of this place?*

Fig. E17 Perception of light in the various stations of each analyzed area

Q7 *In lighting environmental setting, how much do you see the light source that surround you?*

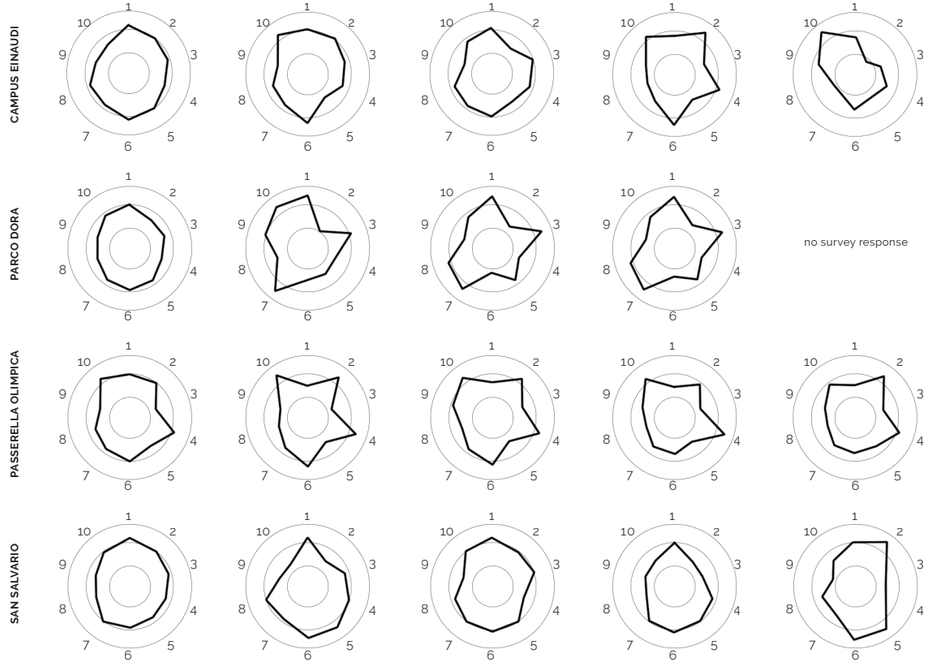


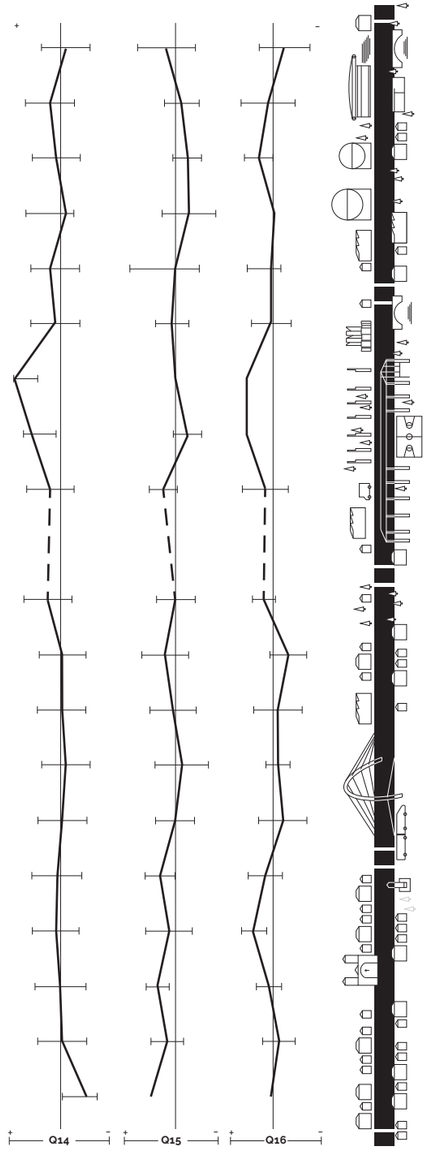
Fig. E18. Perception of light environment of respondents in the various stations of each analyzed area - Q8.

Q8 *To what extent do you agree or disagree with the following sentences about lighting environmental setting characteristics?*

1 pleasant
2 chaotic
3 stimulant
4 gloomy
5 warm
6 monotonous
7 uniform
8 relaxant
9 glaring
10 cold

The section of Perceived Safety, from Q3 to Q6, regarding the safety of the place, in particular the usability, the positive or negative perception of the presence of people and the urban and architectural decay of the place (fig.E15). Perception of safety, such as *I feel worried* is greater in the area of the Passerella Olimpica and about equal in the other areas, while *I feel safe* is greater in Campus Einaudi and Parco Dora. The conservation of the buildings is almost excellent in Parco Dora and it is very bad in the Passerella Olimpica; the other two items also have about the same ratings.

The second section deals with the lighting conditions from Q7 to Q11. Respondents identified the light sources (fig.E17) and defined the environment (fig.E167). The perceived light sources is mainly street lighting in all areas, followed by architectural lighting and lighting from buildings; this latter is greater in San Salvario. Respondents also identify the light environment through ten adjectives, for example the environment is perceived as *gloomy* only in the Passerella Olimpica and in Campus Einaudi even if only little, while it has been defined not at all *relaxing* at the Passerella Olimpica.



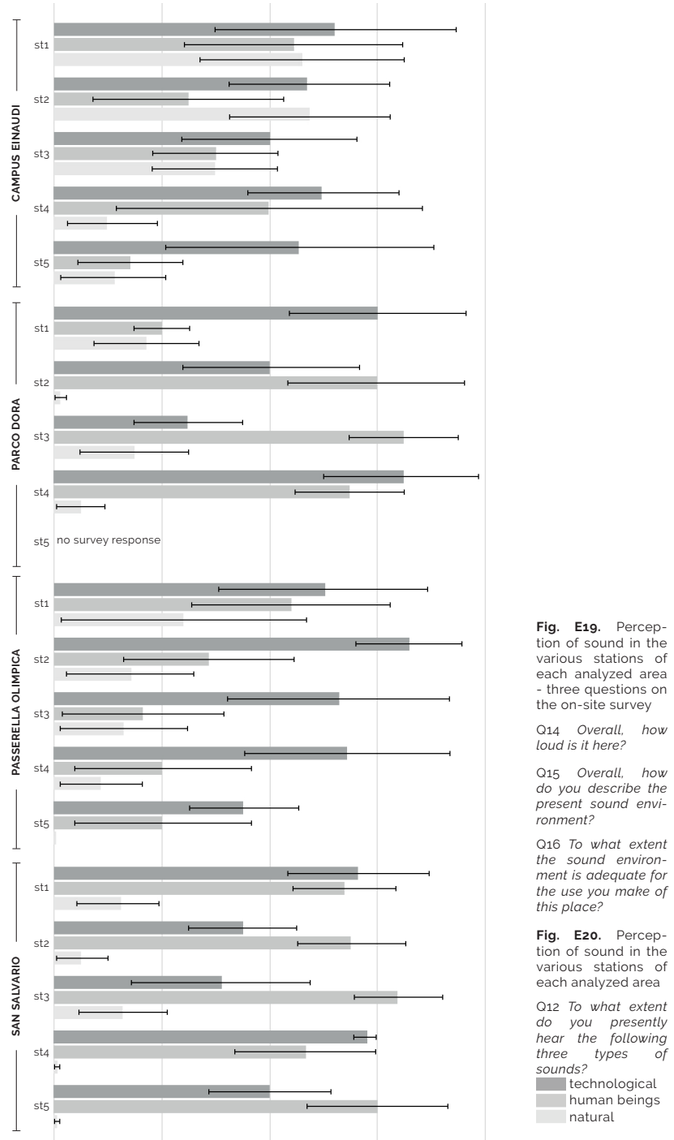


Fig. E19. Perception of sound in the various stations of each analyzed area - three questions on the on-site survey

Q14 *Overall, how loud is it here?*

Q15 *Overall, how do you describe the present sound environment?*

Q16 *To what extent the sound environment is adequate for the use you make of this place?*

Fig. E20. Perception of sound in the various stations of each analyzed area

Q12 *To what extent do you presently hear the following three types of sounds?*

- technological
- human beings
- natural

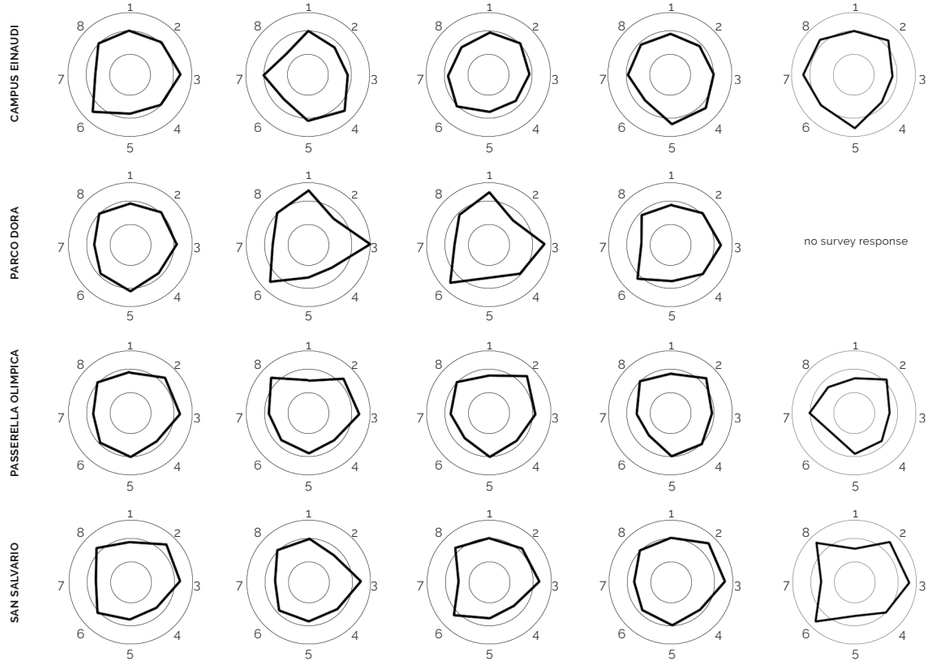


Fig. E21. Perception of sound environment of respondents in the various stations of each analyzed area - Q13.

Q13 *To what extent do you agree or disagree with the following sentences about soundscape characteristics?*

1 pleasant
2 annoying
3 eventful
4 calm
5 monotonous
6 vibrant
7 uneventful
8 chaotic

The general questions about the environment say that the luminous environment (fig.E16) *In general, how do you describe the lighting environmental settings* has values that are almost good and the lighting environment is perceived as quite bright in San Salvario and not bright in Passerella Olimpica. Finally the adequacy is almost good in Parco Dora and it has lower values in other areas.

The next section deals with the sound conditions from question Q12 to Q16. Respondents identified the sound sources (fig. E20): technological sounds are more perceived than others, especially in Passerella Olimpica, even if in the other areas they have a greater value than the other sounds. The anthropic sounds are greater in San Salvario, while the natural ones are greater in Campus Einaudi. Respondents also identify the sound environment through eight adjectives, for example the environment is perceived a little *chaotic* in San Salvario or *eventful* in Parco Dora and San Salvario.

Before asking the research questions, all the items of the questionnaire has been subjected by Principal Component Analysis (PCA), as explained in part B section 11, also the ones of WHO-5 category. World Health Organization guidelines, explained in part A section 3, suggest a method to combine their items into a single normalized well-being score that goes from 0 to 100. But, because the range in answer of this questionnaire go from 1 to 5, rather than base 6 of the WHO-5 items, it was chosen to adopt a more coherent approach with the restant question items using PCA. Only anagraphic items has considered separately because research questions reasons, the necessity to investigate separately the users. Returning to what it has been explained into part B section 11, according with Handle, a PCA with Varimax rotation method was conducted to extrapolate latent values, called factors, by the items with the purpose of verify statistical coherence in questions, find synthetical representation of phenomenon and to have an ease of calculation. The question from Q3 to Q6 (table B1 in part B section 10), has evidenced three independent factors (variance = 63.45% and Kaiser-Meyer-Olkin KMO = .878) as shown in table E10b. Bearing in mind the strong correlation with the type of variables, the fist factor is associated to negative sensations as lack of security or discomfort that people could perceive walking the city. For that reason, the factor is identificated with name of **Perceived Unsafety**. The higher factor value the more people feels insecure, in other way lower value represents safety sensation. The factor two is correlated with loneliness and the possibility that people use a place. It was called **Perceive Social Presence**, the higher factor value the more the place are perceived as comfortable related with other human presence. The last factor is related with urban and architectural decay, waste presence and human centric design in urban place. The higher factor value the more the place are perceived enjoyable, in fact it was defined as **Perceived Urban Quality**.

In same way it was been reduced light questions, from Q7 to Q11 (table B1 in part B section 10), resulting three factors (variance = 53.97%, KMO = .807) The first one is the subjective luminance of a lit scene: the higher factor value the more lighting environmental conditions satisfy the surveyed. It could be explained as the perception of the brightness of the environment. The second factor is the subjective interest in artificial lighting setting, the value increase with increasing of pleasantness and attractiveness of lighting conditions. It explain how lighting patterns and luminance contrasts produce interest respect uniform setting. The last one is the perceived color temperature; it goes from *cold* to *warm* and is correlated with perceived monotonousness of outdoor lighting. As you can see in table E10c, they have a strong correspondence with scientific literature explained in background section, in particular the strong identity with factors found by Loe speaking of quantification of indoor lighting in offices. It was decided to call them respectively **Visual Lightness** (VL), **Visual Interest** (VI) and **Visual Chromaticism** (VC).

Following the previous method, the sound questions from Q12 to Q16 (table B1 in part B section 10) was reduced into other three factors summarized in table E10d (variance = 58.58%, KMO = .744) The first factor, called **Pleasantness of Technological Soundscape** (PTS), indicates the perception of sound environment with decreasing of technological sounds. In fact the higher value the more the environment is perceived as pleasant and more appropriate. The second one, called **Pleasantness of Anthropic Soundscape** (PAS), means the perception of sound environment with increasing of anthropic sounds, the higher value the more the environment is perceived as lively and dynamic. The last factor, called **Pleasantness of Natural Soundscape** (PNS), is the perception of sound environment with increasing of natural sounds, in fact the higher value the more the environment is perceived quiet.

Finally, the last PCA (variance = 53.01%, KMO = .790) reduce wellbeing questions into **Wellbeing factor**, as shown in table E4. It is related with happiness and relax sensation, to the respondent was asked to rate his Well-being thinking the two weeks before the survey submission, as explained in part A section 3.

TOPIC	Q	FACTORS
SAFETY	from Q3 to Q6	Perceived Unsafety
PEOPLE	from Q3 to Q6	Perceived Social Presence
DECAY	from Q3 to Q6	Perceived Urban Quality
LIGHT	from Q7 to Q11	VL, VI, VC
SOUND	from Q12 to Q61	PTS, PAS, PNS
WELLBEING	Q17	wellbeing

Table E9. total of the factors identified by the Principal Component Analysis PCA on the on-site survey.

Table E10a. factor of wellbeing identified with the PCA on question Q17 of on-site survey.

Q17 *Please indicate for each statements which is closet to how you have been feeling over the past two weeks*

Items	wellbeing	
I have felt cheerful and in good spirits	**.847**	Q17
I have felt calm and relaxed	**.747**	
I have felt active and vigorous	**.793**	
I woke up feeling fresh and rested	**.575**	
my daily life has been filled with things that interest me	**.645**	

	ITEMS	PERCEIVED UNSAFETY	PERCEIVED SOCIAL PRESENCE	PERCEIVED URBAN QUALITY
Q3	I feel worried	**.783**	-.166	-.163
	I feel restless	**.779**	-.160	-.239
	I feel comfortable	**-.678**	.288	.354
	I feel safe	**-.731**	.102	.334
	I feel alone	.378	**-.612**	.076
Q4	I would walk alone along this place	**-.759**	-.007	.196
	I would extend my route to avoid walking in this place	**.809**	.079	-.006
	I am feeling uncomfortable along this route	**.804**	-.208	-.193
	I would quickly cross this place to get away from here	**.814**	-.257	-.085
	I have an unpleasant feeling in this place	**.770**	-.290	-.153
Q5	this place is attractive	-.447	**.565**	.264
	this place seems full of life	-.142	**.780**	.266
	this place looks like a cozy environment	-.126	**.816**	.185
	I feel like there is someone else in this place	-.090	**.581**	.307
	this place seems to me designed for users	-.215	.225	**.520**
Q6	maintenance of buildings (decay conditions)	-.180	.234	**.617**
	maintenance of public spaces	-.194	.124	**.864**
	cleaning of public space;	-.180	.127	**.806**

Table E10b. factors identified with the PCA on questions from Q3 to Q6 of on-site survey.

Q3 *To what extent do you agree or disagree with the following sentences? I feel...*

Q4/Q5 *To what extent do you agree or disagree with the following sentences?*

Q6 *How do you describe the elements of the urban context that surround you?*

	ITEMS	VL	VI	VC
Q7	street lighting (eg vehicle seat, sidewalks, cycle paths)	**.523**	.105	.162
	architectural lighting (eg building facades and monuments)	**.499**	.162	-.252
	indoor lighting (eg signs, shop windows, pubs)	.384	.175	-.015
Q8	pleasant	.387	**.671**	-.176
	chaotic	.110	**-.615**	.281
	stimulant	.191	**.672**	-.103
	gloomy	**-.643**	-.248	.403
	warm	.270	.349	**-.683**
	cold	-.039	-.145	**.797**
	glaring	**.581**	-.294	.028
	monotonous	-.025	-138	**.625**
	relaxant	.208	**.807**	.106
	uniform	.187	**.735**	.040
Q9	In general, how do you seem bright the lighting environmental settings?	**.652**	.498	-.134
Q10	In general, how do you describe the lighting environmental settings?	**.826**	.101	-.209
Q11	To what extent the light environmental setting is adequate for the use you make of this place?	**.769**	.329	-.087

Table E10c. factors identified with the PCA on questions from Q7 to Q11 of on-site survey.

Q7 *In lighting environmental setting, how much do you see the light source that surround you?*

Q8 *To what extent do you agree or disagree with the following sentences about lighting environmental setting characteristics?*

Q9 *In general, how do you seem bright the lighting environmental settings?*

Q10 *In general, how do you describe the lighting environmental settings?*

Q11 *To what extent the light environmental setting is adequate for the use you make of this place?*

	ITEMS	PTS	PAS	PNS
Q12	traffic or technological sound (eg car, industry, sirens, construction)	**-.467**	-.102	-.370
Q12	sound from human beings (eg conversation, laughter, footsteps, children at play)	.042	**.686**	.057
Q12	natural sound (eg singing birds, flowing water, wid in vegetation)	.024	.195	**.730**
Q13	pleasant	**.624**	.310	.224
Q13	annoying	**-.633**	.107	-.342
Q13	eventful	-.214	**.757**	-.168
Q13	uneventful	.158	**-.660**	.238
Q13	calm	.183	-.354	**.747**
Q13	chaotic	-.277	.266	**-.681**
Q13	vibrant	.289	**.730**	.182
Q13	monotonous	-.198	**-.699**	.085
Q14	Overall, how loud is it here?	**.874**	.037	.030
Q15	Overall, how do you describe the present sound environment?	**-.588**	.406	-.203
Q16	To what extent the sound environment is adequate for the use you make of this place?	**.821**	.042	-.023

Table E10d. factors identified with the PCA on questions from Q12 to Q16 of on-site survey.

Q12 *To what extent do you presently hear the following three types of sounds?*

Q13 *To what extent do you agree or disagree with the following sentences about soundscape characteristics?*

Q14 *Overall, how loud is it here?*

Q15 *Overall, how do you describe the present sound environment?*

Q16 *To what extent the sound environment is adequate for the use you make of this place?*

As exposed before, in this section there are answers to the research questions; the main point of the investigation is the perceived safety, consequently the analyzed topics (lighting conditions, acoustic conditions, urban and architectural conditions and well-being of the interviewee) are connotate to this central theme, in other words variations on unsafety value are measured and studied.

HOW DOES THE PERCEPTION OF SAFETY CHANGE IN THE AREAS ANALYZED?

The focal point of the investigation was Perceived Unsafety factor identificated before with PCA. Its value goes from -2.08 to 2.60 and globally (n = 124) people tend to feel insecure in this places. Proceeding with separation of the results by area and remembering that the positive value of factor are correlate with unsafety, Parco Dora areas seems to be the most secure perceived place (M = -.479, SD = 1.060) followed by San Salvario (M = .107, SD = .703), Campus Einaudi (M = .262, SD = 1.180), and finally Passerella Olimpica (M = .375, SD = .482) that seems to be the most insecure one.

To further investigate this difference between the areas in analysis a Kruskal-Wallis (p = .005) was made, the result rejected the hypothesis. This last is: :the perceived unsafety distribution is the same between the walk categories and the test reject the null hypothesis. A U-Mann Whitney was thus made between the various areas, the test was performed in pairs of two areas as shown in the table E11.

areas	u-mann whitney	p-value
1 & 2	maintain	p = .868
1 & 3	rejects	p = .006
1 & 4	maintain	p = .195
2 & 3	rejects	p = .005
2 & 4	maintain	p = .300
3 & 4	rejects	p = .013

TableE11. U-Mann Whitney test of Perceived Unsafety factor in different areas of analysis.

1 campus
2 parco dora
3 passerella
4 san salvario

The perception of safety changes according to the areas of analysis: in this case it is greater in the **Parco Dora**, which is perceived as a safe place, and it is smaller in the **Passerella Olimpica**, this last one is considered as the most insecure place among all.

IS THE PERCEPTION OF SAFETY INFLUENCED BY THE TYPE OF USERS?

The first hypothesis was that the personal characteristic of interviewee (residence, gender, education level, age and frequency of use) can affect the perceived safety. A linear regression (R .487, R^2 .238, ANOVA p = .000) was made on the questions Q1 and from Q18 to Q21 that were considered able to respond to the scope (table E12). The global sample (n = 124) shows that the **perceived unsafety decreases with raise in frequency use of space** (β = -.323, SD = .072, p = .000) and **gender** (β = .366, SD = .163, p = .000). To deep understand about gender the sample was divided into two cluster, male (n = 71) and female (n = 53). In general **women are more subjected to feel unsafe** (M = .216, SD = .966) rather than man (M = -.153, SD = 1.00). Normality test of Shapiro-Wilk made a result of .977 in males (p = .216) and .948 in females (p = .022). For each cluster was conducted the same regression explained before and the most evident variation consist into instruction level that for female does not affect the safety (p = .628, β = -.094) but for males have a little impact (p = .211, β = -.166). **Increasing instruction level the males cluster tends to feel more insecure**. Comparison test of averages was made understanding how much frequency of use influences safety. The Kruskal-Wallis test reject the null hypothesis, from the Umann-Whitney test results that **for a frequency of use lower than one a month people feels unsafe** (M = .616, SD = 1.031) more than regular use, from once a week to everyday (M = .098, SD = .793).

Other characteristics has indicated also with those ones without statistical significativity in perceived safety using user characteristics regression. For example age (p = .134) had the subject of Kruskal-Wallis test that reject the null hypothesis.

Q	topic	β	p. value
R .487, R^2 .238, ANOVA p = .000			
Q1	frequency	-.409	**.000**
Q18	age	-.132	.134
Q19	gender	.182	**.026**
Q20	level of education	-.102	.215
Q21	residence	-.114	.183

dependent variable: Perceived Unsafety

The perception of safety varies according to the personal characteristic of interviewee. It changes according to the **frequency of use**, the more people attend the place, the more secure they feel, and it changes according to the **gender**, men are safer than women. While the **level of education** affects only men, the higher the level of education of men, the more insecure they feel.

Table E12. linear regression on the questions Q1 and from Q18 to Q21 with Perceived Unsafety as dependent variable.

Q1 *On average, how often do you visit this place?*

Q18 *Age*

Q19 *Gender*

Q20 *Level of education*

Q21 *Place of residence*

IS THE PERCEPTION OF SAFETY INFLUENCED BY THE PSYCHOLOGICAL WELL-BING OF THE USERS?

In the well-being section of the questionnaire, as mentioned in part A section 3, was asked to indicate for each statements about feeling over the past two weeks. The WHO-5 protocol was used to analyze the wellbeing; this consists only of positive sentences questions and are based on the respondent's feelings over the last two weeks before. For this research it is very important to consider the wellbeing of individuals as this could negatively or positively influence their perception of the surrounding environment, in fact the hypothesis of this thesis' researchers want to suggests that a person may be more subject to negative judge on his safety if he does not respond to an optimal psychophysical condition. Firstly, in a global sampling (n = 124), it was express a **mostly positive rate by people** (M = 1.612, SD = 0.99). Based on the research analyzed in the previous chapters, the answers were divided forcing two clusters and subsequently verifying the variation of the feeling of insecurity. The first one, low well-being (n = 47), have center in -1.064, and the high well-being cluster (n = 77) in 0.649. However, Perceived Unsafety does not seem to be strong influenced by personal well-being. The first cluster seems to suffer more (M = .081, SD = 1.025) than the second (M = -.049, DS = .987), but the results are too much close. In this case it is possible to say that the positive response of the people and the total non-numerous sample did not allow for further investigations.

IS THE PERCEPTION OF SAFETY INFLUENCED BY THE URBAN AND ARCHITECTURAL QUALITY? AND BY THE PERCEIVED SOCIAL PRESENCE?

This research questions, that seem to be very distant in their conception, was analyzed in the same chapter because valuation method reason. The urban and architectural quality and the social presence in cases study need correlation test and linear regression that estimate safety perception. The previous explained PCA fators have been calculated to be independent each other by the method as most as possible. For this reason another PCA was necessary to build alternative factors: **alternative perceived unsafety** (a.1) for question Q3 and Q4 (variance = 61,39%), **alternative perceived Social Presence** (a.2) for question Q5 (variance = 53,73%) and **alternative perceived Urban Quality** (a.3) using item of question Q6 (variance = 71,15%), as shown in table E13a. The correlations was conducted between these alternative factors and it have reported a high correlation between all of its. Unsafety and Social Presence are the most correlated (pearson = -.502) but also the Urban Quality (pearson = .501).To further investigate perceived urban quality and social presence, data of complaints in 2017 provided by the Department of Technological Investigations were used. These are divided into three categories: **social alarm**, **civil cohabitation** and **urban quality**. For each of these categories, those exposed in the various areas analyzed were identified, as can be seen in Part C. These data were subsequently correlated in table E13b with the data of the on-site survey to fully understand the perception of safety. this shows us that the perception of security is influenced by the number of total complaints of the neighborhood, in particular by civil cohabitation and urban quality.

The perception of safety varies according to urban and architectural quality and to the social presence. In fact the higher is the perceived urban quality and the more people feel safe, while the greater is the perception of social presence and greater is the perception of safety.

		a.1	a.2	a.3
a.1	pearson sig.2code	1 -	**-.502** **.000**	**-.455** **.000**

Table E13a. correlation of alternative factors from a Principal Component Analysis PCA.

a.1 alternative perceived unsafety

a.2 alternative social presence

a.3 alternative urban quality

		a.1	a.2	a.3	compl.	social alarm	civil cohab.	urban quality	compl.	social alarm	civil cohab.	urban quality
a.1	pearson	1	.000	.000	**-.271**	-.119	**-.279**	**-.155**	.131	**.168**	**.167**	.058
	sig.2	-	1.000	1.000	**.002**	.190	**.002**	**.086**	.146	**.061**	**.064**	.524
					total neighborhoods				districts analyzed			

Table E13b. correlation of alternative factors and complaints in 2017.

a.1 alternative perceived unsafety

a.2 alternative social presence

a.3 alternative urban quality

Table E14. factors identified with the PCA on questions from Q3 to Q6 of on-site survey.

Q3 *To what extent do you agree or disagree with the following sentences? I feel...*

Q4/Q5 *To what extent do you agree or disagree with the following sentences?*

Q6 *How do you describe the elements of the urban context that surround you?*

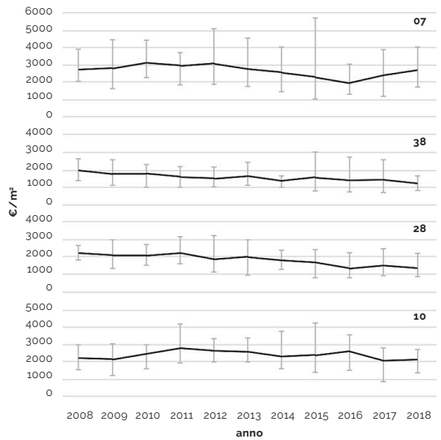
ITEMS	a.1	
I feel worried	**.671**	Q3
I feel restless	**.695**	
I feel comfortable	**.632**	
I feel safe	**.648**	
I feel alone	.262	
I would walk alone along this place	**.574**	Q4
I would extend my route to avoid walking in this place	**.539**	
I am feeling uncomfortable along this route	**.712**	
I would quickly cross this place to get away from here	**.717**	
I have an unpleasant feeling in this place	**.690**	

ITEMS	a.2	
this place is attractive	**.596**	Q5
this place seems full of life	**.749**	
this place looks like a cozy environment	**.697**	
I feel like there is someone else in this place	.280	
this place seems to me designed for users	.384	

ITEMS	a.3	
maintenance of buildings (decay conditions)	**.779**	Q6
maintenance of public spaces	**.873**	
cleaning of public space	**.874**	

IS THE PERCEPTION OF SAFETY INFLUENCED BY SQUARE METER PRICE?

Because the background evidences in socioeconomic implication on perception, it was considered useful implement the square meter price in the correlation database. The values was observed by Turin *real estate market observatory* of the city of Turin (OICT) website, a public tool that collect data on the dynamics, structure and characteristics of the real estate market. Under Microzone and Value section it was possible recover data on 07-Vanchiglia, 38-Corona Nord Ovest, 28-Lingotto and 10-San Salvario. It was taken into account the square meter prize in €/m² for new construction and restructured houses. The correlation showed that **Perceived Urban Quality** is correlated in significative way (p = .003, pearson = .269). Also **Perceived Unsafety** was coherently correlated with price, as the price increases, the insecurity of the people interviewed decreases (p = .016, pearson = -.215).



		price new construction	price restructured construction
		€/m2	*€/m2*
07	Vanchiglia	3181	2625
38	Corona (Parco Dora)	2015	1233
28	Lingotto	2914	1393
10	San Salvario	2780	2070

		price new construction	price restructured construction
Uns.	pearson	.099	**-.215**
	sig.2code	.274	**.016**
Soc.	pearson	-.153	-.240
	sig.2code	.090	.793
Urb.	pearson	-.176	**.269**
	sig.2code	.051	**.003**

The perception of safety varies according to square meter price: in fact the higher is the value of the price per square meter the more people are safe, and the higher the price per square meter, the higher is the perceived urban quality.

Fig. E22. price trend in the areas analyzed during the last ten years, data of real estate market of the microzones. *real estate market observatory of the City of Turin.*

07 - Vanchiglia
38 - Parco Dora
28 - Lingotto
10 - San Salvario

Table E15. data of real estate market of the microzones in analysis - *real estate market observatory of the City of Turin.*

Table E16. correlation of factors Perceived Unsafety, Perceived Social Presence and Perceived Urban Quality and real estate market data.

IS THE PERCEPTION OF SAFETY INFLUENCED BY AVERAGE HOURLY PRESENCE OF PEOPLE?

In order to analyze the average hourly presence of people in the analyzed areas, the data provided by the City of Turin through the TIM Big Data Value software, explained in part B section 9, was used. A bivariate correlation was first made between the Perceived Unsafety factor and the data detected by the SIMs through the software. This showed a correlation between Perceived Unsafety and **Commuters** (p = .023, pearson = .375) and **Visitors** (p = .051, pearson = .349). The data provided are not non-continuous data, in fact in certain time bands the data are not available, as can be seen in the Appendix. Another limitation is represented by the lack adequacy of data for the scope of the research. In fact, because the globality in a certain square area, it is not possible to define exactly the outdoor or streete ones rather than indoor SIM presence. On the basis of the evidenced limits, a **number of residents** has been hypothesized for all the areas because these last are homogeneous; therefore separated correlations by areas have been carried out in order to automatic exclude residents. Following this further idea separate regressions was performed to identificate variation in p. value for each **category of social presence**. Because the problematics of data explained above, the result did not reach a satisfactory results. The hypothesis is that it is possible to obtain better ones deepening the analysis through a more detailed extrapolation of SIM data by more accurate use of TIM Big Data .

topic	β	p. value
R .459, R^2 .211		
average hourly presence of people	.011	.179
male	-3.988	.197
female	-7.437	**.095**
residents	.769	.349
commuters	.375	**.023**
extra-regional visitors	.349	**.051**
intra-regional visitors	.611	.116
foreign visitors	-.274	.109

dependent variable: Perceived Unsafety

Table E17. linear regression on the average hourly presence of people with Perceived Unsafety as dependent variable.

IS THE PERCEPTION OF SAFETY INFLUENCED BY THE PERCEIVED CHARACTERISTICS OF LIGHT?

Based on identificated lighting factors through PCA analysis, Visual Lightness VL, Visual Interest VI and Visual Chromaticism VC, a linear regression was made (R .486, R^2 .236).

This shows that the **perceived unsafety is more explained by Visual Lightness** (p = .001, β = -.271) and **Visual Interest** (p = .000, β = -.395), this shows us that when Visual Lightness and Visual Interest are greater, the perception of unsafety is lower.

Finally, the three perceived factors (perceived unsafety, perceived social presence and perceived urban quality) were correlated with the light ones (visual lightness VL, visual interest VI and visual chromaticism VC). This shows that **Perceived Unsafety is negatively related to Visual Lightness** (p = .000, pearson = -.271) **and Visual Interest** (p = .000, pearson = -.395), therefore the higher the perceived value of Visual Lightness and Visual Interest the greater is the perceived safety. While **Perceived Social Presence is positively correlated with Visual Interest** (p = .009, pearson = .233) **and negatively correlated with Visual Chromaticism** (p = .000, pearson = -.390). So the higher the value of social presence perception, the greater the value of Visual Interest and the lower the value of Visual Chromaticism. **Perceived Urban Quality is positively correlated with the Visual Lightness** (p = .000, pearson = .326) **and with Visual Interest** (p = .000, pearson = -.395).

		β	p. value
R .486, R^2 .236			
VL		-.271	**.001**
VI		-.395	**.000**
VC		.086	.284

dependent variable: Perceived Unsafety

		p. unsafety	p. social presence	p. urban quality
VL	pearson	**-.271**	.186	**.326**
	sig.2code	**.002**	.039	**.000**
VI	pearson	**-.395**	**.233**	**.261**
	sig.2code	**.000**	**.009**	**.003**
VC	pearson	.086	**-.390**	-.070
	sig.2code	.343	**.000**	.442

The perception of safety varies according to the perceived characteristic of light, in particular the higher the value of **Visual Lightness** and of **Visual Interest** the more people feel safer. Visual Lightness is negatively correlated with the Perceived Unsafety, that is the more Visual Lightness is present and the more people feel safe. The same for Visual Interest.

Table E18. linear regression on the perceived factors of light (Visual Lightness VL, Visual Interest VI, Visual Chromaticism VC) with Perceived Unsafety as dependent variable.

Table E19. correlation of perceived factors of Unsafety, Social Presence and Urban Quality and perceived factors of light (Visual Lightness VL, Visual Interest VI, Visual Chromaticism VC).

IS THE PERCEPTION OF SAFETY INFLUENCED BY THE PERCEIVED CHARACTERISTICS OF SOUND?

Based on identificated sound factors through PCA analysis, Pleasantness of Technological Soundscape PTS, Pleasantness of Anthropic Soundscape PAS e Pleasantness of Natural Soundscape PNS, a linear regression was made (R .264, R^2 .046). Only the first sound factor **pleasantness of technological soundscape influence significantly the perception of safety** (p = .016, β = -.211), so the higher PTS value the lower is the perception of safety.

Finally, the three factors Perceived Unsafety, Perceived Urban Quality and Perceived Social Presence were correlated with the perception of sound. This shows that **Perceived Unsafety is negatively correlated with Pleasantness of Technological Soundscape** (p = .016, pearson = -.216), so the higher PTS value the lower is the perception of safety. While **Perceived Social Presence is positively related to Pleasantness of Anthropic Soundscape** (p = .000, pearson = .523), so obviously the greater the perception of PAS the greater the perception of social presence. **Perceived Urban Quality is positively correlated with the Pleasantness of Technological Soundscape** (p = .060, pearson = .170) **and Pleasantness of Anthropic Soundscape** (p = .067, pearson = .165), therefore the more the perception of PTS and PAS increases the more urban quality is perceived.

		β	p. value
R .246, R^2 .046			
PTS		-.211	**.016**
PAS		-.082	.355
PNS		-.128	.148

dependent variable: Perceived Unsafety

		p. unsafety	p. social presence	p. urban quality
PTS	pearson	**-.216**	.127	**.170**
	sig.2code	**.016**	.162	**.060**
PAS	pearson	-.082	**.523**	.165
	sig.2code	.367	**.000**	.067
PNS	pearson	-.128	.033	.140
	sig.2code	.155	.717	.121

Table E20. linear regression on the perceived factors of sound (Pleasantness of Technological Soundscape PTS, Pleasantness of Anthropic Soundscape PAS, Pleasantness of Natural Soundscape PNS) with Perceived Unsafety as dependent variable.

Table E21. correlation of perceived factors of Unsafety, Scial Presence and Urban Quality and perceived factors of sound (Pleasantness of Technological Soundscape PTS, Pleasantness of Anthropic Soundscape PAS, Pleasantness of Natural Soundscape PNS).

The perception of safety varies according to the perceived characteristic of sound, in particular the higher the value of **PTS** the more people feel insicure, so **PTS is negatively correlated with Perceived Unsafety**.

Futhermore **PAS** is positively correlated with Perceived Social Presence and Perceived Urban Quality.

CAN THE PERCEIVED SAFETY BE ESTIMATED STARTING BY OTHER PERCEIVED FACTORS?

Until now, the study focalize its attention on the perception factors of PCA, before passing to objective investigation the researches of this thesis want to estimate the perceived safety based on other factors. For this aim, in order to best estimate the Perceived Unsafety phenomenon all variables considered so far has been conducted. Also in this case the alternative factors a.1, a.2 and a.3 shown in the previous pages, have been used so as to be able to insert them in the same regression. This regression (R .672, R^2 .451, ANOVA p = .000) shows that the **Perceived Unsafety is explained by alternative Perceived Social Presence** (p = .025, β = -.239), **PAS** (p = .086, β = -.155) **Visual Lightness** (p = .001, β = -.395) and **Visual Interest** (p = .000, β = -.395). This regression is very broad and still needs more investigation, therefore further indagation can be object of future research.

	β	p. value
R .672, R^2 .451, ANOVA p = .000		
alternative social presence	-.239	**.025**
alternative urban quality	-.122	.164
PTS	.091	.295
PAS	.155	**.086**
PNS	-.016	.839
VL	-.293	**.001**
VI	-.395	**.000**
VC	.122	.152
wellbeing	-.108	.165

dependent variable: Alternative Perceived Unsafety

Table E22. linear regression on all the perceived factors of this research with Perceived Unsafety as dependent variable.

The perception of safety varies according to different factors, in particular is negatively related to alternative Social Presence, Visual Lightness and Visual Interest and positively to Pleasantness of Anthropic Soundscape. So as the perception of Social Presence, Visual Lightness and Visual Interest increases, the perception of insecurity is reduced and people feel safer.

IS THE OBJECTIVE CHARACTERISTICS OF LIGHT CORRELATED WITH THE SUBJECTIVE CHARACTERISTICS OF PERCEIVED LIGHT?

Before answering the research question, a correlation was made between the **objective factors themselves** shown in table E23a E23b so as to eliminate the factors that explain the phenomenon in the same way. For Illuminance values are average horizontal illuminance $\mathbf{E_{m,h}}$ vertical illuminance $\mathbf{E_{min,v}}$ and overall uniformity $\mathbf{U_o}$ while for 40 horizontal band values are average luminance $\mathbf{L_{m,40°h}}$ and min luminance $\mathbf{L_{min,40°h}}$ For Elements values are pedestrian path dispersion $\mathbf{D_{pp}}$ vertical near elements dispersion $\mathbf{D_{vn}}$ and min vertical far elements luminance $\mathbf{L_{min,vn}}$ while for Fixed regions values are average central 20 degree circle luminance $\mathbf{L_{m,20°c}}$ central 20 degree circle dispersion $\mathbf{D_{20°c}}$ max bottom region luminance $\mathbf{L_{max,bt}}$ and min lateral luminance $\mathbf{L_{min,lt}}$ All factors are all explained in detail in part B section 9.

After this correlation between the objective parameters a further correlation was made with the identified light factors or Visual Lightness VL, Visual Interest VI and Visual Chromaticism VC. Visual Lightness **VL is positively correlated with Average 40 Luminance $\mathbf{L_{m,40}}$** (p = .011, pearson .228), **Vertical Near min $\mathbf{L_{min,-VN}}$** (p = .042, pearson .241), **Central 20 degree average luminance $\mathbf{L_{m,20c}}$** (p = .048, pearson .178) and negatively with **Pedestrian Path Dispersion $\mathbf{Disp_{pp}}$** (p = .009, pearson -.234). Visual Chromaticism **VC is positively correlated with Overall uniformity $\mathbf{U_o}$** (p = .005, pearson .251).

Three different regressions were subsequently performed. Visual Lightness **VL** (R .544, R^2 .296) and Visual Interest **VI** (R .451, R^2 .204) do not appear to be related to any of the parameters entered, Visual Chromaticism **VC** (R .493, R^2 .243) is positively related to **overall uniformity** (p = .002, β = .552).

The objective characteristic of light are correlated with the subjective ones.

VL is positively correlated with Average 40 Luminance, Vertical Near min, Central 20 degree average luminance and negatively with Pedestrian Path Dispersion. VC is positively correlated with Overall uniformity, so when the latter increases also the perception of Visual Chromaticism increases.

		$E_{m,h}$	$E_{min,h}$	$E_{min,v}$	U_o	$L_{m,40°h}$	D_{40h}	$L_{max,40°}$	$L_{min,40°h}$	$L_{m,pp}$	D_{pp}	$L_{max,pp}$	$L_{min,pp}$	$L_{m,vn}$	D_{vn}	$L_{max,vn}$	$L_{min,vn}$	$L_{m,vf}$	D_{vf}	$L_{max,vf}$	$L_{min,vf}$	$L_{m,20°c}$	$D_{20°c}$	$L_{max,20°c}$	$L_{min,20°c}$	$L_{m,bt}$	D_{bt}	$L_{max,bt}$	$L_{min,bt}$	$L_{m,lt}$	D_{lt}	$L_{max,lt}$	$L_{min,lt}$
$E_{m,h}$	pearson	1	.980	.300	.523	.580	.106	.305	.193	.886	.415	.126	.781	.295	.066	.319	.202	.329	.045	.267	.345	.517	.308	.272	.168	.844	.452	.085	.701	.440	-.013	.330	.022
	sig.2code	-	.000	.001	.000	.000	.240	.001	.032	.000	.000	.164	.000	.012	.581	.006	.089	.000	.632	.004	.000	.000	.000	.002	.062	.000	.000	.347	.000	.000	.887	.000	.807
$E_{min,h}$	pearson	.980	1	.300	.569	.501	.074	.280	.231	.870	.414	.068	.739	.176	-.019	.301	.138	.246	-.010	.256	.253	.393	.223	.249	.048	.820	.468	.120	.643	.361	-.026	.307	.046
	sig.2code	.000	-	.001	.000	.000	.415	.002	.010	.000	.000	.450	.000	.139	.872	.010	.248	.008	.915	.006	.006	.000	.013	.005	.600	.000	.000	.183	.000	.000	.775	.001	.611
$E_{min,v}$	pearson	.300	.300	1	.397	.675	.698	.748	-.056	.453	.100	.094	.311	.436	.483	.786	.684	.568	.708	.776	.250	.285	.588	.745	.466	.479	.214	.190	.363	.643	.643	.754	.074
	sig.2code	.001	.001	-	.000	.000	.000	.000	.534	.000	.269	.298	.000	.000	.000	.000	.000	.000	.000	.000	.007	.001	.000	.000	.000	.000	.017	.034	.000	.000	.000	.000	.412
U_o	pearson	.523	.569	.397	1	.378	.218	.343	.290	.532	.079	-.071	.493	.150	.118	.319	.271	.224	.167	.336	.116	.213	.245	.313	.080	.511	.152	.133	.370	.308	.180	.347	.227
	sig.2code	.000	.000	.000	-	.000	.015	.000	.001	.000	.384	.433	.000	.208	.323	.006	.021	.016	.073	.000	.216	.018	.006	.000	.377	.000	.092	.141	.000	.001	.045	.000	.011
$L_{m,40°h}$	pearson	.580	.501	.675	.378	1	.763	.800	-.060	.652	.352	.417	.540	.861	.695	.804	.747	.799	.769	.777	.485	.677	.695	.771	.703	.669	.369	.183	.521	.950	.669	.804	.178
	sig.2code	.000	.000	.000	.000	-	.000	.000	.510	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.042	.000	.000	.000	.000	.048
D_{40h}	pearson	.106	.074	.698	.218	.763	1	.904	-.205	.203	.161	.362	.159	.747	.868	.888	.625	.567	.896	.890	.298	.247	.648	.899	.604	.205	.249	.379	.189	.802	.960	.909	.073
	sig.2code	.240	.415	.000	.015	.000	-	.000	.022	.024	.075	.000	.078	.000	.000	.000	.000	.000	.000	.000	.001	.006	.000	.000	.000	.023	.005	.000	.035	.000	.000	.000	.418
$L_{max,40°}$	pearson	.305	.280	.748	.343	.800	.904	1	-.131	.407	.261	.321	.353	.642	.783	.933	.643	.631	.818	.926	.447	.295	.580	.951	.580	.393	.415	.499	.343	.826	.887	.969	.169
	sig.2code	.001	.002	.000	.000	.000	.000	-	.146	.000	.003	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.001	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.061
$L_{min,40°h}$	pearson	.193	.231	-.056	.290	-.060	-.205	-.131	1	.106	.001	-.101	.126	-.016	-.232	-.130	.020	-.059	-.111	-.207	-.072	-.071	-.262	-.239	-.018	.079	-.045	-.165	.057	-.130	-.209	-.173	.378
	sig.2code	.032	.010	.534	.001	.510	.022	.146	-	.242	.992	.263	.164	.893	.050	.276	.866	.532	.236	.026	.445	.435	.003	.008	.846	.381	.619	.067	.530	.149	.020	.055	.000
$L_{m,pp}$	pearson	.886	.870	.453	.532	.652	.203	.407	.106	1	.511	.240	.775	.198	-.013	.390	.283	.472	.160	.421	.294	.620	.485	.400	.249	.987	.554	.151	.667	.477	.073	.449	.003
	sig.2code	.000	.000	.000	.000	.000	.024	.000	.242	-	.000	.007	.000	.096	.913	.001	.016	.000	.086	.000	.001	.000	.000	.000	.005	.000	.000	.094	.000	.000	.418	.000	.977
D_{pp}	pearson	.415	.414	.100	.079	.352	.161	.261	.001	.511	1	.773	.331	.206	.004	.249	.009	.066	-.030	.245	.338	.218	.194	.304	.219	.509	.899	.408	.283	.271	.091	.312	.007
	sig.2code	.000	.000	.269	.384	.000	.075	.003	.992	.000	-	.000	.000	.082	.973	.035	.942	.480	.752	.008	.000	.015	.031	.001	.014	.000	.000	.000	.001	.002	.314	.000	.943
$L_{max,pp}$	pearson	.126	.068	.094	-.071	.417	.362	.321	-.101	.240	.773	1	.144	.458	.316	.281	.119	.161	.181	.246	.151	.304	.330	.324	.500	.277	.667	.346	.159	.377	.307	.323	-.022
	sig.2code	.164	.450	.298	.433	.000	.000	.000	.263	.007	.000	-	.111	.000	.007	.017	.320	.085	.051	.008	.105	.001	.000	.000	.000	.002	.000	.000	.077	.000	.001	.000	.812
$L_{min,pp}$	pearson	.781	.739	.311	.493	.540	.159	.353	.126	.775	.331	.144	1	.152	-.030	.193	.421	.266	.085	.248	.528	.429	.289	.322	.164	.765	.279	-.067	.899	.452	.049	.363	.021
	sig.2code	.000	.000	.000	.000	.000	.078	.000	.164	.000	.000	.111	-	.203	.802	.104	.000	.004	.366	.007	.000	.000	.001	.000	.069	.000	.002	.457	.000	.000	.587	.000	.815
$L_{m,vn}$	pearson	.295	.176	.436	.150	.861	.747	.642	-.016	.198	.206	.458	.152	1	.846	.704	.620	.509	.742	.633	.279	.462	.656	.608	.822	.202	.180	.202	.204	.875	.672	.640	.112
	sig.2code	.012	.139	.000	.208	.000	.000	.000	.893	.096	.082	.000	.203	-	.000	.000	.000	.000	.000	.000	.024	.000	.000	.000	.000	.089	.130	.089	.086	.000	.000	.000	.349
D_{vn}	pearson	.066	-.019	.483	.118	.695	.868	.783	-.232	-.013	.004	.316	-.030	.846	1	.777	.444	.441	.778	.728	.141	.264	.664	.751	.693	-.038	.135	.440	.105	.807	.871	.760	-.092
	sig.2code	.581	.872	.000	.323	.000	.000	.000	.050	.913	.973	.007	.802	.000	-	.000	.000	.000	.000	.000	.261	.025	.000	.000	.000	.753	.259	.000	.380	.000	.000	.000	.441
$L_{max,vn}$	pearson	.319	.301	.786	.319	.804	.888	.933	-.130	.390	.249	.281	.193	.704	.777	1	.616	.637	.830	.964	.309	.307	.776	.968	.615	.367	.411	.507	.347	.838	.862	.966	-.031
	sig.2code	.006	.010	.000	.006	.000	.000	.000	.276	.001	.035	.017	.104	.000	.000	-	.000	.000	.000	.000	.012	.009	.000	.000	.000	.002	.000	.000	.003	.000	.000	.000	.794
$L_{min,vn}$	pearson	.202	.138	.684	.271	.747	.625	.643	.020	.283	.009	.119	.421	.620	.444	.616	1	.650	.738	.642	.455	.295	.497	.596	.553	.350	-.058	-.055	.548	.745	.547	.593	.256
	sig.2code	.089	.248	.000	.021	.000	.000	.000	.866	.016	.942	.320	.000	.000	.000	.000	-	.000	.000	.000	.000	.012	.000	.000	.000	.003	.629	.644	.000	.000	.000	.000	.030

Table E23a. correlation of the objective factors themselves

		$E_{m,h}$	$E_{min,h}$	$E_{min,v}$	U_o	$L_{m,40°h}$	D_{40h}	$L_{max,40°}$	$L_{min,40°h}$	$L_{m,pp}$	D_{pp}	$L_{max,pp}$	$L_{min,pp}$	$L_{m,vn}$	D_{vn}	$L_{max,vn}$	$L_{min,vn}$	$L_{m,vf}$	D_{vf}	$L_{max,vf}$	$L_{min,vf}$	$L_{m,20°c}$	$D_{20°c}$	$L_{max,20°c}$	$L_{min,20°c}$	$L_{m,bt}$	D_{bt}	$L_{max,bt}$	$L_{min,bt}$	$L_{m,lt}$	D_{lt}	$L_{max,lt}$	$L_{min,lt}$
$L_{m,vf}$	pearson	.329	.246	.568	.224	.799	.567	.631	-.059	.472	.066	.161	.266	.509	.441	.637	.650	1	.733	.615	.324	.694	.504	.600	.649	.518	.136	.028	.321	.778	.533	.609	.213
	sig.2code	.000	.008	.000	.016	.000	.000	.000	.532	.000	.480	.085	.004	.000	.000	.000	.000	-	.000	.000	.000	.000	.000	.000	.000	.000	.145	.765	.000	.000	.000	.000	.021
D_{vf}	pearson	.045	-.010	.708	.167	.769	.896	.818	-.111	.160	-.030	.181	.085	.742	.788	.830	.738	.733	1	.846	.257	.312	.563	.797	.730	.180	.027	.132	.130	.797	.884	.801	.202
	sig.2code	.632	.915	.000	.073	.000	.000	.000	.236	.086	.752	.051	.366	.000	.000	.000	.000	.000	-	.000	.005	.001	.000	.000	.000	.054	.776	.156	.164	.000	.000	.000	.030
$L_{max,vf}$	pearson	.267	.256	.776	.336	.777	.890	.926	-.2'7	.421	.245	.246	.248	.633	.728	.964	.642	.615	.846	1	.397	.280	.660	.967	.577	.399	.390	.462	.225	.778	.866	.950	.165
	sig.2code	.004	.006	.000	.000	.000	.000	.000	.026	.000	.008	.008	.007	.000	.000	.000	.000	.000	.000	-	.000	.002	.000	.000	.000	.000	.000	.000	.015	.000	.000	.000	.077
$L_{min,vf}$	pearson	.345	.253	.250	.116	.485	.298	.447	-.072	.294	.338	.151	.528	.279	.141	.309	.455	.324	.257	.397	1	.183	.137	.465	.307	.280	.248	.027	.473	.545	.279	.465	.239
	sig.2code	.000	.006	.007	.216	.000	.001	.000	445	.001	.000	.105	.000	.024	.261	.012	.000	.000	.005	.000	-	.050	.143	.000	.001	.002	.007	.774	.000	.000	.002	.000	.010
$L_{m,20°c}$	pearson	.517	.393	.285	.213	.677	.247	.295	-.071	.620	.218	.304	.429	.462	.264	.307	.295	.694	.312	.280	.183	1	.675	.300	.573	.654	.270	.059	.448	.561	.127	.321	-.134
	sig.2code	.000	.000	.001	.018	.000	.006	.001	.435	.000	.015	.001	.000	.000	.025	.009	.012	.000	.001	.002	.050	-	.000	.001	.000	.000	.002	.517	.000	.000	.161	.000	.138
$D_{20°c}$	pearson	.308	.223	.588	.245	.695	.648	.580	-.262	.485	.194	.330	.289	.656	.664	.776	.497	.504	.563	.660	.137	.675	1	.683	.543	.504	.300	.317	.358	.620	.514	.648	-.212
	sig.2code	.000	.013	.000	.006	.000	.000	.000	.003	.000	.031	.000	.001	.000	.000	.000	.000	.000	.000	.000	.143	.000	-	.000	.000	.000	.001	.000	.000	.000	.000	.000	.018
$L_{max,20°c}$	pearson	.272	.249	.745	.313	.771	.899	.951	-.239	.400	.304	324	.322	.608	.751	.968	.596	.600	.797	.967	.465	.300	.683	1	.527	.388	.452	.519	.328	.809	.874	.978	.128
	sig.2code	.002	.005	.000	.000	.000	.000	.000	.008	.000	.001	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.001	.000	-	.000	.000	.000	.000	.000	.000	.000	.000	.158
$L_{min,20°c}$	pearson	.168	.048	.466	.080	.703	.604	.580	-.018	.249	.219	.500	.164	.822	.693	.615	.553	.649	.730	.577	.307	.573	.543	.527	1	.278	.188	.042	.193	.670	.537	.553	-.011
	sig.2code	.062	.600	.000	.377	.000	.000	.000	.846	.005	.014	.000	.069	.000	.000	.000	.000	.000	.000	.000	.001	.000	.000	.000	-	.002	.037	.646	.031	.000	.000	.000	.903
$L_{m,bt}$	pearson	.844	.820	.479	.511	.669	.205	.393	.079	.987	.509	.277	.765	.202	-.038	.367	.350	.518	.180	.399	.280	.654	.504	.388	.278	1	.526	.092	.675	.494	.069	.429	.004
	sig.2code	.000	.000	.000	.000	.000	.023	.000	.381	.000	.000	.002	.000	.089	.753	.002	.003	.000	.054	.000	.002	.000	.000	.000	.002	-	.000	.308	.000	.000	.448	.000	.961
D_{bt}	pearson	.452	.468	.214	.152	.369	.249	.415	-.045	.554	.899	.667	.279	.180	.135	.411	-.058	.136	.027	.390	.248	.270	.300	.452	.188	.526	1	.707	.207	.303	.219	.461	-.015
	sig.2code	.000	.000	.017	.092	.000	.005	.000	.619	.000	.000	.000	.002	.130	.259	.000	.629	.145	.776	.000	.007	.002	.001	.000	.037	.000	-	.000	.021	.001	.015	.000	.865
$L_{max,bt}$	pearson	.085	.120	.190	.133	.183	.379	.499	-.165	.151	.408	.346	-.067	.202	.440	.507	-.055	.028	.132	.462	.027	.059	.317	.519	.042	.092	.707	1	-.142	.207	.430	.509	.038
	sig.2code	.347	.183	.034	.141	.042	.000	.000	.067	.094	.000	.000	.457	.089	.000	.000	.644	.765	.156	.000	.774	.517	.000	.000	.646	.308	.000	-	.115	.021	.000	.000	.674
$L_{min,bt}$	pearson	.701	.643	.363	.370	.521	.189	.343	-.057	.667	.283	.159	.899	.204	.105	.347	.548	.321	.130	.225	.473	.448	.358	.328	.193	.675	.207	-.142	1	.460	.064	.341	-.132
	sig.2code	.000	.000	.000	.000	.000	.035	.000	.530	.000	.001	.077	.000	.086	.380	.003	.000	.000	.164	.015	.000	.000	.000	.000	.031	.000	.021	.115	-	.000	.479	.000	.143
$L_{m,lt}$	pearson	.440	.361	.643	.308	.950	.802	.826	-.130	.477	.271	.377	.452	.875	.807	.838	.745	.778	.797	.778	.545	.561	.620	.809	.670	.494	.303	.207	.460	1	.776	.833	.252
	sig.2code	.000	.000	.000	.001	.000	.000	.000	.149	.000	.002	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.001	.021	.000	-	.000	.000	.005
D_{lt}	pearson	-.013	-.026	.643	.180	.669	.960	.887	-.209	.073	.091	.307	.049	.672	.871	.862	.547	.533	.884	.866	.279	.127	.514	.874	.537	.069	.219	.430	.064	.776	1	.882	.175
	sig.2code	.887	.775	.000	.045	.000	.000	.000	.020	.418	314	.001	.587	.000	.000	.000	.000	.000	.000	.000	.002	.161	.000	.000	.000	.448	.015	.000	.479	.000	-	.000	.052
$L_{max,lt}$	pearson	.330	.307	.754	.347	.804	.909	.969	-.173	.449	.312	.323	.363	.640	.760	.966	.593	.609	.801	.950	.465	.321	.648	.978	.553	.429	.461	.509	.341	.833	.882	1	.142
	sig.2code	.000	.001	.000	.000	.000	.000	.000	.055	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	-	.117
$L_{min,lt}$	pearson	.022	.046	.074	.227	.178	.073	.169	.378	.003	.007	-.022	.021	.112	-.092	-.031	.256	.213	.202	.165	.239	-.134	-.212	.128	-.011	.004	-.015	.038	-.132	.252	.175	.142	1
	sig.2code	.807	.611	.412	.011	.048	.418	.061	.000	.977	.943	.812	.815	.349	.441	.794	.030	.021	.030	.077	.010	.138	.018	.158	.903	.961	.865	.674	.143	.005	.052	.117	-

Table E23b. correlation of the objective factors themselves

		VL	VI	VC
$E_{m.h}$	pearson	.164	-.005	.044
	sig.2code	.069	.953	.630
$E_{min.v}$	pearson	.112	-.053	.044
	sig.2code	.214	.557	.630
U_o	pearson	.061	-.004	**.251**
	sig.2code	.503	.967	**.005**
$L_{m.40}$	pearson	**.228**	.046	.043
	sig.2code	**.011**	.611	.633
$L_{min.40}$	pearson	-.025	.014	.012
	sig.2code	.782	.881	.897
D_{PP}	pearson	**-.234**	-.086	-.035
	sig.2code	**.009**	.344	.696
D_{VN}	pearson	.174	.178	-.035
	sig.2code	.144	.135	.696
$L_{min.VN}$	pearson	**.241**	.188	-.054
	sig.2code	**.042**	.113	.654
$L_{m.20c}$	pearson	**.178**	.017	.091
	sig.2code	**.048**	.852	.312
D_{20c}	pearson	.077	-.024	.074
	sig.2code	.394	.794	.415
L_{maxBT}	pearson	-.139	.013	-.048
	sig.2code	.123	.888	.594
L_{minSD}	pearson	.099	.036	-.094
	sig.2code	.276	.691	.298

Table E23c. correlation of the objective factors of light with the subjective ones.

IS THE OBJECTIVE CHARACTERISTICS OF SOUND CORRELATED WITH THE SUBJECTIVE CHARACTERISTICS OF PERCEIVED SOUND?

Before answering the research question, a correlation was made between the objective factors themselves shown in table E24a, so as to eliminate the factors that explain the phenomenon in the same way. This correlation made it possible to obtain: A-weighted sound pressure level **L_{Aeq}**, and for the psychoacoustics metrics Fluctuation Strength **FS**, Roughness **RO**, Sharpness Aures **SH_{AURES}**, Sharpness **SH_{DIN}**, Tonality **TO** and Tonality DIN **TO_{DIN}** which are all explained in detail in part A section 5.

After this correlation between the objective parameters a further correlation was made with the identified sound factors or Pleasantness of Technological Soundscape PTS, Pleasantness of Anthropic Soundscape PAS and Pleasantness of Natural Soundscape PNS.

The correlation shows that **PTS is positively corelated with Tonality DIN** (p = .002, pearson .272), while **PAS is positively related to L_{Aeq}** (p = .000, pearson .388), **Fluctuation Strenght** (p = .000, pearson .411), **Roughness** (p = .000, pearson 328), **Sharpness Aures** (p = .000, pearson .526), **Sharpness DIN** (p = .000, pearson .333), **Tonality** (p = .002, pearson .272). Finally **PNS is related to Sharpness Aures** (p = .020, pearson -.209), **Sharpness DIN** (p = .002, pearson .274), **Tonality DIN** (p = .000, pearson -.367).

Three different regressions were subsequently performed. PTS (R .302, R^2 .091, ANOVA p = .126) is related to Tonality DIN (p = .007, β = .310), while Pleasantness of Anthropic Soundscape PAS (R .573, R^2 .328, ANOVA p = .000) is related to Sharpness Aures (p = .002, β = .525). Finally Pleasantness of Natural Soundscap PNS e (R .528, R^2 .279, ANOVA p = .000) is related to Sharpness Aures (p = .000, β = -.643) and Sharpness DIN (p = .001, β = .414).

The objective characteristic of sound are correlated with the subjective ones. PTS is positively corelated with Tonality DIN, therefore when the Tonality DIN increases also the perception of PTS increases. While the **PAS** is positively correlated with L_{Aeq}, Fluctuation strenght, Roughness, both the Sharpness and Tonality. Finally **PNS** is negatively correlated with Sharpness Aures and DIN and Tonality DIN.

		LA_{eq}	FS	LO_{VI}	LO_{VII}	NC	NR	RO	SH_{AURES}	SH_{DIN}	SIL_{ANSI}	SIL_3	LO	TO	TO_{DIN}
LA_{eq}	pear. sig.2c	1 -	.420 .000	.931 .000	.930 .000	.949 .000	.959 .000	.628 .000	.705 .000	.203 .024	.841 .000	.841 .000	.936 .000	.182 .043	.051 .571
FS	pear. sig.2c	.420 .000	1 -	.440 .000	.430 .000	.497 .000	.474 .000	.611 .000	.659 .000	.382 .000	.422 .000	.388 .000	.445 .000	.466 .000	.069 .448
LO_{VI}	pear. sig.2c	.931 .000	.440 .000	1 -	.995 .000	.938 .000	.933 .000	.719 .000	.725 .000	.184 .041	.938 .000	.915 .000	.993 .000	.105 .247	.144 .112
LO_{VII}	pear. sig.2c	.930 .000	.430 .000	.995 .000	1 -	.924 .000	.931 .000	.753 .000	.727 .000	.202 .024	.959 .000	.937 .000	.997 .000	.102 .261	.109 .230
NC	pear. sig.2c	.949 .000	.497 .000	.938 .000	.924 .000	1 -	.986 .000	.628 .000	.699 .000	.169 .061	.818 .000	.784 .000	.929 .000	.254 .004	.086 .341
NR	pear. sig.2c	.959 .000	.474 .000	.933 .000	.931 .000	.986 .000	1 -	.663 .000	.721 .000	.233 .009	.837 .000	.808 .000	.938 .000	.229 .010	.027 .767
RO	pear. sig.2c	.628 .000	.611 .000	.719 .000	.753 .000	.628 .000	.663 .000	1 -	.693 .000	.416 .000	.802 .000	.783 .000	.754 .000	.136 .133	.012 .893
SH_{AURES}	pear. sig.2c	.705 .000	.659 .000	.725 .000	.727 .000	.699 .000	.721 .000	.693 .000	1 -	.489 .000	.698 .000	.696 .000	.748 .000	.179 .046	.167 .064
SH_{DIN}	pear. sig.2c	.203 .024	.382 .000	.184 .041	.202 .024	.169 .061	.233 .009	.416 .000	.489 .000	1 -	.183 .042	.218 .015	.207 .021	.242 .007	-.389 .000
SIL_{ANSI}	pear. sig.2c	.841 .000	.422 .000	.938 .000	.959 .000	.818 .000	.837 .000	.802 .000	.698 .000	.183 .042	1 -	.986 .000	.957 .000	.084 .356	.120 .183
SIL_3	pear. sig.2c	.841 .000	.388 .000	.915 .000	.937 .000	.784 .000	.808 .000	.783 .000	.696 .000	.218 .015	.986 .000	1 -	.938 .000	.039 .667	.135 .136
LO	pear. sig.2c	.936 .000	.445 .000	.993 .000	.997 .000	.929 .000	.938 .000	.754 .000	.748 .000	.207 .021	.957 .000	.938 .000	1 -	.100 .271	.131 .148
TO	pear. sig.2c	.182 .043	.466 .000	.105 .247	.102 .261	.254 .004	.229 .010	.136 .133	.179 .046	.242 .007	.084 .356	.039 .667	.100 .271	1 -	-.198 .028
TO_{DIN}	pear. sig.2c	.051 .571	.069 .448	.144 .112	.109 .230	.086 .341	.027 .767	.012 .893	.167 .064	-.389 .000	.120 .183	.135 .136	.131 .148	-.198 .028	1 -

Table E24a. correlation of the objective factors themselves.

		PTS	PAS	PNS
LA_{eq}	pearson sig.2code	-.001 .989	**.388** **.000**	-.135 .134
FS	pearson sig.2code	-.054 .551	**.411** **.000**	-.028 .761
RO	pearson sig.2code	-.026 .777	**.328** **.000**	.022 .811
SH_{AURES}	pearson sig.2code	.026 .775	**.526** **.000**	**-.209** **.020**
SH_{DIN}	pearson sig.2code	-.098 .277	**.333** **.000**	**.274** **.002**
TO	pearson sig.2code	-.013 .883	**.272** **.002**	.095 .293
TO_{DIN}	pearson sig.2code	**.272** **.002**	-.055 .545	**-.367** **.000**

Table E24b. correlation of the objective factors of sound with the subjective ones,

Regressions have been carried out to further investigate the relationships between subjective factors and objective ones. Three regressions were performed for the light factors VL, VI and VC and for the sound factors PTS, PAS and PNS.

Regarding light factors, three regressions have also been carried out in this case. The first regression ($R = .465$, $R^2 = .216$) with dependent variable the Visual Lightness **VL** and with Pedestian Path Dispersion $\mathbf{D_{pp}}$ ($p = .000$, $\beta = -.430$) and Luminance mean $\mathbf{E_{m,h}}$ ($p = .013$, $\beta = .278$) as predictors. While the second regression ($R = .282$, $R^2 = .080$) with dependent variable the Visual Interest **VI** and with Luminance mean $\mathbf{L_{m,40°h}}$ ($p = .016$, $\beta = .282$) as predictors. Finally the third regression ($R = .282$, $R^2 = .080$) with Visual Chromaticism as dependent variable and with Overall Uniformity $\mathbf{U_o}$ ($p = .016$, $\beta = -.282$) as predictors.

Regarding the sound factors the first regression with step method ($R = .272$, $R^2 = .074$) between the Pleasantness of Technological Soundscape **PTS** factor as a dependent variable and with Tonality DIN $\mathbf{TO_{DIN}}$ ($p = .002$, $\beta = .272$). While the regression by steps ($R = .557$, $R^2 = .310$) with dependent variable Pleasantness of Anthropic Soundscape **PAS** has the factors Sharpness Aures $\mathbf{SH_{AURES}}$ ($p = .000$, $\beta = .493$) and Tonality **TO** ($p = .000$, $\beta = .184$). The third regression by steps ($R = .367$, $R^2 = .135$) with Pleasantness of Natural Soundscape **PNS** as a dependent variable instead has Tonality DIN $\mathbf{TO_{DIN}}$ ($p = .000$, $\beta = -.367$).

	β	p. value
R .465, R² .216		
D_{pp}	-.430	**.000**
$E_{m,h}$	.278	**.013**

dependent variable: VL

	β	p. value
R .282, R² .080		
$L_{min,lt}$	.282	**.016**

dependent variable: VI

	β	p. value
R .282, R² .080		
U_o	.282	**.016**

dependent variable: VC

	β	p. value
R .272, R² .074		
Tonality DIN	.272	**.002**

dependent variable: PTS

	β	p. value
R .557, R² .310		
Sharpness Aures	.493	**.000**
Tonality	.184	**.018**

dependent variable: PAS

	β	p. value
R .367, R² .135		
Tonality	-.367	**.000**

dependent variable: PNS

Table E25a. linear regression on objective factors of light with Visual Lightness as dependent variable.

Table E25b. linear regression on objective factors of light with Visual Interest as dependent variable.

Table E25c. linear regression on objective factors of light with Visual Chromaticism as dependent variable.

Table E25d. linear regression on objective factors of sound with PTS as dependent variable.

Table E25e. linear regression on objective factors of sound with PAS as dependent variable.

Table E25f. linear regression on objective factors of sound with PNS as dependent variable.

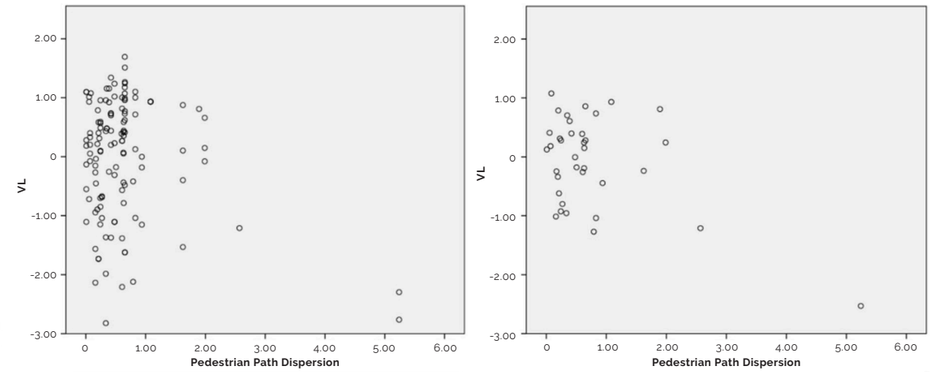


Fig E23a. linear regression on objective factors of light with Visual Lightness as dependent variable.

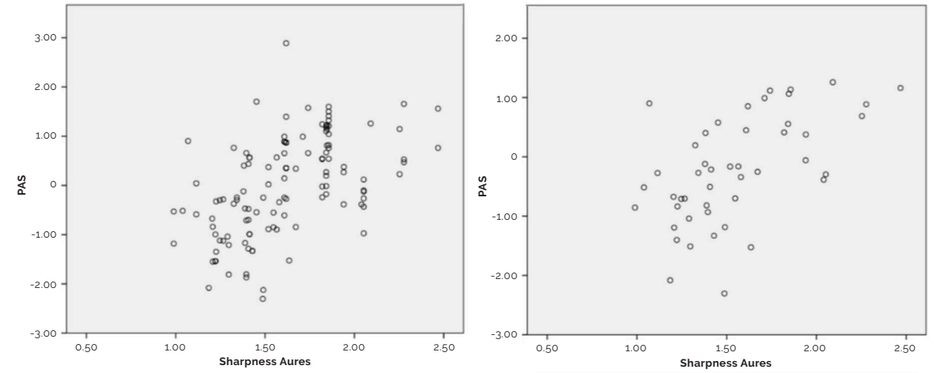


Fig. E23b. linear regression on objective factors of sound with PAS as dependent variable.

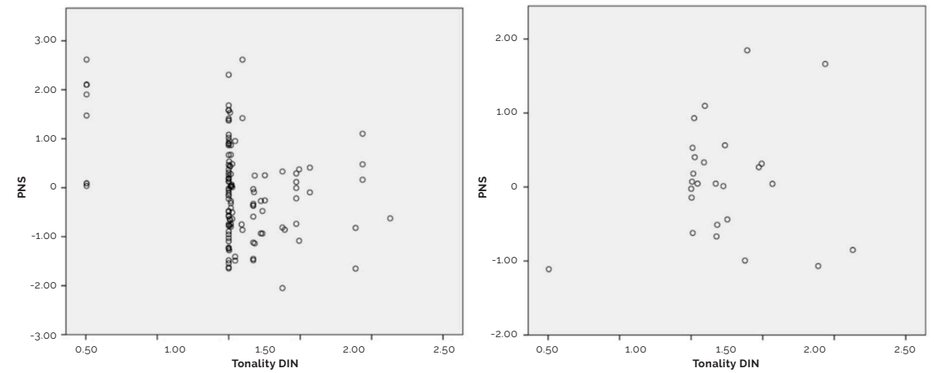


Fig. E23c. linear regression on objective factors of sound with PNS as dependent variable.

Finally on the basis of these investigations on objective factors it is possible to make considerations on lighting and acoustic environments. Regarding light aspects, it is possible to known that **Visual Lightness VL** is positively linked to $\mathbf{E_{m,\,h}}$ and negatively to $\mathbf{D_{pp}}$. The factor of Visual Lightness VL, as described in the second Part E, is defined by PCA based on items that relate to the brightness of an environment; in fact among these there are negative items such as *gloomy* and positive as *glaring* or *In general, how do you seem bright the lighting environmental setting?*. The objective factors measured in the field instead, as described in Part A section 4, concern certain aspects of the light scene: horizontal average illuminance $\mathbf{E_{m,h}}$ and pedestrian path dispersion $\mathbf{D_{pp}}$. As eplained in Part B section 4, illuminance is the total luminous flux incident on a surface per unit area and it is important to consider the ill. of street surface, the ill. of vertical surface surrounds the walk direction and semicylindrical ill. Dispersion instead, as explained in part B section 1, is part of Luminance of Physical Elements method. This last involves measuring started from the environmental elements (like path, near buildings, far vertical element etc..) visible in the frame: it was identified areas and consequently regions to measuring. The lower region included pedestrian path, or the element in which the individual walks.

On the basis of these objective data and of the regression carried out, it is possible to say that as $E_{m,\,h}$ increases, the perception of VL also increases: the VL identifies the perceived brightness of the area, so it is positively linked to the growth of the horizontal average illuminance. While decreasing the dispersion increases the VL, therefore as the dispersion decreases, the perception of the environment tends towards a perception of greater luminosity.

For the second factor instead, **Visual interest VI**, a positive relationship was found with left peripherical minimum $\mathbf{L_{min,\,lt}}$. The factor of VI, as described in the second Part E, is defined by PCA based on items that relate to the interest of the light scene; in fact it is described by items that represent the interviewee's judgment about the light scene as *pleasant* or *stimulant* in a positive way or *chaotic* in a negative way. The objective factor measured in the field is $L_{min,lt}$ and this photometric parameter luminance indicate the apparent surface or light source luminosity. It is defined as the ratio between the luminous flux emitted or reflected by a luminous surface per unit of solid angle in a given direction and the emitting surface projected on a plane perpendicular to the direction itself. $L_{min,lt}$ is part of Luminance of Fixed Image Regions method, as explained in part B section 1, based of central circular region and in general on the analysis of fixed region. In this case, as the luminance increases, the VI is increased, therefore increasing the surface apparent luminosity also increases the VI, that is the interest of the luminous scene.

The last factor, **Visual Chromaticism VC**, is positively linked to Overall Uniformity $\mathbf{U_o}$. The factor VC, as described in the second Part E, is defined by PCA based on items that relate to the the perception of color temperature and chromaticism precisely; in fact it is positively correlated with *cold* and negatively with *warm*. The objective factor measured in the field is U_o and it is the uniformity of light on a surface; therefore as the uniformity increases, the perception of the VC also increases.

After these regressions it is possible to say that the objective factors most closely linked to the perception of the luminous environment are precisely these: $E_{m,\,h}$, D_{pp}, $L_{min,\,lt}$ and U_o. So when one of these objective factors changes, the perception of the lighting environment changes, as we saw in the previous paragraphs.

Regarding the sound aspects, the first regression is the one of the Pleasantness of Technological Soundscape **PTS** factor with Tonality DIN $\mathbf{TO_{DIN}}$. The factor of PTS, as described in the second Part E, is defined by PCA based on items that relate to the perception of sounds, mainly technological ones; in fact, in this factor there are items such as *traffic or technological sound (eg car, industry, sirens, construction)* or *annoying* in negative way or *pleasant* in positive way. The objective factor measured in the field is TO_{DIN} and it is a metric that explain as the human ear is very sensible to the pure harmonic sounds, in fact it measures the number of pure tones in the spectrum of noise. So this psychoacoustic parameter was introduced to quantify the perception of tonal content, it explain the sensation of the timbre of a sound and it defines the composition of a perceived sound, if it consists of tonal components or broadband sounds. There are several methods for calculating the tonality, one of these is Tonality DIN 45681. Therefore from this regression it is possible to affirm that with the increase of the Tonality DIN also increases the PTS, that is when the perception of tonal content increases consequently the pleasantness of that environment in which the technological sounds are perceived increases. So when the number of pure tones increases in the spectrum of noise, the sound environment is perceived as pleasant and not annoying.

The regression of Pleasantness of Anthropic Soundscape **PAS** has the factors Sharpness Aures $\mathbf{SH_{AURES}}$ and Tonality **TO**. The factor of PAS, as described in the second Part E, is defined by PCA based on items that relate to the perception of sounds, mainly human ones; in fact in this factor items such as *sound from human beings (eg conversation, laughter, footsteps, children at play)* are positively included or *eventful* or, in a negative way, *uneventful* or *monotonous* are included. The objective factor measured in the field is SH_{AURES} and TO. Sharpness is an indicator that represents the sensation value caused by the high frequency components of a noise and it can be related to the sensations of density and timbre. The major factors of sound that influence sharpness are the central frequency of the sound band and the spectral contents. If the right amount of sharpness is added to a sound it will give it a more powerful character; however, too much sharpness will make an aggressive sound. The Aures method instead calculates the sharpness considering the absolute volume of the signal. Tonality, as explained before, is a metric that explains as the human ear is very sensible to the pure harmonic sounds. PAS is positively linked to both metrics, so when the-

se metrics increase therefore the PAS also increases. Therefore from this regression it is possible to affirm that with the increase of Sharpness and Tonality also increases the PAS, that is when the perception of powerful character of sound or the number of pure tones increases, consequently the pleasantness of that environment in which the natural sounds are perceived increases. So when these metrics increases, the sound environment is perceived as eventful.

The third regression of Pleasantness of Natural Soundscape **PNS** as a dependent variable instead has Tonality DIN $\mathbf{TO_{DIN}}$. The factor of PNS, as described in the second Part E, is defined by PCA based on items that relate to the perception of sounds, mainly natural ones; in fact in this factor items such as *natural sound (eg singing birds, flowing water, wid in vegetation)* or *calm* are positively included and items as *chaotic* are negatively included. The objective factor measured in the field is TO_{DIN} explained before. Therefore from this regression it is possible to affirm that with the increase of the Tonality DIN also increases the PNS, that is when the perception of tonal content increases consequently the pleasantness of that environment in which the natural sounds are perceived increases. So when the number of pure tones increases in the spectrum of noise, the sound environment is perceived as calm and not chaotic.

After these regressions it is possible to say that the objective factors most closely linked to the perception of the acoustic environment are precisely these: TO, TO_{DIN} and SH_{AURES}. So when one of these objective factors changes, the perception of the acoustic environment changes, as we saw in the previous paragraphs.

The objective factors of Sharpness and Tonality are into soundscape categories such as Noise Annoyance and Pleasantness, as seen in the table of descriptor of Jian Kang and Francesco Aletta. This is a further confirmation of the right relationship between these factors and the three factors that concern the pleasantness of the sound environment: technological PTS, anthropic PAS and natural PNS. According to this table the sharpness is among the indicators that describe *Pleasantness of noise*, but also the tonality is among the indicators that describe the Pleasantness of noise. The sharpness instead are also among the indicators that describe the *annoyance*. On the basis of our investigations it is also possible to identify that both metrics are among the indicators that describe the *Perceived Affective Quality*, such as the descriptors *pleasant, unpleasant, eventful, uneventful, calm, monotonous, exciting, chaotic*. This is because the factors we identified, namely PTS, PNS, PAS, consider all these descriptors, as mentioned before. In fact PTS includes *pleasant*, *annoying*, PAS includes *eventful*, *uneventful*, *vibrant* and *monotonous*, while PNS includes *calm* and *chaotic*. Then PTS is positively linked to TO_{DIN}, PAS is positively linked to SH_{AURES} and TO, while PNS is negatively linked to TO.

DESCRIPTOR CATEGORY	DESCRIPTORS	INDICATORS	REFERENCE
NOISE ANNOYANCE	Unbiased Annoyance	Loudness, Sharpness, Fluctuation Strenght	Zwicker (1991)
	Noise Annoyance	Loudness intrusiveness, Sharpness, Distortion of informational content	Preis (1997)
	Evaluation index	Loudness, Sharpness, Roughness, Impulsiveness, Relative Approach	Fiebig et al. (2009)
PLEASANTNESS	Pleasantness of noise	Loudness, Sharpness, Roughness, Tonality	Terhardt and Stoll (1981)
	Unpleasantness of noise	Sound levels and the relative duration of categories of sound sources	Lavandier and Defréville (2006)
QUIETNESS OR TRANQUILLITY	Perceived Quietness	Slope	Memoli and Licitra (2005)
	Tranquillity	Sound levels and the percentage of natural features in a scene	Pheasant, Horoshenkov, Watts (2008)
PERCEIVED MUSIC-LIKENESS	Perceived music-likeness	Music-likeness (fuzzy)	Botteldooren et al. (2006)
PERCEIVED AFFECTIVE QUALITY	Pleasant, Unpleasant, Eventful, Uneventful, Calm, Monotonous, Exciting, Chaotic	-	Axelsson et al. (2010)
	Calm, Vibrant	-	Cain et al. (2013)
	Cacophony, Hubbub and Constant, Temporal	-	Davies et al. (2013)
	Restorativeness	-	Payne (2013)
SOUNDSCAPE QUALITY	Environmental Sound Experience Indicator	-	Garcia Perez et al. (2012)
	Sound Quality	L_{50} and L_{10-90}	Ricciardi et al. (2015)
	Appropriateness	-	Axelsson (2015)

Table E26. summary table of descriptor category and indicators - Kang, Jian, and Francesco Aletta. n.d. "*Soundscape Indicators and Mapping.*" The Bartlett - Institute for Environmental Design and Engineering.

DOUBLE-CHECK SURVEY RESULTS

A useful tool to verify the evidence that emerged from the on-site survey was the double-check survey discussed in part B section 10. The investigation was replicated in Passerella Olimpica area during first week of December 2018 for three different nights from 7pm to 11pm. The sample (n = 25) has a slight prevalent in male questionnaire (n = 14) than female ones (n = 11) in fig. E24a. No one's had hearing loss problems, only one person claims to suffer from asthma and finally, more than half of the observers have no sight sick while the other suffers from myopia or astigmatism. 84% of respondents are between 18-30 years old, while the remainder is between 51-60 years old. Regarding the **education level** in fig. E24c 4% of the interviewees have a middle school diploma, 36% of people have a higher diploma, 56% a three-year degree, while 4% have a master degree. For the **place of residence** in fig. E24d 92% of people live in Turin, while 4% in Piedmont and 4% in Italy. While fot the **frequency of space use** in fig. E24e 4% of people responded with *this is the first time*, 24% of respondents visit the place rarely during the year, 28% once or twice a month, 24% two or three times a week and 20% of respondents responded to the area every day. For **activity of respondents** in fig. E24f 16% of them carry out the activity of passage, 52% are near their homes, 12% are at work, while the remainder performs leisure activities. More than 44% rated the intensity of sounds in the environment characterized by evaluations as *unpleasant*, *chaotic* and *stressful* that predominate over positive ones. More than half of the sampling think than sound did not influence own life, the other half said than soundscape influence own security. In the same way 48% evaluated urban lighting conditions *inadequate* and *unpleasant*. Also, in this case *dim* and *unpleasant* was rated more than *bright* and *pleasant*. More than 56% think that light did not influence own life, the others said that light affects their ability to walk. 72% evaluated the area inadequate and insecure, they also declare themselves average worried about the condition. Finally, 96% would like to make changes to the environment like better lightness, light uniformity, better visibility and implement routine patrol. Therefore double-check survey results was **compared to on-site survey** results selecting only the answers related to the Passerella Olimpica area (n = 39). The analyzes were done with a bivariate correlation of safety questions with light, sound and urban and architectural decay questions as shown in Table E27a. The results of on-site survey report that there are a **high correlation between the sentence *I feel safe* and the lighting condition** (p = .007, pearson = .424) **and the urban quality** (p = .003, pearson = .458). Indeed the results of double check survey in Table E27b shows that the **safety is correlated to the lighting environment of the area** (p = .098, pearson = .338) **and to the quality** (p = .052, pearson = .393) **and cleaning** (p = .030, pearson = .433) **of the place**. So the **results are on the same line** but the low number of survey is a limit to front if you want better estimate phenomenon.

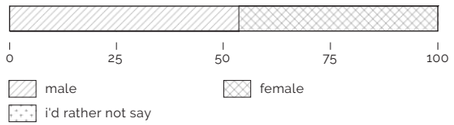


Fig. E24a. gender of respondents - D1 *Gender*

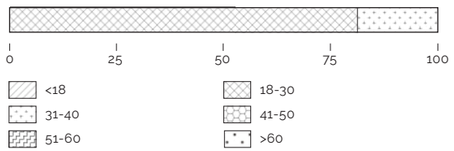


Fig. E24b. age of respondents - D2 *Year of birth*

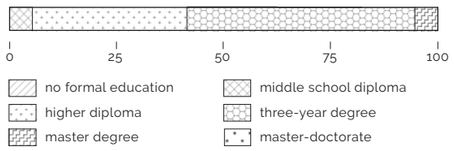


Fig. E24c. education level of respondents - D3 *Level of education*

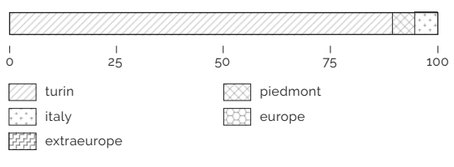


Fig. E24d. place of residence of respondents - D9 *Area of domicile*

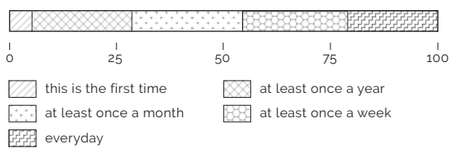


Fig. E24e. frequency of space use of respondents - D12 *How often do you frequent this area?*

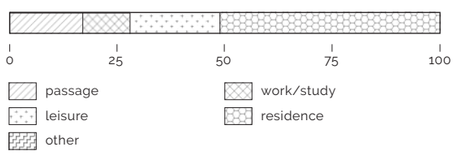


Fig. E24f. activity of respondents in the area - D11 *Why are you in thi area right now?*

Table E27a. correlation of sentences of on-site survey.

Q9 *In general, how do you seem bright the lighting environmental settings?*

Q14 *Overall, how loud is it here?*

Q6 *How do you describe the elements of the urban context that surround you? maintenance of buildings (decay conditions); maintenance of public spaces; cleaning of public space;*

Table E27b. correlation of sentences of double-check survey.

D13 *How do you assess the intensity of the sounds present at this time?*

D27 *How do you assess the brightness of this area (eg possibility to distinguish elements, sharpness, brilliance)?*

D58 *Evaluate each of the following: quality of the place; verbal comprehension; understanding urban signage; services; public transport and frequency; commercial exercises; street cleaning and pavement cleaning.*

ON-SITE			Q3 *I feel safe*
Q9	*In general, how do you seem bright the lighting environmentalsettings?*	pearson sig.2code	**.424** **.007**
Q14	*Overall, how loud is it here?*	pearson sig.2code	-.224 .171
Q6	*maintenance of buildings (decay conditions)*	pearson sig.2code	**.458** **.003**
Q6	*maintenance of public spaces*	pearson sig.2code	.329 .041

DOUBLE CHECK			D47 *I feel safe*
D13	*How do you assess the intensity of the sounds present at this time?*	pearson sig.2code	.338 .098
D27	*How do you assess the brightness of this area?*	pearson sig.2code	-.248 .232
D58	*quality of the place (architectural, environmental ...)*	pearson sig.2code	**.393** **.052**
D58	*street cleaning and pavement cleaning*	pearson sig.2code	**.433** **.030**

The double-check survey tool has proved to be very useful to identify how **the results of the respondents are the same** in the Passerella Olimpica area, even after several weeks. This tool will be subject to subsequent investigations in order to be able to report the results to the other areas of analysis.

SOCIAL SURVEY RESULTS

Another survey, also discussed in part B section 10 has proposed through social channel and produced results as follow.
The social survey (n = 2024) took place from March to July 2019 and it was submitted by 2024 observers who saw the survey thought the **selected social channel** in fig. E25a: 57% via email, 28% via Facebook, 14% via Instagram and 1% through other link. The **location detected** in FigE26b is 98% from Italy, 1% from USA and 1% from Spain. The answers in fig. E25c are divided in 38% of total that answered about Largo Saluzzo in San Salvario area, 11% on Tettoia Vitali in Parco Dora area, 28% Viale O. Mai in Campus Einaudi area, 17% Passerella Olimpica, 3% Piazza G. Bottesini and 2% on Giardini Montanaro in Barriera di Milano area.
In general the mean value of every question is similar. For question S2 *to what extent do you agree that you feel safe?* it is 2.839 (SD = 1.110), but also the other ones are similar: question S3 *overall how would you describe the state of conservation and cleanliness of the public spaces and conservation of the buildings?* (M = 2.680, SD = 0.988), question S4 *overall how would you describe the light environment that surrounds you?*, (M = 2.772, SD = 1.042) and question S5 *overall how would you describe the sound environment that surrounds you?* (M = 2.781, SD = 1.036). The analyzes were done with a bivariate correlation of safety questions and light, sound and urban and architectural decay questions in Table E28a; it shows a **high significance** for all

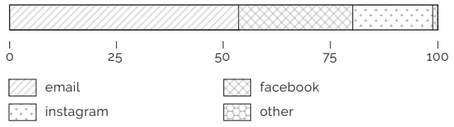


Fig. E25a. social channel of respondents.

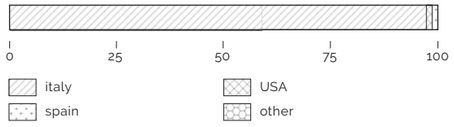


Fig. E25b. location of respondents.

Fig. E25c. analyzed area of respondents - S1 *Which of these areas did you visit mainly in the last two weeks?*

SOCIAL			S2 safety
S3	urban quality	pearson sig.2code	**.449** **.000**
S4	lighting environment	pearson sig.2code	**.473** **.000**
S5	sound environment	pearson sig.2code	**.394** **.000**

ON-SITE			Perceived Safety
a.3	urban quality	pearson sig.2code	**-.219** **.015**
Q9	lighting environment	pearson sig.2code	**-.439** **.000**
Q14	sound environment	pearson sig.2code	**-.300** **.001**

Table E28a. correlation of sentences of social survey.

S2 *To what extent do you agree or disagree with the following statement? I felt safe...*

S3 *Overall, how would you describe the state of conservation and cleanlness of the public spaces and conservation of the buildings?*

S4 *Overall, how would you describe the light environment that surrounds you?*

S5 *Overall, how would you describe the sound environment that surrounds you?*

Table E28b. correlation of the sentences of the on-site survey .

Q9 *In general, how do you seem bright the lighting environmental settings?*

Q14 *Overall, how loud is it here?*

the questions proposed. Therefore social survey results was **compared to on-site survey** results about the same correlation (in this case the alternative factor a.3 explained in the previous pages) was used, table E28b shows that there is a slight change but the results follow the same line.
In order to investigate the perception of safety in selected areas, Largo Saluzzo, Tettoia Vitali, Viale Mai, Passerella Olimpica, Piazza Bottesini and Giardini Montanaro the safety answers question S2 were analyzed. The results report that the **most insecure one is Giardini Montanaro** (M = 1.872, SD = 0.998), followed by Piazza G. Bottesini (M = 2.433, SD = 1.064), Passerella Olimpica (M = 2.481, SD = 1.072), Tettoia Vitali (M = 2.662, SD = 1.139), Largo Saluzzo (M = 2.828, SD = 1.254), instead the **safest is Viale O. Mai** (M = 3.275 SD = 1.135).
To further investigate that the perception of safety varies according to the areas' characteristic, a Kruskal-Wallis has been made which has rejected the null hypothesis (p = .000), so the distribution of *I feel safe* is the same between the categories of analyzed places. A further analysis was made through U-Mann Whitney in pairs between the analyzed places in table E29 this shows us that in most cases the hypothesis is rejected and therefore the distribution of Perceived Safety is not the same in the different areas.
Considering the above mean value correspond to the entire walk, it is interesting understand how the results of social survey can be compared with the **single station of on-site survey**. In fact for each analysis' area in the social survey a link relative to the station was inserted. In this case the Campus Einaudi area with Viale O. Mai corresponds to station 2 of the on-site survey, the Parco Dora area with Tettoia Vitali corresponds to station 3 of the on-site survey, the Passerella Olimpica area corresponds to station 4 of the on-site survey and the San Salvario area with Largo Saluzzo corresponds to station 3 of the on-site survey. The results of this further investigation were: Viale O. Mai st2 (M = 3.125 SD = 1.126), Tettoia Vitali st3 (M = 3.750, SD = 0.500), Passerella Olimpica st4 (M = 2.286, SD = 0.951) and Largo Saluzzo st3 (M = 3.000, SD = 0.775).

The social survey tool has proved to be **very useful to attract a greater number of users**, in fact thanks to the social strategy the adhesions to the questionnaire were very high and still continue to have results. The social survey proved to be useful to **confirm the hypotheses of this research work** and it was also an excellent advertising tool to **make the topic of urban safety known**.

areas	u-mann whitney	p-value
1 & 2	rejects	p = .031
1 & 3	rejects	p = .000
1 & 4	rejects	p = .000
1 & 5	rejects	p = .003
1 & 6	rejects	p = .000
2 & 3	rejects	p = .000
2 & 4	rejects	p = .040
2 & 5	maintain	p = .096
2 & 6	rejects	p = .000
3 & 4	rejects	p = .000
3 & 5	rejects	p = .000
3 & 6	rejects	p = .000
4 & 5	maintain	p = .613
4 & 6	rejects	p = .000
5 & 6	rejects	p = .013

TableE29. U-Mann Whitney test of Perceived Unsafety factor in different areas of analysis.

1 largo saluzzo
2 tettoia vitali
3 viale mai
4 passerella
5 p. bottesini
6 g. montanaro

SENTIMENT ANALYSIS RESULTS

The sentiment analysis of this thesis was carried out to identify the opinions about selected areas of the city expressed by users on social networks; the analysis was carried out through the *Tracx Platform* in collaboration with the Technological Investigation Department of the Municipal Police Corps of the City of Turin. Tracx is a sentiment analysis tool that monitors the sources in real time and monitors social conversations in their life cycle recording the interaction rate and collecting user demographics. The Tracx dashboard is also able to highlight more than one activity, the most used social networks and those that are poorly attended.

All the Turin analyzes were carried out considering the social activities from 7 June 2016 to 7 June 2018, therefore an **interval of two years**. Sentiment analyzes were first made with a **comparison between the districts of the city of Turin**. The Topics and Sentiments for each district were compared: San Salvario, Lingotto, Crocetta, Centro, San Paolo, Cenisia, San Donato, Aurora, Vanchiglia, Nizza Millefonti, Mercati Generali, Santa Rita, Mirafiori Nord, Pozzo Strada, Parella, Vallette, Madonna di Campagna, Borgo Vittoria, Barriera di Milano, Falchera, Madonna del Pilone, Borgo Po e Cavoretto, Regio Parco.

The data relating to the analysis was taken from blogs, Facebook boards, Facebook pages, Facebook groups, online forums, news pages, Google +, Twitter, Flickr, YouTube, Reddit and Instagram. In these two years 1116 conversations, 16'913 posts, 4765 interactions and 17'795 mentions have been produced for the whole city of Turin. **For all the posts the shares have been identified**, that is the total of conversations, posts, interactions and mentions. Based on the total of these data, **the polarities of sentiment have been identified**, which are subdivided into **positive, negative or neutral**.

The study areas of this research have been critically analyzed because many areas are into more than one neighborhood, so it is impossible to have an exact subdivision. Another reason for the imprecision of sentiment analysis is that all the posts are not geolocated in the exact zones to which they refer, in fact a user could talk about the affected area but could be geolocated in a different area. Another problem is that not all posts contain a citation of the area so it is impossible to identify them.

The areas selected for analysis are Campus Einaudi, Parco Dora, Passerella Olimpica e San Salvario. A total of 51 posts on the various social networks were produced for the Einaudi Campus area, while 12 posts were produced for the Parco Dora area. A total of 66 posts were produced for the Passerella Olimpica area, while 48 posts were produced for the San Salvario area. The sentiment analysis on these posts identified **mainly negative sentiments**, especially within the neighborhood facebook groups. The sentiments in general for the areas analyzed have 24.2% of the positive polarity, 64.6% neutral and 11.3% negative.

Analyzing the demographic audience for each of the zones it is possible see that it is almost **equal-**

ly divided between male and female sex and that the age with the highest percentage is that between **35-44 years** (about 45%) followed by the range from **18 to 34 years** (about 30%). The geographic audience includes the whole of Italy, with a **greater percentage in Piedmont** of course.

The sentiments for each area identify the type of object analyzed, such as post or interaction, if this has started a conversation and if the whole is relevant to the analysis. Then the software identifies if this object was subsequently mentioned and the total interactions that it got. For each object, the date and time of publication, the country, the state, the city and the entities (such as taxis or other) and the language in which it is written are shown. Finally it is possible to view the headline, the content, the URLs of the articles or sites, the network on which it is present and the identified sentiment. For each of these analyzes, the data was provided anonymized, without any possibility of tracing the author and for this reason in this thesis there are no actual data but only a total revision or public post visible to everyone on the platform.

Analyzing these sentiments for each zone, taking into consideration the limits mentioned above, it is possible to say that for the Campus Einaudi (n_{SHARES} = 51) sentiments have positive polarity for 22 posts versus 19 negatives. The Parco Dora (n_{SHARES} = 825) has the majority of posts with positive polarity with 312, while the negatives are 202. The Passerella Olimpica (n_{SHARES} = 159) instead has many posts with negative polarity 56 and positives are 43, the same for the area of San Salvario (n_{SHARES} = 980) with 425 posts with negative polarities and 195 with positive polarities. For each of these shares there are also neutral polarities which are referred to posts that have not been well identified or that do not have positive or negative aspects. For the Einaudi Campus (n_{SHARES} = 51) there are 10, for the Parco Dora (n_{SHARES} = 825) there are 311, for the Passerella Olimpica (n_{SHARES} = 159) there are 60 and for San Salvario (n_{SHARES} = 980) there are 360.

Sentiment analysis has proved to be a useful tool to get more information on users' opinions. The expression of ideas on social media has allowed us to learn more about the places that maintain the research hypotheses, as shown by the surveys. The **areas perceived with the most criticism are** those of the **Passerella** and **San Salvario**, while the **areas perceived with positivity are** those of the **Campus Einaudi** and the **Parco Dora**.

Table E30a. Report Analyze, Dashboard of Turin shares in Tracx Platform.

Area	Shares	Conversations	Posts	Interactions	Mentions
TORINO	91.781	8020	46.625	4896	32240

Table E30b. Report Analyze, Dashboard of Turin Platform in Tracx Platform.

Area	Shares	IG	Blog	News	FB	Twitter	Flickr	Other
TORINO	91.781	25.6%	19.3%	16.7%	22.0%	9.5%	3.9%	3.0%

Table E30c. Report Analyze, Dashboard of Turin Sentiments in Tracx Platform.

Area	Shares	Positive	Neutral	Negative
TORINO	91.781	24.2%	64.6%	11.3%

Table E30d. Report Analyze, Dashboard of Areas Shares and Platform in Tracx Platform.

Area	Shares	Blog	Twitter	FB	IG	Flirck	News
CAMPUS EINAUDI	51	3	4	27	12	2	3
PARCO DORA	825	72	69	279	223	59	123
PASSERELLA OLIMPICA	159	21	19	69	22	2	26
SAN SALVARIO	980	99	76	398	253	43	111

Table E30e. Report Analyze, Dashboard of Areas Sentiments in Tracx Platform.

Area	Shares	Positive	Neutral	Negative
CAMPUS EINAUDI	51	22	10	19
PARCO DORA	825	312	311	202
PASSERELLA OLIMPICA	159	43	60	56
SAN SALVARIO	980	195	360	425

Type	Date	Social Media	Entities	Inter-actions	Sentiment	State City	Age	Gender
Post	26.10.17	Facebo-ok	luce, si-curezza, torino	121	Negative	Italy Torino	30-40	F

Headline

Niente illuminazione e troppa paura! E io pago!!

Content of post

Alle 7.25 buio per le strade, niente illuminazione. E io pago!! Stamane siamo andati x la passeggiata con i cani, era tt buio e avevamo paura... in quel momento chiunque avrebbe potuto farci del male e a ki poi avremmo dovuto dire grazie?? Inoltre saremmo potuti cadere e farci male vista la condizione dei marciapiedi! una vergogna!!!!!! Il problema è la mancanza di sicurezza, che d'altronde non si risolve neanche con i lampioni... io ero in giro con il cane sono subito corso a casa facendomi strada con la torcia del cellulare. Assurdo!!

Type	Date	Social Media	Entities	Inter-actions	Sentiment	State City	Age	Gender
Post	12.12.17	Facebo-ok	suono, sicurez-za, torino	64	Negative	Italy Torino	30-40	M

Headline

E per fortuna non vivo proprio su Largo Saluzzo

Content of post

A San Salvario c'è un casino allucinante... domani mattina devo lavorare e ho pure paura a lamentarmi perchè chissà cosa mi tirano dietro!

In this section it is possible to see a post of raw sentiment analysis data, in fact a public post visible to everyone on the platform was chosen because these are sensitive data and it is not possible to report them all. In this example the data such as author, URL, ID, author's score ra memember etc have been deleted (even if visible and public).

Table E30f. Sentiment analysis data in Tracx Platform.

CONCLUSIONS OF SUBJECTIVE ENVIRONMENTAL ANALYSIS

In exhaustive way the results support the hypothesis expressed to the beginning. The research questions were analyzed and explained thanks to the on-site survey through the due analysis; with the valuable tools of the double-check survey and the social survey the questions were further confirmed. The **focal point of the entire research was the perception of safety**, consequently the analyzed topics (lighting conditions, acoustic conditions, urban and architectural conditions and well-being of the interviewee) are connotate to this central theme, in other words variations on unsafety value are measured and studied. The areas analyzed were chosen specifically to investigate this perception in different areas, Campus Einaudi, Parco Dora, Passerella Olimpica and San Salvario. Precisely for this reason it has been shown that **the perception of safety changes according to the areas of analysis**, it is greater in the Parco Dora and it is smaller in the Passerella Olimpica. It was also confirmed by the social survey, as we will see later.

As explained in the background, perception is a subjective process and therefore it is important to know the type of user that answered the questionnaires. It was demonstrated that **the perception of safety varies according to the personal characteristic of interviewee**. Perceived Unsafety factor has negative correlation with **frequency use of space,** when the second factor increase the first one decrease (the more people attend the place, the more secure they feel), this is more evident in **female** than male population, so men are safer than women. In opposite way, **education level** seem to affect more male population, the higher is the level of education of men, the more insecure they feel.

After defining subjective aspects of perception, the surrounding environment was investigated and the perception of safety was compared with those that are the aspects of the urban environment, that is urban and architectural quality and social presence. It has been shown that these also influence people's perception so **the perception of safety varies according to urban and architectural quality and to the social presence**. In fact the higher is the perceived urban quality and the more people feel safe, while the greater is the perception of social presence and the greater is the perception of safety.

To further investigate urban quality, a fixed parameter was used, ie the price per square meter for new buildings and old buildings. Also in this case the relationship between the two was demonstrated: **the perception of safety varies according to square meter price**, the higher is the value of the price per square meter the more people are safe, and the higher is the price per square meter, the higher is the perceived urban quality.

After analyzing the urban characteristics of the areas, the light and sound environment was investigated. Speaking about **environmental perception**: the perceived urban quality has positive correlation with Visual Lightness and in Visual Interest but not with perceived lighting

color temperature. In particular the characteristics of light ranked in surveys that most influence it are pleasantness, gloom and brightness. The perceived chromaticism of light in general only influences the factor of social presence.
What about the sound setting, the Pleasantness of Technological Soundscape affect Perceived Urban Quality, the Pleasantness of Anthropic Soundscape have strong correlation with Perceived Social Presence and Perceived Urban Quality, while the Pleasantness of Natural Soundscape does not have significant correlation. Finally the correlations with Perceived Urban Quality and Perceived Social Presence were carried out and significantly emerged relations between Perceived safety and Social Presence, but also Perceived Safety and Perceived Urban Quality.
After these in-depth analyzes of all the characteristics of light and sound in relation to urban characteristics such as urban quality and social presence, the same characteristics of light and sound were analyzed with the perception of safety, the central theme of the research.
The perception of safety varies according to the perceived characteristic of light, in particular the higher is the value of **Visual Lightness** and **Visual Interest** the more people feel safer. Visual Lightness is negatively correlated with the Perceived Unsafety factor, that is the more Visual Lightness is present and the more people feel safe. Visual Interest follows a similar tendency.
The perception of safety varies according to the perceived characteristic of sound, in particular the higher the value of **PTS** the more people feel insicure, so PTS is negatively correlated with the perception of safety. Futhermore **PAS** is positively correlated with perceived social presence and perceived urban quality.
In order to have a clearer idea all the research factors have been considered, to show that **the perception of safety varies according to different factors**, in particular is negatively related to alternative Social Presence, Visual Lightness and Visual Interest and positively to Pleasantness of Anthropic Soundscape. So as the perception of Social Presence, Visual Lightness and Visual Interest increases, the perception of insecurity is reduced and people feel safer.
Finally after analyzing all the subjective aspects, the **objectively measured values** were tested to the perceptions of the same field. The correlations were then investigated through a consequential triple report on the perception of safety, the perception of the surrounding environments and the objectively measurable characteristics of them. It was demonstrated that **the objective characteristic of light are correlated with the subjective ones**.
VL is negatively correlated with Pedestrian Path Dispersion $\mathbf{D_{pp}}$, so when dispersion increases, the perception of VL decreases. VL is also positively correlated with $\mathbf{L_{m,40°h}}$, $\mathbf{L_{min,vn}}$, $\mathbf{L_{m,20°c}}$ and negatively with $\mathbf{D_{pp}}$. VC is instead positively correlated with $\mathbf{U_o}$, so when the latter increases also the perception of VC increases.
Finally on the basis of these investigations on objective factors it is possible to make considerations on objective factor. Regarding light aspects, it is possible to known that **Visual Lightness VL** is positively linked to $\mathbf{E_{m,\,h}}$ and negatively to $\mathbf{D_{pp}}$. **Visual interest VI** has a positive relationship with left peripherical minimum $\mathbf{L_{min,\,lt}}$ and**Visual Chromaticism VC** is positively linked to Overall Uniformity $\mathbf{U_o}$.
Also due to the sound characteristics it was demonstrated that **the objective characteristic of sound are correlated with the subjective ones**. PTS is positively corelated with Tonality DIN $\mathbf{TO_{DIN}}$, therefore when the Tonality DIN increases also the perception of PTS increases. While the PAS is positively correlated with $\mathbf{L_{Aeq}}$, Fluctuation strenght **FS**, Roughness **RO**, both the Sharpness $\mathbf{SH_{AURES}}$ $\mathbf{SH_{DIN}}$ and Tonality **TO**. Finally PNS is negatively correlated with Sharpness Aures $\mathbf{SH_{AURES}}$ and $\mathbf{SH_{DIN}}$ and Tonality DIN $\mathbf{TO_{DIN}}$. Finally on the basis of these investigations on objective factors it is possible to make considerations on objective factor. Regarding sound aspects, it is possible to known that PTS is positively linked to TO_{DIN}, PAS is positively linked to SH_{AURES} and TO, while PNS is negatively linked to TO.
Thanks to all these research questions it was possible to show that **the perception of safety varies according to many factors** and this research had the task of understanding what these factors actually are. To do this and to analyze the subjective perception of users, four different tools were used, one is the on-site survey that has been explained so far. The other three useful tools are the double-check survey, the social survey and the sentiment analysis.
The **double-check survey** tool has proved to be very useful to identify how the **results of the respondents are the same in the Passerella Olimpica area**, even after several weeks. This tool will be subject to subsequent investigations in order to be able to report the results to the other areas of analysis.
The **social survey** tool has proved to be very useful to attract a greater number of users. In fact thanks to the social strategy the adhesions to the questionnaire were very high and still continue to have results. The social survey proved to be useful to confirm the hypotheses of this research work and it was also an excellent advertising tool to make the topic of urban safety known.
Sentiment analysis has proved to be a useful tool to get more information on users' opinions. The expression of ideas on social media has allowed us to learn more about the places that maintain the research hypotheses, as shown by the surveys. The areas perceived with **the most criticism are** those of the **Passerella** and **San Salvario**, while **the areas perceived with positivity are** those of the **Campus Einaudi** and the **Parco Dora**.
The perception is a mental process that is not easy to explain, especially from a technical point of view as we propose to do this thesis, because it is not only a purely physical and mechanics condition. In the last few years there is a different perception of the objective reality because the user responds to an uncountable quantity of stimuli and therefore provides a re-elaboration of the objective reality, that is transformed into a subjective reality. The perception of individual, ie subjective reality, is not necessarily congruent with the real fact, ie objective reality, in fact this

is the perceptive dissociation process. This process is obviously difficult to demonstrate from a technical point of view because human perception does not depend only on mental representations, actually the perception in conditioned by the mental representation about spatial, social or cultural context. This estrangement dissociation is present in nowadays society indeed more and more people have a distort image of contemporary world in which live in powered by social medias that interpose between reality and perception of it. All these analyzes made are very important because, as explained in background part, especially in this historical period, **objective safety condition and perception of it are two different concept that rarely coincide**. Precisely for this reason, these results are important because in the era in which we find because the process of perception has changed and consequently the perception of safety has reached high levels in our cities.

EVIDENCES

Definitions of background

The work of this research has focused on the perception of safety, mentioned in part A section 3, in order to demonstrate how the latter changes according to many factors. It was indeed shown in the part E section 23 that

> *the perception of urban safety changes in relation to objective environmental conditions, such as acoustic and light conditions, and the subjective perception of these conditions by citizens*

and these influence the life quality of the inhabitants of the places under analysis. It is possible to state that **semiotics** and its **proxemics** branch, explained in part A section 1, play an important role in this perception because through the study of relationships and spaces it is possible to define how perception changes in each individual. These studies are then reflected on the **livingscape**, as explained in part A section 2, because quality of life is a key factor in the process of perception, also for this reason physical factors and psychological factors are very important. As mentioned before it is required a good quality about physical elements, social elements and psychological elements. As far as physical elements are concerned, the **architectural and urban context** is important, for this reason the

perception of the urban and architectural decay was considered in this research. Within these physical factors, the **environmental acoustic** and **lighting conditions** have been introduced. For social elements, on the other hand, it is important to consider the **social context** of the areas; this is definitely a very sensitive topic for the perception of safety and is a very broad topic that must be investigated with future studies. **Psychological elements** indeed are characteristic of the individual and the WHO-protocol was chosen to investigate and to demonstrate these. Also the **engagement strategy**, explained in part D, and the related gamification model obtained the expected results. In particular on Facebook page with 352 active people and on Instagram profile with 170 followers. It allowed to reach unexpected results with the proposal of the social survey with more than 2000 submitted questionnaire. This result was obtained also by Facebook group posting and emailing list.
All these factors mentioned above, that are semiotics and proxemics, livingscape, urban safety, lighting and acoustic conditions and engagement strategy, are therefore essential for a correct definition of the perception of safety, but in this chapter it is therefore useful to define how the **physical aspects** of the places analyzed can be modified in order to improve the urban and architectural decay.
This is very important for a good participatory urban planning, in fact the principal aim of the research is to provide a **structure of a preliminary analysis method** that is based on the correlation of objective aspects and subjective aspects: this correlation could be the basis of a conscious urban planning that places the citizen at the center. The perception of citizens about the topic of urban safety must be the basis for a good preliminary analysis method, and for this very reason the tools that allow a participatory planning between professionals and citizens are increasingly used. **Urban space** is therefore able to increase or decrease this perception and it is necessary to have pre-established guidelines for cities' interventions.

Perceptive design

As explained before, one of the main purpose of this thesis was identify a **structure of a preliminary analysis method scalable and adaptable** not only to other Turin neighborhood but also to **cities of different scale**. Thanks to previous background checked information and to statistical analysis it was possible to identify which variable plays a fundamental role in a conscious design process, which is careful to these themes and human-centric. For example the valuation of the lit scene pass through the personal valuation of luminosity (Visual Lightness VL) and the apparent dynamism of the lit system (Visual Interest VI). In the same way the soundscape was valueted starting from technological, anthropic or natural component that people heard (PTS, PAS, PNS).
In this case the urban planning process that consider Walk Safe Project structure of analysis, that could be called *perceptive design*, expresses the desire to want to change the paradigm behind the design dynamics, that often respond to purely technical parameters like pedestrian path dispersion and horizontal average illuminance for Visual Lightness or Tonality DIN for Pleasantness of Technological Soundscape.
In the opposite way, this type of approach begins to reason from the subjective reality that each person has in mind when the environment that surrounds the individual passes through his perceptive filter. Exactly as it happens with **human centric design**, a properly designed urban reality has not only implications on the ability to perform an activity properly but also on emotions and well-being. This kind of approach could be introduced also to outdoor planning in the same way of interior design. Furthermore, knowing the main user type who will frequent a given location, the technical characteristics of the area and the context in which it is inserted will allow to predict a general perceived safety and the consequent probability of use of the space.
The idea of designing inside the urban fabrics, even at different scales, is the main objective of this research, as mentioned before. This means being able to understand the ways in which a design process enters in urban scene, so as to know its relationships. Inside the urban landscape there are numerous elements, not only of a visual or sound nature, but also referring to **different perceptive modes**. It is precisely these methods that re-design the urban landscape, which is the product of many different aspects. Precisely for this reason, a highly targeted design is required in which perception and communi-

Table E31. perceptive design implication - summary of objective and subjective investigations with results.

TOPIC	FACTOR	INFLUENCES	+ / -
USERS		frequency use of space	+ frequency + safety
		gender	males safer than females
		level of education of males	+ high level - safety
SOCIAL PRESENCE		perception of people presence	+ social presence + safety
URBAN AND ARCHITECTURAL DECAY		perception of quality	+ urban quality + safety
URBAN AND ARCHITECTURAL DECAY		square meter price	+ high price + safety
SUBJECTIVE LIGHT		VL, VI	+ VL and VI + safety
SUBJECTIVE SOUND		PTS, PAS	- PTS and + PAS + safety
OBJECTIVE LIGHT	VL	D_{pp}, $E_{m,h}$	- D_{pp} and + $E_{m,h}$ + VL
	VI	$L_{min,lt}$	+ $L_{min,lt}$ + VI
	VC	U_O	+ U_O + VC
OBJECTIVE SOUND	PTS	TO_{DIN}	+ TO_{DIN} + PTS
	PAS	SH_{AURES}, TO	+ SH_{AURES} and TO + PAS
	PNS	TO	- TO + PNS

cation methods are defined. Urban space in recent years is increasingly important, in fact it has returned to being like a complex intertwining of social, economic and cultural activities inside the local community. The study of relationships in the city is therefore a useful tool for analyzing and intervening in urban spaces.

These relationships depend on the different types of **sensory systems**, as seen in Table E32, which in turn have different sensations. In this research the visual system was investigated based on visual perception and the auditory system based on acoustic perception; but not all the sensations of these two systems are included in this research. Precisely for this reason, the research aspires to further investigate the world of perception, in order to obtain a more wide comprension of it related to space.

In definitive, the necessity to design the city to **human scale** is nowadays more and more central. The security request is central and it is the task of architects to guarantee the **city right** and the **safety right**. It is therefore essential to design cities on a human scale and above all on the basis of perception inside the city.

SENSORY SYSTEM	SENSATIONS
visual system	color form dimension position orientation weaving movement depth
auditory system	intensity duration height rubber stamp direction distance
tactile system	weaving form pressure vibration temperature
proprioceptive system	position movement power
vestibular system	equilibrium orientation
olfactory system	proximity and distance environmental control
taste system	food control salivary reflexes nearness
visceral system	ache hungry and thirsty specific sensations

Table E32. relations between sensory systems and sensations - La Malva, Francesca, Arianna Astolfi, Pasquale Bottalico, Valerio R.M. Lo Verso, and Fabrizio Bronuzzi. 2011. "Livingscape Approach to Improve Urban Historical Places" no. July: 20–24.

Steps of perceptive design

After having understood the importance of a design that is based on the perception of individuals and after having also identified the will of this research to provide a **structure of a preliminary analysis method** scalable and adaptable to cities of different scale, the research proposes useful steps to start the *perceptive design*.

The suggestions in question are in fact inherent to the methodology used in this research, wanting above all to give a preliminary tool. From the definition of the background identified a few pages before, we can identify the **essential aspects to be investigated**, while from the further investigations on the perceptive design identified a few pages before, we can identify the **additional aspects to be investigated** to complete the picture as best as possible. In the first case it is useful to say that it is essential to have a photograph of the **context**, or an in-depth study of the objective state and above all of the subjective state.

The objective aspects concern precisely the **measurable conditions of the context** and the data that can be extrapolated from the institutions, the subjective aspects concern instead the **opinion of the users**.

To identify these aspects, we need to separate them into further categories.

To investigate the context objectively, we must certainly consider the lighting conditions and the acoustic conditions, besides these it is possible to request the objective data representative of the area, such as the price per square meter for example.

Instead to investigate the opinion of the users it is possible to find many evaluable sub-categories, such as for example the decay, the light and sound conditions themselves, safety of course. Opinion and perception are such subjective themes that can be investigated through questionnaires, but because of the variability of the theme it is possible to use different questionnaires, like the three used in this research, and different methodologies, such as sentiment analysis and numerous engagement strategies of this research.

Finally all these data obtained must be processed through statistical analysis to obtain congruent results. Thanks to these results it is possible to compare the opinions of users with the objective environment and understand what the main concerns of users are, which do not depend only on the environmental characteristics but how these aspects are perceived.

On the basis of this it is possible to say that first of all it is essential to know the context and the perception of it:

1. objective analysis
- **1.a** lighting check up
- **1.b** soundscape check up

2. subjective analyzes
- **2.a** surveys
- **2.b** sentiment analysis
- **2.c** engagement strategies

3. get results

4. assess the situation

5. intervene

We have reached step 4 and we have demonstrated all that is contained in part E, after these results we can say with certainty that the characteristics of the interviewee influence the perception that he has of the surrounding environment and that however depends above all on the environment perception. Precisely for this reason a preliminary analysis method must carry out two fundamental steps, namely: **lighting check up** and **acoustic check up**; these allow

to have a first consideration of the surrounding environment and, based on the extrapolated objective data, we can see see which are the characteristics to be improved. For example in this research it is possible to say that the brightness of the environment influences the perception of safety, so this could be a feature to be improved. Or as regards the sound environment, the psychoacoustic metric of the Tonality that influences the perception of safety. The characteristics identified by this research and on which it is possible to intervene are: **perception of social presence**, **perception of urban quality**, **square meter price**, **complaints**, **lighting and acoustics environment**.

Intervene with the perceptive design

This research has identified the aforementioned aspects on which it is possible to intervene to carry out step 5 of this structure of a preliminary analysis method.

The **perception of social presence** is the feeling that one feels in a place when it is perceived lived by other people or when other activities take place. This presence is not necessarily the sight of a person, but also derives from hearing anthropic sounds or the presence of animals. The perception of social presence has a very important significance and this means that in places where this perception fails, unsafety prevails instead. To guarantee this perception it is possible to re-design the space in order to make it "more alive", that is to entice people to use that particular area, also thanks to a re-design of the spaces that allow them to stay or perform certain activities. A very simple example is the famous Volkswagen advertising campaign in the Odenplan subway in Stockholm which included the installation of a piano on the subway stairs. This activity has increased the permanence of citizens in that area, making the environment more lived and not just a passing environment. For example in the area of the Campus Einaudi the social presence is very perceived during the day, due to the presence of the university, but not in the evening and night hours. The redesign of the adjacent space, such as the Viale O. Mai, could guarantee greater use of that area, especially for university students who use the adjacent school canteen service. This would lead to an increase in the perception of social presence, to an increase of urban safety and urban quality.

Precisely this **perception of urban quality** is another of the aspects on which it is possible to intervene. Urban quality is identified on the basis of the conversation of buildings and public spaces and the cleanliness of spaces. The theme of urban quality is very important because thanks to redevelopment interventions it is possible to obtain an improvement of numerous other features. That is, by improving a certain area, it is possible to increase the price per square meter (linked to the perception of safety) and consequently it is possible to reduce the number of complaints items (also linked to the perception of safety). The improvement of the area can also take place not through a decisive intervention, but it is possible to carry out small and precise interventions to improve the cleanliness of the spaces or the decay of the buildings. This is precisely so as not to incur numerous phenomena of gentrification and not to drastically modify an already existing reality. For example, among the areas analyzed, that of Parco Dora has undergone a major redevelopment that led to an improvement in urban quality, in fact the subjective aspects of this area have a very high value on quality. Instead punctual elements can be the introduction of public green, which is not necessarily a park or a dedicated area, but also small presences that allow a *quality view* to the citizens; in fact the major complaints are those concerning the cleanliness and quality of the space.

Further characteristics of the space that can be modified are the characteristics on which a check-up must be carried out, ie **light and sound**. With the change in the perception of the light and sound environment, the perception of the safety of the environment changes accordingly.

The characteristics of light that influence perception of safety are the **perception of the brightness** (VL) of an environment and **the perception of interest** (VI) of that same environment. The objective factors most closely linked to the perception of the luminous environment are $E_{m,\,h}$ in a direct proportion and D_{pp} in an inverse proportion; so when one of these objective factors changes, the perception of the lighting environment changes coherently with current legislation. To improve the characteristics of the perceived environment it is also possible to consider the items within the factor, ie such as negative gloomy and glaring, as mentioned in first part C. Therefore one of the most banal precautions is to avoid that an environment is perceived as a gloomy, consequently a good design of the luminous environment, as a stimulating and not monotonous lighting.

The characteristics of sound that influence perception of safety are the **perception of pleasantness of technological soundscape** (PTS), that is related to the perception of sounds, mainly technological ones; in fact there are items such as *traffic or technological sound (eg car, industry, sirens, construction)* or *annoying* in negative way or *pleasant* in positive way. The objective factors most closely linked to the perception of the acoustic environment are Tonality and Sharpness Aures; so when one of these objective factors changes, the perception of the acoustic environment changes. As shown in table E26 of the previous pages, sharpness and tonality are among the indicators that describe *Pleasantness of noise*, and sharpness are also among the indicators that describe the *annoyance*. Both metrics are among the indicators that describe the *Perceived Affective Quality* because the factor PTS includes *pleasant*, *annoying*, PAS includes *eventful*, *uneventful*, *vibrant* and *monotonous*, while PNS includes *calm* and *chaotic*.

One of the major strategies used to change the soundscape in urban spaces is the decrease in sound level, but it is not always possible and not always is the level playing an important role. It is possible to manipulate the perception of users based on the environmental context by making the sound environment more pleasant, thanks

to the high natural sound and to the reduction of traffic noise and technological noises and to the decrease of annoyance therefore. A very simple solution is the one adopted by a restaurant in Mexico which has a facade that, thanks to a vertical garden, has increased the quality of the sound environment and improved its pleasantness.

These are just some suggestions on how to intervene considering the perceptive design, in fact, as mentioned in the Table E32, the **characteristics of perception** are numerous and others should be investigated in future research.

The perception is a mental process that is not easy to explain and the perception of individual, is not necessarily congruent with the real fact. This process is obviously difficult to demonstrate from a technical point of view because human perception does not depend only on mental representations. Precisely for this reason, these results are important because in the era in which we find because the process of perception has changed and consequently the perception of safety has reached high levels in our cities.

FigE26. facade of padrinos restaurant in mexico city *spazi di lusso blog*

ACKNOWLEDGMENTS

APPENDIX

APPENDIX - LIGHTING DATA

CAMPUS EINAUDI		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
ILLUMINANCE		**nord**	**sud**	**sud**	**nord**	**sud**	**nord**	**ovest**	**est**	**est**	**ovest**
E_m	*lx*	2,35	2,35	2,63	2,63	18,24	18,24	11,58	11,58	81,82	81,82
E_{min}	*lx*	0,00	0,00	1,47	1,47	12,83	12,83	4,92	4,92	68,33	68,33
$E_{v\ min}$	*lx*	1,31	0,33	2,41	2,54	1,73	1,76	1,50	4,21	15,31	12,42
$U_o = E_{min}/E_m$	-	0,00	0,00	0,56	0,56	0,70	0,70	0,42	0,42	0,84	0,84

Table 1. Lighting data - Illuminance indicators
CAMPUS EINAUDI

		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
H. 40° BAND		**nord**	**sud**	**sud**	**nord**	**sud**	**nord**	**ovest**	**est**	**est**	**ovest**
L_m	*cd/m²*	0,41	0,22	0,42	0,38	0,56	0,39	0,58	0,51	2,58	2,39
D	-	1,39	0,87	1,49	1,39	0,70	0,96	0,48	0,39	1,96	3,28
L_{max}	*cd/m²*	55,67	11,17	27,91	24,24	36,38	34,48	17,82	15,50	91,19	117,70
L_{min}	*cd/m²*	0,00	0,00	0,00	0,00	0,00	0,01	0,01	0,01	0,02	0,00

Table 2. Lighting data - Horizontal 40° band indicators
CAMPUS EINAUDI

CAMPUS EINAUDI		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
		nord	sud	sud	nord	sud	nord	ovest	est	est	ovest
PEDESTRIAN PATH (PP)											
L_m	*cd/m²*	0,64	0,04	0,23	0,20	1,13	0,90	0,58	0,59	4,16	3,39
D	-	0,48	0,01	0,07	0,06	0,17	0,19	0,23	0,20	1,62	1,08
L_{max}	*cd/m²*	4,97	0,20	0,66	1,04	2,38	2,86	3.55	5,91	12,74	11,19
L_{min}	*cd/m²*	0,02	0,01	0,02	0,02	0,22	0,12	0,01	0,02	0,29	0,26
NEAR VERTICAL (VN)											
L_m	*cd/m²*	n.a.	n.a.	0,85	0,76	0,93	n.a.	0,58	0,49	2,46	n.a.
D	-	n.a.	n.a.	1,97	1,86	0,62	n.a.	0,23	0,39	1,95	n.a.
L_{max}	*cd/m²*	n.a.	n.a.	22,27	24,28	2,80	n.a.	3,42	4,41	91,19	n.a.
L_{min}	*cd/m²*	n.a.	n.a.	0,01	0,01	0,01	n.a.	0,02	0,02	0,04	n.a.
NEAR FAR (VF)											
L_m	*cd/m²*	0,29	0,74	0,27	0,13	0,46	0,45	0,60	0,68	n.a.	3,08
D	-	1,36	1,58	0,78	0,44	0,49	1,95	0,75	0,48	n.a.	4,05
L_{max}	*cd/m²*	55,67	11,17	27,91	18,47	32,78	34,48	17,14	4,50	n.a.	112,40
L_{min}	*cd/m²*	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,02	n.a.	0,00

Table 3. Lighting data- Physical elements CAMPUS EINAUDI

CAMPUS EINAUDI		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
		nord	sud	sud	nord	sud	nord	ovest	est	est	ovest
CIRCOLAR CENTRAL 20°											
L_m	*cd/m²*	0,85	0,13	0,57	0,27	0,73	0,26	0,64	0,48	2,94	1,74
D	-	2,75	0,47	2,16	0,93	0,32	0,72	0,74	0,33	2,53	3,05
L_{max}	*cd/m²*	45,42	8,85	22,26	17,57	2,80	27,52	17,82	4,51	36,44	87,94
L_{min}	*cd/m²*	0,00	0,00	0,00	0,02	0,05	0,01	0,02	0,02	0,09	0,05
BOTTOM REGION (BP)											
L_m	*cd/m²*	0,57	0,04	0,19	0,22	0,89	0,76	0,53	0,48	3,68	3,37
D	-	0,71	0,01	0,01	0,09	0,38	0,29	0,21	0,29	1,53	1,14
L_{max}	*cd/m²*	44,00	0,24	2,07	0,85	7,26	3,46	3,55	15,50	14,92	13,18
L_{min}	*cd/m²*	0,00	0,01	0,02	0,01	0,02	0,03	0,01	0,01	0,10	0,20
RIGHT REGION (RP)											
L_m	*cd/m²*	0,34	0,65	0,23	1,02	0,66	0,38	0,04	0,68	2,35	2,69
D	-	1,21	1,56	0,58	2,66	0,62	0,88	0,26	0,42	1,83	1,93
L_{max}	*cd/m²*	50,36	10,93	27,91	24,28	2,76	34,48	13,89	2,59	89,58	103,40
L_{min}	*cd/m²*	0,03	0,00	0,01	0,01	0,00	0,01	0,02	0,01	0,03	0,04

Table 4. Lighting data - Fixed image regions CAMPUS EINAUDI

CAMPUS EINAUDI		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
		nord	sud	sud	nord	sud	nord	ovest	est	est	ovest
LEFT REGION (LP)											
L_m	cd/m^2	0,29	0,08	1,00	0,18	0,52	0,34	0,63	0,47	1,46	2,37
D	-	1,25	0,32	2,46	0,49	1,06	0,99	0,30	0,28	1,15	4,56
L_{max}	cd/m^2	55,67	11,17	23,81	21,15	38,38	33,39	16,53	11,92	91,19	117,70
L_{min}	cd/m^2	0,00	0,00	0,01	0,00	0,00	0,01	0,03	0,02	0,02	0,00

Table 5. Lighting data - Fixed image regions CAMPUS EINAUDI

PARCO DORA		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
ILLUMINANCE		nord	sud	sud	nord	sud	nord	ovest	est	est	ovest
E_m	lx	20,02	20,02	27,45	27,45	92,57	92,57	11,79	11,79	22,48	22,48
E_{min}	lx	15,65	15,65	16,44	16,44	73,68	73,68	2,84	2,84	10,06	10,06
$E_{v\,min}$	lx	13,22	2,29	15,25	5,86	11,56	12,47	3,02	2,43	3,74	2,56
$U_o = E_{min}/E_m$	-	0,78	0,78	0,60	0,60	0,80	0,80	0,24	0,24	0,45	0,45

Table 6. Lighting data - Illuminance indicators PARCO DORA

PARCO DORA		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
HORIZONTAL 40° BAND		nord	sud	sud	nord	sud	nord	ovest	est	est	ovest
L_m	cd/m^2	0,78	0,76	1,20	1,19	2,48	2,43	0,81	0,21	0,63	0,86
D	-	1,57	1,79	1,51	1,82	4,81	3,49	1,28	0,48	1,34	1,41
L_{max}	cd/m^2	28,26	58,53	88,43	90,20	184,00	128,60	41,15	17,61	55,42	70,15
L_{min}	cd/m^2	0,01	0,03	0,00	0,01	0,00	0,00	0,00	0,00	0,01	0,00

Table 7. Lighting data - Horizontal 40° band PARCO DORA

PARCO DORA		st.1 nord	st.1 sud	st.2 sud	st.2 nord	st.3 sud	st.3 nord	st.4 ovest	st.4 est	st.5 est	st.5 ovest
PEDESTRIAN PATH (PP)											
L_m	*cd/m²*	0,80	0,87	2,70	2,92	3,96	3,36	0,63	0,22	1,21	2,40
D	-	0,21	0,35	0,38	0,60	1,89	1,99	0,39	0,08	0,26	0,56
L_{max}	*cd/m²*	4,00	5,01	8,38	17,38	22,44	21,08	5,64	2,02	5,37	6,36
L_{min}	*cd/m²*	0,11	0,27	0,43	0,69	0,89	0,68	0,06	0,04	0,14	0,22
NEAR VERTICAL (VN)											
L_m	*cd/m²*	n.a.	1,14	0,58	0,49	n.a.	n.a.	0,94	n.a.	0,16	0,36
D	-	n.a.	1,89	0,27	0,27	n.a.	n.a.	0,71	n.a.	0,23	0,93
L_{max}	*cd/m²*	n.a.	58,53	4,10	3,73	n.a.	n.a.	40,17	n.a.	5,14	30,26
L_{min}	*cd/m²*	n.a.	0,05	0,07	0,04	n.a.	n.a.	0,03	n.a.	0,01	0,03
NEAR FAR (VF)											
L_m	*cd/m²*	1,47	n.a.	0,33	0,21	0,58	0,68	1,20	n.a.	0,39	0,54
D	-	2,69	n.a.	0,72	0,47	0,37	1,13	1,71	n.a.	1,02	1,83
L_{max}	*cd/m²*	22,83	n.a.	77,05	81,97	9,33	109,60	12,01	n.a.	47,13	57,27
L_{min}	*cd/m²*	0,01	n.a.	0,00	0,09	0,09	0,11	0,04	n.a.	0,02	0,00

Table 8. Lighting data - Physical elements PARCO DORA

PARCO DORA		st.1 nord	st.1 sud	st.2 sud	st.2 nord	st.3 sud	st.3 nord	st.4 ovest	st.4 est	st.5 est	st.5 ovest
CIRCOLAR CENTRAL 20°											
L_m	*cd/m²*	0,44	1,23	1,49	1,22	1,80	1,83	1,14	0,19	1,00	1,27
D	-	0,37	2,94	1,79	1,54	4,04	2,29	1,43	0,29	1,30	1,68
L_{max}	*cd/m²*	21,99	43,98	68,89	68,57	139,70	109,30	34,47	13,72	43,10	54,86
L_{min}	*cd/m²*	0,01	0,05	0,00	0,01	0,00	0,00	0,02	0,00	0,03	0,00
BOTTOM REGION (BP)											
L_m	*cd/m²*	0,83	0,83	2,73	2,93	3,26	3,09	0,59	0,21	0,86	1,60
D	-	0,21	0,23	0,36	0,65	1,66	1,65	0,36	0,06	0,46	1,03
L_{max}	*cd/m²*	4,00	5,01	7,57	17,38	19,94	21,08	5,38	1,05	3,47	6,45
L_{min}	*cd/m²*	0,13	0,27	0,66	0,15	0,89	0,68	0,06	0,00	0,01	0,03
RIGHT REGION (RP)											
L_m	*cd/m²*	0,55	0,66	0,96	0,57	2,40	3,33	0,91	0,28	0,43	1,01
D	-	0,86	1,52	1,44	0,43	2,86	3,42	1,31	0,45	1,41	1,82
L_{max}	*cd/m²*	28,26	55,13	88,43	6,23	163,20	141,40	40,17	17,10	54,61	70,15
L_{min}	*cd/m²*	0,03	0,03	0,00	0,03	0,00	0,00	0,03	0,02	0,01	0,03

Table 9. Lighting data - Fixed image regions PARCO DORA

PARCO DORA		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
		nord	sud	sud	nord	sud	nord	ovest	est	est	ovest
LEFT REGION (LP)											
L_m	cd/m^2	1,61	0,59	0,81	1,04	2,76	2,11	1,16	0,18	0,88	0,25
D	-	2,76	1,14	1,28	2,31	4,20	2,56	1,67	0,55	1,84	0,66
L_{max}	cd/m^2	25,00	58,53	83,66	90,20	184,00	128,60	41,15	17,61	55,42	30,26
L_{min}	cd/m^2	0,01	0,03	0,04	0,03	0,00	0,08	0,03	0,02	0,02	0,03

Table 10. Lighting data - Fixed image regions PARCO DORA

PASS. OLIMPICA		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
ILLUMINANCE		nord	sud	sud	nord	sud	nord	ovest	est	est	ovest
E_m	lx	12,51	12,51	8,44	8,44	40,17	40,17	2,29	2,29	2,14	2,14
E_{min}	lx	8,72	8,72	7,09	7,09	30,86	30,86	0,45	0,45	0,02	0,02
$E_{v\,min}$	lx	11,56	5,77	3,04	3,79	21,80	23,26	6,31	2,42	2,17	0,31
$U_o = E_{min}/E_m$	-	0,70	0,70	0,84	0,84	0,77	0,77	0,20	0,20	0,01	0,01

Table 11. Lighting data - Illuminance indicators PASSERELLA OLIMPICA

PASS. OLIMPICA		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
HORIZONTAL 40° BAND		nord	sud	sud	nord	sud	nord	ovest	est	est	ovest
L_m	cd/m^2	0,47	0,68	0,65	0,52	1,63	2,52	1,18	0,68	0,44	0,18
D	-	1,17	2,50	1,86	2,14	2,73	3,94	4,28	3,64	1,43	0,65
L_{max}	cd/m^2	35,37	86,91	73,54	45,85	79,01	134,90	127,50	55,89	26,67	17,84
L_{min}	cd/m^2	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Table 12. Lighting data - Horizontal 40° band PASSERELLA OLIMPICA

PASS. OLIMPICA		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
		nord	sud	sud	nord	sud	nord	ovest	est	est	ovest
PEDESTRIAN PATH (PP)											
L_m	*cd/m²*	0,68	1,31	1,19	0,49	3,26	3,35	1,86	0,27	0,47	0,09
D	-	0,25	0,27	0,63	0,16	0,61	0,63	5,24	0,33	0,79	0,24
L_{max}	*cd/m²*	6,48	3,50	3,39	2,33	11,32	6,48	115,70	8,30	7,36	5,16
L_{min}	*cd/m²*	0,05	0,17	0,14	0,09	0,33	0,27	0,04	0,01	0,01	0,01
NEAR VERTICAL (VN)											
L_m	*cd/m²*	n.d.	n.d.	n.d.	0,81	0,74	1,35	1,86	0,44	0,46	0,23
D	-	n.d.	n.d.	n.d.	3,35	1,01	2,63	3,20	1,59	1,95	0,63
L_{max}	*cd/m²*	n.d.	n.d.	n.d.	39,88	79,01	134,90	127,50	44,02	24,25	16,60
L_{min}	*cd/m²*	n.d.	n.d.	n.d.	0,01	0,05	0,07	0,02	0,02	0,00	0,00
NEAR FAR (VF)											
L_m	*cd/m²*	0,69	0,64	0,43	0,18	1,30	5,22	0,47	1,15	0,35	0,35
D	-	1,88	4,38	2,13	0,98	1,52	6,77	0,86	4,51	1,28	0,93
L_{max}	*cd/m²*	33,68	86,91	73,56	33,68	70,94	134,40	107,20	48,80	26,67	17,83
L_{min}	*cd/m²*	0,00	0,00	0,00	0,01	0,00	0,00	0,04	0,00	0,00	0,00

Table 13. Lighting data - Physical elements
PASSERELLA OLIMPICA

PASS. OLIMPICA		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
		nord	sud	sud	nord	sud	nord	ovest	est	est	ovest
CIRCOLAR CENTRAL 20°											
L_m	*cd/m²*	0,86	0,98	0,65	0,56	2,40	5,89	0,67	0,44	0,38	0,38
D	-	1,36	4,29	2,96	2,22	8,05	6,73	3,29	2,19	1,09	1,48
L_{max}	*cd/m²*	27,87	69,96	55,47	35,07	68,96	109,10	110,00	43,70	14,18	22,27
L_{min}	*cd/m²*	0,04	0,07	0,00	0,00	0,00	0,08	0,11	0,00	0,00	0,03
BOTTOM REGION (BP)											
L_m	*cd/m²*	0,65	1,28	1,10	0,41	3,33	3,48	2,08	0,31	0,10	0,39
D	-	0,21	0,29	0,66	0,34	0,64	1,16	4,55	0,37	0,32	0,69
L_{max}	*cd/m²*	3,26	3,58	67,28	39,28	11,32	30,00	115,70	9,70	13,97	7,85
L_{min}	*cd/m²*	0,05	0,09	0,03	0,01	0,33	0,27	0,04	0,01	0,00	0,00
RIGHT REGION (RP)											
L_m	*cd/m²*	0,45	0,64	0,40	0,31	1,30	2,67	1,03	0,88	0,23	0,49
D	-	1,20	2,80	1,94	1,36	1,24	4,79	4,82	3,76	0,80	1,54
L_{max}	*cd/m²*	33,61	84,93	72,31	45,85	79,01	134,40	109,00	54,68	17,56	26,67
L_{min}	*cd/m²*	0,02	0,00	0,02	0,00	0,07	0,00	0,00	0,02	0,00	0,00

Table 14. Lighting data - Fixed image regions
PASSERELLA OLIMPICA

PASS. OLIMPICA		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
		nord	sud	sud	nord	sud	nord	ovest	est	est	ovest
LEFT REGION (LP)											
L_m	cd/m^2	0,43	0,44	0,82	1,07	1,03	1,91	1,05	1,23	0,18	0,56
D	-	1,45	2,49	0,66	3,66	1,33	2,48	3,87	5,85	0,61	2,05
L_{max}	cd/m^2	35,37	86,91	67,28	39,88	73,56	134,60	127,50	55,89	17,83	24,71
L_{min}	cd/m^2	0,00	0,00	0,03	0,02	0,00	0,07	0,02	0,00	0,00	0,01

Table 15. Lighting data - Fixed image regions PASSERELLA OLIMPICA

SAN SALVARIO		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
ILLUMINANCE		nord	sud	sud	nord	sud	nord	ovest	est	est	ovest
E_m	*lx*	30,41	30,41	20,34	20,34	12,33	12,33	52,85	52,85	12,92	12,92
E_{min}	*lx*	12,63	12,63	12,90	12,90	8,30	8,30	44,92	44,92	9,20	9,20
$E_{v\,min}$	*lx*	13,36	9,44	12,69	11,33	39,17	15,50	10,13	22,60	16,50	5,29
$U_o = E_{min}/E_m$	-	0,42	0,42	0,63	0,63	0,67	0,67	0,85	0,85	0,71	0,71

Table 16. Lighting data - Illuminance indicators SAN SALVARIO

SAN SALVARIO		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
HORIZONTAL 40° BAND		nord	sud	sud	nord	sud	nord	ovest	est	est	ovest
L_m	cd/m^2	2,06	2,89	2,04	1,49	3,03	2,98	1,99	1,46	2,52	1,21
D	-	3,24	7,23	3,41	2,93	14,01	8,74	5,62	8,28	8,13	2,42
L_{max}	cd/m^2	114,10	116,50	104,50	66,92	279,50	226,40	22,60	273,30	141,90	53,87
L_{min}	cd/m^2	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Table 17. Lighting data - Horizontal 40° band SAN SALVARIO

SAN SALVARIO		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
		nord	sud	sud	nord	sud	nord	ovest	est	est	ovest
PEDESTRIAN PATH (PP)											
L_m	*cd/m²*	1,81	1,46	1,12	0,74	1,29	1,33	3,56	2,26	1,27	0,75
D	-	0,65	0,65	0,83	0,94	0,42	0,83	2,57	0,63	0,50	0,23
L_{max}	*cd/m²*	7,61	47,03	35,31	4,44	12,69	25,82	15,75	5,96	4,72	2,05
L_{min}	*cd/m²*	0,23	0,18	0,06	0,10	0,17	0,15	0,13	0,07	0,07	0,04
NEAR VERTICAL (VN)											
L_m	*cd/m²*	n.a.	4,00	2,86	2,48	3,40	n.a.	2,26	1,73	3,23	1,27
D	-	n.a.	9,48	2,76	3,88	9,41	n.a.	2,28	10,57	10,63	2,22
L_{max}	*cd/m²*	n.a.	115,90	102,80	61,06	224,90	n.a.	181,80	225,80	141,90	51,62
L_{min}	*cd/m²*	n.a.	0,05	0,07	0,09	0,10	n.a.	0,00	0,00	0,00	0,03
NEAR FAR (VF)											
L_m	*cd/m²*	2,99	2,38	1,40	0,97	2,76	4,04	1,06	1,00	2,68	1,95
D	-	5,07	7,17	1,13	2,51	13,73	8,84	2,32	4,42	8,50	2,94
L_{max}	*cd/m²*	108,30	93,06	98,41	59,28	279,50	185,70	200,40	243,20	129,60	48,39
L_{min}	*cd/m²*	0,09	0,00	0,06	0,04	0,05	0,08	0,05	0,00	0,00	0,05

Table 18. Lighting data - Physical elements SAN SALVARIO

SAN SALVARIO		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
		nord	sud	sud	nord	sud	nord	ovest	est	est	ovest
CIRCOLAR CENTRAL 20°											
L_m	*cd/m²*	3,51	4,73	2,36	1,76	0,53	1,65	3,42	1,71	2,45	1,62
D	-	6,26	9,49	6,95	4,13	7,98	2,43	14,53	9,44	7,68	4,16
L_{max}	*cd/m²*	92,76	88,47	88,77	55,77	220,90	175,80	178,23	224,00	112,20	4,57
L_{min}	*cd/m²*	0,12	0,16	0,00	0,00	0,13	0,08	0,00	0,02	0,00	0,00
BOTTOM REGION (BP)											
L_m	*cd/m²*	1,81	1,52	1,38	0,91	1,26	1,33	3,08	1,35	1,35	0,68
D	-	0,61	0,59	0,91	0,89	0,46	1,01	2,38	2,83	0,76	0,40
L_{max}	*cd/m²*	6,33	23,77	35,31	58,25	30,27	53,32	47,28	219,10	30,61	17,16
L_{min}	*cd/m²*	0,23	0,18	0,05	0,00	0,16	0,04	0,00	0,00	0,06	0,02
RIGHT REGION (RP)											
L_m	*cd/m²*	2,57	3,10	3,02	0,83	3,97	3,71	1,02	2,54	2,53	1,22
D	-	2,40	7,66	2,14	2,51	17,56	10,90	3,53	14,52	6,08	0,76
L_{max}	*cd/m²*	108,30	112,60	102,80	66,92	279,50	216,00	22,60	225,80	129,60	51,05
L_{min}	*cd/m²*	0,07	0,00	0,15	0,02	0,00	0,05	0,01	0,00	0,01	0,04

Table 19. Lighting data - Fixed image regions SAN SALVARIO

SAN SALVARIO		st.1	st.1	st.2	st.2	st.3	st.3	st.4	st.4	st.5	st.5
		nord	sud	sud	nord	sud	nord	ovest	est	est	ovest
LEFT REGION (LP)											
L_m	*cd/m²*	1,85	2,65	1,49	2,45	2,15	4,00	2,38	0,98	3,39	1,34
D	-	3,02	5,21	2,58	2,44	7,61	12,37	2,58	2,80	11,06	1,64
L_{max}	*cd/m²*	114,10	116,50	104,50	61,06	230,90	226,40	181,80	273,30	141,90	58,87
L_{min}	*cd/m²*	0,00	0,07	0,09	0,14	0,16	0,04	0,00	0,00	0,06	0,02

Table 20. Lighting data - Fixed image regions SAN SALVARIO

APPENDIX - ACOUSTICS DATA

CAMPUS EINAUDI	05.11	08.11	11.11
	dB(A)	*dB(A)*	*dB(A)*
st.1	54.1	61.5	54.7
st.2	51.4	49.2	48.8
st.3	45.9	48.3	42.8
st.4	51.0	47.5	43.7
st.5	58.5	58.3	55.7

Table 21. Acoustic data summary of L_{Aeq} CLE - *Simcenter LMS Testlab (Siemens PLM Software 17)*

PARCO DORA	12.11	15.11	17.11
	dB(A)	*dB(A)*	*dB(A)*
st.1	46.7	62.0	52.5
st.2	47.0	49.0	47.3
st.3	50.0	53.0	48.0
st.4	49.0	73.4	58.0
st.5	47.0	45.2	52.0

Table 22. Acoustic data summary of L_{Aeq} DORA - *Simcenter LMS Testlab (Siemens PLM Software 17)*

PASSERELLA OLIMPICA	03.11	21.11	22.11	24.11	10.12
	dB(A)	*dB(A)*	*dB(A)*	*dB(A)*	*dB(A)*
st.1	66.5	53.2	48.2	55.0	63.5
st.2	67.0	66.3	54.2	52.1	46.3
st.3	54.0	49.0	58.3	58.0	56.0
st.4	57.0	57.4	51.3	50.0	40.4
st.5	51.0	48.0	46.0	46.0	46.0

Table 23. Acoustic data summary of L_{Aeq} PASSERELLA - *Simcenter LMS Testlab (Siemens PLM Software 17)*

SAN SALVARIO	29.11	01.12	08.12
	dB(A)	*dB(A)*	*dB(A)*
st.1	59.0	59.0	59.0
st.2	60.3	61.1	62.0
st.3	61.0	61.0	62.1
st.4	55.0	64.0	63.0
st.5	58.4	61.0	60.0

Table 24. Acoustic data summary of L_{Aeq} SAN SALVARIO - *Simcenter LMS Testlab (Siemens PLM Software 17)*

CAMPUS EINAUDI		st.1	st.2	st.3	st.4	st.5
Articulation Index	*%*	85.0	91.1	97.0	94.3	70.0
Fluctuation strenght	*vacil*	1.27	1.12	1.30	1.33	1.17
Loudness ISO532A	*sone*	7.50	6.40	4.60	6.43	10.35
Loudness Stevens VII	*sone*	9.72	8.04	5.70	8.00	14.00
Noise Criterion	*#*	48.60	45.00	40.40	46.00	54.00
Noise Rating	*#*	50.50	47.00	43.00	47.40	55.40
Roughness	*asper*	0.22	0.17	0.25	0.38	0.17
Sharpness Aures	*acum*	1.61	1.40	1.70	1.63	1.70
Sharpeness DIN45692	*acum*	1.60	1.33	1.60	1.60	1.60
ANSI SIL	*Pa*	0.005	0.003	0.002	0.003	0.008
SIL3	*Pa*	0.004	0.003	0.003	0.003	0.008
Loudness ISO532B	*sone*	0.43	0.38	0.26	0.37	0.60
Tonality	*t.u.*	0.035	0.008	0.013	0.012	0.004
Tonality DIN45681	*t.u.*	0.005	0.006	0.005	0.008	0.004

Table 25. Psychoacoustics metrics - CAMPUS EINAUDI 05.11 - *Simcenter LMS Testlab (Siemens PLM Software 17)*

CAMPUS EINAUDI		st.1	st.2	st.3	st.4	st.5
Articulation Index	*%*	61.5	96.4	97.6	99.1	78.0
Fluctuation strenght	*vacil*	1.12	1.14	1.10	1.14	1.12
Loudness ISO532A	*sone*	12.00	5.50	5.11	4.53	12.00
Loudness Stevens VII	*sone*	15.60	7.00	6.10	6.00	14.17
Noise Criterion	*#*	57.00	43.10	42.10	41.20	56.30
Noise Rating	*#*	58.20	44.30	43.80	42.60	54.10
Roughness	*asper*	0,21	0.13	0.13	0.16	0.19
Sharpness Aures	*acum*	1.46	1.27	1.11	1.23	1.22
Sharpeness DIN45692	*acum*	1.40	1.21	1.10	1.10	1.18
ANSI SIL	*Pa*	0.011	0.003	0.002	0.002	0.006
SIL3	*Pa*	0,010	0.003	0.002	0.002	0.005
Loudness ISO532B	*sone*	0,70	0.31	0.30	0.27	0.61
Tonality	*t.u.*	0.008	0.025	0.020	0.014	0.022
Tonality DIN45681	*t.u.*	1.00	1.00	1.57	1.02	1.01

Table 26. Psychoacoustics metrics - CAMPUS EINAUDI 08.11 - *Simcenter LMS Testlab (Siemens PLM Software 17)*

CAMPUS EINAUDI		st.1	st.2	st.3	st.4	st.5
Articulation Index	*%*	82.00	98.22	100.00	99.30	99.30
Fluctuation strenght	*vacil*	1.17	1.13	1.14	1.10	1.10
Loudness ISO532A	*sone*	8,00	5.10	3.32	3.60	3.61
Loudness Stevens VII	*sone*	10.35	6.30	3.72	4.10	4.09
Noise Criterion	*#*	50.00	43.00	36.30	38.10	38.20
Noise Rating	*#*	51.60	44.10	37.40	39.10	39.00
Roughness	*asper*	0.17	0.15	0.16	0.11	0.10
Sharpness Aures	*acum*	1.57	1.21	1.03	1.00	1.25
Sharpeness DIN45692	*acum*	1.50	1.15	1.01	1.00	1.20
ANSI SIL	*Pa*	0.005	0.002	0.001	0.001	0.001
SIL3	*Pa*	0.005	0.002	0.001	0.001	0.005
Loudness ISO532B	*sone*	0.46	0.30	0.18	0.20	0.20
Tonality	*t.u.*	0.015	0.020	0.013	0.018	0.018
Tonality DIN45681	*t.u.*	1.00	1.10	1.00	1.01	1.01

Table 27. Psychoacoustics metrics - CAMPUS EINAUDI 11.11 - *Simcenter LMS Testlab (Siemens PLM Software 17)*

PARCO DORA		st.1	st.2	st.3	st.4	st.5
Articulation Index	*%*	99.27	95.04	98.60	98.40	99.27
Fluctuation strenght	*vacil*	1.10	1.13	1.10	1.11	1.10
Loudness ISO532A	*sone*	5.01	5.30	5.24	5.20	5.01
Loudness Stevens VII	*sone*	5.41	6.10	6.34	6.30	5.41
Noise Criterion	*#*	40.00	41.80	44.60	42.20	40.00
Noise Rating	*#*	41.40	44.00	45.50	44.00	41.40
Roughness	*asper*	0.13	0.14	0.12	0.13	0.13
Sharpness Aures	*acum*	1.40	2.10	1.70	1.40	1.41
Sharpeness DIN45692	*acum*	1.03	1.50	0.84	1.02	1.03
ANSI SIL	*Pa*	0.002	0.002	0.002	0.002	0.002
SIL3	*Pa*	0.001	0.002	0.002	0.002	0.001
Loudness ISO532B	*sone*	0.26	0.28	0.29	0.29	0.26
Tonality	*t.u.*	0.013	0.019	0.006	0.017	0.013
Tonality DIN45681	*t.u.*	1.90	1.40	1.00	1.00	1.90

Table 28. Psychoacoustics metrics - PARCO DORA 12.11 - *Simcenter LMS Testlab (Siemens PLM Software 17)*

PARCO DORA		st.1	st.2	st.3	st.4	st.5
Articulation Index	*%*	73.70	98.42	92.10	29.13	99.47
Fluctuation strenght	*vacil*	1.11	1.11	1.24	1.42	1.20
Loudness ISO532A	*sone*	12.00	5.12	7.07	26.00	3.90
Loudness Stevens VII	*sone*	15.60	6.20	9.00	36.10	4.70
Noise Criterion	*#*	57.10	43.50	46.70	71.00	40.00
Noise Rating	*#*	57.00	44.60	47.40	69.30	41.20
Roughness	*asper*	0.18	0.14	0.22	0.44	0.11
Sharpness Aures	*acum*	1.41	1.51	1.84	2.50	1.65
Sharpeness DIN45692	*acum*	0.92	1.12	1.30	1.23	1.30
ANSI SIL	*Pa*	0,008	0.003	0,003	0.040	0.002
SIL3	*Pa*	0.006	0.002	0.003	0.031	0.001
Loudness ISO532B	*sone*	0.67	0.30	0.41	1.53	0.23
Tonality	*t.u.*	0.006	0.020	0.006	0.020	0.040
Tonality DIN45681	*t.u.*	1.00	1.63	1.94	1.50	1.00

Table 29. Psychoacoustics metrics - PARCO DORA 15.11 - *Simcenter LMS Testlab (Siemens PLM Software 17)*

PARCO DORA		st.1	st.2	st.3	st.4	st.5
Articulation Index	*%*	95.00	99.40	99.03	85.70	97.10
Fluctuation strenght	*vacil*	1.07	1.02	1.17	1.52	1.16
Loudness ISO532A	*sone*	7.72	4.70	4.81	9.15	5.25
Loudness Stevens VII	*sone*	8.50	5.11	5.73	11.13	6.70
Noise Criterion	*#*	46.40	42.00	42.80	53.70	49.40
Noise Rating	*#*	47.60	43.00	43.80	54.00	49.60
Roughness	*asper*	0.14	0.13	0.14	0.28	0.22
Sharpness Aures	*acum*	1.38	1.01	1.50	1.60	0.91
Sharpeness DIN45692	*acum*	1.00	0.81	1.20	1.11	0.80
ANSI SIL	*Pa*	0.003	0.002	0.002	0.006	0.002
SIL3	*Pa*	0.003	0.001	0.002	0.005	0.001
Loudness ISO532B	*sone*	0.40	0.25	0.27	0.60	0.30
Tonality	*t.u.*	0,020	0,030	0.006	0,014	0.011
Tonality DIN45681	*t.u.*	1.00	1.00	1.00	2.13	1.00

Table 30. Psychoacoustics metrics - PARCO DORA 17.11 - *Simcenter LMS Testlab (Siemens PLM Software 17)*

PASSERELLA OLIMPICA		st.1	st.2	st.3	st.4	st.5
Articulation Index	*%*	50.80	52.00	93.00	85.00	97.3
Fluctuation strenght	*vacil*	1.21	1.35	1.22	1.11	1.27
Loudness ISO532A	*sone*	15.51	14.61	7.12	7.90	6.61
Loudness Stevens VII	*sone*	21.03	19.30	8.72	10.04	7.34
Noise Criterion	*#*	60.90	62.20	49.10	51.80	46.40
Noise Rating	*#*	61.90	30.05	50.10	53.00	46.00
Roughness	*asper*	0.23	2.00	0.20	0.16	0.25
Sharpness Aures	*acum*	2.04	1.22	1.43	1.50	1.11
Sharpeness DIN45692	*acum*	1.21	1.22	1.05	1.05	0.80
ANSI SIL	*Pa*	0.018	0.018	0.004	0.005	0.002
SIL3	*Pa*	0.015	0.016	0.003	0.005	0.002
Loudness ISO532B	*sone*	1.00	0.90	0.40	0.50	0,33
Tonality	*t.u.*	0.008	0.009	0.001	0.015	0.025
Tonality DIN45681	*t.u.*	1.006	1.000	1.000	1.000	1.053

Table 31. Psychoacoustics metrics - PASSERELLA 03.11 - *Simcenter LMS Testlab (Siemens PLM Software 17)*

PASSERELLA OLIMPICA		st.1	st.2	st.3	st.4	st.5
Articulation Index	*%*	96.00	48.25	98.35	82.40	99.00
Fluctuation strenght	*vacil*	1.22	1.27	1.12	1.21	1.57
Loudness ISO532A	*sone*	6.90	16.60	5.00	9.20	4.60
Loudness Stevens VII	*sone*	8.40	21.80	5.90	10.20	5.61
Noise Criterion	*#*	48.70	61.60	43.40	53.30	41.70
Noise Rating	*#*	48.90	62.10	44.70	54.40	42.70
Roughness	*asper*	0.15	0.29	0.17	0.17	0.12
Sharpness Aures	*acum*	1.33	2.28	1.41	1.52	1.23
Sharpeness DIN45692	*acum*	0.98	1.32	1.10	1.10	1.00
ANSI SIL	*Pa*	0.003	0.018	0.002	0.006	0.002
SIL3	*Pa*	0.003	0.017	0.002	0.006	0.001
Loudness ISO532B	*sone*	0.40	1.01	0.30	0.50	0.26
Tonality	*t.u.*	0.013	0.002	0.002	0.020	0.008
Tonality DIN45681	*t.u.*	1.000	1.376	1.000	1.045	1.000

Table 32. Psychoacoustics metrics - PASSERELLA 21.11 - *Simcenter LMS Testlab (Siemens PLM Software 17)*

PASSERELLA OLIMPICA		st.1	st.2	st.3	st.4	st.5
Articulation Index	*%*	98.81	90.60	76.50	97.60	100.00
Fluctuation strenght	*vacil*	1.25	1.11	1.10	1.07	1.07
Loudness ISO532A	*sone*	4.91	6.72	9.50	5.50	4.03
Loudness Stevens VII	*sone*	5.77	8.30	12.34	6.78	4.80
Noise Criterion	*#*	42.20	49.70	52.90	46.60	40.00
Noise Rating	*#*	43.50	50.70	53.60	47.50	41.00
Roughness	*asper*	0.18	0.15	0.16	0.18	0.13
Sharpness Aures	*acum*	1.34	1.55	1.64	1.30	1.20
Sharpeness DIN45692	*acum*	1.01	1.15	1.08	1.00	0.90
ANSI SIL	*Pa*	0.002	0.004	0.007	0.003	0.002
SIL3	*Pa*	0.002	0.004	0.006	0.002	0.001
Loudness ISO532B	*sone*	0.30	0.40	0.60	0.32	0.22
Tonality	*t.u.*	0.004	0.010	0.021	0.016	0.007
Tonality DIN45681	*t.u.*	1.000	1.182	1.000	1.000	1.000

Table 33. Psychoacoustics metrics - PASSERELLA 22.11 - *Simcenter LMS Testlab (Siemens PLM Software 17)*

PASSERELLA OLIMPICA		st.1	st.2	st.3	st.4	st.5
Articulation Index	*%*	86.12	94.24	77.21	98.44	100.00
Fluctuation strenght	*vacil*	1.40	1.23	1.38	1.12	1.13
Loudness ISO532A	*sone*	9.43	6.20	9.00	4.70	3.80
Loudness Stevens VII	*sone*	10.33	7.51	11.70	5.80	4.52
Noise Criterion	*#*	54.90	46.90	52.10	45.30	40.10
Noise Rating	*#*	51.40	48.40	52.80	46.50	41.10
Roughness	*asper*	0.16	0.19	0.27	0.16	0.17
Sharpness Aures	*acum*	1.82	1.50	2.10	1.20	1.30
Sharpeness DIN45692	*acum*	1.21	1.10	1.40	1.00	1.01
ANSI SIL	*Pa*	0.005	0.003	0.007	0.003	0.002
SIL3	*Pa*	0.004	0.003	0.006	0.002	0.001
Loudness ISO532B	*sone*	0.50	0.36	0.55	0.28	0.22
Tonality	*t.u.*	0.036	0.022	0.039	0.020	0.001
Tonality DIN45681	*t.u.*	1.473	1.300	1.030	1.000	1.096

Table 34. Psychoacoustics metrics - PASSERELLA 24.11 - *Simcenter LMS Testlab (Siemens PLM Software 17)*

PASSERELLA OLIMPICA		st.1	st.2	st.3	st.4	st.5
Articulation Index	*%*	85.70	99.00	86.42	100.00	99.21
Fluctuation strenght	*vacil*	1.35	1.27	1.20	0.96	1.10
Loudness ISO532A	*sone*	8.13	4.44	7.40	2.26	3.32
Loudness Stevens VII	*sone*	9.25	5.03	9.25	2.82	4.25
Noise Criterion	*#*	53.30	40.40	50.40	34.70	41.50
Noise Rating	*#*	54.60	41.40	51.90	35.70	42.30
Roughness	*asper*	0.36	0.28	0.16	0.10	0.17
Sharpness Aures	*acum*	1.70	1.34	1.45	1.00	0.93
Sharpeness DIN45692	*acum*	1.19	1.02	1.03	1.83	0.80
ANSI SIL	*Pa*	0.005	0.002	0.005	0.001	0.001
SIL3	*Pa*	0.008	0.002	0.005	0.001	0.001
Loudness ISO532B	*sone*	0.51	0.25	0.45	0.14	0.19
Tonality	*t.u.*	0.024	0.017	0.015	0.012	0.090
Tonality DIN45681	*t.u.*	4.060	1.000	1.050	1.000	1.328

Table 35. Psychoacoustics metrics - PASSERELLA 10.12 - *Simcenter LMS Testlab (Siemens PLM Software 17)*

SAN SALVARIO		st.1	st.2	st.3	st.4	st.5
Articulation Index	*%*	75.50	69.61	64.07	85.34	78.14
Fluctuation strenght	*vacil*	1.22	1.14	1.17	1.45	1.30
Loudness ISO532A	*sone*	11.34	11.70	12.17	8.41	9.35
Loudness Stevens VII	*sone*	13.90	14.95	16.00	10.50	12.10
Noise Criterion	*#*	53.40	55.60	55.50	49.50	53.70
Noise Rating	*#*	53.50	56.00	57.20	50.20	54.20
Roughness	*asper*	0.17	0.19	0.22	0.23	0.19
Sharpness Aures	*acum*	1.84	2.05	2.25	1.94	1.83
Sharpeness DIN45692	*acum*	1.20	1.33	1.42	1.33	1.25
ANSI SIL	*Pa*	0.007	0.009	0.010	0.005	0.007
SIL3	*Pa*	0.006	0.007	0.009	0.004	0.005
Loudness ISO532B	*sone*	0.62	0.07	0.71	0.49	0.56
Tonality	*t.u.*	0.010	0.006	0.001	0.033	0.020
Tonality DIN45681	*t.u.*	1.172	1.021	1.225	1.090	1.026

Table 36. Psychoacoustics metrics - SAN SALVARIO 29.11 - *Simcenter LMS Testlab (Siemens PLM Software 17)*

SAN SALVARIO		st.1	st.2	st.3	st.4	st.5
Articulation Index	*%*	76.60	71.17	65.48	66.12	78.51
Fluctuation strenght	*vacil*	1.19	1.24	1.26	1.50	1.35
Loudness ISO532A	*sone*	9.91	10.90	12.01	12.70	10.00
Loudness Stevens VII	*sone*	13.00	13.80	16.00	16.10	13.00
Noise Criterion	*#*	53.60	58.20	58.60	58.90	56.90
Noise Rating	*#*	53.80	58.30	58.30	59.20	56.50
Roughness	*asper*	0.17	0.19	0.21	0.19	0.20
Sharpness Aures	*acum*	1.61	1.74	1.90	1.94	1.71
Sharpeness DIN45692	*acum*	1.10	1.17	1.19	1.30	1.20
ANSI SIL	*Pa*	0.007	0.009	0.010	0.010	0.007
SIL3	*Pa*	0.006	0.007	0.008	0.008	0.005
Loudness ISO532B	*sone*	0.60	0.64	0.70	0.73	0.60
Tonality	*t.u.*	0.014	0.100	0.033	0.040	0.084
Tonality DIN45681	*t.u.*	1.000	1.236	1.015	1.011	1.

Table 37. Psychoacoustics metrics - SAN SALVARIO 01.12 - *Simcenter LMS Testlab (Siemens PLM Software 17)*

SAN SALVARIO		st.1	st.2	st.3	st.4	st.5
Articulation Index	*%*	76.60	71.20	65.50	66.12	78.51
Fluctuation strenght	*vacil*	1.19	1.24	1.26	1.50	1.35
Loudness ISO532A	*sone*	9.91	10.90	12.01	12.70	10.00
Loudness Stevens VII	*sone*	12.55	13.83	15.94	16.10	12.90
Noise Criterion	*#*	53.60	58.20	58.60	58.90	56.90
Noise Rating	*#*	53.80	58.30	58.30	59.20	56.50
Roughness	*asper*	0.17	0.19	0.21	0.19	0.20
Sharpness Aures	*acum*	1.61	1.74	1.86	1.94	1.71
Sharpeness DIN45692	*acum*	1.10	1.17	1.19	1.26	1.18
ANSI SIL	*Pa*	0.007	0.009	0.010	0.010	0.007
SIL3	*Pa*	0.006	0.007	0.008	0.008	0.005
Loudness ISO532B	*sone*	0.56	0.64	0.70	0.73	0.60
Tonality	*t.u.*	0.014	0.10	0.03	0.04	0,08
Tonality DIN45681	*t.u.*	1.000	1.236	1.015	1.011	1.177

Table 38. Psychoacoustics metrics - SAN SALVARIO 08.12 - *Simcenter LMS Testlab (Siemens PLM Software 17)*

APPENDIX - AVERAGE PEOPLE DENSITY DATA

All the data collected in this Appendix Average People Density Data have been kindly provided by the Municipal Police Corps of the City of Turin whom we sincerely thank. The analysis of the average hourly presence of people in the different places was carried out through the **TIM Big Data Value** platform in collaboration with the *Technological Investigation Department* of the Municipal Police Corps of the City of Turin.

In this section it is possible to see the average hourly presence of people in the places analyzed according to the SIMs detected by the software. The data are not raw but have been grouped according to macro-categories, ie **total presences**, **gender subdivisions**: male and female, **residents**, **commuters** and **foreigners**. Each of these categories has sub-categories that are not explicit and that have not been used separately during the analyzes. The data were extracted from the database provided by the municipal police force to identify the day and the hours in which the measures and questionnaires were carried out, which are three days a week (Monday, Wednesday, Saturday) for each station, from 20pm to 23pm. Then the data were used as explained in the Methodology in part B section 10 and in the Results in part E section 23.

CAMPUS EINAUDI

DATA | ORA	TOTALE	MASCHI	FEMMINE	RESIDENTI	PENDOLARI	VISITATORI
05.11						
20.00	3935	1893	2042	2617	382	932
21.00	4111	1972	2139	2708	343	1056
22.00	5034	2402	2632	3373	312	1358
23.00	5836	2761	3075	n.a.	n.a.	n.a.
08.11						
20.00	4018	1944	2074	2537	394	997
21.00	4208	2058	2150	2626	341	942
22.00	4701	2287	2414	2926	304	1088
23.00	5507	2677	2830	n.a.	n.a.	n.a.
11.11						
20.00	3715	1837	1878	2613	293	828
21.00	3913	1920	1993	2919	258	803
22.00	4010	2013	1997	n.a.	n.a.	n.a.
23.00	4201	2101	2100	n.a.	n.a.	n.a.

Table 39. Average people density data
CAMPUS EINAUDI
Tim Big Data Value
Platform by Olivetti

PARCO DORA

DATA | ORA	TOTALE	MASCHI	FEMMINE	RESIDENTI	PENDOLARI	VISITATORI
12.11						
20.00	1851	1040	811	1117	193	527
21.00	1792	1009	783	1098	228	485
22.00	1741	962	779	n.a.	n.a.	n.a.
23.00	1694	931	763	n.a.	n.a.	n.a.
15.11						
20.00	1846	1016	830	1134	267	523
21.00	1799	986	813	1106	232	486
22.00	1753	976	777	n.a.	n.a.	n.a.
23.00	1711	955	756	n.a.	n.a.	n.a.
17.11						
20.00	1757	1013	744	1148	178	436
21.00	1735	1008	727	1114	151	467
22.00	1750	1011	739	n.a.	n.a.	n.a.
23.00	1748	1003	745	n.a.	n.a.	n.a.

Table 40. Average people density data
PARCO DORA
Tim Big Data Value
Platform by Olivetti

PASSERELLA OLIMPICA

DATA | ORA	TOTALE	MASCHI	FEMMINE	RESIDENTI	PENDOLARI	VISITATORI
20.11						
20.00	3070	1646	1424	1734	383	943
21.00	3009	1573	1436	1766	330	903
22.00	2972	1552	1420	n.a.	n.a.	n.a.
23.00	2911	1534	1377	n.a.	n.a.	n.a.
21.11						
20.00	3068	1706	1362	1717	398	985
21.00	3036	1672	1364	1776	340	955
22.00	2981	1640	1341	n.a.	n.a.	n.a.
23.00	2937	1606	1331	n.a.	n.a.	n.a.
22.11						
20.00	3031	1623	1408	1760	399	920
21.00	2973	1615	1358	1812	342	874
22.00	2964	1600	1364	1898	305	813
23.00	2937	1599	1338	n.a.	n.a.	n.a.

Table 41. Average people density data PASSERELLA OLIMPICA Tim Big Data Value Platform by Olivetti

PASSERELLA OLIMPICA

DATA | ORA	TOTALE	MASCHI	FEMMINE	RESIDENTI	PENDOLARI	VISITATORI
24.11						
20.00	2923	1581	1342	1572	368	964
21.00	2858	1531	1327	1615	308	934
22.00	2787	1517	1270	1665	277	864
23.00	2724	1467	1257	n.a.	n.a.	n.a.

Table 42. Average people density data PASSERELLA OLIMPICA Tim Big Data Value Platform by Olivetti

SAN SALVARIO

DATA | ORA	TOTALE	MASCHI	FEMMINE	RESIDENTI	PENDOLARI	VISITATORI
29.11						
20.00	3206	1732	1474	1760	218	1228
21.00	3320	1815	1505	1781	191	1348
22.00	3504	1944	1560	n.a.	n.a.	n.a.
23.00	3490	1965	1525	n.a.	n.a.	n.a.
01.12						
20.00	3206	1732	1474	1760	218	1228
21.00	3320	1815	1505	1781	191	1348
22.00	3504	1944	1560	n.a.	n.a.	n.a.
23.00	3490	1965	1525	n.a.	n.a.	n.a.
08.12						
20.00	2373	1520	853	1405	140	857
21.00	2374	1519	855	1383	123	876
22.00	2392	1500	892	1392	119	981
23.00	2383	1493	890	n.a.	n.a.	n.a.

Table 43. Average people density data
SAN SALVARIO
Tim Big Data Value Platform by Olivetti

APPENDIX - ON SITE SURVEY

The on-site survey took place on five weeks from November 2018 to December 2018, a week for each examined site, for three days a week (Monday, Thursday, Saturday) in the evening between 08:00 pm to 00:00pm.
The survey is designed to take approximately 6 minutes to complete. The acoustic and lighting measures were carried out through a sound-light walk with predefined measurement points, as mentioned in part C, simultaneously with the administration of the questionnaires.
Before the questionnaire the Information Sheet and the Participant Consent Form were presented and the questionnaire was approved by the BCA.

INFORMATION SHEET

PARTICIPANT CONSENT FORM

1 On average, how often do you visit this place?

- ◯ This is the first time
- ◯ At least once a year
- ◯ At least once a month
- ◯ At least once a week
- ◯ Everyday

2 What activities do you do in this place?

- ◯ Passage
- ◯ Work / Study
- ◯ Leisure (eg sports, pub, free time)
- ◯ Other:_____

PERCEIVED SAFETY

In this safety section you will be asked to evaluate the environment around you

3 To what extent do you agree or disagree with the following sentences? I feel...

	strongly disagree	disagree	neither agree or disagree	agree	strongly agree
...worried	◯	◯	◯	◯	◯
...restless	◯	◯	◯	◯	◯
...comfortable	◯	◯	◯	◯	◯
...safe	◯	◯	◯	◯	◯
...alone	◯	◯	◯	◯	◯

In this safety section you will be asked to evaluate the environment around you

4 To what extent do you agree or disagree with the following sentences?

	strongly disagree	disagree	neither agree or disagree	agree	strongly agree
I would walk alone along this place	◯	◯	◯	◯	◯
I would extend my route to avoid walking in this place	◯	◯	◯	◯	◯
I am feeling uncomfortable along this route	◯	◯	◯	◯	◯
I would quickly cross this place to get away from here	◯	◯	◯	◯	◯
I have an unpleasant feeling in this place	◯	◯	◯	◯	◯

In this safety section you will be asked to evaluate the environment around you

5 To what extent do you agree or disagree with the following sentences?

	strongly disagree	disagree	neither agree or disagree	agree	strongly agree
This place is attractive	◯	◯	◯	◯	◯
This place seems full of life	◯	◯	◯	◯	◯
This place looks like a cozy environment	◯	◯	◯	◯	◯
I feel like there is someone else in this place	◯	◯	◯	◯	◯
This place seems to me designed for users	◯	◯	◯	◯	◯

URBAN AND ARCHITECTURAL DECAY

In this decay section you will be asked to evaluate the environment around you

6 How do you describe the elements of the urban context that surround you?

	very bad	bad	neither good or bad	good	very good
Maintenance of buildings (decay conditions)	◯	◯	◯	◯	◯
Maintenance of public spaces	◯	◯	◯	◯	◯
Cleaning of public space	◯	◯	◯	◯	◯

LIGHTING CONDITIONS

In this lighting section you will be asked to evaluate the environment around you

7 In lighting environmental setting, ow much do you see the light source that surround you?

	I don't see	I see	I see moderately	I see a lot	Dominates completely
Street lighting (eg vehicle seat, sidewalks, cycle paths)	◯	◯	◯	◯	◯
Architectural lighting (eg building facades and monuments)	◯	◯	◯	◯	◯
Indoor lighting (eg signs, shop windows, pubs)	◯	◯	◯	◯	◯

In this lighting section you will be asked to evaluate the environment around you

8 To what extent do you agree or disagree with the following sentences about lighting environmental setting characteristics?

	strongly disagree	disagree	neither agree or disagree	agree	strongly agree
Pleasant	◯	◯	◯	◯	◯
Chaotic	◯	◯	◯	◯	◯
Stimulant	◯	◯	◯	◯	◯
Gloomy	◯	◯	◯	◯	◯
Warm	◯	◯	◯	◯	◯
Cold	◯	◯	◯	◯	◯
Monotonous	◯	◯	◯	◯	◯
Relaxant	◯	◯	◯	◯	◯
Uniform	◯	◯	◯	◯	◯

In this lighting section you will be asked to evaluate the environment around you

9 In general, how do you seem bright the lighting environmental settings?

not bright				extremely bright
◯	◯	◯	◯	◯

In this lighting section you will be asked to evaluate the environment around you

10 In general, how do you describe the lighting environmental settings?

very bad	bad	neither good or bad	good	very good
◯	◯	◯	◯	◯

In this lighting section you will be asked to evaluate the environment around you

11 To what extent the light environmental setting is adequate for the use you make of this place?

not adequate				extremely adequate
◯	◯	◯	◯	◯

SOUND CONDITIONS

In this soundscape section you will be asked to evaluate the environment around you

12 To what extent do you presently hear the following three types of sounds?

	I don't hear	I hear	I hear moderately	I hear a lot	Dominates completely
Traffic or technological sound (eg car, industry, sirens, construction)	◯	◯	◯	◯	◯
Sound from human beings (eg conversation, laughter, footsteps, children at play)	◯	◯	◯	◯	◯
Natural sound (eg singing birds, flowing water, wid in vegetation)	◯	◯	◯	◯	◯

In this soundscape section you will be asked to evaluate the environment around you

13 To what extent do you agree or disagree with the following sentences about soundscape characteristics?

	strongly disagree	disagree	neither agree or disagree	agree	strongly agree
Annoying	◯	◯	◯	◯	◯
Eventful	◯	◯	◯	◯	◯
Uneventful	◯	◯	◯	◯	◯
Calm	◯	◯	◯	◯	◯
Chaotic	◯	◯	◯	◯	◯
Vibrant	◯	◯	◯	◯	◯
Monotonous	◯	◯	◯	◯	◯

In this soundscape section you will be asked to evaluate the environment around you

14 Overall, how loud is it here?

not a lot loud				extremely loud
◯	◯	◯	◯	◯

In this soundscape section you will be asked to evaluate the environment around you

15 Overall, how do you describe the present sound environment?

very bad	bad	neither good or bad	good	very good
◯	◯	◯	◯	◯

In this soundscape section you will be asked to evaluate the environment around you

16 To what extent the sound environment is adequate for the use you make of this place?

not adequate				extremely adequate
◯	◯	◯	◯	◯

WELLBEING

In this wellbeing section you will be asked considering the last two weeks

17 Please indicate for each statements which is closet to how you have been feeling over the past two weeks

	strongly disagree	disagree	neither agree or disagree	agree	strongly agree
I have felt cheerful and in good spirits	◯	◯	◯	◯	◯
I have felt active and vigorous	◯	◯	◯	◯	◯
I woke up feeling fresh and rested	◯	◯	◯	◯	◯
My daily life has been filled with things that interest me	◯	◯	◯	◯	◯

CHARACTERISTIC OF INTERVIEWEE

In this personal section you will be asked to answer to short questions about yourself

18 Age

- ◯ < 18
- ◯ 18 - 30
- ◯ 31 - 40
- ◯ 41 - 50
- ◯ 51 - 60
- ◯ >60

19 Gender

- ◯ Male
- ◯ Female
- ◯ I'd rather not say

20 Level of education

- ◯ No formal education
- ◯ Middle School diploma
- ◯ Higher Diploma
- ◯ Three-year degree
- ◯ Master Degree
- ◯ Master - Doctorate

21 Place of residence

- ◯ Turin
- ◯ Piedmont
- ◯ Italy
- ◯ Europe
- ◯ Extra Europe

APPENDIX - DOUBLE CHECK SURVEY

The double-check survey was developed by the *Department of Psychology of the University of Turin*, in particular by the Associate Professor PhD Francesca M. Bosco and by the PhD student Dize Hilviu. The double-check survey took place on one weeks in December 2018 for the Passerella Olimpica site, for three days (Monday, Thursday, Saturday) in the evening between 08:00 pm to 00:00pm. The survey is designed to take approximately 15 minutes to complete.
Before the questionnaire the Information Sheet and the Participant Consent Form were presented and the questionnaire was approved by the BCA.

INFORMATION SHEET

PARTICIPANT CONSENT FORM

CHARACTERISTIC OF INTERVIEWEE

In this personal section you will be asked to answer to short questions about yourself

1 Gender

- ◯ Male
- ◯ Female
- ◯ I'd rather not say

2 Year of birth

_____

3 Level of education

- ◯ Middle School diploma
- ◯ Higher Diploma
- ◯ Three-year degree
- ◯ Master Degree
- ◯ Master - Doctorate

4 Employment situation

- ◯ jobless
- ◯ student
- ◯ employee
- ◯ freelance
- ◯ other:_____

5 Do you have a hearing problem?

- ◯ no
- ◯ yes: _____

6 Do you have respiratory problems?

- ◯ no
- ◯ yes: _____

7 Do you have vision problems?

- ◯ no
- ◯ yes

8 Yes: what visual problems do you suffer from?

- ◯ myopia
- ◯ astigmatism
- ◯ presbyopia
- ◯ other:_____

9 Area of domicile:

_____

10 For how many years?

_____

11 Why are you in this area right now?

- ◯ Shopping
- ◯ Friends
- ◯ Commissions
- ◯ Work
- ◯ I'm near my home
- ◯ Other: _____

12 How often do you frequent this area?

- ◯ Everyday
- ◯ 2/3 times a week
- ◯ 1/2 times a month
- ◯ Rarely during the year
- ◯ Less than once a year

SOUND PERCEPTION OF THE AREA

Now we will focus on the sound perception of the area that is surrounding you right now

13 How do you assess the intensity of the sounds present at this time?

very high				very low
◯	◯	◯	◯	◯

14 Why?

_____

Make an assessment of each of the following features related to the sound of this zone at this time:

15

very unpleasant				very pleasant
◯	◯	◯	◯	◯

16 Why?

_____

17

very chaotic				very calm
◯	◯	◯	◯	◯

18 Why?

_____

19

very animated — very quiet

○ ○ ○ ○ ○

20 Why?

_____

21

very stressful — very relaxing

22 Why?

_____

23 What are the sources of noise that you perceive most and how do you assess their presence?

	completely present	moderately present	neither present neither absent	moderately absent	completely absent
Road traffic	○	○	○	○	○
Air traffic	○	○	○	○	○
Railway traffic	○	○	○	○	○
Music	○	○	○	○	○
Business activities	○	○	○	○	○
Construction sites and construction works	○	○	○	○	○
Outdoor animals	○	○	○	○	○
People outdoors	○	○	○	○	○
Natural elements (wind, water)	○	○	○	○	○

24 Do you think the sound quality of this area has an influence on your quality of life?

○ no
○ yes

25 If so, which one?

_____

26 To what extent?

very negative — very positive

○ ○ ○ ○ ○

LIGHTING PERCEPTION OF THE AREA

Now we will focus on the light perception of the area that is surrounding you right now

27 How do you assess the brightness of this area (eg possibility to distinguish elements, sharpness, brilliance)?

very inadequate — very adequate

○ ○ ○ ○ ○

28 Why?

_____

29 How do you assess the brightness of this area?

very unpleasant — very pleasant

○ ○ ○ ○ ○

Make an assessment of each of the following features related to the light of this zone at this time:

30

very dark — very bright

○ ○ ○ ○ ○

31 Why?

_____

32

very unpleasant — very pleasant

○ ○ ○ ○ ○

33 Why?

_____

34 How do you rate the temperature and the hue of the brightness?

○ warm
○ cold

35 **Why?**

_____

36 **Do you think that the quality of the brightness of this area has an influence on your quality of life?**

- ◯ yes
- ◯ no

37 **If so, which one?**

_____

38 **To what extent?**

very negative				very positive
◯	◯	◯	◯	◯

PERCEPTION OF THE AIR OF THE INVIRONMENT

Now we will focus on the air perception of the area that is surrounding you right now

39 **How do you assess the purity of the air that characterizes this area?**

very adequate				very inadequate
◯	◯	◯	◯	◯

40 **Why?**

_____

41 **What are the sources of odor that you perceive most and how do you assess their intensity?**

	completely present	moderately present	neither present neither absent	moderately absent	completely absent
Tobacco	◯	◯	◯	◯	◯
Cosmetics, Fragrances	◯	◯	◯	◯	◯
Waste, excrement, mold	◯	◯	◯	◯	◯
Chemicals (solvents, paints)	◯	◯	◯	◯	◯
Food	◯	◯	◯	◯	◯
Pollution	◯	◯	◯	◯	◯

42 **Do you think that the quality of the air of this area has an influence on your quality of life?**

- ◯ yes
- ◯ no

43 **If so, which one?**

_____

44 **To what extent?**

very negative — very positive

○ ○ ○ ○ ○

PERCEPTION OF SAFETY

Now we will focus on the air perception of the area that is surrounding you right now

45 **How do you assess the level of security in the area?**

very adequate — very inadequate

○ ○ ○ ○ ○

46 **Why?**

_____

47 **How do you feel about the safety that characterizes this environment right now?**

very insicure — very safe

○ ○ ○ ○ ○

48 **Why?**

_____

49 **How do you feel about the safety that characterizes this environment right now?**

very worried — very calm

○ ○ ○ ○ ○

50 **Why?**

_____

51 **What are the elements that worry you?**

_____

52 **What are the elements that allow you to feel comfortable?**

_____

53 Are there any changes to make the environment safer?

- ◯ yes
- ◯ no

54 Which?

_____

55 Do you think that the safety of this area has an influence on your quality of life?

- ◯ yes
- ◯ no

56 If so, which one?

_____

57 To what extent?

very negative				very positive
◯	◯	◯	◯	◯

URBAN QUALITY

Now we will focus on the urban quality perception of the area that is surrounding you right now

58 Evaluate each of the following:

	completely present	moderately present	neither present neither absent	moderately absent	completely absent
Quality of the place (architectural, environmental ...)	◯	◯	◯	◯	◯
Verbal comprehension (hearing voices of others)	◯	◯	◯	◯	◯
Understanding urban signage (visual, sound ...)	◯	◯	◯	◯	◯
Services (hospitals, pharmacies, schools ...)	◯	◯	◯	◯	◯
Public transport and frequency	◯	◯	◯	◯	◯
Commercial exercises	◯	◯	◯	◯	◯
Street cleaning and pavement cleaning	◯	◯	◯	◯	◯

59 Why?

_____

THERMAL COMFORT OF THE ENVIRONMENT

Now we will focus on the thermal comfort of the area that is surrounding you right now

60 How do you assess the adequacy of thermal comfort in this area?

very inadequate — very adequate

○ ○ ○ ○ ○

61 Why?

_____

Make an assessment of each of the following features related to the thermal comfort of this zone at this time:

62

very cold — very warm

○ ○ ○ ○ ○

63 Why?

_____

64

very wet — very dry

○ ○ ○ ○ ○

65 Why?

_____

66

very unpleasant — very pleasant

○ ○ ○ ○ ○

67 Why?

_____

68 Do you think that the thermal comfort of this area has an influence on your quality of life?

○ yes
○ no

69 If so, which one?

_____

70 To what extent?

very negative — very positive

○ ○ ○ ○ ○

APPENDIX - SOCIAL SURVEY

The social survey is a questionnaire administered online through the social pages of the project, ie Facebook and Instagram, with appropriate strategies as mentioned in part D, sections 20 and 21, and through institutional emails to the students of the Polytechnic of Turin and to the students of the University of Turin.
The survey is designed to take approximately 2 minutes to complete. The questionnaire, in order to have greater possible adhesions, was reduced to just four questions based on the analyzed topics, such as perceived safety, urban and architectural decay, lighting and sound conditions. Before the questionnaire the Information Sheet and the Participant Consent Form were presented.

INFORMATION SHEET

PARTICIPANT CONSENT FORM

AREA IDENTIFICATION

1 Which of these areas did you visit mainly in the last two weeks?

Largo Saluzzo (San Salvario) map here: bit.ly/LargoSaluzzo

Tettoia Vitali (Parco Dora) map here: bit.ly/TettoiaVitali

Viale O. Mai (Campus Luigi Einaudi) map here: bit.ly/CampusEinaudi

Passerella Olimpica (LIngotto) map here: bit.ly/Passerella

Piazza G. Bottesini (Barriera di Milano) map here: bit.ly/PiazzaBottesini

Giardini Montanaro (Barriera di Milano) map here: bit.ly/GiardiniMontanaro

PERCEIVED SAFETY

2 **To what extent do you agree or disagree with the following statement?**
I felt safe...

strongly disagree	disagree	neither agree or disagree	agree	strongly agree
○	○	○	○	○

URBAN AND ARCHITECTURAL DECAY

3 **Overall, how would you describe the state of conservation and cleanliness of the publich spaces and conservation of the buildings?**

very bad				very good
○	○	○	○	○

LIGHTING CONDITIONS

4 **Overall, how would you describe the light environment that surrounds you?**

very bad				very good
○	○	○	○	○

SOUND CONDITIONS

5 **Overall, how would you describe the sound environment that surrounds you?**

very bad				very good
○	○	○	○	○

APPENDIX - SENTIMENT ANALYSIS DATA

All the data collected in this Appendix of Sentiment Analysis Data have been kindly provided by the Municipal Police Corps of the City of Turin whom we sincerely thank. The analysis of people sentiment in the different places is important to identify the opinions about selected areas of the city expressed by users on social networks and was carried out through the **Tracx** platform in collaboration with the *Technological Investigation Department* of the Municipal Police Corps of the City of Turin.

All the Turin analyzes were carried out considering the social activities from 7 June 2016 to 7 June 2018, therefore an interval of two years.
In this section it is possible to see a post of raw sentiment analysis data, in fact a public post visible to everyone on the platform was chosen because these are sensitive data and it is not possible to report them all. In this example the data such as author, URL, ID, author's score ra memember etc have been deleted (even if visible and public).

Type	Date	Social Media	Entities	Interactions	Sentiment	State City	Age	Gender
Post	26.10.17	Facebook	luce, sicurezza, torino	121	Negative	Italy Torino	30-40	F

Headline

Niente illuminazione e troppa paura! E io pago!!

Alle 7.25 buio per le strade, niente illuminazione. E io pago!! Stamane siamo andati x la passeggiata con i cani, era tt buio e avevamo paura... in quel momento chiunque avrebbe potuto farci del male e a ki poi avremmo dovuto dire grazie?? Inoltre saremmo potuti cadere e farci male vista la condizione dei marciapiedi! una vergogna!!!!!! Il problema è la mancanza di sicurezza, che d'altronde non si risolve neanche con i lampioni... io ero in giro con il cane sono subito corso a casa facendomi strada con la torcia del cellulare. Assurdo!!

Table 44. Sentiment analysis data Tracx Platform