

Proceeding Paper

# Conscious Walk Methodology Design for Acoustic, Air Quality and Biodiversity Evaluation in Urban Environments <sup>†</sup>

Marc Arnela <sup>1</sup>, Mariona Ferrandiz-Rovira <sup>2,3</sup>, Marc Freixes <sup>1</sup>, Danielly Garcia <sup>4</sup>, Carme Martínez-Suquía <sup>1</sup>,  
Ma Eulàlia Parés <sup>4</sup>, Oriol Serra <sup>5</sup>, Ester Vidaña-Vila <sup>1</sup> and Rosa Ma Alsina-Pagès <sup>1,\*</sup>

<sup>1</sup> GTM—Grup de Recerca en Tecnologies Mèdia, La Salle, Universitat Ramon Llull, C/Quatre Camins, 30, 08022 Barcelona, Spain

<sup>2</sup> CREAM, Edifici Ciències, Universitat Autònoma de Barcelona, 08193Bellaterra, Catalonia, Spain

<sup>3</sup> Unitat d'Ecologia, BABVE, Edifici Ciències, Universitat Autònoma de Barcelona, 08193 Bellaterra, Catalonia, Spain

<sup>4</sup> Centre Tecnològic de Telecomunicacions de Catalunya (CTTC/CERCA), Parc Mediterrani de la Tecnologia, Av. Carl Friedrich Gauss 7, Building B4, 08860 Castelldefels, Spain

<sup>5</sup> Replantegem, Carrer Creueta 119, Baixos Esquerra, 08202 Sabadell, Catalonia, Spain

\* Correspondence: rosamaria.alsina@salle.url.edu

<sup>†</sup> Presented at the 9th International Electronic Conference on Sensors and Applications, 1–15 November 2022; Available online: <https://ecsa-9.sciforum.net/>.

**Abstract:** Environmental noise and air pollution as well as the poor green infrastructure quality is a major concern for the European population due to its impact of citizens health, especially for those citizens living in urban environments, which is materialized in a rising number of complaints to public administration. This issue is further stressed for urban areas located close to aggressive pollutants such as airports, railways, highways, or leisure areas. To attend this situation from the citizen everyday life, this paper proposes a hybrid methodology of a collective campaign, where citizens, especially from those environments that have a stronger impact on them, and scientists collect high quality acoustic, chemical and biodiversity data. The campaign consists in a conscious walk that considers both the acoustic measurements conducted by experts but also by citizens, as well as air quality measurements and biodiversity descriptions. The final goal of the method is to obtain subjective and objective data coming from soundscape, air quality and biodiversity to evaluate a pre-designed walk in an urban location, in the surroundings of Parc de la Ciutadella, in Barcelona.

**Keywords:** acoustic pollution; air pollution; biodiversity; citizen science; sensors



**Citation:** Arnela, M.; Ferrandiz-Rovira, M.; Freixes, M.; Garcia, D.; Martínez-Suquía, C.; Parés, M.E.; Serra, O.; Vidaña-Vila, E.; Alsina-Pagès, R.M. Conscious Walk Methodology Design for Acoustic, Air Quality and Biodiversity Evaluation in Urban Environments. *Eng. Proc.* **2022**, *1*, 0. <https://doi.org/>

Academic Editor: Francisco Falcone

Published: 1 November 2022

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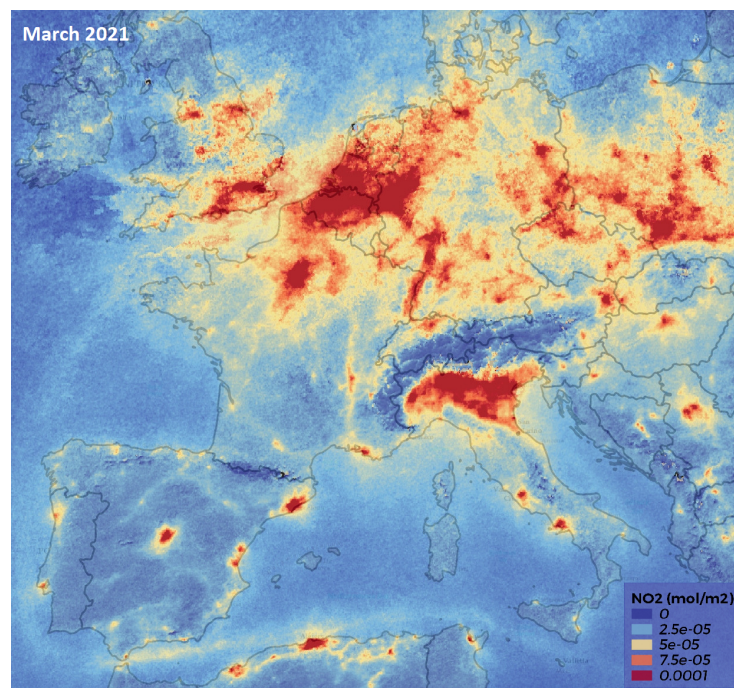
## 1. Introduction

Many studies depict that several pollutants existing in urban environments severely affect citizens' health [1]. From the acoustics point of view, the perception of the quality of the environment was defined as *soundscape* in 1960s by M. Southworth [2]. This term considers the acoustic environment perceived by humans in its context. Not only sound impacts on people. Air pollution and the biodiversity existing in their living environment affect the perception of quality in the surroundings. A study by the Institute of Global Health of Barcelona (ISGlobal) reveals that, only in Spain, NO<sub>2</sub> is responsible for more than 9150 premature deaths per year [3]. Pollution and traffic noise is an invisible killer since citizens are not really aware of the impact of combustion cars. A radical change in citizens' mobility would directly imply a reduction in premature deaths [3]. Biodiversity in urban environments has wide benefits. Air pollution is reduced thanks to vegetation, which decreases the breathing illnesses in citizens, and the probability of having serious diseases [4], heart conditions, endocrine disorders or mental disorders among others. It also regulates temperature and humidity, which improves people's comfort without any additional cost, mitigating the effects of climate change in cities. Actually, being surrounded

by *green* and *blue* environments decrease stress and improves cognitive development, tranquillity and calm, specially in children.

In this case, conscious walks, understood as a practice of mindfulness, bring the participants a deep state of relaxation that can only be experienced by the absence of mental chatter. Specifically, conscious walks are organized activities in which citizens are invited to follow a guided route taking special attention to their environment in three different axes: soundscape, air quality and biodiversity [5]. In this sense, conscious walks involving investigators from different socio-cultural backgrounds and disciplines become a very efficient tool to explore several dimensions by means of different approaches:

- **Soundscape:** The soundscape is usually characterized by soundmarks. The perception is dominated by acoustic comfort. Nevertheless, soundscape descriptors have also been used [6] to develop predictive models of perceived affective quality.
- **Air quality:** it is measured by scientists using different approaches. Firstly, the Copernicus European system provides maps with high coverage and spatial sampling  $7 \times 7 \text{ km}^2$  around Europe [7]. However, this resolution does not allow us to identify the levels of air pollution in different streets of a neighbourhood. An example of a map can be seen in Figure 1. The European Commission provides information on the current air quality situation, based on measurements carried out at more than 2000 air quality measurement stations across Europe. In Spain, the control and surveillance of air quality are carried out through the Networks of the Autonomous Communities and Networks of local entities. Thus, national and regional authorities are using maps generated from the interpolation of measurements acquired at reference stations located in relevant points of the territory among others [8].
- **Biodiversity:** Regarding biodiversity, it is usually analyzed by biologists who can identify different species and characterize the different habitats that are present in the city. There are also an increasing number of apps which allow citizens to identify species in a collaborative way (e.g., Inaturalist (<https://www.inaturalist.org> (accessed on)) ).



**Figure 1.** NO<sub>2</sub> levels in Europe in March 2021. ©DEFIS\_EU

This paper describes the design of a conscious walk activity that took place on May 2022 in the city centre of Barcelona, Spain. Next two sections detail the conscious walk concept and design, aiming to encourage worldwide scientists to organize similar activities

in their locations to promote environmental conscience among the general population. Finally, several conclusions and future work is detailed.

## 2. Conscious Walk Description

The conscious walk designed pretended to face several different urban environments from the three aforementioned axes: (i) soundscape, (ii) air quality and (iii) biodiversity. This impacts directly on the design of the places where the volunteers will walk through, the stops and the intermediate stages from one stop to the other, as well as the starting and the ending point.

From the soundscape approach, the method of soundwalking was initially explored by Murray Schafer in the 1970s in the framework of the World Soundscape Project (WSP). He wanted to explore the relationship between humans and the sounds of their environment and what happens to human perception when the sounds change [9]. From his point of view, a soundwalk is defined as “any excursion whose main purpose is listening to the environment” [10,11]. The main difference between a soundwalk and a conscious walk is that whereas the first one assesses acoustic environment only, the latter one explores the three axes described above.

During the conscious walk, the participants assess the acoustic environment and give feedback about their perceptions. Air pollution is somehow invisible to citizens. Only when approaching a city the pollution cloud can be clearly observed. And, mostly, it can not be detected by the smell. Thus, air pollution is an almost invisible enemy for the citizens. Just by doing the effort of observing our surroundings and measuring some pollutants in real time [12], the citizen will be really aware of the actual situation in their neighbourhood. Finally, from the biodiversity point of view, citizens are usually aware of which street or square is greener, but this does not mean that they understand what do these trees, plants and the whole habitat (or microhabitat) mean. The conscious walk helps volunteers to discover the species of trees, and if they are indigenous or not; something similar happens for birds. E.g., in Barcelona there are 75 species of indigenous birds registered, from which only 55 are protected by law, and there are several others that are non-indigenous (as small street parrots). The conscious walk also allows for the discovery of biodiversity isles. These spaces reproduce Mediterranean habitats in a small scale, and give the city a wider biodiversity, both for plant species and animals, which usually find food in them.

## 3. Conscious Walk Design

The conscious walk was designed to be conducted for a small number of participants (a total of 7 in the end), and it took place on 23 May 2022, starting at 3 p.m.

### 3.1. Route Design

The conscious walk path has been designed in a way that very different scenarios of the city were visited. Starting from the harbour, one of the main noisy and polluted area of the city, the walkers move through wide avenues, isolated squares and two green parks. The evident contrasts on biodiversity and city uses on that spots allow the participants to easily be aware of their daily noisy and polluted surroundings. The route is detailed in Figure 2, containing also the starting and the five selected stop points. Figure 3 shows some images captured at the above points.





**Figure 2.** Conscious Walk Route Design.



**Figure 3.** Images of all the points in the Conscious Walk: (i) Starting point, (ii) First Stop, (iii) Second Stop, (iv) Third Stop, (v) Fourth Stop, (vi) Final Stop.

### 3.2. Stops Evaluation

The main goals of the conscious walk were introduced during the first stop: the Harbour. Next, we walked to reach the first stop at *Plaça Comercial*, a pedestrian square in front of *Mercat del Born*. The participants were asked to examine the soundscape, air pollution and biodiversity with the help of an online survey. The second stop was inside *Parc de la Ciutadella*, next to its entrance from *Passeig Picasso*. Here we focused on the soundscape and biodiversity, asking also the participants to complete the survey for this location. The third stop was next performed in another location of the same park, close to a meteorological station used by the city council to measure air pollution. This gave us a perfect scenario to discuss about background air pollution in the city. The fourth stop was next to a waterfall inside the park, which is known to be pleasant from a soundscape point of view [13]. Sound, biodiversity and urbanism were again topics of discussion. The last

stop was performed in another green area, *Parc de l'Estació del Nord*, in which soundscape, biodiversity and air pollution were again examined. A summary of the conscious walk was also made, sharing conclusions and impressions among the participants.

#### 4. Conclusions

The conclusions of this first work are encouraging. The result of the first Conscious Walk was surprising, due to the diversity of knowledge that was transmitted to the volunteer participants by the leading researchers, and due to the precision with which all the participants analyzed all the stops and the three axes of work (sound, air quality and biodiversity). Very interesting discussions were held in each stop in relation with what the participants had observed personally, and comparing with the objective results measured at each point, by means of the air quality sensors and the sound level meters.

All the data, so objective, measured with the air quality sensors and the sound level meters and recorders that we carried during the Conscious Walk, have not yet been compared, however, with all the subjective data that was collected with the LimeSurvey link to take the surveys. This last part, which will allow us to evaluate the consistency between the measured objective and people's perception, remains as future lines.

**Author Contributions:** Methodology (noise), M.A., C.M.-S., E.V.-V., M.F. and R.M.A.-P.; methodology (pollution), M.E.P. and D.G.; methodology (biodiversity), O.S. and M.F.; data curation (noise), M.F.-R., M.A., E.V.-V.; data curation (pollution), D.G.; data curation (biodiversity) O.S. and M.F.; writing—original draft preparation, R.M.A.-P.; writing—review and editing, M.E.P., M.F.-R., E.V.-V., O.S., M.F. and M.A. All authors have read and agreed to the published version of the manuscript.

**Funding:** This paper received no external funding.

**Institutional Review Board Statement:** .

**Informed Consent Statement:** .

**Data Availability Statement:** .

**Acknowledgments:** The authors would like to thank to all the participants of the Conscious Walk in La Ciutadella Park.

**Conflicts of Interest:** The authors declare no conflict of interest.

#### Abbreviations

The following abbreviations are used in this manuscript:

WSP World Soundscape Project

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