The Effects of Marketplaces on the Spatial Variability of the Urban Soundscape: A Multicase Study in the Department of Cauca (Colombia)

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Abstract
The soundscape paradigm is the emerging alternative to the reductionist vision of noise in all the cities around the world. In particular, urban sound studies of 21 century focus on integrating both physical and perceptual factors, which underlie the interaction between citizenship and its closest acoustic environment. This study examines the soundscape produced by marketplaces of 5 towns in the department of Cauca (Colombia). To do so, 50 noise measurements and 50 stereophonic recordings were made for the purpose of obtaining soundscape cartographies that allowed their proper evaluation. The findings prove a wide range of spatial variability, which suggests the conformation of positive and differenced sound experiences according to the particularity of each evaluated area. Therefore, it is concluded that the soundscape diversity can contribute to the social well-being of the population, especially if it is adopted during urban planning processes. In this logic, the inclusion and revitalization of public market areas can be considered, since their various layers of meaning are part of the invaluable sonorous imaginary of the city and its inhabitants. Likewise, it is also recommended to expand the scale of detail in future studies and to deepen in more technological and human resources for better representation and understanding of the urban soundscape.

Keywords: Urban Soundscape, Soundscape Mapping, Urban Planning

1. Introduction

In recent decades, the rapid urbanization has resulted in the degradation of cities soundscape around the world, and this, consequently, has had serious impacts in social welfare of population (Hong & Jeon, 2014; Iglesias, Díaz & Soliño, 2014; Quintero, Balastegui & Romeu, 2018). However, the sound that is produced in the city is still a neglected issue in urban planning (Raimbault & Dubois, 2005). In most cases, government efforts are just focused on reducing urban noise, although such a control measure only partially improves the conditions of the urban environment (Stanners & Bourdeau, 1995; Berglund, Lindvall & Schwela, 1999; OECD, 2003). In that order of ideas, different scientific fields argue today, the need to use broader and more comprehensive approaches, that involve the different aspects related with urban sound: acoustic ecology and psychoacoustics, among the most prominent (Kang et al., 2016; Rehan, 2016).

Usually, there is the conception that Latin American cities tend to be excessively noisy (Suárez & Barros, 2014; Quiñones, Bustillo & Mehrvar, 2016), due to the vast sound production derived from various urban activities. In public market places, this circumstance seems to intensify, in principle due to commercial activity, but also, motivated, in some cases, by the simple idea of the meeting and social gathering. Further, despite the fact that countries such as Europe and Asia have carried out numerous studies on the sound produced in open public spaces (Kang & Zhang, 2010; Liu, Xiong, Wang & Luo, 2018; Zhang, Ba, Kang & Meng, 2018; Aletta et al., 2019; Van Renterghem et al., 2020), in Latin America little research attention continues to be paid to this issue. In this context, the present work proposes a study of the soundscape applied to the multicase of marketplaces in Cauca, a department of Colombia located in the most southwestern Andean region of the country. This research arises from a broader academic project on territory and multiculturalism carried out in the mentioned region during 2019 (Seber, Castro & Grijalba, 2019).

Thus, the aim defined in this study is based on examining the spatial variability of the soundscape of five public markets in the towns of: Santander, Mondomo, Pescador, Tunía and Piendamo, both of them located in the northern region of Cauca. The foregoing is developed through research focused on the sonic experience of the city. For this purpose, in the following section, the reference theoretical contributions are reviewed. Subsequently, the methodological considerations that were used to obtain the results are provided, starting from a detailed description of the study area. The fourth section is structured in the form of sound cartographies, which represent the physical factor and the perceptual factor of the soundscape. Finally, and in accordance with the analysis developed, a discussion is held on the importance of the soundscape in urban planning, which concludes in a proposal on future lines of research on the matter.

2. Theory

2.1. Soundscape research in cities

The soundscape is the «acoustic environment as perceived or experienced and/or understood by a person or people, in context» (ISO, 2014, pag 1). In this sense, soundscape differs from the acoustic environment in that: the former refers to a perceptual construct; and the second, to a purely physical phenomenon. Now, in an urban context, the public spaces that are configured are diverse: parks, squares and public roads, to mention a few, and, in each of them, a wide range of soundscapes is originated (Ou, Mak, & Pan, 2017; Jeon, Hong, Lavandier, Lafon, Axelsson & Hurtig, 2018). Following that path, it is recognized that the resulting sound diversity is an invaluable resource for the city; an audible wealth, which, if appropriate, can contribute to the attractiveness of the city and the well-being of its inhabitants (Southworth, 1969). In sum, several studies argue that is necessary to understand the human response to the sound of the city, in order to identify and enhance the positive values linked to each urban soundscape in particular (Schaeffer, 1967; Truax, 2006, Hong & Jeon, 2017).

Conventional urban studies have only partially approached the question of sound and have excluded several of its sensory components (Agnew, 2011). These studies generally focus on the evaluation of the physical factor, through noise maps that usually identify places exposed to high Sound Pressure Levels (SPLs) to avoid their excessive propagation (Geraghtya & O'Mahony, 2016; Campello, Peral, Campillo & Velasco, 2017; Vasilyev, 2017; Wang, Chen & Cai, 2018; Di et al., 2018). However, reducing these levels does not *per se* guarantee the improvement of the quality of the urban environment, since the SPLs do not differentiate the different nuances of sound, which, in some cases, can evoke experiences highly accepted by people: improving the people's mood, trigger pleasant memories and encourage relaxation and recovery (Yang & Kang, 2005; Payne, 2013; Cerwén, 2016). Thus, as an alternative to biased and/or reductionist views of the sound, the soundscape approach in the city has emerged to better understand the ways in which sound is heard, perceived and felt in the urban environment (Jennings & Cain, 2013).

Recently, many investigations on the interaction between the set of acoustic signals of the city and citizenship have been carried out (Liu & Kang, 2016; Gill, Grabarczyk, Baker, Naghshineh & Vonhof, 2017; Torija, Li & Self, 2020). So that, it is known that the study of the soundscape in cities is not only based on the physical factor of sound but also on its perceptual factor (Davies et al., 2013; Bruce & Davies, 2014; Zhang et al., 2018). Gozalo, Carmona, Morillas, Vílchez & Escobar (2015, pag 2) point out that «the perceptual approach is aimed at identifying and describing the bases of the psychological processes that underlie people’s appraisal of sound». Therefore, and beyond the physical factor of sound that is limiting, it is imperative to address the perceptual factor (Lui, Kang & Behm, 2013; Watts & Pheasant, 2015). Urban soundscape studies that manage to encompass all the factors concerned tend to be more effective (Leus & Herssens, 2015).

Several models have been dedicated to the classification of the perceptual factor of the soundscape in the city, which are commonly based on the emotions and affective qualities associated with perceived sound (Botteldooren, De Coensel, & De Muer, 2006; Brown, Kang & Gjestland, 2011; Latinjak, 2012; Aletta, Kang, & Axelsson, 2016; Kamenický, 2018). The work of Sun et al. (2019) has taken up the previous models and has proposed a robust hierarchy classification, which delimits the urban environment and the soundscape as an ecological entity susceptible to a comprehensive organization scheme. This scheme is oriented according to the following stages: the first stage, classifies the soundscape according to the extent to which the sound affects the general perception of the place, if the effect is less it is called ‘background’ and if it is greater it is called ‘foreground’; the second stage, distinguishes the ‘disruptive’ sound from the ‘supportive’, according to the type of use assigned to the place where such sound is produced. Here, disruptive sound can cause discomfort, while supportive sound promotes a lived experience fit for permanence; the third and last stage, define the sound according to its degree of excitement, so that, it can be ‘calming’ (low degree of excitement) or ‘stimulating’ (high degree of excitement). Additionally, broader ranges of determination are also considered. Kogan et al. (2017, pag 2) value the «sound as a resource that is liable to be planned and managed in space». Therefore, some evaluations of the soundscape also include cartographic techniques for its development (Liu, Kang, Luo, Behm & Coppack, 2013; Hong & Jeon, 2017).

Research in Latin America on urban soundscape is limited. Maristany, López & Rivera (2016), for example, carried out emblematic work by analyzing the soundscape of a public space network, made up of twelve squares and pedestrian paths in the centre of the city of Córdoba (Argentina). In this contribution, it was found that the objective and subjective parameters of the sounds were related in a non-linear way with the environmental quality of the place. Another outstanding contribution is that of Szeremeta & Zannin (2009), who examined the soundscape of urban parks in the city of Curitiba (Brazil), through an analysis between SPLs and perceptual indicators of sound. This work identified several conditions (land use, vegetation cover, vehicular traffic and types of public transport) that influenced the perception of the acoustic environments examined. Finally, Hermida & Pavón (2019) evaluated the soundscape of the cities Bogotá (Colombia) and Brasilia (Brazil), using fragments of binaural recordings. Their work showed that the perceptual attributes of urban sound change according to its spatial reference.

3. Method

3.1. Study area

The work is carried out in the north of the department of Cauca (Colombia). This region is characterized by being a cultural and ethnographic sector of great diversity and it is geographically articulated by an international road, known as the Pan-American Highway. In such a scenario, a 180m influence area is chosen around the markets of the North Cauca's towns of Santander, Mondomo, Pescador, Tunía and Piendamo (Figure 1). All the cases selected present the following characteristics: first, they are the main food markets of their respective populations, which frequently attract all inhabitants for the purposes of commercial exchange, gastronomy, culture and social life (Sandanter: 50,684 inhabitants; Mondomo: 4,906 inhabitants; Pescador: 2,421 inhabitants; Tunía: 1,949 inhabitants; Piendamó: 14,332 inhabitants) (Departamento Administrativo Nacional de Estadística DANE, 2018; Registraduría Nacional del Estado Civil [*sic*], 2020); second, they are located in areas with considerable building density; third, they are bordered by roads with vehicular and pedestrian flows, which make up vibrant and generally crowded environments; and, fourth and last, they represent part of the collective imaginary for their entire region.

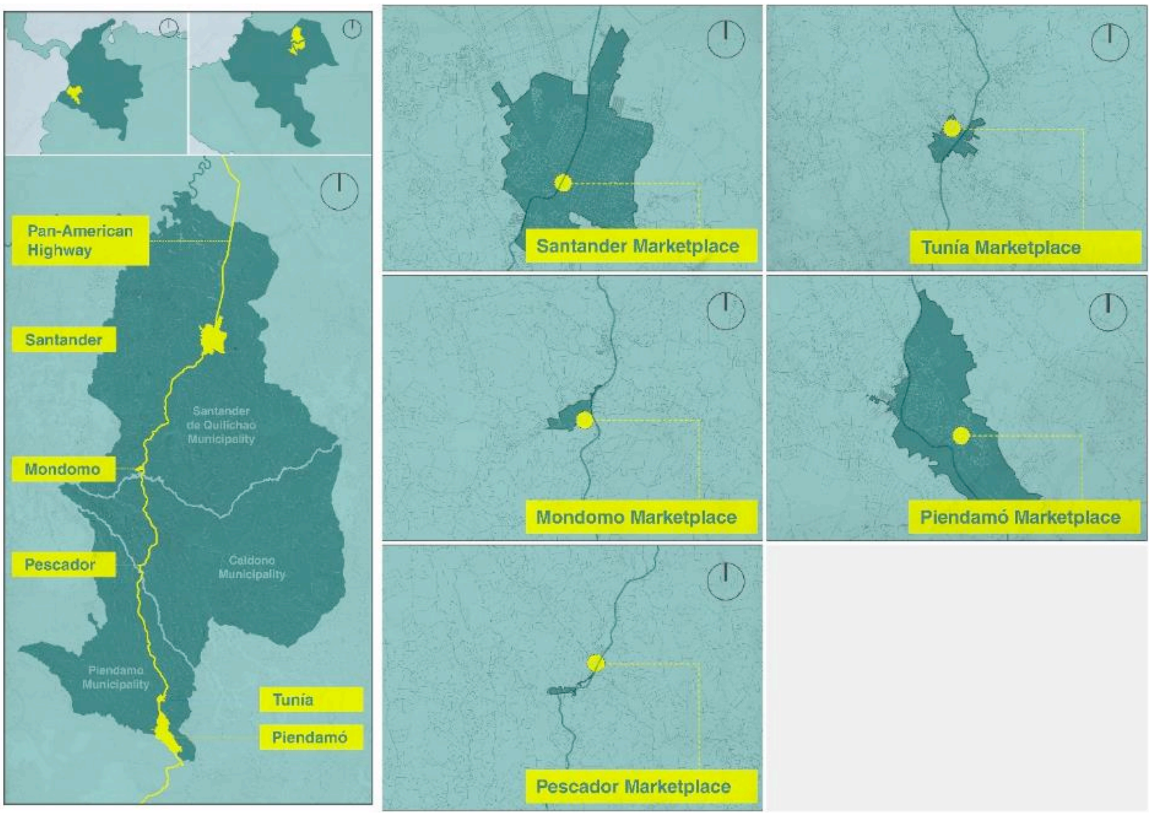

Figure 1: Selected markets on the Pan-American Highway north of Cauca.

The Santander Market is located to the south of the town of Santander, in a significantly consolidated historical area, projected on an irregular form. The market works in a colonial building of approximately 5,138 m^2, which adapts to the new commercial reality of the place. Adjacent to this building and in a northwestern direction is a recently built public square, which conveniently complements the market's commercial function through small temporary open-air shops. This square also borders the Pan-American Highway to the west. Additionally, to the north of the area, the Cholado Park is located; a wooded park that provides recreation, leisure and free recreation services to the inhabitants of the place (Figure 2).

Figure 2: Influence area of Santander Market (180m)

The Mondomo Market is located southeast of the town of Mondomo, in an organic and sinuous urban form. This market has a roof structure installed of approximately 956m^2, which facilitates the daily work of traders. Likewise, two public squares adhere to this area, one to the east and the other to the south, which both of them extend commercial sales in small provisionally shops (Figure 3).

Figure 3: Influence area of Mondomo Market (180m)

The Pescador Market is located to the north of the town of Pescador, with some buildings that gradually disappear and give rise to a much more rural land aptitude. Unlike the other markets of this study, its commercial offer is of less impact and it does not have an infrastructure built for such activity, so its functionality depends on medium-sized tents installed on the open public space. Its area of occupation is only approximately 212m^2 and borders directly with the Pan-American Highway (Figure 4).

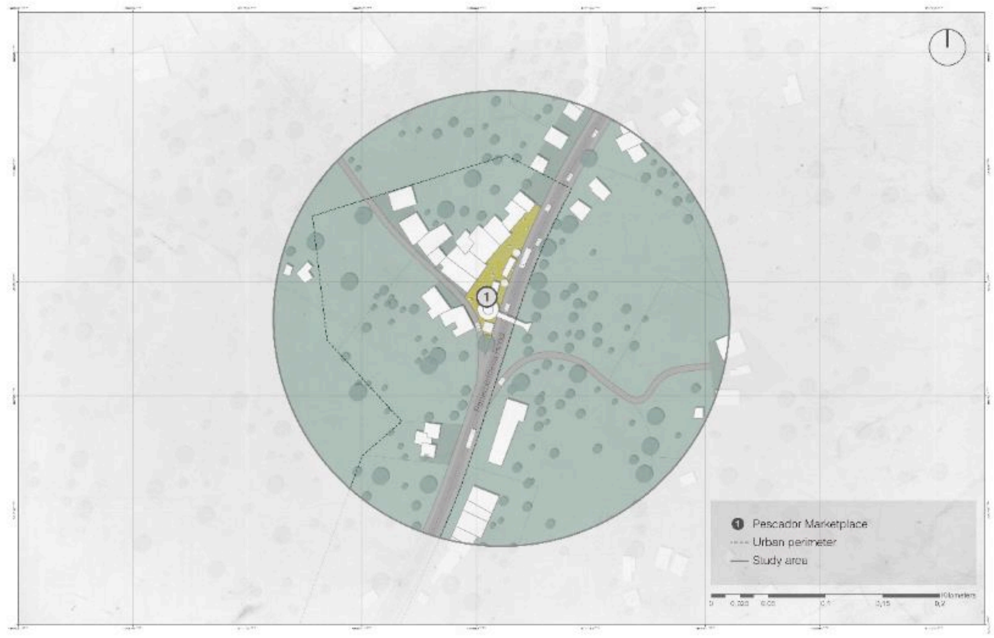

Figure 4: Influence area of Pescador Market (180m)

The Tunía Market develops its functions sporadically in the Central Park of Tunía, located in the northwest of the town of Tunía. The commercial activity of the market is developed in the open air and is very minimal since the recreational activity of the park predominates. The urban landscape of the place reflects the expected pattern of a Spanish-American colonial city, due to its typical central plaza that determines an urban fabric with orthogonal geometry (Figure 5).

Figure 5: Influence area of Tunía Market (180m)

The Piendamo Market is located in the centre of the town of Santander, in a fairly consolidated area with an irregular urban form. For the operation of the market, there is a roof structure of approximately 5,938m^2, which completely occupies its respective block of location. In addition, around the market, in several of its closest streets, can find vendors in small shops that offer fruits, clothes and other products to the visitors (Figure 6).

Figure 6: Influence area of Piendamó Market (180m)

3.2. Data collection

Sampling grids were made to ensure the evaluation of the main factors that concern the soundscape in the markets under study. In accordance with the recommendations of Wei, Van Renterghem, De Coensel & Botteldooren (2016) and Liu, Kang, Luo, Behm & Coppack (2013), 50 x 50 m grid were designed for each of the selected markets. These grids had a distribution of 10 points and a recording time of 3 minutes for each sampling point, through which the physical and perceptual data were collected simultaneously (Figure 7).

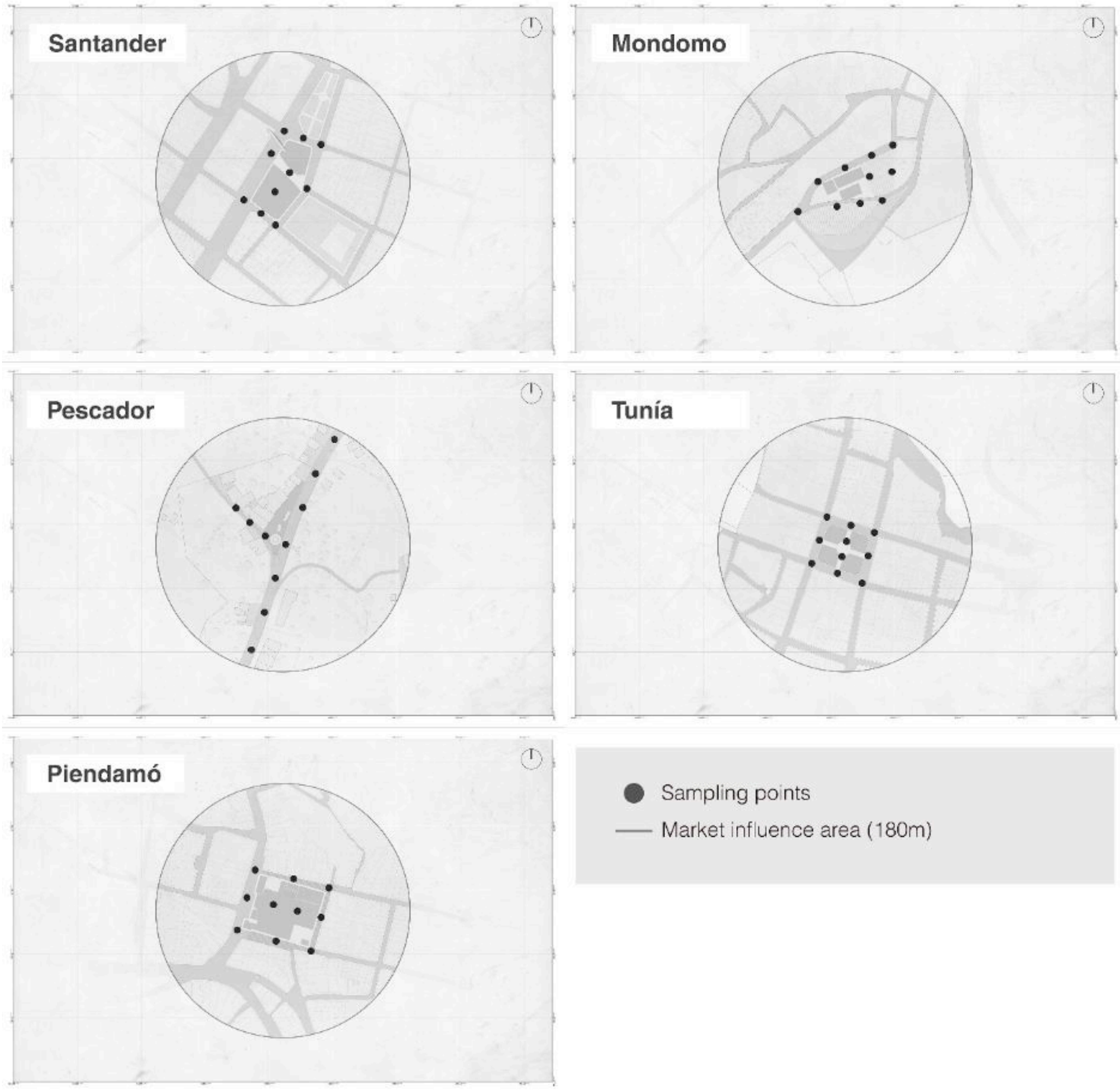

Figure 7: Sampling grids from the markets of: Santander, Mondomo, Pescador, Tunía and Piendamó.

3.2.1. Physical data

Regarding the physical factor, measurements were taken at a distance of 1.5 m from the ground with a Sound Pro Class II sound level meter of 1/3 octave bands and were verified using a high precision AcoustiCal AC-300 calibrator (European Parliament & Consejo, 2002; Zannin et al., 2013). The acoustic indicators evaluated were the equivalent level, the minimum level and the maximum level of sound pressure (dB_{Leq}, dB_{Min}, dB_{Max}).

3.2.2. Perceptual data

Regarding the perceptual factor, it was followed directions of Sun et al. (2019) and audio experiments were carried out to classify the affective qualities of the soundscape. For this, stereophonic recordings were made using a Sennheiser MKH 416 microphone and a ROAD BLIMP wind protection system. The audio samples collected were grouped according to their respective markets (10 samples for each one) and, subsequently, each group representing a particular market was randomly assigned to 5 participants without hearing impairments (1 female and 4 men, Age_{mean} = 24.2 yr, standard deviation 3.8 years, range: 20-30 yr).

All participants conducted the experiments in enclosures isolated from external noise interferences. The recordings were reproduced using a laptop, equipped with the Ableton Live 10 Suite software, which allowed the previously assigned audios to be played. These audios were listened to through the Sennheiser HD 280 Pro headphones and their gains were adjusted proportionally to the set of volume records obtained *in situ* (Figure 8). In this way, an attempt was made to simulate an experience close to the reality of the cases studied.

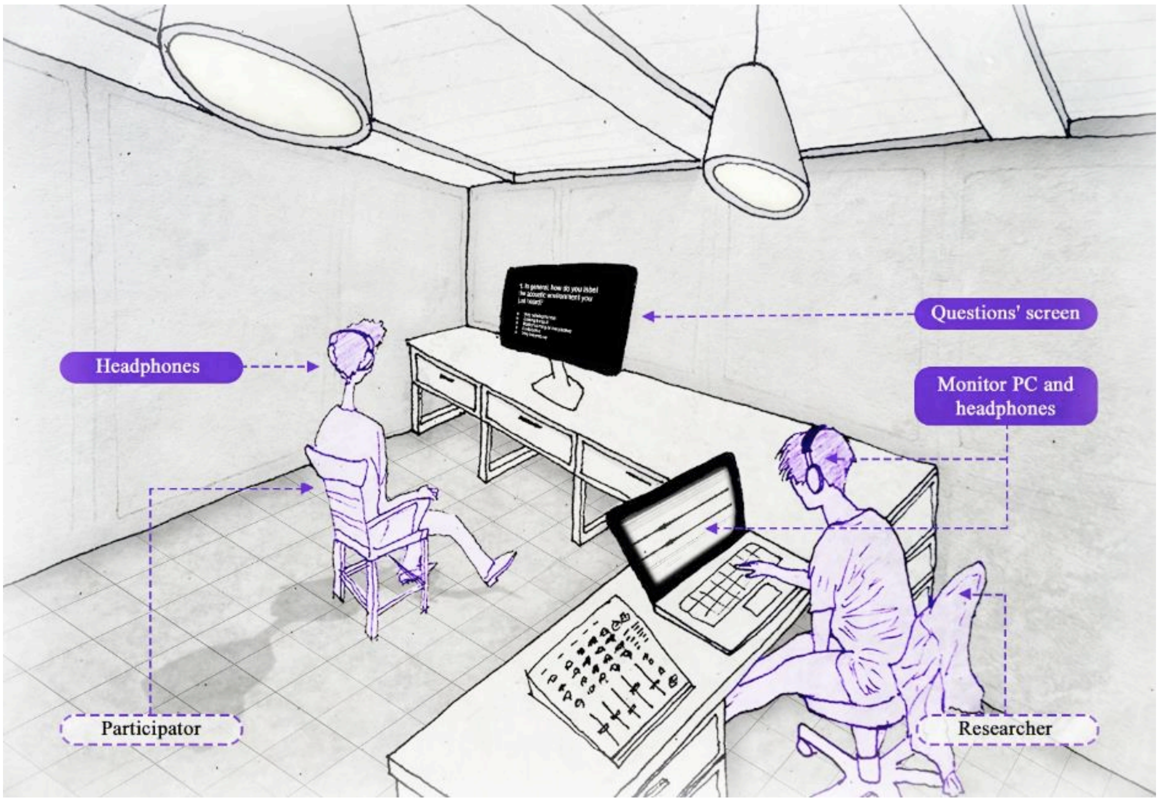

Figure 8: Experiment setup.

Specifically, the experimental procedure consisted of classifying the hierarchical order of perceived urban sound using a questionnaire (Figure 9). For this purpose, each 3-minute audio record was divided into 1-minute sequential stimuli, through which the questionnaires were applied[1] (Figure 4). To evaluate the background/foreground of the sound, the participants were asked: (Q3) *How much did the sound draw your attention?* Preceded by the contextual question: (Q1) *In general, how would you label the acoustic environment you just hear?* Which had as answer options: 'calming/tranquil' to 'lively/active', with the option 'neither' in the middle. According to the answer obtained in Q3, question 4a or 4b was presented (background response = 4a; foreground response = 4b). Meanwhile, the question that distinguishes between a supportive or disruptive acoustic environment depended on the activities susceptible to being carried out in places of interest: (Q5) *Would the sound prevent the activities mentioned at the beginning?* This question was previously framed by the

[1] The original questionnaire was translated into Spanish (regional language) for a better understanding of the participants.

contextual question Q2, which listed the series of possible activities to develop. Similarly, questions 6a and 6b were based on Q5 (supportive response = 6a; disruptive response = 6b). Finally, the contribution of the acoustic environment to the calmness/tranquility and liveliness/activeness of the place was evaluated. Here, question 7a or 7b was presented to the participants according to the response obtained in contextual question Q1 (calmness response = 7a; stimulating response = 7b).

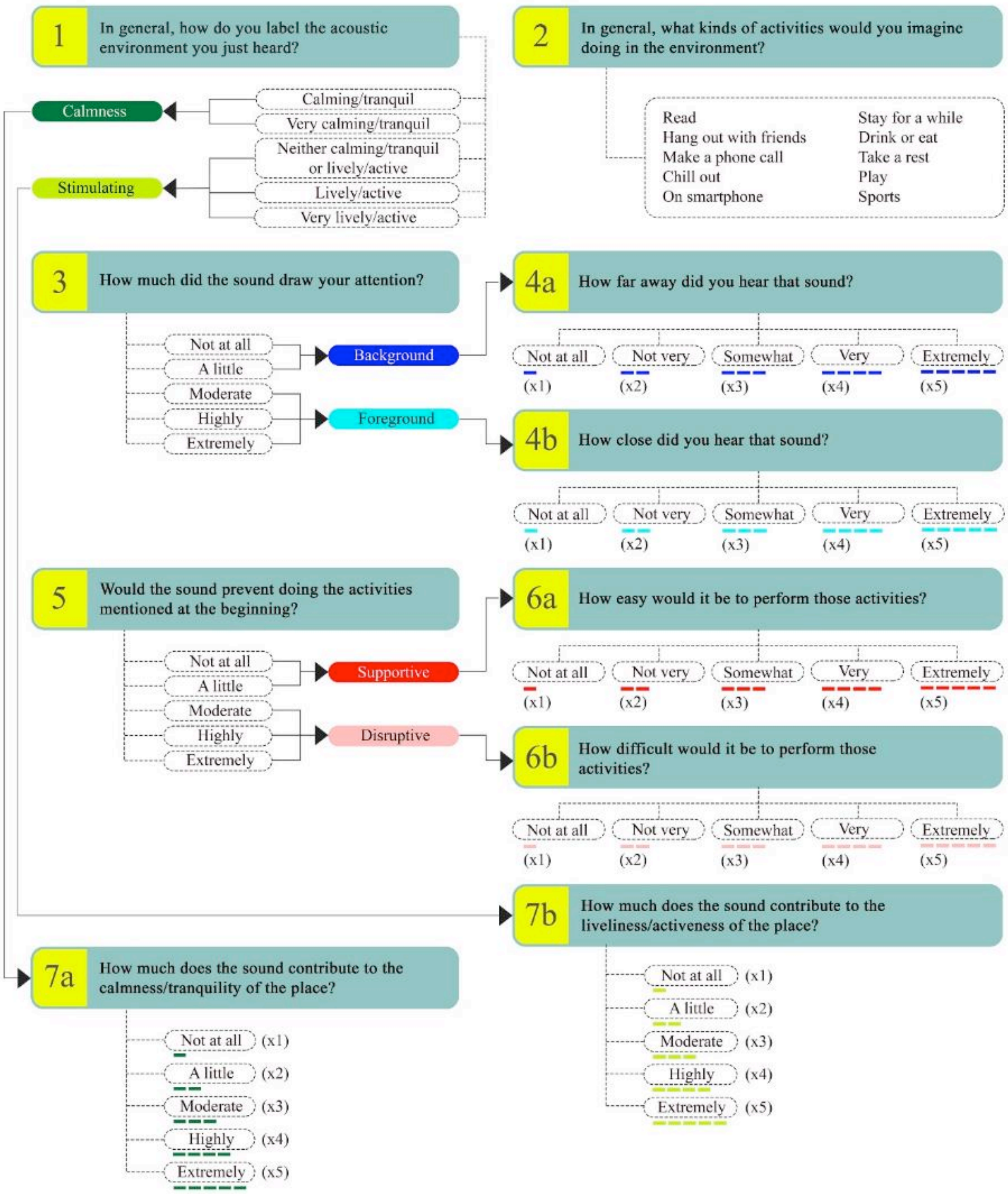

Figure 9: Flow chart of the questionnaire.

Participants had to experience each 1-minute stimulus first, and then answer the 7 questions of the questionnaire, presented on a screen with black background. The questions were assessed verbally, using an equidistant 5-point response scale. Note that only the values obtained from questions 4a-b, 6a-b and 7a-b were respectively used to determine the background/foreground, supportive/disruptive and calming/stimulating qualities of the soundscape. The values at each sampling point were calculated by adding the result of the 3 stimuli (1 minute), into which each record was divided (3 minutes).

3.3. Geostatistical treatment

The acoustic indicators (physical factor) and the accumulated values of the affective qualities of sound (perceptual factor) were classified as analysis data, in order to carry out their corresponding geostatistical treatment. In particular, the method of regionalized variables proposed by Harman, Koseoglu & Yigit (2016) was followed, specifically the spatial interpolation «kriging». The reason to apply this method, it is its high precision in predicting spatial data.

The general equation of kriging is the following:

$$N_o = \sum_{i=1}^{n} W_i N_i$$

Formula in which, N_o represents the value of the soundscape variable to be interpolated at the point (x_o, y_o) and W_i are the weights that correspond to each N_i in (x_i, y_i), used in the calculation of N_o. N_i corresponds to the values of the reference points used in the calculation and n represents the total number of observations used. For its resolution, experimental semivariance models were calculated for every soundscape variables. Then the semivariance models were adjusted to the theoretical models of the kriging: *exponential*, *gaussian* and *spherical*, through which the most suitable ones were selected for the interpolation of each variable. In this way, the creation of the interpolation surfaces, necessary for their subsequent mapping, was ensured (Goovaerts, 1999). All the above calculations were carried out in the RStudio software.

3.2. Soundscape mapping

The mapping of the urban soundscape is based on the visualization of its spatial behaviour pattern. The maps were made in the ArcMap 10.3.1 geographic information system, from the interpolation surfaces obtained in the geostatistical treatment. The present study chooses to map both the physical factor and the perceptual factor of the soundscape, although it is usually tackled to only the first or the second. The results section below is structured according to the maps obtained.

4. Results

4.1. Physical factor

The maps of the physical factor of the soundscape are shown in Figure 10a-b-c-d-e, the acoustic indicators were represented in a similar chromatic range, from pale green (very low values), through oranges and reds (intermediate values) and ending in magentas and dark lilacs (very high values). The ranges of each indicator in each market prove to be differentiated and are listed in Table 1. In the case of the Santander and Mondomo markets, their acoustic indicators register a similar spatial behaviour: the lowest levels are concentrated inside the public squares adjacent to each respective market, since the commercial activity in those places is lower, while the highest levels are located in the perimeter margins of the referred squares, due, above all, to the confluence of their visitors, to their vehicular flow associated and playing music in the surroundings.

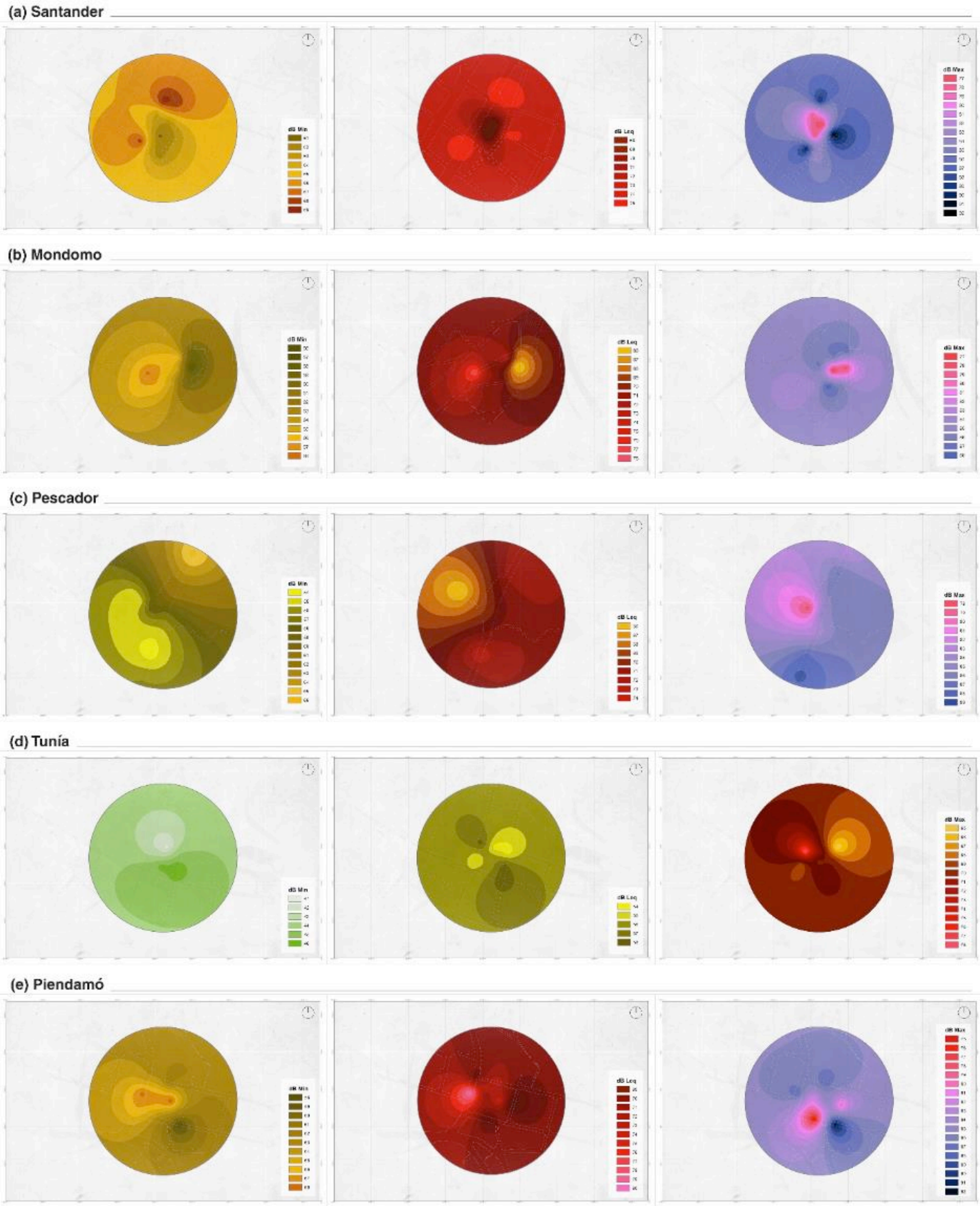

Figura 10a-b-c-d-e. Maps of the physical factor of the soundscape in the markets under study.

In the case of the Pescador Market, its acoustic indicators show similar spatial patterns: the lowest levels are concentrated in the northwestern margin, since it is an edge away from the vehicular flow, and, on the other hand, the highest levels meet at the margin southern, due to heavy traffic on the Pan-American Highway in that particular area. The low impact commercial activity of the market does not show to have a considerable impact on the registered indicators.

Markets	Ranges		
	dB_{Min}	dB_{Leq}	dB_{Max}
Santander	61 - 69	68 - 69	77 - 78
Mondomo	56 - 57	66 - 78	77 - 88
Pescador	54 - 66	66 - 74	78 - 89
Tunía	41 - 46	54 - 58	65 - 78
Piendamó	58 - 68	69 - 80	75 - 92

Tabla 1: Ranges of the acoustic indicators registered in each Market.

On the other hand, the acoustic indicators of the Tunía Market present spatial concentrations with partial coincidences: the lowest levels are focused to the northeast and southwest, and in a contrasting way the highest levels accumulate to the northwest and southeast. The causes are the occasional flow of vehicles and pedestrians that visit the Central Park of Tunía. Here, the much reduced commercial activity of said market is not reflected in the spatial pattern analysed.

For its part, Piendamo Market shows indicators with a comparable spatial behaviour: the lowest levels are registered, to the east, in areas with predominant pedestrian traffic and some sellers on the streets, while in the other margins of the market, which are not located to the east, the levels increase due to vehicular and pedestrian flows.

4.2. Perceptual factor

The maps that describe the spatial behaviour pattern of the perceptual factor of the soundscape can be seen from Figure 11 to Figure 15. In the case of the Santander Market, background, supportive and calming sounds obtain a higher degree of qualification inside the public square next to the said market. This pattern occurs because the interior of the square acts as an isolated place from the main commercial activity, and from the vehicular and pedestrian routes that surround it. In contrast, the foreground, disruptive and stimulating sounds are concentrated in the outer edges of the square, mainly due to the commercial activity at the entrance to the market, to the southeast, and the vehicular flow of the Pan American Highway, to the northwest (Figure 11).

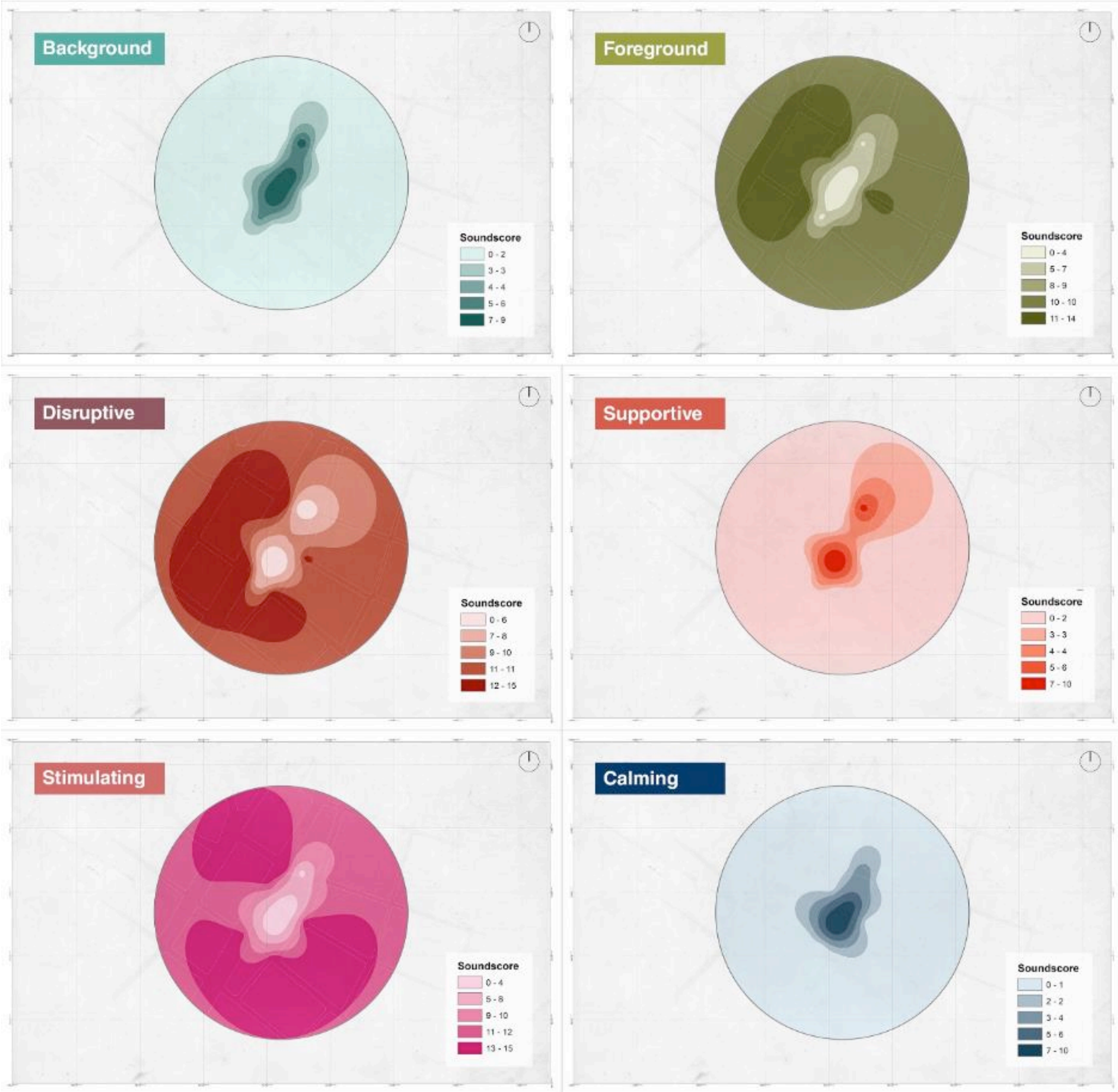

Figure 11: Maps of the perceptual factor of the soundscape in the Santander Market.

In the case of the Mondomo Market, concentrations of background, supportive and calming sounds are reflected on its southeast side, as a result of the adjacent public square that offers reduced commercial activity and the reproduction of music in the surroundings. Conversely, foreground, disruptive and stimulating sounds are brought together, to the southwest of the delimited area of influence, since in this place cargo trucks converge that frequently supply agricultural products to the entire market (Figure 12).

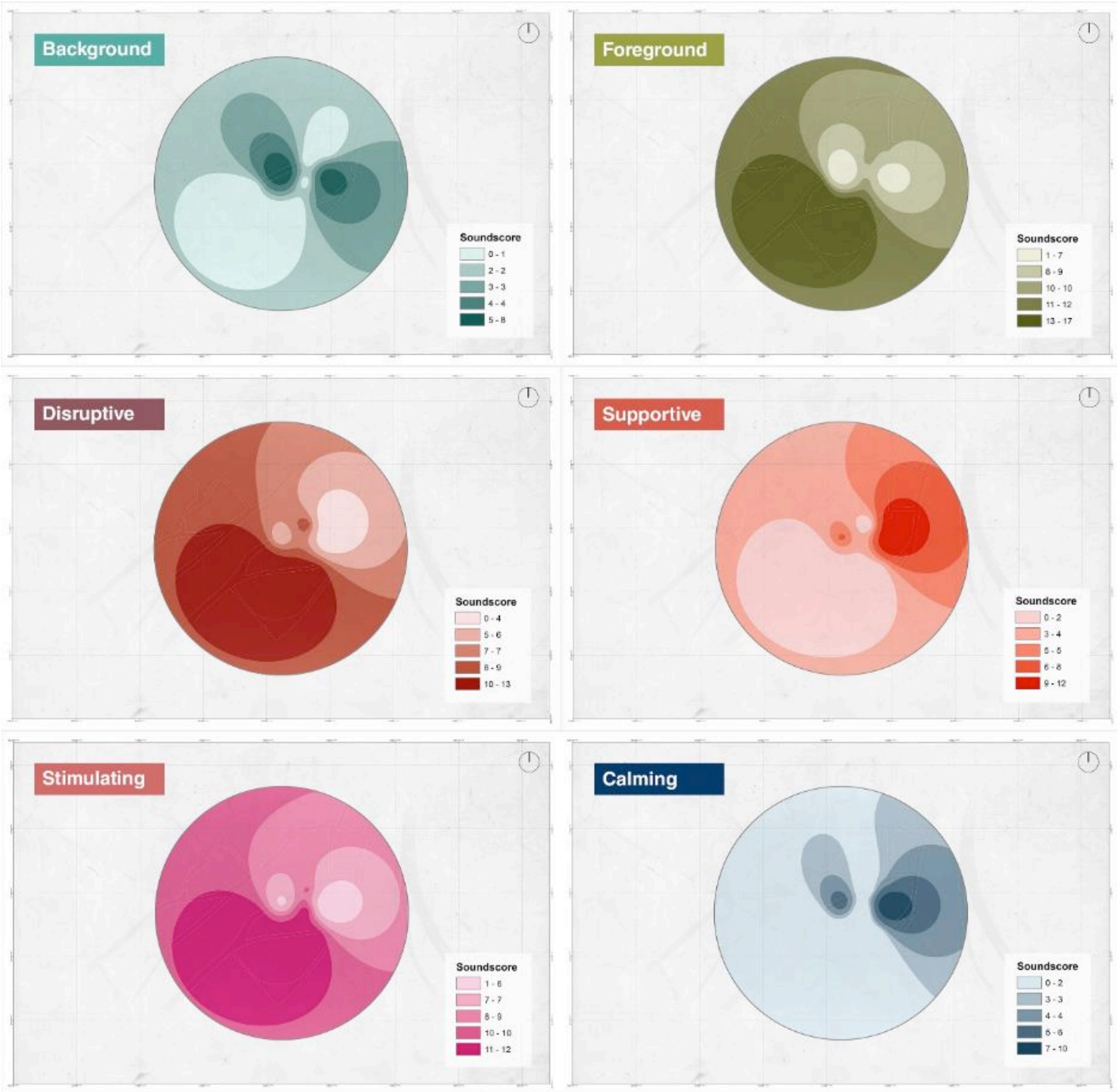

Figure 12: Maps of the perceptual factor of the soundscape in the Mondomo Market.

The background, supportive and calming sounds of the Pescador Market are recorded in its medium-size tents arranged for commercial purposes, in the centre, and on the Pan-American Highway, in the southern area. The pattern is due to the fact that the commercial activity performed in these tents is not high and the green environment of the rural area competes for the perceived global loudness. On the other hand, the foreground, disruptive and stimulating sounds converge, inversely, around the named areas, since in them held sway the circulation of heavy traffic of the Pan-American Highway and the mowing of the lawn by the public maintenance service of green areas, at the time of records (Figure 13).

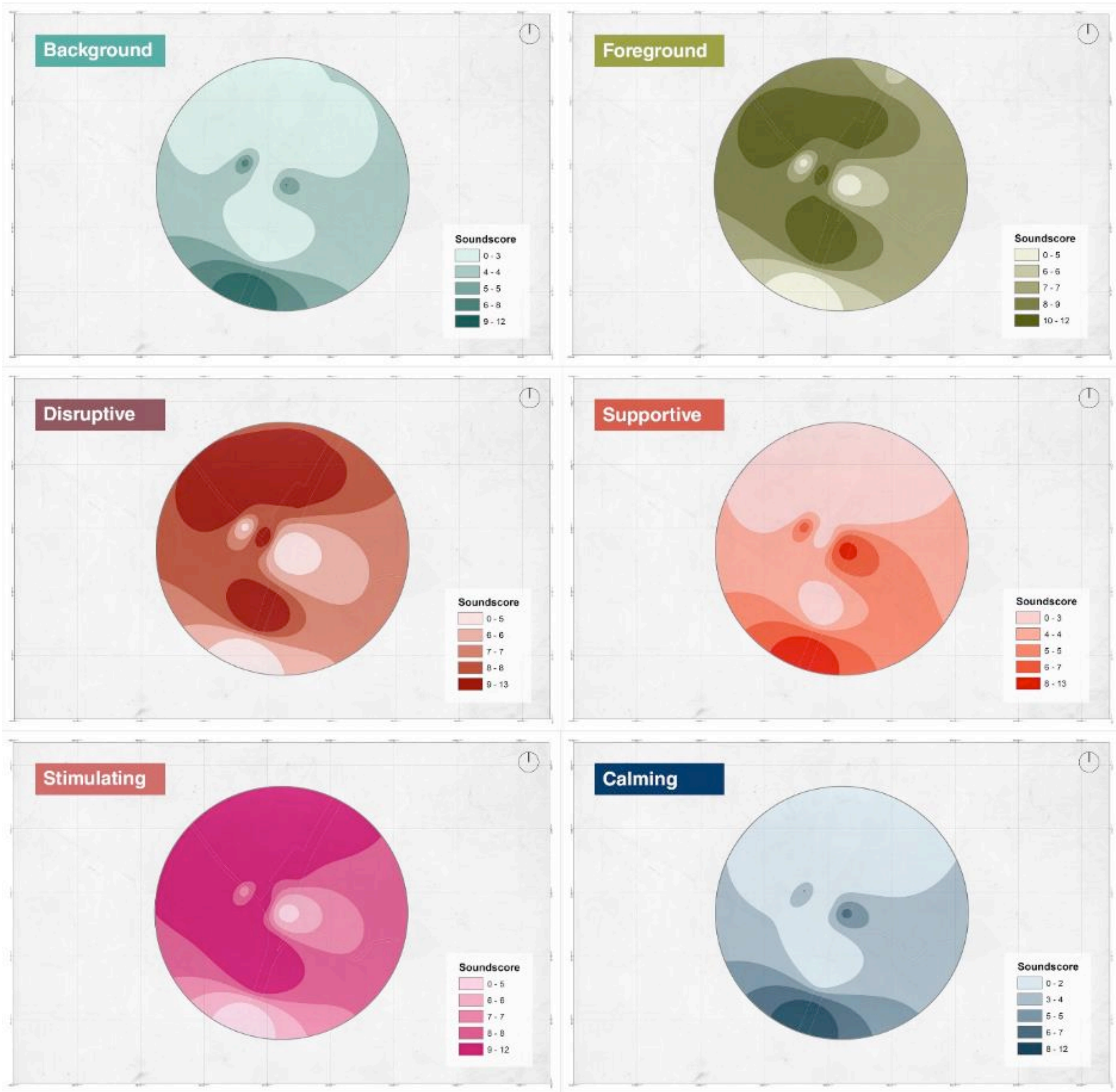

Figure 13: Maps of the perceptual factor of the soundscape in the Pescador Market.

The background, supportive and calming sound maps of Tunía show a spatial pattern similar to each other, which underlie the rest and free leisure activity developed in the northeastern corner of the Tunía Park. In addition, to the southeast of this park, there is a concentration of foreground sound, motivated by groups of people who meet in the public space. The expected sporadic market activity is almost nil and the disruptive and supportive sound has no record whatsoever (Figure 14).

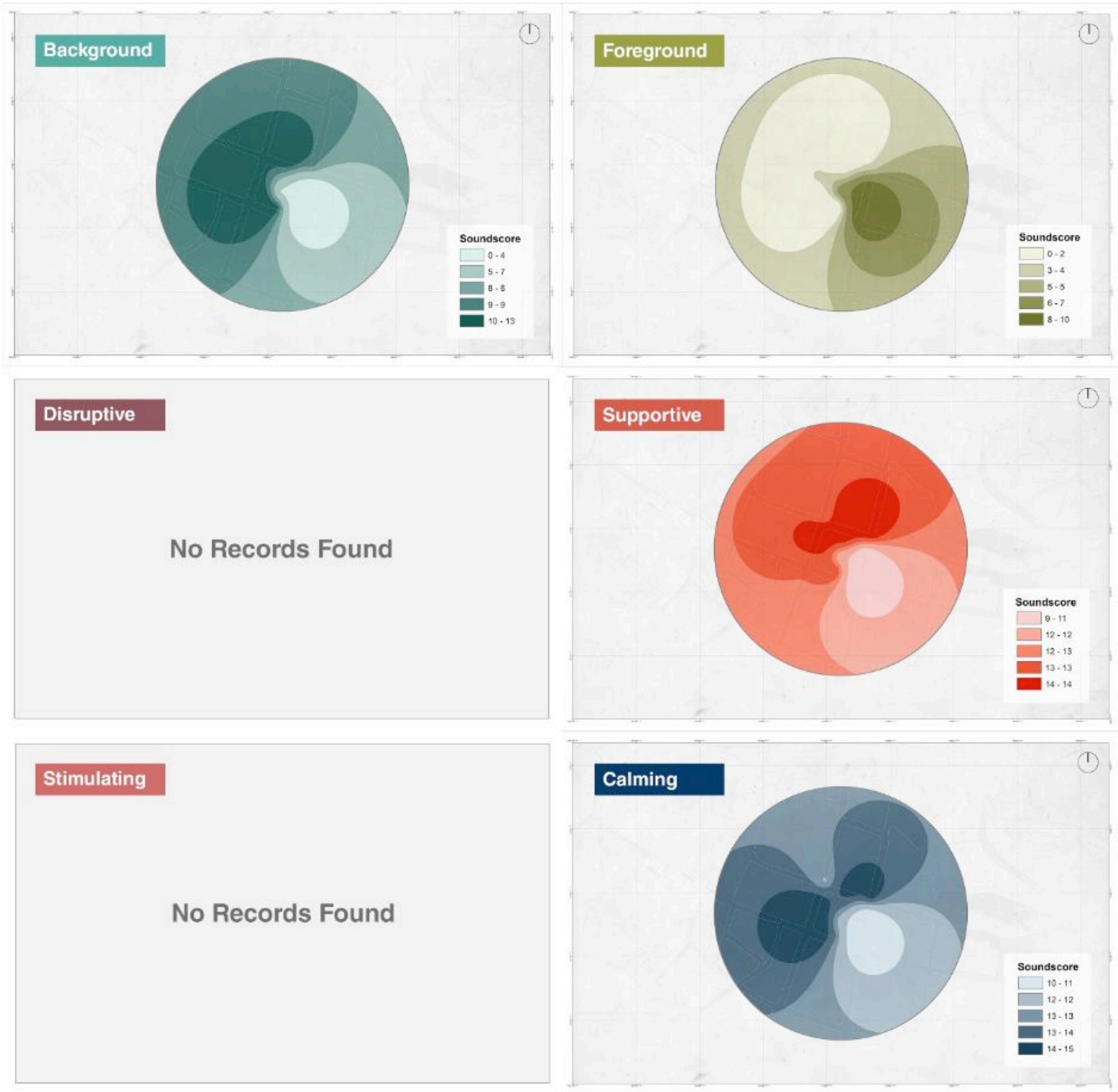

Figure 14. Maps of the perceptual factor of the soundscape in the Tunía Market.

Around Piendamó Market, the concentrations of foreground, disruptive and stimulating sounds show similar patterns, caused by *chirimias*[2] in the public space and by the confluence of visitors to the market. Moreover, the supportive sound is found to the southwest, since the music played on loudspeakers in the distance and the voices of pedestrians walking through the place prevailed.

[2] The *chirimías* are native musical groups of Colombia, which commonly play their music outdoors on instruments made of wood and which have had wide transcendence in Cauca.

Figure 15: Maps of the perceptual factor of the soundscape in the Piendamó Market.

5. Discussion

The evaluation of the urban soundscape revealed a highly dynamic behaviour pattern. This spatial variability of the soundscape in the urban markets of Cauca is strongly related to the activities that take place there. The resulting cartographies in this study suggest that the human response to the sounds produced by music and the interaction of people in public space (voices, laughter, footsteps, among others) has a more supportive association, while the sounds of traffic vehicles present a more disruptive association (Chitra, Jain Chundelli, 2020). Therefore, the quality of the soundscape depends fundamentally on the kind of affective qualities produced in each particular acoustic environment.

Disruptive soundscapes are produced in those areas of the urban markets of Cauca with levels above 70 dB_{Leq}, whereas supportive soundscapes coincide with areas that are below the said indicator. This result confirms the postulates of Zhang & Kang (2007) on the design of the urban soundscape in two directions: the first, that when a certain level is exceeded, the reduction of SPLs is necessary; and the second, that if the level is not so high, the introduction of sounds that reflect traditional and cultural characteristics of the place (live music, water fountains, natural sounds), can have positive effects on the shaping of an appropriate urban sound.

In general, the hierarchical classification of the soundscape proposed by Sun et al. (2019) fixed quite well to the urban markets in this study, although some particular circumstances are remarkable: on the one hand, the concentrations of the background sound coincide with the calmness and supportive sounds (music and murmurs of people in the distance); and, on the other hand, foreground sound concentrations converge in disruptive and stimulating sounds (traffic, horns, and excessive speech of people in the proximity). In this sense, due to the spatial correlation reflected in these situations, there are reasons to believe that the affective qualities of the soundscape in urban markets are intertwined in a more bidirectional sense (Figure 16).

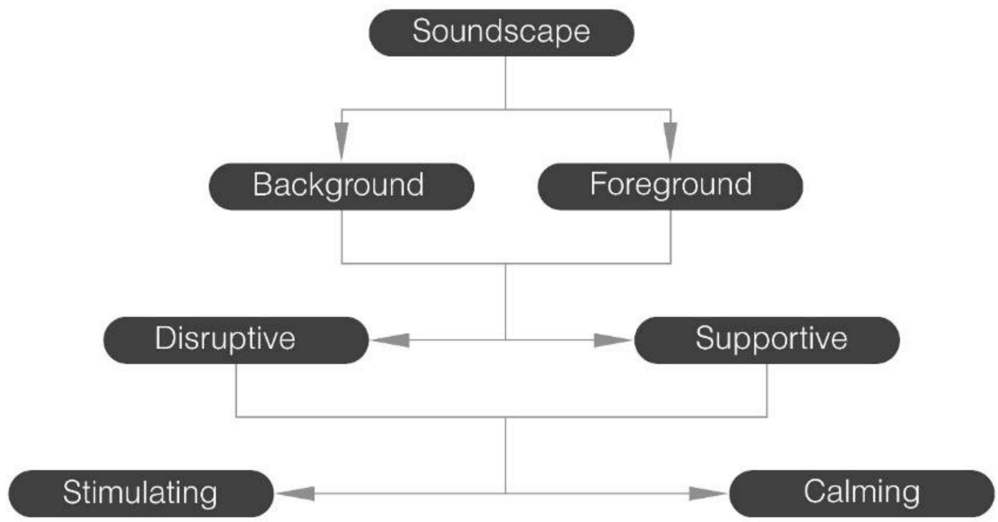

Figure 16: Classification of the soundscape in an urban market, based on Sun et al. (2019).

In any case, the paradigm of the urban soundscape lies in that physical factor and perceptual factor, are unavoidable to discern human responses to sound (Schafer, 1994). The perceptual data from this study show that urban markets, despite exceeding the 55 dBA limit established by the World Health Organization (Berglund, Lindvall and Schwela, 1999) and the Organization for Economic Cooperation and Development (OECD, 2003), can provide sound experiences that are significantly accepted by the public. This refutes several studies, which take for granted, that acoustic indicators of «urban noise» are sufficient to contribute to the creation of healthier and more balanced soundscapes. Thus, the present work qualifies the noise scales set at a global level, because by themselves they do not allow an accurate description of the diverse realities that occur in the Latin American city.

This research also corroborates that public squares adjacent to markets are strategic elements when improving the quality of the urban environment (Jia et al., 2020). The inclusion of the different factors that underlie the soundscape is, in fact, crucial in formulating plans that reverse the negative trend of deterioration of urban sound. By virtue of this, urban planning and design should establish with greater accuracy guidelines for soundscape intervention, which, in the long term, ensure the development of the city (*e.g.*, reduction of sound levels from unwanted sources, recovery of green areas and implementation of alternative transportation systems).

6. Conclusions

The present work points out that the soundscape, widely conceived, should be useful to revitalize the public market areas since in its different layers of meanings the invaluable sound imaginary of urban inhabitants is constituted. Here we do not seek to argue that the auditory replaces the hegemony of the visual. On the contrary, it is taken as a consideration, which invites to incorporate the soundscape of the markets during the urban transformation processes.

Urban sound transcends the traditional exercise of physical measurement, even more in Cauca's town markets, which usually exceed the noise emission parameters established by international regulations. Indeed, it is assumed that the exhaustive exploration of the various behaviour patterns of the soundscape is more convenient to enhance the sound experiences that contribute to environmental health and, therefore, to the social well-being of the population.

The excessively silent city should not be directly associated with the quality of life of the inhabitants, without first considering the complex relationships that originate between the citizens and their closest acoustic environment. Certainly, it is from that perspective that it is appropriate to recognize markets as an integral part of audible wealth in Latin American cities. Those kind of urban environments, popular for their noise, make up, in some cases, vibrant soundscapes that are widely accepted by the community.

Finally, this study recommends expanding the study evaluation scales, so that, larger areas are involved, differentiated urban contexts are added, and the interaction between sound, space and city is deepened. Likewise, it should also deepen in more technological and human resources, which help to improve the representation and understanding of the urban soundscape.

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