INFLUENCE OF MICROCLIMATIC CHARACTERISTICS ON THE USE OF OUTDOOR PUBLIC SPACES: A STUDY IN THE CITY OF BLAGNAC (F)

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***Abstract**: At a district scale, we examine whether microclimatic attributes affect the use of outdoor public spaces. Namely, we present a method to check to which extend the frequency of use and the activities shown by the users varied as a function of the microclimatic characteristics of the areas making up a square. Fundamentally, the objective is to contribute to a better understanding of how urban microclimate takes part in the relation between users and outer public spaces. We also expect to provide urban planners with data that might increase the congruence between the design of public spaces and the user's needs.*

1 Introduction

Numerous studies have already been conducted on the effects of the built environment on people's well-being and behavior. Other investigations focused on architectural and urban attributes that contributes to place atmospheres *(Augoyard /1995)*. However, the influence of microclimatic characteristics on users behavior in outer public space is seldom studied.

We hypothesis that the use of public spaces are function of their micro-climatic properties, which might foster or hinder their usage. To test this assumption we carry on investigations of microclimatic parameters in public spaces associated with psychological approaches of user's behaviors. The study is conducted in three public squares located in Blagnac, a small town in the south-west of France. In each site three types of data are collected:

- **Spatial configurations.** The spatial configuration analyses of the three pubic squares are issued from questionnaires filled up by experts (architects and students in architecture) and from interviews with users. The objective of these analyses is to delineate a partition of the squares in areas defined by their perceived topographical and morphological attributes, as well as their urban furniture and fixtures.
- **Microclimatic measures.** In the selected spaces, measures of temperature, moisture, air velocity, average dry radiant temperature will be implemented in various climatic conditions during the year. We use for these measures a data acquisition system called the BABUC/A, which allows to record simultaneously many parameters.
- **Behavior observations.** Video recordings of people crossing and staying in the squares are repeated on several occasions. Analysis of the videotapes allows to extract several behavioral indicators of the modes occupation and activities exhibited by the users in the different areas of the squares *(Legendre /1992)*.

This paper focuses more specifically on the procedure to collect and compute the behavioral indicators utilised in the study. It also describes the technique used to relate these behavioral indicators to the spatial configuration and to the microclimatic characteristics of the areas making up the studied public squares.

2 Method

2.1 Data recording session

Measures of microclimatic parameters and video recordings are performed in parallel during the same data recording session. This session start with a first assessment of the microclimatic values characterising the areas that constitute the square. Then, it is followed by a video recording lasting 45 minutes, which allows to observe all the persons crossing or staying in the square. It ends with a second assessment of the microclimatic parameters that permits an evaluation of the change in the microclimatic conditions that occurred during the observation of the people's use of the square.

2.1.1 Climatic conditions

The data collection sessions are performed around the middle of every season (autumn, winter, spring and summer), when the temperatures are more likely to account for the average seasonal values. In each season, the sessions are carried out under two sky conditions: clear sky and covered sky. Furthermore, the investigations are undertaken if the wind speed is inferior or equal to 1 m/s. The sky state and the wind speed are two significant parameters especially for the energy assessment, thermal feeling and people mechanical comfort *(Miller-Chagas & al. /1980).*

- Winds influence the ambient air temperature. Several microclimatic studies considered 1 m/s like a limit of discomfort "in interior space". It excluded obviously any embarrassment due to a mechanical or thermal discomfort, and it gives ideal conditions to locate microclimatic variations.
- The state of the sky is as important as the wind in outdoor spaces: it determines the distribution of the solar radiation. For a clear sky, the solar radiation prevails and the distribution of the temperatures is a function of the intensity of that radiation. Every one can experiences that the air temperature in a shade of square is lower than in another part exposed to the solar radiation. By covered

sky, the illumination is determined by the surface multi-reflections. and solar radiation

2.1.2 Time of the day

The observation sessions occur during weekdays. We chose three periods of the day during which the public squares are more likely to be used, avoiding full working time-slots. Furthermore, these periods are also chosen to account for the microclimatic variations occurring across the day as a function of the spatial configuration of the squares and of their various areas. Thus, during a day the three data collection sessions are scheduled as follows:

- The first session occurs in the morning between 8:30 and 10:30 a.m.
- The second session is scheduled during the midday pause at the hottest period of the day, that is between 0:30 and 2:30 p.m.
- The third session is planned in the afternoon before sunset time. Thus, it varies as a function of the season that is between 4:00 and 6:00 p.m. in winter and between 6:00 and 8:00 p.m. in summer.

2.2 Behavior

2.2.1 Behavior recording

In the square, two hidden cameras are used to film the people. The resulting videotape recordings provide a full view of the square. Thus, during the observation session, the behavior of any person crossing or staying in the square is recorded.

2.2.2 Study participants

The behavior of all the persons appearing on the videos will be analysed, without selection. Nevertheless, the individuals will qualified by their sex and broad age categories. This enables us to examine whether some areas are more often used by a specific type of users. It will be possible to check whether these areas are qualified by particular climatic characteristics.

2.2.3 Observed behavior

We extract two basic aspects of the people's behavior from the videotapes: their activities and their precise locations in the square. For every person present in the square during the observation session, both the location and the activity was coded at every 5-second interval throughout the time that person spent in the square *(Legendre /1995)*.

- **People's locations.** At every coding interval the precise location of each present person' is noted on a grid that partitions the public space. Each square of the grid measures 3 by 3 meters and is identified by its co-ordinates (e.g. B9, see Figure 2). This technique of location assessments enable us to analyse how users distribute in the square. Interestingly, preliminaries observations showed that 5 seconds is the average time taken by an adult to move from a square to another square of the grid (distance 3 to 5 meters). Thus, a coding interval of 5 seconds allows us to follow precisely the movement of a person crossing the public square.

- **People's activities**. In parallel to the location, the person's activity is also coded, this means that it could also be localised in the square. The activity categories are designed to characterise the type of relationship that a person establishes with the immediate square environment. Thus, we can examine whether the microclimatic conditions affect the people's activities, and more specifically, whether the microclimatic characteristics of a given area favor or hinder the development of particular activities.

2.3 Occupation indicators

The technique used to record the people's locations allows elaborating and computing more sophisticated indicators describing the density, stability and mode of occupation in the studied squares.

2.3.1 Occupation density

The aggregation on the map of the square of all the observed locations will give us the overall distribution of the occupied positions. Concentrations might appear in particular areas while others are under occupied. An indicator of occupation density giving the average number of position per hour in a given square can be computed. Therefore, statistical analyses can be done to compare the occupation density of different areas, or the occupation density of the same areas as a function of the time of day or the season.

2.3.2 Occupation stability

However, a high occupation density may correspond either to a dense but short occupation of an area by many people, or to a more sustained occupation of that area by fewer people. The occupation stability indicator corresponds to the percentage of the time during which a square of the grid is occupied independently of the number of people occupying it. Thus, high occupation stability points to an area that is regularly occupied rather than to an area in which temporary concentrations may occur. We will examine whether the areas with high occupation stability present specific microclimatic characteristics.

2.3.3 Occupation modes

One of the objectives is to differentiate the occupation mode of the square. Is it a simple circulation space, or is it used as a promenade or a recreation space? We sought to establish a threshold value to differentiate simple crossing from a true usage of the square. Usage is defined as strolling in or spending a moment on the square. In this perspective, we carried out observations in which we register the time spent by people persons to cross each square. In each square, we considered 25 adults moving alone or in-group, who took the diagonal path. Figure 1 shows the distribution of the crossing time, as well as the mean and the threshold value computed for the "Mairie" square.

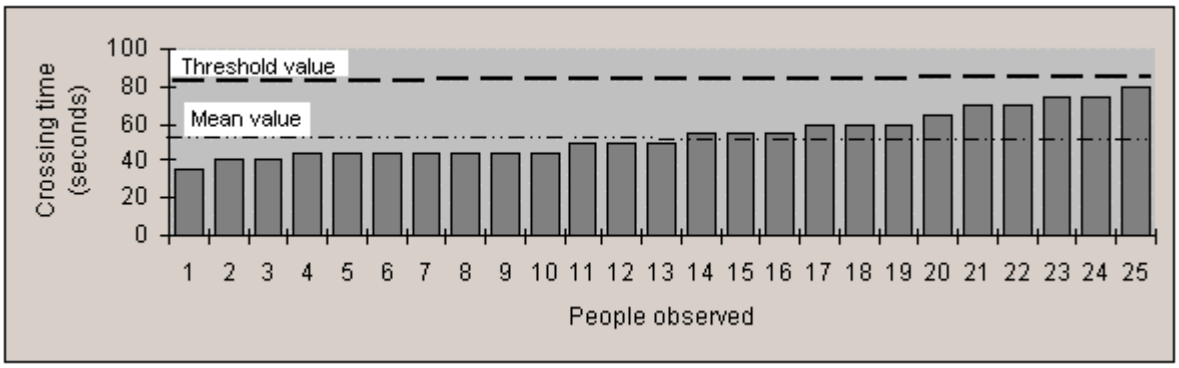

Fig. 1 Example of distribution crossing times in "Mairie" Square

Threshold definition. We calculated the standard deviation of the crossing times collected for each square (see Table 1). The threshold between crossing and strolling is defined as the mean crossing value + one standard deviation.

Tab 1 Average crossing time and crossing-strolling threshold in each square

Name of the squares	Eglise	Mairie	Marronniers
Mean value (N = 25 persons)	20,6	54,4	50,8
Standard deviation	3,9	12,4	8,9
Crossing/strolling threshold (mean + 1 standard deviation)	24,5	66,8	59,7

According to these results, we established the following occupation modes:

- **Crossing** (circulation): if the passage time of the person on the square is inferior to the threshold, we said that the person is crossing the square.
- **Strolling:** if the person time staying in the square is superior to the threshold value, the person slow, thus he is walking in the square.

- **Staying:** if an individual stays more than three interval in the same square of the grid, that is more than 15 seconds we consider that he is making a halt. We will differentiate short halts from prolonged halts by calculating the mean duration of people's halts. The halt will be defined as prolonged if the time spent in the square of the grid is superior to the mean plus one or two standard deviation.

2.4 Activities categories

The behavioral categories were designed to characterise the relationship that a person established with the square environment. These categories are designed to take into account the relationship of the person's activity with the social context of the square and its physical components.

- Social or Individual activity

    - Individual activity, the person is alone the behavior may encompass objects or animals but no other person.

- Social activity, the person is with a partner or a group, the behavior is socially directed as speaking to or playing with others.

- Activity related or not related to the square facilities

  - the person's activity involves brought in objects or animals (e.g. reading a newspaper, taking a dog out for a walk).
  - the person is not utilising any brought in objects, he or she is either just walking or running in the square, or using its facilities like sitting down on a bench, leaning against a wall or a tree.

2.5 Relation between behavior, spatial configuration and microclimatic conditions:
The square grid partition

To accurately relate elements of the spatial configuration, microclimatic parameters and behavioral data we use a grid that partitions the public spaces into squares measuring 3 by 3 meters (see example in Figure 2). Each square of this grid is defined by its coordinates (example C8 or D3), which makes easier the data collection. Therefore, topographical, microclimatic or behavioral measures can be precisely localised in the squares of the grid. The common spatial identification of the localisation of the different types of measures permits to associate them together.

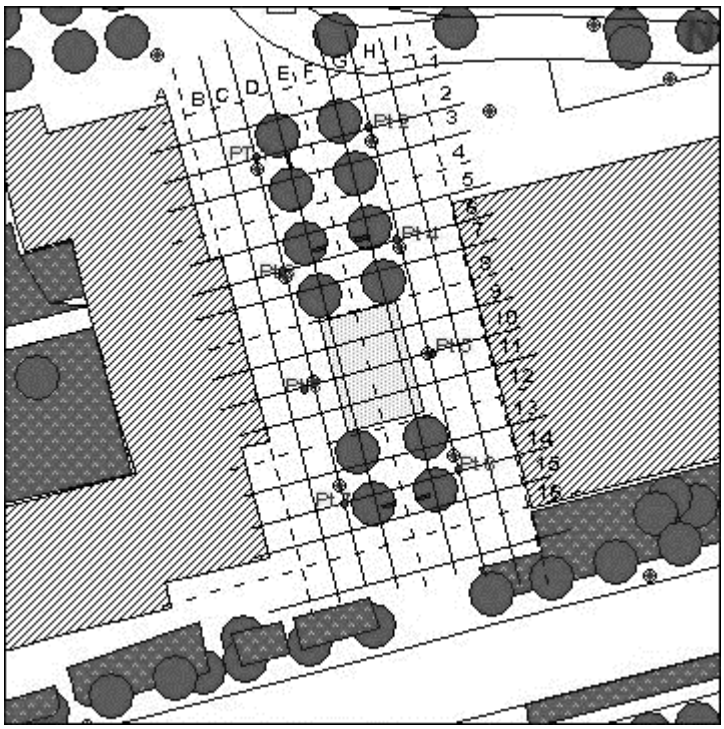

Fig. 2 Example of the grid partition in "Marronniers" Square

As regards the spatial configuration, the different elements can easily be associated to a particular square of the grid. Conversely, each square of the grid can be qualified by a set of elements encompassing the presence of urban furniture like a bench, of natural components like bush, tree or the proximity of water, and topographical properties as a border delineated by wall.

As regard the microclimatic parameters, a 3-by-3-meter square may be too small to show tangible differences from one square to the next square. In addition, the measurement of the average radiant temperature needs at least five minutes because of the thermometer sphere thermal inertia. That is why, we have constituted blocks of 9 squares (12 by 12 m). We make the assumption that one set of measure in the centre of the block is valid for the entire block. Subsequently, each square of a block is qualified by air and radiant temperature, humidity and air velocity.

As regards the behavioral data, in outdoor public space, a 3-by-3-meter square is practical to delimits the interactions of an individual with the immediate environment. In each studied site, we used the squares of the grid to trace people's movements or to draw the map of their activities.

3 Conclusion

In this short note, we outlined the design and the technical procedure adopted to test the hypothesis that the uses of public spaces are a function of their micro-climatic properties. An observation method has been presented, which allowed the elaboration of behavioral indicators that might help to qualify and quantify the use of public space. Considering the results of the preliminary observations, we delineated in operational terms three occupation modes of public squares, namely crossing, strolling and staying. We also depicted a technical procedure that enables us to relate with precision elements of the spatial configuration, microclimatic parameters and behavioral data. This procedure will allow accurately examining potential relationships between the people use of public space and the microclimatic properties of the areas making up those public spaces.

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