

# Microclimate Conditions and Space Use Variations

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**ABSTRACT:** This paper is a part of study about the impact of the microclimate on the space use and the user's behaviours. The purpose of our study is to get an in-depth understanding of how people use outdoor public spaces in different climatic conditions, how their behaviour and perception of the space change with the climatic variations. We have employed a multi-method approach which combines a "qualitative" and "quantitative" analysis. Three squares were chosen as a setting for either a video observations, climatic measurement and interviews with the users. The whole investigations were conducted one day in winter 2009 and one day in summer 2010. The result of the qualitative and the quantitative analysis revealed that the climate variables played very different roles in predicting the use mode and density of the three squares in the two seasonal periods.

**Keywords:** *Microclimate conditions, space use, measurement, video observations, interviews*

## INTRODUCTION

In our study, we focus on the relationship between microclimate conditions and user's behaviour that should be taken into account in architectural space and urban projects.

We are interested in the impact of the climate on user's behaviour at an urban space scale. To achieve this aim, we have collected:

- microclimate data using measurement
- behaviour data using video observations
- users climate perception using a questionnaire.

In this paper, we are presenting some results of the application of these three complementary techniques in three squares (Liberté, L'Indépendance, and 1er Mai) located in the town of Biskra (South-East of Algiers)

## Data recording techniques

### *Microclimate variations*

In these selected squares, we have measured climatic variables: the dry and wet temperature, moisture, air velocity, average dry radiant temperature in two various climatic conditions during the year (winter and summer).

For the climatic measurements, we have used a data collection system called the BABUC (figure 1), which parameters and to transfer them in a computer. Measurements were carried out in

days characterised by a clear sky and a weak wind speed.

### *Behavioural data*

To film people in the three selected squares, we have used two hidden cameras. The resulting videotape recordings provide a full view of the square (figure 2, 3)

For every person present in the square during the observation period, both the location and the activity were coded at every 5 second interval throughout the time that person spent in the square.

This technique enables to examine how users distribute in the square and follow the movement of a person crossing the public square. The behaviour of all the people appearing on the videos was coded and examined without selection.

Every one of the observed individuals was qualified with a number, gender and a broad age category. We have noted also the exact moment (hh:mm:ss) of the user's input of the square and his output of it.

The precise location of each present person was noted on a grid that partitions the square (example: A8 or D13, see figure 4, 5). This technique of location assessments permitted to compute more sophisticated indicators describing density, stability and mode of occupation in the studied squares.

To take into account the relationship of the person's activity with the social context of the square and its physical components, we designed some behaviour categories (body attitudes, walking rhythm, nature of the activity: individual or social ...). We have

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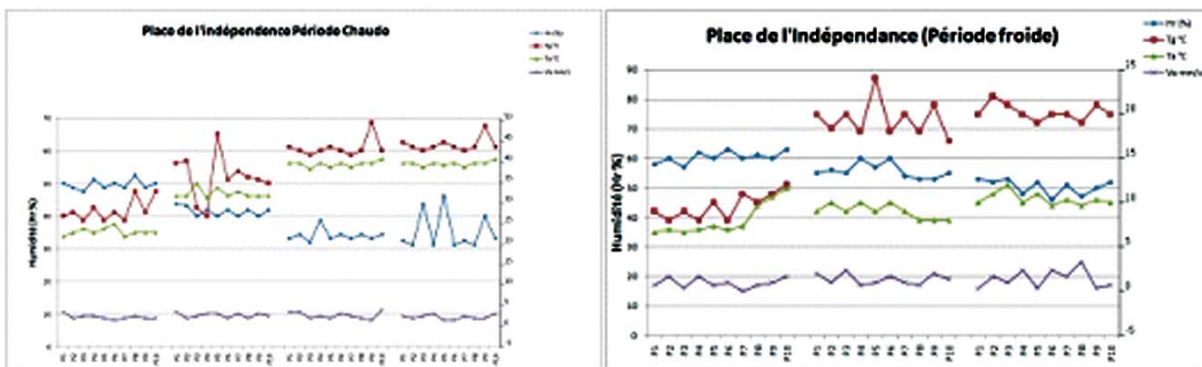


Fig. 1: The data acquisition System BABUC and two examples of microclimatic measurement (winter and summer – Indépendance square)



Fig. 2: One of the three selected squares (Indépendance square) and the two cameras views

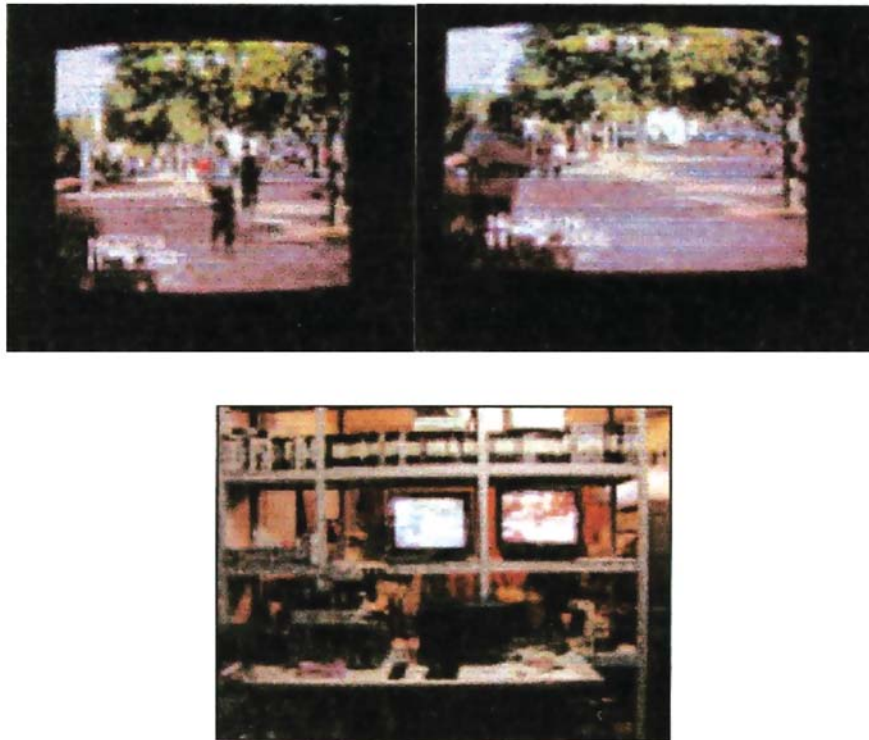


Fig. 3: Videotape recordings.

noted whether the person is coming to the square with an animal or a particular object. We have precise the characteristics of this object (example: fixed or mobile)  
 Thus, we were being able to examine whether the microclimatic conditions affect the people's activities, and more specifically, whether the microclimatic characteristics of a given area favour or hinder the development of particular activities.

*Connection between the microclimatic and behavioural data*  
 We have used a space partition in frame of square boxes in order to connect the microclimatic and behavioural data, which allowed also an easy exploitation of the whole data.  
 Therefore, we could be able to localise the microclimatic measures and the behaviour data in the squares of the grid.  
 For the behaviour data, we have used the small squares. For the

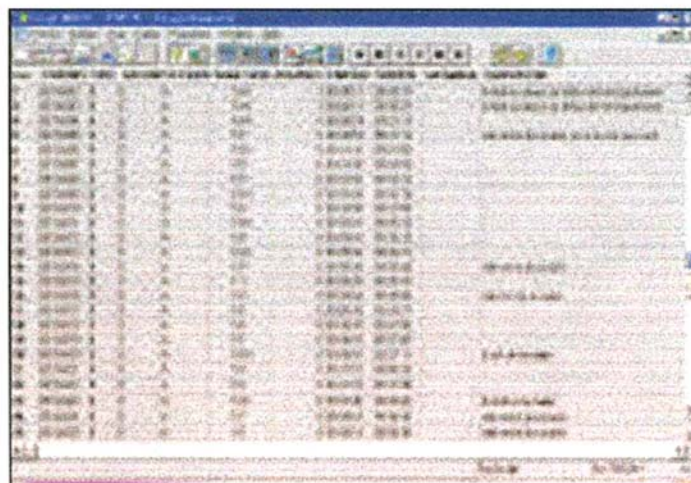


Fig. 4: Behaviour coding (visual D base software)





Fig. 5: Example of the grid partition in small squares and blocks (Independencesquare)

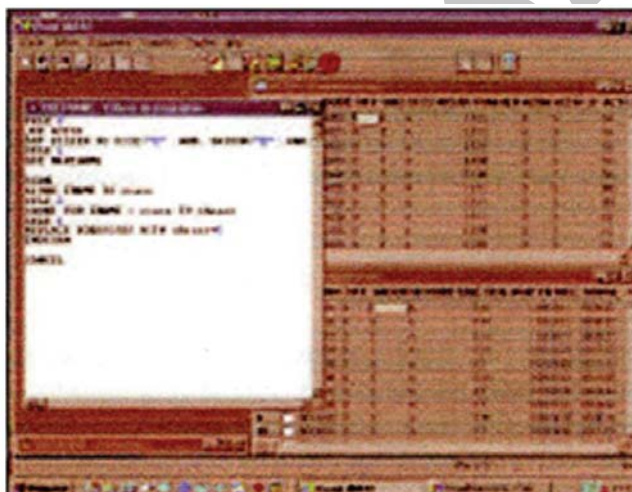


Fig. 6 : Example of visual Dbase treatment



Fig. 7 : Example of Map Info graphic presentation

## Main questions and objectives

Objectives	Asked questions
<ul style="list-style-type: none"> <li>- To elaborate a "perceptive" partition from the investigation: functional, formal ..., to mark climate elements that come out in the user's space perception.</li> <li>- To examine if these subjective partitions are made function of microclimatic parameters: shaded parts, sunny, humid, dry, ... etc.</li> <li>- To examine if this perception changes from one climatic period to another.</li> </ul>	What do you think about this square? Is it formed by: <ol style="list-style-type: none"> <li>1. Only one homogeneous unit?</li> <li>2. Several zones or places?</li> </ol> If(2): Can you describe these places? In what they are distinct or different?
<ul style="list-style-type: none"> <li>- To mark the type of the space use.</li> <li>- To mark the conditioned practices either modelled by the climatic conditions, as well as the role of elements of the urban planning.</li> <li>- To see the importance of climatic parameters and conditions.</li> </ul>	Can you give me the main reasons that drive you to frequent this place?
<ul style="list-style-type: none"> <li>- To see if the climatic parameters (without evoking them) come out again like parameters that influence choices of installation, appreciation, uses of places...</li> <li>- To examine individuals choice, to specify the different factors that influence him? To define the attractiveness of a precise place.</li> </ul>	What is the place(s) that you appreciate the most in the square? Why?
<ul style="list-style-type: none"> <li>- To identify the climatic conditions that users qualify as "the most nuisible".</li> <li>- To examine changes according to the climatic periods.</li> </ul>	Among these climatic conditions(strong wind, strong sun shining, low temperature...) What is the one that limits the most your activities in this square? (Give only one parameter)

microclimatic measurement, we have constituted blocks. The small squares, are embedded in the blocks (figure5)

We have performed microclimatic parameters measures and video recordings during the same data recording session. Every session started with a first assessment of the microclimatic values characterising the areas constituting the square. Then, a video recording lasting 20 minutes followed it. We have chosen periods of the day during which public squares were more used. Furthermore, these periods were also chosen to account for the microclimatic variations occurring across the day as a function of the squares spatial configuration as well as their various areas. Thus, during a day the three data collection sessions are scheduled as follows:

- The first session occurred in the morning between 8:00 and 10:00
- The second session was scheduled during the midday break pause at the hottest period of the day that is between 12:00 and 14:00
- The third session was planned in the afternoon before sunset time. Thus, it varies as a function of the season that is between 16:00 and 18:00 in winter and between 18:00 and 20:00 in summer.

The microclimatic and the behaviour data was inserted in software called « Visual DBASE » that lets it possible to organise and very easily this data according to the various types of analysis considered. Then, we have used the GIS (Geographic Information System)« Map INFO » for the graphic representation of our treatments and results.

These two softwares allows to do several types of treatments by selecting information about various criteria, such as temporal and seasonal periods , personal characteristic of the users , the user's crossing duration in the space and the duration of his staying .

These two data bases software offer a great flexibility to add

other parameters and make different analysis by selecting the information using other criteria.

The microclimatic conditions in user's perception and space evaluation.

#### *Interviews with the squares user's*

Interviews with the squares users were conducted between the measurement and the observation sessions.

The population question was not selected. However, we were careful to interview typical people ensembles of different ages and sexes. The table n°1 sums up the users. By this question, we aim to check the importance and the role of all of collected speeches were transcribed and treated. We have verified if the microclimatic parameters have an incidence on frequency and installation place in the space.

We have also identified the impact of the personal factors like age, gender frequency and the square knowledge degree on the space perception and sensibility to the microclimatic variations

## Results

### *Microclimatic variations*

Analysis of the microclimatic measures collected on the three squares let it possible to confirm the following results:

- Two parameters are the most significant in the presentation of the impact of the space configuration on the microclimatic measures: the variations of the « average dry radiant temperature» and the « air humidity »
- The duration of exposition to the sunshine during the day have an important role in the creation of microclimatic variations between the different space places.
- Microclimatic variations in the three squares are largely due to :
  - Trees shadow and vegetation.
  - Surfaces orientation and materials type.

## Climate perception from user's speeches

### *Personal characteristics*

The treatment of the whole collected speeches allows us to observe the influence of personal characteristics on the climate perception and the environmental preference and satisfaction. We present here the most important ones:

- Age : the younger and the older persons were more positive to the environment as they particularly evoke the climatic parameters .It is the youngest and the oldest people who are most disposed to investigate or take advantage of their environment .
- Anchoring with the space: persons who were strongly (1) were the most positive about the environment. The space evaluation was more positive when the users were weakly or strongly anchored on the site.

### *Familiarity with the space and type of frequency*

1- Users, who were familiar with the space (2), have rarely evoked the climatic conditions in their speeches. The climatic conditions are a part of their surrounding environment; they are accepted just as they are. For them, climatic conditions are elements which cannot be modified and on which we cannot act.

2- Individuals who were not familiar with the space, and who frequent the place by choice and not by need, have a positive appreciation of the site and were more attentive to climatic conditions. The climate was evoked in their description of the space. They have qualified or disqualified it by its appropriate climatic characteristics. the climatic conditions affect the visit frequency to, and their appreciation of places

### *Environment Evaluation*

About environment evaluations, there was no difference between summer and winter; however, we have noticed that the summer was more convenient and auspicious to the expression of sensations. Users tend to express their feelings about the climate in summer more than in winter. Their speech was more centred onto the climatic aspects, which would guide their investment of sites.

In the appreciation of the climate, when someone tells that he likes the weather, it is because he feels fine in the place in which he is. The climate alone is not sufficient to make a pleasant place; in fact, it participates to value or to depreciate the physical characteristics of the site.

The climate is an individual internal indicator consequently, the perception of a pleasant atmosphere passes at first by the visual, built aspect, before the « climatic felt » aspect. User's frequent interest in a certain place is indeed defined by its visual characteristics. The climate comes secondly in the perception of the environment. It thus becomes an element of the microenvironment, and the climatic conditions are then related to the types of organisations and planning of the place. It is only by the presence of spatial organisations that the users perceive the possibility of improving the climatic the

wealth, for example: "In the shade of trees, on a bench"

The most evoked climatic parameters are those related to the period of sunshine "shadow, good weather and light". The embarrassment connected to the parameters was widely associated in types of usage which the person makes of the space.

### *Microclimatic variations*

The speeches analyses permit also to observe that unlike the type. Morphological aspects, the climatic aspects are not perceived as elements able to be modified with the aim to improve the atmosphere of the public space. The climatic parameters are variable and perceived as such. If sometimes they are unpleasant, too cold or too warm, the natural rhythm of the seasons is evoked, and never the building or the space configuration.

Man can modify the public space (buildings, colours, and different organisations), but cannot modify the natural elements. Seasons give rhythm to the urban ecosystem. They are variable and not controllable.

Users appreciate this character of the climate. There is a perception of the microclimatic variations in the space by the users. But there is no perceived link between the typomorphological and microclimatic criteria. They are separate for the users.

### *Space use and climatic variations from the video observations*

Our first objective was to differentiate the occupation modes of the three squares. Are they a simple circulation space, or are they used as a promenade or a recreation space? We have established a threshold value (3) 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 the persons to cross each square. We calculated the standard deviation of the crossing times collected for each square.

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

- 1- Circulation: if the passage time of the person on the square is inferior to the threshold, we considered that the person is crossing the square.
- 2- 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.
- 3- Staying: if an individual stays more than three intervals in the same square of the grid, that is more than three intervals in the same square of the grid, which is more than 15 seconds we consider that he is making a halt. We have differentiated short halts from prolonged halts by calculating the mean duration of people halts.

### *Circulation*

People, who were crossing the squares, were mostly moving alone without using any brought in objects. They were just

walking or running in the square. They have not made a station at all, and when they make one, it was for a very short moment. Crossing is not related to the square facilities, its function of the functional characteristics of the urban spaces. We have not observe differences in the crossing direction on the three squares between the day moment (in the morning, at noon and in the evening), nor between the two seasons; summer and the winter. However, the most taken trajectories were those where the humidity values were the most raised in summer, and the average air radiant temperature values the highest in winter.

#### *Strolling*

From the observation treatment, we have noticed that strolling in the squares was effectuated by similar proportion of persons moving in group and persons moving alone. Users, who were in walk in the three selected squares, were going to a building or to a shop, moving with an object or arrived in with an animal. They have made short stations for activities having as a support squares. Although the average strolling duration on the space was similar in summer and in winter, the average duration of station was longer in summer than in winter. We have noticed similar proportion of the people who move in group or alone and who were in walk in the square and have made short station. We have noticed that in summer as in winter, the short stations were made for the same types of activities, for some adjustment such as to arrange the shopping, to hesitate before continue walking, taking some things in the bag ...etc. Short stations were more frequent in the morning in summer. We can suppose that it's because in winter, users are more dressed than in summer.

#### *.Staying (prolonged halts)*

The prolonged halts (stations of average and long-term) were made mostly by persons who were moving together. They have made a stop for social activities such as to discuss a moment, to wait for another person or to watch a children playing.

The stations of average and long-term were more frequent in summer and in the beginning of the afternoon; however, they were mostly effectuated for social activity using an element from the space:urban furniture or an element structuring the square.

The prolonged halts were longer in winter than in summer because of the mineral character, the facilities and the organisations of the three squares.

The prolonged halts were longer in winter than in summer because of the mineral character, the facilities and the organisations of the three squares. In winter, these characteristic offers possibilities to make recreative activities as for functional ones compared with vegetal spaces. In summer, people prefer stay in vegetal spaces (park, garden...), that does explain why there was rather the walk in the three squares in summer.

We have noticed that no prolonged halt was made in places where the sun was shining. The places where the users made prolonged halts were those where we have recorded the highest

values of air relative humidity, there where it makes more freshly or there where is a shadow.

## CONCLUSION

The most interesting part of our contribution concerns the setting of an allowing method about the "quantification" of the "qualitative" aspect of the space use, thanks to rather rigorous behavioural coding. The three techniques which are measures, observation and questionnaire are complementary and allows the connection between the microclimatic condition and the space occupation mode and density. This methodology is flexible and allows integrating other information or parameters. The whole performed analysis shows that it is extremely difficult to disregard functional aspects, social aspects and climatic conditions of the places. It is clear that the choice of installation passes at first by the visual and functional aspects. The microclimate conditions intervene only in a secondary way.

However and without confirming that microclimate variations have an impact on the number of persons frequenting the space either on the reduction or the holding on the duration of presence on the squares, and in the most taken trajectories. The necessary activities which generate crossing are the most significant elements in predicting use density and the holding potential of the space.

From the observations and the questionnaires analysis we conclude that climate alone is not sufficient to make a pleasant place, it participate to value or to depreciate the physical characteristics of the space.

This study presents a research domain that present a high development potential and that is going to know a growth in the future. So, we think that two types of perspectives can be developed. The first type of perspective concerns the improvement of the three techniques used (video observation, measures and questionnaires). Concerning the observation, we suggest doing them in climatic characterised places (wind effect, thermal effects) and rather the weekend. It is also interesting to multiply the observation and have at last three days of observation for the same climatic condition to verify the stability of the observed phenomena. Concerning climatic measures, it is interesting to vary the climatic conditions and perform measures by windy overcast period, during both intermediate seasons: spring and autumn. It will be also interesting to integrate indicators of individual comfort such as the PMV, PET ... and compare between video observation, peoples speeches and ambience simulations results.

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