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Role of Mental Models in Utilization of Urban Space

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Abstract

The use of urban spaces and the ways in which users perceive these spaces is considered a sustainability concept. Users choose to use the spaces and paths to cross in order to reach their goals with less effort and in a minimum time, that means users choose their path according to their perception of the components.

Patterns of urban space and the notion of the perception of space are key concepts for this orientation. In earlier research we showed through the techniques of Space Syntax, how the spatial configuration of the old historical city centers influences the use of urban space, and how much changing urban structure affects mastery of space. This influence is based on a set of factors related to urban ambiance and cognitive process of spatial perception.

This paper is a complement to the earliest research by adopting conventional methods that consist of a field survey on land, looking for the difference in use of urban space between permanent occupants and visitors in order to show the Role of the mental map in this choice.

Key Words: *Urban behavior, Mental model, Sustainability, Cognition, City centers.*

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1. INTRODUCTION

The study of land use in urban design is one of the main concepts of urban sustainability. People use urban space through their perception. Urban space configuration is a form of representation of the social culture while society is influenced in its behavior by space.

2. URBAN SPACE

Urban space is often perceived as public space or the urban void. Urban planning is seen as the "art of arranging the urban or rural space at large (residential buildings, work, leisure, circulation and exchange networks). It is the space of the city where it exercises all functions and urban actions, it is not only an urban vacuum created by the frames but all parts of the city interact.

Urban public spaces have always played a very important role in urban life and urban development, its history goes back a long time, with the history of human institutions. The agora, the forum and the market streets were the first embryo, but the tradition of designing public open spaces in an urban environment goes back to the industrial revolution itself, when public parks and greenways have been recognized as a critical element in the development of the city of London [1].

The role of urban areas varies depending on their types or locations. They are often used as bonding areas, pedestrian traffic or conveyed, walk consolidation or meetings etc ... But the role is different use. T. Carmona defines the role of urban areas as a vector of social life and the class as an actor. Hillier confirms that the theories of Space Syntax come from the idea that space is not just a background of daily life but also a player in the influence of choice for users of this space [2]. A well-designed space conceived may play an important role beyond his frequent functions as "A well designed open space system can Decrease automobile use, enable people to walk more and drive less, preserve natural land, and Provide connections from Developed to undeveloped land. It can contribute to social interaction and community sensibility. «Therefore, Carmona class dimensions of urban areas into five categories [3].

- The morphological dimension.
- The perceptual dimension
- The social dimension
- The visual dimension
- The functional dimension
- The temporal dimension

2.1. Urban image and mental models:

Kevin Lynch is certainly pioneered this approach, proposed as a tool for reading of urban space since the sixties. The image in the city plays two fundamental roles, the first as a fundamental component in social communication and the second as objects various scattered throughout the city.

The urban image is the result of an operation of back and forth between the observer and his environment [4]. Imageability is the quality of an object that provokes strong images, thanks to the continuity of its structure and clarity of its elements. A powerful image allows both people to move easily to appreciate the aesthetics of the place, to forge a sense of belonging and even consolidate beliefs or worldview. To understand the language of form of cities, the more the image is clear and legible; wayfinding in space is easy.

To read an urban image through a cognitive process based on a set of sense and intellectual faculties. Visibility is certainly the first contact with space; perception is a mental operation that serves interpretation and classification of the visual image as a mental image. Compared with other images in the directory space experiments, that mental picture causes a cognitive reaction, cognition.

Kevin Lynch affirms that the spatial form of the city is the most important determinant to meet human needs. It offers five "dimensions of performance of urban design features that relate primarily to the spatial form of the city"[5] which are defined briefly as follows:

- Vitality: The extent to which the form supports the vital functions, the biological requirements and capabilities of human beings.
- Meaning: The extent to which the place can be clearly perceived and structured in time and space by its users.
- Adjustment: The extent to which the shape and capacity of spaces, channels and equipment match the pattern of behaviour that people normally are.
- Access: The ability to reach other people, activities, resources, services, information or places.
- Control: The extent to which the use and access to spaces ... are controlled by those who use, work or reside in them.

K. Lynch added that the mental image is composed of three components: its identity (which recognizes the fact that), structure (the spatial relationship of the object with the observer), practice or emotional significance. The meaning of a city is very diverse, it is better to let it develop without the guide. The urban landscape, as K. Lynch is made up of five elements: Paths, Landmarks, Nodes, Districts, and Edges to compose the mental image. Whereas, for C. Alexander this is the thing that creates differentiation, and allows differentiation, composed of shape and structure and which are closely linked. The form is the more general term physical arrangement which is for Alexander, "on the scale of a small place ... a sense of how its parts are assembled." The structure can be identified as the connecting network. [6]

It defines the elements of a language like entities called patterns. Each motif describes a problem, and then describes the core of the solution to this problem, so that this solution can be used several times without ever making the same way twice.

Each pattern has the same format. First, there is an image that shows an example of the archetypal pattern, and each pattern introduces an idea. Each pattern linked to the other, so that the collection of all models gives a language in which you can create an infinite variety of combinations. A language is a set of patterns ordered so they can solve a particular problem.

Mental models are deeply held internal images on how the world works, images that limit us to familiar ways of thinking and acting, very often, we are not consciously aware of our mental models or the effects they have on our behavior. The relationship between configurational properties and patterns of space use, and between cognitive representation and patterns of space use. The former emphasizes whether intelligibility leads to a stronger association (Fig. 1)

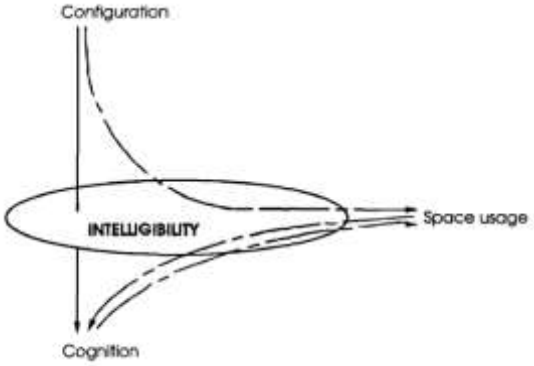

Figure. 1: The intelligibility and spatial experience interface [7]

2.2. Urban space configuration:

The concept configuration is not very far from the concept of urban image or urban model; it can be in the cognitive process as a simulator of the mental image. The urban configuration can be defined as the arrangement and how the parts of a space are put together to form an interconnected system of spatial entities [8] It also defines the "Configuration means clustering, put simply, relationships Taking into account --other relationships ... the way the parts are put together to form the whole is more significant than *Any of the parts taken in isolation "is the order or syntax that* connects and organizes the elements as a system in the space network.

This notion is supposed to provide a sufficient description of the space in order to realize his nature as a physical object and scope of human action. It therefore addresses the space as a space formed by spaces system connected to each other. The spatial configuration concerns concurrent relationships between the parties and constitute the whole.

Specifically, the configuration of the urban space is how spatial elements through which people move - streets, squares, streets and so on - are linked together to form a sort of global model. [9] The concept of configuration is applied to study what the architects (design). It can be compared to urban analysis but at other end and methods. Since the objective of the development of this concept is not the study of space itself as an urban phenomenon, but the study of the consequences resulting therefrom.

An image a mental map is a kind of representation of space in the memory of the user, an identification tool for recognition of space, based on his life experience and formed by the markers sequence or permanents reasons of space; it is the basis of all cognition.

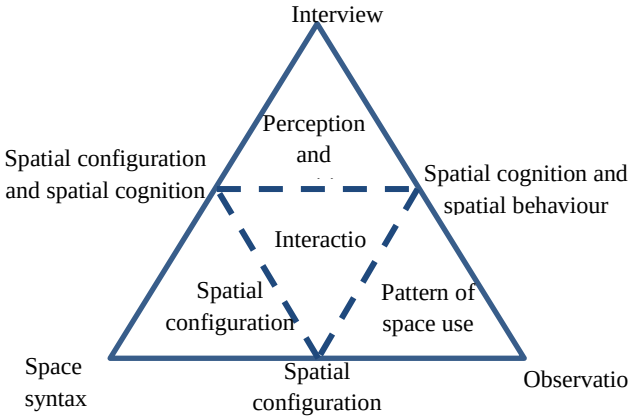

Figure.2: Relation between space components

3. URBAN CHANGE OR URBAN TRANSFORMATION

Urban change is a concept related to urban development or evolution of urban space include several related terms such as transformation, mutation, etc ...

Urban space is constantly changing view development in terms of actors, lifestyle and urban techniques. This implies a revision of the configurational state of the city.

But the notion of urban change is not limited to the space change; it usually starts with a change in the actors of urban life that contribute to the production and use of space:

3.1. Main urban change in Algerian city centers:

Most of cities in Algeria were founded in antique era, developed during centuries by inhabitants without referring to scientific knowledge. The expertise developed through experience and handed down from generation to another was the main rule. This space was characterized by excellent adaptation to living conditions and the environment (climate, geology, topography and especially materials) is a primitive form of sustainable construction.

One of the main characters of this architecture is the compatibility between build space and social structure. This is shown in the daily practices and land use. However urban structure was complicated, people moves easily and use a perfect wayfinding method; the mental map. fig.3 shows the example of Constantine, a city in the east of Algeria with a traditional design, it is a deformed grid based on complexity in urban structure.

A mental map, as defined by K. Lynch is a form of representation of space within all its physical components, phenomenon and users; it's the result of a complex cognitive process. To manage space and use it, the occupant must have a good knowledge the components of this mental map. [10]

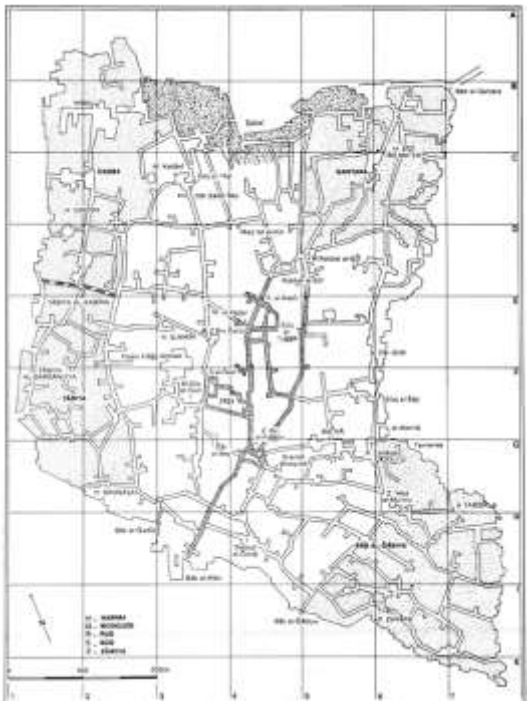

Figure 3. Map of Constantine, 1837 original configuration

The analysis of the case of Constantine 1988 shows two extremely different zones; the first one is the old one with deformed grid and it's characterized by:

- Traditional layout, with curved streets
- Complexity in the urban structure.

The second part which belongs to the period after 1840 is a standard design (chess plan) characterized by:

- Straight streets
- Well organized geometry
- Some straight traces were introduced in the first zone

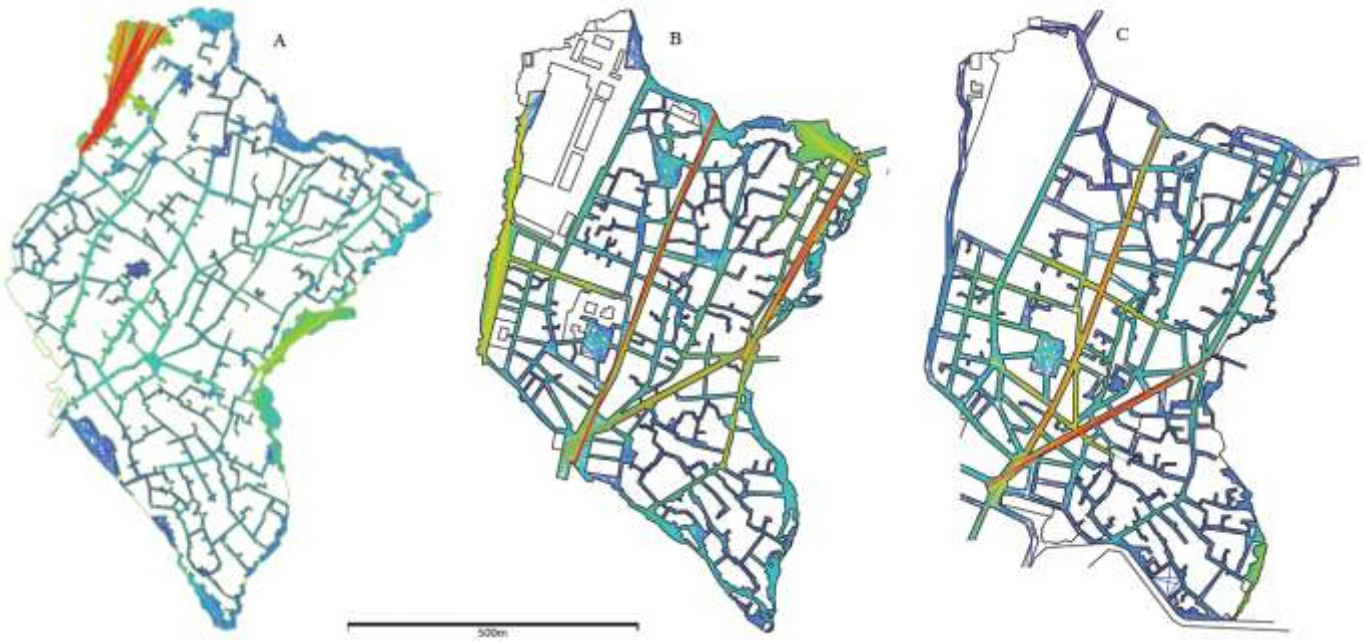

Figure.4: Axial maps, Constantine 1838, 1937 and 2010 showing the evolution of urban configuration (By Author)

The axial maps in figure 4 show clearly that the evolution configuration of urban space evaluated, the most connected spaces (in red) are the main axis that have been subject of major transformations, in 1937 (fig 4.b) the site was occupied by two communities where each one tries to master space and handle its use. Here we should ask what are the mechanisms used by each community to the mastery of space?

In a previous research using space syntax methods and tools, we showed the mechanisms to master urban space and human behavior [11]; the study was based on a set of parameters of space syntax that coincide with the components of the mental model of Kevin Lynch:

- The Visual Step,
- Intelligibility of Urban Space
- Connectivity and Choice.

The result of the analysis focuses that there is a considerable difference in reading urban space in the original configuration and after urban change (Fig. 4). The two models of space were different in configuration and intelligibility. As a result, each one of these urban structures belongs to a way of life and different social interactions and land use.

In this paper we are using the traditional method which is based on the investigation method. It evaluates the Survey of the path used by inhabitants and foreigner users. Hillier (1984) showed that the difference between locals and strangers is the clarity of urban system which is the intelligibility and it can be measured by the difference between Global and local measures. Lynch (1999) confirmed that the difference is the mental model wich allows the locals to navigate without need for reading the global urban structure. [12]

The survey is based on a set of questions for different categories of users on the purposes of:
Origin and destination
The preferred path
Social interaction
Feeling lost
The questionnaire is applied on two types of users, visitors or crossers who don't have a previous knowledge of urban configuration and occupants (inhabitants) who have a complete master of the studied zone. The results of the count of pedestrian movement was represented (fig.5) as mean pedestrian in movement in 100m in a minute. [13]

4. RESULTS AND DISCUSSION

Fig.5: Pedestrian movement represented on axial map, Constantine 2010. (by author)

The results show high rate of pedesrian movement in specific axis that have the highest values in connectivity, integration an choice, these axis are the same ones mentioned as subjects of main transformations in urban configuration (fig.5). diagrams of correlation between space connectivity in axial map 2010 and pedestrian movement (fig 6) shows a high correlation (R^2=0.71) that means people choose to move in high-connected axis.

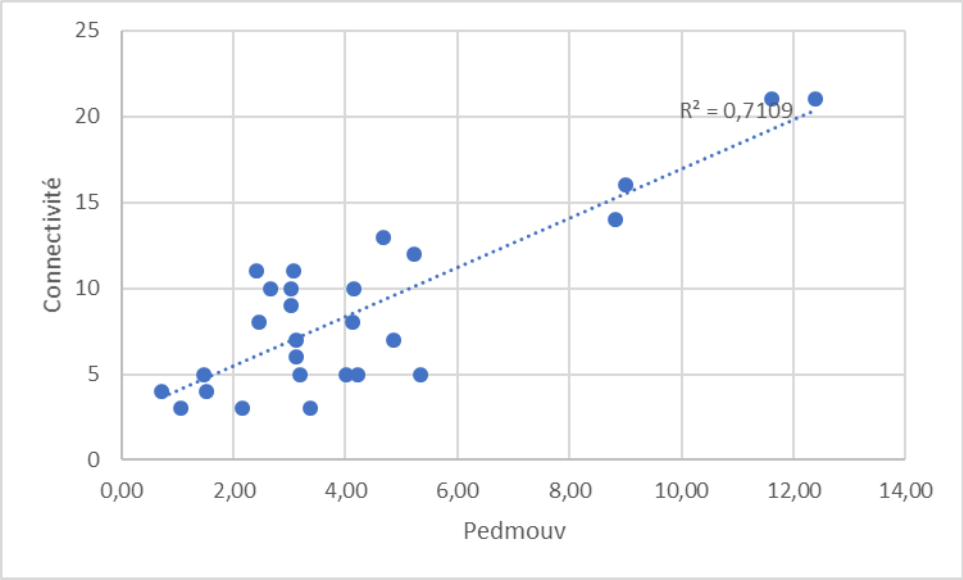

Fig.6: Correlation between space connectivity in axial map 2010 and pedestrian movement (by Author)

Table 1: Summary of the results of the origin-destination survey. (by author)

	Locals			Strangers		
Knowledge of the site	Good 92.3%	Average 7.7%	Weak 0%	Good 12%	Average 58.3%	Weak 29.7%
Destination	Inside the fabric 84.25%	Outside (passing) 15.75%	/	Inside the fabric 68.12%	crossing 31.88%	/
Destination goal	Home 68.18%	Shopping 13.72%	Others 19.1	Home 13.51%	Shopping 68.14%	Others 18.35%
Preferred path	The shortest 90.05	The clearest 9.95	The richest in functions	The shortest 17.9	The clearest 43.18	The richest in functions 38.92

Proposed paths offer the choice between different degrees of spatial intelligibility, visibility and distance (step depth) the results confirm those of syntactic analysis. There is a great difference in perception of urban space between inhabitants and foreign users or crossers.

- Original occupants, who have a confirmed mental map of space can use all kind of urban structure, doesn't mind with curved streets, complex structure of hidden visibility. They can use all zones.
- Crossers or foreign users prefer the zone with straight trace and open visibility to cross, all their goals are in principal axis.

For locals, the preferred path is the shortest in distance or time, the result is known previously because they have one more notion, it's the navigation aids (the mental map). They can trace their path before they start.

For foreign users, the preferred urban structure is the clearer and the simple one, choice means "sure" while traditional trace is "unsure", the concept of the shortest way doesn't much for them but safety and insurance. This shows how much the mental map is important to choose the path.

5. CONCLUSION

Mental map is a result of a complex cognitive process. While using urban space, the user collects information from urban patterns and transforms them to a mental representation of urban ambiance (physical patterns, atmosphere phenomenon and user's presence). This can be considered as a stimulator of the users' reaction: choice of how to use urban space.

This notion can be used in urban design to influence users' behavior, to guide their choice by the degree of compatibility of the design model and their mental models. The most the design model is clear, simple and standard the more it's easy to de used and offers more free choice. To limit accessibility and choice it's preferable to use a complex structure with hidden space patterns, this limits the use of space to those who doesn't have a complete mental map.

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