

CARTOGRAPHY OF THE SUBJECTIVE SPACES: A METHODOLOGICAL CHALLENGE FOR THE COMPREHENSION OF URBAN PROBLEMS.

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Introduction

The dynamic and continuous processes of inside transformation that the Latin-American cities have been characterized in the last historical periods of its evolution, they demonstrate that the urban current reality is far much of that one existing in the previous centuries.

The urban landscape has become considerably complex, in that different aspects are juxtaposed by functionality and different dynamics, shaping a puzzle that becomes less and less legible.

The city of Santiago of Chile can be considered as an interesting example. The disorganized urban expansion of the city has stimulated the use increasingly more massive of the car derived from a significant increase of the distances that population should travel through in its daily activities. People live far from the workplace, from its place of study, from supermarket, from malls and another services.

The convenience of tending to a more rational mobility, which it includes to the whole citizenship and which respects the urban environment, next to the consideration of an offering of environmentally respectful, efficient, and complete public transportation makes necessary the more innovative search of initiatives, with a more integral new vision, by administrations, reason by which the present work intends to contribute with a methodological proposal, since a still not respected perspective properly in the country, that permit to expand the look that of these problematic currently has, providing for it a conceptual frame and the methodological foundations that are needed.

For achieving previously indicated, the present work raises the need to be able to include reliable information, that allows a deeper qualitative and quantitative vision of

the problematic urban, from sources not only official from the organisms traditionally in charge of the planning and urban management, but with special emphasis, from direct sources linked intimately to the cognitive, perceptive and valorativos processes which are taken root in the environment of the subjectivity and routine atmosphere in which the urban inhabitants take their decisions for spatial behavior and, in its entirety, they are finally become in the displacements, rational or not rational, that, with its individual dynamic and complex structure, constitute the backbone of these problematics.

Goals.

- To determine skills more efficient for obtaining basic subjective information for this studio.
- To form different alternatives of cognitive or mental representations about the inhabitants of the Santiago city; according to sociodemographic characteristics and the place where they live.
- To propose models of mental cartography for the visualization of the behavior and spatial valuation that characterize to the residents of the city.
- To analyze the relationship which exists between the perception and the spatial distinguished behavior of population and the urban problematics, related particularly to the daily mobility, traffic congestion and the effective use that this one does of the diverse elements that help to construct the urban landscape.

The first studies and methodological contributions delivered, in the first request by Lynch and then by Gould and Lowenthal, undoubtedly, they opened an important and transcendent line of investigation about the cognitive cartography orientated to the acknowledgment of spatial perceived elements, for the rigorous analysis of the geometry of the cognitive configurations and searching of methods most adapted for the representation of this subjective information.

Inside the general theoretical framework on the perception and the spatial behavior in urban areas, it is convenient to emphasize the prominent role that can comply the perception and subjective appraisal of the urban landscape, the incident that they have as determining factors of the spatial behavior of population and by which way such mobility can be correlated with the urban problematics derived from it.

It is also important to keep in mind that the city inhabitant does not perceive in clear and uniform form the whole urban space, but rather a part of these elements that shape it and they emphasized it for diverse reasons. This fragmentary and partial vision of the city invests a great transcendency for the persons who live in it, since definitively they move in different spaces, which can be considered to be spaces of perception arranged hierarchically from the personal housing to whole urban landscape.

If we add that every man has a respective geographical location and a heap of his own experiences in relation to his environment, difficultly transmissible, we are in conditions to question the relative consensus that defines the objective space. It is a question of an egocentric space closed depending on the personal and vital experience of the man, distinguished by the biological, social and cultural processes.

The organization of the mental image of the city is then carried out from the spaces of activity, understanding as "the subset of all the urban locations with the individual takes direct contact as a result of the daily activities".

In Chile the studies related to the perception of the geographical environment have not been still due considered, especially those that refer to the urban space.

Inside this topic, the Metropolis of Santiago presents a complex and dynamic structure shaped by a set of activities and specific functions which are developed and interrelated between them and a high concentration of population who show a clear differentiation in demographic, socioeconomic, physiological and cultural components where must be added the system of values, interests, necessities, aspirations, religious thing, frustrations and deformations.

This heterogeneity involves important differences in the perception of the city among different social groups, considering the place where their residences are located, which carries also to that the inhabitants of the city of Santiago present notable differences in knowledge, comprehension and valuation of their space, and consequently, in the spatial behavior, which you can many times find, but subjacently correlated with urban environmental problems, which turns out to be indispensable to know, to locate and to make clear if one tries to arrange rationally the city, in order to achieve harmonic and well constructed spaces that allow to improve the living conditions.

From the different studies made about the bibliographical review and analysis according the cognitive images, mental maps and spatial behavior it can be inferred that according Kevin Lynch, who started a searching process of different methods to gather and to evaluate the information of the cognitive maps, diverse technologies have been applied by other researchers for acceding to these contents, all of them supposedly approximate to the mental unattainable scheme for scientific methods.

The analysis contemplated the exposition of a critical synthesis about the main technologies used in the different checked studies, with the particular advantages and disadvantages that each of them demonstrate.

- Drawing or sketch of map. This technology is and no doubt has been the most used, its modality is based in using a blank sheet with the instructions of planning a map of the city or part of it, drawing all those significant elements that form subjectively the selected area.

What is obtained of the sketch is a topological representation of great subjectivity of the urban landscape, which is a result of a mental process of the individual, still not completely known, that perceives and incorporates information about the environment, he tries and interprets, he gives meaning and finally he translates it in a response of action on the urban objective space.

Nevertheless, this technology can be criticized for being, among other things, very sensitive to the personal capacities and bounding of the polled, to transfer the cognitive map to a paper.

- Mute plane, technology in which there is requested the tracing of limits, routes and other urban significant elements for the subject, on a plane base of a selected city sector, which includes only general references about the main streets and avenues.

This modality is kept the bounding ones of the previous procedure, though it facilitates the task of the polled on having framed the drawing inside the contour of the sector, in addition the resultant graph loses information relative to the size and the form of the area in study.

- List of places used in those occasions where the interest is to analyze the archetypical map that a group of persons have about an urban space. In this case you resort to a list of places or spatial elements, especially milestones.

- Estimate of distances, technique that consists in requesting to persons who evaluate the distance between two points of the city, to make possible the analysis of those mistakes or distortions that explain the degree of correspondence between the Euclidean geometry and the spatial representation.

In the application of this still not due used technology is necessary to remember that a cognitive map is a personal product and for this reason, it does not have why to have a complete isomorphical relation with the reality, due to the fact that it is an own and subjective way of constructing a set of urban elements and all those experiences linked to them.

Finally, there are mentioned other modalities of minor relevancy as techniques for the configuration of mental maps, but they have been specially used by pedagogues and psychologists, such as: models, technology particularly used in children's mental maps and recognition of slides and other playful activities, as skills of simulation and evaluation.

In addition, it is suitable to consider that the traditional classification of K. Lynch and the cartographic offer of P. Gould has been widely used, reason for which it thinks that it is necessary to explore and to analyze new methodological modalities that link

themselves efficiently to the cartographic visualization of the cognitive maps and that they contribute this way to a major diversification and deepening in the comprehension and the analysis of the complex process of the perception and of the spatial behavior that characterizes the population who resides in the city of Santiago of Chile.

Territorial conscience of the daily environment.

The daily space is "an egocentric space closed depending on the personal and vital experience of the man ". Therefore, the subjective process of the perception has a meaning more wide than the properly such perception, which incorporates also "the feeling of belonging" and the valuation of the space as result of the subjective and differentiated assignment from values of the same one.

For this reason, which is claimed is to determine the degree of territorial conscience that the inhabitants of the different sectors of the city have of the area where they live and make the majority of the daily activities, of the particular territory where they feel to belong and to identify it as the "place from where they come and that is a part of what they are ", producing a particular relationship between individuals- territory, across the time, affective links that determine an identification with this territory.

Therefore, the urban landscape of Santiago represents, to semiotical level, a set of characteristics that define her inhabitants as belonging to a certain urban category, different this one of the rest for her own identity and for a spatial behavior determined by the perception of the own environment and in addition for the particular necessities that motivate its spatial mobility towards the rest of the city by establishing hereby a network of interactions which hold the totality of the urban space of Santiago and in which underlies complex relations of reason - effect with the urban problems.

For this reason, it is necessary to form, to know and to understand the transcendency there have of these subjective spaces, inside which people try to satisfy their daily needs if they are not having been satisfied in their familiar environment, they induces them to take the forced decision to move towards other areas of the city, which implies an exploratory learning process often spontaneously and of few rationality in their) spatial mobility.. This process is evidently determined by the extension, orientation, quality and loyalty of the geoinformation provided by the mental images that they have about the city.

Cognitive Process of configuration about the subjective space.

This methodological stage tries to achieve an approximation to real situations of daily living that characterizes the inhabitant of the city, where "our mind guides us in this plot of daily living that the urban displacements turn out to be " (de Castro, 1999), for this reason it is necessary to understand how we handle the spatial information in the resolution of the displacements..

In this sense, it is suitable to establish the conceptual differences between terms "mental map" and "cognitive map" according to de Castro, since the decade of 70 in last century, based on the historical publication of David Lowenthal's ("Environmental perception and Behaviour") has produced an overlapping between both concepts.

Thus it is possible to affirm that "the cognitive map is or consists of a mental device that orientates us every day in our urban navigation" (de Castro, 1999). We can understand for mental device as a heap of spatial information of the environment which allows to solve spatial daily problems, that is, for a concrete and personal need that wants to satisfy, it is necessary to make a displacement from one or another direction to arrive to the wished point, adopting a certain "orientation".

For contraposition, the term mental map, adopted by Peter Gould in 1966, in his work "On Mental Maps" and the publication "Mental Maps" (1974), according to Gould's study, it refers to a cartographic representation relative to different regions that were constituting in object of preference or rejection on behalf of the polled population, which it finally was translated in isolines named "isopercepts", which evidently are far from being "a map inside the mind".

The systematic analysis of the bibliography review, and the experience accumulated for several years by the authors of this article, allow to also raise, like a proposition, a conceptual separation inside the term mental map, between the "separated valuation of the space" raised by Gould, which is translated in "residential preferences" and the concept of "subjective space", understood as *an urban landscape that goes beyond "Euclidean or Cartesian" cartographic visualization and that seeks to form and to shape, with the respective distortions, the "life space", personally and subjectively, as a product of the daily mobility and of the social interactions that characterize and differentiate the urban inhabitants, specially inside a city with contrast and high heterogeneity, from the morphologic, functional, economic and social perspective, as it is the Metropolis of Santiago of Chile.*

Conceptual design of cartographic subjective models.

The methodological proposal contemplates the utilization of three configurations of the mental image which are used as a support of the analysis of the spatial deviations and provide the base to establish the correlations between subjective and objective spaces: Polygons of Identification, Polygons of Distortion and Cartography of subjective spaces.

Polygon of Identification.

Configuration shaped on the identification or recognition of nodes, paths and urban relevant milestones, from the physical and architectural point of view of cultural and historical patrimony and as well functional, which are the result of semiotic reading that the urban inhabitant does of his environment and that are constituted in the source of

basic information of orientation and of spatial reference, which definitively they make his cognitive map.

Polygon of Distortion

The result of the searching is configuration of a preliminary and schematic visualization of general trends of the deviations in the perception of the distances that characterize the population. This graph was designed joining urban peripheral milestones to the area of study, before established, of way of making a polygon concerning a node or central widely known point, on the basis of which they find all the distances above-mentioned.

Cartography of the subjective spaces

As it just mentioned, the subjective letters stem necessarily from the information stored in our minds, which raises the first challenge, consisting in defining a methodological procedure that allows to measure the mental images, on which objective information does not exist.

For this reason, diverse procedures were analyzed for the obtaining of this basic information for making this cartography of the subjective space, having in consideration the consequence that this one has for the identification, description and explanation of the deviations that could present between the mental image and the real way.

Methodological alternatives for making maps based on the subjective space.

- Maps or sketches that the subjects draw spontaneously on a paper, which must be made on the basis of personal knowledge of the reference area, without resorting to other sources. Here it interests the own vision of environment and the consequent deformations of itself.

As already it was indicated, this procedure can be made in two modalities: on a blank sheet and taking a blank map as a reference.

The modalities, though they present the disadvantages before described, the first one allows to obtain a topological representation of the area as result of the transfer of the cognitive map of the polled to a paper and the second one makes possible to frame the complex process of moving the above mentioned cognitive information, which is taken root in the mind of the subject, to a paper for giving him the structure of mental map.

- Identification of an urban area on the basis of the administrative divisions which the city is suit it (for example: the city of Santiago and its 34 communes), for this purpose were analyzed different alternatives, from the most general:

- There is requested the identification of the different communes according its names.
 - This modality represents the difficulty that the polled may identify only a part of a commune or certain punctual places which are familiar to him, without knowing what commune they belong. In addition, there is no information wherefrom they are located.
 - There are selected the communes that suit a city, of a more wide list of administrative units. It is partly avoided mistakes derived from the memory, but it presents similar problems than the previous procedure. Communes can be also identified just by its name or on the basis of the knowledge acquired through indirect sources.
 - It consults on what communes have been visited or have been personally known, once defined them, there is requested the identification of relevant milestones inside them. This case allows to check the knowledge that the polled could have of the communes mentioned by him, but a certain uncertainty is kept on the location of the milestones and the influence that could have the indirect sources
- Determination of the mental image according to urban milestones of reference. It is requested to identify significant milestones in every commune, without relationship with the administrative limits. This modality makes possible to perfect the image of the studied area by disregarding the communal limits, so they must define urban representative milestones of each one of these units, which, in its number must be correctly regulated, depending on the area, for avoiding its excess as elements of consultation.

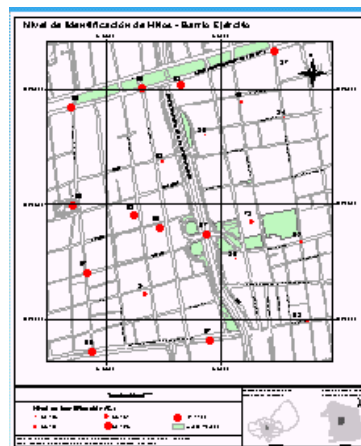


Figure N° 1 : Levels of identification of urban landmarks.

The graphical punctual obtained information is possible to extend it to different sectors that remain shaped on having joined the milestones between them, using for it the technology of triangulation of minimal distance between two consecutive milestones.

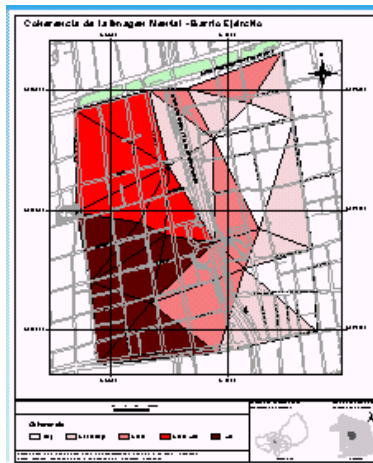


Figure N° 2 Triangulation method

It is also of interest to visualize the trends, for the reason and thanks to the disposition of a network of distributed points in relatively regular form and with numerical attributes; they make the possible construction of isovalues by using the civil module of the software Land Development, which allows to generate the triangulation and later the isolines.

Due to the load of subjectivity which characterizes to the tracing of isolines, the previous procedure will be compared and validated by the mathematical calculation and interpolation made in a manual form.

This procedure, as the previous ones, does not consider the superficial deformations product of the subjective perception of the distances.

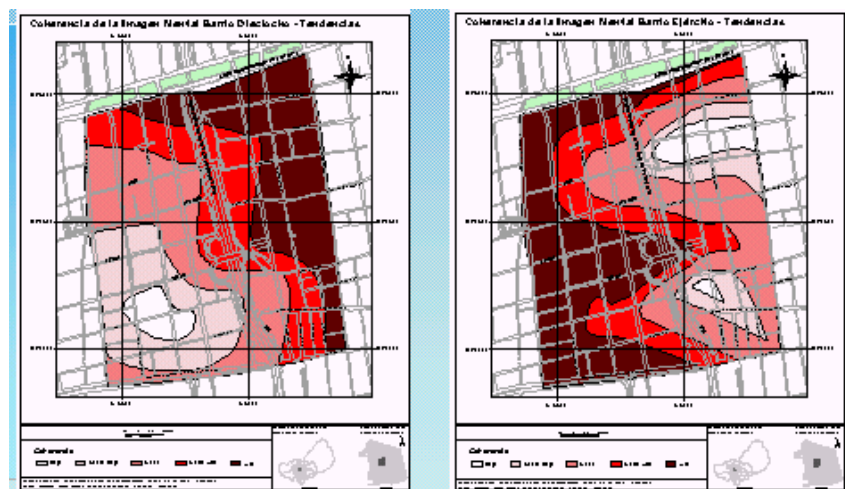


Figure N° 3: Tracings of isopercepts

- Configuration of the mental image according to perception of the distances.

This methodological procedure is the result of an extensive work which has been centered in changing the obtained data according to the subjective perception of the distances to mental maps, where the linear obtained deformations in the polygons of distortion were extended by a technique of interpolation, designed for this purpose, to the whole urban area in study, to make possible a more specific analysis of the spatial variations in the whole extension of its surface.

The stages determined for this mental configuration were the following ones

- Determination of peripheral preliminary points of control
- It corresponds to the identification of urban significant landmarks for the population, located in the peripheral sectors of the area of study close to the limit of the selected sector, in all its extension.
- Validation and selection of peripheral definitive points

Once determined the most significant urban landmarks, it becomes necessary to validate them in area in order to define those that the majority communal population recognizes as the more relevant and therefore, the probabilities do not being identified are very small, if the polled resides or has moved away with certain regularity on the sector where they live.

Also it is located the most relevant point in the center of the area, corresponding to a node or neuralgic point of general reference in mobility for the whole polled population.



Figure N° 5 Connection of central point with peripheral landmarks.

From this node located in the middle of the above mentioned area, there is requested the estimation of the existing distances between this central point and each one of the peripheral landmarks.



Figure N° 6: Conformation of real polygon of reference

Finally, with the application of an interpolation method the estimations of linear distances that have shaped "polygons of distortion ", they are projected to perceptions areas, conforming in this way the respective " mental maps.

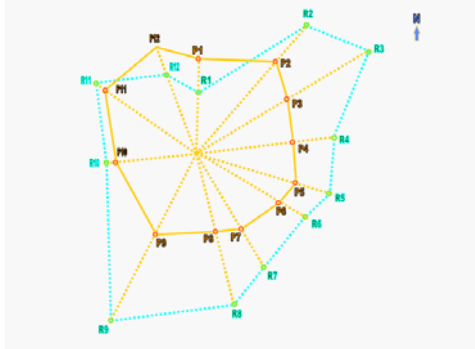
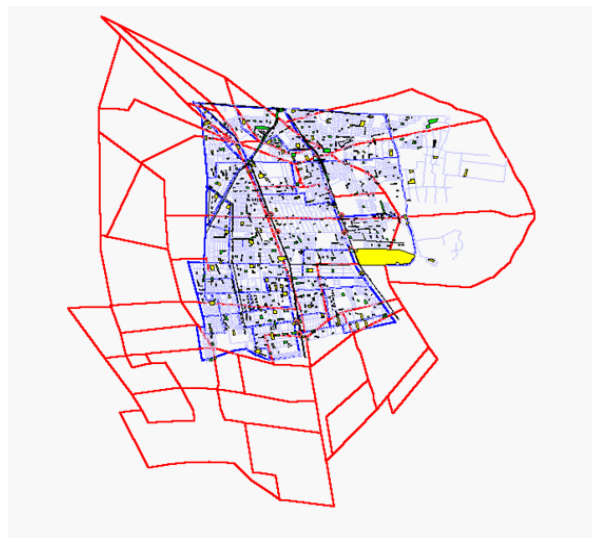


Figure N° 7: Comparison of real polygon - perceived polygon .



— Real Map
 — Spatial Subjective Map

Figure N° 8: mental Map of the commune of La Florida

Technological support for the generation of cartographic models according to the subjective spaces.

The analysis of the spatial behavior of the distortions produced by the distinguished perception of the distances, according to sectors and communes where the population live and of other factors that have relationship with the exploratory process characterizes by the inhabitant of the city, it does necessarily to generate a great quantity of mental maps, for comparison with the objective reality to visualize the existing differences between them.

Also it needs to define criteria that allow to qualify and to quantify the great quantity of information that this cartographic material provides according to the magnitude, orientation and spatial trends that present the perceived deviations.

Having in consideration the exhaustive and laborious thing that they turn out from the mathematical and geometric calculations involved in the representation of this distorted space, studies were made for tending to adapt to the study the computer tool that is needed, framed inside the potentials that offer the Systems of Geographical Information.

Hereby, the designed program was the result of the searching of a necessary technological support, which it was allowing the optimization of the complex and extensive procedure that means the efficient elaboration and it requires maps should shape the subjective and distorted space in a reduced time, in addition promoting with a significant number of complementary tools, which give it the aptitude to allow a deeper and varied spatial analysis of the problematic ones.

The resulting program, named Cartografía Mental Automatizada (Mental Automated Cartography) (MAC), is therefore orientated to the systematic generation of mental maps. The program allows to determine real and perceived surfaces, real and estimated distances, underestimations and overestimations, as well also the coherence of each one of the segments, to create and to consult databases, to make graphs and to export and to print the maps and resultant tables. (Figure N ° 9).



Figure N ° 9: Window of principal menu. MAC Program

Conclusions

The exposed work presents different mental configurations use as support to the analysis of the spatial deviations and provide the base to establish the correlations, the derivatives from existing symbiosis between the objective vision of some urban current problems considered relevant and the subjective, personal and daily dimension, which they allow to understand and to achieve a suitable approximation to explain the spatial behavior of population, in a conscious way or not, they are active actors in the genesis of the above mentioned problems.

It is suitable to highlight the importance that have for all those specialists who in major or minor measure have relationship with the urban planning of the city and the searching of solutions to varied problems which affect to population, to know and to understand these "subjective spaces" according to people develop their habitual activities.

Inside the limits of this Mental Cartography there are many of answers explaining spatial behavior, as also the arguments that allow to foresee, with a certain degree of certainty, the future actions that they will do on the real or objective environment.

References

- BOIRA, José. "La vivencia del espacio urbano. La creación de imágenes en la relación hombre – ciudad". Cuaderno de Geografía N° 41, Valencia, 1987.
- DE CASTRO, Constancio. "Mapas cognitivos. Qué son y cómo explorarlos". Scripta Nova, Revista Electrónica de Geografía y Ciencias Sociales, N° 33, Universidad de Barcelona, 1999.
www.ub.es/geocrit/sn-33.htm
- ESCOBAR, Francisco et all " Prácticas de Geografía de la Percepción y de la Actividad Cotidiana". Oikos –tau, Barcelona España. 1992
- ESPINOZA, Jorge. "Cartografía Mental : una alternativa para la comprensión del comportamiento espacial del habitante urbano". Trilogía, Ciencia-Técnica – Espíritu, Vol. 15, N° 23/24, Universidad Tecnológica Metropolitana, Chile, 1995.
- ESPINOZA, Jorge; RIOSECO, Reinaldo; et all. "Informe Final Proyecto Cartografía de los espacios subjetivos : una alternativa metodológica para la comprensión del comportamiento espacial de la población urbana". Instituto Panamericano de Geografía e Historia (I.P.G.H.- O.E.A.), 2003.
- GREENE, Margarita; SOLER, Fernando. "Santiago: de un proceso acelerado de crecimiento a uno de transformaciones". Facultad de Arquitectura, Diseño y Estudios Urbanos, Pontificia Universidad Católica de Chile, 2004.
www.Sitiosur.cl/publicaciones/Ediciones_sur/02santiago.pdf.

- HAYNES, Robin “Mapas mentales de preferencias residenciales en Chile”. Revista de geografía del Norte Grande N° 7, 1980.
- HONOLD, Juan. “Visión general de los problemas del Gran Santiago”. Revista de Urbanismo, Universidad de Chile, ISSN 0717 – 5051, N° 7, 2003.
- LIZÁRRAGA, Carmen “Movilidad urbana sostenible: un reto para las ciudades del siglo XXI”. Economía, Sociedad y Territorio, vol. 1, N° 22, 2006.
- SILVA, Alejandro. “Sistema para la representación y análisis de la percepción subjetiva del espacio urbano”. Memoria para optar al título profesional de Cartógrafo, Departamento de Cartografía, Universidad Tecnológica Metropolitana, 2002.
- SINTES, María “Movilidad racional en las ciudades”. Centro Nacional de Educación Ambiental CENEAM, 2002.