

Application of a Methodology for Ergonomic Diagnosis of Open Spaces

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Abstract

The article presents a case study regarded to the studies of the ergonomics of the built environment by adopting a methodology of cognitive assessment of open spaces where evokes issues of environmental psychology that involves the system man-environment. In the course of this methodology interviews with goers of the square chosen randomly and with different ages, seeking to grasp levels of empathy and ownership with the environment were carried out. The study aims to contribute in environment-behavior studies serving as an auxiliary model in the diagnosis of environmental performance of open spaces. The methodological tool called "constellation of attributes" generates graphical models that allow visually identify qualifiers attributes in the cognitive framework. Induced questions about the imaginary environment (subjective) and real (objective) generate answers that demonstrate attributes of relevance and the resulting "psychological distance" associated with the affective functionality of habitat. The objective is to present a methodology useful to the dynamic work of architects and designers of the urban environment to allow means to focus the psychological awareness of the user by making an instrument for diagnostic analysis of the constructed environment.

Keywords: Evaluation Post-occupancy, Built Environment, Environmental Ergonomics, Environmental Psychology

1 Introduction

The architecture, while functional art is one that establishes a protective physical structure around our lives, organizing and humanizing the habitat of man with its purposes and intentions.

Zevi (1977) highlights the role of architectural space as something that goes beyond a set of geometric-abstract dimensions, but one that has an "inner space" full of intentions and it can not grasp without becoming involved in an intense experience of appropriation.

The perception we have of the architectural space assumes fundamental and psychological, that is precisely the surroundings closed that will determine our reactions of empathy and attractiveness with the place. The public squares, which is the object of this study, are intensely in this environmental materiality the extent that morphologically establishes an empty space and integrated internal structure of cities setting up a mediating element and symbolic of social life.

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They are indispensable elements for the welfare of the urban population, relieving feelings of oppression to lessen the weight of the masses built among other benefits linked to environmental performance. For this aspect, its importance for an effective social appropriation binds to a required environmental quality and a methodological-projectual approach that provides and ensures a proper performance of their functions both in the urban system and the social aspects.

In compliance with such requirements, and when properly maintained by public authorities, the social acceptance of a public open space is automatically and is reflected in the construction of a morphological identity creating the conditions conducive to its attractiveness. Previsé the deployment in harmony with the environment, arousing elements of perception and awareness of the city which, in the words of Merrifield (1996), "symbolize the solidarity and collective experience". Otherwise, it is fall in mishaps of the fragmentary and hedonistic city that scorns the urbanity when valuing the places of conviviality restricted, concludes Solà-Morales (2002).

In this context, classical studies in the field of environmental perception allow us to understand the importance of (re)building affective and cognitive ties in the apprehension of expectations and satisfactions with the urban environment.

Among these highlights the power of articulation of the urban landscape aroused feelings and emotions that allow the exaltation of affectivity described by Cullen (1971), the importance of environmental legibility as product of immediate sensations and the memory of preterit life experiences, conceptualized by Lynch (1960), passing through the contribution of studies of environmental psychology with GarlockBarker (1968) resulting from the theory of behavior setting or even the definition of psychological assumptions relational person-environment developed by Ittelson, Proshansky, Rivlin and Winkel (1974) whose conceptual basis will help in further studies regarded to the subjectivity of environmental perception.

In this course, highlights the analytical contribution given by Tuan (1974; 1977), for whom the spatial information received by the sense organs go beyond a simple perceptual relationship subject-object. Tuan (op. cit) refers to the affective experiential link to introduce a series of assignments from the term "topophilia" - the way in which people respond cognitively to physical environment- and that delimit by four axes: the appraisal aesthetics, the apprehension of physical space, the relationship of familiarity with the environment and life experiences. Tuan (op. cit.) will call "topophobia" the sensations of aversion and antipathy to place or physical environment, which refers to the concept of "landscape of fear" and the denial of the place.

To ensure individual and collective attractiveness, the environment provides a state of harmony of our experiences and desires of appropriation of the city and its places. Therefore, the construction of place involves feelings of topophilia founded in aesthetic appreciation, in the relations of influence and to sensory stimuli that, acting unconsciously, potentiate conditions of empathy and pleasantness with the place. If this empathy strengthens our bonds of belonging, feelings contrary to this can also generate hostile feelings generating revulsion and even in some cases encourage vandalism. Studies show this relationship crime/feeling of insecurity and "untying of the place", affirming a social pathology that imposes fleetingness to the relationship of people with the urban environments (Jacobs, 1961).

For this reason the square requires a constant rethinking of morphological conformations that meet the predicates of socio-environmental performance in local and temporal contexts for which historically holds its aggregate power of attractiveness.

On the other hand it is well notorious that public squares, despite the fact that there are in good quantity in all the cities, often suffer from pleasantness for a number of reasons, either by insufficient spatial connection with the place, or the deterioration and abandonment resulting from overuse or by functional idleness.

Organizational weaknesses observed in the process of designing such as insufficiency of previous studies or uncertainty of goals and needs eventually motivate projects little connected with the place, referring to a negative relation with the product generated. Designed on the basis of intuition of the designer and free from measurements more sensitive, projects surface can result in confusion, discomfort and disfunctionality, notes Martin (2009), which cancels the perspective of construction of the place, seen as counterpoint the abstraction of physical space undifferentiated. The "place" in the perspective of topophilia must assimilate affective values and a sense of welcome and belonging that favors their appropriation.

However, in the projectual dynamics to which we concentrate (lean, are discussing), the affective and cognitive components active are not always possible to be identified in view of the subjectivity of perceptual issues involved and its intangibility as to allow exteriorize physically. This approach affects the studies of environmental psychology, suggests the application of methodologies that allow properly to grasp the elements that constitute and qualify sensorially the environment and so that we can reajust it to our psychosocial demands. Thus returning the sense of belonging that should illuminate the perspective of usability of the communal space and correctional element to travel there construction of the places.

2 Grounding

According to the International Ergonomics Association (IEA), "Ergonomics is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system" according to their needs, abilities and limitations. And it is up to the environmental ergonomics, a branch of ergonomics that studies the human-environment interactions, provide the means and techniques required to identify and systematize actions of correction / prevention of adverse conditions that interfere with the performance of the built environment.

The environmental ergonomics which is guided this study directs its gaze to physiological, cognitive, social, organizational and environmental factors that act and determine the functionality of the architectural space (Mont'Alvão & Villarouco, 2011; Vasconcelos et al., 2009 and 2010; Villarouco, et al., 2012). Issues related to thermal, acoustic and luminous comfort are associated to cognitive impressions making the set concerns about the suitability of the environments to our needs of comfort and usability. The case study presented below focuses on a post-occupational diagnosis trampled on an informational process of cognitive analysis of an open space in the perspective provided by the environmental ergonomics illuminating conditions of adaptability and conformity of the space to leisure activities and sociability prevised there.

The study aims to contribute to the understanding of these issues related to the cognitive perception of the environment where it adopts the analytical tool called Constellation of Attributes, theorized pioneered by Abraham Moles (1968) and developed by Ekambi-Schmidt (1974), researchers from the Institute of Psychology of Strasbourg in the interest of understanding the so-called "psychological awareness" of the user. Applied to the specific conditions of open spaces, inquires a sample of users by focusing on the analysis of the quality of the human-environment system considering attributes linked to safety, environmental comfort, furnishings, functionality, aesthetics and maintenance.

3 Materials and Methods

The field research was carried out in February 2014 in the Diogenes de Lima Square located in the seaside town of Caraguatatuba, state of São Paulo, Brazil. Interviews were conducted with users of varied age groups and socioeconomic levels over a week at various times and in three shifts, make up the initial stage of the methodology. The sample size was statistically fixed in thirty six (36) respondents considering a margin of error of 5% and a confidence level of 95%. The small amount of users reflects dissatisfaction with the enclosure for the daily leisure whose causes are the focus of the post-occupational research in course.

The methodology establishes the reading of variables (attributes) captured and systematized from the answers obtained that involve the two specific realities to the case study on screen: the lived reality and the image we have of the space. Questions addressed to respondents guide the analysis in two steps of procedures whose results analytically dialogue. The interrogators are instructed to not limit the answers grouped into qualifying and elected categories. The question (1) refers to the imaginary field, the wishes and desires of the user as a living and open space that in its view, it would cause pleasantness: What images or ideas come to your mind when you think in a square? The objective of this question is to determine perceptions about the ideal environment linked to expectations of comfort even if operate in this process stereotyped visions arising from mass-behaviors and values, second puts Ekambi-Schmidt (1974). The question (2) refers to the image of the real square: What images or ideas come to your mind when you think about this square? The question seeks to capture a particular and affective opinion no longer affected by the images and stereotypes, capturing spontaneous returns of the interviewee.

The graphic model generated allows visually capture the level of affective perception of the user and establish a chain of attributes according to its frequency of appearance in the answers. The generated model also allows the calculation of "psychological distance" (see tables) that refer to the attractive ness dimension given to each attribute. Two "constellations of attributes" (real and imagined) are as well built as a result of raised compilations providing a reading of this man-environment interface. The variables are represented graphically through the definition of the probability (P_i) of the attribute association (i) with the object evaluated from the formula (a) and the "psychological distance" (D) in cm that separates each attribute of the object of study based on the formula (b) described below.

$$(a) P_i = \frac{n_i \times 100}{N} \quad b) D = \frac{1}{\log P_i}$$

Being P_i = probability of association of the attribute i
 D = psychological distance (cm)
 n_i = number of appearances of attribute i
 N = total replies

4 Results

Following presents the frames (1 and 2) statements with the quantifications of categorized attributes with the respective psychological distances calculated on the basis of the formula above. The categories are represented by the chromatic code associated to those indicated in the tables with the measures of the bars (scaled in centimeters) calculated by the frequency that attend. The results lead to the construction of two constellations in sequence representing the materialization of a studied phenomenon where interact psychosocial factors, physical social and historical-cultural providing the reading of cognitive perception of the environment.

The graphical construct may be generated using graphical software currently under development by the authors.

Table 1: Attributes associated with the Imaginary Square

Category	Attributes Associated with the Environment	Answ	Class	Psychol. Distance
Environmental Comfort	Many tress/shadow	12	2	1,05
	Ventilation	4	8	2,12
	Cozy welcoming	4	8	2,12
	Cool climate	4	8	2,12
Subtotal		24		
Ergonomics	Comfortablefurnishings	8	4	1,29
	Acessiblepaving	4	8	2,12
	Comfortableenvironments	2	10	5,86
	Accessiblepublicrestroom	2	10	5,86
	Safe playground / comfortable	3	9	2,88
Subtotal		19		
Safety	Drainagefloor	3	9	2,88
	Goodlighting	9	3	1,21
Subtotal		12		
Functionality	Playground	5	7	1,76
	Stage for presentations	7	5	1,40
	Clean publicrestroom	6	6	1,54
	WideSpaces	4	8	2,12
	Exercisingapparatus	4	8	2,12
	Tables with trays for games	4	8	2,12
	Dumpswelldimensioned	2	10	5,86
	DrinkingFountain	4	8	2,12
Fixed and organized handicraft fair	3	9	2,88	
Subtotal		39		
Aesthetics	Pruningmadewithcriterion	3	9	2,88
	Landscapedflowerbeds/Landscaping	13	1	1,01
	Fountain	4	8	2,12
	Paginationsoffloor	2	10	5,86
Subtotal		22		
Maintenance	Garden maintenance	5	7	1,76
	Permanent general cleaning	9	3	1,21
	Furnishingsmaintenance	5	7	1,76
Subtotal		19		
Total ofAnswers		135		
Total ofRespondents		36		

Table 2: Attributes associated with the Real Square

Category	Attributes Associated with the Environment	Answ	Class	Psychol. Distance
Environmental Comfort	FreshEnvironment/Shade	4	6	1,95
	Cozy	2	8	4,74
Subtotal		6		
Ergonomics	Uncomfortable furnishings	9	3	1,16
Subtotal		9		
Safety	Poorlighting	10	2	1,10
	Poor drainage	3	7	2,58
	Unsafe playground	7	4	1,32
	Badfillor	7	4	1,32
Subtotal		27		
Functionality	Precarious handicraft Fair	7	4	1,32
	Dirty restroom/precarious	4	6	1,95
	Layout squarelittlefunctional	7	4	1,32
	Precarious playground	5	5	1,64
	Absenceofdrinkingfountain	3	7	2,58
	Absenceoftrashcans	4	6	1,95
	Absencestage for presentations	4	6	1,95
	Ample space	2	8	4,74
Open spaces sealed to the public	2	8	4,74	
Subtotal		38		
Aesthetics	InadequateLayout andlandscaping	11	1	1,72
	Bad visual of the fair	5	5	1,64
Subtotal		16		
Maintenance	Precarious general maintenance	9	3	1,16
	Lawn/ damagedgarden	11	1	1,72
	Pruningpoorlymade	3	7	2,58
	Dirtyenvironment/vandalized	4	6	1,95
Subtotal		27		
Total of Answers		123		
Total of Respondents		36		

The size of the bars shows the essence of the method and its graphical output with the lesser or greater symbolic value for the attributes in screen; thus greater distances show little affinity, while the smaller show a higher affinity providing this wayemotional information associated with the considered aspects.

The experimental technique and easy viewing points to social demands and symbolizes the level of psychological adaptation of this group to the environment by providing variables of suitability to the needs of habitability. The information given to the researcher conceive a scenario that is associated with the scope of technical, material and organizational aspects that make up the objectives of the research in progress regarded to the performance of the built environment.

Figure 1: Constellation of Attributes for the Imaginary Square

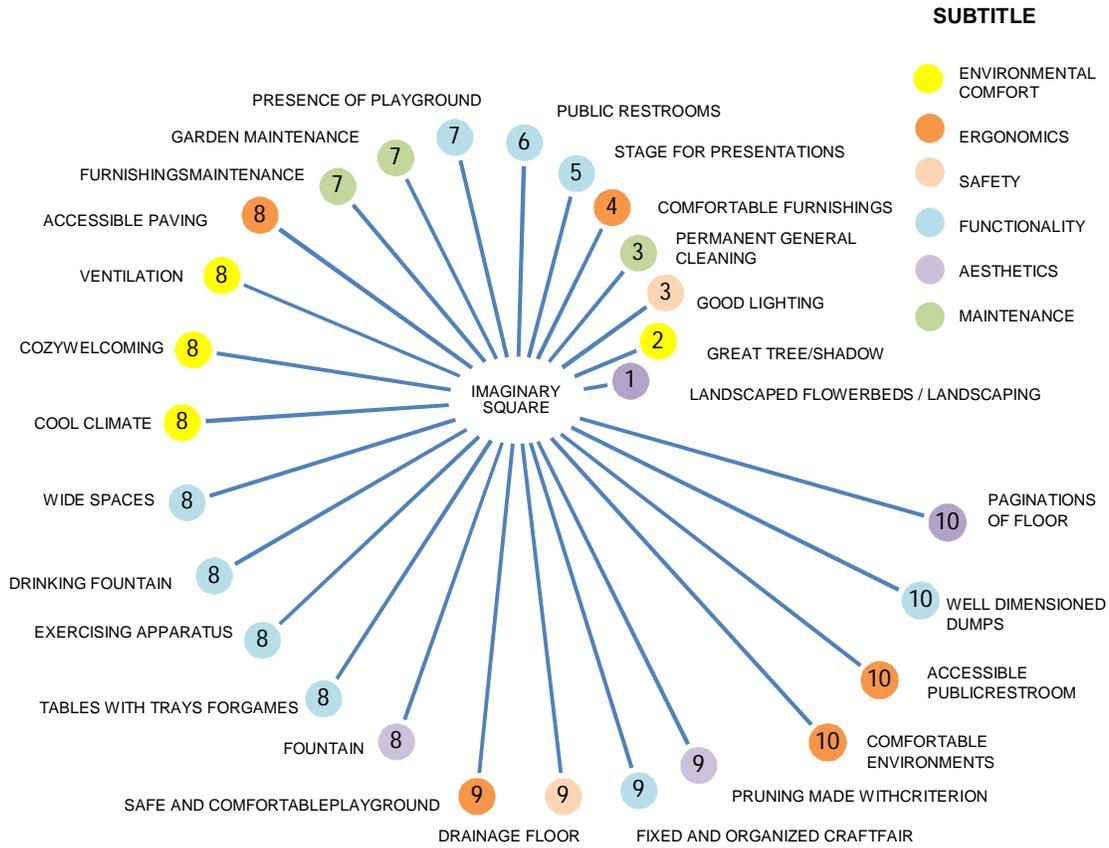


Figure 2: Constellation of Attributes for the Real Square

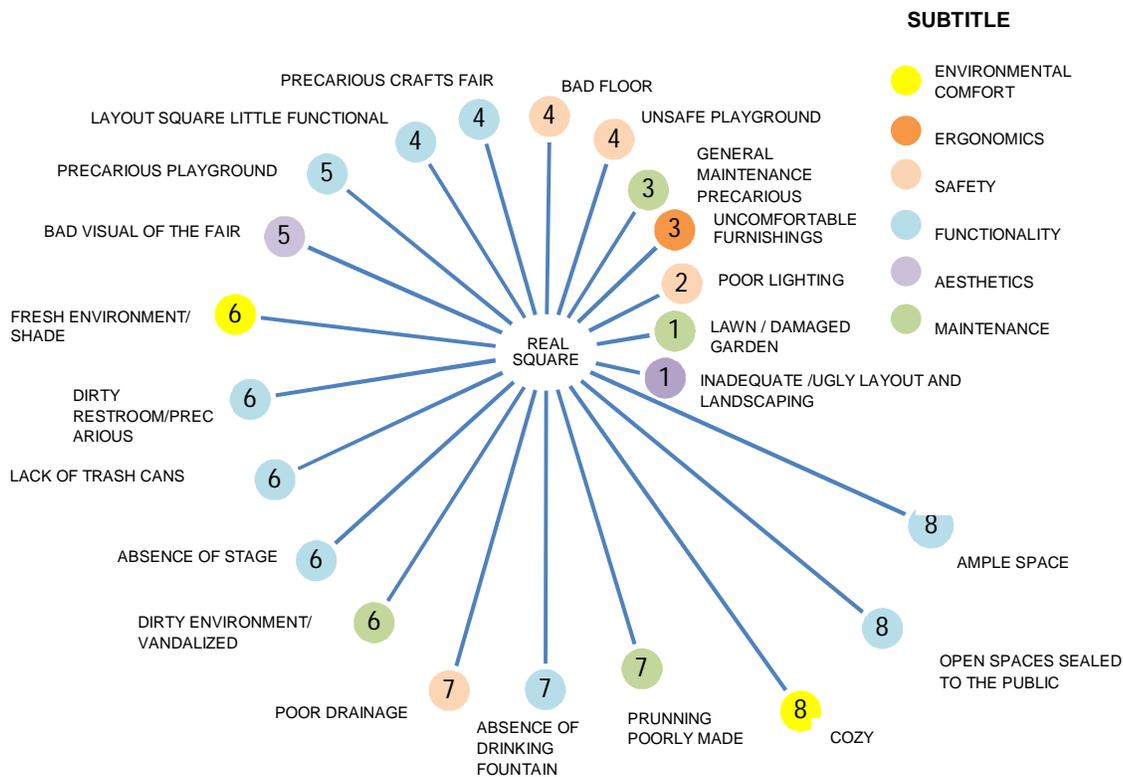


Figure 3: Panoramic View of rendered Square Diogenes of Lima



5 Conclusions

The results show that the imaginary environment meets a strong identification with attributes related to the *environmental comfort, functionality and aesthetics*, highlighting in the valued perception of functional aspects related to the playful use of the square as the presence of playground, stage for presentations and more ample spaces, a dissatisfaction with the design of it. This aspect reveals the tension with the winding and narrow disposition of the existing paths that restricts the use of the square face to the limitations of the appropriate standard of eclectic typology of the promenade.

Confronting this category with the real scenario we verify that it confirms the "barely functional" provision aggregate the existing insecurity of the playground, absence of stage for popular musical / theatrical presentations and the precariousness of the handicraft fair installation existing there on the weekends. Still in this real environment it glimpses uncomfortable with the insecurity of constructive aspects (precarious lighting and drainage and unsafe playground) and the lack of maintenance of the enclosure.

With respect to aesthetics it can be seen that the imaginary attribute of greater request comes from the existence of flowered gardens, finding support in real environment where this important attribute is revealed along with the inadequacy of its layout (design) landscape. Furthermore the square is revealed attractive on weekends regarded to the craft fair, however seen as "poor" by the incompatibility with the space intended to it. Recommendations should be observed regarding the need to reform its design to better accommodate an architectural program to meet the needs there conferred, seen superficially here.

By this point the space analyzed catalyzes a context of poor environmental performance and low esteem of the user population. The square is revealed this way conflicting with the playful needs of the population resulting in difficulty of appropriation for and consequent abandonment of the same, which configures a negative indicator to the valuation of the public sphere and the quality of the experience. In general, the study allowed to assess the effectiveness of the tool in cognitive performance of open environments as it already does in the indoor environments allowing better understand the demands of the user population.

Foresee its use for diagnostics of the built environment to allow a gleam of hidden psychological aspects and difficult to quantify and evaluate on a process of investigation more judicious.

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