Visibility and Spatial Use in Urban Plazas Ref 006

A Case Study from Biskra, Algeria

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Abstract
This paper springs from the assumption that a good space is a used space and people's behavior, movement and use is directly related to the visual fields created by the spatial configuration i.e. visibility. It is also assumed that the use of space is governed by two major factors: Its attractiveness in terms of movement, i.e. how easy for people to move in as its being to-movement and through-movement space; and the conduciveness of its visual properties for people's activities. This paper aims to examine the correlation between the spatial use and isovist properties of plaza spaces with a case study from Algeria. The paper first starts with a comparative study of four urban plazas within the city center district of Biskra, Algeria, in which the correlation between the number of static people in sitting and standing positions and the syntactic and isovist properties of each plaza is examined. The second part of the paper focuses on one of these plazas and explores why within it some parts are busier and more preferred by people then others. Believing that a space may have many sub-settings and that its use is determined by the affordances of these sub-settings, the plaza has been subdivided into subspaces based on its physical properties. Each subspace has been investigated further to look for links between visibility and spatial use. The Depthmap program, developed by Alasdair Turner, has been used to observe the visibility properties while behavior mapping, i.e. people counting and spatial use mapping, has been used to observe the spatial use. The results indicated that spatial use is strongly related to visual considerations relevant to the type of activity and that people might undergo some discomfort for visibility matters.

Introduction

Urban space is the "void" between buildings such as streets, plazas and parks that enable movement and outdoor activities of the general public. It is considered as the "scene" of the city life and has been the center of different theories of urbanism and city planning through history. Nowadays, the concepts of sustainability driven by environmental quality, public health and people's well-being put more emphasis on the quality of public life as exemplified by the set of recommendations and laws put forward to improve public spaces.

The quality and the success of urban spaces such as public plazas is generally investigated either by looking for how comfortable are these spaces in term of ambience characteristics such as thermal and acoustic comfort, i.e. more sensory oriented approach, or by questioning and examining the spatial properties that are considered as qualitative such as enclosure (Sitte, 1945), good proportion (Alexander, 1977) and the landscape features like fountains and benches. However, questioning and examining the use of and people's behavior within these spaces could be informative on what matters most for people and what guides their activity patterns within these spaces. An earlier example is renowned William Whyte's study of New York urban plazas to

understand why some were underutilized while others were crowded. Accordingly, Whyte concluded that plaza use is correlated mostly with the amount of sittable space and its proximity to street life and suggested specific guidelines for the design of successful plazas (Whyte, 1957). Alexander (1977), on the other hand, based on his investigation of the pattern of occupancy of public spaces, argued that people avoid spaces that are either too exposed or too enclosed and that space occupancy ensues around the borders and edges that people prefer. Defined by Gehl (1987) as the "edge effect," once the edges are full, the occupation goes gradually inwards.

As mentioned by Campos (2005), earlier studies failed to link people's behavior and space use to spatial properties of the spaces such as their morphology and visibility properties. In space syntax approach, it is suggested that better locations for unprogrammed static use do not depend on the provision of specific attractions or facilities, but may be associated to "the visual properties of space experienced by the stationary person" (Hillier et al, 1990). Experiencing a space is indeed experiencing the visual fields generated by the arrangement of buildings and urban components. Since experiencing space involves motion, space is more dynamic than static; it is a succession of subspaces involving changing visual fields (Thiel, 1970). This experience definitely impacts people's aesthetic appraisal of as well as behavior in urban spaces.

Visibility and visual perception are of a great importance on how we behave, appreciate and experience the environment and could be determinant factors in designing urban spaces. To represent space as experienced by the perceiver and to quantify the spatial environment through a set of measurements the concept of isovist is introduced by Benedikt (1979). The drawback in Benedikt's method was that it only considered the local properties of space omitting the visual relationship between current location and the whole spatial environment (Turner, 2001). Turner suggested that since the way an individual experiences and uses space involves motion, the experience of space is related to an interplay of isovists and that more than one isovist is needed to quantify the actual perceived space experienced by the individual (Turner, 2001). Turner also developed a software package called Depthmap capable of performing Visibility Graph Analysis (VGA).

Campos (1999, 2005) has used overlapping point isovists as a tool for understanding preferable location of static people in public spaces in twelve squares the city of London and found that the static occupancy of a public space is a function of their spatial configuration and their local interconnectivity in the urban fabric where they are embedded. Papargyropoulo (2006), on the other hand, in a comparative study of Regent's Park in London and Pedion Areos Park in Athens, found that the most integrated spaces are more used by organized activities performed by large groups, while other stationary activities such eating, reading and relaxing take place more on visually secluded spaces.

Although the physical qualities of spaces such as comfortable sitting features or existing of shade are important factors in people's use of plazas, the current study focuses on the importance of visibility and investigates the relationship between visibility and spatial use in the selected plazas in Biskra, Algeria. The investigation considered stationary positions of sitting or standing without considering the specific type of activities being performed in these positions. Moreover, based on the assumption that environments are composed of behavior settings, we believe a plaza could be subdivided into a number of subsettings and that the liveliness and the use of the plaza are dependent on the potentialities afforded by those subsettings. Accordingly, the present work subdivided the studied plazas into several subspaces. The next section will introduce the case studies.

Case Study

Biskra is an oasis city located in the southeastern part of Algeria. It is known by its hot and arid weather. The urban structure of the city is a compilation of principally three different urban fabrics: the colonial fabric with its gridiron characteristics, the irregular and dense fabric as an extension of the old nucleus of the city and the 'loose' and amorphous modern fabric of the post-independence urban development. The main open spaces such as plazas and public gardens encompassing the public life are situated within the city center, which is part of the gridiron fabric and expanding to the edge of the irregular and dense fabric. Most of the plazas were initially created as "left over" spaces or as a result of coming together the two geometrically different urban fabrics, which were

then redesigned to be public spaces (El Houria , Dalaa and Zwaka plazas as case study). It should also be noted that the plazas of the gridiron fabric such as one of the cases in this paper, Larbi Ben Mhidi plaza, were designed as public spaces in the first urban planning scheme of the city during the colonial period.

The plazas to be investigated are El Houria, Zwaka, Dalaa and Larbi Ben Mhidi Plazas (Figure 1). The selection of plazas was guided by the following considerations: their location, size, and the different ways in which they are linked to their surroundings.

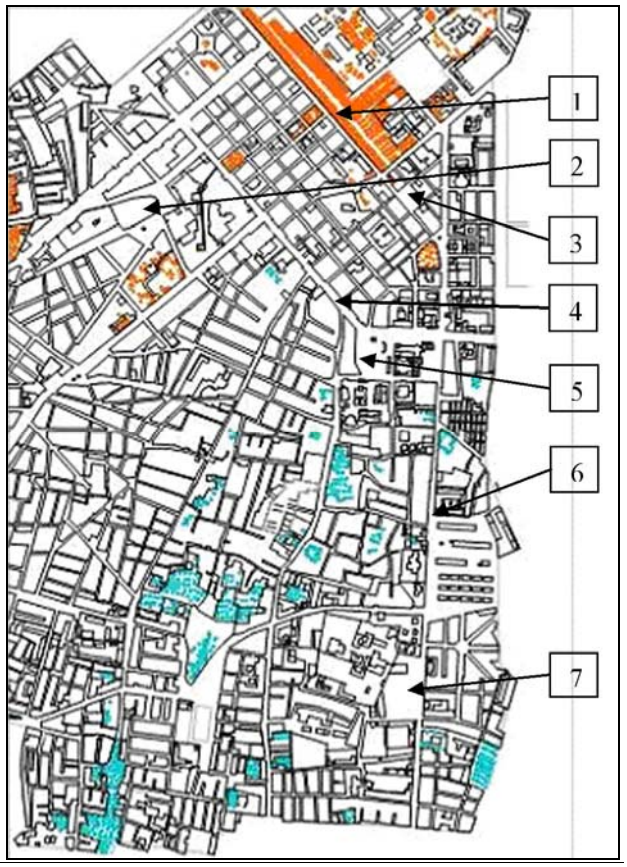

Figure 1
Plan of the city center district, showing the four plazas and important streets nearby: La République street, (2) Dalaa Plaza, (3) Larbi ben Mhidi plaza, (4) Emir Abdelkhader Boulevard, (5) El Houria Plaza, (6) Hakim Saadan street, (7) Zwaka Plaza.

The first plaza, El Houria, was selected for its location which enables it to be used frequently and for the services available such as cafes and shops. On two opposite sides of the plaza, two main busy streets go parallel to each other. The plaza layout is mainly characterized by its two-level space: the higher section limited by El Emir Abdelkader Boulevard, the most livable street of the city and the lower section limited by a busy street that links to a popular market. The height difference between the two levels is about 1.20 meters, and the connection is assured by a series of stairs without causing any visual obstruction within the plaza. The space layout is characterized by a linear fountain along a central pathway, a memorial wall and well defined spaces by built-in sitting areas. Surrounding land uses include cafes, few shops and a state building. In the present study, all the features contained within this plaza do not obstruct eye-level views for pedestrians such as sitting areas, fountains and trees are not considered. El Houria plaza is the one to undergo further investigation of correlation between the visual properties and the spatial use.

Dalaa Plaza is typically characterized by its irregular shape resulting from the presence of a rocky hill within the built area. The plaza is linked to its surroundings by a number of streets. Its layout includes some fountains, sitting places and mixed-use of boutiques and cafes.

Zwaka Plaza is situated within mostly a residential area, Hakim Saadane, one of the major streets of the city, passes through the plaza and constitutes the major link to the rest of the city. The layout of the plaza basically involves a green space crossed by a pattern of pathways together with a fountain, some sitting places, and little service activities.

Larbi Ben Mhidi Plaza is situated within the gridiron fabric near a covered market. It is linked to its surroundings by eight streets and its layout is mainly covered with a bunch of trees in its core that give it a garden like plaza. The mixed–use activities of the plaza consist of boutiques, cafes, and a bank, make it a livable place.

In Situ Observation

The observation conducted in this study is stationary people counting. To make the observation and people counting easier and more accurate plazas have been subdivided into zones with detailed layout plans. For each plaza and for each sub-zone in each plaza a different observer is assigned. Observations were done on two days; a weekday and a weekend, in sunny days on August 2008 in the late afternoons from 7pm to 8pm. Since weather is believed to affect static behavior, although does little on natural movement (Hillier et al, 1992), the observation times were chosen when the weather was conducive to outdoor activities in order to avoid the impact of the climatic factors. All the plazas were observed at the same time. During the observation of stationary activities, static people were sorted into two categories: those sitting in a formal sitting place and those in standing position or sitting in informal places such as on tree borders or flower-bed walls. The type of activity people are engaged in during observation time is not considered as it is irrelevant to the present study. People counting has been done according to people position within space (detailed plan are given to the observers, and plaza pavement are taken as landmark to help to locate people accordingly). During the hour observation, first, static people are counted, then people coming (stopping) are added to the count , however no interest for people leaving the space. The goal of the present study is to see which space is most visited . But it is important to mention that the number of people counted during the whole hour observation (first counting added to people coming) is largely equivalent to the number of people counted at the beginning of the observation.

plaza name	no. of people	Plaza area (m2)	Occupancy rate; people/m2
El Houria	514	11205.969	0.0458
Larbi Ben Mhidi	108	2513.056	0.0429
Zwaka	763	10757.862	0.0070
Dalaa	308	8718.236	0.0353

Table1

The number of static people and occupancy rate for both categories sitting and standing position according to time period for the four plazas.

In this study, the total number of static people is considered for all the plazas, while El Houria plaza is selected for further examination. The first part of the paper aims to compare the occupancy of the four plazas considering the number of users, i.e. all the static people without an interest of their position, and to see their correlation with isovists measurements. Thus, first assessment of the data collected about the amount of use of each plaza considering only the number of static people during the period from 7 pm to 8 pm (after working hour), shows that EL Houria and Dalaa plazas are the most used and preferred for this period of time (table 1). Meanwhile both Larbi Ben Mhidi and Zwaka plazas are underused. In comparing the occupancy rate Here it should be mentioned that these results are neither

conclusive nor exhaustive and object of on going work. However they could give some clues about the plaza uses, albeit limited for a certain period of the time, and help promote questions regarding the relationship between visibility and spatial use of urban plazas.

Syntactic Analysis of the Four Plazas

It is believed that there is a correlation between spatial configuration, i.e. intelligibility of the space, and people's behavior, movement and use of these spaces. According to Hillier (2005), spatial configuration of the street network shapes movement of people and that the position of a street in the overall grid affects to-and through- movement on this street. As the network of streets provides the means for people to get to the plazas, our goal is to examine the accessibility and attractive-ness of the location of each plaza within the broader network, i.e. city center district, using space syntax techniques.

Syntax measrs. . / Plaza name	Visual Integration (HH)		Connectivity.		Visual control		Relativized entropy		Intelligi-bility	Occup. rate people/ m2
	City center distr.	250-m radius	City center distr.	250-m radius	City center distr.	250-m radius	City center distr.	250-m radius	250-m radius	
Dalaa	0.55	0.67	0.22	0.41	0.42	0.48	0.17	0.17	0.52	0.0353
L.Ben Mhidi	0.68	0.57	0.13	0.34	0.40	0.45	0.15	0.20	0.23	0.0429
El Houria	0.78	0.69	0.33	0.63	0.41	0.53	0.13	0.10	0.83	0.0458
Zouaka	0.62	0..63	0.38	0.68	0.38	0.38	0.10	0.07	0.73	0.0070

Table2

Syntactic and isovist measurements of the plazas within the perimeter of the city center district and within the perimeter of 250 meter radius of their center, and occupancy rate.

Two sets of measures are considered. The first measures are those relevant to spatial properties of each plaza: global measures of integration and relativized entropy that indicate how ordered the a system is from a location, and local measures of connectivity and visual control that indicate the degree of choice each space represents for its neighbors to move into. The second measure is the visual access that is the degree to which different places and features can be seen and also the location from which people in a particular environment can see particular places and features (Montello, 2007). The visual access measure is examined using point isovists taken from the most integrated streets that surround or junctions that lead to the plazas to see to what degree is their overall layout is visible. The syntactic measures are calculated, first, considering the plan of the city center district including all four plazas examined, and then considering each plaza by itself within its surrounding of 250 meter radius from its center.

Syntactic analysis has been carried out for the plazas examined using Depthmap 07 software program developed by Alasdair Turner from UCL. The results of the analysis of the plan of the city center district including all four plazas and those of each plaza within its surrounding area have been given in Table 2. A comparative interpretation of the different measures reveal that, in terms of integration value, El Houria plaza is the best integrated within the system with a value of 0.78 and the least integrated is Dalaa plaza. However, in the local measure, connectivity both El houria and Zwaka plaza have the higher connectivity value.

The visual integration (HH) map provided in Figure 2 , highlights the high value of two streets (dark color), El Emir Abdelkader Boulevard passing by El Houria plaza and closer to Dalaa plaza and Hakim Saadan Street passing by Zwaka plaza and closer to Larbi Ben Mhidi plaza, where La Repuplique Street connects Hakim Saadan Street to this plaza. As can be observed from the figure, El Houria Plaza is remarkably integrated within the system. The map also indicates that

there are quite a number of integrated axial lines, lines of sight and movement, crossing this plaza contrary to Dalaa plaza which is crossed with fewer lines.

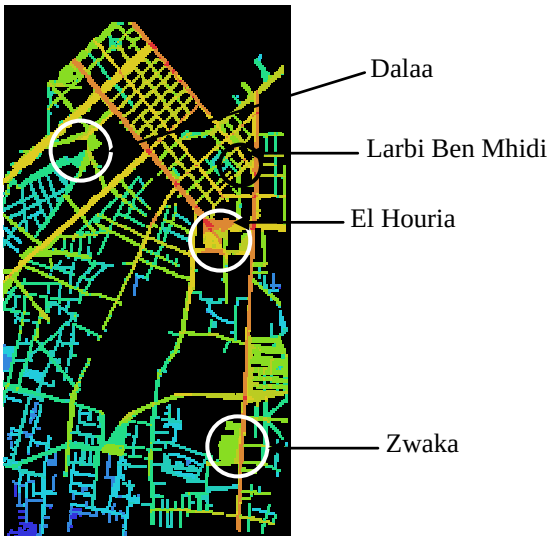

Figure 2
Visual integration (HH) of the city center with the four plazas examined.

Overlapping these measures with the occupancy values shows that the most integrated plaza, El Houria's highest visual integration (HH)) value of 0.78 correlates with the highest number of static people and the highest occupancy rate(0.0452). However, integration measures of Dalaa plaza show two different values: very low value when considered within the city center district and a relatively high value when considered within its immediate surrounding area (table 2).

Intelligibility measures also highlight El Houria Plaza as the most intelligible space with a value of 0.78, which might be though at first as an indication of its relatively high usage. However, the value of Zwaka plaza of 0,73, which is very close to that of El Houria Plaza, does not correlate with its weak occupancy rate (0.007). Furthermore, Larbi Ben Mhidi plaza showed the least intelligibility value and low usage of space, which is a paradox to the character of this plaza that is known to be a very liveable place during the morning and early afternoon hours, which might be due to land uses consisting of a market and banks.

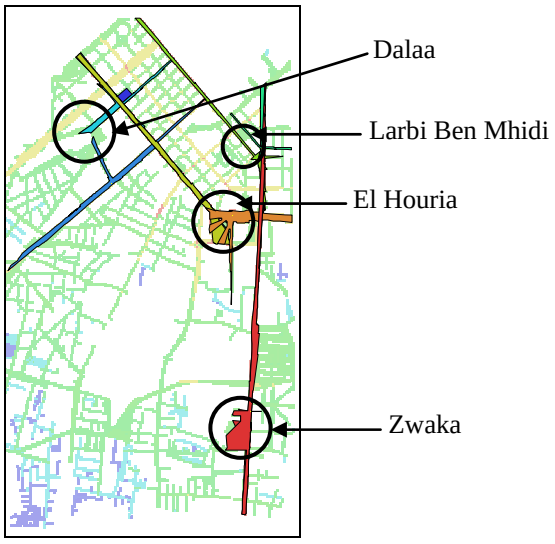

Figure 3
Isovists with a vantage point from the most integrated streets that lead to each plaza showing the visual access. El Houria Plaza presents a larger isovist shape: higher degree of visual access.

In terms of the visual access measures, i.e. the shapes of isovists that correspond to the potential view of an observer and taken from the most integrated streets leading to plazas are examined. A larger isovist shape means more visual information is available of the plaza for people moving on the most integrated streets, El Emir Abdelkader. The analysis shows that El Houria presents higher degrees of visual access, while for Dalaa and Larbi Ben Mhidi, the isovists are "linear", i.e. less visual information is available. It should be noted here that the measure of jaggedness or circularity could be considered as an indicator of the convexity of the isovist but will not be examined in this paper (Figure 3).

El Houria Plaza Spatial Use and Visibility Analysis

El Houria Plaza is selected to be analyzed more in detail as the most integrated plaza within the system and with the highest number of static people. The detailed analysis aims to explore why within this plaza some parts are busier and more preferred by people then others. In the analysis, to see if there is a relationship between stationary activities, both sitting and standing positions, and the syntactic and isovist properties of space, the plaza has been subdivided into subspaces based on its physical properties.

There are six subspaces, A, B, C, D, E, and F, determined and presented in Figure 4. The main physical property that determines the subspaces are the level difference of 1.20 meters, which is connected by stairs. Within these two zones created by level differences there are subspaces that are defined by the layout of the plaza furniture such as sitting benches, vegetation pods, and the memorial wall. The upper level is subdivided into two subspaces, A and B by the presence of the memorial wall, while the lower space is subdivided into four subspaces, C, D, E and F by the built-in sitting benches and the row of the boutiques. The subspace D embraces the main movement axis of the plaza with a linear fountain. The whole hour Mapping (figure 4b) shows that the subspaces A, C and E are very dense and this reflects almost a real space-time experience (at least for some moments) for static activities since the first counting (at the beginning of the observation) is not so different to the final counting; few people coming to these spaces after the first counting.

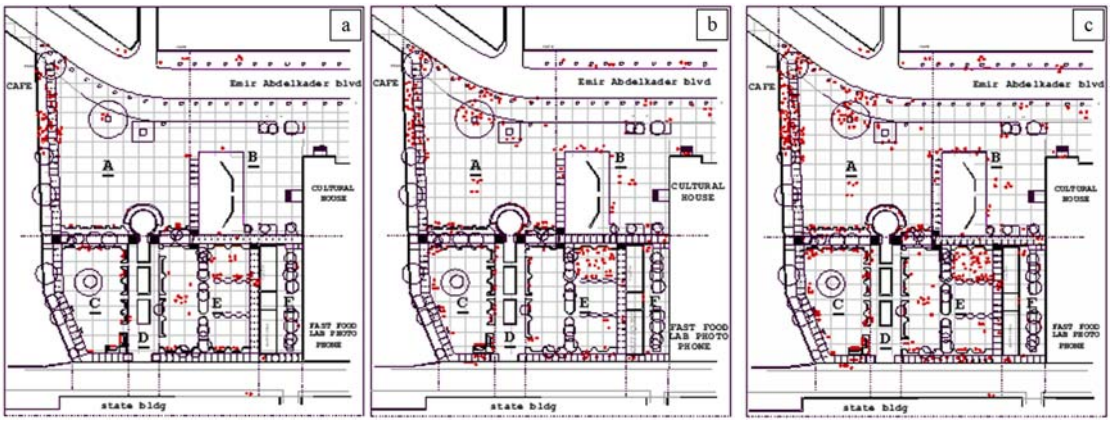

Figure 4

Number of all static people within the subspaces A,B,C,D,E and F of El Houria plaza (people represented by dots): a) Weekend b) Weekday c)Two date aggregate.

The first assessment about the behavior mapping of the spatial occupancy of the plaza shows that the space occupancy of the upper zone, which is connected to a major street, is remarkably higher than the lower zone mainly on the weekday. For subspaces A and B located on higher zone, the number of people is 99 on weekend and 216 on weekday. However for the subspaces C, D, E, and F located on the lower zone, the number of people is 78 on weekend and 132 on weekday . However, if we consider only the stationary people of standing position or sitting in informal space, the number of people represents 43% of the total number of people using the plaza; moreover if

we also omit people sitting in the cafes this rate would increase to 62%. It is also seen that most of standing people (3/4 of all standing) occupy the edge of the higher zone along El Emir Abdelkader Boulevard and the rest (1/4) occupy the lower zone along the street leading to a popular market. This observation suggests that people's choice and preference of their locations is not tied directly to the availability of sitting areas. The effect edge is noticeable on the map both for the plaza as a whole and for the subspaces created within the plaza. Within the subspaces that provide formal sitting places, it seems that the subspaces C and A are preferred by people for sitting, meanwhile, the subspace D that is considered as the main axis of movement within the plaza and the space E shows very weak occupancy rate (0.0095).

Syntactic and isovists measurements of El Houria Plaza are given in Table 3 , while the visual graph analysis overlapped with behavior mapping of the plaza is given in Figure 5 (b). As can be seen from the figure, the most integrated zones (VI = 0.92) are used by stationary people in standing or informally sitting position and that stationary people in sitting position overlap with low integrated spaces (VI= 0.56) corresponding to some of the sitting places of the plaza. Results on Table 3 show that for the subspaces A, B and E there is a correlation of the integration value and the occupancy rate (all static people less people sitting in terrace café) ; the higher integration value the higher the occupancy rate.

Plaza name		Static activity type / Subspaces + Area (m2)	no.. of People Sitting (forml)	no. of people Sitting in terrace Café	no. of people standin-g and sitting (informal)	Total no. Of all static people	Occup. rate (people/m2) stand- ing + sitting (informal)	Occup.rate (people/m2) sitting (formal	Occup. rate (people/m2) Total number Of people.	Integra-tion (HH)	Visual Control	Connec-tivity
El Houria Plaza	Higher Space	A : 3785.695	45	97	103	245	0.0272	0.0390	0,0647	0.78	0.60	0.76
		B : 2471.584	00	00	60	60	0.0242	0.0242	0,0242	0.66	0.54	0.61
	Lower space	C : 1584.088	57	00	13	70	0.0082	0.0441	0,0441	0.57	0.41	0.54
		D : 952. 576	16	00	00	16	00	0.0161	0,0161	0.65	0.44	0.57
		E : 1466.249	18	58	38	114	0.0259	0.0381	0,0777	0.69	0.49	0.68
		F : 945.777	00	00	09	09	0.0095	0.0095	0,0095	0.54	0.42	0.28

Table 3

Shows the numbers people and space occupancy rate of each type of static position according to subspaces of El Houria plaza and their corresponding Syntactic and isovists measurements.

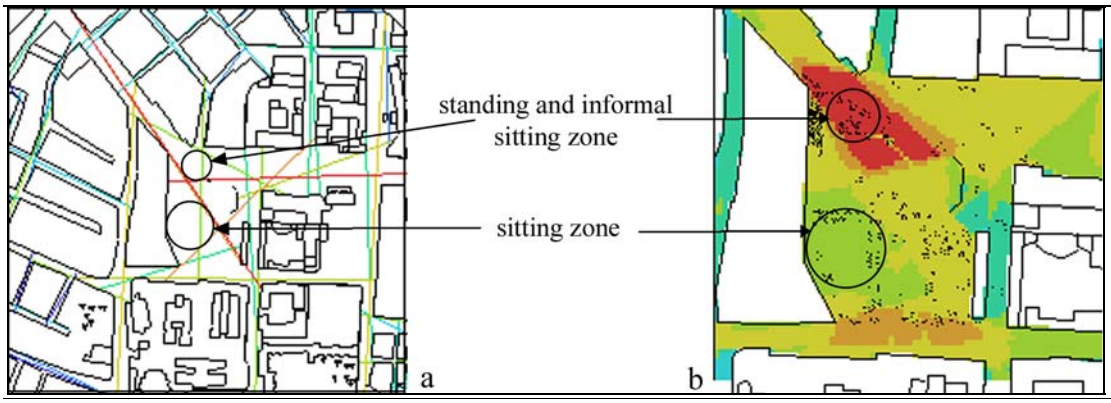

Figure 5

a) Axial Map (few lines the locations of activities According to the longest lines). b) Visibility graph analysis overlapped with two-day aggregate stationary people behavior mapping (people represented by dots) , El Houria Plaza.

Moreover, it can also be seen that for subspaces A and B, stationary people in standing position or sitting in informal spaces, which represent more than four times those sitting in formal sitting spaces, are found around the intersection of the two longest lines of sight (Fig.5 a). However, exception is for the subspace C that has a low integration value and a high occupancy rate(0.441). Furthermore, this subspace is secluded from the main lines of sight and has the lowest visual control value (0.41). It must be mentioned here that sitting positions represent around 80% of all stationary people in this subspace C, it is considered as a secluded area that may match the earlier results (Campos, 2005; Papargyropoulo, 2006) that sitting activity takes place more in visually secluded spaces. Nevertheless, these sitting spaces do provide a certain control of the view of their surroundings. As can be seen from the Figure 6(a), the isovist taken from the center of the busiest subspace C for sitting position covers only visual field within the plaza, while the isovist taken from the busiest subspace A for standing position, given in Figure 6(b), provides visual fields covering all the plaza space and even extending to the surroundings.

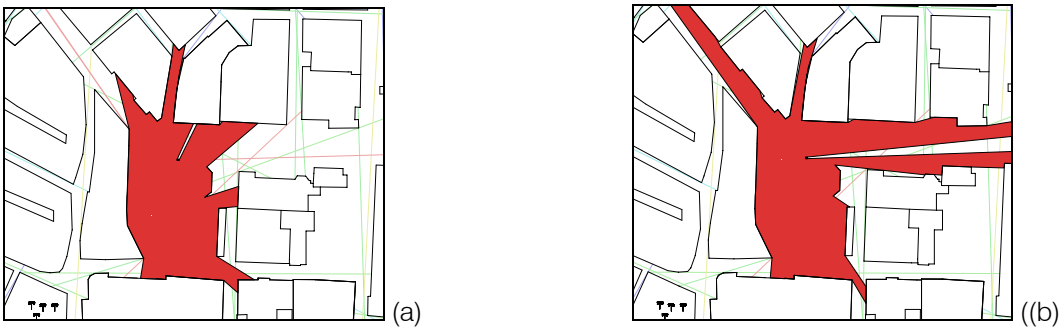

Figure 6

(a) Isovist from the busiest sitting space; Large isovist provide local views. (b) Isovist from the busiest space for stationary activities for standing positions or sitting informally; a "spiky" isovist, views towards covering plaza and the surrounding.

In order to examine these findings and to look into the assumption that people avoid movement spaces for stationary activities such as sitting and relaxing, an agent test has been carried out using Depthmap program. It consists of releasing a number of agents which show human-like movement with a 170° field of view (Turner, 2003) within El Houria Plaza at a 150-meter radius to track their movement trajectories. The results show that the busiest sitting spaces, subspaces A and C, correspond to the least spaces used as there are few traces by the agents or not used at all. Thus these sitting spaces are away from people's natural movement, which is believed to be guided by the spatial configuration of the spaces, and consequently provide a seclusion aspect. However, the sitting spaces, the subspace E and D overlap partially by the agents' trajectories. This might be interpreted that the reason why these subspaces E and D are not as much used as the other sitting subspaces, despite their affordance of sitting areas, are their being too much visually exposed. Comparatively, the spaces used by standing people overlap with the 'medium' density of agents trajectories. It should be noted here that these results are part of an ongoing research to be completed and compared to in situ observation of people's movement.

Discussion and Conclusion

Concerning the comparative study between the four plazas about attractiveness, in term of movement, measures of Dalaa plaza show a noticeable variance between integration and connectivity measures taken within the perimeter of the city center district as can be seen in Table 1. Thus it can be concluded that Dalaa plaza is more integrated within its surrounding than within the whole district. This could be explained by the importance of the number of lines (despite their low integration values) crossing the plaza, on the axial map. This may be interpreted that the plaza is locally a *through- movement* space.

The study of El Houria Plaza use, subdividing the stationary activities in two categories sitting (using the available sitting places) and standing or sitting informally (using other than the formal sitting places) show that the preferences or the choice for the location of these activities are not the same, the former is for more secluded spaces (low integration value) and the later for more exposed spaces (high integration value). The busiest space in the plaza, mostly with stationary people in standing position, is remarkably around the axial lines intersection point of the longest lines of sight (not crossing the plaza). This finding does not validate the results that the use of plazas depends on the amount of sitting spaces provided. People may accept some discomfort (standing or sitting in informal spaces) for the sake of visibility matters.

As approach of the partition the plaza into subspaces that reposed mainly on the plaza layout gave more detailed results but the rules defining the subdivision, raised by many researchers, still to be investigated. Because the behavior map, in this paper, shows that space occupied by people is amorphous and does not correspond the orthogonal layout of the plaza.

Studying urban open spaces such as plazas need considering the space layout and all its components, and land topography, in order to understand the nature of spatial use. It should be remembered that some minute details that might be insignificant in representation could completely change the spatial properties of space versus the perceived space and thus a subdivision of a space examined into sub-spaces may be the appropriate approach.

The belief that a good space is a used space leads to investigate what makes some spaces crowded and preferred by people than others in looking on the person-environment relationship, and to emphasize the visual "affordance" of spaces and the spatial properties needed for a particular pattern of activity. To conclude, the understanding of visibility and people's perception is not only a key to analytical purposes, but also a tool to producing more livable spaces.

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