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Spatial Configuration And Social Dynamics Of Urban Green Spaces Case Study Of Setif (Algeria)

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Abstract
This research examines how public garden design affects women's social behaviour, mainly by checking how the visibility degree of these places influences their interactions. This study opts for a comparative approach that adopts space syntax coordinated with instantaneous observation in four urban public gardens located in Sétif, Algeria. The choice of these case study areas is based on three criteria: their location in the city, period of their creation, and their spatial configurations. The observed activities were mapped over a two-week period for each studied garden. Cross-analysis between social interactions and syntactic measures revealed that spatial configuration has a significant impact on the way women use these spaces. The data mainly show the importance of two indicators: local integration and clustering coefficient, which serve as key measures for predicting social interactions.

Keywords: *urban public gardens; social interaction; women; space syntax; instantaneous observation; spatial configuration.*

INTRODUCTION

Landscaping public spaces has secondary importance. Existing gardens and green spaces are often uninhabited, neglected, and in poor condition. In Algeria, they face numerous challenges that limit their quality and contribution to the well-being of citizens and create inequalities in access for residents.

This phenomenon is apparent in Sétif, one of the most densely populated cities in Algeria. Many of Sétif's green spaces are plagued by a lack of regular maintenance, leading to the deterioration of recreational facilities and the accumulation of waste. Some areas are also affected by noise, air and soil pollution. These conditions compromise safety and discourage residents from using them for recreational purposes.

Distributing urban public green spaces in Algeria is the result of an intermittent strategy that has produced an uneven distribution. In Sétif, these spaces are mainly located within the urban fabric, while they are rare in the densely built-up peri-urban areas.

Interaction during outdoor play facilitates children's emotional development and contributes to the formation of social bonds, especially between parents. However, not all green spaces are equally conducive to positive social interactions, and their importance varies according to user characteristics, accessibility, and aesthetic appeal.

Public green spaces also offer women a place to meet and relax (Vanaken & Danckaerts, 2018). Their design has a significant impact on the way women use them. Well-lit paths, landscaped rest areas, and inclusive design elements promote a sense of safety and well-being.

Experiential landscape and space syntax theories provide relevant tools for examining the configurational characteristics of the environment and their potential influence on people's activity and perceptions, allowing the identification of the relationship between spatial configurations and user behaviour (Thwaites et al., 2008).

A thorough understanding of these spatial relationships is a must to effectively design urban public gardens that promote the use of these spaces by all users, particularly women, whose needs require special attention to ensure equitable access to urban green environments.

LITERATURE REVIEW

The exploration of research focusing on public gardens, social interactions, spatial configurations, and the space syntax method reveals a diversity of significant approaches and results.

1.1 Research on Social and Behavioral Practices in Urban Green Spaces

Regarding research conducted on social and behavioral practices in urban public green spaces, several lines of investigation emerge. Baudry et al. (2014) explore indoor-outdoor links in collective gardens, while Chiesi and Costa (2022) examine human perception and use of small green spaces in a city in Florence. From a different perspective, Gagakuma et al. (2022) analyze the relationship between demographic characteristics of green space users and their activities, taking into account green space categories in Kumasi, Ghana.

Other studies have also provided an overview of urban public green space uses, particularly the association between the uses of these spaces, users' demographics, and their behaviors (Vidal et al., 2022; Łaszkiewicz et al., 2023; Long & Tonini, 2012; Yang et al., 2023). In parallel, Guinaudeau et al. (2023) have developed a methodology for categorizing urban green and blue spaces, while Ahmed et al. (2014) examine the relationship between landscape planting patterns and perceptions of safety in urban parks in Tabriz, Iran.

1.2 Application of Space Syntax Method to Urban Green Spaces

Beyond studies relating to behaviors in green spaces, other researchers have employed the space syntax technique in their work. Research by Mahmoud and Omar (2015) suggests that space syntax techniques can help evaluate planting designs. This method enables quantitative and comprehensive assessment of urban park accessibility across different aspects of accessibility, using five space syntax measures: connectivity, depth, integration, choice, and synergy (Long et al., 2023).

Several studies (Körmecli, 2022; Huang et al., 2023) demonstrate the use of this same method to assess urban park accessibility based on urban integration. Nevertheless, the application of space syntax, requiring careful consideration of boundary span and vegetation treatment, provides a quantitative means of analyzing Urban Public Green Space (UPGS) configurations (Wahyono et al., 2021).

1.3 Gender Influence on Public Green Space Use

Research reveals that the spatial configuration of urban public gardens has a significant impact on their use and gendered practices (Khalid, 2020; Sillman et al., 2022). It has been demonstrated that women are more active in green spaces and perceive greater aesthetic value (Sang et al., 2016; Ode et al., 2009). Other studies have reported gender differences in the perception and use of green spaces (Kaczynski et al., 2009; Ye et al., 2024), but their conclusions depend mainly on the study context, country, and perception of accessibility.

It has been observed that men are more represented in urban parks than women (Kaczynski et al., 2009), suggesting that gender has an important influence on the perception of safety in urban green spaces (Hoyle et al., 2019; Lieber, 2002). In the Algerian context, Naceur (2017) addresses gender relations through the impact of urban space transformations, highlighting the presence of women in public space.

While space syntax theory has extensively studied cities and street networks, no research has examined gendered social practices in urban public gardens. This study focuses specifically on understanding how garden design influences women's use of these urban spaces in the Algerian context.

METHODOLOGY

2.1 Context and case study

Four urban public gardens in Sétif, Algeria (formerly "Sitifis" in Roman times). Sétif is located 300 km from Algiers and serves as a major crossroads city in eastern Algeria. It covers 127.30 km².

Gardens were chosen based on: location within the city, distance from city centre, construction period, and spatial configuration (Figure 1).

Four case study areas were identified: Emir Abdelkader Garden, Raffaoui Saad Garden, July 5th, 1962 Garden, and November 1st, 1954 Garden. The selection process involved a comprehensive census of all urban public gardens to classify and categorise them systematically.

"November 1st, 1954" Garden is in the northeastern part of the town in a residential area, part of Sétif periphery, and occupies a regular-shaped plot of land. It comprises two playground areas, an uncovered landscaped square, a small green theatre, a fountain with water features, a covered walkway, and grassed areas.

Bordering Sétif's ancient town walls, the "Emir Abdelkader" Garden attracts visitors through its Roman ruins and diverse botanical collection. Its layout centres on a tree-canopied main promenade featuring a central stele, complemented by bench-lined secondary alleys and curvilinear paths encircling a fountain.

"Raffaoui Saad" Garden is in the centre of the town of Sétif, covering an area of 1.25 ha. A single entrance serves as access to the garden, while the other three gates are closed. The garden features an exhibition of Roman heritage, a nymph, a garden, a meeting and entertainment area, which was also used for shows and other events. "July 5th, 1962" Garden is in the southeastern part of the city, in a neighbourhood with housing and educational facilities. This space occupied a regularly shaped plot of land that comprises five distinct areas: a fountain, green spaces, covered walkways, tree-lined passageways with benches, and a playground.

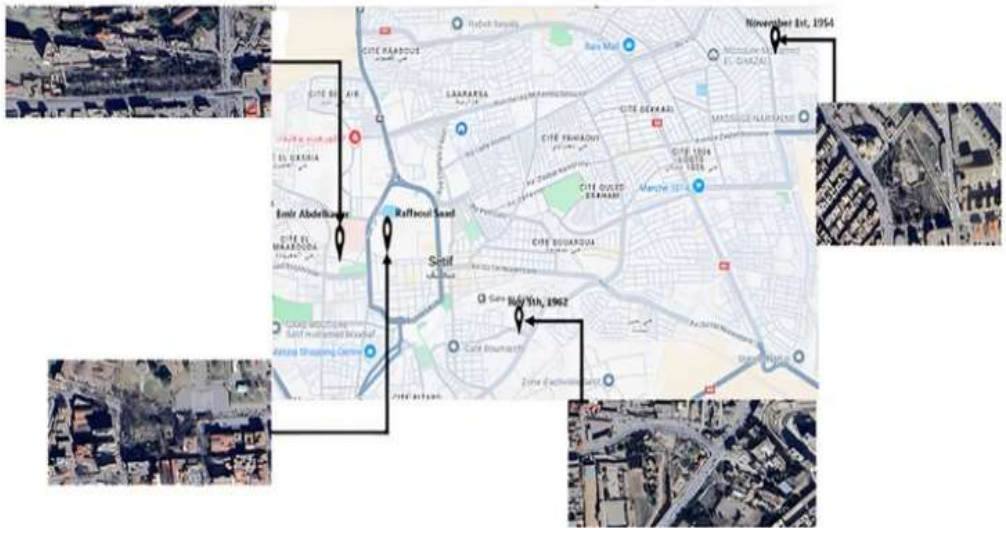

FIGURE 1- CASE STUDY LOCATION AND SPATIAL CONFIGURATION (SOURCE : AUTHORS, 2025)

(Table 1) highlights evolving urban greening strategies in Sétif: historic gardens (pre-1950) are larger and centrally positioned, while contemporary sites (post-2000) are smaller, peripheral, and typologically distinct. Entrance frequency and configuration type further indicate divergent usage paradigms.

TABLE 1- QUANTITATIVE DATA FOR THE FOUR CASE STUDY AREAS (SOURCE : AUTHORS, 2025)

Gardens	Emir Abdelkader	Raffaoui Saad	July 5th, 1962	November1st, 1954
Year of realisation	1883	1908	2009	2010
Surface area	3 ha	0.406 ha	1.5 ha	2 ha
Distance from the city centre	900 m	1.4 km	1.5 km	5 km
Configuration type	Linear	Central	Linear	Central
Entrance number	2	1	1	1

2.2 Analysis Method

The analytical approach is based on a combination of two methods: space syntax and snapshot observations. Syntactic analysis was performed using Depthmap software developed by Alasdair Tuner. The application of syntactic analysis using this software was carried out on the Master plans of urban public gardens, drawn using AutoCAD software, consisting of pedestrian walkways, stairways, playground areas, and grassed surfaces.

Analysis covers urban public gardens and immediate surroundings, as these form part of larger system that would affect syntactic analysis if separated.

visibility radius of 2 was used for local analysis and n for global one. This technique helps to understand the visual and spatial structure of urban gardens with their urban context.

The "snapshot" is an observational tool that records activities of sedentary and ambulant people (children, teenagers, adults, and elderly—both male and female) within a space to understand spatial usage patterns.

Four main sedentary activities were identified in the field of visits: sitting, standing, playing, and chatting.

Activities are mapped using different colours for each activity type and specific symbols for user categories. Interacting users are circled on the map. This method provides insights into activity types, people movement, and spatial distribution within different areas of the studied space (Figure 2).
Observation lasted two days for each studied public garden, from 8:00 am to 5:00 pm, depending on the closing times of certain areas. The aim of this operation was to record user frequentation by compiling the various results of the observation sessions. Several observation stations were specified to cover all urban public gardens. Observations were carried out on Mondays and Tuesdays (September 17, 18, 25 and 26, 2024) when the weather was favourable, with temperatures between 18° and 25° C, clear sky, and a sunny day.

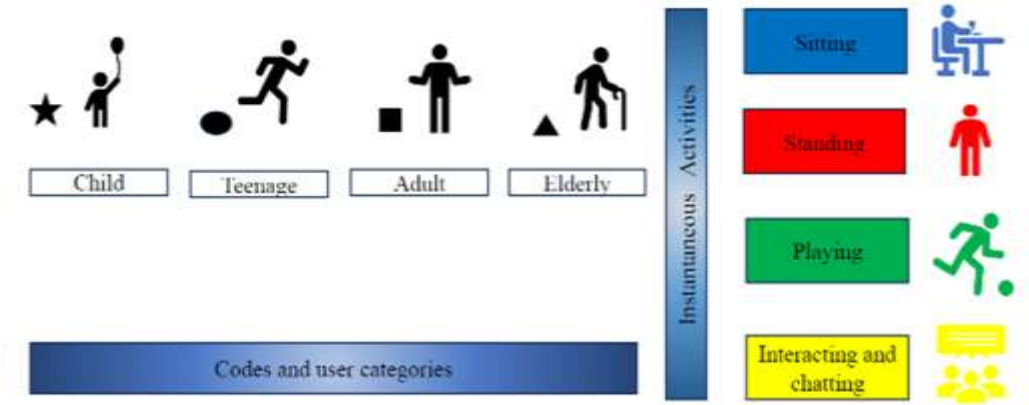

FIGURE 2- CODES AND USER CATEGORIES FOR INSTANTANEOUS ACTIVITY OBSERVATION (SOURCE: GRAJEWSKI & VAUGHAN, 2001 AND AUTHORS' PROCESSING).

RESULTS ANALYSIS AND DISCUSSION

3.1 Results analysis and discussion of VGA

Local integration measures accessibility within restricted areas, capturing how well a space connects to its immediate surroundings (Turner et al., 2001).
In VGA colour gradients, red to yellow represents highly integrated (and thus easily accessible) areas, while green to blue denotes less integrated areas. Visibility Graph Analysis (VGA) serves to identify spatially segregated areas, quantify accessibility gradients by distinguishing highly integrated from poorly integrated areas, and diagnose spatial configurations in relation to the urban environment. This methodology further examines how integration levels correlate with specific garden features and influence social interaction patterns. Understanding local dynamics helps interpret how people occupy and use spaces within urban and architectural environments. This analysis reveals which garden areas facilitate social interaction through their spatial connectivity and accessibility patterns.
The visualisation of November 1st, 1954 Garden is essentially a uniform hue inside, ranging from light blue to green (Figure 3). It is a weakly integrated area, with values varying between 13.34 and 14.64 (Table 2) throughout the space. The dark blue lines bordering the garden are paths, transition areas, or access points into the garden. In the peripheral areas, lines running from the inside of the garden outwards indicate connections with external boundary areas, such as streets and paths leading to other parts of the city.
Emir Abdelkader Garden map shows an area largely depicted in light blue and green on the southwest side, indicating different levels of integration ranging from 9.44 to 12.40 (Table 2). The central area suggests an average integration value. Whereas the blue areas, particularly at the edges, are less integrated with the rest of the garden. A horizontal axis runs through the entire garden, representing one of the alleys.
Map analysis shows that the central area suggests high user frequency, while its edges and some peripheral areas are less integrated (Figure 3).
Raffaoui Saad Garden map mainly shows three different areas with average, low, and very low values, ranging from 5.19 to 9.73. Most of the visible area shows a low level of local integration. A large area in the upper northeast corner suggests average local integration with a value of 16.27, and other smaller areas reveal less integrated spaces with minimum values equal to 5.19 (Table 2).

The rectangular shapes in white represent buildings and structures within this green space; the Roman baths are mainly located to the north. The transition between the area to the northeast and the rest of the garden is clear, suggesting a significant change in local integration. The areas to the northwest and southwest are the most accessible and integrated, constituting focal points, while the areas to the northeast display integration values suggesting a potential for average accessibility.

The smaller areas to the northeast represent less accessible or hidden areas. The analysis reveals a remarkable variability in the levels of local integration within this green space (Figure 3).

For July 5th, 1962 Garden, the graph shows two main categories of values: low and medium. The gradient from light blue to light green indicates a gradual transition in local integration values. The centre of this area is the least integrated, with a value of 10.11 and integration increases towards the edges, with a value of 12.52 (Table 2).

An elongated area to the Southeast, with a value of up to 18.42, appears in the lower zone and seems to be a structuring element in the circulation of this space.

The graph shows green areas around the triangle with higher values, suggesting more connected and/or accessible spaces. A variation in values can be seen in areas potentially indicating specific points of interest or areas of activity that could correspond to path intersections or specific development.

In addition, clear transitions between the northern and southern parts indicate physical or perceptual barriers. These discontinuities are changes in level, hedges, or diversity in landscaping (Figure 3).

Based on the levels of integration, it is possible to predict that visitor movement would be more intense in those garden areas that are more suited to dynamic or transit activities. Whereas the central area of the garden presents a destination rather than a place of transit. This area could accommodate sedentary activities such as resting, picnicking, and contemplation.

This analysis illustrates the structural clarity of this garden, characterised by different levels of integration, underlining the importance of the central zone as a distinctive element of this urban public garden.

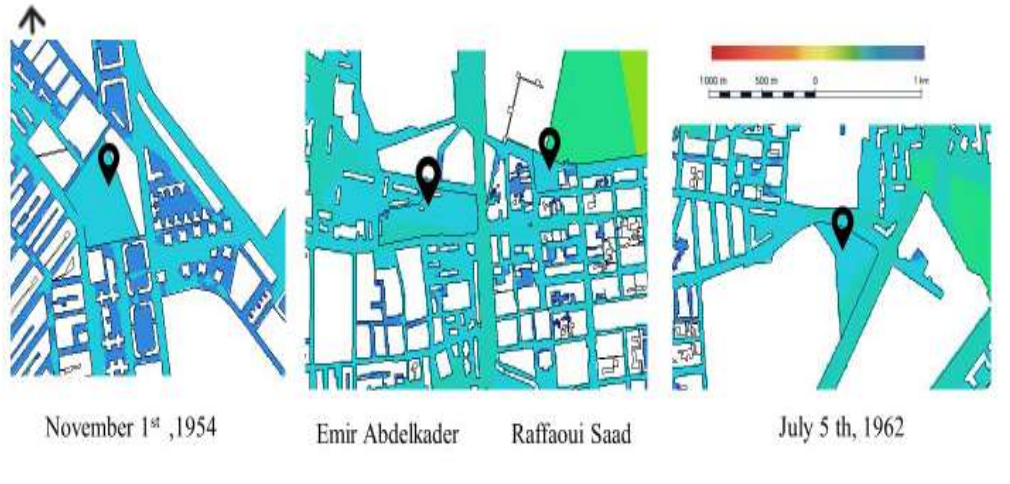

FIGURE 3- "VGA" LOCAL INTEGRATION RESULTS FOR THE FOUR CASE STUDY AREAS
(SOURCE : AUTHORS, 2025)

Clustering coefficient measures spatial connectivity on a scale of 0 to 1, representing actual connections between neighbouring nodes divided by all possible connections (Watts & Strogatz, 1998). It indicates compactness and accessibility of visible space, measuring how well different elements connect within a defined area with colour-coded visualisation that assigns warm hues (red/orange) to represent areas with high integration coefficients, indicating strong spatial connectivity. Conversely, cool tones (green/blue) designate zones with low coefficients. Within this framework, high values signify locally interconnected areas, while low values correspond to decision points where pedestrians evaluate route options, highlighting locations conducive to directional choices. The clustering coefficient reveals which areas facilitate movement decisions versus those that maintain strong local connectivity, helping understand pedestrian behaviour and spatial navigation patterns in urban areas.

Comparing November 1st, 1954 Garden graph generated by Depthmap (Figure 4) with its spatial structure shows that the areas represented with warm colours (red, orange) have a high clustering coefficient value of 0.98. These areas correspond to lawns, flower beds, or paved areas. The areas represented by cold colours (blue, green) have

a clustering coefficient with an average value equal to 0.50. Unlike the places mentioned above, these areas with average values are characterised by an alternation of different types of surfaces (lawn, paths, trees, and paving).
The visibility graph shows that the garden is divided into different areas: those with a high clustering coefficient correspond to distinct functional areas of the garden (for example, a playground and a botanical garden), while the paths and alleys, which separate the different areas of the garden, have a lower clustering coefficient (Figure 4).
Emir Abdelkader Garden map shows a variation of values ranging from 0.81 to 0.93 (Table 2). Thus, a large part of the garden, especially in the northwest, southwest, and central parts, presents high values. This suggests a highly interconnected area, which coincides with many paths and open spaces. The central part displays a high value, marked by a gradient from red to orange, suggesting a progressive decrease in the interconnection of spaces. The areas located in the northeast and southeast are the liveliest, offering many options for movement and interaction. Other areas with a low clustering coefficient are mainly visible on the outer limits of the garden. These areas indicate less interconnected spaces, narrow paths, and more isolated and quieter areas or those with a specific function, including access (Figure 4).
The variation of the clustering coefficient suggests a diversity of spatial experiences in the garden, ranging from very connected spaces to more isolated spaces.

TABLE 2- MAXIMUM AND MINIMUM VALUES OF SYNTACTIC MEASURES IN THE FOUR CASE STUDY AREAS (SOURCE : AUTHORS, 2025)

Gardens	Local integration		Clustering coefficient	
	Min	Max	Min	Max
November 1st, 1954	13.34	14.46	0.50	0.98
Emir Abdelkader	9.44	12.40	0.81	0.94
Jully 5th, 1962	10.11	18.42	0.78	0.98
Raffaoui Saad	5.19	9.73	0.53	0.98

The central area of Raffaoui Saad Garden displays a very high clustering coefficient of 0.98, which suggests a strong local interconnection and forms a coherent cluster in space. This central place, square in shape, is delimited, planted and inaccessible to users, playing an ornamental role (Table 2). The graph shows important areas surrounding the central part displaying medium to high values of the clustering coefficient. These places are well connected, including transition spaces and secondary activity areas. This variation of the clustering coefficient offers a range of activities in the garden, ranging from very connected spaces to more isolated ones with a value of 0.53 mainly at the edges and in some corners, such as transition spaces, circulation spaces, or isolated quiet areas, as well as the main access to the garden (Figure 4).

The central space of July 5th, 1962 Garden displays a very high clustering coefficient equal to 0.98 (Table 2). This can highlight very connected spaces or user gathering points. Also, it is worth noting a gradual transition to a value of 0.78 towards the edges, particularly along the northeast side, which could represent less frequented areas. This abrupt transition from maximum to average values could highlight an unforeseen change in the configuration of the space or a physical barrier. Also, the spaces located in the northeast represent less frequented places.
The visibility graph assumes that the garden of July 5th has a strong tendency to cluster in its central part, representing a focal point, with dispersion areas towards the quieter or less frequented edges (Figure 4).

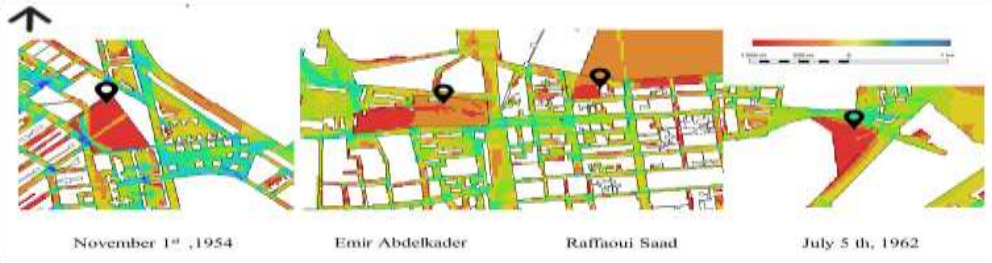

FIGURE 4- "VGA" CLUSTERING COEFFICIENT FOR THE FOUR CASE STUDY AREAS (SOURCE : AUTHORS, 2025)

3.2 Overlaying the space syntax results with the instantaneous observation maps

The comparative analysis of the four case study areas reveals a significant correspondence between certain spatial characteristics and the types of social interactions observed on the premises, specifically activities such as games, discussions, and static positions (sitting or standing) frequently observed in areas with distinct spatial characteristics, notably:

- Average to low local integration values;
- Average to high clustering coefficient values.

In the four case study areas, there is a weak correlation between the observed activities and the degree of local integration, which generally presents low average values.

The Garden of November 1st, is in a dense residential environment, bordered by a primary school and a mosque; it promotes a framework conducive to varied uses (Figure 5). The results show values that reflect medium to low levels of integration with a high attendance rate. Its spatial configuration is distinguished by paths that cross it, dividing it into different zones, facilitating the movement of users, where the wooded areas create green and shady spaces. Between these paths, there is a lawn and playgrounds for children and adolescents.

This favours the presence of women, children, and adolescents, as in the previous case study area, the results affirm that the values reflect medium to low levels of integration with a high attendance rate in the July 5th Garden (Figure 3). Different social interactions are present in all areas, with users, particularly women and children, around and near the playgrounds and the grassy areas as well as the shaded areas (Figure 5).

While in the Emir Abdelkader Garden, the superposition of the local integration graph with the instantaneous observation map indicates that the areas with average values are the most frequented: the main route and the secondary paths that are parallel to it, from the entrance to the back (Figure 5). The central pathway, featuring benches and a commemorative stele, fosters significant social interaction. However, observational data (Figure 5) reveal relatively lower attendance among children and women. Notably, the garden's upper section—characterised by winding paths, two water features, and reduced visibility—experiences minimal visitation and serves as the quietest area.

The data reveal that the Raffaoui Garden displays minimal integration values and the lowest attendance rate in all age categories, especially children and women (Figure 3 and 5). The absence of play areas and the concentration of mature trees testify to the antiquity of the two gardens, Emir and Raffaoui, creating a dense canopy in the urban fabric. The latter combine several important functions of heritage, social, and environmental character.

This study shows that the observed activities have a positive correlation with the measured clustering coefficient (Figure 6). The observed activities in November 1st Garden including games, discussions, and static sitting/standing positions, occurred primarily in high-traffic areas such as play areas, grassy spaces, covered pathways within the square, and adjacent path surroundings. Notably, women of all ages constituted 62% of visitors, while men accounted for 22%, children for 16% (Figure 7). This gender distribution aligns with findings from other sites: July 5th Garden (67% women, 12% children, and 21% men) and Emir Abdelkader Garden (46% women, 14% children, and 40% men) (Figure 7). Social interactions are recorded in areas with high values with the same spatial configurations. However, Emir Abdelkader Garden does not have playgrounds; hence, the nature of the observed activities is more static, like discussions in seated positions and reading, in addition to standing. The presence of women is 46%, particularly in areas with benches and shaded areas. It should be noted that the location of the garden near a hospital and in the heart of the city makes it a refuge for visitors. It is worthy to mention that in Raffaoui Garden, there is no concordance between the areas displaying maximum values of the grouping coefficient and the observed activities. Compared to the other case study areas, the observed interactions are limited to the male sex, particularly delinquent adolescents in hidden areas with a rate of 34%, adults 42%, and elderly people 15%, in a seated position reading their newspapers or consulting their mobile phones (Figure 7). The presence of women is particularly low, equal to 1%, and 8% for children.

The research reveals a complex relationship between spatial design and women's usage of urban public gardens. Spaces with low local integration values create isolated, calmer environments that encourage longer stays and support intellectual activities like reading and meditation, artistic practices such as guitar playing, and intimate social interactions including private conversations. Conversely, areas with high clustering coefficient promote social interactions through enhanced visibility, accessibility, and user movement, becoming focal points of activity. However, Raffaoui Garden case study area demonstrates how safety concerns significantly impact

women's attendance, as the space is perceived as unsafe due to delinquent presence and lacks essential women-friendly facilities like toilets, children's playgrounds, and relaxation areas. Interviewed women described feeling weak in this isolated environment, particularly due to inappropriate occupant behaviour that discourages their participation. The findings indicate that women's low usage of urban public gardens results from a combination of security concerns, spatial configuration challenges, cultural norms, and inadequate leisure infrastructure, highlighting the need for comprehensive design approaches that address both spatial and social factors to create truly inclusive public spaces.

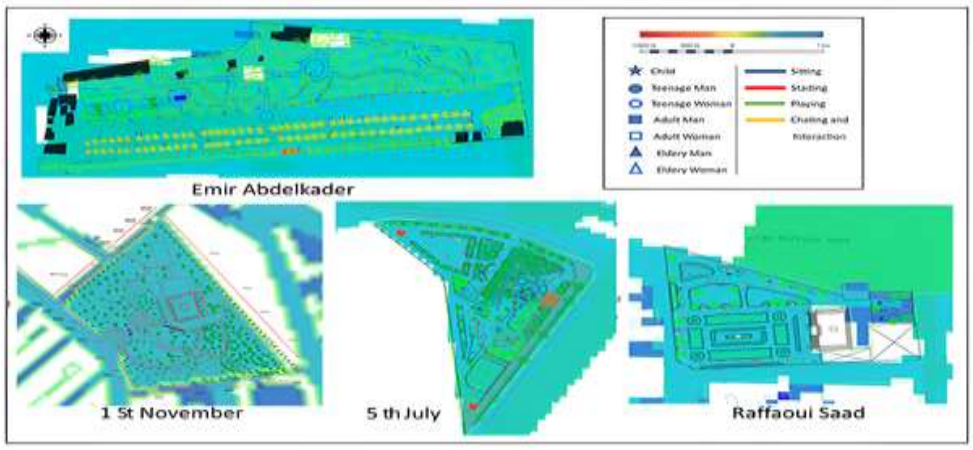

FIGURE 5- SUPERPOSITION OF THE RESULTS OF LOCAL INTEGRATION AND MAP OF THE INSTANTANEOUS OBSERVATION OF THE FOUR GARDENS (SOURCE: AUTHORS, 2025)

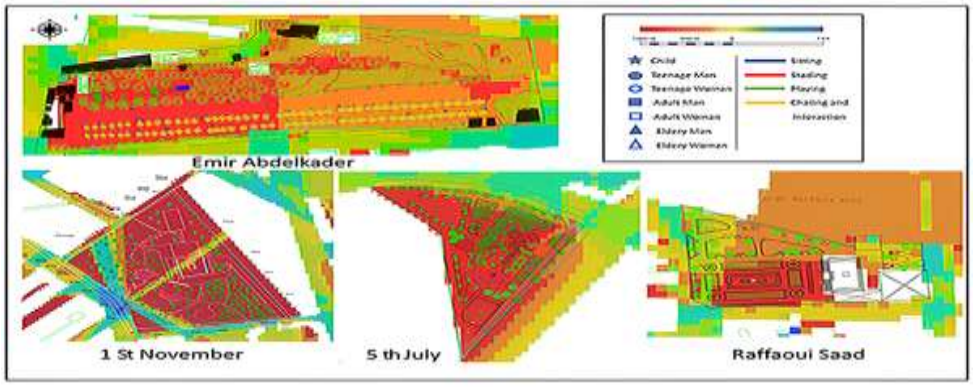

FIGURE 6- SUPERPOSITION OF THE RESULTS OF THE CLUSTERING COEFFICIENT AND THE INSTANTANEOUS OBSERVATION MAP OF THE FOUR GARDENS. (SOURCE: AUTHORS, 2025)

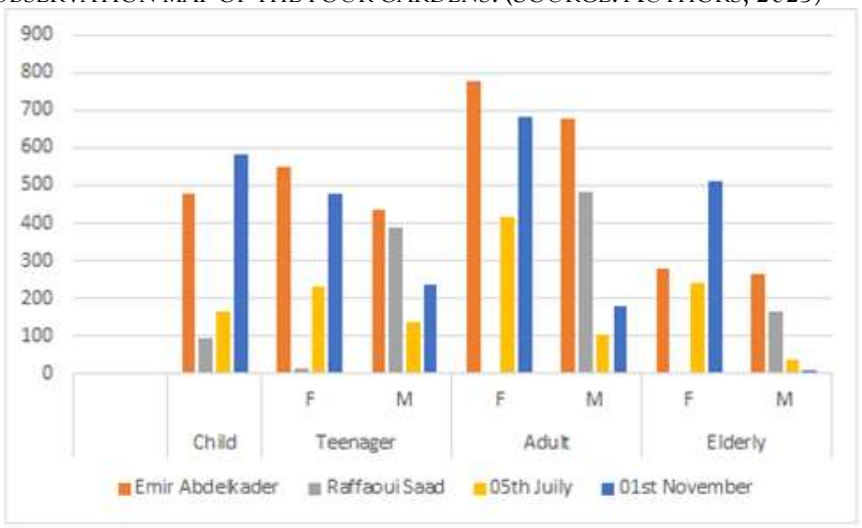

FIGURE 7- DISTRIBUTION OF USAGE BY AGE AND GENDER IN THE FOUR CASE STUDY AREAS. (SOURCE: AUTHORS, 2025).

CONCLUSION

This research has fundamentally illuminated how the spatial configuration of urban public gardens impacts women's social practices, activities, and interactions. We've demonstrated that local integration is negatively correlated with activities due to spatial privacy needs, while better connectivity and a higher clustering coefficient promote more frequent and diverse social interactions. These findings offer invaluable tools for landscape architects and urban planners, enabling them to evaluate and optimise public gardens. They support inclusive design specifically tailored to women's needs, thereby enhancing social inclusion and security through positive social practices.

While this study offers significant contributions, it has certain limitations. Methodological constraints are associated with the use of space syntax and snapshot observations. Additionally, its geographic specificity to a single city, the potential impact of temporary factors (weather, scheduling), and the limitations of the socio-cultural context must be considered.

Nonetheless, this research establishes a solid foundation for more equitable urbanisation that addresses the needs of all users. It underscores the importance of integrating gender- and age-specific requirements into urban planning strategies, contributing to more adapted and inclusive public spaces. Future research could explore longitudinal studies to mitigate the impact of temporary factors, expand the geographical scope to diverse urban settings, and integrate qualitative methods for a deeper understanding of women's perceptions and experiences within these spaces.

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