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PRIVACY AND SEGREGATION IN TRADITIONAL DOMESTIC SPACES: SPACE SYNTAX ANALYSIS OF THE "QUALITY OF LIFE" IN ISLAMIC TRADITIONAL HOUSES

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Abstract

Introduction: The concept of home goes far beyond physical aspects, and its essence is interwoven with the spiritual nature of humankind. **Purpose of the study**: This paper aims at examining the spatial formations of five contemporaneous historical Islamic residences in three cities: Cairo, Damascus, and Aleppo. We intend to show that their layouts, which were mainly governed by certain traditions of privacy and visibility, were negatively affected by those factors in terms of functional and psychological efficiency. **Methods**: The paper utilizes Space Syntax formulas and the UCL Depthmap software to investigate and analyze the spatial configurations of these residences to provide a new comprehension of the life experience and the functional performance in these abodes, which were always regarded as ideal. **Results** show that the layouts in the five residences offer satisfactory qualities in terms of the privacy level, which is certainly a fundamental human need. However, the hierarchy of access to spaces has negative consequences for psychological requirements and functional efficiency. **Conclusions:** In order to meet certain social considerations, the spatial configurations in these residences failed to meet other functional and psychological needs of the inhabitants.

Keywords: domestic architecture; traditional houses; spatial configuration; functional efficiency; Space Syntax.

Introduction

Space Syntax theory of architecture and urban design originated in the 1970s. The Space Syntax term reflects its early analogies to linguistic theories. It was believed that, just as there are certain combinations of words that can be assembled into a meaningful sentence, only certain configurations of spaces would actually make sense. Here, spatial and social forms are in such a close relationship that a certain spatial configuration may define different social patterns. A set of thematic graphs, algorithms and software was developed for the representation, quantification, analysis and interpretation of spatial configuration (Ramzy, 2016).

Quality of life is dynamic, people and the environment change over time. However the historical domains of durability, convenience and beauty continue to be essential needs. Giving priority to one of these qualities over the others may lead to low functional efficiency and performance levels of the layouts. In this paper, we consider the functional qualities of five residences that date back to the Mamluk and Ottoman eras. The architecture of traditional Islamic houses, which have been always considered as perfect places for life (Hwaish, 2015), with their spacious sunlit courtyards and private sheltered spaces, correlate with the concept of quality of life, covering psychological, utilitarian, and interpersonal issues.

For Franz et al. (2005), the property of segregation is an indicator of the degree of social-functional efficiency of space. In traditional Islamic houses, the concept of privacy refers principally to the segregation between males and females. Achieving privacy in a house requires the interior space to be invisible to strangers and the spatial configuration to provide the least amount of communication between the spaces dedicated to males (*Salamlik*) and to females (*Haramlik*) in the house. The paper's hypothesis is that this kind of segregation may have affected the functional performance of the residences. Therefore, the aims of the analysis performed in this paper are to investigate, first, whether space-segregation indeed helped attaining high levels of privacy; and secondly, its influence on the functional performance and the quality of life within residential environments.

The question that arose here was: how to evaluate the impact of spatial configuration on the functional efficiency of these layouts. The paper here suggested Space Syntax analysis as a quantifiable syntactic approach and a complementary tool for illuminating new dimensions of life in historical communities. It is used to detect and measure the functional performance and assess the life quality across the five dwellings subjected to the study.

With this in mind, a Space Syntax analysis of the five residences was performed in four phases. The initial phase has two steps which show: a) the sampling logic behind the choice of the five

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residences as representatives of traditional Islamic residences; and b) the formulas and tools of Space Syntax analysis adopted for the research. In the second phase, we discuss the special qualities chosen to evaluate the residences and the syntactical and mathematical formulas to quantify these qualities. The next phase overviews the results of the syntactic study, showing the numerical results obtained by the UCL Depthmap software for the chosen measures. The final phase presents the conclusions of the study.

Methods

The methodology of Space Syntax was selected here as an approach for analyzing the spatial models on a scientific basis by interpreting them in numerical graphical forms. This method gives the research a good level of credibility and realism in understanding configured space, especially its formative process and cultural significance (Bafna, 2003).

Samples and sampling strategy

To choose suitable samples and representatives of residential architecture from the Mamluk/Ottoman Era, we selected five distinct traditional residences from various cities (Cairo, Damascus, and Aleppo), featuring different sizes (small houses, large houses, and a palace) and different designs (one court, two courts, a court and a large backyard) for analysis. The only common factor among the selected residences is that they all belong to the same cultural background of Islam, where segregation between male and female areas of activities in the house was a must. The samples also cover a wide span of time during both Mamluk and Ottoman eras (1600s–1900s) in Egypt and Syria.

Residences from Cairo

Two residences from Cairo were selected for the study:

(a) *The House of Al-Sohaymi* (or *Abdel Wahab El-Tablawy* house): it was originally built in 1648 (Ottoman Era) in Al-Darb Al-Asfar, Cairo. The house is built around a *Sahn* (court with a fountain). Like all traditional Islamic houses, the house has strictly separated public *Salamlik* and private *Haramlik*.

(b) *The House of Zaynab Khatun*: located in the old town, near Al-Azhar Mosque, it was originally built in 1486 (Mamluk Era), with later additions in 1713 (Ottoman Era).

Such an entrance[1] allows not a glimpse inside for the outsiders. It leads to a large *Sahn*. The ground floor includes a *Mandara* (guest room for men), a kitchen, a mill, and a grain storage room. The terrace overlooking the courtyard in the *Salamlik* is connected to a small corridor that leads to the *Haramlik*.

Residences in Syria

Three residences were selected for the study; two houses from Damascus and one from Aleppo:

(a) *The House of Sheikh Badr El-Din Al-Hasani, Damascus*: it dates back to the late 17th and the beginning of the 18th century with some parts of it being of the 20th century (all belong to the Ottoman era in Syria). It is located inside the wall of the Ancient City of Damascus.

The house has one open courtyard with an *Iwan* (formal lobby leading to the main hall) on the southern side and the main hall on the northern side. Ten rooms on the first floor surround the perimeter of the house, except for the western side (Keenan, 2000).

(b) *Al-Azem Palace, Damascus*: the palace was built during the Ottoman era in 1749, north of the market of Al-Buzuriyah in the Ancient City of Damascus. This residence is actually a palace, with an area of 6400 m², consisting of the two usual wings, *Haramlik* and *Salamlik*, with an addition of a wing for the servants, the *Khadamlik*.

(c) *Ajaq Bash House, Aleppo*: the house dates back to the Ottoman era (1758). It is located at the first Jasmine Gate in Al-Saliba northwest of Aleppo outside the walls of the Ancient City.

The house is currently below the street level. The entrance leads to a large courtyard with a pond in the middle. An *Iwan* is located directly in front of the northern main hall. Bedrooms are located on the upper floor (*Haramlik*).

Formulas and tools

UCL Depthmap software, which was developed by Alasdair Turner and his colleagues, offers a variety of techniques and tools. Based on the data sets needed for the analysis as will be discussed in section 3, we chose the following tools for the study.[2]

(a) *Visibility Graph Analysis* (VGA) with two levels of measurements: local properties, such as Connectivity, Clustering Coefficient (CC) and Visual Control (VC) values; and global properties such as Integration and Relativized Entropy (RE) values (Bada and Farhi, 2009).

(b) *Isovists*, which are sets of all points visible from given vantage points in space and with respect to the environment. The geometrical properties of Isovists are used to measure visibility (eye level isovists) or accessibility (floor level isovists) from each of these locations (Benedikt and Burnham, 1985).

(c) *Agent-based analysis* is a computational model for simulating the actions and interactions of autonomous agents (both individual or collective entities). This tool is particularly useful in archaeological/historical research since it allows insights into the relationship between the built environment and human behavior. It simulates natural human movements, providing researcher with an important measurement called Gate Counts,

[1] An entrance that is not directly connected to the house court is an intermediate space fencing it from the street.

[2] For more details about formulas and tools of Space Syntax analysis see the work by Ramzy (2016).

to predict how a certain space was (or would be) navigated (Bada and Farhi, 2009).

Privacy versus functional efficiency in traditional Islamic houses

A building achieves its function not through its built form, but mainly through the qualities of its spaces (Franz et al., 2005). The discussion in this section seeks to define the life qualities and the spatial properties that have to be measured in the five residences under examination. The criteria for privacy, functional and psychological performance of the five abodes were based on studies by Alitajer and Nojoumi (2016), Franz and Wiener (2005), Mustafa and Hassan (2010), and others, who identified these qualities as fundamental to spatial performance and preference patterns.

Spatial measurements to quantify the level of privacy in a spatial layout

A much discussed notion in the field of environmental psychology is the notion of privacy. To obtain a desirable state of privacy, each individual resorts to certain means, depending on their sociocultural milieu that reflects the ideas of a particular society at a given time (Forgas, 1994). In their study of 2016, Alitajer and Nojoumi suggested the following measurements of Space Syntax theory as indicators of privacy level in spatial layouts.

(1) *Connectivity*: the number of points, at which a space is directly connected to other spaces. For instance, the connectivity of a room with two entrance doors to adjacent spaces equals two.

(2) *Step Depth*: it is basically illustrated as the number of steps (spaces) one must take to pass from one point to the other points. A point is considered deep when a large number of steps lie between this point and the other points.

(3) *Integration*: the integration of a point indicates the degree of connection or separation between one point and the general system or the subordinate system. A space exhibits a high degree of integration when it is assimilated with other spaces.

(4) *Agent analysis*: in agent-based analysis, virtual “people” (agents) are released into the environment, and they make decisions on where to move within such an environment. This indicator is reflected by the so-called Gate Counts (Alitajer and Nojoumi, 2016).

Spatial measurements to quantify the level of functional Efficiency in a spatial layout

Functional efficiency of a building may be defined as the degree to which the activities are supported by its spatial configuration. This is associated with the spatial relationship between rooms (functional zoning) and the routing through the building for the distribution of people, goods and services, etc. (van der Voordt et al., 1997). Functional factors such as the relationship between spaces and activities, appropriate axes of movement, flexibility, suitability, safety, and so forth are key aspects in this respect, with two principal matters to be considered (Mustafa and Hassan, 2010):

a. Physical efficiency, or the ease with which users and visitors can reach, enter and move through a building, thus being able to use its various spaces. A focal point in particular is the integral accessibility, which means that people with physical disabilities can also enter and move through the building independently. Relevant spatial aspects include: a recognizable entrance, clear transitions, and circulation from public to private.

b. Psychological efficiency, or to what extent a building “invites” the potential users to enter, utilize the facility, and engage in the activities taking place within. These are syntactical characteristics which facilitate spatial-functional orientation, clear outline of a building layout, visual axes, points of recognition, differentiation in the use of spaces, etc.

Physical efficiency

Mustafa and Hassan (2010) proposed specific quantifiers as indicators of physical efficiency within residential environments. However, they employed A-Graph analysis techniques, while this study uses the tools of the UCL Depthmap software to acquire the results for the same indicators.

(1) *Symmetry/Asymmetry*. Mustafa and Hassan (2010) suggested the kinetic-visual depth as an indicator. According to their interpretation, a space is more symmetrical when it has less depth than other spaces in the system, and vice versa. As the number of visual-kinetic steps between areas in a residential layout increases, spatial segregation increases correspondingly, leading to a weaker functional link (less efficiency). In the same vein, Hillier (2006) suggested that layouts with maximized depth are functionally rigid and unsuitable for most functional patterns. Conversely, minimizing depth seems to offer greater adaptability and is better suited for a broader array of functions, leading to a more efficient house function.

From Space Syntax indicators, Mustafa and Hassan (2010) suggested Mean Depth and Real Relative Asymmetry (RRA) as indicators related to this property.

(2) *Distributedness/Non-distributedness*. Distributedness, which is sometimes also called “permeability” (Beck and Turkienicz, 2009; Hillier, 2006), refers to the available ways to access all spaces in a house layout (Mustafa and Hassan, 2010). It demonstrates the resident’s movement through the spatial system in a smooth, efficient, and flexible manner, highlighting the presence of multiple non-intersecting routes from one point in the system to another. If there is only one route for any two points in the system, then the system is said to be non-distributed. By increasing the number of ways of accessing a particular space, its distributedness

increases, which means high level of permeability of the space.

Although Mustafa and Hassan (2010) only proposed integration values as a measurement for this property, Beck and Turkienicz (2009) suggested that Intelligibility[3] (connectivity/integration) is a more accurate indicator of this attribute.

Moreover, in his study of 2006 "Studying cities to learn about minds", Hillier brings about the concept of Natural Movement, suggesting Control Value (CV)[4] as a measurement to quantify easy navigation or permeability of a certain space. Control Value quantifies the degree to which a space controls access to its immediate neighbors, considering the number of alternative connections that each of these neighbors has (Klarqvist, 1993).

(3) *Difference Factor of Space*. Measuring how strong or weak social relations correlate with spatial ordering, e.g., the degree to which a space may be shared with others (Arslan and Köken, 2016). The degree of variance in integration values is considered as an indication of this property, where integration values of spaces should be in a consistent order across a layout. In most spatial complexes, different functions and activities are assigned to spaces, which integrate the complexes to different degrees (numerical values). If the integration values of these spaces are in a consistent order across a layout, consequently, a cultural pattern might be said to be spatially expressing itself (Mustafa and Hassan, 2010).

(4) *Degree of Spaceness (space-link ratio)*. In Space Syntax terminology, there are four types of space: a-type space, which has one link; b- and c-type spaces, which have more than one connection but with differences in positions; and d-type space with more than two connections (Mustafa and Hassan, 2010). It is assumed that a-type spaces are more suitable for occupation since there is no "through" circulation. Movement is better in b- and c-type spaces, while d-type spaces offer the greatest variety of movement options. In Space Syntax tools, Choice is a general value for this property that can be best understood as "water flow in space" (Jiang et al., 2000).

(5) *Airflow*. In addition to the previous measurements suggested by Mustafa and Hassan (2010), another factor of efficiency is suggested by Du (2019), which is airflow. For him, the VGA analysis method seems the best choice of the Space Syntax method for the airflow analysis. He suggests the levels of connectivity and integration as the quantifiers for this quality.

Psychological efficiency

Privacy, as previously discussed, is one of the crucial factors in psychological efficiency. But, according to Franz and Wiener (2005), there are other factors that are equally important to psychological comfort. Franz and Wiener (2008) pointed out four spatial qualities of architectural space that make the space preferable by people; these are spaciousness, enclosure, complexity, and order. They suggested some calculations and values to quantify these four qualities in relation to isovist properties as follows:

(1) *Spaciousness:* (Isovist area / Number of vertices).

(2) *Enclosure:* Jaggedness (Isovist perimeter^2 / area), Revelation ((Σ area adjacent isovists – isovist area) / isovist area) and Openness (the length of open edge / the length of closed edge) as opposed to it.

(3) *Complexity:* Vertices (number of vertices), Density (number of vertices / area) and Roundness (Isovist area / perimeter^2).

(4) *Order:* Symmetry (number of symmetry axes) and Redundancy/Regularity (number of unique polygon sections / number of symmetry axes + 1).

Results and discussions

A syntactic analysis was performed on the five residences using the UCL Depthmap software to acquire graphs and numerical measures for the aforementioned spatial qualities. Two sets of analytical processes were performed on the five chosen examples. The first set deals with the residences as a whole to obtain both global and local indicators, such as integration, control value, and connectivity values; the second set is concerned with the properties of the isovists in certain spaces within each residence: the court and the largest adjacent space. The points with the highest integration value in each area were selected as observation points to generate the most representative isovist in the space.

Table 1 illustrates the graphs and attributes of the five residences produced by the UCL Depthmap software, while Table 2 shows the numerical results obtained from the analysis of the attributes in Table 1 after respective calculations. It should be noted that deviant results sometimes appear for the exceptionally large Al-Azem palace and the backyard of Al-Sohaymi. Same is true for Badr El-Din Al-Hasani, which is a very small residence (compared to the others).

The results of the analyses, as shown in Tables 1 and 2, demonstrate the following:

A) *In terms of privacy*

The values of connectivity are very low in most of the spaces in the five residences and very high only in certain points of the courts (Sahn). Minimal connectivity values are observed in kitchens,

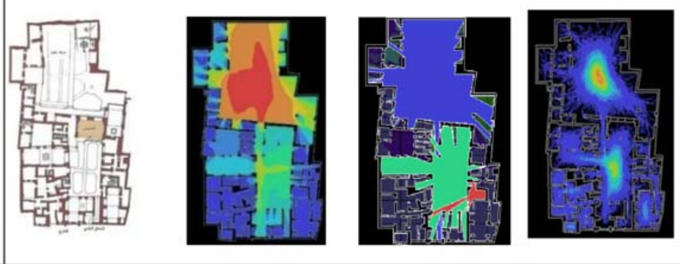
[3] It was measured by Hillier (2006) as the correlation between connectivity and integration. It is notable here that this property contradicts the aforementioned indicators of privacy, as suggested by Alitajer and Nojoumi (2016), by default.

[4] To calculate this value, each space is assigned a score of 1, which is then divided by the number of the neighboring spaces (1/n) to which it is connected. The scores received by each space from its surrounding spaces are totaled. The higher the CV, the more controlling the space is. If a space ends up with a CV exceeding 1, it can be considered controlling; if control values approach 0, it is deemed controlled.

Table 1. **UCL Depthmap graphs and attributes for the five residences**

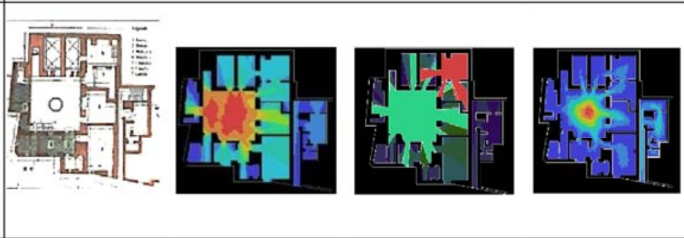
Residence | Floor Plan | VGA | Isovists | Agent A. | Attributes

Al-Sohaymi



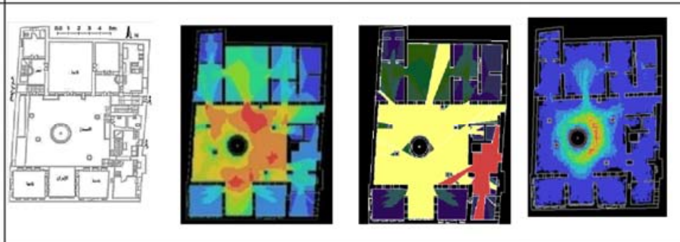
Attribute	Minimum	Average	Maximum
Choice	0	5583.64	224186
Connectivity	3	470.538	1695
Control	0.0501773	1	3.0541
Controllability	0.0132743	0.237298	0.597156
Entropy	1.29069	1.72243	2.16113
Harmonic Mean Depth	17.6723	47.1129	121.295
Integration [HH]	2.29048	6.63778	14.9548
Mean Depth	1.61837	2.53523	5.03739
Mean Depth [Connectivity Wgt]	1.33858	2.25643	4.83712
Node Count	3638	3638	3638
RA	0.000340136	0.000844462	0.00222079
RA [Penn]	0.494701	0.728214	0.845302
RRA	0.066368	0.166014	0.436589
Total Depth	5886	9220.64	18321
Step Depth	0	1.29076	4
Gate Counts	1	8.84388	171

Zaynab Khatun



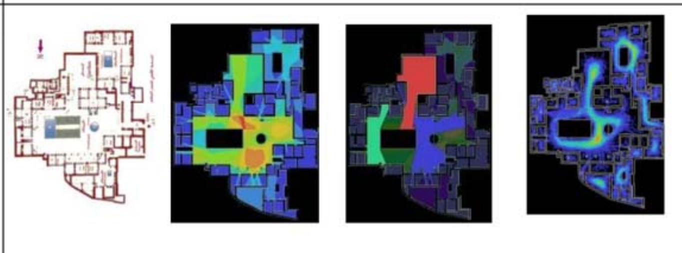
Attribute	Minimum	Average	Maximum
Choice	0	1132.89	2264
Connectivity	29	329.5	630
Control	0.041993	0.853968	1.68067
Controllability	0.042328	0.24756	0.512245
Entropy	1.03136	1.98677	3.72534
Harmonic Mean Depth	3.90226	108.801	201.365
Integration [HH]	2.68702	7.33292	17.5866
Mean Depth	1.27157	2.10201	4.41829
Mean Depth [Connectivity Wgt]	1.00828	1.92973	3.37745
Node Count	1867	1867	1867
RA	0.00144771	0.00212963	0.00467157
RA [Penn]	0.664812	0.722595	0.822394
RRA	0.0514756	0.148332	0.524253
Total Depth	1997	4174.48	6482
Step Depth	0	1.8255	4
Gate Counts	1	88.5933	695

Badr El-Din Al-Hasani



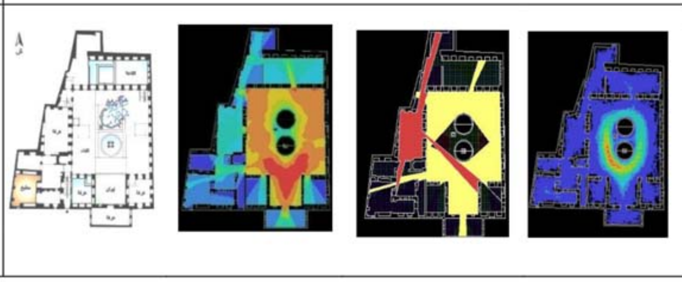
Attribute	Minimum	Average	Maximum
Choice	0	500.618	3391
Connectivity	3	188.988	372
Control	0.0588666	1	1.82946
Controllability	0.046083	0.35361	0.634812
Entropy	0.99297	1.29879	1.77965
Harmonic Mean Depth	8.48871	24.2439	145.81
Integration [HH]	2.18704	8.89606	17.025
Mean Depth	1.39057	1.84279	4.0404
Mean Depth [Connectivity Wgt]	1.2297	1.69702	3.96933
Node Count	595	595	595
RA	0.00131728	0.00284247	0.0102543
RA [Penn]	0.490262	0.799182	0.901944
RRA	0.0587373	0.126746	0.457239
Total Depth	826	1094.62	2400
Step Depth	0	2.16975	4
Gate Counts	1	46.6122	509

Al- Azem Palace



Attribute	Minimum	Average	Maximum
Choice	0	3775.73	496286
Connectivity	4	144.244	409
Control	0.0389332	0.999869	2.08025
Controllability	0.0259179	0.326664	0.622642
Entropy	2.02975	2.42847	2.74479
Harmonic Mean Depth	18.1726	48.3107	147.094
Integration [HH]	1.30857	3.27803	5.79431
Mean Depth	2.35601	3.73207	7.00434
Mean Depth [Connectivity Wgt]	1.54188	3.01248	6.43782
Node Count	1383	1383	1383
RA	0.0019638	0.00395666	0.00869564
RA [Penn]	0.451771	0.650878	0.773425
RRA	0.172583	0.34772	0.764192
Total Depth	3256	5157.73	9680
Step Depth	0	2.56182	6
Gate Counts	1	5.8053	85

Ajaq Bash



Attribute	Minimum	Average	Maximum
Choice	0	1141.68	15698
Connectivity	15	198.624	502
Control	0.161916	0.999968	2.63067
Controllability	0.042328	0.24756	0.512245
Entropy	1.04936	1.38687	1.72534
Harmonic Mean Depth	5.91426	164.891	429.365
Integration [HH]	3.07747	7.33292	13.9966
Mean Depth	1.53185	2.10201	3.41892
Mean Depth [Connectivity Wgt]	1.40828	1.93873	3.37985
Node Count	1037	1037	1037
RA	0.00102774	0.00212949	0.00467424
RA [Penn]	0.514811	0.707591	0.822373
RRA	0.0714457	0.148037	0.324942
Total Depth	1587	2177.68	3542
Step Depth	0	1.8216	4
Gate Counts	1	27.9593	325

storage, dining rooms, toilets, backyards, and stairs.

Step-depth values are generally high, with values up to six steps, which means that most of the spaces are not easily accessible. The lowest step-depth values are in the yards and the corridors between them, and the highest are in some parts of the stairs, the toilets, and the rooms of housekeeping activities.

As for integration, the highest values are recorded in the courtyards and the corridors connected to them. The lowest values are found in the storerooms, kitchens, bathrooms, stairs, and backyards. Al-Sohaymi house in Cairo is a special case in this regard, as the highest levels of integration and connectivity are found in the backyard. The average values of both indicators were found in the middle court (Sahn). This is undoubtedly due to the unusually large area of the backyard in this house, which is 7 times larger than the backyard at Zaynab Khatun's and about 2.5 times larger than the middle court. However, values of integration and connectivity in the middle court of Al-Sohaymi house are almost in the same range as recorded in other houses' courts; it is the backyard where the integration values are exceptionally high.

As for the Gate Count, the highest values are also observed in the courts and the corridors between them. It is the lowest in the backyards, storerooms,

Table 2. **Numerical results and calculations for the five residences**

	Al-Sohaymi	Z. Khatun	Al-Hasani	Al- Azem	Ajaq Bash
Privacy					
Connectivity	3-1695	29-630	3-372	4 - 409	15 - 502
Step Depth	2.19 - 5	1.83 - 4	2.17- 4	2.56 - 6	1.82 - 4
Integration	2.29- 14.96	2.69- 17.59	2.19 - 17.03	1.30- 5.79	3.08 - 13.99
Gate counts	8.8-171	88.6 – 695	46.6-509	5.8-85	28-325
F. Efficiency					
(A) Symmetry/Asymmetry					
Mean depth	1.62 - 5.08	1.92- 4.41	1.39 - 4.04	2.36 - 7.00	1.53 – 3.14
RRA	0.07- 0.45	0.051 - 0.52	0.06 - 0.46	0.17 - 0.76	0.071-0.32
(B) Distributedness/Non-distributedness					
Intelligibility (Connectivity: Integration)	113.3	35.8	21.8	70.6	35.9
Control (CV)	0.05 - 3.05	0.04 - 1.68	0.06 - 1.83	0.04 - 2.08	0.16 - 2.63
(C) Difference Factor of Space					
Variance in integration values	2.29-14.96 (12.67)	2.69- 17.59 (14.9)	2.19- 17.03(14.84)	1.30- 5.79 (4.49)	3.08 - 13.99 (10.91)
(D) Degree of Spaceness:					
Choice	5583.64-226613	1132.89 - 2264	500.62-3391	3775. 73 - 496286	1141.68 – 15689
(E) Airflow					
Connectivity	3-1695	29-630	3-372	4-409	15-502
Integration	2.29 -14.96	2.69- 17.59	2.19 - 17.03	1.30- 5.79	3.08 - 13.99
P. Efficiency Isovists Attributes					
Iso. Area (the court)	427	166.05	126.8 + 95.4	525.4	294.73
Iso. Area (adjacent isovist)	35.7	49.41	63.8	72.2	86.1
Perimeter	301.8	155.5	144.6	294.4	133.8
Vertices (the court)	47	39	27	31	33
Vertices(Adjacent space)	20	21	29	12	33
Adjacent isovists	831.35 + 64.1+ 35.7 + 67.8 + 343 + 232.2 + 25.8 + 8 1697.95	49.41+43.85 + 96.75 + 40.68 + 43.35 + 20.4 + 10.7 705.14	86.3 + 30.7 + 63.8 + 46.7 + 28.8 + 32.21 + 22 310.51	252.2 + 26.5 +72.2 + 62.6+ 12 + 78 503.5	105.2 + 40.4 + 86.1 + 84 + 47.6 + 27.5 390.8
S. Axes	6	9	11	9	6
Measures and Calculations					
(A) Spaciousness					
Isovist area / Number of vertices In the Court	427 / 47 = 9.09	166.05 / 39 = 4.26	222.2 / 27 = 8.23	525.4 / 31- 16.9	284.73 / 33=8.6
Adjacent Isovist	35.7 / 20 = 1.8	49.41 / 21= 2.35	63.8 / 29 = 2.2	72.2 / 12 = 6	86.1 / 33= 2.6
(B) Enclosure					
Openness length $_{open\ edge}$/length $_{closed\ edge}$	0.18	0.26	0.32	0.42	0.16
Jaggedness Isovist perimeter^2/area	91083.24/427= 213.3	24180.25/166 .05=145.6	20909.16/222 .2 = 94.1	86671.36/525 .4=165	17902.44/284 .73= 62.9
Revelation (Σ area adjacent isovists – isovist area)/ isovist area	(1697.95-427)/427=3	(705.14-166.05)/ 166.05 = 3.25	(310.51-222.2)/ 222.2 = 0.4	(503.5-525.4)/ 525.4= (-0.04)	(390.8-284.73)/ 284.73=0.37
(C) Complexity					
Vertices Number of vertices	47	39	27	31	33
Vertex Density Number of vertices/area	47/427= 0.11	39/166.05= 0.23	27/222.2= 0.12	31/525.4= 0.06	33/284.73= 0.11
Roundness Isovist area/perimeter^2	427/301.8 = 1.4	166.05/155.5 = 1.07	222.2/144.6 = 1.5	525.4/294.4 = 1.8	284.73/133.8 = 2.12
(D) Order					
Symmetry: ª symmetry axes	6	9	11	11	6
Redundancy/ regularity ª unique polygon sections / ª symmetry axes + 1	8/6+1= 1.14	10/9+1=1	8/11+1= 0.6	6/9+1= 0.6	6/6+1 = 0.86

kitchens, toilets, stairs, and surrounding spaces. Notably, high levels of movement of the virtual agents are observed in none of the five residences, but in the house of Badr El-Din Al-Hasani. This can be explained by the limited number of spaces (gates) in this house compared to the number of agents used in the analysis (50 agents), causing each agent to pass through the same gate multiple times during the process. A smaller number of agents is usually employed for such a small house, but for the sake of consistency of the experiment, the same number of agents was used for both small and big residences.

B) *In terms of physical efficiency*

As for the measures of Symmetry/Asymmetry, the average values of Mean Depth are almost always around 2, with some values reaching up to 5.08. This indicates that the houses appear to be symmetric, which implies the spaces connect to the original space (root space, i.e., the court) almost directly and are not connected to each other. As previously explained, increasing the so called "symmetry of space" decreases its segregation, which in turn leads to less functional efficiency. This is supported by the low values of RRA, which implies the tendency of the system to be more segregated (less accessible / more controlled). RRA values of 0.6 or lower are considered strongly segregating (Lau, 2010). Thus, with the values consistently below 0.6, this shows the tendency of the system to be more segregated / less accessible.

For Distributedness/Non-distributedness, depending on results obtained for Intelligibility (Connectivity/Integration ratio), it can be said that three of the five layouts have low distributedness, and thus give an impression of low efficiency at the spatial-functional level (Mustafa and Hassan, 2010). The high values of intelligibility in the two other residences, Al-Sohaymi house and Al-Azem palace, are justified by the above-mentioned exceptionally large area of the backyard in the former (with oddly high values of connectivity, raising the average value as a whole) and the unusually low value of integration in the latter due to its distinct layout as a palace in contrast with usual residences. The values in these two residences, although low in comparison with the other three, are actually still high in general. The confined "flow" in the residences is further accentuated by high values of Control (CV), which are all around 2, indicating less accessible spaces and complicated navigation throughout the layout.

Regarding the Difference Factor of Space, the results show very high variance in integration values in all the residences between the courts and the corridors around them, and those in the areas of housekeeping activities, reaching up to 14.9. Note the consistency of the integration values for inner layout areas like kitchens, storage, dining rooms, toilets, and backyards, with differences within 2–3, indicating that these spaces are fairly interchangeable.

As for Spaceness (space-link ratio), the study shows very high values of Choice in the middle areas of the five residences, with average and low values in the other spaces. It is assumed that occupation is more appropriate in areas without "through" circulation, whereas movement is more effective in spaces providing the greatest movement options. The efficiency of the space depends on the balance between the two types of spaces (Mustafa and Hassan, 2010). Except for the house of Badr El-Din Al-Hasani, and due to a small number of spaces included, significant differences are observed between the average values and the maximum values of choice in the other layouts, which indicates that there is a considerable lack of balance. Nevertheless, by taking into account the layouts as a whole, there are all types of spaces present. Although b-and c-types are rather rare, they are not absent.

As for the Airflow, although the court-house plan was always considered an ideal climate solution, the low connectivity and integration values in some areas of the five residences suggest inadequate airflow in those spaces.

C) *In terms of psychological efficiency*

In general, in places where isovists tend to be larger and spread in different directions, the observer is permitted a better evaluation of the space and thus more convenience (Benedikt and Burnham, 1985). Examining the isovists in Table 1, we notice a significant difference between the isovists in the courts, which are large but do not extend in various directions, and those in the adjacent spaces (adjacent isovists), which are skewed with deep dilation in certain directions.

The numerical results and the calculations in Table 2 show moderate values of Spaciousness in most courts, except for Al-Azem palace, where the values are high. In adjacent spaces (adjacent isovists), again except for Al-Azem palace, the values are really low, which characterizes unpleasantly secluded paces.

As for Enclosure, the results show low values of openness and revelation, even in the courts, reaching an extreme of –0.04 in Al-Azem palace, as the area of the isovist in the court exceeds the total of the areas of all adjacent isovists. A result that Franz and Wiener themselves probably could not foresee. High values of jaggedness of the isovists also reflect an intermittent sight-line in the spaces, including ones around the central court.

High Complexity is considered a positive feature of space in Franz and Wiener's opinion. The results show that all spaces are rather complicated or very complicated with big number of vertices and vertex-density for each isovist. For Franz and Wiener, values of roundness over 0:9 are considered high and the spaces are considered complex. Looking at the results in Table 2, it is remarkable that all the values of roundness are over 0:9 reaching 2.12 in Ajaq Bash.

Concerning Order, a large number of symmetry axes (reflecting numerous polygons in every isovist) is a factor of disorder. Rather low values of the redundancy/regularity ratio (below 1) further support this fact.

Conclusion

Confirming the outcomes of many other studies, this paper verifies Space Syntax analysis as a powerful tool that creates a valid alternative to interpret and comprehend spaces by making intangible aspects of space-experience more tangible, or in other words, measurable. Moreover, it is another step towards demonstrating the link between sociocultural background of historical styles and their spatial configuration as captured by Space Syntax methodologies. Space Syntax tools played a role in comprehending these relations, first, by presenting a new language of space that is more statistical and, thereby, more solid, secondly, by constituting a quantitative approach for "evidence-based" analysis of historical architecture, and thirdly, they gave a unique chance to evaluate historical buildings not only in terms of geometric measurements and artistic style, but rather as a social organism with explicit characteristics experienced by the inhabitants.

The analysis of the residences under study, as shown in Tables 1 and 2, reveals that in order to pursue privacy, the inner (activity) spaces of the residences became highly segregated and less functional. The five residences enjoyed good privacy, interchangeability, spaceness and complexity. The visual fields in some inner spaces allow deep vision and fair observation for some of the adjacent and outer spaces, although through very narrow spans.

Nonetheless, in terms of functional efficiency, out of five indicators of physical efficiency, three were found to be lacking, while only two were satisfactory. In terms of psychological efficiency, out of four indicators, only one was found to be satisfactory and three were not. High values of intelligibility in two residences show that, in such segregated layouts, the only chance to produce attractive spaces for life is to make a residence very large. However, in general and for medium spaces, an architectural arrangement with weak connections and great depths of spaces would inevitably exacerbate accessibility and obstruct movement.

The lack of spatial integration and connectivity in activity spaces is also indicative of the layouts with low efficiency at the spatial-functional level. High values of Control also imply complicated navigation throughout the layout and insufficient airflow in most of the spaces.

The results and the configurations of the isovists show that visual fields are either jagged or disrupted, making spaces unpleasantly isolated. They also lack order and uniformity, making the spaces (especially activity spaces in this case) less desirable, as well as less welcoming.

The results of the analysis show that traditional Islamic houses, which have been always considered exemplary for modern generations, are not really pleasant all over the layout of the house, especially in activity areas, or suitable for modern life styles. As the "sacred" interior is safe from being seen by strangers, the overall spatial performance is mild and comfortable only in the courts and the area around them. The daily life activities in these houses are more taxing and are done in unpleasantly secluded spaces.

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ПРИВАТНОСТЬ И СЕГРЕГАЦИЯ В ПРОСТРАНСТВЕ ТРАДИЦИОННОГО ДОМА: АНАЛИЗ «КАЧЕСТВА ЖИЗНИ» В ИСЛАМСКИХ ТРАДИЦИОННЫХ ДОМАХ МЕТОДОМ ПРОСТРАНСТВЕННОГО СИНТАКСИСА

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Аннотация
Введение. Понятие дома выходит далеко за рамки физических аспектов, его сущность неразрывно связана с духовной природой человечества. **Цель исследования**. Данная статья направлена на изучение пространственных формирований пяти исторических исламских резиденций, построенных примерно в одно время в трех городах: Каире, Дамаске и Алеппо. Авторы намерены показать, что на их планировки, в основе которых лежали традиции приватности и видимости, те же традиции оказали негативное влияние с точки зрения функциональной и психологической эффективности. **Методы**. В статье используются формулы пространственного синтаксиса и ПО UCL Depthmap для исследования и анализа пространственных конфигураций этих жилых помещений, с тем чтобы обеспечить новое понимание жизненного опыта и функциональных характеристик, которые всегда считались идеальными. **Результаты** показывают, что планировки в пяти резиденциях предлагают удовлетворительные качества с точки зрения уровня приватности, что, безусловно, является фундаментальной человеческой потребностью. Однако иерархия доступа к пространствам имеет негативные последствия для психологических потребностей и функциональной эффективности. **Результаты**. Это приводит к выводу, что из-за определенных социальных соображений пространственные конфигурации в этих резиденциях, возможно, не могли удовлетворить другие функциональные и психологические потребности пользователей.

Ключевые слова: жилая архитектура; традиционные дома; пространственная конфигурация; функциональная эффективность; синтаксис пространства.