Spatial analysis of different home environments in the city of Trabzon, Turkey

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Abstract
In morphological studies analysis, rather than intuitive explanations, of differences pertaining to the man-made environment requires an understanding of the relational or configurational structure of that specific spatial system. Space syntax is an approach developed for analysing those spatial configurations. This study attempts to formulate the various spatial patterns that have been formed through the history of Trabzon, by means of Space Syntax techniques in a concrete way. It is suggested that the analysis techniques of Space Syntax, supported by a wide range of knowledge, have contributed greatly in the formulation of spatial models in concrete form, further intuition, and can be accepted as a useful tool for defining similarities and differences between different home environments.

Keywords:
space, morphology, space syntax, Trabzon

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1. Introduction: Space as a social, cultural and configurational artefact

In architecture, space has been a central research theme. In addition to its function as a physical shelter for the various activities of people and societies, space is also a meaningful and informative formation expressive of the culture and life-style of different societies and of the transformations that the social structure has experienced. It can be proposed here that distinctive characteristics of societies exist within spatial systems, and their knowledge is conveyed through space itself, and through the organization of spaces.

Spatial formations can be seen as visual symbols of societies (Hillier and Hanson, 1984). In reality, characteristics of societies have a certain form with those spatial formations and the cultural differences between societies come to light by those refined structures. For example, the built environments which reflect separation and those which reflect centrality in the settlement pattern tell different stories about the way of life in that society as do cities which are formed with buildings directly adjacent to the street and those which are formed with ones having courtyards in between. In both cases, spatial formations appear as the signs of that culture. As Hillier and Hanson express, we read the space and anticipate a life-style.

According to Rapaport, without trying to define culture one can say that it is about a group of people who share a set of values, beliefs, a worldview and symbol system that are learned and transmitted. These create a system of rules and habits which reflect ideals and create a life-style, guiding behaviour, roles and manners as well as built forms. What distinguishes one environment from another is the nature of the rules embodied or encoded in it. These rules must themselves be identified with the formation and organization of spaces in the whole. As Rapaport pointed out, if design is accepted as the organization of space, time, meaning and communication, then we are more concerned with the relationship among the elements and underlying rules than with the elements themselves (Rapaport, 1977). In reality, whether it is at the settlement or at the building scale, the man-made environment is formed by similar elements, like the house, the street, the cul-de-sac, or the room, the hall, the courtyard; but differs from one culture to another by how these elements are organized, and their meanings.

According to Hillier, space is a more inherently difficult topic than physical form for two reasons: first, space is a vacancy rather than a thing so even its bodily nature is not obvious, and cannot be taken for granted in the way that we think we can take objects for granted. Secondly, related spaces cannot be seen all at once but require movement from one to another to experience the whole (Hillier, 1996). To understand and experience the man-made environments, the spatial elements and their relational or configurational properties must be clarified.

What does the term “configuration” tell us? According to Hanson (1998), spatial relations exist where there is any type of link between two spaces. Configuration exists when the relations that exist between two spaces are changed according to how we relate each to a third. Configurational descriptions, therefore, deal with the way in which a system of spaces is related together to form a pattern, rather than the more localized properties of any particular space.

Morphological studies try to clarify these configurational properties and their meanings by mathematical and graphical analysis, rather than intuitive explanations. Space syntax is an approach developed for analysing spatial configurations. It aims to describe spatial models and to represent these models in numerical and graphical form; i.e., to interpret them on a scientific basis. In the last two decades, with its theoretical background, this approach has found its chance to be implemented in a wide field of research, training and practice.

2. The sample and the theme

This study attempts to formulate in a concrete way, with the help of Space Syntax, the various spatial patterns that have been formed throughout the history of Trabzon.

Trabzon, a beautiful city located by the Black Sea, once referred to as "Pontos-sea" by the Greeks, is full of remains of its unique historical heritage. Remnants of a variety of cultures that once occupied the city now exist in harmony in its natural green and blue setting. The city was dominated successively by Byzantine, Ottoman and Turkish cultures over the course of time. Following the Turkish Independence War, a majority of the local Greek population migrated to Greece. Being one of the most important trading ports of the region during its history, Trabzon's strategic role in the region has found a new meaning with the establishment of the Turkish Republic. The urban pattern of Trabzon that maintained its original form until the 1960s has been considerably transformed possessing a totally different appearance today. Although it was not possible to conserve the historical heritage to a great extent, the city now reflects a contemporary image with the modern buildings constructed to meet the demands of the new century. Today, with its geographic and strategic location on the Black Sea, and its port and university, the city of Trabzon is still a social, cultural and commercial centre although its physical characteristics are quite different from those of its past.

The aim of this study is to show how different social meanings and cultural values are formed in home environments, how these become reflected in spatial organizations and eventually how different cultures differentiate themselves with their own specific spatial models. The city of Trabzon is selected as the subject of the case study.

The case study is carried out with the intention of defining answers for three major questions by means of mathematical and graphical techniques:

1. Is it possible to talk of abstract rules underlying spatial forms, or in other words, genotypes, specific to different cultural groups in the city of Trabzon?
2. If so, what are the similarities and differences among these genotypes? How did these spatial models, which have been generated within a historical process by different cultural groups that existed together, influence each other, or in what ways did they change with such a process?
3. When the findings of this study and the theses of previous research on Trabzon are considered, what can be said about the potentials and limitations of the spatial techniques used by Space Syntax?

3. The method of analysis

Whether dealing with adjacency relations or with permeability characteristics of spatial models, morphological studies related to the built environment are proposed to be implemented through a tri-phased process, first, interpretation of knowledge derived from spatial models via numerical and graphical languages, second, analysis of those interpretations, and finally, attribution of social meaning to numerical data. Here, analysis techniques are employed as tools to define spatial models and are based on topology, geometry or mathematics. Interpretations and explanations of these descriptions are followed by social knowledge. Yet, neither such an analysis of space nor the derivation of social meaning from numerical knowledge should be considered as a simple mathematical deduction. A rich knowledge base, based on social and cultural characteristics of users, physical characteristics of that site, etc., is assumed to accompany this process.

The research conducted here consists of a comparative analysis of the spatial models generated in three different cultures in Trabzon by using space syntax techniques. These can be classified as: 1. Spatial models generated by Minorities, 2. Traditional models generated under the influence of the Ottoman culture, and 3. Contemporary spatial models effective after the foundation of the Republic.

It must be clarified that the term “Minorities” refers mainly to the Greek and Armenian populations that shaped the housing environment due to the dominance of Christianity and the extroverted and western lifestyles of the society at hand. Following the conquest of the city by the Ottomans in 1461, the Islamic process started to reshape the city population but didn’t reflect directly on housing environments. The Muslim and Christian populations sometimes lived side-by-side, sometimes mingled in the same environment for years. The growing Muslim population also built its characteristic architecture with mosques, inns, baths, bazaars and traditional houses. As a result of sharing a mutual atmosphere, both cultures had impacts on each other and co-existed in the same housing environment for centuries. On the other hand, it can easily be observed that the Muslim population has its distinctive characteristics based on the introverted lifestyles and traditional, conservative values of Ottoman society. With the migration of the local Greek population to Greece in 1923, the living culture of Minorities started to disappear. After the foundation of the new Republic a synthesis of rural and urban characteristics shaped completely different housing patterns. In this period under the forces of rapid urbanization and westernisation many social and cultural changes occurred and the physical environment was influenced by all of these developments. Thus, the emerging new hybrid culture created new kinds of urban and housing patterns.

In this study, spatial analysis of the built environment is carried out at the building scale. A sample, which consists of 20 houses from each group, was chosen to be investigated. Plans of the houses were obtained by site surveys and from previous studies on Trabzon conducted by Çevik, 1984, Güzel, 1984, Karpuz, 1991, Kulo_lu, 1994. The study is conducted on the original plan layouts of the houses, so the plan layouts of the houses that have been subject to alterations are redrawn in their original form with the help of observations made on site and interviews held with the households.

Figure 1: Housing Patterns Related to Three Samples (Dursun, 2002)

Spatial analysis is realized in two phases:

1. Defining the general characteristics and everyday life of the houses such as house-street relations, plan typologies, patterns of use, construction and building materials, (Figure 1).

As the focus of concentration is on syntactic analysis, a brief summary is provided to describe the types of houses and the lifestyles of relevant households.

The first group of stone houses are mostly terraced houses located in gardens and the mean value of their stories is 3.2. They are usually located parallel to the street and can be accessed directly. The spatial organization of this category reflects the impacts of a western life style, rooms are allocated for different functions and are organized around halls between levels. Usually living and activity spaces, the kitchen and sometimes the toilet and bath are located on the ground floor which is sometimes a few steps higher than the street. The first floor is allocated for living and sleeping activities. If a third floor is constructed, bedrooms and guestrooms are located there. Storage rooms are placed in the basement floor.

The second group of wooden houses are detached houses and the mean value of their stories is 2.75. Most of these houses open directly to the garden and they are separated from the street by high walls. This group of houses reflects the characteristics of traditional Turkish houses and they have two fundamental elements forming the spatial structure: the rooms and the sofa. Service spaces are on the ground floor such as the kitchen, winter room, storage room, and larder and living and sleeping activities are located on the second floor. Although the rooms are not specialized and each room is a place for living, eating, working and sleeping together, upper rooms can be accepted as bedrooms with their separate baths. These spaces

are arranged around the sofa which is the central space connecting all the rooms. It both serves as a circulation and social space. The toilet is located separately in the garden and most of the houses do not have a basement floor. If there is a basement floor, this floor is connected to the garden for living activities so it is functionally different from the basement floors of the first group of houses.

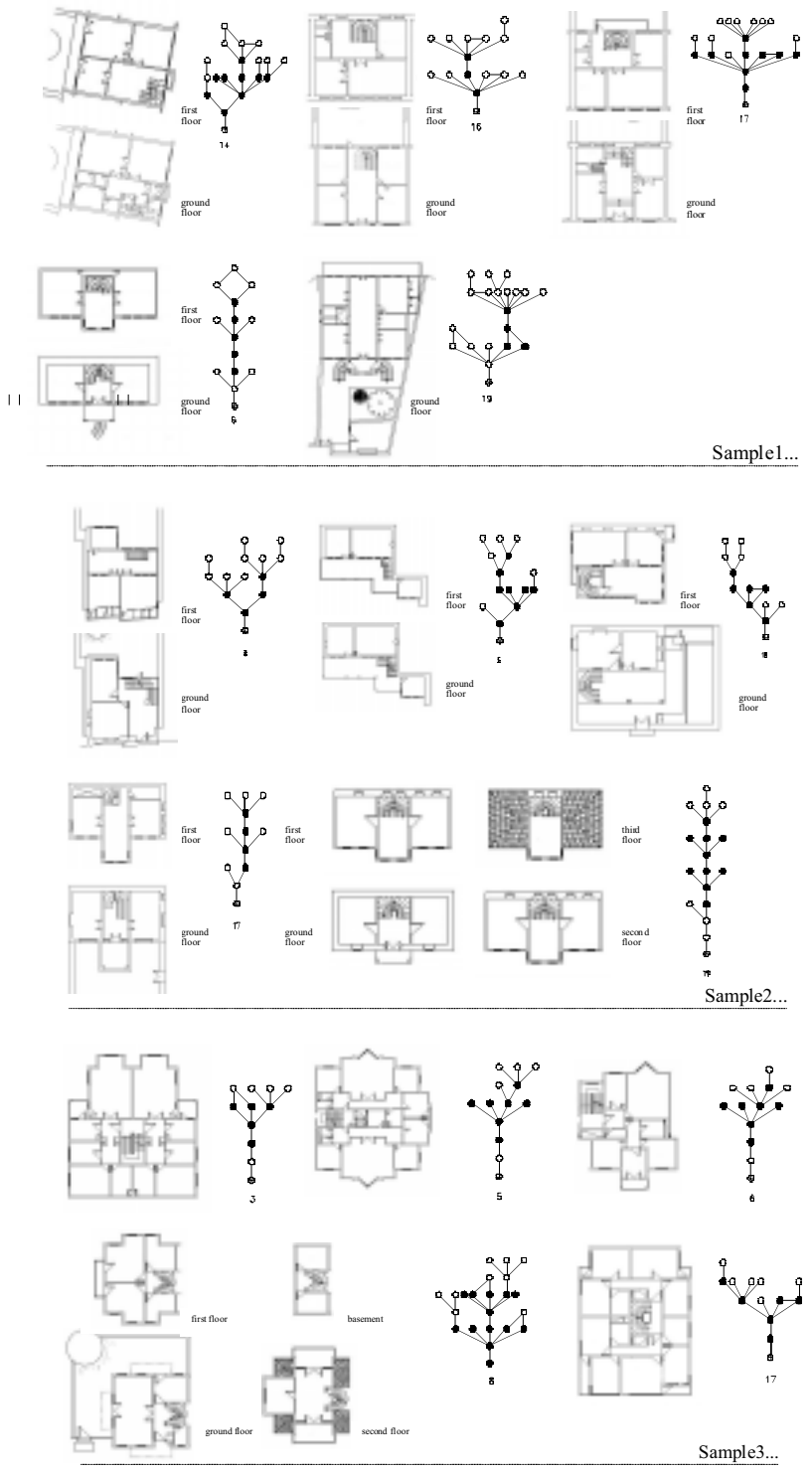

Figure 2: Plans and Justified Graphs of Five Examples from Each Sample

The third and final group of openings that were chosen mainly from the last decade is mostly apartment flats. Detached and semi-detached houses are rarely seen. These flats are separated from the street by semi-public spaces and apartment halls. In spatial organization, rooms are allocated to different functions and organized around sequential halls. The living room, kitchen, and toilet are arranged around the first hall whereas bedrooms and baths are around the second or third halls.

2. Searching for the spatial models of the houses with the help of space syntax techniques and syntactic measurements.

In this kind of analysis first justified graphs of these houses are drawn both by using the exterior as the base and by excluding it in order to understand the relative importance of household-household and household-guest relationships. The relation between the house and the street is accepted as a definitive characteristic. Therefore, the spaces between the house and the street, the spaces that have access from these open spaces, and the main living unit are taken into consideration as a whole. Five examples of each sample and their justified graphs are presented in Figure 2. Second, syntactic analyses of the houses are presented without considering the functions assigned to particular spaces. The final data related to the three samples is tabulated in Table 1. Third, the houses are represented by means of "rooms" in order to see how allocations by different functions are related to each other and how they are located within the whole. To make a comparative analysis, the spaces such as porch, entrance hall, apartment hall, hall, stair, etc., are grouped under the label of circulation, the spaces such as "main room", "winter room", living room, salon, etc., under the label of living, the spaces such as "courtyard", "sofa", etc., under the label of circulation/living, the spaces such as study room, atelier, garret, etc., under the label of activity, the spaces such as baths, toilets, etc., under the label of sanitary spaces, and the spaces such as kitchen under the label of cooking. The spaces such as storage area, larder, etc., are grouped under the label of storage, and finally the spaces such as balcony, terrace, etc., under the label of semi-closed spaces. The final data related to these analyses is tabulated in Tables 2 and 3. Based on these final syntactic data, the research later focuses on whether it is possible to find genotypes or common rules in spatial organizations for each housing sample, and if so, their characteristics are indicated.

4. Comparative syntactic analysis and interpretations

In the light of the syntactic analyses that are expressed by justified graphs of the houses, it becomes possible to observe that there is not only one housing typology in each sample. These houses vary according to their locations, topographical

characteristics, number of spaces, etc. However, some basic rules and tendencies can be observed when the relations between spaces are observed. These can be summarized as follows:

1. Although justified graphs of these houses are different from each other, all of them have a tree-like form with many branches (Figure 2). It is postulated that different spaces between street and houses, topographic characteristics, relations of houses with their neighbours and open spaces, different numbers of stories and spaces, and finally, different spatial relations, cause this branched formation.

The other common characteristic of the graphs is that their formations are based on some transitional spaces such as halls, sofa, and hall-living-activity spaces. All space organizations consist of spatial units that have access from these spaces and these spaces exist in all rings. In some part of the Minority houses and in all traditional Turkish houses these spaces also function to shelter living or activity facilities. In the houses of the modern period, these spaces are only used as transitional spaces as with some of the Minority houses when their geometrical, dimensional characteristics are taken into account. In these cases, living and activity functions such as studying or hosting guests take place in some specialized rooms that open directly to these spaces.

2. When the end points or the deepest spaces of the justified graphs are examined, it is found that these are generally bedrooms and balconies in the Minority houses, baths in traditional Turkish houses, and balconies in the modern Turkish houses. These spaces are followed by baths, toilets and storage spaces in the first group of houses, bedrooms and toilets in the second group of houses, and bedrooms and baths in the third group. Location of the bedrooms and baths can be explained by privacy requirements, but the locations of the balconies or storage rooms have different meanings. This kind of formation can be explained not by privacy requirements but by the effects of the western type of plan layouts that are organized around circulation spaces.

Maximum mean depths of the spaces in the three samples are 7.15, 7.40 and 6.40, respectively. These values are between 5 and 9 in the first case, 5 and 12 in the second case, and 5 and 9 in the last case. This value is lower in the modern period when compared with the other two groups because of the organization of all spaces on a single floor. When we evaluate this group separately as apartment flatsand detached houses these values are 6.00 and 7.33, respectively. These results show that modern detached houses reflect the same characteristics as the other two groups of houses.

Basic Syntactic Data Related to Three Different Samples (mean)										
sample	space number	space/ link ratio	integration (with exterior)			BDF	integration (without exterior)			BDF
			min	max	mean		Min	max	mean	
1	23,20	1,086	0,6967	1,9794	1,2956	0,79	0,6543	1,9136	1,2684	0,78
2	19,65	1,047	0,7776	2,1055	1,4159	0,81	0,7869	2,1510	1,4457	0,81
3	16,35	1,051	0,5919	2,0252	1,2373	0,74	0,5632	1,7751	1,2030	0,77

Table 1: Basic Syntactic Data Related to Three Samples

3. When the justified graphs are analysed, rings are found among all three samples. Based on the space link ratios, a kind of space formation making alternative routes between related spaces is observed much less in traditional houses than in the other two groups of houses (Table 1). 25% of Minority houses, 45% of traditional houses and 40% of modern Turkish houses have no rings because of their space link ratio being equal to 1. Rings that are frequently seen in the first group of houses point to the sophisticated, subtle spatial models reflecting the way of life of their users. It can be stated that these spatial models reflect much simpler space organizations in the last two groups of houses due to their decreasing rings.

In the houses of Minorities the most common rings exist inside the houses and connect living or activity spaces and halls on the ground floor and bedrooms and halls, and sometimes balconies, on the upper floors. Most repeated outside rings contain gardens or courts, entrance halls, storage areas, and kitchens. In traditional Turkish houses, the most common rings are observed outside the houses and connect gardens or courts, entrance, storage areas, and kitchens. The inside rings are rare and enable a relation between the bedrooms and sofa. In modern Turkish houses, the most common rings are inside the houses and connect the entrance hall, living room, kitchen and balconies and halls, bedrooms and balconies. It is very striking that the rings, which occur between bedrooms, halls and balconies can be seen in all three samples.

4. When the mean numbers of spaces are examined, it is observed that this value decreases in houses of the third sample (Table 1). This result is expected when the formation of the apartment flats is considered. These dwellings shelter living and sleeping activities on the same floor with a few activity spaces and do not have any multifunctional, transitional and storage spaces. Distribution of the functions between floors among the three samples is summarized as follows.

5. Table 2 sets out the numbers, mean depths, and mean integration values of the functional groups, and Table 3 indicates the order of integration values appearing in the three samples.

Numbers, Mean Depths, Mean Integration Values for Functions

Sample	Numbers	Dmean	Imin	Imax	Imean	BDF
Space: circulation						
...1	20	3,39	0,4417	1,8740	0,9693	0,63
...2	20	3,80	0,5523	2,0765	1,1378	0,68
...3	20	3,06	0,4173	1,7356	0,9078	0,64
Space: circulation/living						
...1	12	5,57	0,5976	1,5857	1,2033	0,82
...2	20	5,03	0,5098	2,1374	1,0696	0,63
...3	-	-	-	-	-	-
Space: living						
...1	20	3,68	0,7215	1,5376	1,1453	0,89
...2	18	4,04	1,0149	1,6887	1,3404	0,94
...3	20	4,35	0,6828	1,8595	1,1696	0,81
Space: activity						
...1	10	4,75	0,8497	1,9895	1,2148	0,85
...2	5	6,60	1,1046	2,3864	1,9056	0,88
...3	3	5,00	1,0666	1,7555	1,3477	0,95
Space: cooking						
...1	17	3,78	0,8016	2,0856	1,2517	0,81
...2	17	3,00	0,9224	1,8966	1,3740	0,89
...3	20	3,85	0,9093	1,3935	1,1305	0,96
Space: cooking /activity						
...1	5	3,60	1,3784	1,9678	1,5725	0,97
...2	3	3,33	1,3636	2,1374	1,6939	0,95
...3	-	-	-	-	-	-
Space: sleeping						
...1	20	6,30	0,9873	2,1623	1,4416	0,88
...2	20	6,56	0,9771	2,4974	1,5271	0,82
...3	20	5,37	0,9093	1,5806	1,2529	0,94
Space: bath						
...1	17	5,89	0,9774	2,4026	1,4561	0,80
...2	17	6,30	0,9771	2,2615	1,7603	0,86
...3	20	5,43	1,0243	1,5924	1,3254	0,96
Space: wc						
...1	16	4,42	1,1691	2,1143	1,4710	0,90
...2	20	5,48	1,0847	2,4299	1,7303	0,87
...3	18	4,11	1,0998	1,5933	1,3072	0,97
Space: semi-closed spaces						
...1	13	6,32	0,9459	1,9422	1,4751	0,90
...2	4	7,60	1,4997	2,4974	1,8732	0,94
...3	17	5,68	1,1333	2,2128	1,6022	0,91
Space: storage						
...1	19	4,69	0,8497	2,4506	1,6642	0,80
...2	12	3,77	1,0430	2,6935	1,6768	0,83
...3	4	4,00	0,9484	1,8888	1,4794	0,91
Space: garden /court						
...1	18	2,38	0,9613	2,1046	1,3673	0,87
...2	19	1,48	0,9566	2,1624	1,3743	0,86
...3	6	3,00	1,1374	2,6470	1,7996	0,86
Space: street (exterior)						
...1	20	0,33	1,0581	2,1358	1,5675	0,90
...2	20	0,00	1,1467	2,5723	1,7711	0,87
...3	20	0,00	1,1951	2,6653	1,8781	0,87

Table 2: Numbers, Mean Depths, Mean Integration Values of Functions

In Table 3, it can be easily seen that the most integrated spaces are circulation and circulation/living spaces. All spatial models in these samples are structured around central spaces such as the halls and the sofa. These spaces are followed by living spaces. Living and cooking spaces are always on the integrated side of the mean. The most striking point here is the location of the exterior spaces. These spaces always appear as segregated spaces and occur on the segregated side of the mean. Sleeping spaces that are on the segregated side of the mean in the houses of Minorities move to the integrated side in the other two groups of housing. Sanitary spaces such as baths and toilets take place on the segregated side in the first two cases and then

are transferred into the integrated side in the last case. Semi-closed spaces such as balconies and terraces constitute the most segregated spaces in all samples. When the integration values of spaces are compared, the spaces in the traditional houses have higher values than those of the other two groups, except for the exterior, garden/ court and circulation/living areas (Table 2).

c<	l<	c/l<	a<	ck<	g/ct<	slp<	sn (b)<	sn (wc)<	scs<	st<	c/a<	Str<
0,9693	1,1453	1,2033	1,2148	1,2517	1,3673	1,4416	1,4561	1,4710	1,4751	1,5675	1,5725	1,6642
c/l<	c<	l<	ck<	g/c<	slp<	str <	c/a<	sn (wc)	sn (b)<	st<	scs<	A
1,0696	1,1378	1,3404	1,3740	1,3743	1,5271	1,6768	1,6939	1,7303	1,7603	1,7711	1,8732	1,9056
c<	ck<	l<	s<	sn (wc)	sn (b)<	a<	str<	scs<	g/c<	St		
0,9078	1,1305	1,1696	1,2529	1,3072	1,3254	1,3477	1,4794	1,6022	1,7996	1,8781		

integrated segregated

mean

c: circulation, l: living, c/l: circulation/living, a: activity, ck: cooking, g/ct: garden/court, sl: sleeping, sn: (baths), sn: (wc): yam: scs: (balcony/terrace), st: street, c/a: cooking/activity, str: storage

Table 3: Integration Orders of Three Different Samples

6. The mean integration value of Minority Houses with the exterior is 1,2956, the base difference factor which express the differentiation between minimum, maximum and mean integration values is 0.79. These values are 1.4159 and 0.81 in the traditional Turkish houses and 1.2373 and 0.74 in the modern Turkish houses, respectively (Table 1). High integration values point to considerably segregated spatial patterns and this tendency appears much more intensively in traditional houses. Although the values of the other two housing groups are very close to each other, modern Turkish houses seem to have had much more integrated spatial models. This result can be seen as an outcome of the living patterns placed in a single floor. The high difference factors in the three samples indicate that there is no major difference between the integration values of the spaces that are allocated for different functions.

The mean integration value of Minority Houses without the exterior is 1.2684 and the base difference factor is 0.78. These values are 1.4457 and 0.81 in the traditional Turkish houses, and 1.2030 and 0.77 in the modern Turkish houses respectively (Table 1). Compared to the integration values and base difference factors with exterior, there is no important change in this case. However, when we analysed the integration values in the three samples, house by house, two different tendencies appeared:

Similar to the classification of the study of Turkish Houses by Orhun (Orhun et all, 1995, 1996), the houses that are shallower when the exterior participates in the configuration are considered to be extroverted houses, and the houses that are more integrated without the exterior are considered to be more closed and introverted

houses. In this study the houses that constitute strong relations with the outer spaces and become more segregated when the exterior space is excluded are called "extroverted houses". The houses that do not constitute strong relations with outer spaces and become more integrated when the exterior space is excluded are classified as "introverted houses". These houses are also classified into two groups, namely, "houses facing the street" and "houses facing the gardens/courts" based on the relation between the living unit and the street. When the justified graphs of these houses are analysed, it can be seen that the integration cores of the introverted houses are located much more in the centre of the access graphs, whereas the integration cores of the extroverted houses are moved slightly towards the root.

H	I_{mean} with exterior	I_{mean} without exterior	Most Integrated Space with exterior		Most Integrated Space without exterior		Most Segregated Space with exterior		Most Segregated Space without exterior	
introverted houses...										
4	1,5582	1,5141	eh-p	0,9130	s	0,7851	str	2,4506	group[p]	1,9627
5	1,5582	1,5141	eh-p	0,9130	s	0,7851	str	2,4506	group[p]	1,9627
6	1,6475	1,4864	eh	0,961	h/l	0,8701	b	2,4026	group[p]	2,0302
11	1,5320	1,4327	s	0,8869	h	0,7357	str-st	2,1358	b-wc	1,9807
19	1,1379	0,8297	h/l	0,5976	h/l	0,1915	str	1,7927	b	1,2764
20	1,3504	1,0744	h	0,7533	h/l	0,5269	str	2,2212	a	1,7665
extroverted houses...										
houses facing the gar/crt										
10	1,1149	1,1311	h	0,5611	h	0,5377	st	1,5928	str	1,3856
12	1,2575	1,3086	h	0,6495	h	0,6818	br	1,8446	br	1,8595
18	1,3306	1,4506	h	0,8032	h	0,8479	str	1,8924	str	2,2677
houses facing the street										
1	1,4776	1,4805	h	0,8571	h	0,8621	lr	2,4289	lr	2,4574
2	1,2578	1,3163	eh	0,7000	h	0,7250	lr	2,0138	lr	2,2526
3	1,2823	1,3070	eh	0,7134	eh	0,7329	lr	1,9521	lr	1,9924
7	1,2781	1,2946	h	0,6833	h	0,6828	br	1,9815	br	1,9727
8	1,2495	1,2688	s	0,6861	s-h	0,6943	k/ldr	1,9678	k/ldr	2,0830
9	0,9453	0,9579	h	0,4489	h	0,4593	br	1,3948	br	1,4480
13	1,3180	1,3366	eh	0,5766	eh	0,6049	br	2,1143	br	2,1446
14	1,2510	1,2879	h	0,5659	h	0,5888	g	2,0939	g	2,2094
15	1,3119	1,2858	h	0,6697	h	0,6618	bl	1,9186	bl	1,9232
16	1,0479	1,0846	s	0,5523	s-h	0,5766	wc	1,6144	wc	1,6337
17	1,0054	1,0008	eh	0,4417	eh	0,4527	group[p]	1,3250	group[p]	1,3582

eh: entrance hall, **h:** hall, **s:** stairs, **s-h:** stairs-hall, **h/l:** hall-living room, **st:** street, **g:** garden, **br:** bedroom, **b:** bath, **b-wc:** bath-wc, **k-ldr:** kitchen-laundry, **bl:** balcony, **lr:** larder, **str:** store, **p:** porch, **group[a]:** kitchen/bath-living room-bedroom , **group[b]:** kitchen-living room-bath, **group[c]:** wc-store-garden

Table 4: Housing Genotypes in the Houses of Minorities

In the Minority houses, a small group of houses can be called "introverted houses". In these houses, the exterior always occurs on the segregated part of the mean when we take into account the integration values with the exterior. In other words, these houses are separated from the street with some exterior space like gardens or courts. Integration values decrease when the street and the spaces between the street and entrance halls are not considered. In this situation, most segregated spaces like storage spaces are substituted by different kinds of spaces like kitchens, baths, toilets and living spaces. Extroverted houses constitute the largest group in

this first sample. The exterior is also on the segregated part of the mean, but integration values increase and the most segregated and integrated spaces remain almost the same when the street and spaces between the street and the entrance are not considered. In the houses facing the street, the street seems to be a more integrated space than the garden or does not exist in the spatial system. These houses constitute strong relations with the street and can be accessed directly from the street. In the houses facing the gardens/courts, gardens are more integrated spaces than the street. These houses are separated from the street by high walls but integrated to the gardens (Table 4).

H	I_{mean} with exterior	I_{mean} without exterior	Most Integrated Space with exterior		Most Integrated Space without exterior		Most Segregated Space with exterior		Most Segregated Space without exterior	
introverted houses...										
2	1,4446	1,3028	e	0,7923	sf	0,6599	str	2,4617	wc	1,9796
4	1,6407	1,4000	e	0,9484	sf	0,6363	str	2,6935	$group_a$	1,9090
11	1,4247	1,3705	sf	0,7432	sf	0,6818	st	2,2536	b	1,9215
13	1,8661	1,8447	ln	1,1250	ln	1,1222	$group_c$	2,4974	wc	2,7150
17	1,4572	1,3776	e	0,7658	sf-s	0,7251	st-wc	2,0422	k-wr	1,8852
19	1,6632	1,4889	sf-s	1,0227	sf	0,8248	st	2,5723	gr	2,1446
extroverted houses…										
houses facing the street										
3	1,4690	1,5566	e-s	0,8649	s	0,9348	wc	2,1143	wc	2,4545
5	1,0933	1,1120	sf	0,5098	sf	0,4805	b-wc	1,5294	b-wc	1,5376
8	1,1054	1,1415	sf-s	0,5888	sf	0,5808	wc	1,5496	wc	1,6398
12	1,6472	1,6293	e-s	1,0132	s	1,0187	wc	2,3123	wc	2,2920
houses facing the gar/crt										
1	1,3935	1,5636	c	0,7208	sf-s	0,9091	b	2,0662	os	2,2727
6	1,3652	1,4678	c	0,7222	sf-s	0,8297	b	1,9118	mr	2,1060
7	1,2380	1,2404	sf	0,6516	sf	0,6000	b	1,8643	b	2,1111
9	1,2507	1,4088	e	0,6181	e	0,7474	b	1,7770	lr	2,2920
10	1,3319	1,5087	e	0,7725	e	0,8686	b	2,0450	b	2,4196
14	1,4060	1,4262	sf	0,7783	sf	0,7555	gr	2,2806	gr	2,2666
15	1,4947	1,6727	e	0,8938	s-ln	1,0666	b	2,2615	wc	2,4444
16	1,2500	1,3595	e	0,6149	e	0,7222	g	1,8790	g	2,1242
18	1,4128	1,5282	c	0,7698	sf	0,7891	b	2,0896	b	2,1419
20	1,3636	1,5141	c	0,6363	s	0,7851	br	1,9090	$group_b$	1,9627

e: entrance, **e-s:** entrance-stairs, **sf:** sofa, **sf-s:** sofa-stairs, **st:** street, **g:** garden, **c:** courtyard with paved stones, **ln:** landing, **b:** bath, **gr:** garret room, **br:** bedroom, **b-wc:** bath-wc, **k-wr:** kitchen-winter room, **mr:** maid room, **os:** open space, **group[a]:** kitchen-winter room-bath, **group[b]:** kitchen/bath-winter room-bedroom, **group[c]:** bedroom-balcony-larder

Table 5: Housing Genotypes in the Traditional Turkish Houses

In traditional Turkish houses, a small group can be classified as "introverted". In these houses, the exterior always occurs on the segregated part of the mean when we take into account the integration values with the exterior. Integration values decrease when the street and the spaces between the street and the entrance are not considered. In this situation, most segregated spaces like the street and storage spaces are substituted by sanitary spaces such as the bath and the toilet. Extroverted houses constitute the largest group in the second sample. The exterior is also on the segregated part of the mean, yet these spaces are not the most segregated spaces at all. The most segregated spaces are now baths and toilets. Integration values increase and the most segregated sanitary spaces remain almost the same when the street and the

spaces between the street and the entrance are considered. Unlike the Minority houses, most of the houses in this group seem to have been houses facing the gardens/courts (Table 5).

H	I_{mean} with exterior	I_{mean} without exterior	Most Integrated Space with exterior		Most Integrated Space without exterior		Most Segregated Space with exterior		Most Segregated Space without exterior	
introverted houses...										
1	1,1293	1,0633	h	0,5333	h	0,5093	st	1,9333	bl	1,4431
2	1,2287	1,2468	eh	0,5286	eh	0,6028	st	1,9701	bl	1,8839
3	1,2468	1,1964	eh	0,5275	eh	0,5800	st	2,1099	bl	1,7401
4	1,2661	1,2351	h	0,6070	h	0,5499	st	2,0485	bl	1,9246
5	1,2520	1,2000	eh	0,6049	h	0,5454	st	2,0896	$group_a$	1,4545
6	1,1336	1,0545	eh	0,4949	h	0,3636	st	1,9796	bl	1,6363
7	1,1646	1,0876	eh	0,4521	eh-h	0,4350	st	2,0346	$group_b$	1,3051
10	1,2742	1,0513	h	0,6028	h	0,2900	st	2,2606	k	1,7401
11	1,4291	1,2562	h	0,7748	h-s	0,7208	st	2,5104	bl	1,7779
12	1,4738	1,2081	h-s	0,8678	h	0,5766	st	2,6653	wc	1,9220
13	1,1428	1,1167	eh-h	0,5311	h	0,4399	st	1,8968	bl	1,7046
15	1,2092	1,2351	eh	0,5311	eh	0,6049	st	1,8968	bl	1,7046
20	1,2661	1,2351	h	0,6070	H	0,5499	st	2,0485	bl	1,8146
extroverted houses…										
8	1,3030	1,3471	h-s	0,7333	h	0,7432	t-lr	1,8888	t-k	1,9659
9	1,3068	1,3612	eh-s	0,7275	s	0,7640	bl	1,9226	$group_c$	1,9524
14	1,4728	1,5709	eh	0,7445	eh	0,8391	g	2,6470	g	2,7570
16	1,0243	1,0709	eh	0,4173	eh-h	0,4805	bl	1,4795	bl-w	1,5376
17	1,0490	1,0824	eh	0,4399	h	0,4521	bl	1,5947	bl	1,6578
18	1,1276	1,1226	h	0,4936	h	0,4959	bl	1,7927	bl	1,7975
19	1,2466	1,3183	eh	0,6198	eh-s	0,7208	bl	1,7356	bl	1,7830

eh: entrance hall, **eh-h**: entrance hall-hall, **h:** hall, **h-s**: hall-stairs, **st**: street, **g**: garden, bl: balcony, **bl-w**: balcony-wc, **t-l**: technical space-larder, **group**[a]: kitchen-wc-larder-bedroom-bath, **group**[b]: kitchen-wc-salon-bedroom-bath, **group**[c]: technical space-larder-balcony

Table 6: Housing Genotypes in the Modern Turkish Houses

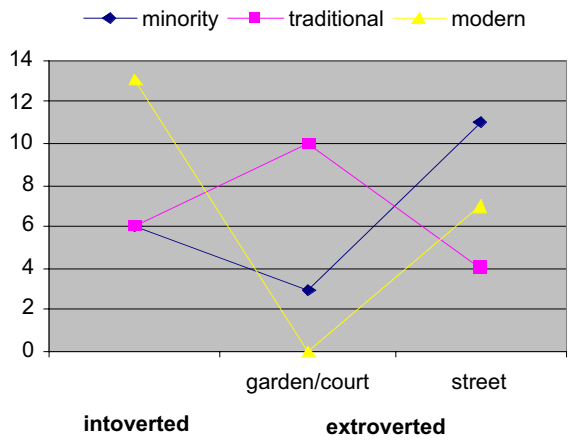

Figure 3: Distribution of Housing Genotypes in Three Samples (Dursun, 2002)

In the third sample, the introverted examples constitute the largest group. In these houses the exterior is always on the segregated part of the mean when we take into account the integration values with the exterior. Houses are separated from the street with semi-public spaces, apartment halls and gardens. Integration values decrease when the street and the spaces between the street and the entrance halls are

Most Segregated Space
with without

not considered. In this situation, most segregated spaces like the street are replaced by the balconies. Extroverted houses constitute a much smaller group in the third sample. The exterior is also on the segregated part of the mean as in the former group, but these spaces are not the most segregated spaces at all. The most segregated spaces are now the balconies. There is no space separating the house from the street. One can enter from the street directly into the entrance hall and into the apartment hall, or the exterior is integrated into the domestic space organization by the gardens and terraces. Integration values increase and most spaces like the balconies remain almost the same (Table 6).

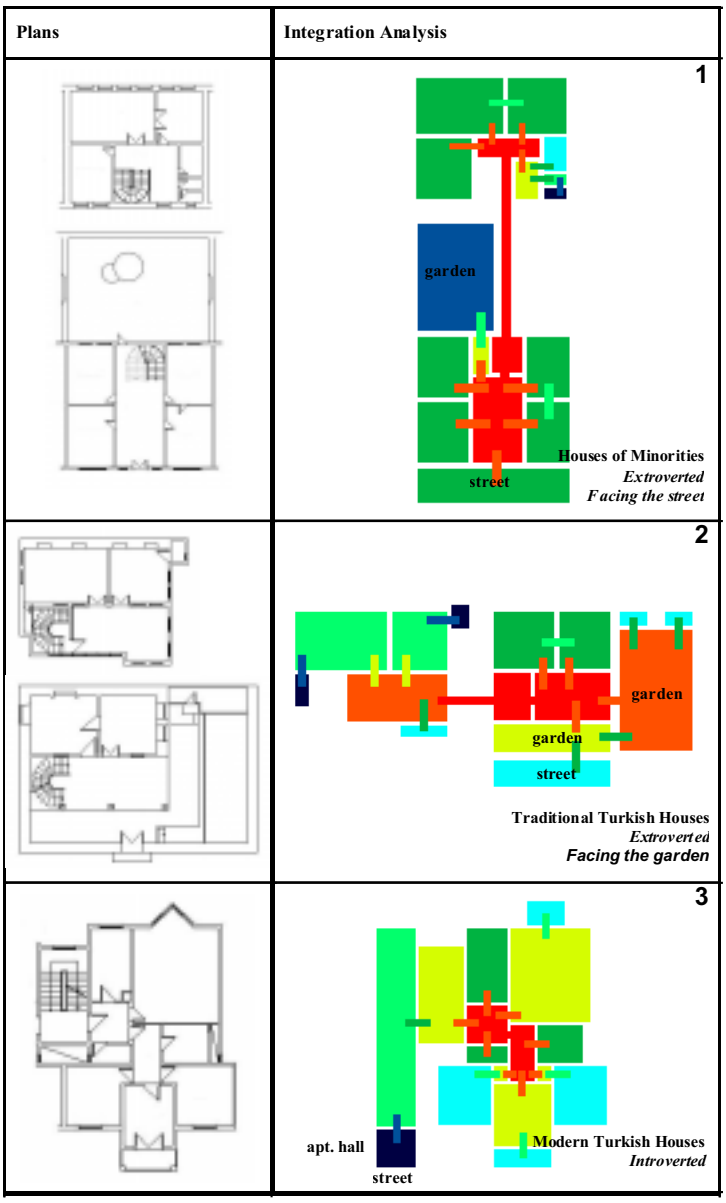

Figure 4: Housing Genotypes in Three Samples (Dursun, 2002)

Figure 3 shows the distribution of housing genotypes among these three groups of houses. If this figure is analysed, it can be seen that most of the houses are extroverted houses in the first two cases, whereas introverted in the last case. It is

suggested that such an unexpected finding is caused by the formation of apartment flats designed separately from the street with the apartment halls and some kind of a semi-public space around the apartment blocks.

When the extroverted houses are evaluated separately it can be seen that in most of the traditional houses generated under the influence of the Ottoman culture and in some of the houses generated by the Minorities, spatial models have strong relations to gardens. Houses are separated from the street by high walls for privacy requirements and gardens are accepted as a part of daily life. On the other hand, in most of the Minority houses and in some of the contemporary houses that were constructed after the foundation of the Republic, spatial models have strong relations to the street. The relation of the street to the entrance hall in the Minority houses is repeated in the detached houses of the modern culture. In the transformation of the detached houses into multi-story apartment blocks, the relation of the street to the apartment hall changes. These relations are rarely seen in the traditional houses.

Figure 4 shows the integration values of spaces among the sample houses chosen from each group of genotypes that belong to the three cultures. In this figure the light colour indicates the integrated spaces and the dark colour indicates the segregated ones.

5. Conclusions

A number of studies around the world show that space syntax reveals concretely how spatial models work employing a graphical and numerical language. The generally adopted approach accepts the built environment as a spatial complex consisting of spatial elements related to each other, and tries to define spatial complexes according to these inter-relations. Space syntax creates important data about how social meanings and lifestyles are expressed in spatial models. In this way, they enable a sound comparison between spatial models formed under the influence of different cultures.

This study aimed to formulate different spatial patterns that have been formed by three different cultures in the city of Trabzon and to provide a comparative analysis through the implementation of space syntax techniques. Common tendencies and different characteristics of the three samples are illustrated and discussed comprehensively based on the syntactic data derived. The syntactic findings show that the main differences lie in the relation between housing unit and exterior. Two genotypes are defined according to the location of the integration core with respect to the street. This kind of data allows us to confirm the main thesis which can be

stated as, “the main difference between minority and traditional houses is that the minority houses open directly to the street, whereas the traditional houses are separated from the street by high walls” (Velio_lu, 1989), as frequently supported by a number of studies carried out in the city of Trabzon employing numerical, graphical and concrete techniques that go far beyond intuitions and observations.

Field studies also confirm that in this kind of analysis a rich knowledge base is needed to interpret architectural plans and represent them in abstract graphic expressions and to attribute social meaning to syntactic data. It once more becomes apparent that space syntax needs to be supported with geometrical and topological tools, and with a background knowledge comprising the social, cultural and physical characteristics of the environment under study.

This syntactic approach brings to mind the following questions: “Can architecture be reduced to pure mathematical statements? Are these numerical formulas enough to explain architectural designs easily?” It is obvious that mathematics alone is not sufficient to define and explain spatial models. Architectural designs cannot be explained nor standardized with pure mathematical statements alone. However, it is clear that there are also some tendencies and rules in the organization of spaces created by cultural properties. Mathematical and graphical languages, like space syntax, can be used as a tool to identify these rules.

The findings of this study prove that the analysis techniques of Space Syntax, supported by a wide range of knowledge, have contributed greatly in the formulation of spatial models in concrete form, and can be accepted as a useful tool for defining similarities and differences between different home environments.

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