In-between spaces and social interaction: a morphological analysis of Izmir using space syntax

Işın Can · Tim Heath

Abstract This research tackles the intermediate spaces between buildings and the street, by examining the definition and importance of spatial configuration in relation to urban morphology and social relations. It also analyses how the organisation of in-between space affects social interaction in different urban forms. To understand the complex relations and socio-spatial structure of the city, it is important to use mixed methods. This research utilises various methods to focus on three dissimilar urban morphologies in Izmir, Turkey. Two inner city quarters and one modern housing estate of middle- and high-income groups are compared using space syntax analysis and snapshot observations. These neighbourhoods are selected according to their syntax measures from more integrated to segregated neighbourhoods in the axial analysis. And for a detailed zoomed-in analysis, similar diameter areas are covered for observations. Subsequently, activity patterns are observed at different times of the day, one weekday and one Sunday in three cases. In each neighbourhood, syntactic measures of all selected streets are correlated with these recorded activities. This study reveals that connectivity of streets is important for supplying niches that trigger long-duration activities and social interaction. In modern estates, stationary activities are not correlated strong enough with movement as it is in inner city neighbourhoods. Additionally, in-between spaces increase the frequency of social interaction and co-presence of people particularly in more integrated areas. However, this is only one element in developing sense of community. Further research is needed especially in correlating space syntax with environmental issues, as well as people's behaviour.

I. Can
Department of City and Regional Planning, Faculty of Architecture, Izmir Institute of Technology, Gülbahçe Kampüsü, 35430 Urla, İzmir, Turkey
e-mail: isincan@iyte.edu.tr

T. Heath
Department of Architecture and Built Environment, Faculty of Engineering, University of Nottingham, B7 Paton House, University Park, Nottingham NG7 2RD, UK
e-mail: tim.heath@nottingham.ac.uk

Keywords Urban morphology · In-between space · Social interaction · Mixed method · Space syntax · Snapshot observation

1 Introduction

1.1 Problem and aims of the study

Imported Western planning approaches, development plans, laws, and spatial development typologies in Turkish cities have often led to identical public and private realms and plot-based urban structures. These factors have rarely responded to the local differences, topographical features, and climate; therefore, they have tended to be unsuccessful in terms of creating unique spatial organisations. As a result, they have often created monotonous environments that lack identity (Aydemir 1989; Ünlü 2006; Ercan 2007). Specifically, since the 1990s, with the development in production types and rapid urbanisation, high-rise buildings have emerged as part of mass housing projects. Significantly, the open spaces of these large-scale development projects were rarely designed and tended to be leftover spaces. Indeed, many researchers have identified that the relationship between buildings and outdoor space has often been neglected in modern residential developments (Anderson 1991; Schittich 2004). Traditional urban morphologies have regularly been replaced by modernist spaces that divorce the relationship of buildings from the street with the consequence of reducing the connectivity of streets. Hanson (2000) defines this as the 'ruptured interfaces' between the dwelling and the street where the physical disconnection of dwellings from urban layouts has changed the urban environment from 'all neighbours' to 'no neighbours' as the streets have been transformed into housing estates.

The space between the street and building has an important role to play in terms of social interaction and behaviour with the organisation of this space often embodying social relations (Gehl 1996; Nooraddin 1998, 2002). These spaces can be an extension of a building's interior spaces directly attached to the street such as courtyards and balconies or front 'open' spaces such as front yards and sidewalks cafes, where such spaces form the interface between the private and the public. These spaces also encourage social encounters and street life in cities, and they can have different meanings according to different cultures.

This paper will examine how these 'in-between spaces' shape social interaction in different urban patterns? It hypotheses that in integrated and connected street patterns, there will be higher movement and encounter possibilities with in-between spaces providing niches for stationary activities that will support and encourage social interaction. However, in modern housing developments with a plot-based structure, there tends to be less social interaction and a more introverted way of life.

1.2 Definition of 'in-between space'

In-between spaces can be defined from many aspects. Nooraddin (1998, 2002) identifies this concept as the relationship between indoor and outdoor spaces. In addition, these intermediate spaces are an important element of urban design that contributes to the form of cities, and as such, their design, function, and use should be considered by urban designers. Significantly, the term 'in-between space' has been adopted by many academics

and practitioners (Anderson 1991; Gehl 1996; Hajer and Reijndorp 2001; Hillier and Hanson 1984; Skjaeveland and Garling 1997; Stevens 2007; Dovey and Polakit 2007). They variously define in-between space as an interface, a public/private boundary, betwixt, threshold, soft edge, liminal space, buffer zone, and as a smooth/striated space.

This space in-between indoor and outdoor can be ambiguous in nature, neither completely belonging to the two extreme situations forming it (inside and outside) nor any other third situation. Drawing on Plato's writings, Grosz (2001, pp. 90–93) states that it is a strange place, which is 'choric', as well as a 'space of becoming and movement' as defined by Henri Bergson. It is therefore a mediation space that has no space, form, and identity of its own being the place between identities involving the readjustment of relations. As such, in-between spaces do not have boundaries of their own and tend to be delineated from both sides; thus, their form is determined by other entities. Nevertheless, these spaces create possibilities for social, cultural, and natural transformation, where various virtuality and potential opportunities can emerge. Their temporality and the flexibility to appropriate these spaces are conducive to diverse possibilities of encounter, personalisation

Fig. 1 Global integration analysis of Izmir, INT RN

(Abu-Ghazzeh 2000), and social interaction. However, it also creates an issue of who will have the ownership and control of these intermediate spaces.

Urban designers should avoid creating fixed definitions of public and private space and the interstitial spaces between them. Indeed, classifications of space such as semi-public and semi-private can also be deceptive, because territory can contain public, private, or both types of space (Habraken 1998). Nooraddin (1998, 2002) also emphasises this overlapping character, and due to the complexity of a territory that has a 'multifaceted nature', he uses the term 'in-between'. The research presented in this paper therefore borrows this term 'in-between space' rather than using the terms semi-public or semi-private.

Consequently, this study proposes a mutually supportive circular analysis method and theory to perceive the city. It starts by analysing and understanding the whole system and subsequently explores the sub-units through morphological analysis and comparisons. Furthermore, understanding these sub-units is conducive to obtaining the whole picture of the city as applied by both Alexander et al. (1977) and Hillier and Hanson (1984). This research adopts a mixed-method approach to focus on the comparison of three neighbourhoods in Izmir, Turkey, using Space Syntax complemented by qualitative methods such as observations (snapshots) and a questionnaire analysis.

1.3 Identification of the case studies

This study analyses the patterns of three different neighbourhoods in the Turkish city of Izmir: Kültür; Karantina; and Mavişehir. These neighbourhoods were selected using the

Fig. 2 Snapshots from three neighbourhoods

integration measures of Space Syntax as outlined in the later section on research methodology. Kültür (city centre) was selected as the most integrated part of the city. Mavişehir (edge of city) was selected as a segregated part of the city, and Karantina (sub-centre) was chosen as an intermediate area between Kültür and Mavişehir (see Fig. 1). Each neighbourhood also differs from the other in terms of its period of development and planning approach. Kültür is located in the Alsancak district, a former European quarter of Izmir, developed in an Ecole-de Beaux Arts style in the 1920s to the Danger and Prost Plan. It is an important neighbourhood due to its architectural heritage as very little other architecture from the eighteenth and nineteenth century and early Republic period remains in Izmir. The second area, the former Jewish neighbourhood of Karantina, was developed in the nineteenth century following the extension of transportation systems in the city. Karantina still contains many of the traditional bay window houses and the original street pattern that are now rare in the city. Indeed, the 1970s saw a transformation of building typologies, in-between spaces and social life in the city due to rapid urbanisation, population growth, and immigration encouraged by the Condominium Act (1965). In the 1990s, gated communities emerged in the area, reflecting the change in consumption culture and lifestyles. The third case study is the Mavişehir neighbourhood, where extensive high-rise housing units were developed during the 1990s. Although it is not a visible gated community, it was a catalyst for the gated community developments in its vicinity. While Kültür and Karantina are examples of inner city neighbourhood types with street-facing dwellings, Mavişehir is an example of a modern residential estate (see Fig. 2).

2 Literature review

In order to understand the relation between the concept of in-between space and Space Syntax, this study first tries to define space syntax and its theory, and secondly, it concentrates on the relationship of urban form and the socio-spatial features embedded in this structure. The relation between Space Syntax and how it tackles the in-between space between the building and the street is examined. This is followed by focussing on issues such as the characteristics of space that enables long-duration activities and social interaction, likewise possibilities for the encounters of people and different age groups, and the differences between introverted (modern housing estates) and extroverted (inner city) neighbourhoods.

2.1 Space syntax and in-between space (bipolar systems: constitutedness)

Hillier et al. (1987, p. 217) define Space Syntax as ‘a model for representation, analysis, and interpretation’. There are two fundamental aspects of Space Syntax: one is configuration, and the other is human activity and movement. This spatial configuration is described as interdependent relations or how spaces within the system relate to each other (Hillier and Hanson 1984; Hillier et al. 1993; Hillier 1996). The aim of Space Syntax is to understand how buildings are grouped to define a continuous open system. Briefly, it aims to comprehend the relation between an urban structure and its social aspects in addition to the indirect or direct connections between spaces (Hillier et al. 1987). Spatial layout is the main predictor of movement, followed by the other attractors and land-use. As a grid layout is accessible and integrated, retail uses tend to locate on these routes and multiply the effect of the pattern in terms of movement (Hillier 1996, 2002). Hillier (1996, 2002)

also defines ‘natural movement’ as the outcome of the relation between the urban structure and movement.

Accordingly, how does Space Syntax treat ‘in-between space’? In Space Syntax, an urban settlement is referred to as a ‘bipolar system’ between the buildings and outside, with buildings and public open spaces being the two opposite poles of this system. Clearly, the entrances of buildings as interactional interfaces play a role in shaping the relation between the inside and the outside, private and public, as well as the residents and the visitors. Hillier et al. (1987) consider axial and convex maps from two points of view; first, how they relate to the entrances of buildings that the residents or occupants come from, and secondly, how they relate to the entrances of urban settlements where non-residents or visitors come from. Hillier and Hanson (1984) used interface maps to illustrate how the entrances of buildings and streets are configured. They referred to the number of buildings adjacent and directly permeable or accessible to that space as ‘constitutedness’, and they identified that as the topological depth increases between the entrance and the street, it becomes less constituted. For instance, if a building has an entrance that directly opens onto the street, we can count it, whereas if it has a side entrance, it is not counted as constituted. To achieve strong constitutedness, Lopez (2003) suggested that doors should be located every 7–9 m, that 63 % of façade should be transparent, and that edge zones should be between 0.7 and 2.0 m in depth. Both Lopez (2003) and Huang (2006) also propose niches or thresholds for pedestrian interaction without interfering with movement. Shu (2000) and Van Nes and Lopez (2007) also studied the degree of constitutedness and intervisibility in Space Syntax. From all of these studies, it is clear that constitutedness is important for street life and safety (Newman 1996; Hillier 2002; Van Nes and Lopez 2007), but it is not sufficient in itself to foster liveliness and to prevent crime.

2.2 Spatial accessibility, activity patterns, and social interaction

Nevertheless, Gehl (1986, 1996, 2006), mentions that these soft edges between private and public space support long-duration activities and social interaction. In-between spaces between the street and the building create the possibility for the residents to spend time together and to socialise. Additionally, the specific characteristics of that space are also very important for encouraging interaction. When the space is too wide, there tend to be fewer encounters, and on the contrary when it is too narrow, it can be uncomfortable and difficult to use. Indeed, as Sailer and Penn (2007) discovered that in a study of office space, narrow corridors and poor visibility inhibit the possibility of interaction. Besides the characteristics of the space, is it only the static activity that enables interaction? Ferguson (2007) emphasises that there are two types of interaction, those that are predetermined events and those that are chance encounters. In his work, Ferguson compared two spaces with the same gross pedestrian flow. He looked at the interaction not only in terms of static activity, but also the interaction of people while moving. He identified that as pedestrian flow and spatial accessibility increased, the levels of encounter also increased. Interaction can therefore be facilitated by spatial accessibility and configuration and through movement, as well as the strong interface between scales of movement, global and local, and centre and edge (Hillier and Hanson 1984; Ferguson 2007; Penn et al. 1999). Moreover, Baran et al. (2008) note that leisure walking is associated with high global accessibility. Importantly, people do not only interact with people, but also with the places and things around them. Through time and with structural processes, people give meaning to their experiences and the features around them become more significant. Hargreaves (2004) emphasises that movement can be either social through chance encounters, or habitual with

regular routes and daily motives and necessities. A sense of belonging can be improved by the intersection of social movements and significance. Greater social interaction between residents and existing features can be sustained via integration of the local attributes and the central facilities of the layout (Hargreaves 2004).

Space Syntax looks at the cyclical encounters at different times but not the type of encounter or people's behaviour. Seamon (2007) suggests that, for a phenomenologically inspired Space Syntax study, observations could involve 'who encounters whom', 'in what way', and 'how often'. Another weakness of the Space Syntax method mentioned by some researchers is that it is a two-dimensional model and does not integrate the third dimension in the analysis (Ratti 2004). However, Hillier and Penn (2004) prefer to look at the co-relations of other metric variables such as building height in regression models rather than in the Space Syntax model, as the main target is to see the effect of urban pattern on the social aspects of the city. Moreover, Space Syntax correlates space with people and activities, function and land-use, movement density and demographic structure (Major et al. 1997; Hillier et al. 1993; Baran et al. 2008).

2.3 Virtual community and co-presence in inner city neighbourhoods and modern housing estates

The urban pattern of modern housing estates, traditional, and inner city neighbourhoods is different. Traditional urban forms with street-facing dwellings have 'internally coherent' structures (Awtuch 2009). In contrast, modern housing estates are often more introverted rather than extroverted due to the main movement routes circling them instead of going through them. Most studies about modern estates find that they tend to suffer from a lack of vitality, as there are less people and less activity, as well as movement. Hence, movement tends to be dispersed and concentrated mainly on the periphery of the development (Awtuch 2009; Major et al. 1997). In Space Syntax literature, 'virtual communities' are defined as those that are 'co-aware' of each other, being formed by different groups of people existing in a space at the same time creating the possibility for their interaction (Hanson and Hillier 1987; Hillier et al. 1987; Hillier 1996). This potential is also used with the concept of a natural control mechanism by various researchers such as Jacobs (1961) and Hanson and Hillier (1987). Major et al. (1997) mention that post-war public housing in the UK tends to segregate its public spaces from the surrounding street pattern. These types of settlements usually have reduced integration values. Further, in terms of 'virtual community', correlation between adults and children reveals an L-shaped graphic. This means that in modern housing estates, there tends to be lower numbers of children and higher numbers of adults usually gathered in the inner parts of the estate compared with traditional urban streets.

In addition, another study conducted by MacDonald (2005) revealed that through embedding traditional townhouse forms into large-scale new developments, it is possible to increase the street quality and safety of these places. This is also related to the inter-visibility issue of buildings that are located along the street by facing each other (Newman 1996; Hillier 2002; Jacobs 1961; Van Nes and Lopez 2007; Van Nes and Rueb 2009). Likewise, Kim (2007) tested the street connectivity of new urbanism projects and found that private streets, driveways, alleys, semi-public streets—all in-between spaces—have an impact on the connectivity of the street pattern.

To conclude, this study benefits from a critical review of literature to understand the part-whole and socio-spatial relationship in the selected three case studies. This also enables the physical and social aspects of the urban pattern to be grouped. The first ones are

the syntactic properties of urban form such as 'spatial configuration' (Hillier and Hanson 1984; Hillier et al. 1993; Hillier 1996, 2002), as well as 'bipolar systems' or in other words 'constitutedness' of the street (Hillier and Hanson 1984; Hillier et al. 1987; Shu 2000; Van Nes and Lopez 2007). Secondly, activities embedded and generated through these physical characteristics of the urban pattern are explored, such as 'soft edges' and long-duration activities (Gehl 1986, 1996, 2006), encounters and spatial accessibility, the interface between different scales of movement (Hillier and Hanson 1984; Penn et al. 1999; Ferguson 2007), leisure walking and global accessibility (Baran et al. 2008), types of encounters (Seamon 2007), virtual community and co-presence (Hanson and Hillier 1987; Hillier et al. 1987; Hillier 1996).

As a contribution through 'zooming in' and 'zooming out' with different tools, this study seeks to identify the in-between spaces and social interaction of three neighbourhoods. The selected case studies have various syntactic and socio-spatial features that add to the knowledge expounded through existing literature. This study supports the view that 'connectivity' and 'in-between space' are important for social interaction and for the frequency of that encounter. However, one has to keep in mind that the acquaintance of residents in a neighbourhood might be the same even for different types of urban patterns.

In research, triangulation is important for validity of the analysis. In this paper, we focus on the relation between urban structure and interaction and implicitly their influence on sense of community. There are currently few studies in space syntax literature that attempt to combine the various different variables with the results of different analysis. Although space syntax is usually considered as a quantitative method and not as a theory, it creates the possibility to make various deductions from the correlations between syntactic measures and qualitative outcomes.

3 Research methodology

As mentioned above, this paper attempts to comprehend the term 'in-between space' and how the organisation of such spaces between the street and building affects the social interactions in three different neighbourhoods in Izmir. Indeed, there is a need in research to examine the places that residents encounter the most and how they use such environments (Hess 2008). In order to understand complex relationships, cities should be analysed by considering part-whole relations and micro- and macro-spatial relationships (Van Nes and Lopez 2007). A mixed-method approach can contribute to a better understanding of socio-spatial relations within the urban fabric, and as Perdikogianni (2007) identifies, there has been little research of this type that has combined quantitative and qualitative methods. Indeed, Perdikogianni (2007) emphasises that it is a precondition to merge empirical studies with analytical studies in undertaking research of this type. In this study, an axial base map model of Izmir was produced to enable the identification of potential case study areas. The case studies were then selected based on a global integration analysis of Izmir, selecting from the most integrated (accessible) to the least integrated neighbourhood patterns. In this section, Space Syntax measures are defined together with an explanation of how the observations were conducted. Subsequently, the mean values of the syntax measures of each street in a neighbourhood were correlated with the mean values of the activities using a Pearson correlation.

3.1 Space syntax analysis and syntactic measures

Space Syntax is a method to interpret and analyse the urban environment through lines, whereby the line is the basic representational element of Space Syntax. However, convex space refers to the composition element of the urban grid. This convex space can be used successfully as a meeting or gathering point for an attractive open space (Hillier and Hanson 1984; Cutini 2003). In Space Syntax, modelling open spaces can be difficult; therefore, researchers have to be careful while drawing the axial lines in modern residential buildings with freestanding blocks and open spaces. Each line represents movement, and as the parks and open spaces are over-modelled with many lines, the analysis cannot be used and there needs to be consistency.

Syntactic measures are the crucial tools in Space Syntax. Connectivity is a local measure that is represented by the number of lines or spaces that are joined to a line or space and used to measure the depth between space and the 'degree of intersection'. Van Nes (2008, p. 63) says that it 'accounts for all the direct connections each street has to other streets in their immediate vicinity'. Integration, both as a global and local measure, is seen as a central concept in Space Syntax and measures how many turns and changes one has to make in order to access one space from another in the system. This reveals the relationship of the part to the whole in terms of integratedness or segregatedness. Depth and syntactic accessibility are important concepts of integration, and the lower the number of axial lines and fewer changes in the system, the more accessible and integrated the system becomes (Hillier and Hanson 1984; Baran et al. 2008; Jacoby 2006; Yang 2004). This can be interpreted as the association between residents or locals and outsiders or global communities (Chiaradia and Hillier 2003). It is also related to its centrality effect, as it is more central and also more accessible between local and global movements.

Intelligibility is about how people can perceive the spatial layout and orient themselves within the system. One place can have connected streets, but if they are not well integrated with the whole, then it would be difficult to understand the urban structure in terms of navigation. In order to calculate intelligibility, the connectivity measure is correlated with the global integration measure in a regression analysis. Hence, if connectivity and global integration measures are strongly related, then residents and visitors will have a clearer perception of the place (Hillier 1996). Read (1999) revealed in a study of five Dutch cities that a higher mean connectivity has higher natural movement means, especially in subcentres. In neighbourhood areas, the relationship between global integration and natural movement is much weaker than the correlation with connectivity and local integration (Read 1997).

3.2 Questionnaires and observations

A questionnaire survey was designed and implemented in each of the three case study areas. This paper summarises the findings of the questionnaire by focussing on the results specifically related to social interaction and 'in-between space'. Residents were asked 'how often they interact in public spaces with other people?' In order to define the size of the sample, sample tables were used with a precision (e) of ± 10 %, and from a population of 7000–9000, 100 were determined as an adequate sample size, with a confidence level of 95 %. This study could not use a random sampling technique because of safety concerns for the researcher in certain neighbourhoods. Instead, concierges of residential buildings were used as a mediator between the residents and the researcher. A covering letter was enclosed with the questionnaires explaining the background of the research and introducing

the researcher. Over 100 completed questionnaires (102 in Kültür, 129 in Karantina, and 109 in Mavişehir) were collected in each neighbourhood, and SPSS software was used to analyse the data. All three neighbourhoods are composed of nuclear families, and the socio-demographic structure of the questionnaire analysis can be seen in Table 1.

Questionnaire results revealed that 43 % of the respondents were male and 57 % female in Kültür; 46 % male and 54 % female in Karantina; and 32 % male and 68 % female in Mavişehir. 48 % had lived for more than 20 years in Kültür; 31 % had lived ⩽5 years in Karantina; and 47 % had lived for 10–20 years in Mavişehir. There was 71 % ownership in Kültür; 55 % ownership in Karantina; and 72 % ownership in Mavişehir. Largely, respondents were employed in the service sector including jobs in health services, accountancy, banks, and engineering: 38 % employees from service sector in Kültür, 30 % in Karantina, and 24 % in Mavişehir. Although the education level of Mavişehir and Kültür was approximately the same (68 % graduates and postgraduates in Kültür; 72.2 % in Mavişehir), the mean of education is closer to high school graduates in Karantina. The socio-demographic structure of the respondents of three case studies did not vary considerably, except for the education levels and home ownership in Karantina.

A 'snapshot' is a type of behaviour mapping of where people sit, stand, and what activity they are doing being recorded at different times of the day. People are categorised as children, teenagers, adults, and elderly. Whether they are in group or individuals is also recorded. In this research, snapshots were conducted on one weekday and one Sunday in each case study neighbourhood. Each snapshot was undertaken over 32-h periods, between 10 am and 12 pm, 2–4 pm and 6–8 pm. A limitation of this study was that for safety reasons, observations could not be undertaken late at night and therefore only focussed on the above times. The snapshot observations and Space Syntax results were correlated

Table 1 Results of questionnaire analysis, socio-demographic structure/frequency of interaction

Socio-demographical structure	Kültür	Karantina	Mavişehir I
Population of all neighbourhood (TUIK 2008)*	9.225	11.058	7.193
Age (mean)	48.88	42.21	45.98
Gender (1 = male 2 = female)	1.57	1.54	1.68
Length of residency (LR)	3.04	2.37	2.17
Ownership (1 = owner 2 = tenant)	1.29	1.45	1.28
Household size (mean)	2.71	3.08	3.06
Number of children (mean)	1.07	1.27	1.24
Education	1.43	1.94	1.32
Occupation	4.01	3.83	3.48
Number of people known and social interaction			
Number of people known by name in the neighbourhood	66.44	31.61	55.38
Number of people known by name in the building	15.45	10.92	18.03
Frequency of social interaction in outdoors (1–3 scale)	2.60	2.39	2.37

Gender 1 = male, 2 = female; Ownership 1 = owner, 2 = tenant; Length of residency 1 = ⩽5 years, 2 = 5–10 years, 3 = 10–20 years, 4 = more than 20 years; Education 1 = graduate and postgraduate, 2 = high school and institution, 3 = middle school, 4 = primary school; Occupation 1 = retired, 2 = house wife, 3 = student, 4 = service sector, 5 = trade marketing business, 6 = manager director, 7 = self-employed, 8 = science academic and education, 9 = art and music

* TUIK Turkish Statistical Institute

through a Pearson correlation. Each street has a Space Syntax value (integration, connectivity) and total number of recorded activities for three different times of the day (morning, midday, and evening). The integration and connectivity values of all streets are correlated with the average number of different activities for weekday and Sunday separately in the three case studies.

In this study, using a mixed-method approach was useful in terms of triangulating the results. On the other hand, social interaction types (whether encountered by chance or by predetermined meeting) could be observed through longer observations at specific locations with in-between space types. However, it was also difficult to manage larger data and information in terms of collecting, analysing, and combining them together. The sampling number was chosen through statistical tables, but random sampling could not be implemented due to safety issues as previously mentioned.

4 Morphological analysis and comparisons

This section examines the morphological differences of the three case study neighbourhoods, using syntax measures, activity patterns, and their correlations, as well as the constitutedness of the streets and co-presence of people.

4.1 Syntactic outcomes

In Kültür (formerly the European Quarter, Frank district), the ruined parts of the area were totally transformed in the 1920s and the existing street pattern is now composed of radial roads and intersections. Analysis of the Kültür neighbourhood shows that integration, connectivity, and intelligibility means are higher than in Karantina and Mavişehir (see Table 2). In the local integration analysis R3, red lines indicate the most accessible routes within three steps. As can be seen in Fig. 3, the most accessible routes cross through the neighbourhoods both in Karantina and Kültür; however, they encircle the boundary in Mavişehir (see Fig. 3).

Regarding the part-whole relation (synergy) and intelligibility, the results (see Table 2) reveal that Kültür has a better correlation between local and global integration values. Kültür therefore has better intelligibility within the structure of the city. Mavişehir is more segregated in the global integration model and has less connectivity and integration values than Karantina, while their intelligibility and synergy measures are similar. Moreover, Mavişehir has slightly higher intelligibility/understandability than Karantina. Karantina is

Table 2 Mean values of SSX (Space Syntax) for each neighbourhood

	Kültür			Karantina			Mavişehir I		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Int_RN	0.518	0.556	0.533	0.430	0.498	0.450	0.328	0.385	0.346
Int_R3	1.958	5.139	3.192	1.273	4.459	2.935	1.163	4.772	2.754
Connectivity	2	20	6.25	2	13	5.507	2	15	4.967
Synergy (RN-R3)	R^2 Linear: 0.498			R^2 Linear: 0.047			R^2 Linear: 0.042		
Intelligibility (RN-connect)	R^2 Linear: 0.458			R^2 Linear: 0.045			R^2 Linear: 0.067		

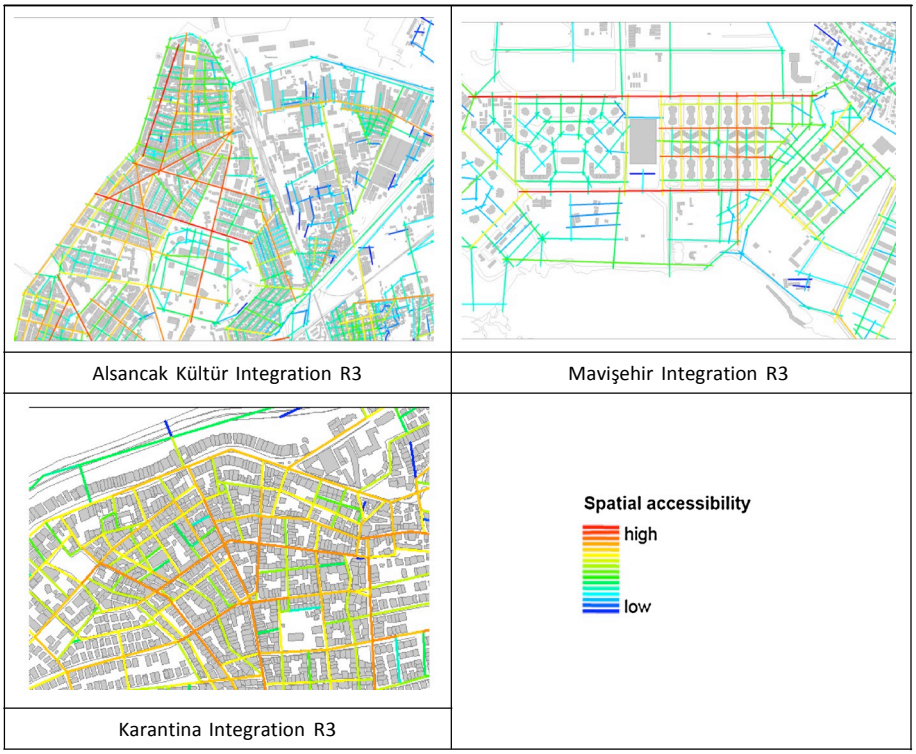

Fig. 3 Integration R3 of three case studies

therefore better integrated within the global system and more accessible, and its connected streets and the accessibility measure of those streets have less relation among each other. So it is clear that the connected streets of Karantina are not as well integrated as the ones in Mavişehir.

4.2 Activity patterns and correlations with space syntax variables

Stationary activities such as sitting and standing tend to occur mostly in 'in-between spaces'. As Gehl (1986) mentions, 70 % of long-duration activities happen along the soft edges of in-between spaces. In Kültür, stationary activities are recorded as 70 % during weekdays and 56 % on Sundays, whereas in Karantina, they are 55 % during the weekdays and 46 % on Sundays, and in Mavişehir, they are 43 % during the weekdays and 35 % on Sundays (see Table 3).

Long-duration activities such as sitting in front of a shop or cafe, sitting on a bench, window shopping, selling and buying, reading a newspaper, children playing in front of an apartment, and men playing backgammon are seen more in the centre and traditional neighbourhoods. Therefore, when these activities are correlated with integration values, the highest correlation was found in the city centre. Stationary activities, such as sitting and standing, are mainly correlated with local measures particularly with connectivity both in the urban patterns of Kültür and Karantina (see Table 4).

Table 3 Total snapshots of three case studies for weekday and Sunday

Total	Kültür		Karantina		Mavişehir I	
People observed	Weekday 1388	Sunday 753	Weekday 608	Sunday 530	Weekday 444	Sunday 382
Gender						
Male (%)	56	58	57	60	55	53
Female (%)	44	42	43	40	45	47
Interaction						
Group (%)	47	57	37	41	31	46
Individual (%)	53	43	64	59	69	54
Categories						
Children (%)	2	2	7	7	5	4
Teenager (%)	6	12	16	22	18	19
Adult (%)	88	82	65	62	69	70
Elderly (%)	4	4	12	9	8	7
Activities						
Sitting (%)	47	36	21	16	18	19
Standing (%)	23	20	34	30	25	16
Walking (%)	30	44	45	54	57	65

Table 4 Correlations between snapshots and SSX

Total snapshots and SSX—R^2 linear	Kültür			Karantina			Mavişehir I		
	R3	RN	Con.	R3	RN	Con.	R3	RN	Con.
Movement (walk and cycle)									
WD	0.737	0.901	0.744	0.317	0.189	0.347	0.480	0.030	0.504
Sun.	0.782	0.885	0.774	0.319	0.170	0.352	0.480	0.030	0.504
Stationary (sit and stand)									
WD	0.665	0.683	0.819	0.210	0.090	0.240	0.086	0.068	0.074
Sun.	0.585	0.564	0.766	0.275	0.081	0.310	0.086	0.068	0.074
Groups (interaction)									
WD	0.871	0.967	0.871	0.222	0.144	0.256	0.404	0.064	0.407
Sun.	0.916	0.931	0.916	0.266	0.123	0.297	0.404	0.064	0.407

WD weekday, Sun. Sunday, SSX Space Syntax, Con. connectivity

Movement is correlated with both global and local measures in the city centre in the Kültür neighbourhood, while it is associated with local measures, R3 and connectivity in sub-centres of Karantina and Mavişehir. Groups/interactions are correlated with all the three measures (RN, R3, and connectivity) in Kültür but only with local measures in Mavişehir and Karantina (see Table 4). Group/interaction does not only indicate that there are groups of the stationary people but also moving people. Therefore, in Kültür where accessibility is high, there is more possibility of co-presence and encounter in line with

Hillier's (1996) findings. As can be seen in Kültür, land-use increases the effect of the pattern as both long-duration activities are seen more on weekdays, when the shops are open. In addition, there is higher correlation among integration RN with movement and groups in centres. In Mavişehir, correlations between the activity patterns and syntactic measures do not change on a weekday or Sunday.

Movement has higher relations with connectivity and R3 rather than RN does in Karantina and Mavişehir (see Table 4). Stationary activities reveal better correlations with global and local measures in Karantina than in Mavişehir. Moreover, groups in Karantina are better correlated with RN global streets. On the contrary, groups (interactions) expose higher correlations with local measurements in Mavişehir than they do in Karantina. For instance, during weekdays, 22 % of the interactions/groups can be predicted from integration R3 in Karantina, while it is 40 % in Mavişehir. This might be again due to the moving people. Movement is also better correlated with local Space Syntax measures in Mavişehir rather than in Karantina.

In common with Major et al. (1997), this research shows that in housing estates with a more inward focused structure, those movement patterns are mostly located at the edges of the settlement and have better correlations with local measures. Indeed, as previously mentioned, most connected and integrated streets do not pass through the layout but instead encircle it. As can be seen from Fig. 3, the most integrated streets are on the periphery of the housing layout in Mavişehir.

When activity patterns are correlated, there is strong correlation between stationary activities, movement, and groups both on a Sunday and during weekdays (see Table 5). However, in Mavişehir on Sundays and during weekdays, movement and long-duration activities have much weaker relation compared with the traditional neighbourhoods. It can be concluded that in many modern housing estates, there are not the niches and 'in-between spaces' that support stationary activities as these activities are mostly found in inner parts of the modern settlements.

4.3 Constitutedness and topological depth between the building and the entrance

To calculate constitutedness, it is necessary to sum the amount of houses that directly open onto a street and divide this by the total number of houses. In this comparative research, Karantina has higher constituted streets (60 %) compared with Kültür (25 %).

Table 5 Correlations of movement, group, and stationary activities

Total	Kültür	Karantina	Mavişehir
Sunday stationary and Sunday group	0.806**	0.963**	0.805**
Sunday move and Sunday group	0.968**	0.942**	0.766**
Sunday move and Sunday stationary	0.640*	0.864**	0.444**
WD stationary and WD group	0.824**	0.929**	0.701**
WD move and WD group	0.979**	0.961**	0.842**
WD move and WD stationary	0.718*	0.834**	0.382*

* Correlation is significant at the 0.05 level (2 tailed)

** Correlation is significant at the 0.01 level (2 tailed)

In Mavişehir, it is not possible to calculate constitutedness because it does not have a typical street layout, and in the middle of the housing units, there are single-family houses.

In all of the case study neighbourhoods, over 70 % of the residents identified the entrance of the building as the main place of interaction. In addition, the frequency of social interaction in the outdoors is similar in Karantina and Mavişehir, whereas the frequency for Kültür was higher. The number of people known in the building does not change either; indeed, in Karantina, fewer people are known in their neighbourhood compared with the other two case studies (see Table 1). As mentioned previously, the streets in Karantina are too narrow without spacious places in front of the apartment blocks for residents to linger and interact. The building entrances along the seashore and the three-dimensional entrances of the old traditional houses with bay windows are the exceptions. This study therefore supports the research of Skjaeveland and Garling (1997), which revealed that spaciousness is an important indicator for neighbourliness.

4.4 Interaction, virtual community, and co-presence

In this paper, the interaction groups were identified from observation studies and the type of interaction (whether by chance or on purpose) was not examined. Moreover, the frequency of interaction and the places where people interact the most are examined through the questionnaire survey. Similar to Ferguson's (2007) findings, the three case studies in this research revealed that both stationary activities and movement have strong correlations with groups. In addition, movement and long-duration activities are also strongly correlated (see Table 5). In Mavişehir, for example, it was seen that the correlation between movement and stationary activities is weaker than in the inner city neighbourhood patterns. It might be concluded that stationary and movement activities are more segregated in modern urban developments than in traditional neighbourhoods.

It is seen that in Mavişehir I, integration values are less than the values of Kültür and Karantina with children usually gathering in inner parts where the playgrounds are located. On the other hand, due to the internal pedestrian street running through the residential area, Mavişehir I. is more 'internally coherent' (Awtuch 2009), particularly compared with Mavişehir II. (Mavişehir I. has villas in between the high-rise blocks).

It is, however, difficult to suggest that Karantina and specifically Kültür have a strong correlation between children and adult numbers. This is because there is a lack of places for children to play outside, especially in Kültür, where the playgrounds are located far apart from each other. In addition, there is only the Gazi Primary School garden, which is used for car parking after the lessons end at 5 pm until the next morning. Although Major et al. (1997) mention that in normal urban streets there appears much stronger correlation between adults and children, it is difficult to accept this in the neighbourhood of Kültür. These findings concur with those identified by Churchman (2003) who states that other parameters should be considered such as traffic, density, safety, and adequate places for children to play, as well as appropriate environmental characteristics that are suitable for outdoor play.

5 Conclusions

This research study shows the interactional locations through snapshot observations and identifies where inhabitants interact and the frequency of interaction through questionnaire analysis. Therefore, returning to the main research question of space organisation and

social interaction, in Space Syntax terminology, spatial configuration generates movement, and through this movement, it provides co-presence as well as encounter fields. The integration values of Kültür have higher movement and co-presence possibilities, compared with Karantina and with Mavişehir, demonstrating a higher frequency of interaction between residents in the Kültür neighbourhood. This is likely to be due to the more diverse territorial extensions in Kültür because of the presence of mixed land-use. 'Third places' that provide different social interaction platforms rather than the home and workplace (Oldenburg 1999), such as cafes and local shops 'spilling out' from interior spaces and increase the possibility of stationary activities and interaction among people in addition to the buyer and seller. Hickman (2013) also revealed in his study that local third places are crucial locations specifically in deprived neighbourhoods for residents to engage and interact. On the other hand, when the ground floor is occupied by commercial uses such as shops and cafes, it does not give residents the opportunity to personalise their front yards.

This study has identified four critical issues related to in-between spaces. First, that spatial patterns with higher integration and connectivity increase social interaction. Nevertheless, there has to be in-depth research looking at the types of the encounter. Indeed, in mixed-use patterns, it can be difficult to differentiate local people from outsiders. Secondly, those modern housing estates tend to be more introverted than inner city neighbourhoods with movement activities that are mostly on the edges where main routes encircle the estates in contrast to the stationary activities located in inner parts. Third, that there is lack of strong correlation among different ages, especially adults and children, even in inner city neighbourhoods with mixed uses, emphasises the need for strong strategies in the development of neighbourhoods for children to play. Finally, that 'third places' are important social interaction places; nevertheless, there should be also third places for different groups, such as children and the elderly.

Importantly, if only adults and high-income groups are the target audience of mixed-use developments, then the neighbourhood will not be diverse enough. Market-driven planning strategies should therefore be replaced with local-driven planning strategies. Fincher and Iveson (2008) emphasise three social phenomena that support and promote diversity in city: 'redistribution', 'recognition', and 'encounter'. The first two are related to the identification of the others, strangers, and providing equality for the needs and attributes of all users. The concept of 'encounter' is considered in a different way to that commonly espoused in literature. Indeed, encounter is not similar to leisure walking or fláneurs; instead, it has an intent, having the possibility of knowing others and interacting. It therefore creates an arena for coming into a close proximity with different groups and categories of people. Fincher and Iveson (2008) also state that people have the 'right to the city', and they also have the 'right to encounter'. The research presented in this paper concurs with this view and links 'encounter' with 'conviviality'. This transforms the process of experience, every time people encounter each other and enables the exploration of different ways of life as well as opportunities.

A lack of in-between space tends to lead to fewer possibilities for interaction; however, this does not mean that an increase in the relation between private and public space will lead to increased neighbourliness. Social interaction is seen as one of the key elements in creating a sense of community and neighbouring. Indeed, there are other factors for neighbouring; hence, we should be more sceptical about the reasons for this, rather than assuming that urban form is the cause of a lack of neighbouring and social relations. Indeed, the number of people known by name does not change significantly among the three case studies. It is therefore difficult to automatically draw a connection between the urban form, people interaction, and the familiarity of people with each other. Indeed, it

should also be noted that sense of community and neighbouring parameters are changing, as communities are transforming. In addition, to actual interaction places, virtual interaction networks might be considered within these parameters. Space Syntax studies should therefore be correlated with an analysis of environmental and behavioural issues. This study supports the ideas of Montello (2007) and Read (2005), and while Space Syntax can treat spaces equally in terms of movement and accessibility, it also needs to allow for different space–time experiences, function, and socio-spatiality.

There are two key outcomes of this research. Firstly, Space Syntax analysis revealed that the connectivity of the street pattern is important for long-duration activities. When traditional quarters, inner city neighbourhoods, and modern estates are compared, it is seen that stationary activities are less correlated with pedestrian movement in modern developments. Secondly, in-between spaces encourage social interaction and increase the frequency and chance of encounter; however, this is only one factor in developing social relations. Although traditional and mixed-use neighbourhoods provide a higher frequency of interaction, their sense of community can be lower compared with modern residential estates or similar. New developments should therefore aim to provide various space types—both homogeneous and heterogeneous—for all members of a community.

For further research, this interface needs more attention from different disciplines. Indeed, correlations in Space Syntax analysis can be also done between the Space Syntax measures of a street pattern, and the quality of space, and people's behaviour. Space Syntax can be seen as a static analysis, but it can be updated with developing features and create the possibility to interpret and test proposed changes or developments. While looking at the physical features of the city, environmental and social inputs should be also considered. Another issue that should be recognised is the right of use by different categories of people. Indeed, detailed research should be undertaken to see how children, or the elderly use spaces, including when or whether they are excluded or not within the neighbourhoods.

Acknowledgments This paper has been developed from a Ph.D. study pursued at the Department of Architecture and Built Environment, University of Nottingham, UK. We would like to thank to Professor Taner Oc for co-supervising this study and for his valuable contributions. Additionally, we would like to thank to the Higher Education Council of Turkey for sponsoring this research.

References

Abu-Ghazzeh, T. (2000). Environmental messages in multiple-family housing: Territory and personalization. Landscape Research, 25(1), 97.

Alexander, C., Ishikawa, S., & Silverstein, M. (1977). A pattern language: Towns, buildings, construction. USA: Oxford University Press.

Anderson, S. (1991). On streets: Based on a project of the Institute for architecture and urban studies (4th ed.). Cambridge, Mass: MIT Press.

Awtuch, A. (2009). Spatial order and security. 7th International Space Syntax Symposium. Stockholm.

Aydemir, S. E. (1989). Imar Mevzuatinin Iklimsel, Topografik, Psikolojik ve Ekonomik Acidan Irdelenmesi, Planlama Dergisi, 2-3-4, pp. 51–55.

Baran, P. K., Rodriguez, D. A., & Khattak, A. J. (2008). Space syntax and walking in a new urbanist and suburban neighbourhoods. Journal of Urban Design, 13(1), 5–28.

Chiaradia, A., & Hillier, B. (2003) Configuration spatiale et mixité sociale ubraine, Final Report, Ministére de l'Équipement, des Transports, du Logement, du Tourisme et de la Mer Plan Urbanisme Construction Architecture e Ministére de la Culture Direction de l'architecture et du patrimoine, Paris, France.

Churchman, A. (2003). Is there a place for children in the city? Journal of Urban Design, 8(2), 99–111.

Cutini, V. (2003). Lines and squares: Towards a configurational approach to the morphology of open spaces. In Proceedings of 4th International Space Syntax Symposium, London.
Dovey, K., & Polakit, K. (2007). Urban slippage: Smooth and striated streetscapes. In K. A. Franck & Q. Stevens (Eds.), Loose space: Possibility and diversity in urban life. Abingdon: Routledge.
Ercan, E. M. (2007). Kentlerimizin Icinde Bulundugu Planlama ve Yonetim Sorunlari. Planlama Dergisi, 2, 69–73.
Ferguson, P. (2007). The streets of innovation. In Proceedings of 6th International Space Syntax Symposium, Istanbul, Turkey.
Fincher, R., & Iveson, K. (2008). Planning and diversity in the city: Redistribution, Recognition and Encounter. London: Palgrave Macmillan.
Gehl, J. (1986). Soft edges in residential streets. Housing, Theory and Society, 3(2), 89–102.
Gehl, J. (1996). Life between buildings: Using public space. Arkitektens Forlag: Bogtrykkeriet.
Gehl, J. (2006). Close encounters with buildings. Urban Design International, 11(1), 29–47.
Grosz, E. (2001). Architecture from the outside: Essays on virtual and real space. Cambridge, Mass: MIT Press.
Habraken, N. (1998). The structure of the ordinary: Form and control in the built environment. Cambridge, Mass: MIT Press.
Hajer, M., & Reijndorp, A. (2001). In search of new public domain. Rotterdam: NAi Publishers.
Hanson, J. (2000). Urban transformations: A history of design ideas. Urban Design International, 5, 97–122.
Hanson, J., & Hillier, B. (1987). The architecture of community: Some new proposals on the social consequences of architectural and planning decisions. Architecture and Behaviour, 3(3), 251–273.
Hargreaves, A. (2004). Building communities of place: Habitual movement around significant places. Journal of Housing and the Built Environment, 19(1), 49–65.
Hess, P. M. (2008). Fronts and backs. Journal of Planning Education and Research, 28(2), 196–212.
Hickman, P. (2013). "Third places" and social interaction in deprived neighbourhoods in Great Britain. Journal of Housing and the Built Environment, 28, 221–236.
Hillier, B. (1996). Space is the machine: A configurational theory of architecture. Cambridge: Cambridge University Press.
Hillier, B. (2002). A theory of the city as object: Or, how spatial laws mediate the social construction of urban space. Urban Design International, 7(3/4), 153–179.
Hillier, B., & Hanson, J. (1984). The social logic of space. Cambridge (Cambridgeshire), New York: Cambridge University Press.
Hillier, B., Hanson, J., & Peponis, J. (1987). Syntactic analysis of settlements. Architecture & Comfort/ Architecture & Behaviour, 3, 217–231.
Hillier, B., & Penn, A. (2004). Rejoinder to Carlo Ratti. Environment and Planning B: Planning and Design, 31, 501–511.
Hillier, B., Penn, A., Hanson, J., Grajewski, T., & Xu, J. (1993). Natural movement: Or configuration and attraction in urban pedestrian movement. Planning and Design: Environment and Planning B, 20, 29–66.
Huang, S. L. (2006). A study of outdoor interactional spaces in high-rise housing. Landscape and Urban Planning, 78(3), 193.
Jacobs, J. (1961). The death and life of great American Cities. New York: Vintage Books.
Jacoby, K. (2006). What is space syntax? Does the urban form of the city affect the level of burglary and crime? Séminaire de Master Architectures et villes face à la Mondialisation, Royal Institute of Architecture, Stockholm.
Kim, J. (2007). Testing the street connectivity of new urbanism projects and their surroundings in Metro Atlanta Region. In Proceedings of 6th International Space Syntax Symposium. Istanbul, Turkey. Lopez, T. G. (2003). Influence of the public–private border configuration on pedestrian behavior. The case of the city of Madrid. Madrid Spain: La Escuela Tecnica Superior de Arquitectura de Madrid.
Macdonald, E., (2005). Street-facing dwelling units and livability: The impacts of emerging building types in Vancouver's new high-density residential neighbourhoods. Journal of Urban Design, 10(1), 13–38.
Major, M. D., Stonor, T., Penn, A., & Hillier, B. (1997). Housing design and the virtual community. In Children and youth in the city. 19th International Making Cities Livable Conference. Charleston, South Carolina.
Montello, D. R. (2007). The contribution of space syntax to a comprehensive theory of environmental psychology. In Proceedings of 6th International Space Syntax Symposium. Istanbul, Turkey.
Newman, O. (1996). Creating defensible space. U.S. Department of Housing and Urban Development, Office of Policy Development and Research, Institute for Community Design Analysis, Center for Urban Policy Research, Rutgers University, Washington, D.C.

Nooraddin, H. (1998). 'Al-fina', in-between spaces as an urban design concept: Making public and private places along streets in Islamic cities of the Middle East. Urban Design International, 3, 65–77. Nooraddin, H. (2002). In-between space: Towards establishing new methods in Street Design. Global Built Environment Review, 2, 50–57.

Oldenburg, R. (1999). The great good place: Cafés, coffee shops, bookstores, bars, hair salons, and other hangouts at the heart of a community. New York: Marlowe.

Penn, A., Desyllas, J., & Vaughan, L. (1999). The Space of Innovation. Environment and planning B: Planning and design, 26, 193–218.

Perdikogianni, I. (2007). From space to "place": The role of space and experience in the construction of "place". In Proceedings of 6th International Space Syntax Symposium. Istanbul, Turkey.

Ratti, C. (2004). Space syntax: Some inconsistencies. Environment and Planning B: Planning and Design, 31, 487–499.

Read, S. (1997) Space syntax and the Dutch city: the supergrid. In Proceedings of 1st International Space Syntax Symposium, April 16–18, in London.

Read, S. (1999). Space syntax and the Dutch city. Environment and Planning B: Planning and Design, 26(2), 251–264.

Read, S. (2005) Flat city; a space syntax derived urban movement network model. In Proceedings of 5th International Space Syntax Symposium. Delft, Netherlands.

Sailer, K., & Penn, A. (2007). The performance of space-exploring social and spatial phenomena of interaction patterns in an organisation. In Architecture and Phenomenology Conference. Haifa, Israel.

Schittich, C. (2004). High-density housing: Concepts, planning, construction. Birkhäuser: München.

Seamon, D. (2007). A lived hermetic of people and place: Phenomenology and space syntax. In Proceedings of 6th International Space Syntax Symposium. Istanbul, Turkey.

Shu, C. F. (2000). Housing layout and crime vulnerability. Unpublished PhD Thesis, The Bartlett School of Graduate Studies, University College London.

Skjaeveland, O., & Garling, T. (1997). Effects of interactional space on neighbouring. Journal of Environmental Psychology, 17, 181–198.

Stevens, Q. (2007). Betwixt and between: Building thresholds, liminality and public space. In K. A. Franck & Q. Stevens (Eds.), Loose space: Possibility and diversity in urban life. Abingdon: Routledge.

Ünlü, T. (2006). Kentsel Mekanda Degisimin Yonetimesi. METU JFA, 2, 63–92.

Van Nes, A. (2008). Introduction to configurative methods in urban studies. Delft: Techne Press.

Van Nes, A., & Lopez, M. J. J. (2007). Micro scale spatial relationships in urban studies: The relationship between private and public space and its impact on street life. In Proceedings of 6th International Space Syntax Symposium, Istanbul.

Van Nes, A. V., & Rueb, L. (2009) Spatial behaviour in Dutch dwelling areas. In Proceedings of 7th International Space Syntax Symposium, Stockholm, Sweden.

Yang, T. (2004). Morphological transformation of the old city of Beijing after 1949. In 3rd Great Asian Streets Symposium: A public forum of urban design, 2004 Street Urban Space and Representation, Singapore, (6–7 Dec 2004), (unpublished).