Chapter 8

Feeling good and feeling safe in the landscape

a 'syntactic' approach

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Introduction

Space syntax is a theory and set of tools and techniques for the analysis of spatial configurations. It was developed at University College London (UCL) in the late 1970s, as an approach to understanding human spatial organisation, and to help architects, planners and urban designers to simulate the likely social consequences of their projects at the design stage. The fundamental proposition of space syntax is that a building or place can be broken down into spatial components, so that an analysis of the interrelations of all the components will yield information about the pattern of space that is meaningful and functionally relevant. Over the past 30 years, space syntax has been applied successfully to resolve problems as diverse as master planning entire cities or revealing the imprint of culture in domestic settings.

One important finding from syntactic studies of urban environments is that syntactic measures of spatial 'integration' (the closeness of each spatial element to all others) are normally a strong predictor of space occupancy and movement, and this has proved critical in designing well-used places. Space syntax has also been used to study modern town precincts and residential areas, to show how the natural and expected relation between spatial integration and pedestrian movement can be disrupted by dysfunctional design and layout. However, it has rarely been applied to the looser spatial arrangements found in landscape architecture, where prospects and vistas are shaped more generously and at a larger scale than in townscape, and where, unlike the built environment, the spatial boundaries of living landscapes not only change in transparency or opacity with the course of the seasons, but are also less well delineated.

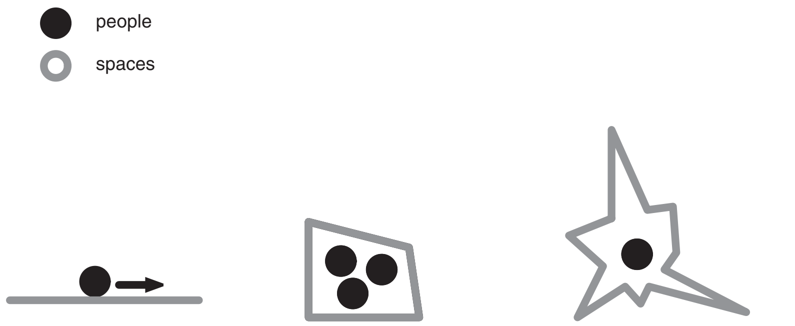
With this in mind, this chapter explores the opportunities and challenges in taking a syntactic approach to the spatial analysis of landscape. To the extent that people avoid walking through landscapes in which they feel apprehensive, understanding the spatial characteristics of such environments should enable landscape designers to create vital landscapes that support healthy lifestyles and avoid those conditions where people may feel insecure. This chapter will therefore focus on how the tools and techniques of space syntax can be adapted to understand the circumstances under which people feel motivated to explore their local landscape, and the spatial factors that may deter people from incorporating walking into their personal strategy for healthy living.

How space syntax works

Space syntax is built on three classes of spatial unit, each associated with a distinct and different representation; axial lines, convex spaces and visual fields (isovists): see Figure 8.1. Movement is essentially a linear activity, whereas social interaction is best supported by a convex space in which all points can see all others. Finally, from any point in space it is possible to construct a 360-degree visual field that describes the area and the boundary that can be directly seen from that location. Following Benedikt (1979), space syntax normally uses the term *isovist* (related terms from landscape studies/geography would be *vista* and *viewshed*, discussed in detail by Conroy-Dalton and Bafna, 2003) to refer to these irregularly shaped slices through the environment. Space syntax proposes that as people move through the complex patterns of space that are typical of buildings or cities, they build up an enduring picture of the pattern of space as a whole. Each of these representations therefore describes some aspect of how people use and experience space practically, retrieve information from and understand space analytically, or generate space creatively through architectural and urban design. A central proposition of space syntax is that there is a link between the representations of space that are adopted and those aspects of functionality that are laid open to investigation.

However, the syntactic (space syntax) approach to architectural and urban space is concerned not just with the properties of individual spaces, but with the relationships between the many spaces that make up the spatial layout of a building or a city. Space syntax uses the term *configuration* to refer to the way in which each space in a layout contributes to how all the spaces in the system affect one another. A fundamental notion of space syntax is that the layout of a network of spaces appears to be different when seen from different locations in the system.

Figure 8.1
The social logic of axial and convex spaces and isovists.

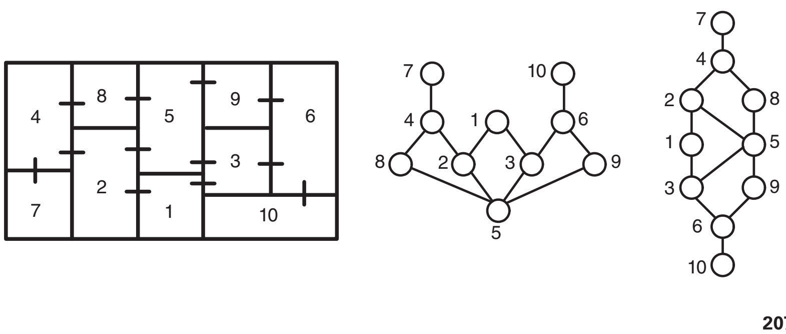


This can be illustrated by drawing a *justified access graph* from different spaces in a layout, as shown in Figure 8.2. The graphs drawn from space 5 (left) and space 10 (right) look quite different, but they are actually the same graph looked at from different points of view. Although different, each graph gives an accurate picture of what the whole layout looks like from that particular space, and thus each graph expresses a real property of the layout.

The shape of the graphs from each space can then be used to assign numerical values to each space.[1] The syntactic, graph-theoretic measure of *integration*, for example, calculates the extent to which it is necessary to pass through other spaces to go from each space to all others. This will be high or low according to whether the graph is shallow, as on the left, or deep, as on the right. To the degree that the graph from a space is shallow, it will be relatively accessible to all others in the system and therefore integrated; to the degree that it is deep, most of the other spaces in the system will be relatively inaccessible and so the location is termed segregated.

Space syntax utilises several such configurational measures, the most important of which is integration, to analyse the spatial patterns that are created by buildings and cities. Systems of axial lines, convex spaces and isovists can all be analysed in the same relational way, depending on the topic under investigation. For large systems, space syntax utilises computer modelling using

Figure 8.2
Configuration - access graphs from different spaces in a system.



DepthMap[2] software to compute the relations between each space and all other spaces, calculate the integration value of each and colour each element according to its degree of integration, where red indicates the most integrated spaces, through the colour spectrum to blue, which identifies the most segregated spaces of all. A greyscale version indicates maximum integration by black, with dark to pale grey representing increasing degrees of segregation.

Since space syntax was first developed, numerous studies from all parts of the world have shown how social and cultural patterns are imprinted in spatial layouts, and how spatial layouts affect the functioning of buildings and cities. One of the most important and robust relationships in urban systems is that between the degree of integration of a street (axial line) and the amount of pedestrian movement carried by that street; all other things being equal, the more integrated the street the busier it will be, and the more segregated it is the quieter it will be (Hillier, 1996, 2001; Hillier et al., 1987, 1993; Hillier and Iida, 2005)

Other studies have used space syntax to describe and quantify the characteristics of different complex public buildings such as museums (Tzortzi, 2004; Peponis et al., 2004), university campuses (Greene and Penn, 1997), laboratories (Hillier et al., 1985), offices (Penn, 1994; Penn, Desyllas and Vaughan, 1999; Schnädelbach et al., 2006) hospitals (Haq and Girotto, 2003), shopping malls (Batty, 2004) and similar settings where way finding may be a significant issue. Space syntax has been used to study the relationship between spatial layouts and social affects such as crime (Hillier and Shu, 2000; Hillier, 2004), traffic flow (Penn et al., 1998; Conroy Dalton, 2007) and the like, and in design applications in architecture, urban design, planning, transport studies and interior design (Hillier et al., 1991).

The syntactic analysis of landscapes

Practical applications of space syntax to landscape studies tend to be directed towards promoting the use of green routes and public parks in urban areas through people-aware design. For example, in 2003 Space Syntax Limited, a commercial spin-off company from the university-based research group at UCL, was commissioned by Thames Chase Community Forest to study the use of two Greenways on the outskirts of London. Greenways are:

> a car free component of a network for non-motorised use, connecting people to facilities and open spaces in and around towns, cities and the countryside, for shared use by people of all abilities on foot, bike or horseback, for commuting, play or leisure.
>
> (Countryside Agency, 1998)

The study analysed local travel patterns on and around the Greenways, and gathered information about the needs and motivations of walkers, in order to suggest ways to improve levels of use, especially for short trips. The key spatial factors that seemed to influence the observed levels of activity on the Greenways were integration, visibility and co-presence (Rose, 2003). The report's recommendations were therefore that to maximise their potential as transport corridors, Greenways should be well integrated with pre-existing pedestrian movement patterns and local street networks, good visibility should be maintained to nearby streets to make people feel safer, and well-used routes should also be well maintained.

Similarly, a detailed observation study of the use of a local Thameside park in the heart of London adjacent to the iconic Greater London Authority building, the headquarters of London's mayor (Savic and Rose, 2003), found that while routes at the perimeter of the park were well used, those in the heart of the park were less busy. Because public spaces are more likely to be used where there are already people walking and cycling nearby, this report stressed the importance of locating city parks at strategic points in the urban grid, drawing movement from the surrounding streets into the park from several directions by fitting the routes through the park into the natural movement patterns of the area, and ensuring that good visibility is maintained between the park and its surroundings by minimising dense and tall foliage, especially at the entrances. It also recommended that adequate seating, lighting and high-quality planting should be provided to encourage passers-by to sit down, and that provision should be made for commercial and community facilities that can maintain a more permanent presence and informally 'police' the park.

Studies of a similar nature have been carried out in several parts of the world (Baser, 2007; Grajewski and Psarra, 2001; Guler, 2007; Makhzoumi et al., 2005; Papargyropoulou, 2006). A common theme in many of these studies is the relationship between visibility (what can be seen), accessibility (where people can go) and observed use and movement (where people actually are, considered in terms of static occupancy of space as well as through-movement). An intriguing insight (Papargyropoulou, 2006) is that the spatial configuration of a parkland setting may be unique in respect of the freedom of choice that it offers its users in terms of where to go, what to look at and who else is co-present with the observer in the visual field.

A second strand of work is rather more theoretical, in that it seeks to understand and quantify the unique properties of landscape as distinct from urban space. For example, Makhzoumi and Zako (1999) have drawn attention to the difficulty of defining landscape elements. Elements such as orchards, fields, woodland and buildings have clear physical boundaries and can readily be distinguished, but others such as maquis (scrub) may be both extensive and amorphous. Makhzoumi and Zako resolved this problem by first defining the boundaries of all the clear elements in the landscape, then treating the maquis as the 'connective tissue' of the landscape, analogous to the streets of a town, which was then analysed using conventional syntactic methods.[3] The results were interpreted using Appleton's (1975) concepts of prospect and refuge. Davies, Mora and Peebles (2006) have also drawn attention to the amorphous nature of large open green spaces with large amounts of vegetation, where conventional isovist measures such as the area/perimeter ratio (Benedikt, 1979) may become difficult to calculate, yielding distorted and unrealistic results when compared with those for urban space.

The issue of visibility has been extensively explored in the field of geoinformation science (GISci) through *viewshed* analysis.[4] This concept has generated an extensive technical literature, which concentrates mainly on mapping the properties of individual viewsheds as opposed to showing how viewsheds with different properties relate systematically to one another in landscapes with different appearances and characteristics. However, Turner and colleagues (2001) have proposed a method for utilising a set of isovists laid out in a spatial environment (architects' houses and art galleries were used to demonstrate the approach) on a 1 m square regular grid in order to generate a graph that captured the mutual visibility between locations, or *visibility graph*. In a subsequent paper, O'Sullivan and Turner (2001) applied the approach to landscape, and suggested that it may provide tools for quantifying the perceptual characteristics of landscape, such as the extent to which an observer in a landscape setting perceives themselves 'inside' or surrounded by the landscape, thus pointing towards the possibility of quantifying concepts like those of prospect and refuge, referred to earlier. In similar vein, Llobera (2003) has suggested that these kinds of visual analysis, which he terms 'visualscapes', may be capable of giving a rigorous, mathematical definition of an object's visual prominence or visual exposure in a landscape.

In this respect, interesting work is being done to develop an algorithm to express the probability that a target object really can be seen from a given location in the landscape, a factor termed 'probabilistic visibility' (Skov-Petersen and Snizek, 2007a, 2007b). Building upon an earlier study of the landscape of Queensland (Preston, 2002), the authors propose that when analysing visibility in small-scale landscapes using visual fields (whether isovists or viewsheds), factors such as the ruggedness of the terrain, the presence of ground-level planting and even the weather and light conditions might interfere with visual contact. They have therefore proposed a measure of 'visibility decay' which takes account of the physical distance between the viewer and the target, the relative transparency of the environment and the viewing angle (concepts frequently employed in computer graphics in order to render natural scenes realistically: Rokita, 1993). These ideas were tested empirically in a field study located in a beech forest setting. This revealed that other features that may need to be taken into account include the exposure time of the target, whether it is moving or stationary and its appearance.

Drawing on the developments outlined above, and previous experience of employing space syntax to analyse a wide range of settings from people's homes (Hanson, 1998) to virtual environments (Conroy Dalton, 2001, 2002), the remainder of this chapter uses the new town of Milton Keynes as a vehicle to examine the potential of space syntax theories and methods to explore people's experiences of walking in landscaped settings. Access to parks and natural landscapes is believed to promote walking as a form of healthy, natural exercise that is accessible to the majority of the population. As Burgess, Harrison and Limb describe, people report:

> a profound sense of personal satisfaction … gained from experiencing the sensuous pleasures of being outside in open spaces: enjoying the changing seasons, feeling the sun, the wind or the rain, being able to walk, run or just sit down and enjoy the view.
>
> (Burgess et al., 1988: 460)

To that end, many towns and cities, including Milton Keynes, have developed walking strategies to encourage local residents to walk more, and so reduce their chances of succumbing to a range of chronic health conditions such as obesity or heart disease, as well as maintain good mental health. Aspects of the landscape that are of particular interest here are not only functional in respect of how people move through the landscape, but also cognitive, relating to how they feel about it. The relationship between spatial configuration and space occupancy and movement is well understood, so the test for space syntax analysis is whether it is possible to develop representations that pin down the relationship between the more functional properties of movement and co-presence, and the experiential spatial attributes that lead people to feel good and feel safe in the landscape.

Milton Keynes

Milton Keynes is the most recent and radical of the English New Towns. It is located 45 miles north of London and was originally planned to cover 8,900 hectares (22,000 acres) of the north Buckinghamshire countryside.[5] It was conceived of as a low-density development with a planned capacity of 250,000.[6] From its inception in 1967, the town adopted an innovative approach to master planning, by layering a 1 kilometre square grid of high speed roads, local distributor roads, cycleways and bridleways, pedestrian routes, linear parks and a variety of local play spaces, in order to create attractive, safe, car-free and healthy landscapes within reach of everyone's home. The planning concept was for 'environmental areas' each occupying a grid square and forming a semi-autonomous community, built in a variety of architectural styles and centred on a primary school, local retail centre and community facilities. The landscape design concept was of a 'forest city', and to that end, 20 per cent of the designated area of the town was allocated to creating a citywide parkland landscape (Walker, 1994). A comprehensive network of footpaths and cycleways threads through the grid squares to link them to the town's varied facilities and amenities, but this is completely separate from the high-speed vehicular grid roads. The town actively seeks to encourage walking and cycling, so pedestrian and cycle links between the grid squares are achieved by either bridges or underpasses.

Footpaths in Milton Keynes are mostly short links within housing estates; there are no footpaths between estates, and for longer journeys pedestrians have to use the cycleways (known locally as Redways, due to their use of distinctive coloured tarmac). These have become synonymous with perceived low personal security. Fear of crime is a barrier to walking, though only 1 per cent of all reported crime in Milton Keynes takes place on the Redways (MKC, 2003). Nevertheless, more people report feeling unsafe walking alone in Milton Keynes than in any other part of the entire region (Milton Keynes Council and Thames Valley Police, 1998). Amongst the contributory factors are the abundant and dense vegetation which lines many routes and contributes to poor visibility, poor lighting (especially at night) and the narrowness and isolation of many routes, which means that it is impossible to take evasive action if a person who appears to be acting suspiciously is encountered while walking or cycling (Franklin, 1999). Another reason may be that '[m]ost Redways have been constructed as a maze of largely indirect local paths' (MKC, 1998) rather than as direct routes linking desirable destinations. Underpasses and bridges contribute to the meandering, maze-like effect. Small wonder, then, that the town's Director of Public Health has highlighted obesity as a growing threat to health, adding that because the town has been designed to facilitate car use, there is a need to promote higher levels of physical activity within the local population (Hicks, 2007).

The spatial structure of Milton Keynes

The master planning of Milton Keynes has led to a very distinctive axial structure in respect of its urban grid (see Figure 8.3). The most integrated (black) line, running southeast to northwest towards the left side of the map, is that of Watling Street, originally a Roman road and now the A5. Integration picks out the mesh of supergrid roads in darker grey tones, while irrespective of their geometric position in the town grid, the local roads are almost all pale grey (segregated). The shopping centre can immediately be identified as a local intensification of mid-grey

Figure 8.3
Axial map of
Milton Keynes.

lines at the geometric centre of the map. Put simply, integration favours the high-speed roads where there is no provision for pedestrians or cyclists; the local environments where people might walk are uniformly segregated and inaccessible.

The polarization between cars and pedestrians can be further illustrated by homing in on one of the grid squares, Loughton, to study in more detail the pattern of local roads, pedestrian paths and Redways, in relation to the local landscape and streetscape. The village of Loughton dates back to at least the *Domesday Book* and is one of the most desirable of Milton Keynes' neighbourhoods. As Figure 8.3 shows, Loughton is strategically located between the station end of the shopping centre and the A5. It lies immediately to the east of the most integrated road in the new town's supergrid, and most of the local roads within the grid square itself are reasonably well integrated. The station is about ten minutes walk away and the town centre can be accessed by the Redways in 15–20 minutes.

Figure 8.4 is an aerial photograph of Loughton. The grid square contains about 1,000 dwellings, both old and new, and the areas of new housing are interspersed with large green spaces that include the playing fields of the local middle school and primary school, the village green, a section of Loughton Valley Linear Park, several pony paddocks, allotments and an equestrian centre.

Figure 8.4
Aerial photograph of the grid square containing the original village of Loughton and the Loughton Valley Linear Park (© 2009 Google - Map data © 2009 Tele Atlas).

At the heart of the village is a thirteenth-century church, which stands at the top of a slight hill that rises above the flood plain of Loughton Brook. The older houses are scattered parallel to Loughton Brook along the Bradwell Road, which before the arrival of the new town used to connect Watling Street and Loughton village to the neighbouring village of Bradwell.

Loughton ought to be an attractive environment in which to walk, and its low density notwithstanding, its location and degree of integration should support reasonable levels of pedestrian activity, yet as Figure 8.5 shows, it is a complex and multilayered environment that even residents of many years find difficult to comprehend.[7] Levels of pedestrian activity are generally low, and despite their beauty and high amenity, Loughton's parks are empty for most of the time. The village environment therefore offers a challenging test bed in which to extend space syntax analysis by exploring issues that relate to feelings of safety, security and well-being as well as functional activity patterns in landscaped settings.

Figure 8.5
The network of vehicular roads (A), pedestrian footpaths (B), cycle ways (C), social trails (D) and bridle paths (E) in Loughton. Image F is the space syntax 'integration' pattern of the combined network.

Spatial analysis

The question that this chapter set out to explore was whether the kinds of objective, configuration-based analyses typically employed by space syntax researchers can be brought to bear on the problem of representing and understanding the role of the natural landscape, particularly with reference to pedestrian movement. In this final section, we shall attempt to demonstrate how certain space syntax techniques may begin to be adapted or extended in order to address this problem, as well as to outline a strategy for future research. It is proposed that there are, broadly, three ways in which space syntax methods may be applied to the study of natural landscapes. These can be characterized as:

- 'assigning attributes to spatial units' (or the nodes in the graph-based representation)
- 'assigning attributes to the relationships between spatial units' (or the edges in the graph)
- the use of multilayered graphs.

Some of the goals of these tactics are to be able to account for the seasonal variation found in the natural landscape, the imprecise nature of natural boundaries and the multiplicity of types of path and/or use. Each of these approaches is briefly described below.

Assigning attributes to spatial units

As discussed in an earlier section of this chapter, there are three kinds of spatial representation or unit that are typically employed in breaking up a continuous spatial setting into discrete chunks amenable to quantitative, graph-based analysis: axial line, convex space and isovist. One method of enriching these spatial descriptors is to assign values or attributes to them, depending upon the specific research question. For example, it has long been recognised that the attribute termed 'constitution', or the degree to which a space is interfaced by doors and/or windows (providing natural surveillance), plays a significant role not only in the perception of crime but also in recorded instances of it (Hillier and Shu, 2000).

Using the grid square of Loughton as an example, the constitution of a space (an intrinsic property of a space) can be combined with its integration value (a configuration property). It is then possible to classify Loughton's paths through the village and its landscape according to how 'integrated and constituted' (I+C), 'integrated and unconstituted' (I+U), segregated and constituted (S+C), or segregated and unconstituted (S+U) each is, in order to test the hypothesis that this may begin to provide an index for perceived safety when walking outdoors (Figure 8.6). Of course, the degree to which a space is overlooked may itself vary, depending upon the time of year. Seasonal variation might mean that a temporary abundance of foliage could have the effect of obscuring views that would be present at other times of year, and a method to allow for such variation is discussed in the next section of the paper.

Another method of assigning a nonconfigurational attribute to a space is by the use of a weighted network graph. In this case each space, or node in the graph, is given a weight according to its position on a spectrum of predefined values. For example, a space could be characterized by the composition of its bounding vertical surfaces. Within a dense urban environment, a significant proportion of a spatial boundary could be expected to be 'hard' brick or masonry vertical surfaces; conversely, in the natural landscape, a spatial boundary could be (fuzzily) delineated

Figure 8.6
Four illustrative routes in Loughton that are: integrated and constituted' (I+C), integrated and unconstituted (I+U), segregated and unconstituted (S+U) and segregated and constituted (S+C), respectively.

by vegetation. Boundaries could therefore be classified as consisting of relative proportions of, for example, building face, solid brick or masonry wall, decorative pierced block wall or screen wall, continuous fence, visually pervious fencing, railings, cultivated hedge, semi-cultivated hedge/shrubbery, trees and so on. Depending upon the relative proportion of 'hard' to 'soft' surfaces, a corresponding value could be assigned to the corresponding node in the network graph. As with the previous example, which combined the values of constitution and integration, these surface attributes could be considered in isolation or combined with other configurational values.

The act of considering the type of surface boundary of, for example, a convex space or isovist, is not new. Benedikt (1979) discussed the difference between the real-world perimeter of an isovist (that section of an isovist's perimeter formed by a material surface) versus those sections of an isovist's perimeter formed by an occluding radial (a line of sight that links the corner of an occluding surface to its termination point at another surface, located at a distance beyond the first point). His measure of 'occlusivity' was intended to capture the ratio between these two types of surface perimeter. Equally, Zako, in her study of London housing estates (Zako and Hanson, 2009), classified sections of a housing estate's boundary according to similar hard-to-soft categories.

Assigning attributes to the relationships between spatial units

After demonstrating how intrinsic and configurational properties might be combined, it is suggested that one method to permit a greater sensitivity to the effect of the changing seasons upon our perception of space might be to assign a weight to the edges of a network graph. In conventional space syntax analysis, the edges between two nodes in a graph represent the relationship between those two corresponding spaces. Usually this relationship is a binary one: two spaces are either connected, meaning that there is a condition of mutual visibility and permeability between them, or they are not. However, if we consider the natural landscape, it may well be that two locations that are visible from each other might only be so in the winter, and not so in the spring or summer (Figure 8.7).

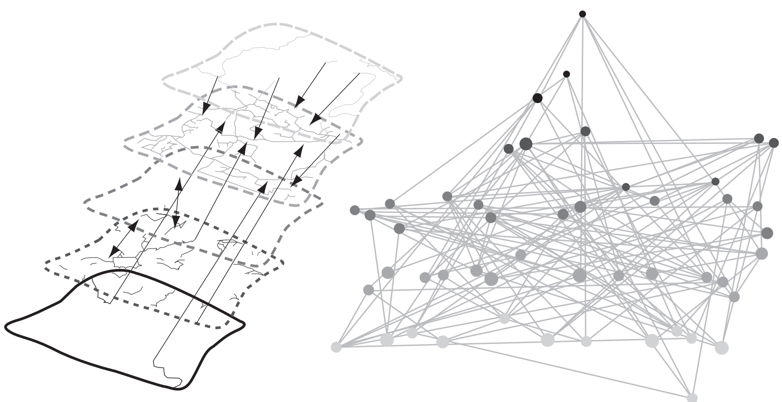
So, for example, if two spaces are mutually visible/accessible all year round, this might be expressed as an edge-weight of 4, as opposed to a pair of

Figure 8.7
The view between a residential lane and an adjacent park in winter and summer. In winter the houses and the park are visible to one another, in summer the view both ways is completely obscured by foliage.

spaces being mutually visible only in winter, which might be expressed as a weight of only 1 (with the weights of 2 and 3 corresponding to the numbers of seasons during which such a relationship is present). In this way a *weighted graph* could be created in which the 'strength' of an edge corresponds to the relative permanence of the spatial relationship. Peponis and colleagues (2004) employed such a method in their study of science exhibitions. In this case, the mutual visibility between separate exhibits was expressed on a scale of 0 to 3 depending upon the perceptual clarity of the visual link. A weighted, spatial network graph was then formed, permitting further configurational analyses. This can be seen as being a way of augmenting or extending commonly used space syntax techniques to add a richer layer of information, pertaining to the experience of being within a natural environment.

Multilayered graphs

In the grid-square of Loughton we have chosen to represent a number of different kinds of paths (Figure 8.5 and Figure 8.8), these being the vehicular, pedestrian, cycle and bridle paths as well as more informal 'social trails' (undesignated paths often evidenced as an eroded track providing a spatial short-cut). One method that can be employed to understand how these different kinds of paths function together is to treat them as separate but layered graphs that happen to intersect at specific, identified points in space. Again, this is taking typical 'tried and tested' space syntax techniques of representation and analysis, and modifying them to be able to address the specific issues that may arise in the natural landscape. The different network graphs from our example area of Loughton can thus be combined to give an overall impression of how these different uses coexist, and the effect that each may have upon the other. This employs a technique described by Dalton (2007). Imagine that each distinct graph from Figure 8.5 becomes a layer in a larger graph, and that these layers are connected at certain points: for example, where a bridle path crosses over a road.



8.8 Left: **the network of vehicular roads, pedestrian footpaths, cycle ways, social trails and bridle paths in Loughton, showing points of possible transition between layers.** Right: **the underlying graph network, showing how different layered subgraphs (differentiated by colour) may be connected at strategic points to form a larger graph.**

Typically in space syntax analyses, these two lines would either be considered to be linked, or be held to be 'unlinked' depending upon the criteria applied. In the case of multilayered graphs, each layer (for example the footpath layer and the car layer) could remain as distinct graphs that intersect at specific locations represented by *directed* links. In the case of the footpath and the car layers, the link would 'point' from the footpath to the car layer, indicating that a person could walk along a road but a car would be unable to walk upon a footpath. These inequalities could be coded into every possible pair of layers, to produce an overall layered graph. Of course, these techniques could be combined with those described above to produced layered and *weighted graphs* if appropriate.

Discussion

This chapter has begun to make some tentative suggestions as to how the family of techniques and methods employed in space syntax analysis, commonly applied to buildings and urban environments, might begin to be both extended and modified in order to begin to quantify the experience of being in and moving through the natural landscape. Some of the properties previously described that may discourage walking – isolated routes, lack of connectivity, poor visibility, and maze-like layouts – are tractable to syntactic analysis. The next step is to pilot the modified and extended 'syntactic' representations and measures described above, to see whether any accord with people's reported experiences.[8] It is clear that the way forward should include a synthesis of three types of expertise: an ability to quantify natural spaces objectively (the contribution of space syntax), environmental/cognitive psychology methods of, for example, verbal protocols and other forms of self-reporting in order to attempt to elicit the types of affordances provided by the natural landscape, and knowledge of the landscape itself, providing structured methods of classification and evaluation. This chapter, therefore, ends with a plea for future, interdisciplinary collaboration, as this will provide the best opportunity to understand the reasons why people are reluctant to make full use of the available, natural environment, and hence feel both good and safe in the landscape.

Notes

1 For a full explanation of the mathematical derivation of the measures, see Hillier and Hanson (1984).

2 Developed by Alasdair Turner, UCL Depthmap is a computer program that performs visibility analysis on architectural and urban systems. It takes input in the form of a plan of the system, and is able to construct a map of 'visually integrated' locations within it. It was first written for the Silicon Graphics IRIX operating system as a simple isovist processing program in 1998.

Since then it has gone through several metamorphoses to reach the current version 4, for the Windows platform. It is designed to run on Windows 2000 and XP operating systems.
3 In this case, a combination of convex analysis, all-line axial maps and isovists.
4 Unlike the usual syntactic interpretation of an isovist, a viewshed need not be spatially continuous.
5 In 2004, the government announced plans to expand the town's designated area to the west and east, in order to raise the population to 300,000 by 2031.
6 At the 2001 census, the population of the urban area stood at just over 184,000.
7 Hanson has lived in Loughton for 18 years; Conroy Dalton for five years.
8 Offering an interpretation for these spatial attributes of landscape is, however, likely to prove challenging; to a fit and active youth a bush may simply present itself as an attractive landscape feature, but a frail older woman may be more wary and avoid the same bush in case it conceals a mugger.

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