An evidence based approach to crime and urban design

Or, can we have vitality, sustainability and security all at once?

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Design and crime: the open and closed solutions

It is generally agreed that a key priority in the design of cities is, insofar as it is possible, to make life difficult for the criminal. But is that really possible? Different crimes, after all, are facilitated by very different kinds of spaces: picking pockets is easier in crowded high streets, street robbery is easier when victims come one at a time, burglary is helped by secluded access, and so on. In inhibiting one crime, it seems, we might be in danger of facilitating another.

Even so, the sense that some environments are safe and others dangerous is persistent, and inspection of crime maps will, as often as not, confirm that people's fears are not misplaced. So is it possible to make environments generally safer? Strangely, although it is now widely believed that it is, there are two quite different schools of thought about how it should be done. The first is traceable to Jane Jacobs book 'The Death and Life of the Great American Cities' in 1962, and advocates open and permeable mixed use environments, in which strangers passing through spaces, as well as inhabitants occupying them, form part of an 'eyes on the street' natural policing mechanism which inhibits crime. The second, traceable to Oscar Newman's book *Defensible Space* in 1972, argues that having too many people in spaces creates exactly the anonymity that criminals need to access their victims, and so dilutes the ability of residents to police their own environment. Crime can then be expected to be less in low density, single use environments with restricted access to strangers, where inhabitants can recognise strangers as intruders and challenge them.

We could call these the 'open' and 'closed' solutions, and note that each in its way seems to be based on one kind of commonsense intuition, and each proposes a quite precise mechanism for maximizing the social control of crime through design. Yet each seems to imply design and planning solutions which are in many ways the opposite of each other. The problem is further complicated by *sustainability*. To minimise energy consumption, we are said to need denser environments, which are easier to move about in under personal power, and with more mixing of uses to make facilities more easily accessible. This implies *permeable* environments in which you can easily go in any direction without too long a detour. From this point of view, the way we expanded towns in the later part of the twentieth century, with large areas of hierarchically ordered cul de sacs in relatively closed-off areas, made trips longer and so more car dependent. So if it were criminogenically neutral, the open solution would be preferable. But its critics say it is not. The open solution, they argue, will facilitate crime and so create a new dimension of unsustainability.

So what does the evidence say? The fact is that on the major strategic design and planning questions it says precious little. The points at issue were recently summarised by Stephen Town and Randall O'Toole (Town & O'Toole 2005) in a table of six points where the 'open' position, which they say is preferred by Zelinka & Brennan in their book 'new urbanist' book 'Safescape' (Zelimka & Brennan 2001), is contrasted to the closed `defensible space' position, which has dominated most thinking until quite recently.

Table 1

	SafeScape	Defensible Space
Public vs. Private	Maximize commons to promote interaction and a sense of community	Maximize private areas to create defensible space; create a sense of community through smaller developments with fewer strangers
Uses	Mix uses to provide activity and increase eyes on the street	Mixed use reduces residential control and therefore increases crime
Streets and Footpaths	Encourage walking and cycling, increase surveillance through a grid street pattern	Limit access and escape opportunities to provide more privacy and increase residential control
Alleys	Face buildings toward alleys to provide eyes on the alley	Eliminate or gate alleys as they increase burglary and are dangerous for pedestrians
Autos	Build homes close to the street, forcing parking to be on the street or in rear courtyards	Autos are safest in garages or visible in front of the house; rear courtyards facilitate burglary
Density	High density to promote activity, sustain public transit, and reduce sprawl	Density creates vulnerability when it increases common areas or unsafe parking

On some of the more detailed issues in the table, for example the dangers of rear or courtyard parking, or the risks introduced by footpaths and alleys, there is ample evidence that the advocates of 'defensible space' are right (for example, Hillier & Shu 2002, Hillier 2004). But on the 'big' issues of grid versus tree-like layouts, public versus private space, developmental scale, permeability, mixed use and residential density, hard evidence is sporadic and inconclusive (for a fairly recent review see Shu 'Crime in Urban Layouts', PhD thesis).

The open question then is: can the open, permeable, dense, mixed use environments that would seem to be preferable for sustainability be constructed in such a way as to also make them safe? Or are such environments in their nature criminogenic? The aim of the UCL Vivacity Crime study was to try to provide a methodology and a body of evidence to address this question. Is one view right and the other wrong? Or is it possible, as will be argued here through a very large body of evidence, that both are right about some things and wrong about others, and both sets of commonsense

intuitions need to be seen as part of a more complex model which incorporates the underlying ideas and mechanisms of both?

The research questions

A first step in the research was to break down the two models into a number of key questions which should be answerable by evidence, but so far have not been, or not decisively:

- Are some kinds of dwellings safer than others?

- Is density good or bad?

- Is movement in your street good or bad?

- Are cul de sacs safe or unsafe?

- Does it matter how we group dwellings?

- Is mixed use beneficial or not?

- Should residential areas be permeable or impermeable?

While looking at these questions we will also bear in mind another major unresolved question which may underlie all others: do social factors interact with spatial and physical factors?

The existing evidence base

Some of these question have of course been addressed before through research, but in terms of compelling empirically based studies, the evidence-base is astonishingly poor, and mixed with anecdote and prejudice. For example, Oscar Newman's work on social housing projects in New York in the nineteen sixties gave flats a bad name (Newman 1972), but Tracey Budd's multi-variate analysis of the British Crime Survey data in 1999 (Budd 1999) suggested that once social and economic factors were taken into account, flats were the safest dwelling type, followed by terraced houses, semi-detached houses and finally detached houses, though the more often quoted raw data said the inverse. Subsequent evidence (Hillier & Shu 2002) suggested that the multivariate order of safety with flats safest and detached houses least safe might sometimes be the case even without taking other factors into account.

Similarly, density has always been assumed to increase crime, and again Newman's work was interpreted as inculpating density, although what Newman actually said was that is was not density per se that facilitated crime, but the building form (double loaded corridors) that was necessary to achieve that density (Newman 1972 p 195-7). A series of recent studies has also failed to find any association between higher densities and crime (Haughey 2005, Harries 2006, Li & Rainwater 2006), though none have so far shown it to be unambiguously beneficial

On movement, closeness to main roads is widely thought to increase vulnerability to burglary, but recent studies (reviewed in Hillier 2004) have suggested that it may also be the case that away from the main roads and within residential areas roads with more

movement potential were actually safer, unless other dwelling-related vulnerability factors, such as basement entrances or back alleys, were in play. The related issue of the safety of cul de sacs again is a core belief in the 'defensible space' view, but it is difficult to find hard evidence one way or the other. Before the turn of the century, the British Crime Survey reported lower burglary rates on cul de sacs than side roads, and less on side roads than main roads, but there are no reports that these raw figures were tested by multivariate analysis as they would need to be to take out possible bias due to social variables. The clearest evidence on cul de sacs in fact comes from space syntax studies (Hillier 2004), where it is suggested that simple linear cul de sacs with good intervisibility of dwellings, set into a through-street pattern, can be very safe, but hierarchies of interlinked cul de sacs can be highly vulnerable, especially if connected by poorly used footpaths.

On grouping dwellings, again we find belief ascendant over evidence in the form of a widely held view that small numbers of dwelling facing each other around a space will promote community and so inhibit crime (for a critique of this concept see Hillier 1989), but compelling evidence that this is so is hard to find. The same is the case with mixed use, permeability and social factors. Passionately held beliefs abound, but little evidence can be located which would enable a reasoned judgement to be made. It must be said also that the polemic positioning that currently marks this debate is often characterised by claims that an evidence base exists when closer examination shows that it does not. Oscar Newman, for example, whose 'Defensible Space' is often referred by the supporters of cul de sacs, provided no evidence about cul de sacs in that research, and indeed expressed the view that well used '...streets provide security in the form of prominent paths for concentrated pedestrian and vehicular movement' (p. 25), adding that 'the street pattern, with its constant flow of vehicular and pedestrian traffic, does provide an element of safety for every dwelling unit' (p. 103).

Methodology

Why then, after all this time and interest, is the evidence-base so sparse? One reason is certainly methodological. To examine the spatial distribution of crime in an urban environment systematically, it would be necessary to have a rigorous, consistent and precise way of describing the differences between one urban environment and another, and between the different locations that make up that environment where crimes may or may not occur. The number of variables involved makes this formidably difficult, and the emphasis in computer packages for 'crime analysis' on 'hot spots' independent of the precise spatial and physical features of locations has perhaps distracted attention from this core problem.

It is here that the 'space syntax' techniques of spatial analysis can play a role. Space syntax is a set of techniques for representing and analysing the street networks of cities in such as way as to bring to light underlying patterns and structures which influence patterns of activity in space, most notably movement and land use. The model works at the level of the 'street segment' between intersections, and research has shown that there are ways of analysing the network that allow potential movement rates along each street segment to me approximated from the spatial analysis alone, and through the relation between the street network and movement, to identify the ways in which centres and subcentres form in the network. As a consequence of this research, space syntax sees the city as being made up of a *foreground* network of high activity linked centres at all scales, (conventionally coloured red, orange and yellow in a space syntax analysis of the network) set into a *background* network of lower activity residential space (conventionally coloured green and blue). The model is explained more fully in Appendix 1.

Since movement, land use and high and low activity patterns are all thought to be linked in some way to crime, space syntax might not only offer a way to describe and compare urban environments from the point of view of crime distributions, but also a means to link crime to the patterns urban life in that environment. Evidence that this is so can be seen in Figures 1 and 2.

Figure 1 shows that the pattern of street robbery over five years in a London borough clearly relates to the redder lines of the foreground network, while Figure 2 shows the much more diffused pattern of residential burglary does not follow anything like the same logic. But more importantly, because the colours stand for numerical values describing each street segment in the network, statistical comparisons can be made with other numbers representing located crimes. In fact, space syntax can do more than this. Because it provides a method to numerically index a large number of properties of the locations and areas that make up the urban environment, it can be used as a basic spatial description to which social, economic, demographic and other kinds of information can be added. In this way spatial factors can be brought into the statistical analysis of crime patterns on a common numerical basis.

Figure 1
The pattern of street robbery over five years in a London borough set against the background of a space syntax analysis of the street network in which potential movement through each street segment is shown by the colouring form red for high through to blue for low. It is clear that the pattern of robbery relates strongly to the 'foreground; network of red and orange streets.

Figure 2
The pattern of residential burglary of five years against the same background. Unlike the robbery pattern, the burglary pattern seems diffused throughout the network, in a way that does not suggest an obvious pattern.

The database

The database for the UCL study in made up of 5 years of all the police crime data in a London borough with a population of 263000, 101849 dwellings in 65459 residential buildings, 536 kilometres of road, made up of 7102 street segments, and many centres and sub-centres at different scales, The crime database covers 5 years and has over 13000 burglaries over 6000 street robberies ,all spatially located, to which can be added social and demographic data from the 2001 Census, and local authority data on the building stock, brought in wherever possible, as well as spatial data from the syntax analysis. Bit because different kinds of data are only available at different scales, data tables have been created at four levels:
 - the 21 *Wards* (around 12000 people) that make up the borough. At this level, spatial data is numerically accurate, but reflects only broad spatial characteristics of areas. Social data from the 2001 Census is available, but at this level patterns are broad and scene-setting at best.
 - the 800 *Output Areas* (around 125 dwellings) from the 2001 Census. At this level, social data is rich and includes full demographic, occupation, social deprivation, unemployment, population and housing densities, and ethnic mix, as well as houses types and forms of tenure, but unfortunately spatial data is fairly meaningless at this level due to the arbitrary shape of Output Areas.
 - the 7102 *street segments* (between intersections) that make up the borough. Here we have optimal spatial data, good physical data and 'council tax band' data indicating property values which can act as a surrogate for social data;
 - finally, the 65459 *individual residential buildings*, comprising 101849 dwellings. Here spatial values are taken from the associated segment. Here we have good spatial and physical data, but no social data, though Council Tax band can be used as a surrogate. So the richest demographic and socio-economic data doesn't quite overlap with the richest spatial data, but the usefulness of creating data tables at different levels with different contents will become clear below as we switch between levels to seek answers to questions.

With this methodology and database we can now address our research questions. But we must first offer a health warning. Although the database is very large, it is confined to one region of London, and the findings would need to be reproduced in other studies for us to be sure that they have any generality, even in one country. Having said this, the area is highly differentiated in terms of social composition and urban type, from inner city to suburban, and this will allow any overall patterns and correlations to be tested by subdividing the data, for example into the 21 wards to see it they hold for each area taken separately. We can do the same with dwellings types or council tax bands (a UK local tax based on property values) to see if patterns hold for each subdivision separately.

Some general patterns

The research questions will be addressed largely through the high-resolution (segments and buildings) data tables, but before we begin it worth looking at some broad patterns identified through multi-variate analysis of the low resolution data tables (wards and output areas). Multi-variate analysis is a set of statistical techniques in which the effects of different factors on an outcome (in this case crime) can be considered simultaneously and so allow it to be shown that an apparent relationship between variables disappears when the influence of another factor is taken into account (as in Budd's study of dwelling types in the British Crime Survey above).

For example, at the Ward level, we find that higher residential burglary rates are associated with social factors such as smaller household size and lower rates of owner occupation, but we also find physical factors are strongly represented, including a higher proportion of converted flats, lower proportions of residence at ground level and even a high incidence of basements. Great care must also be taken in interpreting figures at this scale, since there will often be a double effect, in that a high proportion of crimes will be carried out by criminals who also live in the ward, so figure will may index the local

availability of criminals as much as the vulnerability of victims. At most, ward level patterns suggest an interactive process involving the physical and social circumstances under which different social groups find themselves living, rather than simply a social or spatial process.

The interweaving of social and spatial factors is also suggested by a multi-variate analysis of the 800 Output Areas, where the double effect we noted will be less marked. Social deprivation factors are associated with the incidence of residential burglary, though interestingly it is employment deprivation rather than income deprivation that is strongest, but even stronger are physical variables such as housing type, with purpose built flats and terrace houses beneficial and converted flats and flats in commercial buildings vulnerable. More unexpectedly, there is a *decrease* in residential burglary with *increased* housing density (and the same with population density, but housing is stronger, through the two correlate closely). Against this background, then, we can then pursue our specific questions through the high resolution tables with some expectation there may be answers to be found.

Are some dwelling types safer than others?

Table 2 summarizes the inter-relations between residential burglary rates and dwelling types, aggregated from the database of 65450 residential buildings. The types are arranged on the horizontal axis roughly in order of the number of sides on which the dwelling is exposed to outside space, that is not at all in higher rise flats, and on all four sides for detached houses. The vertical axis shows Council Tax bands from A, the lowest to H the highest. Since Council Tax bands are based on property values, they can be assumed to give some indication of relative

household affluence. The residential burglary rates are for the full five year period. The most notable thing about the overall figures is a more of less consistent rise in average rates from higher flats with the lowest rates through to detached houses with the highest. There could of course be a problem with the high rise flats. All are local authority, and it could be that the lower rates result from non-reporting rather than actual incidence. However, examination of the rates per tax bands, will suggest this is unlikely to be strongly the case. In the two highest rise groups, all dwelling are in the second lowest, B tax band, so we can compare these with the Bs in other dwelling types to see how far they fit into a broader patterns.

Examining the overall pattern of rates, what we find is that for most kinds of flats, rates are lower than for houses and tend to fall with increasing tax band, that is with greater social advantage, while the rates for houses are higher than those for flats, and tend to be U-shaped, with the higher rates for the least and most socially advantaged. This suggests both that dwelling type is a critical factor in vulnerability to residential burglary, but also that two factors are involved in the shifting pattern of risk: the simple physical fact of degree of exposure: on how many sides is your dwelling protected by being contiguous with others ? and social advantage, with the poor and the rich at higher risk. But, overall, houses are more at risk than flats, the more so as they become more detached, and the better off you are the more you are at risk in a house and safer in a flat. It should also be noted that although within most dwellings types the pattern of vulnerability with tax band is U-shaped, with the least and most well off most vulnerable, if we look at the overall rates per tax band, the bias of lower tax bands towards flats means that there is a simple linear increase in vulnerability with increasing tax band.

Table 2

Band		A	B	C	D	E	F	G	H	Mean
Type 1	Sample		590							
	Burglary rate (5yrs)		.084							.084
Type 2	Sample		228							
	Burglary rate (5yrs)		.046							.046
Type 3	Sample	732	588	1098	1031	431	87	23		
	Burglary rate (5yrs)	.086	.193	.118	.111	.105	.093	.087		.109
Type 4	Sample	1018	2198	5673	1136	256				
	Burglary rate (5yrs)	.096	.081	.08	.065	.142				.084
Type 5	Sample		133	594	1296	358	24			
	Burglary rate (5yrs)		.132	.098	.093	.159	.391			.111
Type 6	Sample	66	1176	5013	4201	2070	847	175		
	Burglary rate (5yrs)	.18	.111	.116	.107	.117	.165	.231		.120
Type 7	Sample	175	444	1070	1403	296	53	41		
	Burglary rate (5yrs)	.137	.136	.129	.059	.062	.019	.073		.078
Type 8	Sample		237	599	446	37	-	75		
	Burglary rate (5yrs)		.063	.13	.213	.159	-	.393		.193
Type 9	Sample		859	2349	8076	2570	153			
	Burglary rate (5yrs)		.177	.102	.113	.138	.149			.117
Type 10	Sample		493	3268	4268	10819	2529	507		
	Burglary rate (5yrs)		.249	.097	.12	.145	.148	.152		.138
Type 11	Sample		307	1581	1322	969	606	489		
	Burglary rate (5yrs)		.268	.169	.153	.21	.211	.26		.199
Type 12	Sample	5	73	433	276	363	896	1367	17	
	Burglary rate (5yrs)		.151	.113	.120	.209	.169	.169	.235	.166
Type 13	Sample	15	89	436	440	512	67	378	151	
	Burglary rate (5yrs)		.112	.169	.136	.125	.179	.304	.450	.200
Mean	Sample	2253	9613	27265	27706	20578	5836	3218	217	101849
	Burglary rate (5yrs)	.101	.109	.102	.109	.140	.157	.208	.530	.123

Key
- Type 1 – very tall blocks, point block slabs .084
- Type 2 – tall flats 6-15 storeys .046
- Type 3 – medium height flats 5-6 storeys - .109
- Type 4 – lower 3-4 storey and smaller flats - .084
- Type 5 – low terraces with small T - .111
- Type 6 – low terraces with large T – 120
- Type 7 – linked and step-linked 2-3 storeys and mixed - .078
- Type 8 – tall terraces, 3-4 storeys - .193
- Type 9 - semis in multiples of 4,6,8 - .117
- Type 10 - standard sized semis - .138
- Type 11 - large property semis - .199
- Type 12 - small detached - .166
- Type 13 - large detached - .200

Although these results are consistent with the multivariate results from the British Crime Survey, they invert the raw results. Is this a problem ? We think not. The BCS covers the whole of the country, and represent the whole range of spatial and social circumstances, and in many cases dwelling types like detached houses will be in historically low crime areas, and the converse for flats. Here our data is for a single continuous urban area where the distribution of all kinds of targets is much more compressed. What is taken out of the raw BCS pattern by the multi-variate analysis is the influence of very different area and social types, and the degree of separation of these is much less in a urban environment. So it seems likely that both sets of figures are correct, but also of course that the underlying reality is that flats really are safer than houses.

Is density good or bad?

We have already seen that the low resolution data suggested that higher densities may be associated with lower rates of residential burglary. But the arbitrariness of the shape of Output Areas may mean that factors like parks, other open spaces and non-residential uses may be playing a role. To test this, we developed a measure of what we call *building-centred density* in which we take the centre of each residential building and calculate how many of dwellings are, wholly or in part, within a radius of 30 metres. We distinguish between buildings which are single houses as opposed to some kind of multiple, and also between ground level and off the ground dwellings within the 30 metre radius. The measure in effect indicates density around each building separately, and so is not subject to the problems of area based density measures. With this technique we can use another multi-variate technique called *logistic regression*, to measure how far this, or any other variable, increases or decreases the risk of each building having at least one burglary.

The results are summarized in Table 3 for the overall area and broken down by wards. The left half of the table deal with single houses, the right with buildings with multiple dwellings. In each half of the table, the first column shows the number of building in the sample, and the second column the average increase (+ sign) or decrease (- sign) in burglary risk with increased density. The values in brackets are the statistical significance of each figure, with ** meaning highly significant, and * significant. The first risk column measures the risk change with ground and upper level density, and the second for ground level density only. The Table shows that for single dwellings, all wards show decreased risk with increased density, with an average 27.2% reduction for ground and upper level density together and 38.9% for ground level only.

For multiple dwellings, great care must be taken in interpreting the figures, since the logistic regression technique means that all we can look at is whether or not a burglary occurs in the building, without regard for the number of dwellings in the building. A factor affecting the analysis will then be that the greater the number of dwellings in the building, including on upper floors, the higher the density is likely to be. The fact, then, that first column shows a more or less neutral result, can be taken to mean that increasing numbers of dwellings in the building is not increasing risk to the building, and that means that the risk to individual dwellings will be less with buildings with more dwelling. This can be tested by added the number of dwellings in the building into the equation. We find that in 16 of the 21 wards, risk is *decreased* with increasing on-and-off-the-ground density, although the simple number of dwellings is of course associated with higher risk since there are more targets. As shown in the final column of the table, however, when only ground level density is taken into account, then, even without adding the effects of numbers of dwelling, in 18 of the 21 wards there is a marked decrease in risk with ground level density for multiple occupancy buildings, with an average of 16%.

Table 3 *The effect of building-centred density on burglary risk by ward.*

	SINGLE DWELLINGS				MULTIPLE DWELLINGS		
	number of	% risk change	% risk change		number of	% risk change	% risk change
Ward	dwellings	ground+upper	ground only		dwellings	ground+upper	ground only
1	2548	-41.7 (.0001**)	-46.2 (.0001**)		541	+26.1 (.0295**)	+2.4 (.8308)
2	2887	-46.3 (.0001**)	-51.2 (.0001**)		507	+13.7 (.1758)	+11.3 (.3859
3	1574	-25.3 (.0141**)	-44.9 (.0001**)		703	+15.7 (.0446*)	-31.2 (.0005**)
4	2702	-55.9 (.0001**)	-61.8 (.0001**)		367	-.098 (.3059)	-24.1 (.0217**)
5	2734	-42.4 (.0001**)	-49.7 (.0001**)		829	-25.7 (.0002**)	-32.8 (.0001**)
6	2711	-32.6 (.0315**)	-35.6 (.0001**)		580	+4.2 (.7254)	-25.9 (.0049**)
7	1363	-27.6 (.0073**)	-45.3 (.0001**)		1699	-19.9 (.0010**)	-34.3 (.0001**)
8	1762	-30.7 (.0001**)	-34.6 (.0001**)		1544	-30.6 (.0001**)	-35.8 (.0001**)
9	3072	-13.0 (.3102)	-17.1 (.2586)		314	+3.4 (.8245)	-.4.9 (.7575)
10	789	-14.3 (.3308)	-46.4 (.0011**)		1343	+15.6 (.0033**)	-29.8 (.0001**)
11	1295	-28.7 (.0029**)	-59.6 (.0001**)		1305	+7.8 (.2471)	-20.0 (.0071**)
12	2785	-25.2 (.0452**)	-23.2 (.0884*)		334	-30.9 (.0049**)	30.2 (.0094**)
13	3026	-38.7 (.0003**)	-41.1 (.0002**)		439	-11.7 (.2455)	-14.6 (.1381)
14	1945	-19.5 (.0790*)	-38.4 (.0031**)		1524	-1.5 (.8559)	-24.5 (.0007**)
15	3445	-3.7 (.8003)	-.02 (.9925)		332	+9.4 (.4907)	-7.2 (.5820)
16	2228	-45.3 (.0001**)	-55.3 (.0001**)		688	+2.2 (.7090)	-35.9 (.0001**)
17	2578	-53.9 (.0001**)	-57.8 (.0001**)		609	+22.8 (.0391**)	-1.8 (.8657)
18	2784	-24.9 (.0739*)	-43.3 (.0013**)		434	+1.2 (.3545)	-7.6 (.4878)
19	2758	-28.0 (.0062**)	-24.7 (.0247**)		787	+1.6 (.8666)	-11.4 (.2932)
20	2208	-24.4 (.0234**)	-46.4 (.0001**)		648	+8.1 (.4437)	+3.6 (.6886)
21	1155	-27.0 (.0161**)	-33.2 (.0050**)		1547	-21.8 (.0002**)	-23.0 (.0001)
ALL	48350	-27.7 (.0001**)	-38.9 (.0001**)		17103	2.2 (0.1784)	-16.0 .0001

Table 3 is based on the 65459 buildings data table and shows the reduction in burglary risk with increased building centred density (the number of other dwellings within 30 metres of each residential buildings. The left half of the table deal with single houses, the right with buildings with multiple dwellings. The first column shows the number of building in the sample, and the second column the average increase (+ sign) or decrease (- sign) in burglary risk with increased density, The values in brackets are the statistical significance of each figure, with ** meaning highly significant, and * significant). The first risk column measures the risk change with ground and upper laevel density, and the second for ground level density only.

These are quite remarkable results, and the fact that they are so consistent across the great range of social, spatial and physical circumstances found across the borough suggests they might be found elsewhere.

How are they to be explained? It could be a surveillance effect: that having many other dwellings close to you inhibits the burglar. But it also might be a statistical effect, though none the less real for that. It could be that burglars do not go to the same target zone too often within a certain time frame, as people might be on their guard, and this could have the effect that having more dwellings in a potential target zone, however defined, would mean that the number of burglaries in the same zone would be a smaller proportion of the number of targets.

In the case of the negative effects of off the ground density it could of course simply be that you were more vulnerable because 'close to the flats'.

But it could also be a statistical effect in that having more upper level dwellings, which are less vulnerable to burglary, presumably because they are harder to burgle, will often mean that there are smaller numbers of more easily burgled houses on the ground, so the ones that are there are more likely to be selected as targets within that zone. Whatever is the mechanism, there is little doubt that in this urban area ground level density is a benefit, and upper level density not so, though the degree to which it is a disbenefit remains unclear.

Is movement in your street good or bad?

Multi-variate analysis on the most high resolution data table also allows us to approach the 'movement good or bad' question in a new way. Space syntax allows us to distinguish between two aspects of movement: the *accessibility* of each street segment as a potential destination from others; and the degree to which movement is likely to pass *through* each segment on trips between other segments. We can call the first the *to-movment* potential of a segment i.e. how easy is it to get *to*; and the second the *through-movement* potential i.e

how much movement is likely to pass through. We can also limit each measure to whatever *radius* from each segment we like, meaning that we can ask what the to- and through-movement potential of a segment it within a radius of, say, 400 or 800 metres. In effect, we can use space syntax to measure movement potential either at a localised scale or at the level of the whole city, or anything in between. These are movement potentials, of course, not actual movement rates, but in general there is about a 60-80% correlation between the potentials and observed movement rates.

So we again take the highest resolution (buildings) data table, but this time assign to each building values indicating the two types of movement potential at different radii. We then use the same technique as before, multi-variate logistic regression, to find out which, if any, potential movement factors increase or decrease the risk of burglary. The background to this is, as indicated before, that some studies have found that there is more burglary close to main roads, explaining this through dwelling being on the natural search paths of would-be burglars, while others have shown that within residential areas the more important streets have less, rather than more burglary, and this has been assigned to a greater surveillance effect from movement.

In fact, with the space syntax analysis, we find a neat reconciliation of these two points of view, and one that makes intuitive sense. In Table 4, the upper table deals, as before, with single houses, and the lower one with multiple dwelling buildings. The key figure are under 'Exp.coeff': above 1.0 indicates a percentage increase in risk, below 1.0 a percentage decrease. The figures to the immediate left indicate statistical significance which should be below .05 if the Exp.coeff value is to be taken seriously. As we see, the figures are higher for houses than flats, which is a good start since we would expect houses exposed to the public realm to me more affected by movement than more remote flats.

So for houses we find and 18.7% increase in risk from to-movement and a 10.2 increase from through movement from being on a

main city scale route. This would seem to confirm the 'search path' hypothesis. But for local movement using a 300 metre radius, we find that to-movement is more or less neutral while through movement reduces risk by 15.3%.

The pattern is the same for multiple dwelling, though all values are smaller and less significant. These results then suggest that both the 'search path' and 'surveillance' hypotheses maybe right in different circumstance. Being on an important global route does increase risk, but being on an important local route decreases it.

Table 4

Logistic Model Coefficients Table for Burgled_L
Split By: LUandRU=1then1else0
Cell: 1.000

	Coef	Std. Error	Coef/SE	Chi-Square	P-Value	Exp(Coef)	95% Lower	95% Upper
1: constant	-1.140	.175	-6.522	42.539	<.0001	.320	.227	.450
TOmovCITYscale	.171	.020	8.402	70.596	<.0001	1.187	1.140	1.235
THRUmovCITYscale	.097	.013	7.237	52.379	<.0001	1.102	1.073	1.131
Tomov300m	.003	.001	2.716	7.376	.0066	1.003	1.001	1.005
THRUmov300m	-.166	.045	-3.681	13.552	.0002	.847	.775	.925

Logistic Model Coefficients Table for Burgled_L
Split By: LUandRU=1then1else0
Cell: 0.000

	Coef	Std. Error	Coef/SE	Chi-Square	P-Value	Exp(Coef)	95% Lower	95% Upper
1: constant	-1.139	.233	-4.898	23.990	<.0001	.320	.203	.505
TOmovCITYscale	.061	.028	2.192	4.805	.0284	1.063	1.006	1.122
THRUmovCITYscale	.039	.018	2.222	4.937	.0263	1.040	1.005	1.076
Tomov300m	.010	.001	8.276	68.486	<.0001	1.010	1.007	1.012
THRUmov300m	-.129	.055	-2.347	5.510	.0189	.879	.790	.979

Cul de sacs versus grids?

The study area has relatively few cul de sacs, and most follow the formula identified in previous studies as safe (Hillier & Shu 2002, Hillier 2004), that is simple and linear, and attached directly to the through movement network. There are no hierarchical cul de sac complexes of the kind built in the second half of the twentieth century, largely because the area was more or less fully built by the second world war. The small size and relatively undifferentiated typology of the cul de sacs should be borne in mind in what follows.

There is also a methodological problem. For a large dataset the spatial analysis must be carried out automatically and it is not a straightforward matter to identify what is and is not a cul de sac algorithmically, though of course it is easy enough by eye. For example, if we use the number of connections that a segment has, as in *Figure 3*, a 1-connected segment can only be the end of a cul de sac, since a cul de sac connected to a route from which you can turn in two directions will be 2-connected (to one in each direction), as will the deepest space in a crescent. In some circumstances, even a 3-connected segment can be a cul de sacs, namely one which is connected to a through road but with another connection on the other side of the road. At the other end of the spectrum, a 6-connected segment (to all intents and purposes the maximum in most types of urban system) will usually be part of a grid like layout, but again this will not necessarily be so.
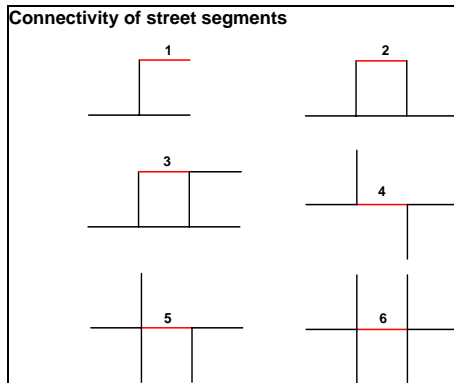
Figure 3. *Segment connectedness.*

Table 5

Logistic Model Coefficients Table for Burgled_L

	Coef	Std. Error	Coef/SE	Chi-Square	P-Value	Exp(Coef)	95% Lower	95% Upper
1: constant	-.392	.144	-2.722	7.410	.0065	.676	.509	.896
TOmovCITYscale	.225	.016	13.980	195.442	<.0001	1.253	1.214	1.293
Tomov300m	.009	.001	10.556	111.427	<.0001	1.009	1.007	1.010
THRUmovCITYscale	.062	.011	5.824	33.913	<.0001	1.064	1.042	1.087
THRUmov300m	-.149	.036	-4.157	17.278	<.0001	.862	.804	.925
SEGMENTlinks	-.037	.014	-2.607	6.797	.0091	.963	.937	.991

Even so, provided we bear these caveats in mind, it still turns out to be useful to proceed by examining segment connectivity in relation to residential burglary. If we aggregate the 1- and 2-connected segments, and assume that they will cover most cul de sacs, we find that on average they have a burglary rate nearly a third lower at .088 compared to an average of .123, and in general higher connectivity is associated with higher burglary rates, though the peak is at 5-connected, with a fall at 6-connected. However, this seemingly clear pattern becomes much more complex when we take into account other variables. First, when we add segment connectedness to the logistic regression analysis we showed in *Table 4*, we find that in the presence of other movement related spatial variables, higher segment connectivity is marginally *beneficial*. *Table 5* Low segment connectedness should not then be taken in itself as automatically positive.

More importantly, segment connectedness is dramatically affected by two other variables. The first is Council Tax Band, which we have previously used as a proxy for social affluence. *Figure 4* shows the burglary rates for 1-2 up to 6 connections for single occupancy houses in the B-H tax bands (A has too few cases). This shows there is great variation in the direction of shift, in that while rates for the D and G bands rise with segment connectedness, the B, C and H bands tend to fall, though with fluctuations, while the E and F bands both rise and fall. Even more striking is the variation of rates by tax bands, which is greater than the variation by connectedness. Most striking of all are the very high rates for the top H-band, and the fact that the highest of all are in the low connectedness bands. We have already seen in our analysis of dwelling types that increasing affluence increases the vulnerability of houses. Now we see that this is particularly focused on houses lying on street segments with few local connections.
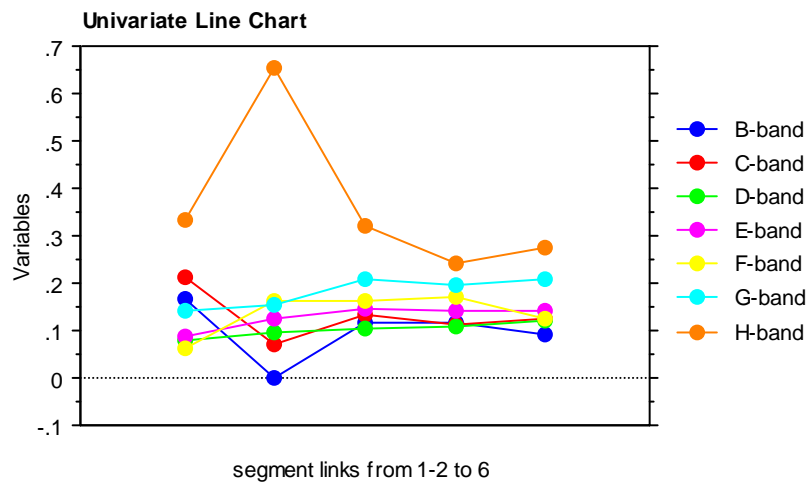
Univariate Line Chart

Figure 4

The second factor that strongly affects segment connectedness is the number of dwellings on the segment. 1- and 2-connected segments with no more than 10 dwellings, for example, have a burglary rate of .209, or nearly twice the average, while 6 connected (grid like) segments with more than 100 dwellings (which account for over 3000 dwellings) have a rate of .086, very substantially below the average .In general we find that for both low and high connected segments, the greater the number of dwellings on the segment, the lower the burglary rate. Most at risk are small groups of affluent houses in poorly connected locations. We might conjecture that the more attractive the target, the more the isolation of the cul de sac, or near cul de sac, benefits the burglar, while for less attractive, perhaps more opportunistic targets, cul de sacs tend to be off the search path, and hence their lower rates. So again we can say that cul de sacs, or near cul de sacs, are not safe in themselves, but they become safe with larger, not smaller, numbers of neighbours, and with less affluent occupants.

Does it then matter how we group dwellings?

What implications might this then have for how we group dwellings. For most of urban history the commonest way to group buildings has been in linear streets, with buildings opening onto the street on both sides, and recent years has seen a return to this formula and a move away from the late twentieth century preference for small scale enclosure around green spaces or piazzas (Hillier 1989). But how big should each segment be, that is, how frequent should intersections be, and what should be the overall block size ? The recent fashion to increase permeability has led to smaller block sizes and to fewer dwelling on each segment. Does this matter ? or are there perhaps scale effects with street networks in general, as there are with cul de sacs?

It turns out that there are indeed scale effects, and understanding them is one of the keys to designing safe open environments. For example, if we take the 328 segments in our sample with only one dwelling on them, we find a total of 197 residential burglaries have occurred over 5 years in the 328 dwellings, a rate over 60%, or 12% per year. But if we take the 34 segments with more than 90 dwellings per segment we find a total of 3708 dwellings and 419 burglaries over five years, a five year rate of 11.3%, or 2.26% a year.
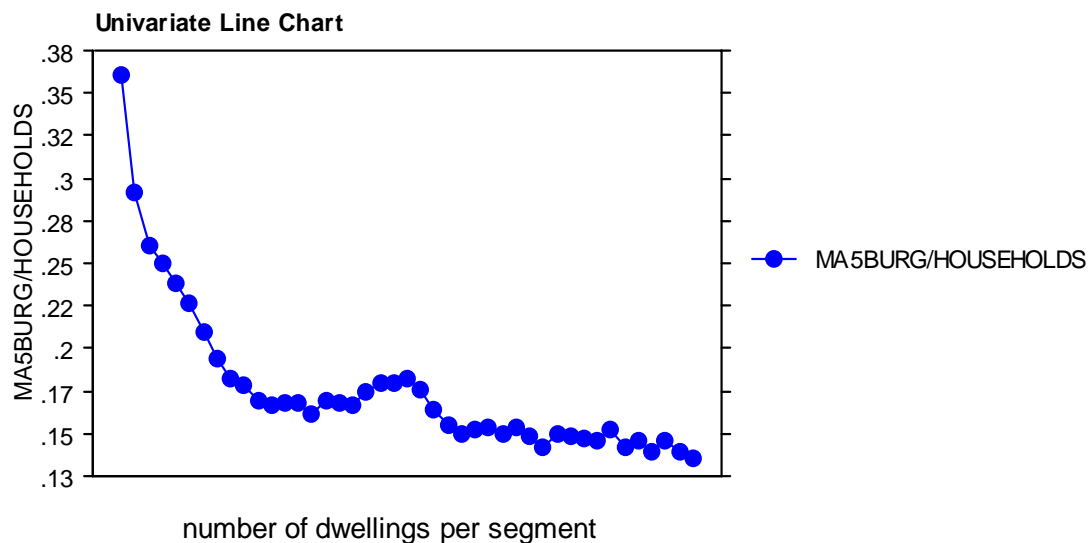
Univariate Line Chart

number of dwellings per segment

Figure 5 *The segment data grouped into bands according to the number of dwellings on the segment. Residential burglary rates fall with more dwellings on the segment. The banding avoids the statistical artefact that would occur if we divided the burglaries by the dwellings on each segment on a segment by segment basis.*

To explore this further, we divide all 4439 segments with at least one dwelling into bands according to their number of dwellings. This gives an average of 94 segments per band, and so a total street length per band of 9.3 kilometres with an average of 1600 dwellings.[1] We then calculate the rates for each band, and plot them on a line chart with dwellings per segment on the horizontal axis and the burglary rate on the vertical (in fact taking the log of each). We see in *Figure 5* that the risk of burglary decreases steadily with increasing numbers of neighbours on your street segment.

This is a remarkable effect, but not unexpected to anyone familiar with the history of cities, since in general we find that residential areas have larger blocks sizes, and so more buildings per street segment, than high activity central areas. It is not a surprise that this make sense in terms of security. This does of course argue that the current emphasis on as much permeability as possible can easily be overdone. This result, as with density, could be explained by increased surveillance, but it could also be explained statistically by the 'safety in numbers' argument we conjectured for density.

The central importance of block scaling in residential areas can be shown by another remarkable result. We noted earlier that higher accessibility for *to-movement* at the larger scale of movement was associated with higher risk of residential burglary. By bringing the *safety in numbers* factor into the equation, we can show that it is not so simple. If we take our dwelling on segments bands and plot the burglary rates against

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[1] The banding is necessary, since if we calculate rates of burglary on a segment by segment basis, then a random burglary on a segment with more dwellings will appear as a lower rate than one occurring on segment with fewer dwelling. The rates would then be 'artefacts' of the way we have made the calculation. With banding we avoid this problem since the number of dwelling on each segment is not involved in each band calculation, and is only an extraneous condition for the band.

large scale accessibility, we find a *bifurcation* in the data, with one arm rising and the other seemingly falling with integration. *Figure 6a* If we then split the primary risk band about half way into those with less than 25 dwellings per segment on the left *Figure 6b* and those with more on the right *Figure 6c,* then it seems that the negative effect of large scale accessibility on crime is eliminated and becomes favourable with increase in the amount of residence. More residence, it seems, balances out the negative effect of being close to large scale movement, and makes it positive. Eyes from the street and eyes on the street conspire to create greater safety. This result also helps to explain the apparently divergent findings in earlier research discussed above.

Regression Plot

$Y = -1.219 + .565 * X; R^2 = .04$

Figure 6a

Regression Plot
Row exclusion: RESperSEGcutcolsmiss081105A.xls (imported).svd

$Y = -9.115 + 3.77 * X; R^2 = .583$

Figure 6b

Regression Plot
Row exclusion: RESperSEGcutcolsmiss081105A.xls (imported).svd

Y = .572 - .172 * X; R^2 = .304
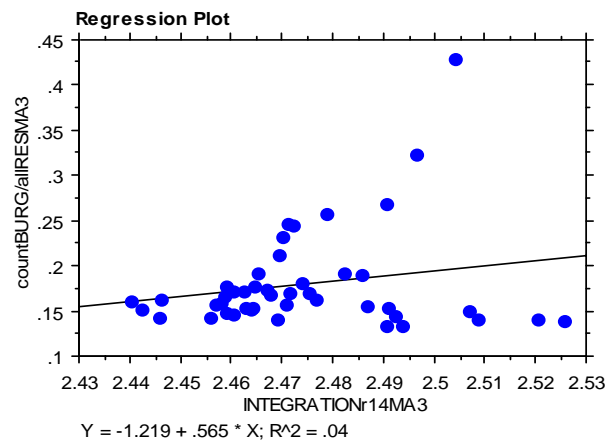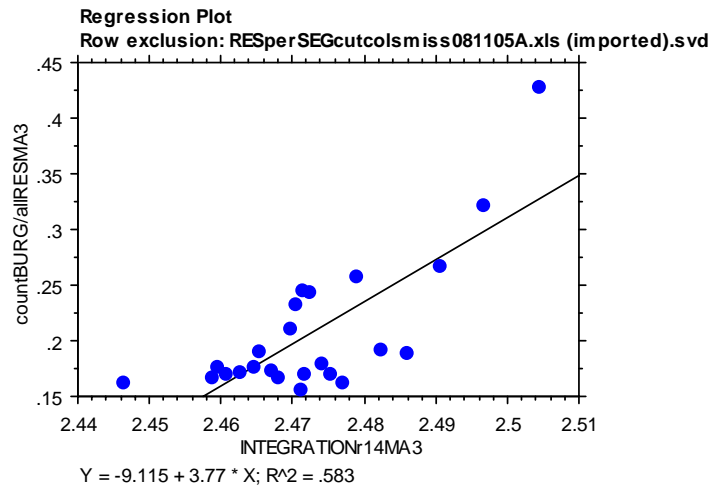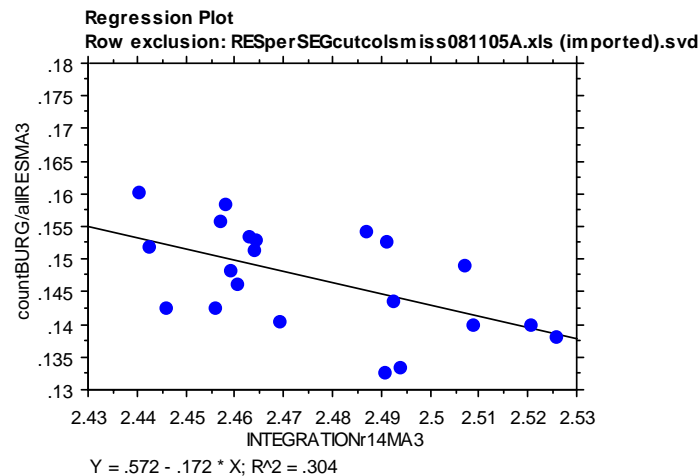
Figure 6c

Is mixed use beneficial or not?

Since we are using the street segment level data for the above analysis, we can also test out the effects on street robbery. Again, we must again take care, since, on such a large database as this, if street robberies happen randomly, then longer segments will have more robberies purely as an effect of chance, and longer segments are likely to have more dwellings on them. We can overcome this, as before, by the banding technique, that is by aggregating all the segments into band of a certain length, the calculating the *robbery rate* at the total robberies over the total length within the band. Again, the length of the segment is not involved in the calculation of the rate, so we have a measure which is independent of this.

By plotting this measure within the dwelling per segment banding we find not, as with burglary, a simple fall, but fluctuations within an overall fall. *Figure 7* These fluctuations are due to the presence of non-residential uses. This can be shown by dividing the robbery rate by the ratio of residential to non-residential uses *Figure 8*. The linearity of the relation now shows not only that street robbery is strongly affected by the presence of non-residential uses on the street, which is well known, but also a new phenomenon: that fluctuations in the pattern due to the presence of non-residential uses are overcome to the degree which there is a high

ratio of residential to those non-residential uses. In other words, as with burglary, residential numbers seem to be the key to a safer environment.

We can use a similar technique to see if a similar pattern is found for burglary. In *Figure 9*, we use the dwellings per segment banding to plot first, in blue, the falling rate of burglary for segments without non-residential uses, then in red the rate for segments with between 1 and 2 non-residential uses, and then in green those with 4-10. On the vertical axis is the burglary rate for the band. We see that on the left of the figure when the numbers of dwellings per segment is low, that the burglary rate with 4-10 non-residemntial uses is size time that for the bands without non-residential, and for 1-2 it is twice as high. So when residence is sparse, there is indeed a penalty for mixed use. But as we move right and increase the numbers of dwellings per segment, all the rates not only fall but also converge, so that when we reach about 15 dwelling per segment the penalty for 4-10 non-residential uses has become very small, and for 1-2 is has vanished.

The implications of this is very significant. It means that mixed use works security-wise when residential numbers are high, but not when they are low.
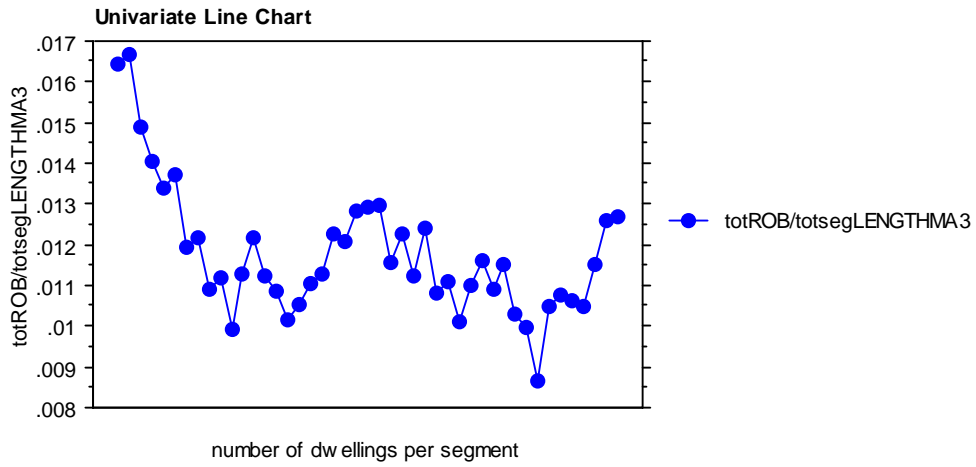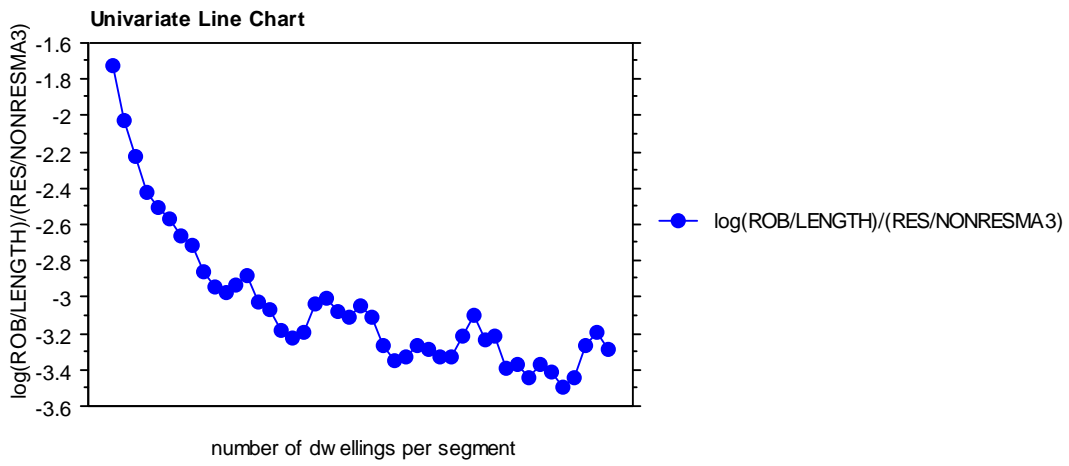
Univariate Line Chart

Figure 7

Univariate Line Chart

Figure 8

Univariate Line Chart

Figure 9

Professor Bill Hillier   Ozlem Sahbaz
An evidence based approach to crime and urban design

Univariate Line Chart

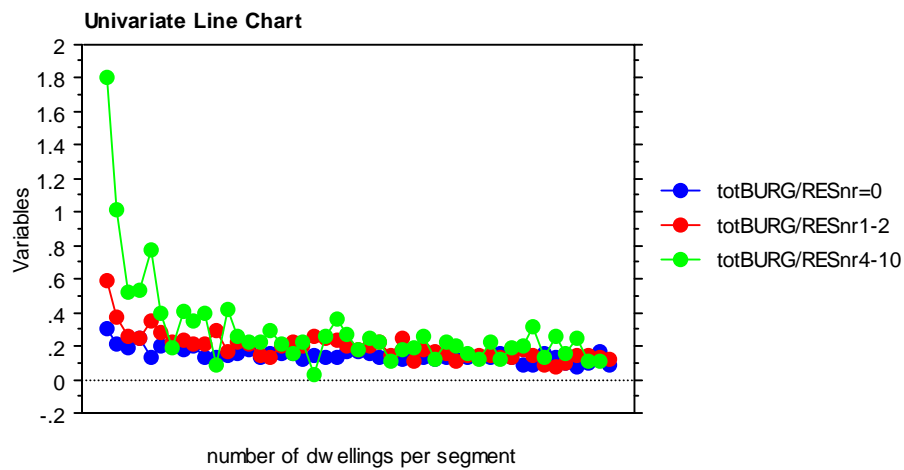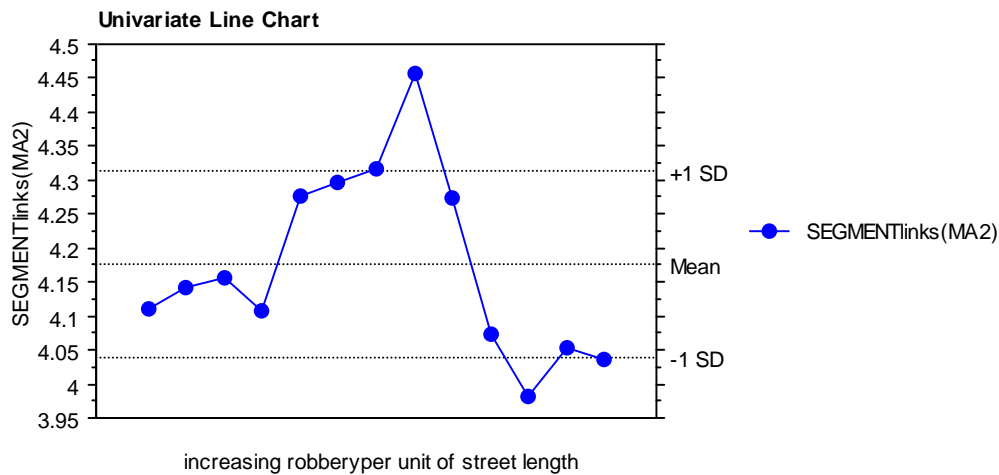*Figure 10*

But what about robbery in and around the network of linked mixed use centres where we saw in *Figure 1* it tended to be concentrated. There are relatively few residents in these areas, so what are the characteristics of the space where it does occur ?. We can take the first step towards an answer by using the banding technique again, but this time banding all the segments according to their rate their density of robbery (robbery per unit of street length), and asking whether the bands with high densities of robbery have different characteristics from those with low rates. We can begin with the simplest spatial variable, segment connectivity. Starting with the lowest rates on the left, *Figure 10* shows first a rise with increasing rates, but with the three highest rate bands there is a very sharp fall to less connected segments. Using the same technique, we see that robbery rates increase with the distance of the space from

buildings *Figure 11*, with the ratio on non-residential to residential units *Figure 12*, and the number of connections for the line of sight on which the segment falls is lowest for the highest robbery rates, *Figure 13*, but the length of segments increases to peak with the highest rates. *Figure 14* In this way, we build a profile of high robbery street segments as being long (in spite of the fact that segments in mixed use areas tend to be shorter) and poorly connected, on poorly connected lines and with very low ratios of residence to non-residence.
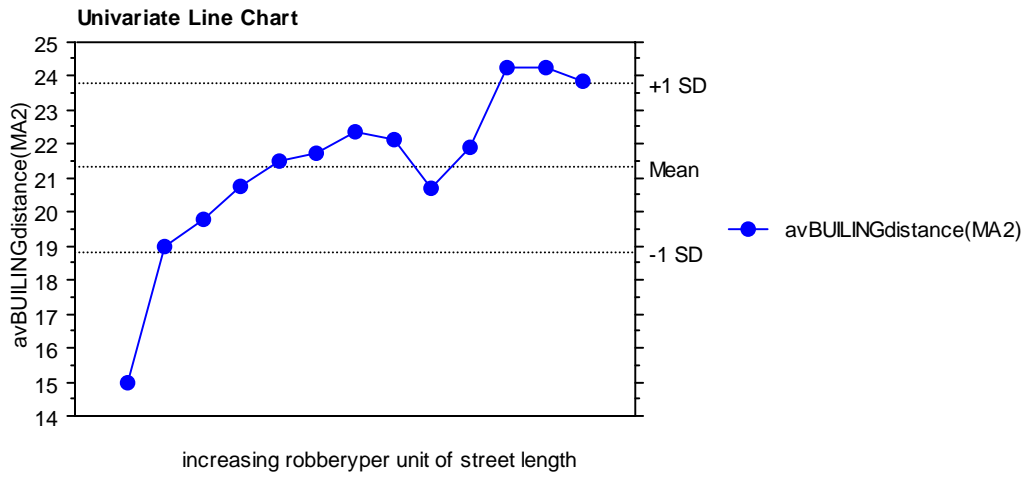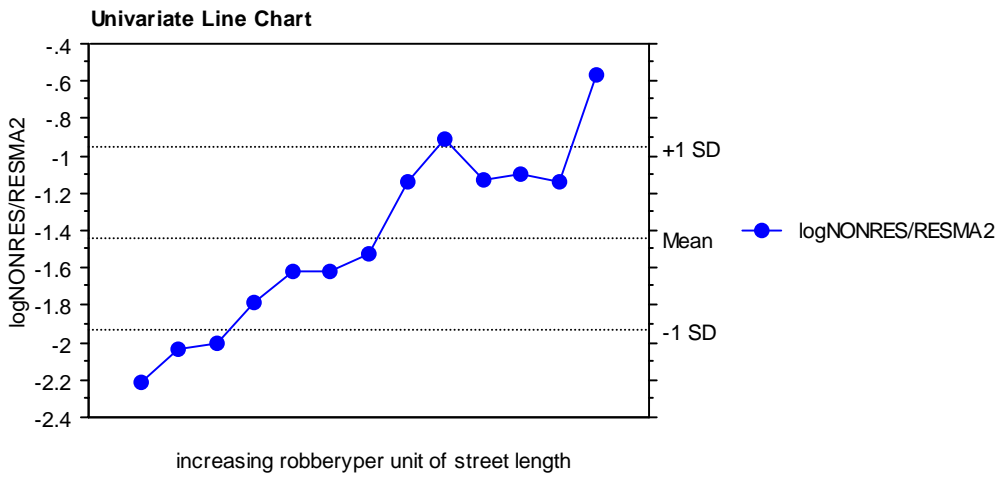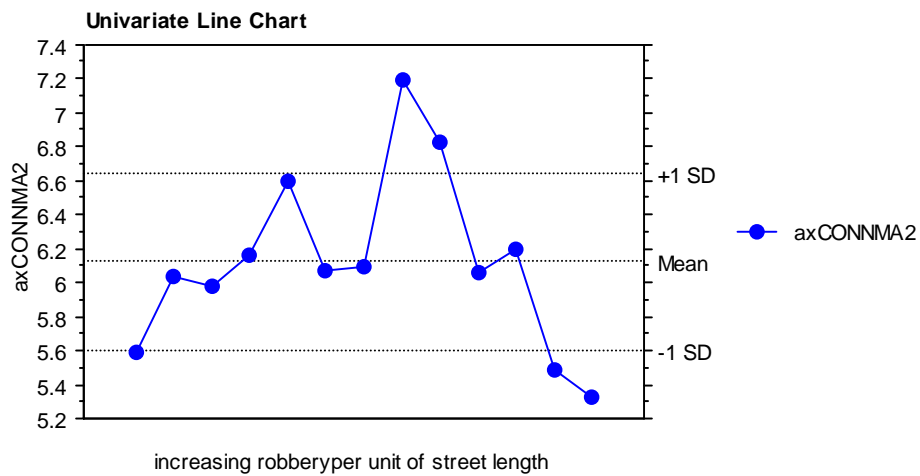
Univariate Line Chart

Figure 11

Univariate Line Chart

Figure 12

Univariate Line Chart

Figure 13

Univariate Line Chart

Figure 14
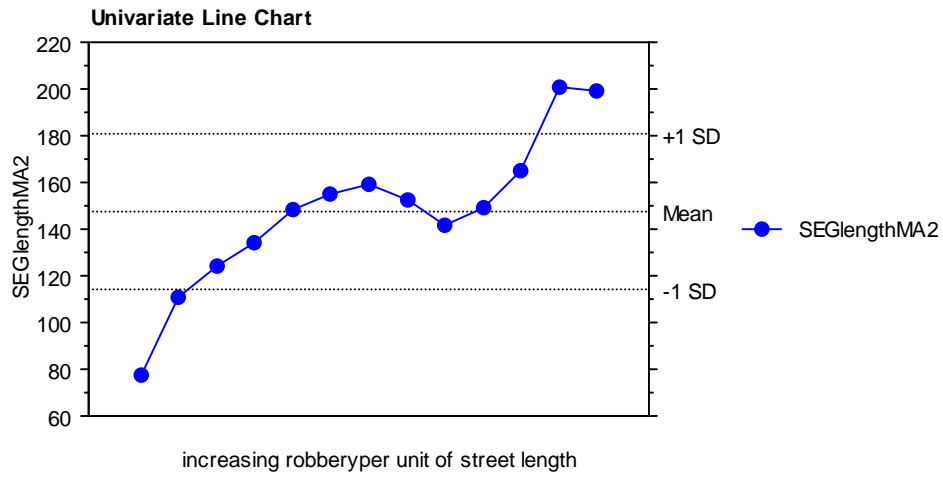
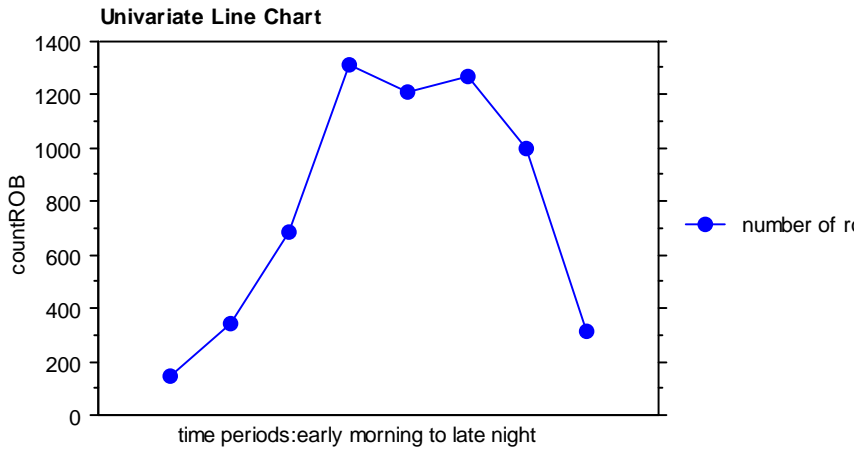**Univariate Line Chart**

Figure 15
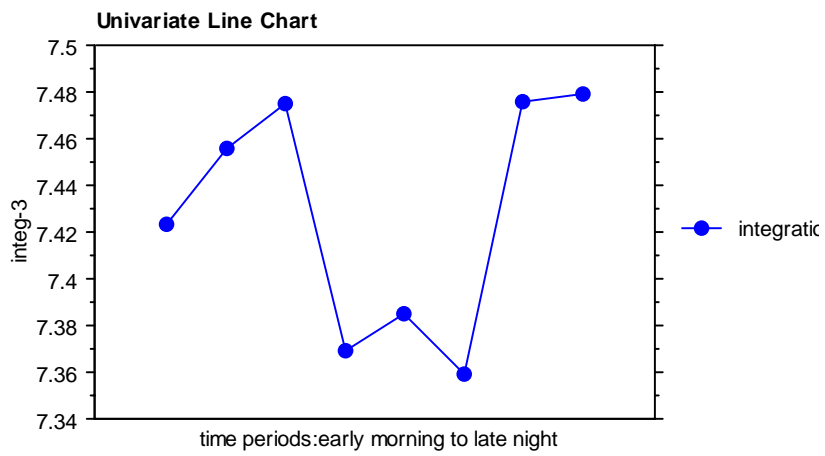
Univariate Line Chart

Figure 16

We find equally informative patterns by dividing the data into time periods. *Figure 15* plots the number of street robbery through 8 three hours periods making up the day, starting on the left with 6-9 am. *Figure 16* then plots the average movement potential in the segments in which they occur. Once again we see that the high rates occur in more isolated spaces. This shows that it is not the high street where the danger lies, but in much less significant segments close to the high street. However, the situation changes after midnight. As *Figure 16* shows, high rates are associated with lower movement potential segments and low rates with higher, but with an important exception. In the post midnight period, high rates of street robbery return to the high movement potential spaces. The maxim would seem to be: *don't go on the high street after midnight, but don't leave it before midnight.*

The final question about mixed use areas is what we might call Newman's question: is the high street safer or less safe, that is, is the increase in robbery rates in and around mixed use areas less than or greater than the increase in pedestrians. It will be this that governs the *risk* to potential victims. We cannot of course observe pedestrian flows in all the relevant segments, but we can make use of our extensive London database on all day pedestrian (and vehicular) flows on over 367 street segments in 5 London areas to ascertain the *average* difference in pedestrian flows on segments with and without retail.

Mean pedestrian movement on all 367 segments is 224.176 per hour. For segments without retail the rate is 158.476 for 317 segments, and for those with any retail (without distinguishing how much) it is 640.714 for 50 segments. This means that the movement rate on segments with retail is 4.042 times those on segments without. The average robbery on segments without non-residential uses, as shown above left, is .0074, while the rate for segments with non residential uses is .0176, or 2.4 times as high. The rate of increase in robbery in then substantially less than the increase in movement rates, and dividing one into the

other, so 2.4/4.042, we get 1.68, so that we can say in terms of *people risk* you are 68% safer on busier street segments with non residential uses than on those without. This of course is a very provisional figure, but it is probably a conservative one. The conclusion is that the apparently higher rates of street robbery in and around high activity centres is not a reason to avoid them. You are actually at lower risk in the high activity centres, in spite of the apparent concentration in these areas.

How permeable should residential areas be?

We cannot directly answer this question with this database as we do not have a level of resolution in the data which reflects plausible area structures below the level of the ward. However, certain results we have already presented are directly relevant to this. First the high integration – and so more movement potential – segment with more that 25 residential units per segment which were shown in *Figures 6a,b* and *c*, to associated higher integration with lower burglary rates, will in most cases be the dominant strategic alignments in residential areas. This re-inforced earlier findings that the main alignments which structure movement in residential areas tend to be safe. Since integration reflects all round permeability, it is safe to infer that well-structured areas with enough permeability to link them in all directions can indeed be relatively safe – though other factors will also be involved here.

The findings in Tables 4 and 5 also have a direct bearing on this, since they showed that local movement up to a certain radius was beneficial. This implies that residential areas should be structured so as to achieve a good integration with local movement, though care should also be taken to ensure that lines which were likely to feature in more global movement patterns were also well above the threshold of 25 residential units per segment that would make them safer. Again, this shows that areas can safely be structured for enough permeability

to facilitate movement in all directions, provided the rules about the numbers of dwelling per segment are also in play.

In fact, although the 'wards' of the borough we well above the scale of anything we might call 'natural areas', it is instructive to examine them from the point of view of the 'potential movement' variables. At first sight, it seem that there is a weak but consistent positive association between various scale of integration and burglary rates. However, the pattern of integration reflects the order in which the borough was built, from the more urban, and so more integrated, areas closer to the city centre that were built from the early nineteenth century on, through to the more suburban areas constructed for the most part in the decades between the two world wars. It is this that produces the apparent association between the movement potential variables and higher burglary rates, and in fact under multi-variate analysis with the full range of physical and social variables, the association disappears.

As *Table 6* shows, the *only* variables that are linked to burglary rate are the proportion of converted flats, which are exceptionally vulnerable, and the proportion of houses with basements. Even the Deprivation Index is excluded in the presence of these two variables. At this level, it seems that we find simple physical variables in the driving seat, and we only need to bring in a fuller social account to explain the historical process which accounts for the higher number of houses divided into flats and the greater frequency of basements in areas built at a certain time.

Table 6

Variables In Model
totBURG/allRESa vs. 10 Independents
Step: 2

	Coefficient	Std. Error	Std. Coeff.	F-to-Remove
Intercept	.117	.007	.117	293.232
%flat(converted)	.208	.034	.570	37.147
%basement	1.603	.287	.521	31.121

Variables Not In Model
totBURG/allRESa vs. 10 Independents
Step: 2

	Partial Cor.	F-to-Enter
segLENGTH	-.048	.039
lineLENGTH	.066	.073
INTEG-n	.091	.142
INTEG-3	.131	.297
local density	-.160	.448
%OWNocc	-.001	2.638E-5
%SOCIALrent	-.244	1.076
IMDscore	-.141	.345

The answers to the questions

On the evidence of this study we can then suggest the following answers to the questions.

Which dwelling types?
In this area, the relative *safety of different types of dwelling* is affected by two simple interacting factors: the number of sides on which the dwelling is exposed to the public realm - so flats have least risk and detached houses most, and the social class of the inhabitants. All classes tend to be safer in flats, but with increasing wealth the advantage of living in a flat rather than a house increase, as does the disadvantage of living in a house - in spite of the extra investment that better off people are believed to make in security alarms. At the same time, purpose built flats are much safer than converted flats. The overall advantage of flats is in spite of the high vulnerability of converted flats

Density high or low?
Higher ambient ground level **densities** of both dwellings and people *reduce* risk, though off the ground density may increase it.

But taking both together overall density is beneficial.

Movement or not?
Local movement is beneficial, larger scale movement not so – but where there is large scale movement, spatially integrated street segments (more movement potential) have lower risk to the degree that they are lined with high numbers of dwellings per segment, and higher risk where number of dwellings on the segment are low.

Cul de sacs or grids?
The principle that larger the numbers of dwellings on the street segment reduces the risk of burglary, applies both to cul de sacs and grid like layouts. Small number of dwellings in a cul de sac are vulnerable, especially if the dwelling are affluent. Relative affluence and the number of neighbours has a greater effect than either being in a cul de sac or being on a through street. The earlier finding that simple linear cul de sacs with good numbers of dwellings

set into a network of through streets tend to be safe is confirmed by this study.

Can mixing uses be safe mix?
Mixed use street segments are relatively safe with good numbers of residents, and vulnerable with few residents. Increased residential population neutralises the risk that is found with sparse residence on mixed use segments.

How should we group dwellings?
Dwellings should be arranged linearly on two sides of the street. Residential blocks should be larger rather than smaller.

How permeable should residential areas be?
Local movement reduces risk, so residential areas should be designed to structure local through movement, while exercising care about larger scale movement. Where there is larger scale movement, safer dwelling types should be used to balance eyes on the street with eyes from the street. Residential areas should be permeable enough to allow movement in all directions but no more. The over-provision of poorly used permeability is a crime hazard.

Do social factors interact with physical and spatial factors?
Social factors interact with physical and social factors in several ways: for example, burglary risk is U-shaped, with the least and most well-off most vulnerable, while robbery risk increases in less well-off areas; the advantage of living in a flat is great for better-off people, though still present for the less well-off; and the well-off are particularly at risk in small cul de sacs.

So do we need to change the paradigm?

So where does this leave the debate between the 'closed' and 'open' solutions? In one sense both sides are right about some things and wrong about others, and each side could, if it wished, claim some selective vindication from the results we have shown. That would misrepresent the situation. At the very best, the evidence presented here suggests that certain principles in each

argument form part of a larger and more complex picture, and that each side needs to rethink its principles in terms of this more complex picture. The advocates of the closed solution seem to have been too conservative in overstating and over-simplifying the case for cul de sacs and closed areas, in insisting on small rather than larger groupings of residents, and in underestimating the potential for, and the importance of, life outside the cul de sac and the closed-off area. The advocates of the open solution have been too optimistic about exposing the dwelling to the public realm, in not linking permeability to a realistic understanding of movement patterns, and perhaps in not appreciating the interdependence between residential numbers and the safety of mixed use areas.

But who is right and who is wrong may not be the most important debate. Throughout the analysis we have presented evidence which calls into question some of the most deeply held assumption that have been made on all sides about the relation between spatial design and security. The most important of these is perhaps the 'safety in numbers' argument that re-appears again and again in our evidence. This challenges long held beliefs that small is somehow beautiful in designing for well-working, low-risk communities. On the basis of the evidence we have presented, the contrary may be the case. The benefits of a residential culture become more apparent with larger rather than smaller numbers. Bigger may be stronger.

A no less challenging implication of this body of evidence is that the relation between crime and spatial design may not pass through the intervening variable of community formation. Again and again, the evidence suggests that the simple fact of human co-presence in space, coupled to simple physical features of buildings or spaces is enough to explain

differences in victimisation rates in different types of location and area, albeit with variations due to social factors. It is not clear from our evidence where we would need to look for further clarification through such variables as community formation. There is a plausible alternative argument here: that simple human co-presence, coupled to such features as the presence of entrances opening on to space, are enough to create the sense that space is civilised and safe. The idea that community formation is the intervening variable between spatial design and urban security may be an unnecessary hypothesis.

Other features of the evidence also suggest modifications to current paradigms. One is that features of environments that relate to crime risk rarely work on their own but inter-depend with other features, social as well as spatial and physical. We cannot introduce one feature at a time and expect good results. Good design must reflect the interdependence of features as we have outlined them. Similarly, local areas rarely work on their own. Every area, closed or open, inter-depends with its context, and both design and research must reflect this.

Most important of all perhaps is the need to recognise that the urban environment is a continuous whole. It is not a set of discrete areas that are somehow joined together to form a whole, but a continuous structure in which the connecting tissue between recognisable areas is as critical as the areas themselves. This is perhaps where space syntax can make its most significant contribution. It tells us that the whole pattern of urban space is involved in the sense of civilised and safe existence, which it is the aim of all urban design to create. This most elementary of urban facts should be reflected in future research as well as in spatial design and planning.

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