Urban form and deprivation: A contemporary proxy for Charles Booth's analysis of poverty

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Abstract

This article explores the relationship between physical segregation and economic marginalisation in the city, contrasting 19th century and contemporary London. It describes the use of space syntax analysis to represent and analyse urban street systems as a spatial network. One of the main challenges with spatial analysis of contemporary deprivation data is the lack of sufficiently detailed data and summaries that can easily be related to specific elements of the built environment. Either constraints of privacy preclude the release of household-level data, or nationally collected statistics are unsuitable for detailed spatial analysis due to their being summarised for relatively large areas which do not correspond to the specific configuration of the street layout and its morphology.

This article highlights how such detail and summaries can provide a powerful tool for policy makers and regeneration projects to address deprivation at the urban and building design scale. A variety of proxies for the Charles Booth map of poverty were considered in order to compare the same area 100 years apart, focusing on places that remained deprived over this period. Housing benefit and council tax benefit data at the household level were provided by two London local authorities. They were transformed into an equivalent to the Booth poverty scales. The first half of this article describes these methods and results and the second half reports on a study in North London using a different measure of spatial integration.

Whilst there is some evidence from both the Booth and contemporary data of a connection between poverty and lack of spatial integration the relationship is not simple.

Introduction

Previous research has used space syntax methods of spatial analysis to analyse areas of deprivation (Vaughan, 2007, Vaughan et al., 2005, Vaughan and Haklay, 2006). The research used primary data from the Charles Booth maps of poverty in 19th century London, which provides a source for spatially detailed poverty statistics. Through a comparison of two distinctive areas of London - Soho in the West End and the famously poor area of London's East End - the analysis showed a consistent correspondence between poverty and spatial segregation. The research also suggested that Booth's economically based 'line of poverty', used to distinguish between those 'in poverty' and those living 'in comfort', related to a spatially defined line of poverty, distinguishing between poor, spatially segregated streets and more prosperous, spatially integrated streets. This article will briefly review this earlier research as an introduction to previously unpublished research using Booth's poverty scale as a basis for contemporary measurement of poverty[2].

This article opens with a review of previous work on the spatial patterning of poverty. It goes on to introduce the challenges of obtaining and using contemporary deprivation data and explains how space syntax analysis provides a crucial dimension to analysis in this area, by allowing the influence of spatial form to be isolated as a variable. Following this, the authors' work on contemporary deprivation statistics is reviewed. The article ends with some propositions for how such data can shed light on the relationship between spatial segregation and exclusion.

The study of Poverty 'Areas'

In an article for *Radical Statistics*, Spicker (2001) has suggested that poverty is a *complex, multi-dimensional phenomenon*: 'the World Bank's participative poverty assessments include not only needs and resources, but problems of social relationships, including gender relations, precarious economic status, lack of security and abuse by those in power; limitations on the ability to participate in society, and on the capabilities of the poor; and issues relating to collective disadvantage, including disempowering institutions, weak community organisations and (of course) excluded locations.' As had been previously noted: 'in the past decade or more we have begun to find increasing evidence first that inequality has grown sharply and secondly that it is more geographically concentrated' (Glennerster et al., 1999, p. 8).

[2] Vaughan's previous research on poverty can also be seen on the *Mapping the East End Labyrinth* website available at: http://tinyurl.com/5ttjd4.

Many studies of deprivation in the contemporary UK city follow this idea of using multiple measures of poverty (e.g. Carstairs and Morris, 1990), but these are based on census area summaries, due to the restricted availability of contemporary household based data. Typically these include measures of unemployment, overcrowding, no car and low social class (defined by economically active members of household, Lee and Murie, 1995).

The suggestion that spatial form can have an impact on the persistence of poor areas is supported by research using the Booth maps of poverty to understand the geography of poverty and its relationship with contemporary mortality from diseases associated with poverty in childhood. In this research Orford (2004), Orford et al. (2002) maintain that despite the many attempts to improve housing quality over the past 100 years, these interventions have 'failed to substantially alter the geography of poverty' (p. 34), due to their relatively small scale and lack of integration of poor and rich within the same area. Orford's team found that although the overall standard of living in the inner-London area had increased in the past 100 years, the spatial distribution of poverty in inner London is extremely robust. A century of change had failed to disrupt it (with the exception of the successful regeneration in the areas bordering the River Thames and north of the East End). Similarly, a White Paper on planning cities, (DTLR, 2000) indicates that "many of the areas of East London identified by Charles Booth in the late 19th century still show up today as having the worst social deprivation; in three wards in Tower Hamlets over 80% of children live in households that depend on means tested benefits" (DTLR, 2000, section 2.18).

This article maintains, similarly to Spicker, that it is vital to consider the physical form of the poverty area, since living in a poor area exacerbates the disadvantages of poor individuals – and the establishment of an area as 'poor' is the result of a series of processes which have an impact on the area's deprivation. These can be concentrations of inadequate housing, bad health and other cycles of areal economic deprivation. For example, the study by Dowler et al (2001) of availability of food required by various impoverished ethnic groups (indigenous White, Asian, Afro-Caribbean etc.) found that the people studied were disadvantaged in their ability to eat a healthy diet due to access (distance, lack of transport) and availability (limited range of food in local shops). Access to open spaces for recreation and for good health can also be limited for poor people (Greenhalgh and Worpole, 2002) and the positioning of large supermarkets outside of poor areas can have a negative effect on the provision of a variety of cheap, healthy food too (Clarke et al., 2002). Similarly, studies in the

1980s and 1990s by the Space Syntax Laboratory found that living in poor areas makes individuals more vulnerable to crime (Hillier, 2002). Lastly, poverty can also lead to unequal access to jobs and thus high rates of unemployment in a particular area (Hamnett, 2003).

Data Challenges

Various methodologies are employed in spatial inequality, deprivation or poverty measurement studies. Spatial deprivation can be measured with a limited use of GIS (Geographical Information Systems), and it can be analysed with statistical tools and methods, using geographical names as proxies for locations and by aggregating data to a larger area approximating a 'neighbourhood'. This is the case with the influential study of Noble et al. (2000), who developed an Index of Multiple Deprivation for the UK government. The proliferation of GIS in census studies and the availability of census data in GIS-friendly formats mean that increasingly more studies are using census information as the basis for their measurement of deprivation. This is the case in a study of the relationship between crime and deprivation by Bowers and Hirschfield (1999), in which data were published at enumeration district level – the smallest census unit that was available at the time.

Within the analysis of spatial configuration of deprivation, the detailed analysis of local variations is crucial. This, in turn, requires highly detailed and localised information about the socio-economic condition of the population under consideration. Whilst the increased computational capacity of GIS and the proliferation of detailed datasets has recently enabled researchers to look at the human-geography at a finer resolution than before (Bracken and Martin, 1995). Although use of statistics that are based on local, neighbourhood scale geographies is now common (Boyle and Dorling, 2004), work in this area continues to suffer from the Modifiable Area Unit Problem (MAUP)[3]. Orford (2004, p. 704) summarises the problem thus: "Since poor areas tend to be clustered within cities... measurements of concentrated poverty need to take into account spatial clustering or run the risk of under-estimating the concentration of poverty within the local population. Statistical measures of concentrated poverty must therefore be sensitive to the spatial configuration of the areas for which poverty is being measured and this implies the use of a spatial statistical approach." Yet even if the need for spatial detail is recognised, one of the main challenges

[3] The essence of the MAUP problem is that statistics summarised by arbitrary (or at the very least, physically meaningless) boundaries are subject to distortion and the incorrect reading of statistics, due to variations in values being masked by area averages. In addition, census output areas are problematic since they average together busy and quiet streets, residential and shopping streets, densely populated tower blocks and single-occupancy family houses.

with obtaining contemporary deprivation data is that spatially detailed data are subject to constraints of personal data privacy.

Researchers into the geography of poverty look jealously at colleagues in the USA, where detailed information is available to the public freely (Thurstain-Goodwin, 2003) and Sweden, where building-block economic statistics are commonly accessible (Marcus, 2007). In the UK these data are normally unavailable due to disclosure and privacy concerns, and even in areal outputs, data are adjusted to ensure confidentiality (Boyle and Dorling, 2004). In the UK it is only in the case of historical data (e.g. census data over 100 years old), that information on individuals and households is readily available. The research reported here therefore was unusually fortunate in obtaining the agreement of two inner-London borough councils to provide access to their household statistics[4].

Deprivation and spatial form

One of the key debates in contemporary urban design and planning is the effect of planning on poverty. As stated by Spicker (2001), the state of poverty is a constellation of different kinds of deprivation, which have a complex interrelationship: “The forms of deprivation are patterned spatially by a series of urban processes, which lead to greater concentrations of problems in particular places” (ibid, p. 1) and it is evident that living in a poor area exacerbates one’s situation, through the lack of access to jobs, food and so on, let alone leisure and culture.

Despite a growing recognition that there are observable patterns to poverty, it is rare to find studies which focus on the role of spatial form or urban design in the persistence of poverty. This is despite the fact that over a century ago Charles Booth recognised that space can have an effect on social outcomes, as pointed out by Reeder (1984) in his notes on Booth's maps: "a gas works or waterworks, a railway line, or just the alignment of a new street – seems to have served to reinforce slum tendencies. Booth and his team were repeatedly to draw attention in later volumes to the importance of physical barriers"[5].

[4] This access was carefully controlled to ensure personal data were held on a secured computer disconnected from the university’s network. The data on individuals and households were deleted as soon as they had been compiled into street-scale data.

[5] Indeed there are plenty of 19th century references to the role of spatial organisation in poverty. See Dickens in the weekly magazine 'All the Year Round', XV (1866), p. 466: "Agar Town was merely a product of its environment, hopelessly trapped between Euston Station and King's Cross, with Regent's Canal and the Gas Works, adding further insult to its handicapped position within the city of London" (quoted in (Swensen, 2006), p. 34).

Charles Booth and the spatial patterning of poverty

The revolutionary work of Booth forms the background to this study. He was the first to outline the variation in the perceived black hole of poverty which was the East End. As mentioned above, Booth produced the first study of the detail of poverty and wealth. His books and maps published as *Life and Labour of the People in London* (Booth, 1889-93) are a study of the local economy of each part of London. The colouration of the maps based on supposedly clear-cut differentiation of poverty counts from street to street are accompanied by his own assessments about each district of the city which were based on house-to-house descriptions collected by Booth and his team of researchers (see the coloured insert giving a section of the hand-coloured 1889 Booth map[6]). The maps show a delineation of poverty situation based on employment patterns. Underlying the classification is the recognition that some of the poor are there for no fault of their own and perhaps a reorganisation of space would eliminate the worse street culture, see Booth, 1891. As stated by Fishman (Fishman, 1988), 11) in *East End 1888*: "the poor were not a homogeneous class", but varied in their situation according to their work status.

Even the briefest of looks at Booth's map shows a distribution of prosperity to poverty in a pattern that closely follows the sequence of square and avenue to thoroughfare, road, street, alley, court, yard, to dead-end, rookery and slum. Booth frequently noted in his writing that physical boundaries such as railways had the effect of isolating areas, walling off their inhabitants and isolating them from the life of the city. The historical geographer Dyos describes how Booth's maps show how minor changes to the street layout frequently reinforced the tendency of poor areas to be cut off from the life of the city, writing how such changes "acted like tourniquets applied too long, and below them gangrene almost invariable set in… it was sometimes possible to run through the complete declension from meadow to slum in a single generation, or even less" (Dyos, 1967). It is not only the fine-scale layout which seems to have had an impact on social conditions, creating pockets of irregularity in the urban grid. Larger scale obstacles in the urban fabric worsened the ability of people to move around and improve their social and economic conditions.

[6] The hand-coloured version formed the basis of the map published in 1889, which can be viewed at http://tinyurl.com/7553os A revised version of the map, published in 1898-99 can be viewed here: http://booth.lse.ac.uk/ .

Poverty and Spatial Configuration: East London

The ability to quantify relational properties between spatial characteristics and detailed social data is critical to a detailed study of social/spatial segregation. Space syntax is ideal for this purpose. Space syntax is a theory of space and a set of analytical, quantitative and descriptive tools for analysing the layout of space in buildings and cities. Originating in the Bartlett School of Architecture, University College London in the 1970s, it started with an attempt to develop a method to systematically model and measure spatial form to see if there was an underlying architectural explanation for the social failure of 20th century English housing estates. The hope was that by learning to describe and analyse different kinds of spatial configuration, or pattern, in the city – for example the differences between the new social housing and traditional urban areas, which seemed *prima facie* to be critically different – it would be possible to detect any influence there might be on social factors in the construction of these spatial patterns and also to explore any consequences there might be in terms of how social life could and did take place. By learning to control the spatial variable at the level of the complex patterns of space that make up the city, it might be possible to gain insight into both the social antecedents and consequences of spatial form in the physical city.

Space syntax analysis is concerned with systematically describing and analysing streets, squares and all open public space as a continuous system in order to measure the spatial relationship between each street and its surroundings. This is done by taking an accurate map and drawing a set of intersecting lines through all the spaces of the urban grid so that the grid is covered and all rings of circulation are completed. The resulting set of lines is called an 'axial map'[7]. Space syntax analysis computes all the lines according to their relative depth to each other, using simple mathematical measures. The terminology used to describe this depth states how spatially *integrated* or *segregated* it is. The resulting numbers then form the basis for coloured up maps which represent the distribution of spatial accessibility.

Space syntax research into the Charles Booth maps (Vaughan et al., 2005; Vaughan, 2007) has found that socially or economically marginalized individuals follow distinctive patterns of settlement and that underlying these patterns were spatial conditions that may have influenced this distribution. For example, analysis found that Booth's London has had east-west inaccessibility, which was reflected in a

[7] For a fuller explanation of space syntax measures, see appendix to this paper.

west-east prosperity/poverty divide. Detailed spatial analysis found that interruptions to the grid structure significantly influenced the spatial configuration of a poverty area, giving rise to conditions of spatial and social segregation.

The research suggested that poorer classes are often disadvantaged by being marginalised spatially, and the formation of poor areas is the outcome of a complex socio-spatial process, which can be further influenced by the impact of the arrival of immigrants to an area. Analysis was made of the distribution of values for each group by a range of spatial measures (see Appendix for details).

Table 1. Descriptive Statistics for Booth's Data
Radius 3 (Local) and Radius n (Global) *Integration*

Booth Class Description	Count	Radius 3		Radius n	
		Mean	SD*	Mean	SD*
1. Lowest class. Vicious, semi-criminal	90	2.7	1.1	1.089	0.149
2. Very poor, casual. Chronic want.	223	2.7	1.0	1.048	0.145
3. Poor. 18s. to 21s. a week for a moderate family.	324	2.4	1.0	1.007	0.117
4. Mixed. Some comfortable others poor.	1203	3.1	1.0	1.077	0.126
5. Fairly comfortable. Good ordinary earnings.	1048	3.4	1.1	1.099	0.124
6. Middleclass. Well-to-do	324	4.3	1.4	1.285	0.149
7. Upper-middle and Upper classes. Wealthy					
Overall	3212	3.2	1.2	1.096	0.146

* SD = Standard Deviation

Table 1 gives summary statistics for two of the measures, one which measures "local" *Integration* of each street segment within the most local grid structure (Radius 3 in columns 4 and 5) and another which measures "global" *Integration* over the whole district (Radius n in columns 6 and 7). Column 3 gives the count (number of street segments) in each group. The large standard deviations reflect the

considerable overlap between the groups but there is a suggestion that the three lowest groups tend to be less integrated than the two highest, in particular the street segments inhabited by Booth's 6th group, "Middle class. Well-to-do" (coloured red on his map), are the most integrated on both measures. Vaughan et al. (2005) and Vaughan (2007) discuss possible reasons why group 3 might be less integrated both locally and globally than the more extreme groups 1 and 2 and conclude that fine-scale variations can give rise to conditions of spatial and social segregation, which in turn may contribute to the persistence of poverty in an area through time.

A comparison of the poverty patterns in the same area of East London today was made in order to test these findings in the transformed contemporary city. A variety of proxies for the classifications used in Charles Booth map of poverty were considered in consultation with housing experts at the local authority in order to make a comparison between the historical and the contemporary situation. The use of tax bands was dismissed as an option, firstly due to their being in some cases 20 years out of date, and secondly, since they relate to the property (and its value) rather than the situation of its inhabitants. Housing benefit and council tax benefit were chosen as the most appropriate indicators of whether individuals are below a threshold of need, and hence the closest to Booth's own form of assessment. As contemporary data are purely an indication of situation below a notional poverty line – a different adaptation of data from the Booth dataset was needed. It was decided to replicate Booth's method of classifying streets by computing a scale in which the greater the proportion of benefit recipients in a street segment, the lower it would sit on the poverty scale.

In order to calculate the proportion of households on benefit, Council Tax data were provided by the local authority so as to ascertain the number of households on each street segment (a segment is a street section between two junctions). The actual matching of households to street faces was more complicated then might be first thought since the precise location of a street address was occasionally distorted by the fact that the entrances to some blocks of flats are not always the nearest street to the building centroid, however a manual checking of data was done to overcome this problem[8].

The households were categorised according to whether they received council tax benefit and/or housing benefit. The street segments were ranked by computing the number of households receiving benefits as

[8] An automated procedure for address matching is currently being developed in Vaughan's suburban research project, see http://www.sstc.ucl.ac.uk/.

a proportion of all households in that segment. The results were then summarised in 10% bands as shown in Table 2.

The spatial measures for the contemporary case were calculated based on an Ordnance Survey map from the year 2000, with spatial models drawn within a GIS environment and checked manually. The boundaries of the contemporary spatial model were closely the same as the historical model, with a 2.5 km approximate radius drawn around the study area in order to take account of its spatial context.

Table 2. Descriptive Statistics for Contemporary Data
Radius 3 (Local) and Radius n (Global) *Integration*

Band % Households on Benefit	Count	Radius 3		Radius n	
		Mean	SD*	Mean	SD*
A. 90 <100	27	3.2	1.4	1.38	0.225
B. 80 < 90	9	3.5	1.0	1.41	0.15
C. 70 < 80	8	2.5	1.2	1.36	0.25
D. 60 < 70	15	3.4	1.3	1.42	0.22
E. 50 < 60	38	2.8	1.3	1.32	0.21
F. 40 < 50	30	3.05	1.3	1.365	0.19
G. 30 < 40	30	3.1	1.2	1.35	0.20
H. 20 < 30	25	3.3	1.2	1.39	0.17
I. 10 < 20	28	3.4	0.9	1.43	0.14
J. 0 < 10	18	3.3	1.4	1.39	0.19
(A to J) some on Benefit	228	3.1	1.3	1.38	0.20
K. none on Benefit	175	3.7	1.3	1.46	0.19
Overall	403	3.4	1.3	1.41	0.20

* SD = Standard Deviation

The results in Table 2 show that for both *Local Integration* (columns 3 and 4) and *Global Integration* there is more overlap than separation between the ten groups of street segments with at least one household receiving benefit but that the 175 street segments with no household receiving benefit tend to have higher *Integration* for both the local and global measures.

What is also striking though is that as in the historical case, there is a clustering of high-poverty streets with median *Integration*, whilst most

poverty streets have the lowest spatial accessibility. One explanation of this is the difference in housing types between the two groups; with the high poverty cases being situated relatively close to the main street structure of the area.

Further observation of the spatial location of these various groups supports this finding, showing in fact two distinct groups of streets in bands A to C: those one to two streets away from the main thoroughfares well connected to the life, markets and workplaces of the area and those in the interstices of the area. It is likely that the shift of the poorest classes away from the edge of the City of London will increase in the next few years. This trend can already be seen, with buildings like the Soup Kitchen in Brune Street, now redeveloped as luxury flats (Figure 1).

Figure 1: 19th century Soup Kitchen in Brune Street, East London, now redeveloped into flats (Vaughan, 2009).

Poverty and Spatial Configuration: North London

As a continuation to this research, a comparison was made of the urban morphology and house form within an inner-London Borough[9]. The study assessed levels of poverty in the London Borough of Islington and compared them with Charles Booth's survey of 1899. The analysis focused on the space syntax measure of '*Choice'*, which essentially measures overlapping paths (using a graph network analysis algorithm). The degree to which a street section forms part of all paths at a set distance is quantified numerically and coloured on the map in a spectrum from red to blue. Analysis at a scale of 3.6km demonstrated that this measure is representative of route choices in the area, which is characterised by a dense transport and road infrastructure.

The reason behind the focus on the measure of *Choice* was recent developments in the analysis of spatial aspects of poverty (Orford et al., 2002; Bailey and Livingston, 2007; Vaughan, 2007). In particular Green and Owen's analysis of commuting distances in relation to levels of skills and qualifications, which showed the low commuting tolerance of unemployed and low-skilled people. Green and Owen (2006) contextualised their findings within the processes of wealth creation through the life course, including a variety of elements related to the built environment, such as access to educational and leisure resources, job opportunities and training, and, more generally, social interaction and networking as well as the quality of the environment. In the North London study, the radius found to best represent route choices in Islington fell within the range of 2Km to 4Km, the median commuting distance for the lowest skilled occupations in England and Wales (Green & Owen, 2006, p.24). The measure of *Choice* was therefore ideal for considering the range of distances from and access to these urban elements and facilities. It was evident that this analysis would be relevant even for the lowest skilled and would therefore be a good indicator of the relationship between housing location on shortest paths to and from all the above enabling elements that affect the persistence of deprivation in any given area.

Three study areas were selected to match the 'lower layer output' census statistical area of 1000-1500 people[10]; chosen because at this

[9] The research can be read in full in Geddes, 2007.

[10] Super Output Areas (SOAs) are designed to improve the reporting of small area statistics. They are made up of aggregated Output Areas (OAs), the smallest geographic level used in the 2001 Census. They range in size – with the smallest, Lower Layer Output Areas (LLOAs), being the one used in this study. Its population ranges from 1000-1500. LLOA comprise normally 5 OAs ((Research and Intelligence Team, 2008).

scale, areas are large enough include a variety of street types and urban elements: major and minor roads, a mix of land uses, a certain amount of public and green space, as well a variety of housing forms from different periods. This variety was needed to establish if there were any differences in the distribution of poverty according to different elements of the urban form. Two areas containing high numbers of benefits claims were selected for comparison; whilst a third, less deprived and with a low numbers of claims, was also included for validation purposes. Another criterion for selection was social make up (see Table 3). This was done in order to gain insight into whether social variables play a part in the distribution of poverty and/or interact with spatial and housing variables in characterising deprivation areas. The benefits data were plotted and summarized in a similar manner to the East London study. Around 75% of the records in the dataset were geo-referenced by Islington Council; of the remaining 25% those that were located within the study areas were geo-referenced manually by the author. The data were plotted into MapInfo GIS software, and, as the households do not bear a unique reference number, it was not possible to join the two datasets in such a way that each record corresponded to each household with a value showing whether each was claiming either or both. The two datasets were therefore summed, rather than joined, resulting in each household being identified by none, one, or two records. In order to draw the proportion of the claims a dataset of all residential properties in Islington was necessary and this was provided by the Council in the form of a gazetteer of all properties. This needed to be cleared of properties which have uses other than residential: some were descriptively recorded in the gazetteer, but many were not and had to be identified and removed by recording different land-uses on site. This method bears some scope for error as some non-residential uses, such as small offices above shops or in other mostly residential buildings, or underground garages, may not be identifiable simply by observation. However, the author checked a range of buildings to ensure that the number of actual residential properties corresponded to the number in the gazetteer, by looking at flat numbers on the Ordnance Survey (OS) map or on the actual properties' bells; this was consistently found to be correct[11]. At this stage, 'Booth-like' blocks of residential properties were drawn in the GIS system to correspond with street segments[12], literally each segment of each street from

[11] All purpose-built blocks with flat numbers reported in the OS landline map were checked. Thirty buildings per area comprising terraced houses and mixed used blocks were checked on site. The scope for error remains greater for the latter type of housing.

[12] The method used here for data compilation is different from that used by Booth. He summarised poverty along the street blocks in an 'organic' way, from gap to gap in the blocks or between blocks. Here the compilation is linked to the specific spatial elements of

junction to junction. This is the smallest element of the urban form which can be treated as a separate object, measured and analysed with space syntax techniques.

Table 3: Summarised 2001 Census statistics derived from Neighbourhood Statistics*

	Case A	Case B	Case C	Islington	London	England
All People Count						
Population	1488	1483	1541	175,797	7,172,091	49,138,831
Persons Percentage						
Ethnic Group White	60%	84%	75%	75%	71%	91%
Ethnic Group Asian	11%	3%	5%	5%	12%	5%
Ethnic Group Black	21%	7%	14%	12%	11%	2%
Ethnic Group Other	8%	6%	6%	8%	6%	2%
General Health Good	63%	72%	62%	68%	71%	69%
General Health Not Good	15%	9%	14%	11%	8%	9%
Economically Active Unemployed	6%	4%	7%	6%	4%	3%
Aged 16-74 No Qualifications	29%	18%	36%	25%	24%	29%
All Households Count						
Households	675	748	758	82,281	3,015,997	20,451,427
Households Percentage						
Owner Occupied	21%	50%	20%	31%	56%	68%
Council, HA or RSL	62%	34%	59%	49%	26%	19%
Shared Ownership Private Landlord and Other	17%	16%	21%	20%	18%	13%

* (http://www.neighbourhoodstatistics.gov.uk/dissemination/ last accessed 26 June 2007).

By running queries in the GIS system, the number of properties in each block was retrieved and doubled to gain the number of potential claims (2 per household, 1 for housing benefit and 1 for council tax benefit), the number of claims was also retrieved and thus the proportion of actual claims out of potential ones calculated. These are summarised in Table 4 and plotted in Figure 2.

the street segments. Although, these are similar to Booth's blocks and can be visually compared, they cannot be statistically compared because of the difference in methodology.

Table 4: Percentages within each poverty range (% benefit claims) for blocks by area.

Range of % Benefit Claim	Case A	Case B	Case C
None	1.8	59.8	2.8
1% to 9.9%	3.5	13.4	2.8
10% to 19.9%	10.5	4.9	14.1
20% to 29.9%	8.8	4.9	15.5
30% to 49.9%	21.1	9.8	18.3
50% to 69.9%	45.6	7.3	26.8
70% to 100%	8.8	0	19.7
Total (number of blocks)	100 (57)	100 (82)	100 (71)

Thematic maps were created from these data by colouring up street blocks according to poverty bands from 0 claims, through three ranges from 1% to 49.9% claims, to two last ranges, which are considered poor (50% to 70%) and very poor (70% to 100%)[13].

These are given in Geddes (2007) 'The Housing Forms and Urban Morphology of Poverty Areas in the London Borough of Islington' and can be seen at http://eprints.ucl.ac.uk/4975/1/4975.pdf which also shows Booth's poverty maps of the same areas and maps showing the level of *Choice* for each area both for the contemporary street configuration and for Booth's time. As an example the poverty map and the spatial analysis map of *Case A* are given in the coloured insert.

From these maps and from more detailed exploration of the three areas we observed:

In the contemporary *Case A* area social housing was found to correspond very closely with clusters of benefit claims. Much of the remaining housing comprises traditional terraced houses. The spatial analysis of the area showed that the most prosperous blocks are generally located along the streets with high *Choice* values, whilst the poorer blocks are actually accessed from the deeper circulation system that was created at the back of these roads in the middle of the blocks.

[13] This is a somewhat arbitrary threshold for poverty, but useful to identify particularly problematic blocks on the basis that a block is to be considered poor if 50% or more of its households are in need of housing or council tax benefits, and very poor if less than a third are able to sustain themselves without these benefits.

Charles Booth's survey of the same area shows it to be evenly a 'middle-class, well-to-do' area, with slightly lower classes (the 'fairly comfortable') along the main roads. The housing is made up of large blocks of back-to-back terraced houses, which dominate and structure the street system. Communal outdoor space is minimal as this is taken up by private gardens, the backs of which are rarely run through by pathways.

Although the middle classes still take up the most accessible roads, some of the poverty classes are found along high *Choice* segments too, primarily the major route through the area. This is possibly related to the fact that this major route also shapes the boundary of two more deprived and more fragmented areas.

The analysis of *Case B* showed a somewhat different picture. The contemporary distribution of benefits showed that the poorest blocks are located in the southern part of the area. Many of the poverty blocks in the southern area are also associated with social housing. Much of the housing in the area is traditional terraced houses, which are accessed from main streets rather than from pathways deeper into the blocks. *Case B* was subject to much less post-war redevelopment than the other two and Modernist housing is almost absent, except for the area to the east, where the street structure has changed dramatically, has become more fragmented, and comprises the poorer blocks found here.

The hierarchy of poverty within this area has remained that of Charles Booth's times: a striking divide between north and south highlighted by the barrier of the river, which continues to act as one of those physical barriers often mentioned by Booth as reinforcing persistent deprivation trends.

In *Case C* the contemporary distribution of poverty is characterised by three areas: a very poor area made up of mostly 1970s social housing blocks in the north; a second, poor area, largely made up of a postmodern social housing estate built in the 1990s, and, finally, a more mixed area in between the two, largely made up of traditional terraced houses.

The area retains similarities with Victorian times: the traditional blocks in the central part of the site belong to the 'fairly comfortable' classes. Much of the site was not developed at that time and a comparison between the spatial properties and values of the area would not be significant in revealing how the area has changed over time.

Geddes (2007) found that the distribution of classes across the housing stock in the Islington area is not solely market driven and therefore is likely to be somewhat skewed by the intervention of the welfare state. Social housing provision is naturally associated with a level of poverty, especially in present day London where this has become the domain of the lowest skilled and unemployed as the working classes, for whom much of this housing was originally designed, slowly moved out of this tenure into the private rental or ownership market (DCLG, 2008). However, the spatial analysis revealed significant findings on a number of occasions, especially when different tenures were more equally mixed throughout the area rather than clustered together in larger estates. In this case the distribution of poverty can be analysed spatially because it is still market driven and thus has a natural relationship with people's means to meet a private market rental or purchase price.

Figure 2 plots the percentage benefits claims against the measure of *Choice* (on a log base 10 scale) for each of the three areas, thus, allowing comparisons between them.

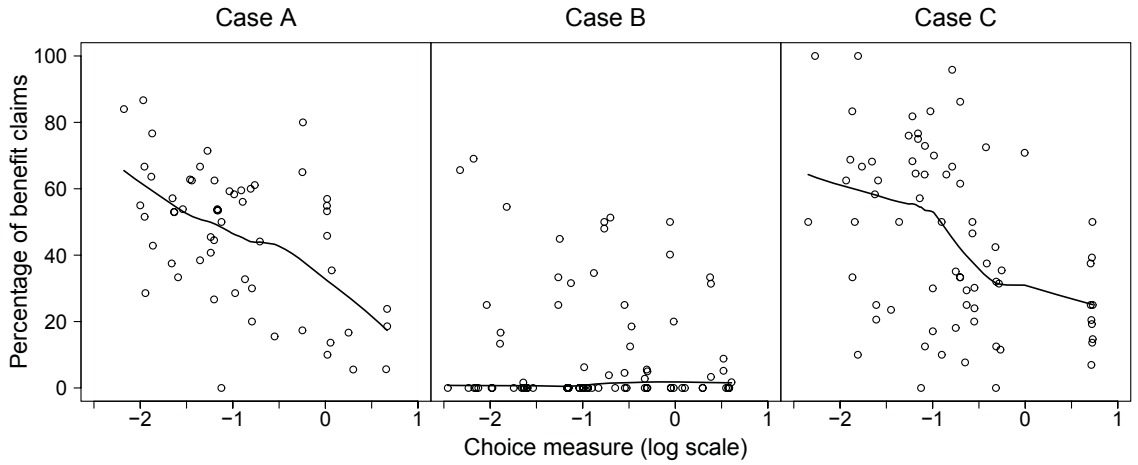

Figure 2: Percentage of benefit claims plotted against *Choice* measure (on a log base 10 scale using a radius of 3.6 km) for Cases A, B and C.

Each point represents a block of residential properties. The lines are the default *lowess* (locally weighted scatter plot smoother) lines in the statistical package R. For Cases A and C they show a general downward trend in percentage as *Choice* increases. The main feature of Case B is the relatively high number of blocks having zero percentage benefit claims.

Overall, blocks with lower levels of *Choice* tend to have higher levels of benefit claims and vice versa. This is an important finding because it suggests a relationship between the ability to access the highest number of shorter possible routes from one's residence and the ability

to create wealth[14]. In *Case B* the relationship is more complex due to the large number of blocks with no benefit claims but *Choice* levels spread across the whole range.

It can be argued that for the *Case A* area the building of large amounts of social housing does not necessarily skew the natural distribution or have an impact on the hierarchical wealth structure of one area. This is because the location choice for the construction of social housing has in itself been largely market driven: it often corresponds to areas that were poor in Victorian times. These are likely to have been the focus of slum clearance in post-war England, thus creating a situation where the private, wealthier housing market has retained its residential areas from the past, and the social market has been relegated to less desirable, cheaper areas.

In *Case C*, as in *Case A*, it was noticeable that most of the poor and very poor block entrances are situated on segments with low *Choice* values. However the slightly weaker relationship between poverty and *Choice* could be because in *Case C* social housing is clustered together into two areas and separated by traditional blocks of private housing.

Case B, which has the lowest proportion of benefits claims, was found to have higher average *Choice* values when compared with the *Cases A* and *B*. It can be suggested that the relationship between benefit claims and *Choice* values is distorted in this area because its population is more polarised. The poor still tend to be located in the less accessible areas, but so are many of the wealthy residents. In the case of the latter, spatial segregation could be a conscious preference to live in well-maintained areas by a population that can overcome distance more easily due to their access to private cars.

Discussion

Vaughan et al's (2005) findings of a relationship between poverty groups and values of *Local Integration* in Charles Booth's 1889 map of the East End of London were not repeated in the contemporary case – there was a weaker relationship between pockets of deprivation and local potentials of movement. However, as discussed above, the distribution of poverty in modern times is likely to be less straightforward than for Victorian times. Whereas in the past poverty was the main constraint on housing choice, nowadays it is affected by allocation policies, the socio-economic make up of an area, and other factors relating to the market desirability of the housing, such as the

[14] This pattern is more marked in *Case A*, correlation -0.5 than in *Case C*, correlation -0.4.

quality of the environment, the transport infrastructure, as well as stigmatisation of social housing on the one hand and popularity of historical properties on the other. Moreover Vaughan (2007) found that, unlike Islington, these areas had a long history of being 'cut off' from life in the city, as well as comprising large areas of wide-spread deprivation. The spatial scale at which deprivation corresponds to network accessibility in modern times is likely to be related to the transport developments that allowed modern society to become more highly mobile than in the past. This is even more likely to be so in the dense environment of inner London, where the inhabitants have easy access to transport nodes, shops, and various services (although variations of access to larger shops by public transport were found to correspond to poverty).

Variations in the spatial distribution can be explained by close observation of the nature of residential areas and their socio-historic contextualisation. In this regard, Charles Booth's map has proved invaluable in revealing similarities and differences between modern times and the past, and therefore between different types of housing and urban structures. The phenomenon of spatial fragmentation caused by Modernist architectural designs and space layout as analysed comprehensively by Hanson (2000) had a demonstrable impact on patterns of local accessibility in the Islington cases of social housing developed after World War II. It is suggested here that the change in the spatial distribution of wealth from Booth's times can be linked to this fragmentation, which had the effect of polarising the spatial situation of poor and wealthy, where formerly they would have been more likely to live cheek-by-jowl.

Further research by Geddes found a relationship between the distribution of poverty, low *Choice* values and housing forms which are inward-facing and have few doorways to the street, as well as with the presence of poorly used public and communal spaces; the pictures below (Figures 3 and 4) from *Case B* and *Case C* respectively are good example of such a poorly constituted environment.

Figures 3 and 4: housing with high proportions of benefit claims located on low *Choice* segments, with no front doors facing the public domain and overlooking either a blank wall or a poorly-used public space.

This phenomenon is partly due to the fact that much social housing comprises developments influenced by Modernist ideas, which often bears such characteristics. These ideas were applied to much public housing in the 1960s and 1970s, but the private market generally steered clear of them, always preferring more street-facing, traditional housing forms. Whilst the extreme poverty that was present in Booth's time has a different structure in a modern welfare state, the outcome of cutting off people from the life of the city is the same now, as then – lack of access to work if public transport is at a distance, lack of access to healthy food if local retail centres have insufficient footfall to sustain them and a lack of housing variety, which means that social integration becomes a greater challenge (Lupton, 2004, p. 24.

Conclusions

London's housing morphology has been transformed since the late 19th century in a number of ways. First, the various Acts which came into play from 1890 onwards; specifically shaping urban form by stipulating minimum street widths, maximum ratio of height to street width, no courts, and no entrances closed off from the streets and no dead end streets. The outcome of these rules has been building at higher densities, with greater distance between the blocks than before. Instead of building dense aggregations of two storey houses arranged in courts and alleys, housing was constructed with a setback from the road in front of the block to cope with the new height requirements, and with open space between the blocks at the rear. For the first time legislation explicitly defined the ways the buildings could be arranged and guaranteed that in the future there were to be no more complicated arrangements of rooms without outside access, light and air (Vaughan, 2008). Second, the subsequent transformation of the city in the 20th century with municipal and government-led housing

provision has had the unforeseen outcome of increased spatial segregation due to the fragmentation of street space to a deeper, more enclosed and hierarchical system, with an inward-facing morphology that puts doorways at a distance - both physical and mental - from the street life (Hanson, 2000, 100). The social outcome of this literal fragmentation of the street-based society has been profound; with position of people with the least capacity to overcome social and physical distance in the most remote positions within the urban structure.

It is apparent that the legislative and market context has undergone an equally significant change. Whilst in the 19th century the spatial distribution of deprivation was part of a bottom-up process relating to the availability of cheap property alongside a need for the poor to live in close proximity to places of work, subsequent developments of the welfare state[15] alongside cheaper transport has had the effect of redistributing deprivation in a more spatially polarised pattern. In the past, the street layout contained a fine grain of poverty and relative prosperity cheek by jowl, creating a situation of high levels of economic interdependence between economic groups.[16] In the contemporary city a greater polarisation of wealth has developed: a situation where the poorer, often in social housing, and the richer, often owner-occupiers, are both to be found in the more isolated areas of the urban system (by need for the latter and by choice for the former): "both poor and wealthy households have become more and more geographically segregated from the rest of society" (Dorling, 2007, *key points*).

Since the 1980s, when Alice Coleman's (1985) polemic against modernist housing and Bill Hillier's (1986 & etc.) subsequent critiques of the modernist 'utopia' became at the centre of the debate around 'the housing problem', the importance of understanding the contribution of spatial form to social outcomes has become increasingly relevant to housing design. Whilst space syntax concepts of accessibility and integration have permeated modern housing theory, it is apparent that management and social programmes are seen to be of equal importance (Lowenfeld, 2008). Yet, it is clear that a sea change has taken place, with the contribution of architecture to emergence of social deprivation now lying at the heart of urban regeneration discourse. The need for architects and urban designers to shape urban form in such a way that the poor are not disadvantaged

[15] Indeed, Booth's petitioning to Parliament for an old-age pension can be seen as the precursor to the welfare state (Booth, 1899).
[16] See Davin, 1996 pp. 158-159.

by spatial segregation is now being written into the planning system.[17] "Today, permeability, integration and constitutedness are like 'motherhood and apple pie'" (Hanson, 2000, 97).

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[17] For example, Croydon Metropolitan Centre Area Action Plan for London Borough of Croydon. http://tinyurl.com/6lnrzw.

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Further Reading

The key texts on space syntax are: *The Social Logic of Space* B. Hillier and J. Hanson (1984), Cambridge: CUP and B. Hillier (1996) *Space is the Machine: a configurational theory of architecture.* Cambridge: CUP, available online at http://eprints.ucl.ac.uk/3881/. *Decoding Homes and Houses* by J. Hanson (1998), also published by CUP, focuses on

domestic space in particular. The Space Syntax Laboratory has an online repository at http://eprints.ucl.ac.uk/view/subjects/14500.html and there is a biennial Space Syntax Symposium, whose most recent proceedings can be found at http://www.sss7.org/Proceedings_07.html.

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Appendix: Space Syntax

Space syntax is a theory of space and a set of techniques for describing and analysing spatial configurations of all kinds, in particular those found in buildings, town and cities. Originating in the Bartlett School of Architecture, University College London in the 1970s, it started with an attempt to understand if there was an underlying architectural explanation for the social failure of 20th century English housing estates. The research field aims to answer key architectural and urban design questions, starting with whether the layout of cities has an impact on how people use streets.

Space syntax analysis is concerned with systematically describing and analysing streets, squares and all open public space as a continuous system in order to measure how each street space is connected to its surroundings. This is done by taking an accurate map and drawing a set of intersecting lines through all the spaces of the urban grid so that the grid is covered and all rings of circulation are completed. The resulting set of lines is called an 'axial map'. The axial map is used in space syntax analysis to represent and analyse all open public space as a continuous spatial network in order to measure how well connected each street space is to its surroundings (figure 5a-b).

Space syntax analysis computes all the lines according to their relative depth to each other, using simple mathematical measures. The terminology used to describe this depth refers to how spatially *integrated* or *segregated* a street space is. The resulting numbers then form the basis for coloured up maps which represent the distribution of spatial accessibility. The range of numbers goes from red for the most accessible (integrated) through the colour spectrum to blue for the least accessible (segregated) or from dark grey to light grey in a greyscale map (figure 5c)**.**

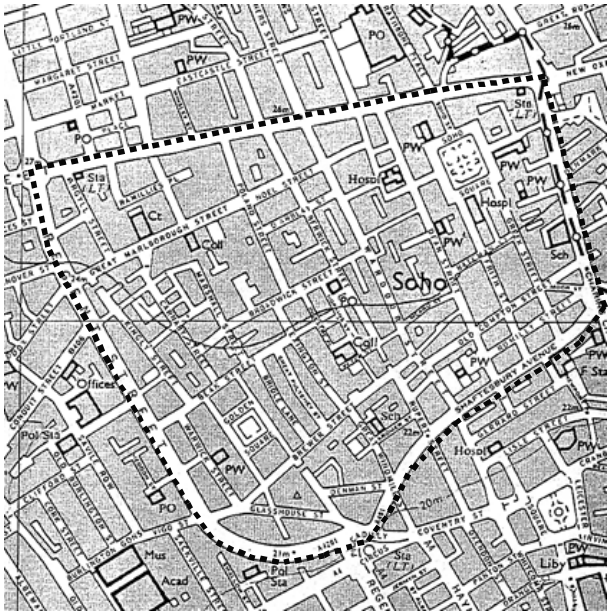

Figure 5a: Area map

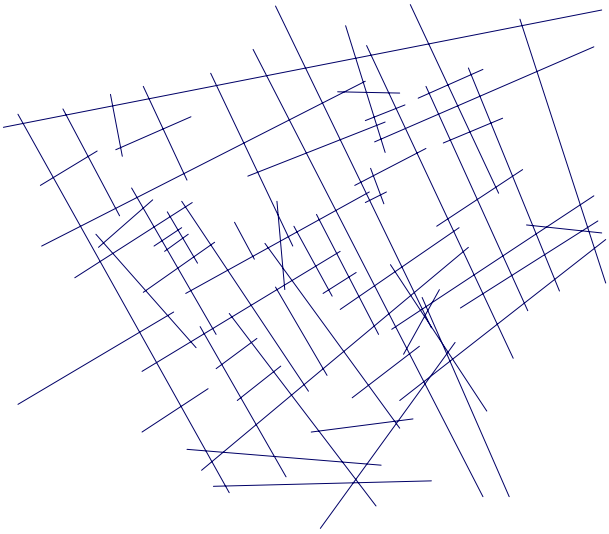

Figure 5b: Axial map

Figure 5c: Axial map processed to show calculation of radius n integration

The **axial map** is analysed as a set of nodes and edges. The depth of each space is calculated by constructing a justified graph (Figure 6), from any particular space in the system, considered the root of the graph, and all other spaces directly connected to this are linked to it one level up; the spaces connected to this are linked a second level up and so on until all spaces in the system have been connected[18].

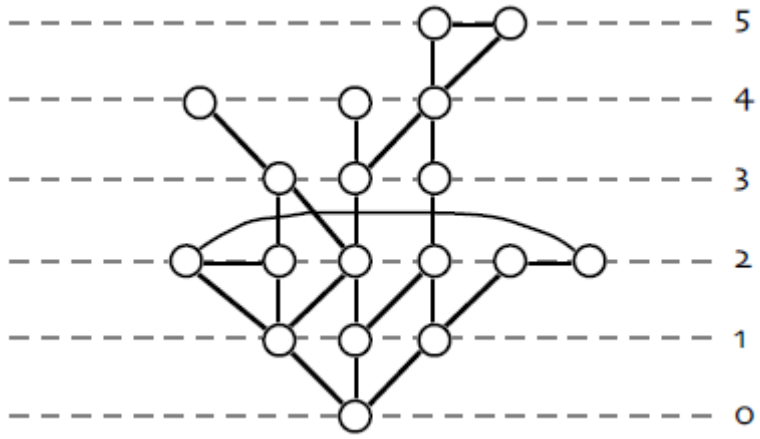

Figure 6: Justified graph, showing first 5 steps in the graph

This process allows the calculation of a measure of *depth* of any space from any other given space. *Mean depth* (MD) is calculated by averaging the depth of each node within each possible justified graph of the spatial system. *Integration* in practice measures the relative accessibility of nodes within a spatial system; spaces, which are found deep in a system have lower integration values, while higher integration values usually correlate with high levels of movement and activity and thus with social interaction.

Integration is calculated according to the following formulas:

Integration = 1/RRA (*Real Relative Asymmetry*)

RRA = RA/Dk (*Relative Asymmetry/A value based on the number of spaces in the system*[19])

RA = 2(MD-1)/k-2 (*Mean Depth as defined above/ where k represents the number of spaces in the system*)

By examining space in this way we can analyse the correspondence between spatial segregation/integration and social statistics. This is done by using statistical analysis to measure the correspondence between spatial and social measures, where the social measures can

[18] Nowadays the graphs are calculated automatically in software written for this purpose, see http://www.spacesyntax.org/software/index.asp.
[19] For more information on how to derive the Dk values for a given system, refer to the *Social Logic of Space* (Hillier and Hanson, 1984).

be attributed to specific spatial locations. For example, we can research whether there is a relationship between the location of burglaries and housing layout; or, whether more successful shopping streets have spatial characteristics in common.

Normally integration is measured for each line in a system in relation to all other lines. This is termed ***integration radius n*** or ***Global Integration*** (n being the number of lines in the system). A version of integration, termed ***integration rad. 3*** or ***Local Integration*** restricts the measurement of routes from any line to only those lines that are up to two lines away from it. This measures the localised importance of a space for access within a particular part of a building or urban network.

Radius-radius integration is a measure that is different for different spatial systems and minimizes the 'edge effect' in radius-n maps by setting the integration analysis to the mean depth of the whole system from its shallowest point. The *edge effect* describes the fact that the edge of axial models appears disproportionately segregated due to the fact that streets on the edge of the map are not connected onwards.

Segment analysis takes each axial line and breaks it into segments at the intersections between axial lines (street-junctions). This representation is referred to as a *segment map*. Segment analysis is concerned with the angular properties of graphs. It involves calculating the relative straightness - least angular deviation or *angular depth* - of each segment from all other segments in the system.

Choice is calculated by counting the number of times each segment falls on the shortest path between all pairs of segments within a selected distance-radius where *shortest path* refers to the path of least angular deviation or straightest route through the system[20]. The segment model can be analysed taking account of metric distance, which makes it a particularly useful model when assessing the relationship of the urban environment and social variables against a background of commuting distances and accessibility to services. This measure is similar to 'betweenness' in network analysis.

Global Choice measures the number of shortest paths connecting each space to all other spaces in the system. ***Local Choice*** measures the number of shortest paths connecting each space to all other spaces within a certain local distance; e.g. a 'walkable' distance (up to 800m).

[20] More information on this can be found in Hillier, B. and Iida, S. (2005) Network Effects and Psychological Effects: a Theory of Urban Movement, 5th International Space Syntax Symposium, i. Delft, TU Delft, Faculty of Architecture: 553-564.