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Abstract

The concept of the 'live centre' is central to Hillier's theory of centrality as a process, whereby patterns of pedestrian movement are influenced by the urban grid, leading to the emergence of networks of linked centres containing retail and other movement-driven activities. Planners and geographers, coming from a different perspective, have also traditionally prioritised retail as the key measure of urban vitality and determinant of a centre's position in the urban hierarchy. Our research into the suburban town centres of Greater London challenges the prevailing retail-centric view by proposing that the sources of vitality in local places are embedded in the diverse socio-economic and cultural activities that take place beyond the high street's shopping hub; we refer to this extended area as the 'active centre'. Our evidence indicates that active suburban town centres are sustained by local industry and the provision of a wide range of professional and community services in addition to office and retail employment. Such centres are enlivened by activities occurring at overlapping scales, the outcome of journeys of different lengths which are most likely to be repeated where network accessibility is most effective. In this paper we present a study of twenty-six outer London suburban town centres using an algorithm developed in a GIS that allows mapped land use data to be analysed in relation to space syntax measures of network accessibility. We combine this data-driven analysis with the results of an ethnographic study of three suburban town centres in which patterns of movement to and through the centres were analysed to provide a more detailed description of the type, range and scale of journeys that define the effective area of an active centre.

1. Background

Previous research into the spatial form of cities has identified the phenomenon of the 'deformed wheel'; part of the generic structure of cities that is required to move people into and out of the centre, with quieter residential areas in the interstices of the 'spokes' (or radial routes) of the wheel. It has been argued that this pattern enables the creation of a natural interface between inhabitants and strangers. Smaller scale deformed linear structures have been observed within local areas too, and frequently these are found to be traces of an older settlement. It has been conjectured

that the manner in which the smaller scale grid is knitted into the super-grid helps shape the relation between local places and the entire city; between city parts and wholes and the relationship in turn between society and space (Hillier and Penn 1996; Hillier and Vaughan 2007). This pattern of relations between local and larger scale has also been conjectured as being subject to the way in which the grid changes over time: the original settlement may in some cases grow into a larger one of the same character, whilst in others it may take on a different (perhaps more exclusive) role (Hillier 2001). The manner in which settlement centres are transformed in their function through time, Hillier argues, is bound up in a process of settlement formation, the impact of its form on patterns of movement, and the way in which movement in turn influences the distribution of land use and lastly the way in which land use itself shapes the formation of a centre as an attractor in its own right.

Hillier's theory of 'centrality as a process' (1999) maintains that 'live centres', namely the functions of retail, markets, catering, entertainment and other activities, benefit from movement in particular since "the spatial processes governing live centrality appear to invoke spatial requirements over and above those related to other central functions such as administration, office employment or religion" (*ibid.*, 107). He also notes the importance of the less movement-dependent activities in benefiting from proximity to the live centre. Lastly, the importance of understanding the formation of centres as part of a temporal process of change in movement patternsspatial configuration – and thus in turn – spatial configurationmovement patterns, contributes to the theory of 'centrality as a process'.

The significance of retail activity to town centres is also reflected in the priority given to retail in the academic literature and in UK policy. However, while the importance of retail to lively town centres is undoubted, the reduction of the town centre's role to its viability as a retail hub is problematic. Where retail indices are used to assign centres within an urban hierarchy then smaller centres with fewer international and national chains (for which reliable data is more easily available than the singular shops found in smaller centres) inevitably begin to fall beneath the policy radar (Hall, Marshall, and Lowe 2001; Griffiths et al. 2008). Moreover, by viewing town centres exclusively in terms of their retail potential then the hierarchical representation is perpetuated, not simply in terms of the number of shops but in terms of what a town centre essentially *is*. This is because a rank-ordering of centres by retail area does not simply have the socio-economic effect of privileging size (comparing from the top-down) but also, from a morphological perspective, fixes notions of convexity and linearity at a single scale (as properties of large centres and small centres respectively).

This paper uses segment analysis to take a detailed 'bottom-up' perspective on urban centrality in which it is suggested that many different forms of activity are interlinked, from the local scale to the urban system overall. The proposition is that smaller centres contain a complex and dense layering of non-residential activity that is enabled by the structuring of space, so that although at the global scale retail activities tend to be strongly linear, a more differentiated pattern emerges at the local scale. Here, the town centre tends to have a rather 'fatter' structure overall, enabling circular movement that takes in a variety of activities distributed well beyond the 'live' centre. We term this (in contrast to the 'live centre'): the 'active centre'. The concept of the 'active centre' stems from the observation of a large number of cases within and around London which demonstrate the importance of all non-residential activity in creating local and larger scale patterns of movement. The suggestion is that the multiplicity of activities contained within suburban town centres -from light industry to the local court- contribute to their liveliness and to their ability to adapt to social and economic change.

In 'Centrality as Process' local grid conditions are shown to be the key variable associated with the attractiveness of a local centre in the sense that grid intensification functions to sustain circulatory of movement beneficial to the development of retail activity (Hillier, 1999, 116). Conroy Dalton and Dalton (2005) have proposed that suburban street networks have a distinctive spatial signature, contrasting them with urban networks in the "frequency, length and distribution of the graph network circuits" (*ibid*, abstract). This paper builds on these ideas by suggesting that suburban centres can be distinguished from their residential hinterlands by their network characteristics. It

proposes that smaller centres emerge as part of a process that benefits movement through and around the whole range of town centre activities: offices, places of production, community activities as well as retail. If this conjecture is correct, then the extended 'active' centre will have a measurable spatial signature that supports it. This paper also aims to provide a critical evaluation of the planning literature's mono-scaled, hierarchical approach to urban environments which tends to privilege the study of larger centres with the effect of obstructing the understanding the role of smaller centres in sustaining the urban system as a whole.

The research uses space syntax methodology to investigate the extent to which the street network of a sample of suburbs in the greater London area (within the London M25 orbital road and outside of the London inner circular road) structures a range of socio-economic and community activities across different scales of movement. By using space syntax analysis the intention is to test the hypothesis that the dual function of suburban town centres as "links in a movement system that connects places", and as "destinations, or 'places' in their own right", involves a complex layering of multiple spatio-functional scales of activity (Jones, Roberts, and Morris 2007, xi).

The research uses UK Ordnance Survey 'Address Layer 2' data processed in a Geographical Information System (GIS) to display 21 categories of non-residential activity for 26 outer-London cases in order to explore the generic characteristics of local town centres. The cases were chosen from a sample of 113 town centres to represent typical small to medium sized suburban town centres. An 800m buffer around each centre was selected to represent an 'as the crow flies' neighbourhood of approximately 15 to 20 minutes walk from the town centre's core for which the land-use data were captured, whilst an axial segment model of Greater London was used for the spatial analysis. An algorithm was developed within a GIS in order to automate the attribution of each land-use address to its closest axial segment. The technical details of this procedure are not provided here due to constraints of space, but the authors intend to publish a paper on this in the near future. In the research reported here, 3 of the 26 cases are discussed in detail. These three were chosen to represent the geographical and socio-economic variation within the 26 cases sample; an ethnographic study of walking and activity patterns was conducted in them during September 2008.

The paper opens with a discussion of the socio-economic complexity of smaller suburban town centres; it then goes on to consider their scaled characteristics through an analysis of land-use distributions and space syntax segment values. The paper ends with some conclusions regarding the spatial character of smaller centres.

2. The complexity of smaller suburban town centres

Supporting evidence for the conception of London as a network of linked centres can be seen in figure 1, which illustrates global choice (lines coloured in a scale from red to blue) overlaid on a density surface (grid squares coloured in a scale from dark to light grey) indicating where retail addresses are at their densest. Examination of figure 1 shows how global choice is evidently a reliable predictor of retail activity. This distinctive pattern suggests how movement-dependent town centre activities emerge in a distribution that reflects the degree to which paths overlap at the urban scale.

Figure 1 also suggests the strong linearity of this pattern in outer London, especially in the smaller suburban centres which often arose along historical access roads to the metropolitan core. Where the distribution of retail activity is rather more convex than linear, it tends to be the larger suburban centres (such as Harrow, in the left-hand side of the image) that display this pattern. In other words, convexity is seen to be a function of the size of the centre's retail offer. While larger centres are easily represented in these terms as 'attractors', destinations one might choose to move to and around; smaller centres, by contrast, are represented as places where one might pass through *en route* to somewhere else. The consequence of a too-exclusive focus on the network's global properties are that larger centres appear as 'natural' destinations while smaller centres appear as highly linear – reduced, effectively, to a high street strip.



Figure 1
Density of retail activity and global choice in London.

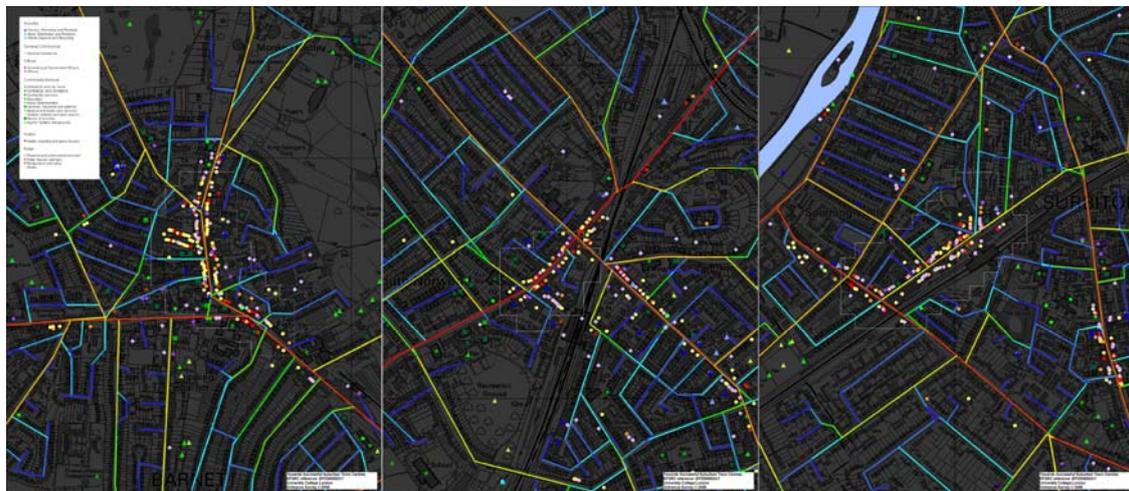


Figure 2
Non-residential activity and segment angular choice radius n calculated for London within the M25, for Chipping Barnet (left), South Norwood (middle) and Surbiton (right). Underlying map is © Ordnance Survey 2008

Yet interestingly, when we look at some smaller centres close up we find that this hierarchical pattern begins to break down, even at the macro scale. Figure 2 shows three suburban centres, also at global choice radius n . Here we note that not only is much of the main retail activity in fact not on the route with the highest value, but when other categories of activity are taken into account, a more convex and more complex description of the relationship between built form and socio-economic activity is required. In fact a preliminary statistical analysis showed little self-evident relationship between land-use and space syntax variables.

One implication of the research question addressed by this paper is that suburban town centres are more complex and diverse than previously thought. A previous study of an outer-London suburb found that a relatively small suburb contained within it a surprisingly varied range of communal, economic and social activities, belying the stereotype of suburban town centres as purely serving the local needs of their residential hinterland (Vaughan 2006). The study found that a variety of groups used the town centre at different times of the day and week, suggesting that such places frequently comprise a dense layering of economic and social activities which work at a variety of spatial scales to serve a range of social groups. Subsequent research has suggested that the reason for this is that suburbs that have succeeded in persisting in the same location through time are able to adapt to social and economic change (Haklay *et al.* 2008). This temporal component is important to the argument that it does not make sense to privilege one scale of analysis over any other, since centres operate at different scales simultaneously and also might shift their importance from one scale to another.

One example of the complex array of land uses present in the sample of 26 centres is Church Street (Figure 3), two turnings away from Rickmansworth high street, in the north-western edge of greater London. Data from a local business directory show that it contains over thirty different categories of business in addition to those traditionally to be expected on a suburban high street (e.g. Agricultural Machinery Dealers, Computer Services, Pharmaceutical Manufacturers, Social Club and Waste Disposal Services). This combination of activities naturally generates a richer pattern of movement, one which requires trips of varying length at varying frequency throughout the day and week. This is borne out by analysis of commuter movements extracted from the 2001 Census data (see www.sstc.ucl.ac.uk/profiler), which confirms the large range of journeys, within Rickmansworth, between Rickmansworth and London and from greater London into Rickmansworth that one might expect from these activities (for example, of the about 8300 reporting Rickmansworth as their place of work, a significant proportion travel in from the neighbourhood itself, with others commuting in from surrounding districts).



Figure 3

Church Street, Rickmansworth contains within it a wide variety of retail and other functions

The significance of smaller centres as places of diverse activities is illustrated by a map of all non-residential activity within one of the suburban cases (Figure 4). Although shops and other retail activities are broadly linear in their patterning, other movement-generating functions, such as medical and healthcare facilities, community services, and libraries and so on are distributed effectively so as to create a semi-circular pattern of movement. A questionnaire survey conducted in the three detailed cases to gather data on people's routes and journey purposes within the suburban town centres illustrates the circuitous pattern traced by locals moving around the area on foot (Figure 4 inset). Moreover, the 192 respondents to the survey stated their intention to carry out additional or *alternative* activities to shopping, such as: business meeting; visit to doctor or dentist; visit the gym, leisure centre or sports club; visit the library; go to the park, allotments or recreation ground; pay bills or go to the post office; visit family or friends; or indeed were in the centre because they work there.

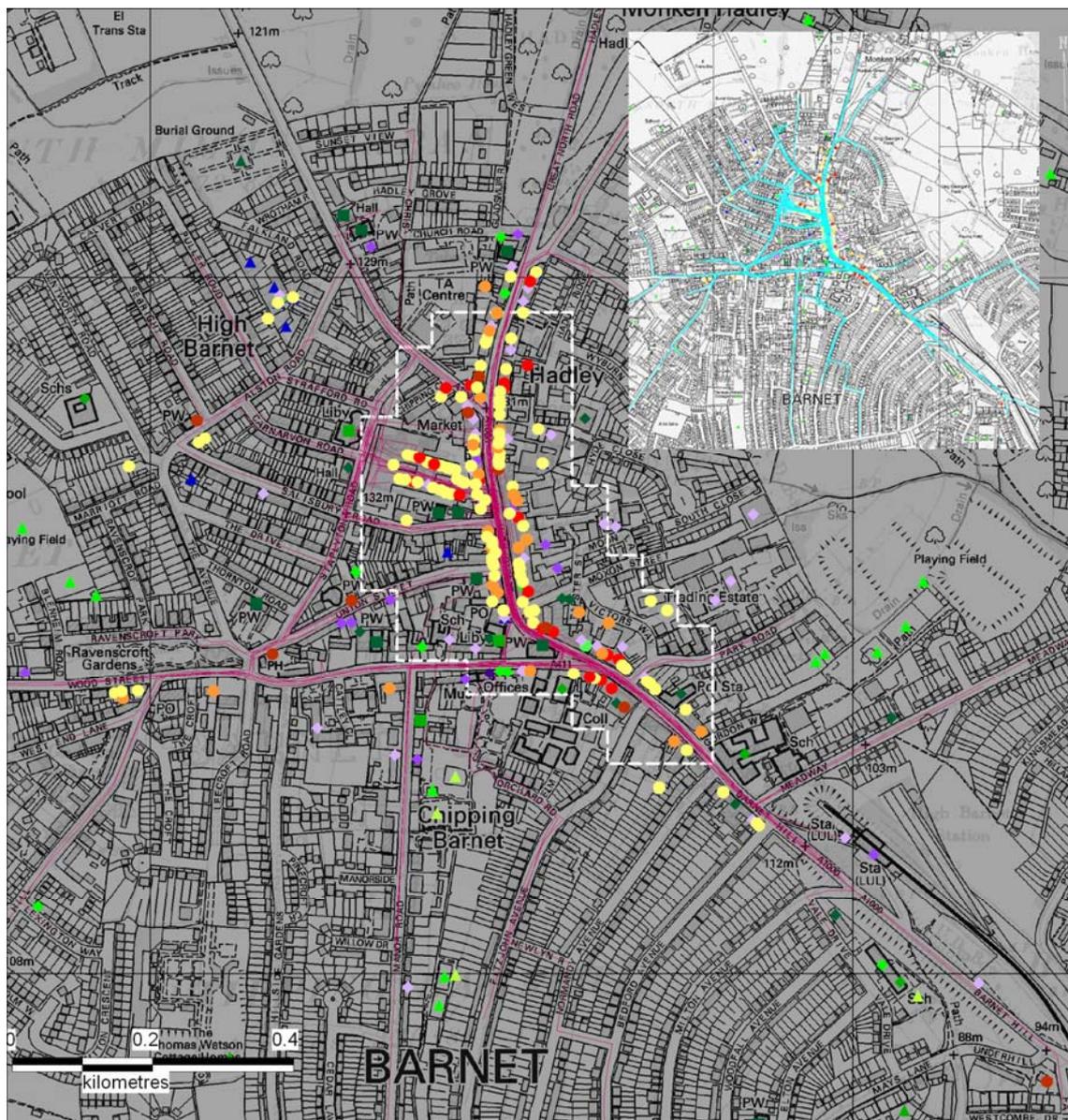


Figure 4
All non-residential activity and (inset) all locals' movement traces, Chipping Barnet. See figure 2 for legend of activity functions

3. Analysis

Analysis of land-use distributions across the sample of 26 London centres has found that although their importance as manufacturing hubs during the first half of the twentieth century has almost disappeared, both in larger and smaller suburban centres, local business and small-scale manufacturing are still present and indicative of their significance as a place of work (Griffiths et al,

2007) (figure 5). These much smaller suburban town centres are frequently found to have productive activities in courtyards or back streets one turning away from the high street (rather than in an industrial district away from it), helping to create an interdependence of activities that generates movement and takes advantage of the services and workforce available within the reach of the town centre. It was also clear that frequently these activities were not captured by the hierarchical (retail-centric) approach to defining suburban town centres. A method of creating a spatial statistical picture of all possible non-residential activity is at the heart of the study described here.



Figure 5

Printing press and other light industrial activity one step behind the high street, Chipping Barnet

3.1. Defining 'Live' and 'Active' suburban town centres

The initial stage of analysing non-residential activity was to use a GIS to capture all address points within an 800 metre boundary of three detailed case studies of suburban town centres and then to attribute the data points to the axial segment adjacent to their street address.

The first attempt at defining 'live' as opposed to 'active' segments according to how diverse were the retail and other classes contained within them was dismissed early on, since it soon became clear that the numerous categories of land uses involved meant that any practical definition would be either so reductive or vague as to raise as many problems as it solved. Moreover, bearing in mind the possibility of frequent changes of land use that are common to such locations, detailed calculations of relative proportions by segment would be unlikely to be generally applicable for long.

The conjecture was that streets – and particularly street segments – are likely to contain a variety of non-retail uses, even when the most retail-intensive segments in the sample are considered. This is based on two sets of facts. First, of all the segments in the three detailed cases, a surprisingly low proportion (42-49%), were found to be purely residential. It is notable that the suburbs are far less 'purely' residential than was expected, even bearing in mind that this captures cases of a single non-residential activity, such as a school, on a residential road. Second, it is evident that within the sample all segments with retail contained other uses. Although the degree of mixing

differs from one use type to another, listing these according to proportion gives a result that seems intuitively to make sense according to the types of activity most likely to co-mingle (Table 1). The table shows that segments containing shops are most likely to also contain offices, financial services, and to a lesser degree restaurants. What might seem surprising is the finding that shops and industrial activities often co-exist, highlighting that the assumption that they need to be separated is somewhat artificial. On the other hand, shops continue to be an important factor in the location of other less obvious 'live' centre activities, namely medical facilities, places of workshop, pubs and schools.

▪ Libraries or museums	1%
▪ Indoor entertainment	2%
▪ Education (schools and colleges)	4%
▪ Pubs	5%
▪ Places of worship	6%
▪ Medical or health facilities	7%
▪ Industrial activity	14%
▪ Restaurants	15%
▪ Financial activities	24%
▪ Offices	40%

Table 1

The percentage of segments with one or more shops (n=251) hosting non-retail functions

Table 2 shows street segments with four or more shops, demonstrating that the focus of co-presence of non-retail activities continues to be offices and restaurants even in more retail-focused locations, as would be expected. What is however striking is the relatively high proportion of segments with industrial activity (this includes small factories and storage; with the caveat that there are relatively small numbers involved, a maximum of 3 addresses in any of the segments involved). It is also evident that non-'live' centre activities are present alongside the 'live' centre activities of shopping, offices and restaurants.

▪ Indoor entertainment	0%
▪ Libraries or museums	4%
▪ Education (schools and colleges)	4%
▪ Places of worship	4%
▪ Medical or health facilities	9%
▪ Pubs	11%
▪ Industrial activity	22%
▪ Restaurants	33%
▪ Financial activities	66%
▪ Offices	70%

Table 2

The percentage of segments with four or more shops (n=24) hosting non-retail functions

In the first instance of defining live and active segments simple calculations were made by calculating the proportion of non-residential addresses to all addresses per segment, but also giving an importance to the topological relationship between each segment and its neighbour. The expectation was that segments conforming to the Hillier (1999) definition of 'live' centre would have a high intensity of activity, and would also have *two* adjacent segments with a high proportion of non-residential activity. The broader town centre area was expected to have what were termed as 'active' segments, in which non-residential activity would be 50% or over, with *one* adjacent segment with the same characteristics.

The initial results showed that a threshold of 50% was not appropriate for identifying live centres in two of the cases, Surbiton or South Norwood. The reason for this was not variation in segments lengths in the centres (which are similar) but the concentration of residential flats located above

ground floor activity on the segments associated to the live centres. The concentrations of these flats acted as a negative influence in the proportion calculations - reducing the importance of the ground floor activity.

Following this discovery the GIS algorithm was adapted to take into account the 'vertical adjacency' relationship of activity. Vertical adjacency was defined as the number of addresses associated with one spatial location (defined by its national grid coordinates). We argued that the way the town centre is constituted by activity at the ground floor level means it needed to be given greater weighting in the algorithm by reducing any cases of *more than one* residential address in the same spatial location to a value of *one*. It was also decided to use 40% as a threshold for non-residential activity as a proportion of all addresses, since this highlighted most of the smaller clusters of activity that had been observed on the ground.



Figure 6

Percentage of non-residential activity by segment, South Norwood. Underlying map is © Ordnance Survey 2008

Following the successful aggregation of residential activity to take account of the vertical adjacency the data was reprocessed to enable the identification of live segments and active segments. The algorithm was generally very effective in automatically capturing non-residential activity observed on the ground (Figure 6). There were a few exceptions to this though, especially where interruptions to activity had occurred due to the presence of a railway bridge, or the conversion into residences on one side of what was once a shopping street (this highlights the

complexity that is at play in this study and future research will consider side-to-side differences). In the cases where the algorithm was least likely to predict observed clusters of activity it was notable that there was both a weakness between the relationship of socioeconomic activity and its corresponding morphological structure and an ecological impact on the activity due to its size and the street layout. In particular, the lack of “liveliness” in the case of South Norwood was evidently influenced by the absence of circularity in the grid of its built environment. The definitions of active and live segments provide a range of socio-economic/topological descriptions of activity in the centres which can be further enriched by analysis at the smallest spatial scales.

3.2. The scaled nature of centres



Figure 7

Non-residential activity and segment angular choice in South Norwood (top-left: radius 400; top-right: radius 800; bottom-left: radius 1600; bottom-right: radius 2000). Underlying map is © Ordnance Survey 2008

3.3. Overlapping paths and routes

Another conjecture that was explored was the notion that the sub-centres considered by this project would feature the characteristics of *axial* intelligibility observed in the more centrally located cases examined in Hillier (1999). An attempt to replicate the analysis using *segment* angular analysis, by correlating small radius (200, 400 and 600) and radius-n integration for all the live and active segments in each of the centres does not show any distinctive pattern. In contrast, analysis of the relationship between choice and integration at the same radius (choice radius-400 against integration radius 400 and so on) came up with some surprising results (Figure 8). Each of the three detailed cases was found to have a correspondence between accessibility (integration) and path overlap (choice) at different ranges of radius. In other words, the street segments which comprise the extended town centre are important for these two types of configuration at particular scales of activity. These preliminary findings suggest that whilst in some cases the centre is primarily adapted for serving its localised area, such as South Norwood (which has the highest r^2 of the three cases at all scales up to 1600), others have adapted to serve a larger-scale complex network of overlapping paths of movement, such as Surbiton (highest r^2 of the three cases at radius 2000) and Chipping Barnet (highest r^2 at radius 3000 and n). These results point to the fact that some of the live and active segments in south Norwood are on a more localised structure; in contrast, Barnet and Surbiton have main roads forming part of centre. It is also notable that 'live' centres are effectively continuous and active centres are more discontinuous – both with different relations to scale.

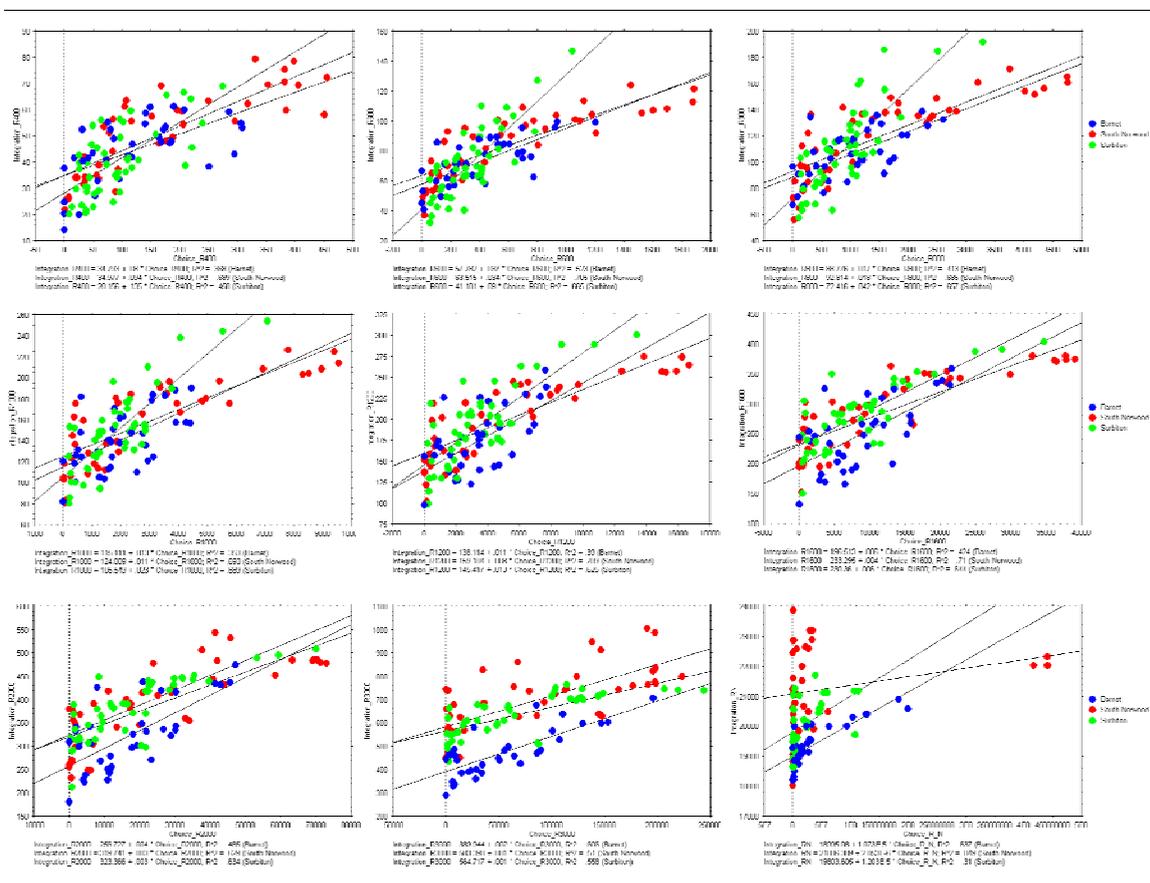


Figure 8
Bivariate scattergrams showing regression of Choice and Segment Angular Integration for 'live' and 'active' segments in three suburban town centres. From top left to bottom right: radius 400, 600, 800, 1000, 1200, 1600, 2000, 3000 and 'n'.

4. Conclusions

This paper has attempted to go beyond the well established relationship between movement and socio-economic activity in the field of space syntax and begin to understand the complexity of these distributions and the role they place in sustaining the local town centre. In particular, it has

presented evidence to suggest that the fine grain urban street network is shaped to differentially locate land uses of different types according to the availability of passing movement at a range of scales and for all types of town centre land uses. This finding may relate to how the centres have emerged through time, through emergent network relationships at different scales.

This study has examined the socio-economic relationship of segments in syntactical terms and conversely, the syntactic relationship of segments in socio-economic activity terms. The topological basis of the definitions of 'live' and 'active' street segments draws into a discussion of syntax methodology the positive multiplier effects of town centre activity beyond the retail core. This paper has provided evidence an underlying spatial signature to smaller suburban town centres that is the outcome of local grid conditions emerging from a process of overlapping networks of movement at a variety of scales and for a variety of purposes. These conclusions need to be verified on the remaining 23 London cases in our sample and in other cities to check that their validity, but with this caveat the results reported here raise the question of whether the success of local centres is conditional on their built form adaptability to social and economic change through time. We conclude that the feature of adaptability in local centres can play an important role in supporting a wider range of locally generated activity than the retail functions with which they are most commonly associated and propose that this feature of adaptability is a sign of the potential for suburban town centres to be economically sustainable.

Although the importance of retail in suburban town centres cannot be overlooked, the *by-product* activity generated by the co-location of a diverse range of activities is clearly vital to the sustenance of smaller centres. It is also not purely an economic function – the fact that additional activities are supported within the locality of the suburb ensures that more time is spent locally, supporting the suburban *virtual community*: its “potential field of probabilistic co-presence and encounter”, (Hillier et al. 1987). This paper suggests that this *potential* embedded in the street network – the basic ingredient of society – is the critical element for sustaining the vitality of local centres. The extensive and varied activity in such areas seeds daily/weekly/periodic movement and engagement of individuals with their locality. Thus, we further propose that we have provided evidence for the suburban town centre as having the potential to be both socially and environmentally sustainable.

5. Acknowledgements

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