Delineating Daily Activity Spaces in Rural Areas[++]

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Abstract

The new relational geography challenges notions of inherently coherent, integrated 'territory-based' systems of relations. This paper uses network methods and correspondence analysis to try and describe some of the spatial differentiation and relational dynamics at three different rural sites. The particular focus is on delineating the daily activity spaces of households and to describe the central-place roles of local centres. The methods used do help us to capture some aspects of the differences that exist in work, shopping and social relations and the spaces that these relations fill. The implications of the findings for local planning and administration are also discussed.

Key Words: daily activity spaces, network methods, correspondence analysis, central places

JEL Classification: R11, R12.

1. Introduction

Researchers have noted that there is a growing separation between origins and destinations, with people living further from schools and workplaces and having to travel more to shops, social activities and leisure activities (Bannister 1999). For example, data for Ireland from the Census of Population 2002 and the Quarterly National Household Survey 2000 show that the numbers travelling over 15 miles to work has increased from 8.2 per cent of the total in 1991 to 10.9 per cent in 1996, 12.4 per cent in 2000 and 20.0 per cent in 2002. Commuting to work has attracted considerable media and research attention. Commuting to work has a direct link to the spatial (and temporal) characteristics of related activities such as buying groceries, accessing services, taking children to school and visiting family. With increases in geographical labour mobility there are likely to be many complex activity spaces derived from the different services demanded by different households. Bennett (1997) suggests that the aggregation of preferences and activity spaces has a non-unique solution pointing out that 'there are as many different activity spaces deriving from the different services demanded by different groups of the population, or by industry, as there are different groups, or industries: there is no single solution'. Bennett also refers to the statistical problems of capturing these spaces within some defined notion of a functional region. He suggests that the modern concept of functional region (as applied in Europe) is based on a commuting hinterland of 15% of the working population and points out that while the journey-to-work of 15% of people is important, it omits the working activity space of the 85% of the population who work elsewhere. He also argues that 'the working population is only usually 40% of the total population. The remainder have often totally different activity spaces based on leisure, social, public and private service demand and supply which do not fit with the commuting workplace which can be at a great distance away' These other activity spaces which Bennett refers to are ones that are more relevant for local administration and planning since they relate more closely to the larger users of private and public services that are supplied locally. The economics of some of these services are now becoming more and more uncertain within the changing dynamic of the local economy and society (NESC, 1997).

The American regional planner John Friedmann (1987) describes the life space of households as being pretty much defined as close to where they live 'it is in close proximity to their homes that households customarily invest most of their resources in the production of life'.

However, he also suggests that beyond this life space of households there is 'the 'wild city' of economic space, created by capital, where people look for work that is paid. 'For the 60 percent or so, who are not in local employment, labour markets extend out from the home for upwards of 30 miles – 1 hour's driving distance. If we were to draw for an aggregate of all households in a metropolitan area, a frequency distribution of the time spent by household members in different locations, we would obtain a bimodal distribution of space use over any 24-hour period on weekdays. The bulk would be centered on the home, but the second major concentration would cluster around the distant workplace. These two "bulges" in the distribution of space/time would be connected by "ridges" along the most frequently travelled corridors' (Friedmann, p.368).

The new relational geography challenges notions of inherently coherent, integrated 'territory-based' systems of relations. We now expect that 'significant relations affecting the qualities of territories may stretch in many directions and link to many and different scales. Spatial effects cannot be analysed merely in terms of variations in physical proximities but may occur 'at a distance' as well as nearby. The social relations which transect a specific piece of territory may each have a different spatial reach, just as they may have different temporalities' (Healey, 2004, p. 47). Elsewhere (Thrift, 1996, Graham and Healey, 1999), we are warned not to over-emphasise the mobility of people and things in simple all-encompassing assumptions about place-transcendence or 'globalisation'. Clearly, the power and roles of different theoretical constructs have to be checked with and balanced against the results of empirical investigation in specific locational contexts.

The focus in this paper is on how we might capture the, perhaps, small scale daily relations found in the 'local' range of the normal daily activities of rural households. The objective is to see what diversity exists in the pattern of these relations as a function of where households are located and where, for example, there may be an increasing separation of places of residence from places of work. This project is linked to the broader task of understanding urban-rural relationships and the role of this concept in the European Commission driven debate on spatial planning. A research task, highlighted under the European Spatial Development Perspective (ESDP), is one of linking analyses of the changing dynamic of the economy and society, a dynamic that is best understood, as suggested above, in terms of the relational geography of a 'networked society', to an appropriate spatial strategy. Is there some kind of objective reality that we can capture which we can then use to do strategic spatial planning and to structure the development of policy concepts? There is no shortage of suggested templates; Functional Economic Areas (FEAs), Local Labour Market Areas (LLMAs), urban regions, transport corridors as a 'skeletal' framework, polycentric urban regions (PURS), any of which might be used as useful frameworks. The question is one of how well each or any of these templates can work as organising devices for policy and planning purposes.

Within this task of trying to understand the spatial organisation of territories and places, several of the papers in a recent issue of the *Built Environment* (2002) refer to the specific challenge of developing appropriate concepts for describing urban-rural relationships 'which can be used to mobilise attention and perform policy work … and to create typologies to capture the diversity in patterns of relations." (Healey, 2002). Comparative data on activity spaces which capture these relationships, either within areas or between areas of different types, are extremely scarce (Bengs and Zonneveld, 2002). The recently published National Spatial Strategy for Ireland (NSS, 2002) draws heavily on the spatial vocabulary of the European Spatial Development Perspective. The planning team propose a spatial development framework based on selected 'gateway' and 'hub' urban centres serving functional economic areas (FEAs). These gateways and hubs are described as "strategic centres with the potential to be drivers of development at national level and within their own regions" (NSS, 2002, p.38). Each FEA is presented as sets of places that "have characteristics in common and share inter-relationships in the way they function economically and socially" but there is no information in the NSS documentation about any methodologies that were used to help understand different relations and how FEAs might be designed to match these relational realities in scale and span.

The NSS deals with development at regional and local level in a broad manner. The maps for all of the regions show a number of common characteristics, see the specimen map, Figure 1, Map of West Region (Appendix 1). The various parts of the urban hierarchy, including certain small towns <1,000 population, are shown. The *Strategy* recommends that these small towns must be supported by local authorities because of the important roles they play as points at which wider communities access local services and employment. Important elements of physical infrastructure are identified, including the principal road corridors. Towns representing 'urban strengthening opportunities' are shown. The *Strategy* recommends that these towns, located on important economic and transport corridors or in important locations and with a capacity to grow, must become a focus for the settlement policies of local authorities as incorporated in county development plans. For rural areas, four broad spatial policy priorities for regional and local authorities, relevant government departments and agencies and other bodies, such as the city and county development boards, are illustrated. The policy priorities in rural areas include: areas with strategic rural assets within a metropolitan hinterland; village strengthening and rural area opportunities; rural areas with strong potential for diversification; and diversifying areas (NSS 2002, pp. 75-76). The National Spatial Strategy only suggests these broad schematic guidelines and it is left to regional planning guidelines, county/city and local development plans to work out the critical linkages, nodes and dynamics in specific local contexts. This paper outlines an exploratory methodology that can produce useful ways for describing some of the spatial differentiation and relational dynamics of different rural sites in the West region as shown Figure 1. The particular focus is on delineating the activity spaces of rural households and describing the central-place roles of particular centres. The working hypothesis is that there are likely to be differences in the nature of relations and connections across places and that simply defining all areas with some fuzzy and obscure labels is of little value for local planning or public administration.

2. Delineating Activity Spaces

The evidence that is most typically considered in understanding FEAs is linked to that used to delineate labour market areas (LLAs). "LLAs are the statistical building stones for 'daily urban systems', functional urban areas', 'travel-to-work areas', 'standard metropolitan statistical areas-SMSAs' or, metropolitan economic labour areas-MELAs" (Van Der Lann and Schalke, 2001). There is none of this kind of evidence used in the NSS in defining any of the features shown in Figure 1. The classification of areas is very general and devoid of any evidence about actors and their spatial behaviour. This conclusion particularly applies to the classification of rural areas as 'areas with strategic rural assets within a metropolitan hinterland' and areas with 'village strengthening and rural area opportunities' The data simply is not there to determine the scope of the relations in question or to measure their dimensions and their actual/potential connectivities. For example, Irish Census data on travel-to-work patterns suffers from a number of limitations which makes it impossible to use the data to construct travel-to-work areas or LLAs with any great degree of definition. The data does not have the basic information on origin/destination or direction of travel; it only tells us about the commuting behaviour of individuals in terms of distances travelled (plus times taken, in the most recent 2002 Census) and the transport modes used. The data is made available on a District Electoral Division (DED) basis and, as such, any DED variable will represent the average behaviour or condition within a local area. Also, the DEDs are irregular in shape and in size and this makes for further difficulties in formally exploring distributional characteristics and other arrangement properties in the data. Keane, (2003) provides an account of using some EDA (Exploratory Data Analysis) methods to tackle some of the difficulties with the DED Census commuting data.

In order to examine the spatial scale and span of the normal daily activities of rural households a household survey was completed in September 2003. Because of the exploratory nature of this work the scale of the survey was kept to a modest level. Households were selected at random from three different types of site. Site A is a DED located somewhat remotely in the area associated with 'village strengthening and rural development opportunities', see Figure 2. Site B is a DED located in the zone designated 'areas with strategic rural assets within a metropolitan hinterland. Site C is also located in the 'village strengthening and rural development opportunities' but is somewhat more centrally positioned relative to urban opportunities compared to site A. More specific locational details pertaining to the three sites can be seen in Figure 2. A total of 58 households were included and a short interview schedule was administered by telephone where each respondent was asked to describe the normal daily activities that members of the household engaged in (Ettema, et al., 1996). Daily activities were defined to include; Work, School (secondary or primary school), Shop1 (shopping for daily needs), Shop2 (weekly shopping or shopping for major or bulky items), Personal (availing of personal services e.g. banking and post office hairdressers) and, Social (activities like eating out, going for a drink and meeting friends). The objective, once again, is to examine the spatial scale and span of daily activities and, in particular, to explore if there are differences in this spatial scale and span as a function of location and of the work-home relationship. An EDA type of approach, using social network methods (Wasserman and Faust, 1994), is used to explore these questions. EDA is numerical and graphical detective work that seeks to maximise what is learned from data, to help identify trends and spatial arrangement or structure. EDA makes a clear distinction between exploratory, investigative, work which generate hypotheses and confirmatory methods used to test those hypotheses using classical statistics (Haining, 1990, Brimicombe, 1999).

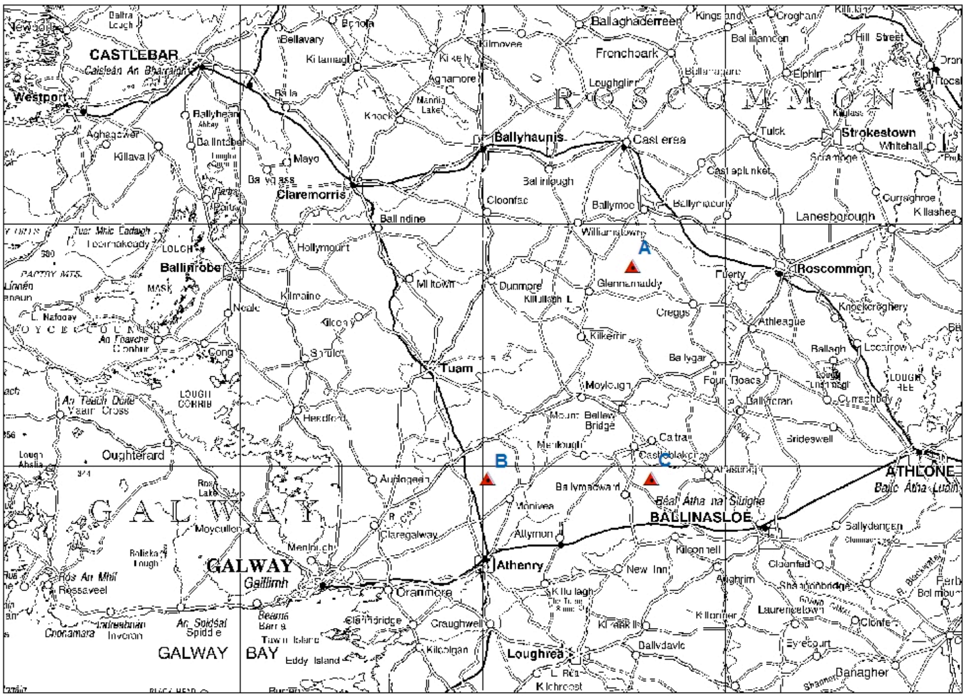

Figure 2. Survey Sites: A Tobberoe, B Ryehill and C Annagh

3. Some Exploratory Analysis with Network Methods

Some summary statistics on journeys-to-work patterns for all persons 15 yrs+ and at work from the household survey are shown in Table 1 along with some comparative statistics from the 2002 Census. Journey-to-work patterns from all three sites are drawn in Figure 3A and boxplots of distances travelled are shown in Figure 3B. The network drawings were all executed with the UCINET 6 package (Borgati, et al., 2002). It should be pointed out that 21% of all journeys-to-work are not counted in Figure 3A or 3B as they represent persons who travel to work but who work in the trades and thus, they have no one specific, or fixed, destination.

Table 1. Commuting-to-work data for all sites plus Census Data 2002

Site	% of worforce who commute 2002 Census	% of workforce who commute in survey	% of workforce commuting > 10 miles, 2002 Census	% of workforce commuting > 10 miles in survey
A	83.0	79.0	51.0	69.0
B	77.0	80.0	91.0	86.0
C	83.0	72.0	91.0	86.0

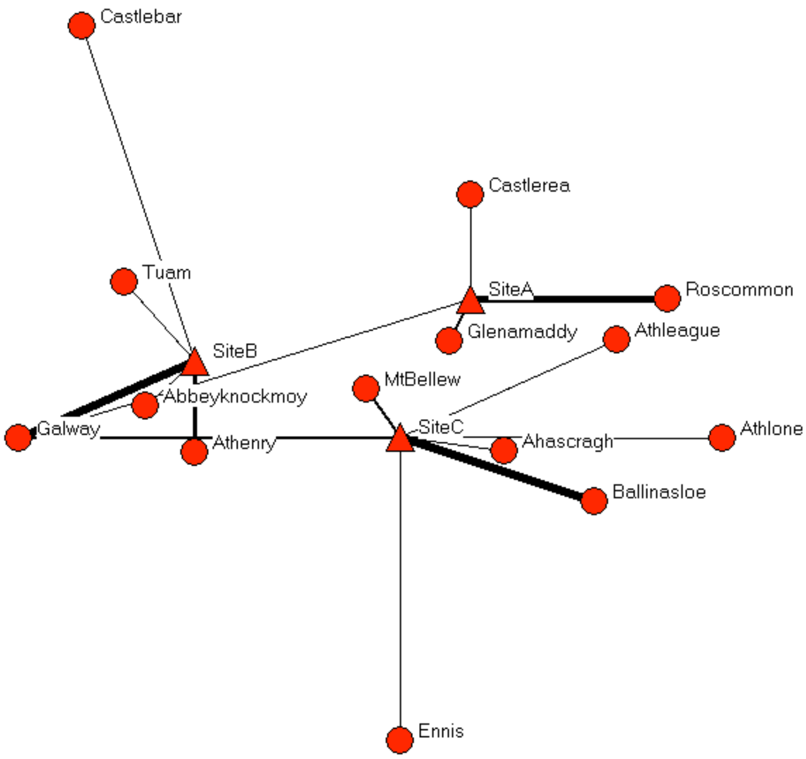

Figure 3A. Travel to Work Patterns

In Figure 3A, the thickness of the individual lines indicates the relative strengths of the travel-to-work connections. The boxplots show some summary statistics of the distances; the median value, the median connect line, spread (interquartile range), skewness, tail length and outlying data points (represented by the * symbol). These statistics allow us to see similarities and differences across the three sites in travel to work distances. The median distances travelled are pretty much the same at all three sites. For Site C the median is close to the lower quartile indicating that the set of distances is positively skewed. The suggestion for this batch of distance data is that while there is a high degree of variability (especially above the median, note the upper tail) in distances travelled, there is a strong concentration of distances at or just below the median value. Distances at Site B display no variation apart from the presence of a number of outliers. Travel to work distance to Galway dominate this data set, see Figure 3A. For Site A all distance are concentrated below the median value, with the exception of one outlier.

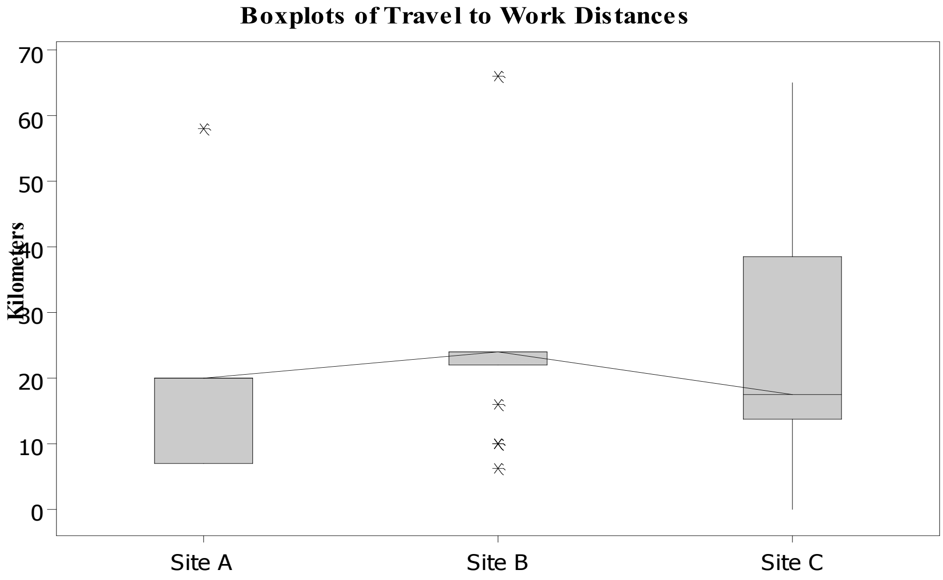

Figure 3B.

We can view the data from each site as an affiliation network. Since affiliation networks are two-mode networks we need to be clear about both of the modes. We have a set of activities N = (n_1, n_2 …n_g) as the first of the two modes and we have the locations M = (m_1, m_2 …m_h) as the second mode. With an affiliation network we can study the ties between the activities or the ties between the locations, or, indeed, both. For example, in one-mode analysis, focusing on ties between activities, two activities have a pairwise tie if they are both affiliated with the same location. Focusing on locations, two locations have a pairwise tie if one or more activities are affiliated with both locations. When we focus on ties between activities we will refer to the relation between activities as one of *co-presence*. When we focus on ties between locations we will refer to the relation between locations as *interlocking* locations. These one-mode ties, either between activities or between locations, are derived from the affiliation data and can be studied using methods for analysing one-mode networks (Wasserman and Faust, 1994).

An affiliation network can be represented by an affiliation matrix K = [k_{ij}]. This is a two-mode socio-matrix in which the rows index activities and the columns index locations. Since there are g activities and h locations, K is a g x h matrix. There is an entry of 1 in the (ij) cell if row activity i is affiliated with column location j and an entry of 0 if row activity i is not affiliated with column location j. Figure 4 shows the affiliation matrix for the household survey data at Site A. An affiliation matrix can also be represented by a bipartite graph. A bipartite graph is a graph in which the nodes can be partitioned into 2 subsets and all lines are between pairs of nodes belonging to the different subsets. Figure 5 presents the bipartite graph that corresponds to the survey data from Site A. The bipartite graph can also be represented as a socio matrix.

Figure 4. Affiliation Network Matrix for Household Survey Data for Site A.

	Castlerea	Glenamaddy	Glinsk	Athlone	Roscommon	Galway	Williamstown	Clonbur	Ballymoe
Work	1	1	0	0	1	0	0	0	0
School	1	1	1	0	0	0	0	0	0
Shop1	0	1	1	0	1	0	1	0	1
Shop2	1	1	0	1	1	1	1	0	0
Personal	1	1	1	1	1	0	1	0	1
Social	1	1	1	1	1	1	1	1	1

We construct a *co-presence* matrix X^N and a location *interlock* matrix X^M from the affiliation matrix K:

$$X^N = K\,K^T$$
$$X^M = K^T\,K$$

The elements in X^N record the number of locations where each pair of activities is present. The diagonal entries in X^N count the total number of locations used for each activity. The elements in X^M record the number of activities each pair of locations has in common.

The values on the diagonal of X^M are the total number of activities that are affiliated with each location. It must be pointed out that in constructing X^N and X^M from K one loses information that is present in the original affiliation matrix. In the activity *co-presence* matrix, one loses the identity of the locations that link the activities. In the location *interlock* matrix one loses information about the identity of the activities which link the locations. One only has information in X^N on how many locations each pair of activities has in common or, in X^M about how many activities are affiliated with each pair of locations. Thus, although the *co-presence* matrix has information about the frequency of co-presence for each pair of activities, there is no information about what locations were used, or about the identity of the other activities (if any) who also use the locations. Thus, there are restrictions in what we end up with and some caution is required in interpreting the information in either X^N or X^M. However, despite this health warning, we can get some interesting initial results.

Figure 5. Bipartite Graph of Affiliation Network at Site A

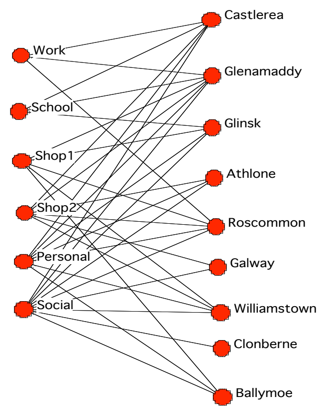

Figure 6 displays the X^N matrix for each of the three sites. This X^N matrix records, for each pair of activities, the number of location that they use together. The diagonal entries count the number of locations that are used for each activity. These diagonal counts are reproduced in Table 2 and they are interpreted as a measure of the spatial spread of the different activities at each of the three sites. The data shows how households at C travel to work to a relatively greater variety of locations compared to households at A or B. Site B is closest to Galway and this dominates the choice of workplace locations. Households at A distribute their Shop1, Shop2, Personal and Social activities over a much wider set of locations relative to their counterparts at B and C.

Table 2. Spatial Reach (# of Locations Used) of Different Activities by Site.

	Site A	% of Total Locations	Site B	% of Total Locations	Site C	% of Total Locations
Work	3	33	3	21	5	45
School	3	33	5	36	5	45
Shop1	5	56	6	43	5	45
Shop2	6	67	8	57	4	36
Personal	7	78	7	50	7	63
Social	9	100	10	71	8	72
Total Space = Total # of Locations	9	100	14	100	11	100

The X^M matrices are not shown here. The diagonal entries from each X^M matrix are shown in Table 3. These numbers indicate the overall number of activities that are affiliated with each location and they are summarised in Table 3 as counts of activities by number of locations. There are nine centres used by households from Site A. Only one centre provides all six activities, three centres (33%) provide 5 activities each and seven centres (78%) provide 3 activities each. There are eleven centres used by households from Site C. Two centres provide all activities, three centres (27%) provide five activities and seven centres (64%) provide three activities. Relatively speaking there are many more locations used by households from A for multiple purposes, i.e. providing between 4 -2 activities, compared to the other two sites. If we think of an Δ-shape template as the norm for a traditional system of rural central places then Site A come close to matching this but B, and C do not. The central place distribution at C is quite fractured with only a few places providing multiple activities, only 27% of places provide 4 activities compared to 56% of places for Site A and 43% for Site B.

Table 3. Number of Activities by Number of Locations for Each Site

Number of Activities	Site A Locations		Site B Locations		Site C Location	
	#	%	#	%	#	%
All activities	1	11	1	7	2	18
5 Activities	3	33	5	36	3	27
4 Activities	5	56	6	43	3	27
3 Activities	7	78	6	43	7	64
2 Activities	8	89	7	50	8	73
1 Activity	9	100	14	100	11	100

4. A Simultaneous Analysis of Activities and Locations

A more interesting approach to an affiliation network is to look at the activities and the locations at the same time. A two-mode analysis of an affiliation network does this by looking at how the activities are linked to the locations they use and how the locations are related to the activities that use them. Correspondence analysis is one technique can be used for such an analysis. For this analysis the affiliation matrix and/or the bipartite graph, is represented as a valued relation. Up to now relations have been modelled as simply dichotomous, i.e. as either present of absent between pairs of activities and locations. Valued relations indicate the strength, intensity or frequency of the tie between activities and locations. The valued bipartite graph for Site A is shown in Figure 8.

Correspondence analysis is a widely used data analytic technique for studying the correlations among two or more sets of variables (Wassermann and Faust, 1994, Greenacre, 1993). The technique is used here to describe the distribution of household activities (e.g. work, school, shopping, accessing personal services and attending social events) across locations and, at the same time, to describe locations in terms of their affiliation with the different activities. A correspondence analysis begins with a two-way table of frequencies [activities by locations]. The typical output from a correspondence analysis includes the 'best' two-dimensional representation of the data along with the coordinates of the plotted points and a measure (called the inertia) of the amount of information retained in each dimension. The correspondence analyses reported here were conducted using MINITAB.

To paraphrase Greenacre (1993, p.85), correspondence analysis does not provide cut and dried conclusions; the goal is to have a global view of the data that is useful for interpretation. There are no statistical significance tests and the main purpose is to produce a simplified (typically a 2-d) representation of the information in the larger frequency table. However, for a set of row points (locations), or for a set of column points (activities), the distance in the 2-d plot does correspond to a statistical distance between pairs of row (column) profiles in the original data and this can be used to describe the different relationships that may be present. For example, because individual locations are positioned at the weighted centroid of the activities which they contain, locations that are close together in the 2-d plot have similar activity profiles. Also, if the individual points representing the different activities are close then, by the same token, their location patterns are quite similar. If the points representing the different activities are spread out then their location profiles are quite different. Furthermore, if a location and an activity are close together in the 2-d plot and they are separated from the remaining points this indicates that the particular activity is associated almost exclusively with the particular location. Finally, there is no direct distance relation between a point representing a location profile and a point representing an activity profile. However, Johnson and Wichern (1998) note that row (location) points that are close to column (activities) points represent combinations that occur more frequently than would be expected from an independence model, that is, a model in which the row categories are unrelated to the column categories. An interpretation of the positions of the two sets of points for this example, supported by Greenacre (1984), is that each location's point will lie in the neighbourhood of the activity in which the location's profile is prominent.

Correspondence analysis can also be described as a method for decomposing the overall *Chi-square* statistic (or *Inertia* = *Chi-square/N*) for a two-way contingency table (as contained in Figure 8) in that it identifies a small number of dimensions in which deviations from the expected values (expected under the hypothesis of complete independence of the row and column variables) can be represented. This is similar to the goal of, say, factor analysis where the total variance is decomposed, so as to arrive at a low-dimensional representation of the variables that allows one to reconstruct most of the variance/covariance matrix of variables (http://www.ststsoft.com/textbook/stcoram.html). In addition to the proximity of the points and their positions in the 2-d space, it is usual practice to also interpret the dimensions and give them a name by studying the distribution of the points, their order along the two dimensions and on which side of the origin particular points fall. These are some of the basic 'rules' for interpreting the data in Figure 9 and Appendix 2.

Figure 8. Bipartite Graph of Affiliation Network with Valued Relations

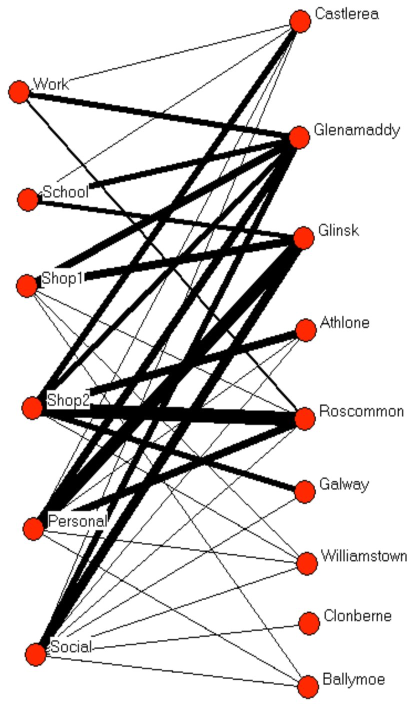

Figure 9 shows a sample correspondence analysis (row/column) plot of the activity-location data for Site B. The MINITAB results for all Sites can be found in Appendix 2. The discussion on interpreting these results is also contained in Appendix 2. These interpretations of activity spaces and location roles are summarised in Figure 10. The eigenvalues and the percentages shown along the co-ordinate axes in Figure 9 represent the *inertia* associated with each of the two dimensions. Thus, for Site B the *inertia* associated with the first dimension represents 47% of the total *inertia*. The second dimension accounts for 25% of the total *inertia*. Together, for Site B, the two dimensions account for 47% + 25% = 72% of the total *inertia*. For Sites A and C (see Appendix 2) the two dimensions account for 84% and 73%, respectively, of the total *inertia*. These *inertia* totals indicate how well the 2-d representation 'fits' the data and how much information (variation) is lost by representing the data in the two-dimensional row/column plots. Within these limits correspondence analysis offers a suitable framework for making comparative descriptions of the locations-activities data across the three sites. This is consistent with the aim of this paper in that it is trying to say something about the way in which activity spaces are configured and the relationships and roles played by various rural settlements.

A Correspondence Analysis of Locations-Activities Data, Site B

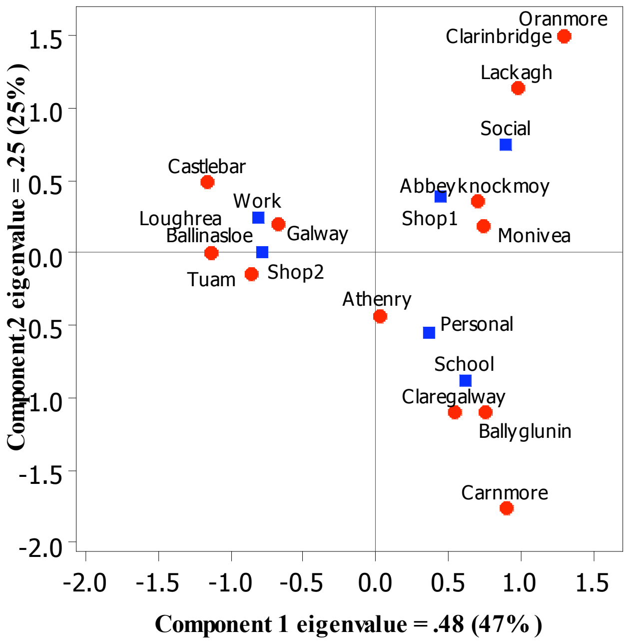

Figure 9

The formal basis for the schematic interpretations of relationships and roles described in Figure 10 is discussed fully in Appendix 2. The purpose of Figure 10 is to try to summarise what the correspondence analysis suggests about how the set of rural settlements function in the different rural-urban settings. These summaries consist of a first dimension that distinguishes between higher order and lower order settlements and this dimension is pretty robust across all three sites. The second dimension classifies local settlements, for Sites B and C, according to specific lower-order roles. The settlements that are located close to the extremes of this dimension are strongly associated with one particular function in the household surveys. Obviously, a survey of households at other sites in this general area may position these particular settlements differently on this local dimension. A fuller insight into how these places function would necessitate more extensive survey work. In terms of the network of settlements involved, however, this more complete survey work is likely to only move the position of particular places up or down this local dimension.

For Site A the second dimension is different. It distinguishes Work from all the other activities. The positions along this dimension suggests that some of the local settlements that serve the households at A play more complete roles in the local economy compared to similar settlements serving B and C. The framework presented in Figure 10 gives some insights into the way in which rural settlements are functionally ordered in different settings. In the more rural setting (Site A) settlements appear to be functionally ordered according to the familiar principles of centrality and hierarchy whereas for the other two settings the influence of organisational principles stemming from rapid growth, mobility (linked to workplaces) and proximity to large urban centres is evident. These principles appear to be breaking down the functional arrangements found within the traditional central place model.

These differences in how places function has much to do with locational context. For example, the relationship between activity spaces and the degree of local/non-local working figures prominently in the debate over settlement relations and viability. Local working refers to the situation where household members work near where they live. Immergluck (1998) provides a number of arguments for how local working can have positive effects on place and community. Extending from Immergluck's arguments, one can hypothesise, prompted somewhat by Tiebout's (1962) discussion on the factors that influence the propensity of consumers to spend locally, that local working supports more local shopping and the demand for personal and social services, whereas non-local working is conducive to also shopping and availing of services away and thus jeopardises the local viability of services. Powe and Shaw (2004) recently cite the findings from a number of studies which lend support for this possibility. These finding suggest, for example, that where people does work does affect the extent to which they outshop, i.e. where households bypass local small villages and shop in larger urban areas. It was shown earlier that, for Sites B and C, the degree of non-local working is substantial, see Table 2. In particular, over 90% of those who commute to work from both sites travel more than 10 miles. For Site B Galway city is the dominant place of work. For Site C there are multiple, distant, workplaces. For Site A, non-local working accounts for only 51% of the workforce and there are less, distant, or dominant locations used relative to Sites B or C, see Figure 3B. These differences can help explain the contrasts in roles played by local settlements. For Sites B and C local settlements are quite differentiated and places have quite specific lower order roles. Settlements that serve Site A also provide lower order functions, but there is less segregation in what places do and places generally appear to be associated with a wider mix of activities.

5. Discussion and Conclusions

A key concern for rural policy and planning is to identify sustainable settlement strategies and development strategies. Many local planning authorities, concerned primarily by the need to distribute new development (mainly housing) amongst their rural settlements, assess features such as services, facilities, transport linkages and various development constraints to suggest those settlements best suited to further development (The Countryside Agency, 2002). For example, the County Galway Draft Development Plan (Galway County Council, 2003) describes an objective of the Plan 'to determine the potential and capacity of all areas of the County to accommodate growth' and for this purpose 'the capacity of each settlement was examined on the basis of a range of criteria'. These criteria included: size, growth trends, water supply and sewerage, service functions, accessibility, zoned land and landscape. The approach and the analysis presented here suggest that it might be helpful if we also try to think of settlements functioning as a network, with differing roles and varying degrees of connectivity.

It is not easy to find methods that will readily unravel these roles and connections and suggest an appropriate planning response. Nonetheless, the methods deployed have been useful and the results do highlight some contrasts in these relations and roles which have implications for how we might think about rural settlement planning issues. In the more traditional rural areas, represented by Site A, the network concept appears to apply well in the sense that settlements are identified as having balanced roles and there are strong local connections. Of course, these strong network attributes may exist because it is a traditional rural area. The question is whether these features will remain if the number of households decline, or if more local residents have to look longer distances in order to access a wider range of employment and earnings opportunities. A clear challenge from a rural development policy perspective must be to try and support accessible employment opportunities and maintain the balance in the way in which local services are provided across the set of settlements. For the rural areas that correspond to Sites B and C, the strategic choices are less clear-cut. Their proximity to large or medium sized employment centres (Galway, pop. 66.000, Ballinasloe, pop. 6,000) heavily influences the functions of the local settlements close to these sites. There are greater specificities in the roles that local places play. The concentration of Work and Shop 2 activities together appears to leave the other centres with more residual activities with no strong pattern or logic as to how the mix of activities is distributed between local places. Households are more specific in where they go, and for what, and it will be difficult to know how to strategically plan in such a context.

The Countryside Agency (2002) has argued for a more sophisticated approach to rural settlements which includes a need to examine far more carefully how settlements and networks of settlement actually function in different places. This paper has utilised some network methods on household survey data to explore these issues. Bennett (1998) is right in suggesting that it is not possible to generate a singe closed, one-fits-all notion that captures these differences in work, shopping and social relations and the spaces that they fill. The dynamics of contemporary rural settlements are complex and the methods used in this paper have only succeeded in capturing some limited aspects of this dynamic. The results that were shown by the network methods suggest some contrasts in the nature of the interactions between different rural and urban areas. The differences across the three sites present different challenges for policy and planning. One clear conclusion is that the pattern of relations shown for the more rural site (A) are considerably less fractured that at either of the other two sites. The activities of households exhibit a strong degree of local connectivity and there is more evidence of balance in roles and relations between places. A key question for an area like this is the extent to which these local roles and good local interrelations may begin to unravel as external forces exert greater influence from different directions and internal forces search for connections elsewhere. This dynamic appears to be well established at the two other sites with local places playing minor or very specific economic roles for local households. Local planners, and those with responsibilities for public administration, can benefit from understanding such differences and the challenges that they pose for particular places.

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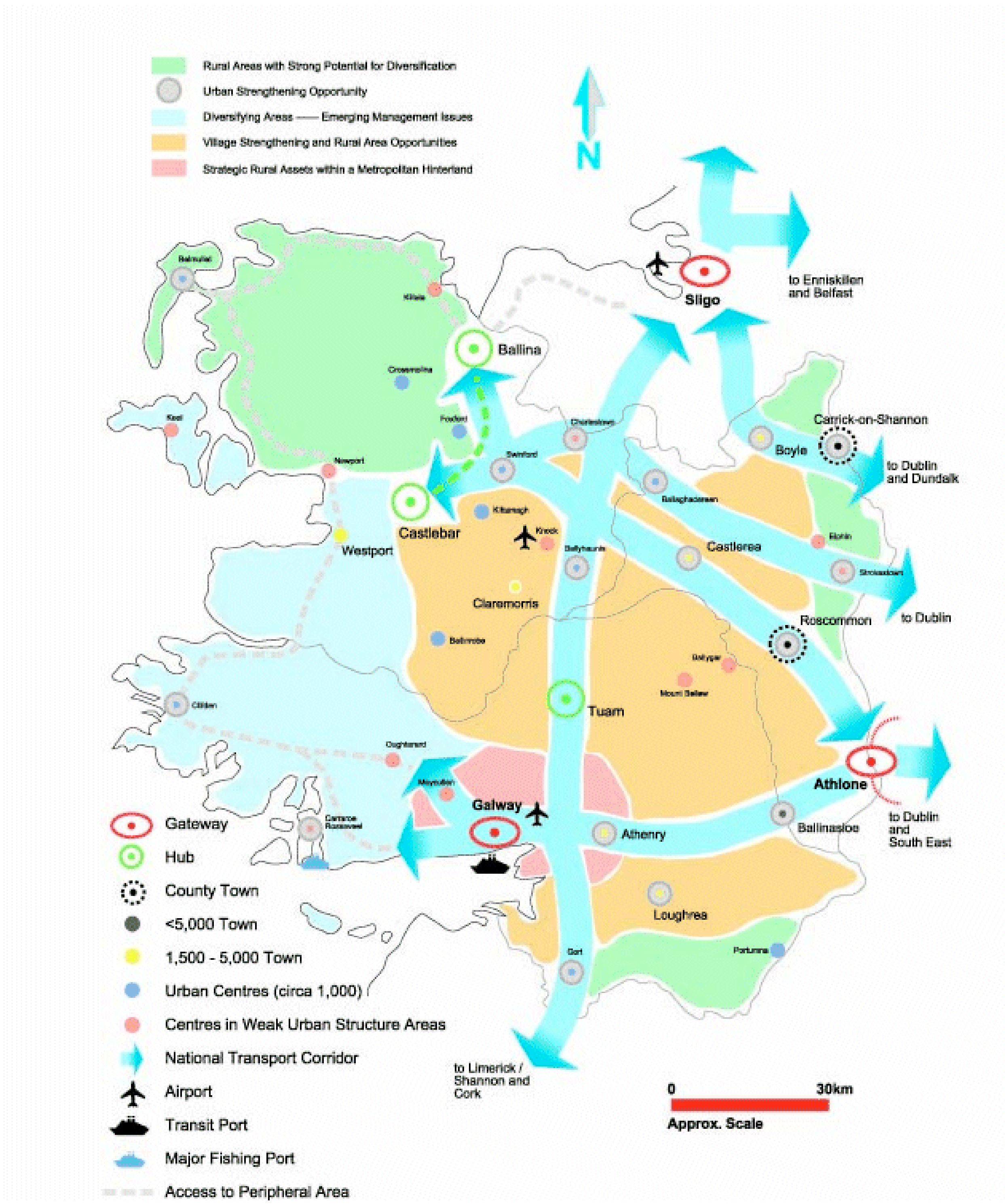
Appendix 1.

Figure 1. West Region, National Spatial Strategy



Appendix 2. Interpreting the Results of the Correspondence Analysis.

The MINITAB output for Site B is reproduced as follows:

Column Contributions

					Component 1			Component 2		
ID	Name	Qual	Mass	Inert	Coord	Corr	Contr	Coord	Corr	Contr
1	Work	0.622	0.157	0.175	-0.803	0.568	0.211	0.246	0.053	0.038
2	School	0.598	0.085	0.162	0.624	0.200	0.069	-0.879	0.398	0.263
3	Shop1	0.415	0.111	0.094	0.454	0.240	0.048	0.389	0.176	0.067
4	Shop2	0.797	0.261	0.199	-0.786	0.797	0.337	0.004	0.000	0.000
5	Personal	0.723	0.229	0.139	0.378	0.232	0.068	-0.550	0.491	0.277
6	Social	0.925	0.157	0.230	0.902	0.546	0.266	0.752	0.379	0.355

Because we are interested in depicting activity spaces the discussion will focus on the column contributions output only. The *Qual* column contains information concerning the quality of representation of the respective column points in the co-ordinate system defined by the two dimensions. The two dimensions explain most of the variability in Social and Shop2, with quality = .925 and .797 respectively, while the variability in Shop1, with a quality value of .415, is explained least.

The column labeled *Coord* gives the principal coordinates of the columns. The column labeled *Corr* represents the contribution of the dimension to the inertia of the column. Thus, dimension 1 accounts for most of the inertia of Shop2 and, to a lesser extent, Work and Social (*Corr* = .797 .568 and .546, respectively), but explains little of the inertia of School (*Coord* = .200). *Contr*, the contribution of each column to the axis inertia, shows that Shop2, Social and Work contribute the most to dimension 1. Social, Personal and School contribute the most to dimension 2. The Column Plot, shown below, displays the principal coordinates.

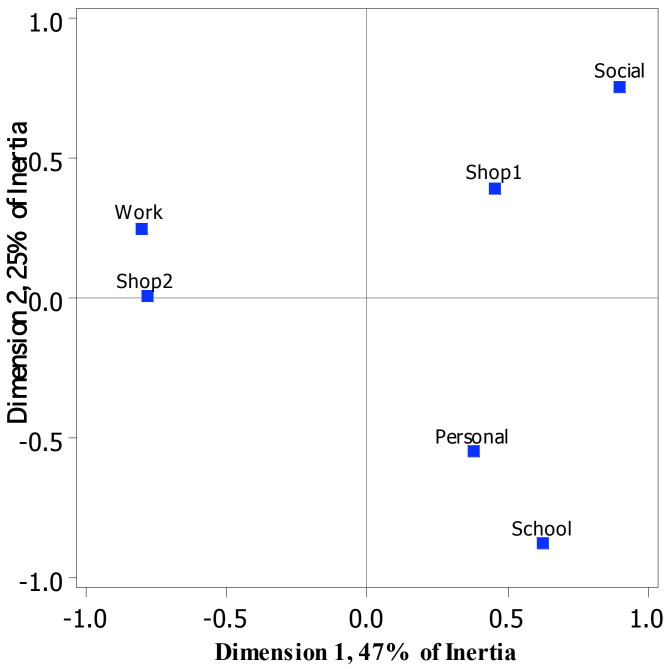


Figure 1A. Column Plot, Site B

Work and Shop2 and Social contribute most to the definition of dimension 1 while Social Personal and School contribute most to dimension 2. The 2-d space shows Work and Shop 2 clustering together and being well separated from Social and the other activities. Dimension 1 can be thought of as distinguishing between higher order 'vs' lower order functions. Dimension 2 contrasts the activities of Social and Shop1 with the activities of Personal and School. The latter imply specific or specialized service(s) like the availability of a primary/secondary school, a range of post office services or a bank which may only be accessed at specific locations. The locations are introduced into Figure 1A, see Figure 2A, to give a picture of the kinds of roles that different centres play. The positioning of the locations lend support to labeling the second dimension local informal/formal

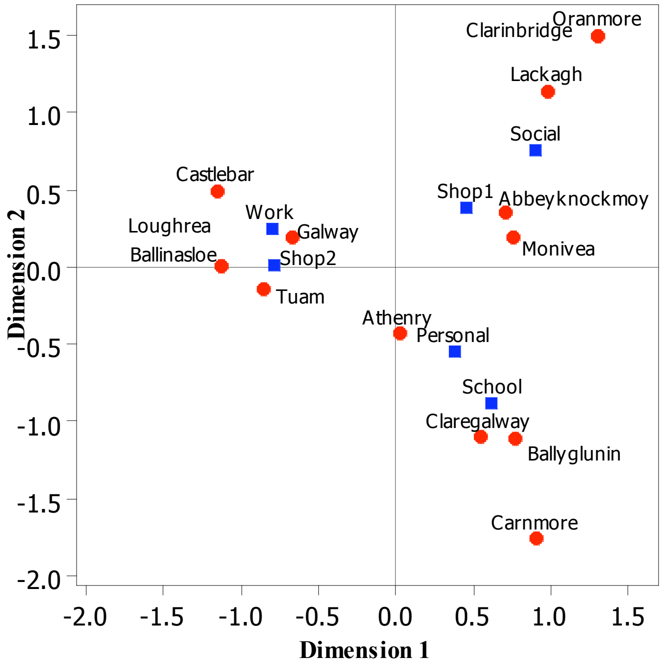


Figure 2A.

MINITAB Output for Correspondence Analysis, Site C

Column Contributions

					Component 1			Component 2		
ID	Name	Qual	Mass	Inert	Coord	Corr	Contr	Coord	Corr	Contr
1	Work	0.608	0.147	0.183	-0.784	0.607	0.200	0.039	0.001	0.001
2	School	0.463	0.051	0.075	0.485	0.198	0.027	0.561	0.265	0.10
3	Shop1	0.525	0.147	0.166	0.679	0.502	0.150	-0.143	0.022	0.020
4	Shop2	0.855	0.250	0.259	-0.846	0.849	0.397	-0.066	0.005	0.007
5	Personal	0.938	0.257	0.136	0.463	0.501	0.123	0.433	0.437	0.325
6	Social	0.856	0.147	0.181	0.562	0.315	0.103	-0.737	0.541	0.537

The Column Plot for Site C is shown in Figure 1B. The description for

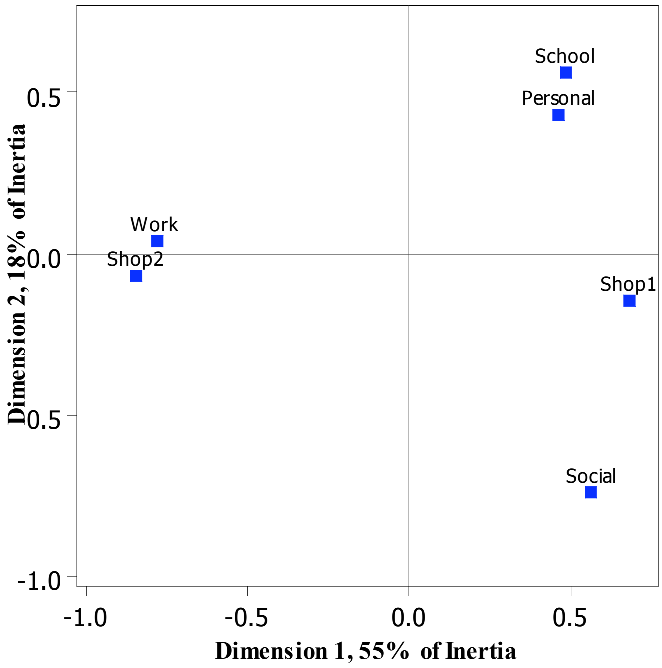


Figure 1B. Column Plot, Site C

Site C is quite similar to that of Site B. Figure 2B introduces the locations which again give an insight into different central place roles. The dimensions suggested are the same as those that were identified for Site B.

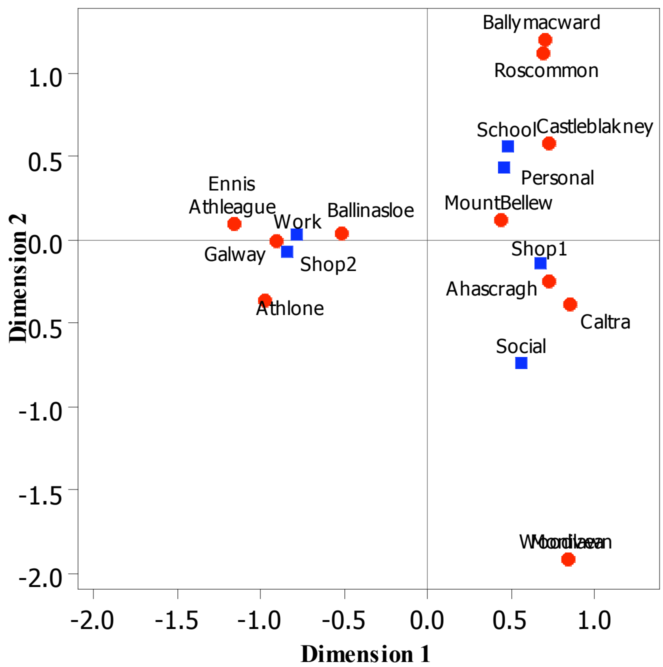


Figure 2B

Minitab Output for Correspondence Analysis, Site A

Column Contributions

					Component 1			Component		
ID	Name	Qual	Mass	Inert	Coord	Corr	Contr	Coord	Corr	Contr
1	Work	0.967	0.127	0.198	0.506	0.288	0.092	0.777	0.680	0.622
2	School	0.368	0.082	0.116	-0.526	0.344	0.064	-0.138	0.024	0.01
3	Shop1	0.797	0.142	0.140	-0.669	0.792	0.180	0.051	0.005	0.003
4	Shop2	0.991	0.269	0.352	0.815	0.889	0.506	-0.277	0.102	0.167
5	Personal	0.767	0.209	0.076	-0.362	0.629	0.078	0.170	0.138	0.049
6	Social	0.687	0.172	0.118	-0.405	0.419	0.080	-0.324	0.268	0.146

The column plot output is shown in Figure 1C. Site A is quite different from

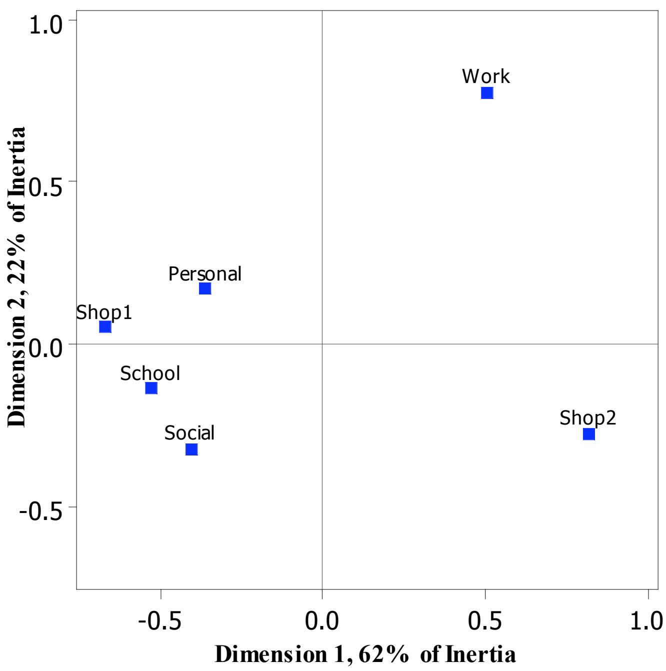


Figure 1C. Column Plot, Site A.

B and C, particularly in the second dimension. The locations are included in Figure 2C and they help to identify Dimension 1 as a higher/lower order dimension similar to what was found for Sites B and C. Work and Shop2 contribute to the second dimension but with opposite sign. This dimension is best thought of as contrasting Work with Work all the all other activities.

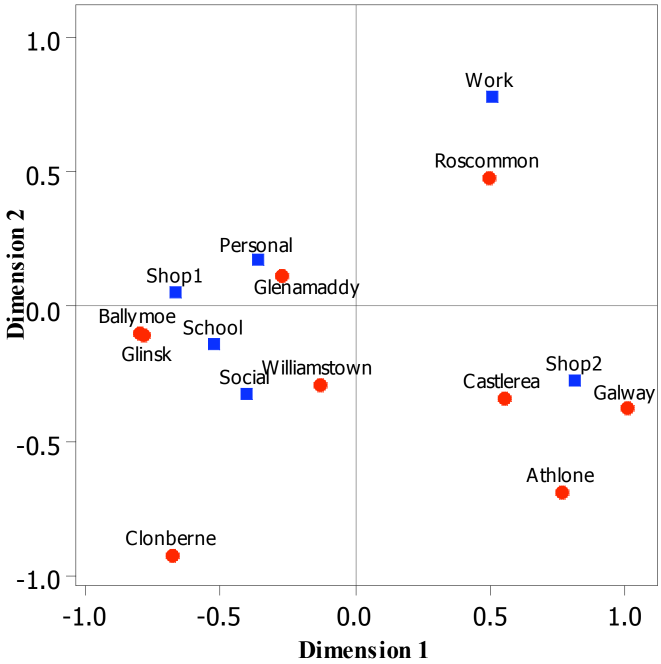


Figure 2C.

There is a close association between a range of activities and local centres for Site A which is in marked contrast to what was shown for Sites B and C. For B and C there was a considerable amount of segregation in activities and in roles played by different local places. Based on the amount of the inertia explained by this second dimension this segregation is strongest for Site C. A second significant difference is that the Work is much less linked to other activities, much less location specific for Site A than for Site B (see also Table 2. There is, for example, no close spatial match between Work and Shop2 activities.

Figure 6. X^N Matrix for the Three Sites

SITE A

3	2	2	3	3	3
2	3	2	2	3	3
2	2	5	3	5	5
3	2	3	6	5	6
3	3	5	5	7	7
3	3	5	6	7	9

SITE B

3	1	2	2	2	2
1	5	4	5	5	5
2	4	6	5	5	6
2	5	5	8	6	6
2	5	5	6	7	6
2	5	6	6	6	10

5	3
3	5
4	3
4	2
3	5
4	4

Figure 10. Spaces and Roles for Rural Settlements