THE STREETS OF INNOVATION:
an exploratory analysis of knowledge transfer in the public realm

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Abstract

This paper investigates the possible mechanisms by which spatial structure can affect patterns of networking and knowledge transfer in the public realm. Drawing on the work of 'The space of innovation' (Penn, Desyllas, Vaughan 1999) into the distribution of interaction inside individual office buildings, the research translates a selection of their methodologies to the public realm of central Birmingham and the City of London. Gate counts and extended observations are undertaken to identify the spatial distribution of gross pedestrian flow, interaction whilst walking and encounter. These results are then related to various spatial measures for analysis.

The research reveals that the level of gross pedestrian flow or static activity in space is not always an indicator of the vibrancy of interaction in the public realm. Analysis reveals that interaction while moving appears to relate strongly with spatial measures even when gross pedestrian flow does not and that levels of encounter in space increase as a proportion of pedestrian flow as spatial accessibility increases. As a result, small stretches of pavement aside busy road environments are often shown to be the most conducive to networking activities and that high levels of activity in less accessible public spaces are not accompanied by an increased level of encounter.

The paper concludes that the level and consistency of interface between different scales of movement affects the efficiency of networking and knowledge transfer both externally and internally to organisations. The concept of radial constancy is used as a means of describing the equality and consistency of access to space for different journey distances and consequently, a spaces ability to create opportunities for encounter and interface between scales of movement.

Considerable further research is required to validate research findings in alternate locations and to directly test radial constancy values against the spatial distribution of recorded observations.

Introduction

This research paper translates the methodological techniques described in Penn et all (1999) to the wider context of the public realm. It seeks to clarify the mechanisms by which spatial configuration can affect opportunities for knowledge transfer and networking within and between wider scales of community. Knowledge of these mechanisms is of increasing value due to the rapid increase in horizontal organisation and cooperation between specialised business communities and the ever increasing need for spatial contiguity as a means of supporting this behaviour.

The transfer of tacit knowledge requires face to face communication and as such is highly sensitive to geographic location (Maskell and Malmberg 1999). The creation of knowledge in emerging productive milieus is heavily dependent on the exchange of this tacit knowledge. The creation of innovative milieu is therefore usually an unostentatious incremental process that gradually changes internal structures and external relations. Over time, reconfiguration of
019-02 economic practice endows an innovative milieu with embedded social characteristics such as interpersonal contacts that enable it to compete effectively on a world stage. Milieus that develop this store of experience based knowledge are often in a better position to make further breakthroughs which add to their existing stock of knowledge (Lundvall and Johnson 1994). It appears therefore that despite being a seemingly inconsequential aspect of all communication between innovative enterprises, an incremental growth in tacit exchange is of fundamental and ever increasing importance for a wide range of organisations and therefore knowledge of the spatial mechanisms that support such growth is also of increasing value.

Cities as Interfaces between Scales of Movement

Society, it is said, begins with interaction, not with mere co-presence and awareness (Hillier and Hanson 1984) and it is this fundamental tenet of the social logic of space that has driven a research methodology for revealing the spatial distribution of interaction and encounter through a direct study of interaction. The spatial distribution of interactive behaviour has been studied at great length in relation to space syntax analysis elsewhere (Penn, Desyllas, Vaughan, 1999). By quantifying the level of interaction found in all spaces in an internal office configuration and relating this to movement traces, Penn et all (1999) was able to categorise space according to its interactive potential and to relate both the level of interaction and spatial accessibility to the perceived usefulness of individuals within the internal spaces. Their study suggested that access to the interface between scales of movement is the key to supporting high levels of interaction and that this is related to the level of integration of space. When deconstructed, this conclusion means that a direct relationship must exist between the gross accessibility/integration of space and accessibility between local and global forms of movement for higher levels of interaction in space.

Given that the key to supporting interaction in this context appears to be the mixing of scales of movement, it is logical to surmise that similar distributions of interaction might be found where different scales of movement interact in the public realm. However, in order to measure these behaviours on a more expansive geographic scale, there are certain methodological constraints that must be overcome.

The practicalities of translating similar research to a much wider geographic scale prohibit the possibility of undertaking the exact same set of methodologies. The resource requirements needed to produce a questionnaire of perceived usefulness at a larger scale are prohibitive but it would also not be possible to undertake snapshot observations of all spaces in the public realm to reveal static social behaviours, certainly not in a controlled manner. Studies of interaction therefore tend to be physically constrained by the resources needed to map a complete image of static behaviour in space; static activity cannot pass observation gates so it is the observer that has to move drastically decreasing the efficiency of observation. One consequence of this is a tendency towards studies of public spaces and internal office environments as there appears to be less observable social behaviour in spaces dominated by movement rather than static activity.

To give an account of the spatial distribution of interaction over a larger scale therefore requires a methodology that records interaction inherent to movement itself. By observing the level of interaction while moving (simultaneous walking and talking), this paper aims to compare a wide variety of urban environments including public squares, minor and major streets. If there are any patterns to the spatial distribution of interaction while moving then such phenomena will give a wider projection of spatial behaviour than its static counterpart.

Another major methodological dificulty is to observe the level of encounter between individuals in space at the location of every gate count. As has already been stated, encounter, as a static behaviour, is unable to move past the observer to be counted so this observation could not be undertaken at the same time as flow and interaction counts. Instead, each gate location must be observed separately as a small scale public space and extended observations recorded for each location to observe the numbers of individuals seen stopping to talk to each other. There is a danger that this methodology may bias quieter spaces where all interaction can be observed, unhindered by intervening crowds, but this is the same hazard that is often experienced when undertaking flow counts on busy streets. The benefit of this observation is that because chance encounter and interaction has been shown to be a short exercise, it does not require locations with extensive street furniture. It therefore allows for direct comparisons between locations that do or do not provide opportunities for static behaviour such as sitting and standing in groups. In a practical sense, it is another social behaviour that can translate to the whole of the public realm rather than in individual convex spaces.

Methodology

To test the combined set of methodologies that are derived from the space of innovation and new methodologies designed to translate the aims of the original paper to a public realm context, two case study locations, with a range of spatial environments, were chosen as appropriate context for analysis. The two locations are the City of London and Central Birmingham. Within these areas, two sections of the city, Cheapside and Bishopsgate and two sections of Birmingham, Brindley Place and Broad Street were evaluated. (See figures 1 and 2 for an O.S map of the case study locations)

Within the City, two locations stand out as providing suitable conditions for useful observation. The first is an area that includes a section of Bishopsgate Street, Liverpool Street Station and a commercial development of grade A office accommodation focused on two public squares, a retail centre and an events platform. This range of pedestrian environments is likely to provide the variety required for comparative research and the identification of behavioural phenomena.

The second study area in the City focuses on what was historically the market street of medieval London, Cheapside. Now just one of six important arterial routes that lead to the central junction of the City, Cheapside is a highly strategic local and city-wide route. The street runs through the heart of the City to Tottenham Court Road and on to Oxford Street and so plays an important role in connecting the City to its wider London context. The area of observation includes the part of Cheapside that runs between Bank Interchange and St Paul’s and its surrounding routes. This study area provides an equally important range of pedestrian environments with which to relate syntactic measures to observed behaviour.

Within Birmingham, two adjacent locations were chosen to represent a comparison of differing urban environments. Brindley Place is a significant office development at the end of a route that links directly to the City Centre through the city's International Convention Centre. The space contains a range of attractors such as a symphony hall, exhibition halls, canal-side leisure activities and the national Sea Life Centre. Adjacent to this area is the other case study location. Broad Street is a local thoroughfare fronted by the edge of the Brindley Place development, offices, bars, retail facilities and a language college. The route traditionally connected the city centre to outlying residential areas but has since been partly severed by the cities middle ring road.

As has already been mentioned there are a number of new methodological techniques associated with this research; these are the counting of interaction while moving (observed by those walking and talking simultaneously) and encounter which was observed at gate locations in the City of London by undertaking ten minute extended observations at each gate location.

Observation gates were disseminated within the case study regions to ensure that all possible directions of movement could be accounted for. This meant that a gate would be placed at every position where a decision could be made to change direction (often a street corner). Although resource constraints led to a relatively restricted area of observation, the chosen gates were designed to maintain coherence and ensure that a wide range of pedestrian environments were included in the study. For example, in the case study site surrounding Cheapside in the City of London, observations were undertaken on all scales of the street network to ensure that observation data would be able to compare variation in behaviour in relation to the integration value of the street.

Individual counts were timed at five and ten minutes. Both sets covered the entirety of the case study site to produce an overall picture of pedestrian behaviour. After all the appropriate gates had been covered, the process was repeated over a two hour and fifteen minute cycle in both Birmingham and the City of London. In this way, data would reveal variations in behaviour throughout the day and enable an aggregate count that encompassed these variations. Finally, extended observations of two spaces within Birmingham were undertaken over thirty minute periods as only a time period of this duration was significant enough to observe encounter. These observations were then overlaid onto snapshot images of other social behaviours in the same two spaces.

Analysis

Where this work differs from previous research is in studying interaction, not as a static activity but a constituent of pedestrian movement. By noting the number of people walking past gate counts and also the number of people walking and talking to someone else, analysis could reveal the level of movement that contained social interaction. The analysis of counts revealed the importance of this observation technique in that the majority of interaction in the public realm appeared to be done while moving and at many of the gates the majority of movement contained interaction.

It is important to mention at this stage various qualifications of observing gross interaction. The level of people walking while talking is not necessarily a factor of the ability of a space to support such behaviour. Again, here it is important to make the distinction between programmed and un-programmed/ 'by chance' interaction as interaction in the public realm could have been generated by either chance encounter or a predetermined event. For example, a school trip generates large groups of pedestrian movement where often all of the group are interacting leading to both a large flow and an extremely high percentage of interaction within the flow. The character of this interaction is often the result of an attractor rather than the ability of space to support co-presence and chance encounter. This means that high levels of interaction in space could be representative of an interactive location or the location of an attractor.

To help distinguish between these affects on interaction, encounter was observed and related to both flow and interaction. The spatial distribution of encounter could then identify locations with a high level of interaction, and little encounter which are likely to be based on programmed interaction and spaces that have a high level of encounter for the level of interaction.

Case Study One, Birmingham City Centre

In the Birmingham case study, the level of interaction was found to have a strong linear correlation with pedestrian flow when observing the aggregate percentages throughout the day. When individual times were considered the morning and afternoon rush hour observations showed a marked decrease in interaction in relation to pedestrian flow. At certain gate locations flow and interaction patterns varied drastically throughout the day with very low levels of interaction at the beginning and end of the day, but only at particular gates. Further to this, in these spaces, an increase in flow was not necessarily followed by an increase in interaction but often signifies a fall in interaction.

Figure 1:

Susceptibility to changes in interaction levels over time: White spaces show Broad Street segments and black spaces show Brindley Place segments

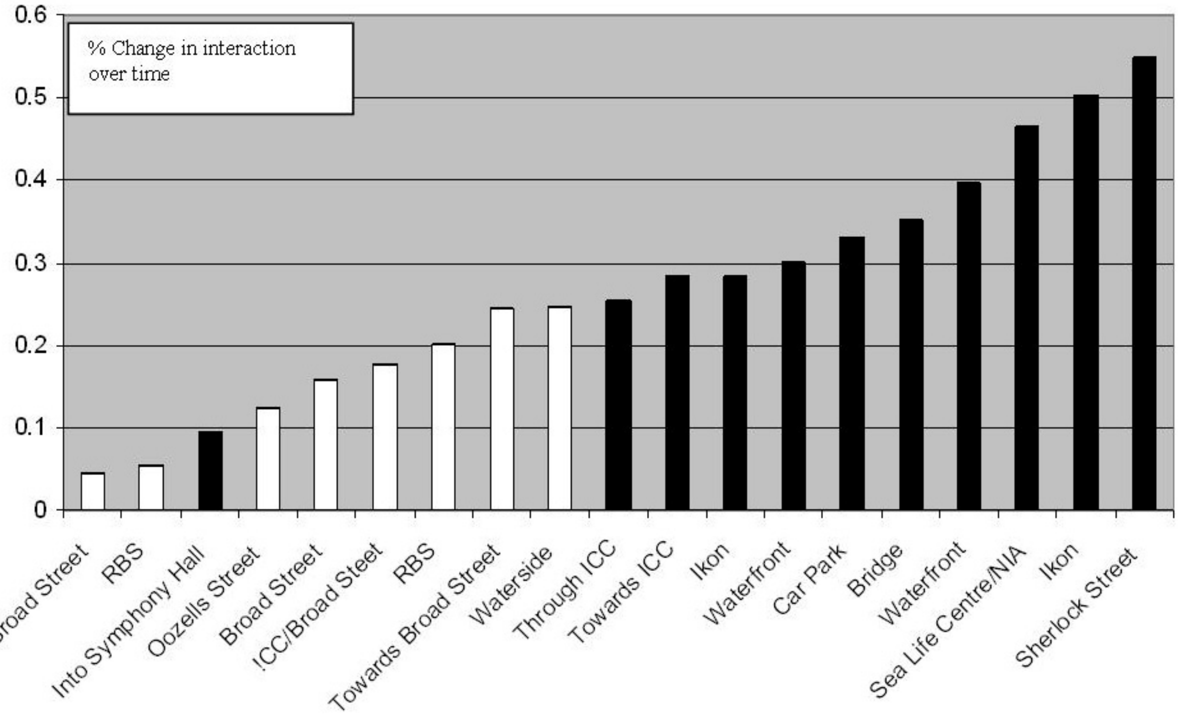
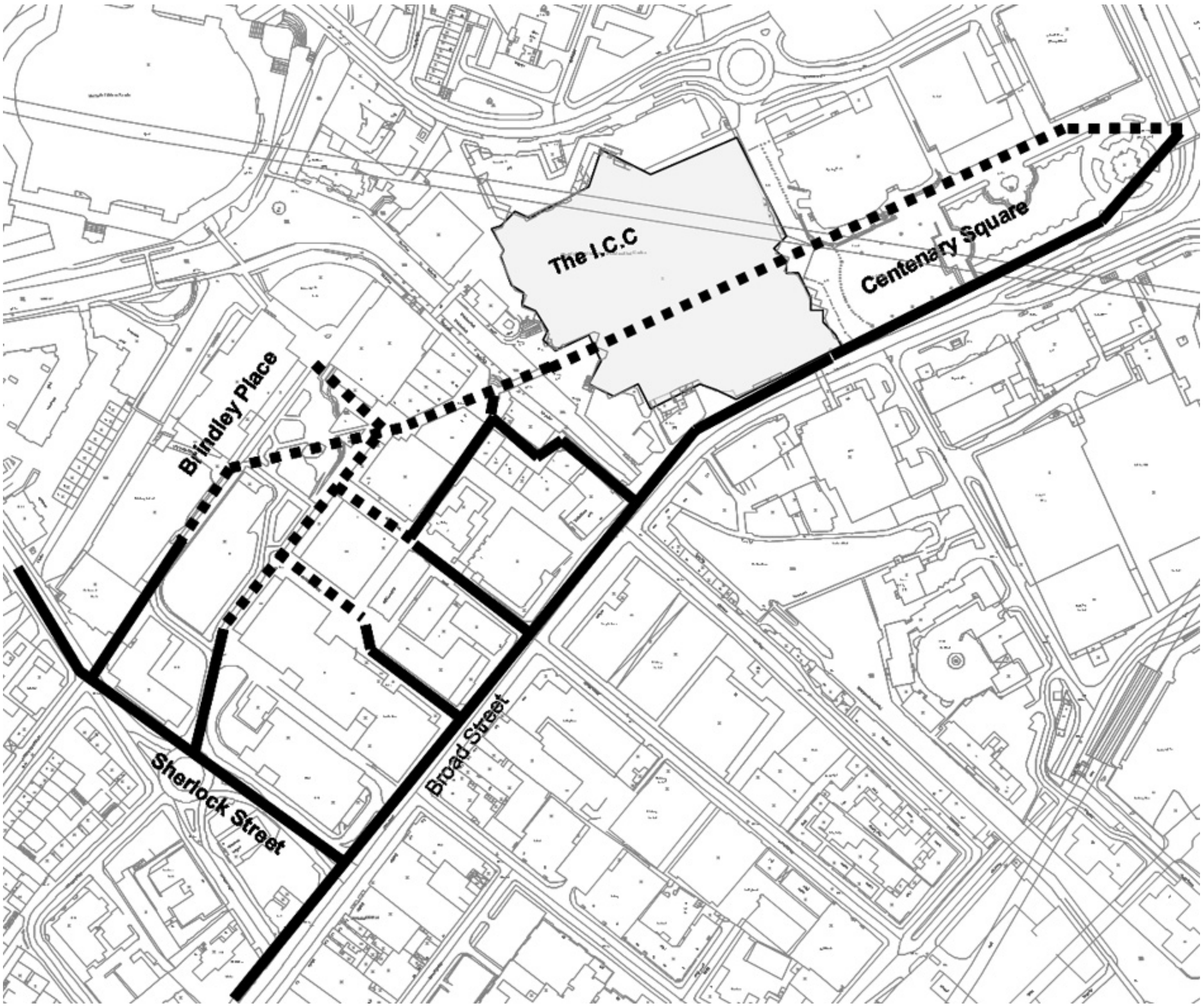


Figure 1 is a bar graph representing the percentage of flow constituted by interaction across the day's four observation periods. The black bars correspond to routes towards Brindley Square and routes that lead from the square whereas the white bars correspond to routes through Broad Street adjacent to the development. The image shows how routes towards and into Brindley Place a far more erratic than those along Broad Street with an unstable level of interaction during the day that records by far the highest and lowest incidences of interaction. The Broad Street route by comparison demonstrates a remarkably stable level of both flow and interaction during the day leading to an equally stable interaction percentage. Figure 2 shows the distinction between Broad Street routes in grey and Brindley Place routes in black.

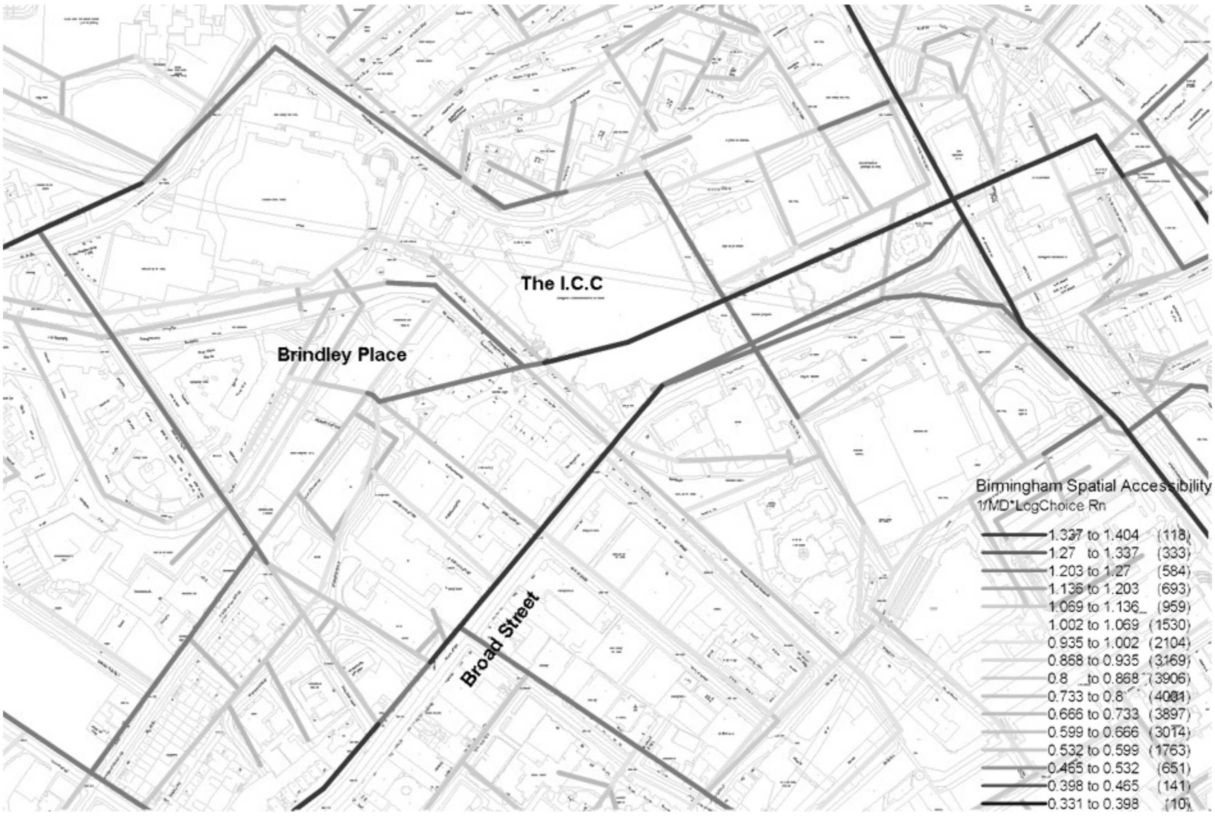
Figure 2:

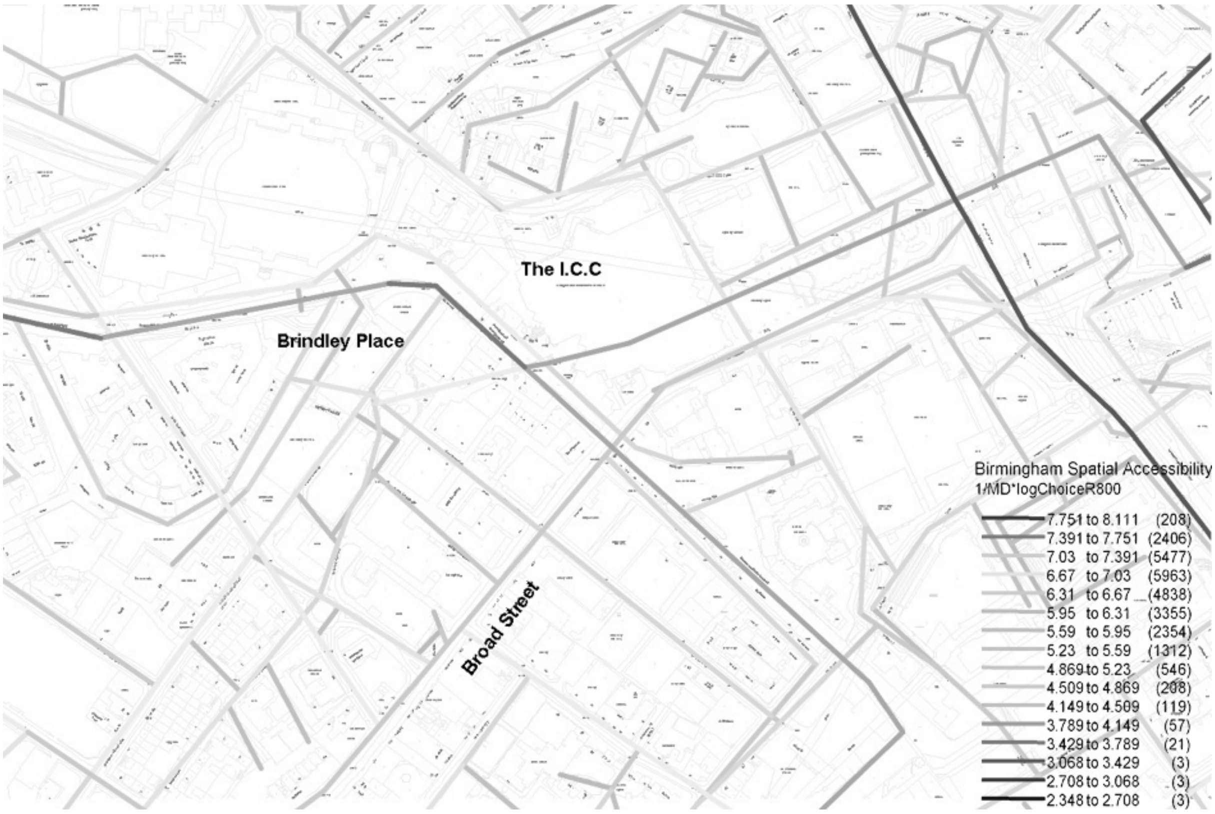
Distinction between Broad Street and Brindley Place



The bar graph in figure 1 shows a strong indication that sensitivity to time change is associated with routes towards Brindley Place and a comparatively stable distribution of interaction along Broad Street. The only exception to the split between the two routes is the entrance into symphony hall that recorded low levels of flow throughout the day but constituted almost entirely by groups entering or leaving the hall to look at the auditorium or attend a midday concert. This stark contrast between the two routes is not picked up by a simple correlation of aggregate interaction against flow but might be picked out by relating either set of observations to spatial measures.

For the purposes of this research, the spatial measure to be used is 1/MD * Log Choice+2. Both closeness and betweenness attributes are considered in this analysis in order to distinguish between high choice spaces that result from segregation of space and high choice values that result from the integration of space. A global radius of this measure was found to correlate most affectively with observed findings in both the City of London and central Birmingham. (See Table 1 for radius correlations and Figure 3 (Rn) and 4 (R800m) for a visual representation of accessibility for Rn and R800m for the Birmingham Case Study Location).





Relating the level of pedestrian flow to 1/MD*LogChoice Rn reveals a bifurcated correlation with four of the Brindley Place routes in particular singled out as having both low levels of flow and interaction in relation to the spatial accessibility. These gates were those that lined the route into the central square of Brindley place through the I.C.C. With the exclusion of these routes a very strong linear correlation was found for both flow and interaction. (See Table 2 of Bivariate Correlations for the Birmingham Case Study area)

Figure 3:

Birmingham Spatial Accessiblity Rn (top)

Figure 4:

Birmingham Spatial Accessiblity R800 (bottom)

It is clear, therefore that there is a definite distinction to be made between the character of interaction towards Brindley Place and that through Broad Street and that this difference is reflected in the disparity between flow and interaction levels when compared to spatial accessibility. To clarify what was happening in the space, extended observations were undertaken to identify 'hotspots' of encounter within the area and undertake extended observations within the central space of Brindley Place and along Broad Street. In this way a more detailed impression of spatial character could be compiled.

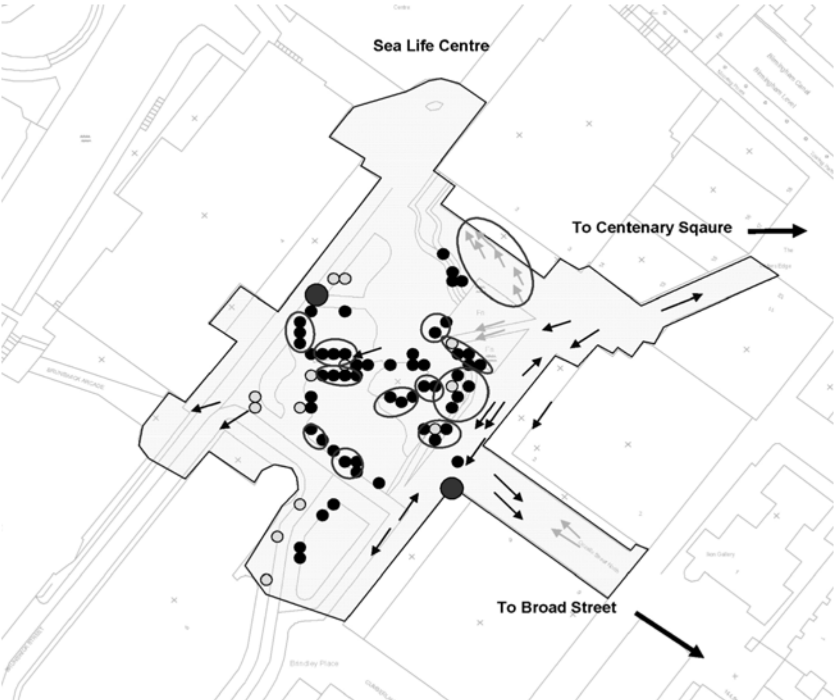


Figure 5:

Extended observations of Brindley Place

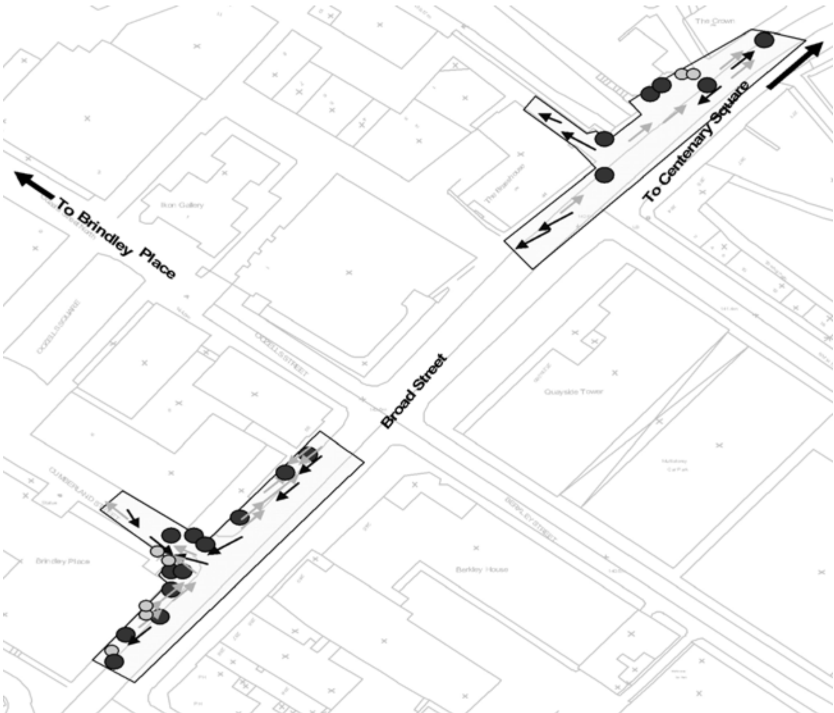


Figure 6:

Extended observations of Broad Street

Figures 5 (Brindley Place) and 6 (Broad Street) display snapshot images of both Brindley Place and a section of Broad Street with extended observations of encounter overlaid on top. They reveal two extremely different characters of space with one space dominated by interaction yet almost devoid of encounter and another with considerably less static interaction but significantly more encounter. On first glance the snapshot of Brindley Place appears to be a highly interactive location with a large number of static individuals within the space and almost all of them interacting. The level of interaction within those moving is however slightly lower and within the half hour extended observation only two individuals were seen to encounter (bump into) each other within the square.

In stark contrast, a section of Broad street showed only a few individuals standing, no-one sitting and as a result very little static interaction. It does however show a large level of interaction while moving and over the extended observation showed seventeen separate counts of encounter with certain locations standing out as centres of this form of social behaviour.

Although no gate counts were undertaken of encounter, these two extended observations suggest that Broad Street is far more effective at supporting un-programmed encounter between individuals than Brindley Place. It appears, therefore, that there is a potential link between the consistency of interaction and the propensity for encounter and between these two social behaviours and spatial accessibility. Despite the surface appearance of Brindley Place as a highly interactive location, on closer inspection the interaction appeared to be almost entirely pre-determined rather than a consequence of the ability of the space to support chance encounter. A quick survey of those inside the square at the time of the snap shot revealed that all of the static individuals in groups had either come down into the square together with the colleagues from their department or were families or school children waiting to visit the Sea Life Centre. The interaction between office workers was of a very different character to that of interaction found elsewhere in Birmingham. This was pre-determined interaction rather than chance encounter which explains the high level of interaction in relation to the level of encounter in the square.

The reason for this lack of chance encounter appears to be the same reason that interaction varies so extensively during the day within and on routes to the development. The fact is that although Brindley Place is well integrated into its surrounding context, it constitutes the end of an accessible route from the town centre rather than a section along a route between the town centre and outlying areas of central Birmingham. The representations of 1/MD*Logchoice+2 Rn and R800m (Figures 4 and 5) shows how Broad the route through the ICC to Brindley Place gradually decreases in accessibility towards the development so that by the time individuals reach the square you are at the end of a route rather than a focus. This means that the routes that adjoin the main square join together at the edge of the square and only increase in terms of accessibility when leaving the development. This has the affect of turning Brindley Place into a ‘To movement’ destination rather than a space that capitalises on through movement.

Broad Street by comparison maintains a strong level of accessibility between the town centre and the edge of central Birmingham, so that the route and routes adjoining Broad street enable a strong interface between those moving locally within Brindley Place, those moving just outside the development within neighbouring developments and those moving back and forth between the town centre and the outlying office developments. The affect this has is that there are reasons for people to move in a variety of directions along Broad Street and use the same spaces as those within and just outside their immediate community. The route towards Birmingham City Centre from Brindley Place is a highly accessible route for those wishing to enter Brindley

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Place but is less advantageous than Broad Street for those wishing to continue to other destinations beyond the development. Clearly, Bindley Place is an example where the interface between scales of movement is weakened and as a result so is its ability to support chance encounter and un-programmed interaction.

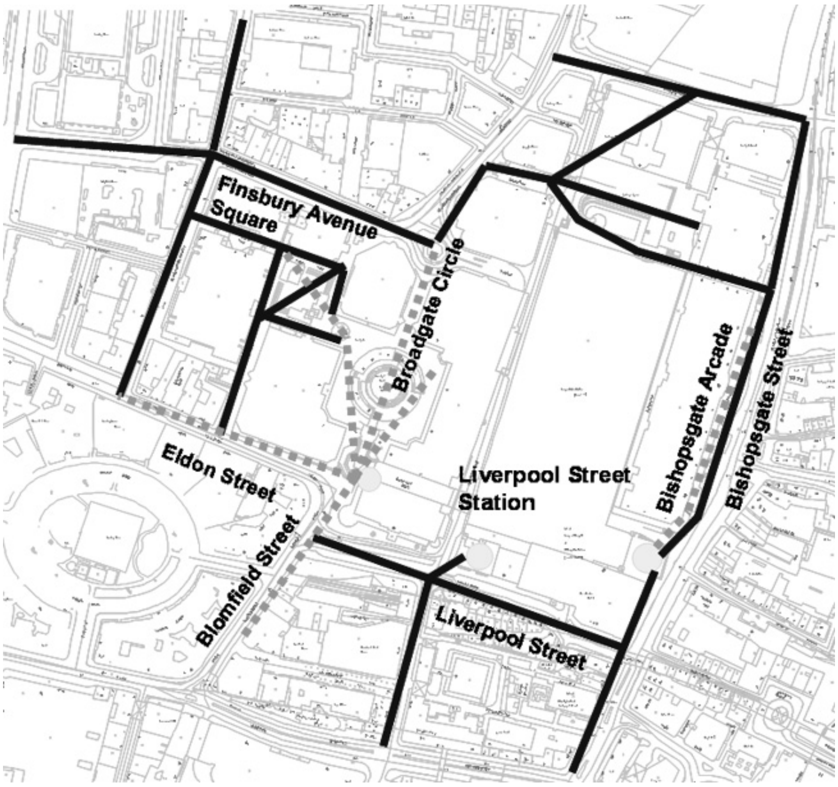
Case Study Two: The City of London

Following the analysis of the Birmingham case study, similar methodologies were undertaken within the City of London. Both pedestrian flow and interaction were again noted but within this case study the encounter was also noted over ten minute periods at each gate. Due to a lack of resources, it was not possible to run longer observations at each gate and unfortunately the rarity of encounter meant that a number of gates revealed no incidences of encounter within the observation time. The results that did register encounter do, however, reveal a distinct spatial distribution of encounter in the City of London Case study areas (Figure 7).

Table 3 shows the bivariate and multivariate correlations for the London Case Study areas. The correlation between flow and 1/MD*LogChoice over the two study areas is shown to be relatively weak (Rsquare 0.503), however when the same measure is correlated with interaction a much stronger result is produced (R square 0 .752) and as such suggests a disparity between flow and interaction in at least some locations. When the correlation between interaction and pedestrian flow is undertaken, a strong correlation is revealed but with a distinct bifurcation of results. When the two sets of spaces are correlated separately the level of correlation for both sets is extremely high (R square 0.87 and R square 0.94). If the same spaces are then selected for the flow model and again the two sets of figures are correlated against 1/md*LogChoice the correlations improve significantly from the original (R square 0.50 to Rsquare 0.84 and Rsquare 0.60).

Figure 7:

Study area in the City of London



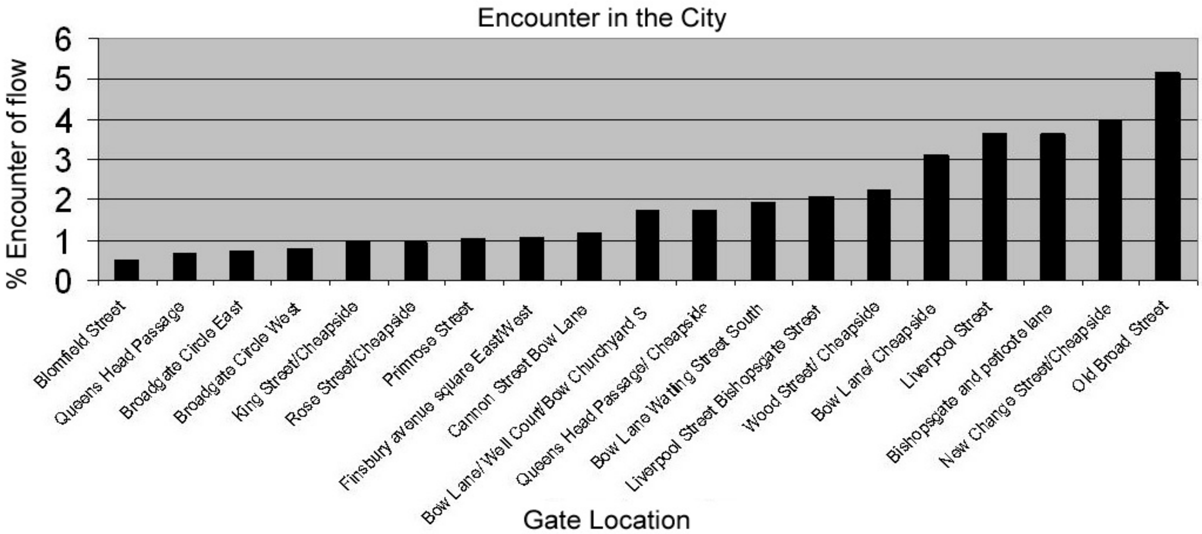
Clearly, therefore, one set of figures is displaying a markedly lower level of interaction within pedestrian flow than the other set and this is simultaneously reflected in the relationship of flow to spatial accessibility. When the location of the poorer performing spaces was investigated it was found that all of the spaces were in close proximity and that they all connected directly to a particular entrance of Liverpool Street station. This entrance gave access to and from the station along quieter streets than the other exits on Liverpool Street and Bishopsgate Street. One route from the Bishopsgate Street exit also exhibited the same tendency for lower levels of interaction but this route was a separated walkway from the street into the Bishopsgate office development and so also represented less accessible space.

It appears, therefore, that where large numbers of individuals are moving in less integrated spaces, the level of interaction falls off. To confirm this, a dummy variable of distance from the train station was used in conjunction with spatial accessibility to create a multivariate fit with both pedestrian flow and interaction. The results show a significant improvement for both flow (.50 to .80) and interaction (.75 to .86) in relation to 1/MD*logChoice+2.

There are two potential causes of this affect. Firstly, at rush hour periods people entering into the public realm from the station or exiting at the end of the day all tend to be moving from the same origin or to the same destination. This has the affect of creating a dominance of one direction of movement in space and if individuals are moving in the same direction, they are not able to move past each other in order to bump into colleagues or friends. Although general levels of interaction are highest at lunch and slightly lower at rush hour periods in all spaces within the City, the affect of the rush hour period was felt far more significantly near this entrance to the station than anywhere else. The same volume of individuals arrive and leave at the other exists but because they mix with an equally large number travelling through the space on a wide variety of journey types and distances, the movement to and from the station in these spaces become just one journey type amongst a wide variety rather than dominating pedestrian flow.

Figure 8:

Encounter levels in the City: Shows an increase in the level of encounter as a percentage of flow in more accessible locations



The other reason behind this pattern could again potentially be the relationship between scales of movement. People entering the public realm from Liverpool Street station have arrived from locations all over London into spaces that would otherwise be dominated by local movement. There is therefore a smaller likelihood that individuals moving locally within these spaces that are known to people whose local communities are located elsewhere within the city. However, at the exits on the other sides of the station, people who have arrived from all over London move into a globally accessible route where individuals are also moving on a wide range of different journey types between local communities. In these spaces, the gross numbers of individuals in space will be constituted by an equal rise in both contacts and strangers of those entering the public realm from the station, the result being a stable level of interaction in space.

To clarify this process, encounter was also considered at the same gate locations, and although, as has already been stated, the results are far from conclusive, counts were suggestive of a spatial distribution of encounter within the City. Figure 8 displays a bar graph representing encounter as a percentage of pedestrian flow at the gate locations that recorded incidences of encounter. It shows that the less globally accessible local areas (with the important exception of Bow Lane) were found to be less effective at supporting encounter. Bow Lane was found to support a surprisingly large level of interaction for its level of pedestrian flow and level of global accessibility. However, if related to a more local radius of accessibility, the affect is explained by Bow Lane's prominence at this radius of accessibility. Encounter therefore appears to be strongest where local communities start sharing the same spaces, often along major global routes such as Cheapside and Bishopsgate that are important at almost any scale of radius within the whole of the London or on routes that are collectors of smaller radii such as Bow Lane.

This idea also translates to the Birmingham case study where encounter was prevalent along Broad Street, a route that acts in a similar way to Cheapside and Bishopsagte as a central focus for adjacent communities and highly accessible at a large range of adjacent radii.

Discussion

Despite the resource limitations of this research paper, relevant data was produced as a result of methodological techniques introduced to quantify interaction and encounter at gate locations while also allowing a wider geographical area to be analysed. Certain observations can be considered more reliable than others and to get an accurate picture of the distribution of encounter requires significantly more resource to enable more extended time periods of observation.

Many of the results do, however, reveal some interesting patterns of social behaviour and perhaps emphasise caution when considering pedestrian flow alone as an indicator of successful locations. For example, the study has shown that two spaces containing the same quantity of gross pedestrian flow may contain drastically different characters of flow, constituted by varying proportions of more advanced social behaviours. Further to this, the paper strongly suggests that spatial accessibility is a major influence on the ability of space to extract more advanced social behaviours from co-presence. It appears that spatial configuration not only affects the co-presence of individuals in space but more importantly affects the jump from co-presence and co-awareness to interaction that Hillier and Hanson (1984) claimed was the start of society.

Certain spaces in both the City of London and Birmingham were found to under-perform in terms of supporting interaction and encounter. In the case of London this was accompanied by a high level of flow in relation to spatial accessibility and in Birmingham a susceptibility to changes in interaction levels over time and a low level of encounter in relation to static interaction. These incidences show similarities to analysis of internal configurations in Penn et al (1999).

As was found in Penn et all (1999), disparities between flow, accessibility, interaction and encounter stem from the degree to which an interface exists between different scales of movement. The same cause and consequence has been found within this research but at a much larger scale. Beyond this, however, there is potentially another consideration that this research has made apparent, that of the degree to which the scales of movement that interface are adjacent and equal in their priority in space; in effect, the consistency of accessibility between different scales of movement.

When analysing the accessibility of spaces over a range of scales/radii the gross and mean accessibility of a space can be measured by simply summing the values of all radii measured and taking the mean. These measures will describe the total radial value of a space in relation to all journey types. As well as this, however, the level to which accessibility varies from one radius to the next (as a percentage change of the previous value) can also be measured. This 'radial variance' or 'constancy' is a description of the equality of access to a space over all radii. It therefore describes the probability of achieving equality of co-presence between wide varieties of journey distances and, as a result, between varied spatial communities.

In traditional urban environments, there is likely to be a positive linear correlation between total radial accessibility of spaces over multiple radii and the level of radial constancy. This is because centrality in contiguous systems produces a synchronous undulation of permeability and legibility causing a convergence of globally and locally accessible spaces in the same location. The locations of these attributes can shift over time but it is these attributes that defines centrality (Hillier, 1999). This means that the spaces with the greatest total accessibility are also those with the greatest average accessibility and least variation between radii. There will therefore be a tendency for radial constancy to increase as gross and mean radial accessibility increase.

When referring back to the case study examples, the varied performance of spaces at supporting interaction and encounter can easily be attributed to this concept. The spaces to the east of Liverpool Street station were found to be highly accessible locally but, due to the station entrance, became accessible globally without intervening radial accessibility In affect inducing a high radial variance or a poor radial constancy. The affect of this is that individuals exiting the station into local routes move through spaces that contain little relevance to their own local community and as a consequence are unlikely to be travelled through by people that they know; uni-directional flow is a symptom of this affect as the accessibility of the route does not allow for similar numbers of individuals to be moving in the opposite direction using the space for a variety of different journey types and distances.

Similarly, Brindley Place is highly accessible at a high radius level from the city centre and at the very smallest radii but not the intervening distances. The affect this has on networking was revealed by the early morning counts within Birmingham that showed a distinct lack of interaction within and towards Brindley Place before it could be pre-determined. In contrast, the route in the area with a high level of radial constancy is nearby Broad Street where the greatest frequency of encounter was observed.

Spaces that benefit from radial constancy are accessible for a wider range of distances are therefore automatically going to be accessible for a wider range of journey types which increases the likelihood of individuals sharing the same spaces at different times, moving in different directions. By inducing this co-presence of city users between scales, individuals are constantly exposed to the margins of their network and are therefore inherently disposed to maximise their ability to expand/adapt their network. Finally, the affect of radial constancy in providing spaces that are used for a wide variety of journeys means that not only strangers and intermediaries will interact in these spaces but individuals internal to an organisation, even a department are more likely to encounter each other by chance in these locations. Radial constancy, therefore, does not just have an influence on external networking between organisations but is just as important for improving communications and knowledge transfer internally.

Bill Hillier has written of the theory that cities are constructed as interfaces between different scales of movement and Jane Jacobs also realised the importance of this attribute when she referred to the need for overlap between different users of the public realm as the first fundamental generator of diversity. From an interaction, networking and knowledge transfer perspective, this research confirms this theory. It has shown that spaces that benefit from a high degree of gross and constant accessibility over all scales of movement are where this interface is located and it is suggested here, that it is how local space gains advantage from more global movement.

The research has shown that radial constancy is a highly valuable spatial attribute for organisations wishing to expose themselves to the margins of their individual networks but significantly, radial constancy may also prove important for improving internal communications. Similar to Penn et all (1999), further research may well reveal that organisations benefiting from this attribute are likely to experience a reduction in the duration and frequency of journeys and an increase in the networking ability both externally and internally.

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Appendix

	Pedestrian Flow	Gross. Interaction
Pedestrian Flow	-	0.8894
Gross. Interaction	0.8894	-
1/MD	0.9205	0.8626
1/MD*LogChoice	0.9127	0.8291
1/MD*LogChoice R800	0.6090	0.7799
1/MD*LogChoice R1200	0.8643	0.9107
1/MD*LogChoice R2000	0.9200	0.9097

Table 1:

Correlation table for Pedestrian Flow and Interaction in Birmingham

Variables	Gates	RSquare Value	T-Ratio
Pedestrian Flow and Interaction	All gates	.8883	10.93
Flow and 1/MD*LogChoice+2	Brindley Place	.8171	8.19
Flow and 1/MD*LogChoice+2	Broad Street	.8509	7.93
Interaction and 1/MD*LogChoice+2 Rn	Brindley Place	.6793	5.64
Interaction and 1/MD*LogChoice+2 Rn	Broad Street	.8036	6.71

Table 2:

Bivariate Correlations for flow and Interaction in the Birmingham case study area

Bivariate Correlations			
Variable	Gate	RSqaure Value	T-Ratio
Flow and Interaction	All Gates	.8051	13.79
Flow and Interaction	Station	.8706	6.36
Flow and Interaction	Non Station	.9499	26.86
Flow and 1/MD*LogChoice+2 Rn	All Gates	.503	6.52
Flow and 1/MD*LogChoice+2 Rn	Station	.8412	13.42
Flow and 1/MD*LogChoice+2 Rn	Non Station	.6091	3.06
Interaction and 1/MD*LogChoice+2 Rn	All Gates	.7525	11.30
Multivariate Correlations			
Variable	Gate	RSquare Value	T-Ratio
Flow from 1/MD*LogChoice+2 Rn and distance from the station	All Gates	.8099	10.81 7.81
Interaction from 1/MD*LogChoice+2 Rn and distance from the station	All Gates	.8684	15.86 7.81

Table 3:

Bivariate and Multivariate Correlations for the London Case Study area