Sketch mapping: A comparative approach to GIS-based network analysis in measuring accessibility

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Summary

This study used sketch mapping as a comparative approach to GIS-based network analysis to measure geographic accessibility and to explore people's perception towards accessibility to green space. As a result, 245 participants were asked to draw their actual route to get to their favourite green space on an A0 base map of the City of Leicester. Actual routes were digitised and imported to GIS environment and compared to the closest destinations and routes identified by GIS-based network analysis. Statistical analyses showed for 39.0% of users physical distance to a green space was not the main factor in their choices over greenspace access indicating the mutli-dimensionality of accessibility as a concept.

KEYWORDS: Accessibility, green space, network analysis, sketch mapping

1. Introduction

Accessibility has a broad and flexible concept to indicate the spatial nearness or proximity of one place to another (Tsou et al. 2005). In green space literature, GIS is being extensively used in measuring accessibility from distance aspect, pattern of usage and equity in provision of access (Schipperijn et al. 2010; Kara and Demirci, 2010; Kessel et al. 2009; Barbosa et al. 2007; Neuvonen et al. 2007; Hillsdon et al. 2006; Tsou et al. 2005andOmer and Or 2005). In fact, despite the prevalent usage of quantitative GIS in studying accessibility, very little research has used to date qualitative GIS as a tool towards exploring the perception of accessibility amongst different social groups. This paper used a comparison of qualitative and network analysis methods to measure accessibility to green space with the added value from the PGIS responses. Although participatory mapping has been often used to increase public involvement in planning and decision-making process, the approach has not been applied to date in the green space literature as a comparative method to GIS-based network analysis nor in studies analysing perceptions of accessibility amongst different social groups.

2. Methods

This study was conducted in the City of Leicester in the UK which has a population of 280,000. The research included asking repsondents to complete a questionnaire and to draw their route to green space areas. In total 245 participants successfuly completed these tasks.

GIS-based network analysis method was used as an alternative technique for mapping distances and routes to green spaces using a 'supply'and 'demand' approach (Comber et. al, 2008). Demand locations were provided by the locations of the 245 respondent post codes and supply created by manually digitised access points to 35 green space areas in the City. The network analysis was run using road data extracted from Edina Ordnance Survey (OS Meridian 2, 1:50,000).

Sketch mapping was described in Carver et al. (2009) and used to capture personal and community meanings associated with different geographic features, locations and landscapes that may be otherwise difficult to document. Gunderson and Watson (2007) used sketch mapping to gain a better understanding of people's relationship to a location that cannot be dissected by quantitative

approaches. This study used sketch mapping to create a database location of participants routes to green space and to compare with routes identified by GIS-based network analysis, finding the closest supply (green space) to each demand point (respondent post code location).

3. Results

Comparing network and actual destinations revealed that 61.0% of participants were local facility users who had an actual destination similar to the network and 39.0% were travelling users with a different actual and netwrok destination. To provide a better undrstanding about comparing actual and network destinations, Table 1 shows the results.

Table 1 Comparing similarity of network destinations with actual destinations

No.	Closest destinations by network analysis	Total incidents	Number of using local areas	Number of not using local areas
1	Abbey Park	9	9	-
2	Appletone Park	3	-	3
3	Ayleston Meadows	8	6	2
4	Beamount Way	2	-	2
5	Bede Park	1	-	1
6	Brocks Hill Park	3	1	2
7	Braunstone Park	3	3	-
8	Castle Garden	3	-	3
9	Evington Park	23	21	2
10	Franklin Park	1	1	-
11	Hamilton Business Park	4	-	4
12	Healthy Park	2	-	2
13	Humberstone Park	5	-	5
14	Judgemeadow Spinney	15	-	15
15	Knighton Park	7	3	4
16	Leicester Riverside	15	-	15
17	Monks Rest Garden	13	4	9
18	Nature Park	1	-	1
19	Nelson Mandela Park	5	-	5
20	Shakespeare Park	1	1	-
21	Spinney Hill Park	26	17	9
22	Victoria Park	29	19	10
23	Watermead Park	8	8	-
24	Western Park	58	56	2
	Total	245	149 (61%)	96 (39%)

According to Table 1, for example, Abbey Park was the closest destination to nine incidents. Figure 9 in front of Abbey Park explained that in actual circumstances all the nine incidents used Abbey Park as their green space destination. Figures 1 and 2 show geo-locations of the nine incidents and actual and network routes to Abbey Park. Although both network and actual routes were ended up to Abbey Park, in actual circumstances people chose longer routes (an average 924.00m) compare to the network (an average 730.00m).
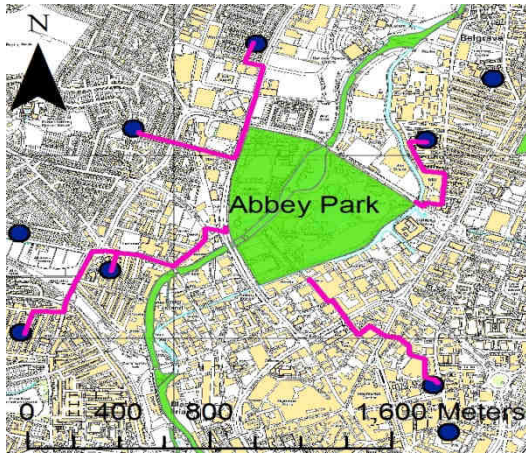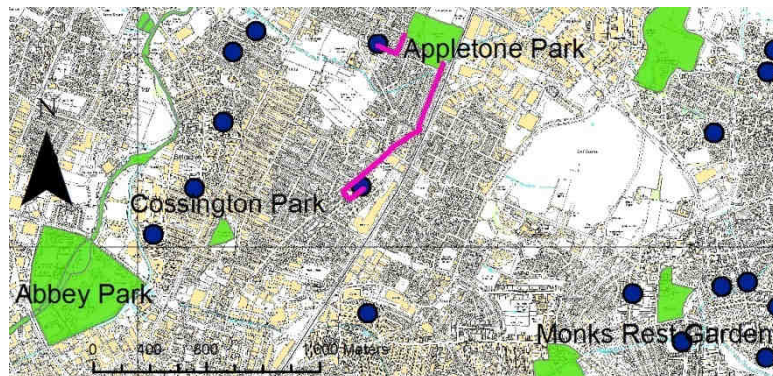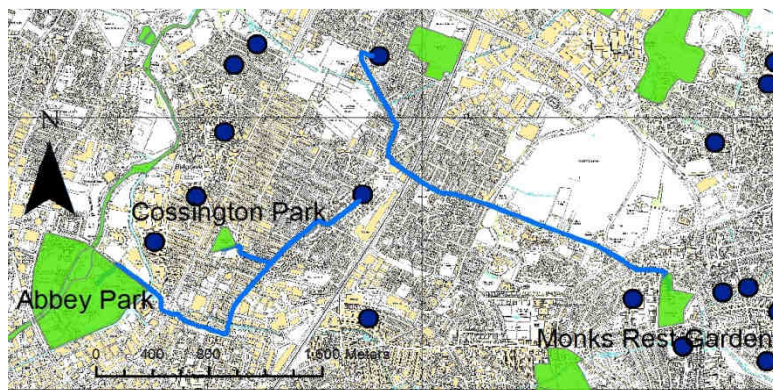
Figure 1 Network routes to Abbey Park
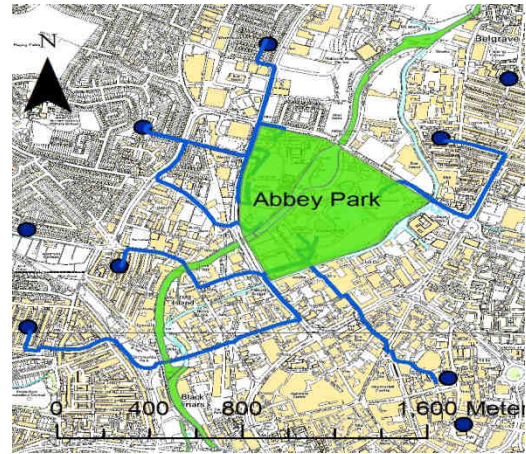
Figure 2 Actual routes to Abbey Park

The second example is Appletone Park. According to Table 1, the network analysis identified Appletone Park as the nearest green space to three incidents. However, none of the three incidents used the Park. Digitised routed extracted from sketch mapping revealed Abbey Park, Cossington Park and Monks Rest Garden were three actual alternative for Appletone Park. Figures 3 and 4 show network and actual routes and destinations to theree incidents. Due to overlapping two of incidents only two of the three incidents and routes are visible in Figure 3. Whilst the average of network distance to get to Appletone Park was estimated 1588m, in actual circumstances people practiced an average of 3206m, which was almost twice than the network.

Figure 3 Network routes to Appletone Park

Figure 4 Actual routes to Abbey Park, Monks rest Garden and Cossingtone Park

To conclude, of the twenty-four nearest green spaces identified by the network analyssi, only five of them were the actual destination for all of the respondnents for whom that was the nearest green space. For nine green spaces the network and user routes were similar for between 30.8 per cent up to 96.5 per cent and for nineteen green spaces the nearest green spaces were not used by participants at all as preferred green space. Further analysis was applied to find out about the potential reasons that caused 39% of participants to not use their nearest network green space as their actual destination. This revealed that for these participants accessibility was not prioritised by physical distance indicating that other factors inflence participants to travel to other green space rather than using their local facilities.

4. Discussion

Questionnaire results were integrated to spatial analyses to find out more about the 39.0% of repsondnents who did not use their nearest green space. The results showed that many of them were students and unemployed, and were people who used green space on a regular base of once a week. About 60.0% of them travelled either by car , bike or public transport to get to green space and preferred to stay for for a longer time than people who used their local green space - staying for 2-4 hours and more than 4 hours – compared to 30min to 1hour and 1-2 hours for those who used their local green spaces.

To explore the potential reasons behind travelling to other green space, Chi-Square Test was used for three categories of social, sporty and relaxing activities. Where *P-Value* was smaller than 0.05 ($\alpha < 0.05$) it was concluded that activity had statistically a significant relationship with travelling to green space. Results of Chi-Square Test showed for 39.0% of users distance was not the only and main reason to use a green space. In fact, for this group accessibility was associated with a better provision of access, relaxing and social activities. For instance, provision of a suitable place to walk the dog was significantly important for those who travelled for relaxing activities. For those travelled to other green space for social activities, eat or drink or to have picnic or BBQ, the provision of access to public facilities such as toilet, cafe as well as running some social events in the area, were significantly important.

5. Conclusions

This study was a comparison of qualitative and network analysis methods to measure accessibility to green space by adding value from the PGIS responses. The study used sketch mapping as a new comparative method in green space literature to GIS-based network analysis to identify whether accessibility is only conceptualised to people by geographic distance or there are other factors that they refer to. This study focused on destination as the key factor to compare the results of network and sketch mapped routes. Further work would extend this area of research by focusing on route analysis to provide a better understanding about perceived accessibility amongst different social groups.

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7. Biography

Fariba Sotoudehnia

I am a Ph.D student in GIS and Human Geography at the University of Leicester. My current research concerns investigating greenspace accessibility through combining a GIS-based network analysis with different qualitative methods involving PPGIS, interviews and questionnaire. I am working under supervision of Dr Alexis Comber.

Dr Alexis Comber

Dr Alexis Comber is a senior lecturer in Geographic Information at the University of Leicester with key research interests in spatial analysis of policy, analysis of uncertainty in geographic information and spatial data, land use / habitats, accessibility / access and geo-computation.