Combining T-communities and GPS tracking to assess the impact of segregation on mobility in Belfast

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Summary

Long-term tensions in Northern Ireland between the main Catholic and Protestant communities have led to widespread residential segregation. In this study we begin by adapting the concept of T-communities developed by Grannis (1998), using ArcGIS network analysis to define residential T-communities within North Belfast based on interconnecting tertiary street networks. With community affiliation assigned to each of the T-communities we then uniquely combine these with GPS tracks for 233 participants to explore the impact of segregation on mobility within the study area.

KEYWORDS: GPS, Mobility, Segregation

1. Introduction

Within Northern Ireland there are long-term tensions between the main Catholic and Protestant communities in regards to whether Northern Ireland should remain part of the United Kingdom or belong to the Republic of Ireland. Although a peace agreement has been in place since 1998, attitudes remain divided and residential segregation remains widespread (Hughes, Campbell, Hewstone, & Cairns, 2007). The segregated residential neighbourhoods often have territorial markings such as flags and murals, designed to both build a sense of community belonging and act as deterrents to those of the 'other' community (Brand, 2009). Peace walls still exist throughout Belfast. Designed originally to reduce opportunities for violence, they act as physical and psychological barriers to movement within the city (Murtagh, 2001). Grannis (1998) introduced the concept of T-communities in realisation that the connection of people through tertiary (residential) street networks was a better predictor of ethnic composition than proximity alone. The concept builds upon the premise that there are greater possibilities for people to interact within networks of interconnected tertiary streets. Grannis defined tertiary streets as being pedestrian focused, not used as major routes for vehicles (Grannis, 1998, 2005). The outer limits of T-communities are defined when they either connect with a main road, open space or other barrier (Grannis, 1998).

Our aim was first to adapt Grannis' T-community concept to the streets of North Belfast. Grannis' work was at the scale of large US cities based upon a predominately gridded street pattern (Grannis, 1998, 2005). We therefore began by translating the T-community concept to a more localised setting with a much less regular street pattern. Secondly we used GPS tracks collected from participants to measure the proportion of time spent moving within neighbourhoods of differing community affiliation. This significantly expands the analysis of T-communities as Grannis' work was restricted

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to using census tract data to examine residential segregation, and unable to explore the impact of segregation on mobility.

2. Methodology

To create the T-communities we began with a road dataset supplied via the Ordnance Survey Northern Ireland (OSNI). Into this we digitised additional residential paths visible either on the OSNI 1:10,000 back ground maps or identifiable on Google Maps. These roads and paths were then combined into a network dataset using ArcGIS 10.4. Both tertiary streets (residential streets not used as cut-throughs) and interconnecting footpaths within residential areas were defined as traversable within the network. Meanwhile main roads (defined as through roads wide enough for two cars to pass), and other features such as peace walls, parks, industrial areas and retail complexes were defined as line barrier restrictions (Figure 1a), thus defining boundaries for each of the T-communities. The network analysis service area function was then used to generate the spatial extents of the T-communities (Figure 1b).

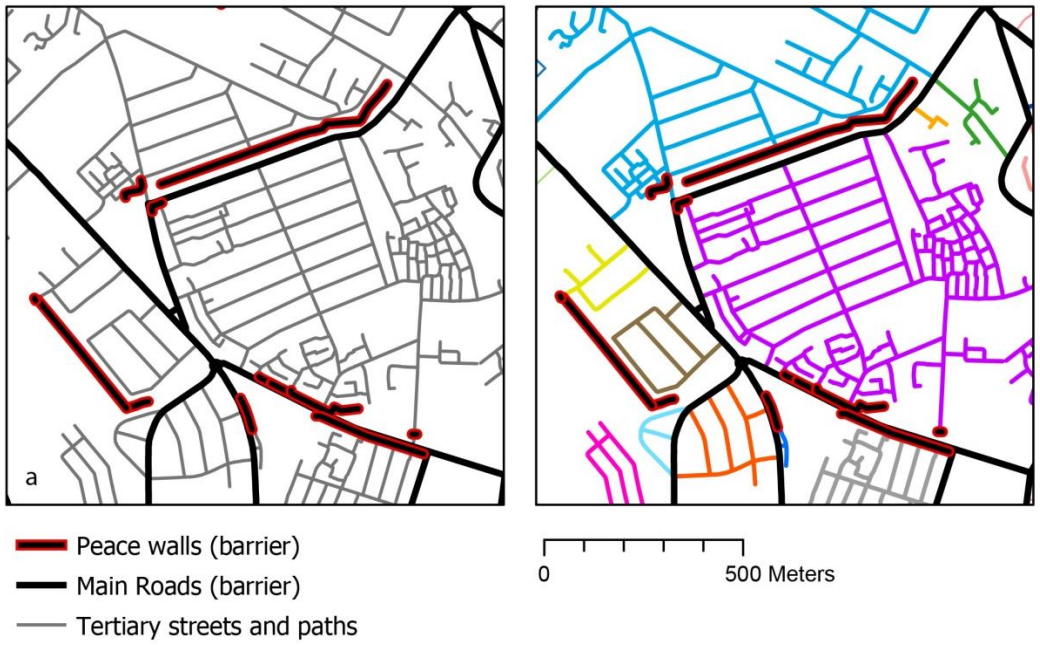

Figure 1 Example section of: a) Tertiary street and path network, with barriers; b) Individual T-communities represented by different colours.

The community affiliation of each T-community was then defined using a combination of population census data and the extensive local knowledge of the Belfast members of the research team. No T-communities straddled boundaries between Protestant and Catholic communities.

GPS tracks were captured for total of 233 residents who were recruited to the study and agreed to use a mobile application to capture their movements for a two week period during 2016 (Whyatt, et al., 2016). These GPS tracks were subsequently processed to separate tracks and identify stop locations. Travel mode was also estimated (Davies, et al., 2017). Track points were then assigned to sections of main road or T-communities by first snapping all points within 20m of a main road to that road section, then snapping remaining track points to the nearest main road or T-community that was within 40m. The proportion of travel time spent within T-communities or along main roads; and within areas of the participants own community affiliation (in group), rather than opposing community (out group) was then determined.

3. Results

Participants were found to spend considerably more time within 'in group' (53.6%) rather than 'out group' areas (14.4%). This difference even more striking when accounting for travel mode, with only 6.4% of travel time on foot spent in 'out group' areas. There is, however, an important further distinction in that the majority of travel time spent in 'out group areas is along sections of main road rather than nested within residential T-communities. When travelling in a vehicle (e.g. car or bus) people are more likely to travel along main roads in 'out group' areas (16.7% of in vehicle travel time), yet still do not spend more than 2% of time within 'out group' T-communities. Meanwhile, time spent on foot within 'in group' areas is mainly within residential T-communities rather than along main roads (Table 1).

Table 1: Percentage of travel time spent in areas of differing community affiliation

	In Group			Neutral			Out Group			Total
Travel Mode	Main Rd	T-comm	Total	Main Rd	T-comm	Total	Main Rd	T-comm	Total	
On foot	27.5	37.2	64.7	18.0	10.8	28.8	4.5	1.9	6.4	100
Unsure	26.6	35.2	61.7	19.4	10.7	30.1	6.7	1.5	8.2	100
In vehicle	29.4	18.3	47.7	28.0	5.5	33.5	16.7	2.0	18.7	100
Total	28.6	25.0	53.6	24.5	7.4	32.0	12.5	1.9	14.4	100

4. Conclusion

The method employed here demonstrates a successful approach for defining T-communities at a very different scale and setting to their initial design (Grannis, 1998), despite creating T-communities of very variable size. The novel combination of T-communities with GPS tracks allows us to test the impact of segregated communities on mobility, rather than just residential segregation which Grannis' work was restricted to. The principles applied here can be analysed in greater detail to explore behavioural differences between gender and community affiliation. Analysis of stop data may also help indicate which locations are used as shared facilities and what (if anything) may draw people to enter other community areas and begin to encourage mixing within segregated areas.

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6. Biography

Gemma Davies is the GIS Officer for the Lancaster Environment Centre, providing support for teaching and research throughout the department.

Duncan Whyatt is a Senior Lecturer in GIS at Lancaster University with research interests in both the natural and social sciences.

Jonny Huck is a Lecturer in GIS at the University of Manchester with research interests in the representation of vague geographical entities in geographical information science, novel approaches to cartography, and the application of new technologies to geographical problems.

References

Brand, R. (2009). Urban Artifacts and Social Practices in a Contested City. *Journal of Urban Technology, 16* (2-3), 35-60.

Davies, G., Huck, J. J., Whyatt, J. D., J., D., Hocking, B., Jarman, N., Sturgeon, B., & Bryan, D. (2017). Belfast Mobility: Extracting Route Information from GPS Tracks. In *GIS Research UK*, University of Manchester.

Grannis, R. (1998). The Importance of Trivial Streets: Residential Streets and Residential Segregation. *American Journal of Sociology, 103* (6), 1530-1564.

Grannis, R. (2005). T-Communities: Pedestrian Street Networks and Residential Segregation in Chicago, Los Angeles, and New York. *City & Community, 4* (3), 295-321.

Hughes, J., Campbell, A., Hewstone, M., & Cairns, E. (2007). Segregation in Northern Ireland. *Policy Studies, 28* (1), 33-53.

Murtagh, B. (2001). *The politics of territory: Policy and segregation in Northern Ireland*. Springer.

Whyatt, J., Davies, G., Huck, J., Dixon, J., Hocking, B., Jarman, N., Sturgeon, B., & Bryan, D. (2016). Belfast Pathways: Space-Time Analysis of Everyday Activities in a Segregated Environment. In *GISRUK*, Greenwich, UK.