

# Belfast Mobility Project: Integrating PGIS and GPS to Understand Patterns of Segregation

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March 07 2017

## Summary

The residents of North Belfast live in a highly segregated environment – one in which Nationalist and Unionist communities live in close proximity to one another yet use very different spaces for their everyday activities. This paper describes how novel PGIS techniques have been used to identify areas of open and closed space in North Belfast and how GPS tracks can be used to analyse the use of such spaces from the perspective of different communities. This will ultimately inform intervention strategies designed to promote spaces which reduce segregation and encourage more equitable access to public environments and resources.

**KEYWORDS:** Communities, Segregation, PGIS, GPS, Spraycan

## 1. Introduction

This study explores emerging patterns of activity space segregation and integration in North Belfast. Segregation in North Belfast assumes a distinctive ‘checkerboard’ pattern in which Nationalist and Unionist communities exist in close proximity, yet remain divided by visible structures, such as peace walls and interface barriers, and invisible cultural boundaries that have been defined and reinforced through history, particularly in the times of The Troubles. Who goes where, when, why and along what routes is an ingrained feature of the local geographic imagination, making North Belfast a particularly rich context in which to explore activity space segregation.

Most researchers have studied segregation at the macro scale, using pre-existing administrative units such as census wards or output areas to reveal the often negative consequences of segregation on outcomes such as poverty, health, social integration and access to resources. However, such approaches fail to capture subtle variations in local geography (perceived or physical) which act as a major influence on how people interact in everyday spaces such as streets, parks, schools, shopping centres and leisure centres. Our study aims to demonstrate how an increased understanding of everyday behaviour in such places can lead to opportunities for increased social integration over time.

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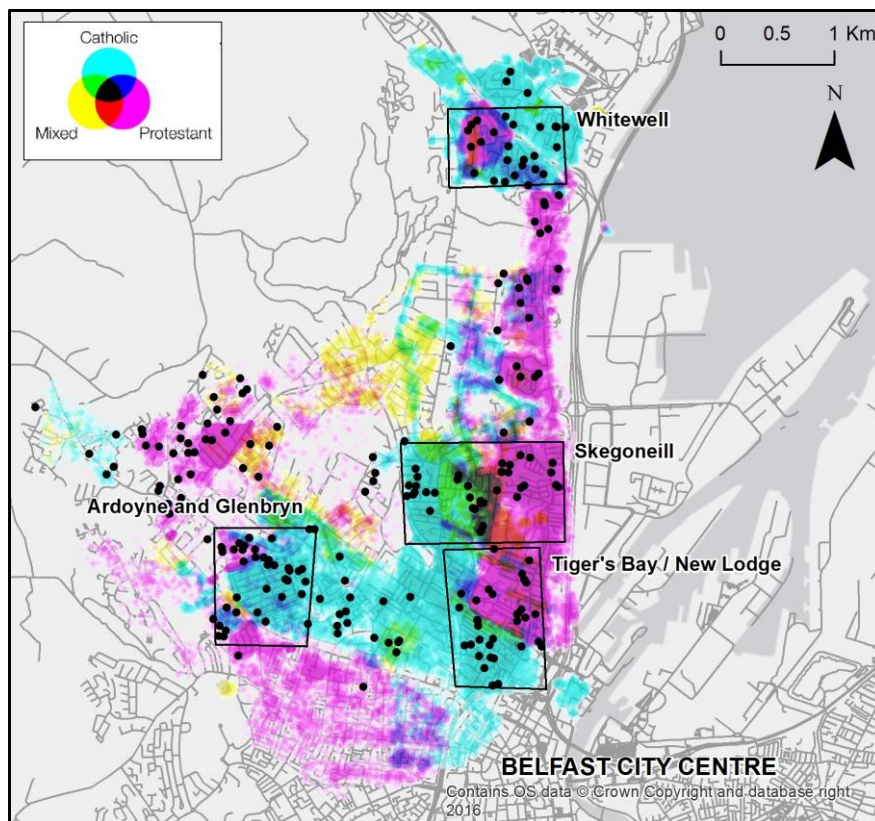
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Historically, it has been difficult to study activity space segregation at the micro scale. However, since the advent of the now ubiquitous smartphone and the plethora of location-based applications capable of capturing real-time positional data through inbuilt GPS receivers, researchers are now beginning to develop new methods to better understand individual patterns of human behaviour (e.g. Palmer et al., 2013, Roulston et al., 2015). Our study also adopted GPS technology, with participants using a customised phone application to record their geographical movements in everyday space (see Whyatt et al 2016 for more detail). It is also widely accepted that statistically-derived approximations of communities fail to capture the subtle nuances of reality as experienced by their residents. Our study adopted a PGIS approach to community definition, with residents using a novel web-based Spraycan tool (Huck et al., 2014) to define their own neighbourhoods.

The aim of this paper is to demonstrate the extent to which PGIS and GPS techniques can be used to explore activity space segregation. This is achieved through combining Spraycan and GPS data in a GIS framework then plotting tracks and stops derived from the raw GPS data (Davies et al., 2016) against a backdrop of religious affiliation which has been colour blended to highlight areas of open and closed space.

## 2. Methodology

To date this project has recruited 233 participants from 4 areas of North Belfast where Nationalist and Unionist communities live close to one another (Fig 1). Each participant has installed the smartphone application; however, the volume of data captured per individual varies significantly both within and between study areas, with females generally contributing more data than males. This is not unexpected since males have historically been subject to more sectarian violence and more restricted in their movements as a consequence.



**Figure 1:** The 4 study areas within North Belfast. The point symbols represent the home addresses of the 233 participants in the study. The coloured background represents community affiliation, as defined by 32 of the participants using the Spraycan (PGIS) tool.

In order to gain a better understanding of the community boundaries in this highly contested landscape we asked 32 participants to use the Spraycan tool (Huck et al 2014) to address a series of questions:

- *Please spray the areas you would consider to be Catholic;*
- *Please spray the areas you would consider to be Protestant;*
- *Please spray those areas you would consider to be mixed;*
- *Please spray those areas where you don't feel safe;*
- *Please spray any local areas that you would define as public spaces that are shared by both communities;*
- *Please spray those parts that you consider to be your neighbourhood;*

The first three questions relate to dominant religion, with Catholics traditionally associated with the Nationalist community and Protestants with the Unionist community. The fourth question asks participants to identify areas which they believe to be unsafe based on past experience or perception of the area. Conversely, the fifth question asks participants to identify areas of shared space. Such areas could potentially help break down segregation through intergroup mixing. The final question relates to the broader definition of community. In some cases the individual responses corresponded very closely with the Catholic and Protestant areas. In other cases, the neighbourhoods were more mixed. For the remainder of this paper we will use the combined responses to the religion questions as a surrogate for broader communities and study the everyday movements of two participants from the Ardoyne and Glenbryn area in more detail.

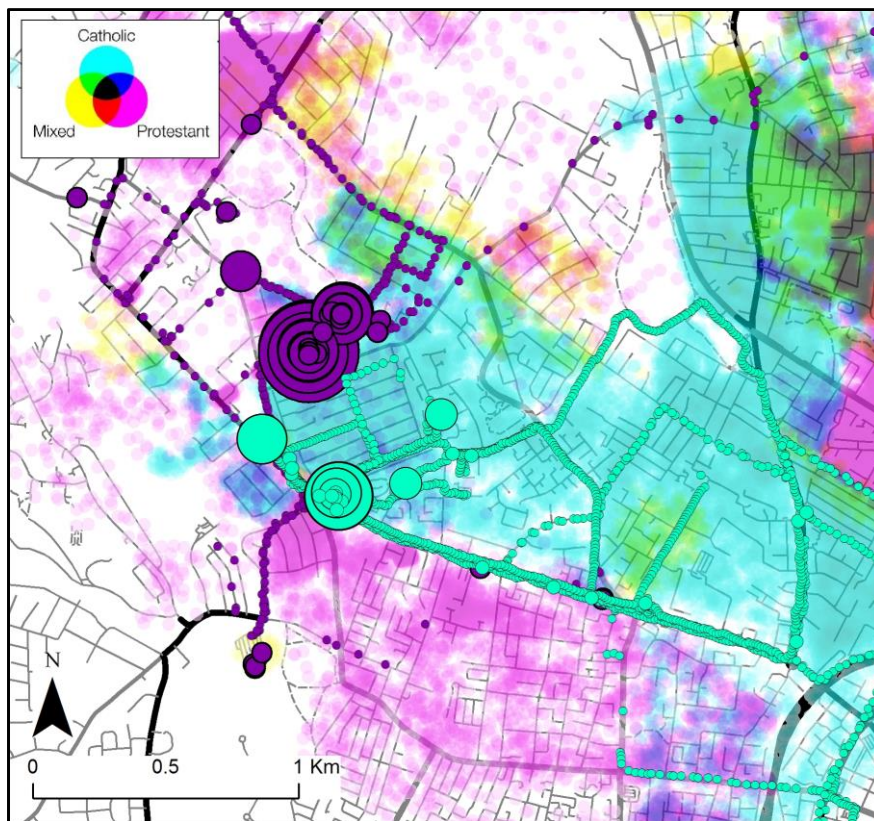
### **3. Results**

Figure 2 shows the everyday movements of a male member of the Nationalist community and a female member of the Unionist community as derived from the GPS data. The small circles depict routes through the local neighborhood whilst the larger circles represent stops, indicating time elapsed outside a shop, school or other public space. Other spatial data are currently being used to analyse these stops in more detail to confirm their characteristics and community affiliation. In an ideal world it would have been useful to compare routes and stops for persons of the same gender, however, in this instance there was a paucity of data from the male Unionist community (spatially and temporally) hence data from a female participant is presented here for illustrative purposes.

Figure 2 also shows how the participants have defined their own neighborhood in terms of religious affiliation. This composite spray was produced by 21 participants in the project (3 female, 5 male and 13 of undisclosed gender of which 2 Catholic, 5 Protestant and 16 undisclosed religion). This composite has been produced using a process known as 'colour blending'. This is an image processing technique that multiplies the colour of each band in the top layer (on a scale of 0-1) by the colour of each layer beneath. This typically results in overlapping areas becoming darker. In this case we have used the colours cyan, magenta and yellow to map the spray associated with Catholic, Protestant and Mixed communities respectively. In addition to revealing core Catholic, Protestant and Mixed areas this technique usefully highlights areas of overlap, for example, where Catholics (Nationalists) and Protestants (Unionists) share common space.

Figure 2 confirms that the Spraycan provides a much more nuanced representation of local communities than anything that could be achieved through the statistical manipulation of census data. For example, the Catholic-Protestant ratio has previously been used as a crude surrogate for the different Nationalist and Unionist communities. In this particular case the communities are remarkably strongly defined by a mixture of hard physical boundaries, such as the Crumlin Road which separates Nationalist communities to the north from Unionist communities in the south, to softer boundaries through housing estates and playing fields. These areas are currently subject to further investigation in our project through a series of 'walking interviews' with a selection of

participants. These will provide us with rich qualitative information which will help us understand the controls on everyday use of space in ‘contested’ places.



**Figure 2:** Sample routes and stops for a female member of the Nationalist community (magenta) and a male member of the Unionist community (cyan).

The above figure deliberately focusses upon the immediate neighbourhood of the two individuals rather than a broader range of more distant locations typically visited less frequently. The extent to which the individual confines his or her activities to their own territory is striking. The male Nationalist conducts his everyday activities almost exclusively in Catholic areas. The female Unionist conducts the vast majority of her everyday activities in Protestant areas although there is some evidence of passing through areas the colour blending suggests are mixed.

#### 4. Conclusions

This paper has demonstrated how the outputs of GPS tracking can be combined with novel PGIS Spraycan techniques to generate new insights into the use of space in contested environments. Here we have simply interpreted the GPS outputs of two participants and focussed on their immediate home ranges. Our challenge now is to analyse the data for all participants in our study and provide new insights into areas of open and closed space with a view to identifying areas where intergroup mixing can be promoted. In addition to our four study areas we will also focus on the city and determine to what extent this environment already supports intergroup mixing. We will also consider the influence of transport mode in determining which routes are taken through different parts of the neighborhood (e.g. do people take different routes when in a car than when on foot or on public transport) and reassess the significance of recent theory suggesting that tertiary (residential) streets reinforce social division (Grannis, 1998).

## 5. Acknowledgements

This work is being funded by the ESRC under grant ES/L016583/1.

## 6. Biography

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.

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

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