Re-evaluating T-communities: An assessment of mobility and segregation in North Belfast

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# Introduction

The concept of T-communities was introduced by Grannis (1998) recognising that relational connections via tertiary streets are a better predictor of racial composition than simple proximity. The idea was built upon the importance of opportunities for interaction, and that these opportunities to interact are greater within interconnected sets of residential (tertiary) streets, than across dividers such as major roads. Grannis (1998) defined tertiary streets as pedestrian orientated streets which were not used as throughways. In later work he defined tertiary streets as streets with one lane either side and with no divider in the middle (Grannis, 2005). Where two or more tertiary street interconnect they are defined to be part of the same T-community, but once a tertiary street interconnections with a main road or other barrier the outer limit of the T-community is defined. In addition to main roads, other areas such as parks, shopping malls or physical barriers such as walls are also used to define the limit of the interconnected T-community (Grannis, 1998). Grannis worked at the scale of large cities, with a predominately grid plan layout. The entire urban extent of San Fransico and a large area of the Los Angeles metropolis (Grannis, 1998) and the urban cores of New York, Chicago and Los Angeles (Grannis, 2005).

Typically neighbourhood definitions used in segregation studies use pre-defined areas such as census boundaries (Li & Wang, 2017; Lloyd, 2010; Merrilees, et al., 2017; Noonan, 2005; Omer & Benenson, 2002; Weaver, 2015; Wong & Shaw, 2011), however, these do not account for residents activities or perceptions, which are important if meaningful neighbourhood boundaries are to be defined (Deng, 2016). Physical barriers such as open spaces, railways or major roads have been seen to effect segregation (Noonan, 2005). These physical boundaries are often poorly accounted for in the definition of census boundaries, as is evident within North Belfast where some apparently very mixed census small areas are in reality highly segregated and physically separated by a peace wall. Kwan (2012) identifies the uncertain geographic context problem, highlighting that the true geographic context relevant to an individual in a given context may not necessarily relate to geographically delineated neighbourhood extents. In the context of this study, the proximity and potential interaction with others is important for understanding the impact that segregation has on the mobility of individuals. Within the T-community concept this proximity and potential for interaction is a central idea, with the assumption that geographic opportunities for passive contact lead to opportunities for active contact and the building of a sense of community (Weaver, 2015). T-communities also account for physical boundaries which may separate neighbourhoods (Grannis, 2005). While there may always remain some uncertainty about the true geographic context affecting individuals (Kwan, 2012), for the purpose of this study T-community definitions help to focus neighbourhood definitions around the opportunities for interaction which are so important to understanding the impact of segregation on people’s mobility. A final consideration in the definition of appropriate neighbourhood boundaries is the scale that they are defined at. The concept of neighbourhood can be applied at multiple geographic scales, in relation to the variety of scales that individuals interact at (Deng, 2016). Defining boundaries at an appropriate scale is therefore important. In the setting of North Belfast, Grannis’ T-community concept therefore needed to be adapted in order to generate much smaller T-communities than the US context to which it was first applied. This reflects the fragmented pattern of segregated communities in North Belfast. Similar adaptations of scale have been required in other studies, such as studying segregation in Tel Aviv where territorial boundaries were often based on smaller areal units than conventional segregation studies (Omer & Benenson, 2002).

Longstanding tensions exist in Northern Ireland between the main Protestant and Catholic communities regarding whether Northern Ireland should remain loyal to Britain or belong to the Republic of Ireland (Brand, 2009; Hughes, Campbell, Hewstone, & Cairns, 2007). Decades of violence and conflict between 1969 and 1998, known as ‘the troubles’, have caused the populations of North Belfast to become highly segregated. Despite the peace agreement which has been in place since 1998 deep seated notions of Britishness or Irishness are still strongly present leading to continued residential segregation, often associated with territorial marking such as kerb painting, flags and murals (Brand, 2009; Hughes, et al., 2007; Shirlow & Murtagh, 2006) These territorial markings make members of the opposite communities feel uncomfortable and more likely to avoid the area (Hughes, et al., 2007). Harassment, intimidation and occasional violence continue in post peace Belfast further fuelling mistrust between communities (Brand, 2009).

Today peace walls are still a significant feature in Belfast. These first began to appear in 1969 initially constructed by the British Army in response to sectarian violence(Byrne, Heenan, & Robinson, 2012). They were designed to reduce opportunities for violence between opposing communities, providing some safety and security (Byrne, et al., 2012; Murtagh, 2001). Peace walls are also, however, associated with a number of negative consequences including impacts on mobility affecting basic aspects of everyday life such as going to the shops, work or recreational facilities (Murtagh, 2001). Byrne et al’s (2012) study found that 41% residents living near peace walls felt that they made it harder for them to access some services and that the peace walls made them feel trapped. Beyond physical barriers, forms of territorial marking both reinforce a sense of community identity within neighbourhoods and act as boundary markers as a warning to those of the opposing community (Shirlow, 2006). The markers take various forms including murals, flags (Brand, 2009; Hughes, et al., 2007) and curb painting.

Not all barriers to movement are however so physical or visible to those from beyond the neighbourhoods. Fear resulting from decades of violence restricts the mobility of those living in highly segregated neighbourhoods, with residents rarely crossing sectarian boundaries, instead adjusting their movements and use of services in response to fear (Lysaght & Basten, 2003; Shirlow & Murtagh, 2006). This restricted mobility affects structures of consumption, leisure and the workplace, thus impacting all aspects of life (Lysaght & Basten, 2003; Shirlow & Murtagh, 2006). The reality of segregation is that in many cases services such as schools, playgrounds, libraries, leisure centres and health services are used only by members of one community (Brand, 2009).

Capturing mobility patterns using GPS tracking has been used for a wide variety of purposes including: health studies (Vazquez-Prokopec, et al., 2013; Zeitler, Buys, Aird, & Miller, 2012); understanding school journeys (Pooley, et al., 2010); identification of spaces for social interaction (Siła-Nowicka, et al., 2016); and tourism management (McKercher, Shoval, Ng, & Birenboim, 2012; Zheng, Huang, & Li, 2017). Meanwhile few studies have used GPS tracking in the context of understanding the impact of segregation on mobility (Palmer, et al., 2013; Roulston, Hansson, Cook, & McKenzie, 2017). In a study of young people’s movements in Coleraine, Northern Ireland, Roulston et al (2017) found GPS tracking significantly added to the understanding of movement in this segregated town, showing potential for further research in this area. Palmer et al (2013) identified great potential for GPS tracking to enable a shift from purely examining segregation by residential census units. By identifying locations people go when not at home, and the routes people take to reach these locations, they discovered that many of the social consequences of segregation were able to be identified. In their study Palmer et al (2013) measured the amount of time spent within census units of different racial characteristics. To measure the amount of time spent within neighbourhoods of different characteristics; this paper will refine the approach developed by Palmer et al by measuring time spent in different T-communities rather than census units.

While previous applications of T-communities have only been used to study residential segregation (Grannis, 1998, 2005) and previous work to use GPS tracks to measure time in neighbourhoods of differing characteristics has replied on census units to define neighbourhood boundaries (Palmer, et al., 2013), this paper seeks to demonstrate the appropriateness of combining T-community neighbourhood definitions with GPS traces to better understand the impact of segregation on mobility. The scalability of T-community neighbourhood definitions will be demonstrated, while arguing their appropriateness as neighbourhood definitions in segregation studies. By combining GPS tracks for xxx participants across North Belfast with the T-community boundaries, the extent to which people move within: their own T-community; other T-communities with their own community affiliation (hereafter referred to as ‘in group’); and time spent in neighbourhoods of opposing community affiliation (hereafter referred to as ‘out group’) is revealed.

# Methods

## Creating T-communities

The road and path network used to define T-communities was derived from the OSNI - Need dataset details. Additional paths were added to this layer using OSNI 1:10,000 scale raster map tiles and Google Maps as a guide. For the purpose of defining T-communities those paths that provided short connections between residential streets were defined as traversable, while paths through open spaces such as park land were not considered valid for T-community connectivity and where therefore excluded. Likewise minor roads within residential areas were classified as traversable, while non-residential streets such as those through retail complexes or industrial areas were excluded. In the context of North Belfast primary roads used to create breaks between T-communities were defined as any road used as a throughway which was sufficiently wide for two vehicles to easily pass. Peace walls were also included as barriers between T-communities. (Figure 1a) Peace walls are typically walls or fences that form a physical barrier to movement. While gates are sometimes open through peace walls these were still considered as barriers to T-communities as they remain a physiological barrier to movement and community connectivity.

With the tertiary street network and barriers defined, network analysis tools within ArcGIS Desktop 10.4 were was used to define the T-communities. Network service areas were generated from a series of origins, terminating only when they met a barrier (primary road or peace wall). Service area origins were defined by selecting all nodes where tertiary streets met primary roads. These origin points were subsequently offset slightly to ensure that the origins did not fall directly on a barrier within the network. A total of ## unique T-communities were generated. The defined T-communities vary considerably in size from individual side streets, to large interconnected housing estates (Figure 1b).

 *Figure 1: A sample of (A) the road and path network and barriers to movement used in the generation of T-communities; (B) Defined T-communities*

While much of the population lives within the defined T-communities, the majority of the primary roads used as barriers between T-communities serve as residential streets as well as being home to many shops and services. Residential primary streets where therefore broken down into ‘Main Road Sections’ which are later used in addition to T-community neighbourhoods when defining the time spent within territories of different community affiliation. The primary roads where divided either where the street name changes, a major road intersection was reached or where a clear split in community affiliation was known to occur.

## Defining community affiliation

While census data is sometimes used to define community belonging (REFS), this can in some instances be misleading. For example in North Belfast some census sectors which appear mixed are actually amongst the most divided as a result of a census small area boundary being drawn across a community divide. In some instances the divide is not just perceived but a physical barrier, with peace walls splitting census small areas in half. Using extensive local knowledge of the research team, the location of barriers and existing census data, census small areas where spilt as necessary and community affiliation redefined where appropriate. Areas where defined as either Catholic or Protestant where it was felt that there is a clear sense of community identity. This definition was subsequently used to define the community affiliation of the defined T-communities. Unlike the census small area boundaries, no T-communities where found to straddle a known community divide. Return to this idea later in the discussion Meanwhile community affiliation of sections of main road were defined with the assistance of local knowledge held by the Institute of Conflict Research.

## GPS tracking

Participants for GPS-tracking were recruited to the project during a one year field campaign in which two project research assistants went door to door throughout North Belfast asking householders to participate by installing a custom application on an GPS-enabled Android Smartphone and collecting data for 14 days (REF Methods paper). The application captured points at a four second time interval, stored locally in a SQLite database and updated to a remote PostGIS server once connected to Wi-Fi (Whyatt, et al., 2016). A total of 233 participants were recruited of which 108 declared their community affiliation as Catholic, 113 as Protestant and 12 as other. The data was then cleaned, and points divided into separate tracks and stop locations (Davies, et al., 2017). A total of xx users recorded at least one valid track used in subsequent analysis, with the amount of tracks varying from 1 to xx per user.

In total 6158 separate tracks and stops were defined. The destination of the stops was then defined where possible, using a variety of source information. Home address for participants where geo-located, with precise household positions refined using OSNI xxxx data as a guide. Home was defined as the track destination if the stop was within 50m of home and the only closer locations where other residential properties. The confidence with which home was defined as a stop depended both on distance from home and other likely destinations close by. Other stop destinations were defined using a combination of: business data provided by Belfast City Council; OSNI map data; Google Maps; Google Streetview; and local knowledge. The limited precision of the GPS locations for the stop locations (+/-20m) leads to some uncertainty around precise stop locations. Where possible additional information, such as time and duration of stop, preceding or proceeding tracks was used to better define likely trip purpose, for example, whether an individual was waiting at a bus stop, or visiting the doctor surgery near the bus stop. Where groups of shops were co-located it was not possible to clearly differentiate exactly which shop was visited and the destination was described simple as that group of shops. [do we need the detail on how homes were geolocated and the error surrounding this?]

Travel mode has a potentially significant influence on an individual’s willingness to move within out group areas (Lysaght & Basten, 2003), however, no information on travel mode was recorded by participants. A simple definition of likely travel mode was therefore adopted (Bohte & Maat, 2009), with travel mode defined as ‘on foot’ if the average track speed was less than 10km/h and the maximum track speed was greater than 14km/h. If average track speed was greater than 25km/h or maximum track speed was greater than 45km/h travel mode was defined as ‘in vehicle’. Travel mode for all other tracks was defined as ‘unsure’ and may have been bicycle, slow moving traffic or a mixed mode journey.

Track points were assigned to T-communities or main road sections, by first snapping all points within 20m of a primary road to those roads, then snapping all remaining points to any road or path in the network that was within 40m. Assigning stops to relevant T-communities or main roads was, however, more complex. For example a stop at a supermarket may be located anywhere within or close to the supermarket or its car park. While most supermarket entrances are located on main roads, parts of its grounds and therefore stop locations may be located nearer to neighbouring tertiary streets or paths. Any stop location within 20m of a main road was therefore assigned to that road, with other stop locations assigned using network analysis by calculating the nearest node through the network that was located on either a main road or within a T-community. In the supermarket example this would snap the stop location to the nearest part of the road network within the carpark, and then assign its affiliation to the main road that the carpark roads join to at the entrance [could use a figure to demonstrate this, but not sure it’s a major enough point to warrant it].

Statistical analysis

Other methods that help explain results e.g. walking interviews etc

*Pg 1111 of Palmer 2013 for explaining benefits of Android system*

# Results

Headline results re use of out T communities etc

Breakdown of results by travel mode, gender and community background

Visits to other T-communities (how many tracks or users entered other T’s)

Visits to stops of different types

Track data for confirming community affiliation.

# Discussion

Adaptability of the T-community concept in very different setting and scale.

Success of T-community – clear difference between use of main roads and tertiary streets – fits neatly within existing understanding of community segregation in north Belfast. Better fit than census boundaries

Usefulness of concept for measuring movement\ use of space – not just residential. Expands current concept

Problem of very small T-communities & challenge of main roads also being residential = limitation of Grannis’ approach at scale and setting used

Ardoyne/The Bone – evidence of through connection, single T-community but referred to as 4 separate communities (incl fig to demonstrate)

Neighbourhood definition, specific to task undertaken – self-identification not nec. Most useful for analysis.

Limited use of out community especially on foot and within T-communities

Examples from walking interviews re lack of willingness to enter opposing T-communities

‘Non-spaces’ retail and other services are main use of out group space. Link to Jonny’s paper

Policy implication

Further work

# Sort out consistency with terminology for main / primary roads

## Statistics

# Conclusions

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