Exploring UK Crime Networks

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***Abstract*—This paper describes our experiences with three different crime networks in the UK: burglary, 'gun' gangs and retail theft. We present an introduction into each of these problems, and highlight some of the issues related to over-simplification of the network analysis.**

We also review the term 'third-generation' analysis, and provide some insights into achieving this, but also conclude that it can be an extremely computationally expensive undertaking.

I. Introduction

Social network analysis has been applied across a wide range of domains, providing a unifying language to describe disparate systems ranging from social interactions to power grids; there is also a growing body of literature applied to crime analysis (see [1]–[8]).

Within the deterministic literature of criminology and crime informatics we find what Klerks calls 'third-generation' analysis [1]. The first generation (crime) analysis techniques were the Anacpapa charts [9] and maps with coloured pins [10]. Second generation techniques include the range of tools available to crime analysts, from powerful freeware (e.g. Pajek) to mid-range solutions offering operationally useful measures beyond standard social network analysis computations (e.g. IBM i2 COPLINK and IBM i2 Analyst's Notebook, ORA [8]), to significantly more expensive bespoke solutions (e.g. Detica NetReveal). The second generation techniques essentially provided graphical representations of simple raw data. Actual content, let alone meaning of such contacts, was analysed only in a very crude way [1].

A number of researchers [7], [11] offer a related approach, analysing the strength of weak ties in crime through steady state equilibria modelling, however Klerks [1] was interested in understanding in a qualitative way the behaviour, motivations and choices of the individuals concerned and contributing to a better understanding of vital social processes, power and affinity structures. Certainly there were misconceptions within law enforcement, particularly with holding simplistic views of their adversaries [1].

II. Disambiguating networks: the meaning of links

Work with the crime type of burglary, in collaboration with West Midlands Police in the UK, investigated the combination of social network measures with spatial data. Links in this dataset were based on codefendence. Incorporated directly into the *betweenness* calculation were values for offender range (geographical difference between linked offenders), the 'danger' of an offender (amount of crimes committed) and the strength of links (product of amount of co-crimes and recency of last crime) [12]. This resulted in a weighted betweenness value that better reflected the importance of an offender.

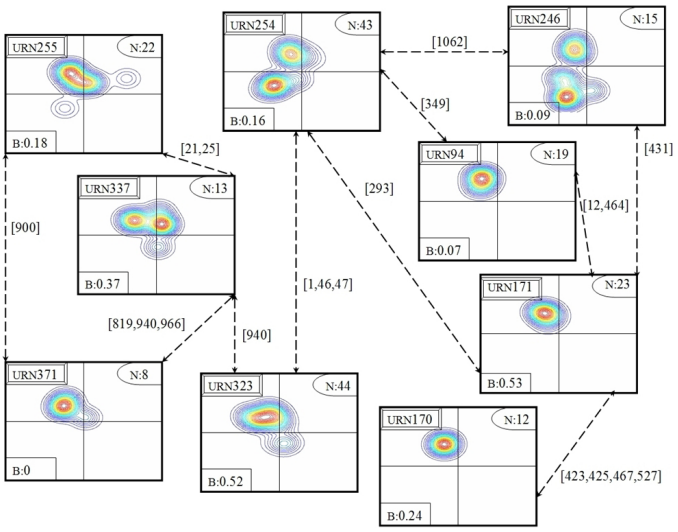

Figure 1. Geographical networks of burglars. Each of the 2x2 squares represents an offender, with Unique Reference Number (*URN*), number of crimes (*N*) and betweeness value (*B*). The crime positions are displayed in interpolated form. The links between offenders are labelled with dates, as days from the start of the project.

From the large networks of linked offenders (n=17000), however it was not clear whether the link could be considered strong or weak, recent or old, and offender pairs committing many crimes together in the recent past would appear the same as those offenders whose activity together was a long time passed through only a single crime.

While the betweenness metric can be useful, it is clear that in the case of crime types such as burglary there is also the need to consider the spatial aspect. Consideration of the temporal and frequency analysis of the crimes constituting the links will also provide a better understanding of the nature of the links, and may highlight links that are not considered significant by the betweenness metric.

III. Gun gangs

The UK has been slow in carrying out research into gang crime, excepting Pitts [13], and especially into what actions work best at controlling it. Greater Manchester, a

region in the north of the UK has had a significant gun crime problem througout the 2000s [14], [15], related to gang activity (primarily due to acute social deprivation in the area).

Reported elsewhere [16], in collaboration with the UK's Greater Manchester Police, the dynamics of a social network study of these gangs and their associates was performed using the intelligence gathered by police observations of known gang members and associated criminals. Links between offenders are a range of intelligence types, from codefendent to 'seen together'. This reinforces the value of using social network analysis for gang research: identifying structural holes, betweenness and social capital [17].

Figure 2 shows links between two rival gangs. In 2000, Gangs A and B were rivals. These later divided in 2001 into Gang C (from A) and into Gang D (from B) in 2004. We investigated this process based on local features (modularity, cliques) and global features (clustering coefficient). Identifying the changes in these could help us identify the possible birth of new gangs (sub-networks) in the social system.

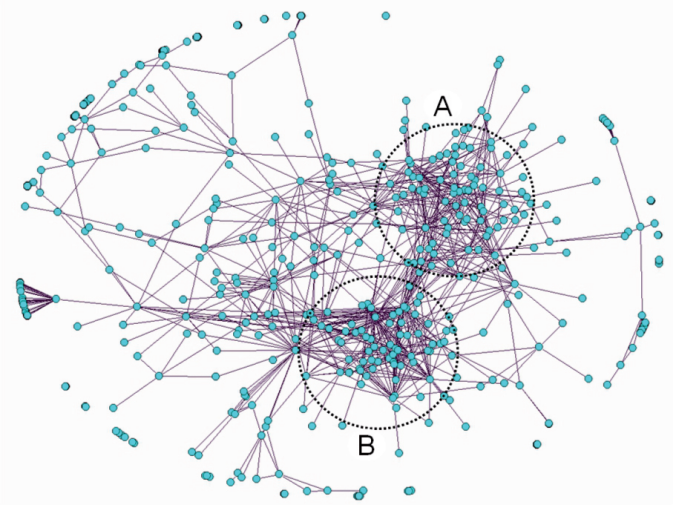

Figure 2. Rival gangs A and B.

Studying the dynamics of these networks globally and locally, we identified the global characteristics that tell us that they are not random graphs – they are small world graphs and therefore the formation of gangs is not a random event. However, there is much more to analyse, based on the specific nature of the links, and the complex histories of each offender.

IV. Third-generation analysis

Recalling the definition presented earlier, 'third-generation' social network analysis focuses much more intensely on the content of the contacts, on the social context, and on the interpretation of such information. We are particularly interested in what constitutes the bonding mechanisms that tie people together in different constellations: greed, ethnic or tribal ties, family relations, common geographical (neighbourhood) or institutional (prison) [1].

A. Specific gang roles

There are many definitions of gangs; for instance Pitts [13] reviews a plethora of definitions and typologies, eventually developing their own six-point typology for their particular study. Aldridge et al. [18] recognise the messiness and looseness of the social networks referred to as gangs, as well as their permeable and fluctuating boundaries. In contrast, Pitts [19] claims, arguably without providing much evidence for it, that we are witnessing the development of new articulated 'supergangs' with long histories of involvement in organised crime, clear subgroups, role differentiation, established territories and neighbourhood control, vertical links into higher echelon organised crime, and organised drug dealing activity.

The *degree* values from our analysis the the gangs suggested that there are no obvious single leaders, however intelligence suggests that South Manchester gangs in the UK do appear to have a basic system of hierarchy. Gang's A and B members store firearms at the home addresses of younger affiliates of the gang, who are eager to prove themselves to 'superior' members of the gang.

While defined roles may give the impression of organisation within the group however the lifestyle of gang members is often disorganised and unplanned. Detailed qualitative/ethnographic descriptions tend to portray gangs as loosely-structured groups that lack clear role expectations and stable leadership [20]. Firearms incidents between gangs are sporadic in their nature and often have the hallmarks of chance encounters with members of opposing gangs, which makes them difficult to anticipate. We should also be careful when looking at data and creating networks from it. However, Klerks [1] cites the case of the 'conspiracies' and mega-hierarchies that police had identified in the past among Dutch and Turkish organised crime which were in fact strings of interlinked smaller groups that lacked a central leader but that coordinated their activities along logistic trails and through bonds of friendship.

B. Link analysis

We require a better analysis of link types, for instance in the study by Patacchini and Zenou [7] of whether weak ties play an important role in explaining criminal activities. They developed a model where individuals learn about crime opportunities by interacting with other peers. The theoretical predictions of the model are confirmed by the empirical analysis since they find that weak ties, as measured by friends of friends, have a positive impact on criminal activities.

To give a better idea of the interconnectedness of the gangs, the following Figure 3 demonstrates a *cycle* in the data, passing from one gang to another via intermediaries. This example has been chosen from the 2001 data when one of the new gangs emerged. Plotted in this way we can see the complex relationships between (rival and sympathetic) offenders in this geographically small region.

Furthermore, for 2001 and 2004, it would be interesting to examine the kinds of links within each gang which emerged.

V. Retail Offending Teams

Retail is one of the largest economic sectors in the UK, yet the impact of criminal activity in this domain has received relatively little attention. Customer theft of goods from shops can account for almost half of stock loss, but there have been few studies on this issue. There is an clear need for

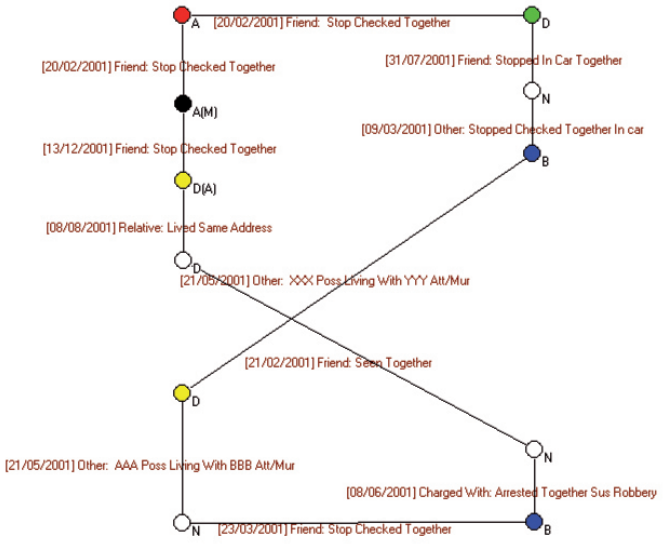

Figure 3. Cycle (2001). The tension is between Gangs A (red), B (blue), C (green) and D (yellow). A(M) is a member of the Gooch gang (Gang A), however they are coloured black to represent the crime of murder.

more research and Ewart and Tate [21] discuss how the investigation of retail offending is able to draw upon a body of criminological findings and methodologies [22].

A unique database was used, held by the UK's North East Retail Crime Partnership (NERCP) [1]. This is a partnership between 29 retail chains, 11 shopping centres, 6 town/city centre partnerships and 4 police forces in the North East of England. It has extensive data sharing links to other regional partnerships across the UK. This includes Yorkshire and Humber Business Crime Forum and the Scottish Business Crime Centre and a further 11 police forces feed into the system. Information on over 30,000 offenders and 102,000 incidents in any twelve month period are recorded and include admitted cases reported to the police as well as those where the retailer has chosen not to report. Despite an emerging operational need, there are no studies of retail criminality, therfore there is a need to explore the organised teams of offenders.

A. Motivation for the study

The proportion of shop theft/refund abuse committed with the objective of determining an empirical basis for informing targeting priorities. The problems of aggregated data [23] are addressed by using a disaggregated approach to establish more precisely the geographical nature of 'prolificness'. We expect a teams activities to be more geographically dispersed in comparison to members' individual offending.

The constitution, stability and roles within teams with the objective of informing detection and prevention strategies. We expect to identify key individuals who provide the core and temporary members who are brought in for specific purposes such as the distraction of security staff. The offending patterns of commuting teams and explore geographic/temporal factors associated with target selection with the objective of informing detection and prevention strategies. We expect to identify factors associated with target selection and delineate teams according to offending patterns.

B. Retail theft data

All NERCP data is collected using the National Information/Intelligence Report Form (5x5x5) [2] approved by Association of Chief Police Officers (ACPO) and conforms to standards required by Police National Intelligence Model [24]. The data comprises information recorded by retailers on sightings of known offenders and all incidents of shop theft and refund abuse detected in their stores (whether subsequently reported to the police or not) and includes biographical details of the offenders. Detected crimes are defined by the apprehension of the offender. The study is anchored to the North East England in that the travelling patterns of offenders based in this region are explored and contrasted with information on those travelling too the region. Detections and sightings are analysed to derive an empirical definition of 'a team' of offenders and explore a typology related to membership stability, offending range or type of offending.

A preliminary analysis of NERCP data on one police force area reveals that prolific offenders more often act in teams. Thirty people committed between 17 and 44 offences of retail crime during 2006 and 24 of them committed almost all their offences with more than one other. All these 'team players' have a large criminal range and operate across two or more police force areas.

There are also no studies of retail criminality that explore offenders who travel widely to commit their offences. Findings from burglary [25]–[27] suggest locations will be significant to at least one of the group members, or a retail chain may be targeted across the country because a corporate strategy produces similar security systems in all its stores. Little is known of their offending patterns in a chosen area. They may 'forage' [28] where numerous premises within a relatively small geographical range are targeted. Alternatively, they may 'hit and run' a few shops over a wider area to avoid detection. Understanding the temporal and geographical characteristics of offending have provided important crime prevention and detection information, yet retail offending remains to be explored in this way.

C. Identifying teams of retail offenders

Intelligence had identified nearly 20 gangs with identifiable modus operandi and/or membership (e.g. family, or from a specific geographical region). We were interested to see if we could find these gangs by automatically partitioning the data. In this way, if we are able to find our known gangs in certain partitions of the data, perhaps un-labelled partitions might indicate previously unknown gangs.

Our tangled network of relations consisted of 31106 vertices with 12742 edges. We used weak components method to partition the data, with increasing number of nodes. The resulting partitions or list of networks were extracted. Actual values of nodes versus partitions (for n=10) were: 1-22133, 2-3807, 3-926, 4-320, 5-153, 6-93, 7-67, 8-49, 9-34, 10-26. That is, when we considered networks to be of size 1 node, then

[1] http://www.nercp.org.uk/

[2] http://www.hmrc.gov.uk/manuals/mlr3cmanual/mlr3c14000.htm

we found 22133 members or partitions. When we considered networks to be of size 2 node, then we found 3807 members or partitions, and so on. The size we initially decided to investigate was 10-node weak components with a resultant of 26 partitions or sub-networks.

Of the 20 known gangs we were able to identify 12 from our partitions, or at least 12 networks that had at least one member from the gang members. However it was initially surprising to see how interconnected several of the gangs were. Using *shortest paths* we identified the following paths between the following gang's (anonymised to): *CM*, *AR* and *SEA*.

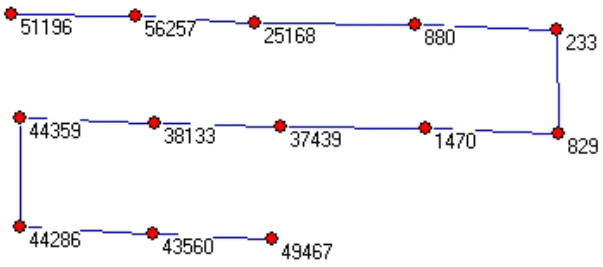

Figure 4. Shortest path between Offender 49467 (Gang CM) and Offender 51187 (Gang AR).

VI. Conclusions

The picture painted by the initial social network plot is quite misleading in all three cases we have presented. The burglary data required spatial data and other features to really start to understand the meaning of the links between offenders [28], [29]. In the gun gangs, the police held hypothesis of two rival sets of gangs is potentially a misrepresentation of the much more complex sets of smaller cliques and fluid changes within the larger gang structures. Not only are the links between offenders of very different natures, but the nodes or offenders themselves are very different as well. How to represent the changing nature of an individual is something we have looked at elsewhere [16]. Finally then the very complex data of retail crime, with a fraction of known gangs, presents its own particular challenges, of how to make use of quite detailed intelligence on individuals (in textual format) and combine with mining of the social networks.

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