
‘Innovation and the Application of Knowledge for More Effective Policing’

N8 Policing Research Partnership Catalyst Project

PROJECT TITLE

Mapping and identifying modern slavery vehicular activity: A proof-of-concept study

INTRO

This project sought to determine the feasibility of using Automatic Number Plate Recognition (ANPR) camera data to identify vehicles involved in the perpetration of modern slavery within two police forces in England. The intended aim was to link police intelligence logs relating to modern slavery with ANPR data and to use machine learning to identify patterns in the driving activity of modern slavery perpetrators and, ultimately, to develop a tool that could be deployed by police forces to identify vehicles as potential perpetrators. For several reasons, the project was unsuccessful in achieving this aim. The report describes these activities and the lessons learned for the predictive application of ANPR and for the future of big data policing.

KEY FINDINGS

- The location of ANPR cameras is confidential to police organisations. This constrains the ability for non-police organisations to use contextual and geographical data to inform the predictive models.
- Anecdotally, there are patterns in the logistics of modern slavery offences, but it is unclear if ANPR camera coverage and data are suitable to describe these patterns. Although the use of ANPR for the detection of modern slavery offences was deemed not to be feasible within the constraints of this project, ANPR data may be useful for the detection of other offences that require vehicles to travel long distances, such as human trafficking and smuggling.
- The prevalence of vehicles that are involved in modern slavery offences is likely to be too low to support a useful live detection tool in control rooms, as it would likely generate a large number of false positives alerts. This low base rate means that maximising the specificity of the tool will be challenging.
- If a detection tool for modern slavery is to be based on conviction data, the one-year retention period for ANPR data may be too short for a non-police organisation to develop robust predictive models as the number of relevant convictions within this timeframe is likely to be low at the level of individual forces.
- The launch of the National ANPR Service presents an alternative method for the development of an application of this type across a wider geographic area. A national service could facilitate a more refined algorithm, but would require a national database of offences on which to develop and test models. This would require efficient coordination of national data on modern slavery or other vehicle-based offences.
- Many of the challenges faced by the project could be overcome by the development of data science capacity within police forces or at national policing level.

In order to determine and exploit the potential of ANPR to identify vehicles involved in modern slavery, a number of foregrounding steps must be taken. This project sought to devise and test a strategy for identifying 'target' vehicles (i.e. involved in the perpetration of modern slavery offences) and to determine the feasibility of developing an identification technique. Changes to the protocol for data retention and the low prevalence of suitable target vehicles meant that we were unable to achieve the main goal of developing a prototype algorithm. However, in the process of attempting this, we identified significant potential and obstacles for the future use of ANPR. We provide a description of our activity and the learning from this project, which has important implications for predictive policing and the future exploitation of 'big data' in policing.

Devising and testing a strategy to identify perpetrators of modern slavery

Anecdotal evidence indicates that the movement of victims to and from a place of work is a common feature of modern slavery. This logistical activity should be regarded as distinct from 'trafficking' from one jurisdiction to another, which is often a pre-cursor to forced labour within a much smaller geographical area than the distance covered in a trafficking event (Kara, 2011). In modern slavery, movement is more regular and shorter in duration and distance than in trafficking. The underlying theory for our project was that modern slavery requires the use of the road network and that the efficient exploitation of these human resources would have routine activities that, over time, form a discernible logistical pattern and that this pattern can inform identification of perpetrator vehicles.

ANPR – coverage, suitability and challenges

The network of Automatic Number Plate Recognition (ANPR) cameras across the UK is a valuable tool of road policing and crime detection. ANPR cameras, which can be permanent, moveable or vehicle-mounted, collect information (a 'read') on the time, date, location and vehicle registration mark (VRM) as well as a photograph of any vehicle passing the camera. 'Read' data is fed to a central database of the owning police force and to the National ANPR Service (NAS). There are approximately 14,000 police-operated ANPR cameras active in the UK, capturing approximately 10 billion reads per year. These cameras are distributed at an average interval of 27 miles per camera, but that approximation is likely to be higher when vehicle-mounted cameras are considered and camera are often clustered around areas of high traffic volume. Therefore, for many journeys in rural areas, ANPR coverage is sparse or absent. The locations of fixed camera are protected and the secrecy of camera locations has been deemed to be in the public interest (*Mathieson vs IC & Devon & Cornwall Constabulary*); the location of ANPR cameras is restricted to police staff and officers. During the project, the period of retention for ANPR data was reduced from two years to one year. Data older than one year must be regularly deleted by police or other organisations processing ANPR data.

Methods

Specifically, we sought to determine what types of offences within the broad category of modern slavery rely on the road network and to identify patterns in movement by vehicles involved in perpetrating this type of offence. Two strategies were used in this aim: top-down interviews with expert modern slavery analysts and bottom-up quantitative description of patterns. The quantitative component of the project was undertaken concurrently. The overall aim of this component was to extract and link information from two police sources for analysis by a university researcher: intelligence logs on the VRMs of vehicles found to have been involved in the perpetration of modern slavery (eligibility for inclusion was on the VRM featuring in the police intelligence logs and an individual having been convicted for a relevant offence) and all ANPR read data (VRM; camera number; time; date) for up to one year.

Top-down description of modern slavery vehicular activity: Two interviews were undertaken with police analysts where they described their knowledge of the logistical component of modern slavery perpetration (the population of expert analysts on this topic is very small). The analysts were asked to describe different modern slavery offence types and the use of vehicles in these offences, vehicles characteristics (type; condition; ownership) and patterns of use and travel across offence and vehicle types.

Encryption training for personal data: As VRMs constitute personal data; the team devised a strategy for the encryption of VRMs (MD5 hashing algorithm) from the two systems. In anticipation of the data extraction, the project team produced data encryption software and training materials and delivered the training to eight analyst/officers in Lancashire, (a relevant officer in West Yorkshire Police was already proficient in data encryption).

Data search and extraction: Data processing agreements were submitted in March 2019 and approved by both universities and both police forces in June 2019 and data extraction began immediately. Analysts from both forces screened police intelligence logs for completed cases of modern slavery offences that had occurred and led to a conviction within one year (i.e. that a vehicle was actively involved in a modern slavery offence that led to a conviction after August 2018).

Results

Description of modern slavery vehicular activity: The extent to which vehicles featured in modern slavery and the proportion of modern slavery offences that these entailed was less than anticipated. The analysts noted four types of modern slavery that use a vehicle at some point in the offence: sexual exploitation, labour exploitation, child criminal exploitation and domestic servitude. Examples of patterned vehicle use in the perpetration of modern slavery offences included regular attendance at transport hubs, such as meeting the same bus/train/plane each week to collect new slaves (a noteworthy cross-over between human trafficking and modern slavery); regular daily movement of victims from a residence to a city centre location, such as a brothel or centre of on-street sex work activity; and regular collection of victims from multiple residences. Analysts also identified obstacles to the development of a detection algorithm based on VRMs. There are: [By request, this list of obstacles has been redacted from the published report on the grounds that they may be instructive in the perpetration of modern slavery offences].

Data searches and extraction: As there is no specific offence of 'modern slavery', analysts used related indicators/'flags' to search police intelligence logs for vehicles involved in the perpetration of modern slavery. These searches failed to identify any VRMs that were involved in offences and in which an individual was convicted within the permitted one-year timeframe of ANPR data retention. In some cases, VRMs were identified within the timeframe, but these related to offences older than one year: often these cases were several years old and had only recently resulted in conviction. In a smaller number of cases, recent prosecuted cases involving vehicles were identified, but the VRMs were not included in the intelligence logs. In the absence of suitable data on which to train a detection model and project time limits, the project was forced to abandon efforts to extract and link the two data sets in July 2019.

Findings – Implications for projects involving ANPR:

Although the project did not achieve its goal of developing the algorithm, in attempting to do so, a great deal of insight into how this and related 'big data' policing project can succeed – and how pitfalls can be avoided was gained.

The one-year retention period for ANPR is incompatible with development of this type of algorithm within a small number of forces. The low prevalence of these offences, the complexity of the investigation and the long time from criminal activity to conviction means that very little ANPR data will be available with which to model offender driving patterns.

The required process of 'rolling deletion' of data in excess of one year old creates a significant obstacle to efficient data sharing between police and other organisations: data processing contracts become more complex and algorithm development becomes a 'race against time' to ensure that target vehicle data can be included in models before the data must be deleted. The central feature of this obstacle is the low prevalence of target vehicles within one or two forces, placing high value on a small number of cases. Using NAS instead of force-level data would overcome this obstacle, but it would require the existence of national intelligence logs on cases of modern slavery.

Modern slavery is a rare event and the number of vehicles on the roads that are involved in perpetrating modern slavery is likely to be very small. In March 2019, there were 1,500 live modern slavery investigation in England and Wales (National Crime Agency, 2019). Even optimistically, for example, assuming, hypothetically, that these vehicles are all vans, only 1 in 400 vans is involved in perpetrating modern slavery; our interviews with analysts revealed that many types of vehicles are used in perpetrating these offences. Consequently, even a very low rate of false positive detection would mean that a large majority of vehicles classified as a target vehicle would be done so incorrectly. This would have implications for the usefulness of the tool, civil rights and police legitimacy.

Modern slavery consists of a broad range of offences that each are likely to have different logistical features. Our initial intention was to develop an algorithm to detect 'modern slavery', but models would need to accommodate these interclass differences, which further reduces the pool of suitable target vehicles on which to train a model.

A general lesson for police 'big data' collaborations: police data science

At present, police forces generally lack the technical skills and software to exploit the large quantities of data they hold. This necessitates partnerships with external organisations such as universities and private companies. In turn, these collaborations require substantial effort in data security (vetting, encryption, information governance agreements and external site assessments) and governance (approvals, data processing agreements and legal compliance). Even when these obstacles are overcome, these partnerships can still be inefficient (for example, as we observed, a civilian researcher cannot know the location of ANPR cameras). A more pragmatic solution is to develop data science capacity within policing through the recruitment of analysts and the secondment of data scientists from universities into police forces to overcome obstacles to information sharing. Evidence of police data science is emerging through the recruitment of data scientists to a small number of police forces but this level of skills is rare and ageing police software systems are not well suited to software such as Python that often relies on open source packages. This obstacle notwithstanding, police should seek to expand their data science capacity through secondment, recruitment and training.

References

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Authors: Iain Brennan, University of Hull, Lancashire Constabulary and West Yorkshire Police – **December 2019**

Further information – Iain Brennan (I.Brennan@hull.ac.uk)