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GEOGRAPHICAL OFFENDER PROFILING: Using Insights from Practical Applications to Enhance Theoretical Explorations

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SYNOPSIS

Geographical Offender Profiling (GOP) has become a lively area for research and debate since its early application to significant police investigations in the mid 1980's. Following the success of these applications decision support software has been developed, notably Dragnet and Rigel, to facilitate the use of GOP by crime analysts and police investigators. Some of this software, notably Dragnet in its various incarnations, has a great deal of flexibility built into it to allow it to be a valuable research tool for exploring criminal spatial behaviour. Questions about the theoretical richness of existing forms of GOP systems and the added requirements for their practical applications, beyond the mere utilisation of a geometrically oriented computer algorithm, undervalue the progress made so far. However, fundamentally these questions point to sources of error in the current modelling of criminal behavioural geography. Rather than assuming GOP is a distinct process it is more fruitfully regarded as a set of hypotheses about patterns in criminal cognitions and actions. These hypotheses are worthy of further development and test rather than being left in the realm of detective hunch and conjecture.

NAIVE JUDGMENTS OF CRIMINAL SPATIAL ACTIVITY

Since the early Canter and Larkin (1993) and Canter and Gregory (1994) studies showed the empirical validity of determining the area in which a serial offender is likely to live from details of where crimes were committed the whole are of what has become known as Geographical Offender Profiling (GOP) has generated an increasing amount of research and heated debate around its theoretical basis effectiveness and ways in which it can be applied in a wide variety of police investigations.

In order to demonstrate the ideas behind the emerging principles and findings of GOP research I used to carry out exercises with my students on the MSc in Investigative Psychology at the University of Liverpool from the mid 1990's for about 15 years. In those sessions I gave students details of the crimes committed by serial killers, drawn from published reports, which included information about the

victims and dates of the crimes as well as the locations on a map of body disposal sites. The students were asked to guess where the offender lived and provide their reasons. Their decisions were then compared with the results obtained from the existing version of the GOP system, Dragnet (Canter et al 2000).

This teaching exercise revealed both the distractions and complexities of working with the details of actual cases as well as the limitations of the computer models of offender spatial behaviour available at that time. In some cases students would do better than Dragnet, for example when they took account of useful sequential or land-use information that the computer ignored. In other cases they would do worse, when for instance they made inappropriate inferences about the offender's familiarity with an area or the significance of the body disposal site location.

The exercise thus taught students a lot about the need to defend their assumptions and how easy it was to be misled by irrelevant details. By giving them a number of examples it was also possible to show the variety of spatial distributions of crime site locations and the consequent challenge of developing any simple models that would apply to all criminal spatial activity.

FROM LECTURE THEATRE TO LABORATORY

Some of my students (Snook et al, 2002, 2004) who took part in those active lectures realised that they could be the basis of some interesting, if somewhat artificial, experiments. They asked their subjects to apply a straightforward set of geometric rules to points drawn on a sheet of paper. These rules amount to asking respondents to mark the spot where they estimate the centre of gravity of the points to be. The dots on the paper reflected locations of offences on a map. So that in so far as the offender's home really is near to the centre of gravity of those locations this task is an analogy for identifying the likely residential location of an offender from where crimes are committed.

What apparently led Snook and his associates to select this as a model for experimental study was that, in general, when students were provided with the broad principles on which computerised geographical profiling systems operate on average their guesses were reasonably close to what the computer would produce, having therefore a similar overall accuracy.

That students can on average be as accurate as GOP software in estimating an offender's location should not be a surprise because the simplified models the students were given that are built into computer systems were derived from empirical studies going back over a decade (Canter and Larkin, 1993; Canter and Gregory 1993). These studies show that in as many as 80% of cases (and usually in at least 50%) offenders live within an area circumscribed by their known offences and surprisingly often live reasonably close to the centre of gravity of those offence locations. Different algorithms can be applied to give more precision to the predicted base of an offender but the police data on which any calculations are based lack precision and accuracy so as Levine and Associates (2000) have pointed out they all tend to give similar results.

However, the average response of a group of judges looking at dots on a page should not be equated with the workings of a computer. From my experience in

workshops using the examples I had used with students, as mentioned earlier, and discussions with police officers on live enquiries it is not uncommon for them to be misled by irrelevant crime details that the computer algorithms ignore. They are also typically inconsistent in the criteria that they use for making guesses about an offender's base in a way that a computer is not. The effectiveness of people or computers will depend on the validity and generelisability of the principles being applied to patterns in criminal spatial behaviour not on the whether it is a person or a computer making use of those patterns. As research adds further subtlety to the models of criminal spatial activity so it becomes more difficult for humans to emulate those models as recent studies are showing (Canter et al, 2012)

It is essential to note, though, that no detailed studies of representative samples of cases show that current geographical profiling models are very accurate in more than a small percentage of cases. This small percentage is operationally useful and produces enough impressive case studies to encourage the mass media and police officers to regard geographical profiling as a useful tool. However, the limits to the effectiveness of the systems in use show that there is considerable noise in the data used and many sources of error in the models that further research needs to address.

The errors in the results from current computer algorithms are thus partly a function of how oversimplified are the models of criminal spatial behaviour on which they are built. In essence these models are little more than a set of straightforward geometrical principles. This raises the questions of whether criminals draw, at least implicitly, on such uncomplicated cognitive rules when deciding where to commit their crimes. Initial explorations by Canter and Hodge (2000), in which criminals are asked to draw ‘mental maps’ of where they commit their crimes, are beginning to show how impoverished are current geometrical models. Therefore the limitations in the effectiveness of geographical profiling systems, whether carried out with or without the aid of computers, are likely to be due to the simple-mindedness of the models of criminal cognition they assume.

As I have commented, the academic experiment of seeing whether people on average can guess where an offender is based as accurately as a computer programme can "raises some important, but is has to be admitted not especially profound, questions about the judgements people are able to make when faced with a simplified summary of the spatial distribution of crime locations. If the task did simulate an important component of an investigative decision making process it would raise the possibility that the skills the subjects exhibit could replace intensive training sold at considerable expense and requiring a dedicated computer system." (Canter, 2005, page 664).

These experiments therefore lead to two sets of issues. One is whether the models that have emerged from research require computer systems to put them into practice? In other words are the weaknesses in the predictive power of current models their inherent simplicity? That does seem to be the case raising the further question of what the basis of their limitations are?

The answer to this question can be found in the other challenge to the laboratory simulations and class exercises where people attempt to determine where an offender may have a base. These are the operational conditions in which application of geometrical models, and computerised support for those models take place? In other words, should the limitations in predicting a serial offender's base, in academic simulations of GOP, be put down to the fact that these simulations GOP do not take account of other relevant information available to crime analysts and police investigators? If that is the case then this relevant information needs to be

incorporated into GOP systems and needs careful definition and the validity of it improvement to GOP needs empirical testing.

APPLYING GOP IN PRACTICE

Rossmo (2005) disputes the claims that people are as effective as GOP systems by arguing that in actual practise these systems are an adjunct to other information available to the 'geographical profiler'. This can include knowledge of land use and transport routes, guardianship and target attractiveness. But surely is it not more appropriate to think of the lack of these being accounted for in GOP systems as sources for error in current algorithms that need further research?

Furthermore, there is the question of exactly how police investigators do make use of decision support systems? This is important to understand because it has implications for the details of how the system should function and the levels of accuracy required. Such information could therefore indicate that many of the questions about the accuracy of GOP systems are less relevant in practice than other matters such as their robustness and ease of use.

In practice police investigators typically select the series of offences for which they consider geo-behavioural analysis to be appropriate. This, ofcourse, biases the sample on which geographical profiling has been operationally tested. This is quite different from the studies of geographical profiling (e.g. Canter et al 2000), in which a full set of cases, unselected in any way, are subject to study. It is that unbiased sample which reveals the broad findings of offender's geo-behavioural consistencies.

The basis for selecting operational cases to work on is sometimes made to seem sophisticated and experience based. Serial offenders are referred to as predator and an evocatively rich vocabulary is drawn on to imply recognisably distinct styles of predation. This implies that the geographic profiler is not just a behavioural scientist seeking to develop objective models of criminal actions, but a hunter with special skills seeking out a prey. Terms such as 'hunting area', 'troller' and 'poachers' are drawn on as rhetorical devices that can obscure the need to provide detailed definition of concepts and explanations. They suggest that the police officer's decisions are a product of experience rather than being based on established empirical findings.

WHEN TO USE GOP

At present there is no definitive account of the objective processes that can be used to select crimes in order to increase the probability of a geographic profiling analysis being effective, although that is certainly a viable and active area for research. Various police officers, however, have offered up suggestions derived from cases in which they have been involved that do provide interesting hypotheses for further study. Some of the issues they raise are revealed through published case studies (Canter 2004). These indicate areas in which further understanding of criminal processes would be productive.

One such issue is the question of the minimum number of cases necessary before a geographic profiling analysis can be conducted. A random numbers trial described as a 'Monte Carlo' analysis is sometimes quoted as a way of answering this question, leading to the claim that a minimum of 5 crimes are necessary before

geographic profiling can be of value (Rossmo 2000). This process uses 'a computer program to generate random crime site coordinates based on a fixed-buffer distance decay function' (Rossmo 2000, page 206). Clearly, such a trial is artificial in the extreme. It is thus not unexpected that detailed published accounts of studies using Dragnet on a non-artificially selected sample of actual crimes (e.g. Canter et al , 2000) have shown that there is no empirical necessity for using five or more crime locations. Indeed there is considerable case study evidence (Canter 2004) to show that serial offenders often indicate their base location in the first two or three crimes they commit. But even in one-off crimes the likelihood of an offender being local to the offence can be of great value to investigators (cf. Jill Dando murder – Canter 2004) and just how local can be estimated by using the decay functions at the heart of geographic profiling software.

Another issue is the claim that in order to use geographic profiling the crimes must be 'linked together and the series relatively complete'. Yet consideration of the statistical issues involved make clear that there is no need for the crime series to be complete, as long as it is a representative, unbiased sample of the crimes the offender has committed. Any subset of the offender's crime locations should give the same result if the model is appropriate.

The need for the crimes to be linked is also a consequence of noise in the information available. In a series with a large number of crimes a small number of inappropriately included crimes that do not distort the overall geography of the crime locations will have little effect on the outcome of geo-behavioural analysis. In a smaller series and with crimes that would greatly modify the spatial configuration the problem of errant data is more marked. The issue is thus not a matter of police intuition but one of estimating the consequences of various types of error for the various conclusions that might be reached. The impact of including or omitting various crime locations, which the flexibility of Dragnet, for example, makes possible is one way of determining the sensitivity to possible biases in the data of any inferences drawn. The question of including crimes inappropriately into the series is thus one of error estimation and its consequences.

The same is true for the need to determine if the offender is travelling into an area to commit his crimes, often somewhat erroneously referred to as a 'commuter', or if the offender has moved home during a crime series. As yet there is no published evidence that police officers are able to determine with any accuracy if the offender is based in the area of his crimes or not. Nor are there any objective guidelines that have been empirically supported to determine this.

The lack of guidelines demonstrates the need for research that demonstrates the size and nature of any errors introduced by the complexities of criminal mobility and how they may be reduced. The different patterns of offender mobility introduce errors into current geo-behavioural models. That is part of the reasons why the results of published studies of geographical profiling do not reveal complete accuracy for the process. What is needed is more careful determination of how to reduce errors by specifying the measurable influences on criminal geographical activity.

The most problematic issue is the process of linking crimes to a common offender in the absence of clear forensic or other identifying information. Bennel and Canter (2002) have shown that geo-behavioural information can be remarkably productive in doing this. Such findings rather turn on their head any proposal that crimes should first be linked then geographically profiled. It may be of more operational value to deal with crime locations first and use that as part of the process of linking.

IS GREAT GEOGRAPHICAL PRECISION NEEDED?

Geographic profiling systems provide probabilities across a geographical area rather than a point location. The idea being that the regional probabilities would be used for setting up police searches for possible suspects. However, in the very detailed accounts Canter (2004) gives of a number of police investigations that used geographical searches it transpires that the police do not often set up searches that directly and precisely shaped by the probabilities generated on the geographically profiled map. The search strategies of investigators typically seem to draw on the locations of known offenders and distance from key points on the map, only partly determined by the highest probability indicated by geographical profiling.

This raises some intriguing questions about the cognitive processes underlying police geographical search patterns and how they may be best integrated into geo-behaviourally based decision support systems. Such explorations will improve our currently limited understanding of the mental models on which police draw to make their decisions as well as opening the way for psychologically richer, new generation of geographical profiling systems.

CONCLUSIONS

The exploration of an exercise that started in my lectures as an analogy for police decision making using geographic profiling that Snook et al (2004) utilised is inevitably limited, being not at all close to operational decision making as Rossmo (2005) argued. Nonetheless, the debate initiated by the confusion of theoretical and operational concerns do help to clarify the ways in which the current simple models built into GOP systems need to be developed to capture more of criminals' geographical behaviour and so be of more practical utility.

The apparent differences between the activity of an experienced police officer and the workings of GOP software help to reveal what limits the effectiveness of geographic profiling computer models. Rather than regarding these limits as merely practical restriction on selecting the offences that can be subjected to computer analysis it is more productive to regard them as areas in which hypotheses need to be developed. In so doing we will understand more about criminals' cognitive processes. We will also open the way to exploring the forms of heuristic that police investigators can actually use when drawing on geometrical representations of criminal spatial activity.

Inappropriate use of geographical profiling can have serious consequences. That is all the more reason why we must develop our understanding of what introduces biases and errors into geo-behavioural decision support systems and into the cognitive processes of those who use those systems. Treating these errors as operational problems that have to remain in the hands of police officers will keep criminal investigation in the dark ages of intuition and hunch.

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