Man versus machine

The case of geographic profiling

Geographic profiling is a police decision-making task that requires a prediction to be made about the home location of an at-large serial offender, based on information about where that offender has committed his or her crimes. The most publicized solution to this task involves using computer systems to produce a probability map that shows the likelihood of an offender residing at various locations around the area where their crimes were committed -*see probability map (diagram one).*

Based on decades of offender spatial behaviour research, these computer systems utilize mathematical functions (derived from large data sets) that reflect the distribution of distances between offender home and crime locations.

What is surprising about these complex and, until recently, costly actuarial systems however, is that they have been implemented around the world without any evidence that they outperform human judgments. We have been conducting experiments over the past three years to determine how people perform on geographic profiling tasks and the sorts of strategies they employ when making such predictions and can now report four major conclusions.

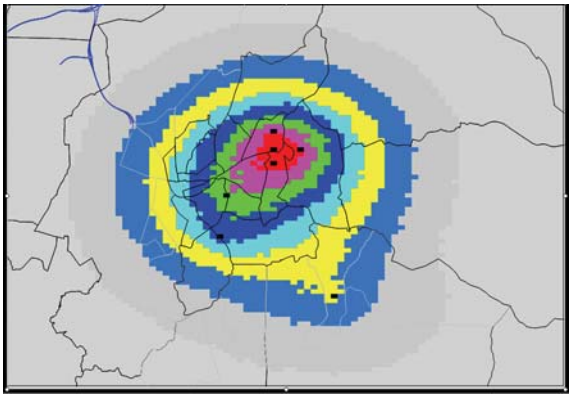

Diagram 1

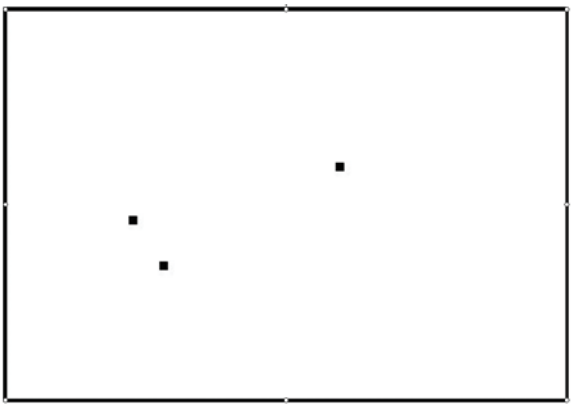

Diagram 2

1. *People use simple cognitive strategies to make accurate predictions.*

Please examine diagram two and predict, by marking an X on the map, where you think the serial offender is living (the black dots represent crime locations).

If you are like one of our participants, you probably used one of two simple cognitive strategies. Prior to being instructed on how best to make such predictions, you may have used either the Equidistant heuristic (you predicted that the offender lives roughly in the centre of all the crimes) or the Cluster heuristic (you predicted that the offender lives close to the majority of crimes). In either case, you would have made a reasonably accurate prediction.

We discovered that people using one of these two strategies made accurate predictions because these strategies exploit the empirical regularities associated with offender spatial behaviour. In other words, a strategy that involves predicting that the home location of an offender will be in the centre of their crime locations matches the empirical regularity that serial offenders often live central to their area of criminal activity.

Of particular interest to the police practitioner is our finding that, before training, police officers who used one of the two strategies above made predictions that were as accurate as those produced by one commonly used geographic profiling system.

2. *It is possible to train people to improve their predictions.*

Although some used inappropriate strategies to make predictions, we have found that it is possible to teach them to apply more effective strategies through a 10-minute training session. We have trained groups of participants to use one of two simple strategies that we knew beforehand would exploit the empirical regularities associated with offender spatial behaviour.

The two strategies are the Circle heuristic (serial offenders often live within a circular area with the diameter defined as the distance between the two furthest crimes in a series) and the Decay heuristic (serial offenders often do not travel far from home). We found that introducing one of these heuristics resulted in improved predictive accuracy. Again, perhaps most important to the police practitioner, is our finding that it is possible to train groups of police officers to make heuristic-led predictions that are as accurate as those made by one commonly used geographic profiling system.

3. *Simple strategies perform as well as more complex strategies.*

Geographic profilers have access to a repertoire of strategies for predicting a serial offender's home location. These range in complexity – some involve more calculations to implement than others – and the assumption often made is that more complex strategies (e.g., negative exponential function) will outperform simpler (e.g., mean centre) strategies.

We tested this assumed relationship between the complexity and accuracy of 11 strategies and showed that strategy complexity wasn't positively related to accuracy. In other words, when used to make geographic profiling predictions, simpler strategies were often more accurate than complex strategies. Simpler methods were also found to perform as well as complex strategies across profiling tasks that ranged in complexity, where complexity was defined by the number of crimes included in an offender's crime series (i.e., increasing number of crimes equates to increasing complexity).

From this evidence we offer the following advice: Geographic profiling experts who rely on complex geographic profiling systems may be providing nothing more than what could be achieved by applying one of the two strategies described above.

4. *Increasing task complexity does not have an effect on human predictive accuracy.*

It has been contended that actuarial systems might outperform human judges when the geographic profiling task becomes more complex (i.e., when there is more information to consider).

In our most recent research, we tested this notion by varying the number of crimes that our participant's had to consider when making their predictions and by providing some of our participants with topographic information. We found that human predictive accuracy wasn't affected by the inclusion of either of these factors, thus human judges appear capable of making accurate profiling predictions under a range of conditions.

Our findings may surprise those who believe it is necessary to use computerised geographic profiling methods that require extensive training. In terms of operational support, our findings suggest that police officers can make highly accurate predictions when using only simple strategies. Furthermore, in terms of training, the findings indicate that police forces may be able to suffice with a quick and inexpensive training exercise that teaches their officers simple decision rules.

The significance of this implication increases with smaller police agencies that may be limited in their technological capabilities. These forces will likely find low-cost, easy-to-implement alternatives to geographic profiling systems particularly beneficial.

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