
GEOGRAPHICAL PROFILING AND CRIMINAL JUSTICE SYSTEM – TRACKING THE SPATIAL PATTERNS OF SERIAL OFFENDERS

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ABSTRACT

Some crimes occur on the spur of the moment, some randomly and some are pre-meditated. In crimes that are pre-meditated, the offender makes decisions pertaining to the choice of the victim, location of crime, the mode of transportation, etc. The offender makes these decisions based on risks; convenience and the benefits associated with the commission of crime. Pre-meditated crimes involve a pattern or *modus operandi*. These patterns become more evident in cases where series of crimes have been committed by the same offender(s). The choice of place or area identified for commission of crime plays an important role. Research has shown that offenders commit crimes in places with which they are familiar. Therefore, the place where the crime has been committed plays an important role in tracing the criminal's likely place of residence or workplace and in apprehending him. Tracing the place of residence or workplace from the scene of crime is termed as Geographical Profiling (GP). GP helps in narrowing down the area of investigation, the pool of suspects and emerges as a very potent tool in criminal investigation. Various software like Rigel and Dragnet have been developed incorporating the principles of GP to trace the offenders. While GP is extensively used in the western countries, India is lagging behind in its application. GP is studied extensively by Criminologists in India, however, its research from the perspective of Law and Criminal Justice System is wanting. The writer of this paper analyzed the studies from various countries like U.K, U.S.A, Japan and Australia to assess the efficacy of GP and its tools like Rigel and Dragnet. The study only revealed the effectiveness of GP and its various tools, especially in crimes committed by serial offenders. Based on these findings, the writer makes a strong case for its integration into the criminal justice system of India.

Keywords: Geographical Profiling, Criminal Investigation, Criminal Justice System, Rigel, Dragnet.

1. Introduction

Santosh Chawle, a watchman raped a nineteen-year-old girl living in the building which he was guarding in Indore, Madhya Pradesh.¹ Munish Ahmed used to habitually steal belongings of passengers travelling late night on local trains in Mumbai between Dadar and Mahim railway stations. The Railway Police identified the *modus operandi* of Munish and started patrolling the local trains at night. He was caught red-handed at Dadar railway station.² A school bus driver sexually harassed a four-year-old girl who he used to ferry from home to school in Thane, Maharashtra.³ A gang of robbers originally hailing from Rajasthan travelled to loot from affluent localities in Bhubaneswar, Odisha.⁴ Sunil Kumar Rastogi, a tailor, admitted to have sexually assaulted around 500 young girls between the age of seven to twelve years over a period of twelve years. He used to travel from Uttarakhand to Delhi every week or fortnight and stalk his victims outside schools and in localities with which he was familiar.⁵ The victims in the above incidents were targeted on the basis of the familiarity of the criminal with the place and the convenience in committing the crime, apart from other factors. Pre-meditated crimes involve a pattern, a *modus operandi*, unlike crimes that occur on the spur of the moment. The patterns or *modus operandi* become more evident in case of series of crimes committed by an individual or a group of individuals. The patterns can be discerned from the victims selected by the criminal, the weapon used, the crime sites, amongst other factors. The choice of the place or locale where the crime is committed plays an important factor in committing a crime. A criminal, often commits the crime in a place with which he is familiar. Therefore, the place where the crime has been committed plays an important role in tracing the criminal's likely place of residence or workplace and in apprehending him. Tracing the place of residence or workplace from the scene of crime is termed as Geographical Profiling (GP). GP helps in

¹On-Duty Security Guard Rapes Teen, Booked, TIMES OF INDIA (May 11, 2024, 04:47 AM), <https://timesofindia.indiatimes.com/city/indore/security-guard-rapes-teen-arrested-in-indore/articleshow/110023232.cms> (last visited Jun. 13, 2024).

² Samiullah Khan, *Mumbai: Railway Cops Arrest Man for Stealing Commuters Belongings in Local Trains*, MID-DAY (Jul. 19, 2022, 07:59 AM), <https://www.mid-day.com/mumbai/mumbai-crime-news/article/mumbai-railway-cops-arrest-man-for-stealing-commuters-belongings-in-local-trains-23236734> (last visited Jun. 13, 2024).

³ PTI, *Mumbai School Bus Driver Gets 7 Years Rigorous Imprisonment for Sexually Harassing Girl*, THE NEW INDIAN EXPRESS, (Mar. 02, 2024, 01:01 PM), <https://www.newindianexpress.com/nation/2024/Mar/02/mumbai-school-bus-driver-gets-7-years-rigorous-imprisonment-for-sexually-harassing-girl> (last visited Jun. 13, 2024).

⁴ Debabrata Mohapatra, *'Chaddi Baniyan' Gang that Broke into 16 Houses Held*, THE TIMES OF INDIA (Jul. 19, 2023, 08:30 AM), <https://timesofindia.indiatimes.com/city/bhubaneswar/chaddi-baniyan-gang-that-broke-into-16-houses-held/articleshow/101908806.cms> (last visited Jul. 13, 2024).

⁵ Somreet Bhattacharya, *Delhi Tailor Says He Sexually Abused 500 Kids in 12 Years*, THE TIMES OF INDIA (Jan. 16, 2017, 07:26 AM), <https://timesofindia.indiatimes.com/city/delhi/delhi-tailor-says-he-sexually-abused-500-kids-in-12-years/articleshow/56581789.cms> (last visited Jun. 15, 2024).

not only narrowing down the area of investigation but also narrows down the pool of suspects and emerges as a very potent tool in criminal investigation.

While GP is extensively used in many countries, India has not seen much of its application. Though, GP is studied extensively by Criminologists in India, its application in criminal investigations and Criminal Justice System in India (CJS) is wanting. The writer of this paper explains the technique of GP, the various principles underlying it, highlights its efficacy as an investigative tool and makes a case for its application to CJS in India.

2. Understanding Environmental Criminology and Geographical Profiling

GP has its roots in Environmental Criminology (EC). There are various factors like family background, economy, media, politics, etc. which play an important role in determining why an offender commits a crime. Geographical factors or spatial factors like location of workplace, home, pub, including topography of a particular place also play a pivotal part in selecting a target for commission of crime. Absence of street lighting, desolate areas, lack of security, availability of escape routes can make a home, a workplace or a pub, etc. vulnerable and susceptible to crimes. EC studies the geography of a particular place and tries to identify spatial patterns which could encourage criminal behaviour. Thus, EC tries to identify the spaces or places where crimes are likely to be committed. Its study also encompasses why offenders choose to commit crimes in particular places. The thrust of EC is to predict 'where' crimes are likely to be committed and identify the common behavioural patterns of offenders. Based on the behavioural patterns of offenders, EC has developed various principles, concepts and theories which not only give an insight into the considerations made by an offender in selecting a place to commit a crime but also demonstrate that the spatial patterns of an offender are predictable. These help EC to predict the place where a crime would be committed from the place of residence of an offender. The principles, concepts and theories developed by EC form the basis of GP.

GP is an investigative technique that analyzes the spatial pattern of a related series of crime locations in order to predict the location of the offender's residence.⁶ GP is basically a crime analysis technique which studies the locations of connected crime sites to determine the

⁶ DARCY K. ROSSMO, *GEOGRAPHIC PROFILING* (Boca Rotan FL: CRC Press, 1st edn. 2000).

probable place of residence of the offender or place of work.⁷ In simpler words, GP is a technique which helps in tracing the probable place of residence or the workplace of the offender from the crime sites. Thus, the crime sites are used as the starting point to determine the residence or workplace of the offender. GP can be applied in cases which are believed to be committed by an individual or group of individuals. A series of crimes not only reveal common behavioural patterns but also common spatial patterns. The spatial patterns of the offender are revealed by plotting the crime sites on a map. These spatial patterns can help in determining the probable place of residence or workplace of the offender(s). Fig. 1 demonstrates how spatial patterns can be discerned.

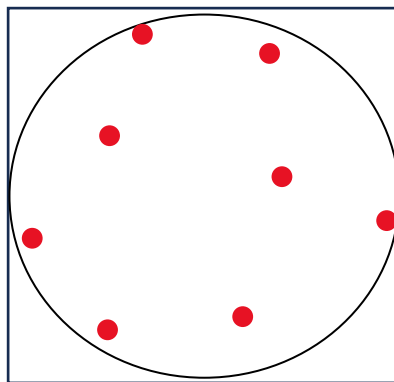


Figure 1: Spatial Patterns of an Offender

Source: Writer's own art work

In Fig. 1, the red dots are the crime sites where murders have been committed. The circle encompasses the area within which the murders took place. All the victims were middle-aged, single white women, living alone. The murders occurred around 2:00 a.m. in Letchworth, Hertfordshire, London. All the victims were stabbed multiple times in their lower abdomen and chest. The *modus operandi* indicates the authorship of the same perpetrator. The above figure, reveals the spatial pattern of the offender. It appears that the offender commits crimes in different locations and does not commit the crime in the same location. It appears that after he commits a crime, he returns to his place of residence or workplace. The spatial patterns allow

⁷ Ian Laverty & Philip MacLaren, *Geographic Profiling: A New Tool for Crime Analysts* 4 CRIME MAPPING NEWS 5-8 (2002), <https://www.ojp.gov/ncjrs/virtual-library/abstracts/geographic-profiling-new-tool-crime-analysts> (last visited Jul 27, 2024).

the Police to infer that the offender is familiar with the locality and that he lives in the same locality. It appears that he lives or works near the centre of the circle (locality).

The inference that offender lives or works in the centre is based on the principles, theories and concepts which GP relies on. The various principles, theories and concepts of EC that GP relies upon are discussed in the ensuing segment. Before these are discussed, there is a need to understand the various divisions of the spatial activity of an offender.

3. Offender's spatial activity and its geographical divisions

The locality in which the offender lives and commits the crime is divided into various zones or ranges. These divisions are based on the behavioural analysis and spatial activity of the offenders and are discussed below.

Buffer Zone

Buffer Zone is an area immediately surrounding an offender's home where he/she will not offend. Though the effort of travelling to commit a crime would be minimal, the likelihood of recognition and apprehension is high. The criminal opportunities increase with the increase in distance from home.⁸ The principle of buffer zone is applicable to the Distant Decay Theory and Rational Choice Theory.

Home Range

Home Range surrounds the residence of the offender and it lies immediately after the Buffer Zone.⁹ The offender is familiar with this area.

Criminal Range

The offender commits crime outside the Home Range. The place where he commits the crime is referred to as the Criminal Range.¹⁰

Fig. 2 given below depicts the various divisions of the spatial activity of an offender.

⁸ RAY BULL ET. AL., CRIMINAL PSYCHOLOGY-A BEGINNER'S GUIDE 21 (Oneworld Publications, Oxford, England, 1st edn. 2010).

⁹ Ibid.

¹⁰ Ibid.

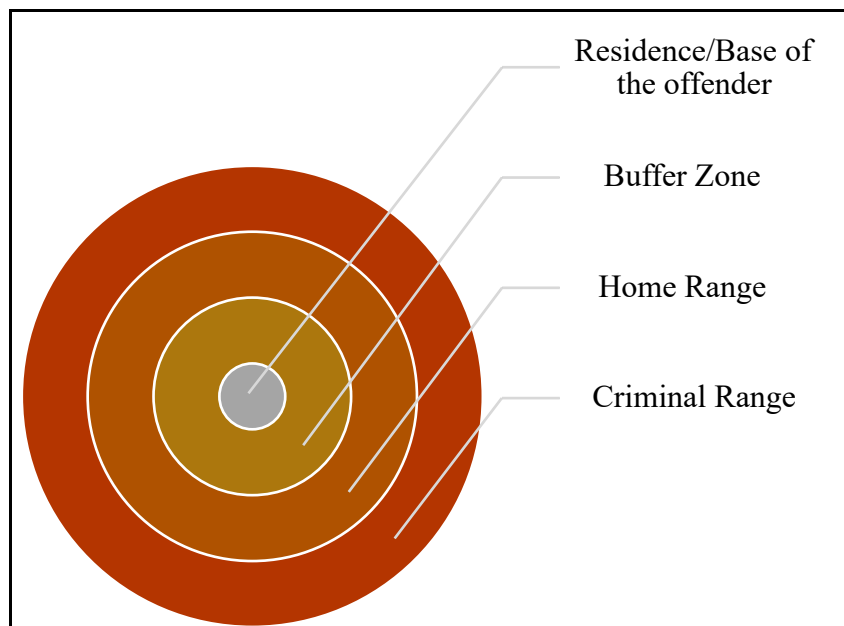


Figure 2: Divisions of Spatial Activity of an Offender

Source: Writer's own art work

4. Principles, Theories and Concepts underlying Geographical Profiling

The various principles underlying GP have been developed based on human nature and behaviour. These indicate the rationale as to why individuals behave in a particular way or take particular decisions in their day-to-day lives. An offender when offending is no different and he too, chooses his victim, location of crime, mode of transportation, etc. based on the decisions that he makes in his day-to-day life. The various concepts, principles and theories underlying GP are discussed below.

Distance Decay Principle

When one wants to obtain something, he or she will prefer to commute to a place which is closer to obtain it rather than travel farther. People in general, do not like to put in more efforts in travelling to obtain their target object. As the distance between the target object and the people grows, there is a less likelihood of them traversing that distance to obtain it. If the target object is available at two different places, then the offender will choose a place where he will have to travel a shorter distance to obtain it, if the risks and benefits associated with both the

places are the same.¹¹

Illustration

The offender has the option of striking at either of the two targets given below. The distance to the two targets from the residence of the offender is as under:

Target X ----) 100 km, Target Y ----) 55 km

The risks involved and benefits derived with regard to both targets are the same but the distance varies. As per the Distant Decay Theory, the offender will choose Target Y which is closer to his home. The Distant Decay Theory postulates that as the distance between the target and the offender increases, he is less likely to offend.

Rational Choice Theory

This theory was developed by Derek Cornish and Ronald Clarke. The theory postulates that an offender will do a risk analysis before making a decision to infringe the law. The offender will compare the risks, i.e., the strain of travelling, possibility of being caught, punishment for the offence, etc. with the gains, i.e., the extent to which he desires the target object, financial gain¹²

Illustrations

- (i) A robber planning to target commercial places might be willing to travel greater distances if the crime yields him greater monetary gains.
- (ii) A murderer who seeks to target a particular type of victim will be willing to travel farther.

Routine Activities Theory

This theory was first developed by American Criminologists, Lawrence Cohen and Marcus Felson. According to them, criminals commit crimes in localities which are known to them. These could be workplaces, recreational areas, schools, etc. While carrying on their daily life, they notice potential targets. When they see that there is no guardian or person to prevent the

¹¹ RAY BULL ET. AL., CRIMINAL PSYCHOLOGY-A BEGINNER'S GUIDE 21-22 (Oneworld Publications, Oxford, England, 1st edn. 2010).

¹² DEREK B. CORNISH ET. AL., THE REASONING CRIMINAL: RATIONAL CHOICE PERSPECTIVES ON OFFENDING. (Springer, New York, United States of America, 1st edn. 2017).

crime or protect the target, they make their move and commit the crime. For example, a vegetable vendor in a particular residential locality may observe that a couple has gone on a vacation and that their house is uninhabited. He may break into the house to steal in their absence.

Case Study of Cletus Wilson - The Bedroom Rapist

In Louisville, 16 women aged between 21 and 25 years were raped. All the victims were young mothers, unemployed and 'white'. The victims were targeted in the late morning hours when their husbands would be away at work and they were alone. The rapist would have continued to target other victims had it not been for the foresight and courage of one of the victims. When the rapist asked this particular victim if she had enjoyed the physical act with him and if could come again the next day, the latter answered in the affirmative. The next day when the rapist barged into the bedroom, the police was lying in wait for him as the victim had tipped them off. The rapist was arrested by the police and he turned out to be Cletus Wilson, a respected Chiro Practitioner. The homes of all the 16 victims were in the areas between his home and clinic.¹³ Due to his regular commute to his clinic, Cletus Wilson became familiar with not only the areas where he committed the crimes but also the demography of the people living there. This familiarity aided him in committing the crimes in those areas. This case only underlies the importance of how the Routine Activities Theory influences the decision making of the offenders and thus, aids in creating a Geographical Profile of an offender.

Mental Maps

Generally, individuals have a mental picture or mental map of the physical environment in which they live and work. These affect the perception of distances to the various places a person commutes or travels to on a regular basis. The distances seem to be shorter or closer than they really are due to familiarity with the routes and availability of transport. Likewise, distance to a particular place may seem farther than it actually is in one's mental map due to lack of transport. The offenders too, have a mental picture of the physical environment and have similar perceptions as to distances. Thus, mental maps not only help an offender in determining the place where a crime can be committed but also help him in choosing the victim. It has been

¹³ RONALD M. HOLMES & STEPHEN T. HOLMES, PSYCHOLOGICAL PROFILING AND RAPE, PROFILING VIOLENT CRIMES: AN INVESTIGATIVE TOOL 155-156 (SAGE Publications Ltd, London, United Kingdom, 4th edn. 2009).

found in a study that availability of transport to burglars determines the distance they travel to commit burglaries. Burglars who owned vehicles travelled greater distances than the ones who did not own a vehicle.¹⁴

Circle Theory of Environmental Range

This theory postulates that when all other factors are equal, the Criminal Range and Home Range of the offender will be in circular shape. The residence of the offender will be located in the center of this circle. When a circle is drawn through two offences which are geographically farthest, the likely place of residence or base of the offender can be predicted. It would be located within the circle and also towards the center. These geographically farthest places where the offences were committed would also be those which are farthest from the residence or base of the offender.¹⁵ The effectiveness of this theory has been substantiated by many studies. The results of some of the studies testing this theory have been depicted below in the form of Table 1.1.

Table 1.1: Accuracy of the Circle Theory vis-à-vis Serial Offenders

Investigators/Researchers	Country	Offenders	Accuracy of the Circle Theory
David Canter & Larkin	England	Serial Rapists	87% ¹⁶
R. N. Kocsis & H. J. Irwin	Australia	Serial Rapists	70% ¹⁷
		Serial Arsonists	82% ¹⁸
		Serial Burglars	49% ¹⁹

¹⁴ Supra Note 12 at 22.

¹⁵ DAVID V. CANTER & PAUL LARKIN, *The Environmental Range of Serial Rapists* 13(1) JOURNAL OF ENVIRONMENTAL PSYCHOLOGY, 63-69 (1993).

¹⁶ Ibid.

¹⁷ RICHARD N. KOCSIS & HARVEY J. IRWIN, *An Analysis of Spatial Patterns in Serial Rape, Arson, and Burglary: The Utility of the Circle Theory of Environmental Range for Psychological Profiling*, 4(2) PSYCHIATRY, PSYCHOLOGY AND LAW, 195-206 (2009).

¹⁸ Ibid.

¹⁹ Ibid.

S. Hodge	U.S.A	Serial Murderers	86% ²⁰
M. Tamura & M. Suzuki	Japan	Serial Arsonists	72% ²¹

Source: Writer's own compilation from the research studies of investigators mentioned in the Table 1.1

5. Typologies of offenders based on Geographical Profiling

Based on the spatial patterns and behaviour of offenders, Dr. Kim Rossmo and Prof. David Canter developed the Marauder and Commuter typologies or models of offenders and the same are described below.

Marauders

There is a close relationship between crime sites and the offender's residence or base in case of Marauders. The Marauders move outwards from their residence or base to commit crimes. After committing the crime, they return to their residence or base.²² The route that they take generally changes every time they venture out to offend. These changes in the route can indicate the crime sites of the past offences committed by them. The Home Range and Criminal Range of Marauders overlap.

²⁰ SAMANTHA HODGE & DAVID CANTER, PREDATORY PATTERNS OF SERIAL MURDERERS, Internal Report, Center for investigative Psychology, Liverpool (1998).

²¹ MASAYAKI TAMURA & MAMORU SUZUKI, *Criminal profiling research on serial arson: Examination of Circle Hypothesis estimating offender's residential area*, 38(1) RESEARCH ON PREVENTION OF CRIME AND DELINQUENCY, 13-25 (1997).

²² DAVID V. CANTER, *Environmental Range of Serial Rapists*, PSYCHOLOGY IN ACTION, 221 (1996).

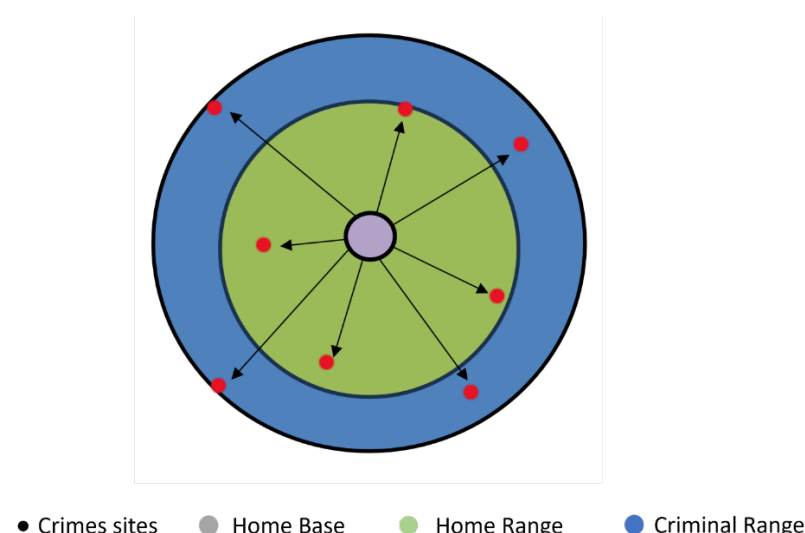


Figure 3: Marauder Model by Canter & Larkin

Source: Writer's own art work

Fig. 3 depicts the Marauder Model developed by Prof. David Canter and Prof. Larkin. The above figure shows that the Marauder commits crime in the Home Range as well as in the Criminal Range. Consequently, the Home Range and the Criminal Range overlap. It has been found that serial stranger rapists, vehicle thieves, rioters, street robbers and serial arsonists belong to the Marauder Typology.

Case Study of Peter Sutcliffe – The Yorkshire Ripper

Thirteen women were killed in Bradford, Yorkshire, U.K. between 1975 and 1980. Most of the victims were prostitutes and the attacks on them took place in the red-light areas. The victims were ambushed from behind and hit on head. The killer would then attack their private parts with a sharp weapon and kill them. The thirteen murders and seven attacks occurred in Manchester, Halifax, Keighley, Leeds, Bradford, Huddersfield and Silsden. Based on the *modus operandi*, the police attributed all the crimes to a single offender. Profiling of the personal characteristics based on the *modus operandi* of the killer was done. Letters and tapes mailed to the police and the press from the alleged killer were analyzed. These led the police to believe that the crimes were committed by an outsider who did not reside in Bradford area. While a manhunt was going on for the killer, Stuart Kind, a Forensic Biologist and a former Royal Airforce Navigator was asked to help the British detectives in tracking the Yorkshire Ripper. Stuart Kind used the techniques that he had employed as the Navigator of the Royal

Airforce to the case and charted the times and dates of the murders to determine the loci of the attacks. By running various calculations derived from his study on his computer he concluded that the killer lived between the towns of Shipley and Bingley in Bradford.²³ The killer, Peter Sutcliffe was arrested, two weeks later in January 1981 near Leeds from a red-light area while trying to pick up a prostitute. As predicted by Stuart Kind, Peter Sutcliffe lived in Heaton District which was between Shipley and Bingley, Bradford.²⁴ The technique employed by Stuart Kind came to be termed as GP and has been proved to be effective in locating the residence or base of offenders. For a better understanding, the maps of the crime sites and that of Yorkshire are produced below in the form of Fig. 4.

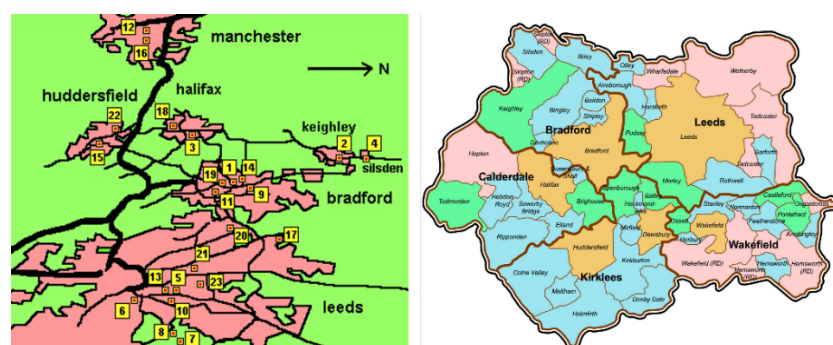


Figure 4: Crime Sites of Yorkshire Ripper and Map of Yorkshire²⁵

Commuters

The Commuters do not commit crimes in their Home Range. They hunt for specific kind of victims who cannot be found in their Home Range. Therefore, they travel away from their homes to a specific area to commit crimes. However, this does not imply that the offenders are not familiar with the area in which they commit the crimes. It only suggests that the Commuters, clearly demarcate the areas in which they commit crimes and the area in which they live. In case of Commuters, the Criminal Range and Home Range never overlap.²⁶

²³ Michael Bilton, *Stuart Kind, Investigator Who Located the Yorkshire Ripper with Geographical Profiling*, THE GUARDIAN (Apr. 30, 2003, 08:46 AM), <https://www.theguardian.com/news/2003/apr/30/guardianobituaries.highereducation> (last visited Nov. 16, 2024).

²⁴ EXECULINK TELECOM, *The Yorkshire Ripper*, <https://www.execulink.com/~kbrannen/arrest.htm> (last visited Nov. 12, 2024).

²⁵ Ibid; https://upload.wikimedia.org/wikipedia/commons/0/01/West_Yorkshire_County.png (last visited Nov. 12, 2024).

²⁶ DAVID V. CANTER, *Environmental Range of Serial Rapists*, PSYCHOLOGY IN ACTION, 220-221 (1996).

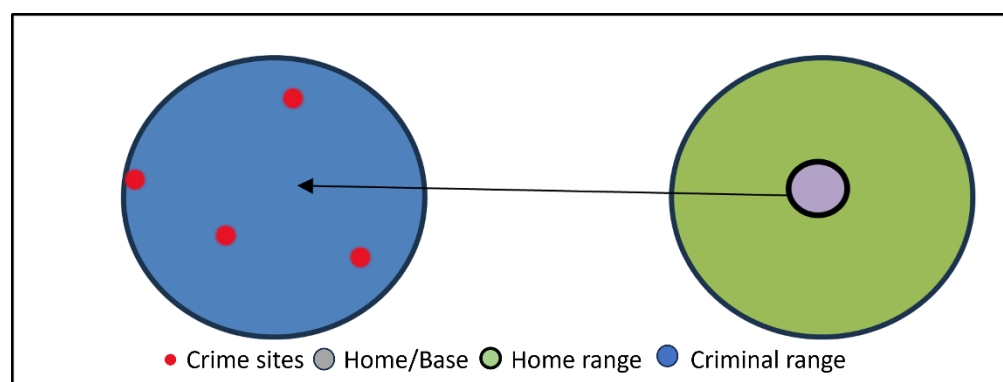


Figure 5: Commuter Model by Canter & Larkin

Source: Writer's own art work

Examples: Commercial robbers, armed burglars, rapists looking for specific kind of victims (school-going girls) belong to the Commuter Typology. Rafael Resendez-Ramirez, a Mexican, who illegally entered into the United States of America (U.S.A) and committed serial murders of those living close to railway tracks fits the typology of a Commuter. He was deported by the Border Intelligence Agents a couple of times and at other times he voluntarily returned to Mexico on being caught. However, he would return to the U.S.A and once again continue with the killings.²⁷

Typologies not rigid but fluid

An offender once classified as a Marauder may not remain a Marauder, he may later become a Commuter and vice-versa. Thus, the classification or typologies are not rigid but fluid. Depending on the goals or targets of the offender, he may either follow the patterns of a Marauder or that of a Commuter. The offender may have started as a Commuter but may later on become a Marauder. Ted Bundy, the American serial killer and rapist was a Commuter as well as a Marauder. He had committed murders and rapes across six States of U.S.A. He had committed ten killings in Washington area, seven killings in Utah, five in Colorado, three in Florida, two in Idaho and one in Oregon.²⁸ He would travel to a State, commit crimes while he

²⁷ U.S. DEPARTMENT OF JUSTICE OFFICE OF THE INSPECTOR GENERAL, THE RAFAEL RESENDEZ-RAMIREZ CASE: A REVIEW OF THE INS'S ACTIONS AND THE OPERATION OF ITS IDENT AUTOMATED FINGERPRINT IDENTIFICATION SYSTEM (2000), <https://oig.justice.gov/sites/default/files/archive/special/0003/exec.htm> (last visited Oct. 30, 2024).

²⁸ BRITANNICA, *Ted Bundy, American Serial Killer*, <https://www.britannica.com/biography/Ted-Bundy> (last visited Oct. 30, 2024).

was there and then move on to another State to continue with the killings.

6. Tracking the Offenders through Geographical Information System

The various principles of GP have been incorporated to develop software applications like Rigel, Dragnet 7, CrimeStat which help the police in criminal investigations. These applications create a grid over the area where a series of crimes have been committed and compute the probability as to where the offender is based. The outcome of the software applications can be shown on Geographic Information System (GIS) which maps locational data of the area in which such series of crimes took place. This locational data includes the names of the streets, landmarks, buildings, etc. of the area mapped. To have a proper understanding of how GP is integrated with GIS, the writer of the paper has tried to explain the same with the aid of Fig. 6.

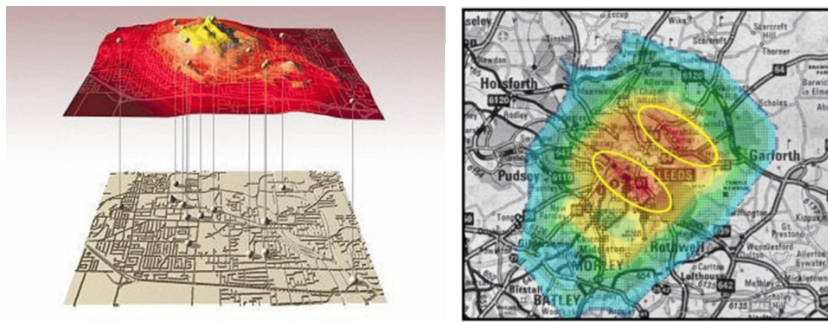


Figure 6: 3-D GP using GIS and GP of Operation Lynx²⁹

The image to the left in Fig. 6 depicts the three-dimensional image of the area covering all the crimes committed by the offender when superimposed on a street map. This three-dimensional image shows the most likely place of home or base of the offender. The image to the right in the figure shows the GP of the two probable areas where the offender who had committed a series of crimes including Murder, Sexual assault, and Kidnappings on women, could have lived or had a base in the Operation Lynx carried out by the British Police. It was found that the offender, Clive Barwell had lived in the two areas encircled in the image to the right in Fig. 6 between 1982 and 1995, the very period during which the crimes were committed crimes.

The integration of GP software applications (GPSA) with GIS enables the police to carry out

²⁹ Spencer Chainey, *Technical note: Introducing geographic profiling analysis in Mexico*, UCL, MEXICO CNS AND IDB 38 (2019), <https://www.ucl.ac.uk/security-crime-science/> (last visited Oct. 30, 2024).

street-to-street or address-based search for the suspect, to identify the area where patrolling and surveillance can be increased and to prioritize the area in a case where mass DNA screening has to be carried out. Thus, GPSA help the police to prioritise the area of investigation, narrow down the pool of suspects and enable optimum use of their resources.

7. Assessing the effectiveness of Geographical Profiling, GP Software Applications and Geographic Information System

This segment of the paper shall examine the effectiveness of the various GPSA with the aid of some of the studies conducted by researchers and profilers. Dr. Kim Rossmo evaluated the effectiveness of Rigel by using it on serial murder cases solved by the Federal Bureau of Investigation. He found that Rigel had an average 'hit score' of 6 percent. Based on the information pertaining to the crime sites fed, the software highlights the 'prioritized search area' in which the police should start looking for the home or base of the offender. The study revealed that only by searching 6 percent of the 'prioritized search area' indicated by Rigel, the residences of the offenders were found.³⁰ David Canter assessed the effectiveness of Dragnet by studying the cases of seventy-nine serial murderers in the U.S.A. However, instead of using the crime sites, body disposal sites were used in this study. Use of Dragnet led to a mean 'hit score' of 11 percent. The homes or bases of all serial murderers were found within the 'prioritized search area' identified by Dragnet. Thus, the study revealed 100 percent accuracy of Dragnet.³¹ In the Wemmerpan (South Africa) Serial Killer's case, GIS and Digital Aerial Photography was used to map eighty-six cases and it was found that most of the killings were committed in an area surrounding the offender's place of residence.³² A study was conducted on fifteen convicted serial killers who had committed the crimes in the city of Campina Grande, Brazil to assess the effectiveness of GP and Dragnet. The killings were committed between 2009 and 2015. It was found that 66.7 percent of the serial killers were based inside the circle which surrounded the two most geographically distant offences.³³ Studies across the globe have

³⁰ KARLA EMENO ET.AL., *Geographic Profiling Survey: A Preliminary Examination of Geographic Profilers' Views and Experiences*, 18 (1) INTERNATIONAL JOURNAL OF POLICE SCIENCE & MANAGEMENT, 1-10 (2015).

³¹ DAVID CANTER ET.AL., *Predicting Serial Killers Home Base Using a Decision-Support System*, 16 (4) JOURNAL OF QUANTITATIVE CRIMINOLOGY, 457-478 (2000).

³² P. SCHMITZ ET AL., *Using GIS and Digital Aerial Photography to Assist in the conviction of a serial killer*, Crime Mapping Research, 4th Annual International Conference, San Diego, California, USA, 9-12 December 2000, 8, available at: <https://researchspace.csir.co.za/server/api/core/bitstreams/8da774a5-56f0-4948-8ed2-6180bc4c23b/content> (last visited on Nov. 15, 2024.)

³³ DENIS LINO ET.AL., *Geographical Offender Profiling: Dragnet's Applicability on a Brazilian Sample*, 15(2) JOURNAL OF INVESTIGATIVE PSYCHOLOGY AND OFFENDER PROFILING, 149-161 (2017).

only reiterated the utility and efficacy of GP and GPSA. GP and GPSA enable the Police to gather information pertaining to the regularly used routes by the offender and his habits apart from predicting the probable location of residence or base. It has been found to be very effective in case of stranger rape cases, arson, murders, vehicle theft and burglaries. However, there are a few limitations of using GP in tracking offenders. GP is suitable only in case of serial offences. The offender should not only have a residence or base from where he is operating but he should also be returning to it after committing the crime. Thus, if the offender falls into the typology of a Commuter or the offences have been committed across States, GP is of very little help. Furthermore, the Police should have accurate information pertaining to the location, time and *modus operandi*, victim typology, etc., of the series, linking it to the offender. If a crime has not been reported, the missing crimes can render the crime series incomplete setting the Police on the wrong track.

8. Conclusion

In times of increased use of technology and faster means of transport, the criminals, too have become tech-savvy and take all measures to cover their tracks. It is increasingly becoming difficult for the Law Enforcement Agencies to trace and apprehend the criminals, especially in times when the incidence of crime rate is high. In spite of the limitations of GP, it still emerges as a powerful tool for tracking the criminals who have committed serial offences. The Police in Australia, Canada, Germany, Japan, United Kingdom, the U.S.A, and many more have adopted GP as a tool of criminal investigation. There is a need for the Indian Police to adopt GP in criminal investigations. The Stone Killer of Mumbai who had killed twelve people sleeping on the footpaths between 1985 and 1988 was never caught. Likewise, the Stoneman in Kolkata who killed thirteen homeless people living on the footpaths was also never caught. Serial Paedophile, Sunil Kumar Rastogi, who had sexually attacked 500 young girls in Delhi and Uttarakhand, though eventually arrested could have been caught earlier with the aid of GP and saved many young girls from being victimised. GP in Nithari Serial Killings could have led to the early arrest of the perpetrators and saved the lives of many victims. With the ever-increasing incidence of crime rate, poor conviction rate in India and waning faith in the administration of Criminal Justice System in India, there is a need to adopt technology and scientific methods in criminal investigations. Use of GP could have led to positive outcomes in cases labelled as unsolved and to earlier apprehension of criminals in cases which were eventually solved. In order to integrate GP into Criminal Justice System of India, there is a

need to create an infrastructure to collate, analyze and interpret geospatial data. Likewise, the Indian Government needs to invest in training the Police in GP techniques and fostering collaboration of the Criminal Justice System with the Academia and Data Scientists for exchange of knowledge and technical knowhow. Integration of GP into Criminal Justice System will not only aid the police in tracing the footsteps of the criminal before the trail becomes cold but shall also help in reposing the faith of people in it.