Review: Principles of Geographical Profiling

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Abstract

Geographical profiling has been developed within the scientific community as a useful criminal investigation method. Its application in violent crimes has demanded a theoretical review and a valuation about the methodology used until now. This article offers a review of the basic concepts of geographical profiling and its evolution over time. To do that, there is an analysis of the main sustaining theories, such as environmental criminology or the circle theory and the main tools developed as computer software. Finally, it also covers a critical review about geographical profiling and its possible developments in the future.

Keywords: Geographical profiling; Crime

Introduction

Geographical profiling was originally based on the three Environmental Criminology precepts, namely rational choice, routine activities and the crime pattern theory, to understand the criminals' spatial behavioral patterns, and later to elaborate different techniques for the localization and detention of the author of a criminal act. Currently, due to the development of new computer technologies, the analytical process has been significantly simplified by using different mathematical models in the analysis of criminal acts.

Theoretical foundations

According to the theory of rational choice, people are considered rational beings by performing different behaviors as a result of a complex decision making process influenced by internal factors (personality, interests, mental disorders, experience, etc.) and external factors (life conditions, effort level, security level, punishment severity, etc.). Consequently, each person perceives the criminal opportunities regarding his context specifically [1]. The main criticism to this theoretical approach is its basic assumption of the cognitive processes as the main axis of the criminal act. Then, sexual assaults or expressive homicides characterized by the spontaneity and impulsivity of the act, which lack an ulterior benefit [2-4], would remain unexplained by this theory.

Referring to the routine activities, a criminal act is due to the coincidence in the same space and time of three factors: a motivated aggressor, a desired target and the absence of a vigilant [5]. According to this, criminals spend most of their time doing activities related to their daily life, during which they find possibilities to offend. The crucial problem is the assumption of the aggressor's passive role towards the criminal act, that is, he or she fins the opportunity, instead of looking actively for it [6].

Finally, the crime pattern theory establishes that opportunities are not distributed randomly nor equally throughout the space, and that not everyone perceives them in a similar way [2]. To do that, there are conceptualizations of both previous theories considering that every human being generates mental patterns based on information about our displacement around the physical space over time. Secondly, those people who are predisposed to offend also generate mental structures with useful information to commit such a crime. These schemes are developed from their daily activities or else through the interaction with others. Once these are generated before the presence of a trigger, which is variable according to each individual's characteristics, and a desired object that fits in his bosom, the execution of the criminal act will take place. This theory, besides, adds the importance of the instrumental motivation, the search of an ulterior benefit to the aggression, or affective, characterized by impulsivity and the fact that its only objective is to hurt or destroy the object of the offense, thus allowing the integration of those crimes whose features are impulsivity and spontaneity [7].

Every theory altogether links the physical space with the criminal behavior by setting the bases of geographical profiling. Criminal profiling uses the information obtained about observable aspects in a crime scene to draw conclusions about the personal characteristics of the aggressor [8]. The objective of geographical profiling is to discover the existing link between a crime scene and its author to consider the base, which is understood as the starting point or a place to which he or she feels a strong connection [9], of any habitual geographical area or sector, also known as a node [10] or the criminal's operating area [11,12].

Taking everything into account, the spatial-temporary context of a criminal event has a narrow connection with the author's characteristics, which may be biological, psychosocial, motivational, criminal experience, etc. [1-2].

Basic principles

Under such theoretical conceptualizations, geographical profiling allows to establish that crimes will be performed in geographical areas that are known by the author due to his or her close contact with them, which contributes to the development of the cognitive idea of control over the place and builds confidence to execute the criminal act.

Thanks to this, different laws regarding criminal behavior and the localization of crimes have been established. First, the predisposition to offend is reduced as the author moves away from his or her base or place of residence [7-9]. Besides, the distance an aggressor can go

through to commit a crime is often similar to the distance covered in consecutive ones [13]. Therefore, crimes committed by the same aggressor will have a tendency to focus on the surroundings of his or her base and around a comfort zone [6].

At the applied level, the hypothesis of the circle reflects these principles to a large extent [11,12]. The technique is about drawing a circle by using the two crimes of a criminal series by the same author that are most distant between each other as the diameter. Despite its great simplicity, it has proven to be a very effective formula to define the criminal range, or the criminal's operating area, and that is the reason why it is still a topic of study nowadays. This theory comes from the distinction of two groups of aggressors, marauders and commuters, depending on their criminal range and the location of their base [12]. Marauders use their base as a center from which they move to commit crimes, and once offend, they go back to such a geographical point. This group of aggressors takes advantage of the knowledge of their comfort zone to offend and, therefore, their base or residence place is inside the physical space established by the criminal range of their acts. Their crimes are often expressive and essentially serial sexual aggressions. On the other hand, commuters move from their base to another geographical zone to commit their crimes, which do not imply a displacement to unknown areas. Due to this displacement, their base is outside the defined limits by the criminal range. Their crimes may be instrumental, that's why they usually have to move to other zones with a greater presence of desired objectives for their crimes, or expressly planned by selecting a specific victim. It is right from this division where the main criticism of the circle hypothesis comes from.

Additionally, several studies by the Journey-to-Crime focused on the decrease of the offending predisposition as distance increases have proven than certain variables, like age [14,15], ethnicity or nationality [16-18], Modus Operandi [18,19] or crime typology [20] affect the relationship between distance and the likelihood of committing a crime.

Geographical Profiling Techniques

Currently, the most important techniques developed in geographical profiling can be classified in three great groups: human judgment, measures of spatial distribution and methods based on algorithms [21].

Human judgments make reference to experts, through the application of different basic principles as the detailed study of the cases and experience, with regard to developing conclusions about the mobility patterns of a criminal, thus helping police forces in their searching efforts and resources management. Despite the important advance of the mathematical formulations and in data analysis technology, this technique is still one of the most efficient ones. This has been tested in different studies where people without previous knowledge on the matter nor police experience, who only had a simple training in basic principles, such as the circle theory or the tendency to offend near their comfort zone, responded so accurately as the software designed specifically for that work [22]. This allows to consider how people who are experts in the field can offer even better results.

The measures regarding spatial distribution are about the study of dispersion of crimes from a series through the application of simple mathematical calculations, such as the mean center (or gravity center), the median center, and the center of minimum distance [21]. These calculations are done on the X and Y axis of the coordinates. The first application of this type of techniques was in the case of the Yorkshire Ripper, England, in the year 1987, when the mean center was used to determine the homicide's place of residence [23]. Although it did not take such statistical results into account during the police investigation, it showed an approach which was accurate enough when the aggressor was arrested.

The problem of these techniques, similarly to the circle theory, is that they are measures of distribution focused on centrality, which always starts from the assumption that the base of the criminal will be in the center or as close as possible of every crime. This would explain its loss of efficiency in the case of commuters, since any crime that is too far from the criminal's operating area influences the accuracy of these techniques negatively [9]. The same authors suggest, as an optimal option to solve the outliers problem, the use of ellipsis instead of measures of centrality, since it provides directionality of the searching areas and the author actions.

Lastly, due to the rise of the new technologies, decay functions have been developed based on complex mathematic formulas or algorithms. Their pioneer was the Newton-Swoope formula, and although it was not implemented in a software support, it allowed to take the first step into the use of algorithms for the localization of criminals [21]. Later, the decay functions were elaborated through the empirically-proven theory and the processing of statistical data used in the Journey-to-Crime studies. These functions are especially useful in the development of the most sophisticated software of geographical localization [24,25].

Nowadays there are four types of decay functions used by geographical localization software: logarithmic, exponential, quadratic or negative linear [24,25]. These functions allow to objectivize the negative influence that the displacement of an individual has as he moves away from the base in the offending predisposition. Thus, the greater the values in the distance variable are, the smaller the probability of offending will be. Each function uses a different formula with different effects in such relationship. The logarithmic function starts from a high frequency of crimes near the aggressor's base, which decreases drastically in the first meters, to be established and keep decreasing gradually as the criminal moves away from it. The quadratic function is characterized by two phases, the former is where the frequency of crimes decreases the same way as in the logarithmic, and the latter is where that frequency of crimes increases slightly from a certain distance. The exponential function shows a high decrease in the criminal frequency when the author starts moving away from his base or residence. After this first distribution, the level of decrease increases exponentially with the same covered distance until the criminal frequency becomes zero. That decrease is more intense in comparison to the logarithmic, since it reaches a null criminal level in shorter distances. The negative linear function represents a constant and proportional decrease in the criminal frequency as the aggressor moves away from his or her base. This function is also known as the "control" function, because it implies a decrease ration that is always the same, without the fluctuations shown by the rest of the functions.

From all these functions, the logarithmic has currently proven to be the most explanatory one for the crimes that take place near the base, or anchor point, of the aggressor and the quick decrease in the probability of committing a crime when he moves away from it, and how it becomes gradual from the five or ten kilometers of distance [24,25].

The concept of decay function understood as a decrease of the probability of committing distance crimes is likely to be applied to

different societies. Its principles are being extrapolated to physical, urban and cultural environments which have a very different structure. Consequently, it is necessary to develop specific decay functions for each spatial zone, or at least do classifications from cities with similar characteristics [19]. On the other hand, regarding the sample, the decay distances by the same aggressor are consistent, that's why, more than generalizing, what matters is to individualize these functions in criminal investigations [26].

Conclusions

Despite the improvement observed in the techniques used in geographical profiling, we have also reached a point where the conclusions are focused on the objectification of coordinates. Consequently, if we perform mathematical calculations through coordinates by leaving the investigator role aside, we may assume that the opportunities or the criminal targets are distributed equally within the environment [15]. However, in order to improve the accuracy in the criminal's spatial localization, it is necessary to have maps where the hot spots are represented as those geographical areas which, given their characteristics, attract the attention of criminals [27]. Finally, the use of topography of cities to analyze the displacements of criminals would allow a more accurate approach to reality [10].

Secondly, we must consider whether it is necessary to invest economic resources in the elaboration, development and management of computer software when professionals of that field certify a similar efficiency or even greater sometimes. On the other hand, such investment would be positive because the technological development would allow us to approach social reality in a more accurate way and therefore it would ease the work of the police force. Finally, geographical profiling professionals have proven that they can determine the searching area of the criminal and also value subjective aspects of the author which would be ignored or objectivized otherwise [28].

To sum up, although geographical profiling still has theoretical, methodological and technical aspects that may be improved, since it is a fairly new methodology, it is necessary that scientific communities of different countries do their own studies in this matter to adjust their application to the different sociocultural and physic-spatial contexts. This way, the error that may arouse the generalization of the results obtained in other geographical zones would be avoided and the scientific wealth would increase.

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