

Chapter 9

Geographic Profiling of Terrorist Attacks

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Summary

Through the use of a computerized geographic profiling system and two case studies, this chapter examines the applicability of geographic profiling in the context of terrorist attacks. The findings of this examination are somewhat mixed with a final discussion of how principles of geographic profiling may be better developed and applied to terrorism.

INTRODUCTION

Terrorism is defined by the Federal Bureau of Investigation (FBI) as “... the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives” (1). Since the terrorist attacks that occurred in the United States on September 11, 2001, attempts have been made to develop more effective and efficient strategies for combating terrorism (2). Many of the procedures that have been proposed deal directly with trying to prevent future terrorist activity by identifying the whereabouts of known terrorists. This chapter presents a preliminary attempt at contributing to this effort by examining whether a procedure known as geographic profiling can be used to identify the location of terrorist hideouts based on an analysis of attack sites. Geographic profiling already assists with similar tasks in other settings,

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namely serial crime investigations, by exploiting identifiable and consistent spatial patterns exhibited by serial offenders in order to isolate probable home locations (3). If such a task could be accomplished with a relatively high degree of accuracy in the military or intelligence domain, it would undoubtedly be beneficial to the current war on terrorism.

Whether it is possible to use geographic profiling techniques successfully in this context will largely depend on whether the spatial behavior of terrorists is similar to that of serial criminals. This issue has not been extensively explored to date [however, see (4)]. There certainly appear to be some similarities between the serial criminal and the typical terrorist (e.g., they both commit multiple offenses), but there are clearly many differences as well (e.g., they commit their offenses for different reasons). Thus, we must examine what it is about serial criminals that allows them to be geographically profiled with such a high degree of accuracy and then make a determination as to whether terrorists, of one sort or another, exhibit similar features. If there is sufficient similarity between the two types of offenders, and we will argue later in this chapter that on some occasions there is, then it should be possible under these conditions to accurately profile the terrorist. Before examining these issues in depth, however, it is first necessary to provide a brief introduction to the field of geographic profiling. More specifically, a discussion of computerized geographic profiling systems is warranted, because these systems currently appear to be a popular method for predicting the home location of an offender based on his or her crime site locations.

A BRIEF INTRODUCTION TO GEOGRAPHIC PROFILING

In its most basic form, geographic profiling involves using knowledge about the relative locations of an offender's crime sites to predict the highest probable location of his or her residence (or some other anchor point, such as a work place) (3). Many geographic profilers are careful to point out that geographic profiling does not solve crimes (3). Rather, it is more commonly conceptualized as a way of managing police information in order to support serial crime investigations. For example, one common application of geographic profiling is to use the prediction of an offender's likely home base in order to prioritize suspects. This is particularly useful in serial crime investigations that result in large suspect pools. More specifically, the police can plot the respective home locations of a list of potential suspects on a map along with the geographic profile and rank order the suspects according to their proximity to the predicted home base (the closest suspect would be considered first, etc.) (3).

Although there were numerous instances of geographic profiling predictions being made in the 1970s and 1980s (5–7), the early 1990s marked the emergence of the field of geographic profiling as we currently know it. During this period, computerized geographic profiling systems were developed, which allowed such predictions to become more systematic and sophisticated (3,8,9). Regardless of the specific computer system being used, the basic operating principles of these computerized geographic profiling systems are the same (9). In essence, mathematical functions are applied to produce a probability surface (Figure 1) that demonstrates the likelihood of an offender residing at various geographic locations around the area where the crimes have been committed (3). On the basis of several decades of offender spatial behavior research (10), the mathematical functions are typically computed from large data sets of offenses to reflect the distribution of distances between offender home and crime locations. These functions typically take the form of a distance decay



Fig. 1. A computerized geoprofile. The different bands (represented here by different shades of gray) indicate the likelihood that an offender lives in a particular geographic location (the area of highest probability is centered on the cluster of four crimes in the center of the profile). The eight crime sites in this particular crime series are indicated by black dots, and the home location of the serial offender is indicated by H. In this case, the offender's home is located near the area of highest probability, and therefore, the hit percentage (see "Case Studies") would be relatively low (indicating an accurate profile).

function(11), which in profiling terms reflects the fact that the probability of an offender residing at a particular geographic location decreases as that location gets farther away from the offender's crimes. The shape of the distance decay function does vary from system to system, but the underlying premise is the same: serial offenders tend to commit their crimes close to home, and, as a result, it should be possible to analyze their crime sites and identify a likely home location. The functions are applied to each crime site, and the locations around the crime sites are assigned a probability reflecting the likelihood that the offender resides in that particular location. Where functions overlap, the probabilities are summed, resulting in higher probability values for those areas. Each location on the map is then assigned a color according to its level of probability (e.g., the locations with the highest probabilities are assigned the color red), resulting in a "geoprofile" that can be used by the police to structure their search for suspects (3).

COMPUTERIZED GEOGRAPHIC PROFILING ASSUMPTIONS

One question that emerges is: How can these computerized geographic profiling systems be expected to reliably predict serial offender's home locations? The answer to this question is relatively simple. These systems can produce accurate profiles because serial offenders are surprisingly structured, at least in terms of their spatial behavior (12). For example, research has repeatedly shown that the majority of serial offenders travel relatively short distances from home to commit their crimes (3,13,14). Research has also demonstrated that the home location of many serial offenders can be found within their area of criminal activity (i.e., their crimes literally surround their home; referred to as a marauding pattern) (15–17). These are the primary reasons for the effectiveness of geographic profiling. Indeed, when serial offenders behave in ways that contradict these findings (i.e., by exhibiting severe directional biases in their travel behavior), geographic profiling will typically be ineffective (3).

Thus, according to many geographic profilers, for computerized geographic profiling systems to achieve their maximum potential, they must only be used under certain conditions. Although there is some debate about the specific nature of these conditions, there seems to be some level of agreement on the importance of five assumptions. Essentially, for computerized geographic profiles to be accurate

1. the profile must be based on multiple crime sites,
2. the crimes must be linked to the same offender,
3. the offender committing the crimes cannot be commuting into the area of criminal activity,

4. the distribution of suitable targets (i.e., target backcloth) must be relatively uniform around the offender's home, and
5. the offender cannot move anchor points (or operate from multiple anchor points) during his or her crime series (3).

These same five assumptions will no doubt play a critical role in determining whether geographic profiling will be successful in predicting the anchor points of terrorists based on the spatial pattern of their attacks.

APPLYING COMPUTERIZED GEOGRAPHIC PROFILING TO TERRORIST ATTACKS

Given that certain factors are known to lead to accurate geographic profiles in the investigative context, the first step in determining whether geographic profiling will be successful when applied to terrorist activity is to consider whether the five assumptions discussed in "Computerized Geographic Profiling Assumptions" holds true for the majority of terrorist incidents. From a review of the literature, it seems to be the case that some of these assumptions will be routinely met while the majority will be violated, at least for certain types of attacks.

Assumptions that will Frequently be Met

It seems likely that the first two assumptions will frequently be met in the terrorist context. In other words, multiple attacks are usually committed by terrorists, and these attacks will typically be able to be linked to one another. In effect, our review of the terrorism literature did not turn up terrorist groups who committed only one or two attacks. Although it was difficult to estimate the exact number of attacks committed by some terrorist groups, the majority of them clearly commit a sufficient number to make geographic profiling a feasible option. Indeed, most of the terrorist groups we reviewed exceeded the thresholds set by Rossmo (3) and Levine (18) of 5 and 10 crimes, respectively. For example, the Revolutionary People's Struggle, a terrorist group in Greece that will be discussed in "Case Study 2: The Revolutionary People's Struggle", is known to have been responsible for over 200 bombings from 1975 to 1995 (19). Even if we focus on attacks committed by specific individuals within these terrorist groups, as we will do in our analysis, the assumption of multiple attacks is frequently met.

In terms of accurately linking terrorist attacks to the group responsible, it will often be the case that the nature of the target itself and the way in which the target is attacked will allow such linkages to be made [in a similar way to how criminal investigators use an offender's *modus operandi* (MO) to

link crimes].* In addition, unlike the typical serial offender, terrorist groups are often known to officially claim responsibility for their actions, generally in the form of public announcements (1,20).† According to Segaller (1) and Drake (20), terrorist groups tend to profess their acts for several reasons, including a desire to propagate their beliefs or to justify their actions to the public. Such claims would make the task of linking terrorist attacks together relatively straightforward, so long as there was sufficient evidence that the group taking responsibility was not being deceptive about their involvement.

Assumptions that will Only Sometimes be Met

The other three profiling assumptions, that targets will be uniformly distributed in space, that marauding behavior will be evident, and that anchor points will remain stable will not likely be met in the terrorist context as frequently as the first two assumptions. However, it is expected that these assumptions will be met under certain conditions. For example, with respect to the uniform distribution of targets around the offender's anchor point, this will depend to a large extent on the terrorist group under consideration and the specific objectives that group is trying to achieve when selecting targets. Consider a domestic terrorist group driven by anarchism (i.e., an opposition to one group of people ruling over others). This group will be relatively non-specific in its selection of targets because its primary goal will likely be to overthrow the existing system of government and business (22). Potential targets will abound, at least in urban areas, and be uniformly distributed in space. In contrast, terrorists with a more specific agenda, extreme anti-abortionists for instance, will have a target selection strategy that is more heavily influenced by target backcloth (23). Target distribution will, in turn, influence the likelihood that a terrorist will commute to his crimes. Compared with a terrorist group with non-specific target requirements, groups with a specific target-selection strategy will be more likely to exhibit commuting behavior.

In terms of anchor point stability, several issues must be considered in the context of terrorism, which typically do not have to be considered in serial crime

* If it does turn out to be the case that geographic profiling in the terrorist context is more feasible when the focus is on attacks committed by specific individuals within terrorist groups, some sort of MO or signature analysis may have to be conducted to link crimes to a specific offender (i.e., knowing that a particular terrorist group carried out the attacks may not be sufficient).

† There are some instances, although these appear to be in the minority, where terrorist groups do not claim responsibility for their actions and in some cases they positively deny acts despite strong evidence of their involvement (21). In these situations, accurately linking terrorist attacks together will obviously prove more difficult.

investigations. For example, although not a serious consideration in criminal investigations, it must always be kept in mind that many terrorist groups consist of a widespread network of membership (20). In these cases, geographic profilers would be faced with a confusing array of multiple offenders, potentially living in different areas and possessing multiple anchor points, with each offender contributing to the attack in some unknown, but potentially important way (e.g., by assisting with the actual attack, by providing intelligence related to possible targets, by supplying weapons or offering hideouts). Clearly such circumstances are not ideal for geographic profiling purposes.

CASE STUDIES

In this section, we will present two case studies for analysis, each involving a different terrorist group—*Action Directe* and *The Revolutionary People's Struggle*. These groups were chosen because of the availability of information about them within the public domain. We will begin each case study by providing a very brief overview of the terrorist group, in terms of their history, general philosophy, target preferences, and typical actions taken. We will then proceed to discuss one particular series of terrorist attacks linked to a member of each group (these series were also chosen because of the availability of data) and will present the results from a geographic profiling analysis that was performed on the relevant spatial data for that attack series. The information relating to each of the terrorist groups and the specific series of attacks under consideration here was collected from a wide range of publicly available sources, including journal articles, books, and webpages.

All of the geographical analyses presented here were carried out using the computerized geographic profiling system known as DRAGNET (8). This system relies on an empirically derived distance decay function, which is applied around the terrorist attack sites in the manner described in “A Brief Introduction to Geographic Profiling”.[‡] The system accepts as input a series of x - y geocoded coordinates, indicating the sites of the terrorist attacks, and provides as output a probability surface indicating the likelihood that the terrorist resides at particular geographic locations. The hit percentage[¶] for each

[‡] The distance decay algorithm used by DRAGNET to perform its calculations was actually derived from a sample of American serial killers and takes the form of a negative exponential function (8). As discussed later in this chapter, this function may not necessarily be appropriate when applied to terrorist attacks.

[¶] Hit percentage is calculated by rank ordering (from largest to smallest) the pixels included in the geoprofile based on their probabilities and determining the percentage of pixels that need to be searched before arriving at the pixel containing the offender's anchor point (3). The smaller the hit percentage the more accurate the profile.

case study is presented in order to quantify the accuracy of the profile. The limited data and scant research on terrorism precluded the inclusion of qualitative profiling considerations (e.g., the potential impact of physical barriers on terrorist movement).

CASE STUDY I: ACTION DIRECTE

Action Directe, was a communist and socialist terrorist group that originally focused its attacks on the French state in conjunction with the communist movement in France (they also pursued some Israeli targets) (1,19). After the election of Francois Mitterrand in 1981, a socialist Prime Minister, their ideology changed to encompass a new focus on anti-Americanism. *Action Directe* was responsible for acts of both domestic and international terrorism. However, its base of operation was mainly in France, with few attacks occurring outside of that country. The group's targets included businesses, airlines, airports, and a small number of government, diplomatic, and educational institutions (1). The group's primary means of attack was the use of explosives, although there were several occasions on which the group carried out armed robberies and assassinations (Rene Audran in 1985, the manager of French arms sales, and Georges Besse in 1986, the head of the Renault Corporation) (1). Following the assassination of Georges Besse, the main leaders of the group were arrested, thereby terminating the existence of the group.

Although *Action Directe* is responsible for an estimated 50 attacks, within the context of this chapter, we are going to examine a series of attacks linked to one member of *Action Directe* who worked and stored explosives at the Guinean Embassy in Portugal. The address of the embassy is R. Alcolena 17, Lisbon, Portugal 1400. The following series of attacks are of interest^{||}:

1. February 23, 1985—The rear entrance of the Marks and Spencer store was bombed at 6–8 Rue des Mathurins, Paris, France 75009.
2. April 3, 1985—The Israeli Leumi Bank was bombed at 35 Boulevard des Capucines, Paris, France 75002.
3. April 3, 1985—The National Immigration Office was bombed at 44 Rue Bague, Paris, France 75015.
4. July 21, 1986—The headquarters of the Organization for Economic Cooperation and Development was bombed at 2 Rue Andre Pascal, Paris, France 75775.

As can be seen in the geopofile presented in Figure 2, DRAGNET was not able to accurately identify the location of this specific anchor point because

^{||} Information about this series of terrorist attacks came from the NMIPT (<http://www.mipt.org/>) (19) and both volumes of *International Terrorism in the 1980s* by Mickolus et al. (24,25).

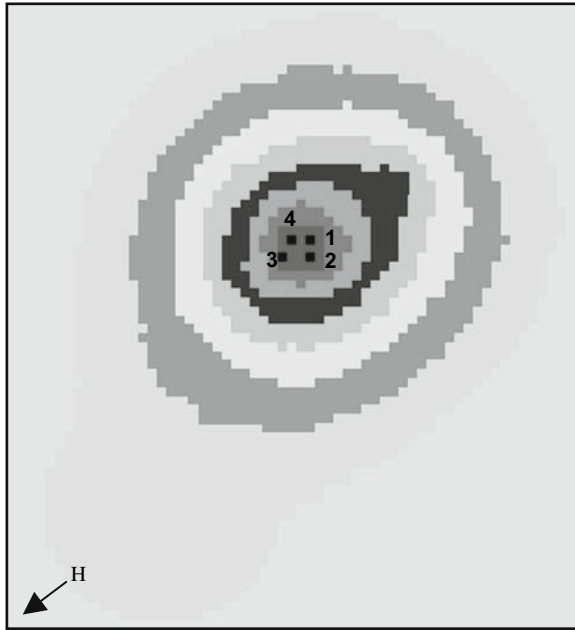


Fig. 2. A geoprofile of the *Action Directe* attacks. The locations of the terrorist attacks are indicated by black dots (the numbers next to the dots indicate the temporal sequence of the attacks), and the terrorist's anchor point is indicated by the letter H.

the offender traveled far distances to carry out his attacks (from Portugal to France). More specifically, the hit percentage in this case was 100% (indicating that the terrorist's anchor point was not located in any part of the prioritized area). It is possible that the offender did have other anchor points (e.g., a residence or place of work) in closer proximity to the attack sites, and these anchor points may be included in the search area. However, there was no indication of this in the data that we collected.

CASE STUDY 2: THE REVOLUTIONARY PEOPLE'S STRUGGLE

The *Revolutionary People's Struggle* (*Epanastatikos Laikos Agonas*—ELA) was a leftist group, which grew out of the resistance to the Greek military government that controlled Greece from 1967 to 1974. The ELA was an anti-capitalist, anti-imperialist, and anti-American group whose goal was to encourage revolution against the government of Greece and to remove US military bases from its country (19). Their targets included mainly businesses, diplomatic and government facilities, and the military of both Greek and

American origin. Throughout its existence, the ELA detonated over 200 bombs (19). The group comprised over 70 people nation-wide, and its attacks were mainly aimed at property destruction. The group terminated in 1995, but its members have gone on to join or create other Greek terrorist groups.

Within the context of this chapter, we examine a series of attacks linked to one member of ELA. During this series of attacks, the member lived at 12 Kyknou St., Palaio Psychico, Greece 15452, where he was arrested in February 2003. The series on which we will focus includes the following[§]:

1. October 14, 1976—The Athens office of the Siemens Corporation was bombed at 8 Artemidos St., Athens, Greece 15125.
2. April 27, 1982—A firebomb was put in a car belonging to a US Embassy secretary in the parking garage of an apartment at 15 Fokylidou St., Athens, Greece 10673.
3. June 2, 1982—Two offices of the American Honeywell Corporation were bombed at 46 Sfingos Avenue, Athens, Greece 11745.
4. June 2, 1982—A car belonging to the Bulgarian Embassy was bombed at 33 Kallari St., Psichiko, Greece 15453.



Fig. 3. A geoprofile of the *Epanastatikos Laikos Agonas* attacks.

[§] Information about this series of terrorist attacks came from the NMIPT (<http://www.mipt.org/>) (19) and both volumes of *International Terrorism in the 1980s* by Mickolus et al. (24,25).

5. July 3, 1982—The Chase Manhattan Bank was bombed at 3 Korai St., Athens, Greece 10564.
6. July 1, 1985—A bomb was placed in a car in the parking lot of the Apollon-Pallace Hotel at 10 Agiou Nikolaou St., Kavouri, Athens, Greece 16671.
7. March 18, 1986—A bomb in the underground garage damaged the entrance to the Greek-American Association at 22 Massalias St., Athens, Greece 10680.

As can be seen in the geopofile presented in Figure 3, DRAGNET was able to identify the location of the anchor point in this series with a reasonable degree of accuracy. The hit percentage for this analysis was 14%. Unlike the case with *Action Directe*, this result was obtained because the offender displayed a distinct marauding pattern of spatial behavior.

CONCLUSIONS

The purpose of this chapter was to present a general framework for understanding whether geographic profiling, as it is commonly practiced in serial crime investigations, has any potential for success when used to identify the location of unknown terrorists. As is the case in the investigative domain, the discussion presented in this chapter suggests that geographic profiling may be possible in the terrorist context, but only under certain conditions. The case studies that were undertaken indicate that one of the reasons for this is that fundamental profiling assumptions can at times be violated when terrorists commit their crimes. For example, in the case of *Action Directe*, the terrorist carrying out the attacks exhibited extreme commuting behavior, traveling from one country to another. Under these circumstances, conventional geographic profiling techniques will be of limited utility. However, when geographic profiling assumptions are met, as in the case of ELA, accurate geographic profiles can be constructed. These results suggest that more research needs to be conducted to determine the exact conditions under which geographic profiling will be successful in cases of terrorism. Such research would have the potential to inform decision-makers in the military and intelligence communities as to the circumstances under which they should rely on geographic profiling techniques.

Given the geographic profiling assumptions discussed previously, this technique will most likely be of use in domestic terrorism, as opposed to international terrorist activity, and current estimates suggest that a sizable proportion of all terrorist attacks are of the domestic type. For example, the FBI has indicated that there have been many recent cases of terrorist acts in the United States committed not only within US borders but also at a very local level (26). One relatively recent case involved a series of arsons that occurred in Phoenix, Arizona. The targets were new homes being built near the North Phoenix Mountain Preserves and a group called the *Coalition to Save the Preserves*

claimed responsibility. In reality, no such group existed. Only one man was involved in the terrorist attacks and, in 2001, Mark Warren Sands was charged and pled guilty to the crimes (26). Given the proximity of Sands' residence to the arson sites (he resided in Phoenix), it is likely that a geographic profile of the attack locations would have allowed the authorities to prioritize Sands as a potential suspect early on in the investigation. Along the same lines, the types of insurgent attacks that are currently taking place within the cities of Iraq and Afghanistan (in addition to many other countries) may be particularly conducive to geographic profiling (because of their local nature). Work is currently underway by other researchers to examine this possibility (4,27).

Given the potential utility of geographic profiling in cases of domestic terrorism, it should be pointed out that the results reported in this chapter likely underestimate the value of this technique. There are at least two reasons why this is true. The first relates to our use of the distance decay function as a model of spatial behavior. As indicated previously, given the many differences between serial offenders and terrorists (e.g., in terms of their underlying motivations to offend), it is likely that specially derived models of terrorist behavior will be required before geographic profiling can reach its full potential in this context. In other words, a decay function derived from a sample of serial killers (as used in this chapter) may not adequately capture the structure inherent in the spatial behavior of terrorists (e.g., the rate of "decay" exhibited by terrorists may differ in a significant way from what is typically found for serial offenders). Indeed, the necessary model may not even take the form of a distance decay function.**

The second reason why the current results may underestimate profile accuracy is that no qualitative analysis was undertaken for any of the profiles presented in this chapter. An important component of most geographic profiles is a qualitative analysis of factors that could be used to refine the quantitative profiling prediction produced by the computer system (3). According to Rossmo (3), such an analysis typically includes, but is not limited to, an examination of how an offender's spatial behavior may have been influenced by

** Some people have argued that, even when describing the spatial behavior of serial offenders, distance decay models are inappropriate. For example, Levine and Associates (9) argued for the use of travel demand models in these situations. Unlike distance decay models, travel demand models can take into account (i) factors associated with the person doing the traveling (e.g., a person's ability to travel), (ii) factors related to the point of destination (e.g., how attractive it is to the traveler), and (iii) costs associated with the travel (e.g., how much time it takes to make the trip). Models such as these might prove more productive when profiling terrorists.

1. victim activities and schedules,
2. physical or mental barriers,
3. zoning and land use,
4. transportation routes,
5. neighborhood demographics,
6. media coverage of the crimes, and
7. police presence.

An analysis of such factors was not possible within this chapter because of a lack of detailed data, but such an analysis must be carried out before any firm conclusions can be reached about whether geographic profiling techniques have the potential to be effective.

Having said all of this, given that we found at least some support for geographic profiling in this chapter, it is perhaps worthwhile to consider how this technique could be used in the terrorist context if it were to receive further empirical support in the future [see (4) for some emerging support]. As mentioned briefly in “A Brief Introduction to Geographic Profiling”, geographic profiling is typically used as an information management tool in the investigative context (3). For example, a geographic profile may allow a police force to select areas for surveillance operations, prioritize suspects based on postal codes, establish patrol saturation efforts, optimize door-to-door canvasses, identify ideal areas for media blitzes, systematize DNA sampling, and so on (3). Nearly all of these applications also have potential value in the context of terrorism, and they would likely contribute to a more efficient investigation (e.g., by using the profile to focus on high probability suspects living near the prioritized search area) and better intelligence (e.g., by using the profile to identify canvassing areas where the generation of useful tips will be maximized). Of course, many more applications would be case specific and could be determined best by the front-line workers involved directly in the analysis of the attacks.

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