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A MULTIVARIATE ANALYSIS OF SERIAL MURDERERS' DISPOSAL SITE LOCATION CHOICE

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Abstract

The application of environmental psychology principles and findings to the work of criminal investigators is gaining ground. This paper presents one particular application of these principles to the study of those very rare criminals, serial killers. An environmental psychology perspective looks on the rational processes that may underlie these disturbing and highly emotive crimes. For, although the murders committed by serial killers may not be considered rational, but rather a consequence of heightened emotion and lack of impulse control, environmental psychology hypotheses predict that their choice of disposal site location may be guided by a recognisable rationality. Support for this rationality would be evident through their spatial patterns of disposal locations, but these spatial patterns themselves would vary depending on the range over which the offender was operating. It was therefore hypothesised that their spatial patterns would reflect the importance of a) the centrality of the home location for determining the disposal site locations, b) the relevance of maintaining distance between sequential disposal site locations themselves. Further, c) the nature of the influences of home and sequence would vary with the size of the area over which the offender disposed of his victims' bodies.

The hypotheses were tested by examining three sub-sets of a sample of 120 American serial murderers, each sub-set travelling a different average distance from their homes to their crimes. The Multidimensional Scaling Procedure, Smallest Space Analysis (SSA-I) was used in order to examine the trends across the distances between each disposal site and every other and their distances from the offender's homes. A three dimensional space was used so that the 'dimension' of temporal sequence could be revealed as well as the two dimensions of geographical distances. All hypotheses were supported. Firstly, the home was central to the SSA disposal patterns for each of the three sub-sets. Secondly, the location of each subsequent disposal location tended to be in a different direction from that immediately prior to it. However, thirdly, this sequential process was strongest for the sub-set of 36 offenders who travelled on average less than 10 km and weakest for those 40 offenders who travelled on average greater than 30 km. The implications these results have for modelling offenders' geographical behaviour are discussed.

Introduction

In recent years, the spatial behaviour of criminals has been related to other studies of human experiences and use of places. This has generated a framework for considering the rationale behind the locations at which criminals commit their crimes (Brantingham & Brantingham, 1981; Rengert & Wasilchick, 1985; Canter & Larkin, 1993). This has indicated that these locations are not arbitrary, but as with non-criminal aspects of location choice, relate to the specific experiences of the individuals themselves. This implies some form of selection on the part of the criminal, even if the basis of the selection is not always clear to the criminals themselves. The present study examines U.S. serial murderers as a way of developing the understanding of these geographical patterns of offence behaviour.

Although very rare, and certainly not a conventional topic for environmental psychology, serial murderers are interesting to consider because they are typically thought of as bizarre, genetically disordered individuals who randomly prey on victims (Revitch & Schlesinger, 1981). Logical or

rational action is not usually assumed to be the hallmark of such offenders. It may therefore be considered very difficult to model their actions in any way. However, although the motivations and causes of these offences may be difficult to determine, it is possible that the offenders' selection of the locations in which to act may have an inherent logic that bears commonalties with other offending and nonoffending behaviour. For although individual motivations for murder are often thought to be the result of a unique combination of biogenetic, sociological and psychological factors, it is hypothesized that the manner in which any individual interacts with the environment will be influenced by a number of spatial processes that are generic to both criminals and noncriminals alike.

For instance, a serial murderer whose motivation is a bizarre desire for sadistic sexual excitement is unlikely, in terms of motivation and murder actions, to share any similarities with other types of offender. However, the extreme nature of his motivation and murder actions will not necessarily be reflected in his spatial behaviour. For although driven by a unique motive intrinsic to himself, in order to maintain some control over his actions and perpetuate his criminal activities, he will need to take account of locational possibilities, as shaped by his own cognitions of the larger environment. Therefore, it is proposed that generic spatial processes will influence the spatial decision making of serial murderers. Such spatial processes include the psychological importance of the home (Canter & Larkin, 1993), familiarity with surroundings (Brantingham & Brantingham, 1981), individual representations of the environment (Downs & Stea, 1973), rational choice considerations (Cornish & Clarke, 1986) and the evident need to reduce the risk of detection.

Human spatial activity is a reflection of each individual's cognitive map of the spatial environment. From its earliest, cognitive mapping research has shown the importance of residential location in giving focus to a person's internal representations and subsequent location selections (Trowbridge, 1913). The power of an individual's residential location is also reflected in their 'home range'; the geographical area around a home which is traversed and used more regularly than areas a greater distance from the home. This area would typically contain the shops, the homes of friends and relatives and the social activities a person frequents. Rengert and Wasilchick's (1985) investigations reflect this concept in their suggestion of the importance of the journeys criminals habitually take around the areas close to their homes. They propose that such journeys provide criminals with information around which they plan their next crime. They emphasize that it is not only the physical dynamics of the area which are important in structuring criminals' behaviour, but that the information which they gather on their 'way home' is also important. Places frequented by the criminal while travelling home, such as, bars, shops and restaurants are therefore proposed as defining their criminal range, tuning perceptions as to which areas are 'safe', both geographically and psychologically.

Centrality of Offenders' Residential Location

Brantingham and Brantingham (1981) suggest that the concentration of activity around the home is influenced by biased information flows. In other words, more information will be available about locations close to the home base and therefore offenders are more likely to be aware of criminal opportunities in such areas. For serial murder this leads to the proposition that such killers may become aware of potential victim opportunities whilst engaged in noncriminal activity. They similarly may also become aware of suitable locations to dispose of their victims' bodies.

The usual procedures for exploring mental representations of the surroundings and the way these influence location choices are through interviewing and sketch mapping. Whilst these procedures have proven their value since the earliest work of Lynch (1960), and have recently been shown to be fruitful when used with some offenders (Canter & Hodge, 2000) they have both practical and theoretical limitations in relation to serial killers.

At the practical level such material is hard to come by. But, even if interviews with these criminals were possible there would be an important question about the extent to which they could be trusted to give valid accounts that were not self-serving. At the theoretical level there is the question as to whether, what ever an offender might say or think about his choice of crime locations, these choices can modelled using *a priori* logical principles. The establishment of such principles may then offer a fruitful basis for later interviews that would therefore be less prone to bias from the interviewee as the sole source of any explanatory framework.

Rational Choice theory (Cornish & Clark, 1986) provides a productive starting point for considering the logic that may be implicit in offenders' site selection. Rational choice proposes that offenders seek to benefit themselves by their criminal behaviour and

this involves the making of decisions and choices which exhibit a trade-off between increased opportunity and greater reward, the further an offender travels from home, and the costs of time, effort and risk. The benefits of a criminal action are the net rewards of crime and include not only material gains but also intangible benefits such as emotional satisfaction. The risks or costs of crime are those associated with formal punishment should the offender be apprehended.

However, models of Rational Choice have been concerned with overtly instrumental crimes such as burglary and robbery. Violent crimes that have a strongly expressive component, such as murder and rape have rarely been subject to analysis from this perspective. The few relevant studies in this area (notably, Athen's 1980 study of rape and homicide) suggest that many such offences do exhibit a substantial degree of rationality.

Criminal range

For serial murder the Rational Choice framework offers some processes from which important hypotheses can be derived. One is that the offender needs to balance the effort required to travel from his residential base, including the risks associated with being in possession of the body while travelling, with the benefits of leaving his victims' bodies as far from his home as possible. The simplest assumption is that, in general, the balance of risks and rewards would remain similar for each offender from one offence to another. Therefore, if his cognitive map of disposal locations is shaped by the location of his home base it would be hypothesized that, no matter what scale of distances he travelled on average, his location choices would tend to be within the same range. In other words there would be the possibility of distinguishing offenders in terms of the general size of the area over which they operate. If they tend to travel far from home for some crimes they will for others and vice versa. Canter and Larkin (1993) offer support for this assumption for serial rapists in the South of England by showing that there is a very high correlation between the smallest distances they travel from home and the largest. In other words those offenders tended to have a consistent 'criminal range' over which they operated.

It might be expected that once an offender located an area that he found suitable for his criminal activity that he would then use it consistently. Yet, whilst there are examples of such offence behaviour, the risks involved in such a course of action are self-evident. It might therefore be expected that the offender will maintain the criminal range from his home in committing his crimes, (referred to by Brantingham & Brantingham, [1981] as a 'buffer zone') but that his criminal activity will be distributed around his home. This is a directly testable hypothesis.

Crime Locations

Although there are a number of geographical locations associated with any one murder in a series (e.g. point of encounter, murder scene, containment location), the present study focuses on the locations and meaning of the body disposal sites that the offender selects. It is assumed that a murderer will choose to dispose of a victim's body in a location that minimizes the likelihood of apprehension. Although each and every location used by an offender in the commission of a murder is of psychological and investigative importance, the location at which the victims' bodies were left was used because it is the least contentious, most objective information available about the location of a murder. Interestingly, in an analysis of the Hillside Strangler case, Newton and Swoope (1987) discriminated between point of fatal encounter, site were the body was left, and victim residence. They found that the geographic centre of the location where the body had been placed most accurately predicted the location of the residence of murderer Angelo Buono.

The body disposal site will often be the only location known to investigators simply because it is the discovery of a body that alerts the authorities to a murder (of course, the location at which the body is found may also be where the murder was carried out or they may be two separate locations). The body disposal location will usually be the 'final resting place' for the victim. It signifies the culmination of the act and therefore may have particular significance to the offender and therefore be particularly relevant to an understanding of his spatial behaviour. Furthermore, the body disposal site may be of particular importance as it is perhaps where the offender has the most locational choice. For example, the choice of an encounter site will be influenced by the distribution of suitable victims while the murder site will be influenced by the difficulty of constraining/transporting a 'live' victim. Once the victim has been murdered, these constraints are no longer factors. Of course, other constraints arise after the victim has been murdered. For example, it can be argued that the offender is at his most vulnerable at this stage of the murder and the risk

of being apprehended with such incriminating evidence may influence the mobility of the offender. Therefore, it is proposed here that body disposal locations will reflect the spatio-cognitive frameworks within which serial murderers operate. Furthermore, whilst the murder itself may be assumed often to take place in the heat of emotion it is more likely that the disposal site is selected after some consideration before or after the murder.

Serial murder and spatial behaviour

Serial murder has been the subject of extensive research (Egger, 1990; Holmes & Holmes, 1989). In particular, many researchers have attempted to provide typologies of serial murder. Such typologies have typically been based on motivation (Holmes & De Burger, 1988) or crime scene behaviour (Ressler *et al.*, 1986). Inherent within these typologies has been discussion of the spatial behaviour associated with the different 'types'. In their organized/disorganized dichotomy, Ressler *et al* suggest that one of the behaviours that distinguish the two types is the distances they typically travel to carry out a murder. They suggest that the disorganized murderer is likely to remain close to home while the organized killer will travel further afield.

Although most researchers recognize the vital part that an understanding of spatial behaviour plays in any definition or exploration of serial murder, there is surprisingly little empirical research that examines this aspect of the crime. The few attempts to address the spatial mobility of serial killers have typically focused on describing the distances such offenders travel from home to offend.

Based on interviews and analysis of over 400 cases of serial murder, Holmes and De Burger (1988) proposed a distinction between geographically stable and geographically transient serial killers. According to the authors, geographically stable killers live in the same area for some time, kill in the same or nearby area and disposes of bodies in the same or nearby area. In contrast, the geographically transient killer travels continuously from one area to the next and disposes of bodies in far-flung places. They go on to suggest that, contrary to the popular belief that nomadic serial murderers drive thousands of miles in their hunt for victims, most 'never lacked for readily available victims within their own neighbourhood; [and] their rational explanation for their travel is that it was used to confuse police'. This suggests that the decision to travel a great distance to offend is greatly influenced by the desire to avoid apprehension, in itself, a rational consideration. Were this risk not present then these offenders would remain within a familiar environment. In other words, it may be an external influence that prompts serial murderers to travel large distances. Although a useful distinction, there is a lack of precision in that there is no attempt to define the distances travelled or the size of area for each group.

Hickey (1991) draws attention to a threefold classification of serial killers that he calls a) 'travellers' crossing state boundaries, covering thousands of miles; b) 'locals' who remain in their home state and c) place specific killers who do not leave home to kill. Hickey found that 50% of the male offenders were categorized as local killers and the majority (71%) operated in a specific place or general urbanized area but did not travel into other states.

Although clearly of value this classification takes no account of the possible role of a base even in the offenders who cover great distances or of the other processes that have been put forward here that may account for the patterns. It is intended more as a general classification that draws together many different descriptive features of the men Hickey studied. As with the classification proposed by Holmes and De Burger, Hickey's definition of these three groups also lacks some precision in that no actual distance ranges are suggested to differentiate between the groups. Furthermore, it is not clear what the distances they report are describing. In other words there is no indication of whether they are describing distance travelled to encounter, murder or disposal site or a combination of them.

The studies above are all descriptive of the distances that serial murderers travel. From a different perspective, Rossmo (1997) proposed a hunting typology to describe the processes that underlie their patterns of mobility. He breaks the serial killer hunting process into two components, the search for a suitable victim and the method of attack. He suggests that the first influences the selection of victim encounter sites and the latter, disposal sites.

As can be seen, the few studies that have explored serial murder from a spatial perspective typically separate such behaviour into broad categories according to the scale of the offender's mobility. There has been no attempt to quantify the categories within specific distance ranges. Instead, more general geographical units such as 'neighbourhoods' and 'states' are used to suggest the scale of movement in each category. Such typologies also suggest that the spatial behaviour of serial murderers can be easily divided into groups. This is in contrast to spatial research for other types of offender. Typically,

other types of offender are differentiated by offence or offender characteristics. Rarely, are typologies based solely on distance differences. This is interesting as it suggests that there may be a greater need to do this for serial murder because the distances involved cover a wider range of distances than other types of crime, which may remain more local in nature. In other words, serial murderers, although not only being at the extreme of a criminal continuum in terms of violence and brutality are also at the extreme of a mobility continuum, travelling far greater distances than other types of offender. The question is that, if this is the case, are the same processes used to explain other types of criminal movement applicable to the extreme behaviour of serial murderers?

Data Collection

Within the literature, there are many definitions of serial killers usually differing in terms of the number of victims any given offender must kill in order to be termed a serial killer. The most common number is a minimum of three victims (Holmes & Holmes, 1996). However, some researchers such as Jenkins (1988) use four or more victims as the cut off point. Our definition recognizes serial killers as those individuals who have killed 'two or more victims over a period of time with a cooling off period between each murder'. The inclusion of a 'cooling off period' ensures that mass murderers are excluded from the definition. The use of 'two or more victims' as the defining number allows for those serial killers who, although being responsible for only two known murders, may still exhibit the traits of serial killers who are known to have killed more than twice.

In order to examine the spatial behaviour of serial murderers, information on serial killers from the U.S.A. (n=120) were obtained from published sources and police records. The data for each murderer was drawn from the qualitative measurement process of content analysis. Sources included newspapers and magazine articles, true crime books and academic texts. It should be noted that many of these sources are published reports from individuals who were involved in the original investigations, such as Keppel's accounts (Keppel, 1997). Furthermore, in many cases, the opportunity was taken to verify details with police sources close to the investigations. The use of such data sources was detailed by Webb *et al.* (1966) and has been used in previous research on serial murder (Leyton, 1986; Hickey, 1991).

For the purposes of the present research, locational information concerning all the 120 American serial murderers was collected. This information consisted of the home addresses of the offenders and the locations where the bodies of their victims were found. The sample was limited to those cases for which clear and corroborated locational information was available.

Procedure

Collectively, the U.S. killers were known to have murdered 898 victims. They had been convicted of killing between 2 (l) and 24 (l) people each. Once the relevant geographical information had been collated, the offenders' home base and the sites at which they left the bodies of their victims were recorded onto local street maps. Where more than one base was known the one that was used during any particular series of killings was recorded. Thus the base recorded was always linked directly to the offences known to have been committed from that base. The base and body disposal site locations were mapped onto a specially developed Geographical Information System 'Mplot', that recorded the points as relative coordinates in a 2-dimensional Euclidean space, together with a specific scale for each offender. The software calculates a variety of distances from the coordinates as well as statistical derivations of these distances.

For the purposes of the present research, it is necessary to consider the relationship that every location has to every other and to examine those locations in sequential order. It can be argued that the locations of an offender's disposal sites around his home area may be illustrating a sort of criminal cognitive map. Mapping the sites of criminal activity over time could be seen as an illustration of how an offender discovers and uses his environment, learning about it in terms of the opportunities for criminal activity it can offer him.

An appropriate statistical procedure for testing this is smallest space analysis (SSA) which is a multi dimensional scaling technique that finds the best fit within a specified dimensionality between a matrix of associations, in this case, the mean distances between all locations and a geometric representation of these associations as distances in a Cartesian space. In effect, a geometric representation of the distances between all the locations allows for the testing of a multivariate model of offender mobility. Therefore, SSA can be used to explore both the relationships between home and the disposal

locations and between the disposal locations themselves. Two hypotheses can therefore be made that relate to these two facets of spatial patterning:

1) There will be some order to the distances between the disposal sites and home with the home being central to that order.
2) There will be ordered differences in the temporal sequencing of disposal sites in terms of both distance and direction.

In order to investigate these proposed relationships, the sample was divided into three subgroups according to mean interpoint distance (MID). For each offender, the MID was calculated by adding the distances between every offence and dividing by the number of distances measured. The first group included all those offenders who operated within mean interpoint distances of 10 km. The second group consisted of those offenders whose mean interpoint distance was between 10 and 30 km. The final group consisted of those offenders whose mean interpoint distance was greater than 30 km. Table 1 summarizes the three groups.

In order to investigate whether these groups are distinct from each other, an Anova was carried out. The results were significant ($F = 43{\cdot}47$ $p < 0{\cdot}0001$ df 2). In order to establish which of the groups were significantly different from each other, a post hoc Scheffe test was carried out. This indicated that group 3 was significantly different from the other two. A Kruskall Wallis test was also carried out as the data is not normally distributed. This was also significant (Chi Sq $105{\cdot}5$ $p < 0{\cdot}0001$).

If serial killers are reasonably consistent in their disposal site choices, there should be a correlation between the minimum distance they travel from home and the maximum. Therefore, the minimum and maximum distances travelled from home were correlated for each group. The correlations between the nearest and the farthest distances from home to a disposal site are:

- Group 1– $r = 0{\cdot}41$ ($p < 0{\cdot}05$)*
- Group 2–$r = 0{\cdot}59$ ($p = 0{\cdot}08$)
- Group 3–$r = 0{\cdot}67$ ($p < 0{\cdot}001$)*

For groups 1 and 3, it was found that an increase in the maximum distance travelled from home was accompanied by a parallel increase in the minimum. The relationship between minimum and maximum distance was not quite significant for group 2.

Smallest space analysis

Smallest space analysis was developed by Guttman (1968). The procedure deals with the off-diagonal elements of a square, symmetric matrix of association coefficients (Lingoes, 1973). The advantage of SSA over other algorithms lies in its robustness and rational step-size (Lingoes, 1973). This is mainly because the algorithm only attempts to find the best fit between the ranks of the association coefficients and the ranks of the distances in the geometric space. Such a matching of ranks can be shown to give a mathematically more efficient solution as well as being less sensitive to extreme values. It also leads to the procedure being recognized as nonmetric. In the present analysis the hypotheses are about the relative associations between locations rather than their absolute differences. The hypotheses here are not precise enough to say how much bigger or smaller the relative distances are in comparison with each other, rather that there are consistent differences in rank. The resulting geometric representation is thus more open to direct interpretation than would procedures using metric algorithms.

A triangular association matrix was generated for the SSA analysis using the mean interpoint distances that serial murderers travelled between their home base and all their disposal sites. The distance metric used to generate the SSA is based on Euclidean distances.

Results

SSA for offenders with MID's of less than 10 km

Figure 1 shows the three-dimensional solution for those offenders who travelled mean distances of less

TABLE 1
Breakdown of sample

MID of group	Number	Mean number of offences per offender	Overall mean distance for group	Range
less than 10 km	36	5·7	4 km	0·69–9·63
10–30 km	44	7·4	19 km	10·13–28·40
greater than 30 km	40	6·6	40 km	34·55–643·45

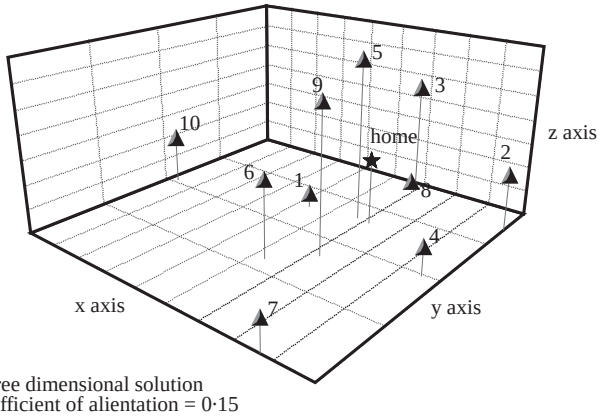

FIGURE 1: Three-dimensional solution for those offenders with MID's of less than 10 km.

than 10 km. The coefficient of alienation indicates the 'goodness of fit' between the correlations and their graphic representation. The score ranges from zero, denoting a perfect fit, to one, a poor fit. The smaller the coefficient, the better the fit. An acceptable score is between 0·15 and 0·24 (Donald & Canter, 1990). The coefficient here is 0·15 indicating a good fit. Each point in the SSA plot represents an average location so the relative distances across the plot represent the relative distances the murderers travelled on average from their home bases to dispose of their victim's bodies as well as the average distances between each and every disposal site. A star represents the serial murderers' home base. So, for example, Figure 1 shows that the average distance from home to the first disposal site was considerably less than the average distance between the seventh and tenth disposal sites.

In Figure 1, the home is clearly located within a region surrounded by the disposal sites. This clearly demonstrates the important influence of the home base as a spatial focus for this group of serial murderers. The best solution that the SSA algorithm can find positions the home in a location so that all the disposal sites surround it, therefore supporting the hypothesis that the home exerts a central significance on the offender. The three-dimensional solution clearly illustrates the strong conceptual influence of the home on this group's disposal site location choices.

Turning to the relative positioning of the disposal sites around the home base, it can be seen that they are reasonably clustered around the base. Interestingly, the SSA positions the first four disposal sites closest to the home base but at different locations around it. Sites one and two and sites three and four are located opposite each other on either side of the home. This suggests that this group of offenders use the first four disposal sites to explore the area directly around the home base.

The SSA further illustrates that there are other processes at work that influence the disposal site choices of the offenders. In the third dimension, the influence of previous disposal location choices on subsequent choices can be clearly seen. In other words, the SSA shows a distancing between chronologically related sites. No two chronologically related sites maintain the same position on the z-axis. For example, disposal site one occupies a location on the z-axis distinct from site two and site three is distinct from site two and so on. One of the clearest examples of this is the positioning of sites eight and nine at opposite points on the third dimension. This further illustrates the important finding that the location of previous disposal activity exerts an influence on subsequent location choice. In other words, the offenders appear to be moving to different locations around the base for each subsequent site so that no two sites are in the same general area. The small area over which these offenders are operating can explain the deliberate separation between subsequent sites. It may be that, in order to maintain a 'perceived' safe distance between disposal sites, the offender has to move to separate areas on each occasion.

SSA for offenders with MID's between 10 and 30 km

Figure 2 shows the three-dimensional solution for those offenders whose mean interpoint distances were between 10 and 30 km. The coefficient of alienation is 0.4 indicating a good fit. As before, the SSA

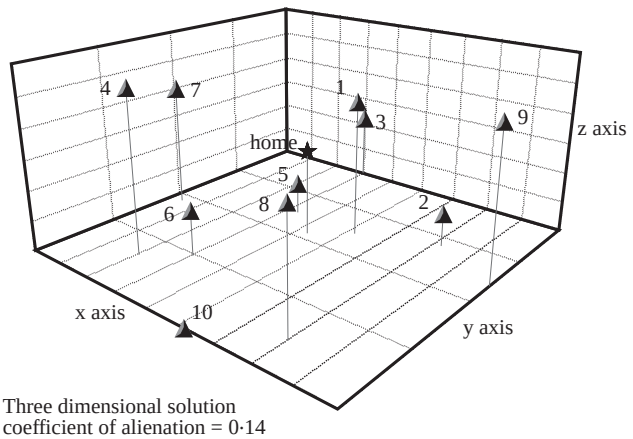

FIGURE 2: Three-dimensional SSA for those offenders with MID's between 10–30 km.

positions the home base at a location where it is surrounded by the disposal locations, again lending support to the home acting as a focus for the offender's spatial behaviour. Interestingly, the overall pattern displayed here is more dispersed than that for the offenders operating over the smaller area. In other words, the SSA accounts for the larger relative distances by spreading the locations further around the plot.

A more complex process to the previous SSA is revealed in terms of the positioning of the disposal sites relative to each other. The first site is located directly adjacent to the home base as before. However, the three subsequent sites are further away towards the periphery of the plot. The last three sites (8, 9 and 10) are a little separate from the previous sites suggesting that the offenders may have a tendency to move to a slightly different area away from the earlier locations.

It appears that, for these offenders operating over larger ranges, the home, although still playing a pivotal role in influencing disposal site choice, is not as strong an influence as was found for the sample operating over ranges of less than 10 km.

SSA for offenders with MID's over 30 km

Figure 3 represents the three-dimensional projection for those offenders with mean interpoint distances greater than 30 km. The coefficient of alienation is 0·12 indicating a very good fit.

As with the previous plots, the SSA positions the home in a relatively central location and the disposal sites are widely dispersed around this central location. Interestingly, the first four sites are all positioned to the left side of the plot in a distinct region. This suggests that the offender uses the first four sites in a very different way to the other two groups. Here, the first offence is located some distance from the home base while the second site is the closest to home. The offender may deliberately place a greater distance between his home and first disposal site because of extra vigilance on embarking on his series of murders. He then appears to move towards home again and then spread to the opposite side of the home for the third and fourth disposal sites. Disposal sites 7, 8 and 9 are located at the same level on the z axis, again suggesting a move on the part of the offender to a separate area at the late stage of his series. It may be that for this group of offenders, the locations of previous disposal sites have less of an influence on the location of subsequent sites. This seems reasonable because of the far greater distances that the offenders are travelling and, as a result, leaving between their sites. The need to place a perceived safe distance between chronological offences is no longer a consideration because of the great size of the area they typically utilise as their disposal zone.

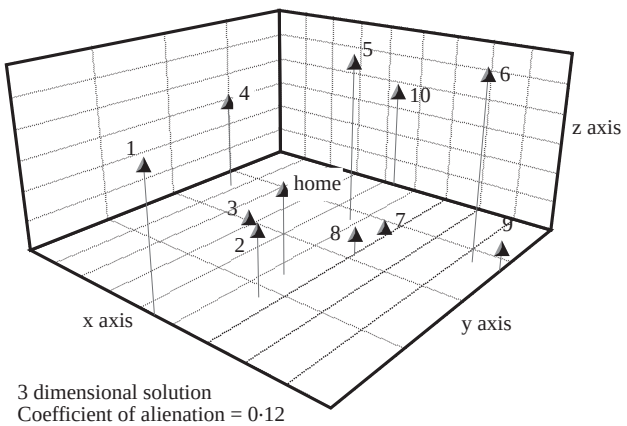

FIGURE 3: Three-dimensional SSA for serial murderers with MID's over 30 km.

Temporal proximity

Table 2 shows the mean distances travelled for each group in relation to temporal proximity. These findings further support the spatial patterns uncovered by the Smallest Space Analysis. For group 1, those offenders with MID's of less than 10 km, there is significant difference between the mean distances they put between chronologically adjacent sites and between odd and even sites. These offenders appear to place a greater distance between chronologically subsequent sites than the sites that are not chronologically adjacent.

For group 2, those offenders operating with MID's between 10–30 km again appear to place greater distances between their chronologically adjacent sites than their odd and even sites, although the differences are not significant.

For group 3, those offenders with MID's over 30 km, a different pattern emerges, already uncovered in the SSA. Here, there is no increase in distances between chronologically adjacent sites compared to the odd and even sites. In fact, there is a significant difference between the groups but it is in the opposite direction. The chronologically adjacent sites are closer together than the non-chronological sites. This further suggests that the influence of home and the location of subsequent sites may not be as important to those offenders travelling greater distances.

TABLE 2
Temporal Proximity and Distance Travelled

Group 1	N	Min	Mean	Max
Chronologically adjacent	36	0·63	5·57	13·00
Odd	36	0·51	3·47	8·31
Even	36	0·00	3·22	9·31
Friedman Nonparametric Anova $p < 0{\cdot}05$ Chi sq = 6·16 (df. 2)				

Group 2	N	Min	Mean	Max
Chronologically adjacent	44	8·33	23·66	94·85
Odd	44	0·87	19·84	38·65
Even	44	0·00	22·17	54·62
Friedman Nonparametric Anova p 0·66 Chi sq = 0·82 (df. 2)				

Group	N	Min	Mean	Max
Chronologically adjacent	40	11·30	101·02	300·83
Odd	40	24·51	138·98	412·16
Even	40	0·00	138·22	718·37
Friedman Nonparametric Anova $p < 0{\cdot}001$ Chi sq = 9·56 (df. 2)				

Conclusions

The present study examined the disposal site locations of a sample of serial murderers in order to identify whether more traditional explanations for spatial behaviour could also explain the behaviour of serial murderers. It was found that the home location of serial murderers had a strong centralizing influence on the spatial patterns of disposal locations. This finding supports the hypothesis that the more generic explanations of familiarity, mental mapping and the psychological role of the home can go some way to explain the spatial behaviour of this unique type of offender.

Furthermore, it was found that the locations of previous disposal locations also exerted an influence on the locations of subsequent disposal sites. It appeared that there was more of a conceptual continuum where the distances the offenders typically put between their disposal sites was determined by their perception of a 'safe' distance. The evidence for the influence of such safe distances was greater for those offenders operating over smaller areas. As the distances the offenders typically travelled increased, it appeared that the influence of previous sites decreased. It can be argued that an offender who operates over a small range may be more likely to consider the locations of his previous disposal sites and the risks associated with disposing of further bodies in a similar area. On the other hand, an offender operating over a range covering hundreds of miles may not be influenced by such constraints simply because of the larger distances involved.

The 'safety space' was also found to exist for the distances the offenders typically put between their home and their disposal sites. Conceptually, this suggests that although the home acts as an important focus to the offenders, their patterns of behaviour are equally influenced by the locations of their previous sites. Therefore, the concept of familiarity is far more complex than first suggested by the Brantinghams (1981). Although serial murderers may commit their offences within an environment familiar to them, the specific locations of their disposal sites will also depend on the locations already utilized for criminal activity. The distance they feel comfortable travelling from home may also apply to the distance they feel comfortable putting between their offences. These characteristic distances will be a reflection of the spatial constraints the offender is operating within.

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