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Serial Murderers' Spatial Decisions: Factors that Influence Crime Location Choice

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Abstract

The outcome of German serial murderer spatial decision making was measured as the straight-line distance (km) between murderer home locations and each crime location (i.e. body recovery location). Geographic and series development data, as well as information on age, intelligence, motive, marital status, employment status, and mode of transportation of 53 German serial murderers was collected from police and prosecution service files and judicial verdict records. Potential effects of the aforementioned factors on spatial decisions were assessed. Results showed that 63% of the murderers lived within 10 km of their crime locations. Home-to-crime distance was negatively correlated with murderer age and positively correlated with murderer IQ score. Results also showed that the mode of transportation used by murderers had an effect on their spatial decisions. Results are discussed in terms of understanding serial murderer spatial decision-making and implications for police investigations. Copyright © 2005 John Wiley & Sons, Ltd.

Key words: spatial decision-making; serial murder; geographic profiling; policing; home-to-crime distance

INTRODUCTION

A limited amount of information is available regarding serial murderers' spatial decisions. Existing research on this topic has been based primarily on American serial murderers, and only a few studies have quantified the distance between where serial murderers live and where they offend (Canter, Missen, & Hodge, 2000; Godwin & Canter, 1997; Hickey, 1991; Lundrigan & Canter, 2001; Rossmo, 2000). Moreover, most of these studies did not consider the factors that potentially influence this violent form of spatial decision-making. Given that police investigators sometimes use geographic profiling techniques to predict

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offender home locations (Canter, Coffey, Huntley, & Missen, 2000; Rossmo, 2000), a better understanding of the relationship between offender characteristics and spatial decisions could enhance the predictive accuracy of such endeavours. Consequently, the current paper examines serial murderers' spatial decisions as well as factors that may have an effect on those decisions.

Serial murderers' spatial decisions

Research that measured criminal spatial decisions as the distance between the offender home and crime location has produced the robust finding that offenders generally select targets near their homes (see Rossmo, 2000 for a summary of journey-to-crime research). Indeed, most offenders, including burglars, rapists, thieves, and robbers, select targets within 5 km of their home, a finding that is strengthened by the fact that it has been replicated across countries (Amir, 1971; Baldwin & Bottoms, 1976; Canter & Larkin, 1993; Capone & Nichols, 1975; Gabor & Gottheil, 1984; Kocis & Irwin, 1997; LeBeau, 1987; Rhodes & Conly, 1981; Turner, 1969; Van Koppen & Jansen, 1998; Warren *et al*., 1998; White, 1932). However, very little criminological and psychological research on this matter has been conducted specifically with regard to serial murderer spatial decision-making.

According to Hickey (1991), serial murderers are perceived by some as unconstrained spatial decision-makers, who drift across national landscapes selecting victims at will. Hickey argued that such an omnipotent perspective is a consequence of media coverage that sensationalizes rare cases where serial murderers travel across vast regions of the United States. The influence of this 'drifter' image is reflected in programs implemented by law enforcement agencies that attempt to link murders that have been committed across several states, provinces, or republics to a single individual, such as the Violent Criminal Linkage Analysis System (ViCLAS) and the Violent Criminal Apprehension Program (VICAP) (Collins, Johnson, Choy, Davidson, & MacKay, 1998; Keppel & Weiss, 1992; Ressler & Shachtman, 1992). Implicit in the development and implementation of these systems is the perception of serial murderers as a special breed of offender whose decision-making is not bound by the same financial, social, and cognitive constraints as other types of criminals.

Quantitative research, however, shows that serial murderers usually select victims much closer to their homes than the drifter image implies. For instance, Godwin and Canter (1997) showed that victim encounter locations were, on average, 2 km from the offender's home, and body recovery locations were 23 km from the offender's home. By comparison, Rossmo (2000) found that American serial murderers generally encountered targets at an average distance of approximately 22 km and left their victims' bodies an average of approximately 34 km from their home location. A breakdown of Rossmo's results indicated that home-to-crime distances were shorter than 20 km for 46% of his sample. Recently, Lundrigan and Canter (2001) reported that the median and average home-to-crime distances for American serial murderers were 15 km and 40 km, respectively, whereas the median and average home-to-crime distances for UK serial murderers were 9 km and 18 km, respectively. Of particular relevance to the current study is the recent finding by Dern, Froend, Straub, Vick, and Witt (2004) that 14 out of 24 German serial sexual murders were committed within 5 km of the murderer's home location and 19 of these cases were committed less than 20 km away from the offender's home. Based on these findings, it appears that serial murderers indeed offend farther from their homes than

other types of criminals. At the same time, these studies challenge the validity of the drifter image by indicating that serial murderers tend to offend relatively close to their homes.

Factors that potentially influence serial murderers' spatial decisions

Lundrigan and Canter (2001) argued that all criminal spatial decisions, including those made by serial murderers, are mediated by social, economic, and cognitive factors. Some factors that may influence where serial murderers offend include: the development of the series; the age, intellectual capability, employment status, marital status, and motive of the murderers; and the mode of transportation that they use. The effects of some of these factors on criminal spatial decisions have been previously examined and reported, yet most of them have not been directly examined with regard to serial murder. Others have never been empirically evaluated. Nonetheless, brief explanations about how they may influence spatial decision-making are offered herein. Additional factors also exist that may account for variation in spatial decisions among serial murderers (e.g. the desire to avoid apprehension) but are not reviewed here because they have not been traditionally documented in legal records and are difficult to assess empirically.

Series chronology

Serial murderers may increase their spatial knowledge by learning from their criminal experiences, and thereby alter their spatial decision-making over time. Assuming they wish to avoid being recognized in their neighbourhoods, altered decision-making may correspond to offending farther from their home location as series progress. For example, Rossmo (2000) reported that the average distance from an offender's home to the victim encounter location significantly increased as a function of time, which he equated to the sequential order of murders in a series. Individual analyses, however, revealed that half of the cases in the sample showed no significant change in this distance as the number of victims in a series increased, and all remaining cases exhibited an increase (i.e. none showed a significant decrease in the distance from offender home to victim encounter location). However, Godwin and Canter (1997) found contrasting results when they examined offender home locations in relation to victim encounter sites and body recovery locations. Victim encounter sites were equally close to the offender's home for each of the victims in a series while the distance from offender home to body recovery location decreased as the number of victims in a series increased. These mixed findings illustrate the importance for further testing of the temporal variable in relation to serial murder home-to-crime distances.

Serial murderers could also gain spatial knowledge between murders as well as during murders. For example, offenders who committed 10 murders over 10 years may gain more spatial knowledge than offenders who committed 10 murders over 10 days. Indeed, another useful temporal measure of murder series is time itself. While the direct relationship between home-to-crime distance and murder series duration has not been empirically tested, some anecdotal accounts suggest that serial offenders commit crimes farther from their home as series lengthen. For instance, maps found in convicted serial murderer David Berkowitz's apartment suggested to police officers that he intended to select future victims farther away from his residence (Rossmo, 2000). Similarly, serial rapist John Duffy initially targeted victims from his neighbourhood but selected victims farther from his home as the length of the series increased (Canter, 1994).

Closely associated with series chronology is the belief that serial offenders live in closer proximity to their first crime location than their subsequent crime locations (Canter, 1994; Canter & Larkin, 1993; Warren, Reboussin, & Hazelwood, 1995). Based on this contention, Canter and Gregory (1994) reasoned that the first rape in a series could provide law enforcement officers with a starting point to search for the rapist's residence. Consequently, Canter and Gregory developed an expert system that placed more weight on the first crime location in a series as a reference point to predict where the offender lives. Although the researchers demonstrated the effectiveness of this simple heuristic for geographic profiling, subsequent tests of this hypothesis have produced mixed and inconclusive results. For instance, Warren *et al*. (1995) studied serial rapists and showed that the first crime was closest to the offender's home in only 18% of cases. Similarly, Davies and Dale (1995) found that the first rape victim in a series tended not to be located closer to the offender's home location than the final victim. However, with regard to serial murder, Rossmo (2000) observed that the first crime location in a series was actually nearer to the murderers' home location than subsequent crime locations in 41% of the cases examined. These mixed results shed doubt on the significance of the first crime location.

Age

Until recently, research generally showed that younger criminals offend closer to their homes than older offenders. For instance, Baldwin and Bottoms (1976) reported this finding for property, breaking and entering, larceny, and taking and driving offences. Similar findings have also been reported for robbers (Nichols, 1980), rapists (Davies & Dale, 1995), and murderers (Groff & McEwen, 2004). Moreover, this trend has been found in different countries including Canada (Gabor & Gottheil, 1984), England (Baldwin & Bottoms, 1976), The Netherlands (Van Koppen & Jansen, 1998), and the United States (Nichols, 1980; Warren *et al*., 1998). In contrast, recent findings suggest that age is not related to home-to-crime distances for thieves, burglars, assaulters (Wiles & Costello, 2000), or rapists (Rossmo, Davies, & Patrick, 2004). Other studies have also detected unclear age-related patterns (Chainey, 2001; Clark & Eck, 2003). Unfortunately, most serial murderer studies have described murderer age without examining how it relates to their spatial decisions (e.g. Ansevics & Doweiko, 1991; Canter *et al*., 2000; Jenkins, 1988; Prentky *et al*., 1989). Due to the lack of direct evidence and the inconsistent findings from previous criminal research, a conclusive age trend for serial murderer spatial decision-making remains to be established. Any research that can contribute to understanding how age may predict serial murderer spatial decision making is thus valuable.

Intellectual capability

A number of researchers have published IQ scores of serial murderers but have not evaluated the relationship between intelligence and spatial decisions. For instance, some have reported that the majority of serial murderers had an IQ score of 100 or more (Ansevics & Doweiko, 1991; Canter *et al*., 2000; Harbort & Mokros, 2001; Prentky *et al*., 1989). There is some literature, however, that alludes to the idea that intellectual capability relates to spatial decision-making. For instance, Ressler, Burgess, Douglas, Hartman, and D'Agostino (1986) studied the crime scene patterns of sexual serial murderers and reported that 'organized' offenders are of an average to above average intelligence and are likely to offend far from their homes, whereas 'disorganized' offenders are of below average intelligence and offend in close proximity to their homes or places of employment. Based

on this research, it appears that differences in intellectual capability may mediate spatial decisions among serial murderers.

Marital status

Consistent with the analysis used in the few studies on serial murder, researchers have typically reported the frequency of different marital status categories. For instance, Jenkins (1988) reported that six of the 12 English serial murderers he studied were married, had a stable relationship, and lived in the same residence for several years. Marriage conceivably acts as a social control, thus rendering it less feasible in some instances for a married murderer to engage in lengthy and costly searches for victims or body disposal locations. Of course, the effects of marriage on spatial decisions may be dependent on other factors such as the strength of the marital relationship and the occupation of the murderer and his spouse. Nonetheless, married serial murderers may make different spatial decisions than their unmarried counterparts.

Employment status

The conceivable effect of employment on spatial decisions is somewhat paradoxical—employed offenders may have more financial resources available to aid travel, but they may also lack freedom of mobility due to job commitments. Furthermore, offenders with workplace locations are likely to have larger daily activity spaces, and thus larger potential target areas (Brantingham & Brantingham, 1981; Wright & Decker, 1994). For instance, Hickey (1991) showed that the majority of serial murderers stayed within the general area of the city in which they resided and had regular employment. Hickey suggested that employment is an indication of spatial stability within a city that may limit the spatial decisions of serial murderers.

Motive

Holmes and De Burger (1988) are perhaps the only researchers that have examined the relationship between serial murderers' motives and spatial decisions. They put forth four categories of serial murderers based upon dominant motives for committing their crimes. The four types were: Visionary, Mission-Oriented, Hedonistic, and Power/Control-Oriented. Rather than reporting the distances from murderers' homes that victims were encountered or their bodies were discovered, Holmes and De Burger discussed the crime locations of each of these types of serial murderers in terms of whether or not they were concentrated or dispersed relative to one another. Serial murderers classified as Visionary, Mission-Oriented, Hedonistic-Lust and Hedonistic-Comfort were found to have concentrated crime locations, whereas murderers classified as Hedonistic-Thrill, Power/Control-Oriented and Opportunists were found to have dispersed murder locations. Based on these results, motive appears to be related to serial murderer spatial decisions.

Mode of transportation

The mode of transportation that murderers use potentially influences their spatial decisions. Some evidence for the relationship between mode of transportation and criminal spatial decisions comes from Van Koppen and Jansen (1998), who found that burglars in the Netherlands were more likely to offend farther from home if they used a vehicle than if they walked. No direct evidence of this relationship has been reported regarding serial

murder, but Ressler *et al*. (1986) reported that 85% of organized sexual serial murderers used a vehicle compared with 62% of disorganized sexual serial murderers, and that the organized murderers offended farther from their home location than the disorganized murderers. This finding suggests that serial murderers who use vehicles may exhibit larger home-to-crime distances than those who walk. Hence, as one would intuitively expect, the mode of transportation a murderer uses may be an important factor in spatial decision-making.

METHOD

Sample and data collection

The fourth author collected a sample of 59 male serial murderer cases from the Federal Republic of Germany. All information pertaining to the sample was obtained directly from the police and prosecution service files of the original inquiries and from the court verdicts. Initially included in the sample were all offenders who 'committed alone or with accomplice(s) at least three completed murders, each of which have to be premeditated and characterized through a new, hostile intent'—a definition put forward by Harbort and Mokros (2001).

Criminal spatial decision-making research requires knowledge of an offender's home and crime locations. This presents a problem for application to serial murder because each case may involve more than one crime location. For example, the victim's body may be recovered from a different location than where the victim was encountered or murdered. In addition, the victim encounter location may be unknown in some cases, and thereby have to be approximated from the location where the victim was last seen or omitted from research samples. In order to avoid spatial approximations and retain large sample sizes, the current study focused on body recovery locations. While there are some inherent problems with using this location (e.g. the fact that a body may be transported by natural elements after it is disposed of), the body recovery location, once it is known, can usually be documented with greater certainty than other locations associated with the murder. Also, for the most part, it is the discovery of a victim that sparks a murder investigation. Of course, a practical limitation of using the body recovery location is that all victims that a particular murderer is responsible for may not be recovered during an investigation and therefore will not be useful to investigators. But with regard to offender spatial decision-making, focusing on body recovery locations may be particularly valuable because body disposal may involve a more conscious decision-making process, which considers the relative spatial location of the offender's residence to a larger degree, than victim selection (Godwin & Canter, 1997).

For each of the 59 murderers in the sample, the location of his residence during the commission of the murders (i.e. the *home location*) and the geographic locations where each of his victims' bodies was discovered by police (i.e. *body recovery locations*) was plotted on a map. Body recovery locations were numbered to indicate the sequential order of the murders. Distances between body recovery locations (i.e. outcome of a decision process) and the home location (i.e. *home-to-crime distances*) were measured with a ruler and converted to kilometres (km) using map scales. The measurements were recorded to the nearest decimal place. Prior to the transference to maps, one murderer was omitted from the analysis because all of his victims' bodies were disposed of

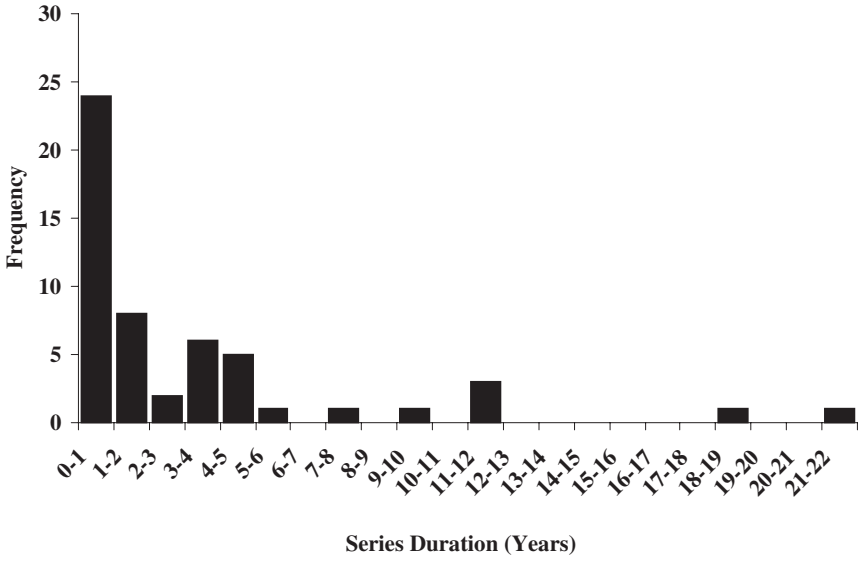

Figure 1. Duration of murder series (n = 51).

in his home,[1] one murderer was omitted because there was no spatial data available regarding his crimes, and four murderers were omitted because they had no known home location. The final sample used in the analysis included 53 male serial murderers who committed a total of 247 murders between 1929 and 1999.

The mean and median numbers of body recovery locations per murderer were 4.6 and four, respectively. In the cases where multiple victims of the same murderer were found in the same location, every recovered body was counted as a separate location.[2] Twenty-six (49%) of the murderers were apprehended after committing three murders, nine (17%) committed four murders, and 18 (34%) murderers were responsible for five or more deaths. The maximum number of victims in a series was 15.

The duration of a killing series was calculated as the elapsed time between the first and last murder. As shown in Figure 1, the distribution of durations was negatively skewed as 45% of the murderers were arrested within a year of committing their first murder. A further 15% of murderers were arrested following a 1–2 year series. By comparison, only 15% of series were longer than 5 years. The mean duration of the 53 series was roughly 3 years (i.e. 1118 days; SD = 1646.5 days) and the median duration was slightly over 1 year (446 days). The series ranged from 10 days to 7810 days (21 years).

The age of each serial murderer was determined at the time of the first known murder in a series and the last murder committed before the murderer was arrested. At the time of the first murder, the murderers were between 16 and 52 years of age and the median

[1]Since this paper was written from an investigative psychological perspective, this case was deleted because the body disposal locations would have been unknown to investigators and therefore could not have contributed to identifying the murderer.

[2]There were five instances when multiple bodies were recovered from the same location—for four murderers. There were three instances when two bodies were recovered in the same location, once when three bodies were recovered from one location, and once when four bodies were recovered from the same location.

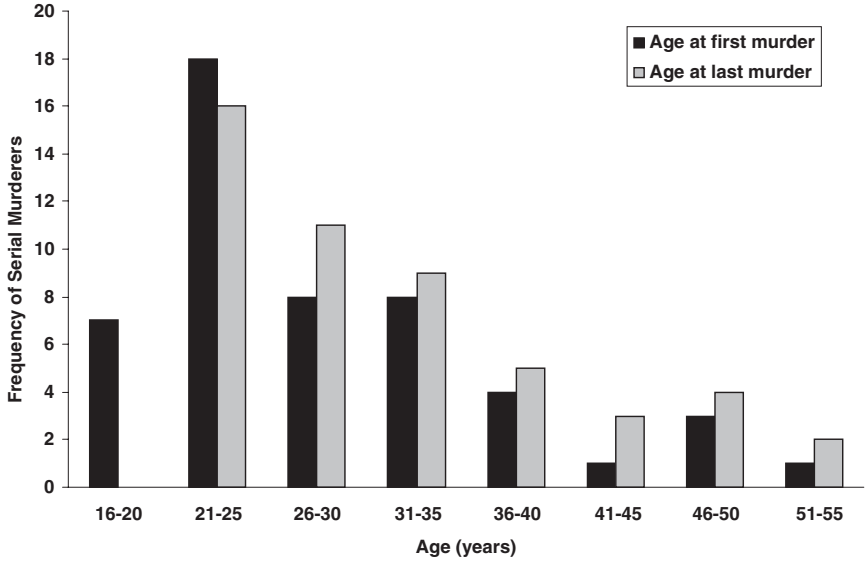

Figure 2. Serial murderer age at the first and last murder in a series ($n = 50$).

age was 26 years ($M = 28$ years, $SD = 9$ years). As shown in Figure 2, the distribution of the ages at the time of the first murder was strongly skewed towards younger ages. Roughly 50% of the serial murderers were 25 years of age or less, and 80% were below 33 years of age when they committed their first murder. On the date of the last murder, the median age of the murderers was 30 years ($M = 31$ years, $SD = 9$ years), with the youngest being 21 years and the oldest being 55 years of age. It can be seen in Figure 2 that the distribution of these ages was also skewed towards relatively younger murderers. Approximately 56% of the serial murderers in the sample were between the ages of 21 and 31 years and approximately 90% were less than 40 years of age when they committed their last serial murder.

The IQ scores of those offenders for whom data from psychometric intelligence tests were available ($n = 29$) follow the expected shape of a normal distribution. Neither the goodness-of fit test put forward by Anderson and Darling (see D'Agostino & Stephens, 1986) nor the one by Bowman and Azzalini (1997) indicates a significant violation of the normality assumption. The test statistics in the Anderson–Darling and in the Bowman–Azzalini goodness-of-fit tests are $A^2 = 0.47$ and $\mathrm{ISI} * 1000 = 36.7$, respectively. These results correspond to p-values > 0.05 in both instances. Figure 3 shows a kernel density estimate of the distribution of IQ scores in the sample, based on a Gaussian kernel with a normal optimal smoothing parameter of $h = 6.63$ (see Bowman & Azzalini, 1997). The IQ scores of these murderers were assessed by psychiatrists and psychologists who commented as expert witnesses in court cases where offenders may have had a mental disorder that could have lessened or eradicated culpability. It is important to note that these expert witnesses used a variety of intelligence tests to assess the mental capabilities of the culprits. Therefore, it is likely that the diverging methods of assessment, as well as differences in conducting these tests and interpreting their results, may have had an impact on the reliability of the IQ scores. Nonetheless, the average IQ score was 100.5 ($SD =$

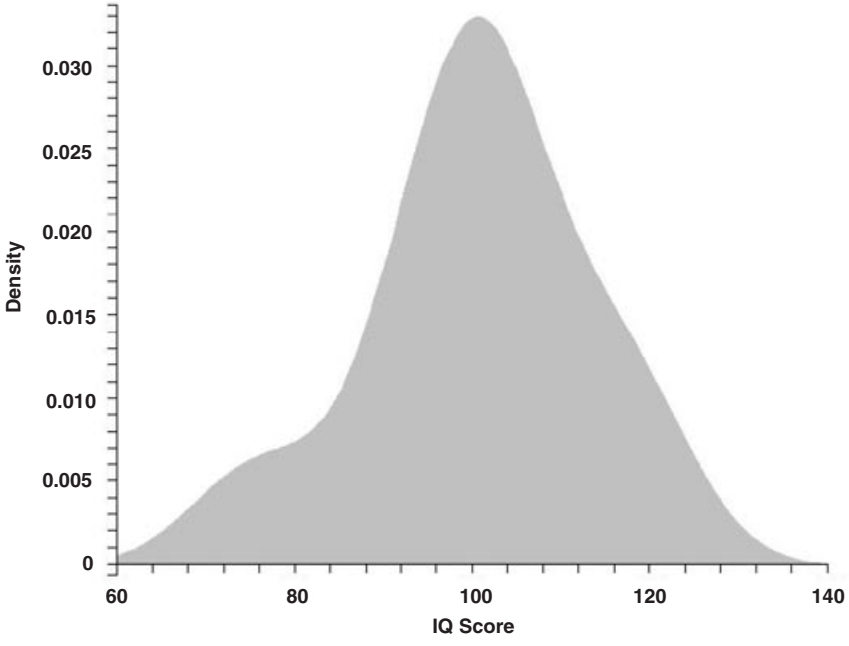

Figure 3. Kernel density plot of serial murderers IQ scores (n = 29).

12.3, *Mdn* = 102). Eighteen of the 29 serial murders had IQ scores between 91 and 110. Six of the murderers had IQ scores over 111 while five had IQ scores under 90.

Twenty-five per cent of the serial murderers in the sample were married, 60% were single, 6% were divorced, and 2% were engaged during the entire murder series. The marital status of 10% of the sample changed during the murder series. Approximately 64% of the serial murderers were employed during the commission of their crimes. Regarding the assumed motives of the serial murderers, as necessitated by German criminal law, 55% of the murderers were deemed to be sexually motivated and 42% were classified as committing the murder for some material gain (e.g. robbery). For one serial murderer, no clear motive could be established because of a severe mental disorder (schizophrenia), and another murderer was motivated by both sexual intentions and robbery.

Table 1 presents all modes of transportation that were used during the murders and the percentages of murders that employed each mode. Driving a car was the most highly used mode of transportation (34%), followed by walking (24%), and public transportation (18%), during the commission of the murders. The police and prosecution service files did not indicate during which parts of the crime these modes of transportation were used. It is unlikely that walking or public transportation were used to dispose of a body but relying on these modes of transportation would still constrain murderers' spatial decision making.

RESULTS

Figure 4 shows the distribution of home-to-crime distances. The distribution was negatively skewed, whereby victims' were usually recovered a short distance from the mur-

Table 1. The home-to-crime distance as a function of mode of transportation

			Home-to-crime (km)		
Mode of transportation	*n*	Percentage (%)	Median	Mean	*SD*
Car	84	34.0	15.5	48.6	90.2
Walk	59	23.9	2.2	3.1	3.9
Public transportation	44	17.8	5.9	10.2	12.7
Bicycle	17	6.9	5	6.8	5.8
Railway/walk	11	4.5	168	166.9	37
Train	8	3.2	1.9	5.3	8.3
Walk/public transportation	8	3.2	7.7	10.4	8.1
Taxi	5	2.0	9	10.6	10.4
Motorcycle	4	1.6	7.4	8.6	3.3
Walk/taxi	3	1.2	15	10.8	8.1
Railway/public transportation	2	0.8	109	109	1.4
Moped	1	0.4	18	—	—
Bicycle/public transportation	1	0.4	440	—	—

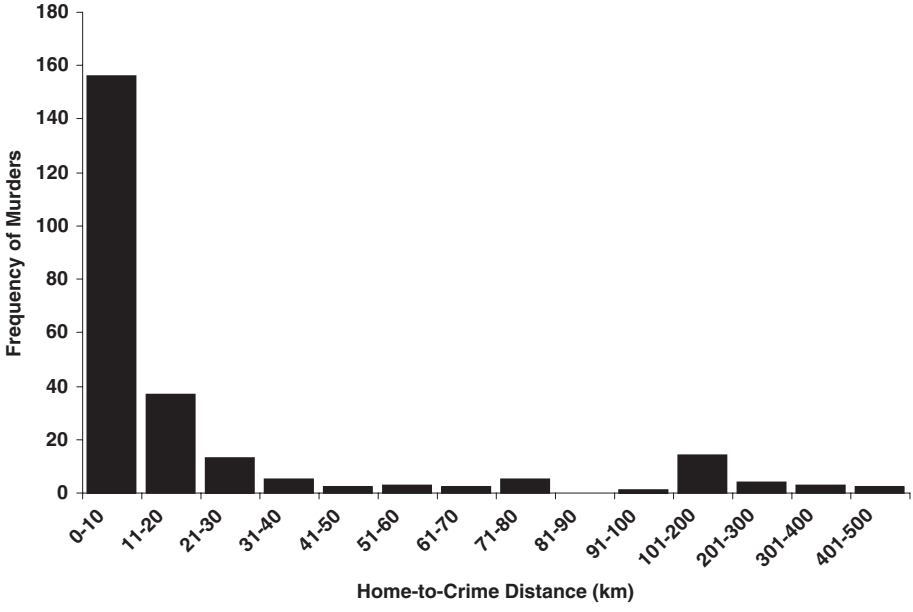

Figure 4. Home-to-crime distance (n = 247).

derer home location. The median home-to-crime distance was 6.5 km (M = 30.7 km, SD = 69.7 km). A total of 156 (63%) of the 247 body recovery locations were located less than 10 km from the murderer residence. Cumulatively, 6.5% of bodies were found within 1 km of the murderer home, 17% within 2 km, 28% within 3 km, 34% within 4 km, and 45% within 5 km. Further, 193 (78%) of the victims were found within 20 km of the murderer's residence, and 206 (84%) were found within 30 km. Only 23 (9%) home-to-crime dis-

tances were longer than 100 km. Five serial murderers were responsible for those 23 murders, and 10 of the 23 were attributed to just one murderer.

Series chronology

Figure 5 shows the relationship between the number of murders (i.e. number of body recovery locations) and the common log of the median home-to-crime distance.[3] Because of non-normality in the home-to-crime distance distribution and the high number of ties in the number of murder locations, a Kendall's tau-b was used to establish that no statistically significant association was present ($\tau = -0.082$, $p > 0.05$).

Table 2 presents summary statistics for home-to-crime distances for the first three crimes in each series. Also presented is the percentage of the time that each of the first three crime locations was the closest to the corresponding murderer residence relative to the other two. There was no trend towards either an outward (increasing distance from one offence to the next) or inward (decreasing distance from one offence to the next) movement from the

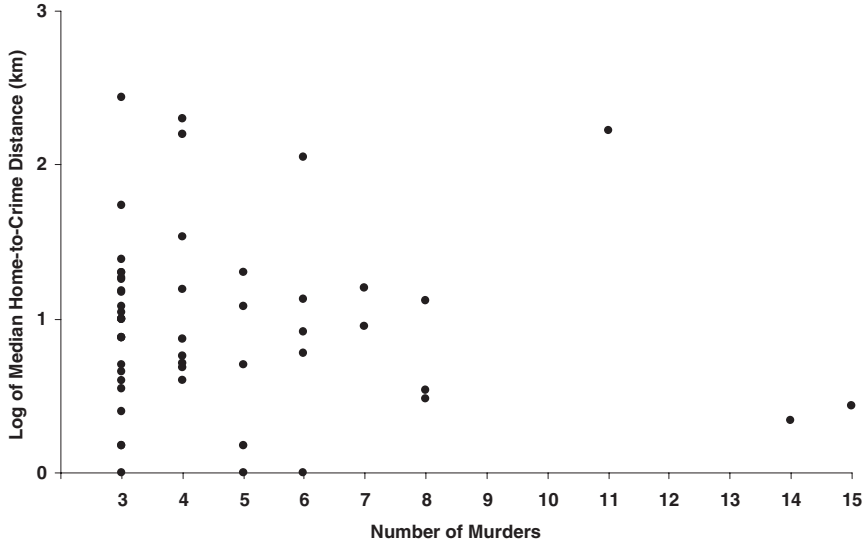

Figure 5. Relationship between the number of murders in a series and the common log of median home-to-crime distance ($n = 53$).

Table 2. Sequential order of the home-to-crime distances

	Home-to-Crime Distance (km)			
Crime Location	Per cent of time closest to home	Median	Mean	*SD*
First	47	6.3	25.9	69.7
Second	34	10.0	37.8	83.9
Third	36	7.8	33.1	74.7

[3]The distances were plotted on a common logarithmic scale (base 10) for Figures 5, 6, 7, and 8 because the wide range of distances made it difficult to observe the proportion of data points located in the lower part of the graph.

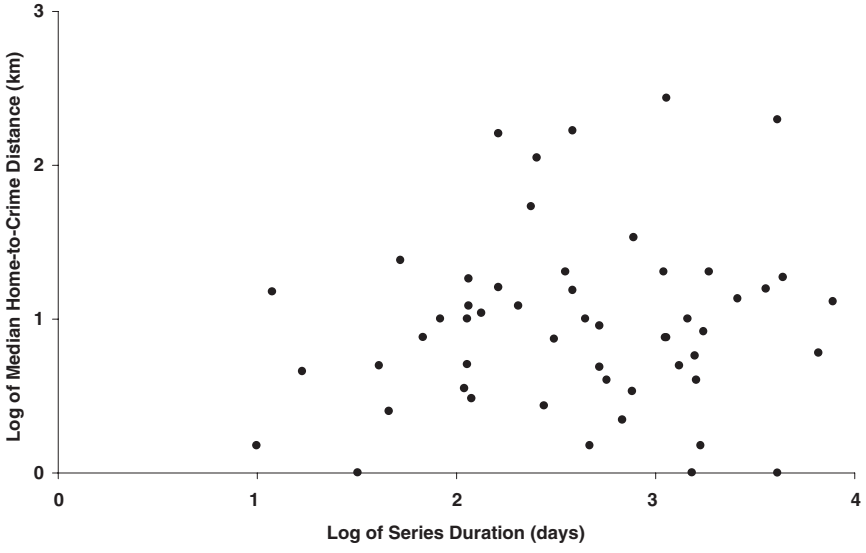

Figure 6. Relationship between the common log of series duration and the common log of median home-to-crime distance ($n = 53$).

first to the third crime location. The first crime location was closest to the murderer's home in 47% of the cases, the second was closest in 34% of cases, and the third was closest in 36% of the cases. A Friedman test for three related samples revealed that the chronology of the crime locations was not significant in terms of home-to-crime distance ($\chi^2 = 1.602$, $p > 0.05$). If averaged over all individuals, neither one of the first three crime locations was located significantly closer to the murderers' home than any of the other two.

Figure 6 shows the relationship between duration of a series in days and the common log of the median home-to-crime distance. Regardless of the increasing length of time that series lasted, the murderers did not leave their victims farther from or closer to where they resided. Even for the two longest series that lasted for 18 and 21 years (in comparison to a median duration of 1 year), the median home-to-crime distance was less than 11 km. These conclusions were supported by a Spearman's rank-order correlation, ($r_s = 0.092$, $p > 0.05$).

Age

Figure 7 shows the relationship between age and the common log of the home-to-crime distances. As the age of the murderers at the time of each murder increased, the median home-to-crime distance decreased. In other words, older German serial murderers left their victims' bodies closer to their home than younger murderers. A Kendall's tau-b correlation confirmed that there was a significant, albeit weak, negative association ($\tau = -0.091$, $p < 0.05$).

Intellectual capability

Figure 8 shows the relationship between IQ score and the common log of the median home-to-crime distance. It can be seen that higher IQ scores corresponded with higher

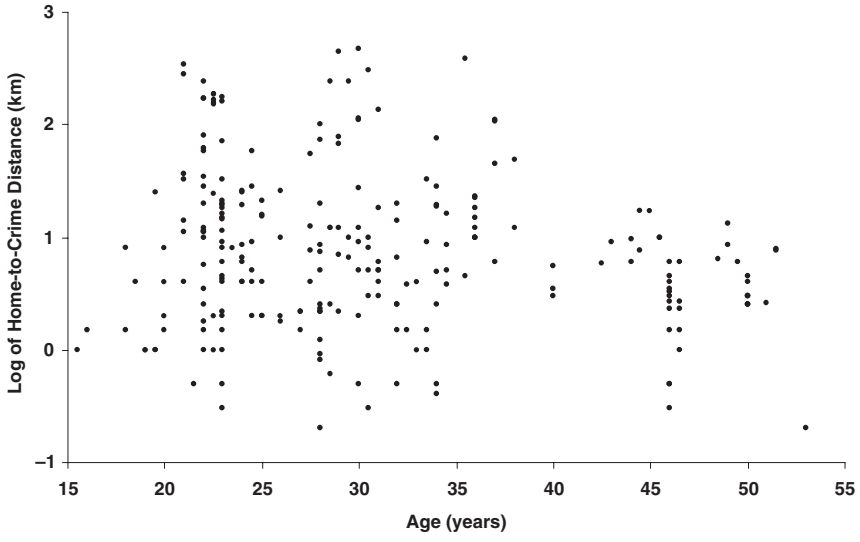

Figure 7. Relationship between serial murderer age and the common log of home-to-crime distance for each murder ($n = 247$).

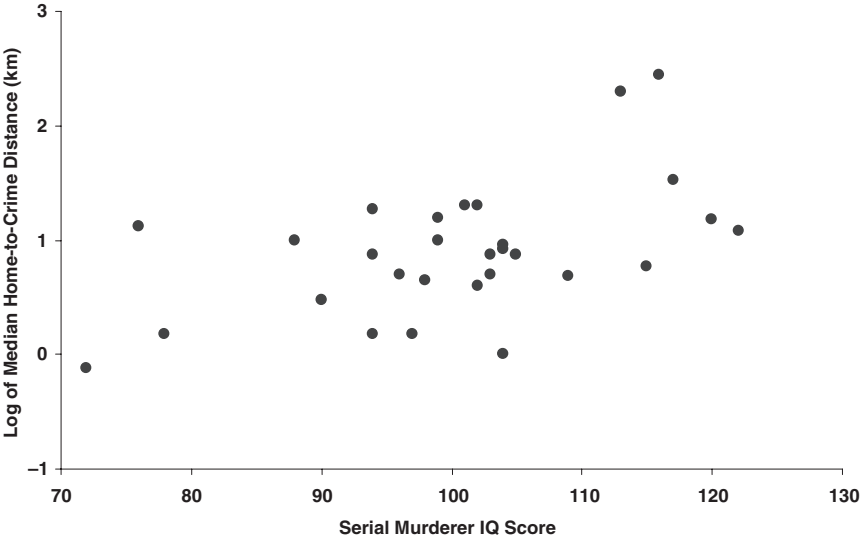

Figure 8. Relationship between IQ score and the common log of median home-to-crime distance ($n = 29$).

home-to-crime distances. A statistical test of this relationship using a Spearman's rank-order correlation supported this relationship ($r_s = 0.407$, $p < 0.05$).

Marital status

A Mann-Whitney test showed that the median home-to-crime distance for single serial murderers ($Mdn = 12.0$ km, $M = 29.5$ km, $SD = 61.5$ km) was not significantly different

than for those who were married (*Mdn* = 10 km, *M* = 31.9 km, *SD* = 51 km), *U* = 203, *p* > 0.05. The median home-to-crime distance for divorced murderers (*Mdn* = 5.1 km, *M* = 5.9 km, *SD* = 4.8 km), murderers with varied marital status (*Mdn* = 4.6 km, *M* = 4.0 km, *SD* = 2.4 km), and the engaged murderer (9 km) were not included in this analysis because of the small number of murderers in each of these categories.

Employment status

A Mann-Whitney test showed that the median home-to-crime distance for employed murderers (10 km, *M* = 31.7 km, *SD* = 64.7 km) was not significantly different than for unemployed murderers (8.3 km, *M* = 18.6 km, *SD* = 27.2 km), *U* = 281, *p* > 0.05.

Motive

The median home-to-crime distance for German serial murderers classified as sexually motivated was 10 km (*M* = 32.1 km, *SD* = 65.3 km) while it was 8.8 km (*M* = 21.1 km, *SD* = 38.3 km) for those murderers classified as robbery motivated. A Mann-Whitney test confirmed that the small difference in home-to-crime distances between these two types of murderers was not significant, *U* = 308, *p* > 0.05. Home-to-crime distances for the schizophrenic murderer (*Mdn* = 3.0 km) and the mixed-motive murderer (*Mdn* = 0.8 km) were not included in this statistical test because a sample of one is insufficient to support statistical analysis.

Mode of transportation

Table 1 contains a complete breakdown of the modes of transportation that the murderers used during the commission of their crimes. A car was the most commonly used mode of transportation, walking was the second most common, followed by public transportation. Since the sample size was small for many modes of transportation, and the home-to-crime distance was not normally distributed, a Kruskal-Wallis one-way ANOVA was performed on only these three modes of transportation. As expected, home-to-crime distances significantly differed between those that used a car (*Mdn* = 15.5 km), those that used public transportation (*Mdn* = 5.9 km), and those that walked (*Mdn* = 2.2 km), $\chi^2 = 74.75$, *df* = 2, *p* < 0.001.

DISCUSSION

In a majority of German serial murderer cases in the past three-quarters of a century, victims' bodies were recovered near their murderer's home location. Godwin and Canter (1997) reasoned that the spatial pattern of body recovery locations may reflect an attempt to dissociate evidence from the offender's residence. Based on this reasoning, body recovery locations indicate conscious spatial decisions of serial murderers. These spatial decisions appear to be influenced by the mode of transportation that the murderer uses while committing a murder, and the intellectual capability and age of the murderer. The series chronology, and the marital status, employment status, and motive of the murderer, on the other hand, appear to have no significant impact on spatial decisions. These results con-

tribute to the cumulative development of knowledge of serial murderer spatial decisions and pose implications for police investigations.

Of relevance to the spatial decision-making and serial murder research is the finding that German serial murderers generally dispose of their victims' bodies in close proximity to the murderer's home. The results of the aggregate-level analysis show that the home-to-crime distance distribution follows a decay pattern, whereby the likelihood of disposing of a body decreases as the distance from the murderer's residence increases, and furthermore that the median and average distances from the murderer's home to the body recovery location are roughly 8 km and 30 km, respectively. While these values are larger than those reported for other types of crime, they are relatively small in comparison to the few home-to-crime distances that were in excess of 100 km. Moreover, the current findings are in accordance with Dern *et al*.'s (2004) findings that 63% of serial sexual murders occurred within 10 km of the murderer's residence. This pattern of spatial decisions is generally consistent with other reports that have also illustrated that serial murder is typically a localized type of criminal activity (e.g. Godwin & Canter, 1997; Hickey, 1991; Lundrigan & Canter, 2001; Rossmo, 2000).

The current results show that relatively more intelligent serial murderers travel farther from their homes to dispose of their victims' bodies than those with lower IQ scores. This supports the notion suggested by the findings of Ressler *et al*. (1986) that intelligence is positively related to home-to-crime distance among serial murderers. Another significant finding from the current study concerned the relationship between spatial decisions and the modes of transportation employed during the commission of murders. As intuitively expected, it appears that serial murderers who use a car leave bodies farther from their home than those who walk and use public transportation. Contrary to previous research that found a positive relationship or no clear linear relationship between offender age and home-to-crime distance (e.g. Baldwin & Bottoms, 1976; Davies & Dale, 1995; Nichols, 1980), older German serial murderers appear to leave bodies closer to their home location than their younger counterparts.

Evidently, German serial murderers are not unconstrained decision-makers who drift freely across Germany murdering people at will. Although this study was not concerned with the cognitive processes involved in serial murderers' spatial decision-making, it appears as though these processes may be influenced by at least some of the same constraints that have been found to influence the spatial decisions of other sorts of criminals (e.g. Costello & Wiles, 2001).

The fact that the length of the murder series, the sequential order of murders, and the marital status, employment status, and apparent motive of the murderer were not related to spatial decisions challenges existing assumptions and contributes new knowledge about serial murderers. For instance, some researchers have proposed that the home-to-crime distance will be larger for each successive victim in a series and claimed that this was due to serial murderers' attempts to avoid recognition and apprehension (Godwin & Canter, 1997; Rossmo, 2000). In the current study, this proposition was not supported; there was no significant difference in home-to-crime distance between any of the first three victims. Perhaps some serial murderers attempt to evade apprehension while others do not. Some may feel that they may soon be arrested while others may be confident that they can avoid detection. Some serial murderers may even gain confidence in their ability to evade authority when they are undetected following a murder. Others still may actually desire to be captured. The belief that offenders live closer to their first crime location than their subsequent crime locations was also not corroborated among the current sample, suggesting

that there is nothing significant about the first crime in terms of the development of criminal spatial decision-making (Canter & Gregory, 1994; Canter & Larkin, 1993; Davies & Dale, 1995; Rossmo, 2000; Warren *et al*., 1995, 1998).

The results have potential implications for whether geographic profiling could be used by police officers in the investigation of German serial murderers. Geographic profiling involves predicting the home location of an at-large serial offender based on information about where that offender has committed his or her crimes (Canter & Larkin, 1993; Rossmo, 1993; Snook, Canter, & Bennell, 2002; Snook, Taylor, & Bennell, 2004; Snook, Zito, Bennell, & Taylor, 2005). In order to determine if geographic profiling will succeed or fail for a particular type of serial crime in a particular environment, it should be demonstrated that the assumptions upon which the geographic profiling technique is based correspond with what is known about the spatial decisions of serial offenders in that environment. Regarding serial murder, geographic profiling is partially based on the distance-decay pattern, according to which serial murderers typically offend near their homes. In this study, we showed that German serial murders live relatively close to where they offend, thus, providing some evidence that geographic profiling may be a useful method in providing the police with a location where they can begin searching for a serial murderer.[4]

The effect of the other variables upon spatial decisions is also of investigative importance. If we can assume an accurate eyewitness account or definite trace evidence, factors such as age and mode of transportation may also be used to adjust inferences on where an offender is most likely to reside. For instance, a suspect who is over 30 is more likely to live nearer to the body recovery location, and a serial murderer that was seen driving away from a crime site in a vehicle probably lives farther from the crime scene than a murderer who left a crime location on foot. Although there were a number of factors that were not significantly related to serial murderers' spatial decision-making, two, in particular, have important applied implications for investigations. First, the fact that more experienced serial murderers do not have longer home-to-crime distance than less experienced murderers indicates that the serial murderers offend locally and continue to offend within the same distance of their home location regardless of the period of time over which the series persists or the number of crimes they have already committed. Second, the fact that neither of the first three crime locations was located nearer to the murderer's home than the other two crime locations suggests that neither of these crime locations should be used as a primary reference point to indicate a future German serial murderer's likely home location.

In sum, this study showed that German serial murderers tend to leave their victims' bodies near their homes. In addition, certain factors appear to be related to the distances from their homes that murderers offend. In particular, IQ, mode of transportation, and age were found to be significant predictors of home-to-crime distance in the current study. Although further research with larger samples is required to determine the reliability and thus the operational value of such indicators for police investigations, it might be possible for investigators to use some of these findings to help predict the home location of at-large serial murderers.

[4]The second assumption is that the home is often located within a circular area with the diameter defined by the distance between the two farthest crimes in the series. A test of this marauder assumption showed that, for the current sample, 71% of the murderers lived within the circular area. It should be noted that 13 of the murderers had more than one home location during their series, thus, each home was classified independently when we tested the marauder hypothesis.

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