

Robert D. Keppel,¹ Ph.D. and Joseph G. Weis,² Ph.D.

Time and Distance As Solvability Factors in Murder Cases

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ABSTRACT: There is no empirical research on solvability factors in murder investigations. This paper analyzes data collected in the first study to provide such, focusing specifically on the extent to which information on time and distance among locations of a murder incident are related to solvability. The results show that the more information on the times and distances separating where the victim was last seen, the location of the original contact between the victim and the killer, where the initial assault occurred, the murder site, and the body recovery site the more likely a murder case will be solved. These findings have profound implications for the management and conduction of murder investigations.

KEYWORDS: criminalistics, murder investigation

Historically, social scientific research on murder has emphasized the ecological, demographic, social structural, and psychopathological characteristics of murder incidents, victims, or offenders [1-4]. These studies typically rely on aggregate-level data or, at the other extreme, clinical case-studies, neither of which are very informative regarding the control of murder, particularly by the criminal justice system. The problem is that researchers, for whatever reasons, have neglected the criminal justice response to murder as an object of inquiry.

Consequently, there is not one rigorous, empirical study that *focuses* on the formal reaction to homicides by those agencies and agents responsible for solving the crime and apprehending the offender. Prior research has not focused on the processes, procedures, and factors that characterize the *investigation* of murder. To the authors' knowledge, there is only one study of murder investigation, but it was somewhat limited in scope and, therefore, generalizability, because it focused only on the investigation of "serial" murder, did not deal with how the murderers were caught, and depended on the veracity of information provided by 36 convicted serial-murderer interviewees [5]. That study may illuminate the understanding of some aspects of the investigation of serial murder, but it cannot address the whole process of investigation of all types of murder.

There are three general sources of information on the investigation of murder: 1) case law on murder, 2) textbooks on criminal investigation, and 3) empirical research on the

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¹Chief Criminal Investigator, Washington State Attorney General's Office, Seattle, WA.

²Professor, Department of Sociology, University of Washington, Seattle, WA.

investigation of crimes other than murder. A somewhat remote source of information affecting the solution of murder investigations is the case law on murder convictions. The procedures used by police in murder investigations are a common source of appellate issues raised by those convicted of murder. The case law is replete with appeals that attack the quality of police investigations in murder cases. Frequently, the law points to several solvability factors: 1) The quality of police interviews of eyewitnesses [6]; 2) the circumstances which led to the initial stop and arrest of the murderer [7]; 3) the circumstances that established the probable cause to search and seize physical evidence from the person and/or property of the murderer [8]; 4) the quality of the investigation at the crime scene(s) [9,10]; and, 5) the quality of the scientific analysis of the physical evidence seized from the murderer and/or his property and its comparison to physical evidence recovered from the victims and the murder scenes [9]. Empirical research has not been generated from these appellate cases.

A controversial body of literature exists in textbooks on criminal investigation in the police science field. These textbooks deal with highly selective elements of murder investigation, for example, the preservation of evidence at the murder scene and various methods of analyzing and handling that evidence [11,12]. The basis for these texts is limited to the practical experiences of each author, and is not the result of generalizations made from empirical research. Very little information is presented in these texts that relates to the actual steps, beyond the original crime scene investigation, that detectives should follow. The logical steps necessary to follow the clues that can be found during the formative stages of a murder investigation are not specified or analyzed in any of these texts or in any empirical research studies.

The empirical research on criminal investigation over the past 15 years has focused on 1) the description of the investigative process, 2) the actions of investigators and information sources used by them in solving crimes, and 3) the management of criminal investigations. Although most of this research is not directly applicable to the investigation of murder and is often flawed methodologically, it does point to a number of important research issues and questions. The early studies of criminal investigation were primarily descriptive accounts of law enforcement efforts to solve crimes. This research has been highly critical of the police role in apprehending criminals. The investigation of crime is described as a serendipitous process, wherein the actions of police have little to do with solving crimes [13,14].

A number of controversial evaluations of police productivity have reiterated the conclusion that the detective function is relatively ineffective in solving crimes [15,16]. But no studies have examined whether the quality of detective work is related to the apparent *declining* clearance rate for murders. Recent estimates are that, from 1960 to 1983, the solution rate for murders has declined from over 90% to approximately 76% for all types of murder [17]. In a related study in San Diego, the major conclusion was that there had been a rapid growth of urban criminal homicide between 1970–1980, coupled with a corresponding decrease in homicide cases cleared by the police [18].

A number of recent studies have focused on the critical elements in solving crimes, particularly burglary and robbery. This research concludes that patrol officers and detectives contribute equally important work toward the solution of these crimes, a finding contrary to earlier studies which emphasized the importance of patrol officers and preliminary investigation and minimized the value of follow-up investigation [19]. The research on solving crimes typically explores the routine police techniques used in identifying solvability factors—for example, canvassing for eyewitnesses, developing informants, and contacting other police agencies—but neglects the characteristics of the crime incident that may be important in solving the case.

It is hypothesized here that there is an important relationship between solving murders and having information about a number of important locations—where the body is dis-

covered, the place where the victim was last seen, the initial contact point between the offender and the victim, the initial assault site, and the location where the murder actually occurred. For example, if a female is found bludgeoned to death in her bedroom and the initial contact between that victim and the killer was at the same place and minutes before the murder, statistics would most likely demonstrate that, in a significant number of these types of cases, the boyfriend or husband was the perpetrator, and the investigation of the boyfriend/husband should receive the highest priority in the investigation process. The avenues of approach and the priorities of the investigative steps can be developed, both prospectively and retrospectively, from information about the various locations.

Overall, even though the empirical research on the process of investigation, the identification of solvability factors, and the effective management of investigations [20,21] suffers from many of the usual methodological problems of inadequate samples, inappropriate data, weak research designs, and simplistic analyses [19,22], it points to a number of important issues in criminal investigation, particularly the critical role of *information* in solving crime. Typically, information is obtained routinely by interviewing witnesses and suspects, canvassing neighborhoods, processing crime scenes for physical evidence, examining records, and so on. One of the most prominent reasons why detectives do not solve cases is the manner in which they gather and use information. The key to solving crimes and making arrests is to understand how much and what kind of information is available and how to organize it to make it more accessible and useful [23]. The main flaw in studies that are critical of the investigator's ability to process information is that they have focused on crimes other than murder, such as burglary and robbery. The investigative response to those crimes is different than for murder; for example, a detective is not always assigned immediately to follow-up these cases, whereas all murders are assigned for follow-up.

Murder investigations have not been the primary focus of any study but have been included as part of other research on murder. For instance, the factors of time and distance have been mentioned as factors that affect the solution of murder cases. The reference to time, however, has been expressed only in terms of its relationship to solving a case when the time of arrest is compared to the time when the murder was discovered. The research has shown that in 66% of solved murder cases, a suspect is in custody within 24 hours and, if the murder is not solved within 48 hours, the chances of it ever being solved fall markedly [24,25]. The relationship of time to other factors in murder cases has not been considered in any scientific research, such as information about the time and place of death in comparison to the time and location of the body recovery site, both elements vital to any murder investigation [11,12,26].

Distances between certain crime scene locations in murder cases have not been included routinely as part of any research project on murder. The importance of distance was first emphasized by the National Serial Murder Advisory Group for the Federal Bureau of Investigation's Violent Criminal Apprehension Program (VICAP).³ The actual intervals of distance among the victim's last known location, the initial contact point between the offender and victim, the initial assault location, the death site, and the body recovery site were recorded on the VICAP Crime Report and submitted to the FBI by

³The National Advisory Group to the VICAP Program operated from 1981 until VICAP was implemented in June 1985. It recommended factors that were important to the solution of multiple murder cases. Those recommendations were based on over 100 years of combined homicide investigation experience of the group's members. They were Pierce Brooks (Los Angeles Police Department), Lt. Terry Green (Oakland Police Department), Captain Robbie Robertson (Michigan State Police), Sgt. Frank Salerno (Los Angeles County Sheriff's Department), and Chief Investigator Robert Keppel (Washington State Attorney General's Office).

local law enforcement officers [27]. Agents of the FBI's Behavioral Sciences Unit have further highlighted time and location factors as crucial to the process of "profiling" violent offenders. They emphasize the importance of analyzing the time it takes to kill and dispose of a victim, in conjunction with the location of where the murder occurred, especially if it is different from the point of abduction and where the body was discovered [5].

A more recent project undertaken by the U.S. Office of Juvenile Justice and Delinquency Prevention also emphasized the importance of time and distance intervals in murder investigations. The purpose of the research was to conduct national incidence studies to estimate the parameters of the missing child problem, including the number of juvenile "victims of abduction by strangers." The time that a child was detained and the distance that a child was transported after the abduction were major factors in this research. The research concluded, tragically, that 2% of the abduction cases where children were coerced or taken a distance of more than 20 feet, or were detained for more than one hour, ended with the murder of those children [28]. However, this project did not consider the effect of time and distance on the solution of child murder cases.

Finally, a major concern in the literature on murder investigation is that the police are not doing their job very well. The most common indicator of their performance is the clearance rate, the barometer of successful investigation. Clearance rates for murder investigations look bad because they are declining. For example, in Illinois, clearance rates for murder have dropped from 90% to 77% since 1972 [15]. In Washington State, the 1984 murder clearance rate was 77% and has dropped to 66% in 1987 [29]. When the murder clearance rates for cities over 250,000 population are examined, the even lower clearance rate for killings is disturbing. For example, New York City reported a clearance rate of 57% in 1979. Also, the police in Denver reported a clearance rate of 46% in 1980, a figure which represents a startling decade change of 179% in unsolved criminal homicides [18].

It is clear that rigorous, empirical research on murder investigation is needed to clarify the issues and problems identified in the research literature and raised in case law on murder conviction appeals. This study is intended to improve the understanding of murder and its investigation, as well as the management and solution of murder cases.

A Model of Murder Investigation

The customary way that the police become involved in the investigation of a murder is in response to calls of shots fired, a missing person, a man down, or a dead body. The course of the investigation is reactive in nature in that investigators follow up the reported call after the incident has occurred.

The most frequent place for a murder investigation to begin is at the site where the victim is found. This location is commonly referred to as the "body recovery site." The finding of a dead body is the starting point and initial focus of the murder investigation [12]. The scene of a murder is, without a doubt, the most important crime scene to which a police officer or investigator will be called upon to respond [11]. How a murder is investigated has traditionally relied heavily upon the role of logic and very little on theories of investigation based on empirical research. To date, advances in the quality of detective work have been motivated and accomplished primarily by the ingenuity and drive of individual detectives [31].

For homicide investigators, there are no current models of investigation that can systematically guide their follow-up procedures in every murder case. Traditionally, detectives have relied on the facts available in a particular case and proceeded on avenues of follow-up investigation based on "gut feelings" and "common sense." This research focuses on the investigation of murder as a process. The process is called a Model for Murder Investigation (MMI). The result of using MMI in the pursuit of follow-up leads

in murder investigations is that the case will be approached systematically, thus making homicide detectives more effective.

The basic premise of the model proposed here is that the crime of murder is an incident. The murder incident contains multiple components that are locations of contact between the offender and victim. MMI emphasizes the search for clues or information about the major investigative locations of a murder incident. A thorough investigator collects all the necessary information that exists around each location. The presence or absence of information that establishes the existence of each location, coupled with when and where each location is found within the incident, and the manner in which their relationships affect each other, will greatly influence the solution of the murder case. Specifically, MMI involves the gathering of information about the important locations of victim-offender contact.

Locations of a Murder Incident

1) The location where and the time when the victim was last seen, or Victim Last Seen Site, is developed from eyewitness information and records that reflect when and where the victim was last seen alive. For example, eyewitness accounts include visual sightings and telephone conversations, and records include official documents, such as traffic citations, police field interview reports, jail booking logs, long distance telephone/toll records, credit card receipts, etc.

2) The place where and the time when the offender initially contacted the victim, or Initial Contact Site, is established from evidence that the offender first met the victim at a certain time and at a specific location during the course of the murder incident. For example, if a husband killed his wife in their apartment after she returned home from work, the time and location for the initial contact within that murder incident is when the wife returned home from work and was confronted by her husband, not the date when they first met two years ago.

3) The Initial Assault Site is the location where and the time when the offender, either at the time of, or after the initial contact, kidnaps or assaults the victim in *any* manner during the course of the murder incident. It is not defined as the place where the actual death producing injuries occurred. For example, a male customer picks up a female prostitute at a bus stop. The customer transports the prostitute in his car to a remote location where he slaps the prostitute and handcuffs her. The slap and handcuffing is the initial assault.

4) The Murder Site is the place where and the time when the victim sustains the death producing injuries. Using the previous example, if the initial assault is followed two hours later by a shooting that causes the death of the prostitute at the customer's home, the location of the shooting is the murder site.

5) The Body Recovery Site is the location where and the time when police, medics, or witnesses find the victim, dead or alive, prior to transportation to a medical facility or morgue. For example, if a living victim is found shot outside a tavern, transported to a hospital for treatment, dies in the emergency room, the body recovery site is the tavern, not the hospital.

The MMI operates on the premise that all of the above locations occur in each incident of murder. Problems with any case's solution surface when investigators cannot obtain information about the location and its time of occurrence within the sequence of the murder incident. Fortunately, in most cases, the events occur simultaneously, and the information that is available suggests that all events are located in the same place and are not separated by intervals of distance or spans of time.

However, in many cases the locations within an incident of murder can become separated by time and distance. The separation can occur in two ways. First, the offender

intentionally separates the locations. The killer believes that the separation of murder locations prolongs the investigation by delaying the discovery of various locations and contributes to the destruction of evidence. The separation also inhibits the investigation by causing problems in communication and cooperation among police agencies because the place of all locations is not within the authority of one police agency. For example, multiple murderer Theodore Bundy intentionally contacted victims in different locations than where he killed them and disposed of their bodies. He contacted a female victim at Oregon State University in Corvallis, Oregon and then dumped her remains 265 miles away in rural King County near Seattle, Washington. Prior to his execution in Florida, Bundy made statements about his murders. He revealed that he was aware that time and distance separation among the locations of disappearance, murder, and body recovery resulted in more weathering and deterioration of human remains and physical evidence. He was also mindful of the problems in cooperation and communication among police investigators when murderers use locations in different jurisdictions when contacting victims and disposing of their bodies.⁴

Second, the offender unintentionally separates the locations by time and distance. For example, a man picks up a woman in a tavern. He transports her to a remote location to have consensual sex in his car. Then, an argument ensues because she wants money for her efforts. The offender pulls out a gun and pushes the victim down. Her head strikes a rock, rendering her unconscious. The offender then transports the victim to a hospital where she dies. The offender has not intentionally separated the locations of the incident to deceive investigators. Additionally, the discovery of a body after the murder may be delayed more by chance than by the efforts of the offender. For instance, an elderly woman, murdered in her own home, may not have immediate family in the neighborhood to check on her welfare. The checks may only be sporadic, so the discovery of her remains might take longer than if she had someone who checked on her daily.

Methodology

This study deals with the separation of the locations of a murder incident by time and distance and their relationship to solvability. The study's general proposition is: the more time and distance information that is known about the five locations of a murder incident, the higher the percentage of investigations resulting in solution.⁵

Five issues that flow from this general proposition were explored in this research:

1) When police investigators know the dates of initial contact, initial assault, and the murder itself, this knowledge will contribute to the solvability of the case; that is, the percentage of cases solved will be greater given this knowledge than when the dates for these locations are not known.

2) (a) When the time between a given pair of locations is less than 24 hours, such relatively close proximity in time will contribute to the solvability of the case; that is, the percentage of cases solved will be greater than when that pair of locations is separated by more than 24 hours.

(b) The time proximity of locations will contribute to the solvability of the case even if the locations are not close in time.

3) When police investigators know the distance between the sites of any pair of the five case locations, this knowledge will contribute to the solvability of the case; that is,

⁴Interview by Robert Keppel with Theodore Robert Bundy at the Florida State Penitentiary, January 1989.

⁵Obviously, there is other useful information which may affect solvability, but the analysis here focuses only on time and distance information about locations. Time and distance may not be the most significant factors in every kind of case scenario.

the percentage of cases solved will be greater given this knowledge than when the distances between pairs of locations are not known.

4) When the distance between the sites of a pair of sites is less than 199 feet, the relatively close proximity of the sites will enhance the solvability of the case; that is, the percentage of cases solved will be significantly greater than when the sites are separated by more than 199 feet.

5) When the time between a given pair of locations is more than 24 hours and the distance between that same pair is more than 199 feet, such relatively distant proximity in time and distance will not contribute to the solvability of the case; that is, the rate of solvability diminishes sharply when both the time span and interval of distance are shorter for that pair of locations.

The data examined here were derived from a larger research project on murder and its investigation conducted by the Washington State Attorney General's Office, Seattle, Washington.⁶ The three objectives of the research were 1) to describe and assess the development of a model statewide homicide investigation system, 2) to determine the critical solvability factors present in homicide investigations, and 3) to identify the salient characteristics of homicides.

To determine the critical solvability factors present in homicide investigations, data were collected on all solved and unsolved murders from law enforcement agencies in the state of Washington from January 1981 through December 1986. The final sample of murders totalled 1309 victims.

Most of the information that was input to the Homicide Investigation and Tracking System was collected from each murder case file with a data collection instrument that was designed for both investigation and research purposes. The final version was used to record comprehensive detailed information on 467 items that tap the characteristics of a murder and its investigation.

The Time and Distance Variables

The dates, times, and places of the locations were recorded from data contained in various reports from each case file, including, but not limited to: 1) case reports, 2) investigator's follow-up reports, 3) crime laboratory reports, 4) crime scene diagrams, 5) autopsy reports and 6) witness statements.⁷

Date and time were recorded as the exact date and time that each location occurred as reported in documents from the case file, or as time frame approximations. For example, a witness reported that a victim was last seen on 2-13-86, but was unsure of the time and estimated it to be between 0230 and 0630. So 2-13-86 was entered in the "exact" date area, and the time frame of 0230-0630 was entered in the "approximate" time area.

Unlike the reporting of time, which was frequently mentioned in the text of various reports, recording the distance between locations was a different matter. Some detectives' reports reflected that they had traced the travel patterns of the offender, noting the distance and the time required to drive or walk from one location to another. However, this was not a standard practice for the majority of investigations.

Since distance information was not systematically found within the case file of most murder investigations, distances between locations were calculated in the following man-

⁶Under the title of "Improving the Investigation of Homicides and the Apprehension Rates of Murderers," this research was funded by the National Institute of Justice (Grant No. 87-IJ-CX-0026).

⁷No information based on the offender's arrest or statement was used to record where and when any of the five components occurred. Independent corroboration was necessary.

ner. Each location was plotted on the street map for the appropriate jurisdiction. The map's legend was used to measure the shortest distance between locations as if the offender had travelled by county roads, city streets, or highways. In those cases where the locations were found on the same property or address, crime scene diagrams, drawn by investigating officers, were consulted for various measurements.

The "Solvability" Variable

The variable used to measure solvability was the status of the murder case at the time of coding. Each murder investigation was classified by Case Status into one of the five categories used in the Uniform Crime Reports of the F.B.I.: 1) Open (active investigation), 2) Suspended (inactive investigation), 3) Open—Arrest Warrant Issued, 4) Cleared by Arrest, and 5) Exceptionally Cleared.

Unsolved murders were defined as "Open" and "Suspended" murder investigations. The former meant that the police were actively following investigative leads at the time of coding the data collection instrument; the latter, that police officers were not actively following leads at the time of coding.⁸ Solved murders were defined as "Open—Arrest Warrant Issued," "Cleared by Arrest," and "Exceptionally Cleared" (cases where the offender committed suicide, was killed by police or witnesses, or was deceased for other reasons, such as from a traffic accident or natural causes).

Data Analysis and Results

There were 1309 victims of murder in the state of Washington from January 1981 through December 1986. The case files for 38 victims were "missing" and could not be located by record's personnel from the responsible law enforcement agencies. The investigations of the available 1271 victim case files were the focus of the larger study. For purposes of this research, only single victim-single offender cases ($N = 967$) were used for analysis. The rate of solved, single victim-single offender murder cases was 74%, while a nearly equal percentage of solved cases was noted for all victims (77%), including multiple-victim murders.

When Any Information Is Known About Distance and Time

Since the basic model for murder investigation consists of the five locations of a murder incident, the extent to which any information was simply "known" about each location was examined before exploring the five main issues in this research. The pieces of information collected and examined on each location were 1) the date of occurrence (exact or approximate) and 2) the type of location (such as sidewalk, residence or wooded area) and/or address. Table 1 shows the rate of solvability when any information was known about each location.

The location that was most often "known" was the Body Recovery Site, followed in order by Murder Site, Victim Last Seen Site, Initial Assault Site, and Initial Contact Site. The order of the locations makes sense, since police officers usually start the investigation of a murder at the site of body recovery and use information gathered at that time to continue the inquiry for further information or leads about the remainder of the locations.

⁸These two categories were further specified to mean that the offender was either unknown and not witnessed, unknown but observed, or named and known to police, but insufficient probable cause existed for arrest. Therefore, any information that is discovered in the investigation prior to arrest may be considered a potential solvability factor. Obviously, the specification of solvability factors should be determined through empirical analyses.

TABLE 1—*Solvability by knowledge of time or place of locations.*

Locations	Place or time known	Percent of cases solved	N	tau b	P
Victim last seen	Yes	75	942	.12	.00
	No	40	25		
Initial contact	Yes	77	914	.31	.00
	No	17	53		
Initial assault	Yes	75	938	.24	.00
	No	14	29		
Murder	Yes	75	955	.17	.00
	No	8	12		
Body recovery	Yes	74	966	.05	.09
	No	0	1		

When the contribution to solvability of each location was examined, a more important order was revealed. Information on the Initial Contact Site showed the highest percentage (77%) of solved cases, but followed closely by the other locations. A dramatic finding is the drop in the percentage of solved cases (by at least 60% to 17% for the Initial Contact Site, 14% for the Initial Assault Site, and 8% for the Murder Site) when information about the locations was "unknown." Even though the Initial Contact Site and Initial Assault Site were not as frequently discovered by the police during the course of murder investigations as were the other locations, they show the strongest associations (tau b) of the five locations. Clearly, the pursuit of information about these two locations should have received priority because of the higher probability of solution when information about them was known. On the other hand, the Body Recovery Site was so rarely unknown that it could not differentiate between solved and unsolved cases.

The Date of Occurrence

The data were also analyzed to determine whether solvability was enhanced when police investigators knew the dates for each of the five locations. Table 2 shows the rate of solvability when the date of occurrence for each location is known. The most notable findings are strong and significant associations between solvability and knowing dates for Initial Contact, Initial Assault, and Murder Sites.

The most efficient indicator of solvability was when the date was known for the murder site, 81% of the cases were solved. Similar percentages were found for the Initial Contact and Initial Assault Sites, 78% and 79% respectively. When the date was unknown for the location of the Murder, the cases that were solved dropped to only 41%, while Initial Contact was 44% and Initial Assault was 46%.

The remaining two locations, Victim Last Seen and Body Recovery Site, were much less strongly related to solvability. Knowledge about the dates of these two locations seems less important for the process of murder investigation. The overall findings support the first issue: When police investigators know the dates of Initial Contact, Initial Assault, and Murder Sites, this knowledge will contribute to the solvability of the case. That is, the percentage of cases solved will be greater when the dates for these locations are known.

TABLE 2—*Solvability by knowledge of dates of locations.*

Locations	Time known	Percent of cases solved	<i>N</i>	tau b	<i>P</i>
Victim last seen	Yes	74	942	-.08	.01
	No	52	25		
Initial contact	Yes	78	857	-.24	.00
	No	44	110		
Initial assault	Yes	79	822	-.26	.00
	No	46	145		
Murder	Yes	81	800	-.34	.00
	No	41	167		
Body recovery	Yes	74	966	.05	.09
	No	0	1		

Spans of Time Between Locations

The next analyses examined whether solvability is enhanced as pairs of locations are closer in time, given that the times for both locations were known. The time spans were examined by calculating the separation of time from one location to each of the other locations; the span, or duration of the separation of time, was measured to the nearest hour. With five locations, there were ten possible pairs of locations for which a span of time was calculated:

1. Victim Last Seen Site to Initial Contact Site,
2. Victim Last Seen Site to Initial Assault Site,
3. Victim Last Seen Site to Murder Site,
4. Victim Last Seen Site to Body Recovery Site,
5. Initial Contact Site to Initial Assault Site,
6. Initial Contact Site to Murder Site,
7. Initial Contact Site to Body Recovery Site,
8. Initial Assault Site to Murder Site,
9. Initial Assault Site to Body Recovery Site, and
10. Murder Site to Body Recovery Site.

The intervals of time ranged from zero to more than two years across the ten pairs of locations. For the solvability analysis reported here, the spans of time were collapsed into broader intervals of 0–24 hours and more than 24 hours. These intervals were chosen for two reasons: 1) the literature on solvability of murder cases emphasized that the solution rate for murders decreased appreciably after 24 hours of the discovery of the body; and 2) the interval of more than 24 hours facilitated more powerful statistical analyses since there were more cases within this category than for the intervals of more than 48 hours, 72 hours, one week, and so on.

Table 3 presents the relationships between solving a case and the time span between each of seven pairs of locations. The other three pairs of locations are not presented because they were inefficient at differentiating between solved and unsolved cases. The pair of locations with the strongest association ($\tau\text{-}b = .37$; $P < .00$) with solvability was Victim Last Seen to Body Recovery Site. For those cases when the victim disappeared less than 24 hours prior to body recovery, 82% of the cases were solved. If the

TABLE 3—Solvability by time between pairs of locations.

Location pairs	Time between locations	Percent solved	N	tau b	P
Victim last seen and initial contact	0–24 h	76	537	.14	.00
	>24 h	51	24		
Victim last seen and initial assault	0–24 h	76	522	.16	.00
	>24 h	46	22		
Victim last seen and murder site	0–24 h	74	527	.11	.00
	>24 h	57	47		
Victim last seen and body recovery	0–24 h	82	498	.37	.00
	>24 h	42	83		
Initial assault and murder site	0–24 h	76	588	–.08	.01
	>24 h	89	56		
Initial assault and body recovery	0–24 h	83	569	.29	.00
	>24 h	50	75		
Murder site and body recovery	0–24 h	81	595	.28	.00
	>24 h	52	101		

victim's body was discovered more than 24 hours after the disappearance, the rate of solved cases fell dramatically to only 42%. The results indicate that investigative problems with solvability will increase significantly when information reveals that the victim disappeared over 24 hours prior to the discovery of the victim's remains.

The findings for six of the seven location pairs support the observation that when the time between a given pair of locations is less than 24 hours, the percentage of cases solved will be greater than when that pair of locations is separated by more than 24 hours. In fact, compared to the pairs of locations when the time spans were less than 24 hours, there was an average significant decrease of 30% in solved cases for six of the location pairs when the time span was more than 24 hours between each pair.

The exceptional finding was for the elapsed time between when the murderer initially assaulted the victim and when the murder actually occurred. When the time of the assault was less than 24 hours in time from when the murder occurred, the solvability rate was 76%. But when the initial assault was more than 24 hours before the murder occurred, a surprising 89% of the cases were solved. These findings suggest that in those cases when the offender did not murder the victim within 24 hours from the time of the initial assault, the murderer kept the victim in captivity for a period of time, which increased the physical contact between the victim and offender. This longer contact probably increased the amount of incriminating evidence and, therefore, enhanced solvability.

The Distance Intervals

The next issue explored was whether solvability is enhanced when police investigators know the distances between the sites of pairs of the five locations. The same ten logical pairs of locations were used to calculate the interval distances.

In 728 investigations, the intervals of distance were known for all ten pairs of loca-

TABLE 4—Solvability by number of pairs of locations for which distances were known (by dichotomized distance information).

Number of pairs for which distances known	Percent solved	N	tau b	P
0–5 Pairs	14	155	.59	.00
6–10 Pairs	85	812		

tions. Those cases had a significantly higher percentage (88%) of solved cases than in the total sample (74%). The distribution of murder cases that contained pairs of locations for which the interval of distance was known ranged from one to ten pairs of locations. In general, the percent of cases solved decreased (to a low of 4%) as the number of known-distance pairs decreased. As pairs of locations were analyzed with dichotomized distance information (Table 4), for five or less pairs and more than five pairs, a strong, significant relationship was produced (tau-b = .59; $P < .00$). When the distance interval was known for more than five pairs of locations within each investigation, 85% of cases were solved, while for five or fewer pairs of locations, only 14% were solved. These findings support the third research issue: As police investigators know the distance between the sites of more pairs of the five case locations, the rate of solvability increases.

After determining the significance of “knowing” distances between pairs of locations, the next analyses examined the actual distances between known pairs of locations. The interval of distance was measured in feet or miles for each pair of locations. Then, the actual distance was converted to one of six categories: 0 to 199 feet; 199 feet to $< \frac{3}{4}$ mile; $\frac{3}{4}$ mile to $< 1\frac{1}{2}$ miles; $1\frac{1}{2}$ miles to < 12 miles; 12 miles to < 70 miles; 70 miles or more. These categories were based, for the most part, on natural breaks in the frequency distribution. For instance, distances for many pairs of locations were recorded as 0 feet, 100 feet, $\frac{1}{4}$ mile, 1 mile, 10 miles, and so on.

Category 1 (0–199 feet) was also based on the collective experience of several homicide detectives.⁹ The consensus of the detectives was that the maximum distance any killer was known to carry a dead body from the place where the victim was killed to the victim’s final resting place was no further than 150 feet. If a killer used a vehicle to transport a dead body to another location, there were no cases in recent memory of a killer carrying the body any further than 150 feet from the vehicle. They suggested that any victim’s body carried a distance of 150 feet or less be considered for investigative purposes to have been found in the same crime scene and, therefore, as if it had not been moved at all. Therefore, the distance should be considered the same as zero. Additionally, there were no geographical, psychological, or investigative differences among those cases where the victims were found within 150 feet from where they were killed.

Although the findings about distance to this point demonstrate that simply knowing information about distance for pairs of locations is important to solvability, Table 5 shows that the relationship between solving a case and the actual distance between five of the ten pairs of sites (Victim Last Seen to Initial Contact, Victim Last Seen to Initial Assault, Victim Last Seen to Murder, Victim Last Seen to Body Recovery, and Initial Contact to Body Recovery) is also important to solvability.

⁹Interviews with John Douglas, FBI Behavioral Sciences Unit, Robert Ressler, FBI Research Unit; Pierce Brooks, Retired Los Angeles Police Homicide Unit; Frank Salerno, Los Angeles Sheriff’s Homicide Unit; and Robert Gebo, Seattle Police Homicide. 1988.

TABLE 5—Solvability by distances between victim last seen and body recovery sites.

Distance between sites	Percent solved	With distance dichotomized		
		<i>N</i>	Percent solved	<i>N</i>
0–199 Feet	86	689	86	689
200 Feet–.74 Mi.	50	32		
.75 Mi. to 1.4 Mi.	47	15		
1.5 Mi. to 11.9 Mi.	47	93	40	218
12 Mi. to 69.9 Mi.	27%	66		
70 Miles or more	24	12		
Total		907		907

NOTE: tau b = $-.43$, $P < .00$.

The most statistically significant pair of locations was, again, Victim Last Seen to Body Recovery Site (tau b = $-.43$; $P < .00$). What is notable is that the distance of 0–199 feet between Victim Last Seen Site and Body Recovery Site produced an 86% solution rate, 12% higher than the average solvability rate for all single-victim murder cases. As the distance increased beyond 200 feet between Victim Last Seen Site and Body Recovery Site, the percent of solved cases dropped below 50%, to a low of 24% solved when the distance was greater than 70 miles.

These findings partially support the fourth research issue: when the distance between a pair of sites is less than 199 feet, the relatively close proximity of the sites will enhance the solvability of the case; that is, the percentage of cases solved will be significantly greater than when the sites are separated by more than 199 feet.

Time and Distance Interaction Effects for Pairs of Locations

The fifth issue explored was whether solvability was enhanced as both times and distances, together, decreased among pairs of locations. The spans of time and intervals of distance, whose relationships to solvability were previously analyzed as separate factors, were examined simultaneously to determine their joint contribution to solvability.

A statistical analysis for each of the ten pairs of locations was completed, using the time periods of 0 to 24 hours, >24 hours to less than 1 month, and more than 1 month, and the distance intervals of 0–199 feet, 200 feet to 1.49 miles, and more than 1.5 miles. Time was used as the independent variable, solvability as the dependent variable, and distance as the control variable. Once again, of the ten possible pairs of locations of a murder incident, only the pair Victim Last Seen Site to Body Recovery Site affected solvability in a significant, meaningful way. The nine other pairs either did not differentiate solved from unsolved cases or had so few cases within cells of a table that no interpretation could be drawn.

Table 6 shows the relationship between solving a case and the time and distance between the Victim Last Seen and Body Recovery Sites. The highest percent (86%) of solved cases are found in the category with the shortest period of time (0–24 hours) and shortest distance (0–199 feet) separating the locations, while at the other extreme, an astounding 4% of cases are solved when the distance is more than 1.5 miles and the time interval is greater than one month. Therefore, in murders where both the time and distance between the Victim Last Seen Site and the Body Recovery Site are the shortest, solvability is maximized. Clearly, both short distance and time are key to enhanced solvability. Generally, for the Victim Last Seen and Body Recovery Sites, the findings

TABLE 6—*Solvability by time and distance between victim last seen and body recovery sites.*

Distance between victim last seen and body recovery	Time between victim last seen and body recovery	Percent solved	<i>N</i>	tau b	<i>P</i>
0–199 feet	0–24 h	86	505	–.12	.00
	>24 h to <1 month	69	52		
	>1 month	78	9		
200 feet to 1.5 miles	0–24 h	53	28	–.14	.43
	>24 h to <1 month	30	10		
	>1 month	50	4		
More than 1.5 miles	0–24 h	58	55	–.40	.00
	>24 h to <1 month	45	60		
	>1 month	4	47		
Total			770		

regarding time and distance interactions are not markedly different than the findings when they were analyzed separately.

Summary and Implications

Clearly, more multivariate analyses are necessary to specify and interpret the role of time and distance as solvability factors in murder investigations. There are other variables—for example, eyewitnesses to the event, physical evidence, confessions of co-conspirators—that are likely related in important ways to the time and/or distance factors. Fortunately, the richness of the data will facilitate the explication of those kinds of interactions in subsequent analyses. To this point in our research, the analyses support the general proposition that the more information that is known about the times and distances among the locations of a murder incident, the more likely a murder case will be solved.

The research produced a number of findings that support this conclusion. First, simply having any information on the dates and locations of the five sites, particularly the Initial Contact, Assault, and Murder Sites, enhances the probability of solution. This finding challenges the efficacy of some of the curricula often included in training courses for homicide investigators, which emphasize techniques for processing the Body Recovery Site for physical evidence (for example, photography, collecting and measuring physical evidence, autopsy protocols, processing outdoor locations). Typically, little to no instruction focuses on gathering the type of information that is vital to identifying the Initial Contact, Assault, or Murder Sites, nor how important that information is to solving murder cases [32–34].

Second, knowing the dates of occurrence for the locations improves significantly an investigator's ability to identify an offender. Linking a date to the location of the murder is most important to the investigation. The Murder Site is the location where the victim and offender are typically together in time and space. Knowing the date allows an investigator to verify or refute the alibis of suspects. For example, if a murder occurred on October 3, 1991, a suspect who was in prison at the time could be eliminated as the murderer.

Third, solvability increases as the time separating pairs of locations decreases. A critical threshold is 24 hours: When the time between a given pair of locations (for example, Victim Last Seen to Body Recovery Site) is less than 24 hours, the rate of solvability is

significantly higher than when it is more than 24 hours. The dramatic effect of time intervals between locations on murder investigations may reflect the influence of other factors, such as evidence deterioration or, more likely, the erosion over time of the ability of witnesses to recall accurately information about locations, dates, and events [35].

Fourth, as investigators know more of the distances between pairs of the five murder event locations, the rate of solvability increases dramatically. Fifth, the shorter the actual distances between locations, particularly less than 200 feet, the greater the percentage of solved cases. This relationship was strongest for the distances between where the victim was last seen to each of the other four murder incident locations. Short distances among the locations, and high solvability, reflects the fact that in a number of murder cases there is substantial overlap in the locations. For example, the victim may have last been seen at the place where the murderer made initial contact and also assaulted, killed, and left the victim for dead. On the other hand, when the distances are longer, sometimes in miles, it usually complicates the investigation because the locations will be much more difficult to discover and may even be located in different law enforcement jurisdictions. This may lead to confusion, or even competition and conflict, about which agency has primary jurisdiction and authority over the investigation. Some agencies may claim jurisdiction because the body is discovered in their domain, while others may use the location of the murder as the criterion. Of course, there are sophisticated murderers who are aware of the difficulty that police departments have in multijurisdictional investigations, and they intentionally distribute their actions, victims, and evidence across jurisdictional boundaries that, sometimes, may cover hundreds or thousands of miles.

Sixth, solvability improves as both times and distances, together, decrease among pairs of locations, especially between the Victim Last Seen and Body Recovery Sites. In murders where both the time and distance between these two locations are the longest (more than 1 month/more than 1.5 miles), an astounding 96 percent were not solved. Conversely, both the shortest time and distance maximize solvability. These results have profound implications for the efficient allocation of resources and manpower in murder investigations. Police administrators need to assess the utility of protracted investigations of murders where the last known location of the victim and the body recovery site are separated substantially in time and distance.

In general, this research contributes to our understanding of the process of murder investigation and should be useful to homicide investigators and police management. Some experienced investigators know that each of the five locations addressed here exist within the chronology of a murder incident. Unfortunately, detectives typically become involved in an investigation upon notification of a body discovery site. As this study has shown, information about this location is not as useful in a murder investigation as most police may believe. And less experienced detectives may have difficulty in identifying the salient characteristics of the other important locations in a murder incident.

For the experienced investigator, the findings reported here should not be surprising. One should expect that those cases about which investigating agencies have more information are more likely to be solved. However, the study shows that it is not simply any information that will enhance solvability—some information is more valuable and useful than other information in murder investigations. As the research shows, obtaining accurate information on the times and distances of the locations of a murder incident is a critical element in successful murder investigations.

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Address requests for reprints or additional information to
 Robert D. Keppel, Ph.D.
 Washington State Attorney General's Office
 900 4th Ave. Suite 2000
 Seattle, WA 98164