

# The Effects of Automated Vehicle Locator (AVL) System on Police Response Time to In-Progress Armed Robbery

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## **Abstract**

*This study aims to explore the impact of automated vehicle locator (AVL) system on police response time to in-progress armed robbery. While practitioners' interests in AVL are increasing more and more, still there is a lack of research on how AVL affects the police response to in-progress armed robbery. Our systematic reviews include several theoretical grounds on the advent of AVL, as well as on the effectiveness of vehicle-based patrol. Specifically, drawing on the theoretical perspectives of situational problem-oriented policing, the present study suggests that the elapsed time for victims' police reports will vary depending upon respective situations surrounding a criminogenic place. Limitations and policy implications are also discussed.*

**Keywords:** AVL, Automated Vehicle Locator, Police Response Time, Robbery, In-Progress Armed Robbery

## **1. Introduction**

There is a need to first consider the rational choice perspective providing theoretical grounds on two main offender choices (involvement and event decisions) [1]. Since there are many limitations for individuals to make rational choices, offender choices should be also illustrated within the framework of bounded rationality [1][16]. To successfully respond to offenders, police agencies have put in a great deal of effort to reduce opportunities for would-be offenders to commit crimes. The introduction of automated vehicle locator (AVL) system is part of an effort to boost police effectiveness. AVL is mainly expected to reduce police response time [29]. When a call is received, AVL allows the dispatcher to identify which available patrol vehicle is closest to the crime scene. Added to this, since “real-time monitoring is available to the dispatcher” [29], it is also possible for both police cars and their mobile units to constantly transfer crime-related data reciprocally, as well as to improve “timeliness and accuracy” of police response while approaching the scene. That is, “through appropriate law enforcement asset selection and resource allocation” [29], space control can be accomplished.

Like other opportunity- and space-based criminological theories, such as routine activities theory and crime prevention through environmental design (CPTED), situational crime prevention (SCP) also limits its focus on reducing criminal opportunities [2]. As Clarke [2] pointed out, many criminological theories are regarded to be inappropriate because they have been out of touch with reality. This criticism allows many practical strategies to be in the spotlight as effective ways to deter crime, and the perspective of SCP is one of them [2]. That is, the popularity of SCP might also trigger the advent of AVL system.

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SCP, on the other hand, can be distinguished from other criminological theories in some respects. Specifically, measures are created by analyzing situational conditions, and applied directly to a specific type of crime [17]. Besides, since SCP is interested in the immediate and proximal settings of a crime, micro-ecological measures including the management, design, or manipulation of the immediate environment are mainly created [17]. This is why the implementation of AVL system cannot be a panacea for all the types of crimes. Although many police agencies are getting interested in implementing the AVL system, it should be also noted that there has been little research to investigate the relationship between AVL and police response to in-progress armed robbery. In this context, the current study can be a good starting point to narrow the gap between researchers and practitioners.

## 2. Characteristics of In-Progress Armed Robbery

The perspective of SCP can be employed to analyze general factors fostering the commission of street robbery [17]. As shown in the figure below, the commission of street robbery is explained by the following situational factors: (1) offender per se, (2) victim characteristics, (3) spatial attributes, and (4) routines of the offender victim [18].

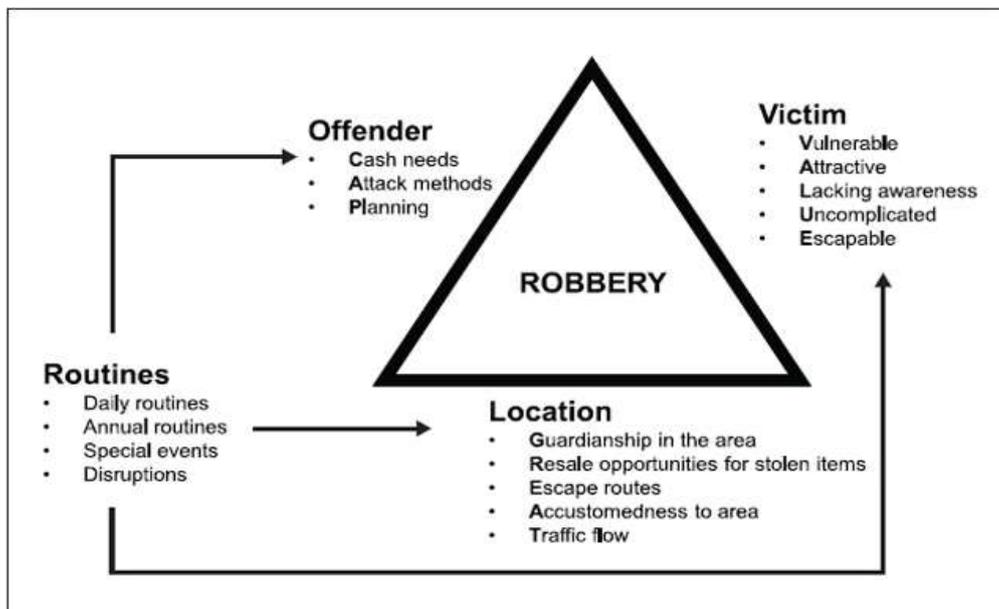


Figure 1. Street Robbery Analysis Triangle [18]

In terms of potential offenders, they might commit street robberies to take valuables from potential victims [18]. In other words, street robberies are mainly committed in order for offenders to take cash from victims. Usually offenders expect to buy something valuable, such as drugs and alcohol, because those items are regarded to be valuable in bad neighborhoods where most offenders commit street crime. If offenders do not take cash, they will rob other valuables from victims as the second best. One-third of street robbery offenders use weapons while committing this type of crime [3]. Given its clear purpose, the street robbery crime is planned [4] and technical [18].

For would-be offenders, potential victims can be recognized as suitable targets who are vulnerable, attractive, lacking awareness, uncomplicated, and escapable [18]. Taking street robbery crime nearby university campus areas for example, since potential victims are mostly students walking from parties or bars at night or on a

weekend, they are likely to be drunk and normally carry valuable items, such as iPhone and laptop computers [18]. In order to fully understand the spatial attributes of the area, moreover, there is a need to consider Brantingham and Brantingham's [5] assertion that in nodes and paths, potential victims are likely to be exposed to potential offenders, and due to the ambiguity of ownership, edges result in low rates of guardianship. In this context, the areas where there are many businesses or disadvantaged neighborhoods are clustered which meet the conditions of problematic space.

### 3. Criminogenic Places and AVL System

Since crime prevention can be accomplished by intervening in an unfavorable spatial setting, a clear understanding of the characteristics of a criminogenic place is required prior to the implementation of AVL system, which is based on GIS and GPS [29].

Before clarifying crime hot spots, there is a need to have a glance at the criminological concept of a place. Routine activities theory is initiated from the assumption that a place matters with respect to a crime occurrence [6][7]. Although Sherman and colleagues [7] define a place as "a fixed physical environment that can be seen completely and simultaneously at least on its surface, by one's naked eye," a place can also be defined by its function. Eck and Weisburd [30] explained that a place has always its own function and a series of single-functional places can be defined by their facilities.

#### 3.1. Characteristics of Crime Hot Spots

Despite the seemingly negative findings of two early experiments (*i.e.*, the Kansas City and RAND studies), accumulating evidence makes contemporary researchers hold a firm belief that the police can reduce crime. Based on the assumption that crime can be reduced by changing places, the police have come up with diverse policing strategies to interfere with the spatial easiness of crime occurrence. Crime-specific policing, which is different from mere police presence, is one of them. That is focused police efforts to reduce particular crimes committed by particular offenders at particular times and places [31]. He argued that the dramatic drop in crime rates in Houston in the 1990s was possible by the benefit of police agency proactivity. Even in terms of the Kansas City study, he also pointed out that Kelling *et al.*'s [19] pessimistic conclusions about police effectiveness was the product of misinterpretation. Since routine preventive patrol in 1972 was not a proactive tactic, police behavior in the field could not help vary by individual, neighborhood, and time differences. His another reasoning concerning the misinterpretation is that given the experiment attempted to examine citizens' perception, the assumption that citizens could exactly notice a small difference in the preventive police actions across beats was originally flawed.

There are several additional studies supporting the position that the police make much difference. First, Braga [20] in his systematic review suggested that seven of nine prior evaluation studies supported the effectiveness of hot spots policing. Blocking would-be offenders' crime opportunities through focused police actions, crime rates in hot spots can be dropped. He argued that even the other two negative studies were probably explained by methodological problems. Moreover, his review denied the possibility of the displacement of crime problems after pumping police enforcement efforts into a specific problematic place.

Second, Telep and Weisburd [8] in their review provided the literature several other valuable suggestions. On one hand, police presence alone can bring benefit to reducing some crime and disorder, as well as to offering a guideline how often the

police should patrol in a hot spot to maintain deterrence effect. The effectiveness of hot spots policing, on the other hand, can be amplified through the linkage with (situational) problem oriented policing strategies including focused deterrence approaches. Apart from these detailed policing strategies, Telep and Weisburd [8] also put emphasis on the importance of using DNA in property crimes and improving police legitimacy during an encounter.

In terms of characteristics of hot spots, Braga and Weisburd [21] posit the following three assumptions. First, since most crimes are concentrated in a few places which are called hot spots, it is true that the patrol presence, focused on hot spots as well as hot times (*e.g.*, nighttime and weekends), is effective in reducing overall crime rates in a city. Second, researchers have found that crime displacement in response to crime prevention interventions is not a serious concern in reality. The Jersey City Drug Market Analysis Program experiment is a good example to show that there is no significant displacement of crime between treatment displacement areas and control displacement areas [9]. That is because, the level of displacement may be dependent on the offenders' familiarity with alternative tactics, places, times and targets [21]. Finally, crime control interventions in crime hot spot areas can often curb crime near those hot places. Clarke and Weisburd [22] also found that there is a statistically significant diffusion of crime control benefits in the Jersey City experiment.

### **3.2. Hot Spots Policing and Computerized Crime Mapping**

In order to identify hot spots, computerized crime mapping technique was employed. More specifically, by using GIS and GPS, police agencies can not only deploy their personnel intelligently, but also allow the surplus police force to be reassigned to proactive work. In addition, by analyzing crime patterns, the police can anticipate where future crime will occur, and this can allow police to focus on predictive policing. That is, GIS can contribute to maximizing the efficiency of policing by reducing the unnecessary use of police resources. That is because, crime prevention initially begins with a prediction of crime patterns [10].

The astonishing success attained by NYPD since 1993 was attributable to Compstat policing which was armed with Compstat technology, such as GIS [11]. Of course, some scholars are skeptical about GIS, arguing that GIS 'information' is largely an aid to analysis, not a 'Eureka' key, whereas Henry puts more stress on its rosy future, claiming that the technology employed in Compstat policing has made police spend much time pondering which enforcement tactics should be chosen, instead of analyzing crime pattern. Although Henry also admitted several drawbacks of the initial crime mapping technology, pin maps that: (1) only provided a fairly limited view of crime's temporal dimension because of the absence of standardization of mapping or updating throughout the department, and (2) they rarely did more than portray a two-dimensional depiction of crime and that they did not lend themselves to experimentation and exploration, he argued that most problems disappeared after the implementation of computerized mapping in 1994, when it made the Compstat unit easily explore relationships between crime, time, and place [11].

Using misdemeanor arrests as one of the independent variables among four (young males, borough cocaine, borough unemployed, and misdemeanor arrests), Kelling and Sousa [23] tested the statistical significance of "the order-maintenance increase-violent crime decrease relationship" during the Giuliani/Bratton era, because misdemeanor arrests were regarded as "a proxy of the 'broken windows' policing." Regarding the efficacy of broken windows policing, they indicated that order maintenance, along with borough unemployed, is significantly related to violent crime decrease. Their two-level (time and precinct) models helped their

study examine change over time in violent crime in a precinct [23]. These findings help their study arrived at a conclusion that “the difference police make is substantial” to the extent that the local context formed by their activities has an impact on “the strength and direction of crime rates” [24].

### 3.3. Situational POP and Fusion Centers

Braga and Weisburd [21] argued that hot spots policing through the introduction of both situational POP and place management can accomplish neither effective crime control especially in hot spot areas nor police legitimacy. In terms of police legitimacy, it is true that law behaves differently depending on who they are [25]. Since crime hot spots are usually located in disadvantaged areas, the neighborhoods here are likely to receive less police service than those who are in advantaged areas. This is why police legitimacy has lost its credit in America. Importantly, situational POP can decrease the police service disparity because this strategy are basically interested in identifying underlying characteristics in crime hot spot areas and ameliorating these disadvantaged conditions.

In order to accomplish a particular purpose in an organization, it is natural to set up a special unit to take charge of it. By doing so, the organization can guarantee the effectiveness in achieving its purpose. This logic gave birth to the concept of a fusion center which acts as a mediator between criminal environments and decision makers. In other words, by operating fusion centers, criminal analysts in police agencies can not only refine intelligence between numberless information, but also facilitate adequate allocation of limited resources [11]. More specifically, through a series of active collaboration efforts, fusion centers can also share their intelligence between one another, and those scientific and analytical supports can help both policy makers and police managers contribute to finding and targeting potential risk factors in our society [11].

As Lambert [11] states, thanks to the open network mechanism between fusion centers, policy makers can easily utilize every fusion center’s accumulated intelligence. Further, based on the knowledge, policy makers can establish a crime prevention strategy appropriate for its time and place [11]. This is why intelligence-led policing (ILP) is in line with the logic of problem-oriented policing [12]. To be sure, more knowledgeable, operational, strategic, and tactical deployment choices can be made on the basis of data-driven products [11].

Although presumably its effectiveness is guaranteed to some degree as the introduction of situational POP spreads across the U.S., there still remain several concerns. Since in practice situational POP is inevitably dependent on data collected by fusion centers, there is a concern for an infringement of civil liberties while they are collecting information and using intelligence on citizens. That is, there is a high possibility that law enforcement agencies are likely to be overzealous when they are authorized to intervene in citizens’ affairs.

In addition, there can be serious problems resulting from fusion center failure, as in government failure. That is to say, the logic of situational POP is totally dependent on the confidence in fusion centers’ ability, but they do not always function flawlessly. Furthermore, one should consider about when police agencies target interventions based on wrong intelligence of fusion centers, who will answer for those unexpected faults.

Finally, given the need for absolute secrecy in their works, it is not easy to monitor fusion centers in reality. Since there might not be an exterior monitoring mechanism, they are likely to proceed with the process of generating intelligence wholly independently. That is why in terms of innovative policing, training analysts is considered as an important factor in determining success or failure.

#### 4. Effectiveness of vehicle-based Patrol and AVL

Braga and Weisburd [21] argued that there are three types of crime control strategies at crime hot spots: (1) “incident-driven,” (2) “enforcement POP,” and (3) “situational POP.” The first strategy refers to a traditional and reactive way of policing only with the object of rapid response, whereas both the second and the third strategies are focused and a proactive way of policing strategies focusing on crime hot spots. The main difference between the enforcement POP and the situational POP is that the latter strategy is interested in “collaborating with others” as well as in finding and modifying the very criminogenic attributes of crime hot spots in order to suppress crime occurrence at the crime-clustered places. According to Braga and Weisburd’s [21] logic, AVL is related to improving the effectiveness of incident-driven or enforcement POP by implanting GPS and GIS into a patrol vehicle.

After the Kansas City preventive patrol experiment found that there was no significant relationship between vehicle-based patrol and crime rates [23], little research has focused on the effectiveness of vehicle-based patrol. Poyner [13] reviewed 122 crime prevention projects and analyzed the effectiveness of various crime prevention measures, but it was found that the effectiveness of “increased police patrol” was about half of the effectiveness obtained by other policing-related measures, such as “increased staffing of facilities,” security guards for housing blocks,” and “extra ticket inspection staff.” The importance of rapid response time has been increased more and more, and this is why the advent of 9-1-1 is considered one of crucial innovations in police history. Prior research has supported the idea that rapid police response is one of the main factors in measuring citizens’ satisfaction with the police [26]. Not only that, Brandl and Horvath [14] found that police response time is one of the most significant factors with respect to victim satisfaction, as well as police professionalism.

As Sorensen [29] states, the introduction of AVL is mainly expected to reduce police response time. That is because, when a call is received, AVL allows the dispatcher to identify which available patrol vehicle is closest to a crime scene. On top of that, since “real-time monitoring is available to the dispatcher,” it is possible for both police cars and their mobile units to constantly transfer data reciprocally and to improve “timeliness and accuracy” of police response while approaching the scene. That is, the existence of real-time GPS tracking enables the police to improve their analytical power as well as their ability to handle with risky situations. “Through appropriate law enforcement asset selection and resource allocation,” space control can be accomplished [29].

The operating model of AVL in the field is pretty similar to that of intelligence-led policing (ILP). Since intelligence-led policing is a business model unlike traditional crime prevention strategies, it can allow police agencies to better understand the overall picture of the contemporary crime settings by collecting and managing crime-related intelligence. By operating fusion centers, police agencies’ analysts could not only refine intelligence between numberless information, but also facilitate adequate allocation of limited resources [11]. Furthermore, based on the knowledge, policy makers can establish crime prevention strategies appropriate for the time and place [11]. That is why ILP is in line with the logic of problem-oriented policing [12]. Truly, more knowledgeable, operational, strategic, and tactical deployment choices can be made on the basis of [ILP’s] data-driven products [11].

Apart from each policing strategy’s original purpose, both AVL-based patrol policing and ILP are based on the data created by their police department (*i.e.*, dispatcher and fusion center), but there is an important difference between them.

The thing is, although AVL-based patrol policing can be included in the area of ILP, no one can deny that AVL enables the police in the field to do real-time responses to calls for service, which is the main characteristic of AVL.

## 5. Discussion and Policy Implications

Mazerolle and colleagues [15] pointed out that there are two main reasons to impede rapid police response. First, depending on crime type, his/her victimization may be discovered long after the crime. For example, in a case of car theft or theft from a car, the crime can be found only after when the vehicle owner comes back to the car. Second, “even when offenders have contact with victims, victims typically take several minutes to decide to call the police once the offender leaves.” The time interval between the victimization of crime and calling the police through the use of 9-1-1 makes the offender escape from the crime scene as far as possible [15].

The process of in-progress armed robbery also has several limitations. Using Tilley and colleagues’ [27] crime process model, the overall picture of in-progress armed robbery can be presented above. In this imaginary but plausible situation, both victims and offenders are affected by various situational conditions surrounding the criminogenic place. If the potential victim is not only alone or drunk, but also this is the first time to experience street robbery, there will be time lapse between the commission of the crime and the time she calls the police. This is why it is hard to increase the arrest rates of street robbery through the use of AVL.

**Table 1. Street Armed Robbery Process Model [27]**

When	Victim	Offender	Location
Long Before	A person moves into a problematic area.	An armed offender needs cash. He identifies the area as a good place to commit a street robbery.	The problematic area
Just Before	The person is walking from party or bar in the area on the weekend night.	The offender is searching for a potential victim which looks vulnerable ( <i>e.g.</i> , alone and drunk) and appears to have valuables.	The problematic area
During	The person’s valuables are robbed by the offender.	The offender robs the victim of cash and valuables, which satisfy the offender’s cash needs.	The problematic area
After	The victim does not have valuables, such as cash and a smart phone, any more. The victim is not familiar with how to get help or report the crime.	The offender escapes from the crime scene, and follows the planned route.	The location will vary.

The findings of the current research also have an implication for future research. Taken the likelihood for victims to hesitate to call the police at the time they are victimized, as well as the fact that crime process model can vary depending on what the type of crime is [15], there is a need to expand the scope of research to other crime types. That is, in case that time interval between victimization and calling the police is short compared to cases of other crime types, it is likely that there is a strong AVL-police response time link.

To date, the U.S. criminal justice system has implemented many innovative policing strategies including community policing, problem-oriented policing, and

intelligence-led policing. Nevertheless, the impact of most policing styles on crime rates has been proved to be inconclusive [28]. With this in mind, contemporary crime prevention policy makers need to think outside the box. Escaping from the fetters of constructivist rationalism that is likely to distort the spontaneous order in our society, they need to put emphasis on the role of law enforcement agency as just a coordinator, not as a regulator, in making crime prevention strategies. That is, given the spontaneous order being in our society, police agencies also try to help the society maintain equilibrium by providing favorable general conditions. To be sure, by continuously providing information such as criminals' modus operandi and specific crime prevention techniques, citizens' attention can be aroused.

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