THE IMPACT OF POLICE-MONITORED CCTV CAMERAS ON CRIME PATTERNS: A QUASI-EXPERIMENTAL STUDY IN THE METROPOLITAN CITY OF BURSA, TURKEY

By

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ABSTRACT OF THE DISSERTATION

The Impact of Police-monitored CCTV Cameras on Crime Patterns: A Quasi-Experimental Study in the Metropolitan City of Bursa, Turkey
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Rapid adoption and expansion of the CCTV systems in Turkey as well as all over the world have produced a fair amount of "technological determinism" among many law enforcement officials, which Norris and Armstrong (1999, p. 9) define as "an unquestioning belief in the power of technology". As a matter of technological determinism, politicians and the public continue to myopically expect that the exclusive responsibility of preventing crime rest on the police-monitored CCTV cameras. Conversely, policy makers may be better informed if they consider why the law enforcement agencies should invest in the installation of the CCTV cameras in public areas based on the research. In fact, a well-designed evidence based paradigm in the CCTV literature is likely to reveal the truth about the question of "does it work?"

In addition to all previous methodological efforts, empirical evaluations in the CCTV literature are still needed to account for alternative perspectives to measure their effectiveness in the deterrence of crimes. Therefore, the present study focused on the concepts of environmental criminology, namely "crime risk at place". This research also considered the environmental risk values that might identify "environmental conditions under which cameras would be most effective" (Caplan et al., 2011, p.271). Thus, the concept of "Environmental risk value" provided a unique methodological approach to the police-monitored CCTV literature.

This study examined the impact of the metropolitan city of Bursa's city-wide system

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and certain individual police-monitored CCTV camera's views used to scan the landscape, respectively on street level, including aggravated assault, auto theft, thefts from autos, and larceny theft crime incident numbers in a spatial distribution of locations; and analyzed whether the environmental risk value effects on the deterrent effect of police-monitored CCTV cameras on aforementioned crime types. To accomplish that statistical analyses (paired t test, location quotient, and regression models) and risk terrain modeling (RTM) were conducted in this dissertation.

Three important findings were found in this study. Firstly, city-wide system effect indicated that larceny thefts and thefts from auto experienced significant reduction. However, aggravated assaults and auto thefts were not. Secondly, the results from assessing the deterrent effect of certain individual police-monitored CCTV cameras on aggravated assaults, larceny thefts, thefts from autos and auto thefts were mixed. Finally, each individual CCTV camera has a unique environment – environmental risk value that influences its deterrent effect on – aggravated assaults, larceny thefts, thefts from autos and autos theft. Further, the affect was discernable and in positive direction for each crime type.

Environmental risk value assessments can advance our understanding of the deterrent effect of CCTV cameras at their viewshed areas. So environmental risk sites must be taken into account when the decision process concerning CCTV cameras is made by local and national level policy makers, police agencies and politicians who try to establish where the most appropriate location to install police-monitored CCTV cameras is. In this respect RTM can be considered as a pre intervention tool so that police agencies can measure the deterrent effect of CCTV before installation. Such a pre-evaluation process increases the capacity for effective police management and crime prevention strategies in police agencies.

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PREFACE

There have been growing public concerns and anxieties about crimes, and an impression from local governments, that "something needs to be done" to prevent these crimes (Tilley, 1999: p.2). Accompanying these concerns, there has also been an increased interest and an exponential growth of Closed-circuit Television (CCTV) surveillance around the world.

Since the exponential growth of CCTV over the last decade, arguments opposed to the use of CCTV have developed, because knowledge about the crime deterrent effect of CCTV cameras is insufficient (Brown, 1995; Ditton & Short, 1999; Gill, Rose, Collins & Hemming, 2005; Phillips, 1999; Ratcliffe, 2009). In addition, as a matter of "technological determinism" (Norris & Armstong, 1999), politicians and the public continue to myopically expect that the exclusive responsibility for preventing crime rests with police-monitored CCTV cameras. Conversely, academicians as well as policy makers need to consider why law enforcement agencies should make investments in installing CCTV cameras in public areas.

As a result of the above factors, the widespread use of police-monitored CCTV has recently been discussed in the academic literature and the issue of whether these work or not has been increasingly discussed. A growing body of CCTV literature indicates that academicians and law enforcement agencies are constantly trying to invent new research approaches to increase the validity and reliability of CCTV studies (Brown, 1995; Ditton & Short, 1999; Gill, Rose, Collins & Hemming, 2005; Phillips, 1999;Tilley, 1993; Welsh & Farrington, 2002). As Sherman (1995) emphasizes in the realm of the importance of continued research, there is always something new to discover. Thus, no conclusion is permanent and science is always evolving.

With this aim in mind, and in the realm of criminal justice, researchers (Armitage, 2002; Eck, 2002; Farrington et al. 2007; Phillips, 1999; Welsh & Farrington, 2002,2004) have started to utilize different techniques to measure the effectiveness of all surveillance cameras in the systems presently used as police crime prevention tools in public spaces. These researchers have used police incident reports and official data before and after the installation of police-monitored CCTV, and have measured changes in the rates and types of crimes committed before and after their use. The empirical results of the use of CCTV cameras for deterring crimes are mixed. Some findings reflect a positive effect, especially in the context of specific crimes such property crimes (Tilley, 1993; Welsh & Farrington, 2002), but some studies (Brown, 1995, Ditton & Short, 1999; Gill, Rose, Collins & Hemming, 2005; Phillips, 1999) indicate non-effective findings regarding CCTV.

In addition, Ratcliffe et al. (2009) and Caplan et al. (2011) who have underscored the value of the crime deterrent effects of individual police-monitored CCTV camera's viewsheds explain why "similar cameras do not have similar benefits everywhere" (p. 266). Each individual CCTV camera commonly has a unique location in different land use contexts that provides different opportunities for crimes to occur. Therefore, each of these might have a greater or lesser impact on crime patterns. Their findings also indicate, "every camera in a city is or is not effective at deterring crime based upon aggregate data and global analyses may not be accurate" (Caplan et al., 2011, p. 271). Similar to this research, a recently proposed study aimed to measure the deterrent effect of a city-wide CCTV system and certain individual camera's viewsheds, respectively.

All the aforementioned empirical studies have thus contributed to or are contributing to our understanding of the deterrent effects of police-monitored cameras.

However, the current study improves upon prior CCTV studies by taking into account their environmental risk value[1]. If the aim is to reduce crimes by using police-monitored CCTV cameras, it seems logical to design a response to alter the landscape of high-risk crime areas and to thereby create effective deterrent opportunities, instead of trying to intervene directly to deal with the individuals' psychological predisposition to offending or sociological factors that influence crime (Caplan et al., 2011).

More specifically, this study examined the impact of the metropolitan city of Bursa's city-wide system and certain individual police-monitored CCTV camera's views used to scan the landscape, respectively on the street level, including aggravated assault, auto theft, thefts from autos, and larceny theft crime incident numbers in a spatial distribution of locations; and analyzed whether individual CCTV camera's impact on reducing the number of selected crimes and whether these would have a significantly higher than average environmental set of risk values compared to those CCTV cameras that do reduce crimes. Finally, it was believed the research findings would raise questions about the role of criminogenic environmental factors and would hopefully lead to some appropriate recommendations for reducing crimes.

This dissertation consists of four chapters. The first chapter reviews an existing body of literature associated with the deterrence effect of CCTV cameras and the theoretical framework. The second chapter provides details on the research design and analytical strategy. The third and fourth detail the methods and results.

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[1] Environmental risk value and its importance, both broadly and specifically to the CCTV literature, discussed in operationalization of definition portion of this dissertation.

Research Questions

RQ-1 Does the addition of CCTV cameras to a landscape reduce the numbers of auto thefts, thefts from autos, and larceny theft incidents, respectively within the camera's viewshed areas?

RQ-2 Do environmental risk values affect the deterrent effect of CCTV cameras on aggravated assaults, auto thefts, thefts from autos, and larceny thefts at their viewsheds?

CHAPTER ONE: CONCEPTUAL FRAMEWORK

Mixed Impact of Police-monitored CCTV Cameras on Crime Incidents

The use of closed-circuit television (CCTV) cameras has been increasing in our daily life. Not all researchers view their use for crime prevention in the same way. Evidence on the effectiveness of CCTV generates "mixed" findings regarding the deterrence of crime incidents. Some studies of the situational crime prevention approach indicate that cameras increase the security of the physical environments (Brown, 1995; Squires, 2000). Some others suggest that public surveillance cameras are in their neighborhoods for purposes of creating a safer environment (Gill & Spriggs, 2005; Gill, Rose, Collins, & Hemming, 2005; Harris et. al., 1998; Welsh & Farrington, 2002). In contrast, there are studies arguing that the use of CCTV cameras has no effect on crime rates (e.g., Ditton & Short, 1999; Gill, Rose, Collins & Hemming, 2005; Phillips, 1999; Brown, 1995). Still others try to explain why CCTV systems help reduce some crimes (i.e., property crimes), but are not effective against other types of crime (i.e., violent crimes) (Clarke, 1983; Cohen & Felson, 1979; Cornish & Clarke, 1986).

According to a meta-analysis by Welsh and Farrington (2007), public CCTV cameras lead to decreased overall crime rates in surveillance areas. The authors concluded that CCTV systems, accompanied by improved lightning, are effective for reducing crime, especially property crimes and vehicle related crimes, even if some studies' findings are not clear as regards understanding the use of CCTV cameras and their impact on crime rates. This review shows that CCTV has a positive effect on property crime rates, where vehicle-related crime, burglary, and vandalism on public

transport systems decreased in eight different studies, but CCTV had no effect on violent crimes in five of the cases (Welsh & Farrington, 2007).

A literature review by Welsh and Farrington conducted in 2003 examined the results of 22 previously published studies on the topic of CCTV systems using data from the United States, and England that included police records, results of crime victim surveys, and numbers of requests for services related to crimes. The data were categorized according operation site, and of these, nine were located in city centers and public housing areas, five parking lots, while four involved public transportation sites. Despite some positive trends, mixed results were reported. Only nine of the 22 systems appeared associated with decreased crime levels. The most significant effects were reported in the context of vehicle related crimes, with no reported impact on crimes of violence. The authors reported that most of the research examined suggested a need for further CCTV evaluations so as to better understand its deterrent effects. .

In another related study conducted in England, Gill and colleagues (2005) examined CCTV systems in an area called South City, where the focus was on examining its impact on crimes of public disorder, alcohol-related crimes, and criminal tendencies towards vandalism. These authors reported that vandalism declined approximately 20 percent. Yet, they found public disorder offenses increased by 64 percent in the area targeted, which suggested the cameras captured more crimes, or that they did not deter certain crimes. They did not seem to decrease violent and public order offences, but allowed police personnel to detect and apprehend individuals who did not act in an orderly way. The extent of crime reduction as a whole was approximately 10 percent lower after a year of CCTV systems exposure.

An earlier CCTV study by Griffiths (2003) conducted in Gillingham (UK) that compared crime records over a one-year period, showed a 35 percent reduction after one year in the context of the main street and car parks. This finding was similar to that reported by others such as Tilley, (1993) and Welsh and Farrington, (2002) that indicated CCTV was most impactful as regards motor vehicle crimes, but least impactful in preventing crimes of violence. This finding led the author to conclude that CCTV systems do create a greater risk perception on the part of the potential criminal, simply by their presence. This may increase the risk for undertaking a crime they would readily commit if the cameras were not present and recording their actions. Tilley's 1993 study in Britain compared crime rates before and after the installation of CCTV in the Hull car park, and found a significant decrease of auto related crimes. Criminal damage to cars decreased by 45 percent. Thefts of vehicles went down by 88.9 percent and thefts from vehicles were reduced by 76.3 percent in a specific car park.

In light of the previous studies, it seemed clear that any research study analyzing the effectiveness of CCTV cameras might suffer limitations due to several factors, which is one reason for their mixed results. Knowing and reviewing the limitations associated with these studies allowed the present researcher to examine what empirical evaluations in the CCTV literature needed to be employed to account for alternative perspectives concerning their effectiveness.

Review of Limitations in CCTV Literature

Over the years, there have been many ongoing debates as to whether CCTV crime prevention is beneficial or not (Gill & Spriggs, 2005; Gill et al., 2007; Harris et al., 1998; Welsh & Farrington 2002). Short and Ditton (1995) identified various limitations of

CCTV in crime prevention contexts especially in earlier studies on CCTV. To begin with, pre and post installation time periods were too short for sufficient testing. Secondly, CCTV applications often ignored reductions or increases in certain crimes, or failed to desegregate crimes. Thirdly, many control areas were not examined in the evaluations provided (Welsh & Farrington 2002). Moreover, without presenting the overall number of incidents and by only presenting the results as percentages, the data did not permit any significance to be demonstrated in many instances. Last but not least, displacement was not adequately measured in many earlier studies (Bowers & Johnson 2003; Sivarajasingam et al., 2003), which may have led to the variable distribution of benefits shown in the research of CCTV cameras.

It is common in the literature regarding CCTV usage to use police incident reports and official data before and after installation of CCTV, and to measure changes in rates and types of crimes committed after that (Armitage et al., 1999; Brown 1995; Ditton & Short 1999; Short & Ditton 1998; Skinns 1998). However, according to Ratcliffe (2009), there have been inevitable limitations in this body of research. One limitation is that data are previously geo-coded by the police departments and not by the scholars themselves. Another limitation is the inability to disaggregate the effectiveness of each camera type. There are often few cameras to analyze; therefore, "an attempt to control for the type of camera at each location is met with difficulty" (Ratcliffe, 2009 p.766). Ratcliffe found a noticeable decline in disorder offenses, however serious crimes could not be measured due to the low number of actual serious crimes committed, which were too low to really conduct any meaningful analysis (Ratcliffe, 2009). To carry out a significant statistical analysis requires a minimum number of crime incidents to be recorded in the study area.

Recent CCTV studies have considered that the deterrent effect of the police-monitored CCTV cameras can only occur where a motivated offender's conception of place and a CCTV camera's line out of sight overlap. For this purpose, Caplan et al. (2010) and Ratcliffe et al. (2009) utilized viewsheds by employing geographic information system (GIS) tools and actual line of sight cameras to identify their unit of analysis.

In addition to the above discussion of the previous studies' limitations, expectations of police-monitored CCTV's impact on crime incidents are important, and therefore several scholars have addressed this issue in their studies. Pawson and Tilley (1994, p. 301) for example, presented nine different mechanisms of how CCTV works: "Caught-in-the-act", "deterring potential offenders", "enhance natural surveillance", "effective deployment", "general publicity"," specific publicity", "time for crime - less time to commit crime", "memory jogging" - encouraging potential victims to be more cautious, and "appeal to the cautious". Likewise, Gill and Sprigs (2005) supported Pawson and Tilley (1994) by suggesting five mechanisms, namely; generating deterrence, increasing usage of the area, apprehending offenders through facilitating successful deployment of police officers, inducing the public to take more precautions, and inducing the public and police officers to interfere to prevent crime. Although, all these mechanisms need more empirical support, they all try to explain how CCTV works. In brief, this review of limitations in the relevant literature reveals that they usually result from the nature of the research design rather than any features of the settings in any given research study. Then, one basic question that is often repeated: is how are most or all of these limitations overcome?

Although, this present study tried to answer this question in the context of its methodology, another issue in the literature is the conceptual discussion of the deterrent effect of police-monitored CCTV as a theoretical framework. To this end, the next section describes what is known about the deterrence generating effect of police-monitored CCTV cameras.

Does the Presence of CCTV Cameras Generate a Deterrence Effect?

In accordance with the CCTV literature, police-monitored CCTV cameras intend to produce a "deterrent effect to potential offenders" (Clarke, 1997, p. 20). Offender behavior is an essential component of the crime event, that is, if someone was watching you, would you commit a crime? This question links the concept of the deterrent effect of CCTV systems and offender behaviors, but it is not clear whether offenders consider CCTV cameras as a deterrent or threat to committing a crime. However, it can be presumed they act as a deterrent if being caught and punished because of the CCTV cameras is seen as a threat. This presumption is based on criminal justice theories such as rational choice theory and deterrence theory that are dealt with in detail later in this section.

While the effectiveness of surveillance cameras is generally evaluated by comparing police crime records before and after CCTV installations, some researchers have evaluated police and citizen reactions' and opinions' about these cameras. Short and Ditton (1998) interviewed 30 offenders in Airdrie in 1996. Most of the interviewees claimed that CCTV can reduce crime. Conversely, Butler's (1994) study focused on in-depth offender interviews (N=27) to explain offender's perspective about the deterrence effect of CCTV. Sixteen offenders argued that CCTV cameras are not effective at crime

deterrence. However, Ratcliffe et al. (2009) point out, "The resultant offender perception will most likely vary from person to person" (p.751). In this respect, the problem that researchers have is determining the offender's reaction to the cameras. To this end, research in this field would require widespread and expensive interviewing interventions to more fully examine this question.

One of the most difficult issues related to analyzing offender behavior is what exactly may deter an offender from committing a crime. As Zimring and Hawkin (1973) state that "the deterrence threat may perhaps best be viewed as a form of advertising" (p. 142). In fact, CCTV aims to increase the criminal's awareness of how risky committing a crime may be, and there are two principles that need to be present in order for the prevention process to succeed. One is that the offender must be aware of the cameras' presence. The other factor is that the offender must believe the cameras present pose enough risk of capture to negate rewards of the intended crime (Ratcliffe, 2006; Welsh & Farrington, 2009). If the potential offender only considers the CCTV as a tricky obstacle to overcome, but nothing else, the cameras may not any generate any deterrence effect. In other words, a criminal must think rationally and consider the costs and benefits of the crime. The offender must also perceive that the costs of being caught outweigh the benefits of any reward (Gibbs 1975; Zimring & Hawkins 1973). According to this theoretical concept, awareness of police-monitored CCTV cameras makes offender behavior more risky on the street level, thus reducing crime opportunities and crime rates.

The rational choice perspective (Cornish & Clarke, 1986) relies upon the offender's decision-making process and offers an opportunity to "see the world from the offender's perspective" (Felson & Clarke, 1998). Supporters of the rational choice

perspective argue "crime is broadly the result of rational choices based on analyses of anticipated costs and benefits" (Cornish & Clarke, 1986). According to this idea, offenders must not only take heed of a few benefits as well as a few risks at any one time, they must think broadly and anticipate the consequences of their actions, in light of the environment they are emerged in. Depending on their goals, having too narrow a focus along with any failure to think more broadly, may limit the offenders' rationality. Depending on the environment situation, the offender may weigh the pros and cons of their decisions in light of their goals, and may correctly apprehend that CCTV systems are a risk to their ultimate goal. If a potential offender makes a conscious choice, based on the environmental context, before committing a crime, they are considered by Cornish and Clarke (1986) to follow the rationale theory. Thus implementing CCTV systems can work to prevent crimes if offenders behave in a rationale manner. Because they will weigh the pros and cons of the actions, and may not want to take excess risks Clarke (1997) states that surveillance affects the potential criminal cost and benefit assessment of crime; because CCTVs can increase the chance of being apprehended. The presence of CCTVs also increases the law enforcement agencies' effectiveness against crimes by detecting the offender's identity and addressing the problems related to the crime.

As in rational choice theory, deterrence theory encompasses an element of rational thought as regards a potential offender's decision-making processes. It also explains why a situation or tool may be a crime deterrent, that is, because the outcome of the crime is viewed very negatively. This negative perception deters the potential offender from committing the crime. Other research shows the perceived rewards versus the risks of undertaking the crime can strongly influence the decision of a potential

offender (Piquero & Rengert, 1999; Reppetto, 1976). Repetto who examined the behaviors of 146 robbers and burglars, found a high percentage were influenced by strategies to avert such crimes. There was a correlation between the perceived degree of risk involved, and the potential for a successful outcome, which led them to perceive the lack of any crime opportunity in the particular context. By using monitoring strategies as a deterrent, the potential offenders felt there was too much risk in carrying out a crime and so the preventive measures were essentially successful. The uses of multi-monitoring networks were especially helpful in increasing the perceived risk of the crime, and lowering the actual crime rates. It is known that CCTV images can be used in court to identify perpetrators and as proof against them. If they are caught, they may suffer considerable punishment, especially if caught red handed, which can raise the degree of punishment, as well as the certainty of this (Cornish & Clarke, 2003; Piquero & Rengert, 1999; Popes, 1977 as cited in Cohen & Felson, 1979, Reppetto, 1976).

The aforementioned theories thus converge in predicting the person's decision-making process to commit a crime or not. This process affects the assessment of carrying out a crime and involves calculating the nature of the crime, and its perceived risk (punishment), and anticipated reward. A criminal event can thus be described as a product of individual decisions as a result of a cost and benefit analysis. The criminal intention or willingness to commit a crime is shaped by the extent of the crime opportunities.

In order to evaluate its use, a relevant and new body of police-monitored CCTV studies (Caplan et al. 2011, Ratcliffe, 2006, Ratcliffe et al., 2009; Welsh & Farrington 2009;) has focused on "place-based policing". In this respect, questions have arisen as to

the role that the criminogenic environment plays in assessing the deterrent effect of police-monitored CCTV cameras. The question is why do studies examining the effect of police-monitored CCTV cameras on crime deterrence show better results in certain places than in others?

According to opportunity related theories, enacting a crime depends on the opportunities available to the offender within an environment. For example, depending on the environment, the risk of criminal victimization can be changed (Caplan, 2011, p. 61). In this respect, scholarly attention has focused on the role of risky places in crime prevention. For example, Caplan et al., (2011. p. 265) states

> "Some places are likely to be more crime prone than others— regardless of any police interventions, including CCTV cameras. Therefore, the effect of police-monitored CCTV cameras on crime deterrence could be very minimal in some places while other places yield better results".

This indicates that micro level environmental features can influence the extent of any CCTV camera impact on street level crime incidents, depending on location. However, no empirical research has focused on investigating in detail the role that criminogenic environmental features play in the context of measuring the impact of CCTV cameras on street level (outdoor) crimes. Furthermore, the focus of the many existing CCTV studies has been on the measurement of its city-wide system effectiveness rather than issues associated with criminogenic environmental context/features specifically, as regards the individual camera's effect.

In light of the existing theories and literature, the installation of police-monitored CCTV cameras may decrease the risk of crimes within their viewsheds (see chapter II, section unit of analysis for a more detailed discussion). This, thus, generates a deterrent effect for the cameras. However, the level of deterrence will not be equal for all the

cameras' viewshed areas because each viewshed has a different environment risk value and opportunity structure. In other words, place is likely to matter in determining whether CCTV cameras will work to be effective. In the following section, this researcher will examine the role of place as a determinant of the outcome on deterrence of CCTV cameras.

"Risk of Crime at Place" in determining the deterrent effect of CCTV

Until the 1980s, the central theme of mainstream criminology research was the offender. Thereafter, the question of "why some people are more (or less) inclined to offending" dominated the literature. A relevant new body of crime theory took the focus off the "criminals" and shifted it to the "crime" itself (Weisburd & McEwen, 1997). Rather than the distant factors that generate a preoccupation for understanding criminal inclinations, the "new crime theorizing" concepts place an emphasis on how settings create more opportunities for crime.

Early on, academics were increasingly focused on identifying the relationships among place, the nature of a crime, and the offender's mind in order to develop more comprehensive and effective crime prevention programs and policies (Brantingham & Brantingham, 1981). In the U.S., Chicago School sociologists (Shaw & McKay's, 1942) based most of their research in this city over a period of time on finding patterns in the geographical distribution of crimes and on disordered challenges in trying to advance geographic criminology.

The crime site literature shows that, similar to the irregular distribution of crimes among offenders, crimes are not equally distributed among different sites or places (Brantingham & Brantingham, 1981). Some people do not commit a crime, some do. In

fact, the literature presents evidence that small proportions of offenders are responsible for very large proportions of criminal activity. Is this true as well for crime locations? In fact, it is true to a degree that the crime concentrations for "repeat" sites are heavier than among repeat offenders. Why some sites experience more crimes than others is a fair question. The answer may lie in the characteristics of the settings that either attract or generate crime by providing crime related opportunities (Brantingham & Brantingham, 1981).

Sherman (1995) cites the famous cohort study of Wolfgang, and reports that the domestic violence concentration among places in Minneapolis is six times greater than it is among persons (3% of the sites generate 50 % of the calls, whereas in Wolfgang's study, 18% of offenders produced 50% of arrests). With this experience, Paul and Patricia Brantingham (1995) offered significant conceptual tools for understanding relationships between crimes and places. They defined the "environmental backcloths" (Brantingham & Brantingham, 1981, p.19) concept that helped explain the convergence of routine activities and the physical aspects of specific locations in a given area. There are two factors that are influential to the backcloth concept, one being "crime attractors" that attract the offender to that location and two being "crime generators" that would be factors of that location that would increase the volume of activity at that location. These two factors contribute to the hotspots where crimes are more frequent. Hot spots are included in this concept, as well as sites or opportunities that have a tendency to foster crime or crime proliferate. Caplan and Kennedy (2009; 2010) operationalized the concept of "environmental backcloths" by using a risk terrain model (RTM) technique and found a statistical significant relationship between environment and crime at places.

In light of above concept, why are some places more risky than others? In response to this fundamental question, environmental criminologists (Brantingham & Brantingham, 1993; Caplan et al., 2011; Clarke, 1997; Clarke & Eck 2007; Felson, 1998; Kennedy et al., 2010) explain risky places as having certain common criminogenic features that make them more susceptible to criminal activity. By properly identifying specific locations where crimes concentrate (Eck, 2001; Eck et al. 2005; Harries 1999; Ratcliffe, 2006; Sherman et. al., 1989; Weisburd et al., 2004) it is possible to figure out what increases or reduces the likelihood of future crimes in a particular area. Because of these criminogenic features found in specific areas, it is theoretically possible to predict areas of crime based on the characteristics of the location (Eck 1995; Mazerolle et al., 2002). Furthermore,

> "…Researchers of the Chicago School of Sociology concluded that characteristics of the urban environment, both socio-economic and physical environmental factors, were responsible for areas or zones of historically high crime rates" (p. 18).

In other words, spatial locations that have more criminogenic features within their environment will result in an elevated crime incidence rate while locations with fewer criminogenic features will experience a decreased rate. This reality is also supported by Caplan et al.'s (2011) study on risk at place that addressed the issue that

> "When certain motivated offenders interact with suitable targets, the risk of crime and victimization conceivably increases. But, when motivated offenders interact with suitable targets at certain criminogenic places, the risk of criminal victimization is even higher. Similarly, when certain motivated offenders interact with suitable targets at places that are not conducive to crime, the risk of victimization is lowered" (p. 61).

In parallel to this perspective, a risk cluster is a concentrated area that consists of multiple environmental risk factors and variables that can facilitate and lead to a crime.

This leads to consistent patterns of interactions between different environmental risk factors (Kennedy et al., 2010). Crime and crime location scholars have taken into account the "environmental backcloths" concept (e.g., Weisburd et al., 2008, 2009; Weisburd & Eck 2004) as well as the risk terrains point of view (Caplan et al., 2010; Kennedy et al., 2010). RTM has the ability to weight the significance of different factors at different geographic points in enabling crime events to occur. For example, in the Township of Irvington, 50 percent of shootings happen in only about 15 percent of the entire area (2.8 square miles). Only a fraction of police resources would be needed to patrol these places, which could address nearly half of the shootings (Caplan et al., 2010). According to this finding, the risk terrain modeling approach can be considered a useful *"method of risk assessment aids in crime forecasting and prevention efforts by incorporating underlying causes of crimes and other threats to public safety"* (Caplan & Kennedy, 2009. p. 1).

At this point, the "Risk of Crime at Place" approach can be seen as a geographical adaptation of the offender-based risk assessment, now commonplace in the criminal justice system, in which the attributes of the suspects and offenders are used to anticipate their likelihood of future behaviors. Because their units of analysis are geographical places rather than offenders, their environmental risk factors are concerned with aspects of place rather than only characteristics of individuals. In addition, this perspective might provide an indication as to the extent of the deterrent effect of police-monitored individual police-monitored CCTV cameras in specific places that have significantly higher average environmental risk values system-wide and can help perhaps establish which certain individual cameras deter crime incidents.

Chapter Summary and Research Questions and Hypotheses

Despite the various published inferences concerning CCTV's deterrent impact on property crimes and violent crimes that have produce "mixed" results when discussing their role in public spaces, no further evidence has been presented in order to explain the variance in evaluations of CCTV that currently exist. Especially in early studies, Short and Ditton (1995) identified various limitations of CCTV cameras in the realm of crime prevention. In addition, Ratcliffe (2009) pointed out that many empirical evaluations and overviews of CCTV are insufficient. A crucial limitation with CCTV cameras is probably that there are no perspectives provided to explain why there are "mixed" findings about its deterrent effect. This is probably because it is difficult to measure certain phenomena and the fact that there is a lack of construct validity in some methods used to measure the effectiveness of CCTV (e.g. offender's behavior in the actual line-of-sight of cameras, pedestrian population, and appropriate unit of analysis). If these two could somehow be solved or improved by using environmental criminology then the effectiveness of CCTV could better be measured and improvements could be made in the field of criminal justice to better use this tool in the deterrence of crime.

Identifying a "site or place" should be a key component in the context of measurements of CCTV. A place can include small units such as buildings or blocks, or larger units such as entire neighborhoods or portions of a city. The more specific the area, the more methodological validity can be attained. Due to larger target areas, which are much more heterogeneous, and can result in measurement validity threats (Brown, 1995; Ditton, & Short,1999; Gill & Spriggs 2005; Mazerolle et al., 2002; Sivarajasingam et al. 2003; Squires 1998, 2000; Williamson & McLafferty 2000), it is necessary to focus on

small target area locations as CCTV cameras' viewsheds (Caplan et al. 2011; Ratcliffe et al., 2009), and to examine crime occurrences before and after a CCTV camera's installation.

For improving upon previous studies, this study utilized environmental risk value and camera's viewshed concepts together to assess the deterrent effect of police-monitored CCTV cameras. An extremely simple, but profoundly significant question was where should the cameras be installed and does this alter their effectiveness. As discussed in the theoretical framework, the "*Risk of Crime at Place*" approach assumes that immediate environmental risk factors play a central role in creating opportunities at certain places for altering the risk of criminal victimization (Freundschuh & Egenhofer, 1997). "The impact of interventions to reduce risk (and avert negative events) can be evaluated by regularly reassessing risk, and then measuring changes in risk values among different risk terrain maps at micro or macro levels using basic inferential statistics" (Caplan & Kennedy, 2009, p.1). The environmental risk values might help to explain why crimes tend to occur in certain cameras' viewshed areas even though the presence of the cameras may be thought to generate a deterrence effect on crimes by increasing the risk of offenders being caught (Caplan et al. 2011; Kennedy et al., 2010). In this respect, the calculation of the risk value by using risk terrain model provides a means of establishing which police-monitored CCTV cameras are most effective within the system.

The conceptual approach offered by "Risk of Crime at Place" was useful in framing this study. More specifically; environmental risk value and the police-monitored

CCTV cameras' viewshed areas constituted the core of the current study that sought to answer the following two research questions:

First, *"*Does the addition of police-monitored CCTV cameras to a landscape reduce the numbers of aggravated assaults, auto thefts, thefts from autos, and larceny theft incidents, respectively within the camera's viewshed areas?*"* It was hypothesized that "The number of aggravated assaults, auto thefts, thefts from autos, and larceny thefts would decrease respectively across all police-monitored CCTV camera's viewshed areas for up to one year after installation when compared to one year prior to the cameras' installations." Many CCTV studies have focused on creating a city-wide system effect. However, much less discussion exists on the deterrent effect of each camera within the system (Caplan et al., 2011, Ratcliffe et al., 2009). For purposes of this aim; the second hypothesis was that "Certain individual police-monitored CCTV camera's viewsheds would reduce the number of aggravated assaults, auto thefts, thefts from autos, and larceny thefts in time period two compared to time period one, while others would not, regardless of whether there was a system-wide effect."

The second research question posed was *"*Do environmental risk values affect the deterrent effect of CCTV cameras on aggravated assault, auto thefts, thefts from auto, and larceny thefts at their viewsheds?*"* To answer this research question, it was hypothesized that individual police-monitored CCTV camera's that do not show statistically significant reductions in aggravated assaults, auto thefts, thefts from autos, and larceny thefts would have significantly higher average environmental risk values compared to CCTV cameras that do reduce these crimes in time period 2 compared to time period 1.

The next chapter examines the two research questions stated in this chapter. To this end, the next chapter will introduce the research setting and operationalization of the key concepts of the present study. Following this, the chapter will provide information on what types of data were used to answer the research questions and what types of analysis were utilized to test each research hypothesis.

CHAPTER TWO: RESEARCH DESIGN AND METHODS

Research Setting

The metropolitan city, Bursa, was selected as the study site for two reasons. First the Bursa police-monitored CCTV camera system is composed of a surveillance network that may be unique among all CCTV camera systems. This surveillance network system allows multi monitoring and connects to specialists in each police district and division regardless of whether CCTV operators monitor the control room at police headquarter (MOBESE[1] center), which may also increase the deterrence capabilities of this form of CCTV (e.g., by improving the target selection approaches and decreasing the police response time).

Previous CCTV studies have emphasized the fact that technical innovations and knowing "how they are operated" increases the effectiveness of CCTV cameras in the context of crime deterrence (Caplan et al. 2011, Mazerolle et al., 2002; Welsh & Farrington, 2004). Wells and Farrington (2002) indicate that the police operators' live monitoring of surveillance cameras can increase the "capable guardianship" by allowing them to intervene earlier in incidents, thus, preventing or keeping them from escalating. As stated in the study of Caplan et al. (2011) "the impact of CCTV cameras should be considered modest in scope and, depending on where they are used and how they are operated, should only be targeted to towards specific crimes under certain conditions" (p. 271). Gill and Sprigs (2005) also define "technical characteristic and operation of control room" (p.63) as a factor that affects a CCTV's operation. In this respect, using the

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[1] In Turkey, this CCTV system is called the Mobile Electronic System Integration (MOBESE) system and is designed to further improve the CCTV surveillance.

surveillance network system in Bursa was believed to reduce the attractiveness of targets; thus, its network could potentially reduce the number of crime incidents.

Second, Bursa has available geo-referenced crime incident data that is required for statistical analyses and utilizing risk terrain modeling appropriately. The availability of a useful and well-organized police-reported data system for street level crimes, which includes crime incident x-y coordinates, is crucial in order to identify indoor or outdoor crimes. Thus, the current study eliminated the need for geo-coding, a related limitation that Ratcliffe (2009) points out because; "data are previously geo-coded by the police department and not by the scholars themselves" (p.766). Previous research (Aksoy, 2009; Duru, 2010) has utilized this or similar datasets. In Turkey, oddly enough, many other potential research locations lack accessible databases for street level crime analyses. This indicates there is high reliability and validity of the Bursa crime incident dataset for purposes of spatial analyses.

However, the literature lacks empirical research conducted on CCTV camera's impact on crime in Turkey, because "there is no evidence to directly link the statistics to the camera's effectiveness" (Gunaydin & Asik, 2008, p.27). This study thus contributes evidence concerning police-monitored CCTV effects by using an environmental risk value approach in which neighborhood level variables are examined in Turkey. As Sampson (2008) states the *"application of neighborhood studies to other societal contexts is badly needed if we are to make further progress in understanding the generalizability of the link between community social mechanism and crime rates"* (p. 162).

Bursa, is a city of 2,550,000 residents according to the most recent Turkish Statistical count (2009), and is located in the northwest portion of Turkey and on the

southwest of the Marmara Sea. More specifically, the city covers 17 districts of the Bursa

province. However, three districts, "Nilufer, Yidirim, and Osmangazi", house

approximately two out of every three members of the population that dwell in the cities

of Bursa Turkish Statistical Institute (TUIK, 2007). According to (TUIK), in 2007, the

highest population was found in Osmangazi with 1630 people per 1 square kilometers,

followed by Yildirim (1444) and Nilufer (525). This indicates that there are striking

regional variations in the population.

Bursa is also the Turkey's fourth largest city and is even larger than some

European countries. The population of Bursa was 445,113 in 1980. Today, its population

is 2,550,000, meaning that over the last three decades; Bursa has grown by nearly 570%

because of migration. According to the TUIK, (2009), only 38% of the population of

Bursa is made up of those who are born in Bursa; the others have come from

different cities in Turkey. Every year, nearly 350,000 people migrate to Bursa from all

over Turkey, but especially from the eastern part of the country. Due to the rapid and

continuous migration, crime has become a significant problem for Bursa. This fact is also

argued by Ergun et al. (2003) who stated that

> "Deficiencies observed in social facilities, infrastructure and
> environmental conditions as well as social, economic, cultural, political
> characteristics of the society are factors that increase or decrease crime
> and criminality among persons after migrations of population in Turkey,
> just as in other parts of the world" (p. 11).

Operationalization of Key Concepts

Concepts associated with the research hypotheses included the premise that

police-monitored CCTV camera have impacts on, aggravated assaults, larceny thefts,

auto thefts, thefts from autos, and also included issues of operationalization of

environmental risk factors for each type of crime, Risk Terrain Modeling (RTM), prior and past installation period of police-monitored CCTV cameras, the cameras' city-wide system and certain individual deterrent effects. These concepts and how they were measured are explained in detail in this chapter.

Police-monitored CCTV camera

In Bursa, law enforcement officials commonly identify hot-spots and after taking the budget into consideration, carefully place CCTV cameras in designated areas where they believe surveillance is needed. The government of Bursa, recently spent nearly $4 million installing police -monitored CCTV cameras in 130 locations, using three different types of cameras, and invested much of its money on funding for CCTV cameras to deter crimes throughout the city. However, only dome cameras (Caplan et al, 2011; Ratcliffe et al. 2009) that maximize construct validity for research are consistent with the present theoretical framework due to their ability to raise the awareness of potential offenders (Caplan et al., 2011). Dome cameras have the ability to zoom, pan 360, degrees and tilt 180 degrees and were used at various locations (N=119) in this study. These cameras are also located at street-level and provide live footage to operators in a control room at local police units as well as police headquarters in Bursa.

Prior and Past Installation Period

Bursa police-monitored cameras were installed during May 2010 in a single phase. The locations of these 119 cameras were selected by the Bursa police department. The BPD met with different police units including intelligence, counter terrorism,

narcotics, public order, and traffic units respectively. Moreover the BPD selected camera locations based on hot-spot policing and intelligence led policing tactics.

This dissertation consists of an examination of prior and past installation periods of police-monitored CCTV cameras. Due to the installation process during the month of May in 2010, this time period was disregarded. Period 1, the pre-installation period in these locations ranged from May 01, 2009 to April 31, 2010; and period 2, the post-implementation period used to examine the impact of CCTV on same locations started on June 1, 2010 and ended on May 31, 2011 in order to provide meaningful data for data analysis and to compare the risk levels of camera viewsheds over time. On this point, previous studies have warned all researchers interested in studying the deterrence effect of CCTV areas to carefully select the length of time for this type of study because many previous studies used too short or too long a time periods (e.g., Brown 1995; Ditton and Short 1999; Phillips 1999; Squires 2000). The purpose of this warning is to reasonably justify the qualities of the study area during the time period previous to this study, which is relevant to the ensuing time period the researcher, is trying to model. Consequently, a full year of study seems best because it can account for any seasonal effect.

Selected Crime Types

There are many different forms of crime; and previous studies' findings and theoretical perspectives show CCTV is effective in deterring "outdoor" crimes and is not as effective in deterring "indoor" crimes. This fact was stated by Farrington et al. (2007. p.22) when they reported "CCTV will be most effective in preventing crimes in public view and least effective in preventing crimes that are difficult to observe or that occur in

private places such as houses (e.g., domestic violence or child abuse)*".* More recently, this reality has also been supported by the study of Welsh and Farrington (2009).

Police-monitored CCTV cameras would be most effective if potential offenders believe they will be seen, however, potential offenders will not be deterred if the coverage of CCTV cameras is low, since people can then choose to offend in places that are not covered by the cameras. Also if CCTV sites are poorly lit, offenders may think they will not be identified. Secondly, CCTV will be most effective in preventing crimes in public view and least effective in preventing crimes that are difficult to observe or that occur in private places such as houses.

Poor identification of "precisely where a crime incident occurred" Clarke & Weisburd, 2005, p.36) is an important limitation in previous research (e.g. Ditton & Short 1999; Squires 1998) that examined all crime types in a targeted area (Caplan et al., 2011) or particular types of crimes such as police misconduct (Goold 2003), criminal damage, and burglary (Brown 1995). There may also be some pieces of evidence that cannot be detected by a CCTV camera. Caplan et al. (2011) and Ratcliffe et al. (2009) found variations in police-monitored CCTV camera evaluations for classified crimes within the CCTV cameras' viewshed area and others. So, it was thought knowledge of the crime incident locations that occurred within or without the police-monitored CCTV cameras' viewshed areas would potentially heighten the statistical validity and reliability of the current study. Without statistical validity, an evaluation of CCTV cameras may present null results (Caplan et. al., 2011). Therefore, the present study used the crime types that predominantly occur outdoors to be consistent with the theoretical framework - rational choice and deterrence theory.

Similar to the above discussion, Welsh and Farrington (2002) contended CCTV cameras have the greatest impact on reducing vehicle crimes. CCTV was also shown to have positive utility in preventing property crimes, especially vehicle related crimes. Potential criminals may change their decisions with the CCTV camera guardianship in place; and this may have a significant impact on all crimes, except for violent crimes (Clarke, 1983; Cohen & Felson, 1979; Cornish & Clarke, 1986). Previous studies also argue that violent crime offenders do not seem to consider the presence of CCTV cameras and how it can identify them (Clarke, 1997; Cohen & Felson, 1979). According to Welsh and Farrington's (2007) review of U.K. cases, vehicle crimes decreased 51% in car parks, decreased 7% in downtown areas and public housing neighborhoods as a result of CCTV cameras. They also stated that CCTV appeared more effective in combating property crimes than violent crimes. On the other hand, Caplan's et al. study (2011) indicates the deterrent effect of police-monitored CCTV cameras on violent crime specifically, including shootings.

Caplan et al.'s (2011) study shows that literature on the deterrent effect of police-monitored CCTV needs more study in order to measure violent crimes as well as property crimes that occur "outside". For this purpose, the current study focused on certain types of crime that occur "outside" including auto thefts, thefts from autos, larceny thefts, and violent crimes, specifically aggravated assaults. Although the aggravated assault rate has declined since 2010 in Bursa where many high-risk areas ("criminogenic features", narcotic hotspots, the locations of fast food restaurants, bars, and social clubs) are more prone to aggravated assault crimes throughout this city, this is still a big problem and it has thus become harder for the residents to live in Bursa.

In this study, property crime categories included larceny thefts, auto thefts, and thefts from autos. It was thought that these selected crime types could be impacted by adding police-monitored CCTV cameras to a landscape (for this study city of Bursa). In addition, selected violent crime type, aggravated assault were added to test whether cumulative and\or certain individual cameras' have a deterrent impact on violent crime incidents.

Definition of crime types and environmental risk factor

Following the selection of crime types, the terms key aggravated environmental risk factors of aggravated assault, larceny thefts, thefts from autos, and auto thefts were operationalized based on empirical literature and employed for the production of risk terrain maps, respectively. Having the knowledge of what environmental risk factors exist for certain crime typologies assists researchers in building upon a risk terrain model. Moreover, knowing what influences these environmental risk factors, whether it is distance or density, supports law enforcement officials and researchers in coming up with resolutions and implementing them to help decrease the occurrence of crimes.

The first selected crime type, aggravated assault is defined as a "Person intentionally giving harm or pain to another person or executing an act which may lead to deterioration of health or mental power of others………….."[2] Many types of environmental risk factors are involved in aggravated assaults. Environmental risk factors include any environmental feature that increases your chance of becoming a victim. This study focused on several key aggravated environmental risk factors, namely " the

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[2] Turkish Bureau of Justice (2004). Aggravated Assault. Retrieved Official Gazette No. 25611 dated 12.10.2004 from http://www.legislationline.org/documents/action/popup/id/6872/preview

infrastructure", "coffee houses and internet cafes"," drug related areas" in order to create

separate risk map layers, respectively. It would be useful to operationalize "high

concentration" prior to operationalization of risk factors. "High concentration" was

defined presence in police-monitored CCTV cameras' viewsheds. Accordingly, each

environmental risk factor was operationalized as follows;

"Infrastructure" was defined as an area with a

> "High concentration of bars, night clubs, entertainment venues, alcohol
> outlets, bus stops, cash points, stadiums, fast food restaurants and late
> dining, areas that would likely increase the risk of dense places having
> aggravated assault incidents." (David &William, 1964; Duru, 2010;
> Gorman et. al., 1997; 1998; 2001; Grubesic, 2011; Madensen & Eck,
> 2008; Scott & Dedel, 2006; Scribner et. al., 1995; Sherman et. al., 1998;
> Yu, 2009)

"Coffee houses and internet cafes" were included because "high concentrations of

coffee houses and internet cafes will increase the risk of dense places having aggravated

assault incidents." (Duru, 2010) "Drug related areas" were "areas with a high

concentration of drug arrests, high drug use and drug dealing (David & William, 1964;

Eck & Wartell, 1996, Green, 1996; Hope, 1994; Parker & Auerhahn, 1998; Weisburd &

Green, 1994a, 1994b, 1995) and would likely pose a greater risk for aggravated assault

incidents". Thus, based on the empirical literature, a density map was created by using a

measure two standard deviations more than the mean density value from the points of

drug arrest areas to constitute the last of the three risk map layers.

The second selected crime type was larceny thefts of which there were two main

types as well as various minor types. The main types were petit larceny and grand

larceny, which are the same crimes but consist of different monetary values. For this

study, larceny theft included only pick pocketing and purse snatching. Any type of

larceny is the unlawful taking of property or goods, which can be committed against anyone who owns anything. The minor types could include shoplifting, but larceny could involve the theft of anything even stolen property. In particular, this study examined only out-door larceny crime incidents that included pick pocketing, purse snatching, larceny thefts from businesses such as "grabbing and running with goods taken from the street vendors, in front of business stores"[3] and this was based on the selected theoretical framework for appropriate statistical analysis.

Returning to the discussion of grand larceny and petit larceny as related to crime reporting, Siegel (2008) stated, "Most larcenies involve small items of little value. Many of these go unreported, however, especially if the victims were business owners who do not want to take the time to get involved with police" (p. 353). Such a statement proves useful in determining the reason as to why petty larceny is as prevalent as it is, because reporting this by victims does not seem to pose any significance for them as regards their loss of minor valuables. However, incidents of grand larceny typically involve assuming possession of highly valuable targets, which more often than not produce high profile cases demanding punishment for the offenders for their illicit actions.

Many environmental risk factors are involved in larceny thefts. However, this study focused on key aggravated environmental risk factors namely "proximity to public transportation" "infrastructure", "areas of tourism", "Coffee houses", and "Schools" to create separate risk map layers for each environmental risk factor, respectively. To this end, each risk factor was operationalized as follows;

"Proximity to public transportation stations" referred to a "high concentration of bus stops and bus terminals that will increase the risk of dense places having theft larceny

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[3] Law No. 5237 on Turkish Criminal Law, code. 142.

theft incidents" (Aksoy, 2002; Atac, 2008; Block & Block, 2000; Brantingham et. al.,

1991; Buckley, 1996; Duru; 2010; Pearlstein & Wachs, 1982; Smith & Clarke, 2000; Yu,

2009). "Infrastructure", referred to a

> "High concentration of bars as outlined by Johnson et al., (2010), including night clubs, entertainment venues, alcohol outlets, goods stolen, proximity to cash points, traditional open shopping centers, entrances of shopping malls fast food restaurants and late dining will potentially increase the risk of dense places having theft from auto incidents" (Aksoy, 2002; Atac, 2008; Boggs, 1965; Hollinger et. al., 1992; LaVigne, 1991; Mustaine & Tewksbury, 1998).

The term "Coffee house" referred to a "high concentration of coffee houses that

will increase the risk of dense places having thefts from autos" (Duru, 2010). "Areas of

tourism", were defined as " areas of high concentration of historical and cultural places,

museums, sports tourisms (e.g. stadiums), travel agents and information desk for tourists

will be at a greater risk for street level (outdoor) larceny theft incidents" (Glensor &

Peak, 2004; Nicholls, 1976; Pizam, 1982; Walmsley et. al., 1983). Hence, based on the

empirical literature, a density map was created by using two standard deviations more

than the mean density value from the points of parking lots in order to create the three

risk map layers. "School" referred to a "high concentration of high - middle schools and

universities that will increase the risk of dense places having larceny theft incidents"

(Maguire, 2007). A "Drug related area" referred to an "area of high concentration for

drug arrests, high drug use and drug dealing and will be at a greater risk for larceny theft

incidents" (Sutton, 2010). Based on the empirical literature, an additional density map

was created by using two standard deviations more than the mean density value from the

points of drug arrest areas to become the last of the six risk map layers.

The third and fourth types of crimes, thefts from auto and thefts of autos were the most common offenses calling for police response. Thefts from autos included: wheels, radios, interior components and items left in the auto. Thefts of autos are more often reported to police due to insurance requirements.

Many types of environmental risk factors are involved in thefts from autos. This study focused on key aggravated environmental risk factors namely "infrastructure", "coffee houses", "parking lots" and "schools" to create separate risk map layers, respectively. Accordingly, each risk factor was operationalized as follows;

"Infrastructure", was denoted as a "high concentration of bars, night clubs, entertainment venues, alcohol outlets, bus stops, cash points, fast food restaurants and late dining and will potentially increase the risk of dense places having thefts from autos" (Boggs, 1965; Jonson et. al., 2010; Levine et. al., 1986; Plano, 1993; Turkish National Police report, 2010; Yu, 2009). "Coffee houses" referred to the idea of a "high concentration of coffee houses that will increase the risk of dense places having theft from auto incidents" (Duru, 2010). "Parking lots" were "areas of high concentration of parking lots and will be at a greater risk for aggravated assault incidents." (Sampson, 2004) Thus, based on the empirical literature, a density map as previously described was created by using a factor of two standard deviations more than the mean density value from the points of parking lots to form the three risk map layers. The term "School" referred to "areas within one Bursa's street block of high - middle schools and universities that will be at a greater risk for thefts from auto incidents." (Marguire, 2007)

Auto thefts, have a relatively consistent definition across police jurisdictions. In addition, this type of crime also has higher reporting rates than other property crimes due

to auto insurance requirements, the average value of auto thefts and the need for routine reporting activities in this realm. In Turkey, a car is not only a form of transportation, but it can also be a means of personal expression. Thus, many people decide to modify their cars with certain items thus rendering their car different from all the others out there. It is not only an issue for the people being robbed, but also for the community. Therefore, auto thefts are thought to be reported more than other property crimes in Turkey. High reporting rates reflect the reliability of auto theft crime rate incident numbers.

In this study, for examining the incidence of the auto thefts, I focused on key aggravated environmental risk factors namely "infrastructure", "land use type", "parking lots" and "schools" to create separate risk map layers, respectively. Accordingly, each risk factor was operationalized as follows;

"Infrastructure", referred to the "high concentration of bars, night clubs, nighttime entertainment venues, alcohol outlets, bus stops cash points, fast food restaurants and late dining sites that will increase the risk of dense places having theft from auto incidents" (Boggs, 1965; Clarke, 2002; Clarke & Goldstein, 2003; Levy, 2006; Roncek & Maier, 1991;Yu, 2009), "Land use type", referred to "areas within one streetblock of retail stores and apartments that tend to have higher auto theft incidence rates."(Clarke & Harris 1992; Krimmel & Mele, 1998; Rice & Smith 2002; Wallace, 2004) "Parking lots" were "areas of high concentration of parking lots will be at a greater risk for aggravated assault incidents" (Clarke & Harris, 1992; Clarke, 2002; Clarke & Goldstein, 2003; Levy, 2006; McCord 2010; Rice & Smith, 2002; Sampson, 2004). As per the empirical literature, a density map was created by using two standard deviations more than the mean density value from the points of parking lots to form the three risk map layers.

"School" was a term that referred to "areas within one Bursa's street block of high -

middle schools and universities will possibly be at a greater risk for auto theft incidents"

(Levy, 2006; Marguire, 2007).

The operationalization of each environmental risk factor was established with

standard tools using 2010 ArcMap's spatial analyst extension. For example, the cell value

for "the alcohol outlets risk factor" was 1, if it was within 230 ft. distance of that cell. If

not, the cell value for proximity to alcohol outlets was 0. By combining all

aforementioned map layers four different "risk" maps for each types of crime namely,

aggravated assaults, thefts from autos, auto thefts, and larceny theft incidents were

generated to determine the most crime prone areas (Caplan & Kennedy, 2011). To this

end, Caplan and Kennedy's (2009) the risk terrain modeling (RTM) approach was

utilized as a method for assessing the impact of police-monitored CCTV cameras on

selected crime types in their viewsheds in this study. Caplan and Kennedy (2011. p. 7)

describe,

> "Risk terrain modeling (RTM) as an approach to risk assessment in which separate map layers representing the influence and intensity of a crime risk factor at every place throughout a geography and is created in a geographic information system (GIS). Then all map layers are combined to produce a composite "risk terrain" map with values that account for all environmental risk factors at every place throughout the geography."

More specifically, risk terrain modeling (RTM) was utilized to test the third

hypothesis and is an approach derived from environmental criminology that focuses on

how social and physical characteristics of communities influence how a crime emerges,

concentrates and evolves (Brantingham & Brantingham 1981). This model provides an

approach to risk assessment that "standardizes all risk factors to common geographic

units even camera's viewsheds over a continuous surface" (Kennedy et al., 2010, p. 364).

In RTM analyses; defining the time period and properly identifying the grid size are crucial steps. The time period for these RTMs in this study was only the post-implementation period of police-monitored CCTV cameras starting from June 1, 2010 and endings on May 31, 2011 and was used for testing the third hypothesis. Grid size, as offered by Boba (2009), that are between 50 and 500ft in size was considered as an appropriate size for a grid. However, Caplan and Kennedy (2011) suggested

> "100 x 100 foot cells were the smallest area that our computers could process reasonably fast and, for this proof of concept of RTM, if a Risk Terrain could predict locations of shootings at the smallest (but reasonable) geographic units, it would best exemplify the utility of RTM for operational policing compared to larger, less specific, unit of analysis" (p.19).

In light of the aforementioned suggestions, the present study used a one street block length (for study area, Bursa's 70 meter approximately 230 foot), so a grid size would be 230 x 230 foot cells in order to provide environmental risk values for the selected crime types.

Unit of Analysis

This portion of the dissertation provides information on the unit of analysis, police-monitored CCTV camera's viewshed areas (N=119) that were used to measure the impact of adding CCTV cameras to a landscape; in the city center of Bursa. In accordance with above discussion in the theoretical framework, the CCTV literature needs more micro level studies. Studying at a "micro" level may also bring to light ideas about why a crime is happening that was not seen before. By looking closer, there may be environmental factors that are actually the primary root cause of crimes in specific smaller areas, which may not be identified if one is looking from a "macro" level

perspective. These factors may play a large part in explaining why a crime is occurring. For example, there may be much less or no supervision in particular places or familiarity with the area. Criminals may believe they are less likely to get caught in these places, thus they may commit crimes there instead of others, or feel more comfortable because they know what is around them. Seeing these features on a "micro" level can then be used and analyzed from a macro level, as well, which is a term referred to as "reductionism" (Groff, Weisbund, & Yang, 2010). In addition, using smaller areas of analysis also provides less opportunity for creating statistical errors, especially if the researcher is meticulous when selecting the unit of analysis (Anselin, 1988).

In addition, determining what the unit of analysis would be was imperative for maximizing validity, reliability and for avoiding biases in the present study. In this respect, recent empirical studies (Caplan et al. 2011; Ratcliffe, 2009) have provided clear guidance in selecting and describing camera's viewshed areas as a spatial unit. Ratcliffe (2009) realized that the cameras would only truly work if "the offender is aware that the camera may be watching their activity, and secondly that the offender perceives that the risk of capture of police may outweigh the benefits of the crime they are considering" (p.751). Police-monitored CCTV camera's viewshed areas represent "the area where the cameras are expected to have positive effect" (Ratcliffe, 2009 p.752) and these should be conducive to successfully completing a fair CCTV evaluation.

As stated by Caplan et al. (2011) and Ratcliffe et al. (2009) this study's methodological perspective, which was used to examine a motivated offender's point of view and whether the offender's decision to create a crime is influenced by cameras and camera's viewsheds is well suited for the current quasi-experimental research. As Caplan

et al. (2009) states, "the calculation of viewshed was based upon empirical research suggesting that crime prone places comprise one or two street blocks[4]". This calculation of the viewshed method was used in this present study. In doing so, each viewshed was produced based upon two street blocks in Bursa (Duru, 2010), within a distance of 140 meters.

Bursa shape file data includes all the data describing the sizes of buildings and other barriers that limit a camera's visibility. This feature allows for the drawing of the camera's viewshed in ArcView by using appropriate ArgGis tools. In this process, the areas of a cameras' viewshed may not show an exact 140 meter buffer zone because of the excluded areas in which there is no camera visibility.

After identifying the unit of analysis, the city-wide system and certain individual camera effects were described to clarify the hypotheses. The city-wide system's effect refers to the change in the numbers of aggravated assaults, larceny thefts, thefts from auto and auto thefts in the cumulative Bursa police-monitored CCTV cameras' viewshed areas for up to a one year period after installation when compared to one year prior to cameras' installations (i.e., the macro-level).

Certain variability in the number of crime incidents which would be hidden if carried out at a city-wide system effect (i.e., the macro-level) can be identified (Johnson et al. 2008; Bernasco 2009). When combined, Caplan et al. (2011) study's results prove that an analysis of certain individual cameras' viewsheds (i.e., the micro-level) yields vital information on the variability in the numbers of crime incidents that would

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[4] In this prospectus, a streetblock is defined as "both sides of the street between two intersections or between one intersection and a dead end" (W. R. Smith, Frazee, & Davidson, 2000, p. 494; see also Taylor, 1997; Taylor, Koons, Kurtz, Greene, & Perkins, 1995).

otherwise have been missed at a more macro level (Caplan et al., 2011; Groff et al., 2010). According to the results of their study, the existence of heterogeneity in the evidence revealed that it is particularly important to measure the deterrent effect of certain individual police-monitored CCTV camera's viewsheds regardless of whether there is a city-wide system effect at the local or micro level. Thus, the operational definition of certain individual camera's effects will be represented by the change in the numbers of aggravated assaults, larceny thefts, thefts from autos and auto thefts in each individual Bursa police-monitored CCTV camera's viewshed areas for up to a one year period after installation when compared to one year prior to cameras' installations (i.e., the micro-level). This effect was measured by calculating a location quotient for each camera's viewshed area.

Location quotients (LQ) were originally applied to non-criminological fields of study, which included regional planning, and economics (Andresen, 2009). Other researchers (Andresen, 2009; Brantingham & Brantingham, 1998) have applied location quotients, which have been used in criminological research for about 20 years (Andresen, 2009). Caplan (2010) describes LQ as *"The location quotient (LQ) is an index for comparing an area's share of a particular activity with the area's share of some basic or aggregate phenomenon"* (p. 79) Location quotients replace traditional denominators with overall crime totals in a specific geographic area and a larger geographic area. The concept of the LQ was developed to indicate activity in one area compared to its surrounding and has been used to understand patterns of crime. They provide additional insight into crime analysis not available using crime counts and crime rates (Brantingham & Brantingham 1998).

"The advantage of location quotients is that it highlights an area's relative concentration of a specific crime in comparison to its ratio for the entire area and identify whether a specific crime is disproportionately high or low in a particular place regardless of the total number of incidents or population in a neighborhood or area" (Zhang & Peterson, 2007, p.7).

Applying location quotients analysis adds strength to the research due to the added ability of LQs to control for overall crime as the dominator. After operationalization of the key concepts embedded in the hypotheses, the next portion continues with what kinds of data sources and data this study provides.

Data Sources

This study relied upon two data sources. The first source of data came from the Bursa City Police Department[5] (BPD). The police data on aggravated assault, thefts from autos, and auto thefts[6] and larceny theft incidents were gathered by receiving official permission to do this. This permission did not include any human subject information or any information about the victims or offenders. This source of data provided information that would be used for testing hypothesis 1 on the total number of crime incidents occurring within the police responsible sub-districts in the city of Bursa. This data was also required to help develop location quotients that were used as a measure of overall crime in the denominator value (to test hypothesis 2).

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[5] In wake of increasing crime rates, in 1999 the Bursa Police Department turned its attention to use of the geographical information system. Aksoy (2004) points out that "Bursa Police Department started using the Geographical Information System effectively in Bursa for the first time among all Turkish Police Departments in 1999" (p. 1). This system is part of the bigger project, namely BEMTAP-2000 (Technological Adaptation Project of Bursa Police Department). BEMTAP-2000 takes information obtained from public bodies or private sectors associated to the digital map of Bursa City to create a city database, and then relates this database to crime reports and criminal data in order to strength the city's crime analysis capacity by using crime mapping in the police department.

[6] In Turkey, data on auto thefts is only gathered from police agencies.

The CCTV literature demonstrates that many studies have used police incident reports and official data before and after installation of police-monitored CCTV cameras, measuring changes in rates of crimes committed. In this respect, Ratcliffe (2009) points out inevitable limitations in CCTV evaluations about crime incident data. As discussed in the research setting section, the crucial problem was that these data have often been geo-coded by the police department and not by the scholars themselves. However, BPD can record the exact crime incident locations by using x and y coordinates owing to this specific database. This provided an opportunity to eliminate police department manipulation or any research bias.

The reliability of this type of data is supported by two facts. First, the BEMTAP is a reliable measure of crime incidents for geographical comparisons owing to the standardization of crime definitions (Duru, 2010). For example, auto thefts or grand thefts of autos by the media and police can be described as the criminal act of stealing or the attempt to steal a motor vehicle. This can include thefts for joyriding, thefts for prolonged car use, and thefts for export or "chopping" (disassembling cars for spare parts). One of the largest issues is youth joyriding, which generally is not a major issue for the police because they typically recover cars quickly that were used in joyriding. However, BEMTAP data provides good evidence for identifying youth joyriding, because as previously mentioned, the BEMTAP data is unique in that it is constantly updated and relies directly upon information inputted by the Bursa police department.

For a usual crime record, police officers have to fill out the crime incident report that they have to complete via a closed circuit computer network. For each crime incident, forms are unified and a data recording system provides accurate data

automatically. This prevents missing information fields in the form. Therefore, the selected types of crime incident variables in this dataset are all the same and accurate.

Second, the Bursa Police Department (BPD) has maintained detailed records of crime incidents since 2003. Data, reporting crime incidents that included variables related to each crime type from the police responsible for selected sub-districts in the city, was deemed especially valuable and was available in the 3 metropolitan districts of Bursa, Osmangazi, Nilufer, and Yildirim. This database maintains information about the type, location, date and time of the crime incidents. The location of crime incidents includes geographic coordinates (x and y), and that meant this research did not have to involve any geo-coding process, and thus the research was based on accurate crime incident locations.

Bursa city's shape files, also come from the Turkish National Police. These shape files allowed the researcher to measure spatial displacement, utilize the risk terrain model, and analyze viewsheds and environmental risk factors. The city police department originally provided those, with several layers. These shape files included a listing of police-monitored CCTV camera locations, and police responsible sub-districts in the city center (attribute tables include names of these sub-district). In addition, they included the locations of infrastructures and their geographical sizes throughout the city (these attribute tables consist of a listing of the categories of these places such as like restaurants, bars, and/or nightclubs, parking facilities, public transportation stations, areas of tourism, malls, bars, liquor stores, fast-food outlets, exotic clubs, schools, post offices, banks, ATMs, drug markets, narcotic hotspots, entrances of shopping malls, traditional open shopping centers, namely "pazar" in Turkish, coffeehouses and internet cafés[7]

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[7] In Turkey, different local risk factors (land use) especially, Internet cafés and coffeehouses have aggregating risk value for street level crime

etc…, and name, phone numbers of the places). As such, this facilitated the digitizing of the camera's viewsheds. Obtaining base maps that Bursa shapes into file data was also important in the process because they limited the risk terrain map to the exact area of this study preventing a bias from occurring when conducting statistical tests of the predictive validity of the study's risk terrain map.

A second source of data came from the Turkish Statistical Institute (TUIK). This census data was used for placement of drug related areas in the risk terrain model as an environmental risk factor. The TUIK data included the population for each sub-district based on the 2007 census and the counts of buildings and demographic variables for each sub-district as of 2000. These data sets are the most recent sets available in Turkey.

Analytical Strategy

In this portion of the study, the data analyses consisted primarily of three stages in order to obtain evidence to support three research hypotheses discussed in first chapter. The first hypothesis was that the number of aggravated assaults, auto thefts, thefts from autos, and larceny thefts would decrease respectively across all police-monitored CCTV cameras' viewshed areas for up to a one year period after installation when compared to one year prior to the cameras' installations.

The first stage involved descriptive statistics and paired samples t – test using selected crime incident numbers of all police-monitored camera's viewshed one year before and after installation period for city-wide effect.

The second hypothesis was that certain individual CCTV camera's viewsheds would reduce the number of aggravated assaults, auto thefts, thefts from autos, and

larceny thefts in time period two compared to time period one, while others would not, regardless of whether there was a city-wide system in effect.

The second stage that tested the second hypothesis involved calculations of crime location quotients sing the following equation LQ equation for each CCTV camera viewshed area within the police responsible sub-districts in the city of Bursa:

LQ = (Cx / Tx) / ($\sum$Ccw /$\sum$ Tcw) (Modified from Caplan, 2010)

Cx :   The number of aggravated assaults, thefts from auto, auto thefts and larceny thefts, respectively in the individual (x) police-monitored CCTV camera's viewshed area,

Tx: Total area of viewshed (x) within the police responsible sub-districts in the city of Bursa,

$\sum$Ccw: Total numbers of aggravated assaults, thefts from auto, auto thefts and larceny thefts, respectively, in all police-monitored CCTV camera's viewshed areas

$\sum$Tcw: Total area of the viewsheds within the police responsible sub-districts in the city of Bursa.

The LQ ranged from values of above one (for positive LQ) to values below one (for negative LQ). A value of 1.00 indicated an average representation of a specific form of crime. Crime LQ's value under 1.00 indicated an under-representation, while values over 1.00 showed overrepresentation (Andresen, 2007).

The results allowed the researcher to assess the impact of individual CCTV cameras on different camera locations in Bursa. More specifically, the LQ values for each police-monitored CCTV cameras' viewshed area for pre and post period were used to measure whether reported aggravated assaults, thefts from autos, auto and larceny thefts

crime incidents, changed following the addition of public CCTV cameras to three police responsible sub-districts in the city center.

It was believed that using location quotients to compare numbers of selected crime incidents in pre and post implementation of CCTV period for each cameras' viewshed might increase the validity of this study. To this end, LQs were calculated for each time period and each camera's viewshed. Viewsheds with negative values were deemed to have experienced crime reductions, while positive changes showed crime rates did not improve following camera installation.

The third hypothesis was that individual police-monitored CCTV cameras that do not show a statistically significant reduction in auto thefts, thefts from autos, and larceny thefts would have significantly higher than average environmental risk values compared to CCTV cameras that do reduce these crimes in time period 2 compared to period 1.

Although using the crime location quotient and paired t- test provided a measure of impact of the CCTV cameras, it is important to note that the measure is not a rigorous test of whether and to what extent CCTV cameras impact street level crime. To this end, the final stage of the analytical strategy involved risk terrain modeling, paired samples t-tests, and linear regression models. With the careful design presently described the risk terrain modeling approach was believed to provide an appropriate test for each selected type of crime incident, respectively (Caplan et. al, 2010).

Firstly, a validated RTM was used to examine aggravated assaults, thefts from autos, auto thefts, and larceny thefts respectively. Secondly, an individual risk value for each camera viewsheds was calculated, and then aggregated cells up to the camera viewsheds were used to set environmental risk values. To accomplish this, an important

step was calculation of relative spatial influence (RSI) of criminogenic features. This was calculated by the number of cells having the attribute of the spatial influence of the environmental risk feature. For instance, 2,356 cells were included in the statistical analyses. So, if 39 cells had a risk value of "3," then the area would be $39/2536 = 0.0153$ or 1.53 percent.

In this respect, LQ differences served as a selective variable. To test the third hypothesis, the following formula was used for each camera viewshed, four times for each crime. The formula was that each camera viewshed's "post" LQ value was subtracted from the "pre" LQ. For example cameras with changes towards the negative (i.e.: 2.4 in the "pre," 1.2 in the "post") were considered to have achieved a meaningful crime reduction while positive changes showed no crime reduction following camera installation. This formula was used to determine whether a specific crime pattern changed in each camera's viewshed after the installation of CCTV in Bursa. The LQ allowed the researcher to create two group viewsheds. This selection variable derived from the change in the LQ was a binary variable denoting whether the change was negative or positive. Then the study compared the average risk values for the viewsheds for those two groups. – Having significantly higher average environmental risk values or not.

Ordered logistic regression with environmental risk value calculations (see for definition and calculation in operationalization portion at the research chapter) served as an independent variable, and the location quotient change within each viewshed was used as the dependent variable. Specifically, ordered logistic regression was run in STATA using "environmental risk value in the viewsheds' as the independent variable and "the Location Quotient Change Score" as the dependent variable (as a ordinal variable as

well) in a model including all viewsheds –aggravated assault, larceny theft, theft from auto, and auto theft, respectively. The dependent variable of LQ change was measured and coded as a three-level ordinal variable and was ranked as follows: a negative LQ change = 0, a No LQ change = 1, a Positive LQ change = 2. The researcher then compared the coefficients to see what the effect of environment was on the crime with the change being the installation of CCTV cameras. The risk value was the same across both pre and post installation time periods and the expectation was that the LQ change would differ and the expected cause of that change in the frequency of crimes would be the camera.

Finally, it was hoped the research findings raised questions about the role of criminogenic environmental factors and would hopefully lead to some appropriate recommendations for reducing crimes.

<u>Chapter Summary</u>

This study improves upon those in the existing literature in several ways. Previous studies have focused on mixed categories of land use (e.g public housing, city and town center, and car parks) however, a city-wide camera system provides for a "big picture" of CCTV camera effectiveness. Although full clarification of the city-wide system effect relies on the size of the CCTV systems that are "mixed," in previous studies many CCTV set-ups have consisted of between eight and 100 cameras within the system (Gill & Spriggs, 2005). However the present set-up consisted of 119 camera location and 187 dome cameras, which was much larger than in previous studies. This means that this study included all police-monitored CCTV cameras in the metropolitan city of Bursa in an effort to explore their city-wide system effect. Furthermore, this study analyzed not

just the city-wide system effects, but certain individual camera's deterrent effects as well to test "the places where cameras deterred crime better than others" (Caplan et al., 2011, p.271).

In addition to all previous methodological efforts, empirical evaluations in the CCTV literature are still needed to account for alternative perspectives to measure their effectiveness in the deterrence of crimes. Traditional responses have been designed to measure the impact of police-monitored CCTV cameras focus on different measurement methods. However, the present study focused on one concept of environmental criminology, namely "crime risk at place". According to Caplan and Kennedy (2009. p.3) "The impact of interventions to reduce risk (and avert negative events) can be evaluated by regularly re-assessing risk, and then measuring changes in risk values among different risk terrain maps at micro or macro levels using basic inferential statistics." Therefore, this research also considered the environmental risk values that might identify "environmental conditions under which cameras would be most effective" (Caplan et al., 2011, p.271). Thus, the concept of "environmental risk value" provided a unique methodological approach to the study of CCTVs. Moreover, the existing body of literature has not utilized RTM to measure the deterrent effect of CCTV cameras on selected crime type incidents aggravated assaults, thefts from autos, auto and larceny thefts, respectively by controlling for criminogenic environmental context. Thus, findings from this analysis could thus fill this gap in the police-monitored CCTV literature.

CHAPTER THREE: RESULTS

The statistical results are first presented as descriptive statistics for the 119 police-monitored CCTV cameras in Bursa, Turkey. These CCTV cameras' viewsheds cover 121,729 square meters, or 0.011% of the total area of the Bursa. Firstly, descriptive statistics are used to describe aggravated assaults, larceny thefts; thefts from autos and auto thefts (including the mean scores and standard deviation) and are presented in that order, respectively. The second group of results provides data that describes what occurred between the pre and post installation period in the form of mean differences for aggravated assaults, larceny thefts, thefts from autos and auto thefts by utilizing paired sample t test results (for examining the city-wide system level deterrent effects of police-monitored CCTV cameras). The third level of results involved calculations of location quotients for each crime type to highlight whether certain individual CCTV camera's viewsheds would have a significant impact on reducing the number of aggravated assaults, auto thefts, thefts from auto, and larceny thefts in time period 2 compared to time period 1, regardless of any existing system-wide effect. The fourth level of data analyses highlight the coefficients of between-group differences at a bivariate level (This negative binomial regression test, done twice, examined what are the environmental risk value effects on crimes before and after CCTV interventions for each crime type across viewsheds) for the pre and post installation periods to see what the effect of environment risk value in viewsheds would be as regards the crime incidence.

To investigate whether the crime rates in the pre and post installation periods differed due to the numbers of each selected crime incident types and whether they differed in a statistically significant way, a paired samples *t*-test was computed (Table 1).

Difference of Means Analysis

As is apparent from Table 1 which presents the differences in mean numbers of crimes between time period 1 and 2 for aggravated assaults, larceny thefts, thefts from autos and auto thefts of (p=.719; p= .037; p=.013; p=.657 respectively, since the present researcher only accepted a p value of < .05 as being statistically significant; only t values for larceny theft and theft from autos were found statistically significant with p values of 037 and .013. Indeed, the fact that the t value was positive and had a larger mean before than after the post 12-month period following the CCTV camera installation process. Therefore, it can be concluded that the number of larceny thefts and thefts from autos decreased significantly across all CCTV camera's viewshed areas for up to one-year after installation when compared to the one year prior to the cameras' installations, t (118) = 2.112, p < .05. and t (118) = 2.531, p < .05, respectively.

Crime Category	Mean	SD	Min	Max	n	*t*	*df*	p
Aggravated Assault						0.361	118	0.719
Pre-CCTV	0.400	0.886	-0.151	0.218	119			
Post-CCTV	0.370	0.735			119			
Larceny Theft						***2.112***	118	0.037
Pre-CCTV	1.970	3.468	0.030	0.944	119			
Post-CCTV	1.490	2.372			119			
Theft from Auto						***2.531***	118	0.013
Pre-CCTV	0.640	0.989	0.044	0.359	119			
Post-CCTV	0.440	0.755			119			
Auto Theft						0.446	118	0.657
Pre-CCTV	0.210	0.535	-0.087	0.137	119			
Post-CCTV	0.180	0.469			119			

*p<.05; **p<.01; ***p<.001

Table 1: Difference of Mean Analysis for Aggravated Assaults, Larceny Thefts, Thefts from Autos and Autos Thefts

The number of aggravated assaults, auto thefts, thefts from auto, and larceny

thefts for each police-monitored CCTV cameras' viewshed area were transformed into an aggregate score for examining the city-wide level deterrent effect of these cameras. (e.g. the number of aggravated assaults in each viewshed were aggregated to obtain total number for aggravated assaults in 119 viewsheds.) Paired sample t tests for aggravated assaults revealed that there was no statistically significant difference between the pre and post installation periods at the .05 alpha level (t (.361) = p < .719). Therefore, the null hypothesis was not rejected. The CCTV mean scores for aggravated assaults were higher prior to installation. The mean number of aggravated assaults within the police-monitored viewsheds was .40 before CCTV and .37 after CCTV installation.

As predicted for larceny thefts, a paired sample t test revealed that there was a statistically significant difference between the pre and post installation periods at the .05 alpha level (t (2.112) = p <.037). Therefore, the null hypothesis was rejected given the finding of no statistical significant difference between the pre and post installation periods. Before CCTV installation the mean scores for larceny theft were high. The mean number of larceny thefts within the police-monitored viewsheds was 1.97 before CCTV and 1.49 after CCTV; an effect size of .688 shows a strong positive correlation existed as a result of the installation. The cameras that deterred larceny crimes before the CCTV period also deterred these crimes after the CCTV installation period.

As predicted for thefts from autos a paired sample t test Table 1 revealed a statistically significant difference between the pre and post installation periods at the .05 alpha level (t (2.531) = p <.013). Therefore, the null hypothesis was rejected due to the finding of no difference between the pre and post installation periods. Before CCTV installation, the mean scores for thefts from auto were higher than they were after

installation. The mean number of thefts from auto within the police-monitored viewsheds was .64 before CCTV and .44 after CCTV installation; an effect size of .531 showed a strong positive correlation of these factors. The cameras that deterred thefts from auto crimes before the CCTV period also deterred this adequately after the CCTV installation period.

Paired sample t tests for auto thefts Table 1 revealed no statistically significant differences between the pre and post installation periods at the .05 alpha level (t (.446) = p <.657). Therefore, the null hypothesis was not rejected. Before CCTV, the mean scores for auto thefts were lower than after installation. The mean numbers of auto thefts within the police-monitored viewsheds was .21 before CCTV and .18 after CCTV installation.

Differences in Location Quotient

The next analysis presents the differences in Location Quotient. Firstly, "post" LQ values were considered for how many cameras had LQ values below one which proposed the viewshed to have less crime (for each crime type separately) than is more generally found across all camera viewsheds. To this end, the analysis of the "post" LQ values of 119 cameras within the Bursa CCTV system demonstrated that 75 out of 119 cameras had location quotient values below 1 for larceny thefts after the camera installation; 85 cameras for thefts from auto and 106 for auto thefts. Viewsheds with a LQ value above 1 for the four crime types were as follows; 4 cameras for aggravated assaults, 44 cameras for larceny thefts, 32 cameras for thefts from auto and 13 cameras for auto thefts. Only two cameras for thefts from autos had LQ values equal to one which means these viewsheds had a share of crimes in accordance with their share of the rest of the city.

Deciding how to best quantify the LQ analysis is an important issue. The author would caution against looking only at the "post" installation period, however. Just because a camera has an LQ below 1 in the post period does not mean crime was reduced. The LQ could have been below 1 (and maybe even smaller) in the "pre" installation period. In this respect, two sets of LQ were calculated for each camera viewsheds - aggravated assaults, larceny thefts, thefts from auto, and auto thefts, respectively: one for the "pre" installation period, one for the "post" installation period. Secondly, although some viewsheds reached LQ values below 1 following camera installation in a one-year period, the second hypothesis tried to answer how many viewsheds did deter the number of these crime incidents.

When calculated with the LQ change formula (details in analytical strategy part), findings were that 23 out of 119 cameras had crime location quotient values that showed a trend towards the negative for aggravated assaults after the camera installation; 45 cameras for larceny thefts, 34 cameras for thefts from auto, 11 cameras for auto thefts, while 27, 38, 29, and 17 cameras did not improve crime LQ values for aggravated assaults, larceny thefts, thefts from auto, and auto thefts.

CRIME CATEGORY	NEG. Difference LQ	Neg. %	POS. Difference LQ	Pos. %	No Change LQ	% No Change
Aggravated Assault	23	19.30%	27	22.70%	69	58.00%
Larceny Theft	45	37.81%	38	31.93%	36	30.25%
Theft From Auto	34	28.57%	29	24.36%	56	47.05%
Auto Theft	14	11.76%	17	14.28%	88	73.94%

Table 2: Number of Viewsheds with Negative and Positive Difference LQ Values for Aggravated Assaults, Larceny Thefts, Thefts From Autos and Auto Thefts.

As demonstrated in Table 2, the largest LQ change values was found for larceny thefts, for which 37.81% of the viewsheds had negative differences for the LQ values and

31.93% had positive differences. In other words, 45 of CCTV cameras were deployed strategically for deterring larceny theft incidents. For aggravated assaults, thefts from autos, and auto thefts, percentage differences were less than four percentages points. In addition, 73.94% and 58% of viewsheds showed no change for auto thefts and aggravated assaults, respectively. Both of the crime categories did not achieve any statistically significant decrease in system-wide city effects, and this might be interpreted as owing to the fact the CCTV cameras did not deter offenders from committing aggravated assaults and auto thefts adequately in their viewsheds following 12-month installation period. In other words, 73 and 58 of CCTV cameras were not deployed strategically when considering auto thefts and aggravated assaults, respectively. These results emphasize the "risk of crime at place" perspective where supporters argue that certain places have unique characteristics (e.g., Brantingham and Brantingham 1998; Caplan et al., 2011; Kennedy & Caplan, 2010; Ratcliffe and Rengert 2008; Robinson 2008; Andresen 2009). Specifically, certain individual camera viewsheds generate significant deterrent effects, while others do not (Caplan et. al., 2011).

Consequently, the results presented here support the second hypothesis that certain individual police-monitored CCTV camera's viewsheds can produce a reduction in the number of auto thefts, thefts from auto, and larceny thefts in time period 2 compared to time period one, while others do not, regardless of whether there is a system-wide effect in Bursa or not. The results were achieved by assessing the deterrent effect of certain individual police-monitored CCTV cameras on aggravated assaults, larceny thefts; thefts from autos and auto thefts were mixed in Bursa. This finding is consistent with the literature (Caplan, Kennedy, & Petrossian, 2011; Ratcliffe et al.,

2009) on the deterrent effects of individual police-monitored CCTV cameras on crime incidents. Specifically, this result supports the view that "some places are likely to be more crime prone than others…" (Caplan et al., 2011, p. 265).

Do Higher Average Environmental Risk Value Effect on Selected Crime Categories?

The deterrent effect of certain individual cameras depends on where the CCTV cameras are placed – and an average high-risk value location, was examined by utilizing risk terrain modeling in ArcGis software. Results for hypothesis three, whether environmental risk values affect the deterrent effect of CCTV cameras on aggravated assaults, auto thefts, thefts from auto, and larceny thefts at their viewsheds was presented in the result chapter.

This dissertation followed a multistep process in carrying out RTM to identify the average higher environmental risk value of the camera viewsheds in Bursa. As a first step, identifying and including environmental risk features identified as related to aggravated assaults, larceny thefts, thefts from autos, and auto thefts were targeted for further analyses in RTM. As previously discussed in the methodology section, the environmental risk features outlined below were selected on the basis of their statistical correlations with the dependent variable. Table 3 represents the results of the chi-square analyses for each crime type. Although, all environmental risk factors were statistically significant at (p<.001) for the level of each crime category, only 20% and higher percentile values for risk factors were accepted in the RTM model, which was recommended by Caplan and Kennedy (2010).

Variables	Aggravated Assault		Larceny Theft		Auto Theft		Theft From Auto
Environmental Risk Factors	%	*Environmental Risk Factors*	%	*Environmental Risk Factors*	%	*Environmental Risk Factors*	%
Bus Stops **79.20*****		Bus Stops **78.20*****		Bus Stops **76.70*****		Bus Stops **77.2*****	
Internet Cafes **60.70*****		Public Phones **61.90*****		Internet Cafes **50.70*****		Public Phones **52.8*****	
Public Phones **57.80*****		Internet Cafes **58.30*****		Pharmacies **42.20*****		Internet Cafes **51.9*****	
Pharmacies **45.70*****		Drug Related Places **42.10*****		Schools **31.50*****		Pharmacies **37.7*****	
Drug Related Places **42.70*****		Schools **40.20*****		Alcohol restaurants & Late dining **28.90*****		Drug Related Places **36.8*****	
Alcohol restaurants & Late dining **35.40*****		University Course Buildings **20.80*****		Bakers **23.30*****		Schools **30.4*****	
Coffee Houses **22.90*****		Coffee Houses **20.30*****		Coffee Houses 18.90***		Alcohol restaurants & Late dining **27.3*****	
Wedding Saloons **22.90*****		Bars & Liquor Stores & Night Clubs **19.60*****		Parks 16.30***		Bakers **19.8*****	
University Course Buildings **19.10*****		Banks & ATM's 18.90***		University Course Buildings 15.90***		Coffee Houses 17.3***	
Banks & ATM's 18.50***		Parks 17.10***		Bars & Liquor Stores & Night Clubs 14.10***		Wedding Saloons 17.3***	
Bars & Liquor Stores & Night Clubs 18.20***		Pharmacies		Banks & ATM's 12.20***		Parks 15.1***	
Hotels 9.70***		Alcohol restaurants & Late dining		Gas Stations 5.90***		University Course Buildings 14.9***	
Gas Stations 5.20***		Sport Facilities		Hotels 4.40***		Jewelry's 13.2***	
Sport Facilities 3.80***		Hotels		Sport Facilities 4.10***		Bars & Liquor Stores & Night Clubs 12.5***	
		Gas Stations		Historic Places 2.20***		Banks & ATM's 10.8***	
		Wedding Saloons		Public Phones		Hotels 6.2***	
		Bakers		Drug Related Places		Sport Facilities 3.7***	
		Historic Places		Wedding Saloons		Gas Stations 3.3***	
						Historic Places 1.4***	
CORRECTED P-VALUE	**0.014**	**CORRECTED P-VALUE**	**0.01**	**CORRECTED P-VALUE**	**0.015**	**CORRECTED P-VALUE**	**0.019**
*p<.05; **p<.01; ***p<.001							

Table 3: Consideration of Environmental Risk Factors for Including RTM

According to the results of chi-square tests, the presence of eight environmental risk factors was statistically significant as regards the aggravated assault model. This included: bus stops (79.2%), Internet cafes (60.7%), public phones (57.8%), Pharmacies (45.7%), drug related places (42.7%), alcohol restaurants & late dining (35.4%), coffee houses (22.9%), wedding saloons (22.9%). Seven environmental risk factors were

statistically significant in the larceny theft model. Bus stops (78.20%), public phones (61.90%), Internet cafes (58.30%), drug related places (42.1%), schools (40.2%), university course buildings (20.8%), coffee houses (20.3%). Six environmental risk factors were statistically significant in the auto theft model. Bus stops (76.7%), Internet cafes (50.7%), Pharmacies (42.2%), schools (31.5%), alcohol restaurants and late dining sites (28.9%), bakers (23.3%). Seven environmental risk factors were statistically significant in the theft from auto model. Bus stops (77.20%), public phones (52.8%), Internet cafes (51.9%), Pharmacies (37.7%), drug related places (36.8%), schools (30.4%), alcohol restaurants and late dining sites (27.3%).

Secondly, according to the selection process, accepted environmental risk factors were weighted due to fact every risk factor in the model did not have an equal effect on the aggravated assaults, larceny thefts, thefts from autos, and autos thefts. This step was applied by the calculation of Relative Spatial Influence (RSI) to determine the effect of each risk factor for selected crime types separately in the viewsheds. Then each risk factor was divided by the least RSI value that "bus stops" as an environmental risk factor has the least RSI values for each crime type 0.158, 0.187, 0.054, 0.175, respectively. Thus the risk factors were weighted. Table 4 demonstrates each risk factor's weighted value including cells those that intersected with streets for selected crime types, which were done separately. Thus, the weighted values for each risk factor were then assigned to their viewsheds.

Environmental Risk Factors	# of Aggravated Assaults	of all cells	RSI	Risk Factor's Weight
Coffee Houses	177	462	0.383	2.4
Wedding Saloons	177	463	0.382	2.4
Pharmacies	353	1165	0.303	1.9
Drug Related Places	330	1188	0.278	1.8
Internet Cafes	469	1795	0.261	1.7
University Course Buildings	148	605	0.245	1.5
Alcohol restaurants & Late dining	274	1124	0.244	1.5
Public Phones	447	2003	0.223	1.4
Bus Stops	612	3862	0.158	1.0

Environmental Risk Factors	Larceny Theft	of all cells	RSI	Risk Factor's Weight
Coffee Houses	188	462	0.407	2.2
Bars & Liquor Stores & Night Clubs	181	491	0.369	2.0
Drug Related Places	389	1188	0.327	1.8
University Course Buildings	192	605	0.317	1.7
Schools	372	1194	0.312	1.7
Internet Cafes	539	1795	0.300	1.6
Public Phones	573	2003	0.286	1.5
Bus Stops	723	3862	0.187	1.0

Environmental Risk Factors	Auto Theft	of all cells	RSI	Risk Factor's Weight
Bakers	63	571	0.110	2.0
Pharmacies	114	1165	0.098	1.8
Internet Cafes	137	1795	0.076	1.4
Schools	85	1194	0.071	1.3
Alcohol restaurants & Late dining	78	1124	0.069	1.3
Bus Stops	207	3862	0.054	1.0

Environmental Risk Factors	Theft From Auto	of all cells	RSI	Risk Factor's Weight
Bakers	173	571	0.303	1.7
Pharmacies	329	1165	0.282	1.6
Drug Related Places	321	1188	0.270	1.5
Internet Cafes	453	1795	0.252	1.4
Public Phones	461	2003	0.230	1.3
Schools	265	1194	0.222	1.3
Alcohol restaurants & Late dining	238	1124	0.212	1.2
Bus Stops	674	3862	0.175	1.0

Table 4: The Weighted Values of Each Environmental Risk Factor.

For the second research question, firstly, LQ differences and the numbers of selected crime incidents were compared in the pre and post periods. Secondly, to measure the effects of the environmental risk values for each crime type, the research strategy utilized four separate ordered logistic regression models.

CRIME CATEGORY	HIGHER Average Environmental Risk Value		Not Higher Average Environmental Risk Value		Average Risk Value
	The Number of Viewsheds	%	The Number of Viewsheds	%	
Aggravated Assault	74	62.18%	45	37.82%	5.454766149
Larceny Theft	61	51.26%	58	48.74%	5.304690477
Theft From Auto	60	50.50%	59	49.50%	4.234840603
Auto Theft	64	53.80%	55	46.20%	3.254121649

Table 5: The Number of Viewsheds Experienced Higher–Below Average Environmental Risk Value in All Viewsheds.

According to assigned risk values for each viewsheds in the system, average risk values[1] were calculated for each crime types - aggravated assaults, larceny thefts, thefts from autos and auto thefts had different average risk values 5.454766149, 5.304690477, 4.234840603, 3.254121649, respectively (as shown in table 5). Based on these values, each viewshed was considered in light of whether they had higher average environmental risk value or not. As seen in table 5, the number of viewsheds experiencing higher than average environmental risk values was more than the number of viewsheds experiencing lower than average environmental risk values for all crime types. This showed that the police monitored CCTV cameras in Bursa are generally deployed in areas described to have higher than average environmental risk values by the model used in this study.

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[1] Each crime type have a respective risk average risk values that calculated by average of environmental risk values in 119 viewsheds. For example, total (119) viewsheds have 649.117166 environmental risk values for aggravated assault. Then, 649.117166 / 119 = 5.454766149 is average environmental risk value for aggravated assault.

CRIME CATEGORY	Viewsheds (HIGHER Average Environmental Risk Value)					
	NEG. Difference LQ	Neg. %	POS. Difference LQ	Pos. %	No Change LQ	% No Change
Aggravated Assault	19	25.60%	17	23.00%	38	51.40%
Larceny Theft	24	39.40%	26	42.60%	11	18.00%
Theft From Auto	14	23.40%	21	35.00%	25	41.60%
Auto Theft	12	18.70%	7	11.00%	45	70.30%
	Viewsheds (Not Higher Average Environmental Risk Value)					
Aggravated Assault	8	17.80%	5	11.10%	32	71.10%
Larceny Theft	14	24.20%	18	31.00%	26	44.82%
Theft From Auto	15	25.50%	13	22.00%	31	52.50%
Auto Theft	5	9.09%	7	12.71%	43	78.20%

Table 6: Differences for LQ in Viewsheds Experienced Higher–Not Higher Average Environmental Risk Value.

The higher average risk value viewsheds in three categories – with negative difference LQ, positive difference LQ, and no change LQ for each crime types are presented in Table 6. Consistent with previous findings (in terms of the LQ analysis for conducted for the second hypothesis in this dissertation) and research (Caplan, Kennedy, & Petrossian, 2011; Ratcliffe et al., 2009) Bursa's police-monitored CCTV system have both effective (having negative LQ differences) and ineffective (having positive differences in LQ) camera viewsheds, which have significantly higher than average risk values. According to Table 6, the frequency of viewsheds experiencing negative and positive LQ values were considered in the context of higher than average risk values. Only two crime types - aggravated assaults and auto thefts had more viewsheds (19,12) that experienced negative differences in LQ value (representing a crime decrease) than viewsheds (17,7) experiencing positive differences in LQ (representing a crime increase), respectively. For larceny thefts and thefts from autos, the number of viewsheds that experienced positive differences in LQ values (26, 21) was higher than the number of viewsheds experiencing negative differences in LQ values (24,14), respectively.

This finding was also evidenced, in substantive terms, in that 19 (25.60%), 24 (39.40%), 14 (23.40%), and 12 (18.70%) higher than average risky viewsheds generated deterrence in the one-year period following their installation for aggravated assaults, larceny thefts, thefts from autos, and auto theft, respectively. However, 17 (23.00%), 26 (42.60%), 21 (35.00%), and seven (11.00%) had higher than average risky viewsheds and did not reveal any generated deterrence over the one- year study period.

Comparing the Mean Scores

For each selected crime category, to investigate whether pre and post intervention periods differed in a statistically significant way in those viewsheds that experienced higher average risk value, four descriptive statistics were computed (Table 7). By comparing the differences in means between the pre and post intervention periods (only in viewsheds experiencing higher average risk values), this dissertation was able to test the third hypothesis (Individual CCTV camera's that do not have a statistically significant reduction in aggravated assaults, auto thefts, thefts from auto, and larceny thefts will have significantly higher than average environmental risk values compared to CCTV cameras that do reduce these crimes in time period 2 compared to period 1).

Variables	Pre-Aggravated Assault	Post-Aggravated Assault	Pre-Larceny Theft	Post-Larceny Theft	Pre-Theft From Auto	Post-Theft From Auto	Pre-Auto Theft	Post-Auto Theft
Mean	0.58	0.47	2.77	2.20	0.77	0.53	0.22	0.25
SD	1.06	.848	4.398	2.926	1.110	.911	.519	.563
N	74	74	61	61	60	60	64	64

Table 7: Statistical Summary of Crime Incidents Variable.

Table 7 presents the mean differences in those viewsheds that experienced higher average risk value for each crime category. As is apparent from Table 7 which shows that number of larceny thefts and thefts from autos in the pre-12 month period, there was a larger mean in the post 12-month period after the CCTV camera installation process took place.

Before CCTV installation, the mean scores for thefts from auto were higher than they were after installation. The mean numbers of thefts from autos within the police-monitored viewsheds was .77 before CCTV and .53 after CCTV installation. Therefore, it can be concluded that the numbers of thefts from autos statistically decreased across all CCTV camera's viewshed areas for up to one-year after installation when compared to the one year prior to the cameras' installations. In other words, the cameras that deterred thefts from auto crimes before the CCTV period also deterred this adequately after the CCTV installation period in viewsheds experiencing higher than average environmental risk values.

For other crime types –aggravated assaults and auto thefts, the results of this analysis did not reveal significant mean differences between these two groups. The mean numbers of aggravated assaults within the police-monitored viewsheds were .58 before CCTV and .47 after CCTV installation. Before CCTV installation the mean scores for larceny theft were high. The mean number of larceny thefts within the police-monitored viewsheds was 2.77 before CCTV and 2.40 after CCTV installation period. Before CCTV, the mean scores for auto thefts were higher than after installation. The mean numbers of auto thefts within the police-monitored viewsheds was .22 before CCTV and .25 after CCTV installation.

Therefore, for three-crime categories –aggravated assaults, larceny thefts (still small mean reduction in the post period), and auto thefts, we can reject the null hypothesis that there is significant difference between pre and post installation periods between each type of viewshed area. This finding is consistent with the literature on crime and place –risk of crime at place theory. Specifically, this result suggests that "the risk of crime in places that share criminogenic attributes is higher than other places as these locations attract offenders and are conducive to allowing certain events to occur" (Caplan & Kennedy, 2011, p. 22) even if they have police-monitored CCTV cameras. To accomplish the answer for the third hypotheses, the last step involved investigating whether environmental risk values affected the deterrent effect of CCTV cameras on aggravated assaults, auto thefts, thefts from auto, and larceny thefts at their viewsheds.

Ordered Logistic Regression

The linear regression test assumes that dependent variables are distributed approximately normally (Maxfield & Babbie, 2009: p. 406). To test this, a Kolmogorov-Smimov (K-S) goodness of fit and Shapiro-Wilk W tests were conducted on the dependent variables (LQ change). The K-S and Shapiro-Wilk W tests compare the scores in the sample to identify whether a sample differs from a standard normal distribution (Field, 2009: pp.144-148). These tests were statistically significant (p<.001) lfor all dependent variables, indicating that all distributions were not normal. When the assumption of linear regression test is violated, Field (2009) suggests coding the data for ordered logistic regression testing that is also assumed the appropriate model in this case. Therefore ordered logistic regression test was conducted to investigate whether environmental risk values affected the deterrent effect of CCTV cameras on aggravated

assaults, auto thefts, thefts from auto, and larceny thefts at their viewsheds.

DEPENDENT VARIABLES					
Coded LQ Change in Crime Category					
Crime Category	Mean	SD	Min	Max	N
Aggravated Assault LQ Change	0.9579832	0.6430193	0	2	119
Larceny Theft LQ Change	1.05042	0.8320766	0	2	119
Theft from Auto LQ Change	1.042017	0.7294641	0	2	119
Auto Theft LQ Change	0.9747899	0.5119286	0	2	119
INDEPENDENT VARIABLES					
Environmental Risk Value					
Aggravated Assault Risk Value	5.469033	3.377821	0	11	119
Larceny Theft Risk Value	5.150695	2.777757	0	10	119
Theft from Auto Risk Value	4.474566	2.185999	0	7.5	119
Auto Theft Risk Value	3.241716	1.797609	0	6	119

Table 8: Statistical Summary of Dependent and Independent Variables in Ordered Logistic Regression

Table 9 reports the results for the ordered logistic regression model for each

selected crime categories.

MODEL. All Viewsheds				
Variables	Independent Variable (Environmental Risk Values of Aggravated Assault, Larceny Theft, Theft from Auto, Auto Theft, respectively)			
Dependent Variables (The LQ Change in Crime Category)	*Coeff.*	*Std. Err.*	*Odds Ratio*	*Pseudo R2*
Aggravated Assault LQ Change	**- 0.1148112***	0.054369	**0.8915345**	**0.0199****
Larceny Theft LQ Change	**- 0.327812*****	0.0701913	**0.7204985**	**0.095****
Theft from Auto LQ Change	**- 0.3615678*****	0.0863101	**0.6965834**	**0.0768****
Auto Theft LQ Change	**- 0.2840073***	0.1197831	**0.7527611**	**0.0329***
*p<.05;**p<.01;***p<.001 Not: (Negative Change = 0, No change = 1, Positive Change = 2): Ordered Logistic Regression Coefficients in Bursa CCTV System.				

Table 9: Associations Between Environmental Risk Value and Location Quotient Change

The coefficient value in ordered logistic regression modeling provided a first look

at the relationships between the dependent "LQ change[2] in crime category" and

[2] For the calculation of LQ change -each period in this case was followed for 12-month. So, exposure time is uniform between pre and post installation periods.

independent variable "environmental risk value" and helped answer the second research question (Do environmental risk values affect the deterrent effect of CCTV cameras on aggravated assaults, auto thefts, thefts from auto, and larceny thefts at their viewsheds?). It is important point to point out that ordered logistic regression (non-parametric) models do not produce true R-squared values (Field, 2009; Long & Freese, 2006). Thus, it was felt pseudo R- squares, which would require eight separate models were inappropriate for interpretation.

According to the findings in Table 9 shows for the LQ change of aggravated assaults, larceny thefts, thefts from autos, and auto thefts. Environmental risk values in all viewsheds were statistically significant for each crime category. In addition, each of the LQ changes in crime category (negative LQ change refers to crime increase, whereas positive changes refer to a crime decrease, for more details on the calculation of the LQ, see the operational definition in Chapter Two) presented negative coefficient values indicating the environmental risk values in all viewsheds associated with post-installation crime increased. The risk values in all viewsheds were associated with higher crime levels for aggravated assaults (- 0.1148112), larceny thefts (- 0.327812) and thefts from autos (- 0.3615678), and auto thefts (- 0.2840073) in the following 12-month installation period, respectively.

To address the magnitude of the influences of the above coefficients, ordinal logistic regression model were used to provide post estimations and the method used involved calculating an odds ratio value. This value was used to investigate the discrete difference in predicted probabilities for LQ change in the various crime categories (Long, 1997). In interpreting the odds ratios in Table 9, the proportional odds ratio for every

point increase in environmental risk value in all viewsheds on LQ change in aggravated assault was used. Thus, for aggravated assaults, for every one point increase in its environmental risk value, the odds of a positive of LQ change (positive LQ change refers to crime decrease) in aggravated assaults versus the combined middle and low of LQ change categories were statistically significant (p=0.035) or 0.8915345 times lower in the following 12-month installation period. Likewise, for every one point increase in the degree of environmental risk values, the odds of the combined high and middle LQ change categories versus low LQ changes (negative LQ change refers to crime increase) were 0.8915345 times lower in the following 12-month installation period.

For larceny thefts, for every one-point increase in the environmental risk value, the odds of a high LQ change in larceny thefts versus the combined middle and low LQ change categories were statistically significant (p=0.000) or 0.7204985 times lower in the following 12-month installation period. Likewise, for every one point increase in environmental risk values, the odds of the combined high and middle LQ change categories versus low LQ changes were 0.7204985 times lower in the following 12-month installation period.

In terms of thefts from autos, for every one point increase in environmental risk value, the odds of high LQ change in thefts from autos versus the combined middle and low LQ change categories were statistically significant (p=0.000) or 0.6965834 times lower in the following 12-month installation period. Likewise, for every one point increase in environmental risk value, the odds of the combined high and middle LQ change categories versus low LQ change were 0.6965834 times lower in the following 12-month installation period.

For auto thefts, for every one point increase in environmental risk values, the odds of a high LQ change in auto thefts versus the combined middle and low LQ change categories were statistically significant (p=0.013) or 0.7527611 times lower in the following 12-month installation period, while the model was held constant. Likewise, for every one point increase in environmental risk values, the odds of the combined high and middle LQ change categories versus low LQ change were 0.7527611 times lower in the following 12-month installation period.

The third hypothesis was also related to viewsheds experiencing significantly higher and below average environmental risk values. That is why, ordered logistic regression results of the LQ change scores of aggravated assaults, larceny thefts, thefts from autos and auto thefts in the viewsheds experiencing higher and below average risk values were examined.

<u>Chapter Summary</u>

This quasi-experimental analysis of the deterrent effect of police-monitored CCTV cameras on aggravated assaults, auto thefts, thefts from auto, and larceny thefts, respectively within the camera's viewshed areas involved using the paired t test, the location quotient and risk terrain modeling which is a system-wide city effect (i.e., macro level), certain individual camera's effects (i.e., micro level) and risk based differences of the viewshed level deterrent effect, respectively. The results of the paired t tests for the systems-wide city effect showed the number of aggravated assaults, auto thefts, thefts from auto, and larceny thefts decreased respectively across all CCTV camera's viewshed areas for up to a one year after installation when compared to one year prior to the

cameras' installations. However, only larceny thefts and thefts from autos showed statistically significant decreases.

The results of the location quotient analysis for certain individual camera's effect was that certain individual CCTV camera's viewsheds showed a reduction in the number of aggravated assaults, auto thefts, thefts from autos, and larceny thefts in time period two compared to time period one, while others did not, regardless of whether there was a system-wide effect, and this means all police-monitored CCTV cameras in the same system do not have an average level impact on crime incidents. Their deterrent effect depends on where they are specifically installed.

Furthermore, the risk terrain modeling approach was applied because it permitted more close scrutiny of the present second research question- Do environmental risk values affect the deterrent effect of CCTV cameras on aggravated assaults, auto thefts, thefts from auto, and larceny thefts at their viewsheds? – This analysis intended to improve upon previous studies in the CCTV literature. The results of the risk terrain modeling helped to determine the fact that the CCTV cameras' viewsheds have a significantly higher than average environmental risk value, as performed by an ordered logistic regression tests for these crime categories. The results of the ordered logistic regression test indicated that crime categories differed significantly when assessed by regression models.

This result indicated individual CCTV camera's that do not have a statistically significant effect in reducing aggravated assaults, larceny thefts, thefts from autos, and auto thefts will have significantly higher than average environmental risk values

compared to CCTV cameras that do yield a reduction in these crimes in time period 2

compared to time period 1.

CHAPTER FOUR: DISCUSSIONS AND CONCLUSION

Rapid adoption and expansion of CCTV systems in Turkey as well as all over the world have produced a fair amount of "technological determinism" among many law enforcement officials, which Norris and Armstrong (1999, p. 9) define as "an unquestioning belief in the power of technology." As a matter of technological determinism, politicians and the public continue to myopically expect that the exclusive responsibility for preventing crimes rest with the police-monitored CCTV cameras. Conversely, policy makers may be better informed if they consider why law enforcement agencies should invest in the installation of CCTV cameras in public areas based on research. For several years numerous researchers have attempted to conduct studies that can accurately define the effectiveness of CCTV installations on crime incidence rates. It is easy to see the automatic trigger in the minds of the public who believe that it only makes sense that CCTV installations would deter crimes, but the reality of the matter is that when CCTV is put under the microscope, one discovers CCTVs do not always have a meaningful impact on the deterrence of crimes. In addition, despite all previous methodological efforts, we are still skeptical as to whether they do work. Ideally, what is needed are varied evaluation methods of CCTVs' effectiveness in influencing crime deterrence. In fact, a well-designed evidence based paradigm in the CCTV literature is likely to reveal the truth about the question of "does it work?"

Therefore, the present dissertation provided an alternative CCTV perspective that focused on the concepts of environmental criminology, namely "crime risk at place" to measure its effectiveness in the deterrence of crimes. Thus, the researcher connected CCTV efforts and an environmental risk factor assessment, by articulating a risk terrain

model to examine the deterrent effect of police-monitored CCTVs on crime rates.
Consistent with this logic, the dissertation moved beyond prior CCTV research (city-wide
systems and individual CCTV camera effects) by considering environmental risk and its
influence on the deterrent effect of CCTV cameras on street-level crime incidents –
aggravated assaults, larceny thefts, thefts from autos and auto thefts. Discussions of
CCTV and its deterrence effect were presented in the context of three levels; a city-wide
system effect, a certain individual CCTV camera effect, and the effect of environmental
risk values, respectively.

Discussions of macro level (city-wide system effect) analysis

In this study, the results of the system-wide city deterrent effect of police-
monitored CCTV cameras showed statistically significant numbers of crime reductions
were presented for larceny thefts and thefts from autos; these did not occur for
aggravating assaults and auto thefts, however. Both auto theft reduction (12%) and
aggravated assault reduction (10%) failed to reach statistical significance within the
viewsheds. Below, Table 9 presents the details regarding pre and post CCTV incidents,
the percentage change and difference of the crime types – aggravated assaults, larceny
thefts, thefts from autos and auto thefts in the camera viewsheds.

Crime Types	Pre-Installation Period	Post-Installation Period	% Change	Difference
Aggravated Assaults	48	44	-8.33%	-4
Larceny Thefts	235	177	-24.60%	-58
Thefts From Autos	76	52	-31.50%	-24
Auto Thefts	25	22	-12%	-3

Table 10: The Number of Aggravated Assaults, Larceny Thefts, Thefts From Autos and Auto Theft Incidents in the Pre and Post Installation Periods

In particular, the system-wide city effect results for auto thefts seem surprising.

This was because, it was expected that the findings of the study would be consistent with previous research, which suggested that the installation of police-monitored CCTV cameras would have a statistically significant deterrent effect on autos thefts (Farrington, Gill, Waples, & Argomaniz, 2007; Gill & Spriggs, 2005; Phillips, 1999; Tilley, 1993; Welsh & Farrington, 2007, 2009). How can these present findings explain the lack of deterrent effect of the police-monitored CCTV cameras on autos thefts, and that such inconsistency appears to be in line with previous research - especially for autos thefts? This question is specifically important for extracting "transferable lessons", from this quasi-experimental study assessing the deterrent effect of police-monitored CCTV cameras in Bursa, Turkey.

This unexpected result regarding auto thefts might be explained by rational choice theory. The theory proposes that the consideration of costs and benefits plays a significant role in target selection (Cornish & Clarke, 1986). From this perspective, despite the presence of a CCTV camera and increased risk of apprehension, the benefits associated with auto thefts are high in Turkey. In order to understand the factors behind this reasoning, one needs to know the market value of cars in Turkey. The minimum wage for a worker is around $2.17[1] in Turkey (TUIK, 2012); whereas the Federal Minimum Wage is around $7.25 in the U.S[2]. The average price of a brand-new family car in Turkey is around $30,5750[3] dollars, whereas an equivalent car in the US is around

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[1] Calculation of minimum wage for a worker In Turkey between Jun 01.2012- December 31 2012 for a day is 31.35 TL. Approximately eight hour working a day so we divide 31,35 \ 8 hour = 3.91 TL which is approximately $2.17 for an hour   http://www.turkhukuksitesi.com/hukuksayfa_asg

[2] However, some states have laws with higher minimum wages (for instance, $8 or $9). But no state can have a minimum wage of less than $7.25.

[3] http://www.honda.com.tr/SeriesPrices.aspx?series=civic-sed

$15,755[4]$ dollars. Car prices are high in Turkey because of the high taxation by the government. Thus, when the prices are compared with minimum wage, a worker should spend 30 fold of his/her monthly wage to buy a car, whereas a US worker should spend almost 5 fold of the minimum monthly wage to buy the same car. This situation makes car theft an attractive option in the Turkish context. As the comparison made above indicates, the benefit associated with car thefts is much higher in Turkey when compared with that in the US. Nevertheless, our results supported this fact and the rational choice perspective can be used to explain the difference between car thefts and theft from autos. In conclusion, because of the higher benefits associated with car thefts when compared with thefts from autos, this makes car thefts in Turkey an attractive option for motivated offenders when compared with thefts from autos.

It is also worth discussing the unique national setting, and Bursa's surveillance network system. Findings of city-wide system level deterrent effect of the cameras on larceny thefts and thefts from autos touches upon the issue of how the CCTV surveillance network system in Bursa is operated. Many have claimed that innovation in CCTV camera operation strategies may increase the deterrence effect of the cameras (Caplan et. al., 2011; Ratcliffe, 2006). The results of larceny thefts and thefts from autos in the context of a city-wide system effect (having crime reduction in following 12-month camera installation period) showed a relationship between deterrence and the certainty of punishment, although the presence of a CCTV camera alone (automatically) did not deter all crime types (Caplan et. al., 2011). The CCTV system of Bursa, however, is different from its counterparts because of its multi-monitoring capabilities, which enables each

police units (such as auto theft division or crime prevention unit) to monitor crimes separately. In other words, this system enables specialized officers in each police division to connect and monitor their jurisdiction independent from CCTV operators' at the control room in police headquarters. Thus, it is considered that this feature of the system might have a great effect in deterring larceny thefts and thefts from autos by increasing the deterrence capabilities (e.g. by improving the target selection approaches and decreasing the police response time) and the certainty of punishment (e.g. the recorded images from surveillance cameras are used in crime and internal administrative investigations. CCTV footage makes evidence available for the police and court).

Discussions of cultural relativity of crime indicators

In following the crime and place studies focused on the settings in western and American countries, as a result of this tendency, correlated crime indicators are only related these countries. However, one of the major goals of environmental criminology is "transferable lessons". To accomplish this, relying solely on indicators in western and American countries is inadequate. The present study provided an attempt to articulate the cultural relativism of crime factors.

This dissertation also sought to explain why these present results related to environmental risk factors make sense. First, environmental risk factors are considerably affected by cultural values. Thus, features of an environment and their spatial influence are likely to vary in different countries. "Proponents of cross-national research have often argued that . .If certain factors are relevant to crime within one country, cross-national researchers ask whether they are also relevant factors in other countries"(Stamatel, 2009,

p. 6). Consistent with this logic, the cultural relativity of crime factors is central to this notion of opportunity in the context of culture. In addition to all correlated environmental risk factors that were found in previous studies, there are three correlated risk factors - wedding saloons, traditional coffee houses, and Internet cafes, which all have a unique cultural concept in Turkey. These risk factors are important factors in increasing the risk of crimes due to the impact of culture, which is an important finding in this research. Duru's (2010) study evidenced that internet cafés and coffeehouses[5] have aggregating risk values for street level crimes (for a more detailed summary, please refer to Chapter One). Yet, there is no prior research specifically concerning the relationship between wedding saloons and crime incidents. However, according to the findings of this study, wedding saloons were found to be significantly related to aggravated assaults. Further, there is some evidence that wedding saloons in Bursa might be conducive to the occurrence of aggravated assaults. Thus, it is reasonable to assume that cultural relativity of crime factors is mostly responsible for how individuals perceive the opportunity for committing a crime.

This study indicated that wedding saloons are crime generators due to their general nature as well as the cultural relativity of this type of environment. Alcohol is readily available. Alcohol reduces your inhibitions, so you are more likely to engage in criminal activities if you are intoxicated. Establishment characteristics such as crowding also cause problems as well. If you are in a wedding saloon and people are constantly pushing or shoving you may get aggravated and engage in some form of assaultive behavior. Temperature can also affect people's behaviors, whereby hotter conditions can cause people to get angry more frequently and can cause someone to get upset more

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[5] Since Ottoman Empire "Coffeehouses" are only serve for men, historical coffee shops.

rapidly and to engage in violence. Noise levels can also increase aggression in individuals as well.

These establishments also do not cut off the amount of liquor that one can consume. Often times they continue to serve patrons who are already intoxicated increasing the risk of that patron assaulting another patron. Competitive situations can also lead to violent behavior. Often at wedding saloons people will tend to try and size each other up. Emotions that arise from competition in wedding saloons such as attempting to dance with girls, changing the music and a mixture of alcoholic beverages can lead to an increased amount of violence. Wedding saloons appear different from bars in specific ways. Many people go to a wedding ceremony to engage in enjoyable behavior but the atmosphere can create opportunities to engage in criminal activity. Firstly, these are more crowded than bars during these events and they are usually filled to capacity around 250 or 300 people in there. More specifically, almost all the relatives attend weddings in Turkey. This means that approximately 500 relatives attend for both groups of the bride and groom, which indicate that Turkish wedding saloons are also more crowded places than American and western countries saloons. Secondly, aggravated assault does not generally appear in the wedding saloons because both families are responsible for that and do not enable this to occur inside the saloon. Moreover, guests usually bring their own guns to lower-class wedding saloons (Ercoskun, 2010). This fact is significantly different from American and Western countries and their wedding ceremonies. The guests that have guns use it around the wedding saloon for celebration. In doing so, they might cause fatal injuries. Thirdly, whereas during American wedding ceremonies, guests bring their presents such as jewelry and\or money to the wedding, in

Turkey a special ceremony is performed for presenting jewelries that hanging on the bride. Thus, bride may be a preferred target for motivated thieves since she is highly likely to carry a significant amount of money and\or jewelries. Capture of a thief in a wedding saloon may easily cause an aggravated assault. So far, the aforementioned factors also highlight cultural differences among the wedding saloons in Turkish and American\Western countries. However, Albanian, Greece, and Syria have similar cultural features with Turkey and can be considered to have the same problems with wedding saloons.

Fourthly, according to bar policies for customers who are younger than 18 or 16 year-olds who are not allowed bars in bars, there is no age policy for wedding saloons. So there may be many juvenile delinquents in wedding saloons.

Last but not least, relatives of bride and groom attend this ceremony as two different and distinctive groups. These groups might have some conflict issues that can suddenly appear. Cultural or ethnic differences between the two groups can also lead to an increased risk of aggravated assaults around the saloon. All these factors can increase the amount of aggravated assaults around the wedding saloons before or after closing hours, such as in the parking lots or in smoking areas.

In addition to discuss the characteristics of the wedding saloons affect on aggravated assaults, consideration of the characteristics of the environment where the wedding saloons are located is important. In this respect,

> "The spatial-temporal context for crime is merely exacerbated when vulnerable places are located near recent past crime incidents. Risky places are formed as a result of the confluence of the spatial influence of certain factors combined with conditions of exposure" (Kennedy & Caplan, 2012, p. 3).

Accordingly, it can be assumed that these wedding saloons are highly criminogenic because high-level crime incidents occur readily in close proximity. However, wedding saloons are only statistically associated with aggravated assault incidents. Therefore, this explanation is inadequate for addressing why the locations of wedding saloons are more criminogenic than others. It may be that these wedding saloons are so criminogenic because bars and taverns are scarce in Turkey. This means that there is a global pattern of propensity to offend in these types of locations. So the type of location may be culturally specific, but the behavior is not.

From a methodological point of view, only statistically correlated risk factors were added to the RTMs for each crime type, and these were added separately. In doing so, environmental risk value for each viewshed were obtained. By using correlated risk factors, the RTM methodology provided more accurate opportunity structure for selected crime incidents than past criminal incidents. The aim of this process enabled the results to make more sense.

This study found that the methodological use of RTMs allowed the researcher to explore the cultural relativism of the examined risk factors −wedding saloons, internet cafés and coffeehouses, while providing reliable outcomes. To foster a more reliable spatial analysis, RTMs were calculated by combining the cultural relativity of risk factors, while allowing for a high level of cultural variability. Further, RTM methods can easily integrate these crime factors that vary in many different societies/countries. Thus, RTM approaches can provide a transferrable form of methodology that adapts the paradigm of risk of crime at place to the spatial analysis observed in any landscape, including those with different cultures.

The findings in this study may hence encourage researchers to take into account the opportunity for crimes in as a cultural concept to better ascertain the degree of risk of crimes at selected places, in light of the different perspectives that may prevail in other countries. Further, they should consider investigating different culture –specific environmental risk factors and their relationship with crime types in different study settings.

Discussions of micro level (individual camera level) analysis

The study findings revealed that the installation of police-monitored CCTV cameras' across Bursa does not have the same or equal deterrent effect in all the CCTV cameras' viewsheds. This finding is consistent with the literature (Caplan, Kennedy, & Petrossian, 2011; Ratcliffe et al., 2009) on the deterrent effect of individual police-monitored CCTV cameras on crime incidents. Specifically, this result presents the fact "some places are likely to be more crime prone than others…" (Caplan et al., 2011, p. 265). In accordance with camera locations, the effect of CCTV cameras on selected types of crime might show a discrepancy. Mixed results of a deterrent effect are apparent at different cameras' viewshed areas. Some camera locations had more successful deterrence effects than others in this study. This was apparent because the calculated location quotient values for each camera viewshed were not equal when comparing period 1 to period 2 and that was consistent with findings of other researchers (Caplan et. al., 2011; Ratcliffe, 2009) that have examined deterrent effects for each police-monitored CCTV camera in city-wide systems. Both of these prior research endeavors found each individual CCTV camera might have different deterrence effects on street level crime incidents within their viewsheds (Caplan et. al., 2011; Ratcliffe, 2009).

In addition to the above discussion, by using a LQ analysis, the researcher presented a careful assessment of the deterrent effect of certain individual police-monitored CCTV cameras. The calculation of the LQ (Caplan et. al., 2011; Ratciliffe et. al., 2009) for each camera was a good measurement approach for exploring the unique deterrent effects of certain individual police-monitored CCTV cameras' on 119 different camera locations in Bursa specific to their viewsheds areas. Thereby, the analysis using LQ appeared promising for adding to the CCTV literature regarding certain individual level deterrent effects of the CCTV camera.

As noted earlier, by installing police-monitored CCTV cameras, the probability of getting caught increases at the CCTV viewshed areas, therefore, previous research implied that aggravated assaults, larceny thefts, thefts from autos and autos thefts would decrease. However, this dissertation found certain individual level deterrent effects of the CCTV cameras, where present, varied among the 119 police-monitored CCTV cameras in Bursa. The numbers of cameras failing to achieve a deterrent effect for aggravated assaults, larceny thefts, thefts from autos and auto thefts were 27, 38, 29 and 17 respectively, and this is perhaps explained by the fact that their environmental risk contexts are in fact different. Previous studies (Caplan et.al., 2011; Eck et al., 2005; Harries, 1999; Ratcliffe, 2006; Sherman, 1995; Sherman, Gartin, & Buerger, 1989; Weisburd, 2008; Weisburd and Braga, 2006) argued "Environmental criminology explains how immediate environments affect behavior and why some environments are criminogenic" (Wortley & Mazerolle 2008, p. 2).

In light of the current findings and previous studies, it can be claimed that police-monitored CCTV cameras have a lower deterrent effect on crime incidents as a result of

the environmental conditions at their viewsheds level. Although, environmental conditions are important, this point was often overlooked in previous studies. Therefore, the present study contributes to the previous literature by asking how those environments in the camera viewshed level influence the deterrent effect of police-monitored CCTV cameras.

The effect of environmental risk value on CCTV in deterrence effect

The deterrent effect of CCTV cameras depends on the environmental risk of crime in a certain place. In other words, the deterrence effect of a camera is lower when a place has a significantly higher than average environmental risk value. The CCTV cameras within high-risk environments would not deter crimes, because, environmental risk at these places provides varied opportunities despite the presence of these CCTV cameras across the city. This fact is also supported by the argument that "criminal behavior is significantly influenced by the nature of the immediate environment in which it occurs" (Wortley & Mazerolle 2008, p. 2). The environmental criminology approach suggests and elucidates crime risk as being situated in environmental conditions that aggravate or mitigate committing crime incidents in specific places (Caplan et al., 2011; Eck et al., 2005; Harries, 1999; Ratcliffe, 2006; Sherman, 1995; Sherman, Gartin, & Buerger, 1989; Weisburd, 2008; Weisburd & Braga, 2006).

According to results from the ordered logistic regressions, significant findings were observed in respect to aggravated assaults, larceny thefts, thefts from autos and auto thefts in the following 12-month installation period. The results of this study found that environmental risk values in the viewsheds produced significantly higher than average deterrence effects among the individual CCTV cameras in the following 12-month

installation period for the occurrence of aggravated assaults, larceny thefts, thefts from autos, and auto theft incidents.

These results comport with theoretical expectations – specifically "risk of crime at place" perspective. The above-mentioned findings provide supportive evidence for Caplan and Kennedy's (2011) model that proposed that higher average environmental risk values are associated with a decrease in deterrence effect of CCTV cameras by suggesting "the risk of crime in places that share criminogenic attributes is higher than other places as these locations attract offenders and are conducive to allowing certain events to occur" (p. 22).

This present research study is unique for several reasons and contributes to the existing body of criminal justice research by examining whether environmental risk values affect the deterrent effect of CCTV cameras. First, the effectiveness of CCTV was evaluated by using a risk terrain model as a control measure of environmental crime risk values. Thus, the research addressed the deterrent effect of CCTV cameras on crimes and environmental risk in an empirical way. Second, the results suggest information related to environmental risk values at their viewsheds is vital for understanding where the CCTV system, by itself, cannot be effective. The presented dissertation thus provides significant findings that can be used to service local and national policymakers' future decisions regarding police-monitored CCTV implementation, consistent with the problem oriented policing perspective (Mazerolle et al., 2002) – where they are deployed and how they are managed for maximum deterrence of specific crime types. Third, the study findings indicated that deploying CCTV cameras on a landscape is not a sufficient solution for deterring crimes. Actually, CCTV is one of the environmental features; however, within

those viewsheds that experienced significantly higher than average risk values, there were more crime attractive environmental features. Since environmental context affects criminal behavior, these attractive places would have an influence on the deterrent effect of CCTV in a negative direction (Caplan, 2011). Then, the critical question is whether the findings of this study might generate "transferable lessons" for assessing the deterrent effect of the police-monitored CCTV cameras regarding policy implications.

Policy Implications

The general expectations of policy makers regarding CCTV are based on the view of "impressive results, ignoring the challenge of making what is quite a complex work, and failing to define what exactly the CCTV system was expected to do" (Gill & Spriggs, 2005 p.116). First of all, local and national policy makers and police agencies must change their approach from a "one size fits all" approach that does not allow for where the more effective place to install the CCTV cameras might be.

For this propose, or first objective, the CCTV literature needs more systematic reviews (e.g. Farrington & Welsh) that consist of objective (non biased) results, certain inclusion criteria (e.g. certain methods, sample sizes), studies with negative results, unpublished literature (e.g. Law enforcement reports), and studies with or without significant results. To achieve the second objective, more evidence based principles and programs should be integrated in the CCTV literature. The greatest utility of this data is that it can be potentially applied to helping to choose appropriately targeted high-risk areas for camera installation and installation strategies and outcomes that are based on empirical studies.

The findings of this study evidenced that environmental risk has to be taken into consideration before installing cameras and also for existing cameras in order to redeploy them. The findings provide a platform for internal policy reform and managerial change about how police-monitored CCTV cameras should be used strategically and effectively since they identify with RTM specific locations that have high and lower environmental risk values. Given the findings, it is easier to understand why certain individual police-monitored CCTV cameras' effectiveness varies based on their locations. Ideally, police agencies need pre-evaluation approaches to determine the likely impact of CCTV cameras before CCTV camera policy/interventions are implemented. To accomplish this, the research presented here confirms the risk terrain model as a useful tool for measuring the deterrence effect of CCTV. Police agencies can then install the required number of CCTV cameras across a city.

In addition, a combination of relevant innovations (e.g. improving street-lighting, and environmental design) and crime reduction strategies (e.g. proactive policing, place based policing, problem oriented policing) with CCTV provides for a multi-dimensional perspective that may increase the capacity of deterrent effect of CCTV in crime prevention. Because CCTV is only one –dimension of a total crime prevention strategy in policing, it could not be successful, as an overall crime prevention strategy because of CCTV camera by itself does not deter crimes.

Police-monitored CCTV systems should be more subject to evidence-based evaluations. Specifically, in Turkey, scholars argue that the CCTV is generally used for the investigation of crimes rather than for proactive policing purposes. However, although practitioners and politicians advocate for police-monitored CCTV cameras that

are believed to have reduced crime in Turkey; this has not been proven to date. That means the CCTV systems of Turkey need to be studied on a long-term basis and higher quality more independent research should be conducted for helping us to have a better understanding of their effectiveness. As well, other countries, which use this technology, can be enlightened.

At this point, Clear (2010) states that "Ian Loader and Richard Sparks (2010) point out, honesty and knowledge are essential elements for an improved public policy regarding crime" (p. 722). To this end, law enforcement agencies should consider their lack of transparency in relation to CCTV systems, clarify they have accurate data, and share these data with scholars. Then, if we can rely on these accurate data, we can apply more evidence based programs and principles towards the application of CCTV cameras to deter crimes.

Trying to bring evidence-based principles to bear in guiding policing interventions is still troublesome in Turkey, as well as all over the world. The results of this dissertation may contribute to the design of alternatives or they may provide specific policy implications concerning the impact of street level police-monitored CCTV cameras, beyond the more stereotypical responses that already exist. Showing a deterrent effect of CCTV cameras in this dissertation may influence CCTV policies and improve proactive policing decisions, rather than relying on reactive policing. Moreover, the results in this dissertation may indicate, "the science will have meaning for practice" (Clear, 2010, p. 721).

For future research, the question really is what should scholars and practitioners do to use more appropriate methodology/methodologies and solve the reasons behind the

"mixed" impact of police-monitored CCTV cameras? Future research theoretically should continue to integrate the risk of crime at place perspective into police interventions that intend to prevent crimes. This quasi-experimental study attempted empirically to test the deterrent effect of police-monitored CCTV cameras from the aspect of risk of crime at place approach – and by an environmental risk value approach that utilized risk terrain modeling. This model is also easily transferable to other police-monitored CCTV camera interventions that are expected to deter crime incidents. Future research in the CCTV literature needs to attempt to add the risk of crime at place approach and may follow the trail of this present approach. Further research is also needed to better inform police agencies, local and national policy makers regarding the optimal duration (i.e., three or five years after the installation of the CCTV cameras) that would yield deterrent effects by these cameras so that maximum benefits could be ensured. For example, some CCTV cameras deter fewer crimes in a long time period so they have to relocate to strategically designated places. Moreover, researchers might replicate this methodology for other police-monitored CCTV camera systems within different cities, if possible, for more than 119 cameras. A relatively high number of CCTV cameras' viewsheds may provide more accurate results.

In addition to the aforementioned discussions, local and national level policy makers need to discuss their concerns – regarding the use of police-monitored CCTV cameras raised in residential settings, which can invade personal privacy, if police are watching people in public places. Justification for government access to place cameras over personal privacy should be scrutinized based on legal documents, regulations and procedures. Thus, the dissertation also recommends that adopting detailed and robust

regulations and guidelines are an obligation of those who are responsible for addressing, qualifying and controlling government use of police-monitored CCTV cameras and preventing their misuse.

Conclusion

The expansion of police-monitored CCTV systems in recent years has produced mixed results as regards its deterrence effect and raises the question regarding its legitimacy and warrants further study concerning the deterrent effect of CCTV cameras and how to measure their impact in an appropriate way. In order to assess the deterrent effect of CCTV cameras, environmental risk values have become extremely helpful for identifying those camera viewsheds most prone to aggravated assaults, larceny thefts, thefts from autos and auto thefts. Generally speaking, viewsheds with a high concentration of environmental high-risk values have a lower deterrent effect despite the cameras.

Environmental risk values attained by utilizing risk terrain modeling provide a key concept for understanding the "mixed" results of the deterrent effects of police-monitored CCTV cameras. Statistical (paired t test, location quotient, and negative binomial regression models) and geographic information system (risk terrain model) analysis methods used in this dissertation were selected so that law enforcement agencies could assess the deterrent effect of cameras in a city-wide system, as well as the individual level and high-risk value viewsheds level, respectively.

Where the system-wide city level (e.g, macro level) analysis was concerned, the deterrent effect of CCTV cameras seems to have flaws and at another level – certain individual police-monitored cameras may provide a more detailed explanation as to why

this occurred. In addition, this dissertation provides evidence that environmental risk values affect (statistically significant way) the deterrent effect of CCTV cameras on aggravated assaults and larceny thefts at their viewsheds. This evidence indicates that policy makers should appraise the deterrent effect of police-monitored CCTV cameras with more evidence-based research. "Mixed" evidence regarding their deterrent effect on aggravated assaults, larceny thefts, thefts from autos and autos thefts are not considered only attributable to the failure of the CCTV cameras. To illuminate the fact, scholars must apply different research methods and tools (likewise risk terrain modeling that measures environmental risk values in this dissertation) in order to build strong, consistent, and reliable results that provide solid evidence as to whether these CCTV cameras deter crime incidents at their viewsheds areas.

One important point that the current dissertation has highlighted is that the installation of CCTV cameras in significantly higher average environmental risky viewsheds does not provide a sufficient deterrent effect for reducing the numbers of aggravated assaults, larceny thefts and autos thefts, except thefts from autos in these viewsheds because of their locations which remain even more risky and prone to crime occurrences. Environmental risk value assessments can advance our understanding of the deterrent effect of CCTV cameras at their viewshed areas. So environmental risk sites must be taken into account when the decision processes concerning CCTV cameras are made by local and national level policy makers, police agencies and politicians who try to establish where the most appropriate location to install police-monitored CCTV cameras is. In this respect RTM can be considered as a pre intervention tool so that police agencies can measure the deterrent effect of CCTV before installation. Such a pre-

evaluation process increases the capacity for effective police management and crime prevention strategies in police agencies.

In sum, a major contribution of this dissertation is the substantive assessment of the deterrent effect of police-monitored CCTV cameras. But another major contribution is the importance and influence of place on this effect. These findings provide policy makers and police agencies with practical solutions for policing risky places. By filling such gaps in the CCTV literature, this dissertation can enable further progress toward scientific realism in criminal justice. It is hoped this dissertation will serve to add a new methodological perspective to RTM or evidence to the knowledge pool in which scholars try to find "transferable lessons" for the mystery of whether police-monitored CCTV cameras deter crimes or not. As such, policy makers will inevitably be able to transfer this perspective or evidence on a large scale.

For each research question, the following table shows what types of data and analysis was used and what the hypotheses were.

R.Q	What Do We Need to Know?	What types of crime will be impacted?	Hypotheses	What kind of data will answer the questions?	Types of Analyses
1	Does the addition of CCTV cameras to a landscape reduce the numbers of aggravated assault, auto theft, theft from auto, and larceny theft incidents, respectively within the camera's viewshed areas?	The numbers of aggravated assault, auto theft, theft from auto, and larceny theft incidents	**H1** The number of auto thefts, thefts from autos, and larceny thefts will decrease respectively across all CCTV camera's viewshed areas for up to a one year period after installation when compared to one year prior to cameras' installations.	• Reported criminal incidents to the Bursa City Police Department within the cameras' viewshed areas, • Only police-monitored camera locations • Geographic Locations of reported selected crime (outdoor) incidents to the Bursa City Police Department within the sub districts, and within the cameras' viewshed areas, • Locations of infrastructures in Bursa. • Environmental Risk value of each camera viewsheds areas	1. Descriptive statistics 2. T test – crime incident numbers of camera's viewshed one year before and after installation period for city wide effect
			H2 Certain individual CCTV camera's viewsheds will have a reduction in the number of aggravated assaults, auto thefts, thefts from auto, and larceny thefts in time period 2 compared to time period one, while others will not, regardless of whether there is a system-wide effect		1. Calculation of LQ value – for each camera's viewsheds

2	Do environmental risk values affect the deterrent effect of CCTV cameras on aggravated assaults, auto thefts, thefts from auto, and larceny thefts at their viewsheds?		**H3**
			Individual CCTV camera's that do not have a statistically significant reduction in aggravated assaults, auto thefts, thefts from auto, and larceny thefts will have significantly higher average environmental risk values compared to CCTV cameras that do have a reduction in these crimes in time period 2 compared to period 1
					1. Validate RTM on each type of crime respectively,
					2. Aggregate cells up to viewsheds by doing so, average risk value for each viewsheds will be calculated.
					3. Ordered Logistic Regression Model
					   a. Using average risk value and
					   b. Location Quotient change or each camera's viewsheds.

Table 11: Summary of the Research Questions, Crime Categories, Hypotheses, Data, and Types of Analyses.

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- 2001- 2005 Ankara Police Task Force as a Sergeant

Research &
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