

Chapter III

Visualization of Criminal Activity in an Urban Population

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ABSTRACT

Crime is a multidimensional, complex, and dynamic activity. In order to understand its nature one has to comprehend not only its spatio-temporal dimensions, but also the nature of crime, the victim-offender relationship, role of guardians and history of similar previous incidents. This is a formidable task due to the limitations of present visualization methods. Both for the police department and criminal justice researcher the need to visualize a vast amount of data is a prerequisite to the task of dealing with the crime phenomenon. This chapter presents an interactive visualization intended to present the viewer with an accurate and intuitive view of the criminal activity in a cityscape. The technique employs many different visualization elements, which taken together presents a useful methodology that can be used to visualize many of the associated factors of crime. The chapter also presents the software technique and discusses points for future investigation.

INTRODUCTION

Crime mapping is now an acknowledged tool for criminal justice practitioners. Its utility has

been suggested in supporting problem solving and community policing efforts improving law enforcement and criminal justice operations to apprehending and convicting offenders (LaVigne

& Wartell, 1998). Crime mapping has also led to some powerful investigative techniques such as “geographical profiling” (Rossmo, 1995) to track serial offenders and understand the movement patterns of offenders. The utility of crime maps in analyzing crime data (Hirschfield & Bowers, 2001; Law & Haining, 2004), in understanding neighborhood ethnic composition (Brimicombe, 2001), in analyzing drug markets (Voltz, 1999), in examining homicide hot spots (Adams, 2001), repeat victimization (Ratcliffe & McCullagh, 1998) and in police management (Walsh & Vito, 2004) have all been demonstrated unambiguously. However, crime-mapping applications have generally been confined to a limited number of dimensions; in particular, the spatial dimensions (Block, Dabdoub, & Fregly, 1995; O’Kane, Fisher, & Green, 1994; Weisburd & McEwen, 1997).

Brantingham and Brantingham (1981) suggest that there are four dimensions that constitute a criminal event: the law which defines the act to be criminal; the motivated offender; the victim or the target and the coming together of all three at a geographical convergence. Further, that crime is facilitated by the environment surrounding a criminal event that takes place against the backdrop of awareness space of the motivated offender. Obviously, the convergence that takes place at the geographical location is itself facilitated by several factors. For example, “routine activities” brings the victim and offender in close proximity in the absence of guardianship at a specific place (Cohen & Felson 1979). Similarly, the nature of “hot spot” (Sherman & Buerger 1989) that makes the place criminogenic and the situational factors (Clarke, 1993) which provide opportunities for the criminal event to occur also play an important role in facilitating crime at a particular spot. Despite this multidimensional nature of criminal activities visualization techniques have largely remained confined to a limited number of dimensions. Commonly, crime maps use street networks and colored symbols to depict the nature of criminal incidents. By adding orthogonal images and sur-

rounding landmarks, mappers are able to add more information to the visualization. However, these methods are unable to depict and incorporate simultaneously other factors and dimensions of crime thus reducing the utility of visualization.

Since a criminal event is an interconnected incident of several dimensions, investigators and analysts need more information than the simple geographical location of the incident. The ability to solve crimes and develop preventive methods is dependent upon the capability of answering the six W’s about the criminal incident: Where and when did it take place, what is the nature of incident, who has done it to whom, and why. Thus, it is not only necessary to know where the crime took place, the spatial coordinates, street address and neighborhood information but also the time period, victim-offender characteristics, relation to previous and neighboring incidents as well as knowledge of police response. This knowledge is best acquired and transmitted through some form of visualization technique and consequently crime mapping is a necessary tool for investigators.

Two-dimensional maps have been used to describe crime since 1830. Due to the inherently geospatial nature of the data, crime visualization borrows heavily from cartographic design, and most designs are based in a geospatial substrate. Current approaches to geospatial crime visualization have successfully addressed the problems of representing crime density information with techniques from cartography utilizing choropleth maps, graduated symbol maps and topographical maps. However, the temporal dimension of crime in most analyses is neglected in favor of the spatial dimensions. One reason is the inherent difficulty of visualizing space and time together. The approaches to representing temporal data in a geospatial substrate are not as well developed as the former techniques.

One current approach is to represent crime data in an artificial 3-D perspective, in which the third dimension represents time. This approach suffers from the problems of projecting a 3-D model into

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