

**MEASURING THE EFFECTS OF BUILT ENVIRONMENT
ON BUS STOP CRIME**

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Abstract

There has been considerable interest in recent decades for the identification of the physical correlates of crime in different urban settings. This study focuses on bus stop crime and seeks to understand how different environmental attributes in the vicinity of a bus stop can affect the incidence of crime. We first review evidence from the relevant literature to understand the impacts of built environment on crime. This is followed by the presentation of our empirical research. We have used a stratified random sample of 60 bus stops in downtown Los Angeles to examine the effects of environmental and land use attributes on crime per capita. Using descriptive statistics, correlations, regression and discriminant analyses, and matched pair analysis the study finds some relations between the existence or absence of certain environmental attributes and the incidence of crime.

Introduction

Bus stops are common settings of transit crime. They provide a cover for criminals, who can hang out waiting for potential victims without arousing suspicion. Bus stops are populated by anonymous riders, who represent easy targets under specific circumstances. Yet, a good number of bus stops show no or very little crime incidence, while others in their near vicinity, seem to be susceptible to crime. Seeking to explain variations in the crime rates of different settings, criminologists have introduced the idea of an "environmental backcloth," that connotes "*the uncountable elements that surround and are part of an individual and that may be influenced by or influence his or her criminal behavior...This working backcloth would explicitly include the physical infrastructure of buildings, roads, transit systems, land uses, design and architecture, as well as the people located within that physical infrastructure*" (Brantingham and Brantingham, 1993:6-7).

Following the lead of environmental criminologists this study examines the physical elements that compose the environmental backcloth at different bus stop settings. The intent here is 1) to understand how specific features of the physical environment of bus stops are related to crime; and 2) to introduce a reliable and objective method for measuring the impact of built environment on bus stop crime. This is the second phase of a preliminary study, which has utilized qualitative methodology (structured observations) to identify environmental elements present around the ten most dangerous bus stops in Los Angeles (Loukaitou-Sideris, 1999). In this second phase, we have used a larger sample of both high and low-crime bus stops. We have utilized quantitative research methods to measure the impact of certain environmental variables on bus stop crime. In the paper that follows we will first explain the theoretical framework of this research, and we will highlight the new criminological theories and their implications for bus stop crime. Subsequently, we will discuss our research methodology and findings from the study of sixty bus stops in downtown Los Angeles.

Theoretical Framework of the Research

The last few decades have witnessed a resurgence of interest in the spatial characteristics of violence and in the importance of space and place as a setting for crime. A place is a very small area (a street corner or street segment, an intersection, a building) that reflects and affects the activities of its users and may impact a specific criminal event or conflict. Places are always embedded within spaces or larger areas (collection of blocks, districts, neighborhoods) (Block and Block, 1998).

The roots of this emphasis on place are not new, but can be traced in the ecological studies of the Chicago School in the 1920s and 1930s. Louis Wirth (1938, 1964) had hypothesized that the physical characteristics of cities have a strong and significant effect on crime. Chicago sociologists Clifford Shaw and McKay (1929) were the first to identify crime variations within the same city. Their study showed that the highest delinquency rates in Chicago in the 1920s were found in the run-down zones at the frames of the central business district. They

observed that crime rates were increasing with distance from the city center, with the exception of areas with predominantly industrial or commercial land uses.

These ecological findings were later disputed by non-ecological or compositional theorists, who denied the importance of physical attributes and gave prominence to the social characteristics of offenders. Non-ecological theorists argued that intercity variation in crime rates can be adequately explained by the socio-demographic characteristics of urban residents (age, ethnicity, class, social mobility, etc.) (Gans, 1962).

In the 1980s and 1990s a number of environmental criminologists started recasting attention to the spatial characteristics of crime settings (Brantingham and Brantingham, 1981, 1993; Clarke et al., 1997; Eck and Weisburd, 1995; Perkins et al., 1993; Taylor and Harrell, 1996). Without disputing the importance of socio-economic variables they argued that *"from a policy perspective this approach [i.e. the analysis of the location of crimes] is promising because, once understood, available technologies can be used to modify these patterns and abate some crimes without doing significant damage to basic human rights"* (Brantingham and Brantingham, 1981:18). Influenced by contemporary writings of geographers such as David Harvey (1974) and Ed Soja (1989), which privileged the geographic over the sociological imagination, environmental criminologists emphasized the importance of crime locations and their characteristics.

Some also argued for a reorientation of crime prevention research and efforts, not only in regards to specific strategies and theories, but also in terms of the unit of analysis. Thus, in the last few years we have witnessed a shift from the study of offenders to the study of the context of crime (Weisburd, 1997). Such approach, which is often coined "situational crime prevention," emphasizes that criminal activities are clearly linked to specific characteristics of a place as well as the nature of guardianship that this place enjoys. By understanding and "designing out" the variables that contribute to crime and enhancing the elements that reduce crime, we can develop more effective crime prevention strategies (Clarke et al., 1997).

The new generation of studies in the 1990s has also witnessed a shift from a macro scale – e.g. the ecological studies of large city areas exemplified by the work of Shaw and McKay (1929) – or a meso scale – e.g. studies that focused on city neighborhoods (Greenberg and Rohe, 1984) or large public housing projects (Newman, 1972; 1976) – to a micro scale. Many recent studies have used the block as a unit of analysis arguing that "*as far as residents and possibly criminals are concerned crime and fear-related environmental cues on the block as opposed to in the neighborhood, may be most important, especially in the case of territorial markers*" (Perkins et al., 1993:22). Ralph Taylor (1988) has noted that the block can be described as an ongoing, ecological behavior setting in which specific environmental features facilitate certain kinds of behaviors for residents and outsiders.

Some studies have also concentrated on the microenvironment of certain facilities or features of the urban form. Researchers have found that the presence of special-purpose structures, such as bars and taverns, high schools, convenience stores, rapid transit stations, or high-rise buildings may increase crime in their immediate vicinity (Roncek and Meier, 1991; Spelman, 1993; Block and Block, 1995; Block and Block, 1998).

This stream of research, within which our study also falls, is concerned with the spatial parameters of crime. It is informed by new criminological theories as the routine activity theory (Cohen and Felson, 1979; Felson, 1994) and rational choice theory (Cornish and Clarke, 1986) that argue that as opportunities for crime increase, more crimes will be committed. Conversely, crime declines as opportunities are reduced. Offenders make choices about places based on site-level social and spatial features. Rhodes and Conly (1981) explain that dangerous places may entail two types of attractiveness for criminals: target attractiveness (when a number of potential victims can be found at the settings) and spatial attractiveness (when the physical features of a setting make criminal acts easier to happen and go unnoticed). During the first phase of this study we found that the ten most dangerous bus stops in Los Angeles combined both target and spatial attractiveness (Loukaitou-Sideris, 1999). They were populated by captive riders, who had

to patiently wait for their bus. They provided cover for potential criminals, who could anonymously hang out at the bus stop waiting for the right opportunity to occur. In their near vicinity many bus stops had facilities (bars, liquor stores, ATMs, single room occupancy hotels) typically known as crime generators.

The review of crime literature clearly implies that "opportunity blocking," the reduction of attributes that enhance opportunities for criminal acts, and diminish the attractiveness of a setting for criminals, can provide a very effective crime prevention strategy. But first we have to clearly identify the variables that affect crime.

Variables Affecting Crime

Research in environmental criminology has shown a spatial concentration of crime. A limited number of sites constitute the loci for the vast majority of offences (Nasar and Fisher, 1993; Sherman, 1995; Block and Block, 1995; Buerger et al., 1995). Locations where a number of criminal incidents have taken place and suffer from chronic safety problems are often called "hot spots" (Maltz et al., 1991). Researchers have hypothesized that crime is strongly related to the aggregate elements of the social and physical environments of the "hot spots."

Earlier research that focused on intracity and intercity variations in crime has examined the effect on crime of variables such as poverty, ethnicity, age composition, income, education, gender, citizenship (percent foreign born in a city) (Byrne, 1986). While Kornhouser (1978:100) concluded that there is a high correlation between community economic level and delinquency rate, others have argued that the association between crime and social characteristics is not always direct or perfect and is very difficult to measure (Gottfredson and Taylor, 1986).

Another stream of research has been concerned with the micro-level situational correlates of crime, identifying the physical environmental factors that may generate opportunities for crime (Taylor et al., 1980; Brantingham and Brantingham, 1993; Perkins et al., 1992). According to researchers the design of the built environment can affect crime through its

effect on the degree of access, ease of entrance and exit and surveillability (Greenberg and Rohe, 1984).

Studies have sought to trace the relation between access and crime. Comparisons of high- and low-crime neighborhoods, blocks, or street segments have shown that area accessibility is associated with higher crime (Eck and Weisburd, 1995). A Canadian study found a very high correlation of more than .95 between the number of streets turning into a block and the block's property crime rate (in Felson, 1994:38). In their "Notes on the Geometry of Crime" Paul and Patricia Brantingham (1981) argued that a concentration of criminal activities occurs close to major transportation arteries and highways. They also noted that paths between high-activity nodes tend to concentrate criminal offenses, as many crimes occur on the main roads that carry high traffic and have major public transit stops (Brantingham and Brantingham, 1993). Areas with grid networks have higher potential crime rates than areas with cul-de-sacs, winding roads, or dead-ends. In the grid areas a potential offender can escape easier and quicker, than in areas with organic street layout, where he or she can get more easily disoriented and lost. Perkins et al. (1993) studying 48 blocks in three working-class urban neighborhoods in New York City found that wider streets tended to invite more traffic and make blocks more "permeable" to crime. Examining liquor-related crime incidents Block and Block (1995) found that many hot spot areas are located at major intersections, especially intersections of grid and diagonal streets. Alleys and mid-block connections also increase the number of escape routes, open a block or a neighborhood to exploration, and aggravate the criminal risk for residential or commercial establishments (Brantingham and Brantingham, 1993). During the first phase of our study we found a number of alleys in the near vicinity of high-crime bus stops.

The type of surrounding land uses has been found to have major effect on the incidence of crime. As early as 1929 Shaw and McKay had noted that commercial and industrial areas were prominent features of neighborhoods with high residential delinquency. A much later study that analyzed the relationship between land use and crime in the District of Columbia found that

commercial and transitional areas tended to be more attractive targets for criminals, followed by industrial areas, with residential areas considered the least attractive. Multi-family housing areas were more susceptible to crime than single-family housing (Rhodes and Conly, 1981). The percentage of lots zoned for commercial use was a significant predictor of increased risk of high robbery rates in Washington D.C. (Harrel and Gouvis, 1994 in Taylor and Harrell, 1996),

Specific commercial uses are more likely to generate crime than others, especially if there is a high concentration of them in a limited area. The presence of a great number of liquor stores, bars, and taverns can have a negative effect on neighborhood crime (Block and Block, 1995). Consumption of alcohol frequently affects aggression and increases willingness to take risks, thus facilitating criminal behavior (Fagan, 1990). Patrons of establishments in which cash transactions take place (pawnshops, check cashing facilities, ATMs) are likely targets. Areas with vacant lots or buildings, public parks and schools often attract youth and gang-related crime (Perkins et al., 1992).

In addition to access opportunities and "negative" land uses the level of physical disrepair and deterioration in an area seems to be related to crime incidence. Skogan (1990) and Wilson and Kellig (1982) have argued that physical incivilities (trash, graffiti, abandoned buildings, disrepair, unkempt lots) and social incivilities (rowdy behavior, drug dealing, public drunkenness, prostitution, panhandling, and loitering) result in higher crime and resident fear. The relationship of physical incivilities to crime is expressed in the "broken window" thesis, popularized by Willson and Kellig (1982). A broken window left unrepaired implies that social control is weak in an area. Potential offenders are more likely to act if they believe that no one is in control. Most relevant studies have measured *perceived* incivilities and have not developed objective measures of physical incivilities (Perkins et al., 1992).

Offenders want to avoid the risk of being seen while committing a crime. The possibility of surveillance by shop owners, managers, employees, guards, or caretakers has been found to have a strong effect in reducing crime (Brantingham and Brantingham, 1993). Surveillance is

dependent on visibility, which in turn is determined by good lighting at night, and unobstructed lines of sight through windows, and from neighboring buildings and streets (Rand, 1983). Thus, the presence of physical features that increase the visibility of a site (such as open storefronts, unobstructed windows, well-lit areas), and the absence of features that can block views (e.g. blank walls, thick vegetation) can help ameliorate crime.

The relationship between density and crime has been quite ambiguous. Jane Jacob's (1961) prescription of "eyes on the street" as a deterrent of criminal activity has been questioned by researchers who argued that high levels of activity do not necessarily imply adequate surveillance (Mayhew 1981). Some studies even found levels of pedestrian and vehicular traffic to be negatively related to the incidence of certain crimes (Duffala, 1976; Pablant and Baxter, 1975). In our study of the ten most dangerous bus stops we found that certain types of crime were more likely to happen in desolate areas, while other types of crime typically took place in situations of high density, when the potential offender could easily hide in the crowd (Loukaitou-Sideris, 1999).

In spite of the considerable number of theoretical and empirical studies that have investigated the link between physical environment and crime, few researchers have measured the physical environment directly and objectively, preferring instead to utilize subjective perception surveys (Perkins et al., 1993). Yet, some have argued that crime indicators can be better predicted by objective measures of the environment than by studies of social perception (Gifford, 1993). In the section that follows we will discuss our method of measuring the different environmental attributes around bus stops in downtown Los Angeles.

Measuring the Impact of Environmental Attributes on Bus Stop Crime in Los Angeles / Research Methodology

The Setting: Downtown Los Angeles is bounded by three freeways (Hollywood, Harbor, and Santa Monica freeways) and a major traffic corridor (Alameda Blvd.). Some 26,000 people live in downtown, while another 300,000 work there daily (Los Angeles Downtown Strategic Plan,

1993). Downtown residents and workers compose a social mosaic of people with very different cultural, racial, occupational, and economic backgrounds. Downtown bus stops are the most heavily utilized in the Los Angeles region. In addition to being destination points for hundreds of thousands of workers, these bus stops also serve as transferring points for other destinations throughout the metropolitan context.

Data Sources: Crime data were collected by the Los Angeles Metropolitan Transit Authority (MTA) Transit Police of all reported crime incidents at bus stops in Los Angeles during the period of January 1994 through December 1995. These data included the type of crime, time of day and day of week. Ridership data came from the MTA for average weekday and weekend passenger boardings and alightings per bus stops. We also obtained a geo-coded MTA data set of all downtown bus stops. This allowed us to identify the location of each bus stop and provide the base data needed to display point data (i.e. crime and ridership densities) in a map format.

Unit of Analysis: We chose to study a sample of downtown intersections. Although all crime recorded by the MTA Transit Police was considered to occur at a bus stop, locations of crimes were recorded by street address or closest intersection. When there are multiple bus stops at an intersection, it is in many cases impossible to tell from the location recorded at which bus stop the crime occurred. We therefore decided to use the intersection as the unit of analysis and aggregate all bus stop crime within a 150-foot radius of an intersection (about 1/3 of a city block). This was accomplished using ESRI's ArcView to geocode data to the closest intersection. As a result, crimes with recorded mid-block addresses were excluded from our database and analysis.

There are a total of 187 intersections with bus stops in the study area. Of these, 73 had no reported crime and another 34 reported two or fewer crimes. Twelve intersections reported over 50 crimes. Bus ridership levels also differed significantly by intersection. Ridership levels ranged from a maximum of 13,150 weekday passengers at an intersection to a minimum of 8 passengers. Total weekday boardings was used to normalize crimes by number of riders.

The selected sample resulted in 60 intersections. This included all intersections with more than 5 crimes (40 intersections). In addition a random selection of 20 intersections with little crime but with high ridership levels was included. Four intersections were included from the Chinatown area (which lies just north of downtown, but outside downtown's official boundaries) that fell in this latter category (high ridership, low crime rate). Figure 1 displays crime and ridership levels at the intersections chosen for study.

Environmental Inventory Data: Crime data collected by the police are often inadequate to explore crime patterns (Maltz et al., 1991). While these data typically include the socio-demographic characteristics of the offender they do not describe the physical context in which the crime incident takes place (e.g. the surrounding land uses, the amount of street traffic, the type of street lighting, the presence of dilapidated buildings, vacant lots, etc.). But as the previous literature review indicates, the physical context can affect when and where crime takes place. For this reason, we collected detailed and exhaustive primary data of environmental indicators at each intersection under study. The environmental inventory data was collected by two researchers who visited the intersections and recorded information concerning physical and traffic conditions. The area surveyed for each intersection consisted of eight segments (a segment was defined by 150 feet measured from the corner of the intersection along one of the intersecting streets). Characteristics were recorded for each of the eight segments and then aggregated to the intersection level. The data collection process utilized three instruments to inventory intersection characteristics: 1) Urban form characteristics at intersections; 2) Bus stop characteristics; and 3) Street characteristics. The environmental indicators measured are presented in Table 1.

Insert Table 1 around here.

Some of the characteristics measured occurred too infrequently to be included in further analysis. These included the existence of converging multiple streets at an intersection; single family residential property; the presence of a police substation; and the presence of adult movie theaters, adult bookstores and pawn shops. The latter three characteristics were, however,

combined with liquor stores to create a measure of the number of undesirable establishments at an intersection. Measurement of pedestrian and street traffic was recorded on a three level scale (light, moderate, and heavy). These variables proved to be too subjective to draw any meaningful conclusions about the relationship of traffic to crime and are not included in the analysis below. We had hoped to be able to use actual traffic counts as a more objective measure of street traffic. Unfortunately counts were only available for 39 of the intersections studied.

Methodological Problems: The inclusion of all high-crime intersections in the sample presents a potential methodological problem, since they are primarily concentrated on two streets within a six-block range. Thus, they have many common environmental attributes and introduce the possibility of spatial autocorrelation in the analysis. However, the level of crime data available for this study was limited and it was felt that for this exploratory analysis it was more important to include all intersections with a significant number of crimes. A second methodological problem comes from the aggregation of environmental characteristics by intersection and the assumption that they apply to all bus stops in the area. While most of the environmental characteristics affect the overall intersection environment, a few (for example, bus shelters) may not be present at all bus stops at an intersection.

Dependent Variable: Crime

Categorization of crime data: The study concentrated on bus stop crime incidents and excluded crimes against the transit system and other incidents irrelevant to the study (such as glue sniffing, gambling, grand auto theft, traffic injuries, lost and found reports, etc.) Crimes included in the study were either those involving public nuisance or public offense (drinking in public, drugs violation, etc.) or crimes against persons (robbery, assault, rape, theft, etc.). The latter group was broken into two categories based on the seriousness of the crime. Thus, crime data analyzed in the study were coded into three categories:

- Type 1: Public nuisance or public offence crimes such as public drinking, lewd or disorderly conduct, drug dealing, etc.

- Type 2: Crimes against people include crimes which are more serious than Type 1 (e.g. petty thefts such as pickpocket or jewelry snatching). In an earlier study (Loukaitou-Sideris, 1999) we noted that such crimes tend to happen in the presence of many people.
- Type 3: Serious crime such as rape, robbery, and assault, which tend to happen in the absence of people other than the victims.

Crime Counts: The total number of bus stop crimes reported for the intersections studied is 1480. This ranges from intersections with no reported bus stop crime (9 intersections) to intersections with over 100 reported crimes (the highest number of crimes reported was 165). Most of the crimes fall in the Type 1 category (1384 or 94%). There are only 24 Type 2 crimes (ranging from 0 to 4 per intersection) and 72 violent crimes (ranging from 0 to 10 per intersection).¹

Almost eighty percent of the intersections reported less than 20 crimes. The number of crimes at the remaining 12 intersections ranged from 50 to 155. These high crime intersections are concentrated within a six block span along two adjacent streets, Broadway and Spring (see Table 2). All of the high-crime intersections have at least one violent crime (Type 3 crime), with the highest number (10) at Broadway and 7th. This intersection has the second highest total crime count (145). In order to study the effects these high crime cases have on the results, we often replicated the analysis for the high crime and low crime subgroups.

Table 2 around here

Ridership: Ridership varied considerably across the intersections with a low of 151 total weekday riders to a high of 13,150. All but one intersection had less than 9000 riders with just over half of the intersections in the one to four thousand range. There is a fairly strong correlation between ridership and crime ($r = .63$), however, looking at the scatter diagram in Figure 2 we see that this is largely due to the scatter of the few higher crime intersections.

Limiting the intersections to those with under 50 crimes (47 of the 59 cases) we find no correlation between ridership levels and crime ($r = -.035$).

Crimes per 100 Weekday Riders: To normalize crime with respect to levels of ridership, crimes per 100 weekday riders was used in the analysis. Crimes per 100 riders ranges from 0 to 6.6 with a mean of 0.9 and standard deviation of 1.3. Three-fourths of the cases are fairly evenly distributed between .03 and about 2 crimes per 100. Only eight of the 60 intersections had over 2 crimes per 100 riders. When the crime data were normalized the most dangerous intersections did not coincide exactly with the most dangerous intersections for total crime. Three of the top five intersections in terms of crimes per 100 riders were not in the high crime group for total crime (see Table 2).

Independent Variables

The following sections report on the relationships found between the measured environmental characteristics and crimes per 100 riders. These relationships were explored using t-tests to evaluate differences in mean crimes per 100 riders where intersections could be classified by the existence of a particular environmental characteristic (i.e. presence or absence of an alley). Results are shown in Table 3. Where appropriate, actual correlation coefficients between crimes per 100 riders and environmental variables were calculated.

Table 3 around here

1) Urban Form Characteristics

Factors that Might Facilitate Escape: There was a significant relationship between the presence of crime and the existence of an alley at the intersection (56% of the intersections have an alley as shown on the map in Figure 3). Average crimes per 100 riders was almost double for intersections with at least one alley (1.19 versus .55 at intersections with no alley). All but one of the high crime intersections have one or more adjoining alleys (11 out of 12) as compared to 47% of the low crime intersections (see Photograph 1). If we exclude the 12 high crime areas from the

analysis we still find higher crime rates at intersections with an alley (.75 crimes per hundred versus .48). This same relationship also holds if we look at just violent crimes (Type 3 crimes).

Eighteen of the intersections (almost 30%) had at least one mid-block connection or a vacant lot connecting two streets. The average crimes per 100 riders was higher for those intersections with a mid-block connection, however, the difference was not large enough to be statistically significant.

The Impact of Land Use: There is little residential property surrounding the intersections studied. Only one single-family residence was recorded and it was located at an intersection reporting no crime. Seventy percent of the intersections (41) had no multi-family housing (see map in Figure 4).² The average crimes per 100 riders for intersections where multi-family housing exists was double that for intersections without (1.4 versus 0.7). Looking only at violent crimes, we found slightly higher average crime rates where multi-family housing exists. This is largely because three intersections with the highest number of Type 3 crimes have multi-family housing present (Broadway & 7th, Broadway & 4th and Spring & 4th).

Commercial property was classified in terms of small/open front establishments; small/closed front establishments and large/closed front establishment. Three-fourths of the intersections had no small/open front commercial properties, however, 86% of the intersections had one or more small/closed front commercial properties.³ All but 3 (95%) intersections had large/closed front commercial properties, ranging from one to 11. There was no correlation between the number of commercial establishments at an intersection and crime counts per 100 riders.

Both surface parking lots and parking structures were counted per intersection. One-fourth (15) of the intersections had either one or two parking structures while almost two-thirds of the intersections had from one to six surface parking lots. Both parking structures and surface parking lots could be found at low and high crime intersections. Comparing average crime statistics for intersections with and without parking structures we found virtually no difference.

There was, however, a slightly higher average crime count per 100 riders for intersections with surface parking lots (an average of 1.06 versus 0.64 for intersections without a lot).

Data were recorded for 6 different types of undesirable establishments: adult bookstores, adult movie theatres, check cashing, “hot-sheet” motels, liquor stores and pawn shops.⁴ Average crime per 100 riders was higher at intersections where liquor stores were found (1.6 crimes per 100 versus 0.5 crimes per 100 at intersections without liquor stores). This difference is significant at the .01 level. This trend held when looking within the low and high crime intersection subgroups. Significantly higher crime statistics also occurred at intersections with check cashing establishments than at those without.

A new variable was created by counting the number of all the undesirable type establishments at an intersection. Almost half of the intersections had at least one undesirable establishment with thirty-six percent having two or more (see map in Figure 5). The average crime per 100 riders was significantly higher for intersections with an undesirable establishment. This was true overall as well as for the low crime group.

Ideally for this study we would have liked to have the length of street front at each intersection dedicated to a particular land use. Since we had no actual area measures (only numbers of establishments) we used a surrogate measure: the percentage of lots dedicated to a specific land use at an intersection. Variables examined included: % multi-family housing, % small open front commercial, % small closed front commercial, % large closed front commercial, % surface parking lots, % parking structures, and % undesirable establishments.

A small but significant negative correlation existed between crimes per 100 riders and the percent large closed commercial ($r = -.278$). There was also a moderate positive relationship between crimes per 100 riders and the percent of undesirable establishments ($r = .410$). This latter relationship also held for violent crime rates ($r = .423$).

The Effect of "Broken Windows": Only 9 intersections (15%) had vacant lots, but most intersections (83%) had one or more vacant building.⁵ Looking at crime per 100 riders, we found

a higher average of 1.7 for the nine intersections with one or more vacant lots than for those without (average crimes per 100 riders was 0.76). Looking only at the 47 low crime intersections, we found an even larger difference between average crimes per 100 for intersections where a vacant lot existed (average 1.74 crimes per 100 riders) and those without (average of only 0.38 crimes per 100 riders). While a considerable difference, it was not large enough to be statistically significant at the .05 level due to the small sample sizes (only 8 intersections have vacant lots) and large standard deviations. Average crimes per 100 riders was greater for the 49 intersections with one or more vacant buildings. Ten intersections had one or more run-down establishments but we did not see significantly higher crime rates at these intersections. We cannot conclude, however, that the "broken window" thesis did not hold, since well-maintained buildings were the majority even at these intersections.

Intersection segments were assigned a value from zero to three to measure the level of graffiti and litter: (0) none; (1) a little; (2) some; and (3) a lot. The values assigned to the eight segments per intersection were summed to form a scale that could range from a low of zero to a high of 24. The values of graffiti and litter were then summed to make one score per intersection with a potential maximum of 48. The actual graffiti and litter scores that we noted ranged from zero to 31. These scores have been reduced to a three level scale in the map shown in Figure 6. There was a weak to moderate correlation between the graffiti/litter measure and crime rates ($r = .350$). When intersections were categorized as either low graffiti/litter areas or moderate to high graffiti/litter areas, we found significantly higher crimes per 100 riders at the intersections with moderate to high amounts of graffiti and litter. This was true for the whole sample as well as the low crime subgroup.

2) Bus Stop Characteristics

A set of characteristics was studied which were associated with the bus stop itself. These included visibility, streetlights, public phones, bus shelters, and caretakers or security guards in the vicinity.⁶

Visibility was assumed to exist if there was a direct line of site from a shop to a bus stop (this only included shops within 50 feet of the bus stop and on the same side of the street). Bus stops at just over half (33) of the intersections had no visibility. While there was more crime per 100 riders at intersections with no visibility (1.07 crimes versus 0.7 at intersections with visibility) the difference was not statistically significant at the .05 level.

Only 6 bus stops (all high-crime) had caretakers or security guards in their immediate vicinity, who were mostly guarding jewelry shops and office buildings. Only three intersections had police substations near the bus stops. These were also located near high crime intersections. The very small sample of bus stops with security guards or police stations near-by constrained any further statistical analysis. Only one-third of the intersections had public phones near the bus stops. Higher levels of crimes per 100 were found at intersections with public phones.

Interviews with officers from the MTA Transit Police revealed that such public phones are often hangout places for drug dealers who receive their phone calls there.

While we found no relationship between the existence of street lighting at the bus stop and crimes per 100 riders, we can by no means conclude that lighting is not important. For one, we did not account for lighting from near-by establishments. Also, the presence of a pedestrian light did not always mean that this light was lit at night.

Bus shelters existed at 13 of the intersections, only one of which fell into the high crime category. Intersections with bus shelters had less crime per 100 riders. This also held true when we look at just the low crime subset. Type 3 crime rates were lower at intersections with bus shelters (an average of 0.14 Type 3 crimes per 100 riders versus 0.48 at intersections without bus shelters).

3) Street Characteristics

As discussed earlier, we were unsuccessful in gathering meaningful data for all intersections with respect to levels of street traffic. For the 39 intersections for which traffic counts were available we found lower crime rates at the very high traffic intersections. However, sample sizes are too

small to draw any significant conclusions. Street width was measured in terms of the number of traffic lanes. There was no correlation between crimes per 100 riders and street width at the intersection. We also found no relationship between crime and width of sidewalks. Average crimes per 100 riders were higher for the 50 intersections with on-street parking (1.01 versus .34 for intersections without on-street parking).

Regression and Discriminant Analyses

On the basis of the t-test and bivariate correlation analysis, an attempt was made to develop a multiple regression model to determine which variables might best explain the variation in crime per 100 riders at intersections. Variables expected to make some contribution included the existence of undesirable establishments, the level of graffiti and litter, the existence of an alley way, the existence or level of multi-family housing, and the percent of large closed front commercial.

The only significant variable entering the regression equation when looking at all intersections was the 0-1 variable measuring the existence of undesirable establishments ($r^2 = .27$). Distinguishing between low and high crime subgroups, we again found that the existence of undesirable establishments was the only variable entering the regression equation for the low crime group. However, the best predictor of crime per 100 riders for the 12 high crime intersections was the percent of large closed front commercial establishments ($r^2 = .49$, $r = .7$).⁷

Discriminant analysis was used to see which, if any, environmental variables might be useful for classifying intersections as high or low crime. A cutoff value of 10 crimes per 100 riders was used to determine if an intersection was high (21 cases) or low crime (38 cases).⁸ Variables selected to build the discriminant function were: the existence of undesirable establishments, the existence of multi-family housing and the percent surface parking. The function correctly classified 18 of the 21 (86%) high crime per 100 intersections, but only 29 of the 38 low crime intersections (76%). It is interesting to note that the three misclassified high-crime intersections did not have any undesirable establishments, but were surrounded by

intersections with undesirable establishments. Almost all of those in the low crime group, which were misclassified had undesirable establishments located at the intersection.

Matched Pair Descriptive Analysis

To complete our analysis we examined more closely pairs of intersections that were within close proximity to each other, had similar levels of ridership, but had large differences in crime counts and/or crimes per 100 riders.

Broadway & 3rd and Broadway & 1st - There is an enormous difference between these two Broadway intersections in terms of both land use and bus stop crime, even though they are just two blocks apart. Broadway & 3rd has the seventh highest crime rate in the downtown area. At this intersection one can see a number of vacant shops, a liquor store, surface parking lots, and alleys. There is also high pedestrian traffic connected to the shopping district of Broadway. Broadway & 1st has high ridership but significantly fewer crimes. At this intersection we find government buildings, a bank on the ground floor and the LA Times facilities on the upper floors, and a fenced lot. There are no ATMs outside the bank. Low walls and landscaping clearly define the realms of public (sidewalk) and private space (office buildings and their edges), reducing places for loitering and hiding.

Hope St. & 12th and Pico Blvd. & Grand - The Pico & Grand intersection has higher crime and lower ridership than the Hope & 12th intersection. The negative environmental factors which may contribute to the higher crime rates at the Pico location include the existence of a liquor store, unregulated parking lots that can provide easy escapes, and the general appearance of neglect and abandonment. A large part of the intersection is dedicated to light manufacturing. Graffiti is widespread here. In contrast, the parking lots on Hope & 12th St. are fenced and the streets have a very clean appearance. The lack of negative land uses at this intersection seems to reduce the attractiveness of the intersection as a place for crime.

Maple & 7th and the other 7th Street Intersections - Seventh Street intersections are plagued by vice establishments, mostly bars and liquor stores (see Photograph 2). Closed and

run-down storefronts line 7th Street. Seedy residential motels, some of which probably function as “hot sheet” motels, are numerous. It is not uncommon to see prostitutes in front of some of these establishments. However, the intersection at Maple & 7th is characterized by much smaller rates of crime per capita than the other 7th street intersections. The main difference is that at this intersection there are no vice establishments in the near vicinity. Land uses include several fenced and well-kept parking lots, some retail stores and a small residential building.

Hill & 1st and Hill & 3rd – There is a dramatic difference in crime per capita between these two intersections, even though they are only two blocks apart. The potential for natural surveillance of the Hill and 3rd is non-existent, as it is only surrounded by surface parking lots and parking structures. We counted a total of nine negative land uses in the vicinity of this bus stop. Liquor is easily available from the Grand Central Market across the street. A near-by tunnel entrance, a pedestrian ramp, and a surface parking lot provide ample hiding places for drug activity. In contrast to the desolation that characterizes the bus stop on Hill & 3rd, its matched pair is easily visible from the first floor windows of an office building. The immediate vicinity of the Hill & 1st bus stop is well maintained, with no evidence of physical incivilities.

Spring & 2nd and Spring & 4th – Despite their proximity these two bus stops are also characterized by a major difference in their crime rate. The Spring & 4th bus stop is located in front of a boarded-up building and is surrounded by a multitude of negative land uses that include a check cashing establishment, two bars, two vacant buildings, and a number of surface parking lots. There is no visibility of this bus stop from the surrounding establishments, while different alleys and vacant lots provide opportunities for criminals to hide or escape. The bus stop is plagued by physical and social incivilities (graffiti, litter, smell of urine, and prostitution). In contrast to the derelict landscape of Spring & 4th its matched pair is located in a pedestrian-friendly environment in front of the Los Angeles Times office building. Natural surveillance from this building’s occupants is constant here, while the number of potential escape routes is minimal.

Conclusion

Our data showed some evidence of the effects of the "environmental backcloth" on intersections with bus stops. The analysis suggests that certain urban form and bus stop characteristics have an impact on crime. This is visually illustrated by the matrix in Table 4, which shows the existence of particular environmental characteristics at the bus stops studied. In this table all sample bus stops are hierarchically ordered based on crime per capita. High-crime bus stops (at the top of the Table) have many more negative environmental attributes in their vicinity than low-crime bus stops. We found that crime rates were higher at intersections with alleys, midblock passages, multi-family housing, undesirable establishments such as liquor stores and check cashing establishments, vacant buildings, and graffiti and litter. The proximity of undesirable establishments, particularly liquor stores, had a major negative impact on crime. The existence of graffiti and litter also aggravated crime incidence. Positive environmental factors included good visibility and existence of bus shelters. The only street characteristic that showed a relationship to crime rates was the existence of on-street parking. As discussed earlier, higher crime rates were noted at intersections with on-street parking.

Table 4 around here

Our matched pair analysis suggested that in addition to the environmental variables measured, the level of crime may also be related to the conditions of specific zones or districts in which the intersections and bus stops are located. Five distinct districts or zones were identified within the study area: 1) the Broadway retail district; 2) the Civic Center district; 3) the light manufacturing district ; 4) the skid row district; and 5) the Business District. Crime was mostly concentrated at certain hot spots in districts 1, 3 and 4 (along Broadway, Spring and 7th Street), while districts 2 and 5 had high bus ridership but low levels of crime. The differences we encountered in the crime rates between bus stop intersections that were in close proximity (for example our matched pairs) could be partly explained by the fact that these bus stops were separated by a border of one of these districts.

Finally, the failure of the regression model to predict crime can be largely attributed to the fact that 1480 total crime incidents distributed around sixty intersections gave very small sample sizes for advanced statistical analysis. In a future study we plan to expand our sample by including more intersections, and to enhance the bus stop crime database, by expanding the timeframe of our investigation. More research is needed to understand the effect of certain variables, which were not adequately measured (e.g. pedestrian and vehicular traffic, lighting). Finally, additional research can investigate the role of different environmental elements in attracting different types of crime (Type 1, Type 2, or Type 3).

This work shed some light to the physical context and environmental factors that affect crime at the bus stops. Identifying and measuring the effects of built environment on crime is the necessary first step for opportunity blocking and for devising crime prevention strategies.

Endnotes

¹ The very low numbers of Type 2 crime seem to be a result of underreporting that is quite prominent (Levine and Wachs 1986; Loukaitou-Sideris 1999). Patrolling officers are routinely giving fines for Type 1 crimes. The serious nature of Type 3 crime ensures reporting. However, most victims of Type 2 crime fail to report it. Many are afraid and intimidated because of their illegal residency status, while others have no faith that the police will capture the criminal.

² At the 18 intersections with some multi-family housing, we found only from one to three residential buildings.

³ This ranged from 11 intersection with one or two small/closed front properties to one with 51 small/closed front commercial establishments.

⁴ There were no “hot-sheet” motels in the intersections observed, only one adult bookstore, 3 pawnshops, and 4 adult movie theaters. Liquor stores were found at 23 intersections (about 40 % of the sample) and check cashing establishments were found at 9 intersections.

⁵ This ranged from 7 intersections with only one vacant building to an intersection with 20 vacant buildings.

⁶ We initially tried to measure and categorize the levels of pedestrian traffic at each bus stop. However, since we had used the intersection (and not the bus stop) as our unit of analysis we had to aggregate our findings, which made little sense. Thus, we had to drop pedestrian traffic from our examination.

⁷ This contradicted earlier results as we found a negative correlation between crime and large closed front commercial establishments when looking at the total set of intersections, which was the result of a negative correlation within the larger low crime subgroup. We also found opposite results between the low and high crime subsets when examining the correlation between the extent of graffiti/litter and

crime per 100 riders. Within the high crime group there was a strong negative correlation between crime rate and graffiti/litter ($r = -.68$), while within the low crime group the correlation was positive ($r = .44$). For both groups combined the correlation was positive ($r = .35$).

⁸ This differs from the high crime subgroup discussed in the paper, which was based on total crime counts.

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