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Publication Date

2002

**The Geography of Transit Crime: Documentation and Evaluation of Crime Incidence on
and around the Green Line Stations in Los Angeles**

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The Geography of Transit Crime: Documentation and Evaluation of Crime Incidence on and around the Green Line Stations in Los Angeles

Abstract

The link between the social and physical environment and transit crime is an important one, but is not well understood or explored. This study explores the environment – transit crime connection by examining in-depth the relation between crime incidence at the stations along a light rail line in Los Angeles and the social and physical characteristics of the stations and their neighborhoods. The study employs a mix of qualitative and quantitative methodologies to analyze crime statistics, census and ridership data, and built environment data. It documents and evaluates the geography of crime along this light rail line, as well as the impact of socio-demographic and environmental attributes on crime incidence at the station.

The Problem: Transit Crime

On December 22, 1984, the nation's TV screens were dominated by images from the Manhattan subway. That day Bernhard Goetz, a lone, white male passenger gunned down four young black males that had harassed him for money on the train. In the media hysteria that followed the victims emerged as the evil, while Goetz's act was justified: a legitimate act of self-defense by a terrified citizen in a scary setting. At that moment and for subsequent years urban railway stations emerged as the nation's primary epitome of urban crime, a "*lurid, underground kingdom ruled by murderers, rapists, and muggers where a subway rider's life sometimes has less value than a token*" (Rangel, 1985).

A number of studies have documented fear of crime on railway stations (Kenney, 1987; Ball and Mierejewski, 1992; Levy, 1994). Most studies on railway crime have focused on East

Coast cities such as New York (Clarke et al., 1996), Chicago (Block and Davis, 1996), and Washington D.C. (La Vigne, 1996). Researchers have argued that personal security can have a significant influence on travel patterns (Lynch and Atkins, 1988). Public concerns over safety may be one of the most important reasons why many chose not to use transit (Hartgen et al., 1993). Researchers have found that people's fear of crime is more acute in the transit station than on the street, since transit users are often confined within the system and are less able to flee a dangerous situation (Kelling and Bratton, 1991). Fear seems to be more prominent among subway users than users of ground transit, who report feeling trapped in underground stations. These fears and feelings of vulnerability are particularly accentuated among women (Wekerle, 1995).

Transit crime is a well known, but underreported trend in urban centers. Criminologists agree that public transit tends to frame opportunities for crime, as it moves large proportions of high-risk populations around the city, along a limited number of paths and destination points (Brantingham et al., 1991). Transit stations are truly public spaces that mix a wide range of constantly interchanging users together (Richards and Hoel, 1980). Offenders can linger anonymously at bus stops and rail stations waiting for potential victims (Block and Davis, 1996). Some passengers represent easy targets; being tired, preoccupied, carrying packages or other stealable objects, or being accompanied by young kids that gather their attention (Myhre and Rosso, 1996). In large transit systems transit stations are often called "crime attractors" because they have the potential of generating crime and disorder by producing crowds. In small systems, characterized by low-volume and low-density stations, opportunities for crime may arise because of desolation and lack of surveillance (Felson et al., 1990).

In general, transit stations are no more unsafe than city streets or other public places. In fact, if we consider only serious crime, rail stations are safer than many city streets, because of the high rates of police deployment. As Kenney (1987) reports, less than 3% of serious crime occurs on the New York City subway, yet more than 12% of the police are assigned to the subway system. However, a few highly publicized crimes in the nation's subway stations have attracted popular attention and concern. At the same time, less serious incidents, incivilities and "quality of life violations" (disorderly conduct, public drunkenness, use of obscene language, vandalism) at transit stations, while highly underreportedⁱ, have intimidated many transit patrons.

Transit crime affects people's decisions to use public transportation. Acts and perceptions of violence cause loss of ridership and revenue. A report titled "*Improving Transit Security*," commissioned by the Federal Transit Administration argues that "*given the sensitivity of transit clientele to even one major crime, reported incidence argues persuasively for diligent monitoring and increasingly effective interventions*" (TCRP, 1997). Thus, many studies have sought to document and analyze transit crime and almost all transit agencies have instigated crime prevention strategies.

From the various studies that have profiled transit crime we know that:

1. Transit crime is mostly a problem of the nation's larger cities (Siegel, 1979, in DeGeneste and Sullivan, 1994).
2. The majority of the incidents represent less serious crime and incivilities. A survey of 45 transit agencies showed that 22% (or 8,000 cases) of all reported incidents were of serious nature. Of the serious crime only 2,700 cases were violent (TCRP, 1997). The vast majority of the less serious incidents involve vandalism, disorderly conduct, public drunkenness, theft, and harassment. These affect and intimidate other transit patrons (TCRP, 1997), but tend to

be underreported. Robberies, assaults, and batteries represent the majority of the reported serious crime (TCRP, 1997).

3. Crime levels vary for different parts of the transit system and are correlated to neighborhood crime (Richards and Hoel, 1980, DeGeneste and Sullivan, 1994).
4. Most crime incidents occur in stations rather than on trains (DeGeneste and Sullivan, 1994), and at bus stops rather than on buses (Loukaitou-Sideris, 1999), since the presence of the train crew or bus driver probably discourages potential offenders.
5. Transit crime varies temporally and spatially. More serious crime tends to happen in late evening and night hours; while less serious incidents occur during rush hours (Shellow et al. 1974, Pearlstein and Wachs, 1982; Levine, Wachs, Shirazi, 1986; Loukaitou-Sideris, 1999). Also different crimes occur in different types of environmental settings (Richards and Hoel, 1980). Pickpockets and purse snatching typically happen in crowded situations, where the offender can easily hide in the anonymity of the crowd and rapidly escape the setting. Rape, homicide, and robbery usually occur in settings with low pedestrian traffic, low surveillance, and many concealed areas (dark corners, elevators, restrooms) (Harris, 1971, Clarke et al. 1996).

While many studies have documented railway crime, most have focused their attention on the social variables of crime—the socio-demographic characteristics of offenders and victims, and the social context of station neighborhoods. With few exceptions (Block and Block 2000; Block and Davis, 1996; Loukaitou-Sideris and Banerjee, 2000) researchers have ignored the spatial environment (type of land uses, urban form attributes) in the immediate vicinity of transit stations. While this can be partly justified for an underground station (La Vigne, 1996), which is drastically separated from the rest of the city, a street-level light rail station is directly affected

by, and in turn affects its surroundings. In fact, such a station is not too different from a bus stop. As previous research has shown, there is a correlation of certain environmental attributes with bus stop crime (Loukaitou-Sideris, 1999; Loukaitou-Sideris et al. 2001; Liggett et al. 2001).

Most studies have documented transit crime in heavy rail systems and underground stations. There is very little documentation of transit crime on light rail systems, even though such systems have mushroomed in the North American cities in the last two decades. A particular concern regarding light rail stations comes from their frequent vicinity to major parking facilities. Thus, the security of the passenger and her property on the train and station platform is as important as her security at the parking lot, or along the route from the platform to the parking lot. However, very few empirical studies have examined the security of transit patrons and their cars in park-and-ride facilities (Barclay et al. 1996).

What Causes Transit Crime? A Brief Literature Review

Historically a number of theoretical approaches have sought to explain crime. In general, we can distinguish between two broad categories of theories, which use different units of analysis to explain crime (Weisburd, 1997). Compositional (or non-ecological) theorists focus their attention on the offenders, the people that commit a crime. Non-ecological theorists typically argue that intercity variation in crime rates can be adequately explained by the socio-demographic characteristics of urban residents (age, ethnicity, class, social mobility, etc.) and economic factors affecting their neighborhoods (e.g. poverty, unemployment, inequality, etc.). Ecological theorists, on the other hand, cast attention to the context in which a crime takes place.

Consequently their emphasis is concentrated on analyzing where, when and how crime occurs (Brantingham and Brantingham, 1981). A second difference between the two approaches lies in the scale of analysis. Compositional theories tend to look at aggregate socio-demographic and

economic data of neighborhoods as independent variables of crime. In contrast, recent ecological approaches tend to analyze the micro-environment of crime, the social and spatial characteristics of the behavior settings in which crime takes placeⁱⁱ.

The ecological approach has witnessed a resurgence in the last decades with an ammunition of criminological theories that stress the role of opportunities in crime causation (Clarke et al., 1997), as well as the interaction of offenders with their physical and social environment (Cohen and Felson, 1979; Felson, 1994), which may influence their choice of targets (Eck and Weisburd, 1995). These theories view criminals as rational individuals likely to act when opportunity arises, but reluctant to commit crimes where there is a high likelihood of being apprehended (Cornish and Clarke, 1986). Explicit in these theories is the importance of place as a setting of crime. The particular socio-physical characteristics of a place (such as the number of people present, the level of surveillability, its physical layout, and environmental attributes) can have positive or negative effects on crime.

Theoretical work on the geometry of crime argues that *“offenders seek out criminal victims from a constricted awareness space based on their familiarity with the places or activity nodes where they routinely spend significant amounts of time, such as home, work, school, shopping, and recreational sites, and from areas adjacent to the principal paths they follow in moving between these nodes”* (Brantingham et al., 1991: 91). Theorists see transit stations as prime settings where crime against persons can be facilitated. Stations concentrate large numbers of people that can become targets for pickpocketing, purse snatching, and robbery. Trains move high-risk population along a limited number of paths, depositing them at a few destination nodes. As Brantingham et al. (1991: 93) argue, *“awareness spaces and target search points become tightly clustered.”*

Empirical studies of transit crime give support to both the compositional and ecological explanations of crime. For one, researchers have found that transit crime is highly correlated with the crime rates at the neighborhood in which a station is located. Poor, inner city neighborhoods with high proportions of nonwhite population typically have higher crime rates than affluent white suburbs. On the other hand, the spatial characteristics of a place are also impacting crime. Examining high- and low-crime bus stops within the same geographic area of downtown Los Angeles Loukaitou-Sideris (1999) and Loukaitou-Sideris, et al. (2001) found a relationship between specific negative environmental attributes and bus stop crime. Yet, if viewed separately the ecological and compositional perspectives run the risk of offering incomplete explanations to crime (Byrne, 1986; Taylor et al., 1984). Thus, a more integrated approach is needed that takes into account both physical and social variables and investigates their relative significance in regards to crime.

A review of the literature shows that a combination of different physical and social variables may impact crime at the station. Researchers have argued that “defensible space” characteristics of station design (such as lighting, fencing, specific security hardware, and open design that allows opportunities for surveillance) can discourage crime (Harris, 1971). For light rail stations the type of platform design may have an effect, depending on the particular neighborhood context. Street level stations can provide easy escape for criminals. On the other hand if set within dense urban environments with good visibility from their surroundings such stations may provide natural surveillance opportunities (Felson et al., 1990). Conversely, underpass stations (and to a lesser extent overpass stations) may allow offenders to trap their victims without being seen, but they also provide more challenging settings for criminals to escape. Studies have also shown that the urban form characteristics of neighborhoods are

important for crime. Particular land uses (e.g. schools, bars, liquor stores, pawnshops, and abandoned buildings) have been found to attract more crime in their vicinity (Block and Block, 1995 and 2000; Byrne, 1986; Greenberg, 1986). The presence of physical disorder and incivility, signified by deteriorating building stock and public environments, with concentration of graffiti and litter is also likely to have an impact on neighborhood crime (Perkins et al. 1993; Skogan, 1990).

Similarly social incivilities (the presence of vagrants, drug dealers, and prostitutes) are thought to have a relation to crime at the station (Wilson and Kelling, 1982). High numbers of pedestrians at the station were originally thought to detract crime (Angel, 1968). Later studies have questioned this assumption. Clarke et al. (1996) studying 206 New York subway stations found that the number of platform robberies was inversely correlated with passenger density at these stations. Others have hypothesized that density affects different types of station crime differently (Harris, 1971). Observing the movement of passengers at New York's mass transit terminal Felson et al (1996) argued that "*crime and disorder are at least likely to occur under two conditions: 1) flow inertia (flow is stable and orderly in the same direction); 2) setting inertia (people are in legitimate behavior settings acting in an orderly fashion). Crime and disorder are most likely to occur under 1) turbulence, in which people are moving in different rates and in different directions; and 2) interstitial idleness, in which people are neither in motion nor in a legitimate behavior setting.*" (p. 78).

As previously noted, researchers have also hypothesized that the compositional characteristics of the neighborhood surrounding a transit station (its density, income levels, age and race composition, educational level, and unemployment levels of residents) have a likely correlation with transit crime.

Based on our reading of the literature we have identified the following possible influences on light rail station crime shown in Figure 1.

Insert Figure 1 about here: Possible Influences on Light Rail Station Crime

Research Design

In this study we use the Los Angeles Green Line as a case study to explore how different physical and social characteristics at the station and neighborhood affect station crime. The Green Line is a light rail line that runs for 19.6 miles from Norwalk to El Segundo in Los Angeles County (see Figure 2). The line has fourteen stations and twenty-four separate parking lots, and had an average weekday ridership of 26,894 passengers in 1999. This is a small and simple light rail system that started operating in August 1995. The Green Line represents a good case to study the relationship between different socio-spatial variables and the incidence of crime for the following reasons:

Insert Figure 2 about here: Location of Green Line Stations with Ridership Levels

1. The 14 stations vary significantly in terms of their surrounding land uses. Some stations are within primarily residential areas (although the ratio between single- and multi-family housing varies). Some stations are surrounded by industrial facilities, some by primarily commercial uses, while others have a mixture of uses in their vicinity.
2. The stations vary significantly in regards to their surrounding environmental conditions, with suburban stations surrounded by well-tended residential environments, and many inner city stations showing a concentration of graffiti and litter in their vicinity.
3. The station neighborhoods also vary in regards to their socio-demographic characteristics. Neighborhoods at the western end of the line are more affluent than the inner city neighborhoods in the middle. Neighborhoods at the eastern end can be characterized as

middle-class. They are ethnically more heterogeneous than the neighborhoods at the western end, which are primarily "white."

4. Two different station typologies are encountered in Green Line stations: Overpass stations on elevated transit guideways and center platforms on the Century Freeway median crossing over a local street, and underpass stations, i.e. center platforms on the Century Freeway median crossing under a local street.

Our study was set up to address the following questions:

- What is the spatial distribution of crime along the Green Line?
- Where does transit crime occur (on the train, the platform, the parking lot, or the escalators/elevators)?
- Do we find a correlation between station ridership and different types of crime?
- Do we find a correlation between neighborhood density (size of the population residing within ½-mile radius from the station) and crime?
- Do we find a relationship between socio-demographic characteristics of the surrounding vicinity and crime incidence at the station?
- Do we find a correlation between different environmental attributes at the station and in the surrounding vicinity and station crime occurrence? Are high-crime and low-crime areas significantly different in regards to land use mix, design typologies and station design elements?

Data Sources

For this study we obtained crime data for the Green Line from the Transit Services Bureau of the Los Angeles County Sheriff's Department from 1998 onward, and ridership data for all Green Line stations from the Los Angeles County Metropolitan Transportation Agency. This data in

conjunction with observation counts at different times of the day at stations gave us information regarding station density. Demographic data available by census block group for 1997ⁱⁱⁱ was aggregated for the area within a ½ mile radius of each Metro Green Line station^{iv}. We conducted a systematic and detailed fieldwork analysis and photographic documentation of the vicinity (1/4 mile radius) of the station area. We compiled an environmental inventory of each station neighborhood by collecting environmental data and attributes that have been shown to be related to crime incidence (Loukaitou-Sideris et al. 2001). Thus, we mapped the adjoining land uses, the overall condition of the surrounding neighborhood, the concentration of undesirable places (e.g. bars, liquor stores, pawn shops, etc.), the visibility and lighting of platforms and park-and-rides, the flows of pedestrian and vehicular traffic, the degree of formal or informal station surveillance, the existence of fencing and security hardware and equipment at the station, the layout of the platform, and the type of linkages to the surrounding area.

Crime on the Green Line Stations

Incidents of serious crime (Type 1) and less serious crime (Type 2) at the fourteen stations along the Los Angeles Metro Green Line were reported for the years 1998 and 1999^v. During this two-year period there were a total of 540 crimes, the majority of which (368 crimes) were of less serious nature (Type 2)-- primarily incidents of vandalism. Most of the serious crime (Type 1) was motor vehicle theft and burglary/theft from vehicles or robbery and assault against persons. There was no reported homicide and only one rape (Figure 3).

Insert Figure 3 about here: Classification of Type 1 Crime

Table 1 shows the spatial distribution of crime along the Green Line system. Stations with the fewest number of crimes were found at the western end of the line where the light rail passes through some rather affluent suburban communities (El Segundo, Manhattan Beach,

Redondo Beach) with low criminal activity. The two stations at the eastern end of the line (Norwalk and Lakewood) were found to have the highest numbers of Type 1 crime, even though their surrounding neighborhoods are not suffering from particularly high levels of criminal activity. These two stations have large parking lots. At least half the crimes there were motor vehicle theft or burglary/theft from autos parked in the station parking lots.

Insert Table 1 about here: Crime by Station

In general, Type 1 crime was mostly concentrated at two locations at the Green Line stations: in the park-and-ride lots (60%) or on the platform (about 20%). Almost all crime in the park-and-ride lots was motor vehicle theft (41%), or burglary or larceny/theft from vehicles (50%) while on the platform over 90% of Type 1 crime was robbery or assault against persons.

Type 2 crimes were predominantly in the access routes to the platform from the parking lot or from the street (i.e. stairs, elevators or escalators). Ninety percent of Type 2 crimes was vandalism and half of these incidents took place in the access routes. About 20% of Type 2 crime occurred on the platform. Figure 4 shows the distribution of Type 1 and Type 2 crimes by location at the station.

Insert Figure 4 about here: Crime Type by Location at Station

The Green Line passes through some low-income inner city neighborhoods, characterized by higher incidence of crime than the county average. Stations in these neighborhoods were found to have more Type 2 crime than other stations in the system. A large proportion of the crime incidents at the Long Beach, Avalon, Vermont, and Hawthorne stations occurred in access routes. These stations had high numbers of vandalism which tended to be concentrated in the elevator/escalator or stair areas. For the Wilmington station, which had the largest number of

assaults in the system, three-fourths of the crimes took place on the platform. Figure 5 shows the primary locations of crime at the individual stations.

Insert Figure 5 about here: Location of Crime at Stations

Ridership varied from a high of about 8000 boardings and alightings per weekday to a low of around 700 boardings and alightings, but most of the stations had between one and three thousand riders. There was a correlation between the number of Type 1 crimes and ridership ($r = 0.486$, $p < 0.1$), which grew stronger if we looked only at crimes that occurred on the platform ($r=0.785$, $p < 0.001$). The number of Type 2 crimes per station, however, was not related to ridership levels. As most Type 2 crimes consisted of incidents of vandalism, we can hypothesize that such acts may not be necessarily committed by riders. Table 1 shows the crime rates per station when normalized by the number of riders.

Station Crime and Socio-Demographic Characteristics of Station Neighborhoods

Based on 1997 census block group data, we found that station neighborhoods differed significantly in terms of the population living within the $\frac{1}{2}$ mile radius of a station (see Figure 6). The two stations in the El Segundo area have essentially no population living within the $\frac{1}{2}$ mile radius, while inner city stations are surrounded by neighborhoods with high densities. The mean and median population per station is about 5000 persons.

Insert Figure 6 about here: Type 2 Crime and Population Density

There was a significant positive correlation between the size of the population living in the vicinity of the station and Type 2 crime, both crime counts ($r = 0.899$) and crime rates ($r = 0.542$). Since most Type 2 crime was vandalism it seems logical that this would be higher where there are more residents. If we exclude the two El Segundo stations from the analysis, the correlation between total population and Type 2 crime counts and crime rates reduces to 0.855

and 0.394 respectively. Because the El Segundo stations have essentially no population in the surrounding area they are not included in the following analysis that looks at the relationship between socio-economic characteristics of the station neighborhood and station crime statistics (see Tables 2 and 3).

Insert Table 2 about here: Neighborhood Socioeconomic Characteristics

Insert Table 3 about here: Correlation between Crime and Socio-Economic Characteristics of Station Neighborhoods

There was a significant relationship between persons per household and numbers of Type 2 crime, which is consistent with our findings with respect to crime and population density in the station area^{vi}. We did not find, however, a significant correlation between unit vacancy rates and station crime^{vii}. There was a significant negative correlation between the percent of owner-occupied units and Type 2 crime counts ($r = -0.777$), however, there was no relationship with Type 1 crime^{viii}. There were large differences in station neighborhoods with respect to race and ethnicity. While the percent white and percent black residents in the station neighborhood seemed to have no relationship with station crime, there was a strong correlation ($r = 0.905$) between percent Hispanic and Type 2 crime counts. Both the Long Beach station and Hawthorne station which had the highest numbers of Type 2 crime had surrounding populations nearly 80% Hispanic.

Assuming that low-income families are those with household incomes below \$25,000, we found no correlation between the percent low-income families in a station neighborhood and Type 1 or Type 2 crime counts or crime rates. There was a strong negative correlation between the percent high-income families in a neighborhood (where high income was defined as over \$75,000) and Type 2 crime. We also found a strong positive relationship ($r = 0.745$) between the percent of the population with no high school education living in the station area and Type 2

crime. Conversely, we found a negative correlation between the percent of the population with more than a high school education (some college, college, or post-college) and Type 2 crime. Higher numbers of Type 2 crime were also observed at stations where a higher percent of the population was under 24.

The previous analysis showed that certain socio-demographic characteristics of the neighborhoods adjacent to the station have an effect on station crime. In summary, we found higher Type 2 crime counts where there were larger populations, more persons per household, a younger population, and a higher percent of the population with less than a high school education living in the ½ mile radius around the station. Type 2 crime counts were also higher where there was a high percentage of Hispanic population. However, it would be false to make any assumption that a relationship exists between the particular ethnic mix of a neighborhood and crime, as the variable “Hispanic” is strongly related to all the other variables that correlate positively with Type 2 crime. Type 2 crime counts were lower at stations where there was a higher percentage of owner-occupied units and a higher percentage of high-income households.

While we found no socio-economic variables related to Type 1 crime counts or crime rates this is largely due to the inclusion of high numbers of auto-related burglary and theft which is concentrated in the two stations at the eastern end of the line. If we narrow the scope of Type 1 crime to include only serious crimes against persons we see a different picture. The number of serious crimes against persons is strongly correlated to ridership. We also found more serious crimes against persons in areas with more persons per household, more low-income families (see Figure 7), a larger percent of the population under 18, more population with less than a high school education, and a higher percent of black residents. There were fewer serious crimes against persons in predominantly white high-income neighborhoods, in areas where more of the

population was college educated, and where there was a high percentage of owner-occupied housing. The percent of Hispanic population in the neighborhood was not related to serious crime against persons at the station which was the opposite of what we found when examining Type 2 crime. It should be noted, however, that these conclusions should be viewed with some skepticism since the number of serious crimes against persons at Green Line stations was quite small.

Insert Figure 7 about here: Crime against Persons and Income

As mentioned earlier, researchers have found a strong correlation between transit crime and the crime rates at the neighborhood in which a station is located (Hoel, 1979). While we are currently collecting and geocoding crime incidence data for many of the neighborhoods adjacent to Green Line stations, for this study we had to rely on information from a Green Line Security Analysis (AEGIR Systems, Inc., 1991). This document classified criminal activity in the area surrounding a station on an ordinal scale ("low", "medium" and "high"). We can see from the classification in Table 1 that the station neighborhoods at each end of the route fall in the low and medium crime categories, while the inner city stations in the middle of the line fall in the high crime category. As seen in Table 4, the average number of Type 2 crimes and Type 1 crimes against persons at the station are directly related to the level of crime in the neighborhood of the station. This is not true when we consider all Type 1 crimes because of the high incidence of auto-related crimes at the eastern end stations.

Insert Table 4 about here: Station Crime and level of Criminal Activity in Surrounding Area

Station Crime and Environmental Characteristics of Stations and their Neighborhoods

a. Stations

Park and Ride Lots

A significant percentage of crime incidents occurred at park-and-ride lots (Figure 4). Twelve of the fourteen stations have such lots. It is interesting to note that the two stations without lots had very low crime. There was a significant correlation between the number of parking spaces and Type 1 crime ($r=.70$, $p<.01$).

All lots were partially fenced and adequately lit. They had little or no graffiti, but most of them had some litter. Those with litter tended to have more Type 2 crime (i.e. more vandalism). Parking lots appeared to be quite void of pedestrians, and this desolateness seemed to facilitate criminal activity.

The average walking time from the parking lot to the platform was just over two minutes, ranging from one to four minutes. There was no relationship between Type 1 crime and walking time, however, we found a moderate positive correlation between Type 2 crime and walking time. Interestingly, there seemed to be no correlation between the existence of parking attendants at the parking lot and crime. The two stations with the highest Type 1 crime counts had parking attendants in the lots, while most of the stations did not (8 of the 12). The presence of a solitary parking attendant in a big lot full of parked cars was apparently inadequate to deter crime.

Platforms

Ten of the stations were “overpass” stations while four were “underpass” stations. The two high Type 1 crime stations (Norwalk and Lakewood) as well as the Vermont and Hawthorne stations with high Type 2 crime counts were underpass stations. A careful examination of the physical environment showed a number of hiding places (under stairways, behind pillars) in the dark underpass stations (see Photographs 1 and 2). All station platforms were linked to the street via stairways, all stations were considered to have adequate platform lighting, only one had platform guards (during observation times), and none of the stations had restrooms. There was little to no

litter or graffiti on any platform. The five stations with the highest platform crime (Wilmington, Long Beach, Norwalk, Lakewood, and Hawthorne) had also minimal visibility from their surroundings (Photograph 3), as they were separated from the adjacent neighborhood fabric by a high-speed freeway and interchange ramps. Unlike many light rail systems that are well integrated in their surroundings, the location of many Green Line platforms in the midst of a freeway negates the potential for natural surveillance from the adjacent neighborhood and increases the level of platform noise.

Neighborhoods

Land Uses

Most of the stations have little residential land use in the immediate vicinity. While the two high Type 1 crime stations at the eastern end of the line are surrounded by residential property, the stations are mostly bordered by freeway access ramps. Stations at the low- crime western end of the line have office or light industrial land use in the immediate vicinity, while stations in the center of the line with high Type 2 crime levels have neighborhood retail in the surrounding area. Only two stations had vacant land in the immediate vicinity and they had low crime levels.

All but four of the stations had single-family residences within their ¼ mile radius. Both Type 1 and Type 2 crime was higher at stations surrounded by residential land use, and lower at stations with primarily office and industrial (light and heavy). This can be explained by the fact that office and industrial areas were also characterized by lower densities than residential areas. We found higher Type 2 crime in station neighborhoods with significant retail facilities in the ¼ mile area.

Studies have shown that specific land uses are more likely to generate crime than others. Bars, liquor stores, or taverns can have a negative effect on crime (Block and Block, 1995).

Customers of establishments with cash transactions (pawnshops, check cashing facilities, ATMs) can be targets for robbery. Areas with vacant lots, public parks, and schools often attract youth and gang-related crime (Perkins et al. 1992). Looking for specific land uses in the vicinity of stations we found only one park, two schools, one café, two banks, two civic buildings, and no ATMs. While half the stations had one or more restaurants there was no relationship with crime levels. Six station neighborhoods had motels and these stations tended to have higher Type 2 crime levels. Locations of undesirable establishments, which included check cashing, pawn shops and liquor stores were also noted. Nine of the station neighborhoods had one or more liquor stores and/or bars (Photograph 4). There was a strong positive correlation between Type 2 crime and the number of liquor stores ($r = 0.815$). Only the Hawthorne station had pawnshops in the area and it had the highest level of Type 2 crime. This station also had three check cashing establishments near-by. A total of six station neighborhoods (three of which were the highest crime ones) had check cashing establishments.

Overall Condition

Our fieldwork seemed to support the “broken window” thesis (Wilson and Kelling, 1982)—that there is a relationship between physical and social incivilities and crime. Station neighborhoods that were considered “decaying” –with littered sidewalks, abundance of graffiti, and deteriorating buildings--also had high numbers of Type 2 crime. In contrast, station neighborhoods considered “prosperous,” “well-kept,” and with good building stock had low crime levels.

Multivariate Analysis

We explored a series of multiple regression models to examine the simultaneous influence of socio-economic and environmental characteristics (at the station and its

neighborhood) on station crime. When looking specifically at Type 2 crime, all factors that seemed to contribute to higher crime levels were also strongly correlated with population density in the station neighborhood (a majority of correlations over 0.8; significant at the .01 level). Once population density was controlled for, other variables made no additional contribution to explaining variation in Type 2 crime. While we hypothesized that interactive effects among the independent variables might better explain differences in crime levels, we were unable to substantiate this with our data. Given that we only had data for 14 stations; two of which had virtually no population living within the station area, there were too few cases to draw meaningful results from multivariate analysis.

When we looked at Type 1 crime against persons (i.e. excluding auto-related burglary and theft) we found that two independent variables in a multiple regression equation: station ridership and percent low income population in the station neighborhood, could explain 82 percent of the variation in station crime. The coefficients on both independent variables were significant at the .01 level. Neither physical characteristics of the station or neighborhood nor other socio-economic characteristics contributed significantly to the regression model either independently or as interactive terms. When we looked only at auto-related crime, we found no additional variables influencing the crime rates, once the size of the parking lot was taken into account.

Conclusion

With an average of 1.55 crime incidents per 100 riders the Green Line can by no means be described as unsafe. However, certain stations suffer more from crime than others; car thefts are a real concern in certain park-and-ride lots along the system, while they are almost a non-issue in others (see Figure 5). While crime at the station seems to be related to overall crime at the

neighborhood, we also noticed some more subtle relationships between the socio-demographic and urban form characteristics of the station neighborhood, the station design, and crime incidence at Green Line stations.

As other studies have shown, we also found that different types of crime take place under different conditions. Crime at the platforms against people was strongly related to ridership—the busiest stations tended to concentrate the most serious crime. Less serious crime (Type 2) tended to be higher in stations located in dense neighborhoods with higher percentages of population with less than high school education. Incidents of vandalism—in particular graffiti spray-painting on elevators and stairs and platform pillars--comprised the vast majority of less serious crime. Other studies have shown that vandalism in transit stations is most often the work of school-age children and young adults (Hoel, 1979). Consistent to these findings we also found that stations with high incidence of Type 2 crime had also higher proportions of youth in the adjacent neighborhood. We also noticed that vandalism tended to be higher in stations with neighborhoods with littered sidewalks and deteriorating building stock.

So far empirical research on crime in railway systems has given very limited attention to incidents occurring at parking facilities. Yet, in systems like the Green Line many riders are expected to reach the station by car, park at the system's park-and-ride lot, and walk to the platform. The safety of the rider during his/her walk to and from the lot and the safety of the car property become important. The Green Line is not immune from car thefts and thefts of private property from parked vehicles. Car thefts tended to happen primarily in large lots which were filled with cars but were void of pedestrian activity. Dark, and desolate parking areas under the freeway projected a feeling of lack of safety (see Photograph 5). Smaller parking lots that were

well integrated to their surrounding context and were visible from the adjacent sidewalks had fewer incidents of crime.

Crimes against people (assaults, robberies) tended to happen primarily at the station platforms, elevators and stairs. Certain design characteristics of the station were found to be related to platform crime. Underpass platforms with no visibility from their surrounding areas had higher crime incidence. At the same time, some socio-demographic characteristics of the station neighborhood were also relevant for serious crime against people at the station. While our results cannot be conclusive because of the small number of serious crimes against people, we found more such crime in low-income neighborhoods with more persons per household, and higher concentrations of youth.

Many of the Green Line stations are located on a platform in the middle of an urban freeway, and they are effectively cut off from surrounding land uses. Therefore, the effect of specific land uses and other urban form characteristics (e.g. layout of streets, existence of alleys, etc.) on station crime does not seem to be as important as in cases where the railway station is located in the midst of an urban neighborhood. Nevertheless, we found a strong correlation between station crime and the existence of liquor stores in the vicinity.

Our study gives a clear indication that a combination of social and physical variables at the light rail station and its neighborhood impact station crime. While transit authorities cannot deal with many of the social variables that affect crime on a light rail system, the study pinpoints to a number of design and policy implications to tackle the physical variables. For one, the security of transit passengers should extend from the platform to the public environment that surrounds the station. The on-street location of light rail stations provides opportunities for more visibility from surrounding establishments (Walker, 1992)^{ix}. On the other hand, the physical

condition of the surrounding environment seems to be more important for the security of light rail stations than for underground stations. Therefore, the upkeep, good maintenance, cleanliness, and surveillance of the public environment that surrounds light rail stations are of paramount importance for the safety of transit passengers.

Second, since many light rail stations are often in close proximity to park-and-ride lots the security of these lots and of the routes connecting them to the station is very significant. The study showed that smaller, well-lit lots, that were well integrated to the surrounding urban fabric scored well in terms of security. As we saw, the presence of a solitary parking attendant did not prove effective in curtailing automobile thefts and crime. Increased police patrolling of the lot, possibly paid from parking revenue, could help in the reduction of park-and-ride crime. Also the incorporation of convenience stores and ticket machines in the parking lot could increase pedestrian presence and reduce car thefts.

Third, appropriate station and parking lot design that eliminates entrapment spots and hiding places, and increases visibility through design and adequate lighting can create “defensible space” (Newman, 1972) – a station environment whose physical attributes contribute to its better security. Incidents of vandalism that plague transit systems can be reduced through the use of graffiti and vandal-resistant materials.

Finally, a regular “security audit” by transit authorities will reveal the hot spots of crime on the transit system and will guide a targeted deployment of security personnel to the most dangerous stations during the most dangerous times.

In conclusion, we wish to state that our study rather than validating the compositional or the ecological theories found merits in both. Methodologically, our research was limited by the

small number of reported crime incidents. More extensive studies are necessary for a better understanding of the importance and interaction of the two theoretical streams.

Acknowledgment

This study has been supported by grants from the John Randolph Haynes and Dora Haynes Foundation and the California Department of Transportation (through the University of California Transportation Center). The authors would like to thank UCLA graduate students David DeGrazia, Katsumi Nonaka, Jose Rodriguez, Manuel Soto, Kimberly Yu, Allison Yoh, who helped with the fieldwork and the input of the data.

Table 1: Crime by Station

STATION	Ridership	CRIME			CRIME PER 100 RIDERS			Criminal Activity in Surrounding Area*
		Type 1	Type 2	Total	Total	Type 1	Type 2	
1- Norwalk	4846	39	27	66	1.36	0.80	0.56	Medium
2- Lakewood	2066	39	40	79	3.82	1.89	1.94	Low
3- Long Beach	2493	13	51	64	2.57	0.52	2.05	High
4- Wilmington	8383	18	24	42	0.50	0.21	0.29	High
5- Avalon	1696	7	32	39	2.30	0.41	1.89	High
6- Harbor	1325	5	28	33	2.49	0.38	2.11	High
7- Vermont	2373	9	41	50	2.11	0.38	1.73	High
8- Crenshaw	2392	12	12	24	1.00	0.50	0.50	Medium
9- Hawthorne	2285	12	54	66	2.89	0.53	2.36	Medium
10- Aviation	2748	8	14	22	0.80	0.29	0.51	Medium/High
11- Mariposa	1358	1	4	5	0.37	0.07	0.29	Low
12- El Segundo	1034	2	5	7	0.68	0.19	0.48	Low
13- Douglas (MB)	691	1	7	8	1.16	0.14	1.01	Low
14- Marine (Redondo)	1064	6	29	35	3.29	0.56	2.73	Low
TOTAL	34754	172	368	540	1.55	0.49	1.06	

*Green Line Security Analysis Appendices, April 1991

Table 3: Correlation between Crime and Socio-Economic Characteristics of Station Neighborhoods

Socio-Economic Characteristics		Crime Counts			Crime per 100 Riders		
		Type 1		Type 2	Type 1		Type 2
		Total	Against Persons		Total	Against Persons	
	Riders	0.486 *	0.810 ***	0.127			
	Population	0.127	0.324	0.855 ***	0.240	0.293	
	Persons/HH	0.048	0.565 **	0.644 **	-0.164	0.156	
GENDER	% Male	-0.042	-0.681 **	0.409	0.257	0.297	
ETHNICITY	%White	0.205	-0.644 **	-0.333	0.261	-0.556 **	
	%Black	-0.267	0.665 **	-0.072	-0.305	0.551 **	
	%Hispanic	0.158	0.199	0.905 ***	0.100	0.192	
AGE	% < 18	0.027	0.650 **	0.569 *	-0.127	0.224	
	% 18-24	0.142	0.443	0.810 ***	0.104	0.521 *	
	% > 65	0.143	-0.293	-0.482	0.022	-0.542 **	
EDUCATION	< High School	0.030	0.513 *	0.745 ***	0.024	-0.247	
	Some College	-0.100	-0.592 **	-0.670 **	0.031	-0.107	
INCOME	% Low Income	-0.095	0.701 **	0.434	-0.158	0.545 **	
	% High Income	-0.207	-0.601 **	-0.696 **	-0.089	-0.495 *	
HOUSING	% Owner Occ.	-0.119	-0.581 **	-0.777 ***	-0.046	-0.468 *	
	% Vacant	-0.109	0.007	-0.066	0.212	-0.149	

* Significant at the 0.10 level

** Significant at the 0.05 level

*** Significant at the 0.01 level

Table 2: Neighborhood Socio-Economic Characteristics (within 1/2 mile radius)

NEIGHBORHOOD	Population Density		Race/Ethnicity			Age			Education		Income		Home Ownership
	Population	Persons/ Household	%White	%Black	%Hispanic	%<18	%18-24	%>65	% < High School	% Some College	Low %<25K	High %>75K	%Owned
Brookwalk	4598	3.38	64%	6%	45%	27%	11%	10%	13%	32%	19%	23%	61%
Brookwood	5836	3.08	68%	5%	45%	28%	11%	9%	13%	30%	21%	21%	50%
Long Beach	9352	4.58	30%	22%	79%	36%	13%	7%	20%	17%	39%	13%	37%
Millington	7425	4.15	18%	53%	49%	39%	12%	8%	20%	15%	58%	8%	29%
Palomares	6884	3.70	17%	56%	47%	34%	11%	10%	20%	19%	54%	7%	45%
Parsons	6668	3.87	21%	46%	57%	35%	12%	7%	20%	19%	45%	13%	41%
Permont	8223	3.75	18%	46%	53%	35%	12%	6%	18%	22%	42%	12%	34%
Renshaw	2409	3.22	19%	64%	24%	29%	11%	6%	10%	38%	20%	31%	58%
Rawthorne	11363	4.05	36%	12%	79%	34%	13%	6%	21%	19%	40%	11%	24%
Recreation	705	2.92	76%	4%	26%	24%	8%	14%	7%	35%	12%	31%	72%
Raniposa	21	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
El Segundo	20	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Douglas (MB)	1706	2.60	82%	3%	13%	20%	7%	10%	4%	50%	9%	53%	84%
Marine (Redondo)	1680	2.55	67%	7%	30%	23%	10%	7%	11%	41%	15%	27%	42%

Table 4: Station Crime and Level of Criminal Activity in Surrounding Area

Level of Criminal Activity in Surrounding Area	Average Numer of Crimes		
	Type1		Type 2
	Total	Against Persons	
High	10.40	7.60	35.20
Medium	17.75	4.75	26.75
Low	9.80	2.20	17.00

Figure 1

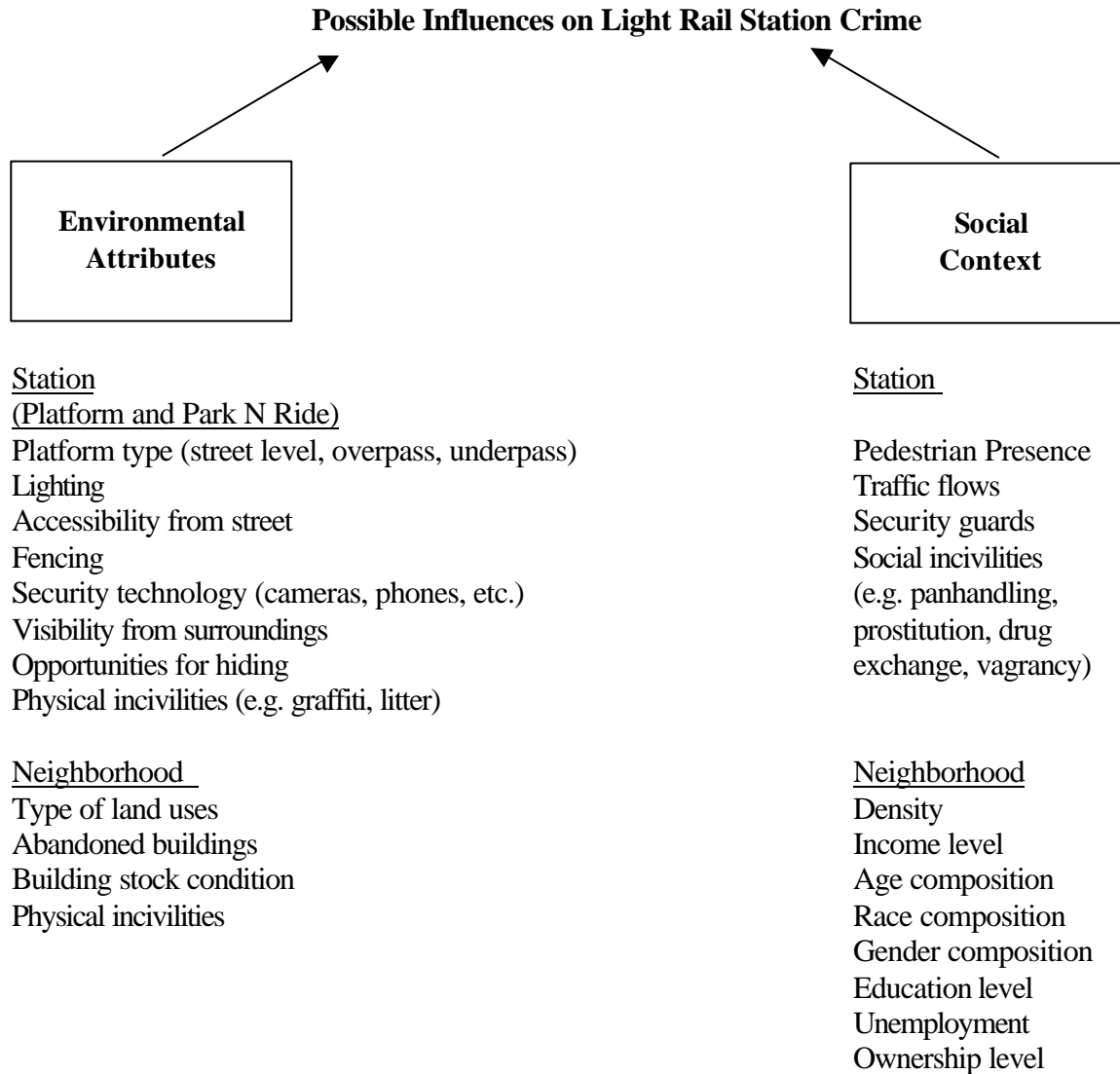


Figure 2: Location of Green Line Stations with Ridership Levels

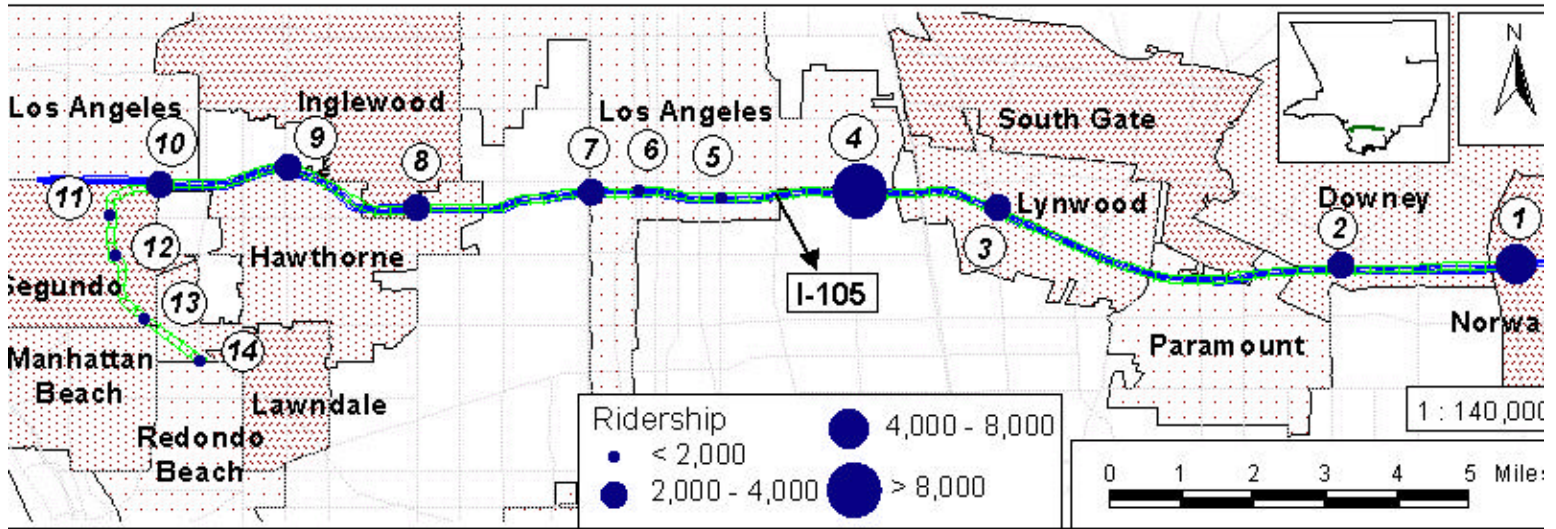


Figure 3: Classification of Type 1 Crime

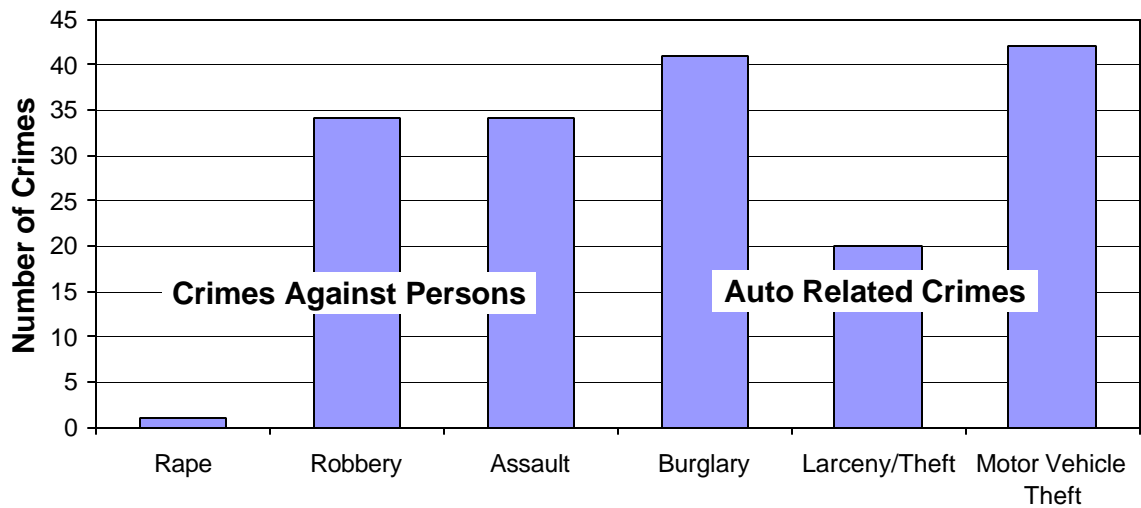


Figure 4: Crime Type by Location at Station

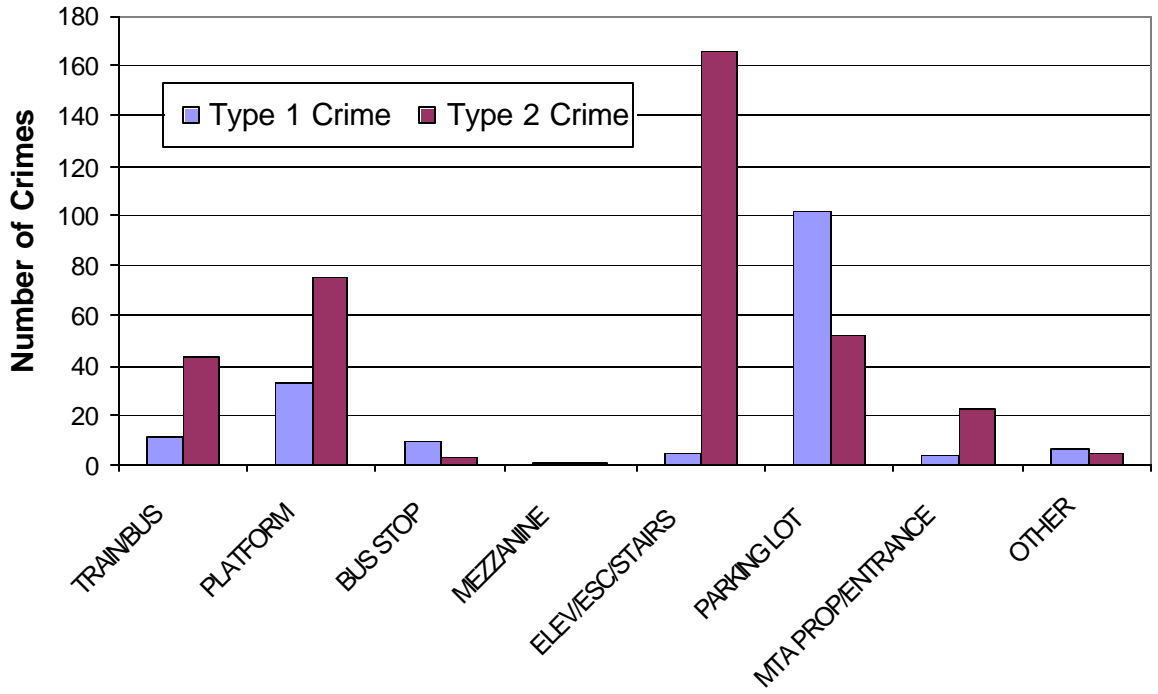


Figure 5: Location of Crimes at Stations

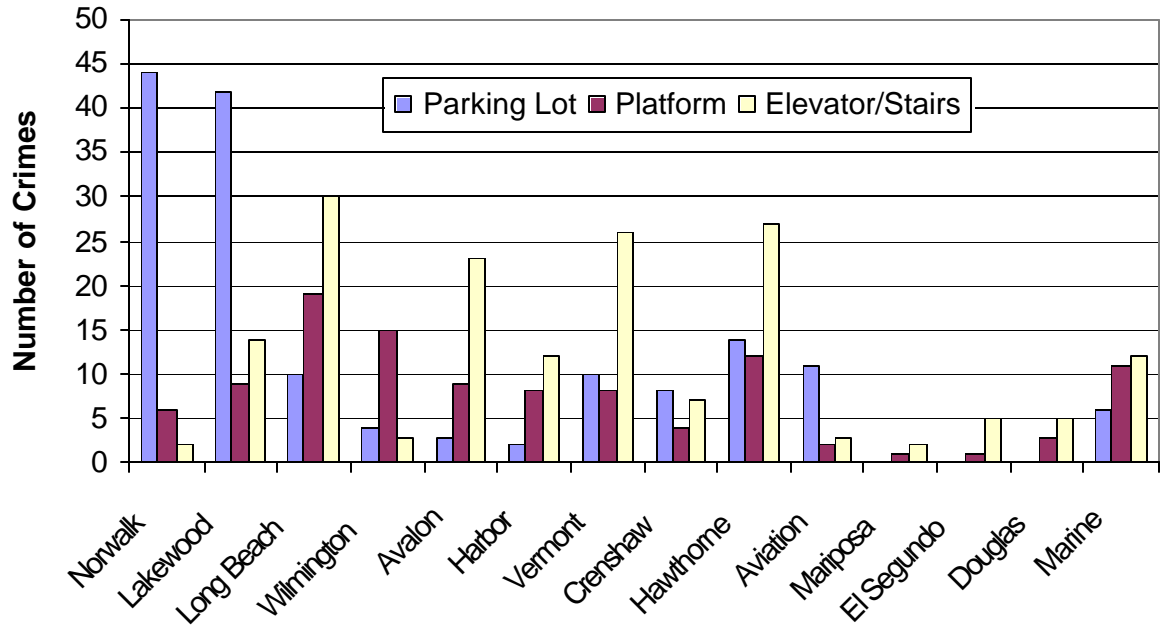


Figure 6: Type 2 Crime and Population Density

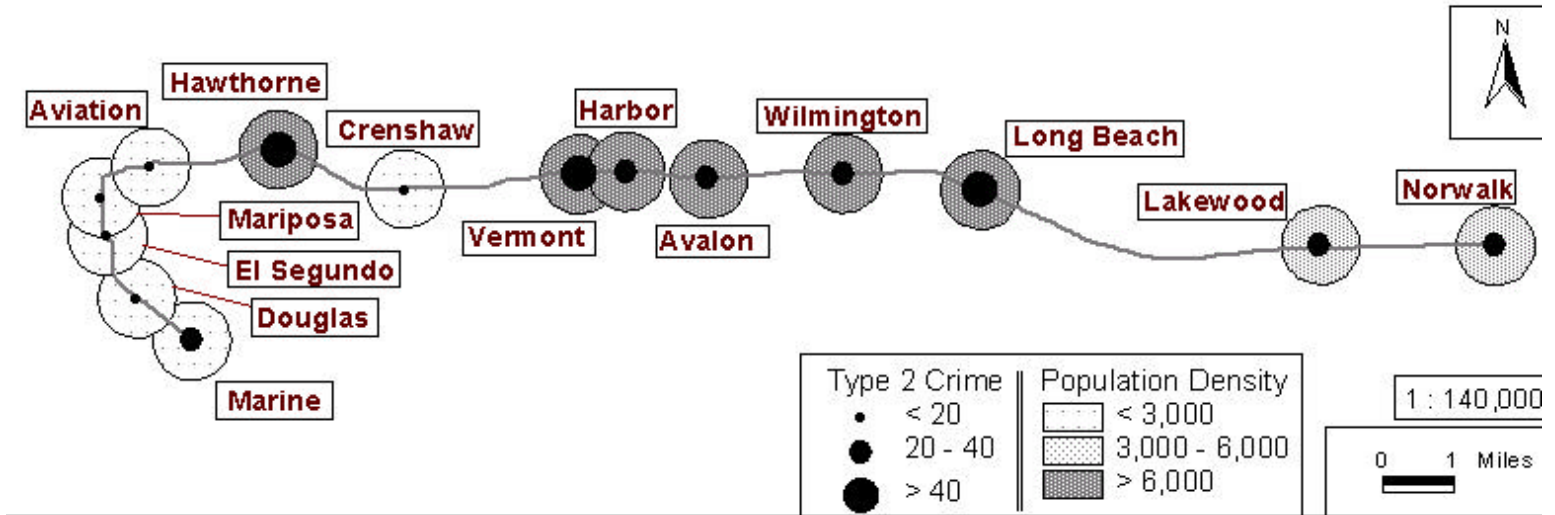
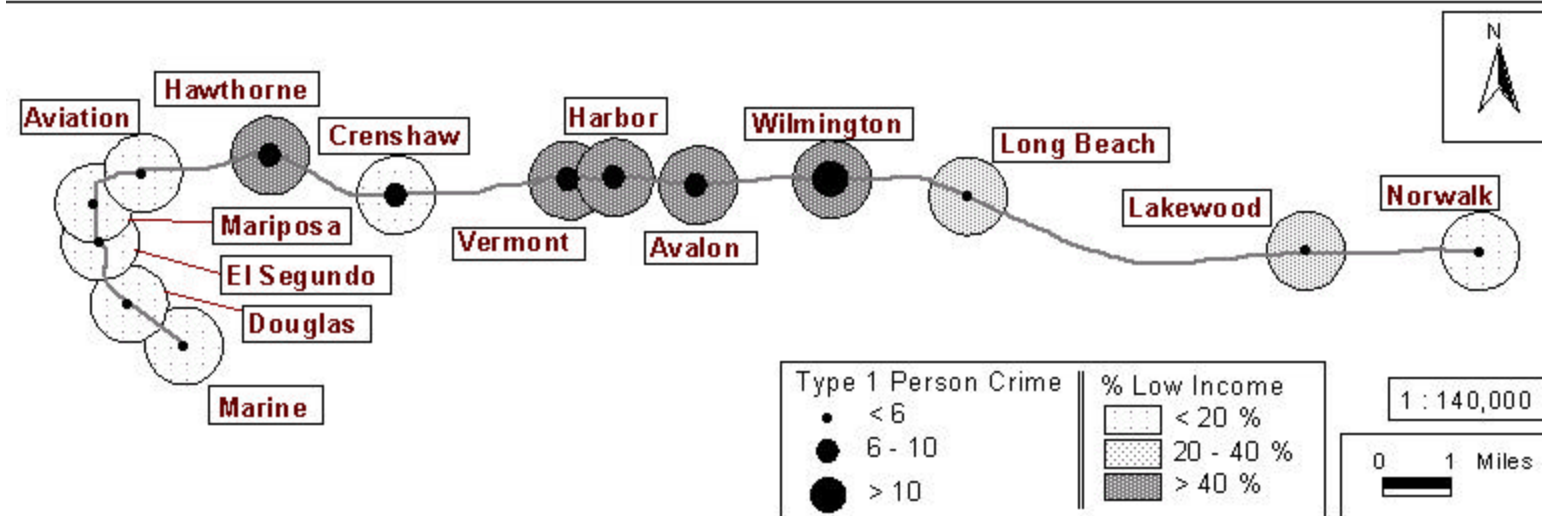


Figure 7: Type 1 Crime against Persons and Income



Endnotes

¹ An article in *Crime and Justice International* states that “only about 38% of all crimes committed are reported to police, according to national statistics. Among the crimes which are least reported are attempted robberies and purse snatching. Interestingly, 18.5% of all personal larcenies with contact, 3.4% of attempted robberies, and 6.7% of all robberies which result in injuries occur on public transportation vehicles or within public transportation stations nationwide (*Crime and Justice International*, 1997).

² The emphasis that ecological studies place on the micro-environment is relatively recent. The scale of first ecological studies was the city as a whole, as studies sought to identify and explain variations in crime within the same city (Shaw and McKay, 1929).

³ The 1997 block groups data came from the Caliper Corporation
<http://www.caliper.com/estimate.htm>

⁴ Census block group boundaries generally do not align with a ½ mile radius circle. Therefore, block group data was allocated based on the proportions of the block group which fell within the

½ mile circle. For sophisticated methods of using GIS to evaluate transportation census data see Hess and O'Neill (1999).

⁵ For classification purposes the Federal Bureau of Investigation has classified crime into two major categories: Type 1 crime (criminal homicide, forcible rape, robbery, aggravated assault, larceny theft, burglary, grand auto theft, and arson), and Type 2 crime (crime of less serious nature against people and their property, such as petty theft, disorderly conduct, vagrancy, non-aggravated assaults, drug violation, etc.)

⁶ Persons per household ranged from a high of 4.6 in the Long Beach station area to a low of 2.6 in the cities at the western edge of the line.

⁷ Only from three to eight percent of the units were vacant in the areas surrounding the stations.

⁸ The percent of owner-occupied units ranged from 84 percent in the area around the Douglas station (Manhattan Beach) to a low of 24 percent around the Hawthorne station which had the highest number of Type 2 crimes.

⁹ As already discussed, this is not always true for the Green Line stations which are located in the middle of a freeway.

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