SPATIAL ASPECTS OF CRIME AND ENVIRONMENTAL

OPPORTUNITY

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PREFACE

Among the many aspects of changes in our society, urbanization has brought about significant changes in the behavior of urban dwellers. Affected by the complexity of physical environment on one hand, and the complexity of human relationships on the other hand, some fraction of urbanites resorted to a unique way of life: stealing; a residue of conflict within the system.

This study was an attempt to understand the effect of physical environment on delinquency based on the investigation of physical characteristics of a community and its property crime rate.

I would like to take this opportunity to express sincere appreciation for the assistance and guidance given by the members of my graduate committee; Professor Keith D. Harries, whose patient guidance and encouragement were invaluable; Professor Harjit S. Sandhu, whose suggestions and directions were of great value; Professor Richard D. Hecock, for his personal interest and encouragement. A special acknowledgement goes to Captain James Hill of the Police Department, Stillwater and Captain Paul Siperiono of the Department of Safety and Security, Oklahoma State University for their interest and assistance.

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INTRODUCTION

Introduction

Statistics in recent years show that there has been an increase of
crime in American cities. Regardless of the precision of this data, it
is widely perceived that cities are becoming more unsafe and insecure. A·
1966 survey by the National Opinion Research Center for President's Com-
mission on Law Enforcement and Administration of Justice revealed that
crime was the second most frequently selected item from a list of six
major domestic problems in the U.S.[1] The survey conducted for the com-
mission found little statistical relationship between personal experience
of victimization (whether direct or indirect), and attitudes toward most
aspects of the crime problem. The majority answered that they acquired
their information either from the news media or other people.[2] What has
been relayed to people by news media has been statistical interpretation
of the Uniform Crime Reports published by the FBI.

The statistical descriptions of crime problems have received numer-
ous criticisms due to the misleading and inaccurate nature of traditional
data gathering/analysis procedures. Many figures have been given as

[1]Jennie McIntyre, "Public Attitudes Toward Crime & Law Enforcement,"
Criminal Behavior and Social Systems, Anthony L. Guenther editor, Rand
McNally & Co. (Chicago, 1970), p. 383.

[2]Ibid., pp. 384-385.

percentage changes based on the absolute number of crimes or as a rate per unit of population which, up to 1958, was measured by a decennial census of population. Computation of crime rates based on the decennial census population meant that computed rates in areas in which there were tremendous population shifts were at variance with the real rates during the years immediately preceding a new census.[3] The continuation of the increase in the size of the population, the proportion among the population of the crime specific target groups and offender groups has not been satisfactorily reflected in the actual statistical manipulation. The changes in the attitudes of the public toward crime and the police were not accounted for and subsequent changes in reporting techniques and changes in law enforcement efforts were inadequately reflected.[4]

Both the actual value of criminal data and an understanding of the typical conclusions drawn from such statistics depend upon an accurate assessment of the basis of the labeling process and its operational characteristics.[5] Furthermore, the value of criminal statistics as a basis for measurement in geographic areas decreases as the procedure takes us farther away from the offense itself - a specific location and a specific setting of an offense.[6]

In terms of measuring the quantity of crime, Gressey's argument seems reasonable, namely that the crimes known to the police probably

[3] Marvin E. Wolfgang, "Limitations in the Use of Official Statistics," Guenther editor, p. 65.

[4] Ibid.

[5] Donald J. Newman, "Criminal Statistics and Accomodations in Justice Administration," Guenther, editor, p. 77.

[6] Thorsten Sellin, "The Significance of Records of Crime," Law Quarterly Review, Vol., 67 (Oct,, 1951), pp. 596-504.

constitute a better index of the true crime rate than the arrest rate; the latter becomes ineffective as we move on to conviction rates and to imprisonment rates.[7] In terms of measuring the quality/reality of crime the raw data are almost meaningless.

The most probable variables have been related to crime in the course of researching the nature of crime and trying to come up with some therapeutic model to prevent crime. Most often, in sociology, criminology and psychology, the socio-economic and ethnic variables of offenders and locations of criminal activities have been studied. These lines of study relate to the idea of corrective prevention.

Corrective prevention assumes that criminal behavior is a caused behavior, and the corrective action involves the elimination of the causes - the factors of motivation - before they bring about the criminal behavior. Other ideas of crime prevention are: (a) punitive prevention which involves law and punishment, and (b) mechanical prevention which involves the direct physical environment.

Although most behavioral aspects of the act of crime could be explained by the analysis of the social environment, the physical environment should also be held partially responsible depending on the individual case. The physical property of a place is not only its physical size but also the relationships between objects, the activities in an area, the people in it, and so on.

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[7]Donald R. Cressey, "Measuring Crime Rate," Gunther, editor, p. 57.

Boundaries of the Problem

Statistics show that crime against property constitutes the largest portion of total crime and constitutes most of the increase in the crime rate. During 1950-1960 the adjusted increase in crime was 22% and the increase was almost entirely in property offenses.[8] Offenses against the person among Index (serious) Crimes make up a significantly large proportion of offenses cleared by arrest, while offenses against property display a significantly lower arrest rate. The percentages of offenses cleared by arrest in 1970 in the Uniform Crime Reports show that murder scored 86%, negligent manslaughter 81%, rape 56% and aggravated assault 65%. On the other hand, robbery clearance was 29%, burglary 19%, larceny 18%, and auto-theft 17%.[9]

In cases of offenses against the person, the existence of studies in the field of criminology, sociology and psychology help the understanding of typologies of specific crimes and enables an inductive search for the offenders. Furthermore, the inevitable personal contact between the offender and the victim provides tangible information. But in cases of offenses against property there is not much of a personal contact and it involves other physical/environmental factors for which not much knowledge has been accumulated yet.

Among the principal findings of Shaw and McKay in their famous study of delinquency in Chicago, was a clear demonstration of the effect of the physical environment upon delinquent behavior. Delinquency was found to

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[8]Marvin E. Wolfgang, "Limitations in the Use of Official Statistics," Guenther editor, p. 69.

[9]John Edgar Hoover, Crime in the United States, Federal Bureau of Investigation, Uniform Crime Reports (1971), p. 32.

be concentrated in those areas where the land use was in the process of
changing from residential to commercial. Those areas always had the
highest delinquency rates even after their population changed almost com-
pletely in national origin, or race, and the delinquency rates of child-
ren changed as their families moved to other locations.[10] Daniel Glaser
said that the approach to crime which is distinctly sociological assumes
that the criminal acquires his interest, ability and means of self-
justification in crime through his relationship to others.[11] This does
not, of course, cover the whole spectrum of criminal behavior. As was
shown in Shaw and McKay's study, a location and the pertinent physical
settings play an important part in criminal activities.

Currently, the Law Enforcement Assistance Administration (LEAA) is
developing an action program to investigate: "Those settings which are
found to be high risk locations."[12] Verification of environmental fac-
tors which foster the setting or opportunity for crimes against property
would not only help understanding of the geography of crime and allow
more reasonable interpretation of the criminal statistics, but also would
help prevent crimes against property by means of proper environmental
design.

Among the Index Crimes, burglary, larceny and auto theft normally
account for more than 85% of total crime. In 1960, for example, these

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[10]Daniel Glaser, "Cultural Influence in Crime," Guenther, editor,
p. 27.

[11]Ibid., p. 26.

[12]Jerris Leonard, Department of Justice, Mimeograph Document, N.D.,
N.T., p. 10.

three crimes accounted for 87% of total Index Crime.[13]

The current study will attempt to verify those environmental factors which might have bearing on the settings/opportunities for the above-mentioned three major crimes against property. Understanding of environmental factors will be utilized in developing a simulation model for diffusion of crime.

[13]Albert J. Reiss Jr., "Assessing the Current Crime Wave," Crime in Urban Society, Barbara N. Mclennan, editor, The Dunellen Co., Inc. (New York, 1970), p. 29.

CHAPTER II

CRIME AND THE ENVIRONMENT

Environment and Criminal Behavior

Psychologically and sociologically, there is little question regard-
ing the profound influence of environment upon human beings.[1] Since a
large part of the input into our minds, from the day we are born, comes
from the perception of our environment, it would be entirely illogical to
assume that our surroundings do not have a great deal to do with the de-
velopment of our mental powers, patterns of prowess.[2] Physical settings
- simple or complex - evoke complex human responses in the form of feel-
ings, attitudes, values, expectancies, and desires, and it is in this
sense as well as in their known physical properties that their relation-
ships to human experience and behavior must be understood.[3]

Of many causes of crime in America, urbanization is among the least
understood and most significant. Our crime is overwhelmingly an urban

[1] Ernest Windle and James W. Marsh, Man and His Motives, Exposition
Press Inc. (New York, 1954), p. 53.

[2] A. E. Parr, "In Search for Theory," Environmental Psychology,
Harold M Proshansky, William H. Ittleson and Leanne G. Rivlin, editor,
Holt, Rinehart & Winston, Inc. (New York, 1970), p. 11.

[3] Edward T. Hall, "The Anthropologh of Space," Harold M. Proshansky,
William H. Ittelson and Leanne G. Rivlin, editor, p. 28.

phenomenon.[4] Urban life is commonly characterized by high population density, spatial mobility, ethnic and class heterogeneity, reduced family functions, and greater anonymity.[5] The urban environment from a criminal's point of view provides more targets with increased density, more freedom in accessibility to targets and from the target areas with increased spatial mobility, and less personal surveillance by other people with increased social heterogeneity and anonymity.

The contrast in crime rate between urban and rural environment reflects the impact of urbanization more clearly. In cities with more than 250,000 people, robberies occur ten times more often than in their surrounding suburbs and are fifty times more common per capita than in outlying rural areas. Auto thefts are fourteen times more frequent per capita in cities than in the country.[6]

Marshall Clinard says that the biological, psychological and social consequences of the physical and social environment are responsible for forming delinquent behavior.[7] Obviously Clinard was addressing the physical and social environment as a background of offenders. The same line of reasoning seems to be also true in the act of offense itself. Physical and social environment of a location is believed to be responsible for bringing about the actual commitment of a crime in that location.

Crime, by nature, is an act of illegal behavior seeking personal

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[4]Ramsey Clark, "Foreward," Crime in Urban Society, Barbara N. Mclennan, editor, The Dunellen Co., Inc. (New York, 1970), p. xi.

[5]Marvin E. Wolfgang and F. Ferracuti, The Substructure of Violence, Tavistock (London, 1967), p. 297.

[6]Ibid.

[7]Marshall B. Clinard, "The Nature of the Slum," Crime in the City, Daniel Glaser, editor, Harper & Row Publishers (New York, 1970), p. 19.

gain - whether material gain or mental-physical satisfaction. Regardless
of the offender's motivation, his preparedness and his socio-economic and
ethnic background, the offender is usually concerned for his safety.
This safety, in turn, depends upon the setting of the criminal activities.
This is especially true in property crime where the main objective of the
offense is to secure intended material. In property crime, the offend-
er's success will depend upon his knowledge of the target, efficient com-
mitment of the crime and, most important, safe escape from the scene.
Existence of any obstacle to and from the scene of crime could be expect-
ed to have a negative relationship to the crime rate. The obstacles may
be various physical barriers such as detective devices and illumination,
the presence of law enforcement, the security of the structure, the num-
ber of witnesses, and the access pattern to and from the scene.

Some of the existing environmental studies tend to come up with mis-
leading conclusions due to the inappropriate use of base variables; these
are dealt with in a subsequent literature review. Some suggestions are
that areas where offenders reside are not likely to be the areas where
most crimes occur; that lower economic status groups have more offenders,
and that down-town locations have higher crime rates.[8] Except for a few
unusual cases such as non-profit oriented offenses, most of the offenders
who commit burglary or purse snatching are supposedly relatively poor
and it can be assumed that there are few material goods to look for near
their residences. Likewise, more crime could be expected where there are
more goods. Another assumption could be that people near their residences

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[8]Sarah L. Boggs, "Urban Crime Patterns," American Sociological Re-
view, Published by the American Sociological Association, Vol. 30, No.
6 (December, 1966), pp. 899-900.

would recognize each other more readily and thus discourage the attempt
while a prospective offender could feel safe apart from his localities,
where people would not recognize him. Perhaps in a more-developed and
higher-status area people mind their own business and care less what
happens to others, thus providing excellent opportunities. Furthermore,
there are generally higher crime rates in the lower income areas.

All these complications seem to arise due to the use of inadequate
and unmeasurable variables. The analysis of data should follow a clear
conceptualization of the real problem. Different criminal activity cate-
gories should be analyzed in view of specific characteristics in terms of
geographic location, motivation, the relationship between the offender
and the target, the time, and the condition of the immediate environment,
beside the general socio-economic factors. Assuming all these factors
have been observed, the interpretation should still not be exclusively of
a general socio-economic nature, but rather a combination of crime-
specific variables, often neglected variables such as police patrol fre-
quency and effectiveness, and the physical environment.

<center>Selected Review on Crime and Environmental

Opportunity</center>

Sarah Boggs tried to conceptualize crime in terms of environmental
opportunity. Using Index Crimes for which the place of occurrence of
crime and the residences of offenders are recorded, two components of
crime occurrence were observed: the familiarity of offenders with their
target areas, and profitability. It was discussed that a valid crime
rate should form a probability statement, and therefore should be based
on the risk or target group appropriate for each specific crime

category.[9] But the concept of environmental opportunity was developed only to the extent of providing independent specific base variables for specific crimes, not to the point of suggesting what really constitutes opportunities. As a measuring device, Bogg's metrics lacked continuity, thus inhibiting reasonable comparison. For example, only a business-residential land use ratio was used as a base variable for business robbery, only the amount of space devoted to parking for auto theft, and the amount of square fottage of streets for highway (street) robbery.[10]

The formulation of the concepts of familiarity and profitability seems to need further verification. The higher occurrence rates observed in high offender neighborhoods for homicide-assault and residential burglary was interpreted into a "familiarity" category, and the weak association between offender and occurrence rates observed in the combination of business robbery, non-residential day and night burglary, auto theft and grand larceny was interpreted into a "profitability" category.[11] Although superficially acceptable, these lines of reasoning do not bear close examination. The degree of familiarity would depend upon one's length of stay at a specific residence and the location of previous residence and job. The instinctive association of familiarity with one's current residence seems to need further verification especially when the location used for the study was an Enumeration District (hereinafter to be called E.D.) or Census Tract that merely contains subjects' residence. The ED or tract may not necessarily contain nor cover one's most

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[9]Ibid., 899.

[10]Ibid., 900.

[11]Ibid., p. 907.

frequent access. Likewise, the association of profitability and burglary rate does not explain a great deal because of the offender's knowledge of the target and physical condition of the target area are critical components of the crime rate. Rather than trying to relate them directly, as was discussed above, seeking a geographic relationship between the two in terms of distance and accessibility could have produced a meaningful result.

Overall, the application of the principle of environmental opportunism appears to be somewhat limited. Certain characteristics contributing to the opportunities should be used as variables applying to all related crime categories and the interpretation of any observed differences among different crime rates should be oriented toward refining the involved variables.

Shlomo Angel approached the problem of providing some insight into mechanical prevention of crime. He narrowed down the problem to consider only crimes in which assailant and victims had not personally associated previously. The study dealt mainly with the crimes against the person which take place in, or are visible from, public areas, especially those public areas where pedestrians circulate.[12] The concept of territoriality, accessibility, and the deterrents against opportunity such as the police patorl, community awareness, number of effective witnesses and general visiblity conditions, were suggested, but most of the effort was in establishing a theoretical framework and no attempt was made to

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[12]Shlomo Angel, Discouraging Crime Through City Planning, Center for Planning and Development Research working paper No. 75, Institute of Urban and Regional Development, University of California (Berkeley, 1968), p. 7.

critically weigh and test the variables.[13] Angel's basic concept regarding environmental opportunities coincides with the basis of the research attempt constituting this thesis.

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[13]Ibid., pp. 8-15.

CHAPTER III

DEVELOPMENT OF THE STRUCTURAL MODEL

Variable Selection

The current study is primarily concerned with the role of the physical environment in promoting crime, and attempts to isolate and verify the contribution of the variables which are potentially significant in the creation of a criminal setting. Those crimes relating heavily to aspects other than the physical environment, such as homicide and other crimes that happen predominantly within offenders' families are eliminated. The study will deal with burglary, larceny and auto theft/bicycle theft, which happen mostly in public spaces, with the exception of night time burglaries.

With the above mentioned three major crimes against property in mind the idea of environmental opportunity seems to need further verification before selecting specific variables which constitute opportunity. The classical theory that "every feeble-minded is a potential criminal"[1] provides an insight into the problem. Even without elaborating on the definition of the threshold of feeble-mindedness, the idea suggests that those who do not have a strong sense of morality or justice can commit crimes. Those who lack morality or a sense of justice could either be

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[1]Arthur Emil Fink, Causes of Crime, University of Pennsylvania Press (Philadelphia, 1938), p. 222.

those who have not yet learned or those who have learned with a negative feedback. The former could be the younger people or uneducated/mal-educated persons who simply have not learned to appreciate the value of justice and morality. The latter could be those who acquired the habit of rejecting current morality and justice because they have been rejected from moral and just treatment by society. Outside the protection of morality and justice, these people might have acquired a skill to live with the majority of people who enjoy different sets of standards and values. Being a minority, having odds against them, they must be more sensitive of their chance of survival.

For the youngsters, merely taking a chance would satisfy their adventurous nature and a desire for excitement. For the rejected adults, taking something illegally which otherwise they could not afford could mean their survival and self-justification. This tends to be a form of justice for oneself.

Through attempts and/or practice they would develop their sense of evaluating chances and ability to capitalize on opportunities. Through exercises - repeated memories and expectations - one would develop a unique way of reacting to a situation by symbolically identifying and understanding the situation. Cloward and Ohlin postulate: "Since perceptions influence behavior, the definitions (perceptions) of the culture have an influence upon the member of the culture. . . ."[2] The process of evaluating a situation is, in many cases, that of a symbolic inter-action because our environment has a symbolic significance as well as functional significance. Man can be stimulated to act by symbols as well

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[2]Marvin E. Wolfgang and Franco Fereacuti, The Subculture of Vio-lence, Tavistock Publication Ltd. (London, 1959), p. 55.

as by physical stimuli, and the very act of evaluating an opportunity could be biased as to how the individual defines objects, actions, and characteristics; as to how he symbolically interpretes a phenomenon.

Gibbons said that "Our view is that criminal and delinquent activities are a function of definition of the situation entrained by persons engaged in these acts."[3] The definition of a situation is twofold. Viewed objectively, it could mean whether the situation is right or wrong or good or bad according to a certain norm or a publicly accepted value. On the other hand, a subjective point of view could be whether the situation is advantageous or not, how much one could get or lose. In other words, the subjective attitude is a process of evaluating opportunities. The act of an offense, in most cases, is a private act for a personal benefit. It is hardly conceivable to assume an offender evaluating a situation objectively.

Trying to figure out just how an offender may interprete an environment seems impossible if not arbitrary due to the fact that it is very much a subjective process. But the approach as to what constitutes an opportunity could be handled quite objectively; in this study this is regarded as an environmental opportunity.

The two distinct components of an opportunity are: first, those which tend to increase chances, and second, those that tend to decrease chances of successful execution of delinquent conduct. Among the former category are those which have absolute values and those which have relative values. The absolute number of targets seems to be the most important because without targets no offense could be committed. The relative

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[3]Don C. Gibbons, _Society, Crime and Criminal Careers_, Prentice Hall (New York, 1968), p. 499.

values could be the locational features of the target in relation to the access pattern around the target area and the characteristics of land use of the area. The access pattern around the target area would affect the mobility and amount of time involved in journey to and from the target. The degree of mix of land use of an area could reflect the state of physical surrounding in terms of its orderliness as well as diversity, thus affecting choice on the part of offenders. These variables affect the degree of attractiveness which relates to the usability of the target on the part of offenders.

Those tending to decrease chances are first, direct barriers and second, indirect barriers. The direct barriers are those physical barriers which affect the amount of physical effort involved in gaining access to targets. The indirect barriers are those which tend to discourage an offense non-physically - visually or psychologically.

Those variables involved in increasing chances will affect an offender in the decision making process at a gross level, whether the commitment of an offense is worthwhile or not; whether he can get what he wants and as much as he wants; whether to commit an offense at all. Those variables involved in decreasing chances will affect an offender evaluating at a technical level, as to how to actually perform the offense, which involves calculating the timing, the most desirable access to and from the offense, the mode of transportation, the type of equipment (if necessary) and other specific details for specific targets, and precautionary measures against an emergency. In cases of impetuous acts, the variables involved in decreasing chances may not have as much influence as those which increase the chances of the commission of a crime.

With the above mentioned criteria in mind, the following variables

related to physical environment are selected for the purpose of develop-
ing a conceptual model.

Target Variables

The absolute number of targets includes the number of residential
units, commercial units and automobiles and bicycles per unit area. The
percentage of residential units per unit area is a function of the per-
centage of non-residential units in the area. The number of automobiles/
bicycles within an area could be represented as the number of open park-
ing spaces in the area and this is also a function of the number of com-
mercial units in that area. All three are in turn a function of the
degree of development of an area.

Locational Variables

The variable which is directly related to locational features is the
amount of street space within an area. This could represent the charac-
ter of access pattern of an area. Another factor is the degree of mix of
land use in an area which also could represent the physical pattern as
well as degree of choice of target in that area.

Physical Barriers

At one end of scale, the number and character of obstacles between
the target and open space could be the most important variable. The num-
ber of doors and the types of locking devices could be considered. At
the other end of scale, the degree of openness from each E.D. could also
serve as a significant variable.

Non-physical Barriers

The frequency of police patrol, the amount of surveillance and the amount of lighting could be considered.

Specific variables for each crime category and general socio-economic and ethnic characteristics of each area will be observed after the physical environment has been understood. Also, any unusually high or low crime rate at a specific point affecting the averages among EDs will be given a special attention.

Stillwater, selected as a sample town due to the convenience of data availability and the familiarity of the city, has the distinct characteristics of a college town. It is expected that the location of the university and the student population would affect the type, rate and location of criminal activities. Other possibilities are seasonal variations following the academic schedule and the effect of the dominant age group present. Certain socio-economic characteristics pertaining to a college town could serve as a gross background in understanding the situation in the event of distinct differentiation of criminal activities relative to existing studies.

Conceptual Model

Some of the basic assumptions preceding the hypotheses are:

1. The physical environment is unique at any given time and place.

2. Human behavior in relation to an environment tends to be enduring and consistent over time and situation; therefore, the characteristic pattern of behavior for that setting can be identified.

3. The physical environment is an active and continuing process whose components define (and are defined by) the nature of the interrelationships among them at a given moment, and over a time, thereby changing the characteristic behavior pattern of the setting as a whole.[4]

Based on these assumptions, the following hypotheses are suggested:

Hypothesis I: The characteristics of a physical environment directly relate to the degree of the locational advantages for crime.

Hypothesis II: Where there are more locational advantages, opportunities for crime are higher.

Hypothesis III: Where there are more locational disadvantages, opportunities for crime are lower.

Hypothesis IV: Where there are more opportunities, crime rates are higher.

In association with the above hypotheses, the following model is acceptable.

$$C = \frac{O}{B} \quad ,$$

where C = crime rate

   O = opportunities

   B = barriers;

$$O = (f) \; [O_{t1}, \; O_{t2}, \; \ldots, \; O_{\ell 1}, \; O_{\ell 2}, \; \ldots] \quad ,$$

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[4]Harold M. Proshansky, William H. Ittelson and Leanne G. Rivlin, "The Influence of the Physical Environment," Harold M. Proshansky, William H. Ittelson and Leanne G. Rivlin, editors, pp. 27-37.

where O_t = target variables

O_ℓ = locational variables;

$$B = (f) [B_{p1}, B_{p2}, \ldots, B_{v1}, B_{v2}, \ldots, B_{s1}, B_{s2}] \quad ,$$

where B_p = physical barriers

B_v = visual barriers

B_s = psychological barriers.

It could be further developed that,

$$C = (f) [\frac{1}{A} \times \frac{O_t \times O_\ell}{B_p \times B_v \times B_s}] \quad ,$$

where if, $O_t \times O_\ell$ = max, and $B_p \times B_v \times B_s$ = min, C = max.

if, $O_t \times O_\ell$ = min, and $B_p \times B_v \times B_s$ = max, C = min.

The reasoning for multiplying target variable O_t with locational variable O_ℓ is that O_ℓ is a factor which affects the effectiveness of O_t. Using a proper scale, O_ℓ could be, at one extreme, a zero which means that the locational aspects are such that even though there is a substantial amount of target, the probability of a crime occurring at that point is nil. At another extreme, the value of O_ℓ could be extremely high meaning that the entire target is subject to offense openly in terms of its locational aspects. The reasoning behind multiplying physical variable B_p with non-physical variables B_v and B_s is that these are of complimentary nature and that they counter-affect each other, neither of the variables being effective by itself. Assuming that B_p, B_v and B_s have been scaled properly, the absence or zero value of one variable would nullify the effect of the other variable. This could be a case such as a concrete

vault with maximum physical protection sitting in the middle of a desert with zero surveillance, in which case the vault could be robbed of regardless of its maximum physical protection.

The reason for introducing a constant A to the denominator is that non-physical and social-regional characteristics should also be represented as a factor; higher living standards and higher educational level would inversely affect crime rates.

Variable Description

$$O_t = \frac{\text{Building Area/ED}}{\text{Total Area/ED}}$$

$$O_{\ell 1} = \frac{\text{Street Area/ED}}{\text{Total Area/ED}}$$

$$O_{\ell 2} = \frac{\text{Commercial Building Area/ED}}{\text{Commercial and Residential Area/ED}}$$

$$B_{p1} = \frac{\text{Parameter Measuring Facing Open Land/ED}}{\text{Total Parameter/ED}}$$

$$B_{p2} = \frac{\text{No. of Openings (Doors) to Target/ED}}{\text{Total No. of Targets/ED}}$$

$$B_{p3} = \frac{\text{No. of Alarms to Target/ED}}{\text{Total No. of Targets/ED}}$$

$$B_{v1} = \frac{\text{Police Patrols/ED}}{\text{Day}}$$

$$B_{v2} = \frac{\text{Traffic Count/ED}}{\text{Area/ED}}$$

$$B_{s1} = \frac{\text{No. Persons Age 25-64/ED}}{\text{Total No. Person/ED}}$$

$$B_{s2} = \frac{\text{Amount of Street Lighting/ED}}{\text{Constant}}$$

O_t would display the state of an environment in an area. O_t could be an urbanization index, density of development in an area or the characteristics of an area in terms of its function and land use. Although it is tentatively assumed that the O_t value decreases as the function of an area changing from commercial to residential, different values could exist regardless of land use depending upon the locality and the degree of development in an area.

$O_{\ell 1}$ could also serve as an urbanization index generally depicting the density of development in an area. $O_{\ell 1}$ value is expected to vary largely from region and also among localities within a region or a city.

$O_{\ell 2}$ displays the degree of mix of land use in an area which would affect many aspects of an area; the street pattern, the diversity of target and other physical quality of an area. Either in commercial area or residential area a zero value could exist, but this does not necessarily mean that the value of targets in that area becomes zero. Variable $O_{\ell 2}$ would largely affect the use of non-building area and closely relate to the street pattern.

B_{p1} describes relative location of an area within a city in terms of proximity to the most developed area. It is a significant variable because different development stages are expected to be reflected in this variable. Non-built open land, whether agricultural or forested, would significantly affect the freedom of escape.

B_{p2} and B_{p3} variables are a measure of the degree of protection of objects which would affect primarily the amount of time involved in gaining an access. An access could be gained through wall, roof or even from underground but doors and/or windows are supposed to be the major access for offenders. These variables actually describe physical property of

target itself, and if the description of a target is to be fulfilled, the specific features such as the material, the form, the weight and the volume of the protective shell should also be investigated because the quality of protection is as important as the quantity of protection. Important as it is, however, these are oriented toward more of understanding an object rather than verifying the environment around and/or leading to the target which is the main objective of this research. The investigation of B_{p2}, B_{p3} and other related variables seems to be another important area of research by itself.

B_{v1} might be a direct reflection of a total crime pattern within an area in which case the variable loses its meaning as an element for an inductive process. On the other hand, it could be viewed as a simple measurement of a visual barrier pertaining to an area in which case it might be a proper variable for this analysis.

B_{v2} in this case displays the density of traffic. B_{v2} value is believed to be another index of urbanization. But not all downtown locations carry high traffic load and those areas in downton with low density seem to have a significant bearing on the environmental opportunities.

B_{s1} is a variable which is critical in the sense that it affects the freedom of access to an area both visually and psychologically. A greater percentage in the 25-64 age group who would have family and economically settled could mean a more stable community both in terms of its physical structure (housing quality, etc.) as well as social structure while the other age groups, under 18 and over 65, are rather unstable in character or ineffective as a positive deterrent because of an extremely mobile nature at one extreme and physical limitations at another extreme.

B_{s2} is a variable which is significant only during night time and

thus in relation to night time offenses.

Since the objective of the study is to verify the effect of environmental opportunities on crime rate, the expected C value using the current model should reflect the degree of variances among C values of EDs.

While all the variables are obviously to be measured using different scales, a significantly hazardous situation could be expected in accomodating the differences. The variables should be controlled in such a way that differences in measuring scale would not hamper the true variances among the rates. One way of standardizing the scale is to calculate percentages for all the variables. But there could still exist unwarranted differences between variables in terms of their overall value. For example, the percentages of street area among total area per ED will be significantly lower than the percentages of certain age group among total number of persons per ED. Such a weighting process would be unsatisfactorily arbitrary. At this stage of hypothetical conceptual modeling, an effort to weigh any variable seems to be premature.

A solution to the problem could be re-scaling the percentages in terms of its relative values among each variable. By dividing the percentages per ED of variables by the average of total value of each variable, a unilateral weighing could be achieved among all variables.

Still another problem exists with $O_{\ell 2}$ variable in finding the degree of mix of land use (building use). The percentage of commercial building area among total building area could be misleading due to the use of only one type of building while the mix ratio involves both commercial and housing. The solution to this problem is to re-scale the values with 50% as its maximum value. Those values exceeding 50% will be given values for the amount above 50%; 25% is 25%; 60% is 100%-60% = 40%, ..., and so

on. The actual Crime Rate (hereinafter to be called C_a) for all EDs will also be re-scaled as a comparative value per unit area with 1 as average value.

Example of Model

If all the variables involved for an ED were average values, the model would be:

$$C_m = \frac{1}{A} \times \frac{1 \times (1 + 1)}{1 \times 1} = \frac{2}{A} \quad .$$

If all the variables involved in opportunities are half the average values and the barriers are average,

$$C_m = \frac{1}{A} \times \frac{0.5 \times (0.5 + 0.5)}{1 \times 1} = \frac{0.5}{A} \quad .$$

If all the variables involved in opportunities are double the average values and the barriers are average,

$$C_m = \frac{1}{A} \times \frac{2 \times (2 + 2)}{1 \times 1} = \frac{8}{A} \quad ,$$

The calculated crime rate (hereinafter to be called C_m) values thus obtained would be the expected crime rate per unit area. In order to compare C_m with C_a on the same basis, the C_m value needs to be re-scaled substituting the averages among all EDs with 1.

Both C_a and C_m, thus obtained, would indicate the degree of actual crime rate per unit area in case of C_a and the degree of potential crime rate per unit area in case of C_m, all on comparative basis. C value 2 would mean that the actual rate or potential is double the rate per unit area while C value 0.5 would indicate half the rate or potential per unit

area based on the averages of all area.

The above process would eliminate the potential illusion foreseeable in the use of actual data, without introducing the variances in the sizes of areas in question.
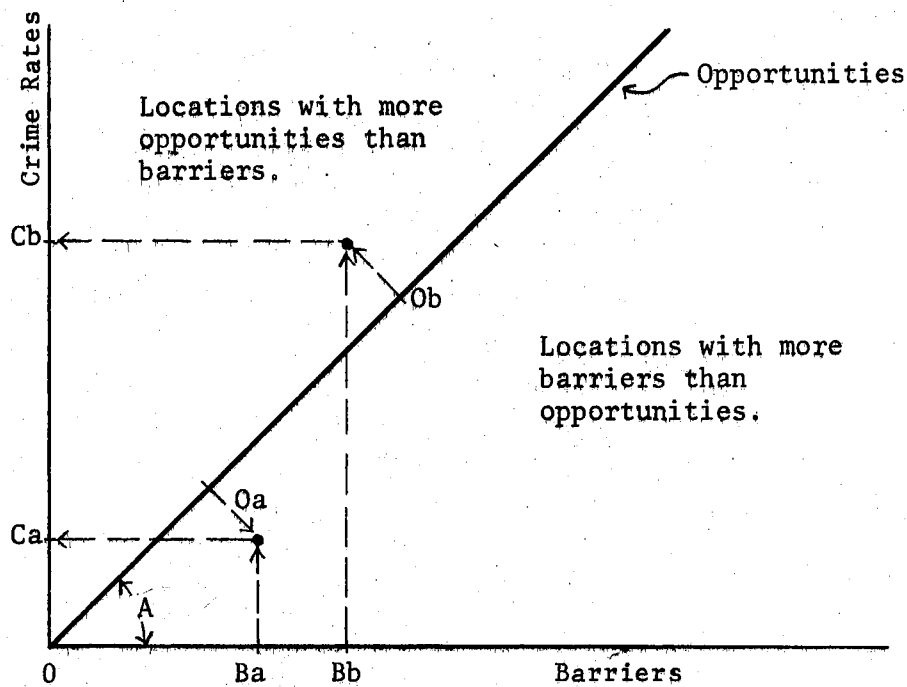
Figure 1. Inter-relationships among Opportunities, Barriers and Crime Rate

CHAPTER IV

DEVELOPMENT OF THE PARAMETRIC MODEL

Crime Rates in Stillwater, Oklahoma

City of Stillwater has a total of 43EDs of which 33 are used in this study. Several irregularities found in Stillwater Enumeration District data, and the areas with suppressed data or negligible populations have been eliminated from the study as follows:

1. ED 29 data are suppressed, and the ED was eliminated.

2. EDs 51A, 51C and 51D have zero population, and were eliminated.

3. ED 39 is in two parts according to Census printout but the official map shows one part. Data for 39A and 39B have been combined and assigned to ED 39.

4. ED 51B is in three parts according to Census printout but the official map has only two. Data for 51B are represented as a single unit in the study.

5. ED 23 appears as 2 parts in the official map. Data refer to a single unit.

6. EDs 33B and 33C have extremely low population with total crime rate less than 1, and were eliminated.

The total population of Stillwater for the 33 EDs involved in this

study was 31,104 in 1970.[1] The total number of Index Crimes reported for the city except the Oklahoma State University area (EDs 27B and 28) was 1,026 in 1970 of which 72% was composed of the three major crimes against property that this study deals with: burglary, larceny, and auto-bicycle theft.[2] The national average crime rate for the three offenses against property for suburban cities with populations between 25,000-50,000 was 3,764.80 offenses per 100,000 inhabitants and the rate for the non-suburban cities for the same size class was 3,939.30 per 100,000 inhabitants.[3] The rate for Stillwater excluding university area was 2,369.47 offenses per 100,000 inhabitants while the rate for all the cities in the state of Oklahoma was 2,138.93.[4] The rate for Stillwater was fairly low compared to the national average but a little higher than the state average. The Stillwater rate increases by more than half if the offenses committed within the Oklahoma State University boundaries are included because the campus shows more than half of the city's total offenses.

The differences between the national average and the city average excluding campus area could be credited to the regional variation in crime rate within the nation. A possible explanation for the higher rate for the city among all cities in the state could be that the relatively larger number of younger people within the community; that these students are more apt to commit such property offenses as this study is dealing with.

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[1]City of Stillwater, Oklahoma, Neighborhood Analysis (Stillwater, 1971), pp. A1-A9.

[2]Ibid., pp. J1-J10.

[3]Hoover, p. 106.

[4]Ibid., p. 79.
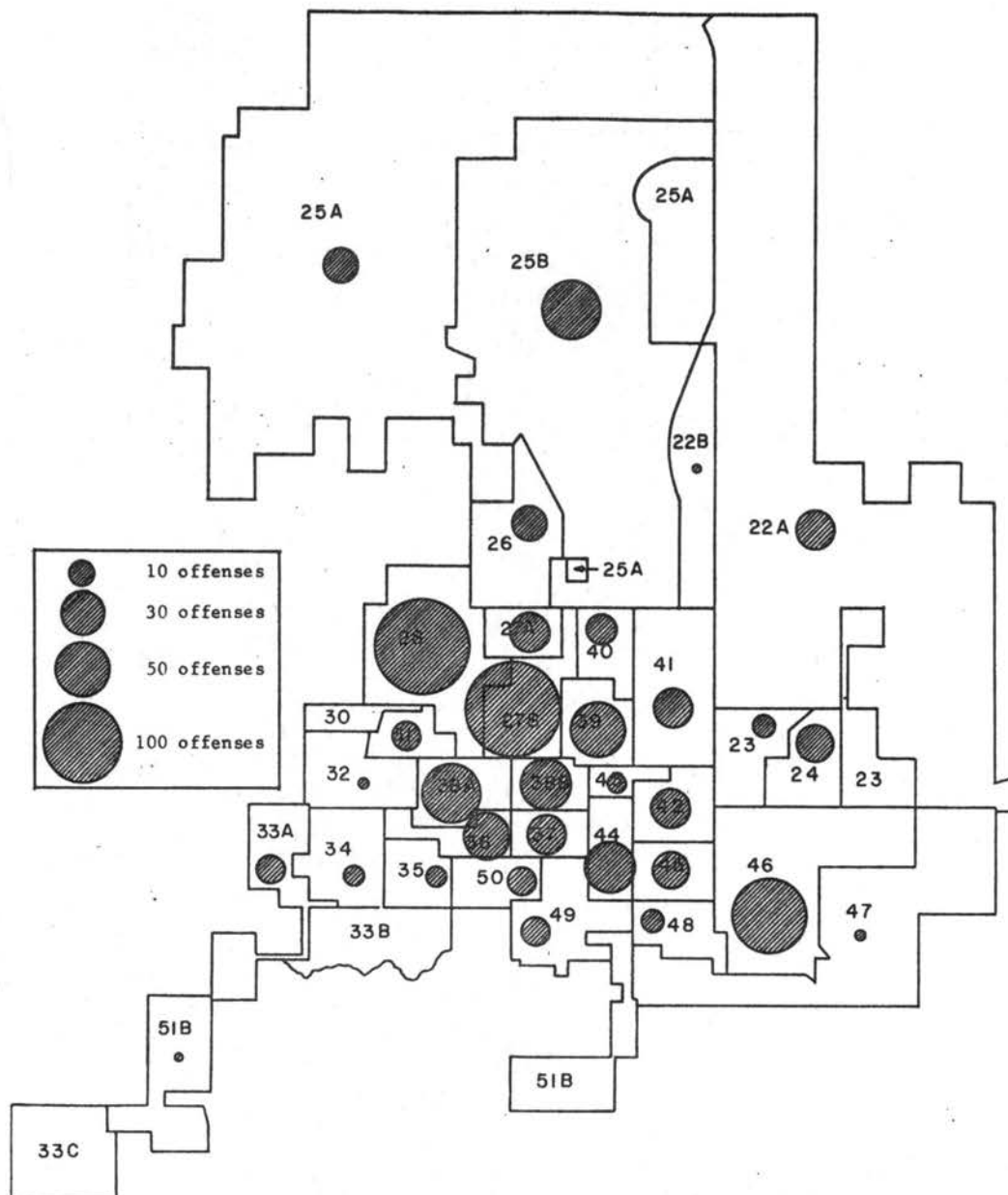
Figure 2. Total Number of Burglary and Larceny per ED, 1970
Based on Neighborhood Analysis, City of Still-
water, Oklahoma, Sept., 1971.

The crime pattern within the city varies significantly among EDs. Those areas adjacent to the university show the highest rate per unit area next to the university area (EDs 27B and 28), followed by the downtown commercial area. The areas next to the university house mostly, student boarding houses and off campus student activities such as eating and drinking. The areas surrounding the immediate neighborhood of the university also show relatively higher offense rates indicating that there is a diffusion of delinquent activities toward the surrounding neighborhood. The second highest offense rate per unit area was observed in the downtown commerical area which features a mixture of commercial/business activities. Other areas showing higher rates are the old sector of town which accomodate a large number of low income groups and poor housing. The predominantly residential areas farther out from the center of the city show the lowest rate while the areas following the major arteries (SH. 51 and SH 177) which pass through the center of town show average rates within the city. Those areas with extremely low rates per unit area were the areas at the periphery of the city which include the airport area and new housing development areas which have large amounts of open land.

Among the three offenses, burglary was accounted for only 25%, leaving 75% for larceny and auto-bicycle theft. The percentage of burglary among the three property offenses for suburban cities with population between 25,000-50,000 was also 25% and the rate for the same bracket of cities in non-suburban areas was 23.3%.[5] The Oklahoma state data show

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[5]Hoover, p. 106.

45.1% for burglary.[6] The higher rate for larceny and auto-bicycle theft for the city compared to the state rate could be credited to the existence of the university within the community, a higher desire for cars and bicycles among the student age group and the magnitude of delinquency among students which does not go beyond the category of minor offenses - a rather spontaneous and advenurous act offense rather than serious profit motivated breaking-in type of offenses.

The university campus area itslef showed an extremely high rate. The total number of offenses in the three property crime category was 384.[7] Burglary was only 5.7%, the remaining 94.3% being auto-bicycle related theft and larceny.

The coincidence between the low monthly rate for all Index Crime for the city and the vacation time for the university provides some understanding of the effect of the large student population within the community. January, June, July and August registered the lowest rate while April, November and December showed the highest rates.[8] January is the winter intersession for the university, and June, July and August are the summer term period with lowest student enrollment. April is the month before the final exams in the spring semester and November and December precede the intersession. The national figures indicate relatively higher rates for all Index Crimes during the summer period, June, July and August, while all the rates are low in November and December except

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[6]Ibid., p. 79.

[7]Captain Paul Siperiono, Department of Safety & Security, Oklahoma State University, Direct Communication, June 29, 1972.

[8]City of Stillwater, p. J-1.

murder and robbery cases.[9]
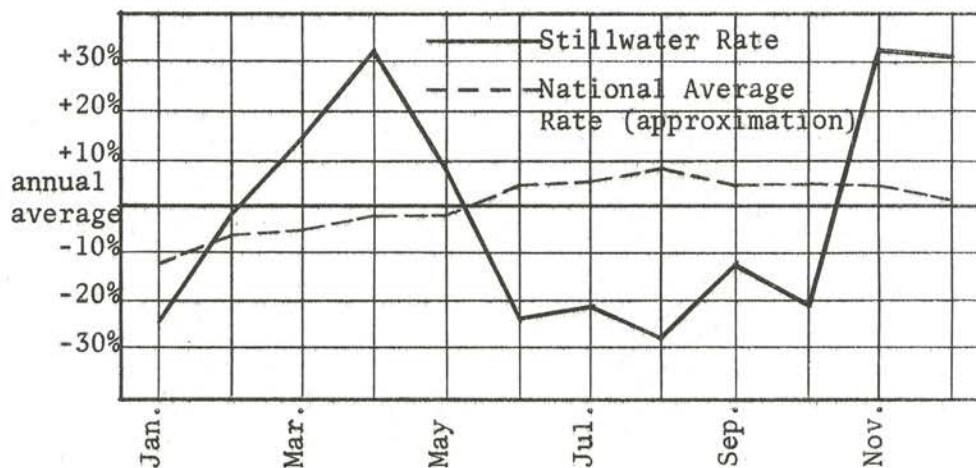
Figure 3.   Crimes by Month; Relationships Between
Stillwater Average and National Average

The national average of police department employees for cities
25,000-50,000 shows an average of 1.7 person per 1,000 inhabitants with a
minimum of 0.3 and maximum of 5.6 person per 1,000 inhabitants. Still-
water shows approximately 0.4 person per 1,000 inhabitants.[10] The aver-
age crime rate, in spite of the low police employee rate, indicates that
the community as a whole considers itself to be high in terms of social
and moral standards. With more than half the population related with the

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[9]Hoover, pp. 26-27.

[10]Captain James Hill, Police Department, City of Stillwater, Okla-
homa, Direct Communication, June 5, 1972 and Captain Paul Siperiono,
Department of Safety & Security, Oklahoma State University, Direct Com-
munication, June 29, 1972.

university either as student, staff or faculty, this view seems to be valid.

Overall, the crime pattern for the city indicates that:

1. The density of development in an area proportionately affects the crime rate in that area.

2. The degree of mix of land use also affects crime rate.

3. The proportion of younger age group present in an area affects crime rate in that area.

4. There is a gradient of diffusion of crime rate among adjoining areas.

5. The physical/social environment of an area is directly related to the crime rate of that area.

Inter-relationships Among Crime Rate

As was discussed in the preceding section, the university campus shows very high offense rates. In offense rates involving burglary and larceny, the campus shows a total of 384 offenses compared to 702 of-fenses for the remaining 31 EDs included in this study. In view of the significant social/physical uniqueness of the campus within the city, the comparative study hereinafter will involve only 31 EDs excluding EDs 27B and 28 (campus area).

TABLE I

CORRELATION BETWEEN OFFENSES

	Burglary	Larceny	Vandalism/Assault	Other
Burglary	1.00	0.59	0.52	0.57
Larceny		1.00	0.53	0.47
Vandalism/Assault			1.00	0.08
Other				1.00

Note: ED 46 was eliminated from the calculation. It had 0 offenses for burglary, 5 for vandalism/assault, 11 for other offenses, and 95 for larceny/theft which by itself accounted for approximately 50% of correlation value with other offenses.

The total number of offenses for the 31 EDs was 978, of which 702 or 71.77% were burglary and larceny. The highest offense rate was observed for larceny (54.18%) followed by vandalism and assault (18.441%) and burglary (17.59%). All other remaining Index Crime offenses accounted for 9.82%.

The result of Pearson's Product Moment Correlation between burglary and larceny and all other index crime rates on an ED basis showed a correlation coefficient of 0.7049. This indicates that the probability of offenses against the person happening in an area is closely and positively related with the probability of property offenses occurring in that area.

The correlations among burglary, larceny and vandalism show relatively significant values which indicates that all these crimes are closely related together in terms of geographic location in Stillwater.

No attempt has been made to further break down other Index Crimes besides burglary, larceny and vandalism/assault and study their geographic distribution because of its significantly low rate (9.82% of total Index Crime) and diversified categories ranging from fraud to sex offenses.

Crime Factors

As was discussed in Chapter III, the most desirable outcome from this study would be first, to understand the relationship between crime rates and environment and second, to predict any future offenses with the knowledge thus obtained. The process of hypothetically understanding the relationship was partially done in previous chapters; now, finding the most proper way to predict seems to be necessary before actually processing data.

Usually, crime rates are given in terms of geographic location, number of population, census area unit, etc. There is no way of knowing the density of offense rates for any given area unless further calculation is done. The offense rates without area bases are not effective for practical uses such as comparing offense rates between different size of areas, assigning law enforcement officers, etc. In these cases, an area base is a necessity. This study will attempt to incorporate area as a unit of measurement and compare offense rates based on the frequency of offenses per unit area for each ED.

The variables suggested in Chapter III were further analyzed and narrowed down to five in view of interdependency among certain variables. B_{pl} (% of parameter facing open land) was found to be a function of O_t (% of building area) because, as the location of an ED is closer to the

periphery of the city, so the percentage of open land increased thus affecting B_{p1} and O_t at the same time. B_{p2} (number of opening to target) and B_{p3} (number of alarms at target) were eliminated because the variables consist of another category of micro environment for which data were not available. B_{p2} and B_{p3} together with other variables pertaining to the building structure itself could constitute another subject for research. B_{v2} (traffic count) was believed to be a function of number of traffic accidents in a given area and B_{v2} was partially reflected in B_{v1} (police patrols). B_{s2} (amount of lighting) was found to be a function of $O_{\ell2}$ (% of commercial building area) because of the predominant street lighting in commercial areas as well as the leave-on-all-night commercial lighting custom.

The selected variables used for modeling are:

S (Size of ED) : Size of each ED re-scaled based on the average size of all EDs. Value 1 would indicate the average; 14,520,462 square feet or 3,333 acre.

C_a (Actual Crime Rate) : Actual offense rates for Stillwater in 1970 for burglary and larceny have been re-scaled to represent the frequency per unit area. This was done first as crime rate per unit area (average size of EDs), then the unit area rates for each ED were re-scaled with the average unit area rates of all ED as 1.

C_m (Calculated Crime Rate): Calculated offense rates using current model.

O_t (Density of Building) : Density of building area has been cal-
culated first, by figuring the percent-
age of building area within an ED,
then, re-scaling the values for each ED
with the average percentage value of
all EDs as 1.

$O_{\ell 1}$ (Density of Street) : Street density has been calculated as a
percentage of street area in an ED,
following the same process as O_t.

$O_{\ell 2}$ (Degree of Mix of Land: The degree of mix of land use has been
     Use)   obtained by first, calculating the per-
centage of commercial/business building
area among total building area. The
percentage values were re-adjusted to
make 50% represent the maximum value;
10% = 10%; 75% becomes 100%-75%, repre-
sents 25%. Values obtained for each ED
following above mentioned process was
then re-scaled based on the average
values for all EDs as 1.

B_v (Law Enforcement Rate) : Law enforcement rates have been calcu-
lated based on officer time per day.
The law enforcement scheme for the city
consists of four officers patrolling
the city at any given time with one of-
ficer at large, and the officers are
supposed to be covering all areas

equally.[11] 2.88 hr./day (4 officers x 24 hr. ÷ 33.5 EDs) has been assigned for each ED except EDs 42, 43 and 44 where the police station is located or immediate major access to the station passes through. For these three EDs another 2.88 hr./day was assigned considering the amount of time for the officers' journey to and from the station which includes 3 shifts plus to and from work (4 officers x 8 journeys x 5 min.). Additional officer time was calculated based on total number of traffic accidents in an ED, assigning 0.5 hrs. of officer time per accident. The total number of hr./day was rescaled based on the averages among all EDs giving the average a value of 1.

B_s (Percentage of 25-64 Age Group) : The percent of persons between age 25-64 has been used to represent the psychological deterrent against crime for each ED. The possibilities of having children, owning a house and adequate income is believed to be higher at this age group compared to other groups over

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[11]Captain James Hill, Direct Communication, June 5, 1972.

64 or under 25. Raising a family and
paying for a property would mean great-
er obligation to their home environ-
ment, both his belongings as well as
others. The proportion of this age
group in a community is believed to be
a factor affecting the physical as well
as the social structure of the communi-
ty. Greater numbers in this age group
would work against the freedom of of-
fenders to move about without apparent
and proper purposes. The percentages
were re-scaled using average of all EDs
as 1.

The variable values calculated for each ED were tested against ac-
tual offense rate using the model developed in Chapter III. The correla-
tion between C_a and C_m was 0.83 with even correlation among large as well
as small values indicating that 68% of the total variance has been ex-
plained by the model. The correlation between C_a and opportunity was
0.77 while the correlation between C_a and barrier was -0.17 indicating
that total opportunity was positively related to C_a explaining over 59%
of total variance by itself, and total barrier was negatively related to
C_a. The two variables, opportunity and barrier, compensated each other
and increased the amount of explanation. This conforms with the hypoth-
esis developed earlier in this study.

TABLE II

CORRELATION BETWEEN PROPERTY CRIME FACTORS WITH ALL VARIABLES

	C_a	C_m	O	B	O_t	$O_{\ell 1}$	$O_{\ell 2}$	B_v	B_s
C_a	1.00	0.83	0.77	-0.17	0.49	0.58	0.60	0.31	-0.66
C_m		1.00	0.75	-0.44	0.53	0.58	0.56	0.02	-0.69
O			1.00	0.22	0.77	0.72	0.71	0.52	-0.34
B				1.00	0.22	0.07	0.18	0.76	0.55
O_t					1.00	0.83	0.24	0.32	-0.06
$O_{\ell 1}$						1.00	0.20	0.23	-0.14
$O_{\ell 2}$							1.00	0.52	-0.41
B_v								1.00	-0.11
B_s									1.00

Note: $O = O_t \times (O_{\ell 1} + O_{\ell 2})$

$B = B_v \times B_s$

C_a: Actual Crime Rate

C_m: Calculated Crime Rate

O: Total Opportunity

B: Total Barrier

O_t: Density of Building

$O_{\ell 1}$: Density of Street

$O_{\ell 2}$: Degree of Mix of Land Use

B_v: Law Enforcement Rate

B_s: Percentage of 25-64 Age Group.

TABLE III

CORRELATION BETWEEN PROPERTY CRIME FACTORS WITHOUT B_v VARIABLE

	C_a	C_m	O	B	O_t	$O_{\ell 1}$	$O_{\ell 2}$
C_a	1.00	0.88	0.77	-0.66	0.49	0.58	0.60
C_m		1.00	0.75	-0.69	0.53	0.58	0.56
O			1.00	-0.34	0.77	0.72	0.71
B				1.00	-0.06	-0.14	-0.41
O_t					1.00	0.83	0.24
$O_{\ell 1}$						1.00	0.20
$O_{\ell 2}$							1.00

Note: $O = O_t \times (O_{\ell 1} \times O_{\ell 2})$

$B = B_s$

C_a: Actual Crime Rate

C_m: Calculated Crime Rate

O: Total Opportunity

B: Total Barrier

O_t: Density of Building

$O_{\ell 1}$: Density of Street

$O_{\ell 2}$: Degree of Mix of Land Use.

Correlation coef. = -0.75
Trend line is approximate
and not based on curvi-
linear regression.

Distance From City Center (Knoblock & Univ. Ave.)
1 unit = 5240 ft. (Ave. Distance of EDs)
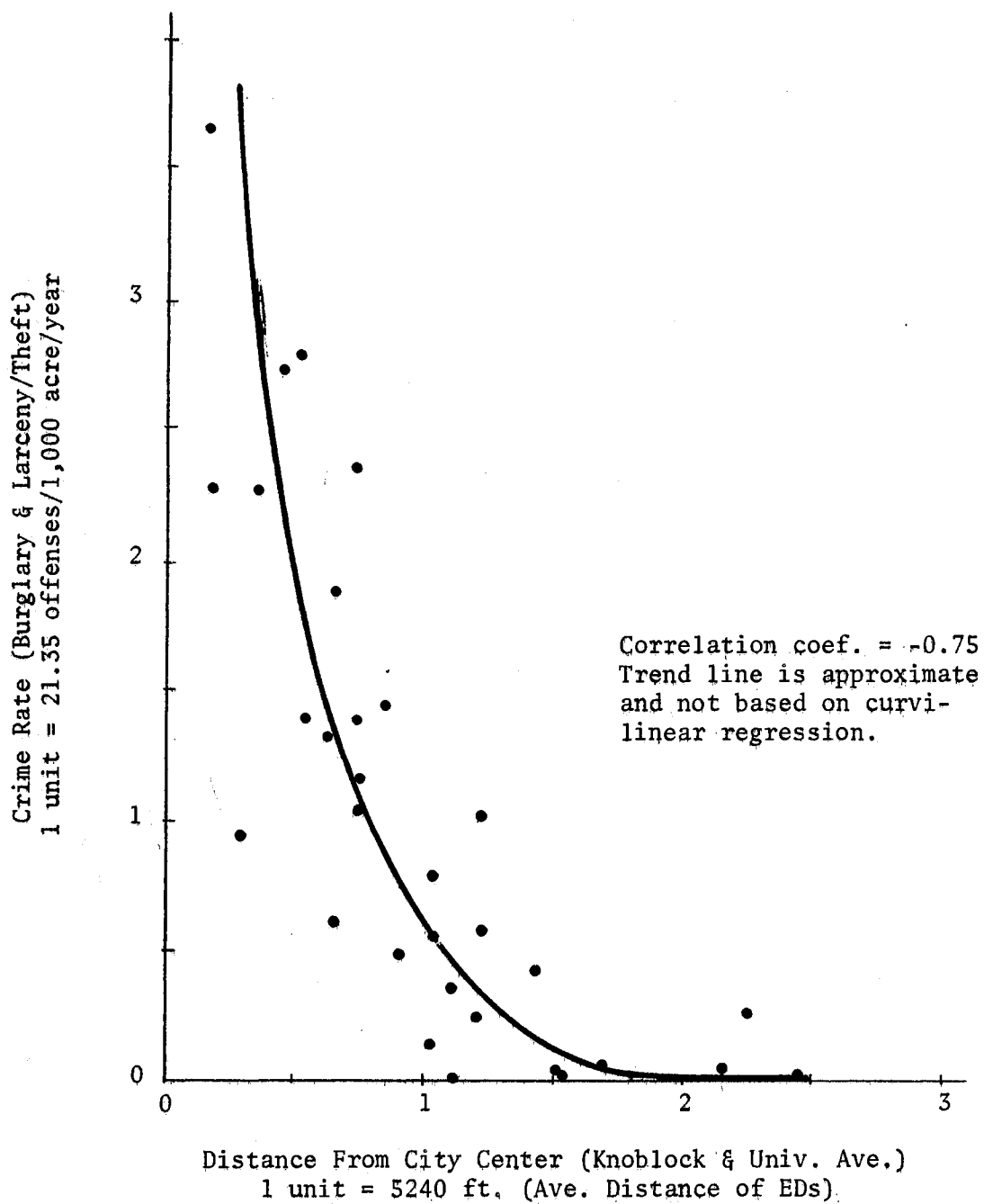
Note: Knoblock and University Avenue is the approximation of the
physical center of the city, which coincides with the cen-
ter of high crime district.

Figure 4. Relationships Between Crime Rate and Distance From
the Center of the City
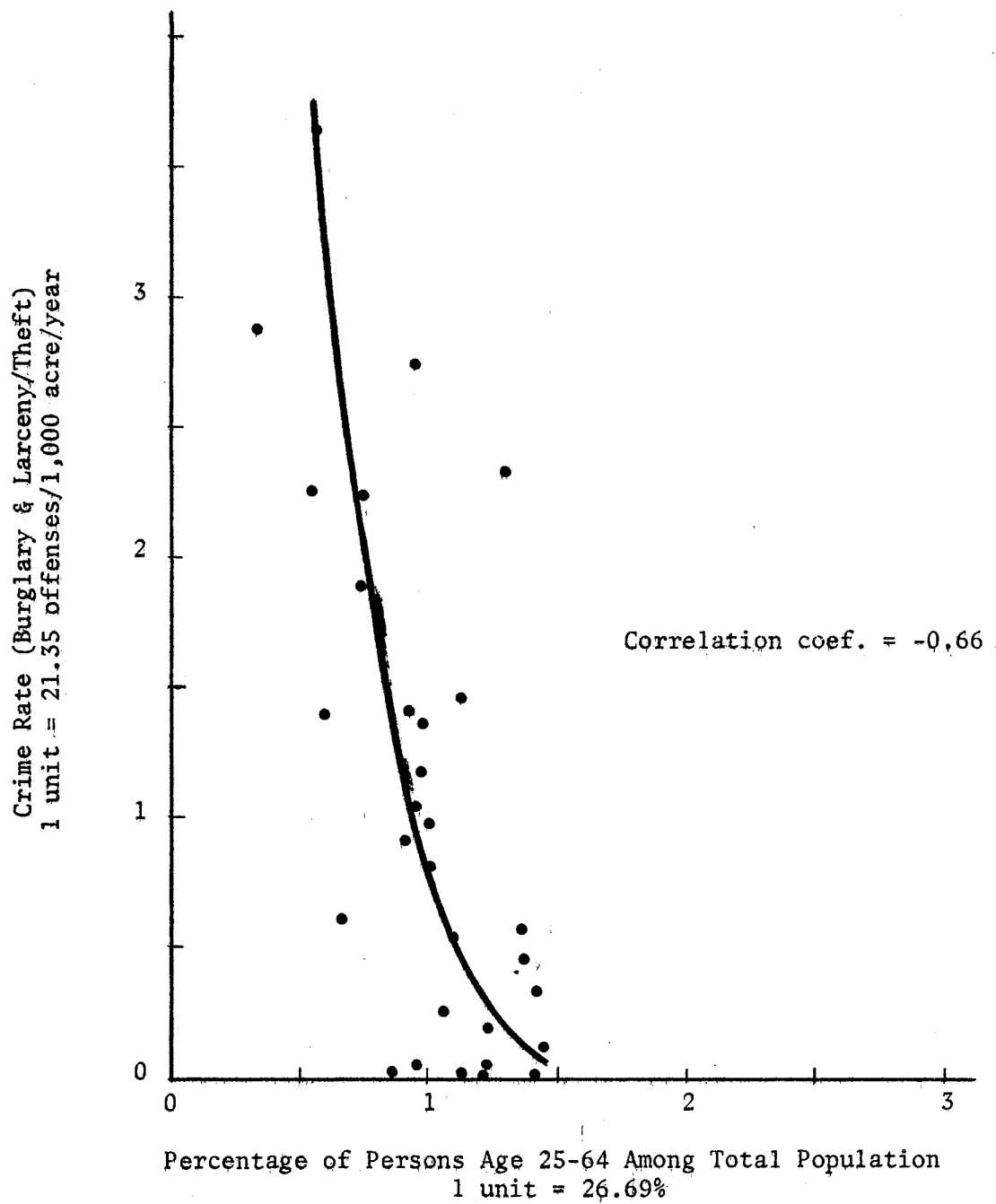
Figure 5. Relationships Between Crime Rate and 25-64 Age Group
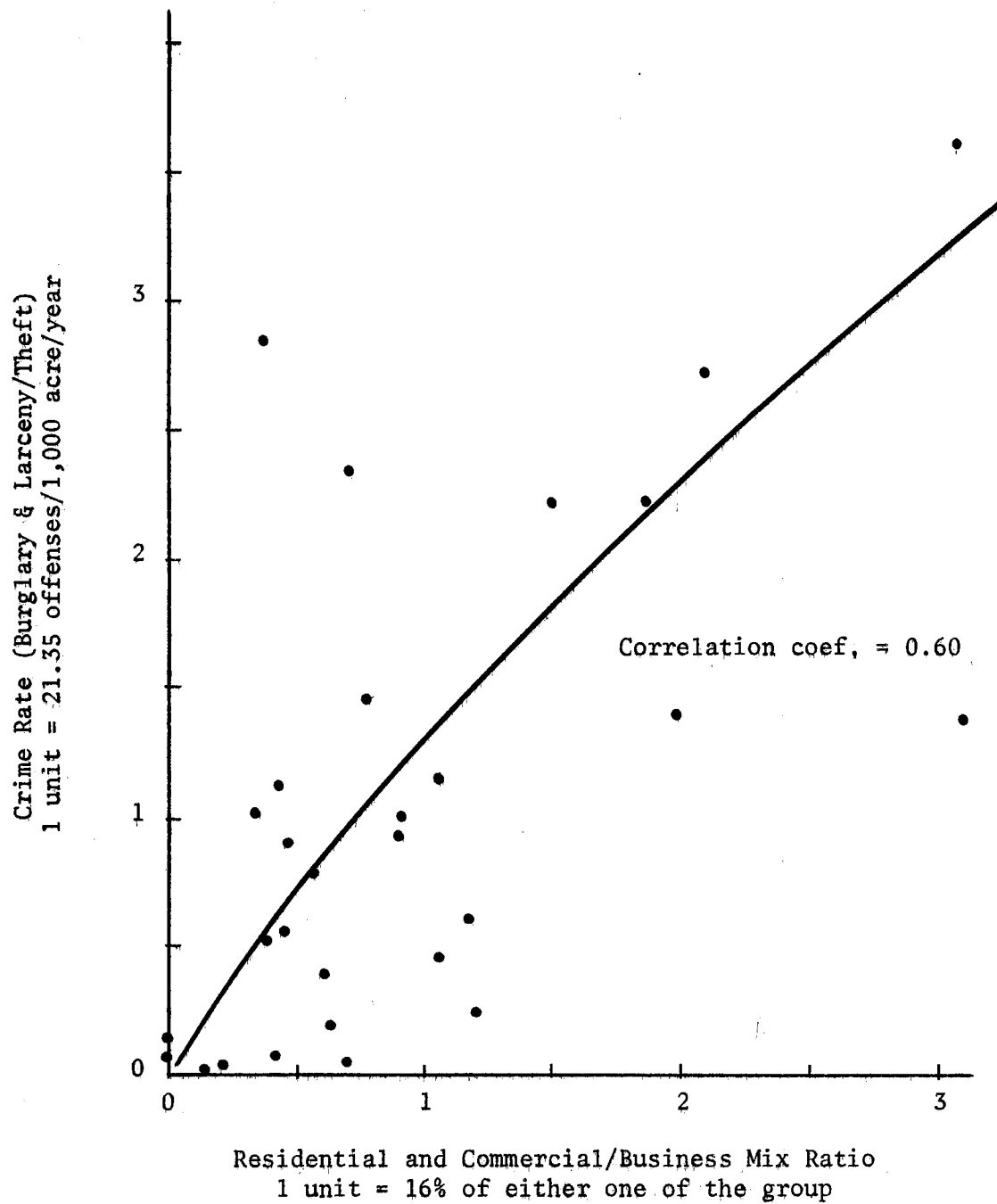
Figure 6.   Relationships Between Crime Rate and the Degree of
            Mix of Land Use
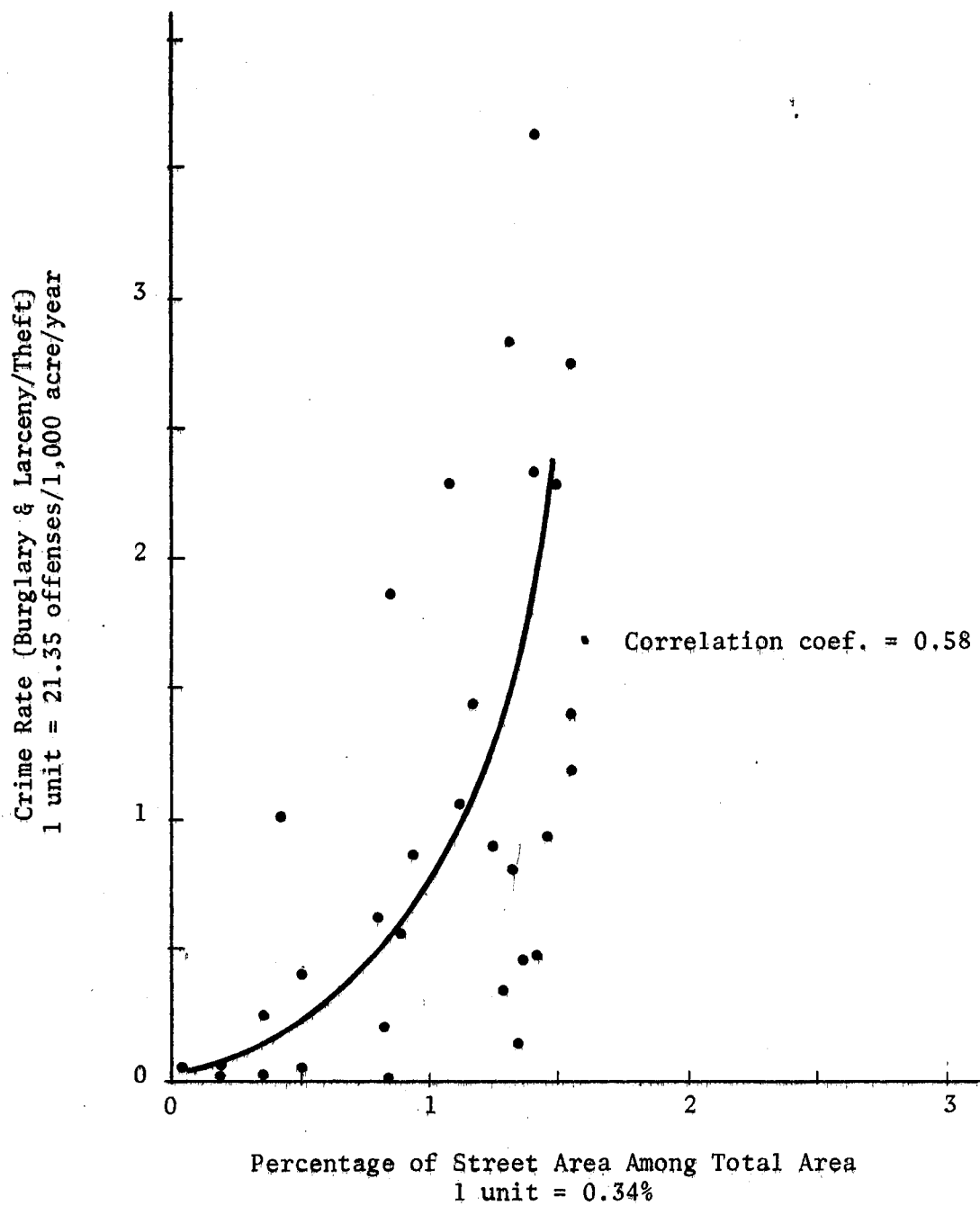
Figure 7. Relationships Between Crime Rate and Street Percentages
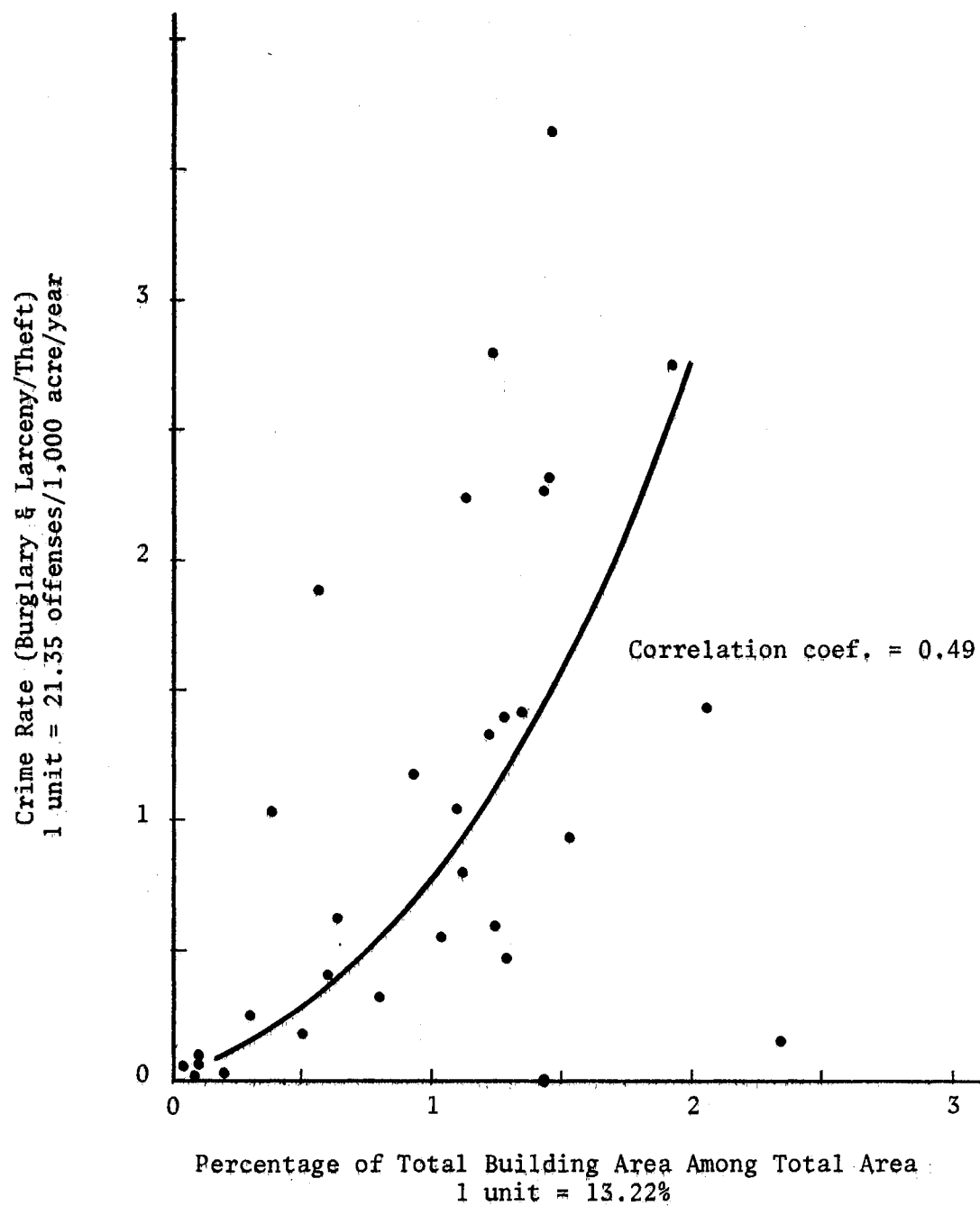
Figure 8. Relationships Between Crime Rate and Building Density

Among the opportunity variable group, $O_{\ell 2}$ (% comm. bldg. area)
showed the strongest correlation with C_a, with a coef. of 0.60 followed
by $O_{\ell 1}$ (density of street) with 0.58 and O_t (density of bldg.) with 0.45.
None of these correlation values exceed the value observed with total
opportunity, which suggests that the model for opportunity, $O_t \times (O_{\ell 1} +$
$O_{\ell 2})$, was satisfactory and further justifies combining $O_{\ell 1}$ and $O_{\ell 2}$ values
as a single factor controlling the effectiveness of O_t.

Among the barrier group, B_s (% of age 25-64 group) showed high nega-
tive correlation of -0.66 while B_v (police time/day) showed a low posi-
tive value of 0.31. The B_s value clearly confirmed the hypothesis while
the B_v value did not. A possible explanation for B_v value being posi-
tively correlated with C_a could be that existing high crime rates neces-
sitated positive law enforcement efforts.

Within the opportunity variable group, O_t and $O_{\ell 1}$ were highly cor-
related with a coefficient of 0.83. This was expected since an increased
amount of building in an area would necessitate an increased amount of
street in the area. It was found that no significant relationship ex-
isted between O_t and $O_{\ell 2}$ or $O_{\ell 1}$ and $O_{\ell 2}$ which means that the percentage
of commercial/business establishment in an area is not necessarily a
function of either the density of buildings in that area or the density
of streets in that area. This seems to be true and confirms the fact
that rezoning of land for commercial purposes is being exercised almost
regardless of its location or existing land use.

Within the barrier group, B_v and B_s showed a negative correlation
of -0.11. This means that even though the value itself is not signifi-
cant, these two variables are not working together as a barrier. B_s was
negatively correlated with C_a which tends to confirm the hypothesis, but

B_v was positively correlated with C_a which counters the hypothesis. The reason for B_v being positively correlated with C_a could be, as suggested before, that more law enforcement is being exercised where there is more crime. Removing B_v from barrier group, using only B_s as a barrier, correlation between C_m and C_a registered a correlation 0.88 explaining over 78% of total variance, an improvement of 0.05 over the correlation with B_v included in barrier group. Although the result itself suggests removal of B_v from barrier group, it is believed that precise measurement of B_v would help improve the model because B_v is an undeniable factor in crime. In this study, the values for B_v used for the model were the only ones that included some guess work in the absence of accurate data. All the other variables were highly dependable due to the nature of the data.

This study was oriented toward verifying only those factors contributing to the effect of environmental opportunities affecting property crimes. But the unexpectedly high correlation coefficient of 0.82 was obtained between all Index Crimes reported and C_m. This could be partially explained by the fact that the three major property crimes proposed for this study occupy over 70% of total crime, and there is a correlation of 0.70 between property crimes and all other Index crimes, among which vandalism and assault accounted for more than 60% (vandalism and assault are offenses different from property crimes). But since the nature of crime is closely related to its environment, these could have been included in the study from the very beginning. However, offenses against persons would have necessitated the introduction of variables such as personal history and so on for which the author did not attempt to hypothesize anything.

Inter-relationships Among Crime Pattern and

Urban Physical Environment

The pattern observed in terms of frequency per unit area for the
city clearly shows that a distance decay rule is working for crime. This
coincides with the idea that "Our crime is a predominantly urban phenome-
non."[12] The city itself demonstrates the idea in a micro spectrum. The
correlation between the frequency of crime and the distance from the cen-
ter of city showed a negative value of 0.75 indicating that there is a
significant correlation between the distance from the center and the fre-
quency of crime. This conforms to the finding of Shaw and Mckay in their
Chicago study.[13]

The rates per unit area varied from 0.01 to 3.68 within the city and
up to 9.68 in the campus compared to average value of 1.00 indicating
21.35 offenses per 1,000 acre per year.

Among the significant features that related most closely with the
crime rate were the degree of mix of land use and the percentage of mid-
dle age group in a community. ED 38B, showing the highest off campus
crime rate, features a concentration of diversified non-residential ac-
tivities to which 44% of total building area was devoted. This is the
area containing about the half of the city's beer joints, with regular
restaurants, record shops, a theater, game rooms, florists, and a photo
shop, dry cleaner, and travel agent, etc., with fraternity and sorority
houses and a lot of boarding houses. A frequency of 3.68 times above the

[12]Ramsey Clark, "Foreward," Barbara N. Mclennan, editor, p. xi.

[13]Clifford R. Shaw and Henry D. Mckay, Juvenile Delinquency and Urban
Areas, University of Chicago Press (Chicago, 1969), p. 78.
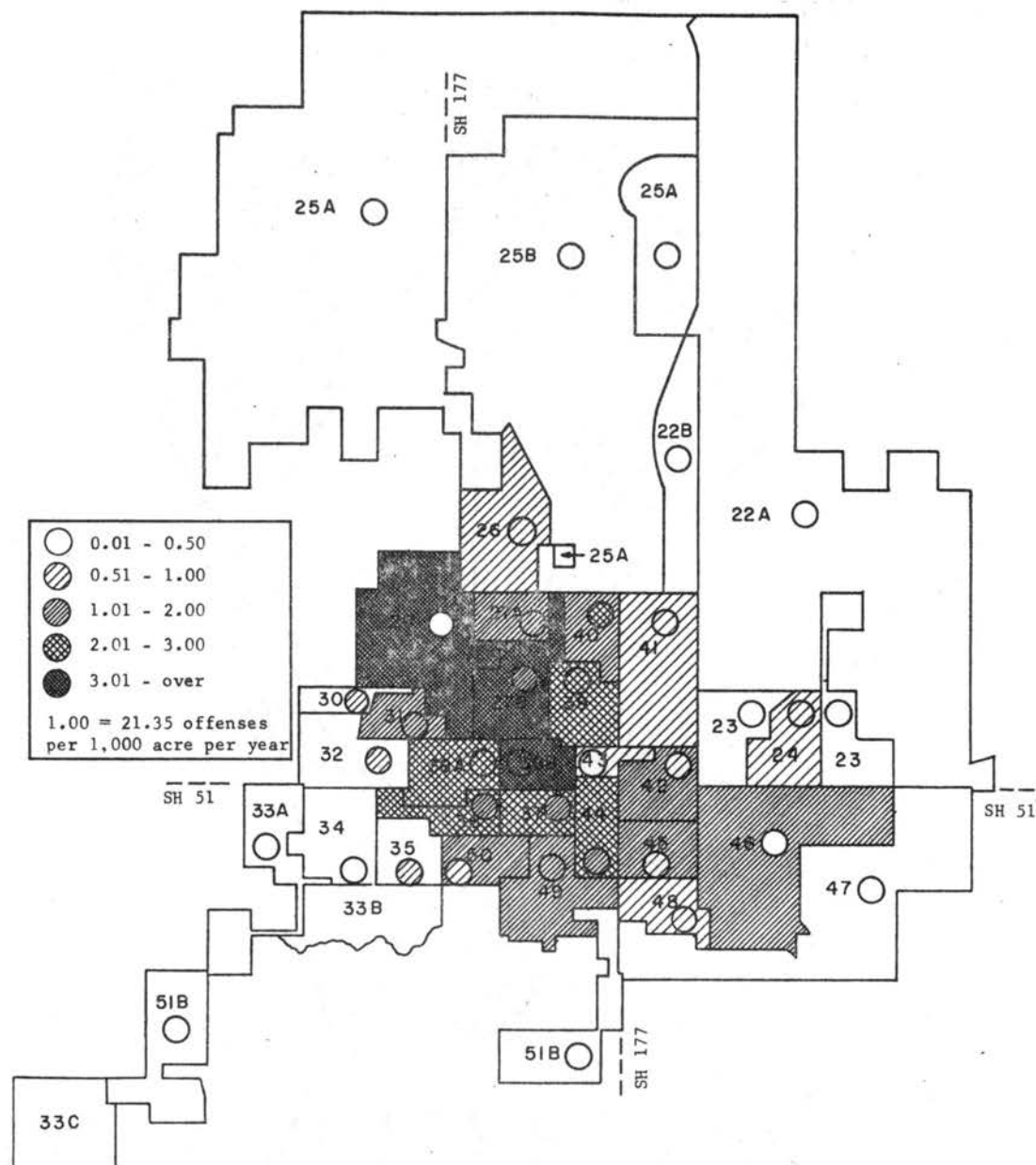
Note: Values in circles indicate predicted C_m values.

Figure 9.   Crime Rate per Unit Area per ED for Burglary and
Larceny

average crime rate was observed for ED 38B compared to a maximum of 2.76 over average in downtown ED 44 which features a stereotype commercial area with clothes shops, shoe stores, household good stores, a bank, theater, restaurants and other business offices. 82% of the total building area for the ED was devoted to commercial.
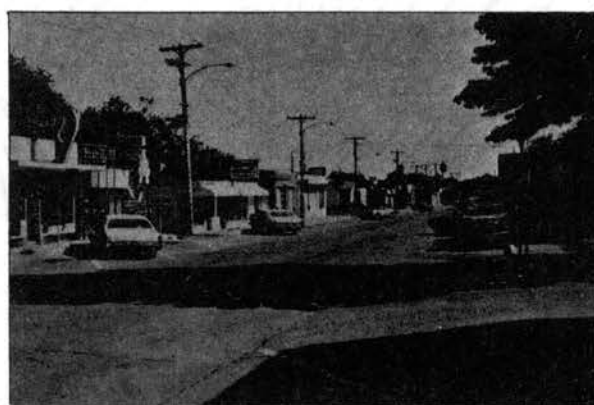
Figure 10. A Selected View in ED 38B

Figure 11. A Selected View in ED 44

The areas showing high crime rates next to downtown commerical areas are, ED 38A, 36, 39 and 37. An interesting characteristic of ED 38A, which is adjacent to the campus, and ED 38B is that the area is almost exclusively (except for 5% of the total building area) composed of fraternity, sorority or other apartment units usually occupied by students. ED 36 has a supermarket, a hospital, professional offices, and a number of small shops such as drug store and photo shop with most of the area (90% of total building area) in housing residential units.

Figure 12. A Selected View in ED 38A

Figure 13. A Selected View in ED 36

ED 39 is a predominantly student apartment district but features the second largest concentration of beer joints within the city with other activities such as a restaurant, small grocery, liquor store, beauty parlor, radio-TV shop, bicycle shop, etc., which occupied 22% of total building area for the ED. The area showed a higher mix of residential and commercial together with ED 37, yet showed a lesser crime rate compared to ED 38A. The possible explanation could be that while the streets in ED 38B and 38A are mostly a narrow residential type of streets which were being over-crowded by the need for commercial and large apartment units, major streets for EDs 39 and 37 are four lane highways or wider streets enough for street parking; the streets are not so over-crowded as in EDs 38B and 38A.

ED 37, with commercial buildings occupying 27% of total building area, houses a lot of gas stations, hamburger joints and governmental office buildings, besides the regular commercial features described for ED 44. Although some of these kind of activities do not seem to create a

very attractive setting for crime, the extremely high degree of mix of land use seems to create enough interest among offenders. All of the EDs mentioned above, EDs 38B, 38A, 44, 36, 39 and 37 show crime rates of more than twice the average rate.

Among the EDs showing crime rates between the city average and twice the average rate are EDs 27A, 45, 42, 31, 40, 49, 46, and 50 in descending order of crime rates. These EDs could roughly be divided into three categories. EDs 42, 45 and 40 are predominantly downtown commerical and grocery shopping, EDs 27A and 31 are almost exclusively housing and are located right next to the campus, and EDs 46, 49 and 50 are residential areas farther out from the center of the city housing low income groups and elderly people with the highest percentage of dilapidated housing within the city.[14]

Among EDs 42, 45 and 40, ED 42 is largely non-residential with large car dealerships, a school, a bus station and other stores. In a sense, ED 42 is a relatively unattractive area compared to the large amount of commercial features, because of the kind of establishments. A state highway cuts across the area with railroads passing through also. ED 45 is the part of commercial district toward the old sector of town which houses old structures with elderly people featuring lesser glamorous commercial activities such as furniture stores and hardware stores with 62% of commercial. ED 40 has two large supermarkets, a couple of gas stations, a car-wash, the local telephone company warehouse, and a few trailer homes. ED 40 does not seem to offer much visible attraction but the fact that 29% of the total building area is commercial and that it is

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[14]City of Stillwater, pp. G4-G5.

right next to the university seems to explain the more-than-average crime rate.

Figure 14. A Selected View in ED 42

Figure 15. A Selected View in ED 43

ED 27A and 31, both of which features the commercial building per-
centages below seven are predominantly residential. A difference between
these housing areas and other areas could be that the area is right next
to campus; this seems to be the only visible reason for the high crime
rate.

EDs 46, 49, and 50 are located at the southern boundary of the city
which is the old sector. With relatively low quality housing and bad
drainage during the rainy season, and with a somewhat unattractive
housing and creek running to the south, the area offers the lowest rents
within the city. These EDs show less than average crime rate within the
city.
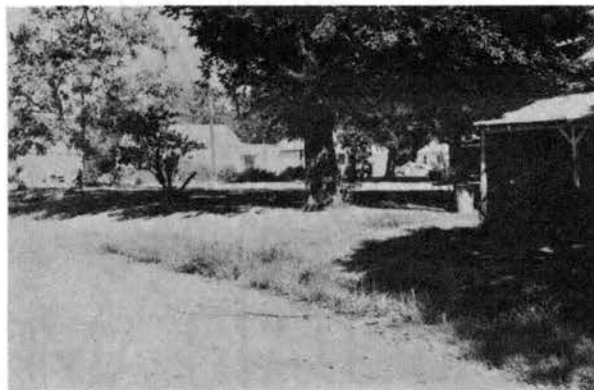
Figure 16. A Selected View in ED 49

Figure 17.   A Selected View in ED 50

Figure 18.   A Selected View in ED 32
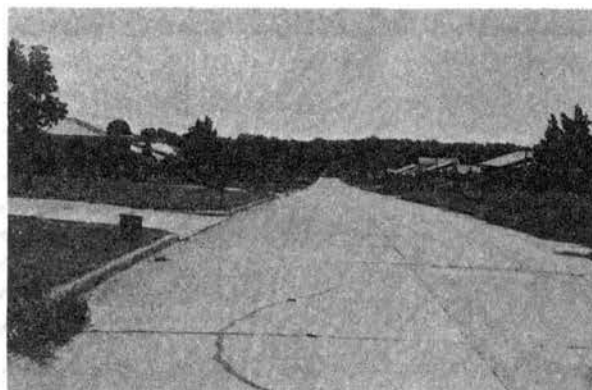
Figure 19. A Selected View in ED 25B

For the rest of the city, the crime rate per unit area decreases as
an ED gets farther from the center and as the percentage of open land in
an ED increases (not only within the ED but also around it), and as the
land use approaches 100% residential.

Those EDs showing crime rates between the lowest and the average are
located in between the low and high crime rate areas. One characteristic
of these EDs is that they have 5-18% commercial building areas and share
one of the two major accesses in the city.

Overall, the crime pattern coincides with the degree of urbanization
and degree of mix of land use in an area, whether in terms of the types
of activities or the kinds of people living in it. The uniqueness of a
student population serving as the nucleus in terms of location and fre-
quence of crime rates does not hamper the overall hypothesis because it
is not necessarily the student population that affects the crime rate,
but rather the physical pattern created to meet the student population.
This could be re-emphasized with the example of EDs 22A, 23 and 25B which

house a large student population yet display lower crime rates due to predominantly single purpose land use and the low density of development.

Evaluation

The model rendered significantly high correlation between actual (C_a) and predicted (C_m) values. Furthermore, the correlation was relatively even throughout high and low crime areas without skewing appreciably (Figure 20). But there were few isolated cases of large differences between C_m and C_a. The highest differences were found in six EDs (22B, 30, 31, 32, 36 and 46) where the predicted values were more than 50% above or below the actual values. Another five EDs (27A, 40, 45, and 50) displayed 25%-50% differences between C_m and C_a.

The cases with high remaining unexplained variances could be credited either to an improper weighing of variables or to a lack of necessary variables. These problems are noticed in several EDs as follows.

1. EDs 22B, 30 and 32 which showed highest C_m value above C_a had no commercial areas. It was hypothesized at the beginning of the modeling that zero commercial does not necessarily mean zero locational advantages, so the residential homogeneity did not receive any particular attention in the model. In view of these EDs, the weighing of percentage of commercial activities seems to need further investigation at the low end of its scale.

2. EDs 31 and 36 showed C_m value below C_a. These areas are located right next to the highest crime area in the city, and it seems like the effect of permanent process needs to be further incorporated in the model.
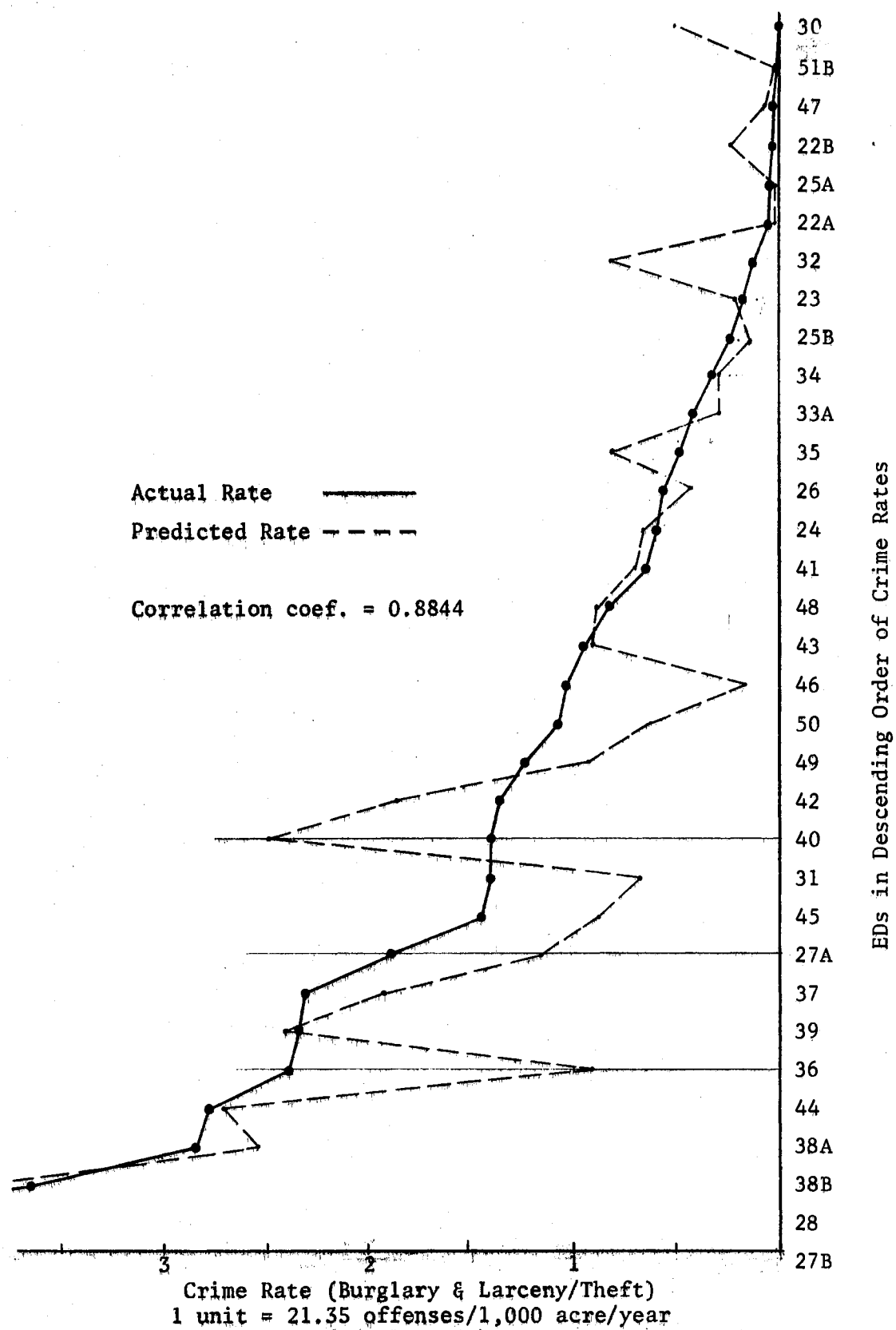
Figure 20. Relationship Between Actual (C_a) and Predicted (C_m)
Crime Rate

3. EDs 35 and 40 showed C_m values above C_a. A possible explanation

could be drawn from the kind of non-residential structures in

the area. ED 35 has a municipal hospital and doctors' clinics

as its major non-residential structure. ED 40 has a telephone

warehouse, three gas stations and two car washes which make up

most of the non-residential structures apart from two small

supermarkets. The question is the effect on the environmental

opportunity for crime of these types of facilities compared to

regular commercial and/or drinking and entertainment types of

facilities. The current model did not distinguish between dif-

ferent non-residential activities; they were all included in the

commercial category, and it is believed that the more uniform

treatment in the current model has brought higher C_m values in

EDs 35 and 40 which is believed to have less attractive types of

non-residential activities from the potential offenders' point

of view.

The purpose of the model was twofold: first, to assist understand-

ing of the relationships between environmental opportunities and crime,

and second, to utilize the information to predict any future crime. The

model seems to have provided an acceptable explanation in the first re-

spect, but it does not incorporate a predictive capacity because data for

all the variables for any future time are unobtainable and hypothetical.

It is believed that the model needs further development in order to

be of any predictive value. Development of a simulation model is one

possible way of serving the purpose.

CHAPTER V

DEVELOPMENT OF THE SIMULATION MODEL

Diffusion of Delinquent Activities

As was noticed in Figure 4 and subsequent discussions in Chapter IV,
the pattern for property crime indicates that there is a gradual decline
of offense rates among adjoining areas from the core of the city toward
the periphery. The variables found to be significantly related to the
crime rate were those also closely related to urban growth. Changes in
crime patterns seem to be inevitable since the urban environment is a
dynamic setting, and thus environmental opportunities change.

Although there exist zoning regulations, they usually describe the
maximum or minimum boundaries of physical development; furthermore, the
regulations are subject to change by and/or through political-economic
pressures. The spatial distributions of urban functions are those of
dynamic interaction and so is the crime pattern because it is a part of
the total urban mechanism.

An analogy to changes in crime patterns could be found in an
"anticipation-turnover-stabilizing" process utilized by Berry in exam-
ining socio-economic patterning.[1] During a prospective change or closing
down of a space, due to a failure of some kind or some other problem, the

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[1]Brian J. Berry, "Internal Structure of the City," Internal Struc-
ture of the City, Larry S. Bourne, editor, Oxford University Press (New
York, 1971), pp. 69-74.

owner cares less and dilapidation starts, continues throughout the turn-over phase with lower rent, and then with a new owner occupying the va-cated space, the pattern stabilizes with a different character, depending upon the type of new facility. The degree of dilapidation (lowering of rent) and changes in the character of facilities could be analogous to the degree of changes in environmental opportunities: less surveillance created by decreased feeling of attachment to the space expecting turn-over of ownership which brings about an unstabilized physical and social atmosphere, and more target value with increased mix ratio among differ-ent facilities.

In the event of any physical changes, whether a house on a vacant lot or a shop instead of a residence, there is a time lag between the physical changes and changes in the total environment. First of all, any changes in physical form take time. Even after the physical changes it would take quite some time before the impact of the changed physical structure was felt in terms of its environment in the volume and charac-ter of traffic, in the attitude of people within and toward the area, and so on. Actually, it could be said that a change in crime pattern is something that may follow changes in the physical environment. It is be-lieved that the changes in crime pattern could be simulated by simulating the changes in the major variables found in the study so far.

Simulation Model

The simulation model is designed primarily on the basis of the ex-pansion of economic activities and changes in the residential structure which are believed to be more dynamic and abundant than other factors, such as changes in the area of street. The changes in the density of

total building area and street are indirectly incorporated in the model because they are related to other factors such as overall population increase and the business expansion in a community.

As was witnessed in Table III, the highest correlation with actual crime rate was inverse to the percentage of 25-64 age group (B) followed by mix ratio of land use $(O_{\ell 2})$, street density $(O_{\ell 1})$ and building density (O_t). Within the selected variables, high positive correlation was found between O_t and $O_{\ell 1}$ and a noticeable negative correlation between B and $O_{\ell 2}$ while the rest showed insignificant correlation.

Since the growth of a community is primarily due to the increase in population and the subsequent increases in the volume of economic activities within the community, it will be natural to simulate urban growth in terms of changes in population and economic activities. The crime rate shares the same factors as those indicated in Table III, only in a modified scale, including the changes in population in terms of the incumbent age group, and changes in economic activities in terms of the degree of mix of land use. While these two variables are found to be most significant, they are of contrasting nature (as was found in preceding studies) showing a negative correlation of -0.41. An increase of commercial tivities in an area would decrease the number of middle age group in that area.

As for the density of streets and building, the changes will be much slower and they could be represented by the other two variables, population and economic activities. The density of streets and buildings is something that is believed to increase steadily in proportion to increase of population and economic activities, which in return could be related to total increase in crime. Since the simulation model is concerned with

the pattern of distribution of expected increase in crime, the introduction of the two variables, density of both streets and buildings, is believed to be a duplication.

The contagion of crime will be simulated following the steps described below.

1. Assign 10% annual increases in total property crime which was found to be the average annual percent increase during 1960-70.[2] The increase will be assigned using random numbers with a probability that the increase is proportionate to the existing crime rate in an area. It could be assumed that an area with a higher crime rate already has high environmental opportunities and that the area is apt to be a target of new offenders. It could also be said that such an area with obviously high development is apt to see more development which in turn would add to the opportunity in that area.

2. In the absence of reliable data concerning the diffusion rate of crime, an assumption of 25% annual diffusion is made as follows; the national average housing turnover rate was found to be 19% for all ages and 20% for persons age 25-64.[3] This means that average annual change in the percentage of persons age 25-64 in an area is 20%, and/or a 20% change in the barrier variable used for conceptual modeling.

The annual average increase in the volume of construction

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[2]"Table No. 216, Crime and Crime Rate, by Type 1960 to 1970," The American Almanac, for 1972, Bureau of Census, U.S. Department of Commerce. Grosset & Dunlap publishers (New York, 1972), p. 140.

[3]"Table No. 41, Mobility Status of the Population Characteristics 1969 and 1970," The American Almanac (New York, 1972), p. 34.

for the 1959-1969 period was 2.5% measured by an index of physi-

cal volume for 1957-59 as 100.[4] The new construction, whether

housing or non-residential would change the physical environ-

ment, and thus the opportunity variable.

The composition of two variables would produce many differ-

ent types of situation depending upon the original composition

and the direction of new changes. At one extreme, with an in-

crease in construction in the non-residential category (thus in-

creasing the opportunity variable) and changes in age group

tending toward the reduction of the 25-64 age group in an area

(thus decreasing the barrier variable) the total change in en-

vironmental opportunity could be assumed as 2.5(%) x 20(%) =

50(%). At another extreme, all the changes could happen in such

a way that there may be a 0% change in the environmental oppor-

tunity in an area.

With one extreme of 50% change and another extreme of 0%,

the average of 25% was taken as an approximation of annual

changes in the environmental opportunity, and thus the potential

of changes in the diffusion rate for crime.

3. Migration within EDs will happen in the following manner: a.

Each urban migrant will behave according to a migration proba-

bility field (Figure 21). The migration fied will be shifted

about so that each migrant would be regarded as located at the

point indicated by X. The numbers in the blocks show where the

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[4]"Table No. 1084, Value of New Construction 1957-1959 Prices, and Index of Physical Volume: 1950-1970," The American Almanac (New York, 1972), p. 658.

migrant is to move depending on which number is selected for him in the manner described below. A random number will be selected for a typical migrant, and the location of the same number on the migration field gives the destination of the migrant relative to his current position X. The crime migration field is designed after the negro migration field used for Morrill's study of negro migration in Seattle.[5]

1	2	3	4	5	6	7	8	9
10	11	12	13	$14-15$	16	17	18	19
20	21	22	23	$24-25$	26	27	28	29
30	31	32	33	$34-35$	36	37	38	39
40	41	42	$43-44$	$45-47$	$48-49$	50	51	52
53	$54-55$	$56-57$	$58-60$	X	$61-63$	$64-65$	$66-67$	68
69	70	71	$72-73$	$74-76$	$77-78$	79	80	81
82	83	84	85	$86-87$	88	89	90	91
92	93	94	95	96	97	98	99	00

Figure 21. A probability Model of Crime Migration Field

[5] Brian J. Berry and Frank E. Horton, Geographic Perspective on Urban System, Prentice Hall, Inc. (New Jersey, 1970), pp. 426-428.

The migration field could be called an information field or
an opportunity field. The idea is that a person's information
about physical environment will decrease as the distance in-
creases from his original operation field. Another point is that
there is a general distance decay rule working in terms of the
dispersion of delinquent activities which is partially confirmed
by the geographically continuous and gradual changes in crime
rates (Figure 2). The above mentioned ideas were incorporated
in the field by assigning more numbers to the locations close to
X (current location). The degree of probability in relation to
distance was derived from Figure 4, and the overall form of the
field has been derived from Figure 2 which indicates that the
greatest geographic dispersion in Stillwater is to the north
followed by west and east with least dispersion toward south.

    b. Randomly selected numbers, as many as there are crime
migrants, are used to choose specific destinations. But whether
the intended migration will happen or not will be decided de-
pending upon the accetability of the area destined. The accept-
ability of an area will depend upon the characteristics of the
area in terms of its physical-social environment. The two vari-
ables used for determining the dispersion rate will be used for
the determination of acceptability in an area. Degree of ac-
ceptability could be measured by dividing the percentage of non-
residential building area by the percentage of 25-64 age group.
It was found that a predominantly residential area with low per-
centage of non-residential building area usually has a high per-
centage of 25-64 age group yielding a low value (acceptability),

Where the mix ratio of land use is high, the percentage of 25-64 age group is generally low and the value (acceptability) is high. The total number of persons in 1970 in the U.S. was 203,166,000 of which 89,765,000 (44% of total) was aged between 25-64.[6] The total building construction in the U.S. during the period 1950-1970 was 318,470 million dollars among which 139,175 million dollars (43.7% of total) was non-residential construction.[7] The volume of new construction during the 20 year period was used to approximate the average percentage of non-residential building area among total building area. The average acceptability based on the above mentioned averages is 43.7(%) ÷ 44(%) = 1.00. An acceptability value 1.00 represents those average locations where crime rates are believed to be average, and the resistance against crime is also believed to be average.

Acceptability values (hereinafter to be called A_v) for each ED will be rounded off using 0.25 as a unit of measurement. The reason for using A_v 0.25 (25% of A_v 1.00, found to be the average value) as a unit of measurement is to comply with the idea of 25% annual diffusion rate set previously. The idea is that the turnover rate of crime is closely related to the changes in the condition which enables the turnover of criminal activities.

(1) A_v 1.00 will be used as a basis for determining the

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[6]"Table No. 21, Population by Age and Sex, 1960 and 1970," The American Almanac, for 1972, p. 23.

[7]"Table No. 1084, Value of New Construction in 1957-59 Prices, and Index of Physical Volume: 1950 to 1970," The American Almanac, for 1972, p. 658.

degree of acceptability; the location with A_v 1.00 or above will enable migration at first contact.

(2) Those locations with A_v less than 1.00 will not receive migration at first contact. Every contact with these areas will increase the A_v by 0.25, and when the successive contacts have been made to increase the value up to 1.00, migration will be accomplished. The reason for adding A_v 0.25 for every unsucessful contact is, as explained before, because the attempted migration, in reality, is an attempt of socio-economic forces to infiltrate the area and change the environmental opportunity in that area. Even though an attempt might fail at the first time, a successive attempt within short periods of time often yields a transaction among the parties involved because attempts are usually made when there are signs of probability. The exact amount of A_v to be increased per contact is subject to further empirical study. For the current study, it is tentatively assumed that each contact will increase one unit of A_v (0.25).

(3) Those areas adjacent to the areas with A_v above 1.00 will automatically be given A_v 0.25. This measure is taken to accomodate the idea of the distance decay rule working in urban development. It is unlikely that an area right next to the average development has zero development. The assignment of A_v 0.25 to previously zero value areas will partially reflect the natural geographic growth of urban areas.

Hypothetical Example of the Model

Distribution of Annual Increase

Assume that the total number of offenses are 100, distributed spatially as in Figure 22. The numbers in each block indicate the number of offenses per year at that location. 10 offenses (10% annual increase) will be added to the total number with the probability that an area will receive any increase is proportionate to the block's current offense rate, which is the same in percentage as the offense is in number. In order to use random numbers to locate the increases, the probabilities are first accumulated as whole integers, from 1 to 100, as illustrated in Figure 23. Each original offense is assigned a number; the third block from the left in the first row has 3 of the 100 offenses, identified by number 1-3, and therefore has 3 percent chance of being chosen as a destination of the newly added offenses. If random number 1, 2 or 3 comes up that offense will be assigned to the third block in the first row.

For the increase of 10 offenses 10 random numbers are needed. Assume that, from a table of random numbers, the numbers 69, 5, 45, 26, 89, 37, 9, 43, 77 and 50 were obtained. The first number, 69, falls in the fifth block in the fifth row in Figure 23. The second number, 5, will fall in the fourth block in the first row. This process is continued until all 10 random numbers are used. The final distribution of the increased offenses is shown by the small marks in various blocks in Figure 23. The offenses per block after this immigration are shown in Figure 24. The large numerals in the blocks in Figure 24 indicate the updated number of offenses after 10% increase has been added.

		3	8	0			
		3	3	2	3		
		0	2	7	4		
	0	8	7	1	1	3	
2	1	5	4	6	4	13	0
	1	2	3	3	1		
			0				

Figure 22. Offense Frequencies
at Start of Period

		1 3	[c] 4 11			
		12 14	15 17	18 19	20 22	
			23 24	25 31	32 35	
		[a]36 43	[b]44 50	51	52	53 55
56 57	58	59 63	64 67	68 73	74 77	78 90
	91	92 93	94 96	97 99	00	

Figure 23. Distribution of Offenses

		h 3	c 9_2	0			
e		3	3	f 2	3		
		0	2	9_2	g 8 4_1	i 1	
	0	a 10_2	b 9_2	1	1	3	
2	1	5_1	d 5_1	8_2	4_1	15_4	0
	1	2	3	3	1		
			0				
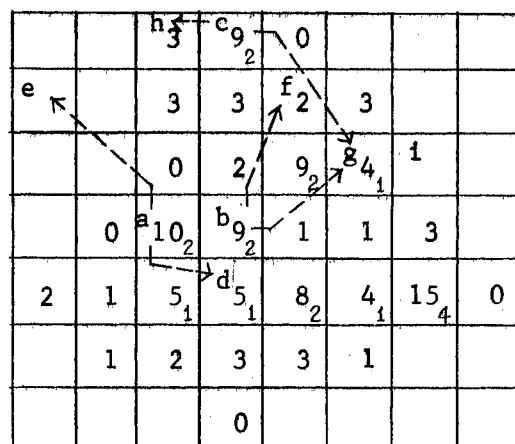
Figure 24. Diffusion of Offenses
From Sample Blocks

		h .25	c .50				
e		.25	.25	f 1.25	.25		
		.00	.25	1.25	g .50	i	
		a .50	b 2.25	.50	.25	.25	
.25	.25	.25	d 1.25	2.25	1.25	.25	.25
	.25	.25	.50	1.50	.25		
			.25				

Figure 25. Acceptability Values at Start
of Period

Diffusion of Offenses

Twenty-five percent of the offenses of each block, rounded off to the nearest whole number, are taken as potential migrant offenses. The rounding off yields a total of 18 potential migrants, as indicated by the small italic numberals in Figure 24. Diffusion from the three blocks marked (a), (b) and (c) will be used to illustrate the process. Assume the random numbers obtained for the six potential offenses are 77, 32, 36, 50, 60 and 89. The first migration from (a) is represented by the random number 77. This provides a location one block down and one block to the right of the migrant's origin, X in Figure 21, to (d). The A_v of the block (d) is 1.25 (Figure 25), so the migration is made. The second migran'ts random number from (a) is 32 indicating the direction is two blocks up and two blocks to the left of the migrant's origin X according to Figure 21 to the block marked (e). Block (e) shows zero A_v, so the migration is not accomplished, instead, the contact increases A_v 0.25 for the block (e). The first migrant from (b) will move to (f) which has A_v 1.25. The second migrant from (b) will not move to (g) which has A_v 0.50, but the contact will increase A_v for (g) by 0.25 to 0.75. The migrant from (c) will fail to move to (h) but increase A_v for (h) to 0.50 from 0.25. The second migrant from (c) will be unable to move to (g) but increase the A_v for (g) up to 1.00, which means that (g) is prepared to receive any future migration. The increase of A_v up to 1.00 in (g) will induce a creation of A_v 0.25 in the adjoining block (i). The actual move is indicated by solid lines and unsuccessful attempts are shown by broken lines.

Although the values used for the model have used Stillwater data, the model used the data only to the extent of explaining an example of

crime diffusion in one year span. Long range simulation seems to be use-
less at this point due to the absence of such data, and subsequent
unavailability of any comparison between the actual dispersion and simu-
lated dispersion.

CHAPTER VI

SUMMARY

The prime objective of this study was to verify the existence of

relationships between property crime rate and physical environment. The

effect of physical environment in bringing about actual commitment of

property crime was conceptualized as those which encourage offenses

(opportunity) and those which discourage offenses (barrier). Ten dif-

ferent variables were defined for the purpose of describing physical en-

vironment of which only four were found to be significantly related with

property crime. Among the findings were that density of building,

density of street and mix ratio of land use in an area relate positively

with property crime rate in the area, and that percentage of persons age

25-64 works negatively. A distance decay function was observed between

property crime rate and the distance from the center of the city. A

simulation of diffusion of property crime rate was attempted based on the

concept of opportunity and barrier.

Although crime and its associated causes have raised a variety of

interests among many disciplines in many different directions in the

past, much of the understanding and benefit have been limited within the

parameter of punitive or corrective prevention. It was only recently

that an effort has been made to relate crime with its physical environ-

ment providing some basis for mechanical prevention. The research into

physical environment, currently metnioned, is an extension of criminology

in which an offender's past history in relation to his social and physi-
cal environment is analyzed. Physical environment has been generally
recognized as a factor that affects a person's psychology and perception
of values as an inseparable factor from the life style of a community.
But physical environment, synthesized as an environmental opportunity in
this study, has been shown to be responsible for the materialization of
potentials for delinquency.

Due to the unavailability of cumulative data for many of the factors
related to the physical environment, statistics about the volume and
changes in buildings and their uses, streets, etc., on a small area unit
basis, this study has shown the effect of environmental opportunity on
crime only on somewhat limited scale. The simulation model was developed
in order to utilize some of the understandings for practical purposes.
Here again, due to the lack of long term statistics concerning diffusion
rates and the diffusion pattern of offenders, the designed model has not
been fully tested but rather suggested with some limitations. Since the
study was carried out in a relatively small community, for a short period
of time, the models developed in the study are believed to be short of
generalization. For a large scale high density area, the variables con-
cerning buildings and streets seem to need further modification in units
of measurement. It is believed that both areal and volumetric measure-
ments are needed for greater urban areas, and the statistics need to be
compiled on a small areal unit basis in order to facilitate further
in-depth research.

Understanding of the role of the physical environment for the actual
commitment of offenses will enable planners and law enforcement officials
in arranging and assigning their schemes and priorities more effectively.

Furthermore, the understanding will help individuals in protecting their properties as well as their future investments.

It is hoped that the concept of opportunity and barrier dealt with in this study will serve as a reference for further investigation in environmental studies and contribute to the more comprehensive understanding of crime.

SELECTED BIBLIOGRAPHY

American Sociological Association, American Sociological Review, Vol.
30, No. 6, December (1966).

Angel, Shlomo. Discouraging Crime Through City Planning, Center for
Planning and Development Research working paper No. 75, Institute
of Urban & Regional Development, University of California, Berkely
(1968).

Berry, Brian J. and Frank E. Horton. Geographic Perspectives on Urban
Systems, Prentice Hall, Inc., New Jersey (1970).

Bourne, Larry S. ed, Internal Structure of the City, Oxford University
Press, New York (1971).

Bureau of Census, U.S. Department of Commerce. The American Almanac, for
1972, Grosset & Dunlap Publishers, New York (1972).

City of Stillwater, Oklahoma, Neighborhood Analysis, Stillwater (1971).

Fink, Arthur E. Causes of Crime, University of Pennsylvania Press,
Philadelphia (1968).

Gibbons, Don C. Society, Crime and Criminal Careers, Prentice Hall,
New York (1968).

Glaser, Daniel. ed. Crime in the City, Harper & Row Publishers, New
York (1970).

Guenther, Anthony L. ed, Criminal Behavior and Social Systems, Rand
Mcnally & Co., Chicago (1970).

Hoover, John Edgar. Crime in the United States, Federal Bureau of
Investigation, Uniform Crime Reports, Washington (1971).

Board of the New York University Law Review, Law Quarterly Review, Vol.
67, October (1951).

Leonard, Jerrs. Department of Justice, Mimeograph Document, N.D., N.T.,
p. 10.

Mclennan, Barbara N. ed. Crime in Urban Society, The Dunellen Co, Inc.,
New York (1970).

Proshansky, Harold M., William H. Ittelson, and Leanne G. Rivlin. ed. _Environmental Psychology_, Holt, Rinehart & Winston, Inc., New York (1970).

Shaw, Clifford R. and Henry D. Mckay. _Juvenile Delinquency and Urban Areas_, University of Chicago Press, Chicago (1969).

Windle, Ernest and James W. Marsh. _Man and his Motives_, Exposition Press Inc., New York (1954).

Wolfgang, Marvin E. and F. Ferracuti. _The Substructure of Violence_, Tavistock, London (1967).

APPENDIX A

CRIME RATES FOR STILLWATER, OKLAHOMA, 1970

	Burglary	Larceny & Theft	Sub Total	Vandalism & Assaults	Other Offenses	Total
22A	5	17	22	11	2	35
22B	0	1	1	2	0	3
23	4	6	10	2	0	12
24	3	17	20	8	3	31
25A	2	16	18	3	1	22
25B	13	48	61	14	8	83
26	8	11	19	4	0	23
27A	4	20	24	3	1	28
27B	11*	7+181*	199	2**	0	
28	1+11*	8+181*	201	3**	1**	
30	0	0	0	3	0	3
31	0	16	16	3	1	20
32	1	2	3	5	0	8
33A	2	12	14	3	2	19
34	0	7	7	9	0	16
35	2	5	7	5	0	12
36	2	33	35	1	1	37
37	10	16	26	9	4	39
38A	12	46	58	12	3	73
38B	15	32	47	19	3	69
39	18	31	49	8	6	63
40	3	14	17	4	3	24
41	6	19	25	12	5	42
42	10	16	26	3	6	35
43	3	3	6	4	2	12
44	16	29	45	2	27	74
45	12	12	24	6	3	36
46	0	95	95	5	11	111
47	1	1	2	1	0	5
48	6	3	9	4	0	13
49	13	5	18	10	2	30
50	10	5	15	4	0	19
51B	0	2	2	2	0	4
Tot.	172	530	702	181	95	978
%	17.22%	52.95%	70.17%	18.11%	11.72%	100%

Note: Datas based on Neighborhood Analysis, City of Stillwater,
Oklahoma, Sept., 1971.
*22 burglaries and 362 larcenies occurred in campus (EDs 27B and
28) were divided among two EDs equally and added to city
rate. The rates for the two EDs were not counted for in
calculating correlation coef. within offense rates.
**Only the rates reported by City Police.

APPENDIX B

AREAL STATISTICS FOR EACH ED.

	Total* Area s.f.	Bldg.* Area s.f.	Street* Area s.f.	Comm.* Area s.f.	No. Traffic** Accident	Total No.*** of Person	Age Between 25-64***
22A	126877580	1502253	77220	99348	170	1360	599
22B	5883000	28860	10050	0	21	84	26
23	10834740	697088	31195	69375	132	1049	467
24	7144260	1161071	34565	72660	85	786	379
25A	99886680	1239315	26995	127650	30	523	185
25B	51738210	1870200	62935	351830	308	2677	1078
26	7170610	954710	21645	53280	70	1254	490
27A	2579420	184544	12000	11100	91	911	244
27B	4216890	892440	9570	0	228	1144	27
28	7755765	907065	15670	0	50	6421	609
30	1478741	280170	6795	0	31	401	199
31	2274520	614830	12097	39686	31	549	186
32	4535072	648025	20910	0	85	792	410
33A	7189710	580652	12235	96700	76	78	37
34	4602173	473234	20925	4440	44	970	486
35	3028750	509383	13965	79920	47	575	283
36	3043694	572475	14865	60060	64	562	258
37	2324350	347796	11910	94916	113	565	150
38A	4195800	672674	19120	34413	229	1863	210
38B	2560775	488453	12435	217008	320	968	202
39	4346760	809426	16487	178713	312	1649	350
40	2488625	414718	10740	120443	0	623	139
41	8151840	697956	22447	120900	121	891	228
42	3901650	616505	12825	279165	231	276	99
43	1348650	270145	6810	34950	92	293	96
44	3356640	829403	18165	677213	732	251	88
45	3406590	599091	14055	369298	106	253	104
46	18992655	891330	28235	114330	164	649	260
47	21080565	485640	22450	14990	23	443	183
48	2318235	353561	10635	30525	77	599	217
49	3076920	380195	16485	61605	131	676	243
50	2889330	411213	11145	17760	54	609	214
51B	44496045	474010	27440	9990	44	360	159

Note: *Coe Crum, unpublished report for Geog. 5510, Geography Dept.,
Oklahoma State University, Spring, 1972.
**Captain James Hill, Police Dept., City of Stillwater, Direct
Communication, June 5, 1972.
***City of Stillwater, Neighborhood Analysis, Stillwater, Okla-
homa, Sept., 1971.

APPENDIX C

CRIME FACTORS FOR EACH ED.

	O_t	$O_{\ell 1}$	$O_{\ell 2}$	Opportunity	B_v	B_s	Barrier			ca	C_a	cm	C_m
	Building % Av. Value	Street % Av. Value	Comm. % Built Av.	$O_t \times (O_{\ell 1}+O_{\ell 2})$ Av.	Officer/Day Av. Value	Age 25-64 % Av. Value	$B_v \times B_s$	Area/ED Av. Size	Burglary Larceny/ Theft	Crime Rate /Unit Area	ca Av. Value	Opportunity Barrier	cm Av. Value
22A	0.09	0.18	0.45	0.06	0.92	1.26	1.16	8.74	22	2.52	0.05	0.05	0.02
22B	0.04	0.50	0	0.54	0.86	0.86	0.77	0.41	1	2.44	0.03	0.70	0.27
23	0.49	0.82	0.69	0.74	0.91	1.29	1.17	0.75	10	13.33	0.19	0.63	0.24
24	1.24	1.41	0.45	2.30	0.89	1.37	1.22	0.49	20	40.82	0.58	1.89	0.73
25A	0.09	0.06	0.72	0.07	0.87	1.00	0.87	6.88	18	2.62	0.04	0.08	0.03
25B	0.29	0.35	1.24	0.46	0.98	1.14	1.12	3.56	61	17.13	0.24	0.41	0.16
26	1.02	0.88	0.38	1.28	0.88	1.11	0.98	0.49	19	38.78	0.55	1.31	0.51
27A	0.55	1.35	0.41	2.30	0.89	0.77	0.69	0.18	24	133.33	1.88	3.33	1.29
27B	1.61	0.65	5.00*	9.10	35.61**	0.06	2.14	0.29	199***	686.21	9.68	4.25	1.65
28	0.89	0.59	5.00*	4.98	35.61**	0.26	9.26	0.53	201***	379.25	5.35	0.54	0.21
30	1.44	1.32	0	1.90	0.87	1.43	1.24	0.10	0	0.00	0.00	1.53	0.59
31	2.06	1.56	0.45	4.13	0.87	0.97	0.84	0.16	16	100.00	1.41	4.92	1.91
32	2.33	1.35	0	3.15	0.89	1.49	1.33	0.31	3	9.68	0.14	2.37	0.92
33A	0.60	0.50	1.14	0.99	0.88	1.34	1.18	0.50	14	28.00	0.39	0.84	0.33
34	0.78	1.32	0.07	1.09	0.87	1.43	1.24	0.32	7	21.88	0.31	0.88	0.34
35	1.28	1.35	1.07	3.10	0.87	1.40	1.22	0.21	7	33.33	0.47	2.45	0.95
36	1.43	1.41	0.72	3.05	0.88	1.31	1.15	0.21	35	166.67	2.35	2.65	1.03
37	1.14	1.50	1.90	3.88	0.90	0.77	0.69	0.16	26	162.50	2.29	5.62	2.19
38A	1.23	1.32	0.34	2.04	0.95	0.31	0.30	0.29	58	200.00	2.82	6.80	2.64
38B	1.45	1.41	3.07	6.49	0.99	0.60	0.59	0.18	47	261.11	3.68	11.00	4.26
39	1.42	1.09	1.52	3.71	0.98	0.60	0.60	0.30	49	163.33	2.30	6.18	2.39
40	1.27	1.26	2.00	4.13	0.85	0.63	0.54	0.17	17	100.00	1.41	7.65	2.96
41	0.64	0.79	1.21	1.28	0.91	0.74	0.67	0.56	25	44.64	0.63	1.91	0.74
42	1.21	0.94	3.14	4.94	1.90	1.03	1.96	0.27	26	96.30	1.36	2.52	0.98
43	1.53	1.47	0.90	2.09	1.79	0.94	1.68	0.09	6	66.67	0.94	1.24	0.48
44	1.88	1.59	2.17	7.07	2.30	1.00	2.30	0.23	45	195.65	2.76	3.97	1.19
45	1.34	1.21	0.79	2.68	0.90	1.17	1.05	0.23	24	104.35	1.47	2.55	0.99
46	0.36	0.41	0.90	0.47	0.92	1.14	1.05	1.31	95	72.52	1.02	0.45	0.17
47	0.18	0.29	0.21	0.09	0.86	1.17	1.01	1.45	2	1.38	0.02	0.09	0.03
48	1.16	1.32	0.59	2.22	0.89	1.03	0.92	0.16	9	56.25	0.79	2.41	0.93
49	0.94	1.56	1.10	2.50	0.91	1.03	0.94	0.21	18	85.71	1.21	2.66	1.03
50	1.09	1.12	0.31	1.56	0.88	1.00	0.88	0.20	15	75.00	1.06	1.77	0.69
51B	0.08	0.18	0.14	0.02	0.87	1.26	1.10	3.06	2	0.65	0.01	0.02	0.01

Note: Values for EDs 27A & 28 were not introduced in calculating averages. The scaled values for EDs 27A & 28 are based on the averages among remaining 31 EDs.

   *Maximum value possible were given to EDs 27B & 28.

   **A total of 240 man-hour (10 officer/day) were divided between EDs 27B & 28.

   ***Total offenses for the campus (384) has been divided between EDs 27B & 28 equally.

2

VITA

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