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LA THÈSE A ÉTÉ
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AN EMPIRICAL INVESTIGATION OF
THE RELATIONSHIP BETWEEN URBAN CROWDING AND CRIME

Submitted to the Department of Criminology,
University of Ottawa, in partial fulfillment
of the requirements for the degree of Masters
of Arts.

JOHN MICHAEL MCFARLANE
1984

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ABSTRACT

The present study employed an ecological approach to investigate the relationship between crowding and crime. The zero-order correlations between crowding and crime were moderately strong; however, partial correlations which controlled for other socio-demographic characteristics substantially reduced the degree of relationship between the crowding and crime variables. This study concurs with most previous investigations that have used controls by suggesting that the relationship between crowding and crime is most likely a spurious one.

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INTRODUCTION

The present study is an investigation of the relationship between urban crowding and crime. By far, the greatest number of academic papers on the topic of crowding have been generated by the community of sociologists and psychologists; however, the observation that crowded conditions may produce a diversity of behavioural, biological, psychological, and physiological effects suggests the complexity and multi-disciplinary nature of this common phenomenon. The present study represents an attempt to isolate three conceptual 'dimensions' of crowding and to measure their relationships to three conceptual 'categories' of criminal behaviour.

A number of socio-demographic indices, including the three measures of crowding, were derived from the census information on the city of Ottawa. The information denoting the spatial distribution of crime in the city of Ottawa was obtained from the files of the local police department. By correlating the extent of crowding and the amount of recorded crime in a number of designated spatial areas, it was possible to measure the zero-order relationship between crowding and

criminal behaviour. In effect, this procedure showed how each socio-demographic factor varied with each of the three categories of crime, and provided an indication of the relative importance of these factors in 'determining' the nature and amount of crime in a given area.

In virtually all previous ecological studies it has been reported that some urban attributes are consistently interrelated. Regardless of any causal speculation, it has often been shown that spatial areas characterized by socio-demographic factors typically associated with 'low socio-economic status' are also those areas exhibiting the highest crime rates. While some of these factors have shown a relationship to crime at the zero-order level of analysis, it is often the case that the degree of association is due to the intercorrelations among the urban attributes. To 'isolate' the relationship between crowding and crime, the effects of other important factors were controlled. The two socio-demographic factors showing the strongest zero-order relationship to crime were selected as control variables. This procedure made it possible to examine the relationship between those measures deemed indicative of crowding and crime while other urban 'attributes' were held constant.

The information relating to crime was classified into

three categories. Each spatial area within the city was evaluated for its 'Total Crime' rate, its 'Violent Crime' rate, and its 'Property Crime' rate. Accordingly, each area was, in addition to the socio-demographic factors, evaluated on the basis of the three crowding measures. The extent of crowding in each area was determined by the Spatial Density, the Density in Living Arrangements, and the Nature of the Living Arrangements. The measurement of these three unique indicators of crowding and the classification of the crime rates into three categories provided an opportunity to test and examine three different hypotheses concerning the relationship between crowding and crime.

The primary hypothesis of the study was that crowding is related to crime in a positive direction. In other words, it was hypothesized that as crowding increases from one area to another, there would be a concomitant increase in the amount of crime. Zero-order correlations were computed and the relationships between each of the three crowding indicators and two categories of crime were examined separately.

The second hypothesis was that the degree of association between crowding and crime would be maintained even after other theoretically relevant factors had been controlled. This hypothesis was tested by analysing the correlation coefficients between the crowding variables and crime categories

after controls had been introduced.

The third hypothesis of the study concerned the nature of the relationship between crowding and crime. It was hypothesized that the categories of crime would be differentially related to crowding with the violent crimes exhibiting higher correlation coefficients than the property crimes. These speculations were based on the premise that the social tension due to crowded conditions would exert its greatest influence on the distribution of violent crimes. This hypothesis was tested by examining the relationships between crowding and the two distinct categories of crime.

The presentation of this study has been organized into five major sections. The introduction contains a preface to the study being conducted. The second section, as its title implies, contains a review of the literature germane to the study of crowding. This section relates a number of pertinent investigations of crowding using both human and non-human populations. It also offers both psychological and sociological conjecture as to how crowding is related to human behaviour in general and criminal behaviour more specifically. The third section is a presentation of the methodology employed to test the hypotheses of the study. The fourth section of the report contains the results directly

related to the original hypotheses of the study, as well as any other findings that may not have been anticipated initially. The last major section contains a discussion of the findings as well as an evaluation of the methodology employed by the study. In addition, this section provides operational direction for further study on the topic of urban crowding and crime.

A REVIEW OF THE LITERATURETHE THEORETICAL BASIS OF THE RESEARCH

According to mass media accounts and countless publications in professional journals, one of the principal factors underlying urban criminality is that of overcrowding (Schanberg, 1981; Galle, Gove and McPherson, 1972; Gillis, 1977; Kvalseth, 1977; Newman, 1973; Schmitt, 1966). Crowding has not been a factor implicated exclusively in individual offences, but has achieved notoriety as an issue in a number of urban and institutional uprisings (Ellis, 1982; Farrington and Nuttall, 1980; McCain, Cox and Paulus, 1980; Wright, 1978). Despite the intuitive appeal of this position and the near universal observation that urban communities exceed their rural counterparts in most forms of criminality, limited empirical evidence exists in support of the criminogenic effects of crowding (Booth, Welch and Johnson, 1976; Radzinowicz and King, 1977; Szabo, 1960). Contemporary conjecture on this topic has had to rely primarily on the evidence of animal research and non-experimental studies with humans as there are few controlled studies dealing directly with the relationship between crowding and criminality.

This study attempts to contribute to the growing body of evidence through an ecological (quasi-experimental) methodology, examining the effects of three different dimensions of crowding upon the distribution of different forms of criminality in a Canadian city (Freedman, 1975; Galle, Gove and McPherson, 1972; Gillis, 1977; Gillis and Hagan, 1982). Before presenting the findings, a review of the pertinent theoretical and empirical evidence relating to crowding and its behavioural effects is in order.

THE IMPACT OF CROWDING ON NON-HUMAN POPULATIONS

Experimental research on the topic of crowding has largely been confined to animal studies due to the limitations imposed by modern ethical standards. Such research has been undertaken with a diverse array of animals including fish, birds, elephants, apes, and different species of rodents (Galle, Gove and McPherson, 1972). Without exception these studies suggest that crowding induces numerous physiological and behavioural concomitants of stress with increased aggressive conduct being reported most frequently (Calhoun, 1962; Christian, 1981). Under extended or intense conditions of crowding these manifestations have included asocial behaviour, sexual deviation, poor parenting, premature mortality, declining fertility and effects on the endocrine system, the

most notable of which is adrenal enlargement. Increased adrenal activity and subsequent enlargement are typical physiological responses to prolonged stress and are said to enhance the likelihood of aggressive conduct (Freedman, 1975). Christian (1981) conceptualized crowding in two ways on the basis of his findings from a study of mice. He suggests that the physiological effects of crowding are the result not only of spatial density (the number of animals relative to a given area), but also of the absolute number of members of the species that share a particular area. The major contribution of this study was that it acknowledged the multi-dimensional nature of crowding.

It has been suggested that population density may not only facilitate the spread of communicable diseases, but may act as the pathogen of certain stress related maladies. Numerous studies using non-human populations have shown that high population density may, to varying degrees, influence the susceptibility, immunity, and resistance to infectious disease within a community (Dubos, 1977). Barrow (1955) determined, from a study of fish, that resistance to infection, and expediency of recovery were in part determined by the position of dominance in the community with the most dominant members exhibiting the most resilience. This finding suggests that even some of the simplest organisms

do not exhibit an adaptive capacity consistent among all members of the community. Different degrees of tolerance to crowding might be expected among the members of more complex animal communities.

Ethnologists such as Ardrey and Lorenz have postulated that instinctive mechanisms, serving a species preserving function, trigger aggressive behaviour when the space marked by an organism is infringed (Ardrey, 1966; Lorenz, 1967). Persistent territorial infringement, as would occur under crowded conditions, is said to augment aggressive conduct, producing shortened life spans, interference with child rearing and infant mortality. However, the idea of instinctive territorial defense has been largely discredited. Lorenz himself acknowledged that the aggressive reactions thought to be precipitated by a shortage of space, are for the most part determined by the type of animal making the encroachment (Lorenz, 1967). He found, for example, that in some cases animals would react aggressively only to encroachments by members of their own species while incursions by other species were observed to be tolerated.

The concept of instinctive territoriality is further weakened by the observation that is it not a phenomenon common to all animal societies nor is it expressed consis-

tently among societies exhibiting such behaviour (Johnson, 1972). Moreover, it has been suggested that adverse reactions to crowding are not due to territorial infringement of inadequate space per se but are only exhibited when the number of animals in a given area threatens the supply of resources or poses a risk to the survival of offspring (Freedman, 1975). Thus, spatial sensitivity may only be manifested under specific conditions and as such is an insufficient indicator of territoriality.

Apart from the obvious consequences of a limited supply of essential resources, observations have been made of several effective means to regulate population size and growth. Kimball (1975) documented a rare regulatory process where a species of flat-worm was observed to produce fewer young as the population of adults was increased. He further related that the breeding territories, common among numerous animal communities, regulate population growth by preventing breeding among surplus members of the species once the spatial capacity of the environment has been exhausted. Honeybees have shown an ability to adjust the production of offspring to the availability of resources (Kimball, 1975).

Various adaptive mechanisms have been observed to reduce the likelihood of intra-species conflict precipitated by either a shortage of space or limited resources. Lorenz

(1967) has acknowledged that continuous fighting is avoided by the members of some species that share a common territory by utilizing it at different times. The social organization of pecking orders and continua of dominance that prevail in various animal communities have been said to be responsible for minimizing the number of conflicts that arise from the natural competition for resources (Allee, 1951; Ellis and Free, 1964).

If spatial deprivation in its own right is not found to exert a direct effect upon animal behaviour, but exerts only an indirect effect by limiting supply, it is even less likely that such an effect would be observed for humans. The principles governing other organisms are weakened by man's 'superior intelligence' and his 'superior ability' to communicate (Webb and Collette, 1975). These 'skills' have provided man with an adaptive capacity that far exceeds that of other organisms by enabling him to alter his habitat or reshape his environment. Man also has at his disposal numerous drugs that can reduce the noxious quality of his environment through psychological and physiological modification. He is provided with a natural ability to invoke numerous psychological defence mechanisms which can effectively mitigate his responses to stressful situations or events, and often engages in complex social organizational networks such as queuing principles,

that minimize the effects of crowding (Lazarus, 1977). Given man's remarkable capacity to adapt to his environment, it is unlikely that his behaviour is governed by environmental contingencies to the same extent as the behaviour of other organisms.

THE RELATIVE NATURE OF CROWDING EFFECTS

The classical division between cognitive and behavioural perspectives in modern psychology is just as persistent among those researching crowding and its various consequences. It is commonly held that the sympathetic division of the central nervous system reacts to environmental stress in a preparatory fashion by regulating the activities of the organs under its control (Cannon, 1929). At issue, is whether the activation of the sympathetic system is dependent on environmental contingencies alone, or whether there is a requirement of a cognitive appraisal of threat. Based on a study of "voodoo" death in which an objectively innocuous stimulus was reported to have affected serious behavioural, psychological and physiological consequences, Cannon suggested that the appraisal of threat alone, is sufficient to activate and overextend the activities of the sympathetic division of the central nervous system (Cannon, 1942). As in the nature of various other "stressors", dimensions of 'crowding' may also be relative.

Some writers suggest that crowding is entirely a subjective state and that it should be distinguished from objective definitions of density (Dubos, 1977; Stokols, 1972). Advocates of this distinction propose that crowding is a psychological state which is sensitive to fluctuations in the physical-spatial dimension of the environment, and further contend that this would account for the diversity of observed effects among individuals exposed to a given level of population density (Loo, 1975). Several different theoretical positions lend support to this notion. According to one position, each individual requires a different amount of space to avoid anxiety. The violation of this space of "body buffer zone" may evoke various psychological, physiological and behavioural stress responses, the most common of which is aggressive behaviour. It has even been suggested that criminal populations require larger buffer zones than do non-criminal populations (Wilds, 1973).

Appley and Trumbull assert that, with the exception of a few extreme, life threatening situations, no single stimulus produces stress responses for all individuals (Appley and Trumbull, 1977). Variations in levels of tolerance are due to physiological factors as well as differences in motivation and prior experience. Lazarus contends that

physiological and experiential variability is a major source of invalidity in studies which attempt to isolate specific stressors and their effects (Lazarus, 1966). In addition, one's recognition of the source of stress may help diminish it. Lambert and Lambert suggest that the ability to identify the source of stress may facilitate effective coping strategies (Lambert and Lambert, 1973). Thus, the principles governing human behaviour are not only qualitatively different from those governing other animal populations, but by their complexity, make it misleading and erroneous to presume otherwise.

The symbolic context within which a potential stressor, such as crowding, occurs is also significant in determining how it will be appraised and responded to. Freedman suggests that crowding only generates discomfort when the situation in which it occurs is perceived as unpleasant--for example, when the persons with whom one must interact or the tasks performed are disliked (Freedman, 1975). He implies that density merely intensifies one's emotional response toward a given situation. Thus, he contends that crowding enhances pleasant feelings toward an already pleasant situation, and conversely, magnifies unpleasant feelings toward unpleasant situations. Freedman

(1975) refers to this as the "density - intensity" hypothesis and implies that the curvilinearity of the relationship between pathology and crowding is due to variations in psychological appraisal.

The contention that crowding is an experiential state rather than an objective phenomenon gains further support from the observation that cultural factors often affect attitudes toward personal space. Hall has described various cultural norms which dictate the physical-spatial nature of social interaction (Hall, 1966). He has related that the most apparent cultural differences are observed in the amount and nature of body and eye contact, as well as the physical proximity exhibited during social interaction. Thus, it would not be surprising to find cultural differences for the definition and tolerance of crowding (McCain, Cox, and Paulus, 1980).

The effects of crowding upon human behaviour are not always observed to be negative. When it is considered that humans, like other animals, 'tend' toward 'sociability', a 'natural' appeal toward 'crowds' is conceivable (Mead, 1936, Wright, 1978). Augmenting this position are numerous studies which detail the negative effects of sensory deprivation, early parental deprivation, and solitary confinement (Davis, 1940; Gove and Hughes, 1980; Hebb, 1934).

Thus, it is unlikely that a positive, linear relationship exists between crowding and stress (Beasley and Antunes, 1974; Freedman, 1975). As some researchers have argued, it is most likely that moderate levels of crowding are most desirable under "normal" conditions with reactions being most negative to either extremes in isolation or crowding (Dubos, 1977; Gillis, 1979).

INSTITUTIONAL STUDIES OF CROWDING

Numerous reports have attested to the 'over-crowded' conditions of North American penitentiaries. As well, a comparable number of investigations have been undertaken to determine the effects of such conditions on human behaviour (Farrington and Nuttall, 1980; McCain, Cox and Paulus, 1980; Ellis, Grasmick and Gilman, 1974). These institutional studies of crowding, using inmate populations, have often yielded mixed results.

Several researchers have argued that the 'size' of a prison can have adverse effects on the inmate population. McCain, Cox and Paulus (1980) compared institutions housing populations of 1,000 and 1,500 inmates and found that the larger institutions had higher violent and non-violent death rates, suicide and self-mutilation rates, a greater number of cases requiring psychiatric attention. There has also been evidence of a strong association between prison size

and prison riots (Lieber, 1981; Ellis, 1982). However, a conclusive position on this relationship is impeded by several deficiencies, including the lack of a consistent definition for "prison riot" and the scarcity of studies that have controlled for other factors associated with riots (Ellis, Grasmick and Gilman, 1974). Farrington and Nuttall (1980) found that prison size was inversely related to inmate assault rates; however, they suggested that the higher rate of violence reported for smaller jails could be an artifact of the intended purpose of these jails. For example, these smaller jails have often been reported to be local "lock-ups" where the diversity and transiency of the inmate population would be expected to contribute to the social instability (Megargee, 1977; Nacci, Teitelbaum and Pratler, 1977).

McCain, Cox and Paulus (1980) studied the effects of crowding on inmate health and behaviour at several American penitentiaries. They found that both the inmate population (social density) and the amount of space per unit per inmate (spatial density) were associated with the prevalence of social and psychological withdrawal, more complaints of illness and psychological stress. They further found, that of the two measures of crowding, social density had a greater effect on inmate behaviour than did spatial density.

Ellis (1982) related several factors which restrict

generalizations based on institutional studies of crowding. Where the public population can modify its crowded environment or control the amount of time spent in crowded conditions, the inmate population is offered little respite that is within its direct control. Among the other numerous differences between the public and inmate populations, the forced confinement of inmates in often unfamiliar surroundings confounds the relationship between crowding and behaviour. Institutional studies are effective means to increase the body of knowledge relating to crowding; however, caution is warranted when interpreting the results of these studies and generalizing the findings to the public at large.

THE CRIMINOGENIC ASPECTS OF CROWDING

Several explanations have been offered for the hypothesized link between crowding and crime. According to one, crowding produces an excess of sensory stimulation, resulting in tension, disorientation and fatigue (Stokols, Smith and Prostor, 1975). Booth, Welch and Johnson (1976) add to this view by suggesting that crowding may interfere with one's ability to effectively mobilize available coping strategies. Furthermore, it has been suggested that an overload of stimulation prevents individuals from detaching themselves from their immediate environment in order to plan for the future (McKay, Jayewardene and Reddie, 1979). Thus, according

to this hypothesis, the probability of various forms of antisocial conduct, including criminal behaviour, is augmented by the psychologically disruptive effects of crowding. In addition, this explanation implies that in some ways, the negative effects of crowding are self-perpetuating.

A second position suggests that high density amplifies the likelihood of a real or perceived shortage of resources (Stokols, Smith and Prostor, 1975). Numerous studies have attested to the various forms of social deprivation that frequently characterize high density areas (Boggs, 1965; Baldwin, 1975). Social conflict and antisocial behaviour, according to this explanation, may serve to deal with the supply problem. Thus, reasoning on the basis of Freedman's density-intensity hypothesis, high density would be most influential when it is accompanied by other forms of social deprivation. Under the psychologically disruptive conditions that characterize highly urbanized areas, there is an increased probability that criminogenic strategies would be employed if crowded conditions lead to real or imagined competition for resources.

A third explanation suggests that the detection of crime is facilitated in a high density environment. The inhibition of behavioural freedom and lack of privacy characteristic of crowded living conditions often subsumes that

youngsters spend a great deal of time outside the home (Newman, 1972; Sommer, 1969; Stokols, Smith and Prostor, 1975). Formal means of social control by law enforcement agencies often compensate for the reduced capabilities of informal control mechanisms, thereby increasing official detection of delinquent activity (Repetto, 1974). Thus, according to this position, the societal reaction to ecological congestion (for example, intensified police surveillance) is responsible for the inflated crime rates of high density areas. In this way, the association between crowding and crime is considered to be only an artifact.

Jeffrey (1971) advocates an interdisciplinary approach to explaining the relationship between crowding and crime. Human ecology is viewed as an interaction of biological, psychological and sociological variables. Crowding has been said to increase the likelihood of aggressive conduct through its various biological and physiological effects. The psychologically disruptive effects of prolonged or intense conditions of crowding may seriously impair one's ability to engage available coping strategies. Furthermore, crowding has various effects on the social environment that may increase the probability of criminal involvement. It has been suggested that antisocial conduct is more prevalent in large gatherings due to the anonymity it affords (Lebon,

1968). In addition, the impersonality of densely populated urban areas may objectively reduce the risk of detection, thereby serving to make such areas more attractive than others (Boggs, 1965; Newman, 1972). Thus, it is suggested that the "stimulus-response" model of human behaviour is inadequate to explain the relationship between crowding and crime. Rather than analyse the relationship at any specific level, it is suggested that it would best be explained when the interaction of variables is considered.

EMPIRICAL STUDIES ON CROWDING

The evidence relating crowding to criminal behaviour derives from two sources: first, a limited number of experimental studies in which people were typically placed in settings of varying density for a fixed period of time, holding a number of other potential stressors constant; and, second, ecological studies in which several indicators of crowding were correlated with various indicators of social pathology and crime (Decker, Shichor and O'Brien, 1982, Gall, Gove and McPherson, 1972; Jeffrey, 1971).

Freedman (1972) has described a number of experimental studies in which varied populations were subjected to different degrees of crowding, controlling for such variables as temperature, ventilation and noise. In general, these

studies have shown that crowding does not contribute to antisocial behaviour after controls have been introduced. These studies have found, contrary to other nonexperimental research, that crowded conditions in a positive social milieu can improve task performance, lending support to Freedman's (1972) density-intensity hypothesis.

The findings of laboratory studies of crowding have often been criticized on the premise that observations made in an artificial setting have reduced generalizability. McCain, Cox and Paulus (1980) studied the behavioural effects of crowding in college dormitories and found that students of the 'crowded' dormitories had more complaints of illness and other manifestations of stress than did the residents of 'less crowded' dormitories. However, caution is warranted when interpreting the findings of studies conducted in either the laboratory or 'natural' setting as the intensity and duration of exposure to crowding is often insufficient or too artificial to provide a clear understanding of the potential adverse effects. Furthermore, the samples often comprise highly motivated, rather than randomly selected subjects. Inferences drawn from experimental studies are also limited by the voluntary nature of participation and the subjects' awareness that the intensity and duration of the discomfort is never entirely out

of their control.

From an ecological standpoint, it has often been shown that the process of urbanization and city growth are associated with rising crime rates (Radzinowicz and King, 1977; Jacobs, 1961; Wolfgang, 1968). As population growth and population density are intrinsic products of urbanization, it is frequently hypothesized that a positive relationship exists between 'crowding' and 'crime' (Wirth, 1938; Beasley and Antunes, 1974; Mladenka and Hill, 1976).

Considerable evidence exists in support of the hypothesized relationship between city size and violent crime. Federal Bureau of Investigation Uniform Crime Reports for the year 1970 show that United States cities of between fifty and one hundred thousand population had an average homicide (murder and non-negligent manslaughter) rate of 5.2 per 100,000 population; cities of between one hundred thousand and one quarter of a million population had an average homicide rate of 10.0 and cities with a population in excess of one quarter of a million had an average homicide rate of 17.5 (United States, 1970). This pattern was also shown for the rates of various categories of assault.

A number of North American and European studies have offered competing explanations for the apparent direct relationship between population size and crime.

(Wirth, 1938; Baldwin, 1975). It has been suggested that the social disorganization and relative deprivation engendered by urbanization serves to increase the prevalence of criminal involvement. Thus, crowding is viewed as one factor among many that influence the prevalence of crime.

Urban ecological research since the nineteenth century has shown that social pathologies of various kinds, including criminality, are concentrated in the most densely populated sections of a city (Decker, Shichor and O'Brien, 1982). Shaw and McKay (1929) and their associates at the University of Chicago were the first to identify a gradient pattern in the distribution of urban delinquency. Their studies showed that the prevalence of various social pathologies, including rates of delinquency, diminish in relation to a neighbourhood's distance from a city's center. This general concentric pattern has been found in most subsequent American ecological studies, as well as some studies in Canada and elsewhere (Bordau, 1959, Chilton, 1964, Schmidt, 1960a, 1960b; Baldwin, 1975). Only a few American studies have shown distributions that are inconsistent with the general concentric pattern (for example, see Lander, 1954). The observation that other important criminogenic factors, including alternative value systems (Hagan, 1977), are frequently present in areas where high concentrations of

crime exist, suggests a necessity to go beyond the bi-variate level of analysis if inferences are to be made regarding the direct relationship between urban crowding and crime levels.

It has been suggested that crowding is one of the most inimical concomitants of urbanization (Mladenka and Hill, 1976). Given the complexity involved in the isolation of the biological and physiological effects of high population density, it is little wonder that so many views are held by sociologists and criminologists studying the effects of crowding on crime. Numerous studies have documented moderate to strong zero-order relationships (where no other factors are controlled) between various indicators of density and crime (Jeffrey, 1971; Decker, Shichor and O'Brien, 1982). These studies have been conducted at both the intercity and intracity levels of analysis and have used various sampling techniques to gauge the extent of crowding and crime.

Studies that have controlled for socio-demographic variables such as social class, economic status and ethnicity have often produced mixed results. Booth, Welch and Johnson (1976) studied both internal density (the crowding in living units) and spatial density and found a consistent, though moderate relationship between crowding and crime even after controls were introduced. Other studies have shown that the apparent relationship is substantially reduced

when controls are used, and in some cases, controls have reversed the direction of the relationship between crowding and crime (Freedman, Heshka and Levy, 1975; Harries, 1974). In general, these ecological studies have suggested that other socio-demographic factors exercise an impact upon crime rates that are equal to, if not greater than the effects of crowding (Galle, Gove and McPherson, 1972; Freedman, 1975; Gillis and Hagan, 1982).

In earlier studies, crowding was primarily measured by areal density or the population of a given neighbourhood taken as a fraction of its land area. Later studies have acknowledged that this indicator presents some problems of interpretation. These measures are indicators of central tendency and do not relate the possible variations in density that may exist in an area (Carnahan, Guest and Galle, 1974). Furthermore, it has been suggested that these gross-density measures may only reflect the congestion which exists in public areas. For these reasons, additional indicators have been introduced, such as the average number of dwelling units per structure in a given area, in order to gauge the extent of crowding in homes and their immediate environs. Where the extent of crowding has been found to affect crime, crowded living arrangements have been shown to be more influential than the areal density (McCain, Cox and Paulus, 1980; Gillis and Hagan, 1982).

Even with novel data collection and coding methods, as well as the innovative statistical procedures that are presently in use, there is little conclusive evidence on the relationship between crowding and crime.

THE ECOLOGICAL APPROACH

Some researchers have suggested that the results of laboratory studies of crowding are often misleading when human beings constitute the subject population. Lazarus (1966) contends that the relationship between a person and his environment is not a mechanical exchange; rather, various cognitive mechanisms are thought to facilitate the regulation of emotion and behaviour. Furthermore, the nature of the relationship is not limited to the immediate situation. The history of experience that a person accumulates often dictates the significance of a particular stimulus and determines the coping strategies used to deal with stress. Within the confines of contemporary ethical standards, there is little progress to be made in terms of the experimental control of these factors. In any case, given the complexity of the relationship between crowding and crime, the best investigative strategy might be to study individuals or an aggregate of their actions, within the context of their usual environment.

The ecological approach has the capacity to illustrate the relationships between resident and environmental attributes on the one hand, and human behaviour on the other. Investigators using this approach have at their disposal various procedural options to study the relationship between crowding and crime.

Researchers have used a number of techniques to describe the amount of crime in a given spatial area. These techniques typically fall into one of two distinct thematic categories; they either comprise delinquency/crime or victimization rates (Bordua, 1959; Chilton, 1964; Lander, 1954; Hindelang, 1976; Reppetto, 1974). Although these two indices are often highly correlated, there are procedural differences in the method of data collection (Hindelang, 1976).

The sources of information relating to crime are often not chosen by design but by convenience. The most obvious example is the 'preference' for police data over that obtained in surveys of the public. Police and judicial agencies have used a number of indices to represent crime. Among others, these include arrests, convictions and number of incarcerations—none of which are above criticism (Hakim, 1983). These indices are frequently codified with more specificity (for example: "violent" and "property" crime),

as the literature has tended to support the notion that certain categories of crime exhibit unique socio-demographic correlates and patterns of distribution (Block, 1979; Skogan, 1977; Mladenka and Hill, 1976).

As with the information relating to crime, there are a number of techniques used for the collection of socio-demographic information. As with the collection of data relating to crime, convenience has a tendency to direct one away from surveys of the public, and toward the body of information that is routinely collected by agencies such as the census bureau. This ecological information has been used to investigate the relationships between crime and countless socio-demographic and environmental attributes at various levels of analysis.

THE DERIVATION OF THE HYPOTHESES


The first hypothesis of the study is based primarily upon the notion that 'crowding' produces an excess of sensory stimulation, resulting in various 'pathological' consequences, criminal activities among them. Animal research on the topic of crowding has consistently documented a relationship between 'crowding' and various physiological and behavioural effects (Gall, Gove and McPherson, 1972). Primarily, these studies have suggested that in-

creased levels of 'crowding' are related to increased aggressive conduct (Calhoun, 1962, Christian, 1981). Similar physiological and behavioural effects have been documented by institutional studies using both inmate and student populations (McCain, Cox and Paulus, 1980), and ecological studies using aggregate data (Galle and Gove; 1979; in Aiello and Baum, 1979). Furthermore, most ecological investigations of large urban areas (i.e., over 100,000 population) have documented 'strong' zero-order relationships between urban 'crowding' and 'crime' (Decker, Shichor and O'Brien, 1982). In short, it is posited that the probability of various forms of antisocial conduct, including criminal behaviour, is augmented by the psychologically and sociologically disruptive effects of 'crowding'. Consistent with this position and the findings of prior ecological studies, it was hypothesized that increases in the extent of 'crowding' would be associated with increases in the amount of 'crime'.

The second hypothesis is consistent with the first in that it is based upon the notion that an increased likelihood of antisocial behaviour, including criminal behaviour, arises within 'congested' areas because of the psychologically and sociologically disruptive effects of 'crowding'. In the majority of cases in which ecological

investigations of the relationship between urban 'crowding' and 'crime' have controlled for other factors, such as social, economic and structural indices, such statistical control has substantially reduced the magnitude of the correlations between 'crowding' and 'crime' (Freedman, Heshka and Levy, 1975, Booth, Welch and Johnson, 1978). It has been suggested that this statistical reduction is due to the 'high' degree of correspondence that frequently prevails between indicators of 'crowding' and forms of 'deprivation'. Thus, 'crowding' has been conceived of as having an indirect effect upon the distribution of crime. With respect to Ottawa, however, it is asserted that such indicators of 'social deprivation' do not correspond with indicators of 'crowding' to the same extent as would frequently be the case in many comparable American cities and 'larger' Canadian cities. In Ottawa, 'congestion' does not necessarily correspond with indices of deprivation as is 'typical' of most other 'large' metropolitan areas. Thus, it was hypothesized that the degree of association between 'crowding' and 'crime' would remain 'relatively' stable after other relevant factors had been controlled.

The literature has tended to support the notion that certain 'categories' of crime exhibit unique socio-demo-



graphic correlates and patterns of distribution (Skogan, 1977; Bock, 1979). This suggests a need to examine separately the effects of crowding upon the distribution of both property offences and violent offences. Studies that have investigated these separate categories of crime have shown that factors such as crowding exert a greater influence upon the distribution of violent offences than upon the distribution of property offences (Mladenka and Hill, 1976). Thus, it was hypothesized that the relationship between Violent Crime and 'crowding' would exhibit higher correlation coefficients than would the relationship between Property Crime and 'crowding'.

VARIABLE DEFINITIONS

With reference to statistical methods of empirical sociological research, Toennies (1971) relates:

"It is true (a) study has to be preceded by groundwork (though not necessarily in the mind of each individual scholar) which must consist essentially in purifying conceptual thinking from the residues caused by using language not specifically made for conceptual thought."

In a similar sense, the same initiative applies to the process by which the social scientist conceives of 'ideas' for investigation and the process by which those 'ideas' are operationalized as variables. However, the 'integrity' of an operational definition (in the sense that it approximates a 'purified' version of a certain concept) is in no way an indication that the 'variable' has acquired a status that is any 'greater' than its original conceptual status (Glaser and Strauss, 1967).

The utility of a study is in part determined by the nature of the variables investigated. For example, if the variables are operationalized to be consistent with those of prior studies; the research may have implications for the generalizability or verification of relationships among such specific variables. On the other hand, the introduction of 'novel' operational definitions (or factors, or combinations) may help to define with more clarity, the substantive parameters of a certain concept. In any case, for a concept lacking 'formal' definition, it is all the more important to explore its possible dimensions and investigate the relationship of those 'dimensions' to other phenomena.

In this particular study, the concept of 'crowding' was substantiated along three dimensions; Spatial Density,

Density in Living Arrangements, and Nature of Living

Arrangements. There has been considerable research to support the notion that 'crowding' may be assessed according to several distinct dimensions (these 3 among them); however, there has been an obvious lack of consistency in how such dimensions have been operationalized (Aiello and Baum, 1979). For example, Galle and Gove (1979) studied aspects of 'crowding' similar to those in the present study, and operationalized these variables with similar indexes. Where they referred to "Density" operationalized as persons per square mile, the present study refers to Spatial Density; and operationalizes this variable as persons per square kilometer. Where they referred to "Interpersonal Press", operationalized as persons per room and rooms per house, the present study refers to Density in Living Arrangements; and operationalizes this variable as the number of persons per house. Finally, where they referred to "structural Press"; operationalized as residential structures per square mile, the present study refers to Nature of Living Arrangements; and operationalizes this variable as the proportion of residences in an area which are apartments. Thus, while the present study uses indices that are different from those of Galle and Gove (1979)

the 'conceptual' similarities are obvious. These indices or variations have been used extensively in past investigations of crowding (Aiello and Baum, 1979; Decker, Shichor and O'Brien, 1982; Jeffrey, 1971).

As with the variables relating to 'crowding', those used as indicators of 'socioeconomic stability' (Employment Income and Household Income), 'social stability' or 'constitution' (Percent Dwellers Unattached, Percent Population Over 15 Years, Percent Males in Population, Unemployment Rate, Percent English, Percent French, and Percent Other Ethnic) or 'crime' (Total Crime, Violent Crime and Property Crime) are supported both on the basis of their conceptual or theoretical appeal and upon their prevalence and utility in prior research (Aiello and Baum, 1979; Decker, Shichor and O'Brien, 1982; Jeffrey, 1971).

The operational definitions of the variables used in the present study are as follows:

Spatial Density - The population per square kilometer in a patrol zone.

Density in Living Arrangements - The proportion of dwelling units in a zone which are apartments.

Percent Dwellers Unattached - The proportion of persons in a zone who are older than 15 years and unmarried.

Percent Males in the Population - The proportion of persons in a zone who are males.

Employment Income - The average income of persons who worked in a zone.

Household Income - The average total income per household in a zone.

Unemployment Rate - The proportion of persons in a zone who are in the labour force but are not working.

Percent English - The proportion of persons in a zone whose mother tongue is English.

Percent French - The proportion of persons in a zone whose mother tongue is French.

Percent Other Ethnic - The proportion of persons in a zone whose mother tongue is one other than English or French.

Total Crime - The 'zonal' aggregate rate per 100,000 population for homicide, rape, various forms of assault, robbery, breaking and entering, theft over and under \$200, motor vehicle theft, arson, vandalism, and trespassing.

Violent Crime - The 'zonal' aggregate rate per 100,000 population for homicide, rape and assaults.

Property Crime - The 'zonal' aggregate rate per 100,000 population for robbery, breaking and entering, theft over and under \$200, and motor vehicle theft.

THE STUDY

The present ecological study sought to examine the relationship between urban crowding and various forms of criminality in a Canadian city. Most of the previous research has been based on American cities. It also sought to add to the small number of multivariate analyses, in which the effects upon crime of other important socio-demographic factors have been considered. Moreover, the city of Ottawa, in which the study was undertaken, is an excellent site for such a study because it lacks the severe urban blight of many American cities in which the effects on crime of crowding and socioeconomic deprivation are easily confounded due to their frequent appearance in the same neighbourhoods (see Appendix A). In Ottawa, some of the most congested areas are affluent. This affords an opportunity to compare areas of varying density while holding economic factors constant.

The city of Ottawa is the capital of Canada and is located in a metropolitan area of one-half million people. The city contains a sizeable French-speaking

minority (estimated at 19%), as well as a large number of other ethnic groups (estimated at 12%). Ottawa is primarily 'middle class' with a considerable number of its residents employed in professional or white collar occupations with the civil service, two major universities and the electronics field (Canada, 1971; Canada, 1976).

For the purposes of police patrol, the Ottawa Police Department divides the city into eighteen patrol zones (see Figure 1). These zones were selected as the geographical units of analysis for the study. Many of the patrol zones conveniently coincide with natural ecological areas. Natural areas are those bounded by waterways, major auto thoroughfares or uninhabited land. Police patrol zones are also more useful than census tracts as units of analysis because they afford an opportunity to monitor the effects of police deployment upon crime rates.

The Ottawa Police Department compiled data relating to the dependent variables for each of the patrol zones. The dependent variables were classified into total, violent and property crimes. The Total Crime category included homicide, rape, various forms of assault, robbery, breaking and entering, theft over and under \$200, motor vehicle theft, arson, vandalism, and trespassing. Included in the Violent Crime category were homicide, rape and assaults. The

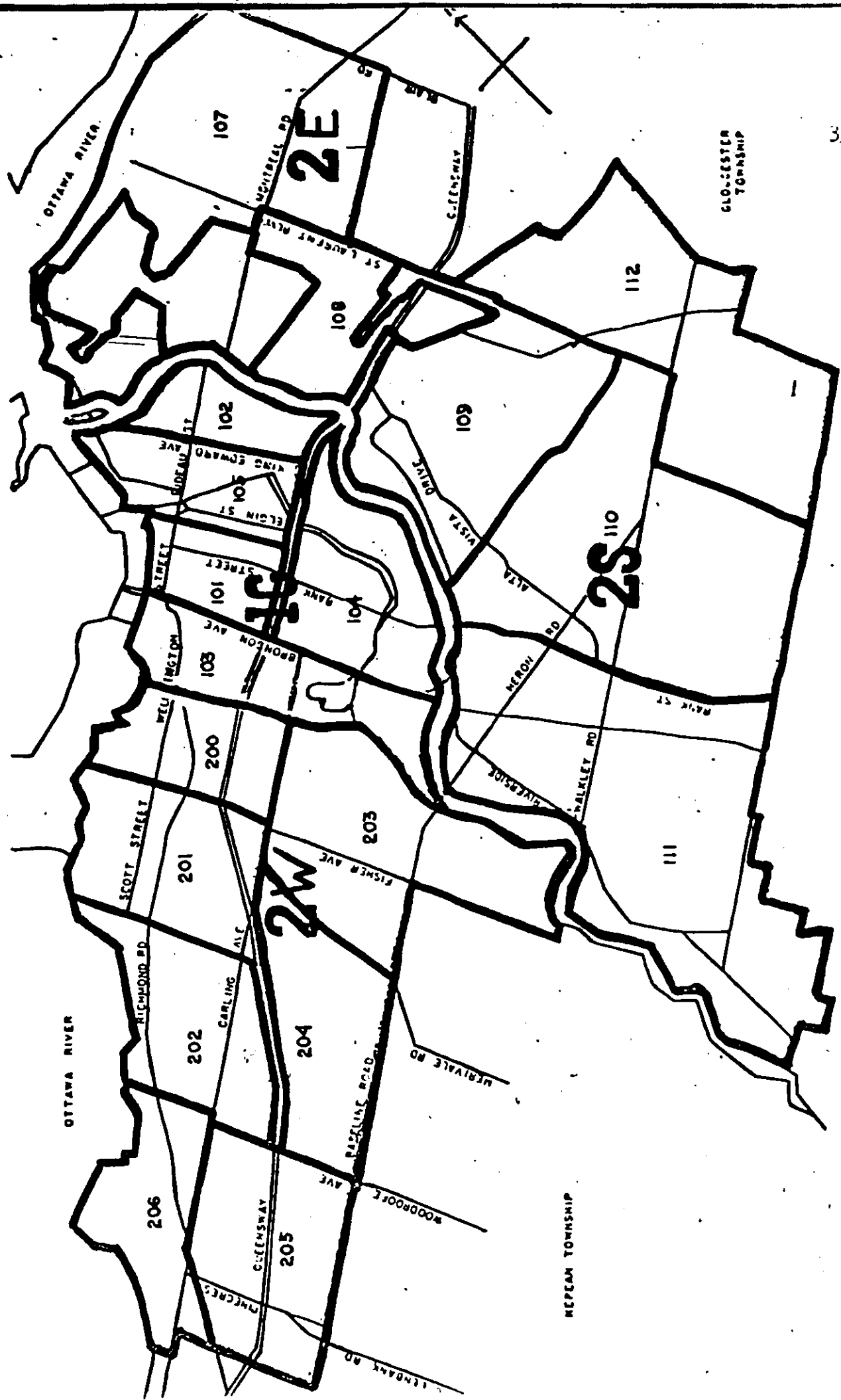


FIGURE 1: OTTAWA ZONE MAP (POLICE PATROL ZONES)
 Ottawa Police Department, 1974.

Property Crime category included robbery, breaking and entering, theft over and under \$200 and motor vehicle theft. The remaining offences included in the Total Crime category were not separately analysed in this study. Crime rates were derived for the year 1981 and computed with population serving as a base (per 100,000).

Data relating to the independent variables were secured from Federal Census Bulletins (Canada, 1971; Canada, 1976). The values of these indices corresponded to the established enumeration areas indicated in Figure 2. As the data relating to crime were calculated on the basis of the police patrol zones employed by the Ottawa Police Department, the information relating to the enumeration areas was aggregated to correspond to these zones.

As the patrol zones frequently contain several census districts, it was imperative that the proportional contribution of each census district to its corresponding patrol zone be calculated. Thus, the contribution of each census district, to the demographic portrait of a police patrol zone, was weighted according to the proportion of physical space it occupied within that zone. For example, a census district occupying three quarters of the physical space of a particular patrol zone would contribute values weighted at 75% in calculating the characteristics of that zone. The constituent census districts of the remaining

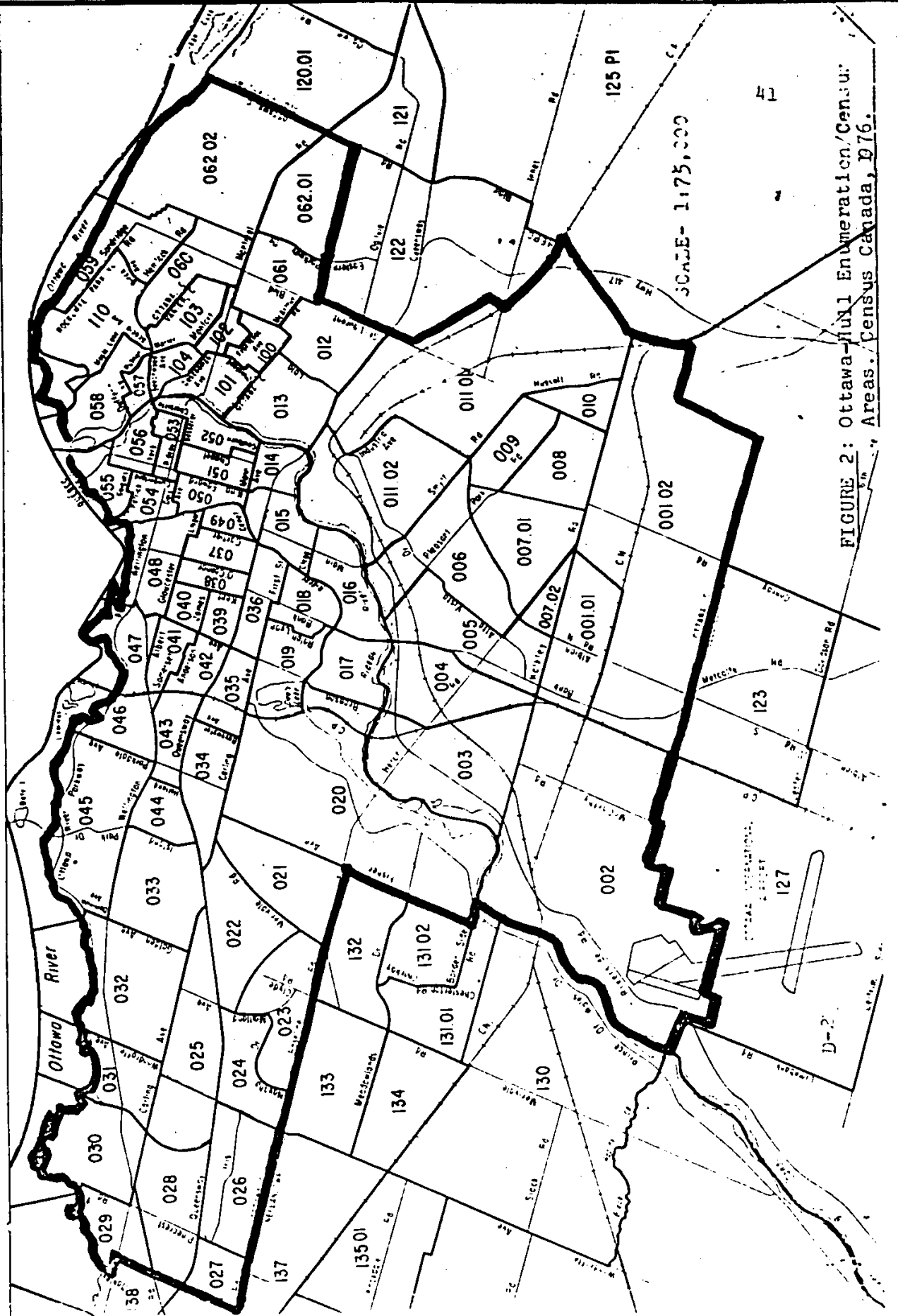


FIGURE 2: Ottawa-July 1 Enumeration/Census Areas, Canada, 1976.

area would be weighted according to their proportional contributions to complete the demographic picture of the zone.

For each census district, proportions of each characteristic were computed then aggregated according to the weighting procedure to provide values corresponding to each police patrol zone (McGahan, 1982).

The present study correlated crime information corresponding to the year 1981 with census information corresponding to the years 1971 and 1976. These sources were selected because they provided the most recent crime and socio-demographic information relating to Ottawa. While recognizing the potential invalidity of correlating information relating to different time periods, it was assumed that the changes would not be significant enough to undermine the findings due to the stability of population growth in the city of Ottawa.

Three indicators of 'crowding' were selected which served as the main 'independent' variables: (1) Spatial Density, consisting of each zone's population per square kilometer; (2) Density in Living Arrangements, which was based on the average number of persons per household in a given zone; and (3) Nature of Living Arrangements, which was the proportion of dwelling units in a zone which were

apartments. The census classifies as apartments, those dwelling units that are located in apartment buildings or in other structures where at least two dwelling units exist. This measure was considered necessary in order to distinguish the effects of occupancy within shared premises from that of detached or semi-detached premises, irrespective of the density factor in living arrangement which has already been considered by the second measure. Indices identical or similar to these variables have been used extensively in past studies of crowding (Aeillo and Baum, 1979; Decker, Shichor and O'Brien, 1982; Jeffrey, 1971; Gillis, 1977).

While some researchers have employed a nomenclature to designate different forms of 'crowding', such as 'spatial density' and 'social density', such speculative differentiation has typically been acknowledged as hypothetical due to the inconsistencies of past research findings (McGanan, 1982; McCain, Cox and Paulus, 1980). As Glaser and Strauss (1967) comment on the a priori use of such designations:

"Probably the researchers are, as is typical, responding to the substantive stimulation with some general implications. All they have done is to raise the conceptual level of their work

mechanically; they have not raised it through comparative understanding. They have done nothing to broaden the scope of their theory on the formal level by comparative investigation of different substantive areas. They have not escaped the time and place of their substantive research, though their formal writing of the theory may lead readers into thinking so."

Thus, in the absence of a 'confirmed' understanding of 'crowding' and its effects, it might be considered presumptuous to engage such designations in anything but a discursive fashion (McGahan, 1982; Gillis and Hagan, 1982).

Separate bivariate and multivariate analyses were conducted to determine the relationships between each of the three indicators of crowding and each of the crime categories. First, zero-order correlations were computed indicating the relationship between each of the three measures of crowding and the three crime categories without controlling for any other variables presumed to affect the respective crime rates.

Secondly, partial correlations were computed, indicating the relationship between each of the independent and dependent variables while controlling for other influences. The control variables were selected from a pool of

nine socio-demographic census variables on the basis of three criteria: (1) the magnitude of their zero-order correlations with the dependent variables; (2) their importance as indicated by a stepwise multiple regression analysis that included all the independent variables; and (3) the substantive or theoretical relevance of the variables.

Finally, the data were examined for evidence that would determine whether violent and property crime are differentially associated to the three measures of crowding. This procedure did not involve a statistical analysis, but was only an examination of the data for trends. Where appropriate, the results were presented in tabular form.

FLINDINGS

To reiterate, the present study employed three indicators of crowding: Spatial Density, Density in Living Arrangements, and Nature of the Living Arrangements. These independent variables were included with nine other socio-demographic measures to examine their independent effects on the three main categories of crime: Total Crime, Violent Crime and Property Crime (See Appendix A for detailed zonal portraits according to these characteristics).

Table 1 shows the zero-order intercorrelations between the twelve independent variables (including the three measures of crowding) and the three crime categories. It can be seen that the variables correlated significantly with at least one category of crime are Density in Living Arrangements, Percent Dwellers Unattached (i.e., the proportion of unmarried adults), Percent Population Over 15 Years and Household Income. Density in Living Arrangements is the only crowding variable that is correlated significantly with the three categories of

TABLE 1: Zero-Order Correlation Coefficients Between the Independent Variables and the Crime Categories

Independent Variables	Total Crime	Violent Crime	Property Crime
Spatial Density	.43	.49	.52
Density in Living Arrangements	-.66*	-.65*	-.73*
Nature of Living Arrangements	.11	.21	.16
Percent Dwellers Unattached	.73**	.67*	.72**
Percent Population over 15 Years	.57	.57	.64*
Percent Males in Population	-.18	-.15	-.26
Employment Income	-.40	-.43	-.42
Household Income	-.55	-.58	-.61*
Unemployment Rate	.37	.23	.28
Percent English	-.39	-.37	-.40
Percent French	.25	.21	.24
Percent Other Ethnic	.45	.51	.49

* P < .01

** P < .001

crime. It is also the only indicator of crowding to show a consistently negative relationship to the three dependent variables. Spatial Density, while not significantly correlated, appears to be moderately related to the three crime categories in a consistently positive direction. The crowding indicator, Nature of Living Arrangements, is consistently related to the dependent variables in a positive direction; however, the correlation coefficients are relatively low.

The results from the stepwise regression analysis are indicated in Table 2. Taken together, the twelve socio-demographic variables, including the three measures of crowding, explained 74 percent of the variation in Total Crime, 69 percent of the variation in Violent Crime and 79 percent of the variation in Property Crime.

On the whole, the density variables are of moderate importance relative to the other independent variables. Examination of the stepwise regression computed for Property Crime shows that the density variables Density in Living Arrangements and Nature of Living Arrangements were the first and second variables to enter the equation. Together these two density variables explained 63 percent of the variation in Property Crime. These two density variables were some of the last to enter the equations for

TABLE 2: Stepwise Regression Solutions for Crime Categories on Independent Variables

Independent Variables*	Total Crime	Violent Crime	Property Crime
Percent Dwellers Unattached	.53*	.45	.05
Percent French	.05	NI ***	NI
Household Income	.01	.02	.02
Nature of Living Arrangements	.03	.01	.10
Density in Living Arrangements	.02	.03	.53
Percent Population over 15 Years	.05	.01	.03
Spatial Density	.01	.06	.01
Percent Males in Population	.004	.03	.004
Percent Other Ethnic	.01	.07	.01
Unemployment Rate	.002	.01	.02
Employment Income	.01	.01	.01
Percent English	NI	.02	.01
Total R Square	.74	.69	.79

* The order in which the independent variables are listed denotes the order of entry into the equation when 'Total' crimes were regressed on these variables.

** These figures denote the additional variance explained in the relevant dependent variable when the each independent variable is included (the change in R square).

*** "NI" indicates that a variable was not included in the regression equation due to its weak relative effect upon a given independent variable.

Total and Violent Crime and were shown to contribute little to the variance that had already been explained.

Spatial Density appears to exert its greatest effect upon Violent Crime. This variable added 6 percent to the explained variance of Violent Crime even after the effects of Percent Dwellers Unattached and Percent Other Ethnic (those whose mother tongue is neither French nor English) had been considered.

The variable, Percent Dwellers Unattached, had the strongest correlation with both the Total Crime and Violent Crime variables and therefore entered first into these two equations. As a result, Percent Dwellers Unattached made the greatest contribution to the variation of Total and Violent Crime in the multivariate analysis. On the basis of its strength in both the zero-order correlations and the regression analysis, this variable was selected to serve as a control.

While the variable, Household Income, was consistently among the last to enter the equations for all categories of crime, it was nonetheless shown to be the most potent of the economic variables. On this basis, as well as its strong zero-order correlations, this variable was selected to serve as a control.

Table 3 shows the partial correlation coefficients for each measure of crowding and each offence category,

TABLE 3: Partial Correlations Between Three Crowding Indicators and Categories of Crime; Controlling for 'Percent Dwellers' 'Unattached' and 'Household Income'

Crowding Variable	Total Crime	Violent Crime	Property Crime	Average Crime
Spatial Density	-.02* (.43)**	.07 (.49)	.11 (.52)	.01 (.23)
Density in Living Arrangements	-.26 (-.66)	-.24 (-.65)	-.37 (-.73)	.09 (.46)
Average R Square		.03 (.24)	.07 (.28)	

* The top row corresponding to each crowding indicator (and the average R square computation) denote the figures after controls had been introduced.

** The figures in parentheses represent the zero-order relationships.

controlling for Percent Dwellers Unattached and Household Income. The coefficients provide little support for the expected positive relationship between crowding and the various forms of criminality as they are either negligible in magnitude, indicating no relationship, or negative, indicating the unexpected finding that the greater the extent of crowding in a zone, the lower the rate of criminality tends to be. In any case, the introduction of controls substantially reduced the correlations between all three measures of density and all three categories of crime.

The variable, Density in Living Arrangements, affirmed its position as the strongest of the three density variables even after controls were introduced. It showed moderate partial correlations, accounting for 9 percent of the variation averaged across the three categories of crime.

Nature of Living Arrangements was the weakest of the three density variables at the zero-order level of analysis, but showed weak to moderate partial correlations that accounted for an average of 5 percent of the variation in the three categories of crime. With the introduction of controls, the average amount of variance accounted for was increased by 40 percent. As well, the direction of its

relationship to crime was reversed from positive to negative after controls were introduced.

The partial correlations for Spatial Density were negligible and accounted for an average of only 1 percent of the variation in the three categories of crime. While this factor showed moderate correlations at the zero-order level of analysis, the average amount of variance in crime that it accounted for was reduced by 96 percent after controls were used.

Table 3 also shows that Violent Crime and Property Crime are differentially associated with crowding. At the zero-order level, the relationship between the crowding variables and Property Crime was shown to be greater in all but one case. After controls were introduced, the relationship between Property Crime and the three crowding indicators was consistently greater than the relationship between these indicators and Violent Crime. Furthermore, it was shown that the crowding variables accounted for an average of 7 percent of the variance in Property Crime after controls were introduced, while they accounted for an average of only 3 percent of the variation in Violent Crime.

SUMMARY AND CONCLUSIONSMAJOR FINDINGS

To reiterate, this study sought to examine three hypotheses on the relationship between urban crowding and crime. The first section of the procedure tested the hypothesis that crowding is related to crime in a positive direction. The second hypothesis was that the relationship between crowding and crime would be unaffected by the introduction of control variables. The third hypothesis was that crowding would exert a greater effect upon Violent Crime than it would upon Property Crime.

The findings as a whole provide no support for the hypothesis that crowding is related to criminality in a linear and positive fashion. The variables, Spatial Density and Nature of Living Arrangements were related to crime in a positive direction, but showed, at best, moderate correlation coefficients when no controls were used. The Spatial Density of an area was found to have no effect upon crime when the effects of Household Income and Percent Dwellers Unattached were controlled. This finding concurs

with some previous studies which have examined the relationship between spatial density and crime controlling for similar socio-demographic variables (Freedman, 1975; Galle, Gove and McPherson, 1972).

The variable, Density in Living Arrangements, had a significant negative relationship with Total Crime, Violent Crime and Property Crime when no controls were used. After controlling for the economic and familial variables, both the Density in Living Arrangements and the Nature of Living Arrangements were found to be negatively related to all categories of crime. This finding shows that when familial characteristics and economic factors are held constant, zones that exhibit high density in the immediate vicinity of people's homes are associated with lower rates of all forms of criminality. This implies that higher levels of crowding, at least within some situations, are associated with positive or beneficial outcomes.

A considerable number of studies have reported that under some circumstances higher levels of density are desirable (Freedman, 1975). The suggestion has, in fact, been made that the relationship between crowding and crime is curvilinear, with moderate levels of social and physical density being the most-desirable conditions (Beasley

and Antunes, 1974; Gillis, 1979; Schmitt, 1957). Investigations that have analysed the effects of social isolation have also tended to support this notion of "optimal" density (Gove and Hughes, 1980).

Several urban planners have suggested that the increased surveillance and activity levels intrinsic to high density environments serve to enhance the likelihood that criminal activity would be detected (Newman, 1972; Jacobs, 1961; Angel, 1968). Factors reflecting the visibility, surveillance and vulnerability of an area have been shown to be among the most influential variables associated with residential burglary rates (Repetto, 1974). Thus, the present finding of a negative relationship between crowding and crime is not entirely inexplicable. This finding illustrates the complexity of the social and psychological factors that influence the relationship between crowding and crime and provides support for the interdisciplinary approach to the study of crowding.

The findings provided no support for the hypothesis that the effects of crowding upon crime are independent of other social and psychological factors. After the variables Household Income and Percent Dwellers Unattached were controlled, crowding was, at best, shown to exhibit

a negligible effect upon crime. This result concurs with the findings of many past ecological studies that have employed similar controls and can be interpreted to suggest that other social and psychological forces have an effect that is equal to, if not greater than the effect of crowding upon crime (Galle, Gove and McPherson, 1972; Freedman, 1975; Gillis and Hagan, 1982).

Contrary to the hypothesis, the findings showed that crowding exerted its greatest influence upon Property Crime as opposed to Violent Crime. The negative direction of the relationship between crowding and Property Crime suggests that it is the nature of the targets in an area, rather than their concentration, that exerts the greatest effect upon Property Crime rates. Aside from the reduced surveillance and activity levels characteristic of low density areas, Jeffrey (1971) suggests that the low volume of street traffic typically observed in these areas bears an important relationship to crime rates. The fact that the present study did not show any strong direct effects of crowding upon any of the categories of crime may be due to the relatively low levels of congestion in the city of Ottawa. It has been suggested that only communities with far greater congestion will experience such effects (McCain, Cox and Paulus, 1980).

Several additional factors jeopardize the validity of any ecological study. For a detailed methodological critique of ecological research, the reader is referred to Gordon (1967), Roncek (1975) and others. The following discussion involved the sources of invalidity most likely to have intervened in this study.

METHODOLOGICAL PROBLEMS WITH THE ECOLOGICAL APPROACH

Aggregation is one of the most frequently cited problems in ecological research. Several criticisms have been advanced against the practice of drawing inferences about individuals on the basis of socio-demographic information relating to groups (Robinson, 1950). In the present study, inferences were based on summary measures that were presumed to reflect the demographic characteristics of the police patrol zones and various attributes of the resident population. In order for this study to proceed, it was necessary to assume that the actual conditions that exist in any particular zone would not be distorted by the use of these averaged factors.

In the present study, all of the socio-demographic characteristics used to describe the zones were recorded as averages. Thus, a variable such as Household Income represented the sum of the household earnings within a zone, divided by the number of dwellings in the zone. The

extent to which an average figure, such as this, adequately summarizes a given zone depends upon the homogeneity of the residents. If the range and standard deviation across all households is great, the measure would be a poor indicator of the population's economic situation. It is conceivable that some zones would possess a small pocket of high income residents and a larger pocket of low income residents. The use of averages to describe the economic conditions within such zones would consequently provide a distorted evaluation of the actual status of the residents.

Similarly, any crowding measure is sensitive to the extent of homogeneity within a particular zone. Any moderately sized area within a city is likely to contain a variety of shopping areas, schools and parks in addition to its residential sections. As a result of this diversified land use, the resident population is rarely evenly distributed throughout any given area. Thus, a measure of Spatial Density that includes unoccupied land, may seriously underestimate the actual congestion that exists in an area.

Gross measures of crowding, such as Spatial Density, do not reflect the heterogeneity that may exist with respect to crowding within households or among dwelling units in a zone. Thus, measures that gauge the extent of social crowding

are frequently used to compensate for these deficiencies. Notwithstanding, caution is warranted when drawing inferences on the basis of averaged measures such as Density in Living Arrangements as the range and standard deviation across any particular zone is likely to be great.

The measures of crime indicated the number of reported offences of a given category that occurred in each zone relative to its population. Typically, only a small percentage of the residents of any zone are involved in this criminal activity. Implicit in this study is the assumption that these offenders live under the conditions described by the socio-demographic averages for the zones. Aggregation precludes the validation of this assumption.

Another complicating factor is the assumption, in all ecological studies, that the crime problem in a given area is wholly attributable to the local residents. If a significant proportion of a community's crime is committed by offenders living outside that neighbourhood, then any inferences based on the relationship between environmental attributes and crime would be misleading. It has been shown that offender mobility patterns in Ottawa are influenced to some extent, by the distribution of criminal opportunities (Gabor, 1983). Thus, zones possessing numer-

ous attractive targets would tend to exhibit inflated crime rates that might be unrelated to factors such as crowding. It was further shown that the relationship between offender mobility patterns and environmental attributes was most pronounced for property offences as opposed to violent offences. The findings of the present study also showed that property crime rates were more strongly related to environmental factors than were rates of violent crime.

Hammond (1973) contends that aggregation may invalidate findings if the basis by which individuals are grouped is related to the dependent variable. Thus, the findings of the present study would be irrelevant if the organization of the police patrol zones was determined by the distribution of crime. In Ottawa, the zones are apparently arranged to facilitate police patrol. The size of a zone is frequently related to the number of streets it contains and natural barriers such as parks and major roadways often serve as the boundaries.

Aggregation problems become progressively more serious as the units of analysis in a given study increase in size. The present study involved 18 police patrol zones which were substantially larger than the census tracts. This increased the likelihood of heterogeneity in the areas studied.

The effects of a few atypical zones are also magnified when the sample consists of only 18 zones.

It has been suggested that heterogeneity within areas could be reduced through the use of smaller units of analysis (Roncek, 1975). Aggregation at this level is deficient in several respects due to the relatively low levels of population and congestion that are typical of Canadian cities. As a zone gets smaller, the population would be expected to be reduced. Thus, summary measures that reflect the conditions within these zones are more sensitive to the distortion occasioned by a few extreme cases.

The level of aggregation also affects the validity of crime measures. Smaller areas would be expected to have lower volumes of crime. Thus, summary measures of crime would be more sensitive to distortion by a few non-routine events. Increased offender mobility is also likely to confound summary measures of crime when smaller zones are used. Even with the large zones used in the present study, the validity of the summary measures of crime is threatened by the consistently low volume of violent crime and the apparent mobility of offenders in Ottawa (Gabor, 1983).

The construct validity of the crowding indicators was another source of concern. The measurement of Spatial

Density, which includes a population count, presents the same problem as the measurement of crime rates. The free movement of people between zones and from more to less densely populated sections of a zone seriously reduces the utility of areal measures of crowding that only consider the resident population. The use of smaller units of analysis would only serve to accentuate this problem.

In past studies, Density in Living Arrangements has been found to be the most influential factor when crowding effects have been observed (Gillis and Hagan, 1982). In the present study, this variable was measured by the average number of persons per household. Of the three crowding indicators, Density in Living Arrangements was shown to be the most strongly associated with crime; however, the relationship was in a negative direction. This finding though, is inconclusive for several reasons. The variable does not take into consideration the size of the home. In fact, it was shown that the number of persons per household was significantly related to economic indicators suggesting that the more affluent people typically have larger families. It would be assumed that the more affluent families would also reside in more spacious homes than would

the less privileged, thereby obscuring the basis of comparison. Thus, the heterogeneity that exists with respect to the number of persons per household could conceivably be reflecting the economic status of the residents, rather than the extent of crowding. On the other hand, if home size is unrelated to economic indicators, then the findings suggest that the negative effects of a crowded home are reduced by the affluence of the residents. This position concurs with Freedman's (1975) density-intensity hypothesis.

The third crowding variable, measuring the proportion of dwelling units which are apartments, also does not address such issues as the time spent by the residents in the immediate surroundings of their home, the facilities and conditions within the structure and the space between structures. In Ottawa, apartment living is characterized by wide ranges in income level, the number of persons per household, apartment size, building size, facilities and the proximity of these structures to other housing complexes.

The findings as a whole reinforced the notion that crowding is a multidimensional phenomenon. The deficiencies of one indicator may occasionally be offset by the introduction of another; however, the problems are rarely resolved. The utility of the ecological approach often requires that the validity of the variables be compromised. Thus, it

would seem that the various measures of crowding must be considered together.

Caution is warranted when interpreting the results of partial correlations. In the present study the effects of economic and familial factors were statistically controlled in an effort to isolate the relationship between crowding and crime. It is unrealistic to suppose that the effects of crowding can be isolated from the interactive effects of the various psychological, sociological and biological factors which constitute every human ecosystem. Both the literature, and this study have documented the interactive effects of various forms of crowding and other social factors. Thus, the ecological approach might have more utility if the combined impact of these effects were assessed rather than their separate effects.

It has been suggested that partial correlations do not actually isolate related factors, but merely control for a portion of the variance due to other influences (Roncek, 1975). A partial correlation between some measure of density and crime, controlling for income, means that the density/crime relationship is calculated only after the income/crime and income/density relationships have been discounted. However, the amount of variance deducted as a result of the income/crime relationship would be in-

flated because this correlation is computed without controlling for the effects of other variables upon crime. Notwithstanding, the amount of variance deducted as a result of the income/density relationship would also be inflated. It has been suggested that the only way to remedy this situation is through the use of simultaneous equation systems.

Aside from the questionable utility of partial correlations, there are several factors that concern the validity of the findings in this study. After controlling for Household Income and Percent Dwellers Unattached, the correlation between Density in Living Arrangements (the strongest crowding indicator) and crime was substantially reduced. Thus, it could be concluded that the relationship is indeed a spurious one. On the other hand, the variable Percent Dwellers Unattached could be considered to be an indicator of social isolation. People who are socially unattached would be expected to have smaller circles of friends and family. Furthermore, there has been a suggestion that these factors are associated with various social pathologies, including crime (Gove and Hughes, 1980). Thus, statistical control of the variable Percent Dwellers Unattached would be expected to suppress the relationship between the number of persons per household and crime.

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The use of the multiple regression analysis as a criterion to select variables for control in the partial correlations is not without fault. In all probability, the sample of 18 police patrol zones was of an insufficient size to perform a regression analysis. The deficiencies of this criterion were, however, offset as the control variables were also selected on the basis of their zero-order correlations with the crime indicators and their theoretical relevance.

SUGGESTIONS FOR FUTURE RESEARCH

Competing theoretical positions and contradictory findings from empirical research indicate a need for further studies of the relationship between crowding and crime. The various methodological problems that are characteristic of ecological studies indicate a need for the development of innovative procedures and novel analysis.

The selection of relatively homogeneous populations for comparison can reduce the problems associated with aggregation. Typically, this would require the use of smaller units of analysis, which in turn would increase the potential for distortion in measurement. If researchers are directed away from citywide investigations these problems may be avoided.

An alternative to the intracity approach could involve an extensive comparison of a few relatively homogeneous areas within a city. In this way, the size of the units of analysis would not necessarily be prohibitively small. The reduced sample size would make various sampling techniques feasible alternatives to the usual reliance upon census information. Crime could conceivably be measured by a combination of victimization surveys and police reported occurrence rates.

Furthermore, these studies would be enhanced if the zones were bordered by true ecological boundaries. This would reduce the amount of offender mobility among zones and limit the amount of free movement of the population between zones. In this way, the certainty is increased that the majority of crime in an area is attributable to the local residents. As well, one can be assured that the natural boundaries maximize the amount of time the residents spend in their own area thereby reducing exposure to divergent experiences. Thus, the validity of an inference is increased if it is based upon observations made in an environment bordered by true ecological boundaries.

In intracity studies of crime it is unlikely that all areas will be bordered by natural boundaries. It is imperative that these studies employ either observational

or mathematical estimation procedures to gauge the extent of offender mobility.

It has frequently been advised that the complexities of human ecology can only be resolved through an interdisciplinary approach (Jeffrey, 1971; Freedman, 1975). The literature, as well as this study, has shown that the relationship between crowding and crime is not an exception.

Given all the methodological problems, the present study provided little support for the hypothesized positive relationship between crowding and crime. Taken in the context of the zero-order and spatial correlations between crowding and crime, there is a suggestion that the relationship is most likely a spurious one.

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APPENDIX A

DEMOGRAPHIC INFORMATION BY POLICE PATROL ZONE

	Patrol Zones																			
	101	102	103	104	105	106	107	108	109	110	111	112	200	201	202	203	204	205	206	
Total Population	11166	17235	13952	25663	13506	16763	15688	5987	3639	15019	13195	9938	11006	15590	18387	18172	18858	16838	16838	
Special Density (per sq. km.)	6906	7511	6279	9883	6068	1806	3556	-1386	3199	980	1825	5832	3269	3282	268	3771	3529	5095	5095	
Density in Living Arrangements	2.0	2.3	2.3	2.7	2.0	3.1	3.1	2.6	3.1	3.4	2.9	2.7	2.6	2.6	2.8	2.9	3.3	2.8	2.8	
Ratio of Living Arrangements	48	68	41	33	71	35	28	1	30	16	23	14	22	35	40	44	24	24	66	
Percent Dwelling Unattached	58	50	49	40	59	44	42	48	37	38	41	42	40	40	38	30	33	28	33	
Percent Population Over 15 Years	82	86	87	83	91	75	76	81	77	75	75	80	81	81	86	78	80	75	82	
Percent Rate in Population	48	46	49	48	46	50	48	49	49	50	49	48	48	46	46	48	49	47	47	
Employment Income	908	6036	4761	5938	5862	5565	9386	6210	6761	7270	5791	5858	5507	7091	5601	6135	6285	5507	5507	
Household Income	8191	10236	8036	13255	8712	12185	10600	12665	15326	17638	12009	11570	12826	15015	12000	13813	13672	10518	10518	
Employment Rate (%)	9.0	7.0	6.9	7.0	7.6	10.8	6.3	11.7	6.8	5.5	6.4	6.6	5.5	6.1	5.5	5.8	6.0	6.3	6.3	
Percent English	65	63	63	75	50	66	67	68	75	79	70	63	78	84	84	75	80	83	76	
Percent French	15	40	17	10	38	26	34	24	13	10	22	21	11	11	7	10	9	9	12	
Percent Other Ethnic	20	17	20	15	12	8	1	8	12	11	8	16	11	11	8	15	11	8	12	
Percent Crime Rate (per 100,000)	33150	12562	18265	8853	21263	7285	10788	21253	5381	11826	6801	15982	6668	7755	9583	8887	7860	11397	11397	
Percent Crime Rate (per 100,000)	27722	10003	11282	7544	17361	5952	8843	18640	4209	5027	6383	12442	5951	6376	7778	6532	6038	8957	8957	
Percent Crime Rate (per 100,000)	1985	627	944	394	1322	382	561	1201	232	613	336	775	150	250	591	567	520	619	619	

* Values derived from the 1975 census information for Ottawa-Kill.
 ** Values derived from the 1971 census information for Ottawa-Kill.
 *** Values derived from the Ottawa Police Department Records Division 1981-complaints.