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The Consequences of Living in High-Rise Buildings

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Abstract: A full account of architectural science must include empirical findings about the social and psychological influences that buildings have on their occupants. Tall residential buildings can have a myriad of such effects. This review summarizes the results of research on the influences of high-rise buildings on residents' experiences of the building, satisfaction, preferences, social behavior, crime and fear of crime, children, mental health and suicide. Most conclusions are tempered by moderating factors, including residential socioeconomic status, neighborhood quality, parenting, gender, stage of life, indoor density, and the ability to choose a housing form. However, moderators aside, the literature suggests that high-rises are less satisfactory than other housing forms for most people, that they are not optimal for children, that social relations are more impersonal and helping behavior is less than in other housing forms, that crime and fear of crime are greater, and that they may independently account for some suicides.

Keywords: Tall buildings, Research methods, Residential satisfaction, Mental health, Stress, Crime and security, Social relations, Prosocial behavior, Suicide, Children

"There is every reason to believe that [the] hi-rise...apartment dwelling has adverse effects on mental and social health." (Cappon, 1972, p. 194).

"...[B]lank condemnation of high-rise dwellings that does not consider specific contexts should be questioned...residents [in my study] showed a high degree of satisfaction at all floor levels" (Kim, 1997, p. iv).

A Brief Historical Background

Natural and Social Science Approaches to Architecture

The ancient Egyptians probably were the first to apply scientific knowledge to the construction of buildings; in any case, their amazing structures are the best-understood ancient large buildings. Not only did their architects use geometry and astronomy to plan the pyramids, but also they had to understand and apply much natural-science knowledge about the properties of materials to design the huge yet precisely constructed tombs that include intricate rooms and passageways. So sophisticated were their calculations that the Great Pyramid not only remains the largest stone building in the world after 4,000 years, but also was built so accurately that the opposite corners of its foundation, some 324 meters apart, are only 2 cm different in elevation.

Later, the architects of the great gothic cathedrals of Europe so well understood advanced principles of construction that modern engineers sometimes marvel at, or are even baffled by, their ar-

chitectural feats. Finally, of course, modern architectural science is full of advances that ancient and medieval architects probably could not imagine, given modern materials, computers and construction technology. All these have been amply documented in this journal for years.

However, in parallel with these natural science accomplishments, social scientists interested in architecture have also been toiling away, but until recently, they have done so beyond the formal mandate of the *Architectural Science Review*. Now the time has come to bring some of the insights of the interdisciplinary social sciences into *ASR*, to complete the domain embodied by the phrase "architectural science."

As documented by several authors (e.g., Gifford, 2002; G. T. Moore, 1984, 1987) social science approaches to architecture can be dated to the middle 1960s, although less rigorously science-oriented understandings of human-building interactions must be traced back as far as the ancient Egyptians. Doubtless, for example, the construction and mere existence of the pyramids had far-reaching social effects in Egyptian society. The study of harmonious proportions (for example, of temples) with psychological implications (the perception of beauty) can be traced to Pythagoras and his school 2500 years ago (Murray & Kovacs, 1972), and one may easily imagine that equally profound social effects were associated with the subsequent design, construction, and use of Greek temples, Roman baths, gothic cathedrals, early industrial factories, and the first high-rise buildings, constructed in the late 19th century.

Modern, formal study of the social and psychological effects of architecture may be attributed to the Chicago school (e.g., Park, 1925), whose members studied the social ecology of cities, which led to a number of sociological studies of housing and community (e.g., Chapin, 1938; Isaacs, 1948; McClenahan, 1945). Research began to focus on the more personal or psychological scale with several seminal studies in the 1950s on housing in relation to social behavior and mental health (e.g., Campelman, 1951; Chapin, 1951; Festinger, Schachter & Back, 1950; Kennedy, 1950; Wallace, 1956; Wilner, Walkley & Tayback, 1956).

The field then organized itself in the 1960s, moving from isolated studies to conferences on what was then called architectural psychology at the University of Utah (1961 and 1966), books like Robert Sommer's *Personal space: The behavioral basis of design* (1967), special issues of journals, like that in the *Journal of Social Issues* (October, 1966), the Environmental Design Research Association (first conference, 1969, co-founded by the current editor of this journal), journals (*Environment and Behavior*, begun in 1969), and interest from sociologists (e.g., Michelson, 1970).

In short, architectural science must be a social science as well as a physical and technical science. In this regard, this paper focuses on the psychological, behavioral and interpersonal influences of high-rise buildings.

A Brief History of High-Rise Buildings

If the minimal definition of a high-rise is a building taller than three storeys, then the history of high rises may be traced back to the pyramids of Egypt (about 48 storeys in height) and the Tower of Babel. Genesis 11 in the Christian *Bible* briefly tells the story of the Tower of Babel. According to the account, before the tower was complete God decided that if humans could complete such a tower, they could accomplish anything. That was not acceptable, so God caused confusion among the people by cursing them with multiple languages (everyone had spoken the same language until then, and their tower-building success was attributed to this). Then the people were dispersed, and apparently the tower was deconstructed soon afterward. Some modern critics of high-rise buildings may believe that God had the right idea about the human conceit involved in building tall buildings.

People did not build tall structures again until the late 1600s, apart from a few Roman apartment buildings of six or seven storeys and Europe's gothic cathedrals. Seventeenth-century Paris had thousands of houses five to seven storeys tall (Laurens, 1954). Tall buildings with iron skeletons began to be constructed in the 1860s (Sundstrom, 1986); in 1885, a ten-storey building was constructed in Chicago by William Le Baron Jenney (Yeung, 1977), followed by Sullivan's Wainwright Building five years later. The rest is history; millions now live in high-rise buildings.

Thus, given the age of our species, living more than a few storeys up is a very recent phenomenon. This tempts one to conclude that high rises are unnatural, and some would argue that what is unnatural must be, in some way, harmful. (Of course, the same has been said about plastics, electricity, automobiles and other recent inventions.) Nevertheless, the question remains a fair one: are high-rise buildings a net benefit or cost to their residents?

The Issue: Are High Rises Bad or Good for People?

What is Bad About Them? What is Good?

High rises have been accused of causing many unpleasant outcomes. Among those examined in this paper are fear, dissatisfaction, stress, behavior problems, suicide, poor social relations, reduced helpfulness, and hindered child development. Early studies and reviews concluded that high-rises are, on balance, not beneficial for residents (e.g., Angrist, 1974; Cappon, 1972; Conway, 1977). At the societal level, they are accused of burdening existing services and infrastructure, worsening traffic problems, and damaging the character of neighbourhoods (Broyer, 2002).

High-rise residences evoke at least six fears. The first is that the residents themselves, a loved one, or a neighbour will fall or jump from a high window. Whenever this tragedy occurs, it receives much media attention, perhaps because the nightmare has come true for someone. Second, perhaps paradoxically, some residents fear that they may be trapped inside during a fire; it usually takes longer to reach the street from a high-rise dwelling than from dwellings of a few storeys. Third, residents in places with active tectonic plates worry about the entire building falling because of an earthquake. Fourth, in the post-McVey, post-911 era, residents cannot help harbouring at least a slight fear that their building might be attacked. Fifth, the sheer number of people who reside in One Big Residence means that, in a sense, strangers share your dwelling, at least the semi-public areas of it. This fear of strangers leads to fear of crime, a felt lack of social support and the absence of community in the midst of many. Anonymous interaction in visually screened areas within high rises creates the objective possibility of crime. This is more likely when outsiders can enter the building. The very fact that many high-rises have entrances with keys and guards proves that this fear exists, even if no strangers manage to enter. Sixth, the sheer number of people in one building may increase the fear of becoming ill from communicable diseases generated by others. Air- and touch-borne flus and colds, for example, spread more easily when many people share hallway air, door handles and elevator buttons.

Perhaps none of these fears is realistic. Perhaps they simply are salient because so many people live so close together, and communicate their fears verbally or nonverbally. Perhaps, on a base rate or per capita basis, no more negative outcomes occur among high-rise residents than among residents of any other form of housing. On the other hand, perhaps, there truly are more negative outcomes, but they are caused by factors other than housing form. These extra-architectural moderators of negative outcomes are considered later. First, this question might be rhetorically posed: Why is it that so few writers (Jacobs, 1961, is a notable exception) hypothesize that high-rise buildings will lead to *positive* outcomes for those who live in them?

What might be *good* about high rises? Tall thin buildings have smaller footprints than the equivalent number of low-rise housing units, and therefore may occupy less land area (but not necessarily, depending on siting). This, in principle, leaves more room for parks and green space (Broyer, 2002), although this open space has

often become a dangerous no-man's land controlled by undesirable elements. High rises offer great views (at least to upper-level residents, unless their view is blocked by other high rises), and relative urban privacy. Their usual central urban location is an advantage for those who desire it. Many services and transportation options are likely to be near, and the large number of nearby neighbours affords greater potential choice of friends and acquaintances for social support (Churchman, 1999). Those who live in their upper reaches experience less noise from outside the building, and may breathe cleaner air. For some residents, high population density at the building level (not the dwelling level) may promote more and better social interaction. Controlled entrances reduce crime and the fear of crime. Compared to the single-family resident, high-rise residents are free of yard and maintenance work, although part of the rent or condominium fees must go to pay others to do that work.

All this, so far, reflects conventional wisdom and speculation, a list of complaints and benefits one might hear anywhere. How many of the negative and positive claims are supported by research? The answer is complex and incomplete, but research does provide some partial answers. The height of a building presumably has few, if any, direct causal effects. Ultimately, as one early research team concluded, different buildings probably have different advantages and disadvantages for different residents (Sinnott, Sachson & Eddy, 1972). The task of the architectural social scientist is to discover which buildings are salutogenic or pathogenic for which people. Furthermore, the outcomes of living in a high rise depend in part on various non-building factors, including characteristics and qualities of the residents themselves, and the surrounding physical context. These factors *moderate* the relation between living in a high rise and the outcomes of living in one.

The Importance of Moderating Factors in Understanding the Impacts of Housing

High-rise buildings can be associated with negative outcomes without causing those outcomes. At least eight factors that are independent of high-rise architecture *per se* may moderate residents' outcomes. Moderators are factors or variables that are associated with differences in outcomes, but not in a causal sense. In contradistinction, mediating factors or variables are part of a causal link between the environment and the outcome (Evans & Lepore, 1997). The moderators may be broadly grouped into two categories, those associated with residents (their personal characteristics and social relations) and context (the environmental and neighborhood). These factors are presumed to influence outcomes for residents in *conjunction* with building height.

Four such moderating factors are residents' economic status, the amount of choice among residences a resident has, the building's location within the urban fabric, and population density. We might expect that if high-rise residents (a) are not poor and (b) choose to live in a high rise when they have other housing options and (c) the high rise is located in a good neighborhood, and (d) its dwelling-unit population density is low, they may well escape most negative outcomes and experience many of the positive outcomes. This appears to be the case, for example, with the high rises on the

edge of Central Park in Manhattan, which are expensive, usually spacious, and in a highly desirable neighborhood.

Consider how one of these moderators, building location, affects the relation between high-rise living and exposure to crime. Research shows that building location plays a role in a resident's exposure to crime that is independent of building form (Luedtke and associates, 1970; Molumby, 1976). For example, crime seems to be more frequent when buildings are placed near easy escape routes (Brill, 1972) or on corners (Brantingham & Brantingham, 1975). Lighting, street activity, and the crime rate of the larger neighborhood also affect crime rates separately from building form (Repetto, 1974).

Four further possible moderators of a resident's outcomes of living in a high-rise building include life-cycle stage, gender, culture and dwelling design. That is, high-rise living may in general be more suitable for some stages of life than others, one gender more than the other, some cultures more than others may, and in some arrangements of space within the unit or within the building more than in others.

Thus, high rises may have positive or negative effects on those who live in them, depending not on building height alone (the defining characteristic of high rises), but on at least eight other moderating factors. Each of these will be discussed later, where evidence exists.

Typical Research Methods

Understanding how the effects of high-rise living are studied is important. Five general methodological approaches have been used. First, in the simplest and least rigorous design, an outcome measure (e.g., satisfaction or helping behavior) is examined in a case study of a single high rise or solely in high-rise buildings (e.g., Korte & Huismans, 1983; Williamson, 1981). Second, slightly better research designs compare high rises with low rises, but fail to consider possible moderating factors (e.g., Oda, Taniguchi, Wen & Higurashi, 1989; Zalot & Adams-Webber, 1977). Third, more sophisticated research designs compare numerous high rises with numerous low rises, and consider at least some potential moderators, perhaps in a more sophisticated correlational or quasi-experimental design (e.g., Edwards, Booth & Edwards, 1982; Gillis, 1977). The more buildings in the sample, the better chance that variations in the construction, design, age, neighborhood, or level of maintenance among the high rises and among the low rises, that is, variations that are not themselves of immediate interest, will not affect the results.

Fourth, and closer to the ideal, is the research design that compares many high rises with many low rises and considers many potential moderators, but also involves (a) random or essentially random¹ assignment of residents to buildings and (b) investigator control of key variables. Some studies have been able to approximate random assignment because of some naturally occurring social process (e.g., Fanning, 1967; D. McCarthy & Saegert, 1978; Wilcox & Holahan, 1976), but architecture researchers virtually never have control over key or independent variables.

In a fifth research design that can be very useful, but also has disadvantages, researchers assess the progress of a group of residents over time, in a longitudinal design. This approach may be used with any of the four previous designs, which is one reason it can be less or more ideal. Longitudinal designs also have the advantage of assessing changes in the same group of residents, but disadvantages, too, such as not always being able to ensure that any observed changes in the residents are caused by factors other than the building.

Probably no study of high rises has been conducted meets all the requirements of a true experiment, and therefore no absolutely certain causal conclusions may be drawn. Many studies have shortcomings and a few have been models of ideal research. Complaints about the adequacy of high-rise housing research have been aired for the last 35 years (e.g., Cappon, 1972; Evans, Wells & Moch, 1998; van Vliet, 1983). However, researchers are not entirely to blame. To carry out a study of housing that meets standard criteria for scientific hypothesis testing is very difficult; often researchers are forced to use non-optimal research designs. On the other hand, when numerous imperfect studies reach similar conclusions, that conclusion has the weight of replication behind it. Alternatively, when different methods are employed ("triangulation of methods") and similar results are found, conclusions based on those results may be taken more seriously. This review occasionally will note which grade of research design a study employed, as a reminder that even published research does not always (in fact, can not) meet the most rigorous standards.

The Evidence: Findings, Conclusions and Interpretations

Experiencing the Dwelling

Before residents are satisfied or not with a dwelling, they perceive or experience its features or qualities. For example, a study of dormitories found that residents of higher floors experienced their rooms, which were all the same size, as larger (Schiffenbauer, Brown, Perry, Shulak & Zanzola, 1977). A similar investigation in another college dormitory complex found different experiences for men and women: the women found higher rooms more spacious, but the men found higher rooms less spacious (Mandel, Baron & Fisher, 1980).

Few studies have examined even such an obvious topic as the ways in which high-rises are perceived. However, one study examined how silhouette drawings of high-rises were related to pleasure and psychological arousal in viewers (Heath, Smith & Lim, 2000). Visual complexity was the strongest predictor of pleasure and arousal. Surely, however, there is much more to the experiencing of a dwelling than this. Presumably, high-rise buildings influence residents' moods, thinking, imagination,

spatial cognition and perceptions other than the apparent size of their unit and their visual complexity. Unfortunately, these are unanswered questions.

Residential Satisfaction and Preferences in High-Rise Buildings

Satisfaction or (the lack of it) obviously is an important outcome of living in one's dwelling, although subsequent sections will show that it is not the only consideration. All else being equal, are residents of high rises more satisfied with their dwellings than residents of low-rise dwellings? Of course, neither all high-rise residents nor all low-rise residents are satisfied. Among high-rise residents, for example, presumably most wealthy denizens of tall expensive apartment buildings in desirable locations are quite pleased with their high rises, and we know that many residents are miserably unhappy with their broken-down ghetto high-rise dwellings. Nevertheless, is there a difference, on average, or in particular contexts?

A number of studies report broad satisfaction with high-rise apartments. For example, Jephcott (1971, p. 48) reported that 90 % of the Glasgow residents in her study of multi-storey buildings were satisfied. Over 75 % of Singapore high-rise public housing residents were satisfied, according to Yeh and Tan (1975, p. 226). Three studies have been conducted in Israel. One found two-thirds of high rise residents were satisfied, although over 40 % intended to move anyway (Ginsberg & Churchman, 1984); another found that 85% of the women interviewed were satisfied with the building, yet half were interested in moving, and only half of them would choose a high-rise again (Landau, 1999). The third reported that general satisfaction was high, but only a few wished to move away (Broyer, 2002). The latter study reported that willingness to reside in tall buildings increased with floor level. A study of eight high rises in major U.S. cities found a high level of satisfaction among residents at all floor levels (Kim, 1997).

Sceptics might point to a well-known social psychological principle, cognitive dissonance (Festinger, 1957), in discounting these results. Once a choice is made (where to live, for example), if residents are not pleased after living there for some time, it may be easier for them to change their mind (decide it is a good place to live) than to change their residence (move), as a way to reduce the discomfort of living in a place they do not like.

Furthermore, some of the studies just cited investigated only high rises; it may be that residents of nearby low-rise or single-family residences more (or less) satisfied, but without a comparison, we cannot know. For example, Kim's (1997) study showed that residents of lower floors were no less satisfied than residents of upper floors, which is interesting in itself, but without a comparable group of low-rise residents, to conclude that high rises are more or less satisfactory than low rises to their residents would be incorrect.

Six studies that included buildings of different heights suggest that satisfaction is lower in high rises. In the first (in chronological order), British flat-dwellers were less satisfied than house-dwellers, and complained more about privacy, isolation, loneliness, and noise (N. C. Moore, 1975). The second investigated satisfaction in low-versus high-rise college dormitories (Holahan & Wilcox, 1979). It

¹ In true experimental studies (often conducted in laboratories), participants are assigned to different conditions truly randomly, by using a table of random numbers or some equivalent method. The term "essentially random" as used in this paper means that a housing authority assigns each resident to a unit in a building or buildings based on availability, that is, when some previous resident leaves. Thus, the assignment to a unit ("condition") is "essentially" random, but not as purely random as when laboratory methods are used.

had the scientific advantage of essentially random assignment¹ to rooms, based on how the university placed students in dorm rooms. Residential satisfaction in low-rise dormitories (2 to 5 storeys) was much greater than that in 10- and 13-storey high-rise dormitories, although this relation was moderated by the students' level of social competence. That is, in the low-rise dormitories, more socially competent students were significantly more satisfied with the dormitory than were less socially competent students, whereas in the high-rise dormitories residential satisfaction did not significantly vary with social competence. The third study was a nationwide survey of 23 urban centers in Canada (Canada Mortgage and Housing, 1979). In general, housing satisfaction was quite high (about 9 on an 11-point scale). However, housing tenure moderated satisfaction: among owners, satisfaction was highest for residents of detached houses, followed by low-rises (6 or fewer storeys) and high-rises. Among renters, satisfaction was highest in the high-rises, but the other housing forms were very close behind, and so the differences among renters may not be important.

Fourth, a New York study also had the scientific advantage of essentially random assignment to high-rise (14-storey) versus low-rise (3-storey) buildings (Saegert, 1979). In these public housing projects, families were assigned to buildings of either type as vacancies arose, creating naturalistic random assignment to conditions. As would be expected from this, the families in the two building types did not differ on any of several demographic variables, except that families in 3-storey buildings had more children. Residents of the high-rise buildings reported greater feelings of alienation and less satisfaction with their building. Nevertheless, citing other studies, Saegert speculated that these differences may not have been the result of the building form *per se*, but of social factors such as mistrust, heterogeneity, and unfamiliarity among residents that themselves are encouraged by the high-rise building form.

If turnover and degree of place attachment are indicators of satisfaction then, according to a fifth study, done in moderate-income subsidized housing, high rises are less satisfactory than row houses and walk-ups: turnover was greater and attachment was lower in the high rises (Franck, 1983). The sixth study (Rohe, 1985-86) found that the taller the building, the lower the residents' satisfaction, after statistically controlling for several possible influences (stage in the life cycle, education and income).

Against these general trends, certain demographic groups are more likely to be satisfied with life in a high rise. For example, a study in New York of residents who lived in three middle-income high-rise sites located in a good neighborhood showed high levels of satisfaction with the city, housing development, and apartment (Mackintosh, 1982). The most satisfied residents were those who lived in the newest development that embodied features illustrating the latest in design theory. The two demographic groups that were most attracted to urban high-rise living were families with employed women and people who had grown up in apartments. Mackintosh concluded that well-designed middle-income high-rises could provide a satisfying housing option and have a positive impact on family dynamics.

A Chicago study suggests that young mobile singles and childless couples prefer high-rise living to suburbia (Wekerle & Hall, 1972).

Singles may want to spend more time working on their social lives than on suburban activities like gardening or mowing the lawn; married couples may be willing to mow the lawn to provide a play area for their children; freed from the time-consuming courtship phase, they have more time for gardening. Thus, an important moderator may be whether residents have children who live at home. That high-rise dwellers with small children are dissatisfied is one of the most consistent trends in the literature (e.g., Gittus, 1976; van Vliet, 1983). Up to 87 % of parents were unhappy with play facilities in one study, and in an Australian study 60% of parents believed that the high rise was having a detrimental effect on their children (Conway & Adams, 1977). These are merely samples of many other studies that have reached similar conclusions, although one large-scale survey in Britain reported a relatively modest 39 % dissatisfaction rate among households with children all under 5 years of age (Conway & Adams, 1977). However, such figures should be contrasted with the rate of dissatisfaction of parents with other forms of housing; it is possible that parents of younger children are equally unhappy with other housing forms.

Another group that some experts (e.g., Newman, 1975) believe to be well suited to high-rise living is the elderly. At this stage in the life cycle, gardening may be tiresome or beyond one's physical abilities; in many communities elderly persons may feel safer within a large building than alone in a single-family dwelling. Studies of the elderly in high rises versus low rises have produced mixed results. A nationwide U.S. study of the elderly found that residents of low buildings liked their housing more than residents of taller buildings, although the magnitude of this effect was quite small (Lawton, Nahemow & Teaff, 1975). A much smaller study of elderly persons who were randomly assigned to high- and low-rises reported a small difference in morale that favoured high rises over low rises (Duffy & Willson, 1984). A study in India found quite widespread dissatisfaction with high-rise living among the elderly, although no comparison was made with other housing forms (Dasgupta, Bhattacharyya & Asaduzzaman, 1992).

The lack of differences in satisfaction among the elderly may be caused in part by a tendency on the part of many elderly persons to report satisfaction no matter what their situation (Nahemow, Lawton & Howell, 1977). However, when more pointed questions are asked, some differences emerge. For example, in one study low-rise residents were happy with their closeness to nature, whereas high-rise residents were happy with the social life in their building (Devlin, 1980). This suggests that a key strategy for maximizing satisfaction may lie in matching resident characteristics and preferences to buildings, where this is possible (Gifford, 1999).

Devlin (1980) also found that low-rise residents offered more positive reasons for liking their residence than high-rise residents did, and the high-rise residents offered more negative comments than the low-rise residents did. This suggests that despite the lack of differences in response to overall or generic questions about residential satisfaction, elderly persons actually are more satisfied with low-rise buildings. Of course other factors, such as fear of going outside, the quality of social relations, and management factors can also affect residential satisfaction.

All the above studies focus on residents. Only a few studies of tall buildings have examined the satisfaction and preferences of non-residents. Despite the dearth of studies, this is an important topic: more people have to look at high-rises than live in any given building. Old brick, complex modern, and "plain" high rises were shown to viewers, who were asked for their preferences (Stamps, 1991). Contrary to the researcher's expectations, the modern high-rises were preferred over the other two types.

Strain, Crowding and Mental Health in High-Rises versus Other Types of Housing

Strain--the effect on a person of overexposure to stressors--has many determinants. Whether high rises contribute to, or ameliorate, strain probably cannot be answered in a definitive manner because of the numerous social and physical factors that may play a role. For example, teens who live in public housing high rises report experiencing high degrees of exposure to violence and concerns for their personal safety (Sweatt, Harding, Knight-Lynn, Rasheed & Carter, 2002), but obviously this is connected with socioeconomic conditions as much or more than with housing form.

Some studies report neutral or even positive results. A study that compared the optimism of residents in a controversial public-housing high-rise with base rates of optimism in the general population found that they were no less optimistic than most people (Greenberg, 1997), suggesting at minimum that difficult high-rise housing does not necessarily crush the human spirit. Another reported that slum-dwellers who moved into apartments showed slight improvements in mental health (Wilner, Walkley, Pinkerton & Tayback, 1962). This result may be anomalous because the apartments had an unusual design that included children's play areas on every floor. A third compared three groups of 25 London families each living in high rises, low rises, and single-family dwellings (Richman, 1974). No significant difference in the number of mothers with psychiatric disturbance was found.

Nevertheless, the evidence, on balance, suggests that high rises do cause strain or mental health difficulties, at least for some residents. More typically, studies report some form of strain associated with high-rise living. In a study with essentially random assignment, British military families in walk-ups (3-4 storeys) had about three times the rate of neurosis as those who lived in detached houses (Fanning, 1967). A study that compared walk-ups and houses found trends in the same direction, but not significant differences (N.C. Moore, 1974, 1975). Moore's residents may have differed in age and gender, so these unexamined moderator variables may have artificially minimized the differences (Ineichen, 1979). Walk-ups seem to act as a stressor for residents with neurotic tendencies: those who lived in walk-ups were more likely to develop psychiatric illnesses than those without neurotic tendencies, whereas residents of houses who had neurotic tendencies were no more likely than residents of houses who were without neurotic tendencies to develop psychiatric illnesses (N.C. Moore, 1976).

Another moderator is resident kinship. Emotional strain among Hong Kong residents who dwelt in very high densities depended more on dwelling density and whether residents of a given unit were members of the same family than on building height (Mitchell,

1971). However, Mitchell's study did find greater emotional strain among people living in multiple-family units who also resided on higher floors. Therefore, kinship did moderate the effect of building height on strain.

Parenthetically, building height might seem to be inextricably interwoven with population density. However, this is not necessarily so: redevelopment in Hong Kong produced taller buildings, yet provided not only more space per person inside the new dwelling, but also more space per person in terms of outside or neighborhood density (Yeung, 1977). Thus, building height and dwelling density should always be considered independently when investigating resident outcomes.

Population density is related to, but not isomorphic with, *crowding*, the psychological sense of overload from too many proximate others. High indoor density has been associated with many negative outcomes, including the strain of crowding (Gifford, 2002, chapter 8). A study of working-class and lower-middle class residents of high rises and low rises in the Bronx found that high-rise residents felt more crowded and reported a lower sense of control and less social support than low-rise residents (McCarthy & Saegert, 1978). This occurred even though the groups were not different in various demographic measures, except that residents of the low rises had slightly larger families but also one extra bedroom, so dwelling density probably was about equal.

Crowding may vary with floor level *within* high rises; in another study, those who lived on higher floors felt less crowded than those who lived on lower floors (Schiffenbauer, 1979). However, a separate study reported that crowding did not vary with floor level (Schiffenbauer, Brown, Perry, Shulak & Zanzola, 1977). In Parisian high-rises, residents reported being more crowded, so that relationships within the building were worse, the building and dwelling felt too densely populated, acoustic isolation was poor, and residents believed there were too many dwellings on each floor (Bordas-Astudillo, Moch & Hermand, 2003).

Mixed results, not only concerning crowding, but in other outcomes to be considered in this paper, may be the result of uneven outcomes in different parts or levels of high-rise buildings.

More serious mental health problems have tenuously been related to building height. In an English study, mothers who lived in flats reported more depressive symptoms than those who lived in houses (Richman, 1974). Rates of mental illness rose with floor level in an English study (Goodman, 1974). Psychological symptoms were more often present in high rises (Hannay, 1979). When residents moved out of high-rise dwellings, they reported fewer symptoms of depression (Littlewood & Tinker, 1981). In India, a study of 100 elderly male residents suggested that the residents failed to cope with the stress produced by living in high-rise buildings (Dasgupta & Bhattacharyya, 1992). Among the negative influences cited by the authors were noise, gloomy and depressing conditions, inadequate size, lack of security and lack of a friendly atmosphere.

The emotional health of 271 elderly African-Americans who lived in high rises in Nashville were compared with that of 373

elderly African-Americans who lived in low-rise neighbourhoods in the same city. The high-rise residents showed a higher incidence of depression, schizophrenia and phobias than the community residents (Husaini, Moore & Castor, 1991; Husaini, Castor, Whitten-Stovall, Moore *et al.*, 1990). Unfortunately, the high-rise group was poorer, less educated, less likely to be married, reported more medical problems and had fewer social contacts, so conclusions are difficult to draw from this study. The same is true of other studies. Bagley (1974) and Hannay (1981) reported that residents of lower floors in high-rises had more mental symptoms or signs of neuroticism, but residents of the higher and lower floors were different in other ways, such as age and life cycle stage, which may have accounted for the differences.

A Canadian study did employ more control over possibly confounding factors, and is worthy of special attention. It investigated strain in 39 public housing projects in Calgary and Edmonton (Gillis, 1977). The housing projects encompassed eight basic design types ranging from single detached houses to 16-storey high rises, including 441 living units in all. Very commendably, twelve possible moderators were considered. Strain was not a function of building height if relations between a resident's gender and such building characteristics as floor level, indoor density, etc., were *not* considered. (This demonstrates the crucial importance of examining moderators). Once these factors were considered, however, statistically significant trends emerged. For example, on higher floors, men experienced less strain, whereas women experienced more strain. The women in this study were all mothers, so the difference may well result from the difficulties of parenting from on high, a problem noted in the Pruitt-Igoe studies (e.g., Yancey, 1972), or from fear of themselves or children falling (cf. Izumi, 1970), but this does limit the study's generalizability to women with children. Nevertheless, the Gillis (1977) study is among the best in the literature in terms of scientific quality.

Two other moderators of high-rise strain appear to be marital status and gender within a marriage. A variety of outcomes for 560 families who lived in (a) single-family, (b) duplex or triplex, or (c) low- or high-rise apartments were examined (Edwards, Booth & Edwards, 1982). Strain levels in the three housing types were compared, and the analyses controlled for age, education and occupational level. Residents of apartments reported more strain symptoms and more family conflict than residents of the other two housing forms. Husbands' and wives' outcomes differed: husbands had a greater incidence of psychiatric impairment in apartments than in the other housing forms, but wives did not. Both genders reported more marital discord in apartments than in other housing forms. Fathers had worse relationships with their children in apartments, including striking them more often.

However, not every study reports more strain in bigger buildings. For example, the mental health of wives in high rises in one study, although not good, was better than that of wives living in single-family dwellings (Ineichen & Hopper, 1974). In an Israeli study (Churchman & Ginsberg, 1984), crowding did not linearly increase with building height (nor was it related to density within the dwelling). More precisely, crowding was significantly less among residents of 12-storey buildings than of either 8- or 20-storey buildings.

Two important points implicit in this study's results should be noted. First, the residents as a whole were a homogenous, mutually familiar and mutually trusting group. Thus, social homogeneity and relations within a building may moderate strain. This is interesting because we are reminded that social relations may be viewed either as an outcome or as a moderator. Researchers must try to decide, based on other evidence, whether the social conditions preceded or followed a given resident's entry into a building. Second, this study's results should remind researchers not to overlook another important possibility: curvilinear relations between variables. Often the *de facto* assumption is that if an outcome varies with building height, that the relation will be a linear. These data (that crowding increased from 8 storeys to 12 storeys and then decreased from 12 storeys to 20 storeys) demonstrate that some outcomes are related to building height in a curvilinear, rather than a linear, manner. Ignoring that possibility in an analysis could lead to the incorrect conclusion that no relation at all exists.

Finally, building location may moderate the relation between building height and mental health (P. McCarthy, Byrne, Harrison & Keithley, 1985). Distress was (non-significantly) greater in low-rise buildings than in houses, and greater in high rises than low rises. However, when the results were examined in terms of building location in desirable versus undesirable areas of town, distress was more related to that factor than to building form. McCarthy *et al.* took age, gender, health and social class into consideration as possible moderators, and the results held up. Incidentally, another curvilinear relation was found in this study: distress itself was less in the under-25 and over-65 age groups than in the 25-64 age groups.

Suicide and Tall Buildings

Do high-rise buildings contribute to suicide? One school of thought (the substitution hypothesis) holds that individuals who wish to dispose of themselves will find a way, regardless of the possible means. The substitution hypothesis asserts that if one means of suicide is removed or absent, people simply will use another means to their end. The substitution hypothesis has been most frequently debated in the context of the gun control issue, but can also be applied to high rises; certainly some people do commit suicide by jumping from tall buildings.

A different view, the availability hypothesis, holds that tall buildings, to some extent, encourage or facilitate suicides that would not have otherwise occurred (Clarke & Lester, 1989). Greater access to lethal means is expected to increase the overall suicide rate. This hypothesis implies that tall buildings give some people the notion and a means of killing themselves that would not otherwise have occurred to them.

Suicide rates in Seattle and Vancouver were compared (Sloan *et al.*, 1990). The study focused on firearms, because guns are more closely controlled in Vancouver yet overall suicide rates are very close in the two cities, which are roughly similar in size, climate, proximity to the ocean, and other ways. Sloan *et al.* found that the rate of suicide by gun was 2.3 times greater in Seattle, but suicide by other means was greater in Vancouver. The researchers combined suicide by jumping and drowning, which is unfortunate for present purposes, but the data showed that Vancouver's rate by

these means was double that of Seattle's. The substitution hypothesis was therefore supported. When suicide methods were more specifically compared (guns versus leaping) before and after gun control legislation in Ontario and California (Rich et al., 1990), a reduction in the number of gun suicides after the legislation was offset by an increase in suicides by leaping, and once again the substitution hypothesis received support.

However, not all studies agree. Suicide rates in the five boroughs of New York City were examined (Marzuk *et al.*, 1992). The five boroughs had quite different basic rates; Manhattan's rate, for example, is about double that of Brooklyn's. However, after correcting for age, gender and method variations in suicides, the authors concluded that all five counties had about equal rates for suicide methods that were equally accessible, and the differences in rates were almost all related to differential availability of methods—including falls from heights. That is, suicides in Manhattan occur about as frequently as in the other boroughs for methods that are equally available in all boroughs (e.g., hanging), but Manhattan's tall buildings added to (rather than substituted for) its total rate. Thus, in contrast to the earlier studies, Marzuk et al. (1992) conclude that the availability hypothesis has more merit than the substitution hypothesis.

A subsequent study conducted in Singapore also supports the availability hypothesis (Lester, 1994). From 1960 to 1976, as the percentage of the population who lived in high-rises climbed from 9 to 51%, the per capita suicide rate by leaping increased from 1.43 to 5.71 per 100,000, a fourfold increase. Over the same period, suicide by all other means declined from 7.17 to 5.49 per 100,000. Thus, although the overall suicide rate increased by 30%, the rate of suicide by leaping increased many times faster, suggesting that more tall buildings leads to more suicides by providing opportunities to leap from them. One is tempted to speculate that dissatisfaction with the high-rise form itself is a contributing factor.

Behavior Problems and High-Rise Housing

Are tall buildings responsible for behavior problems? Human behavior generally results from many influences, and it is difficult to unequivocally attribute it to any one source. Thus, the following studies are merely suggestive. Children who resided in high-rise (versus non-high-rise buildings) were reported to manifest twice as many behavior problems, such as bedwetting and temper tantrums (Ineichen & Hooper, 1974). Juvenile delinquency has been shown to be predicted by living in multiple-unit (as opposed to single-unit) dwellings, and predicted even better than by population density, which has often been associated with social pathology (Gillis, 1974). Yet another study in the same year found no differences in behavior problems among children who lived in high-rises, low rises, and single-family dwellings (Richman, 1974), so the results are not consistent. In this case, and perhaps for other outcomes in this review, the variation in results may be explained by differences in the physical quality of the residence, regardless of housing form. A recent study demonstrated a strong connection between the physical condition of dwellings and behavior problems among children (Gifford & Lacombe, 2006).

However, if children have access to green space, these problems may be ameliorated; that is, nature may moderate the relation between high-rise living and behavior problems. In a study of

high-rises that considered the degree of "naturalness" of views, the more natural a girl's view from home, the better she performed on tasks that require self-discipline (e.g., concentration, impulse inhibition, and delay of gratification (Taylor, Kuo & Sullivan, 2002), but this was not true for boys.

In a study that matched children in terms of gender and economic well-being, children who lived in high-rises were significantly more likely to have severe behavior problems than children in other forms of housing (Richman, 1977). In another, boys (but not girls) who lived in 14- versus 3-storey buildings were rated by their teachers as having more behavioral problems, such as hyperactivity and hostility (Saegert, 1982).

Crime and the Fear of Crime in High-Rise Residential Environments

Progress in the 1950s meant "cleaning up" slums. Tall buildings were seen as the modern, efficient solution to poverty. The most infamous example, Pruitt-Igoe in St. Louis, was touted in this manner prior to its construction (Slum surgery, 1951). It had no "wasted" space. However, as Yancey (1972) pointed out, the lack of semi-private space "atomized" potential community feeling among the residents in the development's 2762 apartments. The lack of semi-private or defensible space was, in Yancey's view, a prime cause of crime and fear of crime in the complex. One might argue that the crime rate mainly was caused by poverty. However, when Sommer (1987) compared crime rates in two student dormitories in California full of presumably middle-class students, the high-rise dormitory was the site of more crime than a nearby low-rise dormitory. The severity of crimes in the dormitories was much less than that of the crimes in Pruitt-Igoe. Nevertheless, it may be that, within any given income group, more crime (per capita) will occur in high- than comparable low-rises.

Building size, in a study of over 2500 residents of moderate- and low-income housing projects in the U.S., strongly increased fear of crime, although it had a more modest effect on personal crime itself (Newman & Franck, 1982). Moderators such as income, the provision of semi-private space, location, and other design details may have reduced the magnitude of the relations between building size and crime, but they also might have revealed groups for whom the relation was even stronger.

Newman's (1975) data show that the number of felony crimes rose with the height of the building in which the family lived for both poor and single-parent families and for moderate-income and two-parent families, although the rate of felonies in the former was about double that of felonies in the latter. Crimes, according to Newman, occur at about the same rate in low- and high-rises inside the apartments, are somewhat more frequent on the outside grounds of high rises and are much greater in the interior public spaces of high rises. A plausible conclusion is that the increased anonymity that naturally accompanies the larger number of people in tall buildings is a key ingredient of the problem, coupled with the existence of interior public spaces that can hide criminal activities from the surveillance of most potential observers.

Among the poor, crime seems to be more associated with high rises than with low rises. Dubrow and Garbarino (1989) interviewed

poor Chicago mothers who lived either in high rises or low rises. The level of crime and fear of crime the mothers reported in the high rises was severe; the authors convincingly drew a parallel with wartime conditions. For example, 100 % of the 5-year old children in the study had "direct contact" (p. 11) with shooting. Gangs, robbery and violence were part of everyday life. In the low rises, far fewer crime fears were expressed. One is reminded of Yancey's (1972) conclusion that the architecture of high rises "atomizes" poor communities, which in turn allows or encourages criminality and violence. Of course, poor community families may have been "atomized" before they entered the high rise, or high rises may merely fertilize the seeds of atomization that lay dormant until residents moved into a high rise.

One may be surprised, then, to hear otherwise. In a study of 900 elderly residents of 42 public housing sites in 15 U.S. cities, residents of taller buildings reported *less* fear of crime than residents of row houses and walk-ups (Normoyle & Foley, 1988). The actual crime rate also was lower in sites dominated by high rises. The authors suggest, however, that the lower crime rate did not cause the lower fear of crime, citing other work (e.g., Newman & Franck, 1982) that showed, somewhat counter-intuitively, little relation between crime rates and fear of crime. Fear of crime was lower even when residents assessed the local crime problem as more serious, and was unrelated to their own history of being crime victims, two potential moderators. The suggestion, then, is that the high-rise housing form itself is associated with reduced fear of crime, at least among the elderly (see also Devlin, 1980).

Housing Form and Prosocial Behavior

Prosocial behavior includes actions that help others. Does housing form affect prosocial behavior? Several studies have compared the helpfulness of residents in high- and low-rise buildings. Students who lived in low rises said they were more willing to offer help and to seek help than those who lived in high rises (Nadler, Bar-Tal & Drukman, 1982). Sense of community was investigated in low-rise and high-rise dormitories for university students in the U.S. Midwest (Bynum & Purri, 1984). The low rises were 3- and 4- storeys and the high rises were 6-10 storeys. Presumably students were essentially randomly assigned to buildings, so the study had that advantage. No differences were found for the reported rates of residents being willing to help one another or "going their own way." Students in the high-rise dormitories reported knowing fewer others of whom they felt they could ask a favour. Although this difference was statistically significant, it was not large in magnitude (54 % versus 47 % believed they could ask "most" other residents for a favour).

Other studies have examined prosocial behavior in a more concrete manner, by measuring behavior, as opposed to asking opinions. For example, stamped, addressed letters without a return address were placed on hallway floors in college dormitories that were 22-25 storeys, 4-7 storeys, or 2-4 storeys (Bickman *et al.*, 1973). The number of letters mailed was the measure of prosocial behavior. Letters were mailed in inverse proportion to building height in both studies, a significant difference in favour of low-rise buildings.

Using a different measure of prosocial behavior, donations of milk cartons for an art project were sought. Again, the fewest donations per capita were received in the high rises. Interviews of residents performed also indicated that the high-rise building was perceived as having the least amount of resident cooperation. The latter was also reported in a different college dormitory study (Wilcox & Holahan, 1976), one that added that perceived social support and involvement declined with height within buildings. Social support also was lower among elderly African-Americans in a high rise than among elderly African-Americans in nearby low-rises (Husaini *et al.*, 1990), although the two groups were dissimilar in other ways, too, which may have had an influence.

High-Rise Housing and Social Relations

Does high-rise housing influence social interaction? Social relations may be divided into two main domains, relationships within a dwelling and relationships among neighbours in the building. One review concluded that high-rise residents have poor social relationships, both among themselves and toward outsiders (Korte & Huismans, 1983). In one within-dwelling study in a building in which residences were equal in floor area and supplied furniture, roommates on higher floors got along with one another better than roommates on lower floors (Schiffenbauer, 1979). However, as reported earlier, Edwards, Booth, and Edwards (1982) concluded that high rises are associated with greater marital discord than low rises.

What about relations among neighbours within the building? Many years ago, Festinger, Schachter and Back (1950) demonstrated that housing form influences friendship patterns among residents. However, theirs was not a study of high rises. An examination of friendship patterns within a high rise showed that proximity is a major determinant of social interaction (Bochner, Duncan, Kennedy & Orr, 1976). Experience suggests that most social interaction occurs among residents of the same floor; if this is so, then buildings with many floors will include a few friends and acquaintances for the typical resident, and many strangers from other floors. In an Israeli study of women who lived in 8- and 20-storey buildings, 97 % knew at least someone on their own floor, and 67 % knew everyone on their floor; in contrast, 36 % knew over 30 % of all people living in their building (Ginsberg & Churchman, 1985). Most women did interact with neighbours, yet reported no problems with privacy (how men fared in the buildings is unknown). Interview of university dormitory residents found that the residents' small living units believed that they facilitated more social interaction than large, high-rise dormitories (Sinnott, Sachson & Eddy, 1972).

In contrast, a large-scale study in Toronto found that high-rise apartment dwellers tended to choose friends outside the building, from school or work (Michelson, 1977). These residents viewed their neighbours negatively and as dissimilar to themselves, except that they were approximate financial equals. In Hong Kong, a high-rise, high-density city, interview results suggest that the overall sense of residential community is low and that where respondents had a very strong sense of neighborhood, their interactions were often work- or school-based, with colleagues or schoolmates living in the same area (Forrest, La Grange & Ngai-Ming, 2002).

Studies that compare housing forms suggest that high-rise dwellers may have more residential acquaintances than low-rise dwellers. For example, German and Italian high-rise respondents reported knowing about twice as many families as those in low rises (Williamson, 1978). However, knowing more neighbours did not translate to close relations; the German (but not Italian) high-rise residents reported less visiting and borrowing among their neighbours, and that their closest friends were more likely to be colleagues at work than neighbours. Both the German and Italian respondents said that they would like to have more friends among their neighbours, and that they believed they would have more friends if they lived in a smaller building.

Outdoor socializing was examined in a study of three housing types in a low-income neighborhood: an old ghetto neighborhood of low-rise tenement houses, a traditional high-rise housing project and an innovative high-rise housing project, where a creative outdoor design had been added to encourage outdoor use (Holahan, 1976). The old neighborhood and the innovative project showed higher levels of outdoor socializing than did the traditional project, which suggests that high-rises will discourage social interaction in their vicinity but that this can be overcome by setting aside an area designed to encourage social interaction. Nature also seems to facilitate social interaction. Researchers observed the presence and location of trees and the presence and location of youth and adults near a high-rise and a low-rise public housing development (Coley, Kuo & Sullivan, 1997). Spaces with trees attracted larger and more mixed groups of people than did spaces without natural elements.

High-rise residents may have more acquaintances but fewer friends because residents of high rises simply encounter a larger number of people in their building than residents of low rises (Churchman & Ginsberg, 1984). More of these people are strangers, too, but one gets to know some of the strangers, over time, at least superficially. In a study conducted in Israel, women who lived in higher floors knew more of their neighbours, but women who lived on lower floors had closer relations with their neighbours. Consistent with the notion that lower levels are associated with more friendships, garden apartment residents reported having three times as many friends in the building as did high-rise residents (Boyd, Morris & Peel, 1965). Similar results were reported in another study: three-quarters of low-rise residents reported they had made good friendships within their project, but only half of the residents of a high rise could make the same claim (Stevenson, Martin & O'Neil, 1967). Saegert's (1979) study of public housing projects found poorer social relations in high-, as compared to low-rise buildings. Zalot and Adams-Webber's (1977) results repeated this trend, and added that, probably as a consequence of less-frequent interaction, high-rise dwellers tended to have less cognitively complex impressions of their neighbours. In a study that investigated the sense of community in high-rise and garden apartments in public housing for the elderly, the residents of garden apartments had a significantly greater overall sense of community, and expressed a greater sense of membership (Zaff & Devlin, 1988).

On the other hand, Franck (1983) found no differences in the frequency of making acquaintances and friends in her comparison

of high rises with row housing and walk-ups. One-third of high-rise residents in public housing estates in Hong Kong had never socialized with their next-door or nearest neighbours, suggesting a low rate of community interaction, but the rate was no different in low-rise neighbourhoods (Chang, 1975).

Of course, friendship formation depends on multiple factors, which probably explains some of these inconsistencies. For example, a study of college dormitory residents found no overall effect of high- versus low-rise building on friendship formation, but did discover that women made many more friends in low-rises than did men; in the high-rises there was no gender difference in friendship formation (Holahan & Wilcox, 1979). However, differences between the low- and high-rises in the friendship-related attitudes were found. High-rises were experienced as lower in involvement, support, order and organization, and student involvement, but higher on independence, suggesting that less social interaction and involvement is found among students in the high-rise dormitories.

Children in High Rises

Numerous studies suggest that children have problems in high-rises; none suggest benefits for them. Early reviews are clear. One states flatly that "for...families with small children, the evidence demonstrates that high-rise living is an unsuitable form of accommodation" (Conway & Adams, 1977, p. 595.) Another concludes that "high-rise housing does not provide an appropriate living environment for preschool or school-age children because too few of the attributes of a single-family house have been accounted for..." (Cooper Marcus & Hogue, 1976, p. 34), although the authors did soften that by concluding that high-rise housing has both positive and negative features for teenagers. This has not changed much with time. Two of the more recent Israeli studies found that raising children in high-rises, especially on the higher floors, is problematic (Broyer, 2002; Landau, 1999). Children under 8 were not allowed to go downstairs by themselves, but after they were allowed to go down, parents found it difficult to supervise their play.

The problems range from fundamental child development issues to everyday activities such as play. For example, a Japanese investigation (Oda, Taniguchi, Wen & Higurashi, 1989) concluded that the development of infants raised above the fifth floor in high-rise buildings is delayed, compared to those raised below the fifth floor. The development of numerous skills, such as dressing, helping and appropriate urination was slower. Children who live on higher floors also go outside to play less often (Nitta, 1980, in Oda et al., 1989). A study in India recognized that children's difficulties are not solely a function of living in high rises (Oke, Khattar, Pant & Saraswathi, 1999). As the authors put it, "The ecological constraints of crowding, the high-rise buildings, unsafe streets, scarce open spaces, the preoccupation with the "idiot-box," all seem to conspire against the urban child's natural propensity to play with joyous spontaneity" (p. 207).

Learning to read may be affected by the floor level on which children live (Cohen, Glass & Singer, 1973). The researchers measured sound levels, ability to discriminate auditory stimuli, and reading skills in children who lived in high rises built above a major highway in New York. Children in lower-level apartments,

which had higher sound levels from traffic, were less able to discriminate sounds and had poorer reading skills, than children who lived in higher floors. Apparently, where traffic noise is a considerable factor, high rises may be good for children who live higher up in high rises.

Children's play clearly is affected, as parents in high rises either keep their children indoors more often, which means close protection or over-protection in an indoor environment, or allow them outside, many floors away, which can result in under-supervision. One outcome is that children in high rises, on balance, spend more time playing alone and in restricted play (Gittus, 1976). Perhaps this is why there is evidence that high-rise raised children have lower levels of motor ability than children reared in single-family dwellings (Crawford & Virgin, 1971; cited in Michelson, 1977). Another outcome is that younger children, up to 20 minutes away from the home bathroom, have been reported to have many "bathroom accidents" in elevators and hallways of high rises (W. Moore, 1969).

Conclusions

The following conclusions must be tentative because the evidence still is imperfect and incomplete, but some trends in the findings certainly are more consistent than others.

The State of Research Itself

The original, simple question this paper set out to answer was whether high-rise dwellings are better or worse than low-rise dwellings for residents, apart from other factors. As noted earlier, research into this question has suffered from the difficulties of fulfilling many of the requirements of the scientific method. In part, this is understandable; for example, random assignment to housing form is often impossible, and experimenter control of independent variables can also be very difficult. Still, there are a number of issues, some correctable, with the research that has been conducted so far.

First, despite earlier admonitions, one might question whether random assignment truly is the best approach to research design in this area. When residents are assigned randomly to high rises and low rises (or single-family dwellings), they do not have control over the type of dwelling they will live in. This causes two problems. First, it differs from the usual case in everyday life when people are able to select from a range of housing. Such groups usually are in the military, university dormitories, or on social assistance. Thus, immediately, there is danger that conclusions drawn from such a study may not generalize to most residential situations in which housing form was not imposed from outside. The quality of housing one selects naturally is restricted to budgetary constraints, and that is to be expected and usually is accepted. However, housing of various forms may be found within most budgets, from fairly poor to quite rich.

Second, when residents select housing, they usually can at least feel a sense of control over housing type. To lose that control in a context where the resident is compelled to live in a housing form chosen by lot, by bureaucrats, or by researchers, must create a sense

of loss in some residents, particularly if (a) they wanted another form of housing and (b) were aware they *might* have been assigned another form of housing. Whether this is felt equally by those assigned to high rises or other housing forms is not known, but it seems safe to speculate that this sense of loss defeats part of the purpose of random assignment. Thus, random assignment may be scientifically pure, but may cause unwanted side effects that have their own influence on resident satisfaction and behavior. Where this is the case, researchers may prefer to let residents choose their housing form, and to deal with demographic or other differences in the makeup of the populations in each housing type by partial correlation or another statistical procedure for controlling variables that are not part of the researchers' hypotheses.

A third important problem is the relative scarcity of research that focuses on residential high rises in the last 15 or so years. One is forced to rely for the most part on fairly old studies. Both the best and the worst studies are older; there seems to be no trend toward markedly improved research methods among the relatively few recent studies that can be found. It goes without saying that progress cannot be made toward understanding the effects of living in tall buildings unless research is undertaken.

Fourth, so far there have been no meta-analyses of research in this area. Meta-analysis is a way of quantitatively combining the results of numerous completed studies (Rosenthal, 1991) that has become a popular and useful tool and has recently entered the environment and behavior literature (e.g., Gifford, Hine & Veitch, 1997). Of course, as long as the complaint above holds, meta-analyses are useless.

Fifth, researchers (as in many other areas) appear to have paid little attention to the possibility of significant curvilinear relations between variables. Building height is linear, but the psychological and behavioral effects of that most linear variable may not themselves be linear. For example, residents of the highest floors may feel somehow superior, or have the best views; they often pay the most for their residence. Those at ground level may value the easy access to streets. Those in the middle may feel they have neither advantage, but are merely squeezed between two more advantaged groups. Perhaps an analysis of unit prices by floor, done across numerous buildings, would confirm or disconfirm these speculations.

Sixth, although some researchers have conducted model studies in which moderator variables have been considered, many still have not. As some studies surveyed in this paper demonstrate, examination of potential moderating variables may reveal a relation that had been hidden in analyses that failed to include moderator variables. Some researchers have oversimplified distinctions, such as ignoring floor level by merely comparing residents on the ground level versus all those above ground level (Hamel & Burns, 1989).

Finally, little effort has been made to construct causal models of outcomes in high rises. One presumes that outcomes are multi-determined and that variables influence one another in causal chains. In this literature, no study even examined a three-variable (A-B-C) chain of hypothesized causality, with factor B mediating an A-C relation (cf. Evans & Lepore, 1997). Without research that is aimed at constructing and refining models, the literature must

remain a shapeless morass of almost random bivariate relations. Few authors have tried to construct theories or models in this area, although a few models of housing in general have been proposed (e.g., Rohe, 1985-86). Without theories, models, moderators or even many studies, meta-analyses are impossible, progress is impossible, and therefore understanding is impossible. Nevertheless, this review has attempted to round up what is known, and its tentative conclusions follow.

Experiencing the Dwelling

Very few studies have examined high-rise residents' experience of their dwellings. Some evidence suggests higher interiors seem larger, but perhaps this is only true for women. However, many other questions might be asked about how residents experience high-rise dwelling interiors. Do they fear fires, earthquakes or falling? Do people on lower floors experience the many floors above them as a sort of crushing burden? Do those on top feel, psychologically, as if they are "on top of the heap" or "on top of the world"? What sort of imagery, symbolism or meaning do high rises hold for residents and citizens who experience high rises as part of their daily street life?

Satisfaction

Satisfaction or the lack of it is only one outcome of living in a tall building, but it is a crucial one, and it depends on many factors. The evidence as a whole leans to the general conclusion that high rises are less satisfactory than other forms of housing. In particular, it suggests that residents will be happier in a high rise if they are not parents of small children, do *not* plan to stay long and are socially competent. Of course, the resident's lifestyle should match that provided by a high rise; avid gardeners will not be happy in a high rise unless perhaps they can fashion a rooftop or balcony garden. Money helps: it provides the means to choose, to live in a better quality building in a better-quality neighborhood, and monied folk have greater opportunity to have a second home (perhaps a cottage in the woods) and to escape the high rise for holidays. Although some evidence suggests that socially oriented seniors and young singles prefer high rises to low rises, the generally sociofugal nature of high rises may mean that other categories of residents will be happier in a high rise if they are relatively asocial.

Strain, Distress and Mental Health

Strain certainly may result from dissatisfaction, the mismatch between needs and preferences and one's high-rise domicile. Apart from those causes, the evidence suggests that strain often results from high building or dwelling density, which can (but does not always) lead to crowding, and that these effects may vary for men and women. Men may experience more difficulties in high rises than women, but may be better off if they happen to live in the upper reaches of the building. Crowding may be less (even in the same-size unit) in the upper floors, perhaps because views are more expansive. However, if towers are clustered, this advantage may be lost.

Suicide

Suicide may be greater in high rises than in low rises; the issue is whether tall building leapers would have used some other method if they did not happen to have a high window available. That is, do

high rises cause an overall *increase* in suicides? The evidence is not univocal, but suggests on balance that high rises are associated with higher suicide rates, and may be the cause of some suicides.

Behavior Problems

Every study surveyed indicated that children who live in high rises exhibit more behavioral problems than children who do not. This includes studies that tried to control for some obvious potential alternative explanations, such as socioeconomic status. One presumes that this results from an odd combination of activity restriction within the residence and too little supervision of activity outside it.

Crime and Fear of Crime

Fear of crime often outstrips actual crime rates. A prime reason for some to seek high-rise living is fear of crime on the street. However, if the building provides no adequate gate-keeping device or person, it becomes a greater liability than would a low-rise or single-family dwelling. This is because an unguarded high rise has poor defensible space properties: ease of strangers roaming, low visibility, more hiding places. Thus, fear of crime in high rises, which the evidence suggests varies, may heavily depend on whether and how well building entry is controlled.

Actual crime appears to be associated more with high rises than low rises, based on the studies reviewed. Poverty would appear to be a major moderator of this finding, but at least one study found more crime, albeit petty crime, in a site where high- and low-rise residents were of equal socioeconomic status.

Pro-Social Behavior

Research is unanimous in find that rates of helping others are lower in high-rise buildings. The sociofugal nature of most high rises supports anonymity and depersonalization of one's neighbours, so that living in a high rise tends to have both the advantages (such as greater privacy and freedom from unwanted social interaction) and disadvantages (less intimate social interaction and less caring about anonymous others) as large cities.

Social Relations

The gist of the evidence about social relations is that residents of high rises encounter many more other residents, know of or about more others, but have fewer friendships in the building, per capita, than residents of low rises. Social interaction is more difficult for residents to regulate. This can lead to withdrawal, which can lead to loss of community and social support.

The structure of high rises usually (but not always; see Wilner *et al.*, 1962; Ginsberg & Churchman, 1985) is such that one is not likely to meet residents of other floors except in elevators and lobbies, which are barely more personal than the street. Thus, one lives physically close to many others, but in practice is limited to those on one's floor for the sort of encounters that might lead to friendship, such as borrowing food or talking while children play. Male-female differences may moderate friendship formation in high versus low rises.

Children in High Rises

No evidence we could find shows that high rises are good for children. The literature includes several studies that sug-

gest high percentages of dissatisfaction among parents about the suitability of high rises for their children. Every study of behavioral problems finds more among children in high rises. There is some evidence that children in lower floors of high rises, where traffic noise is prominent, learn more slowly. Children in high rises may develop certain practical skills more slowly, according to Japanese studies. Long ago, Jephcott (1971) said, "Practically no one disputes that this form of home [the high rise] is unsatisfactory for the family with small children" (p. 130). Some have suggested that this need not be the case (e.g., van Vliet, 1983) but, more than 35 years later, no available evidence contradicts her conclusion.

General Conclusions

The consequences of living in high-rise buildings are many. A few may be caused by the building form itself, but many are moderated by non-architectural factors. Chief among these moderating factors are socioeconomic status, building location, parenting young children or not, gender, and stage of life. Although they have not been studied empirically in high-rises, whether one has a choice about housing form and indoor population density probably are also important.

Irrefutable conclusions about the consequences of living in high rises cannot be drawn, because true experiments are virtually impossible in housing research and because outcomes are determined by multiple factors. Nevertheless, progress nevertheless can be made through careful studies that use good research methods, and by aggregating studies either qualitatively, as in this review, or quantitatively through meta-analyses, and by more and better theory construction and testing. Unfortunately, research on this topic appears to have slowed considerably.

Given these caveats, the best conclusions that one may hazard are the following. Many, but by no means all, residents are more satisfied by low-rise than by high-rise housing. High rises are more satisfactory for residents when they are more expensive, located in better neighbourhoods, and residents chose to live in them. Children are better off in low-rise housing; high rises either restrict their outdoor activity or leave them relatively unsupervised outdoors, which may be why children who live in high rises have, on average, more behavior problems. Residents of high-rises probably have fewer friendships in the buildings, and certainly help each other less. Crime and fear of crime probably are greater in high-rise buildings. A small proportion of suicides may be attributable to living in high rises.

These are tentative conclusions that require more and better research on almost every issue raised in this paper. Given the global growth in the number of tall residential buildings, the issue's importance speaks for itself.

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