DANGER ON THE DANCE FLOOR: A STUDY OF INTERIOR DESIGN, CROWDING AND AGGRESSION IN NIGHTCLUBS

by

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Abstract; *This study is concerned with the role of physical design features in promoting crowding in nightclubs, and with the relationship between crowding and aggression. It measures patron densities, crowding, patron behaviors and aggression levels in 36 two-hour visits to six nightclubs in Surfers Paradise, Queensland, AUS. It was found that the more crowded venues tended to be the more violent, and in these high-risk establishments crowding increased more rapidly with patron density than in low-risk venues. Crowding appeared to arise partly from inappropriate pedestrian flow patterns caused by poor location of entry and exit doors, dance floors, bars and restrooms. Crowding was statistically related to observed aggressive incidents, even when controls were introduced for patron drinking practices, levels of male drunkenness and staff interactions with patrons. It is argued that architectural guidelines for licensed premises should be produced to minimize the risks of unintended contacts leading to aggressive incidents in new or renovated*

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venues. In addition, design and its possible effects on crowding should be incorporated into the model used by officials to set patron limits for individual venues, and regular inspections should be carried out to ensure that these limits are not exceeded.

This paper is concerned with the role of physical design features in promoting crowding in nightclubs, and with the relationship between crowding and aggression. The research, carried out in the second half of 1993, was developed as a specialised substudy within the Surfers Paradise Safety Action Project, described elsewhere in this volume (see also Homel and Clark, 1994). The present study had two starting points: the commonplace experience that crowding, heat, noise, and other sources of discomfort in bars and clubs seem to be associated with aggression and abuse; and the finding in the few scientific studies carried out in licensed premises that crowding is correlated with higher levels of observed aggression and violence (Graham et al., 1980; Homel et al., 1992; Homel and Clark, 1994; MCM Research, 1990).

Nightclubs in Surfers Paradise, a popular tourist destination in the Australian state of Queensland, are not dissimilar to nightclubs anywhere else in the world, in that they aim to provide entertainment and an opportunity to engage in "time-out" activities in a stimulating environment in which many of the rules of everyday life are relaxed or ignored. This is very attractive to young people in their late teens or early twenties, who flock to the coastal resort in large numbers. On entering, one typically finds a Surfers Paradise nightclub dominated by the dance floor and its lighting. Coloured and strobe lights flash in time with the beat of the music, while video screens display complementary images, often highlighting footage of sports or depicting scantily clad women and men. The music usually ranges from painfully loud to deafening. Away from the dance floor the general lighting varies from dim to dark. Movement is extremely restricted, and it can often take many minutes to travel only a few meters. Moving from a location to a bar, getting service, then returning to the original location with a drink order intact is a very time-consuming, difficult and draining experience. The tobacco-laden atmosphere can become very hot and humid as a result of the crowd size, density, and movement, and the whole experience may be tinged with the menace of an unpredictable and potentially nasty reaction should one be imprudent enough to bump a drunken patron or (worst of all) spill his or her drink.

The limited research carried out in licensed premises confirms everyday impressions that crowding is one factor associated with aggression. In their qualitative analysis of violence in licensed venues in Sydney based on many hours of observation, Homel et al. (1992) noted that:

> big crowds in most sites usually mean discomfort for many patrons, a problem exacerbated by a lack of seating and by crowded corridors, stairs, and doorways. Patrons in these situations tend to alleviate their discomfort by more rapid drinking, which causes higher levels of drunkenness, and eventually aggressive reactions to discomfort directed at individuals and property. Overcrowding on dance floors appeared to be linked to several arguments and at least one of the severe assaults observed [p.687].

British researchers also found that "...sources of frustration are evident in pubs...inappropriate flow patterns within the pub may result in jostling and the spilling of drinks...in these circumstances, even quite meek individuals can respond aggressively" (MCM Research, 1990:35).

These qualitative studies highlight the interactive effects of large numbers, inappropriate flow patterns, discomfort and heavy drinking. These observations are supported by the small amount of quantitative research carried out in licensed premises. For example, in 147 two-hour visits to 36 licensed premises in Sydney, Homel and Clark (1994) found that crowding, measured on a 4-point scale (none, low, medium, high), correlated at around .25 with the number and overall severity of observed aggressive incidents, while bar crowding, measured on the same scale, correlated at around .30. Of course, the sheer size of an establishment would be expected to predict violence, simply because more people engage in more interaction, any instance of which is potentially aggressive. It is therefore interesting to note that in the Sydney study the available measures of size (number of bars, number of patrons in view, seating capacity) were only moderate predictors of aggression. Overall crowding correlated more strongly, but bar crowding (which has to do with movement and patron concentration within the premises rather than overall density) was more important, although it did not survive as a predictor of aggression in a multivariate model that controlled for other factors such as male drunkenness.

An attempt was made in the present study to introduce greater analytical precision than was possible in the earlier observational studies by distinguishing *crowding* from *patron density,* and by exploring the relationship between these two variables in two groups of Surfers Paradise nightclubs: those that were known from local security statistics to be at high risk for violence, and those that were known to be low risk. A focus on density and crowding leads naturally to a comparison of physical design features that may impede pedestrian flow and contribute to a sense of crowding. Therefore, care was taken to document the layout of each club, particularly the locations of bars, toilets, entrances and exits.

The present research also builds on the earlier observational study by using the structured observation schedule developed by Homel and Clark (1994) to explore the relationship between crowding and aggression, and to investigate in a limited way whether the relationship is mediated or explained by behavioural variables, such as levels of patron drunkenness, or aspects of the social atmosphere, such as levels of rowdiness or group territoriality. A fundamental assumption of all the studies, including this one, was that no single factor — not even levels of intoxication — is of preeminent importance as a predictor of aggression. Violent occasions are characterised by subtle *interactions* of several variables. Chief among these are groups of male strangers, low comfort (caused partly by crowding but also by factors such as noise, smoke, heat, and inadequate seating), high boredom, high drunkenness, as well as aggressive and unreasonable bouncers and floor staff (Homel et al., 1992).

In summary, the basic issues explored in the present study were, on the one hand, the relationship between crowding and physical design features of nightclubs and, on the other hand, the relationship between crowding and aspects of social atmosphere and patron behaviour, including aggression. The main emphasis is on the way physical design may promote crowding and aggression.

OVERCROWDING AND AGGRESSION

There is a growing body of criminological literature concerned with the ecology of crime (e.g., Felson, 1983; Sherman et al., 1989; Stark, 1987). Some of this literature points to population density or crowding as a facilitator of deviance (e.g., Harries,

1990). This is consistent with a larger psychological literature reporting the results of experiments on animals and humans. For example, Calhoun (1962) and Christian (1961) conducted a series of experiments using rats and mice to measure the effects of overcrowding. These two researchers were able to isolate most of the known extraneous variables from their tests. Adequate levels of food and shelter and all other necessities were provided but the enclosure size was held constant, so as the population increased the living area increased in density. When the density level reached a certain point, abnormal behaviours occurred: nests would no longer be built, young were no longer cared for, and "delinquent" rats and mice developed. Christian (1961) observed that these density studies have been duplicated with similar results in other mammalian groups, but that an environmental factor such as density does not exert a direct causal effect. Rather, it alters the social or competitive situation by shifting social pressures up or down.

There are many studies of humans that suggest a link between overcrowding and aggression (for a full review, see Macintyre and Homel, 1994). For example, Gove et al. (1979) found a strong link between overcrowding in the home and conflict. These authors stressed that crowding usually means that greater opportunities exist for conflict, since crowding lowers the irritation tolerance of people that leads to frustration and then possibly to conflict. Heller et al. (1977) found that increases in crowding led to performance decrements in individuals when actions were reliant on the interaction between individuals. Other negative effects of density include lower levels of comfort and ease (Langer and Saegers, 1977), negative feelings toward other subjects (Paulus et al., 1976) and psychological pathologies (Lepore et al. 1992).

As Christian (1961) noted, effects of density and crowding are seldom simple and direct. Dabbs (1977) found an interaction between gender and crowding, in that males in a male group or with one male partner reacted less favorably to an increase in crowding than a male in a female group or with one female partner. Females appear to have a moderating effect on the behaviour of males. This is consistent with the finding of Homel et al. (1992) that the presence in a bar or club of several groups of males who are strangers to each other is a factor increasing the risk of violence.

The literature suggests the role of some other environmental factors that might interact with crowding to heighten the risk of

aggression and violence. Konecni (1975), Glass and Singer (1972), and Donnerstein and Wilson (1976) all found a strong link between an adversely loud environment and aggression, while Zillman et al. (1981) observed that some individuals display anger and aggression when someone smokes in an inappropriate way in their immediate space. These two aspects are relevant to nightclubs and crowding. It is reasonable to assume that music would be of a high-decibel level in most nightclubs, and that its stressful effects would be amplified by bumping and restricted space for movement. Similarly, the chances that tobacco smoke will provoke an aggressive response would be greater in more crowded venues.

Temperature may also play a role, as one would expect that as the population density of a room increases, the temperature would increase. Criminological research confirms the role of temperature as a factor in its own right contributing to violence and crime (e.g., Anderson, 1987, 1989; Fields, 1992), but there is also some evidence for an interactive or additive effect of crowding and temperature in increasing the risks of aggression. Thus, Griffit and Veitch (1971) exposed humans to overcrowded and hot conditions, and found a deterioration of social conditions that paralleled similar studies on animals. They concluded that as density and temperature increased, a corresponding increase occurred in the negative feelings of the subjects. Similarly, a study by Baron and Bell (1975) revealed that high ambient temperatures facilitated aggression in subjects who were calm and relaxed prior to being exposed to the increase in temperature. These researchers also found that increases in ambient temperature caused increases in the consumption of "cooling drinks," as subjects attempted to mediate the stressor of temperature. In Baron and Bell's (1975) study the cooling drink was an 8-oz. glass of lemonade; in a nightclub the cooling drink is predominantly alcohol-based. The interaction of the stressors of crowding, heat, loudness of music and tobacco smoke result in the consumption of alcohol, which may bring temporary relief but in the longer term increases the risk of drunkenness and aggressive behaviours, as Homel et al. (1992) observed.

RESEARCH HYPOTHESES

It is apparent from the literature that patron density, defined as the number of people per unit area, is not enough on its own to

capture the complexities of the concept of crowding. A realistic explanation of how crowding affects aggression must include an analysis of how a given density affects the way in which patrons interact with the environment inside the nightclub. Many nightclubs have similar patron limits and floor areas but different levels of aggression, making a simple "density increase = violence increase" model inadequate.

"Crowding" is usually understood as a negative subjective experience of too much density in an area. In Rapoport's (1975) words, crowding is "...a subjective experience of sensory and social overload" (p. 134). However, there are practical and theoretical difficulties in measuring the subjective aspects of crowding. An alternative is to use measures based on observed movements and pedestrian interactions.

Khisty's (1985) research provides a useful model for the present study. Khisty was able to film students walking through a university corridor at the point where it intersected with another corridor. For five minutes at the beginning and end of each hour, the corridors increased in density as students made their way to different classes. Because of the design of the building and the use of cameras, Khisty was able to use as a measure of crowding the actual speed of pedestrians as recorded on film. He argued that speed reduction in pedestrian traffic flow was a reliable measure of crowding, but concluded that collisions between pedestrians provided a reliable measure since speed reduction and the number of low-level collisions had a positive linear relationship — at least until standstill occurred, after which conflicts quickly tailed off.

For obvious reasons, Khisty's (1985) method of filming and measuring pedestrian speeds could not be utilized in the nightclub environment. Therefore, a method based on counting low-level collisions was devised as an indirect measure of crowding. Ideally one would also use a measure incorporating a subjective component quantifying the "feeling of crowding" that was experienced by patrons, but this was not practical without extensive interviews. The counting method that was used is described in more detail below.

On the basis of the distinction between density as a statistical measure and crowding as a subjective experience closely linked with patron movement and bumping, one may formulate three hypotheses: (1) Crowding is a product of both patron density and venue design; (2) excessive crowding directly leads to increased

aggression; and (3) excessive crowding indirectly leads to aggression through its effects on patron and staff behaviour. Given the limitations in the research design and in the sample size, the emphasis of the paper is on Hypothesis 1.

METHOD

Research Design

Surfers Paradise is economically a tourist-oriented region, and is physically dominated by tall skyscrapers built to accommodate tourists. Within the main business locale in an area of just under one square kilometer, there are 22 nightclubs and pubs (not counting a number of cafes and restaurants, which are not included in the study). The area is bordered by Elkhorn Avenue on the north, by Hanlon Street and Beach Road on the south, by the Esplanade on the east and by Ferny Avenue on the west (Figure 1)-

For the six-month period from January 1, 1993 to June 30, 1993, a private security company engaged by a committee of the Surfers Paradise Chamber of Commerce recorded 119 incidents linked to the 22 nightclubs, in the sense that each incident occurred inside one of the venues or in its immediate vicinity. The guards would be called to an incident by two-way radio, or they spotted incidents themselves when on patrol. Each night the security personnel completed an incident report sheet. At the end of each week these sheets were collated and handed to the committee representative.

The location of the 22 nightclubs and the number of private security calls are depicted in Figure 1. Fewer than one in five of the nightclubs (18%, or four clubs) accounted for 64% (n=76) of the total of 119 incidents. At the other end of the scale, 41% (n=9) of the nightclubs accounted for only 3% (n=4) of the total number of incidents. Similar concentrations of violent incidents in "hot spots" have been noted by other researchers (e.g., Sherman et al., 1989). The entire nightclub area has long been regarded as a major problem by the Gold Coast City Council, which vigorously lobbied the Queensland State Government for more police protection. The major response was the construction of a special police booth in the middle of the nightclub area. The booth has sophisticated

surveillance' cameras and is staffed from 5 p.m. through 5 a.m. seven days per week.

Figure 1: Surfers Paradise Nightclub Area Showing Security Callouts for January 1, 1993 to June 30, 1993
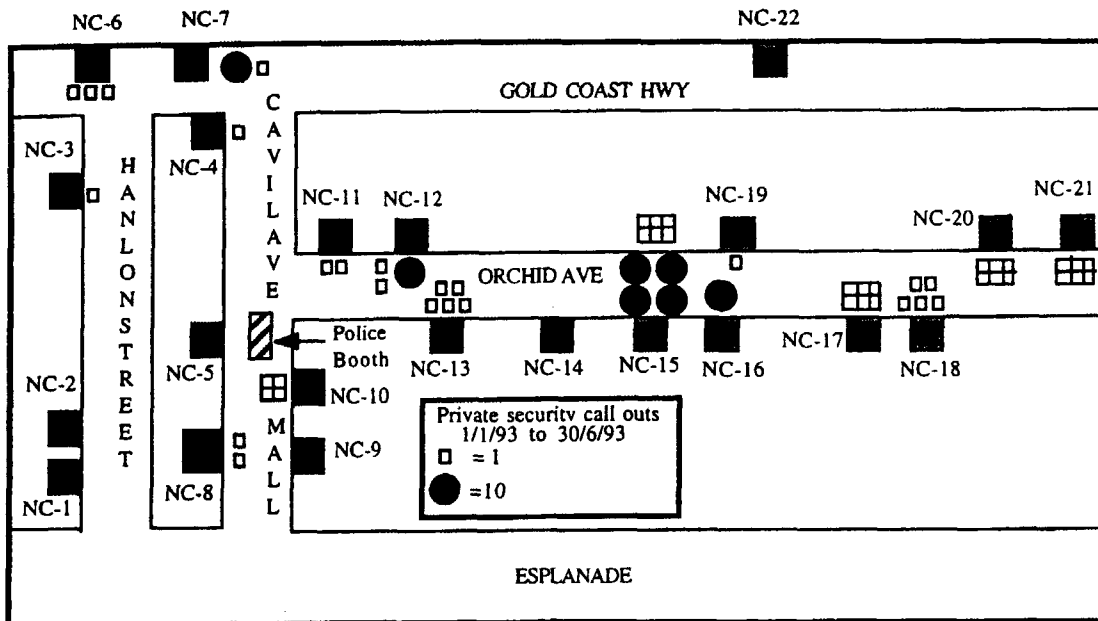
Licensees supplied floor space and patron capacity data so that patron density (patron limit per square meter) and levels of violence (incidents as a ratio of the patron limit) could be computed. Using the violence ratings, the three most-violent and the three least-violent nightclubs that were similar in floor area and patron capacity were selected, so that maximum permitted patron density was controlled. The nightclubs selected with similar permitted density levels were as follows: most-violent nightclubs (high-risk): 7, 15, 16 (with densities of .875, .889, and .889 patrons per square meter, respectively); and least violent nightclubs (low-risk): 1, 5, 8 (with densities of .905, .842, and .875 patrons per square meter, respectively). Other nightclubs were more or less violent than some of the nightclubs selected but were omitted because their overall floor area was too different from the six selected (all those included were between 320 and 480 square meters). The

group of nightclubs had to be limited to six to allow for adequate coverage by a single observer.

A preliminary visit was made to each nightclub early in the evening in order to select the highest traffic area for intensive observation during subsequent visits, and to prepare a detailed floor plan of the venue, noting particularly the locations of bars, entry and exit doors, and toilets. For the purposes of formal observation, each venue was visited six times, for a total of 36 visits, and each visit lasted up to two hours. For each venue, three visits were on quiet nights and three on busy nights to ensure adequate variation in observed patron numbers, and hence, patron densities. The data obtained should be representative of natural fluctuations in patron numbers within each club, allowing the possibility to be tested that low-volume times can also be crowded.

Measurement of Crowding, Aggression and Other Variables

As indicated earlier, the measure of crowding was based on minimal-level contacts between patrons. For 30 minutes all unintended contacts between patrons in the previously selected high traffic area were counted. The area was kept to 10 meters square to control for size, and to enable accurate monitoring. The 30-minute observation periods took place within the "peak" aggression period, from 12 a.m. to 3 a.m., as identified by the security incident data. This three-hour period accounted for 61% (n=67) of all incidents (n=110), even though 12 a.m. to 3 a.m. accounts for only about 25% of the nighttime hours. At the same time that unintended contacts were counted, low- and high-level physical interactions were counted in order to measure aggression.

More specifically, the following patron interactions were counted:

- *Level of Crowding* - number of low-level contacts: brushing past, very slight contact, unintended bumps (clearly no intention to cause harm or to act aggressively).
- *Low-Level Aggression* - number of substantial contacts: bumps, knocks, spilled drinks (intention to act aggressively probably present at some point in the interaction).
- *High-Level Aggression* - number of very substantial contacts: pushing, shoving, hitting, fighting (intention to cause harm definitely present during the interaction).

If a contact started at the low level and escalated to the high level, it was only recorded as one incident of high-level aggression to ensure that multiple counting did not take place. Once the IO-meter-square area was selected, the observer positioned himself in order to get the best vantage point. A mechanical hand-held counter hidden in a pocket was used to count the numerous low-level contacts, but the more substantial contacts of an aggressive nature could be remembered without a mechanical aid.

After the intensive half-hour observation of the most crowded section of the nightclub, the entire club was observed for at least another hour. The extra time was used to make the observations necessary to complete the structured observation schedule designed for the evaluation of the Surfers Paradise Safety Action Project.

It should be noted that there are limitations in the measures of crowding and aggression. One obvious problem is the element of subjectivity in the distinction between accidental and deliberate contacts between patrons. A totally conservative approach would be to restrict "aggression" to high-level incidents, but this has the disadvantage that in only 36 visits there were not enough such incidents to permit reliable analysis. The decision was therefore made to combine low- and high-level aggressive incidents, but the element of unreliability in this measure of aggression, in the absence of patron interviews or inter-observer reliability checks, should be kept in mind.

It is also important to recall that the relationship between density and crowding, and between crowding and aggression, will be to some extent artifactual, simply because all three variables will be partly a product of total patron numbers. As the number of patrons increases, density will increase, and with it all forms of patron interactions. However, the key question for analysis is the *nature* of the relationships: for example, does crowding increase more quickly as a function of density in poorly designed nightclubs, and is there a threshold level of crowding beyond which aggression rapidly increases?

Directly after each nightclub visit two schedules were completed. The first was a simple nightclub matrix layout where the observer could record total patron numbers, the level of crowding, and low- and high-level aggressive incidents. After the nightclub matrix was completed, the detailed observation schedule was filled in (Homel and Clark 1994). To test whether crowding predicted aggression after controls for key risk factors, five variables

known from the previous research to be strong correlates of aggression were selected from the observational data. These variables were: (a) male drunkenness (none = 1, low = 2, medium = 3, high = 4); (b) extent of server intervention, on a 13-point scale from no attempt to intervene to skilled interventions when appropriate; (c) overall server responsibility (very responsible = 1, somewhat responsible = 2, not very responsible = 3, not responsible at all = 4) (d) bouncer interaction (hostile/rude = 1, no interaction with patrons = 2, reserved = 3, friendly =4, sitting with patrons = 5); and (e) extent of buying drinks in rounds (high = 1, medium = 2, low = 3, none = 4).

A number of aspects of the social environment were also explored in the analysis. The two most important of these were rowdiness and hostility, both of which were measured on a 4-point scale (none = 1, low = 2, medium = 3, high = 4).

RESULTS

Hypothesis 1

To test Hypothesis 1 (crowding is a product of both patron density and venue design), density and the risk-level of the venue served as the independent variables, and crowding as the dependent variable. The key question is whether the relationship between density and crowding is stronger for high-risk than for low-risk venues; in other words, whether there is an interaction between risk-level and density. The second stage of the analysis involved relating features of the physical design of each of the six venues to density and crowding.

The data supported the hypothesis. Although the mean densities were similar for high- and low-risk nightclubs, with levels of .41 and .35, respectively, the crowding levels were not similar, with means of 131.28 and 55.00, respectively. Scatterplots suggested that for any given density, the high-risk nightclubs experienced a greater level of crowding than the low-risk nightclubs. A regression analysis verified that this pattern was statistically significant: controlling for density and risk level (expressed as a dummy variable), the interaction term yielded $t(32) = 4.90$; $p = .000$. The relationship is depicted graphically in Figure 2.

Figure 2: Relationship between Density and Crowding in Low- and High-Risk Venues
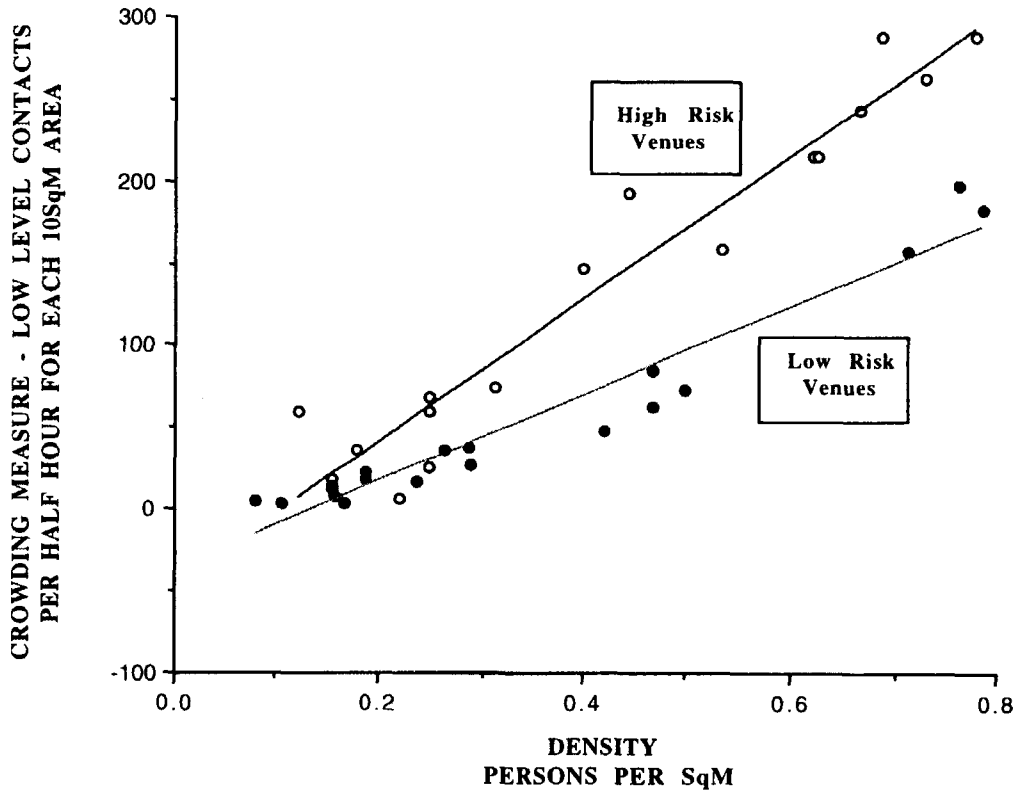
An explanation of the pattern in Figure 2 may be sought in the design of each club. For example, Nightclub 1 (low-risk) has an area with three major pedestrian cross-flows, whereas nightclubs 15 and 16 (high-risk) have six. What this suggests is that although these three nightclubs have similar floor areas and patron densities, their designs may produce differing numbers of patron contacts. Figure 3 displays the main pedestrian vectors for each nightclub.

Figure 3: Main Pedestrian Vectors for Each Nightclub
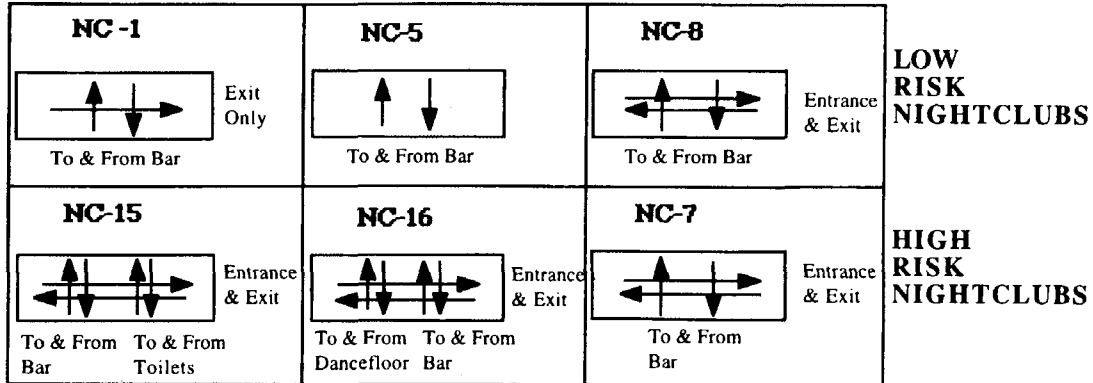
Examining the floor plan for Nightclub 1 (refer to Figure 4), one can clearly identify why the main pedestrian cross-flows are reduced. Entry to the main nightclub area is through a single door, and exit (to go to the bathrooms or to leave) is through a separate door. If a patron has gone to the bathroom he or she must reenter the nightclub through the original entry door. Another cross-flow-reducing influence in the design is that the restrooms are outside the main area. This has the effect of removing any congestion that entry/exits to bathrooms could create if they were in the main area. Thus, the design of Nightclub 1, incorporating one entry and one exit at either end of the main area, causes a circular traffic flow: patrons are always moving predominantly in one direction, since they come through the entrance and then around toward the exit to leave or go to the restrooms. The only major cross-flow that is created is to and from the two bars.

In contrast to the low-risk Nightclub 1, Nightclub 15 has an area that has main pedestrian flows going to and from the bathrooms, exit/entrance and bar. Similarly, Nightclub 16 has an area that has main pedestrian flows going to and from the dance floor, entrance/exit and bar. These nightclubs have design-induced pedestrian cross-flows that create major overcrowding problems.

Hypothesis 2

To test Hypothesis 2 (excessive crowding directly leads to increased aggression), it is necessary to determine if crowding is a significant predictor of aggression for all nightclubs (high- and

low-risk) over other possible intervening situational variables. It is also of interest to test whether any relationship between crowding and aggression differs by risk level of nightclub.

The situational variables selected as controls, which are described in detail above, related to drunkenness and staff practices that have been shown in previous analyses to be important predictors of aggression (Homel and Clark, 1994). The number of control variables was kept small, given the limited sample size. Consequently, aspects of the physical environment that related to crowding, such as smoke levels or temperature, could not be included in the analysis. Possible interactive effects between these variables and crowding should be explored in further research.

Obviously this kind of regression analysis, based on 36 observations and utilising a limited number of statistical controls, cannot do more than *suggest a* direct effect of crowding. Even if more visits had been possible and more controls could have been introduced, a direct causal effect cannot be established without experimental manipulations. However, a regression analysis can at least demonstrate that crowding is a plausible contributor to aggression, particularly if the pattern of results is consistent with the previous analysis, for example, by showing a stronger relationship for high- than for low-risk venues.

Consistent with the security data, the high-risk nightclubs recorded a higher level of aggression per visit (low- and high-level aggressive acts combined) than the low-risk nightclubs (mean numbers of aggressive incidents per visit were 1.00 for low-risk venues and 3.05 for high-risk venues). The overall correlation between crowding and aggressive incidents was a high .88, but a scatterplot of the relationship between crowding and aggression (Figure 5) suggests that a simple correlation does not capture the complexity of the relationship. It can be seen from Figure 5 that, paralleling the analysis for Hypothesis 1, the relationship between crowding and aggression is stronger for high-risk than for low-risk venues, and that the relationships are non-linear. Whereas in the high-risk venues aggression increases rapidly with crowding, in the low-risk venues aggression appears to "plateau out" once crowding reaches a certain level.

A regression analysis was carried out, fitting the five control variables first, followed by the dummy variable representing the risk-level of the venue, then crowding (represented by both a linear and a quadratic term) and, finally, the interaction between risk level and crowding. As expected, the control variables were

highly significant *(F(5,25)* = 5.12; *p* < .005), as was risk level (controlled for the covariates: F[l,25] = 12.7; *p* < .001). More importantly, crowding was highly significant after fitting the controls and risk-level (^2,25] = 48.89; *p* < .001). However, the interaction between risk level and crowding, controlling for all other factors, was not significant, although the regression coefficients indicated a similar pattern to that depicted in Figure 5 (F[2,25] = 1.62; p = .22).
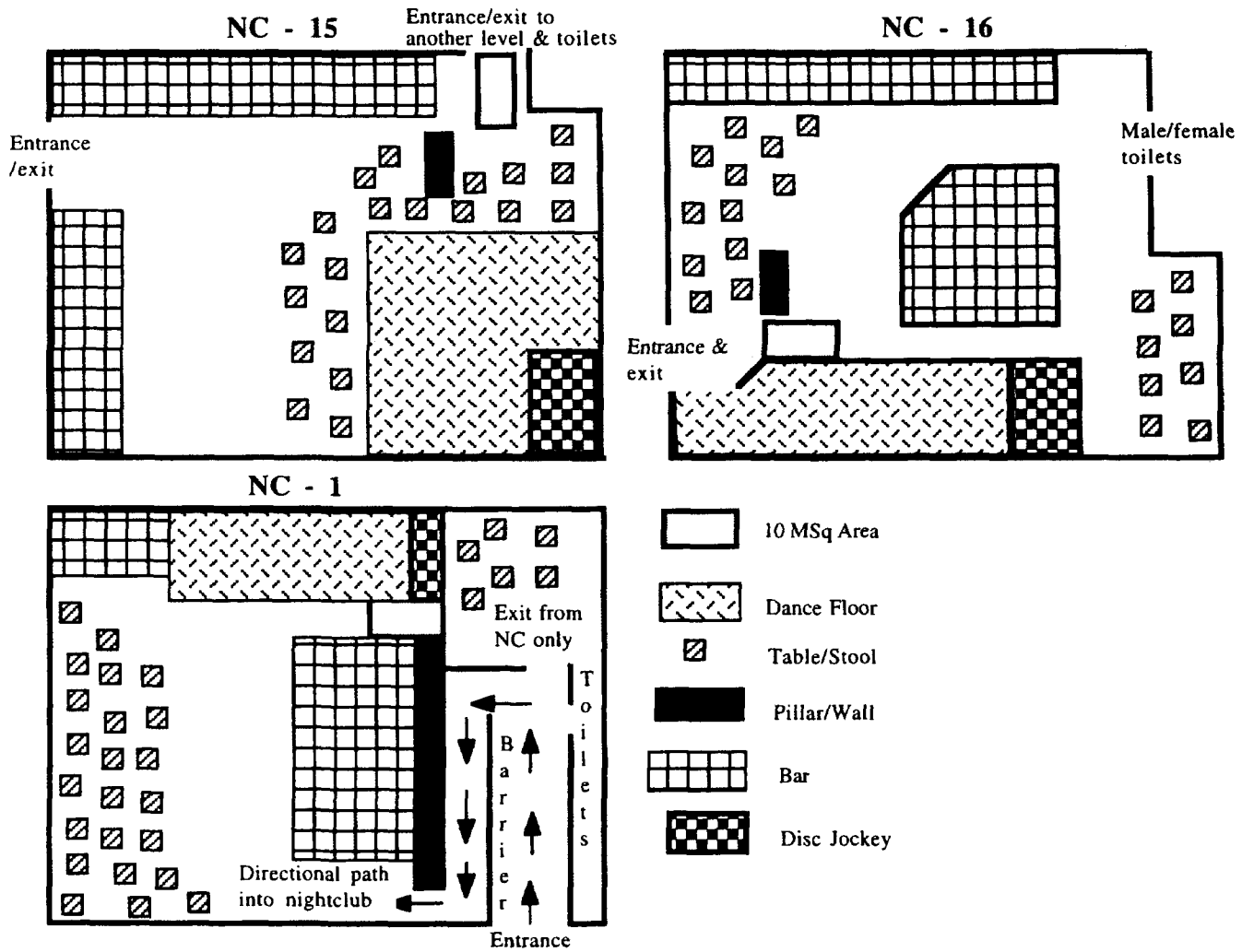
In summary, to the extent that controls were possible in a small sample, the analysis supports Hypothesis 2, since crowding predicted aggression over and above the five covariates and the risk level of the venue. If other controls had been introduced, or if other aspects of crowding such as temperature had been included, it is possible that the apparent effects of crowding *as such* would have been reduced. The data failed to support the sub-hypothesis of an interaction between risk level and crowding, although a larger sample size may have yielded a significant result.
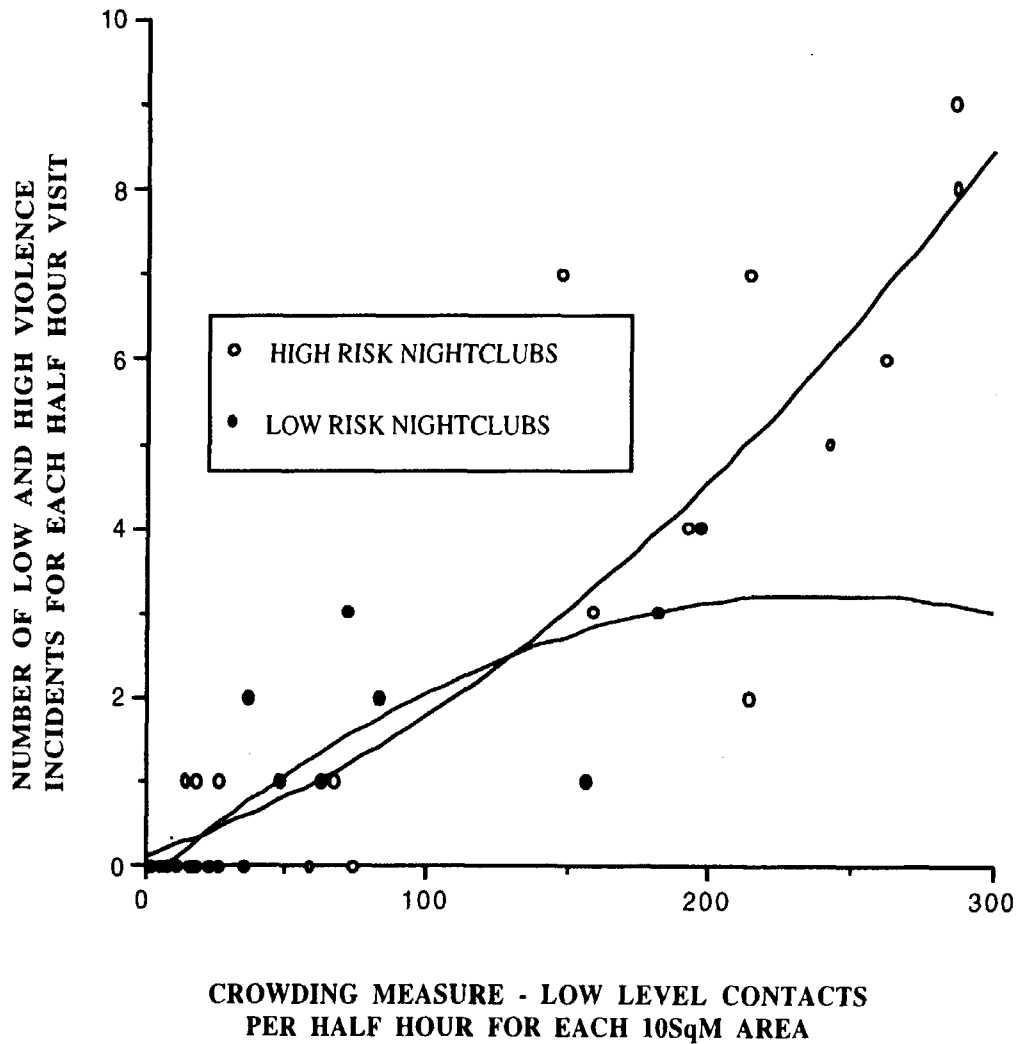
Hypothesis 3

Although of theoretical interest, Hypothesis 2 is impossible to test adequately in a non-experimental study. Therefore, it may be argued that Hypothesis 3 (that excessive crowding indirectly leads to aggression through its effects on patron and staff behaviour) is of more interest overall, provided the intervening variables are carefully chosen. Hypothesis 3 was explored in a limited way by examining correlations between crowding and aspects of the social environment that have been shown to correlate with violence (Homel and Clark, 1994). Some interesting patterns were revealed, which mostly failed to reach statistical significance because of the small sample size (a correlation was significant at the .05 level at around ±.32). For example, the degree of group territoriality (measured on a 3-point scale) increased as crowding increased *(r* = .424). Consistent with the qualitative research of Homel et al. (1992), higher levels of aggression corresponded to high levels of group territoriality (r = .288). The clearest results were obtained for rowdiness and hostility, both of which increased as crowding increased (with correlations of .568 and .473, respectively) and both of which correlated strongly with aggression (.447 and .412, respectively). This seems consistent with the

Figure 4: Nightclub Floor Plans: NC-1, NC-15, NC-16

NC - 15

Entrance/exit to another level & toilets

Entrance /exit

NC - 16

Male/female toilets

Entrance & exit

NC - 1

Exit from NC only

Toilets

Barrier

Directional path into nightclub

Entrance

- 10 MSq Area
- Dance Floor
- Table/Stool
- Pillar/Wall
- Bar
- Disc Jockey

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Figure 5: Scatterplot for High- and Low-Risk Nightclubs of All Aggressive Incidents by Crowding

CROWDING MEASURE - LOW LEVEL CONTACTS
PER HALF HOUR FOR EACH 10SqM AREA

common observation that increased physical contacts through crowding may loosen informal and formal controls on behaviour and promote a negative atmosphere.

DISCUSSION

This study examined the relationships among physical design features of licensed venues, crowding and aggression. The results

suggest that crowding is significantly influenced by design, and that for any given level of patron density some venues exhibit higher levels of crowding than others. The more crowded venues tend to be the more violent, and in these high-risk establishments crowding increases more rapidly with patron density than in low-risk venues. Crowding appears to arise at least partly from inappropriate pedestrian flow patterns caused by poor location of entry and exit doors, dance floors, bars and restrooms. Crowding, in turn, is statistically related to observed aggressive incidents — even when controls are introduced for patron drinking practices, levels of male drunkenness and staff interactions with patrons. The evidence for a stronger relationship between crowding and aggression in high-risk venues was suggestive but not conclusive.

The limitations in the research design should be kept in mind. The number of venue observations was too small to permit extensive multivariate analyses or to examine possible interactions between crowding and related aspects of the physical environment such as temperature, smoke, and noise. Only a small part of each venue could be observed intensively to measure levels of crowding, and the crowding measure lacked a subjective component reflecting patrons' feelings of discomfort or sensory overload. Because the intentions of patrons involved in physical contacts with other patrons had to be inferred, the aggression measure is to some extent unreliable, particularly in the "mid-range" of seriousness of contact. Moreover, because observations could only be carried out intensively in one area within each nightclub, it is possible that patron flow features that were desirable from the "inside" perspective might simply have transferred violent incidents to the street outside.

Apart from measurement and sampling difficulties, there are significant problems inherent in attempting to link design, crowding and aggression. It could be argued, for example, that the better-designed venues have had more money invested in them and are better managed, or that because they are better designed they attract less troublesome patrons than the more poorly designed establishments. It may be possible to address some of these problems, which are unavoidable in a non-experimental design, by intensively studying a sample of nightclubs before and after extensive renovations that rectify some of the design problems identified earlier.

Despite the limitations of the study, the core analysis of design, density, crowding and patron flow yielded quite persuasive

results. The high-risk venues were known to be more violent, not just on the basis of observations carried out for this study but from extensive data collected previously by the private security firm. There do appear to be features of the physical designs of the more violent venues that exacerbate the problems caused by lax regulation, poor management and inappropriate serving practices. It is therefore reasonable to consider the implications of this study for the prevention of violence.

One major issue is design standards. All three of the high-risk nightclubs would meet the requirements of the Building Code of Australia 1990 (Australian Uniform Building Regulations Co-ordinating Council, 1990). But as Khisty (1985) points out, excessive crowding occurs in certain locations because designs "are determined generally by building codes rather than with respect to pedestrian traffic demand" (Khisty, 1985:684). He points out that many studies have been conducted investigating designs that produce single channels of pedestrian flow, primarily corridors (e.g., Navin and Wheeler 1969, Pushkarev and Zupan, 1975), but research that examines environments where pedestrian cross-flows occur is almost nonexistent. Khisty (1985) could only find three such studies: Khisty (1982), Fruin (1971) and Weston and Marshall (1973).

On behalf of the Operations Research Department of the London Transport Executive, Weston and Marshall (1973) researched an area where pedestrian cross-flows occurred at Victoria Station. They concluded that regardless of the building code minimum standards, the design and size of those particular areas at Victoria Station should be based primarily on pedestrian traffic demand. They recommended that a floor plan be developed that in peak times would mean that pedestrian speed would only be reduced by up to 50% of the optimum unimpeded time.

In light of this kind of work, there is a clear need for more research so that minimum standards can be developed for nightclubs to reduce the number of pedestrian cross-flows. Such a set of guidelines could keep bumping and overcrowding to a minimum, in relation to overall patron density. Ideally, architects practicing in the nightclub field would be furnished with a set of well-researched guidelines that could be refined over time through the use of "post occupancy evaluations," a relatively new tool in architecture. As part of the evaluation process, after a newly designed building has been occupied for a time, the owners and us-

ers are surveyed about the main strengths and weaknesses in the design. The results are then used to improve future designs.

A more sophisticated knowledge base would also assist in the regulation of existing premises. Design and its possible effects on crowding should be incorporated into the model used by officials to set patron limits for individual venues. Inspections should be made regularly, at busy times, to ensure that this number is not being exceeded, particularly in establishments known to be high-risk for violence.

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