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Perception of Residential Crowding, Classroom Experiences, and Student Health[1]

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The present research is based on a typology of crowding experiences incorporating two main dimensions: neutral-personal thwartings and primary-secondary environments. The thwarting dimension concerns the degree to which crowding experiences are associated with spatial inconveniences, alone, or with spatial as well as social constraints. The environmental dimension relates to the type of setting in which crowding experiences occur. A major assumption of this typology is that crowding experiences involving social conflict will be more intense and disruptive to the individual than those in which interpersonal conflict is minimal. The reported study examined the relationship between college students' evaluations of the physical amenity, social climate, and crowdedness of their residential environments, on the one hand, and their sensitivity to crowding in a classroom situation, their academic performance, and the frequency of their visits to the campus health center, on the other. Results indicated that perceived residential crowding and negative perceptions of residential social climate were strongly associated with increased sensitivity to crowding in a classroom situation, impaired course performance, and visits to the student health center. The implica-

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tions of these correlational findings for future field-experimental research are discussed.

KEY WORDS: residential density; crowding; health.

INTRODUCTION

A core concern of environmental design research is the impact of the physical and social environment on human health and behavior. Professional designers often approach this issue through direct observation of the relationships between architectural variables and behavioral patterns. Design-oriented behavioral scientists, while sharing designers' concern with the direct linkages between objective environments and overt behaviors, more commonly approach the environment-behavior interface by way of theoretical, or intervening constructs. These constructs help to specify the social and physical conditions under which specific features of the physical environment might correlate with certain types of behavior.

The design-practitioner and behavioral-scientist perspectives are, of course, complementary in the sense that the first keeps environmental-design research firmly tied to concrete, measurable variables, while the second assists the researcher in predicting, *a priori,* those environmental dimensions that will exert the greatest influence on behavior across diverse situations.

The utility of combining design and behavioral perspectives can be illustrated through a consideration of the issue of human crowding. An architecturally oriented analysis of crowding would focus primarily on physical variables, such as the amount and arrangement of space, and the correlations between these variables and behavioral patterns within specific settings. A typical assumption underlying this approach is that spatial limitation is associated with a number of negative behavioral effects, including withdrawal from social interaction, impairment of task performance, and pathological behavior. The problem with a purely physicalistic perspective on crowding is that is does not account for numerous situations in which limited space is associated with positive rather than negative behavioral consequences; for example, work situations in which the proximity of others enhances collective task performance; or crowded parties which promote camaraderie among members of a group. In order to predict where spatial limitation will induce physiological, psychological, and behavioral problems, it becomes necessary to consider the social-psychological dimensions of various situations.

A behavioral science approach to crowding attempts to identify social-psychological factors which mediate the impact of architectural (especially spatial) variables on behavior. A central assumption underlying this approach

is that the categorization of environments in terms of both physical and social-psychological dimensions should provide a basis for developing design guidelines pertaining to several related questions, such as: in what types of environments will spatial limitation lead to major disruptions in individual and interpersonal activities? What kinds of adaptive strategies are available to occupants of high-density settings? To what extent will psychological and behavioral deficits associated with crowding in one setting generalize to other situations?

These questions are examined below in relation to a typology of crowding experiences (Stokols, 1976; in press). The typology focuses on the subjective experience of crowding rather than on conditions of high density which may or may not be related to perceived crowding. A number of derivative hypotheses pertaining to the intensity, persistence, and reducibility of crowding experiences are discussed, and some preliminary research on the generalizability of crowding experiences from one situation to another is presented. It is assumed throughout this discussion that a refinement of the crowding construct will provide a basis for predicting crowding potentials and related behavioral impairments as a function of both physical and social dimensions of the environment; and that such prediction ultimately will contribute to the design of physical settings which are maximally congruent with the needs of their users.

A TYPOLOGY OF CROWDING EXPERIENCES

The typology is based on the distinction between density, a physical condition of limited space, and crowding, a subjective experience of psychological stress in which one's demand for space exceeds the available supply (Stokols, 1972a). A basic assumption relating to this distinction is that increased demand for space can arise not only in response to direct spatial restriction but also as a result of social circumstances which sensitize the individual to potential problems posed by continued proximity with others.

Recent analyses have suggested a variety of nonspatial antecedents of crowding. Stimulus overload models, for example, posit that the experience of crowding is heightened by excessive social stimulation (cf. Desor, 1972; Esser, 1972; Milgram, 1970; Valins and Baum, 1973; Zlutnick and Altman, 1972). Behavioral constraint formulations link the perception of crowding to restraints on behavioral freedom and infringements on privacy imposed by the proximity of others (cf. Proshansky *et al.*, 1970; Stokols, 1972b). And ecological perspectives on crowding suggest that increased demand for space may result from a scarcity of social and/or physical resources in the setting (cf. Hanson and Wicker, 1973; Wicker, 1973).

Stimulus overload, behavioral constraint, and ecological theories of crowding converge on the assumptions that crowding (1) involves the perception of

insufficient control over the environment, and (2) increases the desire to put more space between oneself and others as a means of avoiding actual or anticipated interferences. The shared utility of these analyses is that they provide insights into the nature and determinants of perceived crowding. Their major limitation is that they offer few clues concerning the parameters of crowding intensity and persistence. The conditions under which overstimulation, behavioral constraints, and resource scarcities lead to the most disruptive experiences of crowding remain unspecified.

An additional assumption concerning the nature of crowding is required to permit an identification of factors that mediate the intensity and persistence of crowding experiences, namely: Increased demand for space will be most intense, persistent, and difficult to resolve when it is associated with perceived threats to physical or psychological security. Proximity with dangerous or insulting persons, for example, would lead to more intense crowding than the same degree of proximity with others who are seen as posing no threat to the individual's security.

The present typology of crowding experiences incorporates two dimensions which help to "sort out" the determinants of crowding intensity and persistence: neutral-personal thwartings and primary-secondary environments. The thwarting dimension pertains to the nature of interferences imposed by proximity with others. Neutral thwartings are essentially unintentional annoyances stemming from either the social or nonsocial environment, whereas personal thwartings are those interferences intentionally imposed on the individual by other persons (cf. Stokols, 1975). Under conditions of *neutral crowding,* the need for more space relates primarily to physical concerns such as the restriction of movement and the discomforts associated with high-density conditions. To escape these inconveniences, the individual desires more control over the physical, i.e., spatial, environment. In situations of *personal crowding,* increased demand for space relates to both physical and social concerns. Here, the salience of physical inconveniences is increased by the presence of hostile or unpredictable others. To resolve feelings of crowding, the individual must gain control over social as well as physical aspects of the environment.

The primary-secondary dimension of the model concerns the continuity of social encounters in a particular setting, the psychological centrality of behavioral functions performed within the setting, and the degree to which social relations occur on a personal or anonymous level. *Primary environments* (e.g., residential and work environments) are those in which an individual spends much time, relates to others on a personal basis, and engages in personally important activities. *Secondary environments* (e.g., transportaion and commercial environments) are those in which the individual's encounters with others are relatively transitory, anonymous, and inconsequential.

The model of crowding experiences outlined above suggests several hypotheses. First, it can be predicted that experiences of personal crowding will be

more intense, persistent, and difficult to resolve than those of neutral crowding, since the former are more likely to involve perceived threats to one's physical safety or self-esteem and to induce frustration of expectancies regarding the adequacy of space. Furthermore, assuming that the individual is confined to the situation, perceptual and cognitive modes of adaptation to crowding (e.g., ignoring spatial constraints, adopting more favorable attitudes toward other occupants of the area) will be less viable in situations of personal crowding, because the potential for social conflict is greater there than in instances of neutral crowding.

A second hypothesis is that crowding experiences will be of greater intensity and duration in primary environments than in secondary ones. This prediction is based on the assumption that primary settings tend to be associated with higher expectations of personal control along a greater diversity of need dimensions and, therefore, proximity-related interferences will be more likely to thwart personally important needs and goals in primary vis-a-vis secondary environments.

A third hypothesis pertains to the generalizability of crowding experiences from one setting to another. It is expected that personal crowding experiences, particularly in the context of a primary environment, will generalize more readily to other situations than will neutral crowding experiences. (The generalizability of crowding experiences could be measured, for example, in terms of a person's need for space, susceptibility to performance deficits, and medical complaints across a variety of settings, subsequent to his or her experience of crowding within a particular situation.) The main assumption underlying this prediction is that personal crowding, because it typically involves ambivalent or negative attitudes toward others, provides a cognitive base from which anxieties about proximity with certain persons in the setting can generalize to other people in different situations.[4] In contrast, the impact of neutral crowding experiences, which are less closely associated with persisting attitudinal changes, would be more confined to the immediate situation.

The present research provides preliminary data which pertain directly to the third hypothesis and are of general relevance to the first and second predictions mentioned above. The data were gathered through a three-part campus survey in which college students evaluated their residential environments (e.g., dormitory suites, apartments) during the second and third weeks of the academic quarter, and rated the amenity of a particular classroom setting during the fourth week of the quarter. Subsequently, most of the students who had completed the dormitory and classroom questionnaires consented to have the student

[4] This assumption is consistent with social learning theory which postulates that one's general expectations concerning the quality of interaction with others will be determined largely by his or her interpersonal experiences in specific situations (cf. Duke and Nowicki, 1972; Rotter, 1966; Rotter *et al.*, 1972).

health center release information regarding the number of visits they made there during the academic year. They also reported the number of times they had consulted off-campus physicians during the year.

The residential and classroom questionnaires incorporated items pertaining to both physical and social features of the environment. On the basis of questionnaire responses an attempt was made to predict sensitivity to crowding in the classrooms as a function of subjects' ratings of their residential environment. Moreover, the classroom responses of students reporting neutral and personal crowding experiences in their residences were compared in order to detect possible differences in the generalizability of crowding sensitivity from residential to classroom settings. Grades achieved by the students were recorded to determine possible effects of crowding on classroom performance.

The present investigation differs from earlier studies of dormitory crowding in an important respect. Previous studies have focused on the behavioral effects of exposure to different levels of social density, or group size, within residential situations.[5] Thus, the recent research conducted by Aiello and Epstein (1978), Aiello *et al.* (1975), and Baron *et al.* (1975) examines the psychological, social, and health consequences of residing in tripled-up rooms; that is, where three students occupy a dormitory room originally designed for two. And the studies reported by Baum and Valins (1973) and Valins and Baum (1973) focus on the differential effects of corridor-design (34 residents per corridor) vs. suite-design (six residents per suite) dorms on the social behavior of their occupants.[6]

In contrast, the current study focuses on the psychological processes that may mediate one's sensitivity to crowding and the behavioral concomitants of this experience, irrespective of existing levels of physical or social density in the residential setting. Thus, one of the major concerns of this research is whether or not the subjective experience of crowding in the context of negative feelings about one's roommates is more highly predictive of crowding sensitivity in nonresidential situations, medical complaints, and impaired academic performance, than perceived crowding which is not accompanied by negative feelings toward others. We are interested in knowing, for example, not only whether the residents of corridor and suite-design dorms differ in their perceptions of crowding, but also whether the residents within each of these groups are more adversely affected by this experience when they are not compatible with their roommates.

An examination of the behavioral and health-related concomitants of perceived crowding, rather than of social or physical density *per se,* seems

[5] Physical density refers to the amount of space available to a particular number of people, whereas social density denotes the number of people occupying a fixed amount of space.

[6] For more extensive reviews of this research, see Baum and Valins (1977), Stokols (in press), and Sundstrom (in press).

important for several reasons. First, a number of experimental studies have shown that perceptions of crowding can vary independently of density levels as a function of certain nonspatial factors, e.g., personality characteristics, the quality of social relations existing among the occupants of an area, and situation-specific needs for privacy or solitude (cf. Altman, 1975; Stokols, 1976). Moreover, a comprehensive survey study of Toronto families conducted by Booth (1975) suggests that any behavioral and health-related outcomes that occur in high-density residential environments are more strongly associated with the subjective experience of crowding than with the levels of density existing within (persons per room) and outside (persons per acre) the household. Thus, the perception of crowding, in certain instances at least, appears to correlate significantly with important indices of personal well-being; it therefore seems important to learn more about the social and psychological circumstances that affect the intensity and impact of this experience.

The specific predictions of the study were as follows. (1) In a stepwise multiple regression analysis the prediction of classroom crowding will be significantly more reliable when ratings of both the physical and social dimensions of the residential environment are employed as predictor variables than when assessments of the physical environment are used alone. (2) Subjects whose residential evaluations indicate a pattern of personal crowding will express greater feelings of crowding in the classroom than those whose dormitory or apartment ratings reflect the experience of neutral crowding. (3) Students' visits to health centers on and off campus during the academic year and their course grades during the fall quarter will be significantly associated with their ratings of residential crowding and their evaluations of the physical and social conditions within their residences, as reported by them during the fall quarter.

METHOD

Subjects

Participants in the study were drawn from a large undergraduate course (approximately 400 students) offered at the University of California, Irvine, during the fall quarter. From a listing of students taking the course, prospective subjects were identified on the basis of two main considerations: (1) place of residence and (2) year in college. An attempt was made to comprise the sample primarily of first-year students living in suite-design dormitories, so as to minimize subjects' prior exposure to classrooms on the Irvine campus and to control for variations in residential density and design. Participants were drawn from the same lecture class to control for the effects of professorial style, course content, and classroom design on the data.

From an original listing of 60 prospective subjects, 21 volunteered to participate in the study and completed both the residential and classroom questionnaires. In view of the small sample size, an additional group of second-year students, some of whom resided in off-campus apartments, was included in the sample. The sample employed in the statistical analyses of the residential and classroom data consisted of 20 females and 11 males.

Near the end of the spring quarter, 1975, an attempt was made to contact these same subjects in their dormitory suites or by telephone. Two of the subjects could not be traced and two others did not consent to the release of information regarding their visits to the student health center. This brought the sample size used in the prediction of doctors' visits to 27 subjects. Of these, 12 females and six males resided in double rooms of suite-type dormitories, one female occupied a single dormitory room and three females and five males lived in off-campus residences. Three subjects had changed rooms within the dormitories since the fall quarter and one subject had changed his off-campus apartment.

Procedure

Prospective subjects were contacted by telephone during the second week of the quarter and informed about a "study of the reactions of college students to dormitory (or off-campus) living conditions at U.C. Irvine." They were told that if they agreed to participate in the survey they would fill out questionnaires concerning the physical and social attributes of their current residence. The caller further explained that the questionnaire session would last for approximately 20 minutes, and that participants would be paid $2.00 at the session. Students agreeing to participate in the study were asked to report to an office on campus during the second or third week of the quarter where they completed the residential questionnaire.

The collection of classroom data occurred during the fourth week of the quarter. The professor[7] distributed a questionnaire to all members of the class during the initial portion of a class period. The questionnaire was described as part of a research project being conducted by a faculty associate, the purpose of which was to learn more about students' reactions to different kinds of courses at the University of California, Irvine. It was emphasized that completion of the questionnaire was entirely voluntary, and that each student's responses on it would have nothing to do with the grade he or she received in the course. Students volunteering to assist in the project were asked to put their student identification number on all pages of the questionnaire to facilitate collation of the data.

[7] The authors would like to express their appreciation to Ralph Catalano, who administered the classroom questionnaires to students enrolled in his Principles of Social Ecology course, and to Susan Miller, who assisted in coding the data.

The professor also noted that questionnaire responses would remain anonymous and would be coded on computer cards for statistical use only.

The questionnaire contained several items regarding the relative advantages and disadvantages of large lecture classes in comparison with other types of courses – small seminars and large discussion classes, for example. Embedded among these items was a set of bipolar scales concerning the physical conditions and social climate of the present classroom. These were identical to the items included in the dormitory questionnaire.

When the students were approached again during the spring quarter, they answered several questions pertaining to their health and were asked to sign a consent form allowing the student health center to release information regarding the number of visits made by each student during the three quarters of the academic year.

Measures and Analyses

The residential questionnaire incorporated six sets of seven-point semantic differential scales. The first included eight items pertaining to subjects' perception of their dormitory suite or apartment in terms of the quality of its physical dimensions. Subjects were asked to indicate the degree to which their residence permitted privacy and was pleasant, comfortable, spacious, quiet, large, uncluttered, and cheerful. The second set of scales related to the perceived quality of social relationships existing among themselves and their suitemates (roommates). Subjects were asked to rate the degree of trust, competition, alienation, similarity, and hostility felt among themselves and other occupants of the residence, as well as the extent to which they tried to make each other feel secure, were considerate of each other's feelings, and confided in each other about personal problems. A third set of scales pertained to the degree of crowding and spatial restriction felt by subjects in their dormitory suite or apartment.

Three other sets of semantic differential scales were included in the questionnaire. Two contained items from Rotter's (1966) Internal-External Scale and Keniston's (1965) Short Alienation Scales, respectively. On the remaining set subjects were asked to rate "people in general" along 10 dimensions, including, for example, "harmful-beneficial," "hostile-friendly," "disturbing-calming," and "bad-good."

Two final assessments were incorporated into the residential questionnaire. First, subjects were asked to draw a map of their dormitory suite or apartment on a blank piece of paper. Second, they were requested to complete the Comfortable Interpersonal Distance Scale (CID), a paper-and-pencil measure of personal space needs (Duke and Nowicki, 1972).

The classroom questionnaire incorporated three sets of seven-point scales. On the first set of scales, subjects were asked to rate how crowded, restricted,

threatened, insecure, and tense they "usually feel in the present classroom." The second and third item-clusters pertained to subjects' evaluation of the classroom in terms of its physical conditions and social atmosphere, respectively. These items tapped the same dimensions of environmental amenity as those reflected in comparable scales of the dormitory questionnaire. Finally, a number of open-ended filler items were included in the classroom questionnaire which required subjects to list the relative advantages and disadvantages of large vs. small and medium-sized classrooms.

The spring questionnaire consisted of questions pertaining to the number of times the students had visited medical doctors on or off-campus during the academic year. The student health center located on the University of California campus reported the actual number of visits made by each student during the three quarter terms.

Three major analyses were performed on the data. First, the correlations between residential and classroom assessments of environmental quality were examined. The units of analysis were item-cluster total scores which were computed by summing subjects' responses on the various scales within a particular cluster. Thus, each of the three cluster scores obtained from the residential data was correlated with each of the three total scores derived from the classroom data. The correlations between environmental evaluation scores and the additional indices included in the residential questionnaire also were examined.

Second, a series of step-wise regression analyses were performed on the dormitory, classroom and health center data. In the primary analysis the classroom measure of felt crowding was employed as the response variable while cluster scores pertaining to the physical quality of the residential environment, its social atmosphere, and the perception of residential crowding were utilized as predictor variables. In a subsequent analysis assessments of subjects' internal-externality, chronic alienation, interpersonal distance preferences, and residential map size were incorporated into the regression equation as predictor variables.

In two other analyses course grades and visits to the student health center during the year were used as dependent variables, and residential crowding, physical conditions, and social atmosphere were employed as predictor variables in each. The classroom social atmosphere index was employed as an additional independent variable in the analysis of course grades.

Third, multivariate analyses of variance (MANOVA) were performed on the classroom data, utilizing the major indices of residential evaluation as blocking factors. In the first analysis subjects were divided into "low crowding" and "high crowding" groups through a median split of their residential crowding total scores. For the second analysis subjects' evaluations of the physical environment (EPE) and social environment (ESE) were utilized jointly to distinguish among four different groups of respondents: (1) those who evaluated both the physical and social dimensions of their residence positively (+EPE/ESE); (2)

those who evaluated both dimensions negatively (–EPE/–ESE); (3) those who reacted positively to the physical conditions of their dormitory suite or apartment but negatively to its social climate (+EPE/–ESE); and (4) those who reacted negatively to the physical conditions and positively to the social climate of their residential environment (–EPE/+ESE). On the basis of these groupings, a two-factor (EPE × ESE) MANOVA was performed on the three major classroom total scores.

The EPE/ESE taxonomy of subjects provided a means of identifying individuals whose feelings of crowding were correlated with negative reactions to only the physical attributes of their residence, and those whose perceptions of crowding were associated with negative reactions to both the physical and social conditions within their residence. The differentiation between these groups was accomplished through a median split of subjects' crowding total scores and the subsequent grouping of these scores on the basis of subjects' EPE/ESE response patterns. It should be noted that the –EPE/+ESE and –EPE/–ESE configurations of data correspond to patterns of neutral and personal crowding, respectively. Thys, by comparing the classroom crowding scores of these two groups through MANOVA procedures it was possible to assess the relative degree to which neutral and personal crowding experiences in the residential environment affected subjects' sensitivity to crowding in the classroom.

RESULTS

Correlational Analyses

Intercorrelations among the major predictor and criterion variables are presented in Table I. It is evident that assessments of the residential physical environment were highly correlated with those of physical and social conditions in the classroom. Residential crowding, for example, was significantly related to classroom crowding ($r_{31} = .59, p < .001$), physical amenity ($r_{31} = -.45, p < .01$), social atmosphere ($r_{31} = -.47, p < .01$), and security ($r_{31} = -.57), p < .001$). The total score for evaluation of the residential physical environment reflected a similar pattern of correlations with the classroom variables. Additionally, size of subjects' residential map (measured by the area covered on an 8 1/2 × 11 inch sheet of paper) was significantly correlated with classroom crowding ($r_{31} = .30, p < .05$), social atmosphere ($r_{31} = -.45, p < .01$), and security ($r_{31} = -.41, p < .01$).

While the index of residential social atmosphere was not correlated with classroom total scores, it was significantly related to residential crowding ($r_{31} = -.39, p < .05$) and physical amenity ($r_{31} = .53, p < .001$). Also, subjects' ratings of people in general were significantly correlated with residential crowding

Table I. Correlations Among Major Predictor and Criterion Variables[a]

Variable	RCrowd	EPE	ESE	I–E	Alien.	People	CID	Map Size	Cl. Crowd	Cl. Phys.	Cl. Soc.	Cl. Sec.
Residential crowding												
EPE	−.82[d]											
ESE	−.39[b]	.53[d]										
I–E	−.08	.17	−.03									
Alineation	.23	−.24	−.36[b]	.28								
People	−.42[c]	.32[b]	.50[c]	−.25	−.42[c]							
CID	−.07	.07	.09	.20	.04	−.27						
Map size	−.03	.12	.35[b]	−.28	−.34[b]	.23	.17					
Classroom crowding	.59[d]	−.45[c]	−.03	−.07	−.11	.13	−.05	.30[b]				
Classroom physical	−.45[c]	.35[b]	.07	.08	.11	−.18	.08	−.17	−.39[b]			
Classroom social	−.47[c]	.33[b]	−.12	.05	.32[b]	−.28	−.08	−.45[c]	−.25	.50[c]		
Classroom security	−.57[d]	.50[c]	.19	−.04	−.02	.16	−.19	−.41[c]	−.33[b]	.33[b]	.56[d]	
Course grade	.15	−.07	−.15	.14	.36[b]	−.37[b]	.02	−.19	−.07	.18	.35[b]	.40[b]

[a] Pearson correlation coefficients provided.
[b] $p < .05$.
[c] $p < .01$.
[d] $p < .001$.

Table II. Summary Table of Step-Wise Multiple Regression Prediction of Classroom Crowding by Indices of Residential Evaluation[a,b]

Residential index	Step	Multiple r	Cumulative r^2	Simple r	Beta
Perceived crowding	1	.588	.346	.588	.635
Evaluation of the social environment	2	.625	.391	−.031	.246
Evaluation of the physical environment	3	.626	.392	−.450	−.060

[a]Simple correlation of residential index with criterion variable.
[b]Reliability of regression: $F = 5.81; df = 3, 27; p < .01$.

($r_{31} = -4.2, p < .01$), physical amenity ($r_{31} = .32, p < .05$), and social atmosphere ($r_{31} = .50, p < .01$). Although alienation from people in general was not correlated with either residential or classroom crowding, an index of perceived alienation from roommates (which was included in the ESE total score) was significantly associated with residential crowding ($r_{31} = .57, p < .001$). Finally, the summary index of classroom social climate was highly correlated with assessments of classroom physical conditions ($r_{31} = .50, p < .01$) and security ($r_{31} = .56, p < .001$).

Regression Analyses

In the initial regression analysis the total scores for residential crowding, physical conditions, and social atmosphere were utilized to predict classroom crowding. All three indices contributed significantly to prediction of the criterion variable ($F_{3,27} = 5.81, p < .01$). The analysis accounted for a total of 39% of the variance (see Table II).

Table III. Summary Table of Step-Wise Multiple Regression: Prediction of Classroom Crowding by Indices of Residential Evaluation and I–E, Alienation, CID, and Map Scores[a,b]

Index	Step	Multiple r	Cumulative r^2	Simple r	Beta
Perceived crowding	1	.588	.346	.588	.619
Evaluation of the social environment	2	.626	.391	−.031	.180
CID score	3	.634	.402	−.131	−.147
Map size	4	.645	.416	.149	.142
Evaluation of the physical environment	5	.646	.417	−.450	−.078
I–E score	6	.647	.419	−.097	.046

[a]Criterion variable: perception of crowding in the classroom.
[b]Reliability of regression: $F = 2.88; df = 6, 24; p < .05$.

Table IV. Summary Table of Step-Wise Multiple Regression: Prediction of Course Grade by Indices of Residential and Classroom Evaluation[a,b]

Index	Step	Multiple r	Cumulative r^2	Simple r	Beta
Classroom social climate	1	.290	.084	.290	.415
Perceived residential crowding	2	.435	.190	.151	.975
Evaluation of the residential physical environment	3	.579	.336	.067	.756
Evaluation of the residential social environment	4	.589	.346	−.148	−.101

[a]Criterion variable: course grade. (Other variables not entered into the equation were map size, CID score, classroom crowding, classroom physical environment, and I–E).
[b]Reliability of regression: $F = 3.44$; $df = 4, 26$; $p < .05$.

In the second analysis additional predictor variables were incorporated, namely, residential map size, I-E score, CID score, and alienation from others in general. Again, the indices of residential crowding, physical conditions, and social atmosphere contributed significantly to the prediction of classroom crowding, as did map size, I-E, and CID scores ($F_{6,24} = 2.88, p < .05$). A total of 42% of the variance was accounted for in the second analysis (see Table III). It is evident from Tables II and III that residential crowding alone accounted for most of the variance (35%) in both analyses.

In the third regression analysis the classroom social atmosphere measure predicted the grades achieved in the course, with residential crowding and the subjects' evaluation of both the physical and social dimensions of their residences improving the prediction significantly ($F_{4,26} = 3.44, p < .05$) (see Table IV). And in the final regression analyses all three residential indices, crowding, physical conditions, and social atmosphere, contributed significantly to the

Table V. Summary Table of Step-Wise Multiple Regression: Prediction of Visits to Student Health Center During Academic Year by Indices of Residential Evaluation[a,b]

Residential index	Step	Multiple r	Cumulative r^2	Simple r	Beta
Perceived crowding	1	.496	.246	.496	.781
Evaluation of the social environment	2	.615	.378	.095	.496
Evaluation of the phsyical environment	3	.716	.513	−.493	−.534

[a]Criterion variable: total visits to student health center during academic year.
[b]Reliability of regression: $F = 8.07$; $df = 3, 23$; $p < .005$.

Table VI. Summary Table of Step-Wise Multiple Regression: Prediction of Total Visits to Health Centers, On and Off Campus, During Academic Year by Indices of Residential Evaluation[a,b]

Residential index	Step	Multiple r	Cumulative r^2	Simple r	Beta
Perceived crowding	1	.527	.278	.527	.290
Evaluation of the social environment	2	.580	.337	−.025	.441
Evaluation of the physical environment	3	.647	.419	−.508	−.545

[a]Criterion variable: total visits to health center, on and off campues, during academic year.
[b]Reliability of regression: $F = 5.53$; $df = 3, 23$; $p < .01$.

prediction of visits to the student health center ($F_{3,23} = 8.07, p < .005$) and total visits to health centers on and off campus during the academic year ($F_{3,23} = 5.53, p < .01$)[8] (see Tables V and VI).

Multivariate Analyses of Variance

In the first analysis a one-way (residential crowding) MANOVA was performed on the classroom total scores of high- and low-crowding subjects. Results indicated that subjects who felt crowded in their residence rated the classroom environment more negatively than did low-crowding subjects (multivariate $F_{4,26} = 3.97$, $p < .01$). Univariate analyses revealed that high-crowding subjects felt more crowded ($F_{1,29} = 9.53$, $p < .004$) and less secure ($F_{1,29} = 13.53$, $p < .001$) in the classroom than did low-crowding subjects. The former group also rated the physical conditions ($F_{1,29} = 4.63$, $p < .04$) and social climate ($F_{1,29} = 4.52$, $p < .04$) of the classroom more negatively than did the latter. An additional MANOVA indicated that high-crowding subjects rated people in general more negatively than did low-crowding subjects ($F_{1,29} = 8.34, p < .007$).

A two-way (EPE × ESE) MANOVA on the classroom total scores revealed that low-EPE subjects (those who rated the residential physical environment

[8] An additional regression analysis was performed on the health center data using only those subjects who occupied architecturally comparable dorm rooms (10 feet, 9 inches × 17 feet, 1 inch) and had remained in the same suite throughout the entire academic year ($N = 15$). This analysis was intended to control for the effects of architectural factors on the relationship between perceived quality of the residential environment and total visits to the student health center during the year. As in the previous analyses, perceptions of residential crowding, physical conditions, and social climate were significantly related to total student health center visits during the academic year ($F_{3,11} = 3.96, p < .05$).

negatively) felt more negative about the classroom environment than did high-EPE subjects (multivariate $F_{4,24} = 4.23, p < .008$). Univariate analyses indicated that low-EPE subjects felt more crowded ($F_{1,27} = 11.38, p < .002$) and less secure ($F_{1,27} = 14.16, p < .001$) than did high-EPE subjects, and also evaluated the physical features ($F_{1,27} = 4.21, p < .05$) and social atmosphere ($F_{1,27} = 5.99, p < .021$) of the classroom more negatively. Neither a significant main effect for ESE nor an EPE X ESE interaction effect was obtained.

In a final analysis, the classroom crowding scores of –EPE/+ESE and –EPE/–ESE subjects within the high residential crowding group were compared to detect possible differences in the generalization of neutral and personal crowding experiences from one situation to another. Results indicated that the means of the two groups were not significantly different.

DISCUSSION

The results of the present study suggest that crowding experiences in residential settings are highly predictive of sensitivity to crowding in at least certain nonresidential environments. The correlation and regression analyses, as well as the MANOVAs, provide strong evidence that perceived crowding at home and negative feelings about the residential physical environment are associated with unfavorable reactions to both the physical and social dimensions of nonresidential settings.

In support of our first prediction the regression data revealed that subjects' evaluation of the social atmosphere of their residence contributed significantly to the prediction of their cross-situational sensitivity to crowding. This finding provides some support for a basic assumption underlying the proposed typology of crowding experiences, namely, that social factors as well as spatial variables mediate the perception of crowding and the generalization of crowding experiences from one situation to another. Similarly, Baum *et al.* (1975) found that residents of corridor-design dorms who rated their social environment as "cohesive" reported lower levels of residential crowding than did those who rated their dorms as noncohesive.

The association between social variables and felt crowding also was reflected in the significant correlations between residential crowding and ratings of people in general, alienation from roommates, and perceived social climate of the residence. In line with these data, a recent experiment by Stokols and Resnick (1975) indicated that heightened levels of perceived evaluation by others and threat to personal security were associated with increased interpersonal distance and elevated ratings of subjective crowding in a laboratory situation.

The second prediction, that subjects in the personal-crowding residential group would express greater feelings of crowding in the classroom than those in the neutral-crowding group, was not supported by the MANOVA data. The

absence of significant differences in classroom crowding between these groups may indicate that personal crowding experiences are not more generalizable between settings than are neutral crowding experiences; or, alternatively, the absence of significant between-groups differences may be related to certain features of the present study. First, small sample size limited the representativeness of our EPE/ESE groupings and the reliability of the related statistical analyses. Second, the fact that ratings of the residential social environment were obtained during the first few weeks of the fall quarter may have limited the extent to which social features of the residence could exert a significant impact on subjects' sensitivity to crowding in nonresidential settings. In view of the above limitations of this study, the prediction of differential generalization among neutral- and personal-crowding experiences remains to be more adequately examined through additional investigations.

The third prediction, that students' visits to physicians throughout the academic year and the quality of their coursework during the fall quarter would be significantly associated with ratings of residential crowding, social climate, and physical conditions, was supported by the data. Students' visits to health centers on and off campus as well as their course grades obtained during the fall quarter were significantly predicted by subjective ratings of the residential environment, although the quality of course performance was more highly correlated with a measure of social atmosphere in the classroom than with the residential measures.

While the obtained pattern of health and academic performance data generally supports our third prediction, it does not provide a basis for inferring causal connections between residential crowding, classroom performance, and student medical complaints. Certainly, it is possible that residential crowding experiences promote medical problems and poor academic performance, but it is equally plausible that chronically unhealthy or unsuccessful students are more susceptible to crowding experiences and social problems than their healthy or academically gifted counterparts. At the same time, the significant inverse correlation observed between perceived residential crowding and positive feelings toward people in general ($r = -.42$, $df = 30$, $p < .01$) can be interpreted either as evidence that exposure to residential crowding promotes a negative view of other people or, alternatively, that individuals who are inherently antisocial are more likely to feel crowded in most situations than those who tend to react favorably toward others (see Table I). To provide a straighforward test of our hypotheses, then, a longitudinal study is required in which students who are similar in terms of their prior health, interpersonal orientation, and scholastic achievement patterns can be interviewed at different times during the year to determine whether their academic and medical records are systematically affected by exposure to crowded living conditions. It also would be important to match the students with regard to the architectural features of their residences (e.g., amount and arrangement of space within dormitory suites). A follow-up study

which incorporates the above-mentioned design features is currently in progress at the University of California, Irvine.

The results of this study suggest some additional directions for future research. First, the fact that perceived crowding was more highly associated with social variables within the residential environment than those within the classroom setting suggests that the contribution of social factors to crowding experiences may increase as a function of the "primaryness" of the environment. Because subjects spend more time performing personally important activities in their residences than in a given classroom, the impact of socially mediated interferences on feelings of crowding would probably be greater in the former setting than in the latter. In order to explore the differential association between feelings of crowding and social dimensions of the environment, it will be necessary to develop a means of locating various environments along the primary-secondary continuum, and to sample the distribution of personal vs. neutral crowding experiences within a diversity of settings.

In developing criteria for the coding of diverse environments it is important to recognize that the primary-secondary distinction implies both functional and experiential dimensions. Although most persons spend more time engaging in personally important activities within residential vis-a-vis nonresidential settings, individual judgments as to the importance of one's activities and the degree of personal investment in a particular setting are bound to vary. Thus, subjective-report as well as observational criteria should be utilized in attempting to distinguish among primary and secondary environments.

The proposed typology of crowding experiences will be useful to professional designers only to the degree that it predicts specific relationships between environmental dimensions and behavioral patterns. To assess the utility of the typology as a design tool, it therefore will be necessary to examine more thoroughly the linkages between environmental factors, perceived crowding, and corresponding behavioral effects. Recent experiments indicate that subjective crowding is associated with at least short-term behavioral deficits under certain conditions (cf. Booth, 1975; Dooley, 1974, Evans, 1975; Rodin, 1976; Sherrod, 1974). An important task for future research will be to determine more precisely the conditions under which crowding experiences result in both immediate and cumulative behavioral impairments.

REFERENCES

Aiello, J., and Epstein, Y. (1978). Effects of residential social density on human behavior: A longitudinal field experiment. In Esser, A., and Greenbie, B. (eds.), *Designing for communality and privacy*. Plenum, New York.

Aiello, J., Epstein, Y., and Karlin, R. (1975). Field experimental research on human crowding. Paper presented at the Eastern Psychological Association Convention, New York.

Altman, I. (1975). *The Environment and Social Behavior: Privacy, Personal Space, Territory and Crowding.* Brooks/Cole, Monterey, California.

Baron, R., Mandel, D., Adams, C., and Griffen, L. (1975). Effects of social density in university residential environments. Paper presented at the Annual Convention of the American Psychological Association, Chicago.

Baum, A., and Valins, S. (1973). Residential environments, group size, and crowding. *Proceedings of the American Psychological Association* 211-212.

Baum, A., and Valins, S. (1977). *The Social Psychology of Crowding: Studies of the Effects of Residential Group Size.* Lawrence Erlbaum Associates, Hillsdale, New Jersey.

Baum, A., Harpin, R. E., and Valins, S. (1975). The role of group phenomena in the experience of crowding. *Environment and Behavior* 7: 185-198.

Booth, A. (1975). Final report: Urban crowding project. Paper presented to the Ministry of State for Urban Affairs, Government of Canada.

Desor, J. (1972). Toward a psychological theory of crowding. *Journal of Personality and Social Psychology* 21: 79-83.

Dooley, B. (1974). Crowding stress: The effects of social density on men with "close" or "far" personal space. Unpublished doctoral dissertation, University of California at Los Angeles.

Duke, M., and Nowicki, S. (1972). A new measure and social-learning model for interpersonal distance. *Journal of Experimental Research in Personality* 6: 119-132.

Esser, A. (1972). A biosocial perspective on crowding. In Wohlwill, J., and Carson, D. (eds.), *Environment and the Social Sciences: Perspectives and Applications.* American Psychological Association, Washington, D.C.

Evans, G. (1975). Physiological and behavioral consequences of crowding. Unpublished dissertation, Department of Psychology, University of Massachusetts, Amherst.

Hanson, L., and Wicker, A. (1973). Effects of overmanning on group experience and task performance. Paper presented at Western Psychological Association Convention, Anaheim, California, April.

Keniston, K. (1965). Short alienation scales. Unpublished manuscript, Department of Psychiatry, Yale University Medical School, New Haven, Connecticut.

Milgram, S. (1970). The experience of living in cities. *Science* 167: 1461-1468.

Proshansky, H., Ittelson, W., and Rivlin, L. (1970). Freedom of choice and behavior in a physical setting. In Proshansky, H., Ittelson, W., and Rivlin, L. (eds.), *Environmental Psychology: Man and His Physical Setting.* Holt, Rinehart and Winston, New York.

Rodin, J. (1976). Crowding, perceived choice, and response to controllable and uncontrollable outcomes. *Journal of Experimental Social Psychology* 12: 564-578.

Rotter, J. (1966). Generalized expectancies for internal vs. external control of reinforcement. *Psychology Monographs* 80 (Whole No. 609).

Rotter, J., Chance, J., and Phares, E. (1972). *Applications of a Social Learning Theory of Personality.* Holt, Rinehart and Winston, New York.

Sherrod, D. (1974). Crowding, perceived control and behavioral after-effects. *Journal of Applied Social Psychology* 4: 171-186.

Stokols, D. (1972a). On the distinction between density and crowding: Some implications for future research. *Psychological Review* 79: 275-277.

Stokols, D. (1972b). A social psychological model of human crowding phenomena. *Journal of the American Institute of Planners* 38: 72-84.

Stokols, D. (1975). Toward a psychological theory of alienation. *Psychological Review* 82: 26-44.

Stokols, D. (1976). The experience of crowding in primary and secondary environments. *Environment and Behavior* 8: 49-86.

Stokols, D. (in press). A typology of crowding experiences. In Baum, A., and Epstein, Y. (eds.), *Human Response to Crowding.* Lawrence Erlbaum Associates, Hillsdale, New Jersey.

Stokols, D., and Resnick, S. (1975). An experimental assessment of neutral and personal crowding experiences. Paper presented at the Annual Conference of the Southeastern Psychological Association, Atlanta, March.

Sundstrom, E. (in press) Crowding as a sequential process: Review of research on the effects of population density on humans. In Baum, A., and Epstein, Y. (eds.), *Human Response to Crowding.* Lawrence Erlbaum Associates, Hillsdale, New Jersey.

Valins, S., and Baum, A. (1973). Residential group size, social interaction, and crowding. *Environment and Behavior* 5: 421-439.

Wicker, A. (1973). Undermanning theory and research: Implications for the study of psychological and behavioral effects of excess populations. *Representative Research in Social Psychology* 4: 185-206.

Zlutnick, S., and Altman, I. (1972). Crowding and human behavior. In Wohlwill, J., and Carson, D. (eds.), *Environment and the Social Sciences: Perspectives and Applications.* American Psychological Association, Washington, D.C.