PHYSICAL, SOCIAL, AND PERSONAL DETERMINANTS OF THE PERCEPTION OF CROWDING

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In contrast to society's current concern over the population crisis and the presumed ill effects of overcrowding, several contemporary theories of urban design ascribe great value to high-density living and emphasize the potential benefits of population concentration. Le Corbusier (1933: 32), for example, views the large city as the crucible of human development: "The virtue of the big city is that it becomes a magnetic pole of attraction from which emanate the spiritual achievements resulting from intense concentration." For Jane Jacobs (1961), the value of population density resides in its contribution to the "exuberant diversity" of urban areas. Similarly, Paolo Soleri (1969) and Kenzo Tange (1970) regard density as a prerequisite for the optimal organization of society and the enhancement of human life.

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Implicit in each of the above perspectives on urban design is the assumption that population density per se is not harmful to human beings—on the contrary, it is potentially beneficial to the extent that it is accompanied by certain conditions within society. Thus, in Le Corbusier's "radiant city," the utilization of vertical architecture and the provision of ubiquitous parks and gardens would mitigate the pressures of high density and, thereby, facilitate the beneficial effects of intense social interaction. As another example, Jane Jacobs contends that city districts incorporating a mixture of primary functions provide the context in which density becomes a positive social force. The great value of mixed land use is that it attracts a variety of different users to an area throughout the day. Hence, the presence of many "eyes on the street" contributes to urban safety, and the convergence of several users at different times promotes an efficient and continuous use of space over time.

Turning from the proposals of planners to the realities of "hard data," recent research on the behavioral effects of density offers incomplete and sometimes contradictory evidence concerning the impact of high densities on people (compare Freedman, 1971). On the one hand, experiments reported by Calhoun (1966, 1962) and Christian et al. (1960) demonstrate that population density can exert a variety of negative effects upon animal communities. On the other hand, research focusing on human populations suggests that the adverse effects, often associated with density, may be mediated by socioeconomic and educational status (compare Schmitt, 1966; Winsborough, 1965), group size (Griffit and Veitch, 1971; Hutt and Vaizey, 1966; Ittelson et al., 1970; Smith and Haythorn, 1972; Sommer and Becker, 1971), or may be offset by cultural traditions (Schmitt, 1963), the nature of activities performed in a given area (Sommer, 1969), or the judicious arrangement of space (Michelson, 1970; Desor, 1972).

Although some of the above findings may be inconsistent, the majority of them tend to support the assumption that density (within human populations, at least) is not invariably correlated with behavioral maladies. Given, however, that social

problems *are* sometimes associated with density and that people often refer to crowded situations as unpleasant ones, what appears to be called for is an experimental approach which explores, more fully, the conditions determining the impact of density across various situations.

The present experiment was designed to provide some systematic information about the ways in which density interacts with certain social and personal factors to influence a person's behavior as well as his perceptions about the environment. Our research approach stems from a basic distinction between the terms "density" and "crowding" (Stokols, 1972a). Whereas density denotes a physical condition involving the limitation of space, crowding refers to an experiential state in which the restrictive aspects of limited space are perceived by the individuals exposed to them. The major research task posed by this distinction, then, is to identify those circumstances which sensitize the individual to the potential constraints of limited space.

BACKGROUND

In an earlier article it is proposed that crowding is experienced as a syndrome of stress resulting from the disparity between one's supply of and demand for space (Stokols, 1972b). An analysis of human crowding phenomena is developed which suggests the ways in which environmental and personal attributes jointly accentuate one's demand for space. According to this analysis, any social circumstance which requires the individual's close coordination with other persons or his surveillance of them (e.g., a complex or competitive task) should heighten his demand for space. Likewise, personal traits which impair one's ability to interact smoothly with others under conditions of limited space would predispose him to feelings of restriction and crowding.

From the conceptualization of crowding discussed above, three experimental hypotheses were derived and tested in the

present study. First, it was predicted that, as the supply of space in a given area is reduced, the occupants of the area will tend to feel crowded. The experience of crowding should induce subjects to perceive the environment as confining, and to manifest behavioral symptoms of stress (e.g., hostility toward others, reported anxiety, and dissatisfaction with the situation). Second, under conditions of spatial limitation, subjects should feel more crowded and exhibit greater stress when they are competing against each other than when they are cooperating as a group. When space is adequate, however, no such effect is expected. Finally, it is expected that females interacting in an area of limited space will experience less crowding and display fewer manifestations of stress than males in the same situation. This prediction is based upon the observation in previous experiments (compare Freedman, 1970; Ross et al., 1972) that males are more susceptible than females to the restrictions of limited space. This evidence, then, suggests that sex may be an important personal factor which mediates the experience of crowding.

It should be noted that our analysis of crowding, as well as our experimental predictions, are compatible with certain other theoretical perspectives. In terms of Sommer's (1969) concept of personal space, social interference in the form of competition with others can be viewed as a factor which renders the individual more sensitive to violations of his personal space. The increased salience of others' intrusions on one's personal space may, thus, predispose him to the experience of crowding. Also, from the perspective of Proshansky et al. (1970), the perception of crowding results from the realization that one's range of behavioral freedom is limited by the presence of too many other persons. The perceived restriction of one's freedom should eventuate in feelings of reactance (Brehm, 1966) and, in the context of our analysis of crowding, this experience should be manifested as dissatisfaction with the discrepancy between one's supply of and demand for space.

A final word about the scope of this study is in order. While urban designers and social planners are generally concerned with

macrocosmic or sociological crowding phenomena, the present research focuses upon the experience of crowding at a microcosmic level—i.e., within the context of a laboratory situation. The dissimilarities between our experimental situation and the urban environment limit the generality of our findings to macro crowding phenomena. For example, subjects in our study, unlike the inhabitants of a crowded city, experience crowding for a relatively short period of time and realize that they will eventually leave the situation. Nonetheless, this research *is* relevant to environmental concerns in two respects. First, it explores certain factors which may mediate a person's perception of the environment, as well as its impact on him. Second, urban crowding can be characterized as an aggregation of micro crowding phenomena. Hence, an understanding of crowding at the psychological level should have implications for dealing with crowding at the societal level.

METHOD

SUBJECTS

Five hundred twelve students at the University of North Carolina participated in this study as part of a course requirement. Subjects arrived at the experiment in same-sexed groups of eight, with a total of 64 groups participating in the experiment. An attempt was made to include in each group only subjects who were unacquainted with each other prior to the experiment.

INDEPENDENT VARIABLES

The experiment utilized a 2-x-2-x-2 factorial design with each of the three factors corresponding to a physical, social, or personal variable. The amount of available space was manipulated by varying the size of the experimental room; a large and a small room were used. (The laboratory rooms in this study were

identical to those used by Ross et al., 1972.) Both rooms were rectangular in shape with a one-way mirror at one end. They were formed around the same mirror by varying the position of a movable wooden partition which was 8 ft. (2.44 m) high. The ceiling of the room extended another 2 ft. 4 in. (.71 m) beyond the top of the partition. As a result, fresh air was allowed to circulate into both the large and small rooms without sacrificing the impression of a complete enclosure. It was expected that this feature would serve to offset differences in temperature and stuffiness between the large and small rooms.

The large room was created by using the entire partition as one wall. It resulted in a room 9 ft. 11 in. (3.02 m) wide and 13 ft. 6 in. (4.11 m) long. The small room was formed by bending the partition to make two walls, resulting in a room 5 ft. 7 in. (1.70 m) wide and 8 ft. 1 in. (2.46 m) long. In both rooms, eight molded plastic chairs were arranged in the largest oval possible. In the small room each chair touched the one next to it. In the narrow part of the oval there was a distance of 16 in. (.41 m) from the front of one chair to the front of the chair directly opposite. In the large room, there were roughly 15 in. (.39 m) between adjacent chairs and 5 ft. (1.55 m) between chairs.

In addition to room size, the degree of social interference was orthogonally manipulated by imposing either a cooperative or competitive task set on each group of subjects. All experimental groups participated in a quiz game, the object of which was to answer a maximum number of quiz items correctly in order to accumulate as many points as possible.

In the cooperative condition, subjects were told that they would each receive $3, $0, or an intermediate amount depending on how well their group did in comparison to groups which had participated in the study previously. The group score was determined by adding the number of correct responses for all members and subtracting, from that total, the sum of incorrect answers for each member of the group. The group score, then, depended on a joint effort by all members of the group.

In the competitive condition, subjects were informed that they would be competing with each other for a limited amount of money. More specifically, the person accumulating the greatest number of points would receive $3, whereas the individual earning the least number of points would receive $0. The intermediate amounts paid to the other subjects would depend upon their relative ranking within the group as reflected in their game scores.

Finally, the personal factor incorporated in the design was sex of the subject. Half of the experimental groups were composed of males, while the other groups consisted of females.

PROCEDURE

Subjects signed up for an experiment entitled "Group Process." Each participant, upon reporting to the experimental session, was ushered into one of eight separate cubicles, where he filled out a preliminary questionnaire pertaining to his personal background. Next, the subjects were escorted as a group to either the small or large experimental room. There, a set of standard instructions was read by one of four experimenters, two of whom were male and the other two female. The experimenter first asked the subjects to announce their names to each other. He then stated that the experiment was designed to study "thinking under pressure." Each group member was given a clipboard with a list of quiz questions and answers. The quiz items pertained to various types of general information such as the dates of historical events and the meanings of standard abbreviations. The experimenter instructed the subjects that they were to take turns asking each other questions from their respective lists. Once a question was asked, the first person to raise his hand would have a chance to answer it. If he answered correctly, he would receive a score of +1; if he answered incorrectly, he would receive a −1. The person asking the question would judge whether or not the answer was correct. If the answer was incorrect, another player could raise his hand and have a chance, with the same scoring

procedure applying. A question would die if a player answered it correctly or when more than 15 seconds had elapsed without another player raising his hand for a try. The role of asking a question would then pass on to the next player. The players, thus, alternated asking questions in a clockwise fashion such that, for each round of the game, all eight players read one item to the group.

Each player was provided with a grid sheet on which he was to keep score. In the cooperative condition, all players were told to record the cumulative group score as the game proceeded. In the competitive condition, players were told to keep track of their individual scores. At the end of every eight rounds, they would take turns announcing their cumulative scores aloud, so that everyone would be aware of how well he was doing as compared to the other players.

Finally, the potential winnings were described. The individual prizes were explained to the competitive groups, and the shared prize was explained to the cooperative groups. All groups were informed that they would be observed through the one-way mirror during the game. They were told to continue asking each other quiz questions until the experimenter returned to describe the winnings.

After the game had proceeded for 70 minutes, the experimenter returned and administered a questionnaire which contained semantic differentials pertaining to the subjects' feelings during the game. After everyone had completed the questionnaire, the experimenter handed out another set of papers and requested that the subjects write down as many names of their fellow players as they could remember. After the final sheets were collected and the winnings distributed, a complete debriefing was presented to the subjects which revealed the true purpose of the experiment.

DEPENDENT MEASURES

In order to assess the perception and manifestations of crowding stress, three types of measurement were utilized. The

first involved a series of questionnaire items which pertained to the participants' feelings during their involvement in the experiment. These semantic differentials assessed the subjects' sensations of crowding, physical comfort throughout the game, general enjoyment of the game, anxiety during the experiment, feelings of aggressiveness and relatedness toward the other members of their group, and the likeability of the other players. The second form of measurement consisted of three observational measures which were recorded over five-minute intervals throughout the game by the experimenter and an observer. These indices related to (a) the number of friendly jokes and comments expressed during the game, (b) the amount of group laughter during the game (i.e., the number of times four or more players laughed simultaneously), and (c) the number of hostile comments expressed during the course of the game. Finally, a measure of group task performance was included in the experimental analyses. This index was merely the total number of points earned by all members of the group during the experimental game.

The semantic differentials which assessed the participants' subjective reactions were included in a questionnaire administered to each member of the group at the conclusion of the game. The specific items, all of which were nine-point scales, were grouped according to the various perceptual or subjective dimensions mentioned above. The questions pertaining to the perception of crowding were as follows: "How you felt during the game: crowded-uncrowded, restricted-free to move," and "The experimental room: spacious-confined." Physical comfort was assessed with three semantic differentials: "physically uncomfortable-physically comfortable, cold-hot, and not stuffy-stuffy." The items associated with enjoyment of the game were: "dull-fascinating, not enjoyable-enjoyable, bored-entertained, and unhappy-happy." Also, in order to detect feelings of anxiety, participants were asked whether they felt patient or impatient, upset or not upset, and tense or relaxed during the game.

With respect to their fellow group members, subjects were

asked to rate the general likeability of the other players on the following items: "unlikeable-likeable, bad-good, and unfriendly-friendly." In addition, the subjects' perceived relatedness to the group was assessed by having them indicate how sociable, intimate, informal, and friendly they felt toward the other players throughout the game. Finally, the subjects' perceptions of aggressiveness during the game were measured with two items: "The other participants: passive-aggressive," and "How you felt during the game: passive-aggressive."

Embedded in the postexperimental questionnaire were four supplementary items which were not included in the above groupings, but were assumed to be related to them. As checks on the experimental manipulations, subjects were asked to rate the size of the experimental room on a scale ranging from "small" to "large," and to indicate how cooperative or competitive they felt throughout the game. In order to gain further information about subjects' perceptions of the experimental room, they were asked to indicate how "cozy" or "stark," and "noisy" or "quiet," it seemed to them. Finally, after they had completed the questionnaire, subjects were requested to write down as many names of their fellow players as they could remember. It was assumed that this measure would provide additional information about the participants' sentiments toward the other players.[1]

The utilization of both subjective reports and behavioral indices represents an attempt to overcome certain conceptual problems inherent in the assessment of crowding stress. Since, in the present discussion, crowding is conceptualized as a particular syndrome of stress, it was expected that the perception of crowding, as reported on the questionnaire items, would be accompanied by certain general manifestations of stress—e.g., hostility, anxiety, and so on. Moreover, the lack of such symptoms of stress, and the occurrence of laughter and friendliness would suggest the absence of crowding stress. However, it might be argued that laughter should be viewed as a coping response to the experience of crowding. In order to reduce the interpretive ambiguity of any given measure, the

data were viewed configurationally such that the presence of laughter, the absence of hostility, and questionnaire responses which did not reflect the perception of crowding were viewed as maximal evidence for the absence of perceived crowding, whereas it was assumed that the presence of crowding stress would be reflected by an opposite pattern of results at each level of measurement.

COVARIATES

Multivariate analyses of variance were performed on all dependent measures. In the analyses of the grouped semantic differentials, a set of covariates was utilized in order to control for individual differences along certain dimensions, which were presumed to influence a person's perception of crowding. It was suspected, for example, that the subject's family size, his propensity to participate in class discussions or engage in friendly debate, and his level of achievement motivation would affect his susceptibility to the experience of crowding. Hence, background data relating to these dimensions were gathered by administering a preliminary questionnaire containing open-ended items to each subject before he was escorted, with the other participants, into the experimental room.

RESULTS

The data were analyzed using the group as the unit of observation since the responses of individual members within each group were nonindependent and, therefore, might yield spuriously high significance levels. A four-way analysis of variance was performed on all dependent measures in order to detect possible effects due to sex of the experimenter. No experimenter effects were found on the groupings of items pertaining to participants' subjective reactions during the experiment. Thus, the analyses of these measures were collapsed over the experimenter factor and are reported in terms of a

three-way, multivariate analysis of variance. (In the three-way model there were eight groups per cell.) Three other variables, however, reflected significant experimenter effects. The results for these items are reported therefore in terms of the four-factor analysis of variance model.

The results for the semantic differential items are reported first and are followed by a summary of the behavioral data. The semantic differential groupings were analyzed both with and without covariates. One of the covariate measures was not randomly distributed over all treatment conditions and was omitted from the analysis. The analysis of covariance utilizing the other four covariates revealed no noticeable shifts in the data and did not significantly improve prediction. Thus, all analyses reported below are without covariates.

ROOM SIZE AND TASK SET MANIPULATION CHECKS

The analyses confirmed that subjects in the small-room condition perceived the experimental room to be significantly smaller (mean $X = 1.57$) than did subjects in the large room condition ($X = 3.98$). In addition to this main effect for room size ($F = 505.69$, $df = 1/56$, $p < .001$), a sex-by-task set interaction ($F = 7.75$, $df = 1/56$, $p < .001$) was observed, which indicated that males perceived the room to be smaller when they were competing, whereas females rated the room as larger when they were competing (see Table 1).

The results also indicated the effectiveness of the task set manipulation. Subjects participating under a cooperative set rated themselves as feeling significantly more cooperative ($X = 6.87$) during the game than did those playing under a competitive set ($X = 5.31$). In addition to the task set main effect ($F = 50.09$, $df = 1/56$, $p < .001$), a main effect for sex was revealed ($F = 4.09$, $df = 1/56$, $p < .048$). Females felt significantly more cooperative throughout the game than did males.

MULTIVARIATE ASSESSMENTS OF PARTICIPANTS' SUBJECTIVE REACTIONS

The major dependent variables of this study were those included in the cluster of items pertaining to the perception of crowding. From our conceptualization of crowding as a syndrome of stress, it was assumed that the experience of crowding would be accompanied by both subjective reports and behavioral manifestations of stress. Our analysis of crowding, however, provided few clues regarding which dimension of stress would be most strongly related to perceived crowding, and just what the nature of the relationship would be. Therefore, as an exploratory strategy, items were grouped on the basis of face validity into clusters representing different dimensions of stress. The data from these assessments were viewed as supplementary or suggestive information though it *was* tentatively expected that their results would parallel those observed for perceived crowding.

The perception of crowding. As predicted by the first hypothesis, subjects experienced a greater degree of crowding in the small room than in the large room (multivariate $F = 115.63$, $df = 3/54$, $p < .001$). All three measures of perceived crowding reflected highly significant univariate Fs for room size. Subjects

TABLE 1
MEANS PERTAINING TO PERCEIVED ROOM SIZE AND CROWDING[a]

		Males		Females	
		Coop	Comp	Coop	Comp
Room Small-*Large*	Small	1.64	1.61	1.26	1.78
	Large	4.23	3.81	3.84	4.07
Room Spacious-*Confined*	Small	8.44	8.21	8.49	7.91
	Large	6.19	6.39	6.35	5.98
Restricted-*Free to Move*	Small	5.60	5.06	5.41	4.90
	Large	6.74	6.32	6.50	6.52
Crowded-*Uncrowded*	Small	3.99	3.58	3.93	3.62
	Large	6.49	6.24	7.21	6.82

a. Larger means indicate higher ratings on the attribute underlined.

felt more restricted ($F = 27.88$, $df = 1/56$, $p < .001$), more crowded ($F = 194.26$, $df = 1/56$, $p < .001$), and perceived the room to be more confined ($F = 301.58$, $df = 1/56$, $p < .001$) in the small room than in the large room.

Although the predicted interaction between room size and task set was not reflected in the measures of crowding, a significant main effect for task set was revealed by the analyses, indicating that subjects' perception of crowding had been affected by the competitive-cooperative dimension (multivariate $F = 3.84$, $df = 3/54$, $p < .014$). The direction of the means indicates that subjects felt less crowded and restricted under the cooperative condition than under the competitive one, but these differences are not statistically significant ($p < .108$, $p < .136$, respectively). A significant univariate was revealed for the assessment of room confinement ($F = 4.48$, $df = 3/54$, $p < .039$), but interestingly, the direction of the means for this variable runs opposite to the pattern reflected by the crowding and restriction means. That is, subjects in the cooperative conditions perceived the room to be more confined than did subjects in the competitive condition. Furthermore, a marginally significant, univariate sex-x-task set interaction was found ($F = 3.90$, $df = 3/54$, $p < .053$) indicating that the differences in perceived room-confinement, between the competitive and cooperative conditions, were greater for females than for males (see Table 1). This interaction parallels the pattern of results reported for perceived room size.

The means for perceived crowding, restriction, and room confinement are presented in Table 1. The discrepancies in the directions of these means will be taken up in the discussion section. It should be noted that the predicted interaction between room size and sex was absent: within the small room, there were no apparent differences between males and females regarding the degree of perceived crowding.

Anxiety. A significant multivariate F for room size was associated with the cluster of anxiety items ($F = 3.18$, $df = 3/54$, $p < .031$). Only one of the items, however, reflected a

significant univariate F for room size: subjects felt more patient in the large room than in the small room ($F = 9.34$, $df = 1/56$, $p < .003$).

Moreover, a significant main effect for task set was observed on all three assessments of anxiety (multivariate $F = 6.74$, $df = 3/54$, $p < .001$). Subjects felt more patient ($F = 5.24$, $df = 1/56$, $p < .026$), less upset ($F = 5.22$, $df = 1/56$, $p < .026$), and more relaxed ($F = 18.83$, $df = 1/56$, $p < .001$) in the cooperative condition than in the competitive one.

Game enjoyment. Analyses indicated a significant main effect for task set on subjects' ratings of game enjoyment (multivariate $F = 2.92$, $df = 4/53$, $p < .03$). Three of the items reflected significant univariate Fs: subjects found the experimental game to be more enjoyable ($F = 4.05$, $df = 1/56$, $p < .049$) and felt happier ($F = 10.14$, $df = 1/56$, $p < .002$) and more entertained ($F = 6.89$, $df = 1/56$, $p < .001$) in the cooperative condition than in the competitive one.

Aggressiveness. Subjects' perceptions of aggressiveness were significantly affected by the task set manipulation (multivariate $F = 3.44$, $df = 2/55$, $p < .039$). It is surprising to note, however, that subjects attributed more aggressiveness to others in the cooperative condition than in the competitive one ($F = 6.86$, $df = 2/55$, $p < .011$). Moreover, the same pattern of results is reflected in the subjects' perceptions of their own aggressiveness but for this variable, the difference between the cooperative and competitive conditions is statistically nonsignificant ($p < .114$).

It was also observed that females attributed less aggressiveness both to themselves ($F = 5.66$, $df = 1/56$, $p < .021$) and to others ($F = 3.95$, $df = 1/56$, $p < .052$) than did males, though the latter finding is not quite significant at the conventional level. The sex multivariate F for the two variables was significant at $p < .047$ ($F = 3.22$, $df = 2/55$).

Finally, a highly significant room size-x-sex interaction was observed for the pair of aggressiveness measures (multivariate $F = 6.91$, $df = 2/55$, $p < .002$). The multivariate effect was

primarily attributable to the self-aggressiveness item which indicated that males perceived themselves to be significantly more aggressive in the small room, whereas females felt more aggressive in the large room ($F = 14.07$, $df = 1/56$, $p < .001$). The same pattern was reflected by the means pertaining to the others' aggressiveness, though for this variable, the room size-x-sex interaction was not statistically significant ($p < .088$). The means for the two aggressiveness variables are reported in Table 2.

Relatedness to group and likeability of other. No significant treatment effects were revealed for these variables.

Physical comfort. Although an attempt was made to control for differences in comfort between the large and small rooms, the analyses revealed a significant main effect for room size on subjects' ratings of physical comfort (multivariate $F = 22.89$, $df = 3/54$, $p < .001$). Subjects felt more uncomfortable ($F = 64.98$, $df = 1/56$, $p < .001$) and perceived the room to be hotter ($F = 21.87$, $df = 1/56$, $p < .001$) in the small room than in the large room. These results may partially explain the lack of a significant room size-x-task set interaction on the assessments of perceived crowding, but have no bearing on most of the interactions discussed above.

A significant sex-x-task set multivariate F ($F = 4.44$, $df = 3/54$, $p < .007$) was also found for the assessment of physical comfort. This interaction effect, however, was primarily attributable to the stuffiness variable, which reflected a highly

TABLE 2
MEANS PERTAINING TO AGGRESSIVENESS[a]

		Males		Females	
		Coop	Comp	Coop	Comp
Others Aggressive	Small	7.03	6.49	6.57	5.69
	Large	6.68	6.35	6.48	6.47
Self Aggressive	Small	6.59	6.43	5.73	5.27
	Large	5.94	5.87	6.32	5.95

a. Larger means indicate higher ratings on the attribute listed.

significant univariate F ($F = 8.80$, $df = 1/56$, $p < .004$). For males, the room was perceived to be stuffier under the competitive task set, whereas for females, it was rated as stuffier under the cooperative set (see Table 3). There were no significant sex-x-task set univariates for the other two measures of physical comfort.

Supplementary semantic differentials. There were two additional items which pertained to subjects' perception of the environment. These measures concerned the perceived coziness and quietness of the room; they were analyzed separately rather than grouped into a multivariate cluster.

For the coziness item, a significant room size-x-sex interaction was observed, indicating that males rated the room as less cozy or more stark in the small room whereas females perceived the large room to be more stark than the small one ($F = 8.76$, $df = 1/56$, $p < .004$). These results parallel those for the aggressiveness measures and will be taken up more fully in the discussion section (see Table 4).

The results for the room-quiet measure are reported in terms of a four-way ANOVA model since they reflected an experimenter effect. First, females perceived the room to be significantly quieter than did the males ($F = 20.86$, $df = 1/48$, $p < .001$). This main effect for sex, however, is qualified by a room size-x-sex interaction which indicates that males rated the large room as quieter whereas females perceived the small room as quieter ($F = 15.61$, $df = 1/48$, $p < .001$). Also, a significant sex-x-experimenter interaction revealed that male subjects perceived the room to be quieter in the presence of a male

TABLE 3
INTERACTION MEANS FOR PERCEIVED STUFFINESS OF ROOM[a]

	Male	Female
Coop	6.32	6.54
Comp	6.49	5.17

a. Higher numbers indicate greater stuffiness.

TABLE 4
INTERACTION MEANS FOR PERCEIVED STARKNESS OF ROOM[a]

	Male	Female
Small	6.09	5.17
Large	5.52	5.83

a. Higher ratings indicate greater starkness.

experimenter, whereas female subjects rated the room as quieter in the presence of a female experimenter ($F = 4.28$, $df = 1/48$, $p < .004$). Finally, a significant room size-x-task set interaction was found, indicating that subjects in the small room perceived the room as quieter under a cooperative task set, whereas subjects in the large room rated it as quieter under a competitive set ($F = 5.02$, $df = 1/48$, $p < .030$).

One additional measure pertained to the subjects' ability to recall the names of their fellow players at the conclusion of the game. This item was included as an assessment of deindividuation. The analyses revealed significant effects attributable to sex of experimenter and, thus, the results for name recall are reported in terms of the four-way ANOVA model.

There were significant main effects on name recall for both sex of subject ($F = 16.39$, $df = 1/48$, $p < .001$) and sex of experimenter ($F = 7.00$, $df = 1/48$, $p < .001$).[2] Female subjects, in general, recalled more names than did male subjects, and in the presence of female experimenters, significantly more names were remembered than in the presence of male experimenters. The sex main effect was qualified, though, by a sex-x-room size interaction ($F = 8.31$, $df = 1/48$, $p < .006$). Males recalled more names in the large room, whereas females recalled more names in the small room. Interestingly, these results parallel the pattern observed for the aggressiveness measures.

OBSERVATIONAL INDICES AND PERFORMANCE CRITERION

Reliability check. Assessments of observer reliability were gathered during 12 of the 64 experimental sessions. In the course of these sessions, a second observer overlapped with the

main observer and the experimenter in making ratings of the groups on the three observational measures. The index of observer reliability for each measure was simply the percentage of agreement among the three observers.

It was found that the observers agreed 93% of the time on their assessments of group laughter. With regard to the number of friendly jokes expressed during the game, observers agreed 73% of the time, and for the number of hostile comments expressed, observers agreed 77% of the time. These figures may be somewhat elevated, however, since the observers were not isolated from each other, and though the observational room was quite dark, it was possible for each observer to perceive the movements of the others.

Due to the differences between measures in observer reliability, they were analyzed separately rather than as a multivariate cluster.

Group laughter. Significant main effects for room size and task set were observed on the assessment of laughter. There was more laughter in the small room than in the larger room ($F = 4.84$, $df = 1/56$, $p < .032$), and subjects in the competitive condition laughed more than those in the cooperative condition ($F = 4.71$, $df = 1/56$, $p < .034$). These effects are further qualified by a significant room size-x-task set interaction ($F = 7.01$, $df = 1/56$, $p < .011$). Subjects in the small room laughed more under the competitive task set whereas subjects in the large room laughed more under the cooperative set. These results follow the pattern observed for the room-quietness measure. It is interesting to note that the room size-x-task set interaction, predicted for perceived crowding, is reflected in the laughter variable, suggesting the possibility that laughter in this experiment may have operated as a coping response to perceived crowding stress.

Friendly jokes. A significant main effect for sex of experimenter was found such that more friendly jokes occurred in the presence of a male experimenter than in the presence of a female experimenter ($F = 11.27$, $df = 1/48$, $p < .002$).

Hostile comments. Males were observed to express significantly more hostile comments during the game than females ($F = 6.32$, $df = 1/56$, $p < .015$). Also, there were more hostile comments in the competitive condition than in the cooperative one, but the difference was not quite significant ($F = 3.70$, $df = 1/56$, $p < .059$). Finally, it should be noted that the room size-x-sex interaction, which was observed for the aggressiveness and name recall measures, was not significant for the assessment of hostile comments ($p < .123$).

Group task performance. Analyses revealed that male subjects amassed a greater score during the experiment than did female subjects ($F = 4.16$, $df = 1/56$, $p < .046$).

DISCUSSION

It is evident, from the analyses of the manipulation checks, that the experimental treatments were effective. The small room was indeed perceived to be smaller than the large room, and the competitive task set did induce a greater degree of competitiveness than did the cooperative set.

It was proposed earlier that the experience of crowding arises from the perceived disparity between one's supply of and demand for space. It was assumed that this disparity results from (1) the reduction or limitation of one's supply of space, and (2) the presence of social and personal factors which render the individual more sensitive to the potential constraints of limited space. Moreover, the impact of social and personal factors on the perception of crowding would be more pronounced in situations where one's supply of space was limited to begin with. The experimental hypotheses were derived from the above assumptions.

Our first hypothesis, that subjects would experience greater crowding in the small room than in the large, was supported. Subjects felt more restricted, crowded, and perceived the room to be more confined in the small, compared to the large, room.

The small room was also perceived as more uncomfortable, hotter, and stuffier. Despite these clear differences between the two physical environments and the levels of perceived crowding within each, few parallel differences occurred with respect to other manifestations of stress; only subjects' self-ratings on the anxiety items reflected a significant main effect for room size. In the present study, room size showed no effect upon subjects' task performance, enjoyment of the game, relatedness to the group, their liking of or hostility toward the other group members; the lack of such effects may be attributable to the consistently high level of game enjoyment expressed by subjects in all conditions ($X_{enjoy} = 7.81$). Thus, as in the Freedman et al. (1971) and Ross et al. (1972) studies, the subjective experience of crowding, which from our perspective is psychologically stressful, did not automatically translate into a variety of negative behavioral effects.

Our second hypothesis, that subjects in the small room, as compared to those in the large, would experience more crowding under a competitive task set than under a cooperative one, was not supported. Verification of this hypothesis required a room size-x-task set interaction on the perception of crowding. A number of post hoc explanations can be offered to account for the absence of such effects. First, the potency of the room size manipulation may have "swamped out" the effect of a competitive task set on the perception of crowding within the small room. As pointed out in the results section, the means for perceived size of both the small ($X = 1.57$) and large ($X = 3.98$) rooms are found at the "small" end of the nine-point scale, whereas the means for the cooperative ($X = 6.87$) and competitive ($X = 5.31$) conditions are both located toward the "cooperative" end of the task set scale. Thus, the small room was judged to be maximally small, permitted little further movement, and, hence, the moderate amount of competition generated under the competitive task set may have been insufficient to elevate differences in perceived crowding, within the small room, beyond the level of differences observed in the large room. The highly significant main effect for room size on

subjects' physical discomfort, despite our attempt to control it, made the differential effect of task set on perceived crowding, within the small and large rooms, even more unlikely.

Another possibility, though, is that subjects in the small room, competitive condition initially experienced more crowding than subjects in the other conditions, but alleviated their perceived restriction by engaging in more laughter throughout the game. As pointed out earlier, a significant room size-x-task set interaction was observed on the amount of group laughter and perceived quietness of the room, with subjects in the small room, competitive condition engaging in more laughter and rating the room as noisier than subjects in the other conditions. Further evidence that laughter served as a coping response to felt crowding, rather than as a pure indication of good humor, is provided by the pattern of the crowding and restriction means, which reflects most crowding and restriction in the small room, competitive condition (see Table 1). Since this experiment did not control for or manipulate the factor of time, however, it is impossible to ascertain whether the perception of crowding actually decreased over time within the small room, competitive condition.

The general assumption on which the second hypothesis is based, namely, that social factors can affect the subjective experience of crowding—obtains some support from the results. It will be recalled that a significant multivariate F was obtained for the effect of task set upon the three items assessing the perception of crowding. This indicates that subjects' perceptions of crowding were affected by the competitive-cooperative manipulation. The direction of this effect, however, was not consistent for the three items. The univariate analyses indicated that subjects in the competitive condition tended to feel more crowded and restricted, but perceived the room to be less confined, than did subjects in the cooperative condition. The main effect for task set upon perceived confinement, however, is further qualified by a marginally significant ($p < .053$) task set-x-sex interaction indicating that females, as compared with males, perceived the room to be relatively more confined in the

cooperative than in the competitive condition. This pattern resembles the task set-x-sex interactions observed for ratings of room size and perceived stuffiness. For items which reflect subjects' appraisal of the physical environment, then, males operating under a competitive set tend to respond in a manner which parallels their subjective ratings of crowding and restriction, whereas females who are competing seem to differentiate more extensively between their feelings of crowdedness and their perceptions of room size, spaciousness, and other aspects of the physical environment.

How can we account for the differential effects of competition upon ratings of the physical environment by males and females? The simplest explanation is based upon two major findings in the present study. First, both males and females in the competitive condition experienced more anxiety, crowding, restriction, and found the game to be less enjoyable than did subjects in the cooperative condition. In other words, all subjects, regardless of their sex, found the competitive condition relatively unpleasant over various dimensions of subjective stress. Second, females perceived the small room as cozy, whereas males, by comparison, evaluated it as stark (see Table 4). That is, females seemed to express greater favorableness toward a small room than did males. From these two observations, it is plausible that the general unpleasantness of the competitive condition may have generalized to ratings of perceived crowding and restriction for both males and females, but there was less assimilation of room-size ratings to the unpleasantness of the situation for females than for males. This interpretation suggests that the different connotations of spatial limitation for males and females may lead the former to attribute their feelings of crowding more exclusively to physical features of the environment, whereas nonspatial sources of perceived crowding may be more salient for females due to their relatively greater favorableness toward smaller quarters. This suggestion is highly speculative, though, and remains to be investigated empirically.

The third hypothesis predicted that females interacting in an

area of limited space would experience less crowding and display fewer manifestations of stress than males in the same situation. This prediction was based upon evidence from Freedman's (1970) study that, under conditions of limited space, the interpersonal relations within female groups were more intimate and friendly than those observed in male groups. Similarly, Ross et al. (1972) found that ratings of self and others were more positive in the small room than in the large room for female subjects. They interpreted their results as indicating that identical perceptions of available space are interpreted differently by males than by females because the sexes differ with respect to their expectations about personal space. Males find the interpersonal distances in the small room to be too close for comfortable interaction, while females find it to be comfortable. Conversely, the large room provides interpersonal distances which are comfortable for males, but not for females. Leibman (1969) has suggested that the socialization of sex role requirements (e.g., independence, psychological distance for males versus dependence, intimacy for females) accounts for the development of different orientations toward personal space on the part of males and females.

The results of the present study add some confirmation concerning the differential effects of limited space on males and females. Although no significant room size-x-sex interactions were found for feelings of crowding, such effects were present for other dependent variable measures. As noted above, females perceived the small room to be cozier and quieter than the large, whereas males perceived the large room as being cozier and quieter. Males rated themselves as more aggressive in the small room, whereas females rated themselves as more aggressive in the large room. Finally, females recalled more names in the small room and males recalled more names in the large room. Taken together, these results suggest that males experience more stress in the small room than in the large; they are more dissatisfied with the physical environment, rate themselves more aggressive, and manifest greater deindividuation (as suggested by the name recall measure). Females, on the other hand, appear to be more comfortable in the small room than in the large one.

With respect to the aggressiveness data, it was observed that subjects rated others as more aggressive in the cooperative condition than in the competitive one. This finding seems somewhat puzzling at first, but becomes more understandable when considered in the context of attribution theory (see Jones and Davis, 1965; Kelley, 1967). Because the task used in this experiment required only one individual to answer a given question, some competition was inevitable in both the cooperative and competitive conditions. The occurrence of such competition in the cooperative condition, though, would have provided a stronger basis for attributing an aggressive disposition to fellow players, since the situation itself had been defined as a cooperative one. In other words, aggressiveness would have been viewed as noncorrespondent with the cooperative structure of the situation. In the competitive situation, though, any aggressiveness on the part of others would have been attributed more to the demands of the situation than to the personal dispositions of others. These results are relevant to the issue of crowding in that they suggest the importance of further exploring the subtle effects of task structure on an individual's reaction to the physical and social environment. This is especially true in light of the numerous experimental effects, attributable to task set, which were observed in the present study on measures of perceived crowding, as well as other dimensions of subjective and behavioral stress.

It should finally be noted that a number of experimenter effects were also found—e.g., on perceived quietness of the room, name recall, and number of jokes. These effects are neither uniquely relevant for understanding crowding nor easily interpretable and will therefore not be discussed. They do add further evidence about the complexity of the determinants of perceptions of the physical environment and their mediation of effects upon social behavior.

Although the results of this experiment did not verify all the specific hypotheses tested, they do demonstrate that social and personal variables mediate the perception of the environment, as well as the experience of crowding. Perceptions of limited

physical space do not always translate into identical feelings of crowdedness; rather, the impact of spatial variables on affect and behavior is determined through an interaction or juxtaposition of physical, social, and personal factors. In this experiment, competition was viewed as a source of social interference in that it implies the necessity of monitoring the behavior of others whose interests conflict with one's own, and thereby makes more salient the need to "keep others at a distance." Similarly, Proshansky et al. (1970) have proposed that social interference leads to the perception of restricted freedom, and, in the context of density, such restriction is perceived as crowding.

The above theoretical positions are compatible with certain perspectives on urban design (Jacobs, 1961; Perin, 1971) which assume that the ill effects of population density can be offset through the utilization of behavioral timing adjustments in order to minimize social interference. Recently, two additional conceptualizations of crowding have been proposed. Freedman (1971) has suggested that the stressful effects of density increase as the number of interacting organisms becomes greater. Also, Desor (1972) has proposed that the perception of crowding is directly related to the level of social stimulation impinging on an individual. With regard to the first position, the present study held group size constant yet still observed differences in perceived crowding attributable to both spatial and nonspatial factors. Concerning the latter perspective, it was impossible to ascertain, in this experiment, whether the increased level of laughter and noise perceived in the small room, competitive condition reflected the absence of crowding, a mode of coping with it, or even a nonspatial source of heightened crowding. Though the pattern of the crowding and restriction means (shown in Table 3) suggests that laughter occurred as a coping response to perceived crowding, it is equally plausible that initially greater laughter in the small room, competitive condition engendered the experience of crowding through the process of overstimulation. Thus, further research is required in order to assess the conceptualization of

crowding as a form of perceptual "overload" (Milgram, 1970; Desor, 1972).

In conclusion, this study suggests two major directions for future research. First, it is necessary to explore more fully the dimensions of stress which overlap with the experience of crowding and to specify more clearly the mechanisms by which perceived spatial restriction and its related symptoms of stress arise. Second, it would be useful to delineate specific behavioral indices of crowding stress, and to state more precisely the conditions under which behavioral responses to the experience of crowding will occur. The latter research task will require further analysis of the temporal or developmental aspects of crowding, and the ways in which people respond to the perception of crowding over time.

NOTES

1. The name recall index was incorporated at the suggestion of Dr. Stephen Worchel as a measure of deindividuation—i.e., a state of affairs in which group members do not relate to each other as individuals qua individuals (Festinger et al., 1952; Singer et al., 1965; Zimbardo, 1969). Pilot tests by Dr. Worchel suggested the utility of assessing deindividuation in terms of the number of names recalled by group members. It was hypothesized that deindividuation would arise under conditions of crowding as a means of making less salient the extreme proximity of fellow group members. Moreover, in line with the findings of previous studies, it was expected that deindividuation would be accompanied by heightened feelings of aggressiveness.

2. The experimenter main effect on name recall was qualified by both room size-x-experimenter and task set-x-experimenter interactions. In both the small and large rooms, subjects recalled more names in the presence of a female experimenter than in the presence of a male experimenter, but this difference was much more pronounced within the large room condition ($F = 4.71$, $df = 1/48$, $p < .035$). Also, in the presence of a male experimenter, subjects participating under a competitive set recalled more names than those playing under a cooperative set, but in the presence of a female experimenter, subjects in the cooperative condition remembered more names than those in the competitive condition ($F = 6.04$, $df = 1/48$, $p < .018$). These interactions are reported for the sake of completeness though they are not immediately relevant to the central concerns of this paper.

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