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THE ENERGIZATION PROPERTIES OF OVERCROWDING

A DISSERTATION

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Abstract

A theoretical explanation for responses to overcrowding is proposed which states that individuals respond to available space (i.e., room density) relative to the amount of space which is considered to be acceptable. Based upon this conceptualization, overcrowding is considered to be a complex aversive stimulus which elicits arousal or drive. The present experiment was designed to determine if overcrowding possesses one of the functional properties of drive, namely, the differential energization of responses with different habit strengths. Performance on a competitional or non-competitional paired-associate list was compared for subjects in crowded or uncrowded rooms. It was hypothesized that crowding would facilitate performance on a non-competitional list and impair performance on a competitional list. Mean differences for measures of trials to criterion, number of correct responses, intrusions, and omissions were in the predicted direction. The data provide support for the arousal interpretation of overcrowding and for the theoretical explanation of responses to overcrowding.

The Energization Properties of Overcrowding

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Although there has been an increasing interest in the effects of overcrowding on behavior in the past few years, relatively few theoretical ideas have been proposed to explain the effects of crowding. It has been assumed that overcrowded conditions are generally aversive in nature, but several researchers have pointed out that the data are quite complex and often seem inconsistent (Duke & Nowicki, 1972; Evans, 1973; Freedman, Klevansky, & Ehrlich, 1971; Freedman, Levy, Buchanan, & Price, 1972; Marshall & Heslin, 1973). Freedman, et al. (1971) concluded that overcrowding is a complex situation and thus it is not an "ordinary aversive stimulus" (p. 24).

Stokols (1972) has pointed out that a distinction can be drawn between density and crowding. Carey (1972) has made a similar distinction. Density is a physical stimulus referring to how many people are present in a given amount of space and, thus, is determined by only two factors (number of people and amount of space). Crowding, on the other hand, is a complex psychological stimulus determined by an individual's perception of the density and can be affected by a great many environmental and subject factors. Any theoretical explanation of responses to overcrowding must take into account this distinction and specify the variables which determine the crowding stimulus.

One possible explanation is that _Ss_ respond to the available space (i.e., density) _relative to_ how much space is considered to be acceptable. "Acceptable space" is conceptualized as an individual's normative expectation for space in a given situation, based upon his past experiences with the cultural norms for space in that or similar situations.[1] In other words, an individual learns from his culture and from his previous experiences how much space is appropriate or acceptable for a given situation. This interpretation is consistent with observations that different cultures require different amounts of space for the same activity (e.g., Hall, 1959). Within this framework, if the available space is less than the space acceptable to an individual, then the situation would be defined as crowded. If the available space is approximately equal to the acceptable space, then the situation is considered uncrowded. Since there will be individual deviations from the "average" cultural norm for space in a given situation, one would expect great variability in crowding data due to the fact that not all _Ss_ will perceive the same density as being equally crowded.

Based upon the interpretation of crowding as determined by the relationship between available space and "acceptable space," it is possible to offer an explanation for the aversiveness of overcrowding by a connection with learning theory. An important concept in learning theory is expectation of reward, which is learned on the basis of previous experience. If acceptable space is defined as a learned expectation concerning spatial norms, then acceptable space can be considered analogous to expectation of reward, since both concepts are a learned expectation concerning a (quantifiable) environmental event. In overcrowding the amount of space available is less than expected. In learning theory, when the amount of reward available is less than expected, the situation is defined as frustrating, which is aversive. If the analogy holds between acceptable space and expectation of reward, then overcrowding is, via definition by analogy, frustrating and hence aversive.

If crowding is an aversive stimulus (albeit a complex one), then it should function in the same way as other aversive stimuli. There is evidence to support this notion. A common principle in learning theory is that Ss will perform an instrumental response which will allow them to avoid an aversive stimulus. If crowding is aversive, then people should avoid it if at all possibe. This has been found to be the case (e.g., Barefoot, Hoople, & McClay, 1972; Carey, 1972; Leibman, 1970; Sommer, 1962).[2] Another common principle in learning theory is that Ss will escape from an aversive stimulus. Given Argyle & Dean's (1965) hypothesis that the psychological distance between people can be functionally reduced in several ways, a variety of behaviors can be considered to be escape from crowding, including physical withdrawal (e.g., Dabbs, 1972; Hall, 1959; Hutt & Vaizey, 1966), decreased eye contact (Argyle & Dean, 1965; Goldberg, Kiesler, & Collins, 1969), increased "territorial" behavior (Altman & Haythorn, 1967), reduced self-disclosure (Jourard & Friedman, 1970), and complete escape from the situation (Ellsworth, Carlsmith, & Henson, 1972; Felipe & Sommer, 1966).

Another effect of an aversive stimulus is that is produces affective arousal. High density has been shown to produce negative affect (Efran & Cheyne, 1973; Evans & Howard, 1972; Griffitt & Veitch, 1971; Marshall & Heslin, 1973; Ross, Layton, Ericson, & Schopler, 1973; Smith & Haythorn, 1972).

Within Hull-Spence theory affective arousal in interpreted in terms of drive. One of the functional properties of drive is that it differentially energizes responses of different habit strengths, with greatest energization of the response with the greatest habit strength, or the dominant response (Brown & Farber, 1968). This energization property of drive has been shown to have predictable effects on task performance (e.g., Spence, Farber, & McFann, 1956).

Some evidence has been provided for this energization effect when space is manipulated (Evans & Howard, 1972; Rawls, Trego, McGaffey, & Rawls, 1972). However, Freedman, et al. (1971) found that density had no effect on task performance. They concluded that density (i.e., crowding) "should not be conceptualized, as many writers tend to, as a drive-inducing stimulus" (p. 24). However, in the tasks employed in those experiments (crossing out numbers, forming words, naming object uses, memory, concentration, and anagrams) it is not clear what the dominant responses are. As Miller and Dollard (1941) have pointed out, it is necessary to know the conditions of learning in order to predict performance. Therefore, unless a task is used in which the dominant response is (empirically) known, the drive hypothesis of overcrowding cannot be adequately tested. In a later article, Freedman, et al. (1972) concluded that "crowding tends to intensify or emphasize typical responses to a situation" (p. 545), which is consistent with a drive or arousal interpretation.

The purpose of the present experiment is to test the hypothesis that crowding functions as an aversive stimulus and produces arousal, by using a task which has been shown to be quite sensitive to differences in drive level. The classic paired-associate list first used by Spence, Farber, and McFann (1956) has proved to be a sensitive measure of the energization effects of anxiety (Spence, Farber, & McFann, 1956; Spence, Taylor, & Ketchel, 1956; Standish & Champion, 1960), both agreeing and disagreeing attitude statements (Davis & Lamberth, in press; Lombardo, Libkuman, & Weiss, 1972), cognitive dossonance (Waterman, 1969), and social facilitation (Cottrell, 1968). If energization effects can be demonstrated, then the data would provide clear support for the conceptualization of overcrowding as an aversive stimulus which increases arousal level. It would also provide support for the idea that Ss respond to density in relation to "acceptable space" norms.

It is predicted that, on a non-competitional list of word pairs in which the correct response is dominant, crowded conditions will facilitate performance relative to an uncrowded control group.

On a competitional list of word pairs, in which the incorrect response is dominant, crowded conditions would show poorer performance than an uncrowded control condition. In other words, it is predicted that there will be an interaction between list difficulty and density (i.e., level of crowding).

Method

Subjects and design. Subjects were 88 male introductory psychology students at the University of Oklahoma who were required to participate in experiments as part of the course credit. The experimental design was a 2 X 2 factorial, with 2 levels of paired-associate list difficulty and 2 levels of density. Ss participated in groups of 11 with each experimental condition replicated once.

Two experimental rooms, nearly identical in all respects except for size, were employed. The only feature about the rooms which differed was that the large room had gold walls with green curtains covering the windows while the small room had green walls with gold curtains. Twelve straight back chairs facing the same direction were evenly spaced throughout the room in a matrix of four columns and three rows. The E sat in the far right chair in the back row for all groups.

According to the theoretical ideas proposed above, it is necessary to have some estimation of how much space is acceptable for a given situation in order to designate a room as uncrowded.

Since the experimental situation and rooms were similar to a classroom setting, the spatial norms for classrooms were considered to be reasonable approximations of the acceptable space norms for this experimental setting. Several classrooms were measured, and the densities ranged from approximately 11 to 13 square feet per chair (excluding the area in front of the rooms by the blackboard). Therefore, a room which allowed 12.61 square feet per person was chosen for the uncrowded (large) experimental room; it measured 11.50' X 13.16'. The crowded (small) room measured 7.16' X 8.23', allowing 4.91 square feet per person. Since other data has suggested that the proportions of a room affect perception of crowding (Daves & Swaffer, 1971; Desor, 1971), the proportion of length to width was 1.15 : 1 for both experimental rooms.

As indicated above, the paired-associate lists used by Spence, Farber, and McFann (1956) have been shown to be sensitive to arousal level. Therefore, the paired-associate lists employed were taken from those used by Spence, Farber, & McFann. The difficult or mixed list was virtually the same as that used by Spence, Farber, and McFann in their Experiment II. This list was taken from the Haagen (1949) word list and contained four non-competitional pairs and eight competitional pairs. Twelve non-competitional pairs taken from the list used by Spence, Farber, and McFann in their Experiment I constituted the non-competitional or simple list (see Table 1). This list contained the four non-competitional pairs from the mixed list and eight other

Insert Table 1 about here

non-competitional pairs. In order to control for any serial-position effects which might occur, three random orders of each list were employed with three restrictions: (1) no pair could occupy the first or last position in more than one order; (2) no two pairs could appear adjacent in the same sequance on two orders of the list; (3) the non-competitional pairs in the mixed list occupied the same positions in the three orders as the same pairs in the non-competitional list. In addition, remaining pairs were "yoked" so that any given competitional pair in the mixed list occupied the same position on all three orders as its yoked non-competitional pair in the non-competitional list.

Apparatus. The words were presented by a Kodak Carousel 800 series slide projector in the middle of the wall in front of the Ss (i.e., between the two middle columns of chairs). The projector sat on a shelf mounted on the back wall. The projector was modified so that it would accept two Hunter Decade interval timers as external timing devices. On timer controlled the anticipation interval while the other controlled the feedback interval.

Although the usual paired-associate procedure employs spoken responses, the fact that Ss participated in groups made such a procedure inappropriate. Therefore, responses were written in response packets which contained 12 lines per answer sheet plus background information on the front sheet. Response packets were attached to clip boards which Ss held on their laps while writing.

Procedure. Since the procedure in the present experiment involved changes from the typical procedure in paired-associate learning tasks, pretesting was done in order to determine if the procedural changes affected the results of this type of experiment. Pretest _Ss_ were selected on the basis of Manifest Anxiety Scale (MAS) scores; high anxious _Ss_ were from the highest 20% and low anxious _Ss_ were from the lowest 20% of the distribution of 300 pretest _Ss_. The _Ss_ were run individually with written responses or in groups of 5-11 with written responses. Trends in the pretest data were comparable to the results found by Spence, Farber, and McFann (1956) with high and low MAS score _Ss_.

Based on individual pretesting, the anticipation interval was set at 2.67 sec. to allow for production time involved in written responses. Feedback interval was 2.33 sec. The inter-trial interval was 5.00 sec. except for every third trial, when it was necessary to allow a 10.00 sec. interval in order to accommodate the 80 slide tray and still maintain synchronization of timers.

After _Ss_ were seated in the experimental room, they were instructed to write their responses to the stimulus word on the answer sheets, and to turn the page to the next answer sheet during the inter-trial interval. _Ss_ were also instructed to stop writing when the slide changed (to the feedback slide) even if they were not finished writing a word. Twenty trials were given to all _Ss_ because pretest data indicated that a criterion of two successive perfect trials was met by almost all _Ss_ within 20 trials.

Scoring procedure. Since written responses were employed, it was necessary to set a criterion for a correct response. The criterion used was that a maximum of one letter could be missing in order for a response to be considered correct. Thus, "headstron" or "duble" were counted as correct while "headstr" or "doub" were not. Also, if a response was competely illegible, it was counted as incorrect.

Results and Discussion

Inspection of the number of correct responses over trials revealed that a surprisingly high proportion of Ss in the mixed list conditions failed to achieve the expected two successive perfect trials within 20 trials. Several Ss in the Crowded-Mixed list condition failed to show a learning curve. In addition, debriefing indicated that several Ss in the various conditions did not understand the instructions. Therefore, Ss who did not understand instructions or who failed to show a learning curve were eliminated from the analysis. Since eight Ss were eliminated from the Crowded-Mixed list condition for one or both of the above reasons, the necessary number of Ss were randomly eliminated from the other experimental conditons in order to obtain equal N's (14) for analysis. Since some Ss still remained who did not achieve even one perfect trial in 20 trials, the criterion for analyses was set at 11/12 correct responses in a given trial in order to include 56 Ss in the final analyses.

Trials to criterion. At an overall level, mean trials to the criterion of 11/12 correct responses indicated that the differences between the crowded and uncrowded groups are in the predicted direction for both lists (see Table 2). As indicated in Table 3,

Insert Table 2 about here

the test for the list effect was significant, with fewer trials required to meet criterion for the non-competitional list than for the mixed list.[3] The List X Density interaction was very close to

Insert Table 3 about here

significance ($p = .06$). Since the direction of the differences between means was predicted, planned comparisons were performed between the crowded and uncrowded group means for the two lists, with the Type I error rate controlled per comparison (Kirk, 1968, p. 73). The Crowded-Non-competitional groups required significantly fewer trials to reach criterion than the Uncrowded-Non-competitional groups ($\underline{t} = 2.00$, $df = 26$, $p < .05$). Mean trials to criterion for the Uncrowded-Mixed groups were not significantly lower than for the Crowded-Mixed groups ($p = .22$). The lack of significant differences in the mixed list obviously accounted for the lack of a more significant List X Density interaction, although differences between the means are in the predicted directions.

Number correct. Figure 1 indicates the pattern of performance

Insert Figure 1 about here

in mean number (per cent) of correct responses over blocks of two trials for the various experimental conditions. Since all groups approached asymptote on trials 11-12, the number of correct responses were analyzed over trials 1-10 only in a 2 X 2 X 5 analysis of variance, with the latter factor a repeated measure of blocks of two trials. Although the List X Density interaction showed only a slight trend toward significance ($p = .17$), planned comparisons on blocks of trials indicated a pattern of significance suggested in Figure 1. On the non-competitional list, the crowded groups performed better than the uncrowded groups ($\underline{t} = 1.46, 1.52, 1.52$ on trials 5-6, 7-8, 9-10 respectively, df = 26, $p < .08$). On the mixed list, the uncrowded group was superior to the crowded group early in learning as predicted (on trials 3-4, $\underline{t} = 1.52$, df = 26, $p = .07$). No other significant differences occurred between densities on the mixed list.

<u>Errors</u>. Intrusion errors and omission errors were also analyzed in a 2 X 2 X 5 analysis of variance. On the analysis of intrusions over blocks of two trials, the List X Density interaction approached significance ($\underline{F}$, 1, 52 = 3.26, $p = .07$). Table 4 gives mean intrusion errors over blocks of two trials. Planned comparisons

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Insert Table 4 about here

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indicated that the Uncrowded-Mixed groups made significantly fewer intrusions than the Crowded-Mixed groups early in learning as predicted (trials 1-2, $t = 2.34$, df = 26, $p < .025$; trials 3-4, $t = 4.05$, df = 26, $p < .001$). On the non-competitional list there were no significant differences between the crowded and uncrowded groups. On the analysis of omission errors over trials the List X Density interaction was nonsignificant. Table 5 gives mean omission

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Insert Table 5 about here

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errors over blocks of two trials. However, planned comparison tests on the non-competitional list indicated that the crowded groups made fewer omissions than the uncrowded groups on trials 1-2 and 9-10 ($t = 2.19, 1.70$, df = 26, $p < .025, .05$ respectively). No significant differences occurred between the crowded and uncrowded groups on the mixed list.

While overall measures of responding do not show highly significant interactions between the List and Density variables, the pattern of significant values on individual comparisons tests suggests that the data do follow the predictions made. On the measures of correct responses the Crowded-Non-competitional groups are superior to the Uncrowded-Non-competitional groups throughout learning as predicted. Also, the Uncrowded-Mixed groups are superior to the Crowded-Mixed groups as predicted. Moreover, the long (10 sec.) inter-trial interval after every third trial probably attenuated differences between the crowded and uncrowded groups by providing sufficient time for rehearsal of unrecalled responses, especially for competitional pairs in the mixed list conditions. Thus, these data serve to support the hypothesis that crowding functions as a drive variable.

While the pattern of intrusion and omission errors for the two lists is complex, these data are also consistent with theoretical predictions based upon the interpretation of crowding as arousing. Since in the mixed list there is a great deal of competition among the responses and stimuli, the dominant response to a stimulus in a competitional pair of words will be another word which is initially highly associated with that stimulus but which also appears on the list. Therefore, emission of the dominant response to such a stimulus not only will be an error but an intrusion error. For example, the words in the list which are initially highly associated with the stimulus word "serene" are the stimulus words "tranquil" and "quiet" and the response word "placid." If crowding serves to energize the dominant response, then the response elicited by "serene" will tend to be a stimulus intrusion ("tranquil" or "quiet") or a response intrusion ("placid"). Therefore, in the Crowded-Mixed groups, arousal tends to produce responses which are highly associated but which are incorrect and, specifically, are intrusions. In short, errors in the mixed list conditions will tend to be intrusion errors (rather than omission errors) and, hence, increased arousal level should produce more intrusion errors in the mixed list conditions. As indicated above, the Crowded-Mixed groups made significantly more intrusion errors than the Uncrowded-Mixed groups early in learning with no differences between the groups in intrusions on the non-competitional list.

The pattern of errors on the non-competitional list should be different from the mixed list. The response words on the non-competitional list are initially highly associated with the stimulus words. If a S cannot think of the correct response when the stimulus word appears, then the tendency will be to emit no response at all. That is, relatively few errors will be made on this list because the dominant response is the correct response, but when errors are made they will tend to be omission errors because any other response word would be less highly associated than the correct word. This pattern of data was obtained. As indicated above, the Uncrowded-Non-competitional groups made significantly more omissions than the Crowded-Non-competitional groups while no differences in omissions occurred between the groups on the mixed list.

Thus, the significant differences in the predicted directions on trials to criterion and the measure of correct responses, significant differences between densities for intrusions on the mixed list only and for omissions on the non-competitional list only all lend clear support for the hypothesis that crowding functions as a drive variable and produces affective arousal. By implication, then, these data support the idea that Ss respond to density (i.e., available space) relative to their individual norms for how much space is acceptable in a given situation.

This explanation for the effects of overcrowding seems quite useful for several reasons. First, it offers an explanation of the aversive nature of crowding in terms of an individual's learning experience. Such a connection with learning theory should prove useful since learning theory (broadly conceived) can provide paradigms for research on how crowding might function as an aversive stimulus. In addition, learning principles may provide explanations for the relationships between environmental events, spatial norms and behavior (e.g., the interpretation of crowding as frustrating). A second advantage of the explanation of crowding effects in terms of acceptable space norms is that it considers crowding as a relative stimulus and thus suggests future research on the variables which affect the perception of crowding. Finally, the conceptualization of crowding in terms of acceptable space norms obviously indicates a straightforward relationship between overcrowding and personal space. Crowding, then, is seen as a special case of spatial behavior rather than an isolated phenomenon, with the implication that it is necessary to specify the relationship between all aspects of spatial behavior and to search for integrating principles. In addition, the consideration acceptable space suggests the questions of what variables determine acceptable space and how these variables combine.

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Footnotes

1. When one considers only the space surrounding an individual as being adequate or inadequate, "acceptable space" is equivalent to the concept of personal space.

2. Since Little (1965) defined overcrowding as a situation in which an individual's norms for interpersonal distance (and, hence, personal space) are violated due to high population density, violation of personal space by just one other person can be considered to be _functionally_ a crowding situation.

3. The list effect was highly significant in analysis of all other measures.

Table 1

Pairs of words used in the mixed and non-competitional lists.

Mixed List		Non-competitional List	
tranquil	placid	tranquil	placid
gypsy	opaque	pious	devout
undersized	wholesome	stubborn	headstrong
quiet	double	wicked	evil
arid	grouchy	insane	crazy
little	minute	little	minute
petite	yonder	frigid	arctic
desert	leading	adept	skilful
barren	fruitless	barren	fruitless
migrant	agile	distant	remote
serene	headstrong	mammoth	oversize
roving	nomad	roving	nomad

Table 2

Mean Trials to Criterion

Room Density		List: Mixed	List: Non-competitional
Crowded	$\bar{X}$	10.57	4.14
	SD	3.79	1.45
Uncrowded	$\bar{X}$	9.64	6.57
	SD	3.33	3.33

Table 3

Analysis of Variance for Trials to Criterion

Source	df	MS	F
List (A)	1	315.88	30.31 *
Density (B)	1	7.88	<1
A X B	1	39.44	3.78**
error	52	10.41	

* $p < .0001$
** $p = .06$

Table 4

Mean Number of Intrusions

Room Density	Blocks of 2 Trials				
	1-2	3-4	5-6	7-8	9-10
	Mixed List				
Crowded	2.28	2.57	1.25	.96	.39
Uncrowded	1.39	1.03	1.07	.92	.32
	Non-competitional List				
Crowded	.92	.21	.03	.03	.00
Uncrowded	.42	.35	.35	.42	.10

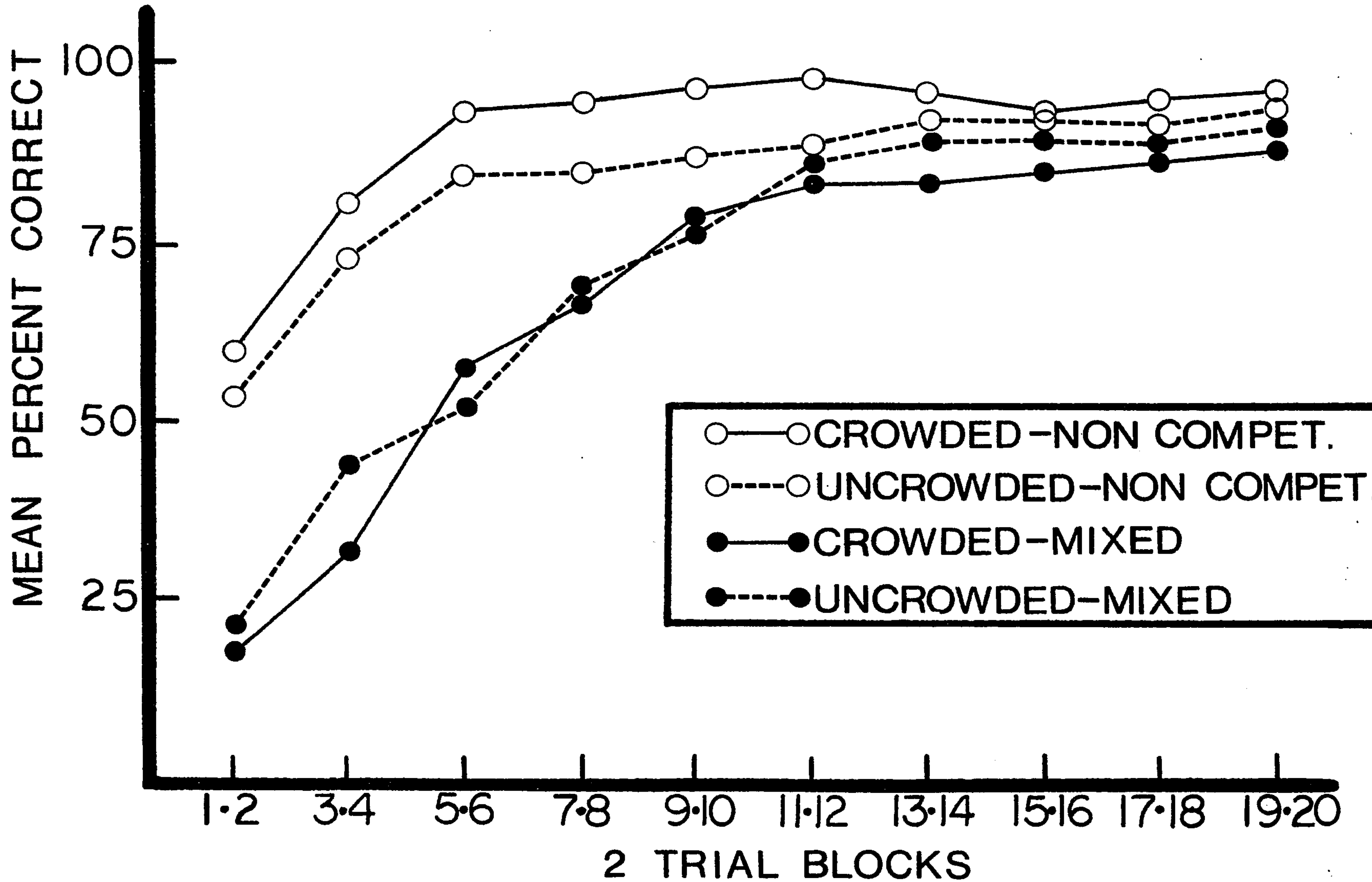
Table 5

Mean Number of Omissions

Room Density	Blocks of 2 Trials				
	1-2	3-4	5-6	7-8	9-10
Mixed List					
Crowded	7.35	5.14	3.78	3.10	2.17
Uncrowded	8.00	5.53	4.14	2.82	2.42
Non-competitional List					
Crowded	3.92	2.03	.96	.46	.22
Uncrowded	5.28	2.78	1.75	1.17	1.28

Figure Captions

Figure 1. Mean percent of correct responses over blocks if 2 trials for different combinations of list difficulty and room density.



MEAN PERCENT CORRECT
100
75
50
25
CROWDED-NON COMPET.
UNCROWDED-NON COMPET.
CROWDED-MIXED
UNCROWDED-MIXED
1·2
3·4
5·6
7·8
9·10
11·12
13·14
15·16
17·18
19·20
2 TRIAL BLOCKS

APPENDIX A

PROSPECTUS

A Social Learning Theory of Overcrowding

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Abstract

At present there is no theory of human spatial behavior which adequately integrates the data and precisely specifies the relationships between overcrowding, personal space, interpersonal distance and territory. The present paper proposes a social learning theory of overcrowding which fills this important gap. It considers overcrowding to be a special case of spatial behavior in which the available space is less than what is acceptable. This distinction between the physical aspects of overcrowding (i.e., available space) and the psychological aspects of overcrowding (i.e., acceptable space) forms the basis for a social learning interpretation of the aversive nature and the behavioral consequences of overcrowding. The literature on crowding is explained and integrated in terms of the theory. Finally, some of the major predictions and research strategies flowing from the theory are discussed.

A Social-Learning Theory of Overcrowding

John Haller

A. Spatial Behavior: Concepts

1. Territory
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3. Interpersonal Distance
4. Overcrowding

B. A Theory of Crowding

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A Social-Learning Theory of Overcrowding

John Haller

University of Oklahoma

Although a very large literature on human spatial behavior is beginning to develop, only a relatively small portion of the literature deals specifically with overcrowding. An equally small portion of the overcrowding literature is adequately controlled experimental research. Yet the most notable characteristic of the literature on overcrowding is the lack of a theory which can integrate the data available or, perhaps even more important, guide further research toward an adequate understanding of responses to overcrowded conditions. This paper attempts to fill this important gap by proposing a theory of overcrowding that can integrate much crowding data and can also be a source of prediction and guidance for future research.

First, the main concepts related to spatial behavior and overcrowding will be discussed so that their nature and definitions can be made quite clear. Then the theory of overcrowding proposed here will be discussed in detail and some of its major implications will be pointed out. Finally, some of the predictions derived from the theory and the strategies for future research suggested by the theory will be discussed.

A. Spatial Behavior: Concepts

Throughout the literature on human spatial behavior there exists a rather distressing confusion of the concepts of territory, personal space, interpersonal distance, and overcrowding. They are often used interchangeably. Since these separate and separable concepts represent the main aspects of the use of space, it seems essential to clarify their meaning.

Territory

The concepts of territory and territorial behavior have come from the ethological literature. Since Howard (1920) provided the first systematic presentation of territory, the concept has been used to explain the spatial behavior of a great many species, including primates and man (e.g., Ardrey, 1966; Burt, 1943, 1949; Carpenter, 1934, 1958, 1964; Ellefson, 1968). Howard (1920) first defined territory as the place in which an animal spends most of its time and which is defended against intruding conspecifics. Based upon this definition, a wide variety of criteria have been employed for determining whether or not a given species is territorial. The diverse criteria for territorial behavior have led several researchers to the conclusion that the notion of territoriality has been greatly overapplied (e.g., Burt, 1943; Carpenter, 1965; DeVore & Hall, 1965; Ellefson, 1968; Mason, 1968). Carpenter (1965) has suggested that some behaviors which at first appear to be territorial can be better explained by Burt's (1943) concept of home range. Ellefson (1968) has suggested a more restricted definition of territory as a tract inhabited and defended exclusively by one group. He has pointed out that, by this definition, relatively few primate species are clearly territorial, and that describing a behavior as territorial may be quite misleading. According to the criteria for territoriality (Burt, 1943; Carpenter, 1965; Ellefson, 1968; Mason, 1968), man is not strictly territorial, because he does not inevitably defend a specific portion of his home range against all intruding conspecifics with ritualized threat and aggression. Moreover, a home does not serve all the same functions that a true territory does (e.g., Burt, 1949; Carpenter, 1958).

It should be noted that, although humans may not be territorial in the strict sense, a great many human behaviors are related to territorial behavior. For example, a person who is accustomed to sitting in a particular chair at home or at an office or in a classroom may feel frustrated or hostile if another person "invades the territory" by sitting in the chair. Strong social and legal sanctions against the invasion of an individual's private property are obviously related (functionally) to territoriality. Such behaviors could be termed "quasi-territorial."

Personal Space

Personal space is a second major concept related to human spatial behavior. It is usually described as the area surrounding a person, outside of which most social interaction occurs. Little (1965) conceptualized personal space as a fluctuating globe surrounding the person. Sommer (1959) pointed out that the area encompassed by personal space varies with environmental conditions. In fact, almost all research on human spatial behavior has revolved around this point by attempting either to measure or manipulate changes in personal space.

Sommer (1959) has also made a well-known distinction between territory and personal space; namely, that a territory is a fixed geographic spot while a person carries his personal space around with him. Moreover, Sommer points out that the reactions to invasion of the two areas are exactly opposite: invaders are driven out of the territory while invasion of personal space results in retreat. Another important distinction is that while humans do not have territory *per se*, they most definitely have a personal space surrounding them.

Interpersonal Distance

Perhaps the greatest confusion in the literature on spatial behavior is between the concepts of personal space and interpersonal distance. Personal space refers to the area surrounding a person which others may not enter. Interpersonal distance refers to the distance which a person prefers to keep between himself and another individual in a given situation. Hediger (1955) has distinguished between flight distance, social distance, and individual or fight distance in non-humans. Interpersonal distance in humans has some of the characteristics of each of these concepts. For example, most people will "flee" if an intruder comes closer than their preferred interpersonal distance. Social distance is the average distance maintained by conspecifics; the average interpersonal distance for a group of people is analogous to this. If individual or fight distance is violated in non-humans, the animal will fight to drive away the intruder; extreme violation of interpersonal distance in humans may, in some cases, result in a "fight" or dominance display (e.g., eye contact, verbal statements, physical aggression, etc.) intended to drive away the intruder.

The distinction between interpersonal distance and personal space is implied by the labels: interpersonal distance is a linear distance, while personal space is a three-dimensional space. Figure 1 indicates the relationship between personal space and interpersonal distance. Figure 1a shows that two people (with the same personal

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Insert Figure 1 about here

----

space) will position themselves at the perimeter of each other's personal space area.[2] The distance between them is their interpersonal distance. Figure 1b indicates that if the personal space areas for two individuals are unequal, then one individual will invade the personal space of the other. Person A attempts to stand close enough to person B so that B will be on the perimeter of his personal space. Since B's personal space is larger than A's, A is invading the personal space of B. The interpersonal distance will be too short for person B and he will typically withdraw (e.g., Hall, 1959, 1966).

Overcrowding

A fourth major concept related to spatial behavior is overcrowding. Overcrowding is clearly related to territory, interpersonal distance and, especially, personal space. Simply stated, overcrowding is a situation in which people (or animals) do not have enough space. Little (1965) implied this in his statement of the relationship between crowding and interpersonal distance: "Crowding (is) a situation in which the population density reaches a point where individual distances can no longer be held inviolate" (p. 237). A more consistent formulation deals with the relationship between crowding and personal space, since both concepts refer to an area. Overcrowding is a situation in which personal space is violated. This situation can be a result of high population density. In addition, invasion of personal space be even one person can also be conceptualized as a crowding situation. However, even a broad definition of overcrowding as a situation in which personal space is violated would still appear to be inadequate.

A rather far-fetched example may make the point clear. It is possible to conceive of a hermit living in the wilderness as being crowded if the cabin he lives in is so small that he is uncomfortable. Such an example is obviously related more to the concept of "territory" than personal space per se. That is, if crowding is a situation in which an individual does not have enough space, that situation can be brought about in more than one way. High population density is one way to cause overcrowding. The simple restriction of available space is another. Since it is meaningful to discuss overcrowding with only one person present, the notion of space in crowded conditions has its own significance, quite apart from the presence of others implied in the term population density. This distinction between space and population density will be discussed in detail in the description of the theory. The main point is simply that crowding is best defined as a situation in which an individual does not have enough room. Moreover, this definition implies that the space available for an individual's personal space _or_ "territory" is not large enough in an overcrowded situation.

One final note concerning population density is in order. It has been pointed out that high density can be either aversive or non-aversive (e.g., Freedman, Klevansky, & Ehrlich, 1971). The population density at a crowded party is extremely high, but the situation is not aversive. On the other hand, a family of eight living in a one room apartment is certainly an aversive situation. Researchers do not seem particularly interested in the first situation but they are interested in the latter. Thus, it is implicit in the present discussion (as it is in most crowding research) that overcrowding refers specifically or an aversive situation. Non-aversive, high density situations are not _psychologically_ overcrowded.

B. A Theory of Overcrowding

In the past few years several theoretical ideas have been proposed to explain spatial behavior, such as adaptation level theory (Patterson, 1968), level of social stimulation (Desor, 1972), equilibrium in psychological distance (Argyle & Dean, 1965), general systems theory (Pederson & Shears, 1973), and a cognitive view of personal space (Evans & Howard, 1973). Duke and Nowicki (1972) have proposed a social-learning model for interpersonal distance based upon the social learning theory of Rotter (1954, 1966). They have proposed that locus of control (i.e., external vs. internal) mediates the use of space, and they provide empirical support for their model. While the present theory would also be classified as a social learning theory, it differs from Duke and Nowicki's conceptualization. The present theory is more concerned with external stimulus cues and their relationships to the responses which are associated with those cues, based upon past experience. The main focus is on the way in which external stimulus cues combine to form a mediating response (i.e., personal space) and how this mediating response, in turn, determines behavior. Moreover, the present theory is concerned primarily with explaining overcrowding. Since personal space is obviously related to overcrowding, explanations of personal space will be a necessary by-product but not the main focus of the theory.

Any theory of crowding must do several things. It must maintain the logical, internal consistency required of all theories. It must explain the aversive nature of overcrowding, and also why crowding is aversive in some cases and not in others. Finally, a theory of overcrowding must explain and predict how and why crowding affects behavior. The present theory seems to serve each of these functions.

Theoretical Concepts

Stokols (1972) has pointed out that there is a necessary distinction to be made between density and crowding. Carey (1972) has made a similar distinction. Density is a physical stimulus referring to how many people are present in how much space. Crowding, on the other hand, is a stimulus which is determined by a person's perception of the density and, hence, can be affected by a great many environmental and subject factors. Thus, the physical aspects of crowding are different from the psychological aspects. At the same time, there is some correlation between them, since very few people would feel crowded when they are standing atop Mount Everest, and very few people would feel that they were surrounded by vast expanses when in a New York subway at rush hour. It seems that the best way to view overcrowding is to consider physical space <u>in reference to</u> psychological space. From this viewpoint, then, a given level of density could be viewed as crowded with reference to one person but not crowded with reference to another. In the present theory the term "available space" will refer to the physical dimension of density while the term "acceptable space" will refer to the psychological dimension of crowding.

Available Space

Since available space refers to a physical variable, it is quite easily conceptualized and defined. It is a function of the physical space available and the number of persons present. Thus, population density can be expressed in terms of square feet per person.

Acceptable Space

The meaning of the term acceptable space is perhaps best approached initially from an intuitive standpoint. It is quite easy to conceive of a certain amount of space for a given activity as being acceptable or unacceptable. If the amount of available space is the right amount for a given activity, then that space is acceptable. If the amount of available space is too large or too small, then the available space is unacceptable. The concept of acceptable space encompasses both personal space and "territorial space." If only the immediate area surrounding an individual is being considered, personal space and acceptable space are equivalent terms. If only a fixed geographic area is being considered, "territory" and acceptable space are equivalent terms.

Two points concerning acceptable space are obvious. The first point is that the intuitive definition offered is not adequately rigorous for purposes of scientific theory or research. Second, it is quite obvious that how much space is acceptable will vary from situation to situation and from individual to individual.

The question of a more rigorous definition of acceptable space is perhaps best answered in a somewhat indirect way. As pointed out above, Hall (1959, 1966) has observed cultural variations in the amount of personal space. The implication is that an individual learns how much space he should maintain through (often very subtle) experiences with the cultural norms. The important point is that an individual learns how much personal space he should have. Since personal space is a subset of acceptable space, then it follows directly that an individual learns how much space is acceptable. Translated into psychological terms, this means that acceptable space is a learned response. More specifically, acceptable space is a learned response which has behavioral consequences.[3]

Several writers have considered the concept of expectancy in discussions of personal space. Sommer (1969) has described personal space as a "normative expectation" about how much space is appropriate or acceptable for a given situation. Ross, Layton, Ericson, and Schopler (1970) discuss personal space expectations. Duke and Nowicki (1972) note that: "In social learning theory it is the situation as a complex set of cues which provides for the elicitation of the expectancies" (p. 128). They then relate personal space and locus of control as a generalized expectancy. It is suggested here that expectation (i.e., a learned response) is quite appropriately applied to the concept of acceptable space. Based upon this application it is now possible to state a rigorous definition: acceptable space is a learned expectation concerning spatial norms, which has behavioral consequences. Thus, it is possible to discuss in both the everyday sense and the psychological sense how an individual expects that a certain amount of space is acceptable for a given situation. If the available space matches the acceptable space, then certain behaviors occur. If the available space does not match the acceptable space, then certain other behaviors occur.

A second point mentioned regarding acceptable space is that it will vary from situation to situation and from individual to individual. This, of course, is the nature of a psychological variable. The question then becomes: What factors determine this variability and what are the relationships involved? At least five variables can be seen to affect acceptable space: functional space, presence of others, activity, time, and personality characteristics

Functional space. This term refers to how much space is functionally available to an individual. It does not necessarily have a one to one correlation with physical space, because it can be affected by such variables as furniture arrangement (Mehrabian, 1968), partitions in the area (Desor, 1972), eye contact (Argyle & Dean, 1965), body orientation (Horowitz, Duff, & Stratton, 1964), and even the proportions of the room (Daves & Swaffer, 1971; Desor, 1972). Available space is not affected by these variables. Functional space can be considered as a continuum, with each determining variable increasing or decreasing the space functionally available. For example, people sitting back to back on a bench in a train station functionally have more space than if they were facing each other. Whether a variable increases or decreases the functional space and the strength of the effect are empirical questions. One of the main concerns in studies of personal space and crowding should be the evaluation of such effects.

Psychological presence of others. This term refers to the psychological impact on an individual of the people around him. (The number of others present is considered in the measurement of available space.) At least three variables determine whether the presence of others increases or reduces the available space: the individual's attraction toward them, the sex of the other persons, and the evaluation potential of the other persons. A consistent finding in spatial research is that people maintain closer distances with liked others than with disliked others (e.g., Byrne, Baskett, & Hodges, 1972; Byrne, Ervin, & Lamberth, 1970; Duke & Nowicki, 1972; Holahan & Levinger, 1971; Little, 1965; Little, Ulehla, & Henderson, 1968; Mehrabian, 1968). In terms of the present theory, there is an inverse relationship between a person's attraction to another and his acceptable space (i.e., space required). Data on sex effects show that acceptable space is greatest for subjects in male-male situations, smaller for female-female situations, and least for heterosexual situations (e.g., Duke & Nowicki, 1972; Hartnett, Bailey, & Gibson, 1970; Hiat, 1971; Leibman, 1970; Meisels & Guardo, 1969). Zajonc (1965) suggested that social facilitation effects function to increase drive and thus to differentially energize responses with different habit strengths, with the greatest energization of the response with the greatest habit strength. It has been shown that social facilitation effects occur only when the others present have potential for evaluating the S (as perceived by the S), and that mere presence of others is insufficient to produce social facilitation (Cottrell, 1968; Martens & Landers, 1972). Thus, social facilitation effects can be seen as an important source of arousal in crowded conditions if the others present are perceived as evaluators. In the present theory, social facilitation would function by increasing the psychological presence of others and thus increasing the amount of acceptable space, resulting in a perception of greater crowding.

Activity. This variable is one of the most clear-cut determinants of whether or not a situation is overcrowded. For example, the space in an area 12' X 25' is much too small for some activities but much too large for others. Thus, acceptable space will vary with the activity involved. A distinction can be made between coaction and interaction, with some evidence to suggest that acceptable space is larger for coaction than interaction (Desor, 1972; Sommer, 1965).

Time. This factor is most closely related to adaptation to overcrowded conditions. Haller and Lamberth (1973)[4] have suggested that extremely crowded conditions in a laboratory may at first be novel to Ss; after they adapt to the novelty of the stimulus, crowded conditions become aversive. Altman and Haythorn (1967) found an increase in "territorial" behavior over a 10 day period, and Smith and Haythorn (1972) found a greater crowding effect after the first nine days of isolation. On the other hand, people who live in crowded conditions may adapt to the surroundings after some time period so that the crowding would become less aversive. It has been shown that people can adapt to other environmental stressors (e.g., Glass, Singer, & Friedman, 1969; Wilkinson, 1969). In this type of adaptation there would be a decrease in acceptable space norms over time, although if the crowding is severe, acceptable space would probably still be greater than the available space even after adaptation. Moreover, data on generalized resistance to stressors (Terris & Rahhal, 1969) suggest that adaptation to overcrowding in one situation may facilitate adaptation to crowding in another situation, possibly by decreasing the individual's norm for acceptable space. It is important to determine the functions relating, time, acceptable space, and reactions to overcrowding.

Personality characteristics. Personality variables will certainly have some effect on an individual's norm for acceptable space, although the relationships must be determined empirically. For example, sex differences affect acceptable space and thus perception of crowding. In the case of some personality characteristics it is possible to hypothesize what the relationship with acceptable space will be (e.g., high authoritarians maintain a larger personal space than low authoritarians, Frankel & Barrett, 1971; high test anxious Ss maintain a larger personal space than low test anxious Ss, Karabenick & Meisels, 1972), while in the case of other characteristics (e.g., IQ) the direction and explanation of the relationship would be considerably more obscure without data.

Composition Rules

Given the theoretical concepts of available space and acceptable space and a specification of what variables determine them, it is necessary to state a composition rule which determines how these stimuli combine to affect behavior. A straightforward proportion rule is proposed, which states that the crowding response is a function of the ratio of available space to acceptable space:[5]

$$R_{crowding} = f \ \frac{\text{available space}}{\text{acceptable space}}$$

If the available space is less than the acceptable space, then the ratio is less than 1 and the situation is, by definition, crowded. An uncrowded condition refers specifically to the case where the available space equals the acceptable space and the ratio is equal to 1. If the available space is greater than the acceptable space, then the ratio is greater than 1. Thus, this model can be viewed as a general model for spatial behavior, in which overcrowding is seen to be a special case where the ratio in the model is less than 1. Since the purpose of the theory is to explain overcrowding, most of the remainder of the discussion will be restricted to the case in which the ratio is less than or equal to 1.

In addition to specifying composition rules for the central concepts of available and acceptable space, it is also necessary to specify rules which state how their determining variables combine. In the case of available space, the rule has already been stated as the ratio of space to the number of people, expressed as square feet per person. In the case of acceptable space the rules are more complex and less certain. At this point in time only the strategies for possible composition rules will be indicated. Since the principles governing the elementary processes of functional space, psychological presence of others and activity are probably not separate and independent, a hierarchical formulation for the organization of the simple processes is preferred. Thus, a functional space per psychological persons ratio could be formed on the basis of a psychophysical-like conception of these variables. For example, physical space with a certain architectural feature could be translated into functional space without the feature. Thus, if a barrier functionally doubles the available space, then the functional space could be "measured" as twice the available space. The same technique could apply to the other variables which determine acceptable space. Given such a rule for the combination of functional space and psychological presence, this ratio would then be modified by the activity in the situation. Rules for these combinations will clearly be complex. Strategies for composition rules at this point are obviously speculative and precise statement of rules will probably have to await normative data on acceptable space.

Implications

Since this ratio rule for available space to acceptable space is the essence of the theory, it is important to note the ways in which it can integrate the various concepts related to overcrowding. This model considers available space in relation to acceptable space, and thus intrinsically implies that overcrowding is a relativistic concept. The ratio rule implies that the proportion of available space to acceptable space is the effective stimulus for determining the perceived magnitude of overcrowding and, ultimately, the individual's response to overcrowding: the smaller the proportion the greater the crowding.

This conception of the proportion of available space to acceptable space as the effective stimulus can be best be amplified in another way. According to the overcrowding concepts described above, the model implies that crowding can be achieved in more than one way. If all variables determining acceptable space are held constant, then decreasing the available space increases the amount of overcrowding. Likewise, if available space is held constant, then increasing the acceptable space also increases the amount of overcrowding. In either case, the behavioral result is predicted to be the same if the ratio is the same because the proportion is considerd to be the effective stimulus. That is, the model implies that the perceived amount of crowding is the same for a given proportion, regardless of which variable or combination of variables is altered to obtain that proportion.

Another point concerning the model is that it is consistent with Patterson's (1968) conceptualization of space in terms of adaptation level and the concept of equilibrium proposed by Argyle and Dean (1965). Implicit in the model is the assumption that people will attempt to maintain a ratio of 1 between available space and acceptable space (i.e., an adaptation level or an equilibrium). If the ratio becomes less than 1, people will attempt to alter whatever variable is necessary to regain the ratio of 1.

The model also explains why some high density situations are not perceived as overcrowded. If an individual goes to a theater, for example, he has learned to expect that a certain amount of space will be allotted to him, and this becomes his norm for acceptable space in that situation. Thus, the available space is not less than the acceptable space, and the theater is not perceived as overcrowded. However, if he is required to sit in in the aisle, the situation would be perceived as crowded. This logic also explains why there are sex differences in experiments, thus yielding a sex by density interaction. In these experiments, the density is the same for all groups. However, the all-male groups, the available space is less than acceptable, while for all-female groups this is not the case because females have a smaller acceptable space than males.

It was pointed out above that one thing which a crowding theory must do is to explain why overcrowding is aversive. An explanation is possible with this model. Acceptable space was defined above in part as a "learned expectation concerning spatial norms." An important concept in learning theory is "expectation of reward," which is also learned. Based upon this definition of acceptable space, then, it can be considered <u>analogous to</u> expectation of reward.[6] In overcrowding the amount of space available is less than expected. In learning theory, when the amount of reward available is less than expected, the situation is, by definition, frustrating, which is aversive. If the analogy holds between acceptable space and expectation of reward, then overcrowding is, via definition by analogy, frustrating and hence aversive. In short, this model implies that overcrowding causes frustration, and that frustration is the explanation for the aversive nature of overcrowding. The analysis is consistent with data which have shown that overcrowding is aversive. It also is consistent with a common-sense notion of the effects of overcrowding.

Another criteron for a theory of overcrowding is that it must be able to explain the effects of crowding on behavior. The interpretation of overcrowding as eliciting frustration provides for such an explanation. Frustration is commonly assumed to produce arousal or drive, which has been shown to have definite effects on behavior.[7] Brown and Farber (1968) have suggested that drive has certain functional properties: (1) the onset is punishing or aversive, (2) its presence differentially energizes or elicits responses with different habit strengths, and (3) its offset is reinforcing. Since overcrowding is considerdd to be frustrating and thus arousing, it theoretically should function in the same ways. Entering into an overcrowded situation (i.e., onset) should be aversive and people should avoid it if possible (e.g., Barefoot, Hoople, & McClay, 1972; Carey, 1972; Leibman, 1970; Sommer, 1959, 1962, 1965). Being in a crowded situation should energize the dominant response (i.e., the response with the greatest habit strength) in that situation (e.g., Efran & Cheyne, 1973; Evans & Howard, 1973; Greenburg, 1969; Hutt &

Vaizey, 1966; Jourard & Friedman, 1970; Loo, 1972; Rawls, Trego, McGaffey, & Rawls, 1972). Leaving or eliminating a crowding situation should be reinforcing and thus people would tend to escape if possible (e.g., Altman & Haythorn, 1967; Dabbs, 1972; Ellswirth, Carlsmith, & Hensón, 1972; Felipe & Sommer, 1966, Garfinkel, 1964; Hall, 1959, 1966).

Based upon a lack of effects of density on task performance, Freedman, et al. (1971) concluded that density (i.e., crowding) "should not be conceptualized, as many writers tend to, as a drive-inducing stimulus" (p. 24). However, in the tasks employed in those experiments (crossing out numbers, forming words, naming object uses, memory, concentration, and anagrams) it is not clear what the dominant responses are. As Miller and Dollard (1941) have pointed out, it is necessary to know the conditions of learning in order to predict performance. Therefore, unless a task is used in which the dominant response is (emiprically) known, the drive hypothesis of overcrowding cannot be adequately tested. The studies cited above in which overcrowding is either avoided or escaped or in which it energized dominant responses indicate that overcrowding does possess the functional properties of drive and thus they support the present theory.

Boundary Conditions

An essential part of any theory is the specification of boundary conditions. Although the boundary conditions can be extended empirically, they represent the limits within which the theory is applicable. Initially four boundary conditions seem appropriate.

First, the theory is intended to apply only to humans since the spatial behavior in animals varies so widely from species to species. Thus, the statement must be made (ironically) that the theory and results based on human crowding must be extended to studies of animals with great caution.

Second, the theory does not seem particularly well suited for explanation of physiological responses. This seems appropriate since this theory is a social learning theory and little is known about physiological concomitants of complex human learning processes.

In most of the research upon which this theory is based the Ss were evenly spaced throughout the crowded conditions. Although it is an empirical question, it would seem that the theory would apply only in this situation since uneven spacing of Ss would result in differential crowding. However, uneven spacing of the population should fit into the theory if the relative crowding for each individual is considered.

Finally, the theory is intended to be primarily a theory of crowding, so that a fundamental boundary condition is that the ratio in the model must be less than or equal to 1. The situation in which the ratio is greater than 1 holds intriguing research possibilities, especially in light of the fact that the relationship between crowding and psychological effects may be curvilinear. One possibility in this direction is to conceptualize spatial behavior in terms of deviations (in either direction) of available space from acceptable space, with the suggestion that equal deviations in either direction may produce equivalent psychological effects. In addition, psychophysical scaling of available space in terms of number of jnd's from acceptable space may prove useful. If the model can be extended in this direction, then it would seem that many concepts from adaptation level theory would be quite applicable and useful.

C. Theoretical Predictions and Future Research Strategies

The final criterion for a theory is that it must be able to make testable predictions and thus guide future research. The predictions flowing from the present crowding theory are generally aimed at social learning research and can be divided into both quantitative and qualitative predictions.

Quantitative Predictions

Quantitative predictions stem directly from the ratio model. It was suggested that the effective stimulus for determining crowding effects is the proportion of available to acceptable space, regardless of which variables are manipulated to obtain the proportion. The proportion can be reduced by decreasing available space, increasing acceptable space or both. Available space can be decreased by increasing the number of people present or decreasing the physical space. Acceptable space can be increased by manipulating any of the variables which affect it (e.g., reducing the functional space via increased eye contact, decreasing the attraction toward the others present, switching to an activity requiring larger space, etc.).

For example, the model predicts equal perception of crowding and equal behavioral effects when the available space is 15 square feet per person with an acceptable space of 20 square feet per person and when the available space is 7.5 square feet per person with an acceptable space of 10 square feet per person.

Qualitative Predictions

Due to the structure of the model, it is predicted that variables which increase acceptable space will increase crowding, all other things being equal. Thus, one line of research stemming from this model is to explore the empirical relationships between acceptable space and its determining variables. A great deal of normative data on acceptable space would allow specification of composition rules for the determining variables, and would provide information concerning crowding manipulations, particularly choice of control conditions.

According to the theory, overcrowding elicits frustration and thus increases arousal or drive. Evidence has been cited above that supports the notion that overcrowding is arousing. The theory predicts that overcrowding should have the functional properties of drive. One of these properties is the energization of dominant responses. Therefore, in crowding studies which employ tasks with responses of (empirically) different habit strengths, the theory predicts that overcrowding (relative to an <u>uncrowded</u> control) should facilitate performance on a task in which the correct response is dominant and it should impair performance when the incorrect response is dominant.

The conceptualization of overcrowding as eliciting frustration immediately suggests the frustration-aggression hypothesis. Thus, overcrowding, via frustration, should lead to aggression. However, this prediction must be carefully qualified in light of the drive interpretation of frustration. That is, since frustration induces drive or arousal, it is predicted that overcrowding will result in aggression <u>only when aggression is the dominant response in the situation</u> (i.e., has more habit strength than other responses to frustration). If aggression is an individual's primary means of coping with frustration, overcrowding will probably elicit aggression from that person. However, if an individual's primary means of coping with frustration (and probably also anxiety) is escape, then overcrowding will probably not elicit aggression but rather escape responses from that person. Thus, the theory predicts that crowding will elicit an individual's dominant coping response to frustration. Although density and group size were confounded in a study by Hutt and Vaizey (1966), their data are at least consistent with this reasoning. As "density" increased they found that normal children were more aggressive but that autistic children tended to sit more on the boundaries of the room. While the frustration-aggression hypothesis is relevant to the crowding theory, the overcrowding-aggression hypothesis must be tested within the bounds of the above qualification.

The conceptualization of overcrowding as an aversive stimulus in general suggests that it should function as an aversive stimulus in a variety of learning paradigms. For example, Ss should learn to perform an instrumental response which will allow them to escape from overcrowding or to avoid getting into the crowded conditons. Evidence in support of these predictions was cited above. "Presentation" of overcrowding contingent upon an instrumental response follows a punishment paradigm; thus, the theory predicts that the laws concerning the effects of punishment on intsrumental responses should hold if crowding is used as a punisher.

Following a classical conditioning paradigm, a stimulus associated with the aversive overcrowded conditions should also take on aversive qualities. Contrast effects produce another intriguing paradigm for the study of overcrowding, particularly in light of the common experience of a shift in awareness of distance when one goes from the city to the country or vice versa.

Field research would be another especially fruitful area for the study of the effects of crowding based upon the present theory. It predicts that attraction toward others would be lower in crowded living conditions; long term studies on the effects of crowding on attraction would prove quite useful. The theory also predicts, with qualifications, increased aggression in crowded living conditions; long-term studies of aggression and crowding would also prove quite important.

D. Conclusion

Rohles (1967) has pointed out the great complexity of the effects of environment on behavior, and has concluded that environmental psychology is a "bucket of worms." It is hoped that the present theory will be able to make one part of environmental psychology a somewhat more coherent and predictable bucket of worms.

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Footnotes

1. This schema was suggested by Roger S. Fouts.

2. This principle holds regardless of body orientation or angle of approach.

3. Just as with other learned responses which have behavioral consequences (e.g., attitudes, beliefs, and values), it is assumed here that the response of knowing how much space is acceptable is learned by the same principles which govern the learning of external responses. One research direction suggested by this conceptualization is to focus on the actual process of learning acceptable space norms (e.g., classical conditioning).

4. Haller, J., & Lamberth, J. Room density as a determinant of affect and attraction. Paper presented at the annual meeting of the Southwestern Psychological Association, Dallas, 1973.

5. With respect to the variables which determine it, acceptable space is a response. With respect to responses to overcrowding, acceptable space functions as a stimulus.

6. The analogy is more straightforward than it might seem at first. Acceptable space is a learned expectation concerning a quantifiable environmental event (i.e., space). Expectation of reward in learning theory is, after all, the same thing: a learned expectation concerning a quantifiable environmental event (e.g., food). Therefore, space and reward can be considered to be similar in their functional properties.

7. Drive in interpreted here as meaning general arousal in order to avoid the controversy over a metatheoretical definition of drive and the specifics of Hull-Spence learning theory. Aspects of this theory (or any theory) which seem useful will be used. Arousal, like drive, is considered to be a motivational state, and thus the two terms will be used interchangeably.

Figure Captions

Figure 1a. Top view of an interaction between two people (Person A and Person B) facing each other. The areas indicated by the solid line represent the personal space of each individual. The dashed line represents interpersonal distance. Note that personal space is not circular.

Figure 1b. Schema of an interaction between two people with unequal personal space areas.

FIGURE 1[1]

FIGURE 1a

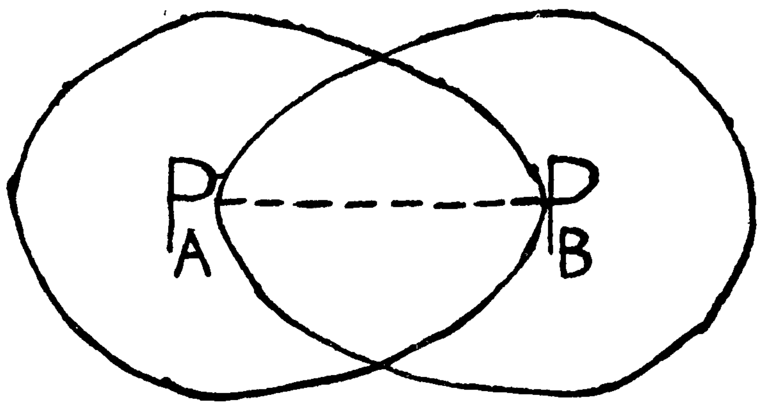
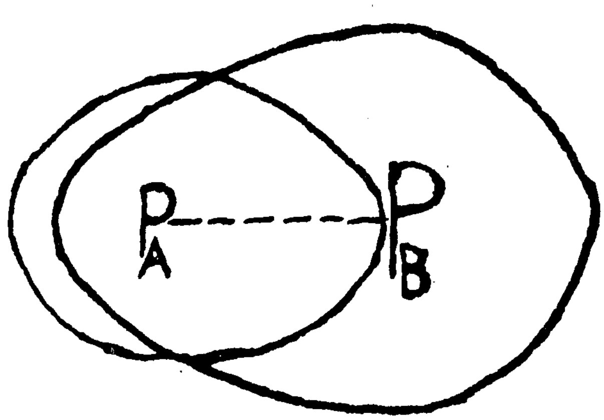


FIGURE 1a



APPENDIX B

STATISTICAL TESTS

Planned Comparisons: Trials to Criterion

List	
Mixed	Non-competitional
.76	2.00 *

$* \ p \leq .05$

Planned comparison tests for mean trials to criterion for crowded and uncrowded groups. Entries are the _t_ values for the comparisons of the crowded and uncrowded groups. (df = 26)

Percent Correct per Base of Opportunity

Room Density		List: Mixed	List: Non-competitional
Crowded	$\bar{X}$	54.7	71.6
	SD	14.2	10.7
Uncrowded	$\bar{X}$	53.6	69.5
	SD	11.7	8.0

Mean percent correct to the base of opportunity for various combinations of list difficulty and room density.

ANOVA Table: Percent Correct
per Base of Opportunity

Source	df	MS	F
List (A)	1	.379	27.48 *
Density (B)	1	.003	1
A X B	1	.001	1
error	52	.013	

* $p < .0001$

Analysis of variance for percent correct per base of opportunity measure.

Planned Comparisons: Percent Correct
per Base of Opportunity

List	
Mixed	Non-competitional
.35	.67

Planned comparison test for mean percent correct to the base of opportunity for crowded and uncrowded groups. Entries are the t values for the comparisons of the crowded and uncrowded groups. (df = 26)

Intrusions per Base of Opportunity

Room Density		List	
		Mixed	Non-competitional
Crowded	$\bar{X}$	.119	.056
	SD	.071	.058
Uncrowded	$\bar{X}$	.087	.028
	SD	.066	.024

Mean number of intrusions per base of opportunity for various combinations of list difficulty and room density.

ANOVA Table: Intrusions
per Base of Opportunity

Source	df	MS	F
List (A)	1	.051	14.82 *
Density (B)	1	.012	3.68 **
A X B	1	.000	1
error	52	.003	

* $p < .0001$
** $p < .07$

Analysis of variance for number of intrusions per base of opportunity measure.

Planned Comparisons: Number of Intrusions
per Base of Opportunity

List	
Mixed	Non-competitional
1.52*	-1.33

* p < .10

Planned comparison tests for mean number of intrusions to the base of opportunity for crowded and uncrowded groups. Entries are the _t_ values for the comparisons of the crowded and uncrowded groups. (df = 26)

Omissions per Base of Opportunity

Room		List	
		Mixed	Non-competitional
Crowded	$\bar{X}$	.355	.224
	SD	.069	.067
Uncrowded	$\bar{X}$	.386	.279
	SD	.115	.072

Mean number of omissions per base of opportunity for various combinations of list difficulty and room density.

ANOVA Table: Omissions
per Base of Opportunity

Source	df	MS	F
List (A)	1	.170	23.00 *
Density (B)	1	.016	2.17
A X B	1	.006	1
error	52	.007	

* $p < .0001$

Analysis ov variance for number of ómissions per base of opportunity measure.

Planned Comparisons: Number of Omissions per Base of Opportunity

List	
Mixed	Non-competitional
-1.00	1.77 *

* $p < .05$

Planned comparison tests for mean number of omissions to the base of opportunity for crowded and uncrowded groups. Entries are the t values for the comparisons of the crowded and uncrowded groups. (df = 26)

Number of Correct Responses

Room Density	Blocks of 2 Trials				
	1-2	3-4	5-6	7-8	9-10
			Mixed List		
Crowded	2.35	4.17	7.00	8.03	9.50
Uncrowded	2.60	5.28	6.75	8.25	9.21
			Non-competitional List		
Crowded	7.14	9.57	10.96	11.50	11.71
Uncrowded	6.42	8.85	9.89	10.39	10.60

Mean number of correct responses over blocks of 2 trials for various combinations of list difficulty and room density.

ANOVA Table: Number of Correct Responses

Source	df	MS	F
Between			
List (A)	1	804.10	64.01 *
Density (B)	1	9.46	1
A X B	1	23.16	1.84 **
error	52	12.56	
Within			
Trials (C)	4	284.16	164.76 *
A X C	4	17.20	9.97 *
B X C	4	1.88	1.09
A X B X C	4	.63	1
error	208	1.72	

* $p < .0001$
** $p = .17$

Analysis of variance of number of correct responses over blocks of 2 trials.

Planned Comparisons: Number of Correct Responses

Blocks of Trials	List	
	Mixed	Non-competitional
1-2	.48	.97
3-4	1.52 *	.97
5-6	.48	1.46**
7-8	.11	1.52*
9-10	.55	1.52*

* p = .07
** p = .08

Planned comparison tests for number of correct responses given by crowded and uncrowded groups over blocks of 2 trials. Entries are the t values for the comparisons of the crowded and uncrowded groups. (df = 26)

ANOVA Table: Number of Intrusions

Source	df	MS	F
Between			
List (A)	1	60.82	28.07 *
Density (B)	1	3.54	1.63
A X B	1	7.07	3.26 **
error	52	2.16	
Within			
Trials (C)	4	9.42	12.65 *
A X C	4	2.93	3.94 ***
B X C	4	2.64	3.54 ***
A X B X C	4	1.24	1.66
error	208	.74	

* $p < .0001$
** $p < .07$
*** $p < .01$

Analysis of variance of number of intrusion errors over blocks of 2 trials.

Planned Comparisons: Number of Intrusions

Blocks of Trials	List	
	Mixed	Non-competitional
1-2	2.34*	-1.31
3-4	4.05**	.36
5-6	.47	.84
7-8	.10	1.02
9-10	.18	.26

* $p < .005$
** $p < .001$

Planned comparison test for number of intrusion errors given by crowded and uncrowded groups over blocks of 2 trials. Entries are the t values for the comparisons of the crowded and uncrowded groups. (df = 26)

ANOVA Table: Number of Omissions

Source	df	MS	F
Between			
List (A)	1	423.61	51.27 *
Density (B)	1	25.44	3.07
A X B	1	7.69	1
error	52	8.26	
Within			
Trials (C)	4	194.70	144.94 *
A X C	4	5.40	4.02 **
B X C	4	1.09	1
A X B X C	4	.25	1
error	208	1.34	

* $p < .0001$
** $p < .005$

Analysis of variance of number of omission errors over blocks of 2 trials.

Planned Comparisons: Number of Omissions

Blocks of Trials	List	
	Mixed	Non-competitional
1-2	1.04	2.19 *
3-4	.62	1.20
5-6	.58	1.27
7-8	.45	1.14
9-10	.40	1.70 **

* $p < .025$
** $p < .05$

Planned comparison tests for number of omission errors given by crowded and uncrowded groups over blocks of 2 trials, Entries are the t values for the comparisons of the crowded and uncrowded groups. (df = 26)

APPENDIX C

EXPERIMENTAL INSTRUCTIONS

Experimental Instructions

First I would like to have you fill in the information on the front sheet. In this experiment I want you to learn a list of words. The list has several pairs of words in it. When the first word in the pair comes up by itself on the slide projector, you should write down the other word in that pair. After you have written the second word, the slide will change, and both words will be shown so that you can see if you were right. Then the first word of the next pair will come up, and you should write the other word in that pair and so forth. For example, if the pair of words is "yes-no", when "yes" comes up by itself you should write "no." During the first run through the list just read the words. After that, write your answers on each trial.

Each time we go through the list, start on the top line of the answer sheet and work down. If you cannot think of the word you are supposed to write, skip a line and continue on the next line when the next word comes up by itself. After the list is finished, there will be 2 blank slides, which will give you time to turn the page and get ready for the next trial. The order of the words will be different each time.

It's very important that you understand how to do it before we start. Are there any questions?

The words will be coming up fast, so write as fast as you can and still be reasonably legible. If you are not finished writing a word when the slide changes, stop writing anyway. Do not finish the word. (Repeat.) Never go back and finish or change a word. Also, please don't talk during the experiment.

(At end: Please go back through the answer sheets and number the pages in the lower right hand corner. Has anyone ever seen this list of words before in another experiment?)