

ROLE OF ROOM SIZE AND INTERACTION DISTANCE  
ON STRESS-RELATED FEELINGS AND  
SOCIAL INTERACTION OF  
DYADS

by

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## Introduction

Recently much research has been conducted to investigate the effects of crowding. Different approaches have been adopted such as the investigation of animal populations both in experimental setting and in the wild. Most studies on crowding with animals have shown that animals respond pathologically when density is high. For example, Calhoun (1962) limited the amount of space available to a community of Norwegian rats and observed such pathological behaviors as an increase in deaths among the females and young, heightened aggression, abnormal sexual behavior, and the withdrawal of individual animals from social interaction. Christian, Flyger, and Davis (1960) studied a herd of deer on an isolated island and found a rapid increase in size which was followed by a pronounced decrease in reproductivity.

Crowding has also been investigated with humans. Early work consisted mainly of surveys, interviews, and correlational studies. In most of these studies investigators relied upon census tract data and correlated various measures of population density (e.g., people per acre or people per dwelling unit) with indicators of social and medical pathology (e.g., crime, mental illness, and disease rates), while controlling for such variables as income level and education. Schmid (1937;1960) reported high population densities and high crime rates in ghettos and central city areas of Minneapolis and Seattle but found a high positive correlation between population density, juvenile delin-

quency, and adult crime in Honolulu. Furthermore, Schmid (1966) examined the relationship between social breakdown (e.g., mental illness, tuberculosis, venereal disease, crime, illegitimate births) and two measures of population density, i.e., population per acre (outside residences) and people per dwelling unit (inside residences). Population per acre was found to correlate with social breakdown whereas density per dwelling unit did not.

Other correlational studies have indicated position relationships between population density and rates of mental illness. Faris and Dunham (1965) found less mental illness in suburbs than in inner-city areas. Recent studies by Galle, Gove, and McPherson (1972) used more sensitive density indicators by distinguishing different types of density according to the relative closeness of the interacting people, e.g., number of people per room in dwelling units, number of rooms per dwelling unit, dwelling units per structure (apartments), and building structures per acre. The effects of variables such as social class and ethnicity were controlled. The highest correlations were between person-per-room density measures and juvenile delinquency, and successively lower correlations appeared for the more general, less interpersonally-oriented measures of density. Marsella, Escudero, and Gordon (1970) found a higher incidence of psychosomatic illness, anxiety, and tension in crowded homes but weaker relationships when density was based on other indicators.

The experimental investigation of crowding phenomena represents the most recent approach used by researchers. In these studies, crowd-

ing was operationally defined in different ways which perhaps contributed to inconsistent findings. For example, some investigators defined crowding in terms of group size (Griffith and Veitch, 1971; Hutt and Vaizey, 1966; Ittelson, Proshansky, and Rivlin, 1970); whereas others defined crowding in terms of room size (Freedman, Klevansky and Ehrlich, 1971; Hutt and McGrew, 1967). Results from studies that defined crowding in terms of group size indicated that members of larger groups are more aggressive and asocial than those of smaller ones, regardless of whether the setting is a psychological experiment, a playground, or a psychiatric ward (Griffith and Veitch, 1971; Hutt and Vaizey, 1966; Ittelson, Proshansky, and Rivlin, 1970).

Hutt and McGrew (1967) found that social interaction increased in smaller-sized rooms whereas aggressive behavior did not show consistent trends. Freedman, et al., (1971) investigated the effects of room size, and observed that the task performance of subjects in a small room was no less efficient than that of subjects in a large room.

The findings of these early crowding studies were not conclusive in that they did not indicate any consistent pattern of effects due to crowding. This led investigators to further examine their conceptualizations and definitions of crowding.

Stokols (1972) made some important distinctions between the terms crowding and density. He stated that density has a strictly physical meaning, i.e., the number of people per unit of space; while crowding is viewed as a psychological concept, or that which evokes a subjective or personal reaction. Stokols remarked that density is a necessary,

though not a sufficient condition for the feeling of being crowded. Crowding implies a feeling of too little space and it motivates the person to do something to alleviate the discomfort imposed by spatial limitation. Stokols further differentiated between nonsocial crowding and social crowding. Non-social crowding refers to such factors as the amount and arrangement of space and stressor variables such as noise or glare which generate feelings of inadequate space. Social crowding refers to such factors as interpersonal competition, personality, and past experiences with others which generate feelings of crowding. Stokols also differentiated between molecular crowding which is associated with large-scale, urban populations. Finally, Stokols observed that all feelings of crowding involve stress, either psychological or physiological. Psychological stress is characterized by cognitive inconsistency, i.e., one's demand for space exceeds the available supply of such space, and emotional imbalance resulting from feelings of infringement, alienation, and lack of privacy. Physiological stress involved a disequilibrium of internal states such as rise in blood pressure, temperature or hormonal secretion.

Proshansky, Ittleson, and Rivlin (1970) proposed that crowding is not simply a matter of the number of persons in a given space. Rather, they suggested that the feeling of being crowded depends on the on going activity, the number of people in close proximity to the individual, and the individual's previous experience involving particular numbers of people in similar situations. Esser (1971) defined crowding as a mental state in which stimuli are experienced as inappro-



prate and stressful. While Esser stated that a high density condition can cause stimulus overload, he indicated that an individual can experience crowding even when others are not present. Desor (1972) defined crowding as receiving excessive stimulation from the social environment. Other authors have also emphasized the stimulus overload aspect of crowding (e.g., Milgram, 1970; Rapoport, 1972; Wohlwill, 1974). Altman (1975) described crowding as a breakdown in privacy regulation, i.e., the achieved level of interaction is more than is desired and the control of social interaction is inadequate. Altman has suggested that space availability, access to resources, intrusion, and duration of contact with others also affect crowding.

In crowding research, investigators have often associated crowding with high density, but several different operational definitions of density have been offered. Generally, density refers to the number of people per unit of space. However, the unit of space is not always the same, in that it can be the number of people per acre of land, the number of people per room in homes, or the number of dwelling units per acre of land. Galle, Gove, and McPherson, (1972) distinguished between neighborhood density (i.e., structures-per-acre and number of dwelling and number of persons-per-room). Further, Zlutnick and Altman (1972) differentiated between inside density (i.e., number of people per unit of space within a residence), and outside density (i.e., number of people per unit of space in a larger spatial unit such as a street).

Several writers have made the distinction between social density and spatial density (Hutt and McGrew, 1967; Hutt and Vaizey, 1966;

Loo, 1973a, 1973b; McGrew, 1970). Whereas spatial density refers to comparisons of same-sized groups in different-sized spaces, social density refers to comparisons of different-sized groups in same-sized spaces. Rapoport (1975) defined density from a perspective of man-environment relations. Rapoport viewed density in two major ways. First, he viewed density spatially in terms of the perceived environment, where it is the relationship among elements that is important (height, spacing, juxtaposition). High perceived density is related to such qualities as a high degree of enclosure and intricacy of spaces which result in higher rates of information gathering from the environment. Secondly, Rapoport (1975) viewed density in terms of social interaction; actual, desired, or perceived. Rapoport draws the following distinction between density and crowding: "density is the perception and estimate of the number of people present in a given area, the space available, and its organization, whereas crowding or isolation is the evaluation or judgment of that perceived density against certain standards, norms, and desired levels of interaction and information" (p. 136).

Thus, it is evident that crowding and density have been conceptualized and defined in many different ways. Indeed, there appears to be little consensus as to the meaning of crowding and density. Thus, in reviewing the experimental literature in this area it is critical to outline the specific procedures used to generate the effects of crowding and high density.

It has generally been assumed that crowding creates arousal and stress. However, Freedman et al., (1971) conducted a number of studies

which demonstrate that crowding does not necessarily have negative consequences. First, Freedman et. al., investigated the effects of crowding on cognitive task performance, reasoning that a certain level of arousal can be beneficial to certain kinds of tasks while detrimental to others. For example, an extremely aroused or anxious person will find it difficult to perform a complicated task while conditions of high drive can enhance performance on simple tasks. Therefore, if crowding produced stress, it should interfere with performance on complex tasks and improve performance on simple ones. Groups of students were put in either a large room (160 sq. ft.), a moderate-sized room (80 sq. ft.), or a small room (35 sq. ft.). These five or nine-member groups consisted of either all males or all females. The groups were randomly assigned to one of the three rooms on the first day of the experiment and then moved to the other rooms during the next two days. Each group worked at simple tasks (e.g., crossing out all the sevens on a page of random numbers and using scrambled letters to make a word from them), or at more complex tasks (e.g., producing many uses for a common object such as a brick or a 10-gallon barrel). There were no effects due to either room size or group size on any task performance. That is, individuals in the small room performed just as well as those in the middle-sized or large room on both simple and complex tasks. The study was then repeated with different subjects and different tasks. Again, there were no effects due to neither room size nor group size on task performance. These results suggested that crowding does not necessarily provoke arousal or stress.

Freedman (1975) suggested that crowding might only affect social behaviors and not nonsocial behaviors such as performing cognitive tasks. Aggression was a critical social behavior to study since it is probably the most widely believed "product" of crowding. Therefore, the stressing effects of crowding on social behaviors such as aggression, attraction, and social interaction was investigated in several studies reviewed below.

Several laboratory studies examined aggression under conditions of high density. Hutt and Vaizel (1966) observed brain-damaged, autistic, and normal children in a free play situation, where three group sizes were used: 1) small ( $n < 6$ ) 2) medium ( $n = 7-11$ ), and 3) large ( $n > 12$ ). The results indicated that as density increased autistic children spent significantly more time at the boundaries of the room. Brain-damaged children as well as normal children increased their aggressive behaviors as group density increased. For social encounters, the normal children showed progressively less social interaction with increasing group size. In another study, Hutt and McGrew (1967) manipulated spatial density by observing the same-sized groups in different-sized areas. As density increased the social interaction and aggressive behaviors of nursery school students among one another and with adults increased. Loo (1972) examined the behavioral consequences of high and low spatial density on the aggression of normal children of ages 4 and 5, and found significantly less aggression and less social interaction in the high density condition than in the low-density condition.

While the results of these observational studies have been somewhat

inconsistent, the more extensive and controlled experimental investigations conducted by Freedman and his colleagues have shown no overall negative effects of crowding. Freedman, Katz, and Kinder (1972) studied aggressiveness among crowded and uncrowded male and female high school students. Subjects remained in either a small room (25 sq. ft.) or a large room (72.25 sq. ft.) in groups of four males or four females. After being in the room for forty minutes the groups were asked to play the prisoner's dilemma game, which could be played either cooperatively or competitively. The results indicated no effect due to room size in that there was as much competition in the small room as there was in the large room. However, there was a difference in the reaction of the all male and all female groups due to room size. Groups of females were somewhat less competitive in the small than large room, whereas groups of males were more competitive in the small than large room.

Freedman, Heshka, Levy, Buchanan, and Price (1972) designed a study to test the robustness of this sex effect in crowding research. They placed all males, all female, and mixed-sex groups, ranging in size from six to ten, in either large (300 sq. ft.) or small (110 sq. ft.) rooms for a 4-hr. mock-jury session. Tape recordings of five very brief trials were played and these subjects were asked to decide on a verdict regarding each case. After giving their verdicts, subjects answered questions that attempted to assess their emotional reactions to the other people in the group. Results indicated that room size had no main effect on the severity of the sentences given. However, there was a significant interaction between sex room size. The all-female group gave less

severe sentences in the small than the large room, whereas the all-male groups were more severe in the small than the large room. There were no effects of room size or sex on the sentencing of the mixed sex-groups. Concerning the participants' feelings about the experiment, there was again a Sex X Room Size interaction. The all-female groups in the small room reported that they liked each other more, found the experiment more pleasant, and judged the people more friendly. On the other hand, the all-male groups showed the opposite reaction in each case responding more positively in the large than the small room. Again, on these specific measures, no effects of room size or sex were found for the feeling of subjects in mixed-sex groups.

Thus, there is consistent evidence to support two major conclusions. First, it is apparent that conditions of crowding do not always produce stress and arousal. Second, males and females react differently to crowding, i.e., males respond negatively to crowding, whereas females respond positively. In order to account for these findings, Freedman (1975) proposed a theory of crowding in which he suggested that: "crowding by itself has neither good effects nor bad effects on people but rather serves to intensify the individual's typical reactions to the situation" (p. 100). That is, the effects of crowding depend upon the nature of the particular situation. If the situation is pleasant and one enjoys having people around, crowding usually has either no effect or actually enhances the enjoyment ( e.g., at a cocktail party or at a football game). On the other hand, if the situation is unpleasant or one in which the individual does not enjoy having many people around,

then crowding will usually make things even worse (e.g., taking a test in a crowded class or traveling in a New York subway). Thus, crowding intensifies the normal reaction to a situation, making a bad situation "feel" worse and a good situation "feel" better.

A number of experiments have been conducted to test Freedman's density-intensity theory of crowding. In one study, Freedman, Heshka, and Levy (1975) investigated the effects of room size and criticism in an experiment involving public speaking. All female or mixed-sex groups, consisting of six to ten subjects, each participated in either a small room (70 sq. ft.) or a large room (150 sq. ft.). Each person in the group delivered a speech that was followed either by positive or negative feedback on their speaking. Supporting Freedman's theory, the results indicated a consistent interaction between room size and the type of criticism. For the pleasant condition there were more positive ratings in the small than the large room, and in the unpleasant condition there were more negative ratings in the small than large room. This interaction was also significant for ratings of liking other group participants, ratings of speech, and willingness to participate in the experiment again.

Freedman et. al. (1975) conducted another experiment to demonstrate the intensification effects of crowding with all male groups. Specifically, groups of six to eight subjects were placed in either a large room (150 sq. ft.) or small room (70 sq. ft.). These groups worked on tasks which consisted of transforming one word into another by changing one letter at a time. Some of the groups experienced "success" in that

the problems were designed so that most of the problems could be solved, whereas other groups experienced "failure", in that most of their problems could not be solved. The results indicated that the failure groups in the small room found the experiment more boring, less lively, and generally a worse experience than did those in the large room. In contrast, individuals in the success groups rated the experience more positively in the small than large room.

Thus, in these two studies Freedman and his colleagues demonstrated that crowding, as defined in terms of room size, intensified the individual's typical reaction to a situation. Further, the findings demonstrated that males and females do not have different responses to density, but rather all-male, all-female, and mixed-sex groups showed the same intensification effects. The key to understanding this sex difference lies in defining the typical male and the typical female response in a particular situation. These findings provided support for Freedman's notion that high density does not generally produce negative effects but rather high density makes other people more prominent and influential thereby intensifying the typical reaction to the situation.

Freedman defined crowding in terms of density or room size, whereas Worchel and Teddlie (1970) suggested that personal space is more directly related to crowding than is density. Personal space is an invisible boundary around the individual which is directly related to interpersonal distance. Hall (1959; 1966) examined how people respond to and use the distance between themselves and others. Several factors were shown to effect interpersonal distance, i.e., the type of interaction, the relation-



ship between interacting individuals, their personal characteristics, and the environmental setting. For instance, friends maintain a closer distance between one another than do acquaintances or strangers. According to Hall, stress results when the appropriate interpersonal distance is violated.

Worchel and Teddlie (1976) indicated that most previous crowding research confounded interaction distance and density when manipulating conditions of crowding. Therefore, they conducted a study in which they unconfounded density and interaction distance. Spatial density was manipulated by varying room size: large room (235.8 sq. ft.) or small room (112.5 sq. ft.). Interaction distance was manipulated by the arrangement of chairs in the room. The chairs were always arranged in a circle and for the close condition the front legs of the chairs touched the front leg of the chairs on either side of it. In the far condition, there was a 19.5 in. distance between the front leg of one chair and the front leg of the chair next to it. Subjects were told that the study involved the investigation of group performance on various tasks and the examination of the group processes that result while the group works on specific tasks. The first task involved forming as many words as possible from the master word "industriously". The second task involved reading the case history of a delinquent who had just perpetrated a serious crime and then making both an individual decision as well as a group decision regarding the course of action that should be taken in this case (i.e., the standard Johnny Rocco case). The results indicated strong support for the notion that it is invasion of personal space i.e., interpersonal

distance on interpersonal attraction. In this study, both the affective quality of the interaction as well as interpersonal distance were varied. The interaction was either positive and pleasant, neutral, or negative, and interpersonal distance was either close (2 ft.) or far (5 ft.). Measures of attraction clearly indicated an intensification effect due to interpersonal distance. That is, in the positive interaction condition there was more liking for the close rather than the far partner, whereas in the negative interaction the close partner was liked less than the far partner. Further, in the neutral condition there were no significant differences due to interpersonal distance.

The present study was designed to test both the density-intensity theory of crowding presented by Freedman, as well as to study the comparative influence of room size and interpersonal distance in producing the intensification effects of crowding. In line with Freedman's position it is predicted that crowding will intensify one's typical reaction to the situation. Further, following the research of Middlemist, et. al., (1976), Schniffenbauer and Schiavo (1976), and Worchel and Teddlie (1976), it was hypothesized that violations of personal space (i.e., interpersonal distance), not room size, would be the critical spatial characteristic determining the intensification effect of crowding. Therefore, the current study varied both spatial density (i.e., room size) and interpersonal distance independently in order to test the effects of each variable on the experience of individuals waiting to participate in either a stressful or nonstressful experiment. It was hypothesized that the negative experience of individuals waiting for the stressful experiment would be intensified when subjects sat at a relatively close inter-

personal distance. Specifically, given Freedman's density-intensity theory, close individuals were expected to report feeling more worried, tense, and rattled and jittery than individuals seated at the far interpersonal distance. Further, the close individuals were predicted to perceive the environment less favorably than the far subjects, and it was hypothesized that the nonverbal behavior of the close subjects would reflect more stress than the far subjects. Further, in the stress situation, evaluations of the other participants in the experiment was predicted to be more negative when given by subjects sitting close than far.

### Method

Subjects. The subjects were 80 males and 80 females enrolled in an introductory psychology course at Virginia Polytechnic Institute and State University. Each subject received voluntary research credit for participating in the experiment. Subjects signed up for an experiment entitled "Paired Associate Learning". A male and a female subject were assigned to each experimental session.

A total of 11 subjects were eliminated from experimental analysis. One pair of these subjects that was replaced knew each other previously, and another subject knew one of the confederates. Four other subjects were replaced because they realized that they were being watched through the one-way mirror. Three other subjects were replaced because they changed their interpersonal distance during the 10-min. waiting period. If subjects got off the stool while respecting the range of the pre-assigned interaction distance, i.e., close (4 ft.) or far (9 ft.) they were not eliminated. One subject that was replaced sat beneath the one-way mirror changing her interaction distance from 9 ft. to about 5 ft. The other eliminated subject pair sat against the wall leaving an interaction distance of about 2 ft. between them.

Design. All subjects were randomly assigned to one of eight conditions in a factorial design of 2(Stress Conditions: Anticipated Shock vs No Shock) X 2(Room Sizes: Large vs Small) x 2(Seating Distances: Close vs Far). For each of the eight between-subject conditions, 10 males and 10 females were paired and exposed to the independent variables

for the experimental session. The subjects were in either an Anticipated Shock or No Shock situation, determined by the task instructions given by the experimenter. They sat on stools either 1.22m (4 ft.) or 2.74m (9 ft.) apart in a 5.94, (18 ft.) X 3.96m (13 ft.) room or a 5.94m (18 ft.) X 2.44m (8 ft.) room. For both the large and small rooms the ceiling height was 2.44m (8 ft.).

Experimental setting. The experimental setting was a wood-panelled, carpeted room arranged to appear like a waiting room for a psychology experiment. The panelled walls were bare except for a one-way mirror on wall with a "No-Smoking" sign positioned above it. A trash can was located in one corner, and a coat rack was positioned adjacent to the one-way mirror. Next to the entrance/exit door of this windowless waiting room was an air conditioner. A 150 watts lamp hanging from the ceiling provided constant illumination.

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Insert Fig. 1 about here

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As depicted, in Figure 1, there were four stools in the waiting room, two of them were assigned to two confederates (one male and one female) according to the distance condition of the experiment: Far (2.74m) or Close (1.22m). The waiting room had one entrance/exit door leading outside and positioned on the outside of this door were two signs: one reading, "Infant Behavior Lab - 6:00 p.m. - 8:00 p.m."<sup>1</sup>, and the other "Paired Associated Learning Experiment - Come In".

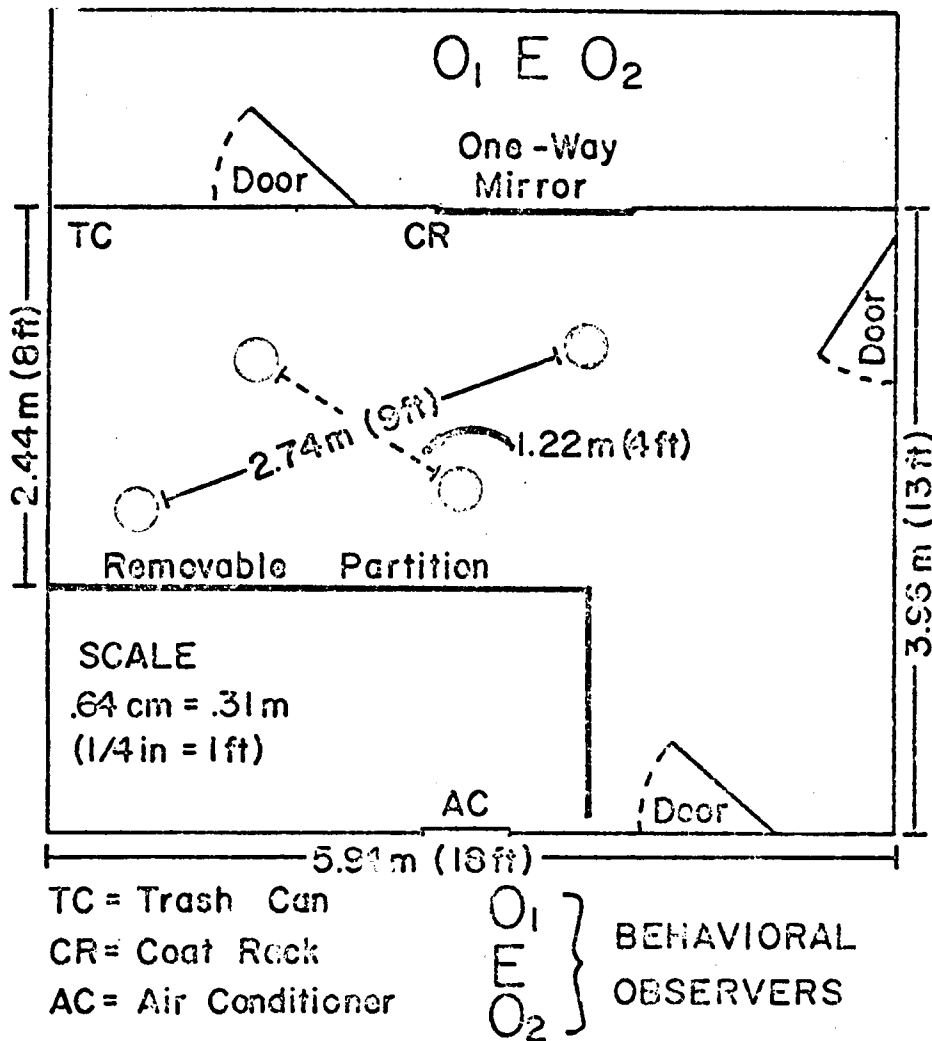


Figure 1: The experimental setting. The two subjects sat on the two stools 1.22m apart (Close condition) or 2.7m apart (Far Condition), and the removable partition was positioned as shown for the Small Room and removed for the Large Room.

As depicted in Figure 1, another door inside the waiting room was located at the corner of the room; this door led to a bathroom and was always open at the start of the experimental session. A third door was located at the front wall adjacent to the one-way mirror. This door led to the experimental booth; tacked to this door was a sign reading: "Experiment in Progress". Once the experiment began, the door was used by the experimenter to go from the waiting room to the experimental booth. It was never left open.

The experimental booth, located behind the one-way mirror (see Figure 1), was equipped with an interval timer and stepper mechanism that enabled the alternated presentation of a red and green indicator light every 10-sec. A click, audible in the waiting room, occurred with each alternation. As discussed below, the mechanism enabled consistent interval sampling of the subjects' behaviors during a 10-min. waiting period. An audio pick-up system, consisting of amplifier, microphones and head sets, allowed the three observers to hear ongoing conversations in the waiting room. The experimental booth remained dark throughout the waiting period.

Procedure. Before any subject arrived for the experiment, the experimenter (a female) was in the experimental booth while two confederates (a male and a female) were seated on assigned stools in the waiting room. When a subject entered the waiting room, one of the confederates informally relayed the instructions supposedly given to him by the experimenter. These instructions were that the subject should sign his or her name on the sign-up sheet and fill out the questionnaires. Each of four

questionnaires were attached to separate clip boards; one clip board per subject. The sign-up sheet was also attached to a separate clip board, on which the names of the two confederates were included, as well as their sex, their identification number and their class year, i.e., freshman, sophomore, junior, or senior. Both sign-up sheet and clip boards were located next to the entrance/exit door on top of the air conditioner that protruded from the panelled wall. The confederated remained silent while filling out the questionnaires.

The first questionnaire was in a semantic differential format and was designed to assess subjects' state and trait anxiety, their opinions of the waiting room environment, and their attitudes when interacting with strangers. This questionnaire is included in Appendix A. Each of the following bipolar adjectives were separated by an eight-point scale. To assess feeling states, the following bipolar adjectives were listed below the heading, "AT THIS MOMENT, I FEEL": Rattled and Jittery vs Cool and Collected, Calm vs Worried, Stimulated vs Bored, Tense vs Relaxed, Regretful vs Not Regretful.

Headed with "I GENERALLY FEEL" were the bipolar adjectives: Tired vs Restful, Happy vs Sad, Calm vs Worried, Insecure vs Confident, Steady vs Nervous, Elated vs Depressed and Tense vs Relaxed. Further, listed under the heading, "WHEN INTERACTING WITH STRANGERS, I GENERALLY FEEL" were the bipolar adjectives Secure vs Insecure, Self-Conscious vs Confident, Withdrawn vs Outgoing, Pleasant vs Unpleasant, Talkative vs Quiet, Attractive vs Unattractive, Uncomfortable vs Comfortable, Steady vs Nervous, Over-Excited vs Calm. To assess opinions of the waiting room environment, the following bipolar adjectives were listed below



the heading: "THIS ENVIRONMENT SEEMS": Pleasant vs Unpleasant, Dull vs Interesting, Crowded vs Roomy, Comfortable vs Uncomfortable, Unattractive vs Attractive.

In order to keep the subjects busy writing and decrease the probability of verbal interaction, a filler questionnaire, the Rotter Internal-External Scale (Rotter, 1966) was also attached to each clip board. When the experimenter saw (through the one-way mirror) that the first questionnaire was completed by each of the two subjects, she came out of the experimental booth, collected all questionnaires and then handed each subject a copy of the task instructions. Any subject who came with a book or magazine was asked to leave it in the corner of the room (this was done to increase the probability of verbal interaction between subjects once the experiment started). No subject took his book back during the session.

The experimenter read the instructions aloud. For the No Shock condition subjects were told that the object of the study was to investigate how feedback affects the relationship between a teacher and learner (see Appendix B for a copy of the No Shock task instructions). The experimental booth was described as a table divided by a screen where each subject would play the role of "teacher" for one-half of the experiment and "learner" for the other half. The learning task was described as learning the pairing of certain sequences of lights and pressing a left-hand button for correct pairs and a right-hand button for incorrect pairs. Feedback was to be given to the "learner" by the appearance of a green light on the screen for the correct associations and a red

light for incorrect responses. The feedback was to be provided by the "teacher" who was to press either a green or a red button following the appearance of either the red or the green light on the teacher's side of the screen.

In the Anticipated Shock condition, the instructions were the same as in the No Shock condition with the exception that electrodes were to be attached to the wrists of the learner so that electric shocks could be administered as feedback (see Appendix C for a copy of the task instructions for the Anticipated Shock condition). Thus, for correct responses a green light was to be presented on the learner's side of the screen, but for incorrect responses the teacher was to give the learner an electric shock that would be painful but cause no physical harm. The intensity and duration of the shock would depend on how long the teacher held down the feedback button.

After reading the instructions, the experimenter asked if there were any questions. One of the confederates pointed to the mirror and asked, "Is this a one-way mirror?". The experimenter replied, "Yes, it is; it is used in the Infant Behavior experiments, which are designed to study infants' perceptions of space".

After answering any additional questions from the subjects the experimenter collected the task instructions, and then from the sign-up sheet read the names of the confederates who were to perform first in the "Paired Associate Learning" task. After calling the names of the confederates, the experimenter informed all the subjects that they had to fill out consent forms before starting the experiment.

Two different consent forms were used: one designed for the No Shock condition (see Appendix D for a copy) and one designed for the Anticipated Shock condition (see Appendix E for a copy). The former may be summarized by the following: 1) the subject consented to participate in the experiment with the understanding that no negative consequences would result from participation in the experiment except for possible fatigue, 2) all of the subject's questions would be answered at the end of the session, 3) that the subject could leave the room at any time without penalty, and 4) for each hour or part thereof the subject would receive one research credit to be later applied toward his or her final grade in Introductory Psychology. The subjects were asked to sign their name at the bottom of the consent form. For the Anticipated Shock Condition, the consent form was the same as that for the No Shock condition except it indicated that the subject would receive an electric shock which would be painful but would cause no physical harm.

After collecting a consent form from each individual the experimenter read the names of the confederates from the sign-up sheet. They were to perform the learning task first. Then, the experimenter and both confederates went into the experimental booth. These three individuals stood behind the one-way mirror, the experimenter between the two confederates. Each had three behavior checklists attached to a clip board (see Appendix F for a copy), and used this data sheet to complete a 10-min. interval sampling procedure as follows. Each confederate observed the same subject during the whole observation period, while the experimenter alternated 10-sec. interval sampling periods between subjects. Thus, the

experimenter observed each subject 50% of the time and gathered data to be used for the calculation of reliability indices.

The timing mechanism clicked at repeated 10-sec. intervals; and simultaneously with each click indicator lights changed from red to green or vice versa. When the green light was illuminated, the observer observed their assigned subject until a click sounded and the red light illuminated (for 10-sec.). Then the observer engaged in data recording on the behavior checklist for 10-sec.; until the clock sounded again and the green light was illuminated. Each observer marked an "X" adjacent to each of the listed behaviors that was observed at least once during the previous 10-sec. The observers wore headphones in order to hear on-going conversations between the subjects.

The behavior checklist indicated the specific categories of behaviors to be observed. The first major category was "Posture" with the sub-classes a) Sitting, b) Standing, c) Lying, and d) Walking. The observer indicated which one of those postures was taken by the subject, at least once during a 10-sec. observation period by marking an "X" in the specific category on the check list.

The second major category was Orientation, with Face and Body as sub-classes. The observer checked the Face-Orientation category only if the subject faced the other subject at some time during the observation period. For the Body Orientation category, a check was given if the subject's body was turned in the direction of the partner at any time during the observation period. This meant that the subject's trunk, shoulders, and legs were all oriented toward the partner.

The third category was Verbalization which was subdivided according to the nature of the conversation: a) Experiment Avoidance b) Experiment Other and c) Other. Each category of verbalization dealt with the nature of the individual's verbalizations at the time they were recorded by the observer. The sub-class "Experiment Avoidance" was checked whenever the subject expressed some concern to leave the experiment or to find a way to avoid or minimize the Shock condition (e.g., partners could make a mutual contract to minimize the amount and/or duration of the shock feedback). Checking "Experiment Other" on the checklist occurred whenever some of the observed subject's verbalizations were related to the present experiment, but it did not concern the particular task for which they were waiting. For example, the conversation could be concerned with questions or suspicions regarding the environmental setting, the one-way mirror, the confederates, the experimenter, or anything else dealing with the procedure of the experiment. The category "Other" was checked when the subject conversed about non-experiment topics such as the weather, school, place of birth or even if they were talking about an experiment in which they had previously participated. The observer checked one, two, three, or non sub-classes of verbalization, depending upon the number of categories related to the observed subject's verbal behavior during the (10-sec.) observation.

The category "Fidgeting" was defined as a repetitive movement of a specific part of the body. According to Ekman and Friesen, (1972), one index of discomfort that is readily observable is that of body movements, particularly those that are referred to as "adaptors". In contrast to

more conscious and communication-relevant movements, adaptors are incipient segments of tension-reducing body movements such as grooming and petting. These are largely hand to body movements that occur most frequently when persons are experiencing negative affects ranging from anxiety to depression (cf. Lefcourt, 1975).

The sub-categories of "Fidgeting" were a) Hand, b) Leg, and c) Body. The subject could be repeating a movement with his/her fingers (e.g., drumming them, or manipulating a pencil). The subject could also be shaking a foot or leg (e.g., tapping a leg against the other with both legs crossed). The subject could also fidget with his/her whole body (e.g., swivel on the stool). The rate of responding was important in defining the fidget. Repetition at least once in a 10.-sec. observation period was necessary to qualify as an instance of fidgeting; a single movement in one 10-sec. interval did not count.

After 10-min. of observation, the experimenter stopped the timer and entered the waiting room to ask the subjects to fill out a second questionnaire (shown in Appendix G). The experimenter instructed the two subjects as follows: "This is another questionnaire that I would like you to fill out before you start the experiment. Although you will be seeing some of the same items as in the first questionnaire, be sure to answer all items according to the way you feel right now".

Like the first questionnaire, this scale was a list of bipolar adjectives separated by an eight-point scale, including only items that had been on the first questionnaire. Under the heading, "AT THIS MOMENT, I FEEL :'' were listed the following bipolar items: Rattled and Jittery

vs Cool and Collected, Calm vs Worried, Insecure vs Confident, Confined vs Free, Stimulated vs Bored, Tense vs Relaxed and Regretful vs Not Regretful. Under the heading: "THIS ENVIRONMENT SEEMS" were listed the following bipolar items: Pleasant vs Unpleasant, Dull vs Interesting, Crowded vs Roomy, Comfortable vs Uncomfortable, and Unattractive vs Attractive. And, under the heading: "I GENERALLY FEEL" were included: Tired vs Restful, Happy vs Restful, Happy vs Sad, Calm vs Worried, Insecure vs Relaxed.

The experimenter stayed in the waiting room with the subjects while they completed this questionnaire. After collecting them, the experimenter told the subjects: "The experiment will continue for about five more minutes with the other pair of subjects back in the experimental booth." Then the experimenter went back to the experimental booth, and after approximately 5-min. the experimenter and the confederates returned to the waiting room. Confederates and subjects were then given a sociometric questionnaire to complete. The experimenter instructed the subjects: "This is a final questionnaire that all of you are asked to fill out." The experimenter did not mention anything about the learning task.

For the sociometric scale (shown in Appendix H), the subjects were asked to indicate their opinions about the subject with whom they had been paired along the following 8-point dimensions: Like vs Dislike, Calm vs Anxious, Sociable vs Unsociable, Attractive vs Unattractive, Talkative vs Quiet, and Unfriendly vs Friendly.

After collecting these last questionnaires, the experimenter read the debriefing instructions included in Appendix I. For the Anticipated

Shock condition, the experimenter informed the subjects that the first pair of subjects were actually confederates who, along with the experimenter, observed the interaction of the two subjects through the one-way mirror. The purpose of the experiment was explained as a study to determine how anxiety or the anticipation of aversive stimulation interacts with a variety of environmental and personality variables.

The debriefing instructions for the No Shock condition also explained that the first pair of subjects were confederates of the experimenter who observed their behavior during the waiting period. The purpose of the experiment was defined as a way to determine how a variety of environmental and personality variables interact to affect behavior in a waiting room.

After debriefing the subjects, the experimenter and the confederates answered any questions posed by the subjects about the experiment and invited the subjects to see the experimental booth. The experimenter asked the subjects not to talk about the experiment to their friends nor to other prospective subjects in the experiment. In order to certify that they had been debriefed, the subjects again signed their names on the consent form that they had previously signed. The entire experimental session lasted from 50 to 55 minutes.



## Results

Behavioral Sampling. The frequencies that each subject was observed emitting the behaviors on the checklist were tabulated for each of the two consecutive 5-min. periods. Since there were six 10-sec. observation intervals per minute, the maximum frequency of occurrence for any behavior was 30 per 5-min. period.

The independent reliability checks on the behavioral observations indicated that the recordings were quite reliable for each behavior. More specifically, each subject was watched during 50% of the time periods by two independent observers, and for these time periods the data recordings for each behavior were systematically compared. A reliability index was derived for each behavior by dividing the total number of agreements by the sum of the agreements and disagreements (Miller, 1975). The results of these calculations were .89 for talking, .87 for fidgeting, .87 for face orientation toward partner, and .82 for body orientation toward partner. These values indicate relatively reliable observations vis-a-vis the literature.

Frequency data for each of the defined behaviors was subjected to an analysis of variance with four between-subject variables and one repeated measure, i.e., the factorial of 2(Stress Conditions: Anticipated Shock vs No Shock) X 2(Room Sizes: Large vs Small) X 2(Seating Distances: Close vs Far) x 2(Sex of Subject: Male vs Female) x 2(Assessment Time: First vs Second Consecutive 5-min. observation period). the Results of

these analyses were surprisingly uncomplicated. For the frequency of face orientations toward partner, no effects were reliable (all  $p_s > .10$ ); and for both amount of talking and fidgeting only a main effect of seating distance was found (all other  $p_s > .05$ ). Subjects were observed talking and fidgeting significantly more often in the Close than in the Far condition,  $F(1,144) = 6.49$  and  $5.63$ , respectively,  $p_s < .025$ . The mean frequencies of talking and fidgeting per 5-min. period were 9.76 and 12.65 respectively in the Close condition, and 7.35 and 10.78 in the Far condition.

The analysis of variance for frequency of body orientations toward the partner showed main effects of distance,  $F(1,144) = 6.44$  and a Stress X Time Period interaction,  $F(1,114) = 5.52$ ,  $p_s < .025$ . Thus, subjects showed significantly more body orientation toward their partner in the Far rather than Close condition (i.e., mean frequencies per 5-min. period of 9.68 vs 7.24). The Stress X Time Period interaction was largely due to a decrease in body orientation from the first to the second 5-min. period for only the Shock condition. That is, for the Shock condition, the mean number of body orientations was 8.33 in the first period and 6.96 in the second period, whereas for the No Shock condition these means were 9.01 and 9.54, respectively.

Stress States. Three of the bipolar adjectives included on both the questionnaire administered at the beginning of the experimental session (Questionnaire 1) and the questionnaire given after the pair of subjects had waited 10-min. for the paired associate learning task (Questionnaire 2), were designed to assess each subject's current

stress state. Specifically, the subjects indicated their stress state at the moment by encircling a number on an 8-point scale intervening the following bipolar states: Rattled and Jittery vs Cool and Collected, Calm vs Worried, Tense vs Relaxed. The numbers were transformed so that the higher values indicated more stress and each analyzed according to the factorial: 2(Stress Conditions: Anticipated Shock vs No Shock) X 2(Room Sizes: Large vs Small) X 2(Seating Distances: Close vs Far) x 2(Sex of Subject: Male vs Female) X 2(Assessment Time: Before vs After the task instructions and the 10-min. waiting period).

The results for each of the stress items were identical indicating two significant main effects and two interactions. Therefore, a composite stress score was determined by calculating the mean value of these three items for each subject and performing an analysis of variance on the means. The results of the composite stress scores were the same as when the items were analyzed individually. The two main effects were for stress condition and assessment time (higher stress ratings after the waiting period):  $F(1,114)=11.66$  and  $F(1,114)=24.35$ , respectively  $p<.001$ . The two significant interactions were Stress Condition X Assessment Time,  $F(1,114)=27.75$ ,  $p<.001$ , and Stress Condition X Seating Distance X Assessment Time,  $F(1,114)=5.76$ ,  $p<.02$ .

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Insert Fig. 2 about here

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The interactions can be seen in Figure 2, which depicts subjects'

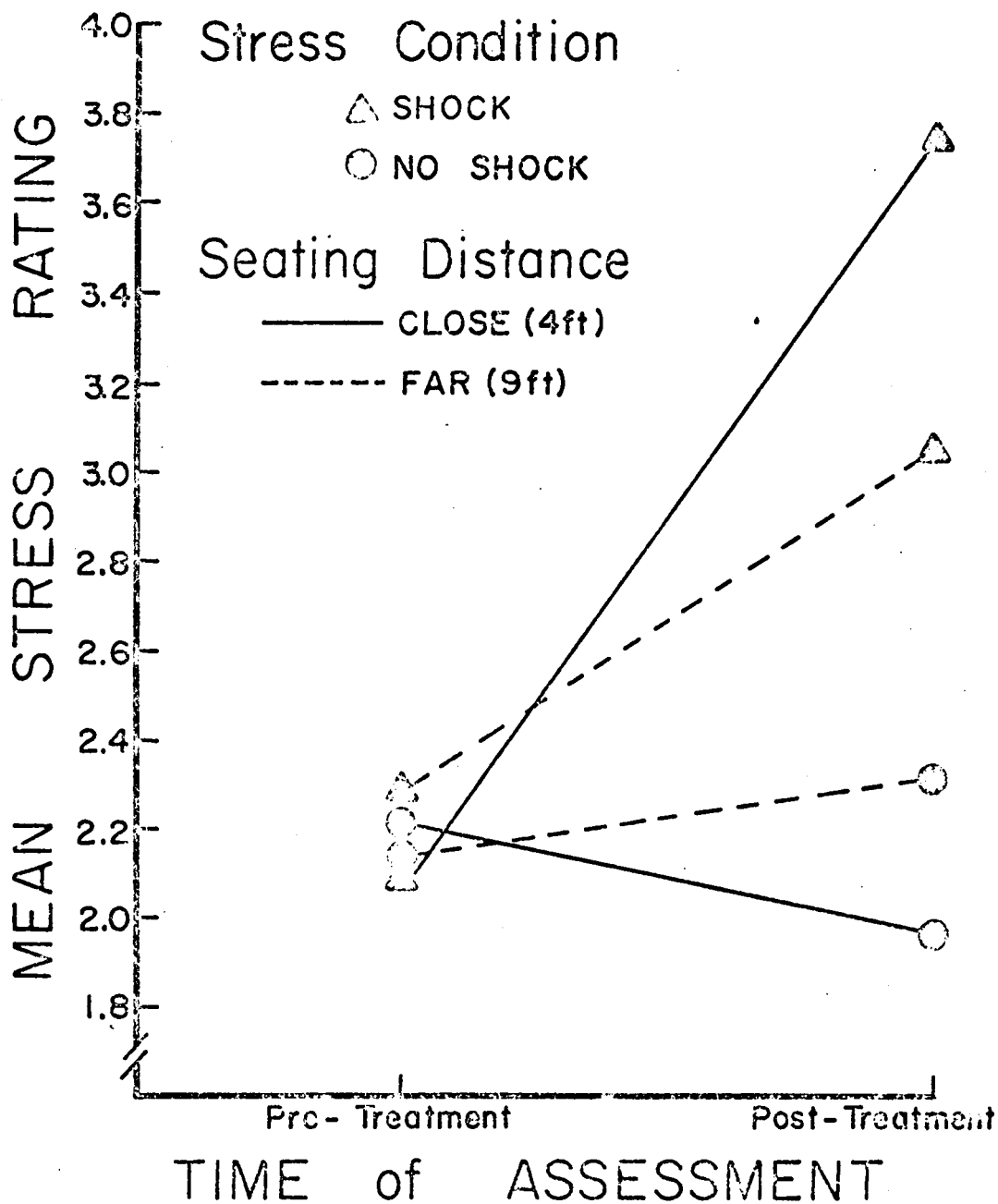


Figure 2: Mean stress ratings as a function of stress condition, seating distance, and assessment time.

mean stress ratings as a function of the Stress condition, Seating Distance, and Time of Assessment. At the start of the experiment the stress ratings were at equivalent levels, but after the task instructions and the 10-min. waiting period the stress ratings increased prominently for the Anticipated Shock condition and remained at approximately the same level for the No Shock condition, thus the Stress condition X Assessment Time interaction. Furthermore, the increase in stress ratings for the Shock condition was greater when the seating distance was close than far, but for the No Shock condition subjects' stress ratings decreased somewhat for the Close Seating Distance and increased slightly for the Far Seating Distance x Assessment Time interaction. A test for simple effects (i.e., Turkey's Least Significant Difference) indicated that the post-treatment differences due to seating distance were significant for the Shock condition ( $p < .01$ ), but not for the No Shock condition ( $p > .05$ ).

Other States. Subjects' ratings for the other four bipolar adjectives designed to measure certain feeling states before and after treatment were also analyzed according to the factorial of 2 (Stress conditions: Anticipated Shock vs No Shock) X 2 (Room Sizes: Large vs Small) X 2 (Seating Distances: Close vs Far) X 2 (Sex of Subject: Male vs Female) X 2 (Assessment Time: Before vs After the task instructions and 10-min. waiting period). For the bipolar dimension, Insecure vs. Confident, only main effects of sex and assessment time were obtained,  $F(1,114) = 4.09$ ,  $p < .05$ , and  $9.39$ ,  $p < .005$ , respectively. Males reported feeling more confident than females (i.e., mean confidence ratings of 5.88 vs 5.47,

and ratings of confidence were reliably higher for the first assessment time (i.e., means of 5.88 vs 5.48). The only significant interaction was Stress condition X Assessment Time,  $F(1,114) = 8.82$ ,  $p < .005$ , indicating a decrease in confidence occurring only for the Shock condition. The Pre-Treatment and Post-Treatment means were 5.89 and 5.10, respectively for the Shock condition and 5.86 and 5.85 for the No Shock condition.

The analysis for the dimension, Confined vs Free, indicated significant main effects of only Room Size and Seating Distance  $F(1,114) = 4.93$  and  $4.07$ , respectively ( $p < .05$ ). The mean ratings for the four environment categories that combine two room sizes with seating distances were as follows (the higher the number, the more "free" the rating): Small Room - Far Distance = 4.15, Small Room - Close Distance = 4.49, Large Room - Far Distance = 4.54, and Large Room - Close Distance = 5.20. Thus, subjects felt most confined when sitting far from their partner in the small room and most free when sitting close to their partner in the large room. The only interaction to reach a .05 level of significance was Room Size X Assessment Time,  $F(1,114) = 4.15$ ,  $p < .05$ . Apparently, the small room became somewhat less confining over time (i.e., an initial rating of 4.21 and a post-treatment mean of 4.43) whereas the large room became slightly more confining over time (i.e., a pre-treatment mean of 5.00 vs a post-treatment mean of 4.74).

The analysis of the ratings along the Regretful vs Not Regretful dimension indicated only a main effect of assessment time,  $F(1,114) = 19.37$ ,  $p < .001$ , and a Stress condition X Assessment Time interaction,

$F(1,114)=16.53$ ,  $p<.001$ . These effects occurred because only the subjects in the Anticipated Shock condition became more markedly regretful after the 10-min. wait. The mean levels of regret before the task instructions and waiting period were 1.50 and 1.92 for the Shock and No Shock conditions, respectively. Then, after the 10-min. waiting period the level of regret increased to 2.86 for the Anticipated Shock condition, while remaining at about the same level for the No Shock condition (i.e., 1.97).

For the Bored vs Stimulated dimension, only one main effect reached a .05 level of significance. Specifically, a main effect of assessment time occurred as a result of subjects indicating less boredom at the second (post-treatment) rating,  $F(1,114)= 6.67$ ,  $p<.01$ . No interactions were reliable with all  $ps>.05$ .

Environment Ratings. The five 8-point scales referring to opinions of the environment were administered before and after the experimental treatment and were therefore analyzed according to the same factorial used to study feeling states. Recall that the manipulated environment conditions (i.e., Room Size and Seating Distance) were in effect for both assessment times (i.e., pre- and post-treatment). For the Crowded vs Roomy dimension only one main effect was obtained i.e., the large room was rated as markedly more roomy than the small room,  $F(1,114)= 45.94$ ,  $p<.001$ . Only one interaction was reliable, i.e., Stress condition X Assessment Time,  $F(1,114)= 5.20$ ,  $p<.05$ . This interaction indicated that the room appeared more roomy after the No Shock treatment. More specifically, for the initial ratings the mean roominess levels were

5.51 and 5.55 for the No Shock and Anticipated Shock conditions, respectively. After the task instructions and the 10-min. wait, the average roominess rating increased to 5.9 for the No Shock condition, while decreasing slightly to 5.45 for the Anticipated Shock condition.

The analysis of the environment ratings for the Unpleasant dimension resulted in a main effect for assessment time,  $F(1,114) = 5.52$ ,  $p < .05$ . These results were due to the perceived pleasantness of the environment decreasing from a mean of 5.14 for the first assessment to 4.46 for the second assessment when the subjects waited 10-min. for the shock task. For the No Shock subjects the mean pleasantness ratings were 5.14 and 5.13 for first and second assessments, respectively.

For the Unattractive-Attractive dimension, one main effect and one interaction were obtained. A main effect of stress condition was due to lower attractiveness ratings for the Anticipated Shock condition,  $F(1,114) = 4.03$ ,  $p < .05$ . The Distance X Assessment Time interaction occurred because ratings of environmental attractiveness increased for the Close Seating Distance (from a mean of 3.98 to 4.33), but decreased for the Far Seating Distance (from a mean of 4.24 to 4.09),  $F(1,114) = 4.07$ ,  $p < .05$ .

No main effects and only one interaction were obtained from the analysis of the Uncomfortable-Comfortable ratings. The Room Size X Sex interaction occurred because males were more comfortable in the smaller room (i.e., mean ratings of 4.84 vs 4.30), while females rated the larger room as more comfortable (i.e., mean ratings of 4.45 vs 5.05),



$F(1,114) = 5.10, p < .05.$

The analysis of the Dull vs Interesting dimension showed a main effect of assessment time,  $F(1,114) = 17.59, p < .001$ , due to the environment being judged more interesting during the second assessment, (i.e., mean ratings of 3.78 for first assessment and 4.31 for second assessment). Two interactions were reliable: Room Size X Assessment Time, and Seating Distance X Assessment Time,  $F(1,114) = 4.40$  and  $5.74$ , respectively,  $ps < .05$ . These interactions were largely due to the environment becoming more interesting from Pre- to Post-Treatment when the room was small and when the seating distance was close. That is, for Pre-Treatment the mean interest ratings were 3.78 for both room sizes but for Post-Treatment the interest ratings increased to 4.56 in the small room and to 4.05 in the large room. Likewise, the mean interest rating increased from 3.60 to 4.42 in the close condition, and from 3.96 to 4.19 in the Far condition.

Sociometric Ratings. The third questionnaire administered at the end of the experimental session, included seven bipolar adjectives separated by 8-point scales, and designed to assess the subjects' opinions of their opposite-sexed partner. The ratings for each sociometric dimension were studied with a  $2(\text{Stress Conditions}) \times 2(\text{Room Sizes}) \times 2(\text{Seating Distances}) \times 2(\text{Sex of Subject})$  analysis of variance. For the Dislike-Like and Unattractive-Attractive dimensions, no effects were reliable. The analysis for both the Unfriendly-Friendly and Unsociable-Sociable items indicated only main effects of Seating Distance,  $F(1,114) = 7.62$  and  $9.13$ , respectively,  $ps < .01$ . The partner was judged to be more friendly and more sociable in the Close rather than Far seating arrangement.

The analysis for the Anxious-Calm ratings indicated only a main effect of Stress condition,  $F(1,114) = 6.55$ ,  $p < .025$ . Subjects in the Anticipated Shock condition rated their partners significantly more anxious than did subjects in the No Shock condition.

For ratings on both the Talkative-Quiet and Outgoing-Shy dimensions a main effect of Seating Distance was found  $F(1,114) = 8.88$ ,  $p < .005$ , and  $11.34$ ,  $p < .001$ , respectively. The subjects judged their partner as significantly more talkative and outgoing in the Close rather than the Far Seating Distance. The same one interaction was reliable in both of these analyses, i.e., Seating Distance X Room Size,  $F(1,114) = 7.91$ ,  $p < .01$  and  $5.44$ ,  $p < .025$ , respectively. According to these interactions the subjects judged their partner as most talkative and outgoing in the Small Room and Close Distance and least talkative and outgoing in the Small Room and Far Distance. These interactions are depicted in Figure 3.

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Insert Figure 3 about here

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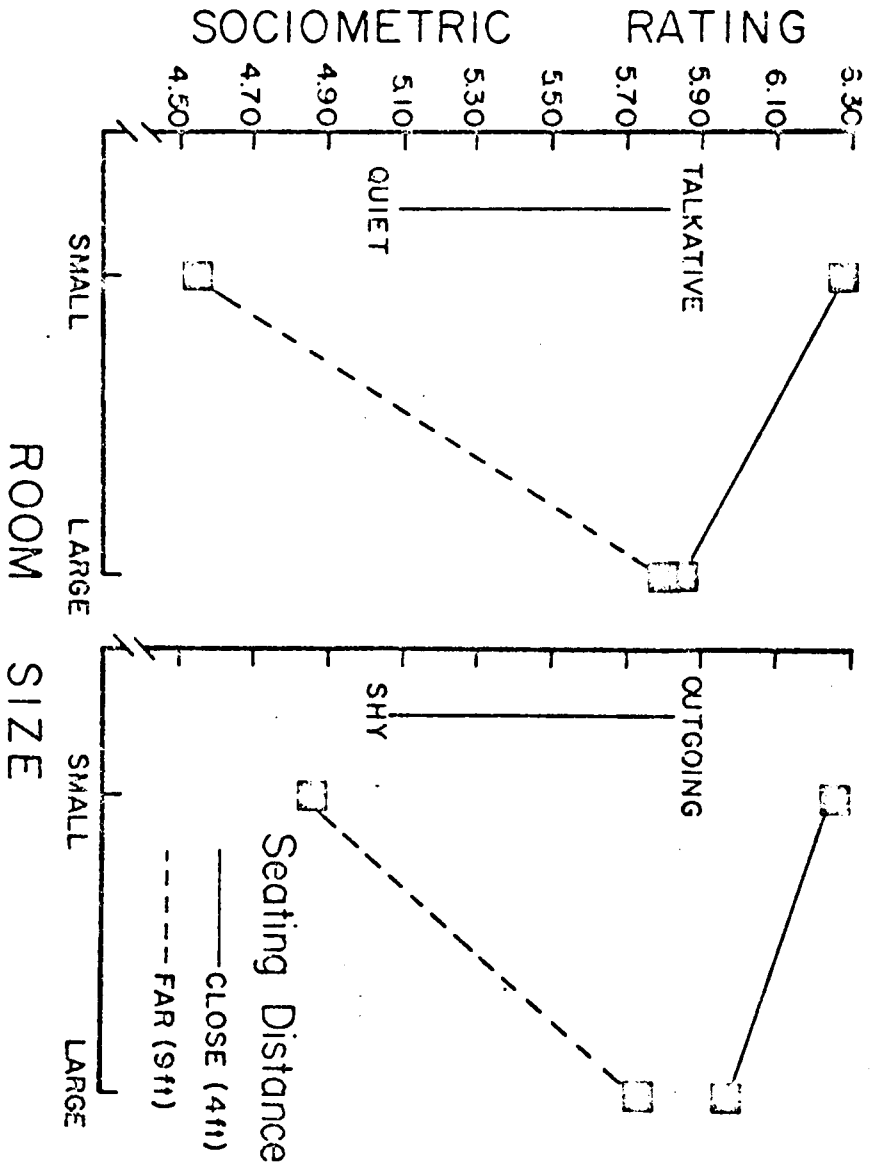


Figure 3. Mean ratings of partners' talkativeness and outgoingness as a function of seating distance and room size.

## Discussion

The current study compared independently the effects of two crowding variables, room size, and interpersonal distance, on the social interaction, and environmental and sociometric perceptions of dyads. In most previous research (Freedman, Klevansky, & Ehrlich, 1971; Griffith & Veitch, 1971; Hutt and Vaizey, 1966; Stokols, Rall, Pinner & Schopler, 1973) interaction distance and density were confounded when defining crowding. That is, in early crowding research, density and interactive distance were manipulated concomitantly to vary levels of crowding.

Perhaps the most provocative finding of this study was that one spatial variable (i.e., interaction distance) significantly influenced the stress ratings of mixed-sexed dyads, whereas the second spatial variable (i.e., room size) influenced neither stress ratings nor social behavior. Thus, regardless of room size, in the Anticipated Shock condition, subjects interacting at the close distance felt significantly more stressful than did subjects in the far distance.

These results are consistent with Freedman's density-intensity theory of crowding (1975), and with the findings of Middlemist, Knowles, and Matter (1976), and Worchel and Teddlie (1976). According to Freedman (1975) "crowding by itself has neither good nor bad effects on people but rather serves to intensify the individual's typical reaction to the situation" (p. 89-90). Thus, the close subjects in the present study showed a reliably greater increase in stress as a result of shock in-

structions than did the far subjects. The closer interactive distance intensified the ongoing anxiety state of the subjects in the Anticipated Shock condition.

In the No Shock condition, a trend opposite to that in the Anticipated Shock condition was observed. That is, subjects in the Far condition felt somewhat more stressed after the 10-min. waiting period, while there was a slight decrease in stress for the Close condition. The No Shock condition did not have the aversive qualities of the Anticipated Shock condition, therefore it is reasonable to assume that the Close interaction intensified any positive feelings between the partners, thereby producing a slight decrease in stress ratings.

The assumption that a decrease in interpersonal distance can produce arousal or stress was used to interpret the environment-behavior relationships in two recent studies (Middlemist et. al., 1976; Worchel & Teddlie, 1976). In a men's lavatory, Middlemist et. al. recorded delay of onset and persistence of micturation as indicators of physiological arousal to spatial invasion. As hypothesized, Middlemist et. al. found that a decrease in interpersonal distance (i.e., a confederate using an adjacent urinal rather than a nonadjacent urinal) led to a greater delay in the onset of micturation and to shorter persistence time. Similarly, Worchel and Teddlie studied interaction distance by varying the distance between chairs in a small or large room. Violations of personal space led subjects to report feeling uncomfortable, confined, ill-at-ease, and crowded. Violations of personal space were also arousing and stressful, and these effects were found regard-

less of room size. The results of both of these studies were interpreted in terms of the notion that arousal increases with decreases in interpersonal distance (c.f. Evans and Howard, 1973; Hall, 1959; Sommer, 1969).

The stress manipulation of the present study was supported by the observed main effect of the Stress condition on the anxiety ratings. That is, after the task instructions and the 10-min. waiting period, the subjects' ratings of their own stress ( or state anxiety) were significantly more anxious than did subjects in the No Shock condition suggesting that either subjects' own level of anxiety influenced their perceptions of the partner's stress state or that subjects accurately perceived their partner's increased stress in the Anticipated Shock condition. Further, from the first to second half of the 10-min. waiting period, the frequency of body orientations toward the partner decreased significantly for subjects in the Anticipated Shock condition. This observation can be interpreted with an assumption that subjects under stress were protecting their personal space zones. In fact, others have found that in a stressful situation, people tend to increase their interactive distance between one another (Altman, 1975; Dosey & Meisels, 1969; 1971; Evans & Howard, 1973).

Also supporting the validity of the stress manipulations of the present study was the finding that after the 10-min. waiting period, subjects in the Anticipated Shock condition rated the environment as reliably less pleasant and less attractive than did subjects in the No Shock condition. These results suggest that the stress feelings of subjects in the Shock treatment generalized to perceptions of

the environment.

The interval-behavioral sampling in the present study indicated that for both the Anticipated Shock and No Shock conditions, subjects talked significantly more often in the Close than Far condition. Apparently, the close distance influenced the subjects to interact more frequently, supporting the notion that close proximity between people facilitates interpersonal communication, (Mehrabian, 1967, 1968). Other studies have demonstrated that close interaction distances lead to "good" interpersonal relationships as defined by evaluations of friendship and liking (Goldring, 1967; Haase & Pepper, 1972; Kelly, 1972). However, talking may be interpreted as nervous behavior. This interpretation is supported by the observation that subjects sitting close fidgeted significantly more often than did subjects sitting far. Fidgeting was defined as any movement of some part of the body, indicating discomfort (Ekman & Fricson, 1972). Talking may have been a way of distracting oneself from the stress-producing situation.

Another noteworthy behavioral observation was that subjects in both the Anticipated Shock and No Shock conditions, showed significantly more body orientations toward their partner in the Far compared to the Close condition. This finding can be interpreted by assuming that the subjects sitting far from each other did not have as much need to protect their personal-space boundaries as did the subjects sitting close. Indeed, several other studies have shown that individuals make their angle of orientation toward each other less direct as the distance between them decreases (Aiello & Jones, 1971; Clore, 1969; Mehrabian

& Diamond, 1971; Patterson, Mullens & Romano, 1971; Sommer, 1962, 1969).

In the course of social interaction, individuals attempt to establish a comfortable level of intimacy. Patterson (1973) proposed that nonverbal intimacy between interacting persons varies as a function of interpersonal distances, eye contact, body orientation, smiling and other related variables. Typically, once a comfortable level of intimacy has been reached any change in one of the above factors requires a reciprocal change in another so as to maintain equilibrium. Further, Argyle and Dean (1965) proposed a theory of equilibrium, postulating that approach and avoidance forces produce an equilibrium level of physical proximity, eye contact, and other aspects of intimacy. If one of these is disturbed, compensatory changes may occur along these dimensions. These propositions explain how an uncomfortably close approach may temporarily upset the equilibrium until a reduction in eye contact or less direct body orientation restores equilibrium. Thus in the present study, subjects in the closer seating arrangement showed less body orientation toward their partner than did subjects in the farther distance. However, the results did not indicate an influence of seating distance on frequency of facial orientations although according to Patterson (1973), and Argyle and Dean (1965) an inverse relationship between interaction proximity and facial orientations should have occurred.

Both the environmental and sociometric ratings showed noteworthy effects of room size and seating distance. Regardless of stress condition (i.e., Anticipated Shock vs No Shock), subjects indicated that



most confined when they sat far apart in the small room and most free when they sat close together in the large room. These results are consistent with some recent observations by Tumarkin and Schiffenbauer (in press). That is, Tumarkin and Schiffenbauer used a magnitude-estimation scaling procedure to study relationships between physical distance and subjects' judgement of perceived closeness to another person. From each of 14 interpersonal distances (Experiment 1) and 10 interpersonal distances (Experiment 2) observers made two magnitude estimations with both a male and a female experimenter. The authors reported a significant interaction between room size and interaction distance such that at distances of 4, 10, 18, 22, and 34 inches subjects felt closer in a relatively small room (9½ ft. X 9 ft. X 10 ft.) than in a large room (15 ft. X 9 ft. X 10 ft.), while at distances of 80 and 114 inches, subjects felt closer in the large room. These results were interpreted in terms of the location of the individuals in the rooms. That is, the subjects in the small room were at the limits of the room at the 9½ ft. interaction distance, and the walls constituted boundaries that imposed spatial restrictions on the subjects and increased the perception of social distance from the other person. The large room extended 5½ ft. beyond the 9½ ft. limits of the small room, and this apparently decreased the perception of interpersonal distance. In other words, as the subject moved from a position of being very close to another person to a position 9½ ft. away, the perceptions of closeness diminished less rapidly in the large than the small room.

In the present study, the subjects sitting far in the small room

were also at the limits of the room for the 9 ft. distance, being next to the walls that constituted room boundaries and made them feel confined. However, subjects sitting close in the large room did not feel these spatial restrictions, and felt least confined because the large room extended 4 ft. beyond the 9 ft. limits of the small room.

The sociometric ratings indicated a significant interaction between seating distance and room size. In only the small room subjects judged their partner as significantly more talkative and outgoing in the close than far seating distance. These results can be interpreted with reference to the concept of proxemics (c.f. Hall, 1959; 1966) and immediacy (c.f. Wiener & Mehrabian, 1968). That is, by sitting closer or further away from one another the individual increases or decreases accessibility to others, and the closer distance increased accessibility to others and encouraged communication (Mehrabian & Diamond, 1971). It is not clear why seating distance only influenced judgments of talkativeness and "outgoingness" in the small room. Perhaps for these judgments the seating distance was more obvious or prominent in the small room (i.e., the far distance was at the extreme of the room).

Thus, the current study showed how seating distance can influence the social interaction and anxiety reactions of dyads in stressful and non-stressful situations. One crowding variable, interaction distance, influenced attitudes and behavior to a much greater extent than did another crowding factor, room size. In fact, the observed influence of interactive distance on stress ratings has applied implications for environmental designers. For example, the observation of higher stress

ratings for subjects interacting at the close than far distance is relevant for the design of certain environments such as waiting rooms in hospitals, doctor's offices, airports, bus stations and subway stations. Assuming that too much closeness will intensify ongoing anxiety feelings, hospital waiting rooms should be designed so that they minimize (as much as possible) social interaction between the patients. In a hospital waiting room, sitting close to another patient may be stressful. Seeing a sick person's expression may well arouse feelings of anxiety in someone else waiting to see the doctor. The closer you are to that person, the better you can be aware of his facial expression, his wounds, his sighs. Sitting close to a patient may also be arousing in the sense that one may talk about the pain of his toothache, stomachache, or medical treatment and such discussions may certainly increase another patient's level of anxiety.

Anxiety-minimizing waiting rooms should leave maximum space between adjacent seats. However, since the dimensions of waiting rooms are usually quite limited in size, reasonable arrangements could be made so that at least two people sitting in adjacent seats would be able to move their bodies freely (e.g., without having elbows or shoulders touching while sitting). This consideration is important for offices using fixed furniture with chairs bolted together and arranged in a theatre-style row.

The above considerations can also be applied to the design of bus or subway stations or the seating arrangement in an airport. In those settings, the seats are typically bolted together and arranged

in rows, facing the ticket counter or the passenger-boarding area. In most terminals, one is very apt to sit next to strangers that should not be readily trusted. Without control over seating distances, such a situation could be quite unpleasant. Thus, I suggest that such settings could use chairs that are not fixed, thus allowing people to regulate their interactive distance with others.

One of the recently designed subway cars in New York offers subway riders a choice of seating arrangement, thereby allowing spatial regulation between social contacts. In this subway car the seating arrangement is not the typical bench-like seat, but instead contains a variety of seating configurations. That is, seats are set apart or only two seats are bolted together. This variety of seat placement allows one to sit alone or with a friend. One may in fact choose a seat such that he or she can avoid facing another person.

Given that close interactive distance intensifies ongoing state feelings, environmental designers should take into account the fact that furniture should be designed according to the function of the particular setting and the user's needs. While more space between chairs in a doctor's waiting room may be desirable, less space between chairs in a social lounge may be more desirable.

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## Footnote

1

This sign served as a cover to justify the presence of the one-way mirror in the waiting room, implying that the mirror was used to observe infants at play. The drawings of the baby and cartoon animals on the one-way mirror were also a subtle means of labeling the area as an infant behavior laboratory, and provided an excuse for the presence of a one-way mirror.

APPENDIX A

Personal Reaction Inventory (Administered  
Before the 10-min. waiting period  
Questionnaire I)

## PERSONAL REACTION INVENTORY

Last two digits of ID NO \_\_\_\_\_

We assume that an individual's reactions to his or her surroundings change considerably over time and may be very different from the reactions of another individual. We are interested in how widely people differ in their opinion of and reactions to various situations. The value of this questionnaire is dependent upon your willingness to be thoughtful and frank in indicating your reactions, attitudes, opinions and feelings. Please be assured that your answers will be kept strictly confidential. They will NOT under any circumstances be shown to anyone other than the supervisors of this study and at that time your answers will be identified by the last two digits of your ID number. Your name will NEVER be associated with your answers.

Please circle the number along each continuum that most closely indicates your personal position at this time. Please read the extremes of each continuum carefully and note that some of the items will ask for your current feelings (that is, how you are feeling at the moment), whereas other items will ask about your feeling in general. Please answer each item in sequence and do not go back and change an answer after moving to the next item. Don't spend too much time making decisions. Your first reaction is usually the most accurate. We are grateful for your thoughtfulness during this task. Thank You.

## I. GENERALLY, I FEEL:

Tired Restful

|-----|

1      2      3      4      5      6      7      8

Happy Sad

|-----|

1      2      3      4      5      6      7      8

Calm Worried

|-----|

1      2      3      4      5      6      7      8

Insecure Confident

|-----|

1      2      3      4      5      6      7      8

Steady Nervous

|-----|

1      2      3      4      5      6      7      8

Elated Depressed

|-----|

1      2      3      4      5      6      7      8

Tense Relaxed

|-----|

1      2      3      4      5      6      7      8

## II. THIS ENVIRONMENT SEEMS:

Pleasant Unpleasant

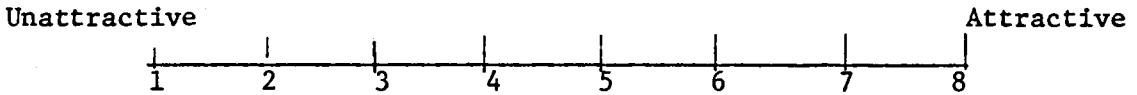
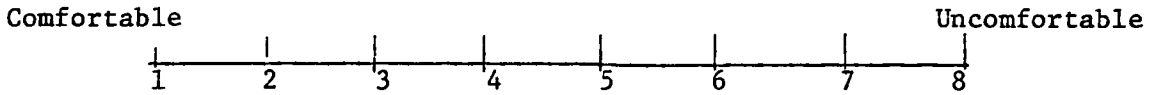
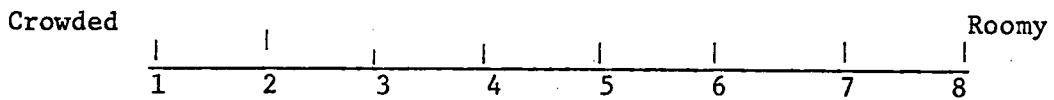
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1      2      3      4      5      6      7      8

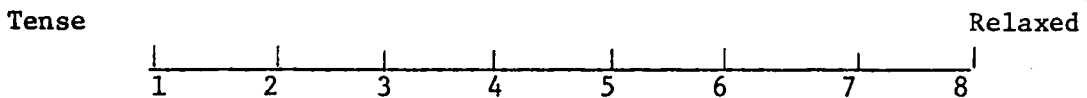
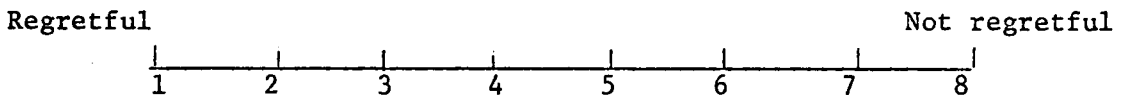
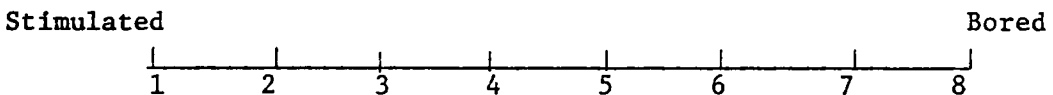
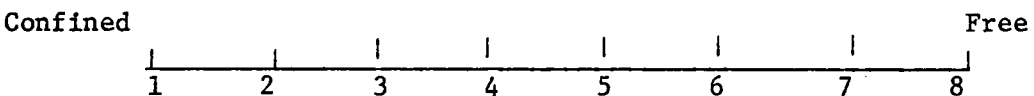
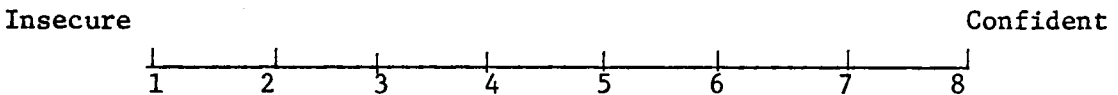
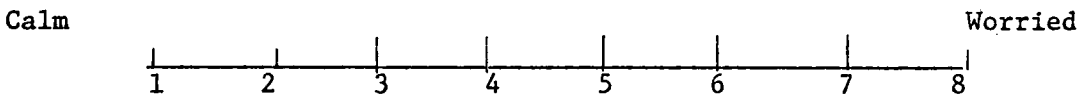
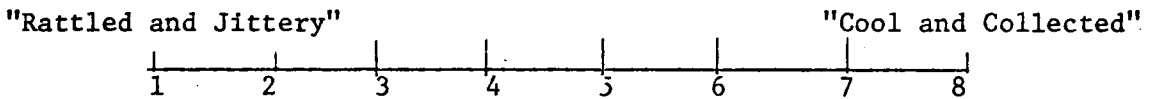
Dull Interesting.

|-----|

1      2      3      4      5      6      7      8



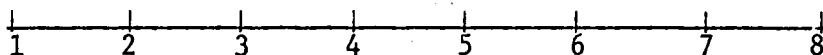
III. AT THIS MOMENT, I FEEL:



## IV. WHEN TAKING AN IMPORTANT TEST, I GENERALLY FEEL:

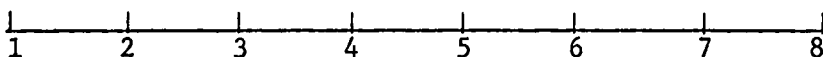
Panicky

Calm



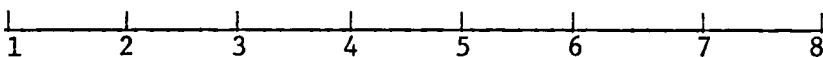
Relaxed

Tense



Worried

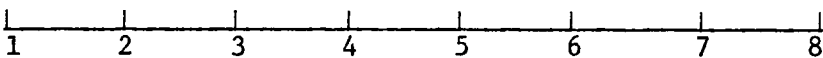
Not worried



## V. WHEN INTERACTING WITH STRANGERS, I GENERALLY FEEL:

Secure

Insecure



Self-conscious

Confident



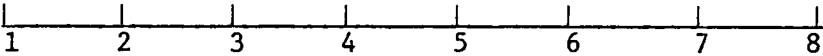
Withdrawn

Out-going



Pleasant

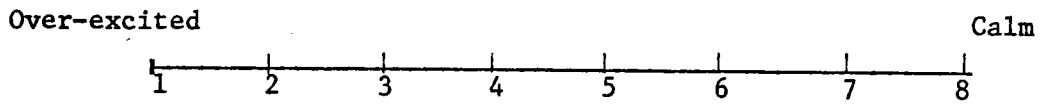
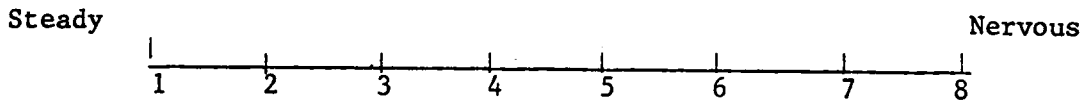
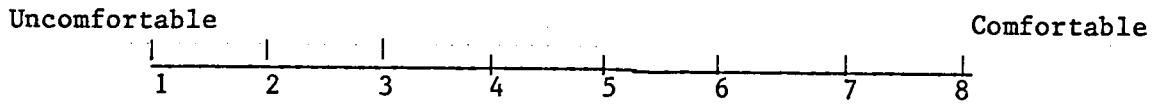
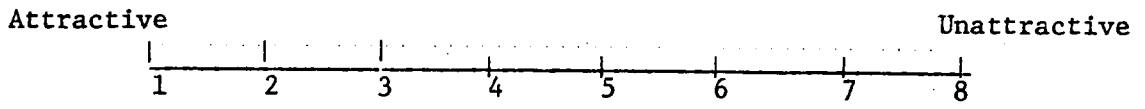
Unpleasant



Talkative

Quiet







APPENDIX B

Task Instructions for the No Shock Condition

## TASK INSTRUCTIONS

(No Shock Condition)

We are studying various aspects of the relationship between a teacher and learner. In this particular study, we want to look at the ways in which feedback affects this relationship. I am going to take you into the experimental booth in pairs. The experimental booth consists of a table divided by a screen. Both participants in the experiment will play the role of teacher for one half of the experiment and learner for the other half.

The learning task we will use involves paired associate learning. On each trial, the learner must pair certain sequences of lights by pressing a left-hand button if the sequence is correct and a right-hand button if incorrect. The "teacher" is shown the correct pairing as well as the learner's response and gives feedback to the learner after each trial. If the learner has correctly paired the sequences, the teacher will press a green button thus flashing a green light on the learner's screen. If the learner has paired incorrectly, the teacher will press a red button and a red light will flash on the screen. I will observe and record data as teacher and learner perform their tasks.

APPENDIX C

Task Instructions for the Shock Condition

## TASK INSTRUCTION

## (Shock Condition)

We are studying various aspects of the relationship between a teacher and learner. In this particular study, we want to look at the ways in which feedback affects this relationship. I am going to take you into the experimental booth in pairs. The experimental booth consists of a table divided by a screen and members of each pair will be seated on opposite sides of the screen. I will then attach electrodes to your wrists for the administration of electrical shocks. Both participants in the experiment will play the role of teacher for one half of the experiment and learner for the other half.

The learning task we will use involves paired associate learning. On each trial, the learner must pair certain sequences of lights by pressing a left-hand button if the sequence is correct and a right-hand button if incorrect. The "teacher" is shown the correct pairing as well as the learner's response and gives feedback to the learner after each trial. If the learner has correctly paired the sequences, the teacher will press a green button, thus flashing a green light on the learner's screen. If the learner has paired incorrectly, the learner will receive an electrical shock, the intensity and duration depending on how long the teacher holds down the button. The shock will be painful, but will cause no physical harm. I will observe and record data as teacher and learner perform their tasks.

APPENDIX D

Consent Form for the Shock Condition

VIRGINIA POLYTECHNIC INSTITUTE  
AND STATE UNIVERSITY

STUDENT: \_\_\_\_\_ DATE: \_\_\_\_\_

STUDENT #: \_\_\_\_\_

1. I, the undersigned, hereby consent to participate in a paired-associate session for the purpose of studying effects of feedback on personal learning.
2. I understand that I will receive some shocks which will be painful but will produce no physical harm.
3. I understand that any questions I have will be answered by the experimenter after research session.
4. I understand that my participation is voluntary and I may terminate it at any time. I further understand that my refusal to participate will have no negative effects on my grade or standing in the University.
5. I understand that I will receive one credit for each hour or part thereof which will supplement my final grade in Introductory Psychology.

Signature: \_\_\_\_\_

\_\_\_\_\_  
I have been debriefed, and I have no more questions regarding this experiment.

Signature: \_\_\_\_\_

APPENDIX E

Consent Form for the No Shock Condition

VIRGINIA POLYTECHNIC INSTITUTE  
AND STATE UNIVERSITY

STUDENT: \_\_\_\_\_ DATE: \_\_\_\_\_

STUDENT #: \_\_\_\_\_

1. I, the undersigned, hereby consent to participate in a paired-associate learning session for the purpose of studying effects of feedback on personal learning.
2. I understand that no negative consequences are expected to result from this participation except for possible fatigue.
3. I understand that any questions I have will be answered by the experimenter after the research session.
4. I understand that my participation is voluntary and I may terminate it at any time. I further understand that my refusal to participate will have no negative effect on my grade or standing in the University.
5. I understand that I will receive one credit for each hour or part thereof which will supplement my final grade in Introductory Psychology.

Signature: \_\_\_\_\_

\_\_\_\_\_

I have been debriefed, and I have no more questions regarding this experiment.

Signature: \_\_\_\_\_



APPENDIX F

Behavior Checklist for the Interval Recording

during the 10-min. waiting period

OBSERVER \_\_\_\_\_ PAGE \_\_\_\_\_ DATE \_\_\_\_\_

SUBJECT No \_\_\_\_\_ TIME \_\_\_\_\_

SUBJECT ID No \_\_\_\_\_ CONDITION \_\_\_\_\_

TIME PERIOD (10 sec. intervals)

RESPONSE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
I. Posture															
A. Sitting															
B. Standing															
C. Lying															
D. Walking															
II. ORIENTATION															
A. Face															
B. Body															
III. VERBALIZATIONS															
A. Exp. Avoidance															
B. Exp. Other															
C. Other															
IV. FIDGITING															
A. Hand															
B. Leg															
C. Body (rock, swivel)															

COMMENTS:\*

APPENDIX G

Personal Reaction Inventory (Administered  
after the 10-min. waiting period)  
(Questionnaire II)

## PERSONAL REACTION INVENTORY

Last two digits of ID number \_\_\_\_\_

Once more, we ask your cooperation in indicating your reactions along particular continua according to your current or general feelings. Remember that your answers will be confidential. Before reacting, please read each continuum carefully. As before, do not spend too much time on any one decision. Just circle the number which best describes your feelings.

## I. AT THIS MOMENT, I FEEL:

"Rattled and jittery" "Cool and collected"

1	2	3	4	5	6	7	8

Calm Worried

1	2	3	4	5	6	7	8

Insecure Confident

1	2	3	4	5	6	7	8

Confined Free

1	2	3	4	5	6	7	8

Stimulated Bored

1	2	3	4	5	6	7	8

Tense Relaxed

1      2      3      4      5      6      7      8

Regretful Not regretful

1      2      3      4      5      6      7      8

II. THIS ENVIRONMENT SEEMS:

Pleasant Unpleasant

1      2      3      4      5      6      7      8

Dull Interesting

1      2      3      4      5      6      7      8

Crowded Roomy

1      2      3      4      5      6      7      8

Comfortable Uncomfortable

1      2      3      4      5      6      7      8

Unattractive Attractive

1      2      3      4      5      6      7      8

III. GENERALLY, I FEEL:

Tired Restful

1      2      3      4      5      6      7      8

Happy Sad

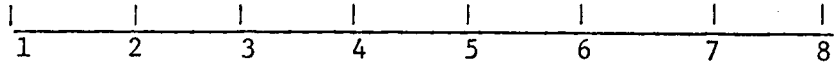
1      2      3      4      5      6      7      8

Calm



Worried

Insecure



Confident

Steady



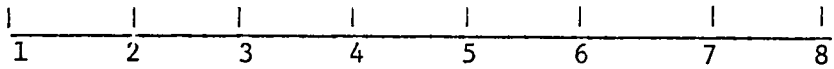
Nervous

Elated



Depressed

Tense



Relaxed

APPENDIX H

Sociometric Scale (Administered  
before the debriefing instructions were given.)

## SOCIMETRIC QUESTIONNAIRE

Last two digits of ID number \_\_\_\_\_

Indicate your current personal impression of the person with whom you have been paired in this experiment.

Like Dislike

|-----|-----|-----|-----|-----|-----|-----|-----|

1        2        3        4        5        6        7        8

Anxious Calm

|-----|-----|-----|-----|-----|-----|-----|-----|

1        2        3        4        5        6        7        8

Sociable Unsociable

|-----|-----|-----|-----|-----|-----|-----|-----|

1        2        3        4        5        6        7        8

Unattractive Attractive

|-----|-----|-----|-----|-----|-----|-----|-----|

1        2        3        4        5        6        7        8

Talkative Quiet

|-----|-----|-----|-----|-----|-----|-----|-----|

1        2        3        4        5        6        7        8

Outgoing Shy

|-----|-----|-----|-----|-----|-----|-----|-----|

1        2        3        4        5        6        7        8

Unfriendly Friendly

|-----|-----|-----|-----|-----|-----|-----|-----|

1        2        3        4        5        6        7        8



APPENDIX I

Debriefing instructions for the Anticipated Shock condition  
(given at the end of the experiment)

## DEBRIEFING

(Shock Condition)

The actual purpose of this experiment has been to determine how anxiety, or the anticipation of aversive stimulation, interacts with a variety of personality variables. These two 'subjects' (indicate observers) are actually confederates in the experiment. The three of us have been observing your behavior through this mirror. The questionnaires you filled out earlier in the session measure a variety of personality variables. This study is designed to discover how these personality variables interact to determine the individual's anxiety levels in a stressful situation, and how these anxiety levels effect subsequent behavior.

APPENDIX J

Debriefing Instructions for the No Shock condition

(given at the end of the experiment)

## DEBRIEFING

(No Shock Condition)

The actual purpose of this experiment has been to determine how a variety of personality variables interact to effect behavior in a waiting room situation. These two subjects are actually confederates in the experiment. The three of us have been observing your behavior through this mirror. The questionnaires you filled out earlier in the session measure a variety of personality variables, which we believe may be related to the way people interact and behave in a waiting room.

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ROLE OF ROOM SIZE AND INTERACTION DISTANCE  
ON STRESS-RELATED FEELINGS AND  
SOCIAL INTERACTION OF  
DYADS

by

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(ABSTRACT)

Eighty male and 80 female college students participated in an experiment to study reactions to stress as a function of room size and interaction distance. Two subjects (one male and one female) sat on stools either relatively close together (1.22m) or far apart (2.74m), in a waiting room relatively large 5.94m X 3.96m or small 2.44m X 3.96m. They completed a Personality and Environment questionnaire, received task instructions and consent forms, and then waited 10-min in the large or small room for the experimental task that involved receiving either shocks or lights as performance feedback. During the waiting period three observers watched through a one-way mirror and recorded specific behaviors of each of the subjects. After the 10-min wait, the Personality and Environment questionnaire was readministered as well as a sociometric questionnaire.

The design was a factorial of 2(Stress Conditions) X 2(Room Sizes) X 2(Seating Distances) X 2(Sex of Subject) X 2(Assessment Times). Ten

pairs of subjects were randomly assigned to one of the eight experimental conditions. The analysis of the three semantic differential items relating to current stress state (Rattled and Jittery vs Cool and Collected, Calm vs Worried, Tense vs Relaxed) indicated a significant Stress Condition X Seating Distance X Assessment Time interaction. That is, when anticipating the Shock Condition subjects showed a greater increase in stress feelings when they interacted Close than Far. No effects of sex nor room size on these stress ratings were observed. These findings supported the notion that interaction distance, and not room size, is the more prominent spatial variable associated with crowding effects.