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RELATIONSHIP BETWEEN HUMAN SPATIAL DENSITY AND SENSORY OVERLOAD, PERSONAL SPACE, PROJECTED SPACE (TERRITORIAL) REQUIREMENTS, AND PHYSIOLOGICAL ACTIVATION

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JOHN R. HACKWORTH

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RELATIONSHIP BETWEEN HUMAN SPATIAL DENSITY AND SENSORY OVERLOAD, PERSONAL SPACE, PROJECTED SPACE (TERRITORIAL) REQUIREMENTS, AND PHYSIOLOGICAL ACTIVATION

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CHAPTER I

INTRODUCTION AND LITERATURE REVIEW

Currently there has been an increasing level of concern among the scientific community over the deplorable deficiency of data relative to human behavioral change under high density conditions. Prodigious world population growth and patterns of urbanization most assuredly have contributed to the urgency of data procurement.

The universal axiom of individual uniqueness, whether biological, psychological, or sociological, would suggest that variations in response to crowded conditions would be anticipated. It is of paramount importance to examine not only possible psychological and physiological effects of crowding in man, but to also endeavor to predict individual response to crowding. This study will examine selected aspects of the above queries.

This endeavor might be appropriately termed an exploratory study, in that it is characterized by a limited sample number and techniques not firmly established by the scientific rigor of independent, repetitive validation.

Theory and Survey of the Literature

General Overview

In the literature, one encounters two usages ofthe term "population density." Density may be manipulated by varying numbers of individuals while holding space constant, or by varying allotted space while holding numbers of individuals constant. McGrew (1970) has applied the terms "social density" and "spatial density", respectively, to the two contingencies mentioned above. This terminology is adopted in the present study. It is indeed unfortunate that the literature does contain research which has not circumspectly delineated and controlled for these two elements of the term.

Almost all of the previous research on the interaction of population density and behavior has involved non-human subjects. Increases in density have been correlated with increased aggression and emotionality in rats (various species), dogs, mice, rabbits, and opossums. It has also been noted that stable hierarchies reduce these negative effects (Thiessen, 1964). Nevertheless, some investigations with animals have yielded negative results and others have not controlled for social versus spatial density effects.

Calhoun's (1966) data relating various sorts of aberrant behavior to crowding in rats caused a veritable furor when disseminated to the public. To the dismay of those fearing prompt generalization of behavioral data from lower animals to man, very little research has been conducted to substantiate such effects in man. Within the past two years, several investigators have commented on the dire lack of data in this area (Bartz, 1970; Freedman, 1971; Proshansky, Ittelson, & Rivlin, 1970).

Hutt and Vaizey (1966) studied the interaction of three group sizes (small, medium, and large) with aggression and social contact in three to eight year old children. They found aggression positively related, and social contact negatively related to increased group size. The effects were even more pronounced with brain-damaged and autistic children. Room size was held constant, thus falling into the defined category of social density. In this study, spatial effects alone were not investigated. Freedman (1971) found evidence that increased spatial density with men increases competitiveness, a jury's severity of sentencing, and dislike for other subjects. However, these effects were not observed in women, and when women were mixed with men, the negative effects were obliterated.

Kinzel (1970) in making daily clinical observations of prisoners at the United States Medical Center for Federal Prisoners, observed that physical proximity to another inmate was at least as powerful as initiator of violence as was theft, threats, and other actions.

Martin (1967) contended that a clear association exists between health and overcrowding from the British data he reviewed. Faris and Dunham (1934) have cited suggestive evidence that crowding may be an etiological factor in schizophrenia. Tsung-yi (1953) correlated mental disease with spatial density in the Chinese culture. Schmitt (1966) found that spatial density was associated with a number of measures of social breakdown including juvenile delinquency, adult crime, mental hospital admissions, illegitimate births, death rates, and venereal disease. Schmitt did attempt to control for education and income, but the adequacy of his controls has been questioned (Freedman, 1971).

Biderman et al. (1963) studied historical incidences of overcrowding in prisoner-of-war camps, slave ships, and other conditions and concluded that pathology from overcrowding occurred when there was lack of group organization or optimism.

A number of investigations have yielded results in contradiction to those reported above. Winsborough (1965), controlling for a number of factors relating to density, reported no correlation between death rate, tuberculosis rate, or public-assistance rate and density. Michelson (1968) found that various types of school achievement measures (kindergarten through third grade) were negatively associated with the number of families on the block but not with internal overcrowding. In addition, the very high density of Hong Kong (2,000 persons per acre) is not correlated with abnormally high death, disease, or crime rates (Schmitt, 1963).

Data on the relationship between increased spatial density and behavioral change in man is not only limited, but is often contradictory as well. A major objective of this study is to document and predict possible adverse behavioral change as induced by short term high spatial density conditions.

Spatial Density and Sensory Overload

Whereas the literature is replete with data on sensory deprivation (underload), data on sensory overload is extremely limited (Ludwig, 1971). Several hypotheses have been advanced to explain the stress generated by over and under stimulation. Lindsley (1965) postulated that understimulation and overstimulation disrupts the ascending reticular activating system, which in turn interferes with cortical functioning. Individual optimal levels of stimulation have been proposed by Zuckerman (1969) and Berlyne (1960), maintaining that deviations from optimal levels in either direction are adversive. The above postulations are actually descendants of the old Yerkes-Dodson Law, relating drive to rapidity of habit formation (inverted U function). Zuckerman has drawn heavily on data from sensory deprivation studies.

Miller (1960) and his colleagues have investigated information input overload on five levels of behaving systems: cell (neuron), organ (brain), individual, small groups, and larger social institutions. In nearly all instances, output rises as a linear function of input up to a certain point, where channel capacity cannot be exceeded. Beyond this point, increase in input results in a rapid drop of output performance. Hence, the inverted U function of input rate and performance appears to be valid within several system levels. They also identified and studied seven mechanisms of adjustment to input overload.

That sensory overload can result in adverse cognitive effects has been shown by Ludwig (1971) and Sato _et al._ (1970). Mild to profound altered states of consciousness were produced in about 40 percent of the normal subjects Ludwig tested with sensory overload. Lipowski (1970) asserted that approach-approach conflicts are common and distressful dilemmas engendered by modern man. Milgram (1970) has suggested that the overload concept can be aptly applied to urban living. Development of new norms (impersonality, non-involvement), highly defined and segmented roles, technical facilities, and altered cognitive function are all adaptive responses to the overload state. Milgram delineated six adaptive responses, one of which--decreasing intensity of input by filtering devices--will be utilized in the present study. The well-established psychological concept of generalization, and minimal aversion threshold (MAT) of stimuli as employed by Sullivan (1969), will also be used.

Ludwig (1971) has recently reported experimental evidence citing variations in individual preference of quality (auditory versus visual) and quantity (overload, underload) of sensory stimuli. Anecdotal evidence of variation of desirable levels of sensory input has existed for some time.

To summarize, there is some evidence that individual optimal levels of stimulation exist. Such levels are generalized and subject to variation by a number of factors. Sensory overload has been shown to be adversive to a substantial proportion of subjects tested. Since other people are typically a most important sensory source, it is quite conceivable that overcrowding will induce sensory overload, and that individuals will cope with this adversive state by decreasing all or selected sensory input. Both quantity (rate and intensity) and quality of sensory input must be considered. Our present culture exhibits not only an increased quantity of sensory input, but the quality is now more attention demanding than experienced previously. The hypercohesiveness now being fostered through enhanced communication channels in our society may not be without mixed blessings.

This study will examine the possibility that high spatial density conditions may induce sensory overload, and that senory overload may be reflected by decreases in auditory Minimal Aversion Threshold values. Decreased tolerance of sound intensities would enhance vulnerability to the well documented adversive effects of high intensity auditory stimuli (Cameron *et al.*, 1972; Rosen & Olin, 1965). Urban environments characteristically exhibit both high spatial density and high intensity noise levels.

Personal Space, Home Territory, and Spatial Density

Historically, in 1920, Howard (1920) published the first scientific study of the new parameter of territoriality in animal behavior studies. The concept of territoriality in man was introduced into sociological analysis later in the 1920's, under the label of the "ecological school". The supposition that much of human spatial behavior may be conceptual rather than physical has only recently been given attention.

Proshansky *et al*. (1970) postulated that territoriality is needed to supply biological, psychological, and sociological needs, and included both physical and conceptual levels in their examples. For example, certain occupational or social roles establish exclusive right to certain areas, on both physical and conceptual levels. Psychological needs for identify and privacy are primarily satisfied through establishment of personal territory. Gesell (1939) has stated that the need for personal territory begins at age seven.

Hall (1959) subdivided human spatial parameters into fixed, semi-fixed, and informal space. Informal space is further subdivided into public distance (12 feet or more), social distance (4-12 feet), personal distance (1.5-4 feet), and intimate distance (0-1.5 feet). Lyman and Scott (1967) categorized human territoriality differently. They distinguished four types of territory: public, home, interactional, and body, citing numerous examples of each.

The term "space (territorial) requirement" as used in the present study is a modification of Lyman and Scott's term, "home territory," and is defined as that optimal quantity of two dimensional space within which a person desires to establish intimacy and control. Examples of human territory drawn from Lyman and Scott include makeshift club houses of children, homosexual bars, public blocks which have been claimed by youth gangs, and personal dwellings. In some of these examples, it can be seen that home territory may be a subset of public territory. The compulsory diminution and restriction of the public and home territory of various racial and ethnic groups in our society is a stark reality.

Spatial requirements are relative and our early spatial perceptions appear to exert a powerful influence over later spatial needs (Clay, 1969). Such a measure as projected territory may be one means to achieve an estimate of spatial needs, and thus susceptibility to overcrowding. For purposes of this study, the territorial dimension will be measured by a form of play therapy, relying on the psychological phenomena of projection and acting out. The study will not attempt to identify nor establish relative weights of the physical, biological, psychological, and sociological variables which interact to determine an individual's spatial (territorial) requirements.

Somer (1969) has recently published a book on one category of human spatial behavior--personal space--providing an excellent source of evidence procured from very diverse sources. Somer defines personal space as an area with invisible boundaries surrounding a person's body into which intruders are forbidden. Horowitz _et al_. (1964) has emphasized the psychological protective function of personal space, employing the synonymous term "body buffer zone". Horowitz defines the body buffer zone as the area around a person within which anxiety is produced if another enters. McBride _et al_. (1965) have recorded differential Galvanic Skin Responses as functions of sex and approach angle of other individuals. Subjective discomfort reported upon invasion of personal space is thus corroborated by evidence that there is sympathetic nervous system activation. The concepts of personal distance (Hall, 1959), personal space (Somer, 1969), body territory (Lyman & Scott, 1967), and body buffer zone (Horowitz _et al_. 1964) are essentially synonymous.

Considerable evidence exists that both cultural and psychological factors are instrumental in the determination of an individual's personal space. Hall (1959), an anthropologist, has documented marked cultural differences in the use and perception of personal space. He has noted that the phenomenon of "cultural shock" occurs when people from different cultures fail to interpret correctly such non-verbal cues as personal space (Hall, 1962). Horowitz (1968) has described and documented three individual (as distinct from cultural) determinants of spatial behavior: (1) the extension of the body image into attitudes about space, (2) the expectancy or fears of certain types of interpersonal interactions, and (3) communication usage of spatial messages both in and out of awareness. Horowitz has also found considerable stability of personal space measures in short term experiments (1968). Recently, several studies have investigated the relationship between personal space and personality variables such as self-esteem, authoritarianism, and introversion-extroversion, but such data are not of paramount importance to this study. Kinzel's (1970) study relating personal space to aggression is an exception in that his findings have special implications relevant to behavior under high density conditions.

Kinzel compared the body buffer zone area of eight violent prisoners with six non-violent prisoners. The body buffer zone was calculated employing eight different approach angles (adopted from Horowitz), and measurements were taken at weekly intervals for twelve weeks. Results revealed: (1) zones were significantly greater in violent prisoners (four times as large), (2) the rear zones were larger than the front zones in the violent group, the opposite case held for the non-violent, (3) the size of zones of both groups decreased with time (familiarity with experimenter), and (4) the zone shape of violent prisoners changed over time, the size of the rear zone relative to the front zone decreased abruptly.

Meisels and Guardo (1969) studied the development of personal space in children, grades three to ten, with silhouette figures. With this semi-projective technique, they found that children use less space as they grow older, and that personal space varies as a function of age, sex, and affect. The authors assert that their data correlates well with sociological data of these age ranges.

Thus the following evidence concerning personal space exists: (1) it is a universal, real phenomenon, (2) inter-individual dimensions of personal space vary in size and geometric shape, (3) the variables of age, sex, affect, and culture are all important, (4) personal space exhibits a developmental history, and (5) violation of an individual's personal space creates anxiety or anger. In view of this evidence, personal space dimensions may be of considerable significance under conditions of increased spatial density.

The evidence suggests that personal space and territorial measures may be employed to predict differential reactions to high spatial density. Specifically, those subjects with high territorial and personal space requirements would be expected to experience greater discomfort under high spatial density than those requiring low personal space and territory. There is also suggestive evidence that high personal space and territorial subjects may be more disposed to experience sensory overload from high spatial density conditions than low personal space and territorial subjects. Both of these possibilities will be examined in this study.

Physiological Effects of Spatial Density

The physiological effects of increased population density have been extensively studied in a number of animals. Correlations between increased density and physiological response include: increased anterior pituitary weight, hypertrophy and hyperplasia of adrenal cortex and medulla, increased glucocorticoids, increased ACTH, thymus involution, decreased weight, decreased inflammatory response, decreased antibody production, decreased gonadotropin titers, retardation of ova maturation, failure of ova to implant, decreased lactation, and decreased litter size. An excellent and thorough review is provided by Thiessen (1964). If one assumes that increased spatial density is a stressor interacting with the central nervous system (in particular, the hypothalamus), such a diverse array of effects becomes intelligible. Interference with some of the hypothalamic releasing factors, particularly corticotropin-releasing factor (CRF) and follicle-stimulating hormone-releasing factor (FSHRF), would be expected to produce a myriad of effects. Prolonged sympathetic nervous system activation could also elicit a number of the observed effects. Population regulation in many instances can be best explained by considering density as a stressor, with the central nervous system serving as a mediator between density and somatic response. Contrary to common opinion, population declines are not always associated with inadequate food supply, environmental intoxication or communicable disease.

There exists voluminous material on the physiological effects of stressors on man. Regrettably, the data are infiltrated with inadequate measuring techniques, lack of adequate controls, and unjustified conclusions. Sternbach (1966) cautions potential researchers in this field that the correlation between central, autonomic, and motor indices of activation may be poor, and that considerable interindividual variation of responses exists.

Rises in systolic and diastolic blood pressures, as well as heart rate increases, would be expected under sympathetic nervous system activation during stress. It is also important that, whereas norepinephrine effects do include increases in both systolic and diastolic pressures, epinephrine typically decreases diastolic pressure while increasing systolic. The physiological effects of catecholamine release under sympathetic nervous system activation have been shown to be evident almost immediately, and significant quantities of glucocorticoids are released within 15-60 minutes (DiGiusto *et al*. 1971).

This study will document possible sympathetic nervous system activation under high spatial density conditions by recording changes in heart rate and blood pressure as functions of spatial density conditions.

Hypotheses

1. It is postulated that high spatial density may induce sensory overload, and that such overload may generalize

to other sensory modalities. Mean Minimal Aversion Thresholds (MAT) for auditory stimuli will be significantly less following conditions of high spatial density than means following conditions of normal spatial density.

A. High density is operationally defined as 10-15 square feet per child.

B. Normal density is operationally defined as 20-25 square feet per child (Oklahoma classroom suggested minimum).

2. Subjects differentiated on the basis of upper versus lower ½ personal space requirements will significantly differ in mean value of:

A. MAT values under high and normal spatial densities.

B. Feeling state discomfort under high and normal spatial densities.

3. Subjects differentiated on the basis of upper versus lower ½ of projected space (territorial) requirements as determined by play therapy will exhibit significant mean differences in:

A. MAT values under high and normal spatial densities.

B. Feeling state discomfort under high and normal spatial densities.

4. Positive correlation will exist between personal space and projected space (territorial) requirements.

5. Significant mean differences in heart rate and diastolic and systolic blood pressure will be evidenced under high and normal spatial densities.
6. Feeling state discomfort, as measured by model room size change X intensity, will be significantly greater under high density conditions than low density conditions.

Definitions

1. Minimal Aversion Threshold for auditory stimuli is defined as that intensity of white sound which is subjectively experienced as annoying or bothersome.
2. Personal space is that area around a person within which anxiety is produced if another enters. It represents the boundaries to what is felt as "inner" versus what is felt as "outer".
3. Projected space (territorial) requirement is that optimal quantity of two dimensional space within which a person desires to establish intimacy and control.

Significance of the Study

1. Prodigious world population growth, increased urbanization, increased construction of high density apartment complexes and nursing homes, increased class sizes, and congested prisons are just some of the conditions which warrant acquisition of data on possible behavioral effects of high density conditions in man. Additionally, there exists a need to distinguish spatial density effects from

those of social density. This study will provide measures of possible overt and covert effects from high spatial density conditions.

2. Presently there exists only speculation that urban environments induce sensory overload, particularly affecting those individuals foreign to such environments. This study will provide data which may aid in establishing validity to this proposition. Changes in Minimal Aversion Threshold values may provide a sensitive indicator of possible sensory overload engendered by conditions of high spatial density, and may find applicability in various other types of research.
3. Measures of personal space and territory needs may prove valuable as simple predictive instruments of psychological discomfort incurred from a given density condition.
4. The data should provide information regarding preferred density conditions with selected elementary school boys. Data gathered will provide some measure of the range and intensity as evidenced in this particular population.
5. Data obtained from this form of interdisciplinary research might be of value in delineating future productive, in depth avenues of research in population behavior.

CHAPTER II

RESEARCH METHODS

Population

The population chosen for this study consisted of 26 boys, with an age range of 8 years to 14 years. Age distribution was as follows: 8 yrs - 3, 9 yrs - 6, 10 yrs - 4, 11 yrs - 2, 12 yrs - 4, 13 yrs - 3, and 14 yrs 4.

Subjects were members of families attending the Summer Institute of Linguistics at the University of Oklahoma, Norman, Oklahoma. All the families represented were members of the Wycliffe Bible Translators, and represented a variety of professions within the above organization.

During the day subjects were under the supervision of two college-age boys and were permitted considerable freedom of activity.

Sixteen of the boys had spent approximately 10 days together prior to experimental intervention. The remaining 10 had arrived 6 days prior to invervention.

In terms of activity levels, interests and intelligence, subjects appeared to be quite normal.

A brief questionnaire was designed and administered to provide information on such variables as residence, grade levels, number of siblings, geographic mobility, and father's occupation (Appendix A). Subjects were separated to minimize interactions during questionnaire administration. All the questions were read aloud and time was allocated for individual clarification following each question.

Initial Organization

Prior to the collection of data, a general meeting was held with the subjects in order to facilitate cooperation and punctuality. Subjects were advised that the "information gained during the following days would be important to other boys like themselves." It was stressed that the sessions to follow were not tests of any sort and that there were no "right" or "wrong" answers. It was also stressed that it would be imperative that the boys not discuss any of their personal responses with anyone else in the group. Subjects were additionally informed that they would really enjoy many of the activities to come, but that punctuality and accurate following of directions was essential. Additional reinforcement was provided in that all subjects displaying satisfactory cooperation were to be given their choice of desserts following the last experimental session. This proposed contract was greeted with unanimous, enthusiastic approval.

Measures of personal space and internal need for physical space (territory) were obtained prior to experimental density conditions as pretest data. Personal space and territorial measures served as independent variables and were used to predict variation in response under high and normal density conditions.

Measurement of Personal Space

The direct measurement of personal space was patterned after a method employed by Frankel and Barrett (1971). Two intersecting strips of masking tape were placed on the floor of a room 30 feet x 15 feet. The tape intersected at right angles, one strip parallel to the width and the other parallel to the length of the room. Subjects were brought into the room individually. Subjects from 8 to 10 years old were approached by a 9-year-old boy who was unknown to them. Subjects of ages 11 to 14 were approached by another boy, aged 13. The 13-year-old boy was also a stranger to the subjects. The use of two different aged boys was designed to reduce the predicted effects physical size might evoke in determining personal space. The 9 and 13-year-old boys used in the experiment were of average appearance and demeanor.

Each subject was measured individually. Upon entering the room the subject was instructed to stand at the intersection of the floor tapes. Then he was told that the closeness of other people can effect body balance, and that one of the first signs of loss in balance is a feeling of being uncomfortable or bothered. Each boy was also informed that a stranger would approach him from the front, side, and back. They were to remain looking forward at all times. As the stranger approached from the three directions, each subject was requested to report initial uncomfortable or bothered sensations by saying "now". At this point the approach was terminated and the distance was marked and later measured. Complete instructions are given in Appendix B.

Personal space was also measured by a semi-projective technique as reported by Guardo (1969). Subjects were taken outside and seated on the playground. Each was given a sheet of paper with a cut out silhouette securely placed along a baseline (representing ground level). Each was then given another silhouette of equal size and requested to pretend that the additional silhouette represented themselves. Self-referent figures were to be taped on the baseline. They were told that a situation would be described to them, and that they were to indicate where they would be standing relative to the other figure. The test situation was "This is a boy in your class that you sometimes play with". An example was presented before actual testing was initiated and all questions were answered. Silhouette distance was measured in centimeters as nose to nose distance. The reader is referred to Appendix C for the exact instructions administered.

<u>Measurement of Internal Need for Space (Territory)</u>

Internal need for space was measured by a form of play therapy. Measurements were taken individually in the subjects' recreation room. Room dimensions approximated 30 feet x 40 feet.

Subjects were escorted to the center of the room and shown a cabin made of Lincoln logs with scaled figures of a boy, a dog, and a picnic bench outside the cabin. These figures were provided to control for figure-ground discrepancies. Each subject was asked to imagine himself as a pioneer, the cabin (pointed out) was his home, and he was in the process of constructing a fence around his land.

Subjects were informed that they could use as much or as little land as they wished, and that the entire floor was available land. Cardboard strips were utilized by the subjects to designate the fence boundaries in the four directions. After the subject left the room, the four distances to the cabin were measured.

Complete instructions are presented in Appendix D.

Measurement of Density Effects

Two adjacent rooms in the first Baptist Church of Norman, Oklahoma were used to induce high and normal density conditions. The rooms measured 10' x 26', and 33' x 18' respectively. High density conditions approximated 10 square feet per child; normal density approximated 23 square feet per child; The two rooms were very similar in architecture. Curtains were drawn to prohibit outside distractions. Temperature was held constant in the two rooms by a large central air-conditioning unit; the thermostat being carefully monitored. During the experimental sessions all doors remained closed to retain constancy of room size.

In order to control for activity level variation within the two rooms, art and craft sessions were conducted during all of the trials by an experienced art student. Art materials included clay, drawing paper, crayons, wooden sticks, glue, and assorted materials to design collages. Time required for initial group leadership was equally distributed between the two rooms. The subjects' two supervisors were also present to aid in maintaining order and facilitating measurement.

Experimental sessions were conducted over a time space of six days. The first day was designed to facilitate the subjects' adjustment to the novel environment, art and craft procedures, and to the mechanics of room change. Consequently, no measurements were taken at this time. During the second day, instruction and recording of all data were introduced. Measurement was terminated after the sixth day due to increased enmity expressed by some in regard to the art and craft sessions and the repetitiveness of some of the measures. It was ascertained that additional sessions would only further antagonize some of the subjects and increase the level of artifact within the data. There was a three day "intermission" between trials 1 and 2, and trials 3 and 4.

Subjects were initially given instructions that each of the art and craft sessions would last 40 minutes, at which time the group would have to move to the adjacent room. They were informed that such a move was mandatory because there were other groups in the church that might have to use the room and that it was important to procure some of the information from both rooms.

Blood Pressure and Heart Rate

Subjects were informed that another man would take their blood pressure and heart rate at various times. Blood pressure procedures were demonstrated and they were assured that it would not inflict any pain. To further diminish anxiety, subjects were informed that the astronauts have their blood pressure taken almost continuously during flights. They were also told that their heart rate would be recorded by holding their wrists for a few seconds. One subject at a time was removed from the room to record heart rate and blood pressure. Recordings were initiated 30 minutes into each 40 minute density condition. Subjects were assigned on a random basis to one of four groups, with eight subjects per group. Heart rate and blood pressure data from one group of eight subjects were obtained following both density conditions for each day. The order in which subjects were measured within a single group was varied to mitigate bias due to anticipation.

MAT Value Measurement

Minimal Aversion Threshold values were obtained in a manner modified from that of Sullivan (1969).

A white sound tape amplified through an Ampex Power Amplifier was utilized as a sound source. White sound was selected because it offers simultaneous presentation of all frequencies, and is tailored to conform closely to the sensitivity of the ear. Sound levels were calibrated in 5 decibel increments, ranging from 55 to 95 decibels. A type 1565-A sound level meter was employed to calibrate the decibel levels at a radius of 7 feet from the amplifier speaker. The A weighted scale was used in the calibration and independent calibrations were conducted within each room. The smaller room required a comparatively lower volume setting to achieve an equivalent sound level as generated in the larger room.

Immediately following the completion of blood pressure and heart rate measures under both density conditions, subjects were requested to sit in a circle comprising a radius of approximately 7 feet from the amplifier speaker. The speaker was placed in a horizontal position to equilibrate directional output. Subjects were requested to sit facing outward, thus minimizing social interaction. Paper and pencils were supplied to each subject, and they were informed that a tape would be played unlike any they may have heard previously. They were informed that the sound intensity would increase in intervals, and that each interval would be identified by a number. Subjects were cautioned that the numbers were not in order, and that they were to designate the first sound level that began to annoy or bother them by recording that number on paper. They were admonished that this exercise was not related to how much noise they could tolerate, and that their preference might change from one time to another. Exact directions are presented in Appendix E.

Feeling State Discomfort Measures

Two separate assessments of feeling state discomfort induced by normal and high spatial density were obtained in order to provide a more accurate appraisal of real levels. After each spatial density condition, subjects were provided an opportunity to project any discomfort engendered by altering one dimension of scaled room-size models. Models consisted of scaled two dimensional drawings of each room density, with circles drawn within the scaled rooms to represent the people present within each condition. The circles were also drawn to scale in an attempt to accurately portray the high and normal spatial density conditions. The scaled models measured 9 inches x 14.5 inches (high), 25 inches x 13 inches (normal). Considerable effort was expended initially to explain the concept of scaled models and examples were given comparing various actual room densities with corresponding model densities. Subjects were told that as builders they could increase, decrease, or retain the same dimensions of the room they were in. The model room was drawn on one end of brown utility paper so that those subjects desiring an increase could simply roll out the paper and draw a line to designate the new room boundary. Subjects were permitted a maximal increase of 18 inches, enough range to augment discriminatory powers. Room size changes were measured in centimeters, from the midpoint of the subjects' lines.

To arrive at some measure of the intensity of feeling concomitant with the model room size alterations, subjects were asked to designate on the same paper a number ranging from 1 to 5 which represented the strength or intensity of their convictions to alter the room size. Five was designated as "very much", 4 - "much", 3 - "medium", 2 - "little", 1 - "none". Complete instructions are presented in Appendix F.

The product of the model room dimensional change and intensity component (numerical scale rating) was employed to quantify the feeling state discomfort induced by the two spatial density conditions.

Additional Measurement

Information was obtained after the experimental density trials relative to level of enjoyment of arts and crafts sessions, like/dislike of other members of the group, and degree of preference for the large or small room. A similar 5 point scale as previously administered was utilized to assess degrees of position. These questions were incorporated as a component of the demographic questionnaire previously cited.

CHAPTER III

RESULTS

Sample Population

Data on subject's age, father's occupation, number of brothers and sisters, geographic region where majority of life was spent, and educational level are presented in Table 1.

TABLE 1

SELECTED DEMOGRAPHIC INFORMATION ON SAMPLE POPULATION

Subject	Age	Resided majority of life	Father's occupation	Parental time with Wycliffe (years)	Number of siblings	Grade entering
1	12	Tulsa, Okla.	Maintenance	0	2	8
2	9	Mexico	Translator	17	4	5
3	14	Atlanta, Ga.	Industrial manager	0	3	9
4	10	Atlanta, Ga	Industrial manager	0	3	5
5	8	Montana	Translator	6	3	3
6	12	Mexico City	Teacher	23	2	7
7	14	North Carolina	Teacher	4	1	9
8	8	Santa Paula, Calif.	Maintenance	0	2	4
9	11	Santa Paula, Calif.	Maintenance	0	2	6

TABLE 1--Continued

Subject	Age	Resided majority of life	Father's occupation	Parental time with Wycliffe (years)	Number of siblings	Grade entering
10	11	Lake Norden, S.D.	Teacher	5	2	6
11	9	Columbia	Translator	19	2	4
12	14	Mexico City	No legal parents		2	8
13.	12	Atlanta, Ga.	Rental property	0	4	7
14	9	Atlanta, Ga	Rental property	0	4	4
15	14	Cocoa Beach, Fla.	Teacher	0	5	9
16	9	New Guinea	Translator	0	3	3
17	13	Mexico	Translator	14	3	8
18*	9					
19	10	Warsaw, N.C.	Pilot	31	2	5
20	9	Lansdale, Pa.	Teacher	0	2	5
21	13	Cedar Rapids, Iowa	Radio technician	0	2	9
22	12	Mexico	Translator	21	4	6
23	10	Costa Mesa, Calif.	Translator	3	2	5
24	13	New Guinea	Translator	13	2	9
25	10	Riverside, Calif.	Unknown - Divorced	0	3	5
25	8	Bolivia	Secretary	20	2	4

* Left prior to termination of study.

The results reveal that 9 out of 25 subjects (36 percent) have spent the majority of their life outside of the United States. Approximately 25-30 percent of subjects would be characterized as having considerable urban experience, although the validity of this figure could easily be challenged on the basis of inadequate supplemental information. The subject population might truly be characterized as culturally diverse.

The occupations of the subjects' fathers are similarly diverse. A minimum of eight different occupational areas are represented with translators (eight) and teachers (five) being the most predominant numerically.

Twelve parents of a possible 24 (50 percent) had just recently joined the Wycliffe Bible Translators organization. One subject from Mexico City had no legal parents, and another left prior to the termination of the experiment. Parents of the remaining 12 subjects were employed by Wycliffe for a mean of 14.7 years.

The average number of siblings was 2.7, with a range of 1 to 5.

Personal Space

Data obtained from direct and semi-projective techniques employed to determine personal space is presented in Appendix G. The coefficient of correlation of these two techniques was significant ($r = .446$, $p < .05$), even though the social stimulus situations were not identical (Table 2A).

The direct measuring of personal space was based on mean distance between subject and stranger, whereas the semi-projective measure was based on projected distance between subject and a "boy you sometimes play with." Additionally, the direct measures were obtained in a large closed room; the semi-projective measures obtained in a playground area. Thus the correlation of these two procedures must necessarily be qualified.

The extraordinary range of inter-individual personal space requirements (direct measures) in the age group examined is in contrast to the more limited range of equivalent measures reported on adults by Hall (1959), Horowitz (1964), and others. The intra-individual variation in personal space distance as a function of direction (front, side, back) was also of considerable magnitude. Thirty-five percent of the 26 subjects examined expressed no anxiety or discomfort from the three directional approach of a stranger approximating their respective age. These subjects did not halt the approaching unfamiliar boy from any of the three directions. Six of these subjects were between 11 and 14 years old, and three were between 8 and 10 years old.

A qualification is in order as two subjects who did not verbally stop the advance of the stranger did express non-verbal anxiety and discomfort in the form of loss of eye contact, fidgeting, and shift of body position. The two subjects were 13 and 14 years old, which would amend the above totals of subjects expressing no personal space violation to four subjects between 11 and 14 years old and three subjects between 8 and 10 years old. The percentage expressing no personal space violation would be decreased to 27 percent.

TABLE 2

A. RELATIONSHIP BETWEEN DIRECT AND SEMI-PROJECTIVE MEASURES OF PERSONAL SPACE

	Personal space (direct)	Personal space (semi-projective)
Mean:	18.36 in	5.42 cm
SS:	8019.04	479.93

y = 8.476 + (1.824) X
RR = .199
r = .446

B. RELATIONSHIP BETWEEN SEMI-PROJECTIVE MEASURES OF PERSONAL SPACE AND AGE

	Personal space (cm)	Age
Mean:	5.42	10.81
SS:	479.93	93.41

y = 10.59 + (-.466) X
RR = .043
r = -.208

C. RELATIONSHIP BETWEEN MEAN THREE DIRECTIONAL PERSONAL SPACE (DIRECT) AND AGE

	Personal space (inches)	Age
Mean:	18.36	10.81
SS:	8019.04	93.41

y = 34.29 + (-1.466) X
RR = .024
r = -.158

The group mean personal space requirement as measured directly was 17.8 inches. The range was from a mean of 4.7 inches to 79.3 inches. The means cited above are based on pooled data from all three directional approaches. A median split was performed to subdivide the subjects on the basis of mean three directional personal space requirements. The resultant lower one-half group mean personal space requirement was 5.2 inches; the upper one-half group mean was 30.2 inches.

Group means of each directional approach were: front, 17.3 inches; side, 14.5 inches; and back, 21.7 inches. Directional ranges were: front, 4-69 inches; side, 5-66 inches; back, 5-114 inches. The data did not reveal any consistent inter-subject rank order patterns relative to front, side, and back personal space requirements.

Mean personal space, as measured by the semi-projective technique was 5.2 cm, with a range of .7 cm to 14.8 cm (n = 26). A mean of 5.4 appears in the data analyzing of Table 2, where n = 25.

The relationships between personal space and age are summarized in Tables 2B and 2C. Spearman Rank Order Correlation Coefficient values of both personal space measuring techniques and age were negative, suggesting the possibility of an inverse relationship. However the correlations were not significant.

Spatial (Territorial) Measures

The subjects responded to the opportunity to enter the fantasized pioneer environment with fervor. The range of spatial dimensions circumscribed as "their own land" was of considerable magnitude; from .0001 square feet to 1,164 square feet (Appendix H). The mean was 112.3 square feet. The group means for each territorial dimension were: front, 46 inches; side 1, 42 inches; side 2, 46.5 inches; back, 47 inches. Although group dimensional means were very similar, there was considerable variation between subjects. Ten subjects designated the front dimension as the largest, four designated side 1, four designated side 2, and seven designated the back.

A Spearman Rank Order Correlation Coefficient test was selected to examine the relationship between territorial measures and age. Territorial measures did exhibit a significant ($r_s = -.386$, $p < .05$) inverse relationship with age (Table 3A).

The relationship between territorial measures and personal space (both direct and semi-projective) is presented in Tables 3B and 3C. The correlations were not significant, in opposition to experimental prediction (Hypothesis 4).

Density Condition and Feeling State Discomfort

A comparison of feeling state discomfort under high and normal density conditions, as measured by model room

TABLE 3

A. RELATIONSHIP BETWEEN SPATIAL (TERRITORIAL) REQUIREMENTS AND AGE

n	Mean age	Σdi^2
24	10.8	3144.00

Spearman rank order, corrected for ties.

$$r = \frac{\Sigma x^2 + \Sigma y^2 - \Sigma di^2}{2\sqrt{\Sigma x^2 \quad \Sigma y^2}}$$

$r_s = -.386$

$p < .05$

B. RELATIONSHIP BETWEEN SPATIAL (TERRITORIAL) REQUIREMENTS AND PERSONAL SPACE (DIRECT)

n	Mean age	Σdi^2
27	10.8	2256.00

$$r_s = \frac{1 - 6 \cdot \Sigma di^2}{n^3 - n}$$

$r_s = \Sigma\ .02$

p = N.S.

C. RELATIONSHIP BETWEEN SPATIAL (TERRITORIAL) REQUIREMENTS AND PERSONAL SPACE (SEMI-PROJECTIVE)

n	Mean age	Σdi^2
24	10.8	2626

$r_s = -.10$

p = N.S.

size change (cm) X intensity of associated feeling, is presented in Table 4.

TABLE 4

COMPARISON OF MODEL ROOM SIZE CHANGE (CM) X INTENSITY VALUES UNDER NORMAL AND HIGH DENSITY CONDITIONS

		Normal density	High density
Mean:		50.08	62.23
n = 24	Var = 772.96		
STD = 27.80	STD ERR = 5.68		
Max = 57. 5	Min = -90.2	Range = 147.70	
t = 2.14			
$p < .05$			

The overall mean for all subjects for model room size X intensity was 50.08 under normal density conditions and 62.23 under high density conditions. This difference was significant ($p = 2.14$, $p < .05$), thus confirming Hypothesis 6 that feeling state discomfort, as measured by model room size X intensity, would be significantly greater under high spatial density than normal spatial density. Standard deviation was 27.8, with a range of 147.7.

Sixteen subjects exhibited a mean increase (+25) in model room size X intensity values under crowded conditions as contrasted to normal conditions. Eight subjects scored a mean decrease of -12.8 under the high spatial density condition. However five of the latter eight scores were under 6.0. It is noteworthy that intensity and room size change ratings were not always in concordance. For example, there were subjects registering large increases in their models with minimal levels of intensity. Occasions of small increases in room size associated with maximal intensity of feelings were also recorded.

The mean increase of feeling state discomfort levels reported above was corroborated by evidence gained from the terminal questionniare administered whereby 67 percent of the subjects rated the larger room as more favorable by at least a margin of four on a five point scale. The skewed distribution of the scale ratings, from 1 (not at all) to 5 (very much) can be appreciated below.

Scale rating	Frequency
1	0
2	2
3	4
4	7
5	9

One subject rated both rooms of equal preference, and another preference and another stated a preference for the smaller room by a rating of "2".

The subjects expressed no overt resentment of confinement within the high spatial density condition, nor of compulsory room change during their art and crafts sessions. Thus, even though the suujects expressed an overall preference for the normal density conditions by both model changes and questionnaire, the magnitude was not prodigious nor was the preference universal.

Density Condition and Personal Space Requirements

Summary data of relationships between personal space and feeling discomfort engendered by normal and high spatial density conditions is presented in Tables 5A, 5B, and 6A, 6B. Neither direct nor projective measures were statistically associated with differential feeling state discomfort under high and normal spatial density conditions. Thus hypothesis 2B, that high and low personal space subjects would differ significantly in feeling state discomfort under high and normal spatial density, was not supported.

Subjects within the upper one-half of personal space measures (semi-projective) were characterized by higher mean values of feeling state discomfort from normal to high spatial density: 9.4 with low personal space subjects and 14.3 with high personal space subjects. This is reflected in the cell and marginal means presented in Table 5A. A relatively large intersubject variation is evident by the large error term.

An analogous median split of subjects into low and high personal space (as measured directly) is presented in Table 5B. Mean increases in model room change X intensity values from normal to high density were 17.73 for low personal space subjects and 6.54 for high personal space subjects. This pattern is in opposition to that established with subjects subdivided on the basis of semi-projective personal space requirements. As previously cited, these mean differences were not significant.

TABLE 5A

ANOVA--THE RELATIONSHIP BETWEEN SEMI-PROJECTIVE MEASURES OF PERSONAL SPACE AND FEELING STATE DISCOMFORT (MEASURED BY MODEL ROOM CHANGE X INTENSITY) UNDER HIGH AND NORMAL SPATIAL DENSITY

Source	df	SS	MS	F
Group (High & low personal space)	1	1124.24	1124.24	.373
Subject $_w$ Group	22	66313.50	3014.25	
Discomfort (high & normal density)	1	1767.83	1767.83	4.41[a]
Group X discomfort	1	72.28	72.28	.180
Subj X discomfort $_x$ group	22	8834.22	401.56	

a $p < .05$

Cell & marginal means

	Discomfort (Normal density)	Discomfort (High density)	
Low personal space	46.78	56.15	51.5
High personal space	54.00	68.29	61.1
	50.4	62.2	

TABLE 5B

ANOVA--THE RELATIONSHIP BETWEEN DIRECT MEASURES OF PERSONAL SPACE AND FEELING STATE DISCOMFORT (MEASURED BY MODEL CHANGE X INTENSITY) UNDER HIGH AND NORMAL SPATIAL DENSITY

Source	df	SS	MS	F
Group (High & low personal space)	1	27.76	27.76	.009
Subject $_w$ group	22	67628.59	3074.03	
Discomfort (normal & high density)	1	1767.83	1767.83	4.57[a]
Group X discomfort	1	375.76	375.76	.972
Subj X discomfort $_w$ group	22	8504.19	386.55	

a $p < .05$

Cell & marginal means

	Discomfort (Normal density)	Discomfort (High density)	
Low personal space	48.05	65.78	56.9
High personal space	52.13	58.67	55.4
	50.1	62.2	

Additional analyses were performed to further examine the relationship between personal space and feeling state discomfort. Feeling state discomfort was assessed on the basis of model room size change alone. Equivalent statistical analyses (2 factor ANOVA) supported the prior finding of no significant interaction between personal space requirements and feeling state discomfort under normal and high spatial density (Tables 6A and 6B).

TABLE 6A

ANOVA--THE RELATIONSHIP BETWEEN SEMI-PROJECTIVE MEASURES OF PERSONAL SPACE AND FEELING STATE DISCOMFORT (MEASURED BY ONLY MODEL ROOM CHANGE) UNDER HIGH AND NORMAL SPATIAL DENSITY

Source	df	SS	MS	F
Group (High & low personal space	1	4.88	4.88	.046
Subject $_w$ group	22	2285.90	103.90	
Discomfort (normal & high density)	1	55.69	55.69	2.92
Group X discomfort	1	16.22	16.22	.85
Subj X discomfort $_w$ group	22	419.24	19.06	

Cell & marginal means

	Discomfort (Normal density)	Discomfort (High density)	
Low personal space	13.48	14.47	13.97
High personal space	12.95	16.27	14.61
	13.21	15.37	

TABLE 6B

ANOVA--THE RELATIONSHIP BETWEEN DIRECT MEASURES OF PERSONAL SPACE AND FEELING STATE DISCOMFORT (MEASURED BY ONLY MODEL ROOM CHANGE) UNDER HIGH AND NORMAL SPATIAL DENSITY

Source	df	SS	MS	F
Group (High & low personal space)	1	3.58	3.58	.034
Subject $_w$ group	22	2287.20	2287.20	
Discomfort (normal & high density)	1	55.69	55.69	2.83
Group X discomfort	1	2.48	2.48	.126
Subj X discomfort $_w$ group	22	432.98	19.68	

Cell & marginal means

	Discomfort (Normal density)	Discomfort (High density)	
Low personal space	13.26	15.76	14.56
High personal space	13.17	14.87	14.02
	13.21	15.37	

Density Condition and Spatial (Territorial) Requirements

Subject territorial measures were not associated with differential effects under high and normal spatial density conditions, as was predicted. A two factor analysis of variance revealed no significant difference between groups (median split of territorial measures) nor in the interaction between territory measures and room density discomfort values (Table 7). As previously cited, the pooled mean feeling state discomfort, as measured by model room change X intensity, was significantly ($p < .05$) greater under high spatial density than low spatial density.

TABLE 7

THE RELATIONSHIP BETWEEN SPATIAL (TERRITORIAL) REQUIREMENTS AND FEELING STATE DISCOMFORT (MEASURED BY MODEL ROOM CHANGE X INTENSITY) UNDER HIGH AND NORMAL SPATIAL DENSITY

Source	df	SS	MS	F
Group (High & low territory)	1	1816.71	1816.71	.607
Subject $_w$ group	22	65839.63	2992.71	
Discomfort (Normal & high density)	1	1767.83	1767.83	4.69[a]
Group X discomfort	1	594.32	594.32	1.57
Subj X discomfort $_w$ group	22	8285.63	376.62	

a $p < .05$

Cell & marginal means

	Discomfort (Normal density)	Discomfort (High density	
Low territory	59.76	64.86	62.3
High territory	40.42	59.59	50.0
	50.1	62.2	

Mean feeling state discomfort values under normal and high density conditions were actually greater with low territory subjects than with high territory subjects. Low territory subject mean under normal density was 59.76, whereas high territory subject mean was 40.42. Analogous means under crowded conditions were 62.3 and 50.0, respectively. In contrast, the mean increase in discomfort scores from normal to high density was 19.17 for high territory subjects, and 5.10 for low territory subjects.

Sensory Overload--MAT Values and Spatial Density

Initial difficulty was experienced in the mechanics and comprehension of tasks involved with this component of the experiment. As previously mentioned, the data from the initial trial was not included in the analysis. Difficulties were only minimal for the remainder of the experimental trials. It was apparent, however, that the subjects were experiencing increased resentment relative to this aspect of the experiment as the terminal experimental session was conducted. Therefore the analyses were performed not only on data derived from the combined total of experimental sessions (Trials 1, 2, 3, 4), but from only trial days 1 and 2 as well. The first two trial days were selected on the basis of probable increasing artifact level occurring during the latter trials due to resentment.

A three factor ANOVA was selected to examine possible differences and interactions between subjects, order, and

Minimal Aversion Threshold values under normal and crowded conditions (Tables 8A and 8B). The analysis was performed on both the combined four trials and the combined first two trials. The cell means of the two trial analysis were in the predicted direction--a decrease of MAT values under crowded conditions. The density X subject terms were not significant within the two trial analysis, but the subject X order interaction was ($p < .05$).

Three factor ANOVA of the combined four trials revealed neither a mean decrease of MAT values under crowded conditions nor statistical significance in any relevant category.

Of the 20 subjects in which complete data were obtained, two responded with identical MAT values under both conditions for all trial days.

The data did not support Hypothesis 1 that mean MAT values for auditory stimuli are less following conditions of high spatial density than subsequent values following conditions of normal spatial density.

TABLE 8A

THREE FACTOR ANOVA--AUDITORY MINIMAL AVERSION THRESHOLDS (HIGH AND NORMAL DENSITY: TRIALS 1, 2, 3, 4) X ORDER X SUBJECT

Source	df	SS	MS	F
MAT (High & normal density)	1	.01	.01	.004
Order	1	.61	.61	.215
Subjects	19	405.24	21.33	7.513[a]
MAT X Order	1	.31	.31	.110
MAT X Subject	19	44.24	2.33	.820
Order X Subject	19	118.64	6.24	2.199
MAT X Order X Subject	19	53.94	2.84	1.000

a $p < .05$

Cell means
Minimal aversion thresholds (dbA)

Density order		Normal density	High density
	High--normal	86.0	87.0
	Normal--high	86.5	86.7

TABLE 8B

THREE FACTOR ANOVA--AUDITORY MINIMAL AVERSION THRESHOLDS (HIGH AND NORMAL DENSITY: TRIALS 1, 2) X ORDER X SUBJECT

Source	df	SS	MS	F
MAT (High & normal density)	1	1.80	1.80	1.684
Order	1	.20	.20	.187
Sibjects	19	140.70	7.41	6.931[a]
MAT X Order	1	.20	.20	.187
MAT X Subject	19	46.70	2.46	2.300
Order X Subject	19	116.30	6.12	5.730[a]
MAT X Order X Subject	19	20.30	1.07	1.000

a $p < .05$

Cell Means
Minimal Aversion Thresholds (dbA)

Density order		Normal density	High density
	High--normal	87.5	84.5
	Normal--high	87.5	85.5

Personal Space, MAT Values, and Normal and High Spatial Density

Two factor ANOVA conducted to examine the relationship between personal space and Minimal Aversion Threshold values is presented in Tables 9A, 9B, and 10A, 10B.

A median split of personal space (semi-projective) did reveal differential tolerance under normal and high density conditions during trials 1 and 2 (Table 9B). The interaction of group (personal space) X density was significant ($p < .05$), as predicted (Hypothesis 2A). Mean MAT values of high personal space subjects decreased by 5.5 dbA, whereas the corresponding values in low personal space subjects increased by 2.5 dbA.

MAT value changes from normal to high density with low personal space subjects for both trials one and two were: 12, no change; 5, increase; and 3, decrease. Equivalent values for high personal space subjects were: 10, no change, 0, increase; and 10, decrease. The mean decrease for high personal space subjects was 9.3 dbA.

The relationship was not evidenced when MAT values for all four trial days were incorporated. It is of note that a similar pattern emerged--high personal space subjects decreased minimal auditory aversion levels under crowded conditions whereas an overall mean increase was present in the low personal space subjects. This interaction did approach significance in the pooled trials (Table 9A). MAT value changes from normal to high density with low personal space subjects for four trials were: no change, 19; increase, 12; and decrease, 9. Equivalent values for high personal space subjects were: no change, 20; increase, 7; decrease, 13.

The data analysis summary presented in Tables 10A and 10B examined the relationships between personal space (direct measurement) and MAT values under normal and high density. Although the cell means exhibit synonymous trends to those stated previously in regard to the semi-projective personal space measures, no relationships reach significance.

TABLE 9A

ANOVA--THE RELATIONSHIP BETWEEN SEMI-PROJECTIVE MEASURES OF PERSONAL SPACE AND AUDITORY MINIMAL AVERSION THRESHOLD VALUES (TRIALS 1, 2, 3, 4) UNDER HIGH AND NORMAL SPATIAL DENSITY

Source	df	SS	MS	F
Group (High & Low Personal Space)	1	30.63	30.63	.731
Subject $_w$ Group	18	753.25	41.85	
MAT (Normal & High Density)	1	.63	.63	.148
Group X MAT	1	15.63	15.63	3.686
Subj X MAT $_w$ Group	18	76.25	4.24	

Cell & Marginal Means

	MAT (dbA) Normal Density	MAT (dbA) High Density	
Low Personal Space	84.5	86.3	85.4
High Personal Space	88.0	87.0	87.5
	86.3	86.7	

TABLE 9B

ANOVA--THE RELATIONSHIP BETWEEN SEMI-PROJECTIVE MEASURES OF PERSONAL SPACE AND AUDITORY MINIMAL AVERSION THRESHOLD VALUES (TRIALS 1, 2) UNDER HIGH AND NORMAL SPATIAL DENSITY

Source	df	SS	MS	F
Group (High & Low Personal Space)	1	10.00	10.00	.663
Subject $_w$ Group	18	271.40	15.08	
MAT (Normal & High Density)	1	3.60	3.60	.954
Group X MAT	1	25.60	25.60	6.790[a]
Subj X MAT $_w$ Group	18	67.80	3.77	

a $p < .05$

Cell & Marginal Means

	MAT (dbA) Normal Density	MAT (dbA) High Density	
Low Personal Space	83.3	85.8	84.6
High Personal Space	89.9	84.3	86.6
	86.6	84.5	

TABLE 10A

ANOVA--THE RELATIONSHIP BETWEEN DIRECT MEASURES OF PERSONAL SPACE AND AUDITORY MINIMAL AVERSION THRESHOLD VALUES UNDER NORMAL AND HIGH SPATIAL DENSITY (TRIALS 1, 2, 3, 4)

Source	df	SS	MS	F
Group (High & Low Personal Space)	1	105.63	105.63	2.803
Subject $_w$ Group	18	678.25	37.69	
MAT (Normal & High Density)	1	.63	.63	.125
Group X MAT	1	1.23	1.23	.244
Subj X MAT $_w$ Group	18	90.65	5.04	

Cell & Marginal Means

	MAT (dbA) Normal Density	MAT (dbA) High Density	
Low Personal Space	84.0	85.0	84.5
High Personal Space	88.5	88.0	88.3
	86.3	86.5	

TABLE 10B

ANOVA--THE RELATIONSHIP BETWEEN DIRECT MEASURES OF PERSONAL SPACE AND AUDITORY MINIMAL AVERSION THRESHOLD VALUES UNDER NORMAL AND HIGH SPATIAL DENSITY (TRIALS 1, 2)

Source	df	SS	MS	F
Group (High & Low Personal Space)	1	48.40	48.40	3.74
Subject $_w$ Group	18	233.00	12.94	
MAT (Normal & High Density)	1	3.60	3.60	.745
Group X MAT	1	6.40	6.40	1.325
Subj X MAT $_w$ Group	18	87.00	4.83	

Cell & Marginal Means

	MAT (dbA) Normal Density	MAT (dbA) High Density	
Low Personal Space	82.8	83.3	83.1
High Personal Space	90.3	86.8	88.6
	86.6	85.1	

The hypothesis that subjects differentiated on the basis of low versus high personal space requirements will significantly differ in MAT values under high and normal densities was supported employing the semi-projective measures, but not the direct personal space measures.

Territory Measures, MAT Values, and Normal and High Spatial Density

The relationship between territorial requirements and MAT values under normal and high density is presented in Table 11. Analagous to the interactions of personal space and MAT values, mean MAT values decreased under high density with high territory subjects and increased with low territory subjects. The interaction of territorial requirements and discomfort under normal and high density was not significant in either the combined four trial ANOVA or the two trial ANOVA. Interaction did approach significance in the two trial ANOVA. A tally of directional change of MAT values from normal density to high density revealed:

(a) low territory--no change, 13; increase, 3; decrease, 4.

(b) high territory--no change, 9; increase, 2; decrease, 9.

Hypothesis 3A of a differential feeling state discomfort based on low versus high territorial requirements was not supported although one might argue that such a trend did exist.

TABLE 11A

ANOVA--THE RELATIONSHIP BETWEEN SPATIAL (TERRITORIAL) REQUIREMENTS AND AUDITORY MINIMAL AVERSION THRESHOLD VALUES UNDER NORMAL AND HIGH SPATIAL DENSITY (TRIALS 1, 2, 3, 4)

Source	df	SS	MS	F
Group (High & Low Territory)	1	21.03	21.03	.496
Subject $_w$ Group	18	762.85	42.39	
MAT (Normal & High Density)	1	.63	.63	.124
Group X MAT	1	.63	.63	.124
Subj X MAT $_w$ Group	18	91.25	5.07	

Cell & Marginal Means

	MAT (dbA) Normal Density	MAT (dbA) High Density	
Low Territory	87.0	87.5	87.3
High Territory	85.1	85.1	85.1
	86.5	86.2	

TABLE 11B

ANOVA--THE RELATIONSHIP BETWEEN SPATIAL (TERRITORIAL) REQUIREMENTS AND AUDITORY MINIMAL AVERSION THRESHOLD VALUES UNDER NORMAL AND HIGH SPATIAL DENSITY (TRIALS 1, 2)

Source	df	SS	MS	F
Group (High & Low Territory)	1	6.40	6.40	.406
Subject $_w$ Group	18	283.70	15.76	
MAT (Normal & High Density)	1	2.50	2.50	.548
Group X MAT	1	14.40	14.40	3.157
Subj X MAT $_w$ Group	18	82.10	4.56	

Cell & Marginal Means

	MAT (dbA) Normal Density	MAT (dbA) High Density	
Low Territory	86.0	87.0	86.9
High Territory	87.0	82.8	84.9
	86.5	85.3	

Heart Rate and Spatial Density

The experiment had to be terminated at a point in time when only 10 replicates of heart rate and blood pressure had been obtained. It was decided, upon statistical consultation, to incorporate only first measures of heart rate and blood pressure to test the hypotheses. Summary data of the replicates are presented as an adjunct to the main analyses.

Two factor ANOVA disclosed no significant relationship between heart rate and density order (normal-high, high-normal), condition (normal and high density), or order X

TABLE 12

ANOVA--HEART RATES UNDER HIGH AND NORMAL SPATIAL DENSITY CONDITIONS

Source	df	SS	MS	F
Order (Hi-Nor, Nor-Hi)	1	232.69	232.69	1.923
Subject $_w$ Order	24	2903.28	120.97	
HR (Normal & High Density)	1	6.23	6.23	.171
Order X HR	1	73.92	73.92	2.03
Subj X HR $_w$ Order	24	873.85	36.41	

Cell & Marginal Means

	Order: Normal-High	Order: High-Normal
HR (Normal Density)	72.92	74.77
HR (High Density)	71.23	77.84

condition (Table 12). Of the 26 subjects, 9 exhibited a heart rate decrease under crowded conditions (mean -8.2), 12 an increase in heart rate (mean 9.3), and 5 were unchanged. Directional correlation (increase, decrease, no change) in heart rate with 7 of the 8 subjects receiving replicated heart rate measures was attained, but the average variation within replicates was 12. Thus although the directional agreement was high, numerical concordance was low.

Systolic Blood Pressure and Spatial Density

Group mean systolic blood pressure was significantly ($p < .005$) greater following high spatial density conditions than comparable recordings following normal spatial density conditions (Table 13). Order, and order X spatial density condition were not significant. Even though the group mean increase in systolic blood pressure was only 5.7 and 2.2 within the 2 orders, individual increases occurred in 18 of 26 subjects. Average total increase was 7.2 mmHg, whereas the average total decrease was -3.5 mmHg. Group mean systolic blood pressure did reveal an overall increase in second measurement values, as contrasted to first measurement values. Systolic blood pressure means within the four permutations (condition X order) ranged from 96.7 mmHg to 102.5 mmHg. Directional correlation was registered in 6 of the 8 replicated subjects.

TABLE 13

ANOVA--SYSTOLIC BLOOD PRESSURE UNDER HIGH AND NORMAL SPATIAL DENSITY CONDITIONS

Source	df	SS	MS	F
Order (Hi-Nor, Nor-Hi)	1	13.00	13.00	.1465
Subject $_w$ Order	24	2128.31	88.68	
Systolic BP (High & Normal Density)	1	200.08	200.08	12.09[a]
Order X Systolic BP	1	40.69	40.69	2.46
Subj X Systolic BP $_w$ Order	24	397.24	16.55	

a $p < .005$

Cell & Martinal Means (mmHg)

	Order: Normal-High	Order: High-Normal
Systolic BP (Normal Density)	96.77	99.54
Systolic BP (High Density)	102.46	101.69

There was absolutely no evidence of fear or resentment observed during the experimental trials. A number of the subjects actually expressed degrees of concern that their opportunity for measurement had not arrived.

Diastolic Blood Pressure and Spatial Density

Diastolic blood pressure was also significantly ($p < .05$) increased under high density as contrasted to normal density (Table 14). Two factor ANOVA additionally disclosed a significant interaction effect between order and density condition ($p < .005$), with second measures elevated over first. A mean diastolic blood pressure increase of 8.5 mmHg under high spatial density was recorded in 16 subjects, whereas a mean decrease in diastolic blood pressure of -5.2 mmHg was recorded in the remaining 10 subjects. Diastolic blood pressure means with the four permutations (condition X order) ranged from 59.7 mmHg to 62.9 mmHg. Directional correlation was registered in only 3 of the 8 subjects with replicated measures, placing reliability in question.

TABLE 14

ANOVA--DIASTOLIC BLOOD PRESSURE UNDER HIGH AND NORMAL SPATIAL DENSITY CONDITIONS

Source	df	SS	MS	F
Order (Hi-Nor, Nor-Hi)	1	17.31	17.31	.272
Subject $_w$ Order	24	1528.00	63.67	
Diastolic BP (High & Normal Density)	1	129.31	129.31	5.55[a]
Order X Diastolic BP	1	249.92	249.92	10.73[b]
Subj X Diastolic BP $_w$ Order	24	558.77	23.28	

a $p < .05$
b $p < .005$

Cell & Marginal Means (mmHg)

	Order: Normal-High	Order: High-Normal
Diastolic BP (Low Density)	59.69	62.92
Diastolic BP (High Density)	67.23	61.69

To summarize, statistically significant increases in systolic and diastolic blood pressure under high spatial density tend to confirm Hypothesis 5. However heart rate measures did not exhibit a statistically significant increase, and the meaning of "significance" relative to blood pressure and heart rate will be explored later.

Additional Observations

One subject demonstrated a considerable proclivity for overt aggression. The forms of aggression included pushing, striking, and verbal abuse. Since the recordings of such activities were not a stated objective of the study, the frequency of overt aggression under the two spatial density conditions could not be compared at a sufficient confidence level. There were simply too many other mandatory activities to perform which prohibited accurate recording.

Kinzel's (1970) finding that violent prisoners required significantly greater personal space than non-violent prisoners prompted an inquiry into the above subject's measured personal space and territorial requirements. The subject in question ranked third highest in semi-projective personal space requirements, with a value of 14.1 cm. The group range was .7 cm to 14.8 cm, with a mean of 5.2 cm. The subject ranked second highest in direct personal space requirements, with a three-directional mean of 41.5 inches. It will be recalled that the corresponding group mean was 17.8 inches, with a range of 4.7 to 79.3. The subject's directional personal space requirements were: front, 43.5 inches; side, 21 inches; and rear, 60 inches. The above rankings were based on a total of 26 subjects.

The subject's territorial requirements ranked tenth highest, of a similar total of 26 subjects. His territorial value of 60 square feet may be compared with the group mean of 112.3 square feet, and range of .0001 square feet to 1164 square feet. The front, sides, and back dimensions were very similar--52 inches, 45 inches, 41 inches, and 48 inches, respectively. Thus the larger back dimension recorded with direct personal space measurement was not duplicated with the territorial measurement.

Responses on the terminal questionnaire to item number 10, "How much did you enjoy our arts and crafts?" were based on a five point scale, ranging from 1 (not at all) to 5 (very much). The results are summarized below.

	Scale Number	Frequency
(Not at all)	1	0
	2	6
	3	6
	4	6
(Very much)	5	6

Responses to item number 11 on the questionnaire, "How much do you like the other members of the group?" are summarized below.

	Scale Number	Frequency
(Not at all)	1	0
	2	1
	3	14
	4	6
(Very much)	5	3

CHAPTER IV

DISCUSSION AND SUMMARY

Results Summarized

Feeling state discomfort levels significantly ($p < .05$) increased under high spatial density conditions. Neither the personal space nor territorial measures successfully predicted subject feeling state discomfort variance between "normal" spatial density conditions and high spatial density conditions. The difference between the pooled auditory MAT values following normal and high spatial density conditions was insignificant. However data analysis did reveal a significant ($p < .05$) interaction between personal space and changes in auditory MAT values. Subjects with higher personal space requirements (semi-projective) exhibited a decreased tolerance for auditory stimuli intensities following high spatial density conditions. A similar trend existed with high spatial (territorial) subjects. Significant increases in both systolic ($p < .005$) and diastolic ($p < .05$) blood pressure occurred under high spatial density conditions. Territorial measures correlated inversely with age ($p < .05$). Direct and semi-projective personal space measures correlated ($p < .05$), but neither personal space measure correlated with the territorial measures.

Explanation of Findings

Personal Space Measurements

Data from the direct measures of personal space reveal a pronounced dichotomy between subjects permitting close approach and subjects maintaining rather large distances between self and stranger. The group median splits of individual mean three-directional personal space requirements were 5.2 and 30.2 inches. This bimodal distribution of three-directional personal space primarily depicts the influence of variables other than age, as the personal space measures and age were statistically uncorrelated. Meisels and Guardo (1969) have reported, on the basis of semi-projective tests results, that preadolescents place themselves closer to same-sexed peers under neutral and positive affect conditions than do postadolescents. Positive and neutral affect conditions included interpersonal conditions of acquaintance, like, group friends, and friend. Superficially, the relationship between personal space and age established with the present study and Meisels and Guardo's study are contradictory. A more in-depth examination resolves the apparent disparity. The study population did not include representatives from grades nine and ten, and the age samples of the study population were extremely small. Furthermore, the cultural diversity represented within the subject population exceeded the corresponding diversity in Meisels and Guardo's study.

In consideration of these points, cultural variables appear to dominate the expression of the numerous other variables operant in determining personal space. Supporting this hypothesis, Watson (1970) has verified that cultural background can differentiate personal space requirements without inclusion of other social and psychological variables. Little (1968) has established that the nature of the interaction, the degree of acquaintance attributed to dyad members, the setting of the interaction, the sex and shared beliefs of the dyad member, and the sex and cultural background of the subjects are important factors in modifying distance between semi-projective figures. Conceivably, age emerges as an important variable in the determination of personal space only when the conditions of large sample numbers and cultural homogeneity are satisfied. Twenty-seven percent of the subjects failed to express any observable verbal or nonverbal anxiety over the approach of a stranger, with approximately equal representation from the younger (8-10 years) and older (11-14) boys. In part, this may reflect social and psychological evidence verifying the occurrence of a period of mutual attraction between like sexes, commencing in the early elementary school ages and waning in the early junior high ages. Generalization of this finding to other age groups therefore would be unwarranted.

The validity of the semi-projective technique as an instrument to measure personal space might be justifiably questioned. Upon appropriate conversion, Addis (1966) used a similar semi-projective technique and obtained values in excellent accordance with published direct measures of personal space. The present study provides support for the utility and validity of the semi-projective techniques. The correlation of the direct and semi-projective techniques ($r = .446$, $p < .05$) is respectable under the experimental limitations.

Several factors inherent in the experimental design mitigate higher correlation of the two techniques. First, the social stimulus conditions were dissimilar--the direct technique employed a stranger and the semi-projective technique a "boy in your class you sometimes play with." Subject ranking of personal space values might differ from one social stimulus condition to another. For instance, a dependent, withdrawn child might group rank very high in personal space requirements with strangers and relatively low in personal space requirements with friends or acquaintances.

The age and physical size of the same-sexed peers used with the direct measures approximated subject age and size. In contrast, the subjects presumably responded to the semi-projective task on the basis of projection of a peer very similar to themselves. Such subtle differences in the perception of the stature and demeanor of the peer the subject interacted with would introduce error.

Finally, the experimental settings of the two techniques differed; direct measures were obtained in the confines of a room, and the semi-projective measures obtained in an outdoor site. As stated previously, Little (1968) has published evidence that the setting of the interaction modifies interpersonal distance. A well-designed experimental analysis of the comparability of the two techniques would demand identical settings.

Some data in the literature permit at least a cursory comment on the reliability of the semi-projective technique. Guardo (1969) has published results of semi-projective measures of personal space with sixth graders. The silhouettes employed in this study were replicates of those used by Guardo. The social stimulus situations between the present study and Guardo's were analogous. The sixth graders' mean was 1.34 inches; the eleven to twelve year old study population mean was 5.3 centimeters, or 2.08 inches. The higher study population mean might be accounted for on the basis of differing experimental environments (classroom versus yard), the inclusion of females in Guardo's study, and the limited sample number of ages eleven and twelve (n = 6) in the present study. The spacious outdoor setting might particularly augment spatial distances.

Thus the study does lend qualified support for the continued utilization of semi-projective techniques to measure personal space, although such an appraisal was not a stated objective. The two measures were used to examine their applicability in predicting variable response to crowding.

Personal Space and Spatial Density Conditions

Why were personal space requirements ineffective in predicting differences in feeling state discomfort under normal and high density? On the basis of existing knowledge concerning personal space, one would expect that those subjects exhibiting large personal space requirements would experience greater discomfort under crowded conditions than low personal space subjects. The personal space values as determined by the semi-projective technique most closely approximated the social stimulus condition of the group in that distance was measured between the subjects and "a boy in your class you sometimes play with." Since the group was incohesive at the inception of the experiment, the two social stimulus conditions were comparable. The results based on the semi-projective personal space values were in the predicted direction, but were statistically insignificant.

The failure of the personal space measures as predictive instruments might be explained on the basis of domination by one or more additional factors. For example, cultural and social variables might profoundly alter the anxiety induced by invasion of personal space. Even though establishment of the relative weight of factors determining spatial needs was not a specified goal of this study, one might conclude that the cultural diversity of the sample population has superseded the personal space measures in importance.

The possibility exists that the high spatial density condition was sufficiently adversive to mask the predicted differential response based on personal space requirements. Both the feeling discomfort instrument and the terminal questionnaire support the premise of increased discomfort engendered under the high spatial density condition, even though verbal expression of discomfort was absent during the period of experimental intervention. Whether the adversiveness of the crowded room was of a magnitude that would subjugate the variable of personal space requirements remains a moot question. The very low F values calculated from the interaction of personal space and room discomfort might be construed as evidence against the subjugation of the variable of personal space by the adversiveness of the high spatial density condition.

It may be contended that the measurement of feeling state discomfort was insensitive under the given conditions. In rebuttal, the model room size and intensity product values were significantly ($p < .05$) greater under high spatial density conditions than normal density conditions, as expected. The wide range of values suggests that the discriminatory powers of the instrument are adequate. Also the instrument values did correlate adequately with questionnaire data at the termination of the experiment.

A more plausible criticism of the instrument developed to measure feeling state discomfort contends that the values obtained reflect not only the discomfort due to the proximity of other subjects, but also internal energy or activity levels and prior conditioning. Those subjects inherently more active would have, of necessity, required greater space. Subjects conditioned to occupying large space might have felt more "at home" in a larger area even though the discomfort level experienced might have been minimal within the high spatial density room.

Spatial (Territorial) Measures

The inverse correlation of territorial measures with age receives support via evidence from diverse sources. On the basis of years of classroom experience, the school accreditation agencies of many states have established greater classroom size per pupil minimums for kindergarten children than for elementary school children. Many school administrators attempt to either provide larger classrooms or limit enrollments within kindergarten, first, and second grades. First, second, and third grade instructors often experience difficulty in restricting physical mobility within the classroom. Prominence of large muscle activity in combination with short attention spans constitute a serious problem for teachers attempting to maintain order in the earlier grades. Numerous younger boys learn best through physical means, as contrasted to aural and visual means (Riesman, 1964). Young children employ displacement activities such as scratching heads, shaking legs, and pulling at their clothes with greater frequency than older children (Musser, 1970). Such coping mechanisms necessitate increased space. Furthermore, the territorial measures might interact with socialization patterns; as socialization progresses, territorial needs decline.

Age must be a comparatively important variable in determining territorial needs, as the diversity of cultural, social, and psychological variables of the study population might be expected to mask the effects of any single variable. As discussed previously, there is a high probability that the inverse relationship expected between personal space and age was masked by cultural and social variables which were uncontrolled. Since an inverse relationship between territorial measures and age was observed, it may be conjectured that territorial needs are more profoundly influenced by factors intimately associated with chronological age. For example, transition from uncoordinated large muscle activity to coordinated fine muscle activity characteristically parallels biological aging. The increased territorial values recorded with the younger boys might depict greater demands for physical space due to extensive large muscle activity.

Territorial measures were statistically uncorrelated with either measure of personal space. Two major plausible explanations for the absence of correlation are presented below:

1. There is evidence from this study that personal space and territorial measures are manifestations of two separate spatial components rather than of a unitary spatial behavior component. First, the territorial measures were

correlated with age unlike both measures of personal space. Secondly, since personal space and territorial measures were statistically uncorrelated they are either validly or invalidly independent. Invalidity could result if the measures might have been influenced by individual variations in creativity, fantasy, and activity levels. Finally, although these measures are statistically uncorrelated, they are both capable of differentiating subjects on the basis of auditory MAT changes under normal and high density. This final point is elaborated later in the discussion.

2. Data from social psychology and psychology purport that a lack of external structure enhances expression of genuine internal feelings (Sherif, 1969). By the nature of the experimental procedures, territorial measurement imposed less structure upon the subject. However, the wide range of territorial and personal space responses suggests that the "experimental demand character" of the measurements was of inconsequential magnitude. The limited sample size in conjunction with the experimental error in measurement of direct personal space would be expected to influence the correlations to some extent. Even assuming that personal space and territorial measures are correlated, it seems dubious that the limited experimental error of the measurements could completely account for such low correlation coefficients.

The inefficacy of the territorial measures in predicting subject feeling state discomfort under high spatial density might indicate that the component of spatial behavior quantified by the territorial measures assumed relative unimportance within the group interactions. As an alternative explanation, the high spatial density conditions might have been sufficiently unpropitious to the subjects, thus masking predictability by any variable.

Aggression, Personal Space, and Territorial Requirements

Although essentially as an aside to the study, the personal space and territorial measurements of the previously identified (page 59) physically aggressive subject merit consideration.

The case corroborates two of Kinzel's observations of violent prisoners. From a sample total of 26 boys, this subject ranked second highest in the direct measures of personal space and third highest in the semi-projective measures. Secondly, the rear zone personal space of the subject approximated the sum of the front and side zones. The violent prisoners studied by Kinzel exhibited significantly greater total and rear zone personal space requirements as contrasted to non-violent prisoners.

One might expect the expression of aggression through spatial behavior to be profoundly influenced by social sanctions. For example, if physical aggression is condemned socially, an aggressive person might consciously or unconsciously attempt to cope with this conflict between internal drives and external sanctions by increasing the space between himself and others. Since the expression of physical aggression upon others is condemned by New Testament theology, it would be expected that the study population would be particularly affected.

The subjects territorial values were not unusually large, contradicting expectations based on observed correlations between aggression and increased territorial demands in animals. The territorial values also oppose anecdotal evidence that children commonly express aggression through territorial means. The degree of aggressiveness in boys might be expressed quantitatively as increased control and defense of neighborhood areas or qualitatively as control over desirable playground equipment such as climbing bars, slides, and see-saws. The limited data renders analysis of the disparity imprudent.

Auditory MAT Values and Spatial Density

It was hypothesized that auditory MAT values would decrease under crowded conditions. The hypothesis was based on two premises. If auditory MAT values are influenced by levels of other sensory stimuli (sensory generalization), then the prominent increase in visual, tactile, and auditory sensory stimuli under spatial density conditions would conceivably be counterbalanced by a subsequent attempt to decrease sensory output. Another reason for predicting a decrease in MAT values under high spatial density conditions involved the probable correlation between internal levels of frustration induced by crowding, and the displaced expression of this frustration in terms of lowered auditory MAT values.

The pooled data from all subjects failed to support the hypothesis of a significant decrease of MAT values under high density conditions. Although the values were generally in the predicted direction, the effect failed to reach statistical significance. When the subjects were subdivided on the basis of personal space requirements, the experimental predictions were upheld. Support was based primarily on data derived from Trials 1 and 2, rather than on data derived from the combined four trials. A cogent argument could be presented that the data derived solely from Trials 1 and 2 would be of greater validity. As cited in Chapter III, the subjects did express progressive disturbance relative to the experimental demand of the sensory overload experiment. Based on this observation, experimental error would increase with each successive trial.

As contended previously, the semi-projective technique would be the preferential choice of the two techniques to predict subject response. The significant ($F = 6.79$, $p < .05$) interaction between personal space (semi-projective) and MAT values following high and normal spatial density conditions can be explained. High personal space subjects would be expected to experience greater sensory overload levels and/or frustration levels under high spatial density conditions than low personal space subjects. The proximity of other subjects should command greater attention when violation of personal space occurs, as contrasted to other social interactions where personal space remains inviolated. Greater compulsory attention to our most important sensory source, other people, might induce effects similar in nature to experimental laboratory induction of sensory overload. Perhaps sensory overload states are partially responsible for the discomfort and disorientation experienced by some individuals upon entrance into high spatial density conditions. Further implications will be expounded later in this chapter.

The practical significance of a mean decrease of 5.5 dbA in the MAT values following high spatial density might be questioned. From the standpoint of simple auditory mechanics, a decrease of 5.5 decibels within the experimental ranges of approximately 84 to 90 decibels represents considerable magnitude. A decibel decrease of 5.5 is equivalent to a power or intensity reduction of a factor of 7.4 ($\log_{10}$ 5.5 x 10).

The very small increments of MAT values observed with low personal space subjects under high density conditions might be simply within the jurisdiction of experimental error. However, the constancy of the increase might warrant further research.

The role of habituation in the MAT experiment should be clarified. It will be recalled that during calibration of the white sound decibel levels in both normal and high density rooms, the acoustical characteristics of the high density room necessitated reduced calibrations. Therefore, since the high density room in actuality amplified group sound levels to a greater extent than the normal density room, habituation to high sound intensities should have occurred to a greater degree under high density conditions than normal. Thus one would predict a relative increase in sound intensities tolerated under high spatial density. Applied to the results of the study, this recognition enhances the significance of the results.

Careful analysis of the data does permit some speculation in regard to whether the decrease in MAT values under crowding represents a function of sensory overload or of internal frustration. If frustration were the primary cause, then one would expect that these negative feelings would have been translated as increases in feeling state discomfort values, recorded as the product of model room size changes and intensity values. The feeling state discomfort values of low and high personal space subjects were not different under the two density conditions. In addition, a comparable analysis of variance using only model room size change values as indicators of feeling discomfort revealed no differences within low and high personal space subjects. In consideration of this evidence, the decrease in MAT values under high spatial density by high personal space subjects probably does reflect initial attempts to decrease sensory input. A tentative conclusion might be reached that the high spatial density condition did induce sensory overload, but on a selective basis.

In retrospect, that personal space requirements would differentiate auditory MAT responses and not feeling state discomfort responses under normal and high spatial density assumes credibility. Whereas MAT value change might be integrally dependent upon the proximity of others, the feeling state discomfort values might also reflect activity levels and prior conditioning.

Since territorial requirements were uncorrelated with personal space requirements, it would be logical to assume that territorial measures would fail to predict differential MAT response under normal and high density conditions. However as previously mentioned, the interaction of territorial requirements and MAT value change following normal and high spatial densities did approach significance ($F = 3.16$), and was in the anticipated direction. High territory subjects decreased MAT values by a mean of 4.2 dbA under high spatial density, and low territory subjects increased MAT values by a mean of 1.8 dbA (Trials 1, 2).

Both personal space (semi-projective) and territorial measures are associated with a decrease of auditory MAT values following crowded conditions, although admittedly, the territorial association remains weak. This functional overlap of territorial and personal space measures becomes enigmatic upon consideration of the absence of correlation

(r_s = -.10) between the personal space measures and the territorial measures. Furthermore, the territorial measures inversely correlated with age (r_s = -.386) whereas the personal space measures were uncorrelated with age. In view of these interrelationships, the personal space (semi-projective) technique and the territorial measurement technique might be measuring separate components of spatial behavior, as alluded to earlier in the discussion. If the territorial measures were simply an inferior measure of the same spatial behavior component being measured by personal space, then at least some degree of correlation would be expected between the two measures.

Heart Rate and Blood Pressure Change Following High Spatial Density

The experimental procedure employed to measure heart rate and blood pressure change proved adequate. The same person recorded subject blood pressure and heart rate throughout the experimental sessions, using the same sphygmomanometer. The subjects exhibited absolutely no fear of blood pressure and heart rate measurement procedures. Measurement was randomized, and there were no waiting periods prior to recording. Subjects were individually requested to leave the room and recordings were taken immediately. The blood pressure means attained were compatible with values expected with boys 8 to 14 years of age. In addition, ordering effects were controlled by reversing room density order.

The significant increase in systolic ($p < .005$) and diastolic ($p < .005$) blood pressure under high spatial density conditions was in accordance with experimental prediction. Apparently, the high spatial density condition did induce sympathetic nervous system activation. However, increases in heart rate would also be expected with sympathetic nervous system activation and such increases were experimentally unobserved. The precedent for absence of correlation between heart rate and blood pressure has been established. Averill (1969), in a carefully designed and controlled study of psychophysiological correlates of sadness and mirth, reported significant increases in systolic and diastolic blood pressure and yet insignificant changes in heart rate. Lack of correlation between blood pressure and heart rate can also be observed in a number of other published studies. Physiologically, increases in blood pressure without corresponding increases in heart rate could be satisfactorily accounted for by increased peripheral vasoconstriction. Increases in blood pressure are not always associated with increases in cardiac output. Lacey (1967) and others have concluded that heart rate changes can be reliably predicted. External focusing of attention reliably elicits heart rate decreases, whereas internal focusing of attention and noxious stimuli elicit heart rate increases. Lacey has reported general congruity in heart rate and blood pressure changes, but his published blood pressure data is incomplete. Subsequent focusing of attention by the subjects on the measurement procedure may have effected a more rapid lowering of heart rate than blood pressure, perhaps nullifying significant increases which might have occurred under high spatial density.

The increase in both systolic and diastolic blood pressure might indicate elevated nor-epinephrine release during the high spatial density condition. In contrast, epinephrine effects include increased systolic but decreased diastolic blood pressure. Schildkraut and Kety (1967) have concluded from various evidence that epinephrine increase correlated with states of anxiety or threatening situations of unpredictable nature in which active coping is required but remains unaccomplished. Nor-epinephrine is associated with states of anger or aggression or in situations which are challenging but predictable, permitting active and appropriate behavioral responses to the challenge. Applied to the present study, the subjects may have experienced internal hostility regarding compulsory confinement under high spatial density conditions. This affective state might have led to increased nor-epinephrine secretion, increasing both systolic and diastolic pressure. Affective states associated with epinephrine increases are less plausible under the given experimental conditions.

The significant increase in systolic and diastolic blood pressure must be evaluated in terms of practical significance as well as statistical significance. Seventy percent of the subjects experienced an increase in systolic blood pressure under high spatial density; a group mean increase of 7.2 mmHg. Based on an average initial systolic blood pressure of approximately 100 mmHg, this represents an average increase of 7 percent. Diastolic blood pressure increased by a mean of 8.5 mmHg in 62 percent of the subjects. Since the diastolic blood pressure mean was approximately 63 mmHg, this represents an increase of 14 percent. The percentage increases are of sufficient magnitude to assume practical significance.

The significant interaction of order with diastolic blood pressure requires explanation. The relative increase in second measurement values over first has been cited in Chapter III. Since second measurements were recorded near the termination of each experimental trial, the excitement of impending free time might be implicated in the blood pressure increases.

Limitations-Error

Although each of the various experiments within this study has unique limitations and sources of error, certain limitations and error are inherent in the study as a whole. The limited sample numbers employed throughout the various experiments introduced greater error margins and might have effected non-significant outcomes. The restricted age range involved (8-14 years), the exclusive use of males and the cultural diversity of the study population constitute generalized limitations. Fifty percent of the subjects had missionary exposure and significant homogeneity of value systems probably existed due to their common affiliation with Wycliffe. Even though arduous attempts were made to decrease the "artificiality" of the experimental sessions by integrating data collection with normal activities, imperfect integration was achieved. Consequently, error induced by the experimental environment must be acknowledged. A brief treatment of error sources and limitations intrinsic to some of the specific experiments within this study will follow.

Potential sources of error arising from the direct measurement of personal space require mention. A population with heterogeneous age distribution presents an immediate dilemma in regard to direct measurement of personal space. To achieve maximum validity of direct personal space measures, ages and particularly size and demeanor inequities between subject and approaching stranger should be controlled. The potential association between the physical size and demeanor of the approaching stranger and the degree of "fear" induced within the subject may be readily appreciated. Such fear could be expressed as increased interpersonal distance. In a variety of real-life contexts, however, homogeneity within collectives of people rarely exists. For purposes of this study, it was determined that the personal space requirements as evidenced with just two different-aged strangers would better approximate the conditions within the art and craft sessions. Therefore, while the absolute values of the direct personal space measures might be questioned, theoretically, predictability of subject discomfort under high spatial density conditions should be enhanced.

A second error source inherent with the direct measurement personal space techniques concerns the conscious or unconscious association of masculinity with increased tolerance of approaching strangers. Hypothetically, those subjects highly sensitive to defense of their own masculine identity might be expected to introduce erroneously low values into the data. The two subjects observed expressing various forms of nonverbal anxiety over the approach of a stranger, while not verbally halting the approach of the stranger are exemplary. In retrospect, the instructions to the subjects should have included additional provisions that would have permitted the subjects to halt the approaching stranger without experiencing any loss of masculine prestige. Even though the measurement was disguised as a study of balance and no other group members were present, it is still probable that those subjects highly sensitive about their masculinity were reluctant to admit feeling uncomfortable or bothered over the approach of a stranger.

Third, any measurement of personal space which does not incorporate nonverbal expressions of discomfort necessarily introduces error. Horowitz (1968) has substantiated that withdrawal from others may include forms of physical, perceptual, and cognitive maneuvers. The relatively more primitive physical process includes isolating oneself in another room or area, increasing space between self and others, and postural aversions. Perceptual maneuvers include behavior such as inattention or concentration on peripheral perceptions, aversion of the face, and avoidance of eye contact. The overlap of physical and perceptual maneuvers in such activities as averting the face and avoiding eye contact is evident. Cognitive maneuvers include such processes as altering states of consciousness, blocking or fragmenting thought, disinterest, and preoccupation with other thoughts. The cognitive maneuvers are considered as more "progressive" processes. It might be conjectured that the more "progressive" processes are, in general, directly proportional to maturation level. If valid, then the personal space measures of the older subjects of this study would tend toward erroneously small values.

Three general characteristics of boys 8 to 14 years old introduce some difficulty in the measurement of MAT values of auditory stimuli. Subjects within the age range of 8 to 14 years generally display short attention spans. Second, the concept of designating aversive sound levels is precariously related to the masculine identity. Some subjects might equate masculinity with increased tolerance of sound levels. Finally, the prodigious activity levels of subjects within these ages introduce test administration difficulties. Efforts were rendered to minimize these difficulties.

The absence of replicate measures of both heart rate and blood pressure increases the error potential of the physiological activation experiment. Another source of error indigenous to the physiological measures was first formulated by Wilder (1957), and has since received supplemental evidence. An autonomic nervous system response to a stimulus varies as a function of the prestimulus level. For instance, an increased systolic blood pressure of 7 mmHg at a prestimulus level of 110 mmHg is of greater practical significance than a corresponding increase of 7 mmHg at 90 mmHg. Baroreceptor and other physiological negative feedback mechanism increases are directly proportional to blood pressure increases. Since pre-experimental heart rate and blood pressure levels did vary, the significance of increases or decreases in these measures following experimental manipulation would be correspondingly effected.

Basic Implications

With concomitant population and urbanization increases as presently evident in the United States, it stands imperative that more research be conducted in behavioral responses to high density conditions. It defies reason to continue extensive urban design, with subsequent behavioral impact, without first establishing a firm empirical basis for action. The mutual interaction between material cultural design and human behavior has received increasing attention and has recently been cogently explored by Newman (1972). A summary of some of the more basic applications of the data derived from this study will follow. The content organization centers on two basic points: (1) the importance and implications of measures of covert responses to high density conditions, and (2) the importance and implications of considering individual as contrasted to group responses to high density conditions.

The magnitude of feeling state discomfort incurred under high spatial density was incommensurate with some of the rather dire predictions found in the literature on population density. The study results denote that boys of 8 to 14 years of age may exhibit considerable overt tolerance of high spatial density confinement; at least for short periods of time. On analysis, this overt acceptance revealed deceptive as covert measures employing projection of feeling state discomfort onto models disclosed significantly ($p < .05$) higher discomfort under high spatial density than "normal" spatial density. Both systolic and diastolic blood pressure increases observed under high spatial density ($p < .005$; $p < .05$) constitute conditional evidence for physiological activation; another covert indicator of generalized stress conditions.

An additional covert effect of high spatial density documented in this study was decreased tolerance of auditory intensities, particularly evidenced with subjects requiring large personal space. Decreased tolerance of auditory intensities is a characteristic manifestation of sensory overload state. As postulated by Milgram (1970) and others, urban environments may engender conditions of sensory overload. The data provide evidence in support of this contention. Increased spatial density conditions are usually conjunctive with urban environments, and therefore may assume partial responsibility for impelling the adaptive responses enumerated by Milgram. The evidence does imply that the proximity of other individuals might contribute to the general surfeit of sensory stimuli often encountered in urban environments.

Ludwig (1971) and others have demonstrated that sensory overload conditions are associated with an array of undesirable psychological effects. Of particular relevance, Rosen (1965) has published results of his studies of the Maabans of the Egyptian Sudan. He reports a positive correlation between sustained noise level and arteriosclerotic heart disease. This relationship seems plausible as the literature is replete with evidence supporting the interrelationship between psychological stress and concomitant physiolocial change. Cameron, Robertson, and Zaks (1972) have recently completed a study which suggests an association between high intensity urban noise and both chronic and acute disease.

The covert effects which have been documented in this study lend empirical support for the findings of Martin (1967), Faris and Dunham (1934), Tsung-yi (1953), and Schmitt (1963, 1966), who have reported negative relationships between various aspects of health and increased human density conditions. To cite a specific example, the covert effects of feeling state discomfort, sensory overload, and increased systolic and diastolic blood pressure might in part explain the association between urbanization and increased cardiovascular disease documented by Cassel and Tyroler (1964). The subtle changes observed within the subject population under high spatial density conditions might have been magnified by long term exposure or by populations evidencing different physical, social, and cultural traits. It is also feasible that manipulation of <u>social</u> density (maintaining room size constant while increasing subject numbers) would have elicited even greater behavioral modification.

Whereas it is evident that man may indeed adapt to high density conditions, one must question the price of such adaptation. This is particularly true in the United States where the mystique of the "old west", and subsequent equation of occupation of large expanses of space with well-being, power, and privilege, remains part of the cultural heritage of many.

At this point, assessment of the importance of high spatial density relative to other variables concurrent with urbanization should be limited to conjecture. The social and cultural changes compelled by urbanization are probably of greater import in the etiology of cited adverse effects upon health. Once the important variables related with adverse reactions to urbanization are identified and quantified, it should be possible to develop new coping methodologies to ameliorate such consequences. These methodologies may range from enlightened architectural design to instruction in social and psychological techniques to cope with the stresses of urban life. Since it is highly dubious that the trend toward urbanization will subside in the near future, such suggestions are pragmatic.

On the basis of this study, it may be imprudent to permit classroom densities to continue to increase. The subtle spatial effects documented may impede learning and optimum social-psychological development. The inverse relationship between age and territorial requirements justifies increased appropriation of space for the primary grades. If additional evidence supports the preliminary relationship between physical aggression and increased personal space requirements, then it would be inadvisable to confine aggressive boys to small classroom settings. The inadvertent violation of an aggressive boy's personal space by other boys may provoke still further aggression.

The results of this study also strongly imply that reactions to high spatial density conditions are subject to considerable individual variation. The range and geometric configuration of both personal space and territorial measures exceeded expectations. High spatial density conditions maintained for limited periods of time were not adversive to all subjects, and considerable ranges in feeling state discomfort values existed. The sound intensity levels subjectively experienced as annoying ranged from 60 to 95 dbA within the study population. Research confirms that threshold of discomfort begins at approximately 120 decibels, and threshold of pain at 130 decibels. The prodigious range of sound intensity subjectively experienced as annoying within the subject population substantiates the profound influence of psychological state upon sensory perception. The interaction of personal space requirements with auditory discomfort levels further reinforces this relationship. Cognizance of individual variation in response should prevail in the establishment of city and industrial noise standards. Environmental features such as spatial and social density and levels of visual, tactile, and olfactory stimulation may influence noise levels perceived as adversive. For example, a background noise level of 85 decibels at a crowded urban intersection may elicit considerably greater discomfort than an equivalent decibel level at an intersection within a rural community. In addition, individuals engaged in psychologically frustrating circumstances may evidence lower thresholds of auditory discomfort and annoyance.

Within the experimental limitations of this study, the variables of personal space and projected spatial (territorial) requirements have been demonstrated ineffective in predicting individual adverse reaction to high spatial density. Selected social and cultural variables may enhance predictability. For example, Hall (1970) asserts that we internalize earlier experiences with fixed space and that such internal images significantly effect our present reactions to fixed space. Material cultural variables such as size and density of residential area, and size, density, and architectural characteristics of home environment may prominently augment or diminish anxiety induced by invasion of personal space. Additionally, non-material cultural variables such as documented by Hall (1962) and Watson (1970), and prior social experiences would be expected to exert considerable influence. Cultural and social variables might be important not only in the establishment of optimum personal space distance, but might also influence profoundly the reactions to invasion of personal space. Even biological factors such as sympathetic-parathetic nervous system balance as an intervening variable warrant consideration.

On two major points, the results of this study question the sagacity of continued construction of high density dwellings. High spatial density conditions coexistent with many public housing projects may injure occupants in a variety of abstruse manners. The subtle deleterious effects noted with the study population may generalize to populations of differing ages. If this finding attains validation by supplemental research, the high spatial density may be indicted as an important factor in the dissatisfaction expressed by numerous tenants of these complexes.

The second point of relevance to high density dwellings concerns the implicit assumption by designers and builders that uniform individual spatial needs prevail. Residential unit spatial dimensions are often homogeneous within a given building complex. As documented in this study, the interindividual range of spatial needs might be extensive. Whenever economically feasible, designers should assess individual needs during planning stages. Unfortunately, the instrumentation to assess spatial needs remains unavailable. Knowledge of the role played by cultural, social, psychological, and biological factors in relation to high spatial density would permit environmental planning at a more sophisticated level than now practiced.

Further Research

This exploratory study has furnished sufficient documentation to warrant additional research in behavioral modifications induced by high spatial density conditions. The absence of verbal expression of discomfort under high spatial density conditions merits specific attention. Physiological measures such as heart rate, blood pressure, catecholamines, and 17-hydroxycorticosteroids would provide important experimental data which may supplement a variety of psychological instruments. Such physiological data would also furnish a basis for prediction of the medical consequences of high density conditions.

The tentative association between high spatial density and increased systolic and disastolic blood pressure requires substantiation. Larger sample numbers, numerous replicate measures, lengthened experimental periods and advanced methodology incorporating prestimulus levels in the analysis would render the necessary verification. The wisdom of controlling for ordering effects has been amply substantiated by this study; order did significantly interact with the dependent variable of diastolic blood pressure.

Focusing on group means during statistical analysis may conceal very significant individual physiological changes. For example, the systolic blood pressure of one subject increased 22 mmHg under high spatial density. Information on subjects registering changes of large magnitude may provide valuable orientation for further exploration. Subdividing subject populations in terms of cultural, social, and psychological variables and analyzing subsequent interactions between high spatial density and blood pressure change offer considerable promise.

Even though personal space measures failed to predict subject response to high spatial density, subsequent research in personal space may prove edifying. Video-taped recordings and analysis of the experimental measurements would significantly enhance the precision of the direct personal space measures. As cited previously, expression of interpersonal distance may occur in perceptual and cognitive forms as well as physical forms. The utility of personal space measures as a predictor of discomfort under high spatial density should not be completely discounted until more sophisticated personal space measurement techniques are employed.

The variation of personal space requirements as a function of direction (front, side, back) deserves investigation. It may prove informing to examine the relationship between selected personality traits and directional personal space requirements. The subject data indicate that the possibility exists of procurring three subpopulations subdivided in terms of directional personal space requirements. Kinzel (1970) has established some precedence for such a study by associating large rear zone personal space requirements (as contrasted to front zone) with violence in prisoners. Conceivably, directional requirements may correlate with other personality traits.

On the basis of this study, there is adequate justification to encourage selective research into the interactions of personal space, territorial requirements and changes in auditory MAT values under normal and high spatial density. Hearing acuity tests prior to the experimental trials and increased sophistication of personal space measurement techniques would improve experimental design. The data provide suggestive evidence that high spatial density conditions may induce sensory overload states. This should be pursued by examining alterations in MAT levels of a variety of sensory modalities.

Independent variables other than personal space and territoriality offer potential in predicting individual response to high spatial density conditions. A system could be developed to quantify earlier experiences with fixed space, incorporating both density and time parameters. Several other cultural, social, and psychological variables merit investigation, such as ethnic background, number of siblings, social class, group membership and position patterns, and introversion-extroversion ratings. With additional research in the area of spatial and social density, it may become possible to define explicitly an "optimal" spatial and social density for various individuals or even groups of individuals. The concept of optimal spatial and social density is firmly established for a variety of animals, and may find applicability in human affairs.

Summary

The study was designed in part to examine the feasibility of employing personal space and territorial measures to predict discomfort under high spatial density conditions. The subject population consisted of 26 boys, ages 8 to 14 years old. Two separate techniques of measuring personal space were utilized; one based on direct measurement and the other on a semi-projective format. Although there was reasonable statistical correlation between the two techniques, neither measures successfully predicted subject feeling state discomfort variance between a "normal" spatial density condition and a high spatial density condition. High spatial density conditions were induced by decreasing room size by approximately one-third, while maintaining constancy of subject number. Feeling state discomfort was quantified by permitting the subjects to alter the size of two-dimensional scaled room models following both normal and high spatial density conditions. Concomitantly, subjects translated their intensity of desire to alter the room size to a five-point scale. The product of the scaled room model change and intensity of desire for change was considered the quantitative measure for feeling state discomfort. The instrument disclosed significantly ($p < .05$) higher scores following high spatial density conditions, even though verbal expression of discomfort during the experimental trials was absent.

The territorial measures were obtained by a form of play therapy. The operational definition of territoriality differed from that commonly employed by ethologists; defense of territory was not requisite. The territorial measures inversely correlated ($r_s = -.86$, $p < .05$) with age, but were statistically uncorrelated with either of the personal space measures.

It was hypothesized that the high spatial density condition would induce states of sensory overload similar to those which have been achieved in experimental laboratories. Sensory overload states were measured by changes in auditory MAT values. The subjects listened to a white sound tape played in 5 decibel increments from 60 to 95 dbA following both normal and high spatial densities. Subjects were requested to designate the first intensity level which they found bothersome or annoying. Contrary to prediction, variance in auditory MAT values following the two density conditions was insignificant. However, data based on the first two of the total four trials revealed a significant ($p < .05$) interaction between personal space values (semi-projective) and MAT values following normal and high density conditions. Subjects with higher personal space requirements (semi-projective) exhibited a decreased tolerance for auditory stimuli intensity following high spatial density conditions. An analogous trend was observed with high territory subjects, but failed to reach statistical significance.

Significant increases in both systolic ($p < .005$) and diastolic ($p < .05$) blood pressure were recorded under high spatial density conditions. The hypothesis of heart rate increases following high spatial density conditions was unsupported.

This study implies that high spatial density conditions might be responsible, in some degree, for the adverse physiological and psychological effects that have been associated with increased urbanization. The increases in feeling state discomfort and systolic and diastolic blood pressure recorded under high spatial density conditions lend support to the above statement. In addition, it was ascertained that subjects requiring large personal space might be more susceptible to conditions of sensory overload induced by high spatial density than low personal space subjects. Under high spatial density conditions, considerable individual variation in response prevailed. Future research should consider other independent variables, such as selected cultural and social variables, in attempting to predict adverse reactions to high density conditions.

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APPENDICES

Appendix A

QUESTIONNAIRE

NAME________________________________

1. Where did you live before you came here? City and State.

____

2. How many brothers do you have?___What are their ages?____
3. How many sisters do you have?____What are their ages?____
4. Where have you lived most of your life? City and State.

____

5. Before you came here, how many people besides you lived in your house?_____
6. How many people besides you live in your house here at the summer institute?_____
7. What does your father do for a living?__________________
8. How many years have your parents been with Wycliffe?_____
9. What grade in school will you be going into?_____
10. How much did you enjoy our arts and crafts? Circle one.

    Not at all 1 2 3 4 5 Very much
11. How much do you like the other members of the group? Circle one.

    Not at all 1 2 3 4 5 Very much
12. Before you came here, did you share your bedroom with anyone else?

    Yes_____No_____
13. Have you shared bedrooms with members of your family most of your life?

    Yes_____No_____
14. Which of the two rooms we used for arts and crafts did you like best? Circle one

    Larger Smaller Both the same
15. If you like one more than the other, how much? Circle one.

    Very little 1 2 3 4 5 Very much

Appendix B

PERSONAL SPACE (DIRECT) INSTRUCTIONS

Would you please stand where the lines meet and stay there until we're finished. Please look straight ahead at all times.

It is known that the closeness of other people can effect our balance. One of the first signs of losing our balance is a feeling of being uncomfortable or bothered. Someone you don't know will walk toward you three times, once from the front, once from the side, and once from the back. You may look at him when he walks toward you from the front, but you are to look straight ahead when he walks toward you from the side and from the back.

When you feel uncomfortable or bothered as he walks toward you, say "now" and he will stop. Remember, as soon as you feel uncomfortable or bothered, say "now" and he will stop.

Do you have any questions?

Appendix C

PERSONAL SPACE (SEMI-PROJECTIVE) INSTRUCTIONS

"On the paper you have just received, print your first and last name.

You will use one of these figures (held up one cut-out silhouette) who is supposed to be <u>you</u>. I want you to set up this figure pretending that it is you. I will describe what is going on and you will set yourself somewhere along this line (baseline pointed out) to show where you would be standing. Then you will tape the figure in place. There are no right or wrong places. I want to know where <u>you</u> would stand."

An example was then presented.

"Here is the situation: You are in a schoolyard and this is a boy that you sometimes play with. Where would you be standing?"

Appendix D

SPATIAL (TERRITORIAL) INSTRUCTIONS

Imagine that you are a pioneer and this is your home which you have just built. You need to build a fence around your land. Use these four pieces of cardboard to show where you would build your fence. Put one piece of cardboard on the floor to show where you would build your front fence, another to show where you would build your back fence, and the last two to show where you would build your side fences. You may use as much or as little land as you wish. The entire floor is available land.

Do you have any questions?

Appendix E

MINIMAL AVERSION THRESHOLD INSTRUCTIONS

"Sit in a circle facing outward, so that your back is to the center. I will place four of you, and the rest of you fill in. In a minute, you will each be given a piece of paper and pencil. Write your first and last name on the top of the paper when you get it. Then I will play a tape for you. It will be different from anything you've heard before. The sound will gradually become louder. Each time it becomes louder, I will call out a number. The numbers will <u>not</u> be in order. When the sound level <u>first</u> begins to annoy you, write down the number. This has nothing to do with how loud you can stand it, it is to find out what bothers you. Your dislikes may change from one time to another, and one day to another, so put down what you feel right now."

Illustrations were then provided.

"Remember this is not a test, and what the fellow next to you puts down has nothing to do with what bothers you."

Appendix F

MODEL ROOM CHANGE X INTENSITY INSTRUCTIONS

"Spread out and face away from one another. I will give you a rolled up piece of brown paper and a crayon.

A rectangle is drawn on the paper, and is a model of the room we are in. The circles drawn within the model room represent each of us."

The concept was then illustrated.

"Pretend that you are a builder, and could change the size of the room to make it larger or smaller. When I give you permission, unfold the paper and draw a line with your crayon to show how much you would change the room size. If you would not change the room size, draw a line over the line already there."

All three possibilities (increase, decrease, no change) were illustrated, and permission granted to proceed.

"Now I want you to write a number to show how much you care about the room being changed. If you care:

Very, very strongly.............................5

Strongly..4

Medium about it.................................3

Don't care much about it........................2

Don't care at all...............................1

Remember, this represents yourfeelings. Turn your paper over when you are completed."

Appendix G

Subject Data Tables

DIRECT AND SEMI-PROJECTIVE PERSONAL SPACE REQUIREMENTS

Subject Number	Front (in)	Direct side (in)	Back (in)	Semi-Projective (cm)
1	34	33	38	4.3
2	4	5	7	.7
3	4	5	31	2.3
4	26	27.5	5	8.7
5	5	5	5	2.5
6	5	11	12	10.6
7	69	5	43	7.2
8	4	5	7	2.3
9	4	5	5	2.3
10	10.5	25	7	2.8
11	4	5	5	4.1
12	35	5	7	3.0
13	4	5	5	1.7
14	36	30	19	3.1
15	4	5	5	1.1
16	4	5	5	.7
17	4	5	5	3.0
18	58	66	114	6.1
19	43.5	21	60	14.1
20	30.5	25.5	36	14.7
21	26	27.5	42.5	4.3
22	4	5	5	10.3
23	4	5	5	1.1
24	4	5	5	2.0
25	18.5	5	5	8.7
26	5	30	80.5	14.8

PROJECTED SPATIAL (TERRITORIAL) VALUES

Subject	Front (in)	Side (in)	Back (in)	Side (in)	Total ($feet^2$)
1	48	58	91	77	130
2	176	190	230	223	1164
3	5.5	1	1	.5	.0001
4	45	40	55	82	85
5	56	52	68	46	84
6	38	7.5	20.5	12	8
7	16	11	16	13.5	5
8	37	52	42	41	51
9	30	16.5	36	16.5	15
10	32	14.5	18.5	20.5	12
11	138	122	100	175	491
12	1	28	27	19	9
13	23	23	22	27	16
14	63	78	72	57.5	123
15	63.5	18	43	15.5	18
16	58	47	16	31	40
17	19.5	26	23	17.5	13
18	80.5	53	78	72	138
19	52	45	41	48	60
20	60	52	42.5	54.5	76
21	30.5	27	34	27	24
22	26	24	27	24	18
23	25.5	25	23	30	19
24	62	56.5	61	61.5	101
25	23	9.5	17	5.25	4
26	16.5	11	14	12.5	5

AUDITORY MINIMAL AVERSION THRESHOLD VALUES (dbA) AND DENSITY ORDER (NORMAL-HIGH; HIGH-NORMAL). NORMAL DENSITY VALUES PRESENTED FIRST

Subject number[a]	Trial 1 (H-N)	Trial 2 (N-H)	Trial 3 (H-N)	Trial 4 (N-H)
1	85;85	90;60	90;90	85;90
2	95;95	85;95	95;95	75;80
4	95;95	95;95	85;90	95;85
5	95;85	95;95	95;95	90;95
8	95;95	65;65	75;95	90;80
9	80;75	95;95	90;85	90;90
10	85;80	90;90	85;80	80;95
11	80;65	85;80	95;95	70;95
12	95;95	95;95	95;95	80;95
14	85;75	95;90	80;85	75;95
15	90;90	60;60	70;65	80;65
16	70;80	60;95	95;95	95;95
17	80;80	80;85	80;85	90;90
19	75;70	85;80	80;95	75;75
20	85;85	90;80	85;90	85;80
21	85;85	95;95	90;90	90;90
22	90;80	90;85	85;80	85;85
24	75;85	80;80	85;80	75;80
25	95;95	95;95	95;95	95;95
26	95;95	95;95	95;95	95;95

[a]Data on subjects 3, 6, 7, 13, 18, 23 incomplete.

ROOM DENSITY ORDER AND HEART RATE, SYSTOLIC BLOOD PRESSURE AND DIASTOLIC BLOOD PRESSURE. NORMAL DENSITY VALUES ARE PRESENTED FIRST

Order 1 (Normal-High Density)			
Subject number	Heart rate	Systolic	Diastolic
21	72;60	108;114	64;72
22	88;78	98;100	54;66
5	68;68	92;98	58;64
7	68;60	94;100	68;64
3	80;84	114;118	66;70
14	68;72	86;94	52;68
4	76;72	98;104	50;68
13	68;68	88;98	50;56
18	72;72	96;92	68;66
6	80;76	96;94	64;58
23	64;64	92;108	60;68
24	72;68	92;114	66;80
16	72;84	94;98	56;64

Order 2 (High-Normal Density)			
Subject number	Heart rate	Systolic	Diastolic
19	104;80	102;100	60;52
15	64;64	98;94	68;58
24	64;76	104;108	64;60
26	64;72	92;102	56;52
17	72;68	100;94	68;60
1	72;80	104;100	66;62
11	88;84	90;98	54;60
10	76;84	96;94	52;58
9	88;96	102;112	70;68
20	76;72	108;114	76;78
2	68;80	96;98	58;64
8	72;80	100;96	58;60
12	64;76	102;112	68;70

MODEL ROOM SIZE (CM) X INTENSITY VALUES FOR HIGH SPATIAL DENSITY

Subject number	Trial 1	Trial 2	Trial 3	Trial 4	Mean (Product)
1	8 x 5	10 x 5	13 x 3	14 x 5	49.4
2	17 x 5	12 x 5	18 x 5	45 x 5	114.0
3	21 x 4	29 x 5	-	-	-
4	13 x 2	8 x 2	9 x 2	8 x 2	19.0
5	9 x 5	17 x 1	16 x 5	9 x 2	39.1
6	16 x 5	17 x 5	-	8 x 5	68.3
7	-	33 x 5	33 x 5	36 x 5	125.8
8	16 x 5	17 x 5	15 x 5	10 x 5	60.3
9	13 x 3	16 x 3	18 x 3	8 x 3	40.7
10	5 x 4	9 x 4	13 x 4	12 x 4	39.3
11	46 x 5	32 x 5	45 x 5	12 x 3	162.1
12	10 x 4	12 x 4	13 x 4	11 x 4	45.2
13	12 x 5	7 x 3	15 x 5	-	51.2
14	16 x 3	17 x 4	19 x 4	21 x 5	73.5
15	22 x 5	27 x 5	30 x 5	29 x 5	134.4
16	8 x 1	17 x 1	13 x 1	0 x 1	9.3
17	25 x 2	10 x 2	18 x 2	14 x 2	32.9
18	7 x 4	12 x 4	-	-	-
19	17 x 4	16 x 5	13 x 4	16 x 5	68.4
20	11 x 5	13 x 2	14 x 5	13 x 4	49.0
21	23 x 5	22 x 5	23 x 5	27 x 5	118.8
22	8 x 5	7 x 5	11 x 5	9 x 5	43.1
23	17 x 3	-	-	-	-
24	9 x 5	15 x 3	16 x 1	15 x 2	34.0
25	15 x 4	8 x 2	15 x 4	10 x 4	43.2
26	13 x 3	13 x 3	12 x 3	10 x 3	35.4

MODEL ROOM SIZE (CM) X INTENSITY VALUES FOR NORMAL SPATIAL DENSITY

Subject number	Trial 1	Trial 2	Trial 3	Trial 4	Mean (Product)
1	6 x 3	9 x 3	3 x 4	5 x 4	18.9
2	7 x 5	12 x 5	13 x 5	33 x 5	75.6
3	0 x 1	8 x 5	-	-	-
4	11 x 2	13 x 2	11 x 2	10 x 2	22.0
5	0 x 2	12 x 4	18 x 3	0 x 2	25.8
6	7 x 5	10 x 5	-	7 x 5	40.3
7	-	39 x 5	35 x 5	36 x 5	183.3
8	8 x 5	17 x 5	10 x 5	9 x 5	54.4
9	39 x 3	17 x 5	5 x 4	10 x 3	63.4
10	6 x 3	11 x 3	8 x 3	9 x 3	25.1
11	0 x 1	44 x 5	0 x 1	14 x 5	71.9
12	13 x 4	7 x 2	10 x 3	13 x 3	33.3
13	22 x 1	4 x 3	9 x 4	-	23.0
14	25 x 5	0 x 1	0 x 1	0 x 2	31.3
15	24 x 5	27 x 5	30 x 5	31 x 5	140.0
16	15 x 1	13 x 1	15 x 1	0 x 1	10.6
17	10 x 2	14 x 2	8 x 2	9 x 2	20.5
18	12 x 4	7 x 4	-	-	-
19	11 x 4	12 x 3	13 x 4	17 x 4	49.1
20	5 x 3	4 x 3	7 x 4	14 x 4	35.9
21	15 x 5	21 x 5	25 x 5	27 x 5	108.8
22	0 x 1	0 x 1	0 x 1	0 x 1	0
23	-	-	-	20 x 3	-
24	31 x 3	25 x 3	38 x 1	0 x 2	51.1
25	9 x 4	11 x 2	15 x 4	11 x 4	40.0
26	13 x 3	14 x 3	15 x 3	11 x 3	39.4