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Eye Contact, Spatial Invasion, and Personal Space

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EYE CONTACT, SPATIAL INVASION, AND PERSONAL SPACE

A Thesis

Presented to the Department of Psychology

College of Liberal Arts and Sciences

and

The University Honors Committee

Butler University

In Partial Fulfillment
of the Requirements for Graduation

Cum Laude

With Departmental Honors in Psychology

Thomas E. Eby

May 1, 1973

10
11
12
13

Table of Contents

	Page
Introduction - - - - -	1
History and Review of Literature - - - - -	2
Research Hypotheses - - - - -	21
Research Design - - - - -	24
Subjects - - - - -	26
Apparatus - - - - -	26
Procedure - - - - -	27
Results - - - - -	31
Table 1 - - - - -	32
Discussion of Results - - - - -	33
Table 2 - - - - -	34
Footnotes - - - - -	41
References - - - - -	42

Eye Contact, Spatial Invasion, and Personal Space

It has been noted by a number of psychologists, anthropologists, and other astute observers of man's social milieu in general, that human beings tend to maintain some degree of physical distance between themselves and other persons or objects. In addition to territoriality, which connotes fixed geographic location, a concept of the significance of distances between individuals has evolved in psychological literature. This "individual distance" is assumed to reflect a physical area surrounding the person that he regards as a part of himself, rather like a portable territory; this area is termed "personal space" (PS). Personal space has been theorized to act in part as a buffer zone which serves as protection against perceived threats to one's emotional or physical well-being. Though there have been several experimental investigations of personal space in humans, only a very limited number of studies have systematically examined the effect of violations of personal space in humans, and virtually none have concerned themselves with the mechanisms by which humans accommodate the stress known to accompany such intrusions. The present investigation was initiated to explore some of these areas in which little experimental work has been completed.

History and Review of Literature

The concepts upon which this study was based originated over sixty years ago when Dr. Franz Boas, a linguistic scholar, and two other anthropologists, Dr. Edward Sapir and Dr. Leonard Bloomfield, were confronted with the radically different languages of the American Indians and the Eskimos. The conflict between these two different language systems produced a revolution concerning the nature of language itself. Before this time, European scholars had taken Indo-European languages as the models for all other languages, and insisted that there is an underlying similarity in the structure of all languages. Boas and his colleagues, however, discovered in effect that each language family is a law unto itself, a closed system, whose patterns the linguist must reveal and describe.

In the 1930's a student of Sapir's, Benjamin L. Whorf, suggested that language, in addition to being a medium for expressing thought, was additionally a primary instrument in the formation of thought. That is, Whorf suggested that man's very perception of the world about him and the way he structures external reality may be programmed by the particular language he speaks. Thus people who speak different languages will think and react to various situations in characteristically different ways.

Only in recent years, and to just a handful of people, have the implications of Whorf's thinking become apparent. Difficult to grasp, they strike at the root of the doctrine of "free will," because they indicate that all men are intellectual captives of the language they speak as long as they take their language for granted.

In the 1950's Dr. Edward T. Hall, an anthropologist, became

3

intrigued with the implications of Whorf's thesis, agreed with them, and carried them to their logical conclusions. Hall concluded that the principles developed by Whorf, in relation to language, apply to the remainder of human behavior as well, in fact, to all aspects of culture. People from different cultures, Hall contended, not only speak different languages but, what is possibly more important, inhabit different sensory worlds. Selective screening of sensory data admits some things while filtering out others, according to Hall, so that experience as it is perceived through one set of culturally patterned sensory screens is quite different from experience perceived through another. From these early theoretical underpinnings, Hall has proceeded to concentrate his study in a previously largely unexplored area of inquiry. Drawing upon the findings of ethology and comparative psychology, and incorporating the results of cross-cultural studies, Hall has begun to investigate man's use of the physical space surrounding him as a specialized elaboration of culture.

In The Silent Language, published in 1959, E.T. Hall completed the theoretical foundation for his contention that the most crucial differences among cultures occur outside normal awareness, and that people of various diverse cultures experience such fundamental entities as time, space, and hierarchies in different ways. By the time he published The Hidden Dimension in 1966, Hall had become preoccupied with one specific area of cultural difference, that of the perception of space. Many of his ideas revolve around the concept of "territoriality," which the English ornithologist H.E. Howard first described in 1920. Territoriality, a basic concept in the study of animal behavior, is usually defined as behavior by which an organism characteristically lays claim to an area and de-

fends it against members of its own species. Howard (1920) stated the concept in some detail, although naturalists as far back as the seventeenth century had taken note of various events which Howard recognized as manifestations of territoriality.

Many important functions are believed to be expressed in territoriality, and new ones are constantly being discovered. Dr. H. Hediger, Zurich's famous animal psychologist, described the most important aspects of territoriality and explained succinctly the mechanisms by which it operates. Territoriality, he says (1961:43), "insures the propagation of the species by regulating population density. It provides a frame in which things are done, places to learn, play, to hide. Thus it coordinates the activities of the group and holds the group together." Another psychologist, C.R. Carpenter (1958), who pioneered in the observation of monkeys in a native setting, listed thirty-two separate functions of territoriality, including important ones relating to the protection and evolution of the species.

Drawing upon the work of such men and others, E.T. Hall began to apply the concept of territoriality to the behavior of the human species, and in doing so, his central thesis emerged. "One of the most important functions of territoriality," Hall (1955:23) writes, "is proper spacing, which protects against over exploitation of that part of the environment on which a species depends for its living." "Each organism," he has written (1959:157), "no matter how simple or complex, and in addition to territory that is identified with a particular plot of ground, has around it a sacred "bubble" of space, a bit of mobile territoriality which only a few other organisms are allowed to penetrate and then only for short

periods of time."

To explore and investigate this area of human territoriality, Hall has had to create a new scientific discipline, which, because it emphasizes culturally based variations in the handling of space, he has termed "proxemics." The science of proxemics emphasizes that virtually everything that man is and does is associated with the experience of space. This experience of space is believed to be a synthesis of many different sensory inputs: visual, auditory, kinesthetic, olfactory, and thermal. Not only does each of these modality inputs constitute a complex system, (as, for example, the dozen different ways of experiencing depth visually), but each is considered to be molded and patterned by culture. Proxemics might thus be generally regarded as the study of how man structures micro-space, how he relates physically to other persons with whom he is interacting, and what is communicated by these physical relationships. E.T. Hall has focused his investigations primarily on cultural differences in the use of physical space and has found that, for example (1959), what may be a comfortable living space for a Latin American, who requires a certain amount of physical contact with his fellows, may be unbearably crowded to an Englishman, who requires a somewhat larger bubble of space around him to feel at ease.

More recently, the concept has come to be referred to in psychology as "critical" or "personal space" (PS), and investigations have shifted to the dynamics of "intra-" rather than "inter-" cultural spatial behavior. The term PS apparently was first coined by Katz (1937), though certain aspects were implicit in Stearn's (1935) "personal nearness" and in Lewin's (1935) "life space." PS involves the maintenance of a portable, flexible area surround-

ing an individual which has been viewed as a buffer zone against perceived threats to one's physical and emotional well-being. Other definitions have stressed the fact that personal space reflects an area surrounding the person that he "regards as part of himself" (Hiat, 1966) rather than portable territory. PS is clearly a form of territory but, as Sommer (1959) points out, it can be distinguished from territory in that it has no fixed geographic reference points, moves about with the individual, and expands and contracts under varying conditions.

There is also a considerable similarity between PS and "individual distance" (ID), or the characteristic spacing of species members. ID exists only when two or more members of the same species are present and is greatly affected by population density and territorial behavior. ID and PS interact to affect the distribution of persons. The violation of ID is the violation of society's expectations; the invasion of PS is an intrusion into a person's self-boundaries. ID may be outside the area of PS, as when conversation between two chairs across the room exceeds the boundaries of PS. Conversely, ID may also be less than the boundaries of PS, (e.g., sitting next to someone on a piano bench is within the expected ID but also within the bounds of PS and may cause discomfort to the player).

This "bubble" of PS has been experimentally demonstrated to vary in size or dimension, depending on such diverse variables as the particular emotional state of the individual at any given time (Little, 1965), the immediate activity of the individual (Hartnell, 1970), the individual's position in a social hierarchy (Nehrabian, 1968a), cultural background (Watson, 1966), sensory acuity (Little, 1967), time of day (Rodgers, 1972), voice loudness (Sommer, 1962),

and a host of other factors. Despite this demonstrated plethora of variables determining or influencing PS, the actual physical dimensions of any given individual's characteristic bubble of PS has been shown to be a remarkable consistent measure, with test-retest correlations being typically greater than +0.80 (Hiat, 1971).

PS is not necessarily spherical in shape, nor does it extend equally in all directions (Kinzel, 1969). Individuals are seemingly able to tolerate or withstand closer physical presence of a stranger at their sides than directly in front. For this reason, PS has been likened to a small shell, a soap bubble, an aura, or "breathing room" by various investigators.

Birds and mammals not only have territories which they occupy and defend against members of their own species. They also have a series of distinct, uniform distances which they maintain from one another according to the nature of the particular type of interaction they are in at a given time. Hediger (1955) has identified and distinguished "flight distance," "social distance," and "individual distance" representing in order, points at which an animal will flee a predator, the average distance maintained between members of the same species, and the particular individual boundary (in non-contact animals)¹ beyond which even fellow species members may not encroach without being bitten, butted, kicked, pecked, stung, gored or otherwise rejected.

Man, too, has been observed to manifest a uniform way of handling distance according to particular situations. Differences in the zones of PS, in fact their very existence, became apparent when Americans began interacting with foreigners who organized their senses differently so that what was intimate in one

culture might be personal or even public in another. Since man is the predator supreme and a social one at that, however, Hediger's conceptual system cannot be directly applied. For example, flight distance for humans would be relevant only in rather rare circumstances, (e.g., in Central Park, New York City, around two a.m.). E.T. Hall (1963) has suggested an alternative system for the notation of proxemic behavior for humans in which PS is divided into three distance zones: the intimate, the casual-personal, and the social-public. These in turn are each divided into a near and far phase. For a given individual each of the zones has quite stable boundaries although they may fluctuate depending on the immediate situation. Since Hall's classification schema is germane to the nature of the present study, each of the proxemic zones will be briefly mentioned. "Intimate distance" ranges from actual physical contact between individuals to a maximum distance of approximately eighteen inches away; it is almost exclusively restricted to those situations in which physical contact or the high possibility of physical involvement is uppermost in the awareness of two highly familiar persons. This is the spatial area that might be thought of as the small protective sphere that the human organism attempts to maintain between himself and others.

"Personal distance" encompasses the area from eighteen inches to roughly four feet and designates the distance at which most social interaction occurs between two people. The near phase of this zone, (the distance at which one can hold or grasp the other person), is generally reserved for interactions between familiar individuals. The far phase is that just outside the limit of physical domination, the range at which a person cannot easily "get his hands on" another person. Subjects of personal interest

and involvement can be discussed at this distance between strangers.

"Social-public" distance ranges from four to twelve feet (near phase) and twelve to twenty-five feet (far phase). It is the distance at which most social interaction occurs between more than two people. Most business and formal social discourse is conducted within the near phase. The far phase, while not restricted to public figures, is that distance which is generally thought of as being automatically set around important public figures. Much of the nonverbal part of communication shifts to gestures and body stance at this distance.

Personal space may thus be considered, in Hall's schema, as a series of fluctuating, concentric, globes of space, each defining a region for particular types of interactions. Where individuals stand in relation to each other signals the nature of their relationship, or how they feel toward one another, or both. It should be emphasized that these generalizations concerning proxemic patterns are not representative of human behavior in general, or even necessarily of American behavior in general. As Hall indicates, proxemic behavior is heavily dependent upon and influenced by cultural determinants, and it can be expected that variations from this schema do, in fact, exist.

Experimental investigation in the area of PS has been, unfortunately, rather scanty. The most extensive examination of PS in humans has been made, not surprisingly, by E.T. Hall. In a series of studies (1959, 1960, 1962, 1963) he has pointed up the marked cultural differences in proxemic behavior that exist, the various sensory cues employed by man to judge PS, the manipulation of PS as a form of nonverbal communication, and partially validated his

system for the notation of proxemic behavior.

Prompted by Hall's early treatment and classification of proxemic behavior, Sommer (1959, 1961, 1962, 1965) has concerned himself for the most part with the distances most effective in eliciting conversational interactions, the influences of various spatial distances on leadership effectiveness, and the effect of distance on the nature of interactions between mental patients. Kuethe (1962, 1964a, 1964b) has dealt tangentially with human personal space in his investigation of social schemata. While his major concern has been with what might be called the "geometry" of human interactions, his findings suggest that appropriate interaction distance, (i.e., PS), is a powerful and pervasive phenomenon.

More recently, Watson (1966) and Engebretson (1970) have obtained empirical verification for Hall's observation that members of different cultural groups do, in reality, maintain different but consistent variations in proxemic behavior.

Animal studies and some early pilot studies in humans (Bass, 1972; Fry, 1972; Russo, 1972) have indicated that appropriate PS behavior is learned at some early stage in life, typically before the age of five years in humans. When an individual is deprived of contact with his fellow humans, as in isolation studies, he apparently cannot learn proper spacing, which sets him up as a failure in subsequent social intercourse. Of related interest is the fact that studies of psychotic, schizophrenic, or even mildly disturbed individuals have obtained distorted and inappropriate use of personal space by these individuals when compared with "normal" controls. (Blumenthal, 1967; Fisher, 1967).

A number of investigators have suggested that certain personality characteristics may be related to various types of proxemic

behavior. Such variables as "self-esteem" (Frankel, 1972), "anxiety," "authoritarianism" (Justice, 1970), "introversion" and "extroversion" (Williams, 1971) have been examined with regard to individuals' characteristic use of PS and moderate, significant correlations have generally been obtained. For example, individuals scoring "high" in anxiety, introversion, or authoritarianism on various personality inventories also tend to use relatively more PS in their social interactions with others, than those individuals scoring "low" on these qualities.

Other outgrowths of studies on spatial proximity have demonstrated that the amount of PS maintained between individuals is positively correlated with shared beliefs and value congruence between individuals (Little, 1967), popularity (Tolor, 1970), physical attractiveness (Kleck, 1968), various indices of physiological and emotional arousal (McBride, 1965), and "arguing" (Dabbs, 1971). Kleck (1968) has reported that the ascription of some stigmatizing condition to an individual results in less proximate spatial interaction by others with regard to this individual. Another interesting finding, which demonstrates how PS can markedly influence one's behavior, is that argumentative persuasiveness is positively correlated with the distance existing between two individuals. That is, the maintenance of close spatial proximity with one's polemic adversary may serve to facilitate his acceptance of an issue or argument (Albert, 1970).

Finally, experimental evidence presented by Hiat (1971) concerning the actual physical dimensions of PS suggests that the "sphere of personal space" is not a sphere at all but a "pear-shaped enclosure relatively expanded to areas of frontal approach to the individual.

Contemporary issues such as urban crowding, overpopulation, and pollution have led many investigators to concentrate increasingly on what happens when these bubbles of PS overlap. The studies which have been devoted to this problem suggest that if man's spatial bubble is crushed, dented, or otherwise pushed out of shape, he suffers virtually as much damage as though his actual body were crushed, dented, or pushed out of shape. The only difference appears to be that the effects of unwanted spatial intrusions take longer to make themselves evident.

About the time of World War II, a few scientists began to suspect that there was more to population control than the Malthusian doctrine which relates population to food supply and predators. The yearly mass suicide of Scandinavian lemmings, the death dance of the march hare, and similar self-destructive behavior among whales and a species of rat on some Pacific islands have recently and tentatively been interpreted as direct results of stress induced by overcrowding. Man may not be immune to this physiological density-control factor. Even if technology permits us to produce unlimited quantities of food, (putting to rest the Malthusian apprehension that population eventually outstrips food supply), there remains the certainty that the supply of terrestrial space, which may be just as vital a factor in the maintenance of life, is a fixed quantity on this globe.

In The Hidden Dimension Hall (1966) recounts the experiments of an ethologist with training in medical pathology, Dr. John Christian, with Sika deer on James Island in the Chesapeake Bay. Several of the deer had been released on the otherwise unpopulated island in 1916, and by 1955 the herd numbered about three hundred, or one deer per acre. Since Sika deer were presumed to require

about this much space, Christian began to observe the development of the herd. In the first three months of 1958 more than half the deer died, and in the following year the population dropped to about seventy. Detailed histological examination of the dead animals, most of which were does and young deer, indicated that the cause of death was shock, following severe metabolic disturbance caused by prolonged hyperactivity of the adrenal glands.² Since food was in good supply on the island, and since, except for the adrenal disturbance, the animals were in good health, Christian concluded that the massive mortality among the deer was caused simply by the stress of crowding beyond density levels that the deer were able to tolerate.

The progressive stages prior to population collapse have been observed and described in detail by another ethologist, Dr. John Calhoun (1962), who experimented with domesticated Norway rats. Earlier experiments by Calhoun had indicated the spatial requirements of the rats in a wild state. Between 1958 and 1961 Calhoun permitted the density of a laboratory rat population to reach approximately twice that of the estimated normal healthy maximum. Since he was primarily interested in the long-term effects of stress on the social habits of his subjects, he removed excess infants to prevent total population collapse.

What developed in Calhoun's experiment is now commonly referred to as a "behavioral sink." The word "sink" is used figuratively to mean a receptacle of foul or waste things. Calhoun invented the term to designate the gross distortions of behavior which appeared among the majority of the rats in his experiment. Such a phenomenon, he believes, is "the outcome of any behavioral process that collects animals together in unusually great numbers!"

"The unhealthy connotations of the term are not accidental: a behavioral sink does act to aggravate all forms of pathology that can be found within a group" (1962:84). The normal social structure of rat society suffered a severe breakdown. Traditional family groupings were abandoned, and many males lost all sense of sexual discrimination, mounting aged and infant rats or other males. Other rats, unable to compete with the hyper-active satyr-rats, lost interest in sex altogether. Sadism, in the form of tail-biting, became prevalent. Courtship and mating customs, a rather rigid routine among Norway rats, were abandoned in favor of promiscuous affairs. Females stopped taking care of their young and let their nests become cluttered. Some animals went abroad only at night, while the others slept. A few rats, in an apparent attempt to escape from the constant turmoil, developed the rather extreme but ingenious technique of sleeping at night by hanging upside down from the wire grid roof of the colony. Certain aggressive aristocrats were able to protect their territories within the pen, and continued to observe the rules of rat society, but the mass of the population, under the stress of crowding, became unruly and neurotic. The constant turmoil of the sink resulted in a sharp increase in the death rate, especially among females and the young. Infant mortality rose to seventy-five per cent. Kidneys, livers, and adrenals of the dead animals showed signs of adrenal hyperactivity usually associated with extreme stress. Such experiments indicate, E.T. Hall and others believe, that animals regulate their own density as a function of self-preservation.

Many ethologists have been reluctant to suggest that their findings apply to man, even though crowded, overstressed animals are known to suffer from circulatory disorder, heart attack, and

lowered resistance to disease. Recent reports, however, by pathologists H.L. Ratcliffe and R.L. Snyder (1967) of the Philadelphia Zoo's Penrose Laboratory are of pertinence. Their report on a twenty-five year cause-of-death study of 19,000 birds and mammals demonstrates not only that a wide variety of animals are stressed from overcrowding but that they suffer from exactly the same diseases as man: high blood pressure, circulatory diseases, and heart disease, even when fed low fat diets.

One of the first attempts to assess the effects of long term spatial proximity in humans was conducted by Chambart de Lauwes (1959), a French psychologist, who produced some of the first statistical data on the consequences of inadequate physical space in urban housing. Chambart de Lauwes collected measurable data on every conceivable aspect of the family life of the French worker. At first he computed and recorded crowding in terms of the number of residents per dwelling unit. This index revealed little and de Lauwes then decided to use a new index to establish crowding, the number of square meters per person per unit. The results of this index were startling; when the space available was below eight to ten square meters per person social and physical pathologies tripled. When the space available rose above fourteen square meters per person, the incidence of pathology of both types also decreased markedly. (This figure is, as Hall indicates, likely only applicable to a very limited segment of the French population at a particular time and has no demonstrable relevance to any other population.)

What all these studies have to do with the human population in general, crammed into subway cars or stacked up in high-density vertical slums, has not yet been scientifically investigated to any appreciable extent. The behavior of the Norway rats, however,

raises fascinating speculations. Crimes of violence, sexual deviation, breakdown of familial ties, lapse of habits of cleanliness, and many other symptoms of social disorganization in our cities might be traceable to the effects of crowding. Probably there is nothing pathological in crowding per se that produces these symptoms that have been observed. Crowding, however, disrupts important social functions and so leads to disorganization and ultimately, perhaps, to population collapse or large scale die-off.

The vital question raised by these studies is whether man can learn enough about the relationship between space and human behavior and put this knowledge to work to prevent the intolerable conditions mentioned above, which, by implication, is a possibility if nothing is done to alleviate the stress of urban life.

Probably the most feasible method for exploring PS with its invisible boundaries, and the results of violations of it, is simply to approach people and observe their reactions. The most systematic work along these lines has been undertaken by the anthropologist Ray Birdwhistell (1966) who records an individual's response to spatial violation with zoom lenses which are able to detect even minute eye movements and hand tremors as the invader approaches the emotionally egotistic zone around the victim.

One of the earliest attempts to invade PS on a systematic short-term basis was undertaken by Williams (1963) who wanted to know how different people would react to excessive closeness. Classifying students as introverts or extroverts on the basis of their scores on a personality test (MMPI), he placed each individual in an experimental room and then walked toward the person, telling him to speak out as soon as he (Williams) came too close. Afterward he used the reverse condition, starting at a point very

close and moving away until the person reported that he was too far away for comfortable conversation. His results, among other things, demonstrated that introverts kept people at a greater distance than extroverts, and reacted much more markedly to intrusions of their PS.

The same conclusion was reached by Leibold (1963), who studied the distance at which introverted and extroverted college students placed themselves in relation to an interviewer in either a stress or non-stress situation. Results showed that students given praise sat closest to Leibold's chair, followed by those in the neutral condition, with students given the stress instructions maintaining the most distance from Leibold's chair.

Experimental evidence (Crook, 1964), that regressed, catatonic, or supposedly "burnt out" schizophrenic patients can be moved from their places by sheer physical proximity is of theoretical and practical importance. In view of the difficulty that nurses have in obtaining any type of response at all from these patients, it is noteworthy that an emotion sufficient to generate "flight" can be produced simply by sitting "too close" to them.

Dr. Glen McBride has done excellent work on the spatial behaviors of fowl, not only in captivity but in their feral state on islands off the Australian coast. He has recently turned his attention (1965) to human spatial behavior using the galvanic skin response (GSR) as an index of emotionality. The GSR picks up changes in skin conductivity that relate to stress and emotional behavior. McBride placed college students in a chair from which they were approached by both male and female experimenters as well as by paper figures and nonhuman objects. It was found that GSR was greatest (skin resistance least-stress greatest) when a person was ap-

approached frontally, whereas a side approach yielded a greater response than a rear approach. Students reacted much more strongly to the approach of someone of the opposite sex than to someone of the same sex, and being touched by an object produced less of a GSR than being touched by a person. The intensity of the GSR was positively correlated with the degree of intrusion made by the experimenter.

A similar procedure without the GSR apparatus was employed by Argyle and Dean (1965), who invited their subjects to participate in a perceptual experiment in which they were to "stand as close as possible to see well" to a book, a plaster head, and a cut-out life-size photograph of the author with his eyes closed and another photograph with his eyes open. Among other things, it was found that the subjects placed themselves closer to the eyes-closed than the eyes-open photograph. Horowitz, Duff, and Stratton (1964) used a similar procedure with schizophrenic and non-schizophrenic mental patients. Each individual was instructed to walk over to a person, or in another condition a hatrack, and the distance between the goal and his stopping place was measured. It was found that people came much closer to the hatrack than they did to another person. Each tended to have a characteristic individual distance that was relatively stable from one situation to another, but was shorter for inanimate objects than for people.

As has been indicated previously, personal space may be conceived of in the sense of a body buffer zone that can be used for protective purposes. This applies, on the basis of experimental evidence, to threats of one's self esteem as well as to the threat of bodily harm. Thus, environmental or internal threats to self-esteem should produce greater PS distances. Leibold (1963) and

Little (1967) have reported some tendency for spatial distances to increase under conditions of stress in the sense of "reproof" by others. Leibold's study also reported a tendency for males, but not females, who scored high on the Taylor Manifest Anxiety Scale to maintain greater PS.

Architecture students at the University of California, Berkeley, now undertake behavioral studies as part of their training. One team noted the reactions of students on outdoor benches when an experimenter joined them on the same bench. The occupant shifted position more frequently in a specified time frame and left the bench significantly earlier than control subjects who were alone. A second team was interested in personal space on ten foot benches. When the experimenter seated himself one foot from the end of the bench, three-quarters of the next occupants sat six to eight feet away, and more than half placed books or coats as barriers between themselves and the experimenter. Other students studied eye-blink and shifts in body position as related to whether a stranger sat facing away. Observations made by a second experimenter using binoculars from a distance indicated that a male stranger directly facing a female markedly increased her eyeblink rate as well as body movements, but had no discernible effect on male subjects.³

The stress-producing effects of spatial invasion have long been intuitively familiar to those proficient in the art of persuasion. For instance, spatial invasion techniques are not uncommon during police interrogations. One police textbook (1963) recommends that the interrogator should sit close to the suspect, with no table or desk between them, since "an obstruction of any sort affords the subject a certain degree of relief and confidence not otherwise obtainable". At the beginning of the session, the officer's chair

may be two or three feet away, "But after the interrogation is under way the interrogator should move his chair in closer so that ultimately one of the subject's knees is just about in between the interrogator's two knees".

Ethologist Ewan Grant (1963) has conducted a detailed analysis of mental patient's micro behaviors in response to intrusions of PS. Among a group of confined mental patients he determined a relatively straightforward dominance hierarchy based on aggression-flight encounters between individuals. Aggressive acts included threat gestures, frowns, and hand-raising. Flight behaviors included retreat, bodily evasions, closed eyes, withdrawing the chin into the chest, hunching, and crouching. These defensive behaviors occurred when a dominant individual sat too close to a subordinate, and the various behaviors were preceded by some overt signs of tension, such as rocking, leg swinging, or tapping.

Another study on short term intrusions of expected conversational distance (Felipe, 1966) indicates that it produces first of all various accommodations on the part of the victim. The intensity of the subject's reaction is influenced by many factors including the previously mentioned territoriality, the dominance-submissive relationship, the locus of the spatial invasion, and the victim's attribution of sexual motives to the intruder. Generally, however, the first reaction is typically some form of adaptation or accommodation to the intrusion. The individual temporarily attempts to "live" with the intrusion. When this fails to relieve the tension, flight reactions typically occurred. In fact, violation of PS by a stranger in a natural setting elicited a significant ($p < .001$) movement away from the intruder in Felipe's investigation.

Research Hypotheses

The use of intimate distance in public (defined by E.T. Hall as 0" to 18") is clearly not considered "proper" by adult, middle-class Americans. Crowded subways and buses may bring strangers into what would ordinarily be classified as intimate spatial relations, and as indicated before, such intrusions seem to produce stress. The means by which this increased stress is seemingly tolerated is in defensive devices or mechanisms which take the real intimacy out of intimate space in public situations. The basic tactic, as Hall describes it, appears to be to remain as immobile as possible and, when part of the trunk or extremities touches another person, withdraw if possible. If this is not possible, the muscles in the affected areas are kept tense and the hands are kept at the side or used to steady the body by grasping a railing. The eyes are fixed on infinity and are not brought to bear on anyone for more than a passing glance.

While a number of investigators have described at length these various mechanisms by which the concomitant stress of PS violation is accommodated, experimental verification of such descriptions has been rare. The present experiment was designed to examine the nature of some of the mechanisms which permit individuals to accommodate these unwanted short-term violations of PS.

Comparative studies have typically demonstrated that violation of PS in animals elicits some form of aggressive response. In man, the much more frequent response appears to be some form of "flight"; yet when flight is impossible, aggression is still a relatively uncommon event. Evidence strongly suggests, however, that intrusions of humans' PS (short-term or sustained) result in just as much stress, behavioral and physiological pathology as in animals.

From the presented conceptualization of PS as a means of protection or a "body buffer zone" against external physical or emotional threat, and on the basis of various experiments demonstrating the stress producing effect of short-term as well as long-term violations of PS, it was predicted that (1) more PS will be used by individuals under conditions of stress than non-stress. More specifically, (2) that the spatial buffer or distance zone an individual characteristically employs will extend or "bulge" outward in a direction opposite from that which a threat or intrusion operates. This "bulge" phenomenon is hypothesized to function by maintaining a psychological avenue of "emotional escape", thus temporarily preventing the often observed "flight" reaction.

Common experience suggests, however, that this postulated "bulge" phenomenon is not always appropriate or even possible in a given situation, (as, for instance, in a crowded subway). Another mechanism which has often been described as relevant to the maintenance of composure under crowded conditions is "eye-contact". Studies concerning the relationship of eye-contact to PS have also been quite limited. Common experience again suggests that the maintenance or avoidance of direct eye-contact would be related to the distance at which individuals interact, and observations of people in crowded situations indicate that when PS is limited, eye-contact seems to be avoided. Just what the exact relationship between eye-contact and the use of PS is, however, is not yet known. Some studies (Argyle, 1965) have demonstrated that the closer people stand to one another, the less eye-contact is maintained, and that subjects will stand closer to each other if their eyes are closed. Dumont (1971) confirmed that eye-contact is indeed depressed by

close physical distance between individuals, and Russo (1972) reports that this reduction of eye-contact at close distances is learned by individuals at a very early age.

Nowhere, however, is the role of eye-contact in determining PS in any given situation assessed. It was therefore predicted in this experiment that, since direct eye-contact seems to elicit stress and depression of eye-contact occurs in physically "close" situations, (3) greater PS will be maintained by a target individual when direct eye-contact is intermittently held with the intruder than when no eye-contact is maintained.

Sex-linked differences in the manifestation of PS behavior are also expected to be obtained in this experiment. In light of the fact that spatial behavior is currently regarded as being an essentially learned phenomenon, (within certain limits), and on the basis of the observation that "territoriality" has traditionally been a more relevant variable for males of the human species,¹⁾ the present experiment predicts that (4) males will employ greater PS under the stress of intrusion than females.

The notion that personality differences may be supplemented or evidenced through spatial usage led to the further hypothesis that (5) individuals scoring "high" in aggression as measured by the Edwards Personal Preference Schedule will employ relatively more PS and be more markedly affected by intrusions of PS (in terms of the "bulge" phenomenon) than individuals scoring "low" in aggression.

Additionally, this experiment will attempt to verify that portion of E.T. Hall's classification of proxemic behavior (two-person, stranger interactions) on a sample of college students.

Research Design

It is paradoxical but perhaps not illogical to suggest that the best way to study violations of PS is to stage them deliberately. This experimenter believes, as others have demonstrated (Finzel, 1966; Williams, 1971) that the easiest way to learn the location of PS's invisible boundaries and determine the point at which an approach becomes a violation, is simply to keep walking until somebody complains. If, as Hall and others contend, proxemic behavior is such an omnipresent and all pervasive phenomenon, it shouldn't disappear even under deliberately staged, overt experimental conditions. Moreover, at least one other study employing this overt methodology has obtained a moderately high correlation (+.71) between overt measures of PS taken in the laboratory and the same measure observed in a "natural" setting (Hiatt, 1971).

Another reason supporting the use of an overt experimental methodology in studying PS relates to an important but often overlooked consideration in defining a spatial invasion. That is, whether or not the parties involved perceive one another as "persons." A non-person cannot invade someone's personal space any more than a tree or chair can, and it is common under certain circumstances for one person to react to another as an object or part of the background. For example, many subway riders who have adjusted to crowding through psychological withdrawal apparently prefer to treat other riders as non-persons and keenly resent situations, such as a stop so abrupt that the person alongside pushes into them and then apologizes, when the other passenger becomes a person. The advantage of an overt experimental situation is, therefore, that it forces the subjects attention onto the experimenter.

Similarly, the different ways in which target victims react to invasions of PS may be due to variations in their perception of the expected distance or in their ability to concentrate, (e.g., it has been demonstrated (Crook, 1961) that the individual distance between birds is reduced when one bird's attention is riveted to some other activity). Again, the advantage of an overt experimental situation is that it assures the target subject's attention is directed to the appropriate stimuli.

The particular technique utilized in this study is illustrated by the previously mentioned work of Williams (1971). Labeled by some as the "method of limits," (based on the psychophysical technique of measuring stimulus-sensation thresholds), this procedure requires the subject to remain in one place while the experimenter proceeds toward the individual, from a given distance away and at a pace at a time, until the subject indicates at which point the experimenter is becoming "too close" or is making him (the subject) "uncomfortable."

Obviously, a number of implicit assumptions are being made when such a technique is employed. First, it is assumed that subjects are at least partially aware of their zones of PS and able to consciously communicate them, and secondly, that these reported zones reflect the same consistent measure that would have been observed in a more natural setting. It may prove to be true, however, that the usual sanctions of the outside world may not apply to forced close proximity in the experimental setting. Nonetheless, the moderately high correlations, (as reported earlier), between measures of PS taken from the "method of limits" and observations in a "natural" setting seem to indicate that continued efforts with this technique are warranted.

Subjects

The subjects (Ss) participating in the present experiment consisted of twenty-five male and twenty female ($N = 45$), eighteen-to-twenty-year old, college freshman volunteers recruited from introductory psychology and sociology classes at Butler University. Every student in each of the introductory classes solicited was first administered, with the permission of the instructor, two scales of the Edwards Personal Preference Schedule (EPPS) (Heterosexuality and Aggression Scales), and was then requested to volunteer for an experiment. Ss were told nothing about the exact nature of the experiment, other than the fact that it was short (twenty minutes), safe, and "not embarrassing or painful." Each S was assigned a random number to be used for identification purposes before taking the EPPS, and all Ss were then subsequently assured that their anonymity would be preserved. Each S was tested individually and, after a number of Ss were eliminated from the analysis of data for various reasons (to be discussed later), the final sample consisted of twenty-four males and seventeen females.

At the time of this present experiment, all Ss that were recruited also participated in a simultaneous study being conducted by a fellow student. To prevent any "order effects" from contaminating the data of either study, the order of the presentation of the two experiments was alternated consecutively.

Apparatus

The experimental condition consisted of a large (approximately thirty by fifty feet), well-lighted, unused lounge, which was relatively unfurnished and to which the experimenter (E) had sole access.

Dumont (1971) has reported that the size of a room in which studies of PS are conducted does not greatly affect an individual's responses unless it is extremely small. Hiat (1971) has confirmed this stability of PS over a wide range of room sizes.

The floor of the experimental room was conveniently covered with twelve-inch square tiles, and these served as a basis for a measuring grid. Two pairs of footprints were chalked onto the floor at the center of the room, facing each other "toe-to-toe" and separated by a distance of nine feet. This nine foot interval of space separating the two pairs of chalk footprints was divided into one-foot intervals by the natural "joints" between the 12" floor tiles, and was divided into one-inch intervals by unobtrusive chalk marks. Another pair of chalk footprints was marked into one empty corner of the room (the heels of one pair of the footprints extending three inches directly out from the corner), and a corresponding chalk grid was marked out extending nine feet from the bisection of the corner to the toes of a similar pair of chalk footprints.

Procedure

The same male E took each male S, (and the same female E took each female S), into the experimental setting, one at a time, and directed the S to stand on the pair of chalk footprints marked on the floor at the center of the room. (If violations of PS are made by members of the opposite sex, it has been demonstrated (Little, 1965) that sexual intent may be considered by the victim or target to be the motivation force behind the behavior. For this reason, only homogeneous intruder-victim sex pairings were made in this experiment.) The E then assumed the position indicated by the corresponding pair of chalk footprints. Thus E and S stood in the cen-

ter of the room, facing one another, and separated by a distance of nine feet. The following instructions were then read verbatim to each S:

"I'm going to approach or walk up to you under a number of different conditions in order to determine some of the ways people characteristically use the physical space around them. As I approach you, your task is to tell me to stop when you feel that I'm getting "too" close or you begin to feel "uncomfortable". There are no correct or proper answers for this experiment. Do not try to be consistent in your responses. It is very important that you respond on the basis of what you are feeling rather than what you think might be correct. Do you have any questions? Are you ready to begin?"

Each S was placed in four different conditions. In each of the treatment conditions the E began his approach from a distance of nine feet away. In each treatment condition the E approached the S one step at a time, asking "here, is this too close?" after each pace. In each treatment condition the E approached the S in this manner, stopped where the S indicated, and recorded the distance to the nearest inch on the data recording sheet. Distance was measured by observing the distance from the E's toes to the S's toes, by counting the number of twelve inch tiles and the number of inches beyond the last completely uncovered floor tile. The order of presentation of each of the four treatment conditions was varied randomly for each S in an attempt to avoid any contaminating "order effects".

The first treatment condition was designed to obtain a measure of the S's characteristic or base-line area of PS, (i.e., the minimum distance at which the individual typically responds to or interacts with a stranger of the same sex in a non-threatening situation). In this first condition the E's eyes were averted downward and to the right. This was done in order to avoid any interaction effects with eye-contact in establishing PS.

The second experimental condition was designed to test the hypothesis that relatively more PS would be employed by an individual if he is maintaining direct eye-contact with the E than if he is not. To insure that the "uncomfortableness" reported by the S was not merely due to the stress of sustained eye-contact, the E "broke" eye-contact with the S by looking down as each step was taken. In this experimental condition Ss were instructed, "On this trial I want you to continue looking at me and we'll repeat the procedure just as before". This was the only experimental condition in which the E and the S maintained direct eye-contact. In the remaining three conditions the E, as indicated previously, directed his gaze downward and to the right.

In the third experimental condition the S was directed to stand of the chalk footprints which had been marked in one empty corner of the room. The S faced outward while the E again approached frontally from a distance of nine feet away. Again, the E proceeded toward the S one step at a time, asked the S "Here, is this too close?" after each pace, stopped when the S indicated, and recorded the distance. This measure attempted to determine if a S's PS would expand in a direction opposite from that in which an inanimate object (the wall) intruded or prevented escape. In other words, will having one's PS violated on two sides by an inanimate object produce the same reaction (expanded PS) as having one's PS violated by other human beings.

In the fourth experimental condition three experimental confederates (of the same sex as the S) entered the room, approached the S from the S's two sides and rear, and stood facing the S "as close as possible without touching him". Thus the S was surrounded on three sides by individuals facing him, while he (the S) continued

to face the E, nine feet away, in the remaining "open" direction. Before the confederates entered the room the S was given the following instructions: "On this trial I'm going to bring in some other people who are going to stand around you. Your task is again to remain on the footprints and, as I approach you, tell me where to stop when I make you uncomfortable, not anyone else." Again, the E approached the S one step at a time, asked the S "Here, is this too close?" after each pace, stopped when the S indicated, and recorded the distance. This last experimental condition was designed to test the hypothesis that a S's PS will expand in a direction opposite from that in which a violation of PS operates. That this intrusion of PS by the experimental confederates was stress inducing was indicated by a considerable number of overt behaviors on the part of the S, (e.g., flushing, folding of arms over the chest, laughing, and refusals to continue with the experiment by two Ss).

The experimental confederates used in this portion of the experiment were recruited from the campus cafeteria, and if any of them were personally familiar with the S, the trial was terminated. (N = 2)

At the conclusion of the four experimental conditions each S was thanked and cautioned not to talk to other students about the nature of the experiment.

Results

For the primary analysis of data, the results obtained in the present experiment were analyzed in terms of: (1) a "two by four way" analysis of variance followed by Tukey's test and, (2) a product moment correlation assessing the relationship between Ss' scores on aggression (as measured by EPPS) and their (a) characteristic or "baseline" PS and (b) degree of "bulge" or expansion of PS in response to violation of PS.

A summary of the PS measures obtained for the four experimental treatments is presented in Table 1 (page 32).

The "two by four way" analysis of variance followed by Tukey's test reveals that the three experimental treatments differed from the baseline measure of PS. That is, all of the treatment conditions produced statistically significant differences in Ss' responses, except that between measures two and three, (maintaining eye-contact and standing in the corner of the room). The amounts of PS employed by Ss maintaining direct eye-contact with the E and standing in the corner were both significantly ($p < .01$) greater than the baseline measure of PS but not significantly different from one another; while being surrounded on three sides by experimental confederates produced a statistically significant ($p < .01$) "bulge" of PS employed by Ss greater than any of the other experimental conditions. The results of the analysis of variance are summarized in Table 2 (page 32).

Further analysis of data indicates that there were no sex differences in response to any of the experimental conditions, (females used just as much PS and in the same manner as males), and that there were no significant interaction effects between

Table 1

Personal Space in inches under
the four treatment conditions.

		Baseline Measure	Eye-Contact Measure	Corner Measure	PS Violation Measure	Total
Males	Mean	22.57	32.29	33.71	39.83	32.72
	S.D.	5.97	12.05	9.62	12.18	
Females	Mean	21.47	31.03	27.64	34.28	28.73
	S.D.	7.89	16.42	11.65	16.15	
Total	Mean	22.21	31.97	31.37	37.44	

Table 2
Studentized Range Test (q - statistic)

Obtained Values

(2) Eye-contact	-9.5	-	-	-
(3) Corner	-8.5	+1.0	-	-
(4) PS Violation	-15.0	-5.5	-6.5	-

(1) Baseline

(2) Eye-contact

(3) Corner

(4) PS Violation

$(F_{4,117}) = 3.68; (p < .05)$

$(F_{4,117}) = 4.49; (p < .01)$

MSerror = .9015 (1,39 d.f.)

Ss' sex and any of the experimental conditions.

The hypothesis that Ss' scores on the EPPS Aggression Scale would be positively correlated with the characteristic amount of PS used by them was not supported by the data (Table 3, page 34). Trends in the predicted directions did occur, but did not in any instance reach statistical significance. For females, (N = 14), scores on the EPPS Aggression Scale correlated +0.24 with the baseline PS approach distance and +0.25 with the degree of PS "bulge" produced by intrusions of the experimental confederates. For males, (N = 19), EPPS Aggression Scale scores correlated +0.16 with the baseline measure of PS and, interestingly enough, -0.33 with the amount of "bulge" produced by spatial violation of PS. (i.e., "Highly aggressive" males permitted greater spatial violations of PS than less aggressive males or any of the females.) It is to be emphasized that all of these correlations represent "trends" only and are not statistically significant. Nor were there any statistically significant differences between the male and female correlation values.

A "chi-square" comparison of male-female correlations revealed that there were similarly no significant differences in the number or frequency of male or female Ss responding differentially to the various treatment conditions.

Discussion of Results

The following hypotheses were advanced at the beginning of the present experiment:

- (1) relatively more PS will be used by individuals under conditions of stress than non-stress;
- (2) the spatial buffer or PS distance zone an individual characteristically employs will extend or "bulge" out-

Table 3

Correlation between Ss' Aggression scores and PS treatment measures.

	Baseline Measure of PS	PS Violation Measure	
Male Aggression Scores	+ .16	- .31	(d.f. 5,16) = .341 (p < .05)
Female Aggression Scores	+ .24	+ .25	(d.f. 5,11) = .424 (p < .05)

ward in a direction opposite of that from which a threat or intrusion operates;

- (3) relatively more PS will be maintained by a target individual when direct eye-contact is held with the intruder than when no eye-contact is maintained;
- (4) males will employ greater PS under the stress of PS violation than will females;
- (5) individuals scoring "high" in aggression as measured by the EPPS will employ relatively more PS and be more markedly affected by intrusions of PS (in terms of the "bulge" phenomenon) than individuals scoring "low" in aggression.

Hypotheses (1), (2), and (3) appear to have been supported by the experimental evidence, while hypotheses (4) and (5) were clearly not supported.

The most obvious result obtained in this experiment is that the mean baseline PS approach distances (Table 1, page 32) used by Ss clearly support H.T. Hall's classification system for proxemic behavior. As Hall has indicated (1966), for the purposes of any particular form of interaction people take up a position a certain distance from one another. Hall reports that Americans will not stand nearer than eighteen inches to twenty inches from one another when talking to a stranger of the same sex. If they have to stand closer than this preferred distance, they will turn and face each other at right angles, or stand side to side.

As Hall would have predicted, Ss in this experiment kept the E outside of their "intimate distance zones" (0" to 18") and, on the baseline PS approach distance, at least, clearly within the "personal distance zone" (18" to 30"). Male and female Ss in this experiment responded on the baseline PS approach distance measure with mean distances (Table 1, page 32) of 22.57" and 21.55" respectively. Under the more stress inducing conditions of this experiment, and again, just as Hall would have predicted, the Ss re-

sponded with mean PS approach distances ranging from 31" to 39". These distances fall within what Hall has described as the "limit of physical domination", "the zone in which a person cannot easily get his hands on another person" (30" to 48"). Hall's classification of proxemic behaviors thus seems well borne out in this experiment as applying to a limited sample of Caucasian, eighteen to twenty year old, college freshmen.

The data also provides rather strong support for the conceptualization of PS as a "body buffer zone" or protective mechanism against stress inducing intrusions. Visual intrusion by eye-contact, spatial intrusion of Ss' PS in the form of "intimate" contact with strangers, and approach toward Ss who were physically incapable of escape, all apparently seemed to create stress and a significant concomitant increase in the amount of PS utilized. (Spatial invasion by strangers seemingly being more threatening and involving the use of greater PS than eye-contact or physical constraintment.) Whether this increased stress resulted in the predicted "bulge" of PS in the direction opposite from that in which the threat operated, or just an overall increase in the amount of PS used in general, was not determined. Such a determination would likely have to involve approaching the S from several different directions, (as opposed to frontal approach only in this study), and measuring the S's PS in the opposite quadrant. Since Ss have been shown to be more sensitive to frontal approaches (Hartness, 1970), some type of correction factor would have to be enlisted.

There were no significant product moment correlations between aggression (as measured by EPPS) and the characteristic amount of PS used by Ss in this experiment. For females, how-

ever, aggression tended to be positively correlated with the amount of "bulge" in response to spatial intrusion, while for males aggression tended to be negatively correlated with the tendency for PS to "bulge". The E feels that the rather small sample size employed ($N = 33$) in this portion of the experiment might have prevented the results from achieving significance, as three of the four correlations obtained very closely approached significance ($p < .05$) and did reach significance at the ($p < .10$) level.

There were, as indicated in the results section, no sex differences in the characteristic handling of PS in this experiment. Since PS has been demonstrated to be to a certain extent a "learned" phenomenon, and since the protection of territoriality is a concept which, until recent times, has traditionally been more relevant for male members of most species, it was predicted that males would respond more markedly to violations of PS than females. This feature was not supported, however, as data demonstrate that there were no significant ($p < .05$) differences in male and female use of PS. Nor were there any significant interaction effects between sex grouping of Ss and measures obtained in any of the four experimental treatment conditions.

In reviewing the results obtained in this experiment, and the experiment itself, it becomes apparent that there are a number of factors which might have potentially contributed to data contamination. One important factor deserving of mention was that the experimental sample was largely one of convenience. In recruiting volunteers for any experiment, one can never be certain that subtle selection factors have not entered into the selection of Ss or the analysis of data. Furthermore, as indicated previously, the sample size employed in the correlative section of

this experiment was rather small to have complete confidence in the results obtained. As E.T. Hall and others have taken great pains to demonstrate, however, the results of studies of the proxemic behavior on one sample of Ss are not readily or even justifiably generalized to other samples of Ss. (Clear evidence for this was demonstrated in the present experiment, when the only two Black Ss' scores were thrown out of the data analysis due to the radically different nature of their responses to intrusions of PS by Caucasian confederates. Had their responses been included, the overall results would have been even more significant, (i.e., their PS "bulged" much further in response to violations of PS than did the other Ss').

Another criticism which may be leveled against this experiment is that the experimental confederates employed were different for different Ss, and one might justifiably argue that violation of PS by certain strangers may be intrinsically more "stressful" than violation by others. While every attempt was made to use the same group of three confederates for each S, the logistics involved in attempting to get five different people together (3 confederates, 1 S, and 1 E) at the same place, several times a day, for several days, proved to be virtually impossible. Since, however, the confederates were not visually accessible to the S during the experimental procedure, their differences in physical appearance should not have greatly affected the obtained results.

Undoubtedly, there are a great number of other factors which may have acted to influence the nature of the results obtained in this experiment. One of the major difficulties in conducting experimentation in the realm of social psychology is this wide range of potentially contaminating variables. In order

to be entirely thorough, this experiment might have included experimental conditions in which the S was approached from several different directions, with different numbers of confederates being used, and with interaction effects between the experimental variables being observed, (i.e., combining, say, eye-contact and violation of PS by confederates in one experimental condition).

The concept of PS is, without question, a complex phenomenon in human beings. Through evolution and development of culture, man has likely added numerous circumstances and items to his repertoire of spatial behavior which he considers as inviolable space. An increasing source of tension and aggression in the contemporary world, this E is coming to believe, is the violation of such inviolable space. In view of this observation, and in light of current world crises in two areas directly related to the concept of PS, (overpopulation and various forms of visual, auditory and ecological pollution), a systematic inquiry into the concept, dynamics, and mechanisms of PS seems eminently warranted to this individual.

The ability to recognize man's characteristic spatial zones of involvement and the activities, relationships, and emotions associated with each has, therefore, become extremely important. If we continue to view man's spatial requirements in the same manner that the early slave traders did, conceiving of human's spatial requirements simply in terms of the actual amount of air displaced by their bodies, one pays very little attention to the demonstrated debilitating and deleterious effects of overcrowding. If, however, one sees man as surrounded by a series of invisible, concentric bubbles which have measurable dimensions, it then becomes possible to conceive that people can be "cramped" by the

spaces in which they have to exist. Like gravity, the influence of two human bodies on one another may prove to be inversely proportional, (in terms of emotional and physiological effect), not only to the square of the distance but possibly even to the cube of the distance between them. Recent evidence (Hall, 1966) also suggests that a type of "spatial spiral of effect" may exist, such that when stress increases, sensitivity to crowding rises, people get "more on edge", so that more and more space is required as less and less is available.

Despite the implied significance of this phenomenon of spacing, the determinants of PS in man, its development, the effects of violations into PS zones, and boundary variations under different settings, and the effects of age, sex, race, and content of interaction on PS have not yet been systematically investigated to any appreciable extent.

Footnotes

- (1) With regard to the use of space, it is possible to observe a basic and sometimes inexplicable dichotomy in the animal world. Some species huddle together and require physical contact with each other while others completely avoid touching.
- (2) In interpreting Christian's data, it is important to clarify the significance of the adrenal glands. The adrenals play an important part in the regulation of growth, reproduction, and the level of the body's defenses. The size and weight of these important glands is not fixed but responds to stress. When organisms are too frequently stressed, the adrenals, in order to meet the emergency, become overactive and enlarged. The enlarged adrenals of characteristic cell structure showing stress were therefore highly significant.
- (3) These were term projects in Architecture 140 taught by Professor Richard Seaton. They are available on microfilm from the Department of Architecture, University of California, Berkeley 97106.
- (4) This is only an assumption being made by the E, and it is not supported by any known empirical evidence in humans.

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