I. Introduction

Statement of the Problem

The concept of personal space has been studied by many authors, including, but not limited to Hall (1966), Sommer (1969), Altman (1975), and De Long (1976). Hall (1966) discussed personal space as an invisible bubble that surrounds an individual. The bubble can be large or small and Hall (1966) described it has having four basic sizes, defined by distance, which he called proxemic zones. These invisible boundaries serve to maintain proper spacing between individuals with the size of the zones varying across cultural, social, personality, and environmental dimensions. Many facets of personal space have been explored, including cultural influences, social influences, seating arrangements, and crowding perception. However, few studies have attempted to examine how illumination may affect personal space behavior. Hall's (1966) initial research alludes to the possibility that lighting may have an effect on proxemic behavior. Baum and Davis (1976) examined the condition of light-colored versus dark-colored spaces on the perception of crowding. Adams and Zuckerman (1991) studied personal space distances in dim and bright conditions, but did not take into account a particular behavior setting.

Few studies to date have attempted to examine the potential effect of illumination level on personal space in a particular environmental/behavior setting. This study will attempt to examine this potential effect within the theoretical framework of Michelson's (1976) Intersystems Congruence Model (ICM). The ICM states that social, cultural, personality, and environmental systems co-exist and affect human behavior. The variable within this model is space. The research will also work within Hall's (1966) definition of personal space as defined by four major personal space distances called proxemic zones. A waiting/reception area will be used as the environmental setting the research is to be conducted within. This type of environmental/behavior setting was chosen because no apparent prior research exists in this type of setting regarding illumination levels and personal space behavior. Specifically, this research will investigate the effect of dim and bright illumination levels on proxemic zones within waiting/reception area settings.

Related Literature

Michelson's (1976) Intersystems Congruence Model provides the theoretical framework used to organize the components of this study. The following literature review discusses this framework and provides information on the concepts of territoriality, crowding, privacy and personal space. Further information is provided regarding visual perception, waiting/reception area design, lighting design of reception/ waiting areas, and simulation as it pertains to the format of this proposed study.

Intersystems Congruence Model

Human behavior is studied using three different systems, either independently or in combination, including the cultural, social, and personality systems. Anthropologists concern themselves with the cultural systems, focusing on the generally accepted rules and goals that guide behavior in a particular culture. Sociologists examine the relation-ships and behaviors between people with particular social groups. Psychologists study personality and attempt to understand the behaviors people internalize as a result of their life experiences (Michelson, 1976). These three systems are studied independently in an effort to understand and demonstrate the relationships of variables within each system. However, these three systems, cultural, social, and personality, are closely inter-related. Studies exist that focus on intersystem relationships, such as culture and personality or personality and social structure. In addition to these three systems, a fourth system can also be examined in its inter-relation with culture, social, and personality systems - the built environment.

Restricting study to the built environment, Michelson (1976) suggests a frame-work to study the interdependence of the physical environment, cultural environment, social organization, and elements of individual personality. The systems can be studied separately in terms of how each affects and influences human behavior. However, Michelson (1976) proposes a framework that does not suggest that only one system determines human behavior, or that one particular system dominates another. Rather, the systems co-exist and interact to influence human behavior. One system may set limitations upon another, thereby limiting the possible behaviors that could potentially

occur in a particular behavior setting. "Each system can still be viewed as analytically distinct from the others, but the significance of mutual contact and interchange must be noted" (Michelson, 1976, p. 24) (see Figure 1).

Michelson (1976) refers to this model as the Intersystems Congruence Model. "Research can proceed from the point of view that a particular physical environment sets broad limits as to the range of phenomena from other systems which can be found there. Some social systems, personalities, or cultural goals (possibly only a few) may be given in possible settings. Beyond this limit, an environment may make some phenomena in other systems either easier or more difficult to maintain, so that, all else equal, these phenomena will tend to be found successfully maintaining themselves more in some types of settings than in others" (Michelson, 1976. p. 25). The environment as a restrictive agent on human behavior is not a novel notion. Louis Wirth (1969) notes "physical factors …. are at best conditioning factors offering the possibilities and setting limits for social and psychological existence and development" (p. 177). However, the intersystems congruence model recognizes that environments may be limited by people's cultural, social, and personality traits or needs. "…people rationally seeking to best match a specific social, cultural, or personality variable with a planned setting may find their range of possible environments narrowed " (Michelson, 1976, p. 25).

The intersystems congruence model also suggests that incongruence between systems is possible. Mismatches of cultural, social, personality, and environmental settings may occur because of economic or political constraints. For example, a family may choose to live in a public housing high rise with reduced security and increased crime because such housing is more affordable. This choice would be a mismatch with the family's social desire to live in a safer dwelling and more secure environment to raise their children. Michelson (1976) states "Congruence carries with it the opposite, incongruence, and the latter may be found in real life situations linking the environmental system with the others. Mismatches are possible and they may even be frequent due to the extingencies of economics and politics " (p. 26).

There are two approaches to researching how people relate to their spatial environment. It is necessary to understand both when examining the different systems

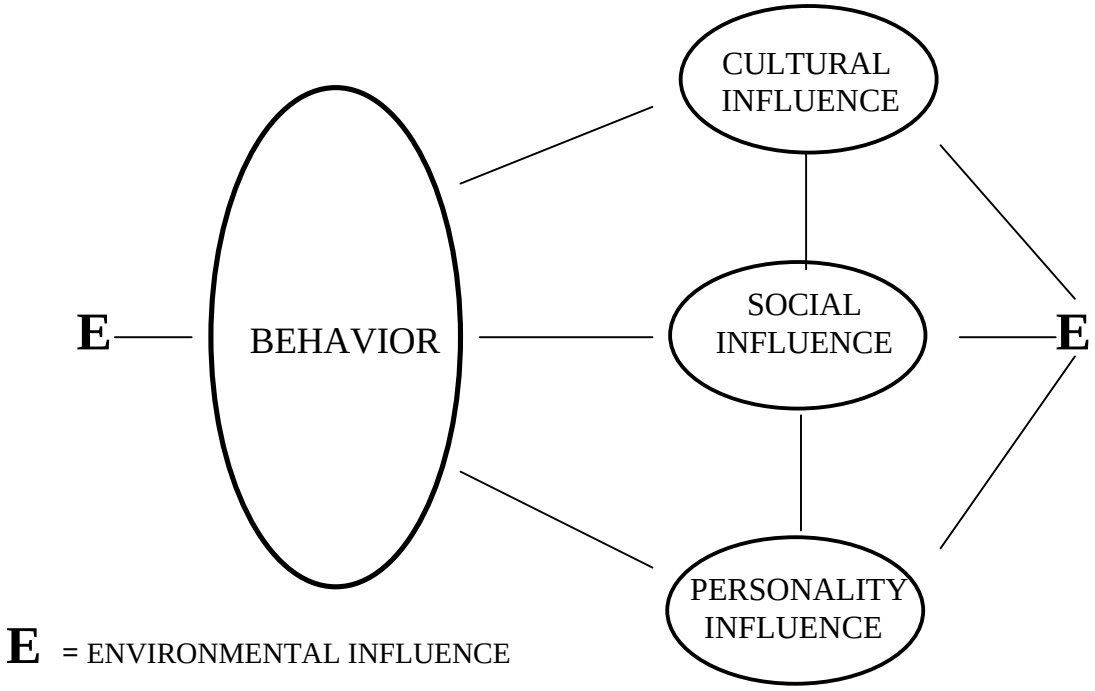


Figure 1. Intersystems Congruence Model (Michelson, 1976) as adapted by author.

that affect human behavior. Michelson (1976) states, "Man, as a thinking being, relates to his spatial environment both in his mind and in his actual presence." (p. 30). This approach suggests both a mental congruence and an experiential congruence between people and the environment. Mental congruence is defined when an individual feels that particular spatial patterns will successfully accommodate his/her personal characteristics, values, and style of life (Michelson, 1976). Experiential congruence "deals with how well the environment actually accommodates the characteristics and behaviors of people" (Michelson, 1976, p. 30). Thus, people use both mental and experiential congruence to make decisions on what behaviors and what physical surroundings are appropriate/ inappropriate in particular environments.

The Intersystems Congruence Model is demonstrated in Michelson's studies of cities and urban housing. Michelson's gives the example that working class families living in crowded older sections of a city depend on relatives for companionship, recreations, and assistance (Michelson, 1976). When these families relocate to suburban type areas, they experience a deterioration of family activities. Michelson explains that this deterioration is due to environmental factors. In the crowded area of a city, the family interactions were congruent with the physical factors. In the suburban area of the city, the family interactions were incongruent with the physical factors.

The Intersystems Congruence Model is not limited to application to only macro-environments. It can also be applied to micro-environments. The behavior in micro-environments is affected by cultural, social, personality, and physical man-made characteristics just as behavior is affected by these systems in macro-environments. Michelson (1976) presents the following argument: "Just when the positivists have come up with what they think is a design that is congruent with a specified social variable (e.g., chairs spaced around a hotel lobby just well enough to let people talk if they want or ignore others if they want). Perceptionists [explain] it won't always work…because people from different backgrounds learn on the basis of their culture to give different meanings to the separations involved. As result, they perceive them differently, and hence act differently in the same objective spatial orientations." (p. 28).

The Intersystems Congruence Model (ICM) (Michelson, 1976) provides a

framework to study human behavior and environment. The ICM states that there are three systems typically used to analyze human behavior, the cultural, social, and personality systems, and these three systems co-exist to influence and affect human behavior. These three systems may work together and limit possible behaviors, or variables present in each system. At the same time, the built environment sets broad limits on what behaviors (influence by cultural, social, and personality factors) can occur in a particular environment. Congruence results when "variables in one system co-exist better with states of variables in other systems than with others of alternative states" (Michelson, 1976, p. 26). Incongruence can also result when variables of one system interact with variables of another system and stress results. The variable always under study in the ICM is the variable of space. "Space is treated as a variable, not as an indeterminate medium to which people give meanings" (Michelson, 1976, p. 30).

The ICM provides the framework for this research. It is understood that the cultural, social, and personality systems interact with each other and with the environmental system. Each system can be studied independently and each system can also be studied in terms of how they interact with each other. In the following literature review, the method of looking at each system independently is followed. For the purposes at hand, the issues to be considered within the cultural, social, and personality systems are territoriality, privacy, crowding, proxemics, and visual perception. The variables that will be manipulated within this study are seating arrangements within waiting/reception areas and lighting design of waiting/reception areas. The literature review will address both the issue of appropriate waiting area design and the lighting design of waiting areas. The research design will look for how the variable of personal space is influenced by the variable of light within the environmental setting of a typical waiting/reception area. As Michelson (1976) suggests, the variable of space, is the variable under scrutiny. Space is the result of how limitations of the physical environment and behaviors (dependent upon cultural, social, personality factors) interact. In this study, space will be the result of environmental changes and influences from the cultural, social, and personality systems.

Territoriality

Territoriality is often thought of as the behaviors exhibited by animals in defending their territory, or home. However, humans also exhibit territorial behaviors. In chapter one of Spatial Behavior of Older People, Altman (1970) looks at several definitions of territory and points out that they all make common references to a geographical area, which is claimed for purposes of feeding, child rearing, and reproduction. The geographical area may change with the need to satisfy these basic urges. These definitions also were noted when referring to several behaviors associated with the concept of territoriality. These behaviors included marking territory and using defenses when territory is invaded. Corresponding to the idea of territoriality, there is a behaving unit. This unit may be an individual, a family, or a group (Altman, 1970).

Altman (1970) suggests that there are four concepts connected with human territoriality. The first is behavior forms. At any time, there may be action to mark or defend territory. Humans do this by using environmental props. These props may be pictures, objects, or fences placed strategically to lay claim to an area. Aggressive behavior is common when territory is invaded by those unwelcome in it. Humans may use verbal and non-verbal threats to notify the trespasser to be aware and to get out of someone else's space. The second concept refers to situational factors. The amount of territory humans require changes from place to place in any given period of time. However, the idea of territoriality can surpass geographic location. Humans are possessive towards objects, relationships, and even ideas. Thirdly, there is the concept of antecedent factors playing a role in human behavior in regards to territoriality. There may be personal relationships (between individuals or groups of people) that are influential in stimulating behavior. Finally, humans not only need to satisfy their basic organismic needs (food and shelter), they need to associate themselves with certain social groups. Territoriality plays a role in this association. By defining territorial boundaries, people know where to and how to interact and associate with each other.

The concept of territoriality also takes on different forms. There is the notion of personal space. Personal space is the territory that a person carries around himself or herself (Hall, 1966). The boundary is invisible, with the body at the center. Next,

situational territory is the space that is a person's only while he or she is using it. Fixed territory defines a space that belongs to a person even when its not in use. An example of this type of territoriality may be a car, a dormitory room, a private office, or a house. Lastly, there is public territory. Many people may have access to a space, but they do not have the freedom of action with in the space. For example, public nudity or drunkenness may not be permitted (Flannery, 1992).

Any of these territories are subject to some form of intrusion. Sommer (1969) describes three types of territorial encroachment; violation, invasion, and contamination. Violation is using a territory without permission. Invasion involves the physical presence of an intruder or intruders within the boundaries of a specific territory. Contamination causes the territory to become impure in some way.

Closely related to the concept of territoriality are the concepts of crowding and privacy. Crowding occurs when many people occupy the same space at the same time. Privacy is a state desired by an individual(s) at some point in time when they do not wish to be disturbed by others (Altman, 1975). Mechanisms are employed by individuals to protect themselves in crowded situations and to gain privacy in other situations. Both concepts deal with the issue of personal space. Crowding is perceived when personal space violations are sensed, and as a result, greater personal space distances are desired, perhaps resulting in an increased need for privacy.

Crowding

Crowding can be referred to in both large and small scales. Crowding can occur in a relatively large geographic location, or in small spaces such as a house. There are many problems that are created when too many people interact within an area. Personal space violations are a result of crowding. People tend to experience a reduction in their sense of personal control and they feel more stress. Crowding intensifies perceived characteristics of certain situations, and as a result people have heightened feelings of excitement, friendliness, antagonism, and fear. The sense of crowding is affected by the duration of exposure and the predictability of exposure. Feelings of crowding are also affected by whether they are experienced in public spaces or personal spaces (Flannery, 1992).

Often when people feel crowded by others, they desire a feeling of privacy, they may or seek out another place to establish physical privacy.

Privacy

Westin (1967) described privacy as the right of an individual to decide what information about him or herself should be communicated to others. That decision of what information should be conveyed unto others may vary depending on the situation. Westin (1967) categorizes privacy into four states and describes four functions of privacy. The four states of privacy are solitude, intimacy, anonymity, and reserve. In the solitude state, individuals seek withdrawal from others. Typically, this withdrawal is physical in nature. The reasons for this withdrawal vary, but commonly, the individual seeks privacy to be alone with one's own thoughts or to perform bodily functions. In the intimacy state, individuals interact in a small group. The small group setting may be used to achieve a relaxed atmosphere so as to share personal confidences. The anonymity state refers to when individuals in public spaces do not want to be recognized or acknowledged. The individual is physically not alone, but is still private because he or she is not engaging in social interaction with others. In the reserve state, individuals feel the need to limit the interaction with others so as to preserve the self. Altman (1975) gives this example, "One literally 'tunes other people out'. Whether in the presence of one person or one hundred other people, we have all learned how not to listen to others and ignore them psychologically, often without anyone even knowing" (p.18).

Westin (1967) also describes four functions of privacy including personal autonomy, emotional release, self evaluation, and limited/protected communication. Personal autonomy refers to an individual concentrating on issues of self-identity, self-independence, and self-worth. Emotional release allows the individual to relax from social roles and doing personal things typically not allowed in public. Self-evaluation allows the individual to assess past experiences and plan actions for the future. "Generally, (individuals) meditate about themselves in relation to the world" (Altman, 1975, p. 19). Limited and protected communication refers to the individual's right to determine when to communicate with others and how much information to convey to others.

Altman (1975) maintains that privacy is "central to understanding environment and behavior relationships; it provides the key link among the concepts of crowding, territorial behaviors and personal space" (p. 6). Various states of privacy can be achieved through different behavior mechanisms including verbal mechanisms, paraverbal mechanisms, non-verbal mechanisms, environmental mechanisms, and cultural mechanisms (Altman, 1975).

Verbal mechanisms include the use of words to convey personal states and desires. Paraverbal mechanisms refer to the structural components of speech such as vocabulary, pronunciation, voice quality, and vocalizations such as yawning and/or crying to convey certain meaning to others. Nonverbal mechanisms use parts of the body to express communication to assure privacy. This expression may be accomplished by using arms, legs, body positions, and facial expressions. Nonverbal behaviors such as glaring, leaning away, or re-orienting the body may be gestures used to protect privacy and personal space. Other nonverbal behaviors such as sitting closer to another, more eye-contact, frequent smiling, and leaning towards another may indicate the welcome closeness of others (Altman, 1975).

Environmental mechanisms of privacy concern clothing and adornment, personal space, and territory. The use of clothing can signal a person's approachability as well as express acceptance or dissatisfaction with particular social situations. Restrictions of an individual's use of clothing and adornments may be considered a violation of that individual's right to express themselves and these restrictions also interfere with the individual's privacy regulation mechanism (Altman, 1975). Personal space as a mechanism of privacy regulation allows an individual to have contact with others or choose not to have contact with others. Territorial mechanisms use the distant environment to control levels of privacy by using physical spaces to provide identity and security (Altman, 1975).

Cultural differences play a role in the management of privacy. Some cultures may divide their interior spaces with physical barriers to ensure privacy, while other cultures may not. Instead of using physical barriers to ensure privacy within a group or family,

psychological barriers may be practiced. These types of barriers may include not expressing feelings towards others or about situations, talking softly, or allowing individual autonomy (Altman, 1975). Ultimately, privacy is used to protect oneself from the intrusion of others, to set boundaries and to protect communication (Westin, 1970). The process of achieving various states of privacy is very dynamic. The exercise of control on privacy is not always successful in achieving in a desired state of privacy. Privacy regulating mechanisms such as verbal, paraverbal, nonverbal, and environmental mechanisms are put to use in many combinations. These mechanisms may change with any given situation and circumstance, and they may also change over time (Altman, 1975).

Thus, Altman (1975) described personal space as a mechanism of privacy regulation. This concept of personal space has been explored in depth by other authors as well, such as Hall (1966) and Sommer (1969). Further research on personal space has been carried out by many authors such as Baldassare and Fellar (1975), De Long (1976), Hayduk (1978), Scott (1993), White (1975) and Adams and Zuckerman (1991). The research of Hall, Sommer, De Long, Altman, Adams and Zuckerman is presented next.

Proxemics

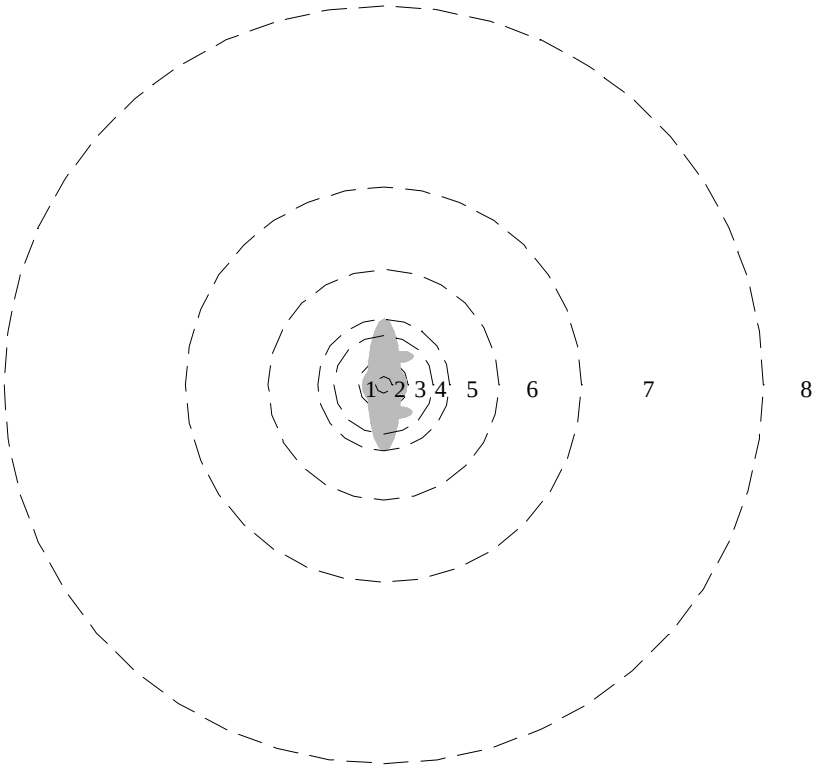
Edward T. Hall (1966) has observed the personal space aspect of territoriality and how individuals use this space as a form of social communication. He described personal space as proxemic zones. Hall (1966) described the study of proxemic zones as being "…interrelated observations and theories of man's use of space as a specialized elaboration of culture" (p. 1). There are many aspects of personal space, from the biology of how humans perceive space, to more unique factors such as age, gender, cultural associations, ethnic characteristics and personality (Hall, 1966 & Sommer 1969).

Hall (1966) describes the invisible space that surrounds animals and people as "a series of bubbles or irregularly shaped balloons that serve to maintain proper spacing between individuals" (p. 10). In studying territoriality in animals, it is recognized that there are four types of spacing mechanisms. These mechanisms can also be identified in terms of human behavior. When individuals of different species meet either flight distance or critical distance is used. Flight distance is the distance at which one animal gets too close to a

second animal and the second animal flees. Critical distance is the distance at which the second animal will attack the first when it cannot flee. When individuals of the same species meet, personal distance and social distance mechanisms are at play. Personal distance refers to the invisible bubble that surrounds an animal. Only others that are well known or trusted are allowed in this space. In humans, this space is the closest an individual will let others get without feeling discomfort. Social distance is the farthest an animal is allowed to drift away from a group. In humans, this distance is the amount of interpersonal space beyond which individuals begin to feel anxious about being separated from others (Hall, 1966).

People sense space not only with their eyes, but also with auditory and olfactory capabilities. Hall (1966) calls the use of these senses as distance receptors. Individuals are concerned with the examination of distant objects. When using the skin, individuals are using immediate receptors to experience their world up-close and personal (Hall, 1966). The skin is the largest sense organ, detecting heat, cold and various textures for the spatial experience of an environment. Not only is space perceived by what information individuals take in through their senses, it also perceived by what they filter out. Humans have the ability to use their senses to filter out noises, smells, and other sensations while focusing their attention to other specific noises and smells, deemed important. These experiences are processed and play a significant role in how people orient themselves in space and with one another. There are several other factors that influence interpersonal spacing patterns as well. These include individual factors, cultural factors, interpersonal factors, and situational factors.

Hall (1966) describes four categories of personal space zones. These zones radiate from the body including an intimate distance, personal distance, social distance, and public distance. Each of these distances has a close and a far phase (see Figure 2). The intimate distance, close phase is zero to six inches from the body. This distance is the closest physical contact people can interact. Reproduction, wrestling, and comforting occur at this distance. The sense of smell and sense of radiant heat are intensified. Vision is blurred because the space between people is so close. Vocal communication is reduced



Legend

1 - Intimate distance, close phase (0" - 6")
2 - Intimate distance, far phase (6" - 18")
3 - Personal distance, close phase (18" - 30")
4 - Personal distance, far phase (30" - 4'-0")
5 - Social distance, close phase (4'-0" - 7'-0")
6 - Social distance, far phase (7'-0" - 12'-0")
7 - Public distance, close phase (12'-0" - 25'-0")
8 - Public distance, far phase (25'-0"+)

Figure 2. Personal space zones as defined by Edward T. Hall (1966).

or is involuntary (Hall, 1966). Intimate distance, far phase is six inches to eighteen inches from the body. This distance is close enough for hands and feet to come into contact, but the head, thighs and pelvis are not easily brought into contact. At six inches to eighteen inches vision is still slightly distorted and heat and odor from another person may still be detected. Vocal communication may be performed, but is usually done at a whisper or low level (Hall, 1966).

Personal distance, close phase is eighteen inches to thirty inches from the body. Vision is no longer distorted and there is still an exchange of smell, touch, and verbal communication. One can easily hold or grasp another person at this distance. Where people place themselves in relation to each other signals their relationship and/or how they feel about each other. Personal distance, far phase is thirty inches to four feet from the body. This distance extends just outside of easy touching distance of another person. If two people extend their arms, they can touch fingers. Beyond this distance, a person cannot easily touch another. Details of another person can easily be seen such as wrinkles, gray hair, and fine details of the skin (Hall, 1966). At personal distance, far phase, personal conversations and interaction can occur.

Social distance, close phase is four feet to seven feet from the body. At this distance heat, olfactory, and touch cues are unimportant, and the visual perception of fine details is reduced. Impersonal business tends to occur at this distance. Interaction among people in a work setting typically occurs at this distance. It is also an acceptable, appropriate distance in public settings for interaction among casual acquaintances. Social distance, far phase is seven feet to twelve feet from the body. The whole figure of another person can be seen with one sweep of the eyes. Fine details of the face are no longer perceived, but hair and condition of clothes are still readily visible. Heat and odor from another person are not usually detected at social distance, far phase. Eye contact during conversations of significant length becomes important and voice levels may be noticeably louder. At social distance, far phase, people may use the space to insulate or screen others out if involvement is not desired. This social separation can be achieved by placing chairs back to back, making it possible for people to be uninvolved (Hall, 1966).

Public distance, close phase is twelve feet to twenty-five feet from the body. This

distance is considered to be formal because changes in the voice and tone of voice shift as compared to other distances. Fine details of the skin and eyes are no longer perceived, but the whites of the eyes can be seen. At this distance, an alert person can either take evasive or defensive action if there is a perceived threat (Hall, 1966). Commonly this distance is used for arrangements of official dinners, lecture classrooms, and courtrooms. Public distance, far phase is twenty-five feet or more from the body. To communicate at this distance, facial expressions and movements are exaggerated and the voice is amplified. Words are enunciated more clearly. Much of the nonverbal communicated is done by hand gestures and body positioning (Hall, 1966). This distance is used for important public figures and public speakers.

Within each of these personal space zones, behaviors are perceived. These behaviors can be categorized as follows: (a) postural-sex identifiers: standing, sitting, squatting, (b) sociofugal/sociopetal orientation: body angling or facing positions, (c) potentiality for touch, (d) touching, (e) visual possibilities, (f) thermal cues, (g) olfactory cues, and (h) voice loudness (Altman, 1975). These behaviors within each of the personal space zones is not necessarily universal. There are wide cultural variations in what behaviors are permissible within each zone. There are also wide cultural variations in which distances are appropriate in certain settings and between certain people. These zones may not be important in terms of physical distance, but they are important in terms of what interpersonal communication possibilities each zone offers (Altman, 1975).
The personal distance zones described by Hall (1966) allow for the regulation of contact with other people and make the boundaries around the self more or less permeable. "By moving closer to or away from other people, we change their accessibility to us. By moving away we signal a desire for more privacy and use personal space as a mechanism to shut off certain channels of communication. By moving closer to someone, we permit greater access to our self and open up an increasing richness of communication" (Altman, 1975, p. 61).

Robert Sommer (1969) describes personal space as "an area with invisible boundaries surrounding a person's body into which intruders may not come" (p. 26). Sommer (1969) further explains that personal space is a "portable territory since the

individual carries it with him wherever he goes" (p. 27). Unlike Hall's description of personal space, Sommer (1969) describes personal space as not being specifically spherical in form. Personal space may not be extended equally in all directions from the body. However, Sommer does agree with Hall that there are cultural differences among what distances people maintain between themselves.

Personal space is similar to individual distance. Individual distance refers to the spacing animals keep between themselves. Individual distance exists only when two or more species are present. When only one member of a species is present, the individual distance is infinite (Sommer, 1969). Sommer states that the interaction of individual distance and personal space affects spacing distances between people. "The violation of individual distance is the violation of society's expectations; the invasion of personal space is an intrusion into a person's self-boundary" (Sommer, 1969, p. 27). A specific figure for individual distance cannot be calculated. Individual distance and personal space is formed and varies by the relationship between individuals, the bodily orientations of individuals towards one another, and the distances at which others in the situation are placed (Sommer, 1969).

In studies performed observing people and how they maintain their personal space, three particular distances were observed (Sommer, 1969). These distances were arrival distance, settled distance, and distance after departure. Arrival distance refers to how far a newcomer will place themselves from an already placed individual. Settled distance refers the resulting distance individuals place themselves after adjustments are made. Distance after departure refers to how far apart individuals remain after some individuals have left. These distance behaviors are based on J.H. Cook's studies of bird behavior (Sommer, 1969).

Sommer (1969) describes studies conducted in a college library and in a mental hospital to observe people's spatial behavior. Results showed that when a newcomer would come close to an individual who had already placed him or herself, the newcomer could maintain the arrival distance, but a comfortable settled distance was not achieved. It was also shown that if the newcomer ignored or did not recognize defensive gestures and shifts in posture, the placed individual would eventually leave (Sommer, 1969).

In maintaining personal space and protecting it from invasion, many defense mechanisms may be used. Because personal space boundaries are invisible, people must use gestures, postures, and specific locations to express meaning to others. In public spaces, people may keep a stiff posture and lower their eyes to ward off any social interaction. Sommer (1969) offers the following example, "During rush hour, subway riders lower their eyes and sometimes 'freeze' or become rigid as a form of minimizing unwanted social intercourse" (p. 29). Even in intimate contact, people will close their eyes. Sommer (1969) offers this example, "Lovers pressed together close their eyes when they kiss. On intimate occasions lights are typically dim to reduce not only distracting external cues, but also to permit two people to remain close together" (p. 28).

Behavior observed in animals suggests that individual distance is learned during early years of development. At some point during the early stage of life, an individual learns how far and how close it can come to other members of its species. If the individual comes too close, it may be perceived as a threat. However, if it strays too far, it may not be considered as part of the group (Sommer, 1969). Learned individual space is also recognized in humans.

Altman (1975) reviews personal space as affected by three broad classes of factors including individual factors, interpersonal factors, and situational factors. Individual factors include properties that are specific to the person such as age, sex, cultural characteristics, personal skills, and personality. Research on each of these properties has dealt with the differences among people and their personal space zones and the permeability of these zones (Altman, 1975). Research in regard to personal space and age suggests that personal spacing stabilizes early in life, but its not until adolescence is reached that the personal space boundary system is well established and can handle a variety of situations and social relationships. Children gradually seem to learn only appropriate distances to maintain from others on different social situations. Some parents may actually place their children at specific distances away from them to teach the children where and how to stand (Altman, 1975). Studies of sex differences in relation to personal space generally show that males have larger space zones than do females, and people in general maintain greater distances from males than they do from females (Altman, 1975).

Sex differences should be examined in regard to whether males or females are interacting with males or females. Male and female pairs have typically been found to be closer in proximity to one another than same sex pairs. However, in homosexual pairs, closer proximity is noted. These results are less clear when age, ethnic and other situational factors are considered (Altman, 1975).

Data on cultural influences of personal space shows that there are both similarities and differences among cultures in how personal space is used and maintained. Several studies have looked at personal space characteristics of Asian, American, Latin American, Middle Eastern, Mediterranean, and European countries. Little empirical evidence exists, but data has suggested that some cultures generally have closer interaction distances, while other cultures have larger interaction distances. Interaction distance refers to the physical distance people stand or sit away from each other while in conversation. People from Mediterranean cultures showed closer interaction distances, people from European cultures showed larger interaction distances, and Americans demonstrated intermediate interaction spaces (Altman, 1975).

Personality characteristics have also been examined in regard to personal space. Research suggests that anxiety-prone people place greater distances between themselves and others. These people indicate that close distances provoke more anxiety and stress. Data has also been collected to support the idea that extroverts maintain closer personal space than do introverts (Altman, 1975). Other studies have been conducted to see how people space themselves in relation to those with social stigmas. In general, it was found that people placed themselves at a greater distance from those who had some sort of abnormality, such as mental patients, amputees, or obese people (Altman, 1975).

Interpersonal factors act to regulate personal space zones. Differences in personal space distances are noted in differing social relationships. Many studies on interpersonal space have indicated that "(1) Positive relationships between people are associated with closer interpersonal distances or smaller personal spaces zones, and (2) people located at close (but not overly close) distances are viewed as having good interpersonal relationships" (Altman, 1975, p. 80). In both laboratory and field studies designed to compare the spacing of strangers, casual acquaintances, and close friends, it was found

that friends kept a closer distance than did acquaintances or strangers. In studies designed to examine the outcomes of social interaction along positive and negative dimensions, it was found that people place themselves closer to figures with pleasant expressions, and farther from figures with negative expressions, thus closer distances are associated with favorable social exchange than unfavorable social exchange (Altman, 1975).

Situational factors also determine personal space distances. Existing research has looked at the formality or informality of settings and the familiarity or strangeness of situations and the effect on personal space. People in formal settings may act in a restrained way, "adopting stylized roles and modes of behavior, using barriers such as distance, and thereby not making the self very accessible to others" (Altman, 1975, p. 84). When people are in places they are more familiar with, they may be more willing to be closer to others than compared to places they are unfamiliar such as streets and parks.

Research regarding Hall's theories is continuously being done. De Long (1992) has taken Hall's concept of four personal space categories and expanded upon them. In studying how individuals orient themselves to one another in seating arrangements, De Long has revised these categories. De Long (1992) found that compared to Hall's circular personal space zones, zones were "more ovoid in shape" (p. 21). De Long also discusses how furniture arrangement can change the perception of how people relate to one another in space. The arrangement of furniture in relation to where people sit can give signals to passageways and direct people through space. These passageways sometimes direct others right through personal and social space zones.

The concept of personal space has also been studied by Adams and Zuckerman (1991), and it was quantified that lighting appears to alter an individuals sense of closeness to others. Adams and Zuckerman (1991) conducted experiments with female college students and found that in dim lighting conditions, personal space distance increases compared to personal space distances in bright conditions. In low illumination levels, feelings of inappropriate intimacy may be aroused, which can cause an increase in personal space distances. This study found that under dim lighting conditions as compared to bright lighting conditions, there was an increase in the personal space bubbles on the sides and to the rear of the study participants (Adams & Zuckerman,1991).

Hall's (1966) research suggests that personal space bubbles are round as the individual is standing. Adams and Zuckerman's (1991) research was also conducted on standing participants and it suggests that the personal space bubbles are not round, but greater in the rear and sides than in the front. This finding suggests that personal space bubbles are not round as in Hall's research, but are more irregularly shaped. In contrast, De Long's (1992) research was conducted on seated individuals, and the personal space bubbles were described to be ovoid in shape. Thus, further research on the shape of personal space bubbles appears in order.

In studying how people behave within the personal space bubbles or within the proxemic zones, it is necessary to understand how people perceive space and their environment. Therefore, it is necessary to understand how people see and how they process the information that they see. This process is called visual perception. Visual perception has an influence on how the information people see is processed and given meaning. When meaning is given to the information received from the visual environment, behavior may be affected.

Visual Perception

Much of the way people experience the world is through the sense of sight. What people experience and perceive is influenced by cultural, social, and personality systems. In studying how people perceive space, its is necessary to understand how information received from the visual field is processed. There is an extraordinary amount of information taken in by the process of sight and transmitted to the brain for interpretation and classification at any given moment. At any particular moment, the interpretation of information is done either consciously or subconsciously, because the amount of incoming information is so vast. Some information may be determined important and is immediately put into the consciousness of the observer for further action (Lam, 1977). Other information is determined to be unimportant, and may be put into the memory for later use. The process of visual perception is very complicated because so much of what is seen by the eye and transmitted to the brain becomes shaped by cultural, social, and

personality characteristics of an individual.

To understand how the process of visual perception begins, it is necessary to understand how the eyes operate. The eyes are constantly scanning the environment and receiving information which is then transmitted to the brain through the process of sight. The brain dictates the scanning pattern of the eyes by a focus selector (Lam, 1977). When the eyes are not under the conscious control of the brain to view something particular, it is constantly monitoring the environment to assure that no significant changes have occurred that warrant specific conscious attention. The focus selector is also influenced by past memories, personal habits, expectations, and the current emotional state of the observer.

Because of the physical construction of the eye, two types of vision are possible; central (foveal) vision and peripheral vision. Central vision occurs as the eyes scan the environment and collect detailed information about elements within the visual field, as directed by the focus selector. Peripheral vision monitors the remainder of the environment for any changes that may require the attention of central vision, or redirection of the focus selector. As visual stimuli (raw data) are received by the eyes, the process of visual perception begins.

Lam (1977) describes three components of the process of visual perception that occur after information is received by the eyes, including the attributive, expectation, and affective components. Although these three components can be examined independently of each other, they do not function independently of each other.

> "All three aspects of perception - the attributive, the expectant, and the affective - are inexplicably interwoven in real life…The attributive establishes links prior to experience, activating expectations and provoking emotional responses. Expectations, in turn, influence what will be chosen as the next object of sensory attention, and can trigger any emotion from joy to fear to apathy depending on the nature of the anticipated developments. The affective qualities of a perception determine the

> importance which we give it, which in turn influences what impact it has in terms of re-calibrating the experience" (Lam, 1977, p. 34).

The attributive component of visual perception begins after raw data is brought in through the eye and transmitted to the brain. Data is begun to be interpreted, sorted and classified, and subsequently given meaning. Meaning is assigned through association with past experiences. This association is accomplished by the use of the experience filter (Lam, 1977). The experience filter is the portion of the unconscious memory that warehouses all the data received from past experiences. When raw data is received by the eyes, the experience filter compares new data with old data, deciding what characteristics the new data have in common with previously stored data (e.g., objects, situations). After comparisons are made, meaning is then assigned to the new data. "…Linkages to prior experience, established by subconscious mechanism which matches or 'recognizes' analogous items in the experience filter, are essential to the assignment of meaning to incoming data…Attributive classification involves the simplification of incoming data by classifying it according to the highest level of order which can be found in the experience filter" (Lam, 1977, p. 32). The association of meaning to visual stimuli by the experience filter is not performed on the basis of individual characteristics of the raw data alone. The association of meaning is also attributed to the context within which the stimuli are viewed. The experience filter stores not only information about visual stimuli, but the context within which the visual stimuli are viewed (see Figure 3).

The expectation component of visual perception establishes a standard for comparative judgment and evaluation for the incoming visual stimuli already given meaning through the attributive stage. An incoming visual stimulus is expected to be like something previously experienced and stored in the experience filter. Lam (1977) gives the following example, "If one is lost in a city, one expects that the streets will be arranged in some rational order and that the houses will be numbered consecutively. Prior experience tells us that the signs of a certain shape located on poles of a certain height will probably be helpful direction indicators; the scanning pattern of the eyes is directed

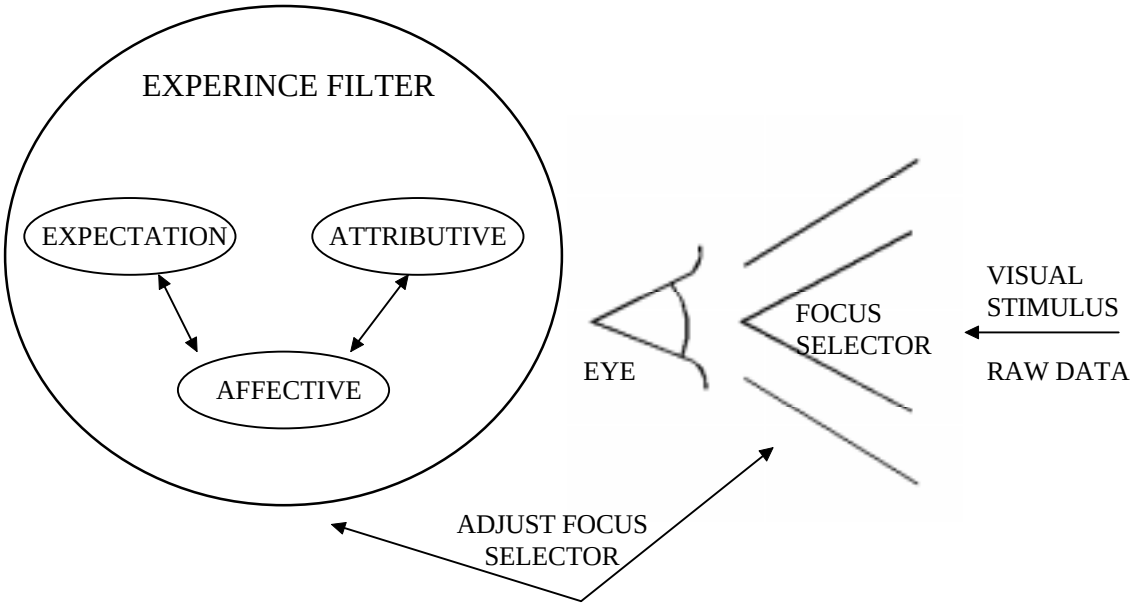


Figure 3. The process of visual perception (Lam, 1977) as adapted by author.

accordingly" (p. 34). The expectation component also establishes expected sequences of events. The expectation component redirects attention, controls eye movement, scanning patterns, and determines which data stored in the experience filter will be used to compare to new incoming data.

The affective component of visual perception is concerned with the emotional response elicited or affected by a visual stimulus. "The attributive classification to which a stimulus is assigned and the expectations which are activated by that classification trigger emotional responses which in the aggregate determine how we feel in a given situation or environment" (Lam, 1977, p. 34). Depending on the triggered emotional response, attention to something in the visual field is assigned when the visual stimulus is determined to be important, interesting, or attractive. If the visual stimulus is determined to be unimportant, dull, or irrelevant, little attention is assigned to it, and the data may not be stored in the experience filter. To some degree, the affective component decides where in the experience filter data or "memories" are stored (Lam, 1977).

The experience filter is constantly being updated with new information as new visual stimuli are received, interpreted, classified, and expectations and attention are directed to new stimuli. "If the environment behaves as expected, the web of associative relationships which constitute the experience filter will remains essentially unchanged; the relevant association will merely be strengthened by confirmation" (Lam, 1977, p. 35). However, if the environment does not behave as expected, the experience filter is adjusted as the unfamiliar new visual stimuli are re-evaluated and classified.

Throughout this process of visual perception, there is tremendous selectivity, and a search for meaning to the information obtained. Because meaning is given to what is seen, this process of visual perception may have some kind of influence on behavior. Thus, the perception of how a space is illuminated may have an effect on spatial behavior. An exploratory study by Flynn, Spencer, Martyniuk, and Hendrick (1973) considered this potential influence.

Lighting Variation Influence on Behavior

Flynn, Spencer, Martyniuk, and Hendrick (1973) set up an experiment in a

restaurant setting. They invited various groups of un-informed subjects in for coffee at a lighted coffee-bar. The subjects were free to choose seats at nearby tables. These tables were located in an area that was only lit by spill-light (light from adjacent areas). Subjects were also free to choose seats at tables located in a more remote part of the restaurant that was illuminated in an interesting and pleasant manner.

The researchers used behavior mapping methods to obtain data, making note of the subjects' various actions, including circulation patterns, seat selections, posture, comments, gestures, and facial expressions. The result of the preliminary data collection showed that subjects selected seats in the nearby darker space. However, seating patterns revealed that seats were selected to let the subjects face the adjacent lighted area (towards the entrance). The researchers then went back to the restaurant setting, and changed the lighting design. A different wall than in the first scenario was illuminated, and the remote table area was curtained off. Nearby tables were lit only by the spill light from the illuminated wall and coffee-bar. The lighting at the coffee-bar was not changed. Again, behavior mapping methods were used to record circulation patterns, seat selections, posture, comments, gestures, and facial expressions. The results showed that the subjects chose to sit at seats facing the illuminated wall. This placed their backs to the entrance, which in the first scenario they were facing. These results suggest that lighting may have an influence on seat selection, circulation patterns, and proxemic zones.

The research at hand proposes to examine whether or not spatial behavior is affected by the variable of illumination within waiting/reception areas. Therefore, to gain an understanding of typical design of waiting/reception areas and lighting design of waiting/reception areas, the following design guidelines are presented.

Waiting/Reception Area Design

Waiting areas are one of the most common spaces found in many commercial organizations ranging from hospitals, hotels, banks, small and large offices, and the like. Waiting areas may be any type of lounge or lobby and designs range from formal to informal. Any given waiting area has several things in common; its purpose is a place where people are waiting to go into another space, and it is a place where people gather

(Deasy & Lasswell, 1985). Some of the people in the waiting area will be acquainted with one another, and others will not. Beyond those commonalties waiting areas vary in their size, spaces adjacent to waiting areas, furniture arrangement, furniture comfort, and finishes. The design varies greatly with the type of organization it is located within and cost of materials used. However, no matter what type of organization, the size, arrangement, and decorations of the waiting area project a message about the organization and the way it views its visitors (Deasy & Lasswell, 1985.)

In Designing Places for People, Deasy and Lasswell (1985) recommend several guidelines for the design of waiting areas and spaces where people gather as they either enter a space, or wait in a space before going on into an organization to accomplish their business. Generally, all waiting areas should consider providing cues to help visitors find their way, make them comfortable, consider any special needs and demonstrate that the visitors are important to the organization. If a waiting area is located right off an entry from the outdoors, it should provide a transition area from the outside to the inside where visitors can stow coats, umbrellas and the like. To help visitors find their way, either a receptionist should be easily accessed to check-in or to ask questions, or an information center should be provided. Seating must be offered, and should be of an appropriate kind and amount. The design of the furniture and the layout of the furniture should consider ADA guidelines and universal design recommendations. Where people must wait for service, a queuing system is recommended of the appropriate type for the organization. If the people in the waiting area are going to spend a lot of time waiting, it is necessary to provide some sort of entertainment for them. Entertainment may be provided through magazines, brochures, aquariums, and televisions. The type of entertainment should be appropriate to the facility.

There are several guidelines for arranging the seating in a waiting area (Deasy & Lasswell, 1985). The number of people who will need to use the waiting area at any one time is considered foremost. The type of seating specified for the waiting area may be decided upon based on how many people will be using the space. The use of the space, and how long people will be waiting may affect the comfort level of the seating to be specified. Understanding peoples' seating preferences influences what types of furniture

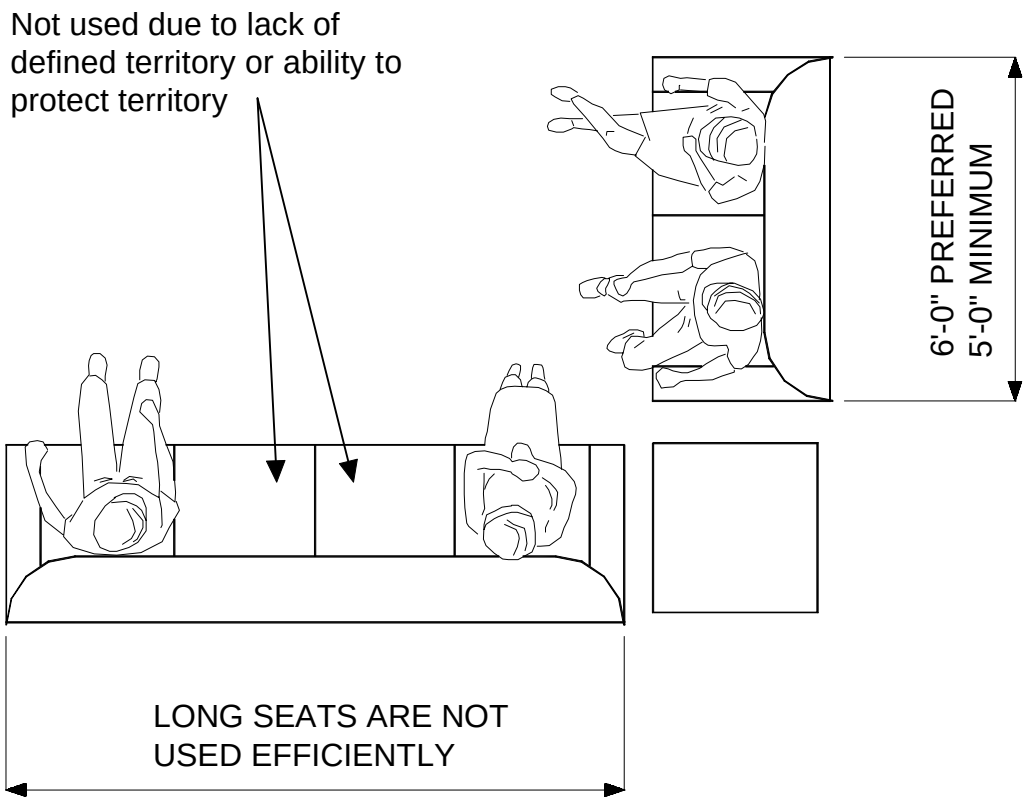


Figure 4. Seating Preferences. (Adapted from Deasy & Lasswell, 1985)

should be provided. People tend to prefer individual chairs or short couches that seat two people (see Figure 4). When long couches that seat three or more are used in public spaces, people tend to choose the end seats. When the end seats are occupied newcomers tend to not take the center seats unless there is no where else to sit (Deasy & Lasswell, 1985).

Seating arrangements should favor small groups, because most informal groups rarely exceed three people. It is suggested that seating arrangements in parks, hotel lobbies, and other waiting areas where people meet should be designed with small group gatherings in mind. In studies that have observed informal groups in public space and how many people comprised these groups, it was observed that 71% contained only two individuals, 21% contained three individuals, 6% four individuals, and only 2% five or more individuals (Deasy & Lasswell, 1985). There is a human tendency to form into groups, and so these groups tend to congregate in lounges, lobbies, and recreation type areas.

When furniture such as ganged seats, or sectional type seating are used in waiting areas, some sort of distinct separation between arm rests or seats should be made so that territorial boundaries are well-defined (Deasy & Lasswell, 1985). Providing seat dividers, or some type of clear boundary marker between seats helps to resolve sources of annoyance or discomfort to strangers that are forced to sit next to each other in situations such as airplanes, airport terminals, or hospital waiting areas where ganged seating is commonly used (see Figure 5).

Seating arrangements in waiting areas should also accommodate conversations. If small groups are in the waiting area, seating should facilitate their desire to communicate. Face-to-face and side-to-side conversations are generally not preferred. Most people prefer to sit at an angle to converse with a companion, and will adjust the seating arrangement to sit at an angle if it is not already adjusted (Deasy & Lasswell, 1985) (see Figure 6).

Seating arrangements may also encourage or discourage the formation of groups. When a socialfugal seating arrangement is used, the formation of groups and discussion is discouraged due to the separation of spaces because only peripheral vision is

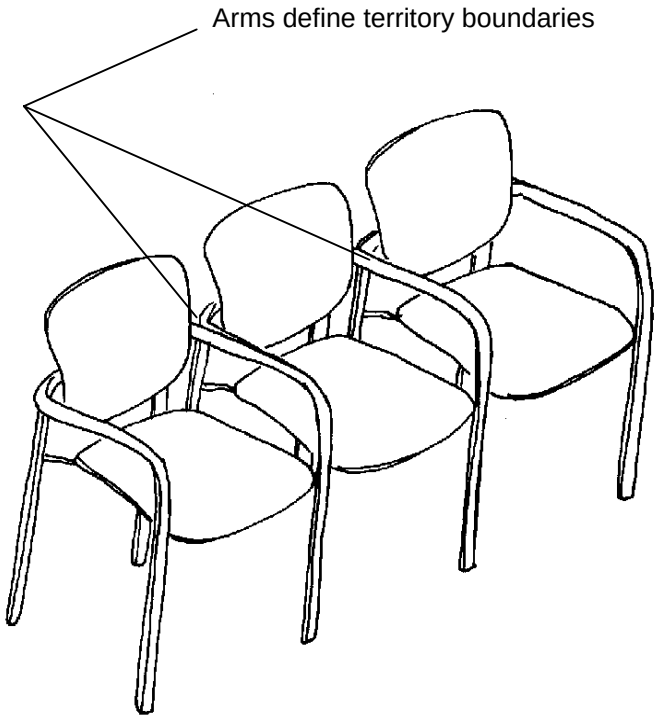


Figure 5. Utilize arms in ganged seating to define territory.

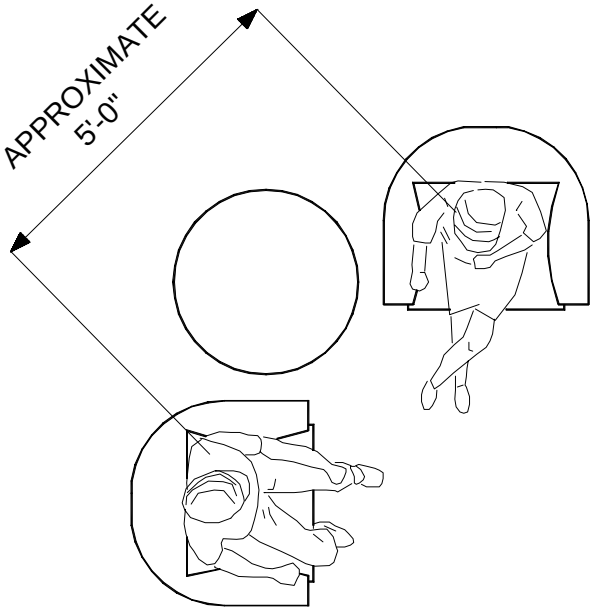


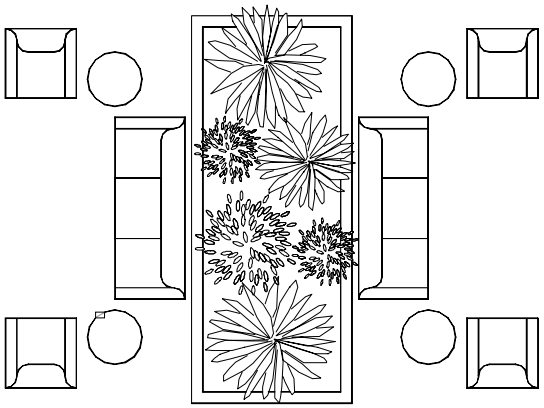
Figure 6. Optimum conversation distance. (Adapted from Deasy & Lasswell, 1985)

incorporated. These types of arrangements seem to isolate people or minimize interaction with others. However, when a sociopetal seating arrangement is provided, it encourages people to form groups and to interact (Deasy & Lasswell, 1985)
(see Figure 7).

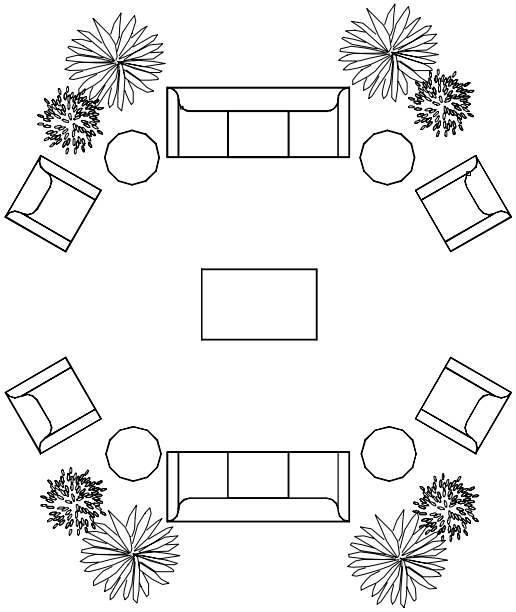
There are many ways in which waiting areas may be designed for accommodating the needs of the people who will use the space. The design is dependent upon the type of organization the waiting area is to be located within, how many people will be using it, and what the mission of the organization is. However, there are recommended arrangements to benefit the design of such spaces. De Chiara, Panero, and Zelnick (1991) recommend specific distances between groups of chairs, and particular arrangements of chairs be used. De Chiara, Panero, and Zelnick (1991) also indicate that individual seats in waiting areas are preferred over sofas (see Figure 8). This may be due to people wanting to sit in their own defined space, rather than having to share a sofa with a stranger. The personal proxemic and social proxemic zones are better defined with chairs than with sofas.

Lighting of Waiting/reception Areas

When lighting any type of space, it is essential to understand both the quantitative and qualitative aspects of lighting. In interiors, light is considered to be an element of design, such as color, texture, line, shadow, and form (IESNA, 1995). How spaces are perceived is greatly dependent upon the placement of light and shadow. "Design solutions should not only provide the needed illumination, but should enhance the aesthetic qualities of the space" (IESNA, 1995, p. 1). The lighting of a waiting area is approached with the same methodology used to light any given space, and it is critical to understand that the lighting within a space has a great effect on the perception of a space.
Lighting can effect the way space is perceived due to the placement and quantity of light in space. Different effects can be achieved through the manipulation of light sources and light direction. This manipulation can effect the visual appearance of the space itself, objects in the space, people in the space, and affect the performance of tasks in a space. There are three basic types of lighting methods used to develop lighting solutions;



Sociofugal arrangement: Groups are separated.



Sociopetal arrangement: Groups are integrated.

Figure 7. Sociofugal and sociopetal seating arrangements (Sommer, 1969) as illustrated by author.

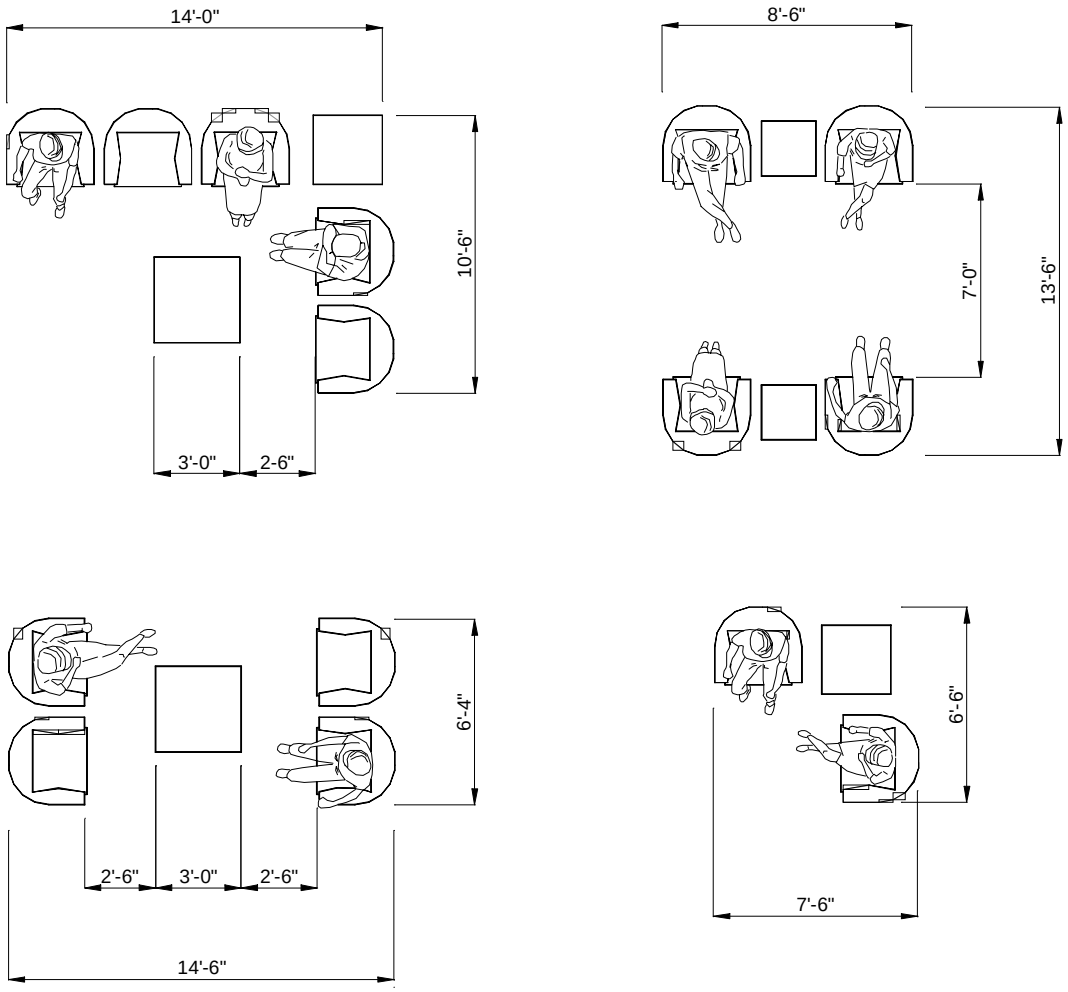


Figure 8. Typical seating arrangements for lounge or waiting areas. (Adapted from De Chiara, Panero & Zelnick, 1991)

ambient lighting, task lighting, and accent lighting (Egan, 1983).

The first of these lighting methods is ambient lighting. It appears as a non-directional, un-concentrated, soft, and uniform light. It is used for general lighting purposes and is achieved by using a diffuse point or linear sources that may be either incandescent, fluorescent, or high intensity discharge. Spaces tend to be bland or dull in appearance with ambient lighting because objects and their background are equally visible and no highlights are created. In spaces where harsh shadows are a problem, or make visual tasks difficult to perform, ambient lighting can be used to soften harsh contrasts (IESNA, 1995) (see Figure 9).

The second method, accent lighting, focuses light on an object with very little spill-light and creates a high contrast from the object to its background. This effect creates sharp shadows and visual interest. Accent lighting can be achieved with the use of point sources of high intensity such as low voltage incandescents or line-voltage incandescents (IESNA, 1995). The source used should cast narrow beams of light and is typically recessed into the ceiling and aimed downward. Any type of fixture used for accent lighting purposes should allow for adjusting the aim of the beam of light. Care must be taken to aim the light away from normal viewing angles so that direct glare and reflected glare problems can be avoided. Accent lighting should be used in combination with other lighting systems for balance (IESNA, 1995) (see Figure 10).

Thirdly, task lighting is lighting provided for the performance of specific activities such as cooking, reading, sewing, drafting, writing, etc. Any activity that requires detailed visual tasks, should have additional lighting. Light should be placed at the task, but care must be taken in the placement of the light so that shadows or glare problems are not created and eye-strain is minimized (see Figure 11). These three types of lighting methods used in combination or alone can influence the perception of space. A space can be made to look larger or smaller than it really is by the placement of light, the quantity of light and the distributed pattern of light. To make a space appear larger, indirect or ambient lighting should be used to either illuminate the floor, the walls, or the ceiling. The illuminated surfaces should be highly reflective to enhance the perception of brightness. The enhanced perception of brightness on either the walls, floor, or ceiling lends to the appearance

Figure 9. Ambient lighting (Adapted by author from IESNA, 1995).

Figure 10. Accent lighting (Adapted by author from IESNA, 1995).

Figure 11. Task lighting (Adapted by author from IESNA, 1995).

of expanding space. Light sources that produce this effect include diffuse point and linear sources that may be either incandescent, fluorescent or high intensity discharge. With the surfaces evenly illuminated and uniformly illuminated, the room dimensions will appear larger (see Figure 12). However, with only this type of lighting, there is little contrast, colors may appear less vibrant and sparkle from shiny surfaces is reduced. To improve the dull appearance, direct shielded luminaires can be used to focus light on objects to create interest. This type of accent light should be two-to-twenty-times as bright on particular objects of interest (IESNA, 1995).

Lighting effects such as grazing or washing can be utilized to give a space a larger appearance. Grazing is achieved by using well-shielded luminaires that are either recessed into the ceiling or surface mounted onto a wall or ceiling and cast light down upon a surface. Grazing is best used on surfaces such as brick or stone because aesthetically pleasing shadow patterns are produced (see Figure 13). This effect is dependent upon the sharp angle of incidence of light against the surface being illuminated (IESNA, 1995). The type of light source used to create a grazing effect can either be incandescent, fluorescent or high intensity discharge, and can either be a point, diffuse, or linear source. Grazing gives the impression of expanding space and emphasizing texture and colors of surfaces.

Washing also gives the impression of expanding space by providing even illumination across the planes of walls or ceilings. Washing effects are produced through the use of well-shielded directional luminaires that may be either recessed into the ceiling or surface mounted onto a ceiling or wall. Such types of luminaires may also be floor-mounted. The light source itself may either be a point-source or linear-source and it can be either incandescent, fluorescent, or high intensity discharge. Washing a surface with light adds ambient light to a space, softens shadows, and makes the wall or ceiling planes illuminated appear larger (IESNA, 1995.) Washing should only be used on matte surfaces because a glary reflection may occur if used on highly specular surfaces (see Figure 14).

Washing should also be used with other lighting systems for balance. Changing the pattern of distribution and quantity of light can make a space appear smaller and more intimate. To create the appearance of a smaller space, shielded luminaires recessed into

Figure 12. Lighting can expand the appearance of space (Adapted by author from IESNA, 1995).

Figure 13. Grazing (Adapted by author from IESNA, 1995).

Figure 14. Washing (Adapted by author from IESNA, 1995).

the ceiling, or mounted along walls or ceilings aiming light downwards, should be used (see Figure 15). Such luminaires should have concentrated beam spreads. Typically incandescent light sources are used because warm, yellow light sources are considered to be more intimate (Gordon & Nuckols, 1995.) With this type of lighting, high contrasts are created, colors will appear more vibrant, and sparkle and glitter are enhanced. The shadows created from the high contrast emphasize textures, but human faces are modeled very harshly. A space with this type of lighting is perceived as being very dramatic and intimate, but the performance of prolonged visual tasks is not recommended without task lighting (IESNA, 1995). High contrasts should be balanced with ambient lighting.

The above approaches to lighting space may be applied to lighting waiting and reception areas. However, it is important to recognize that many waiting areas are part of a larger space such as a lobby where people are making a transition from one space to another, stopping to ask a question to a receptionist, or reading. The design of the space may also establish the main theme for a facility. The lighting design needs to address both the architectural design intent and the functions of the space. IESNA (1993) states:

> Reception areas are designed for people who are waiting for their appointments. While they are waiting they can read or converse with others. The lighting should be restful yet provide enough illumination for reading. One way to provide a restful atmosphere without direct glare is by illuminating one or more of the walls. Another way is to light the ceiling and part of the walls. Accent lighting for pictures or a piece of sculpture enlivens the appearance of the room. If there is a receptionist located in the area, the ambient light may need to be augmented depending upon the visual tasks involved. Care should also be taken to light the receptionist's face, so as to make this person look approachable and also to eliminate harsh shadows caused by downlight directly overhead (p. 534).

Figure 15. Lighting can make a space appear smaller (Adapted by author from IESNA, 1995).

Reception areas may also serve as an entrance area into a building acting as a transition between facilities, so adaptation must be considered in terms of going from outside-to-inside or inside-to-outside. IESNA (1993) states:

> First Impressions of office buildings are often perceived in entrance lobbies. The lighting should compliment the architecture and provide a safe transition from the exterior to the interior. Consideration must be given to readaptation by the visual system from bright daylight conditions to darker interior lighting conditions, or vice versa. The degree of readaptation depends upon the fenestration and the changing exterior lighting conditions (p. 534).

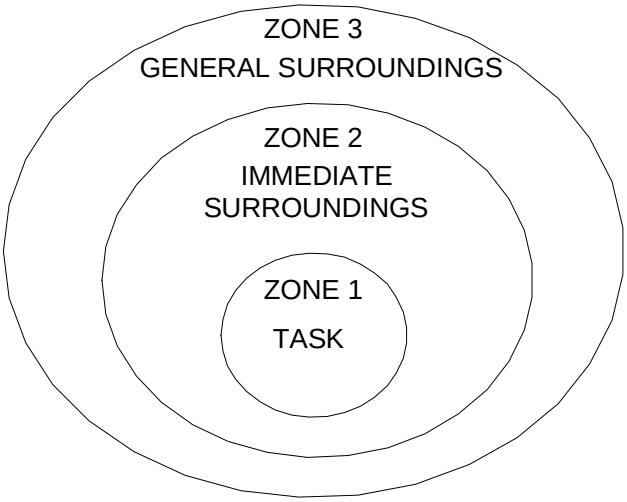
The difference in the adaptation process from daylight to nighttime conditions must also be considered. "If the lobby is enclosed with glass, the interior walls need to be at a higher luminance during the day in order to be seen from the outside against the high luminance of daylight. At night, much lower luminance is required. The variable luminance also makes it easier for the eyes to adapt to the luminance difference when entering or leaving a building. For these reasons, the lobby lighting should incorporate dimming or switching controls" (IESNA, 1993, p. 534.)

In addition to be being aware of the different methods of lighting a space and their effect on the perception and appearance of a space, there are several additional concepts that must be considered when choosing the appropriate design. Consideration should be given to the appropriate luminance levels for any given space and there must be an evaluation of the users' needs, age and life style and function of the space. The age of the users affects the quantity of light needed. The older the user, more light is required to enhance visual acuity (IESNA, 1995). The life style or cultural orientation of the users may also effect the quantity of light needed as well as the distribution of light. It is also critical to analyze the needs of the users. What kinds of tasks will they be doing in the space? What kinds of equipment will be used? The answers to these questions affects the

lighting system and controls needed for a space. The use of the space is important to understand, because the lighting can be designed to create a serene or stimulating mood, for example.

However, the above questions are not the only concerns that must be addressed when a lighting solution is being developed. The architectural qualities of a space should also be considered, including the architectural lines, forms, patterns, and textures of a space. Then, it is necessary to determine what should be emphasized or possibly minimized by use the lighting. Architectural limitations may effect the placement of luminaires within a space, so it becomes necessary to consider the following: the height, width and depth of the space, the type of ceiling -- wood, plaster, concrete, or plasterboard, the slope of the ceiling, plenum depth, insulation, HVAC ducts/plumbing, the location of structural beams and joist spacing (IESNA,1995). The location of doors, windows, and orientation to sunlight, as well as the finishes of a space will also affect decisions in developing a lighting design. It is necessary to consider vertical and horizontal surfaces, noting their color, texture, and reflectance characteristics. The type of furniture in a space, its scale, placement, and surface color, finish, texture, and reflectance characteristics will also influence luminaire decisions. The code requirements for a space need to be considered as well. Note the electrical, energy and equipment requirements. When all the above information has been obtained, luminaire and lamp choices can then be made (IESNA, 1995).

In understanding the users' needs of a space and selecting the appropriate illumination level, seeing zones should be evaluated. One person's visual field consists of three zones. Zone One is the task-at-hand, Zone Two is the area immediate around the task, and Zone Three consists of the general surroundings (IESNA, 1995). To maintain visual comfort, particular luminance ratios need to be maintained. In Zone Two, the luminance should not noticeably exceed Zone One or be less than one-third of Zone One. Zone Three should never be less than one-tenth as bright as Zone One (IESNA, 1995) (see Figure 16).



ZONE	**LUMINANCE RATIO**
Zone 1 - The Task	Typically task luminance is 4 to 12 cansdelas/ft^2 Seldom exceeds 20 candelas/ft^2
Zone 2- Intermediate Surroundings	
- Desirable ratio:	1/3 to equal to task
- Minimum accepted ratio:	1/5 to equal to task
Zone 3- General Surroundings	
- Desirable ratio:	1/5 to 5 times task
- Minimum accepted ratio:	1/10 to 10 times task

Figure 16. Illuminance Ratios (Adapted by author from IESNA, 1995).

The lighting of waiting areas, reception areas, lobbies may be achieved in many ways, but ultimately the design must meet the needs of the various tasks performed within the space; reading, paper and computer tasks of the receptionist, entry and transition space from one area to another. The lighting must also enhance the image and architecture of the facility, while taking into consideration the users of the space, their needs, and their age. IESNA (1995) recommends that twenty to fifty footcandles be supplied to areas where casual reading tasks are performed. For more critical tasks and prolonged reading tasks, fifty to one hundred footcandles should be supplied. For general lighting for passageways, five to ten footcandles should be the minimum supplied.

The lighting methods described above along with the design guidelines for waiting/reception area design will be used to create an environmental setting to examine the potential effect illumination level changes may have on proxemic behavior. One way to collect this information is through the use of simulation. Simulation as a means for collecting data for behavioral research studies has been tested by several authors such as Baum and Davis (1976), De Long (1976), and Lau (1970). The results have shown that data results are similar between simulations performed at full-scale and simulations performed in scale-model.

Simulation as means of behavioral research

A primary reason for doing behavioral research is to define activities performed in a given environment and to gain insight helpful in resolving specific research problems concerning how people interact within space. Behavior is described as the activities that an organism is observed doing at any one moment (Bechtel & Zeisel, 1987). Behavior can be observed in both molar units and molecular units. Most environmental behavior research looks at molar behavior; the researcher(s) wants to know where people go and how they get there. Molecular behavior is studied when examining the interaction individuals have with machines or furniture. Molecular behavior is sometimes associated with human factors research (Bechtel & Zeisel, 1987). These units of behavior are recorded and then analyzed. Questions are raised asking why this behavior occurs and what it means.

It is necessary then to understand the environment-behavior paradox (Bechtel & Zeisel, 1987). This paradox is based on the assumption that the environment is dominant over behavior, that is, it is the environment that causes or influences the behaviors that occur within it. More research is necessary to determine if this paradox is the reality of the environment-behavior relationship. A frequent study done in environmental behavior research is one that looks for behavior changes when environmental factors are manipulated. When looking at behavior changes as a result from environmental changes, a stimulus-response relationship is anticipated. "The unit of analysis is the S-R or stimulus-response relationship, in which observable behavior is elicited by equally observable and measurable stimuli" (Ittleson, Rivlin, Proshanky, & Winkel, 1974, p. 65). Ittleson, et. al. (1974) go on to state that "in human behavior only those events that can be observed and empirically specified have any legitimacy for a science of man" (p. 65). S-R units are either biologically determined or are reliant upon an essential response system that is learned through forming new S-R relationships. S-R units are evoked and created to lead to the ultimate satisfaction of an individual. The need to find satisfaction may be in response to drive-related needs as the search for food, water, or shelter. Or, it may be in response to the avoidance of situations that are potentially dangerous, painful or threatening to the individual (Ittleson, et.al., 1974).

An environmental/behavioral study may either be executed in an existing space where observations and methods such as behavior mapping are used to collect data, or it may be executed by use of some type of simulation of an existing or proposed environment. When conditions do not allow for natural observations of an existing space, simulation may be a better option for studying and recording human behavior. The conditions that do not allow for natural observation may include prohibitive cost factors, or there may be too many variables to control in an existing space. Use of simulations may also facilitate the manipulation of environmental variables for their apparent effect or in-effect on human behavior. Many authors have discussed the effectiveness, reliability, and validity of simulations (Bosselmann & Craik, 1987; Baum & Davis, 1976; De Long, 1976, 1977; Lau, 1970).

Bosselmann and Craik (1987) describe various techniques of simulations to study the environment constructed from McKecnie's (1977, In Bosselmann and Craik, 1987) typology of environmental simulations. The techniques are characterized by whether they are conceptual or perceptual and either static or dynamic. "A conceptual simulation seeks to convey abstract forms of environmental information" (p. 162). Conversely, a perceptual simulation attempts to convey specific information about the physical environmental setting or place (Bosselmann & Craik, 1987). A conceptual simulation may be either static or dynamic. Static conceptual simulation may use maps or floorplans, whereas a dynamic conceptual simulation may use computer modeling to simulate an environment (Bosselmann & Craik, 1987). A perceptual simulation may be either static or dynamic, as well. Static perceptual simulation includes photographs or sketches of an environment, and dynamic perceptual simulation may include filmed modelscope tours of scale-models of places (Bosselmann & Craik, 1987). These types of simulations are further differentiated by their context of application. A simulation may be used in environmental planning and design, auto, flight or navigational training, or the simulation seen in entertainment and feature films or television.

The interest here is with simulation of environments and their design, however, there are similarities between the three types of simulations described above. The goal of environmental planning, design, and visual simulation is to "convey accurate impressions of a place" (Bosselmann & Craik, 1987, p. 163). These impressions would include what is supposed to be seen within the environment, what descriptions the environment provokes, and what evaluation it provokes (Bosselmann & Craik, 1987). The typical purpose of this type of simulation is to provide a preview of a proposed environment so that responses can be collected and considered throughout the design decision making process. The type of simulation is commonly performed through the use of scale-models or sketches (Bosselmann & Craik, 1987).

This study of environmental perception through simulation seeks to understand the impressions people form of settings, environments, and places. When viewing a simulation, the observers response is generally a first impression, because the observers are viewing a proposed project for the first time and rarely are given a chance to view the

presentation model repeatedly over a period of time. Thus, in the evaluation of how effective a simulation is in generating accurate perceptions of an environment, it is necessary to judge the effectiveness of a simulation in predicting the first-impressions of a real-world setting (Bosselmann & Craik, 1987).

In the evaluation of a simulation's effectiveness for predicting accurate impressions of real-world settings, the following factors should be analyzed: (1) characteristics of the observers, (2) medium for selected for presenting the setting, (3) the response formats used, (4) the environmental attributes of the setting, and (5) the nature of the transaction with the simulated setting (Bosselmann & Craik, 1987). The characteristics of the observers may include their attitudes towards the environment in question, their cultural backgrounds and beliefs. The medium of presentation for the setting is how the observers view the simulation, either through slides, a direct site visit, scale-models, sketches, or floorplans. The response format deals with how observers are required to report their impressions of the simulation. The observers may be given instruction to freely write out their impressions, or fill-in descriptive checklists, or make evaluative judgments. "Although research in environmental perception and assessment has sought to identify a basic set of descriptive and evaluative measures, it has not yet produced a standard set of response formats commonly accepted in evaluation research of visual simulation" (Bosselmann & Craik,1987, p. 165). The environmental attributes of a setting refer to how closely the real-world setting and its characteristics are represented in the simulation. The nature of the transaction with the simulated setting refers to how the observers are instructed to view or experience the situation and whether they have had or have not had prior familiarity with the simulated environment.

The use of simulation methods, in the study of proxemic behavior, has been tested by both Baum and Davis (1976) and A.J. De Long (1976, 1977). Baum and Davis (1976) used scale-model environments to examine the impact of color, visual complexity, and sensory stimulation on the perception of crowding. Subjects were presented with scale-model rooms constructed from plywood, painted like an interior and given clothespin people to use as scale figures. Subjects were asked to place the scale figures in the scale-model rooms. The results of the study showed that light colored interiors, which appear

larger, maintained more scale figures than darker colored rooms. Thus, in lighter colored rooms, the perception of crowding was not as severe as in darker colored rooms (Baum & Davis, 1976).

De Long (1976) used the distance for a comfortable conversation as reported by Sommer (1969) as the basis of a study comparing the accuracy and reliability of data collected in scale-model environments with those data collected in full-scale environments. De Long (1976) used data from Sommer's (1969) study to replicate four scale-model conditions, arranging scale-model sofas similar to those used in Sommer's (1969) full-scale study. Subjects viewed scale-model arrangements of sofas placed facing each other, and the distance between the sofas was gradually increased from 1'-0" to 6'-0". Subjects were asked to place scale figures on the sofas where they could have a conversation at a comfortable distance. The results showed that scale figures were placed side-by-side on one sofa for conversation when the sofas were approximately 3'-6" apart. These results were nearly identical to Sommer's (1969) full-scale study.

De Long (1977) also tested the accuracy of spatial perception by participants in scale-model environments. De Long (1977) set up an experiment to compare the accuracy of dimensional and spatial perception of scale-model environments to the accuracy of dimensional and spatial perception of full-scale environments. The scale-models used in De Long's (1977) study were 1" = 1'-0". The participants of the study were asked to view a scale-model consisting of two lounge chairs, each occupied by a scale figure. The two chairs were gradually moved closer to one another, and as they were the participants were asked to note any changes they felt in the spatial relationship between the chairs as if they were seated in the chairs. As changes in feelings were noted, distances between the chairs were measured. This type of spatial measurement was also performed using full-scale lounge chairs. Participants were asked to sit in a lounge chair, and each of the two lounge chairs were gradually moved closer to one another. The participants were asked to note when a change in spatial relationship was felt. When the change was noted, the distance between the two chairs was measured. Three different orientations of the chairs were used. One orientation had the chairs facing each other, one had them at right angles to each other, and the third orientation had them side-by-side, facing the same direction. The

participants used in De Long's (1977) study were considered to be "spatially-naïve." The participants were considered to have not had any special training or education in any type of design profession.

The results of De Long's (1977) study showed a remarkable consistency of spatial perception between full-scale environments and scale-model environments. "The deviations in distance setting in scale and full-size vary no more than repeated trials in full-size. The results which show an average difference of 6% are even more remarkable when volumetric and informational reduction involved in moving from full-size to 1/12 size [model] environments is considered" (De Long, 1977, p. 58). De Long (1977) goes on further to suggest that "human beings [may] encode certain spatial relationships independently of scale" (p. 58). De Long (1977) emphasizes that "when working in scale with informants…they must be instructed to respond in terms of *how they feel.* If they are informed to 'think' carefully, to be as 'accurate' as possible or to 'rationalize' what they experience, responses deviate far beyond the constant factor of 6-7% identified in this study" (p. 57).

Lau (1970) studied the differences between full-scale and scale-model rooms to evaluate the perception of lighting quality. Lau (1970) was interested in the perception of pleasantness or gloominess of a room in relation to lighting quality. Lau (1970) states: "…in the investigation of lighting quality, and indeed in lighting design when the qualitative aspects are to be appraised, there is a general preference for reduced scale physical models, because of convenience and ease of manipulation" (p. 43).

In Lau's (1970) study, subjects were asked to assess the different lighting arrangements for a single bedroom with study area. The lighting in the full-scale room was created by placing a fixture at the center of the room or at the side of the room and used either a 100W lamp or a 40W lamp. The scale-model used similar lighting fixtures that replicated the luminous distribution of the full-scale-model. Care was taken to prevent light from the room the models were viewed within from entering the model by using viewing apertures and placing the models at a standard height for viewing. The independent variables for the study consisted of: the mounting position of the light-source, the type of lighting fixture, and the luminous flux output. The dependent variable

was the pleasant or gloomy quality of the lighting.

In Lau's (1970) experiment it was apparent in either viewing condition that "…as the illumination increases, the room becomes more 'pleasant', but beyond a certain point, further increases in illumination result in decreases of 'pleasantness'….and for the assessment of gloom, there is a direct relationship with the level of illumination" (p. 44). Lau's study (1970) did indicate that subjects agreed on the pleasant or gloomy quality of lighting of the scale-model more so than they agreed on the pleasant or gloomy quality of lighting in the full-scale room. Overall, there was consistency on what was considered pleasant or gloomy according to the lighting arrangements in either the scale-model or full-scale condition.

Simulation methods have been used successfully to study personal space behavior in both scale-model and full-scale environments. DeLong (1977) used scale-models to evaluate personal space as affected by furniture, as well as compare scale-model results with full-scale results. Baum and Davis (1976) used scale-models appropriately to analyze the effect of visual complexity and perception of crowding upon individuals. Simulation methods have also been used successfully to examine lighting quality impressions. Lau (1970) used scale-models to record impressions of lighting characteristics compared to full-scale models, finding very similar results between the two models. Therefore, it is reasonable to claim that accurate data can be collected on personal space behavior as influenced by manipulations of illumination level changes in a scale-model environment.

Rationale

Research on personal space behavior has focused on many aspects that affect human spatial behavior, such as cultural, social, and personality influences. People from different cultures may have different interaction distances. For instance, people from Mediterranean cultures converse at closer distances than do Americans. In public spaces, social influences may affect the way people behave. If someone does not wish to interact with others, he or she may not make eye-contact, and keep a stiff posture. Also, studies have shown that friends keep closer distances than do acquaintances or strangers. Because

of personal experiences or personality characteristics, individuals may also exhibit unique spatial behavior (Altman, 1975). Males and females also exhibit different spatial zones. Generally, mixed sex pairs exhibit closer distances than do same sex heterosexual pairs (Altman, 1975). The distances that individuals maintain is also influenced by the environmental setting and the arrangement of space.

Research on personal space behavior has examined the effect of seating arrangement selection. Sommer's (1969) research demonstrated that people who wish to engage in causal conversation tend to choose corner-to-corner or face-to-face seating arrangements. People desiring to interact or participate in an activity together where sharing is involved tend to choose side-to-side seating arrangements. In contrast, people that do not wish to interact tend to choose catty-corner seating arrangements (Sommer, 1969).

The color of finishes within a space has also been examined for its effect on perception of personal space and crowding. Generally, light-colored spaces tend to be perceived to be less crowded than do darker-colored spaces (Baum & Davis, 1976). The idea of perceived light or perceived dark-color is related to the same perception of perceived brightness or perceived gloominess of a space due its lighting. Depending on how a space is illuminated, it may be perceived differently. Spaces that are evenly illuminated on either the walls, ceiling or floor tend to be perceived as larger, where as spaces that have high contrasts in illumination are perceived to be smaller (IESNA, 1995).

Although research has been conducted to study the effect of illumination changes on personal space requirements, little research has been conducted to examine the effect of illumination level change on personal space behavior in a particular environment/ behavior setting. Flynn, Spencer, Martyniuk, and Henrick's (1973) study involving light distribution changes and its effect on behavior, did indicate that lighting does play some role in human spatial behavior. However, this study did not attempt to keep room dimensions the same under two testing conditions.

To the author's knowledge, no study, to date, has taken into account that personal space behavior may be affected by illumination level changes in a public space such as a

waiting/reception area. Partly, this is due to the fact that it is very difficult to control extraneous variables that could affect personal space behavior in a real-world setting. It is also difficult to locate a real-world setting in which the users of the space would allow the researcher to manipulate lighting fixtures and lighting levels without causing disruption. To control for extraneous variables and facilitate the manipulation of illumination changes, simulation methods may be used to conduct the research at hand. Research on proxemic zones and simulation as a means to collect data has been performed. Results of this data conclude that data collected in either scale-model environments or full-scale environments is remarkably consistent (De Long 1977).

The proposed study is designed to investigate the effect of low and bright illumination levels on proxemic zones within waiting/reception area settings simulated in a scale-model environment. The scale-model environment will follow the design recommendations for both the design of waiting/reception areas and the lighting design of waiting/reception areas.

Research Question

This study will examine the potential effect of bright versus dim illumination level on personal space requirements, specifically the intimate, personal, and social proxemic distances defined by Hall (1966) in simulated waiting/reception areas. Is there a difference in proxemic distances due to light level in a simulated hotel lobby waiting area, a simulated physician's office waiting area, and a service-oriented waiting area?

Hypotheses

$H1_0$: In a simulated hotel lobby waiting/reception area, there is no difference in proxemic distances between bright and dim lighting conditions.

$H2_0$: In a simulated physician's office waiting/reception area, there is no difference in proxemic distances between bright and dim lighting conditions.

$H3_0$: In a simulated service-oriented waiting/reception area, there is no difference in proxemic distances between bright and dim lighting conditions.

Operalization of Variables

The following variables have been identified as independent variables: illumination level and environmental/behavioral setting of a waiting/reception area. There are two levels to the illumination level variable: bright lighting level and dim lighting level. These two conditions will be simulated following IESNA recommendations for creating perceived bright illumination conditions and perceived dim illumination conditions. There are three levels to the variable of setting, a hotel lobby waiting/reception area, a physician's office waiting/reception area, and a service-oriented waiting/reception area. The furniture layout of these typical waiting/reception areas will follow design guidelines recommended by Deasy and Lasswell (1985) and De Chiara, Panero, and Zelnick (1991).

The following dependent variable has been identified: space, the proxemic distance between people. This distance is defined by Hall's (1966) description of proxemic zones. The intimate distance close phase is 0"-6" and far phase is 6"-18". The personal distance close phase is 18"-30" and far phase is 30"-48". The social distance close phase is 4'-0"-7'-0" and far phase is 7'-0"-12'-0". The public distance close phase is 12'-0" - 25'-0" and far phase is 25'-0" and beyond. For the purposes of this study, attention will focus on the close and far phases of the intimate, personal, and social zones as well as the close phase of the public zone.

Significance of the Study

Interior designers and designers in related fields understand that environmental factors influence behavior, but it is unclear how lighting has an impact on human spatial behavior. Research on how illumination levels may have an effect on proxemic behavior in a social environmental setting such as a waiting/reception area will be a part of the understanding of light's effect on human behavior. The findings of this study may indicate what light levels and light distribution patterns cue users of a space where to sit. Designers can take this information to better integrate lighting design and furniture space planning so that waiting areas can be designed more efficiently and effectively for users.

II. Methodology

The research question asks if there a difference in proxemic distances between bright or dim illumination level in simulated waiting/reception areas. To investigate this question, it is necessary to understand Michelson's (1976) Intersystems Congruence Model (ICM) for how cultural, social, personality and built-environment systems interact to limit or promote human behavior, particularly human spatial behavior. The dependent variable of the ICM is space. For the research at hand, the variable of space is defined as the intimate, personal, social, and public proxemic distances described by Hall (1966). It is also necessary to understand the design guidelines for the type of behavioral setting chosen for this research. Deasy and Lasswell (1985) recommend several considerations for the furniture arrangement and types of seating to be used in waiting areas. The IESNA (1995) also recommend several guidelines to follow for the lighting design of waiting/ reception areas. In this study, the design of the scale-models used for simulating waiting/reception areas followed these design recommendations.

Simulation methods were chosen to collect data in this study so that several extraneous variables could be controlled. These extraneous variables included color, temperature, texture, behavioral setting, and cultural background of participants. Three types of waiting/reception areas were chosen to evaluate proxemic behavior so that comparisons between the waiting areas could be made. The simulation method chosen for the research included gathering volunteers to participate in the research and asking them to interact with scale-models of brightly or dimly illuminated waiting/reception area environments. Participants viewed the models, were instructed to place scale-figures in the models, were given both quantitative and qualitative questionnaires, and their interaction with the models was video and audio recorded.

Sample

Subjects for this study were volunteers from the faculty and staff at a large university located in southwest Virginia. Volunteers were obtained from sending a campus wide e-mail requesting their participation in this study (see Appendix A). Faculty

and staff were chosen as the population for this sample because they were expected to have more experiences in waiting areas, such as hotels and physician's offices. This differs from previous studies (Baum and Davis, 1976; Adams and Zuckerman, 1991) where students were used as the subjects. As Hall (1966) stated, cultural influences do affect proxemic behavior. For the purposes of this study, only subjects who had lived in the United States for at least seven years were included.

Measures and Procedures

In order to examine the effect of illumination level on proxemic zones, subjects were asked to consider scale-models of waiting/reception areas. The procedures used in this study followed Baum and Davis (1976), with some exceptions. Subjects were tested individually, and each subject worked with all the models presented to them. Six models were presented to the subjects; a brightly illuminated condition and a dimly illuminated condition of a hotel lobby scenario, a brightly illuminated condition and a dimly illuminated condition of a physician's office scenario, and a brightly illuminated condition and a dimly illuminated condition of a service-oriented waiting area scenario. The order in which the subjects viewed the models was randomized, and the subject worked with one model at a time. Each subject was asked to place three scale-figures inside of each model as if each figure was a person entering the space to choose a place to sit. One scale-figure, representing a stranger seated, was already placed in each scale-model. The location of this "antecedent" figure was determined through the pilot study.

Upon entering the laboratory, a subject was told that he or she was participating in a study regarding environmental perception. He or she was asked to read and sign an informed consent form for research using human subjects (see Appendix B). At that time, the subject was told the session would be video and audio taped, but only the gestures and movements of the subject's hands would be video taped. The purpose of the video and audio tapes was to allow for qualitative analysis of the subject's interaction with the models to be performed.

When explanations were completed and any questions answered, the subject was placed in front of a randomly assigned model. He or she was asked to pick up the first of

three figures placed on top of the model and told to pretend the figure was himself or herself walking into the space for the first time to wait approximately fifteen minutes. The subject was then told to choose a place to sit. Once this task was completed, the subject was informed that the person was no longer himself or herself, but a stranger. The subject was instructed to pick up the second figure, pretend it was him or herself, and choose a place to sit, and all other people sitting in the waiting area were strangers. Once this task was completed, the subject was informed again that the figure was no longer him or herself, but a stranger. Then, the subject was instructed to pick up the third figure, pretend it was him or herself, and choose a place to sit, and all other people sitting in the waiting area were strangers. Each time the subject was instructed to choose a place to sit, he or she was told the waiting time would be approximately fifteen minutes. This script for instructing the subject to place figures in a model was followed for each of the six models (see Appendix C).

Each time a subject completed placing the three scale-figures in a model, the subject was asked to fill out a short semantic differential questionnaire (see Appendix D) located on a clipboard beside the model. The purpose of this short questionnaire was to obtain data concerning the subject's perception of the space the model represented. This questionnaire was prepared following the semantic differential format used by Lau (1970). At the completion of the experiment, there were six semantic differential questionnaires, one per each model.

After completing the interaction with the six models and answering the six short semantic differential questionnaires, one last open-ended questionnaire (see Appendix E) was given for further qualitative analysis. Demographic information with respect to the subjects' background was also obtained (see Appendix F). After each subject completed these tasks, a full explanation of the study was given, and the subject was dismissed.

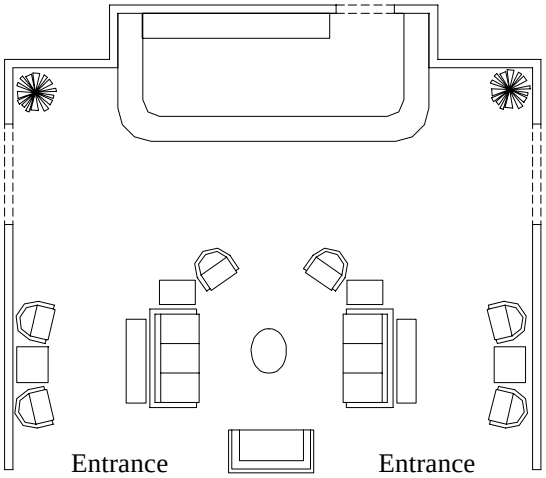
At that time, the experimenter measured the distance between the scale-figures placed in the model. The placement and noted distances of the scale-figures was transposed onto an in-scale drawing of each model. These drawings serve as a permanent record of scale-figure placement. See Appendix G for a typical example of this record.

Description of Models

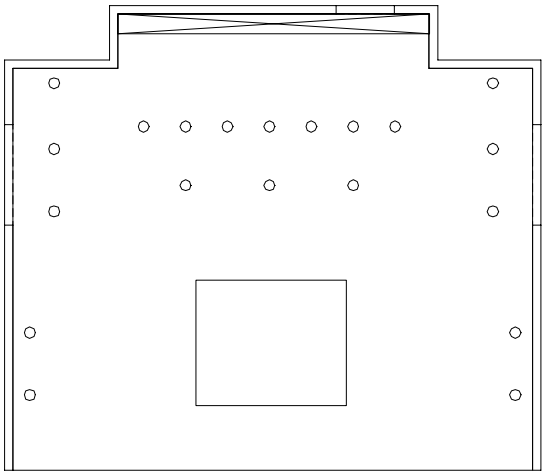
The six scale-models and all furnishings were built in 1"=1'-0" scale, the same model size as used by De Long (1976). The lighting of these models was limited by the types of light sources available to illuminate scale-models. This study attempted only to create a contrast in bright versus dim lighting condition, and not simulate the color and type of light source found in real-life situations. The light source used in each model for this study was a 12" undercounter fluorescent fixture with a T-5, 8 watt cool-white fluorescent lamp. The furniture arrangement remained the same between lighting conditions in each scenario. To control for any effect of color on spatial behavior, all models were constructed of white foam core, white matte-board, and any other materials used were painted white. (Baum & Davis, 1976).

The hotel lobby waiting/reception area models represent a space that is 30'-6" wide by 27'-6" deep. With a combination of three-seat sofas, two-seat sofas, and lounge chairs, this waiting area accommodates fourteen individuals. The reception desk is included in the waiting area space and openings were created that would lead into adjacent hallways and elevator bays. This floorplan was adapted from the Williamsburg Lodge lobby which represents a typical average sized hotel lobby space based upon a literature search of typical hotel lobby plans (Janjigian, 1995) (see Figure 17.) The lighting plan of the hotel models remained the same between the bright and dim conditions. Differences in the light emitted into each model was created by using different diffusers. See Figure 18 for the footcandle readings for the bright and dim lighting conditions. See Figure 19 for a photographs of the each of the hotel lobby lighting conditions.

The physician's office waiting/reception area models represent a space that is 21'-0" wide by 23'-0" deep. With a combination of two-seat sofas and arm chairs, this waiting area accommodates twenty individuals. The receptionist can be approached through a window looking into the receptionist station, and an adjacent doorway would lead to the physician's office. This floorplan was adapted from a typical waiting area in a medical office (Malkin, 1982) (see Figure 20). The lighting plan of the physician's waiting/ reception area models remained the same between the bright and dim lighting conditions.

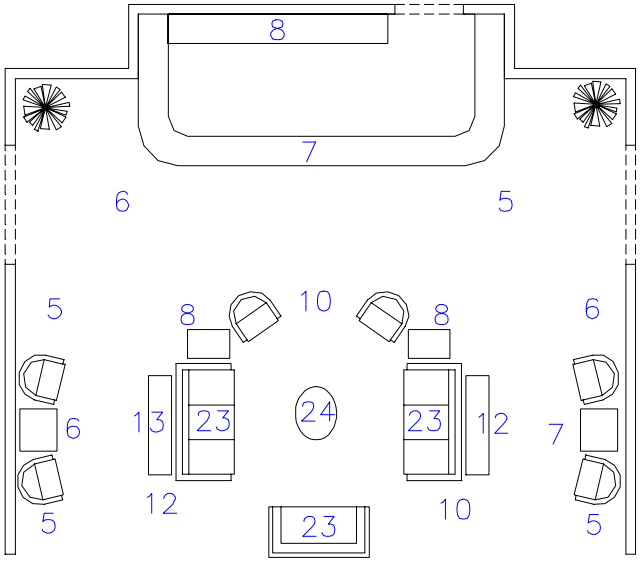


FLOORPLAN

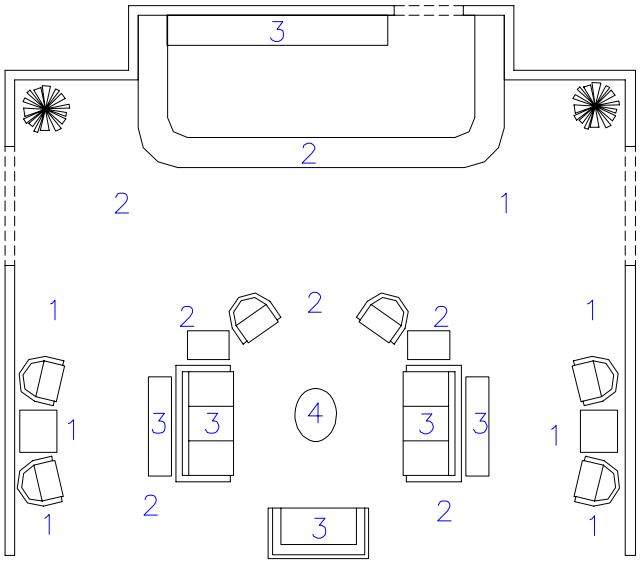


LIGHTING PLAN

Figure 17. Floorplan of model representing a typical hotel lobby waiting area, adapted from Janjigian (1995). Drawing not to scale.



Bright lighting condition



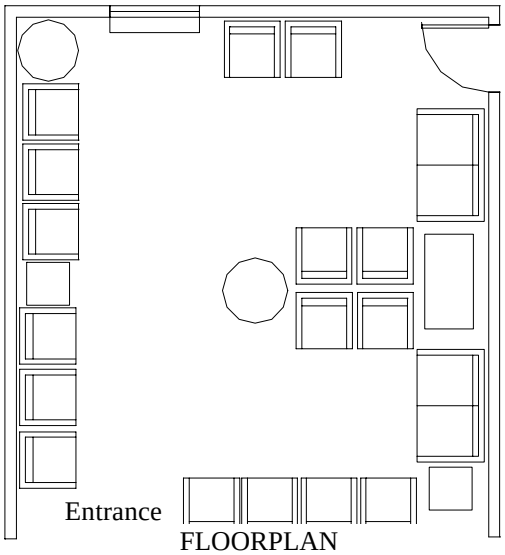
Dim lighting condition

Figure 18. Floorplans of hotel waiting/reception lobby with footcandle readings noted. Each number represents the footcandle reading taken at that particular location in the model. Drawing not to scale.

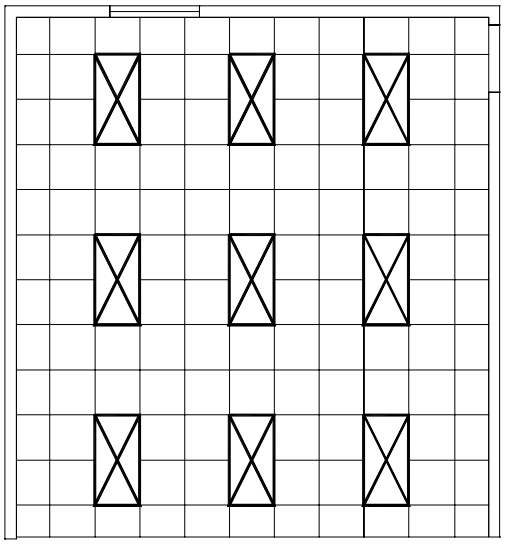
Hotel Lobby Waiting/Reception Area - Bright Condition

Hotel Lobby Waiting/Reception Area - Dim Condition

Figure 19. Photographs of hotel waiting/reception area scenarios. (Photographed by author).



FLOORPLAN



LIGHTING PLAN

Figure 20. Floorplan of model representing a typical physician's office waiting/reception area, adapted from Malkin (1982). Drawing not to scale.

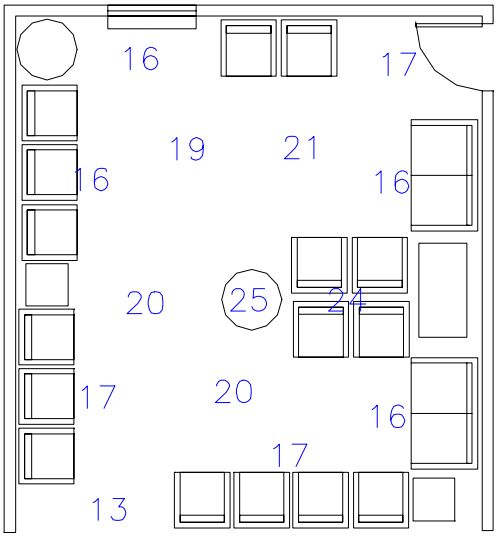
Differences in the light emitted into each model was created by using different diffusers. See Figure 21 for the footcandle readings for the bright and dim conditions. See Figure 22 for a photograph of the each of the physician's waiting/reception area lighting conditions.

The service-oriented waiting area models represent a space that is 26'-0" wide by 20'-0" deep. This waiting area accommodates up to sixteen individuals. The customer service/receptionist desk is part of the waiting area. The design of this waiting area is adapted from a typical waiting area layout (Malkin, 1982) (see Figure 23). The lighting plan of the customer service waiting/reception area models remained the same between the bright and dim conditions. Differences in the light emitted into each model were created by using different diffusers. See Figure 24 for the footcandle readings for each of the bright and dim conditions. See Figure 25 for a photograph of the each of the customer service waiting/reception area lighting conditions.

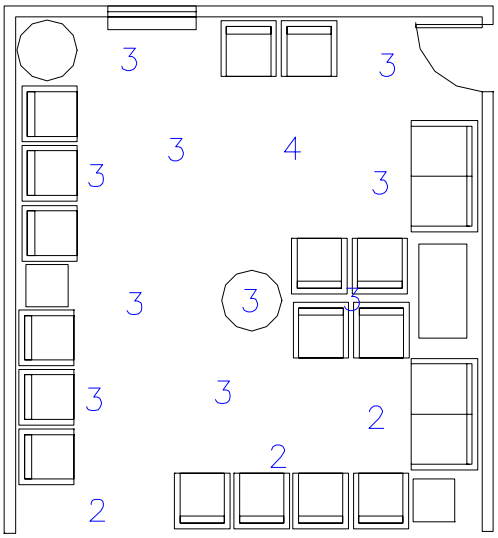
The laboratory where this experiment was conducted was set up with six drafting tables set at 37" above finished floor. A scale-model was placed on top of each table. Castered, adjustable task chairs were placed in front of each model. When the subject sat at in the chair, his or her eyes were eye level with the interior of each model. Figure 26 depicts the layout of the lab.

Pilot Testing and Analysis

A pilot test using the scale-models and questionnaire was performed with faculty and staff representing the sample for this study before being administered to the actual subjects. The pilot test aided the researcher in adjusting the video camera and the wording of the script for the employment of the actual experiment. The pilot test determined the location of the antecedent figure within each waiting/reception area scenario. The determination for this location was based upon the pattern of placement established by the subjects' location of the first scale-figure. The placement of the antecedent figure was the same between bright and dim lighting conditions for each scenario. The pilot study also determined how many subjects were needed for the full experiment. It was decided that sixty subjects would be needed for the completion of the experiment.



Bright lighting condition



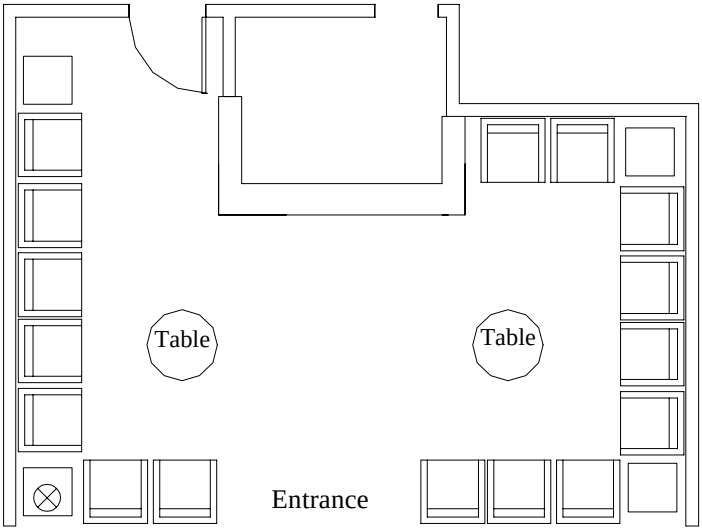
Dim lighting condition

Figure 21. Floorplans of physician's office waiting/reception area with footcandle readings noted. Each number represents the footcandle reading taken at that particular location in the model. Drawing not to scale.

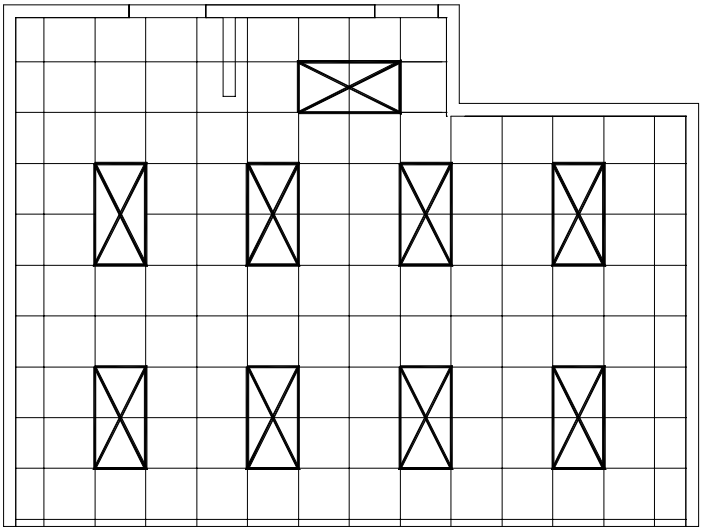
Physician's Office Waiting/Reception Area - Bright Condition

Physician's Office Waiting/Reception Area - Dim Condition

Figure 22. Photographs of physician's office waiting/reception area scenarios. (Photographed by author).

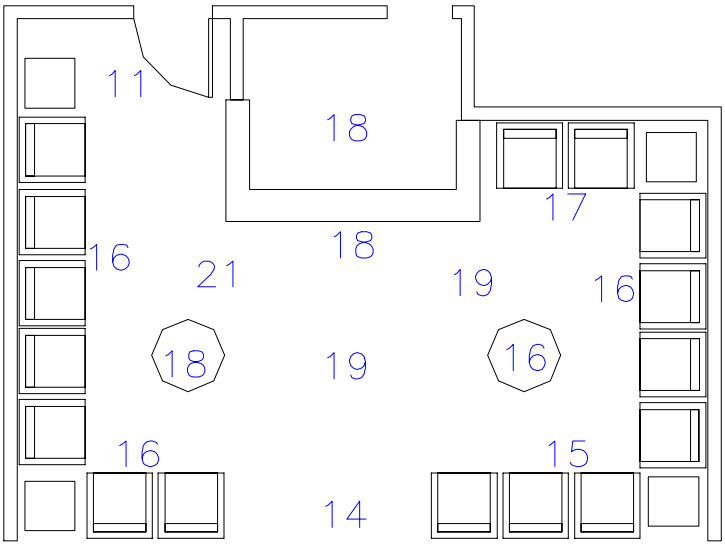


FLOORPLAN

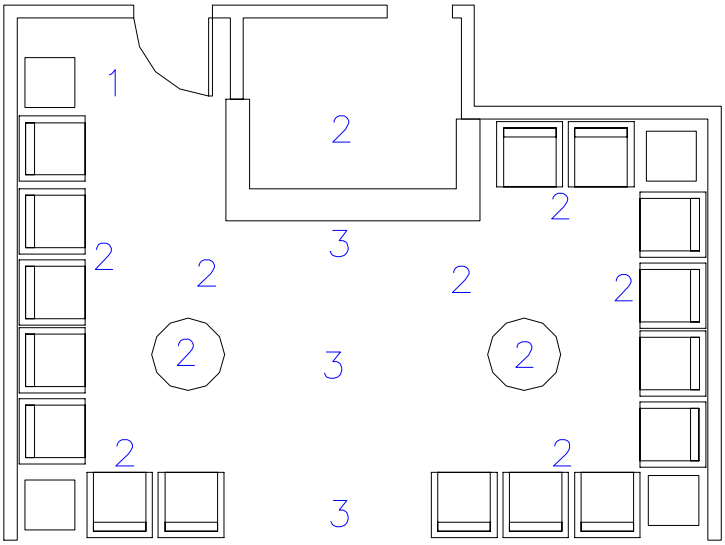


LIGHTING PLAN

Figure 23. Floorplan of model representing a typical service-oriented waiting area, adapted from Malkin (1982). Drawing not to scale.



Bright lighting condition



Dim lighting condition

Figure 24. Floorplans of service-oriented waiting/reception area with footcandle readings noted. Each number represents the footcandle reading taken at that particular location in the model. Drawing not to scale.

Service Waiting/Reception Area - Bright Condition

Service Waiting/Reception Area - Dim Condition

Figure 25. Photographs of service-oriented waiting/reception area scenarios. (Photographed by author).

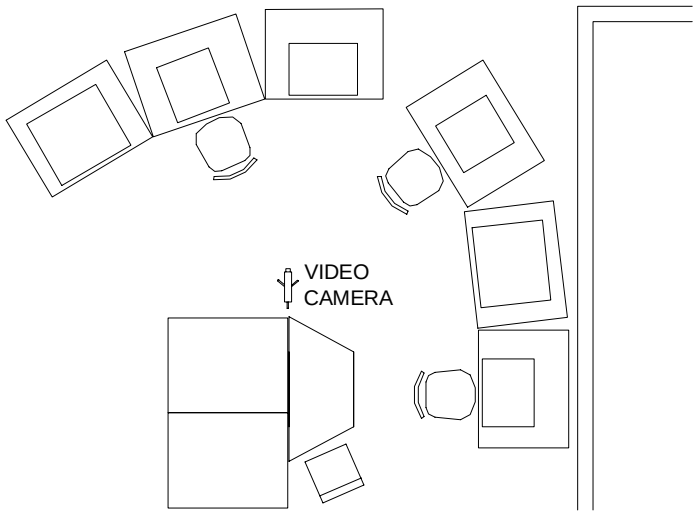


Figure 26. Schematic layout of laboratory space where experiment was performed. Drawing not to scale.

This study was designed to use a two-factor mixed model experiment in a randomized complete block design where the subject equals the block. A contingency table analysis was to be performed that would analyze the number of subjects placed within the three proxemic zones in question (intimate, personal, and social zones) and the two lighting level conditions (bright and dim). The basic design of the experiment is shown in Table 1.

In addition to the contingency table analysis, composite maps of the placement of figures in the bright and dim illumination conditions for each of the three scenarios was to be prepared to evaluate seating preference differences and proxemic differences under the two lighting conditions. Content analysis of the video and audio tapes of the subjects working with models was also to be performed after all subjects had completed the experiment. The content analysis looked for common movements of how scale-figures were placed in the models. Common movements and dialogue were coded to better comprehend the data (Kincade, 1997). The qualitative analysis was performed to give a richer understanding of the quantitative analysis of the proxemics demonstrated in the models.

Table 1

Two factor mixed model experiment in a randomized complete block design

	Seating Arrangement		
	Hotel Lobby	Physician's Office	Service-Oriented
Lighting Condition	A	B	C
Bright	A_{b1}	B_{b1}	C_{b1}
	A_{b2}	B_{b2}	C_{b2}
	A_{b3}	B_{b3}	C_{b3}
Dim	A_{d1}	B_{d1}	C_{d1}
	A_{d2}	B_{d2}	C_{d2}
	A_{d3}	B_{d3}	C_{d3}

Note. Subscript numbers represent the following: 1 = intimate zone (0"-18"), 2 = personal zone (18" - 4'-0"), 3 = social zone (4'-0" - 7'-0").