PERCEPTION AND EVALUATION OF SPACIOUSNESS IN INTERIOR SPACES

A THESIS

SUBMITTED TO THE DEPARTMENT OF

INTERIOR ARCHITECTURE AND ENVIRONMENTAL DESIGN

AND THE INSTITUTE OF FINE ARTS

OF BİLKENT UNIVERSITY

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MASTER OF FINE ARTS

By

Çiğdem Demirörs
January, 1994

I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Fine Arts.

Prof. Dr. Mustafa Pultar

I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Fine Arts.

Prof. Dr. Vacit İmamoğlu

I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Fine Arts.

Assoc. Prof. Dr. Cengiz Yener

Approved by the Institute of Fine Arts

Prof. Dr. Bülent Özgüç, Director of the Institute of Fine Arts

ABSTRACT

PERCEPTION AND EVALUATION OF SPACIOUSNESS IN INTERIOR SPACES

Çiğdem Demirörs

M.F.A in Interior Architecture

Supervisor: Prof. Dr. Mustafa Pultar

January, 1994

Man and Built-Environment studies have increased rapidly in recent years, leading to a better understanding and examination of the effects of different architectural variables on the assessment of interior spaces. The aim of this thesis is to analyze the effects of some of these factors, namely, room geometry, color, lighting, window, and furniture on the perception and evaluation of spaciousness. These have been studied in the context of man-environment interactions, based on the studies of well-known researchers of the field. In addition, two case-studies have been conducted to study the effects of furniture organization and lighting arrangements on the

assessment of interior spaces in terms of spaciousness.

Keywords: Environmental behavior, Built environment, Spatial perception, Openness, Enclosedness, Spaciousness.

ÖZET

İÇ MEKANLARDA FERAHLIK ALGILAMASI VE DEGERLENDIRMESI

Çiğdem Demirörs

İç Mimari Bölümü

Yüksek Lisans

Tez Yöneticisi: Prof. Dr. Mustafa Pultar

Ocak, 1994

Mekanı oluşturan farklı etkenlerin mekanların değerlendirilmesindeki etkisini daha iyi anlamak ve incelemek için insan ve insan yapısı mekan üzerine yapılan çalışmalar son yıllarda oldukça artmıştır.

Bu tezin amacı, oda geometrisi, renk, aydınlatma, pencere ve mobilya gibi etkenlerin iç mekanların ferahlığının algılanmasına ve değerlendirilmesine etkisini incelemektir. Bunun için insan-mekan ilişkileri çerçevesinde, bu alanda tanınmış araştırmacıların çalışmaları temel alınmıştır. Ayrıca, bu çalışmalardan elde edilmiş bazı sonuçları sınamak üzere, mobilya düzenlemelerinin ve aydınlatma biçimlerinin iç mekanlardaki ferahlığın algılanmasına ve

değerlendirilmesine etkisini saptamak üzere iki deneysel çalışma yapılmıştır.

Anahtar sözcükler: Çevresel davranış biçimi, Yapısal çevre, Mekansal algılama, Açıklık, Kapalılık, Ferahlık.

ACKNOWLEDGMENTS

I am truly grateful to Prof. Dr. Mustafa Pultar, who generously helped me preparing my thesis and improving it in the process. I wish to extend my gratitude to Prof. Dr. Vacit İmamoğlu, Assoc. Prof. Dr. Cengiz Yener and Dr. Feyzan Beler for their valuable comments and other critical support.

I also should mention and thank to Institute of Fine Arts of Bilkent University for the financial support in realizing the experimental stage of this study.

I would like to thank Elif and Guita for helping me at the final stage.

Eventually, to my family and İlkin for their patience and all time supports during this study.

TABLE OF CONTENTS

LIST OF TABLES

APPENDIX B

LIST OF FIGURES

1. INTRODUCTION

1.1 Study of The Man-Built Environment

There is a growing interest on better understanding and utilization of space in 20th century architectural design (Zevi, 1957). In order to achieve this goal some researchers studied broadly the built environment at the scale of interior spaces, through evaluating the effects of various independent variables on the variations of images and subjective visual impressions. Thus, in recent years attention has been directed towards the empirical determination of the nature and extent of such effects on some visual impressions of interiors. One important area of interest has been in the perception and evaluation of spaciousness in interior spaces.

The active process of perceiving and evaluating such qualities of the built environment are conducted within the context of man-environment interaction, in which interior spaces, man and behavior are considered as the three major components.

It can be stated that the overall study on spaciousness refers directly to:

1. Man; as regards person-based variables.

2. Interior spaces; as regards functional and aesthetic aspects, and refers indirectly to:

3. Behaviors; as regards types of behavioral outcomes with the mediation of individuals,

all acting in the continuum of man-environment interchange.

1.2 Aims and Scope of the Thesis

The concern of this thesis is to deal with man-built environments, particularly at the scale of interior space through perceiving and evaluating one of its factor, namely, "spaciousness." Thus, the study is constructed in two main parts.

The first part through a literature survey which provides a theoretical base for

a. a context in which the processes of perception and evaluation takes place (chapter 2) and

b. the effects of some architectural variables on assessing spaciousness in interiors which has been studied

by various researchers throughout their earlier works. (chapter 3)

The second part, of this thesis aims at conducting two case studies in order to visually observe and experience the effects of, particularly two architectural variables; light and furniture by the help of the so known Spaciousness-Crampedness Scale. One extension of the aim of conducting the case studies is to support or contradict the hypotheses which have been reached out previously.

It has been stated that:

> However, when the scales used and the subject population are held constant, differences nevertheless appear in scale scores and/or factor structures as a function of different stimuli. (Kasmar, 1970; Kasmar, et.al., 1968; Moos, et.al., 1969; Seaton and Collins, 1972, all cited in Kaye and Murray, 1982, p.610)

Thus, a further aim of the case studies can be considered to be drawn to answer the question of what discrete differences between architectural spaces lead to different ratings and how these discrete manipulations of environmental variables can influence an individual's evaluation of an architectural space?

2. THE BUILT ENVIRONMENT

2.1. Basic Concepts

The term "environment" which embraces some several processes:

a. Perceiving and experiencing the built environment in the psychological sense.

b. Controlling and modifying the built environment according to its physical attributes, or giving new meanings and uses, new shapes and appearances.(Ittelson, et.al., 1974)

c. Adaptation of human behavior to the alteration of the man-made environment.

These processes constitute topics of the relation between man and the built environment and are summed up by the words of Ittelson, et.al.:

> The environment is cognized as a set of mental images; mental images predispose the manner in which we interact with actual physical setting.(p.13)

Physical settings, are formed by social and cultural attitudes (norms), resulting from the intended purpose of the settings, the kind of people who will use it, and what activities and outcomes will occur. Many researchers, in psychology and environmental design studies, define physical settings as " independent variables" which are the major factors influencing behavior. It is often declared that physical settings are the "causes" of behavioral change in the man-environment transaction. (Heimstra and McFarling, 1974; Ittelson, et.al., 1974; Altman and Christensen, 1990).

According to Heimstra and Mc Farling (1974), the physical environment, in its broadest sense, connotes everything that surrounds a person. But if we generalize, environmental psychologists divide the physical environments into two principal types which are parts of a continuum on a number of dimensions:

1. Man-built (man modified) Environment
2. Natural Environment

The environment is composed of subsystems like climatic conditions, cities, buildings, interior spaces, and so forth all interacting and influencing behavior. As behavioral scientists, Heimstra and McFarling state that:

> It is difficult, if not impossible, to isolate one feature of the environment and study its effects on human behavior without having the behavior modified, at least to some extent, by other features. (1974:5)

From this foregoing statement it can be concluded that when studying the relationship between man and the built environment researchers must consider the environment as a whole with its various types of features.

What is meant by the term 'built environment' is that it has been designed and formed to a large degree by man, in which each behavior occurs in unique ways. (Heimstra and McFarling, 1974). Figure 1 illustrates the nature of the elements of the built environment.

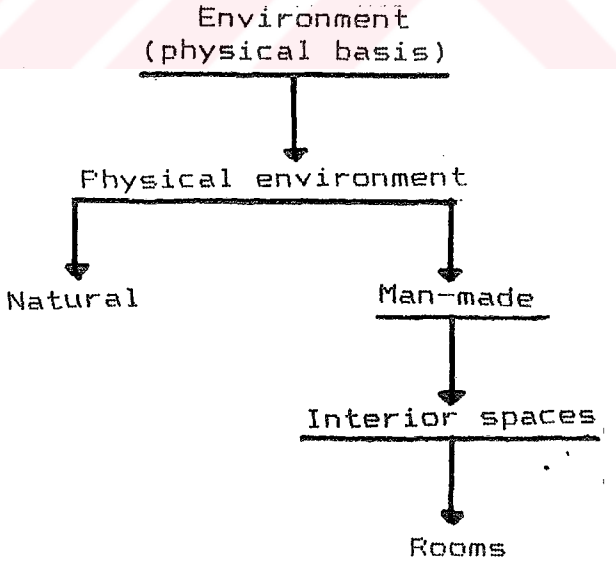


Figure 1 Nature of the elements of the built environment

There is a transition from general to specific; from environment to physical environment through built environment and finally to interior spaces as rooms.

Although some of the studies in these types of physical settings seem to focus on the architectural and design aspects, it is obvious that the built environment has great potential for influencing our activities and use of space-through social, cultural and psychological norms.

Ittelson, et.al., (1974) qualify the complex nature of the built environment in terms of five general characteristics:

1. The built environment is physical. An architect builds spatial boundaries around people to satisfy basic needs of the human body. (Ittelson, et.al., 1974, p.344)

2. The built environment is effective. It involves certain architectural variables (later they will be called as independent variables) in its spatial boundaries and these variables affect the individual's use of space.

3. The built environment is functional. It is designed in different manners for the given tasks.

4. On a cognitive basis the built environment provides a continuum of meanings, or messages, as to how it shall be

used and interpreted.

5. The built environment is social. It provides a base for social activities.

Ittelson, et.al. (1974) go on to state:

> It is precisely this complex set of needs, attitudes, experiences, and choices that the built environment, beyond its obvious function of providing shelter, is intended to serve. (1974, p.343)

The physical boundaries (physical aspects) of the built environment affect the perception of the spatial properties which influence patterns of behavior. Thus, the built environment is accepted as a variable factor; in the literature of the field of environmental psychology it is called "the stimulus".

There are two important sets of variables related to the built environment:

1. Independent variables. These are conditions or situations in which a person is behaving.

2. Dependent variables. These are the kinds of behavior that may vary with the independent variables.

The independent variables are also divided into two categories within itself. The first category involves the structural features which contains all parts that are necessary for the completeness of the built environment such as the size and shape of rooms and buildings; arrangements of walls, corridors, and rooms; placement of doors and windows; external arrangements. The second category refers to the more adaptable physical aspects of both a particular setting and ambient environments such as color scheme, furnishings and their arrangement, illumination, temperature, and noise. (Heimstra and McFarling, 1974).

The independent variables as a whole are considered to be the subjects of research conducted in relation between human behavior and the built environment. These experimental research base their study on the information collected from the studied environment. The role of the independent variables here is to affect and determine the information rate which causes certain emotional reactions in a person or in short affects the dependent variables. These reactions cause the person to approach or avoid that environment. The relation between information rate and behavior types is illustrated in Figure 2 in which situations that produce pleasure causes approach behavior to increase with the arousing quality of the environment whereas, in situations producing displeasure we expect

avoidance behavior to decrease with the arousing quality of the environment.

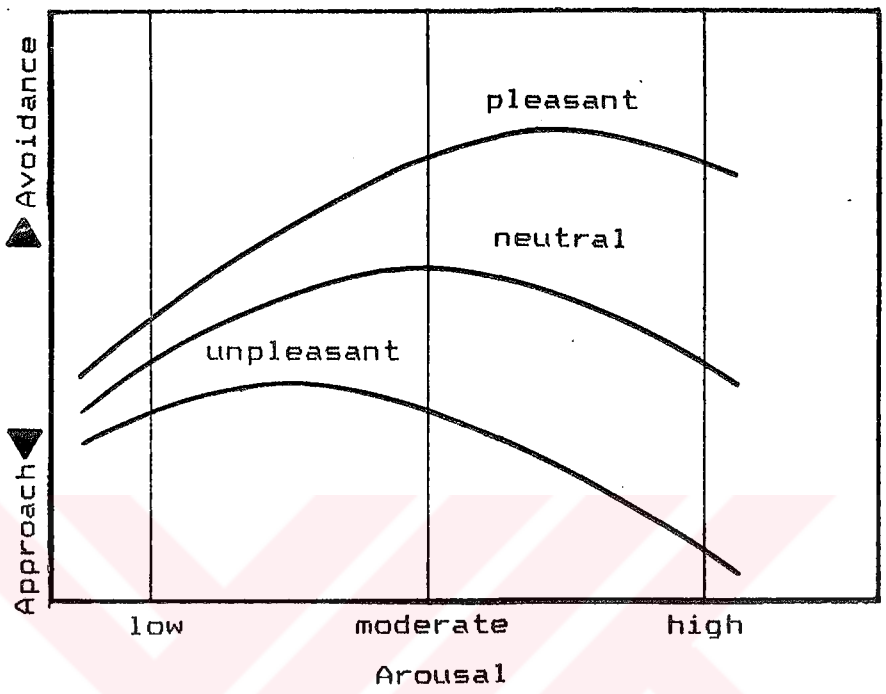


Figure 2 Combined effects of pleasure and arousal on approach-avoidance behavior. (Mehrabian, 1976, p.22).

Environmental psychologists have developed a descriptive system to compare various interior spaces. The schematic explanation of this descriptive system with its various concepts is illustrated in Figure 3.

The term "load" in Figure 3 refers to the information rate of any built environment. Mehrabian (1976) defines an environment which has a high information rate as a high-

loaded environment, and an environment which has a low information rate as the low-loaded environment.

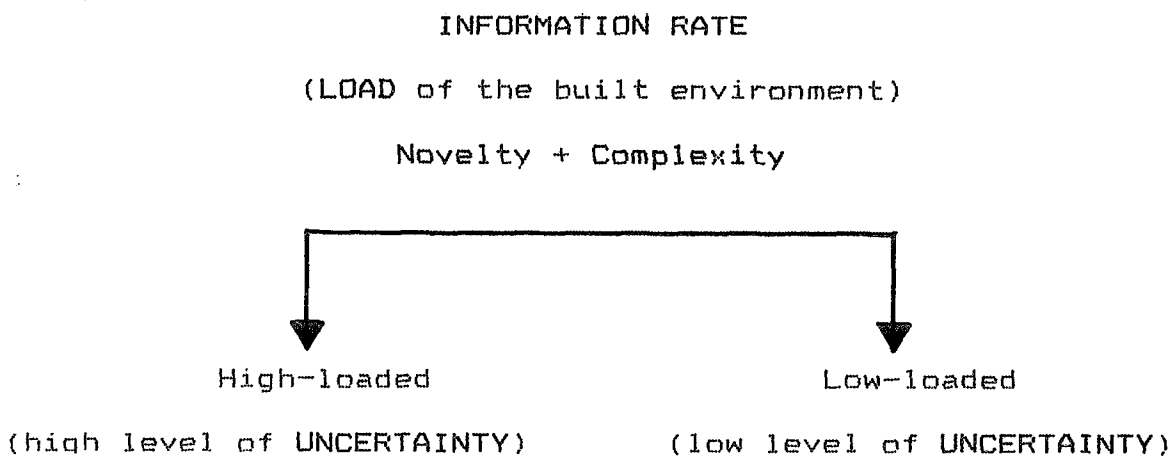


Figure 3 A descriptive system for the built environment

Researchers rate the load of built environments in semantic scales through some descriptive adjective pairs which are called "environmental descriptors." Some of these adjective pairs are as follows:

Uncertain-certain; varied-redundant; complex-simple; novel-familiar; large scale-small scale; contrasting-similar; dense-sparse; intermittent-continuous; surprising-usual; heterogeneous-homogeneous; crowded-uncrowded; symmetrical-asymmetrical (Mehrabian, 1976, p.12).

An environment which suits to many of the left-hand terms

in these adjective pairs has a high load; the ones described mostly with the right-hand terms is low-load.

The term load can also be described as a combination of novelty and complexity features of an environment, since each of the descriptors relates to some aspects of these two dimensions. When an environment seems unfamiliar, probable, rare, surprising, unexpected or uncertain to the observer, it means that the environment has a high load or high level of uncertainty. Conversely, when an environment seems familiar or expected, it has a low load or low level of uncertainty.

Mehrabian also gives a definition for the term complexity:

> The complexity of an environment has to do with how many elements, features, or changes it contains.(1976, p.13)

When the environment contains many elements or many varieties in its architectural features, then it has a high load or high level of uncertainty. The uncertainty of an environment derives from the feeling that the observer is trying to impose a meaning or pattern to that environment. This kind of environment can be described as random, unpatterned, crowded rather than patterned or crowded.

2.2 Theoretical Approaches to Interior Spaces: The Relation Between Built Environment and Man

Broadly, the relation between built environment (specifically interior spaces), man and behavior has been the concern of Environment-Behavior studies in recent years. The subjects of studies in the E-B context are the following:

1. Interior Spaces - Objective features as functional and aesthetic aspects.

2. Man - person-based variables.

3. Behavior - Behavioral outcomes as types of behaviors.

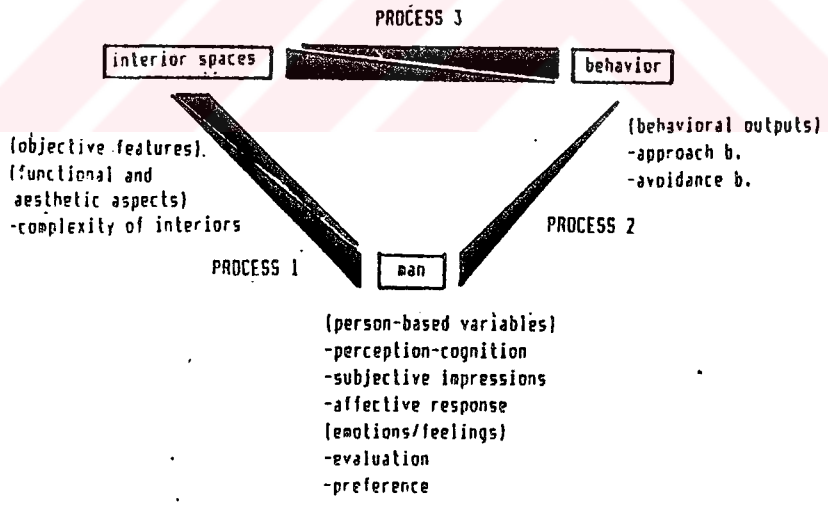


Figure 4 Basic process of the interaction between interior spaces - man - behavior

As illustrated in the Figure 4, the whole interactions between these elements can be studied in the form of three

process, nested each other. The first one refers to the relation between interior spaces and man. The second concerns man and his behavioral outcomes; the third is an indirect relationship between interior spaces and behavior in which man serves as an interval variable.

In the interaction between interior spaces and man, man manipulates his milieu through mediations of his person-based variables and this gives him a degree of control. At the end of this alteration he is influenced by his own environment. This brings along the second process: the relation between man and his behavior as can be clearly seen in Figure 4. Concerning the interactions, Mehrabian (1976) states the following:

> The person as an individual, psychological one has environmental properties. He is an environmental component and how he interacts with his setting helps determine the nature of that setting and its effect on his actions. The individual's relationship to his environment therefore, is a dynamic one. (1976, p.11)

In order to understand the man-environment reciprocity better, present day researchers study this field together with various features of architectural spaces and personal variables. These functional and aesthetic aspects of space (such as color, lighting, furniture arrangement and so on) refers to the features of architectural spaces that aid

the spatial understanding and provide cues for additional learning about interior spaces (S. Kaplan, 1975, cited in O'neill and Jasper, 1992). These features of architectural spaces and personal variables are the major factors (or important cues) for the linkages between all processes in the reciprocity of man and his environment.

From the foregoing, it can be stated that person-based studies based on explanatory and theoretical standpoints are collected in cognitive representations and make use of environmental and personal factors that may be relevant to spatial cognition in the man-environment interaction (O'neill and Jasper, 1992). Thus, the process of man-environment interchange begins with spatial-cognition in which environmental preference (or subjective impressions) is a predictor of results coming from evaluation of spaces. (Kaplan, 1975, 1977, Quoted in O'neill and Jasper, 1992, p.429). According to Rushton "spatial behavior, exactly as any other behavior, is determined by preferences only." (Quoted in O'neill and Jasper,1969, p.400). An observer's responses through cognitive representation which is defined as the amount of knowledge of the features of the environment has an influence on spatial behavior.

Through affective response, a type of emotional response in person-based variables, man alters and modifies the

features of interior spaces. By changing the visual dimensions, any desired atmosphere in that space can be created and the atmosphere becomes the sole predictor of human behavior. (Heimstra and McFarling, 1974).

According to O'neill and Jasper (1992), decision making on the features of interior spaces is held through emotional responses of individuals. He refers to Rushton's research methodology and says that:

> ...decision behavior is evaluated by examining sets of choices between alternatives rather than through the approach taken by gravity model researches, in which descriptive statistics are used to predict spatial behavior in a system. (1992, p.419).

It can be said that an assessment of features of interior spaces can be made through man-environment interchange, how behavior indirectly alters the environment and how the environment with its physical features and man's alteration of it, affect behavior. The environment serves a motivating force because of its complexity and people react to this in terms of few basic emotional responses. These basic emotional dimensions are called the following:

1.Arousal-nonarousal. Arousal is related to the interest-evoking qualities of interior spaces.
2. Pleasure-displeasure. leasure has to do with feelings of liking and disliking.

3. Dominance-submissiveness. Dominance refers to the feeling of freedom of action.

These in turn, produce varied kinds of behaviors as outputs. (Heimstra and McFarling, 1974; Mehrabian, 1976; O'neill and Jasper, 1992). The behavioral outcomes are categorized in two groups; the first one is approach behavior, and the second one is avoidance behavior. It is supported by some researchers that interior spaces may elicit positive and negative feelings through these behaviors. In Mehrabian's words:

> ...approach behavior, or an environment that causes approach, is usually a positive or desired sort of thing, conversely, avoidance behavior or an avoidance-causing environment is generally negative. (1992, p.6)

2.2.1. Determinism in Man-Environment Relationship

In summary, there are three theoretical approaches to the man-environment transaction:

1. Free-will approach. This approach claims that the built environment does not affect behavior.

2. Possibilistic approach. This approach claims that social and cultural attitudes of the environment have an

impact on individuals.

3. Deterministic approach. This approach sees the environment, together with its subsystems, as the major determinant of behavior. (Lang, 1987).

In general there are two contradictory opinions (approaches) concerning the relationship between man and environment: while the first one refers to the belief that environment determines an individual's behavior, the other states that behavior determines the qualities of the environment. One way or the other, they imply a simple cause-effect relationship in the man-environment transaction.

The first approach lies specifically in architectural determinism which denotes that certain qualities associated with a particular interior space will affect the emotional responses of the individuals and this will produce some behavioral outcomes. In this transaction, there exist empirical linkages between environmental factors and psychological events that sees the environment as the independent and man as the dependent variable:

> A feature of strict deterministic theory is the notion of unidirectional causality: Stimulus (the environment) acts on the subject to produce a given behavior, mood, or attitude. This is intriguing for design but poor psychology, since it ignores the feedback role of the participant...(Ittelson et.al., 1974, p.346-347).

The latter approach, however, not only objects to the idea that man is a passive receiver but also sees man as a modifier of the architectural variables, through his own perceptions and reactions. (O'neill and Jasper, 1992). Another similar approach is found in the ecological psychology of Barker (1968), that recognizes the input of the individual into environmental situations. We can not ignore the accommodative role of interior spaces (Lang, 1987), but this does not mean that "the individual will perceive a cheerfully decorated room as cheerful if his own mood is gloomy; indeed, the decor may be seen as totally inappropriate or at best neutral." (Ittelson et.al.,1974, p.346). The role of interior spaces thus can be expressed by the words of Studer (1970):

> What operant findings suggest, among other things, is that events which have traditionally been regarded as the ends in the design process, e.g., pleasant, exciting, stimulating, comfortable, the participant's likes and dislikes, should be reclassified. They are not ends at all, but valuable means, which should be skillfully ordered to direct a more appropriate over-all behavioral texture. They are members of a class of...reinforcers... (Quoted in Ittelson, et.al., 1974 p.348).

2.2.2. The Importance of Perception in the Assessment of Interior Spaces

The mutual relationship between man and the built

environment has its root in the question of how he perceives his environment. When this question arises, it is worthwhile to talk about the process of cognition as well because, according to Kaplan (1983), the relationship between man and the built environment has its starting point through the informational process in which the actions (which an individual caries out in an interior space) and the informational patterns (or the image that shapes the space) determine the quality of the interface between man and the built environment.

Referring to Figure 4 we, see that perception hence cognition, has an important role in the basic process of the interaction between interior spaces man and behavior:

> Research in environmental perception is ...concerned with discovering the lawful relationships that are assumed to exist firstly between the characteristics of the physical environment and the way it is perceived and secondly, between the way it is perceived and subsequent spatial behavior. It must therefore consider not only the factors involved in the endowement of meaning, in the development and change of attitudes, factors affecting decision making and the relationship between all these and spatial behavior. (Lee, 1973, p.118)

It is clear from the figure and from the foregoing that cognition plays a central role in the whole process of perception, therefore it is very difficult to separate the process of perception and cognition. (Lang,1987).

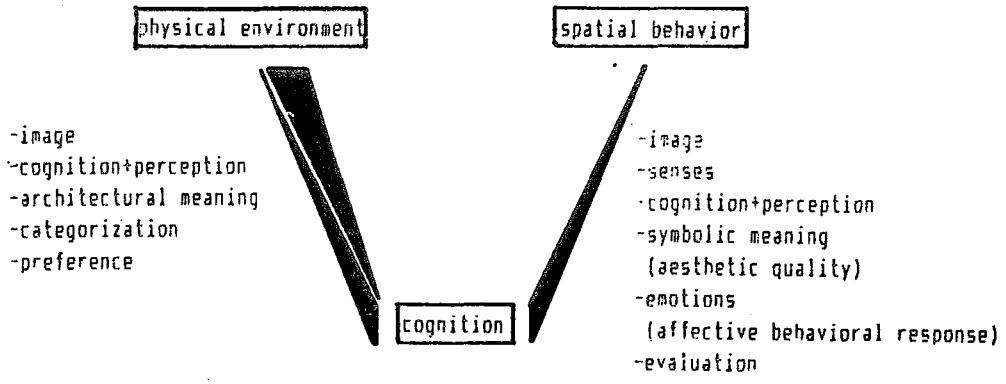


Figure 5 The role of cognition-perception process in the assessment of interior spaces

Before beginning to discuss the first relationship in environmental perception it can be concluded that perception of interior spaces is a psychological process, at the same time it is learnt, selective, dynamic, interactive and individual. We each structure the world in unique ways. (Lee, 1973; Wade and Swanston, 1991; Bloomer, 1990; Ittelson et al., 1974).

2.2.2.1. The Relation Between Physical Environment and The Way It Is Perceived

In the complex relationship between the physical environment, perception and behavior, the concept of meaning seems crucial. The term "meaning" is derived from the informational patterns (the image) that make up the built environment. Empirically the term can be understood

in two ways: The first one is architectural meaning,which is the concern of this section; the second one is the 'symbolic meaning' which will be discussed in the next section 2.2.2.2. For this classification of meaning, Wade and Swanston state the following:

> Some theorists consider that we can derive information regarding the orientations of surfaces in the environment without recourse knowledge about the nature and purpose of objects. On the other hand, perception can be linked to thinking and other high level cognitive process like reasoning and problem solving. (1991, p.2)

According to Hesselgren (1975) and Lee (1973), during the process of perception we build up, during the process of perception a "set of organized categories in terms of which stimulus inputs may be sorted, given identity and given more elaborated connotative meaning." In the terminology of perceptual psychology, this process of matching patterns and classification of stimuli is called the "attributive" component of perception, since it involves the "attribution of meaning" to the incoming stimuli. (Lam, 1992, p.32)

The images of the built environment are organized into meaningful patterns. Faced with a choice, individuals show a preference for one type of space over another. Thus, perception with active participation of individuals is

regarded as a dynamic process. (Lam, 1992; Prak,1968) Inui and Miyata (1977) and Baird et.al., (1978) have found that room preference is a function of a. perceived architectural features (in turn their perception depends on the nature of the architectural stimuli) and b. the activities occurring in the room.

2.2.2.2. The Relationship Between Perception and Spatial Behavior

Contributions to the understanding of environmental perception and behavior have increased rapidly in recent years. (Lowenthall, 1972). Werner (1987), in a study listing the 'range of environment-behavior relationships' describes one as "perception of environment, mediating interpersonal behaviors".(p.174) and It can be argued that perception and preference studies provide a better indication of reasons behind behavior patterns.(Lee, 1973:118). The actual and potential importance of this research is evident in such values as environmental qualities which are regarded as the sources of many varieties of potential stimulation.

Meaning is important in man-environment relationship. The concern in this second state of perception-behavior is the symbolic meaning of the built environment which is a major factor in people's senses of liking and disliking

(as outputs) their surroundings (as inputs). (Lang, 1987; Lam, 1992).

It is known from the prior discussions that the visual clues of an interior space cites three primary emotional responses: pleasure, arousal, and dominance which, as a result, produce two types of behavioral outputs; approach and avoidance behaviors. (Bloomer, 1990). The concern here is with the pleasurableness and interestingness of environments - their affective symbolic meaning:

> Here, we are not simply being stimulated by our surroundings, or evaluating them in terms of behaviors; we are assessing and experiencing their intrinsic beauty and value. (Ittelson et.al., 1974, p.108)

Consequently, it can be concluded, as in the words of Lam (1992) that the perception process is affective on our emotional and evaluative responses to stimuli. In other words, one might say that:

> ... environmental evaluation, then, is more a matter of overall affective response. Affective responses are based on the "meaning" that environments, and particularly aspects of them, have for people. (Although, these meanings are partly a result of people's interaction with these environments). Thus it becomes extremely important to study meanings. Meaning also gains importance when it is realized that the concept of function is so important.(Quoted in Rapoport, 1990, p.13-15)

The evaluation of an interior space can also be considered in two ways: the first one is formal aesthetic evaluation, where the spaces are evaluated intrinsically; the second one is the architectural evaluation in which the spaces are evaluated according to their functional aspects.

These two processes of evaluation are described in terms of the affective responses given to an interior space. Obviously these judgments are qualitative and it is not easy to associate quantitative results with them. Thus, at this point research in this field is faced with the problem of measuring the visual perception of interior spaces.

2.2.2.3. Measuring Visual Perception

An individual's total perception of an environment can be affected through manipulations of elements in a space or variations in the sensory stimuli. This perception can be studied with respect to the following evaluative factors (aspects):

1. Pleasantness Evaluation Factor. This is considered as a feeling of comfort, sense of security, well being. Some of the terms with high loadings related to this factor are: pleasant, inviting, boring, repulsive, nerve-

racking. (Acking and Kuller, 1972)

2. Social Evaluation Factor. This factor implies an estimation of the social status. Some of the related terms are: expensive, fine, poor, simple. (Acking and Kuller, 1972).

3. Spatial Enclosedness Factor. This factor contains words describing the appearance of a space and its conditions of light. Some of the related terms are: open, light, spacious, closed, dark, encumbered. (Acking and Kuller, 1972)

4. Factor of Complexity. This refers to the intensity or complexity of the items in the space. Some words relate to this factor are: motley, composite, complex, discrete. (Acking and Kuller, 1972)

5. Factor of Unity. This factor considers the unity of an environment. Some of the terms related to this factor are: unitary, whole, pure style, badly thought-out, split. (Acking and Kuller, 1972).

Studies of perception and behavior that employ questionnaires or interviews based on the altered images of environment which are described through bipolar adjective pairs involving the factors given above. A

quantitative measure for the perception of environmental stimuli is achieved through semantic differential techniques, which usually refer to these verbal descriptions as inputs for obtaining data for factor analysis.

In such research research, Lowenthall (1972) points out that:

> ...every investigator of environmental reactions, judgments, and preferences has constructed his own lexicon of environmental descriptors, generated either from terminology employed in the design and environmental management professions, or by the reduction of vocabularies selected by test observers. (p.336-337).

Such a measure for spaciousness has been developed by İmamoğlu (1986).

3. SPACIOUSNESS IN INTERIOR SPACES

Interior spaces and rooms are the basic units of buildings. They are the enclosures which have a great potential through their architectural and aesthetic qualities for affecting visual perception, activities and behavioral outcomes. Research in this area are concerned with spaciousness in describing and evaluating some aspects of spaces.

3.1. Definition of Spaciousness

According to the various studies conducted, the notion of spaciousness can be examined in two ways: the first one is the semantic definition and the second is the empirical definition.

The semantic definition of spaciousness is widely used in everyday language and architecture to describe and evaluate spaces. This definition can be given as "the state or quality of being wide, spacious or commodious; extensivenes of area or dimensions, roominess", "containing much space, amply large." (İmamoğlu, 1986). The term also refers to a meaning between the 'feeling of liberation' and the 'sensation of being open'. (Inui and Miyata, 1973) or it signifies width and openness.

Obviously, these similar concepts are closely related to the quality and amount of space.

The terms 'open' and 'enclosed' are used to describe space in everyday speech. In some studies the meaning of spaciousness may be related to the feeling an interior provides of being open or enclosed:

> We feel enclosed when we are in a small windowless room, while we feel in the open when we are on a balcony which commands a bright prospect. (Inui and Miyata, 1973, p.111)

Although the semantic meaning of spaciousness is related to a feeling of openness or closedness, empirically it is defined as a general feeling deriving from visual perception in interior spaces (Inui and Miyata, 1973). Thus, spaciousness is limited to a visual aspect only:

> The voice of a bird outside or the sensation of fresh air coming in through the window is ignored even if it gives the building occupants some sort of feeling of spaciousness. (Inui and Miyata, 1973, p.104)

Much discussion through studies has led to the conclusion that spaciousness has come to be used as a new index to evaluate interior spaces.

In their experimental study, Inui and Miyata (1973),

consider that spaciousness as usually experienced (or perceived) between two extreme values:

> Spaciousness would have a minimum value in a situation deprived of every bit of visual information; in a completely dark room the value would be zero. The maximum value would be found in a place which commands an unobstructed hemisphere of sky, e.g. a boundless desert or sea. (p.104)

In a similar manner, spaciousness in interior spaces also falls between two extreme values. As open and enclosed feelings are the bipolar complements, regarding the manipulations of architectural variables, it is possible to evaluate spaciousness on a bipolar scale. Such a semantic differential scale can be based on the affective judgments which derive from two main emotional responses:pleasure and arousal.(e.g. pleasant-unpleasant or comfortable-uncomfortable).

İmamoğlu (1986) states that semantic and empirical studies in environmental psychology often given way to a space-related spaciousness or enclosedness dimension either independent of other factors, (Kasmar, 1970; Acking and Kuller, 1972) or confounded with regard to evaluative factors.(Kaye and Murray, 1982; Inui and Miyata, 1973, 1977). Some other researchers have shown and implied a positive correlation between satisfaction and spaciousness. (Inui and Miyata, 1977; Sommer, 1971).

In the study of Kasmar (1970), the environmental descriptors are categorized in to two groups in which the first referred to the aesthetic aspects of spaces, and the other referred to the functional aspects of spaces. Kaye and Murray (1982), however, categorize aspects of architectural spaces in three groups with regard to descriptive adjective pairs: the aesthetic aspect, the behavioral aspect and the physical aspect.

In both studies, a relation has been constructed between spaciousness, categories of descriptive adjective pairs and the three aspects of interior spaces.

Another study on spaciousness, behavior and the visual environment was performed in 1977 by Inui and Miyata. The results indicated that there was a relation between various aspects of behaviors (based on the types of activities carried out in the room) and the visual environment besides the relation between behaviors and subjective assessment of spaciousness. It was concluded that spaciousness could be used as a measure as a key variable in order to assess and evaluate visual environments.

These studies and others that have not been discussed, all reveal that spaciousness is an important construct on which people can base their descriptions and evaluations

of interiors and that it is closely related to such variables as color, lighting, window size and shape, furniture arrangement, and room size and shape as the major components which affect the design and the general atmosphere of the whole visual environment.

3.2 Factors Effecting Spaciousness in Interior Spaces

3.2.1. Room Geometry

Experimental studies on human spatial perception of architectural spaces have been concerned with various architectural features that determine the perceived volume, openness and closedness. These can be considered under the general notion of room geometry. Human Space Factors Office (1986) indicates that room geometry is an important contributor to visual spaciousness and can be analyzed by the "Isovist Theory":

> An Isovist is the set of all points visible from a given point, and isovist properties significantly influence perceptual and attitudinal judgments about interiors. Here, aside from greater visual volume, increased variance of isovist is driven by long views, particularly long diagonal views. (p.112)

A relation between visually closed spaces, perceived volume and sense of oppression have been constructed in two studies by Uchida (1979 a; 1979 b). The results of

these two experiments indicated that sense of oppression and openness were dominated by the perceived volume of spaces. Perceived volume found to be affected mainly by the physical volume and the configuration of the plan, for example the solid angle of the walls. In addition to this, the sense of oppression was dominated mainly by the area of the plan when it was dealt with in terms of the parameters (ceiling height).

Consequently, the openness-closedness of rooms is determined by some of the features which construct a room's geometry. Thus, the discussion in this section focuses on such features as vertical elements, size and shape, room proportions (height/depth ratio), and so on.

Lynch (1971), Simonds (1961) and Spreiregen (1965) agreed that the organization and characteristics of vertical elements like walls or colonnades distinguish an open area from a confined enclosed space. (Cited in Hayward and Franklin, 1974, p.37).

Norberg Schultz (1965) has suggested that spatial "closure" depends on the walls which were

> ...joined together in the corners to form a continuous, embracing boundary. Apertures at the corners therefore open the space more than holes places in (the middle of) the wall, especially if the former extend from the floor to the

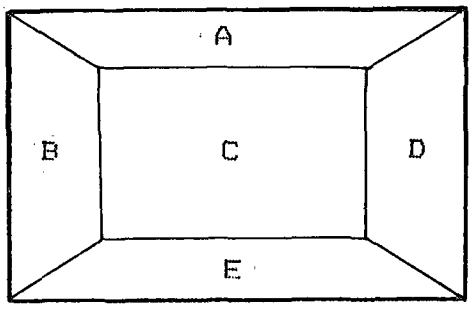
> ceiling. Continuous horizontal openings directly under the ceiling have an analogous effect. The corners may be characterized as the "critical" zones of the space, and their treatment is essential to the interpretation. (Quoted in Thiel et.al., 1986, p.231)

He goes on to say that the closure of a space may also be emphasized or loosened in the interaction between light, color and the boundary surfaces. The description of the space-form depends upon the interpretation of the boundaries.

Two studies were conducted by Thiel et.al.,(1986) to test a hypothesis which claims that:

> Perceived differential enclosing effect of architectural surfaces is a function of their position, weighted in the ratio 1:2:3 for surfaces in the horizontal under, vertical side, and horizontal over positions, respectively. (p.227)

They found that the overhead surface (horizontal over position) was assessed to be most enclosing, the underneath surface (horizontal under position) the least whereas the vertical side surfaces were judged to be intermediate in enclosing effect, having a distinction between left, right and the center surfaces (see Figure 6).



A: Overhead surface

B: Side surface

C: Center surface

D: Side surface

E: Underneath surface

Figure 6 Enclosing surfaces of interior spaces

If we think of various features making up a room, either flexible or fixed, size and shape are undoubtedly the most rigid. Ashira (1970) indirectly studies this issue with the relative enclosing effects of different types, sizes, and positions of surrounding vertical elements. (Cited in Thiel et.al., 1986, p.231)

The perceived or apparent size of rooms is an architectural variable that is likely to influence the perceived openness-enclosedness of an interior space. A series of investigations by Garling (1969 a; 1969 b cited in Thiel et.al., 1986) and Sadalla et.al. (1978, cited in Sadalla and Oxley 1984) confirmed a hypothesis that larger rooms can give rise to feelings of expansiveness and freedom whereas small ones may lead to feelings of confinement and crowding.

While the main discussion on room geometry concentrates on the perceived size of rooms, it is unavoidable to talk about it in relation with the shape. In general, the

experiments have concluded that rooms of the same physical size might have different perceived sizes depending on their shape. Specifically, it has been claimed that rectangular rooms would appear to be larger than square rooms of the same physical size. (Sadalla and Oxley, 1984, p.394).

The same authors (1984) cited some earlier laboratory studies of form perception which have demonstrated a relationship between the shape and the perceived size of a variety of objects and figures. (Seashore and Williams, 1902; Lauer, 1929; Peters, 1933; Holmberg and Wahlin, 1969; Holmberg and Holmberg, 1969; Smith, 1969). In general, these studies concluded that the apparent size of rectangles increased as the height/width ratio increased. If these results were extended to the problem of perceived room size, it could be suggested that the apparent size of a room may be related to the shape of the room, and further, the ratio of length/width may be correlated with the apparent size of rectangular rooms.

Based on the studies cited above, Sadalla and Oxley (1984) conducted a study to explore the relationship between the shape and the perceived size of rectangular and square rooms. The results explored an illusion created by rectangularity where more rectangular rooms were judged as larger than less rectangular rooms of equal size. Thus, it

could be concluded that rectangularity illusions when connected with the perceived size of rooms would allow designers to maximize and minimize a limited, given amount of space. If this is so, what are the psychological properties of rectangular rooms that lead them to appear larger than square rooms? Two possible explanations may be given to this question:

1. There is an effect of "increased size estimates" on the attentional processes of observers.

> Because rectangular rooms also have a greater perimeter, they also may produce an increase in scanning activity. Furthermore, rectangular rooms would allow a potentially greater swing of eye movements and a potentially longer single line of sight than would square rooms. The greater apparent size of rectangular rooms may be related to the increase in the magnitude or displacement of scanning activity. (Sadalla and Oxley, 1984, p.403)

2. There is a concept of "anticipated behavioral constraint".

> ...one antecedent of the experience of crowding is the cognition that one's behavior or one's privacy is limited by physical barriers (Proshanky et.al., 1970). Rectangular rooms may be seen as less limiting than square rooms because they allow occupants of the room to place themselves at greater interpersonal distance. ...The greater estimated spatiousness of rectangular rooms may be related to the observer's cognitions of the ways in which rooms might expand or constrain behavioral possibilities. (Sadalla and Oxley, 1984, p.404)

However, a finding, contradictory to this rectangularity illusion, was demonstrated by Imamoglu (1988). In a study on the room proportions, the author found that rooms having square or almost square shapes were assessed as being more extensive, large, space free and well-planned. This could be due to the position of windows in relation with the walls of rooms. Rooms having windows on short sides appear to be more cramped whereas rooms having windows on the long sides are assessed as being less cramped but more unpleasant. As for the square rooms, İmamoğlu stated that:

> A square room is accepted as the most advantageous amongst the others: It is neither assessed as unpleasant as in the case of rooms having windows on the long sides, nor possess a feeling of clutteredness as in the case of rooms having windows on the short sides. In addition, square rooms, because of their shapes, are judged as both space free and well planned. (1987, p.39; translation mine.)

There is another factor that affects the perceived openness-enclosure, namely, the ratio between width and depth. Inui and Miyata (1973) tested the openness-enclosure of interiors in terms of spaciousness. They investigated the effects of not only the interior illuminance, window size and sky luminance but also the room size and shape by changing the ratio between width and depth. In order to find the best indicator for the size of rooms, the followings were studied.

1. Floor area.
2. Volume of room.
3. Width of room.
4. Depth of room.

Strong correlations were observed between spaciousness and "floor area" and "volume of room", where the two variables were in direct proportion as long as the ceiling height was held constant.

Hayward and Franklin (1974), with some drawings examined this factor by varying both spatial size and height-distance ratio. It was hypothesized that perceived openness-enclosure is determined with the height/depth ratio and is independent of the scale of space. (Size of space was referred to as scale of space). Increases in the height/depth ratio were accompanied by increases in perceived enclosure. Perceived enclosure was similar for both spaces which had similar height/depth ratios. On the other hand, the hypothesis that apparent openness-enclosure is directly related to size of space received only minimum support.

Their results may also be interpreted as empirical support for Spreiregen's (1965, p.75) hypothesis that the impression of openness-enclosure of an architectural space is determined by the relationship between two variables:

boundary height as seen from the frontal field of view and physical distance of the boundary from the observer. (Cited in Hayward and Franklin, 1974, p.45).

The perception of rooms can be altered by rearranging their physical dimensions . Size and shape of any particular room have been largely accepted as fixed and is dependent upon room function. While the effect of size of rooms can be thought of as an interaction with other independent variables, such as the number of people in the room, researchers have concentrated manipulating other aspects of the room environment such as: color, ambient conditions, window size and position, and furniture organization. (Heimstra and McFarling, 1974).

3.2.2 Color

As indicated above, spaciousness is an important construct for describing and evaluating interior spaces as regards their architectural and aesthetic qualities. Since color is one of most important aspect of the whole visual environment, it has an effect on the general atmosphere of interiors.

It is useful to discuss color first of all on the bases of an interaction between physical environment, the way color is perceived and behavioral outcomes, and then

particularly to concentrate on the effects of different combinations of color on the evaluation of spaciousness in interiors.

Although perceived as an integrated whole, there are three subjective dimensions of color. These are hue, saturation and brightness (which is often called lightness). Among designers, these dimensions are also known as hue, chroma and value, respectively. Hue is the term most often used to describe color, saturation (chroma) describes a color's purity or the extent of its departure from gray. Acking and Kuller (1972), also discuss saturation as chromatic strength. Value (brightness or lightness) is the degree to which a color varies along the white-black continuum. What is known empirically about our responses to color, and how, if at all, color influences the perception of a setting or one's behavior in that setting is based on the different variations and combinations of these major dimensions.

Color is a pycho-physiological environmental variable which possess both architectural and symbolic meanings through its hue, chroma and value. It can influence our affective responses like feelings and emotions, judgments, evaluations and preferences toward the places respectively. (Human Space Factors Office, 1986). A person's total perception of his environment can be

divided into different factors and Acking and Kuller (1972) build a systematic relation between those aspects and some dimensions of color.

The first two factors **Unity** and **Complexity**, are two important terms in the visual environment. Unity involves various components and parts fitting together into a coherent unit, the second involves variation.

Study performed by Acking and Kuller (1972) found that perception of complexity showed a marked dependence on chromatic strength where complexity increased as chromatic strength increased. On the other hand there was an inverse relation between unity and chromatic strength. As the chromatic strength increased, unity decreased. No such dependence was found on value.

A contradictory result to these findings brought out a relation between complexity and value:

> Complexity was seen with the decreasing value. Complexity appears to be more of an interaction between chroma and value; with colors of low chroma but low or high value, regarded as simple, while complex colors are generally of medium value. (Human Space Factors Office, 1986, p.92)

Earlier studies supported the idea about the hue dimension that different colors did elicit different feelings. More recent studies review below some hypothesized color-

behavior links.

For arousal response (which derives from interest evoking qualities of interior spaces), Mahnke mentions that colors warm in hues were more arousing than those of cool ones. (e.g. a red room would have a continuously higher arousal effect than a blue one). (Cited in Demirörs, 1992). In fact, exposure to any strong color will cause an immediate reaction that can be measured easily but the duration of the effect is not continuous. Another aspect of color in creating the perceived excitement of an interior is the chroma. The research done by Space Human Factors Office (1986) indicates that strong colors will make a room appear exciting, weak ones give an impression of calmness, regardless of hue. Also color contrast is effective on the apparent excitement of a space.

Another type of emotional response, pleasure (which derives from the feeling of liking or disliking an interior) has been studied by Mahnke (1987) with the dimension hue. He found that, with warm colors and high levels of illumination, an individual directs his attention to the space and produces a centrifugal action; whereas with cool colors and lower levels of illumination there is withdrawal into oneself and an individual produces a centripetal action.

This discussion may bring such a result that centrifugal

action can be regarded as a positive reaction to the space and can be called "approach behavior", whereas centripetal action is a sort of negative reaction to a place and refers to the "avoidance behavior".

Whereas Mahnke (1987) concentrates on hue, the Space Human Factors Office (1986) relates these action types to the value of colors regardless of hue. The results indicate that colors with high value invite centrifugal action, whereas when value decreases centripetal action takes place.

Regarding the second factor **Pleasantness Evaluation** of the whole visual environment, Acking and Kuller (1972) found no dependence between pleasantness evaluation and the three color dimensions. Although it was in agreement with the results of an earlier study performed by Sivik (Cited in Acking and Kuller, 1972), it contradicts the results of a recent study by Kunishima and Yanase (1985) which revealed that pleasantness evaluation was most affected by chroma.

The **Social Evaluation Factor** varied with values and to a lesser extent with chromatic strength. According to Acking and Kuller (1972), blackness in NCS (Swedish Natural Color System which describes each color in terms of chromatic amount, whiteness and blackness) might be a more relevant

variable than lightness.

As pointed out earlier room preference is a function of perceived architectural features. From this point of view, a relation between preference (a kind of evaluative judgment) and color can be developed:

> Early research focused on hue to the exclusion of other features of color. However, in 1934 a laboratory study involved variation not only of hue, but also of saturation (or purity of hue) and of value (or lightness-the amount of light reflected). With saturation and value held constant, the same ordering preferences for hues observed in earlier studies appeared: blue, red, green, violet, orange, yellow. (Sundstrom, 1986, p.181).

This statement is also reinforced by some earlier studies (Guilford and Walton and Guilford) cited by Space Human Factors Office (1986), researchers presented their results in terms of most preferred colors: Blue, red, green and least preferred colors: violet, orange, yellow. Little consideration was given to the contribution of value and chroma on affective judgments.

As far as preference judgments are the results of emotional qualities felt for spaces, a question arises related to:

> What type of behavior or verbal report serves as the best response measure from

> which color induced emotion is inferred. Some studies measure preference in terms of one evaluative dimension pleasantness/unpleasantness. (Space Human Factors Office, 1986, p.28)

On the other hand, some studies have examined in greater detail the contributions of value and chroma to pleasantness ratings. The result showed that chroma accounts for 88% of the variance and brightness 12%. Besides this, there was a preference for lighter values and pure colors e.g. a light pure tint of red received higher ratings than a dark shade or a greyish "mixed shade of red." (Smets, 1982, cited in Space Human Factors Office, 1986, p.30 and Sundstrom, 1986, respectively). Kunishima and Yanase (1985) have also investigated the pleasantness of different wall colors. Their findings revealed that the most preferred wall colors were the ones warm in hue, high in value and low in chroma. Preference also depends on the contrast effects:

> Granger (1955), resulted that background contributed to determining preference-orefernce increased the more it contrasted with the background against it was seen but as saturation increased so did preference up to a point-colors seen as too vivid were rated as as less preferred. (Cited in Space Human Factors Office, 1986, p.32).

The last factor of interior spaces the **Spatial Enclosedness Factor**, concerns the relation between color and spaciousness.

Man alters the perception in interior spaces through affective responses to color stimuli. Thus, any desired atmosphere can be given to that space. One of the most important influences of color as an independent variable on perception concerns the perceived "openness-enclosedness" of a room and a person's perception of spaciousness can be considered a behavior of a sort.

The effect of color on the perception of "volume" has been studied under two main headings by Space Human Factors Office (1986): surface color effects and object color effects.

"Advance-recede rule" and "contrast effects" between surrounds and backgrounds" are the most important concerns as regards the effect of surface colors on spaciousness or perceived volume of interior spaces. It is believed by design professionals that warm colors advance, appear closer and make space seem smaller, while cool colors recede, appearing farther away and make space seem larger. Consequently, a blue surface is supposed to seem farther from the viewer than it actually is, whereas a red surface appears closer. (Birren, 1968, cited in Sundstrom, 1986). However, the distance effects of colors on spaciousness were not found to be as simple as the advance-recede rule would suggest. This brings to the discussion the findings

of Taylor and Summer which was summarized in Space Human Factors Office (1986). They found that when the apparent distance of colors are held constant, the brighter colors are seen nearer than the darker ones. According to this, a cool hue like a bright blue can appear closer than a warm hue like a dark red.

As regards the research on the contrast effects between surrounds and backgrounds, Space Human Factors Office (1986) mentions a study performed by Tedford, et.al., who proved that as chroma of a color increases with respect to its background, its apparent position advances. (Cited in Space Human Factors Office, 1986, p.70).

Acking and Kuller (1972) discussed these contrast effects earlier in a study in which the subjects were asked to rate the full scale rooms on an extensive list of adjective pairs that could describe an environment. The variations of the wall colors on the three dimensions whereas shown in Table 1.

The results showed that the room with the strong green colored walls (high in chroma) was judged to be most complex, whereas the room with white colored walls was evaluated somewhat lower but seen as least complex. The room with dark colored walls (low in value), on the other hand, was rated as least open, whereas the white room was seen as most open.

Table 1 Variations of wall colors in a room

room	hue	value	chroma
1	green	low	medium
2	green	medium	high
3	white	high	low

Studies on color also have revealed that the brightness and saturation of colors influence perception of weight and size:

> ...The relation of color and weight also influences the spaciousness of interiors. The practice of perceptually lowering an overly high ceiling, in a small space, by painting a dark, saturated color around its periphery, exploits the perceived weight of color. Other applications may be placing a 'heavier' color atop a 'lighter' one to decrease the perceived height to width ratio of an enclosed room, in order to enhance furniture appearance is to alter space enclosure impressions. (Demirörs, 1992, p.51).

In summary, regarding only the hue dimension, distance effects of colors are not as simple or direct as it has previously been believed. Rather spatial impressions of color are most influenced by contrast effects:

a. Perceived openness increases as values increases either in the interior details or on walls.

b. Perceived openness increases with corresponding increase in the chromatic strength of interior details. No such dependence was noted however when chroma increased in the walls.

When the chromatic strength of details increase, the contrast between the details and walls is naturally enhanced. It might be this contrast effect and not the higher chromatic strength in itself that results in judgments of higher openness. (Acking and Kuller, 1972).

Regarding all the results of the studies given by Space Human Factors Office (1986), it is held that in order to maximize the sensed spaciousness through color applications the guidelines below could be useful:

a. The major enclosing surfaces should be kept high in value and low in chroma.

b. The subdividing partitions and elements should be kept lower in value and higher in chroma than the major surfaces.

c. Minor elements such as trims, reveals, edges, fixtures, hardware and small areas of furnishings should be kept either very high or very low in value and high in chroma. (Cited in Space Human Factors Office, 1986, p.112).

3.2.3. Lighting

> The premise of the discussion on light begins with recognition of the fact that visual consciousness does not seem completely explainable with the simple notion of an optical imposed on the retina of the eye and photographically interpreted by the brain. Instead, there are indications that there is considerable selectivity in the process of visual experience - a search for meaningful information. This suggests that light can be discussed as a vehicle that facilitates the selective process and alters the information content of the visual field (Martyniuk, 1972, p.51).

This process of alteration is created through changes in lighting modes, alters in turn, spatial clues and thus the user's impressions of spatial meaning. Therefore lighting should be approached as a complex system (both physiological and psychological inducer) of designed patterns, which involves space, volume, form, texture, color, impressions and tension, behavior and preferences within any built environment.

According to Wurtman, light is the most important environmental input, after food, in controlling bodily function. (Quoted in Birren, 1988, p.13). Without light and/or the use of our eyes we have neither visual architecture nor interior design. Thus lighting (design) of the built environment may be crucial in determining the visual meaning of interiors, affecting feelings and emotions as subjective impressions and in turn reasoning

behavioral outcomes. (Hendrick et.al., 1977).

Steffy (1990) states that for whatever reason, different light patterns composed by different lighting arrangements help to elicit various subjective responses such as arousal-nonarousal and pleasure-displeasure. Light not only helps us to perform seeing tasks but also has an impact on how we feel in a given environment.

A series of studies have been performed in this field in reaching the discussion given above. Flynn found five specific impression factors which were influenced by lighting pattern. These subjective impressions, namely pleasantness, relaxation, privacy, visual clarity and spaciousness, are considered to be the primary concern for any space where people are expected to live and/or work. (Cited in Steffy, 1990, p.5,6,30). An excessive amount of one or more aspects of the ambient conditions in a room may cause individuals to perceive the room as unpleasant, which may lead to a more active behavior-avoiding the room. On the other hand, a relation between the level of arousal and pleasure and behavior types could be considered:

> High arousal and high pleasure environments create feelings of excitement conducive to social interactions. High arousal and low pleasure environments promote stressful, hectic feelings and promote less

> consideration for others, or less attention to detail, because users will tend to avoid such places. High pleasure and low arousal environments create and promote a feeling of relaxation. (Boubekri et.al., 1991, p.489-490).

During the same period, Martyniuk, et.al., (1973) and Hendrick, et.al., (1977) performed studies with the same purpose, in which the primary concern was with the effect of environmental lighting on user impression and behavior in a behavior setting.

The experiment was conducted in a room where the only physical alteration consisted of were the changes in the lighting arrangement. A representation of the lighting arrangement is shown in Figure 7.

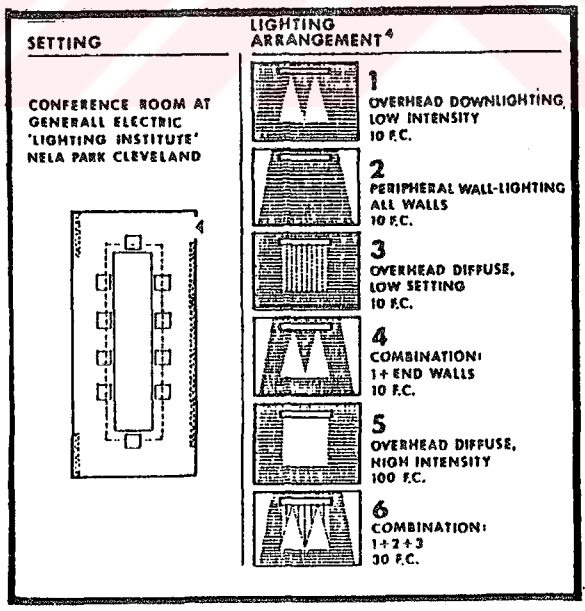


Figure 7 Descriptions of setting and lighting arrangement. (Martyniuk et.al., 1973, p.53)

Semantic differential scale results showed significant differences in response to the room under six lighting arrangements. Five factors or categories of impressions were constructed as follows:

1. Evaluative.

2. Perceptual Clarity. This was also named as spatial brightness.

3. Spatial Complexity. The term 'visual clutter' might also be appropriate.

4. Spaciousness.

5. Formality.

Although factors 3 and 5 did not show any strong differention, factors 1, 2 and 4 showed significant difference in impression between two or more of the six lighting arrangements:

a. Overhead diffusing systems did affect impressions of perceptual clarity and tended to increase perceived spaciousness.

b. Overhead lighting systems with equal horizontal illumination affected evaluative response and yielded significant differences in the impression of spaciousness.

c. Overhead lighting and limited wall lighting in comparison to downlighting used alone did enhance evaluative and spaciousness impressions. (Martyniuk et.al., 1973). See Figure 8.

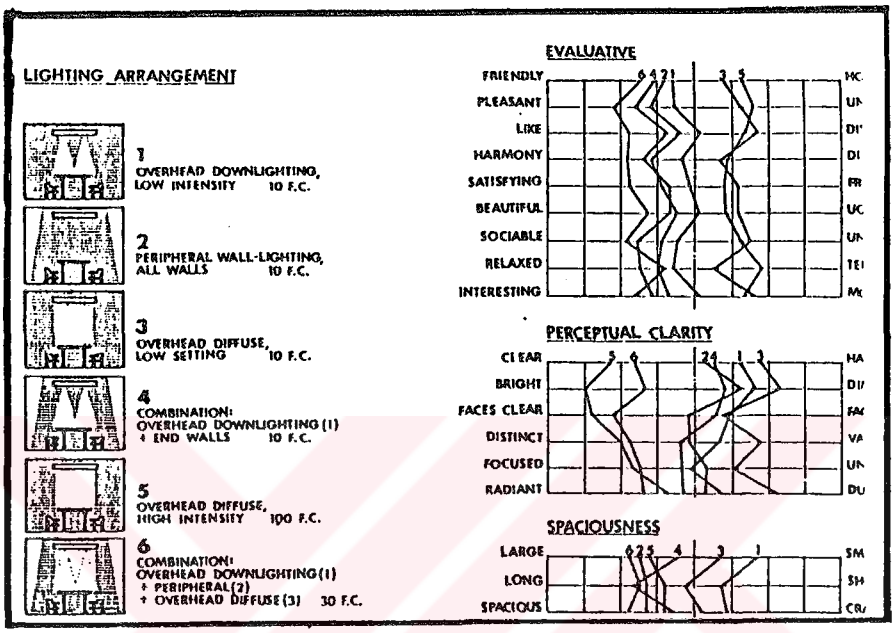


Figure 8 Lighting arrangements comparison.
(Martyniuk, et.al., 1973, p.57)

One of the important result beside the ones discussed above indicated that some of the lighting arrangements stimulated descriptive comments, which suggested that participants associated certain images with the lighting. This further suggests that some lighting conveys meaning.

One of important factors affecting subjective impressions (particularly openness in a space) has to deal with brightness on the vertical surfaces. Attention will be

drawn to the broadest and brightest surface, and this will establish the direction of awareness and movement in the room.

The term visual quality refers to the perceived size or volume of the architectural enclosure around an individual where 'large' signifies a luminous environment that promotes impressions of expanded spatial limits-increased volume. 'Small' signifies a luminous environment that promotes impressions of confinement. (Flynn, 1988; Steffy, 1990).

This subjective visual impression appears to be reinforced by two lighting systems:

1. Uniform ambient lighting, which is reinforced by uniform lighting, and

2. Peripheral lighting, reinforced more specifically by uniform "wall" lighting.

Smith and Bertholone define uniform ambient lighting as below:

> Uniform ambient lighting is a system brightens the entire space. Ambient lighting will be the best when there is low-contrast perception and vulnerability to glare but there is lots of light. (1986, p.60)

By selecting a fixture giving "direct-indirect" beam shape, the room will seem spacious, there is an overall room brightness.

Flynn, Spencer, Martyniuk and Hendrick have demonstrated how brightly lighting a space in a uniform manner at its periphery created a greater sense of spaciousness. (Cited in Space Human factors Office, 1986, p.78). This effect was produced by uniform peripheral wall washing of the light. They also found that:

> Different people in different rooms do assess lighting on a consistent basis. For instance both old and young people will experience a room with only wall-washing as spacious and hushed. Regardless of the room's function, the impression of spaciousness and quietude will persist as long as the wall-washing light is present. (Cited in Space Human Factors Office, 1986, p.78).

Space Human Factors Office (1986) discussed some studies which tested the effect of some light sources with their particular characteristics on spaciousness assessments. Flynn and Spencer (Cited in Space Human Factors Office, 1986)) studied the effect of light source color on various rated evaluative dimensions. They found a very little effect of light color, although cool white fluorescents were perceived more positively in terms of spaciousness and "clarity" of light, particularly when compared with high pressure sodium. Bennet, et.al. found that cool

white fluorescent yielded greater spaciousness and clarity in the furnished model rooms the subjects experienced. (Cited in space Human Factors Office, 1986, p.78).

Another study on the other hand, compared the brightness (so the contrast) effects between vertical and horizontal surfaces and related this to spaciousness. The results indicated that:

> An impression of being confined is elicited when vertical surfaces (full-height and partial-height walls) and/or ceiling surfaces are quite dark compared to the lower horizontal plane (e.g., worksurface and/or floor). An impression of spaciousness usually is elicited when vertical surfaces and/or ceiling surfaces are relatively bright (e.g., the surface are lighted). (Steffy, 1990, p.30).

Inui and Miyata (1973, 1977) as well as Steffy tested the effect of interior illuminance on spaciousness. They also confirmed a (moderate) effect on spaciousness due to the overall average horizontal illuminance and vertical illuminance at the eye position which agrees well with Flynn et.al.,(1973) findings for general brightness of ambient interior light.

3.2.4. Window

Windows constitute one of the important architectural elements of buildings. In studies of the visual

environment in buildings, daylight, sunlight and ventilation have been used as criteria for windows rather than visual ones. On the other hand, one of the fundamental functions of windows is to give a building occupant a feeling and perception of spaciousness by providing a visual link between the interior and exterior of buildings. As Inui has stated:

> The building occupant may avoid a feeling of being enclosed where there is a side window even if the room is very small. He may divert himself by observing the view. (1973, p.103)

Another study relating outdoor view to interior perception assessment has been performed by Schiffenbauer, et.al., They have found that rooms on the upper floors were perceived as larger than those on the lower floors. Although the results seemed to explore that differences in perceived spaciousness were determined by differences in height, it was unclear whether the determining variable was the height or the view. (Cited in Mandel, et.al., 1980, p.309). A partial replication of the findings of Schiffenbauer, et.al. was reached by Mandel et.al., (1980), indicating a significant correlation between lightness and perceived room size as well as perceived crowding. Perceived room size was related to differences with height from the ground and not view. It was height from the ground and not view per se which was the more

important factor in the perception of density.

There are some aspects such as the orientation of the building and closeness of other buildings, as well as view and sunshine, where spaciousness is less affected. It should be noted that view, orientation and closeness of other buildings are hard to measure quantitatively.

At first sight spaciousness seems to be related to the view from the window only, but in fact it is a criterion to evaluate the whole visual environment. In other words, even windowless buildings can give a certain amount of spaciousness regarding the room size, by enlarging the interior space, and raising the interior illuminance coming from the artificial lighting.

One aspect of windows, which is also hard to measure quantitatively, is the psychological effect of window on human judgments and preferences. For interior spaces, evidence suggests that discrete manipulations of environmental variables can influence an individual's evaluation of an architectural space (Kaye and Murray, 1982).

In Tognoli's study, the presence as opposed to absence of windows did not make the room more "interesting", but did make it more "friendly" which also confirms the results of the study performed by Wools . On the contrary, in another

study with a different group of subjects, Canter and Wools found no effects of windows on the assessment of "friendliness". (All cited in Kaye and Murray, 1982, p.615).

The same researchers aimed to understand whether a particular architectural variable affects perception of space other than ones they might intuitively expect them to. That is, although it was expected that presence of a window would affect the perceived "spaciousness" of an interior, it was considered important to determine whether this variable could affect judgments of feelings as how "exciting" or "friendly" the space was. (Kaye and Murray, 1982, p.610, 611)

As space factors, four items were found to be relevant for the assessments of either emotions/behaviors or the perceived qualities of interiors:

1. Social-Aesthetic Factor; whereby such aspects as "happy", "inviting", and "friendly" seem to capture a social dimension, whereas "bright", "interesting", exciting", "colorful" and "beautiful" capture an aesthetic dimension.

2. Mood Factor, which involves such aspects as "unattractive", "drab", "dead", "closed" and "gloomy".

3. Size Factor, which includes scales "large" and "spacious."

4. Physical Organization Factor, which includes scales "cluttered", "organized" and "accidental."

Kaye and Murray in their study indicated a significant effect of windows on the "Social-Aesthetic Factor", with the presence of the window making a room more friendly and inviting as well as more interesting and exciting. In addition, this manipulation had an effect on the "Mood" and "Size" Factors. These data are consistent with the body of literature indicating the psychological importance of windows in work and other environments. (Collins, 1976; Ruys, 1971 cited in Kaye and Murray, 1982, p.616).

As for the preference judgments on windows Buttler and Steuerwald (1989) studied the effects of view, room size and type of the room on preferred window size and shape. The results confirmed that view had an effect on window size preferences; larger windows are preferred for more desirable scenes. In addition, room size affected window size preferences; the preferred size of a window was not a constant percentage of wall size rather, as wall width increased, window width and area preferences were found to have a smaller percentage of wall size.

Another result out of this experiment confirms an indications on the criterion of "critical minimum acceptable window size" (Cited in Inui and Miyata, 1973). Kaye and Murray (1982) found that minimum window size preferences were influenced by lighting levels. In other words, subjects wanted windows in the space to allow the entry light. In addition to these findings, Buttler and Biner (1989) found a linear relationship between size of windows and peoples' subjective preferences for them; large windows were preferred over smaller ones because they allowed more daylight and/or sunshine. (Cited in Kaye and Murray, 1982, p.617)

Parallel to the study above, previous work by Inui and Miyata revealed the degree of relevance of various aspects of behavior to the activities taken in the environment. They used the term "visual environment" as well as the relationships between the behavior measured and the subjective assessments of spaciousness. They concluded that:

> The variables strongly affecting spaciousness are the illuminance and window size. Thus the activities associating with spaciousness in terms of relevance may well be "thoughtful activities", "lecturing and having a meeting", "physical exercises" and "walking and standing". (1977, p.62).

A close relationship between satisfaction and spaciousness

is also indicated where the variable most strongly related to satisfaction was the window size, suggesting that a big window as well as other aesthetic elements was useful in giving occupants a feeling of satisfaction.

One of the important psychological dimensions which windows provide for individuals in interior spaces is spaciousness. Spaciousness is an important construct for the visual quality of spaces and is closely related to window size and position with reference to enclosure provided by the vertical elements (walls) of interiors. (İmamoğlu, 1984).

Mercer in a study found that rooms with windows and without windows were crucial in the processes of assessments and evaluations. The presence of windows provided a phenomenological extensiveness (largeness) for interiors. (Cited in İmamoğlu, 1984, p.59). Studies have confirmed that windows create a sort of psychological extensiveness and comfort to interiors as well as providing illumination.

In a study conducted by İmamoğlu (1981), the degree of spaciousness was varied with the room's natural lighting, view and general atmosphere as well as its perceived size and shape. It was found that for a room to be spacious, it must give a sense of extensiveness, it must possess large and wide windows and it must have daylight penetration in.

Considering windows as being isolated from other architectural variables, we can talk about and inverted-U shape relationship between window size and psychological satisfaction. (See Figure 9). In other words, people do not prefer rooms with too large or too small windows. Rooms having small windows give occupants a feeling of clutteredness, whereas, rooms with too large windows seem to be unpleasant and cold. (İmamoğlu, 1984)

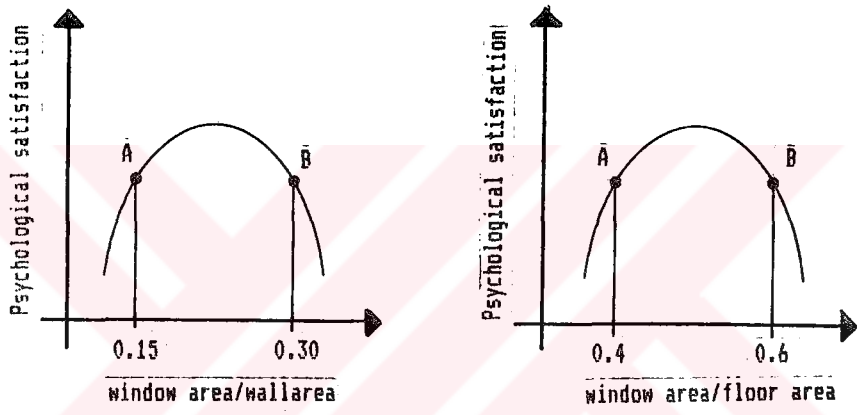


Fig 9 The Relationship between window-size and psychological satisfaction. (İmamoğlu, 1984, p.61)

Considering windows in relation with artificial lighting, Rossler found that when there was an increase in artificial lighting besides an increase in window width, people felt themselves less enclosed and less restrained. (Cited in İmamoğlu, 1981, p.3). Inui and Miyata (1973), on the other hand, through studies on various room models, found that when the size of room and illumination level

increased, rooms were assessed as being more spacious.

İmamoğlu (1981, 1984), using Spaciousness-Crampedness Scale referred to as S-C-S, carried out some studies to understand the meaning and structure of spaciousness in interiors and its relationship with the size and position of windows. The results of his experiments can be summarized as below:

1. In general, when window size increased, the rooms were assessed as being more spacious.

2. A significant effect on perceived size of rooms was found to be related to the position of the windows. Rooms having windows on the long side were assessed as being larger but more unpleasant than ones having windows on the short side.

3. Window position affected the perceived clutteredness of rooms. Windows located on the short sides lead to the room, being perceived as more cluttered. On the other hand window size affected the apparent size of rooms; rooms appeared to be large, wide and space free when they had larger and wider windows.

4. Rooms having windows on the short side, as well as having a window area/floor area, ratio of 15% appeared to be cramped and oppressive.

In conclusion it could be stated that:

> The design practice of windows has a crucial role in architecture and should be treated with a multi-factored approach. In the optimization studies of windows, variables like illumination, view, orientation, ventilation and heating, subjective assessments and evaluations of interiors must also be regarded as psychological factors (Imamoğlu, 1981, p.9 translation mine).

3.2.5. Furniture

Past research has shown that furniture density and furniture organization affects the perception of interior spaces and leads to different types of interaction patterns. (Sommer, 1969; Canter and Wools, 1970, cited in Imamoglu, 1976). In two studies, İmamoğlu (1973, 1986) found an inverted u-shape relationship between furniture density and spaciousness evaluations of rooms. Kaye and Murray (1982) have assessed the effects of furniture density and arrangement on the "social-aesthetic", "physical organization", "mood" and "size" factors that emerge with respect to the specific stimuli and scales used.

The effect of orderliness is seen to be with the general pleasantness of interiors, rather than receiving direct research attention on spaciousness. Maslow and Mintz (1957) investigated the psychological effects of

beautiful, average and ugly rooms on the perception of the moods in facial expressions. Results indicated that the ugly room was found to be less orderly than the beautiful one. Moreover, the participants in the ugly room had a reaction of avoiding the room. In a similar manner, Kasmar et.al. and Kasmar (1970) rated a beautiful and an ugly room on the Environment Description Scale, in which it appeared that the ugly room was rated as having less aesthetic appeal, being less physically organized and was assessed as being smaller compared to the beautiful room. (Cited in İmamoğlu, 1976, p.205).

Samuelson and Lindauer (1976) experienced the effects of both a neat and a messy room on perception, evaluation and performance. They found that the messy room had a general appearance of disorder as compared to the neat room having an appearance of order. In addition to this, the messy room was perceived as being filled up and smaller compared to the neat one. In fact, the study did not exactly clarify the effect of disorder of furniture on the perception and evaluation, since the term "disorder" was regarded in terms of "messiness". (İmamoğlu, 1976).

İmamoğlu (1976) on the other hand, explored the effects of organization-disorganization of furniture on the evaluation of rooms, directly on spaciousness rather than the effects of messiness or ugliness. The results of the spaciousness evaluations indicated that as the room became

more and more orderly, it was perceived as being more and more spacious. This generalization was valid for all the three spaciousness factors: appeal, planning and space freedom. However, crampedness evaluations indicated that there were no differences between disorganized and very disorganized rooms, whereas an organized room was perceived as being significantly less cramped than the former ones. In conclusion, it was stated that the level of organization or orderliness of furniture in a room affected its evaluation significantly in terms of spaciousness and crampedness factors.

Spaciousness-crampedness is a derivative concept of openness-enclosedness. An indirect study on the effect of furniture on spaciousness was performed by Uchida (1979 a, 1979 b) who aimed to examine the sense of visually closed spaces with the effect of such factors as perceived volume, sense of oppression, and degree of oppression. He explored the effect of furniture on the sense of visually-closed spaces regarding their placements in various patterns in the rooms. Consequently, it was found that furniture organization had a stronger effect on the sense of oppression than the number of furniture items (density).

The data by Kaye and Murray (1982) also show a significant effect of furniture density on the "Organization Factor" and "Size Factor" (where the latter factor is closely

related to spaciousness) whereas furniture organization was found not to be very effective. Moreover, the authors relate "low density" condition with sociopetal and sociofugal actions. The terms "sociopetal" and "sociofugal" were introduced by Osmond in 1957 to describe furniture arrangements that are presumed to bring people together or drive them apart respectively. (Cited in Kaye and Murray, 1982, p.611). Low density-sociopetal conditions were found to be a positive attitude (positive affiliation which corresponds to the approach behavior type) felt for the room in which furniture items were largely oriented towards each other. On the other hand, a "high density" condition, represented by the addition of a few more furniture items, was found to be effective in making the room perceptually more "cluttered" and "accidental".

Studies on space perception and the size judgments, as being carried out from a general psychological standpoint, have dealt with illusions which could serve as cues for the relationship between size and distance. The only group of studies which seemed to be related to the studies of İmamoğlu (1973, 1986) concerning the effect of furniture density could be the ones dealing with "divided" or "filled" space.

The "Oppel-Kundt" Illusion state that:

> A divided line is overestimated in comparison to an undivided line of equal length (Cited in İmamoğlu, 1973, p.343).

By extension, a divided space seems to appear larger. But a question arises that could this be generalized to the subjective size estimation of interior spaces with various features experienced in a complex order? Should it be accepted that the more elements a space contains, the larger it appears? An answer to these questions was given by İmamoğlu (1973, 1986) in his studies, where the results indicated an inverse relationship between the amount of furniture and estimation of size of rooms:

1. As for the spaciousness evaluations, the relationship between empty, furnished and over-furnished conditions and their spaciousness evaluations appeared to be of an inverted u-shape, that is, both an empty room and over-furnished one is assessed to be less spacious than a furnished one. The general trend seems to indicate that:

> Some degree of furnishings has a positive effect on spaciousness assessment... It seems that there is an optimal level for the furniture density; when this density is exceeded, additional items start playing a negative role on people's feelings of spaciousness (İmamoğlu, 1973, p.349-350).

The results of the crampedness evaluations indicated that

over-furnished rooms were evaluated as being significantly cluttered and appeared to be less spacious. Thus, it is confirmed that spaciousness is closely related to being "uncluttered".

2. As for the size estimations, the relationship between perceived size and furniture density appeared to be inverse. In other words, the empty room is perceived as the largest and the overfurnished as the smallest. This contradicted the "Oppel-Kundt" Illusion, that is, "filled" or "divided" spaces can not be generalized to full-size rooms, where there is an interaction of various factors.

İmamoğlu, in his studies concerning either "the effect of furniture organization" or "the effect of furniture density" on the spaciousness judgments, always concluded with a statement that judgments were made in specific settings, under specific circumstances, thus, it needs a further experimentation to specify the degree to which those findings could be generalized to the population in general and other settings having different layouts.

3.3 Spaciousness-Crampedness Scale (S-C-S)

Obviously, if a researcher is going to observe a change in the subject(judgment or behavior), because of the modifications through above mentioned architectural

variables in interior spaces, there must be some means of measuring that change. In other words, as Canter (1973) puts it, to measure the quality of the environment/activity interaction, a measuring instrument is needed.

Semantic measurements have been used for many years as a systematic way of getting verbal response. The first of these, called "The Semantic Differential" was constructed by Osgood et.al., and has been used concerning aesthetics and perception of environments. In this type of measurements, researchers use "Bipolar Adjective Pairs" called semantic scales to describe and to distinguish among settings . (For a sample list of these word-pairs which are also used in the case studies see appendix A.1). All semantic responses given by means of adjective pairs are then treated with factor analysis to find a few main dimensions along which a researcher can order his material.

Semantic studies in environmental and architectural psychology often gave way to a space-related spaciousness or enclosedness dimensions, either directly or indirectly. (İmamoğlu, 1986). The advantages of scales were spelled out by a number of researchers whose studies have been discussed throughout this thesis: Canter and Wools (cited in İmamoğlu, 1986); Kuller (1973); Acking and Kuller (1972); Martyniuk et.al., (1973); Samuelson and Lindauer

(1976); Hendrick et.al., (1977); Kasmar (1970); Kaye and Murray (1982) and Kunishima and Yanase (1985).

İmamoğlu, in 1975 (cited in İmamoğlu, 1986) has developed, with the same intention a Spaciousness-Crampedness Scale (S-C-S) hoping that this scale would not only clarify the meaning of spaciousness but also provide a descriptive tool to evaluate interiors. He constructed this scale in five stages:

1. Selection and ratings of descriptive adjective pairs on appropriateness to describe the spaciousness of a room.

2. Selection and evaluation of interior slides in terms of spaciousness.

3. Ratings of selected slides with the final list of bipolar adjective pairs.

4. Factor analysis.

5. Selection of the final adjective pairs for spaciousness and crampedness scales (s-c-s).

At the end of the final stage, the S-C-S contained 19 adjective pairs and was made up of two parts: the first part consists of three spaciousness factors to describe

'spacious interiors' whereas the second part consists of four crampedness factors which describe 'not spacious interiors'. The related adjective pairs of both spaciousness and crampedness factors are given in appendix A.2.

For spacious interiors, the factors chosen are the following:

Spaciousness Factor 1. **Appeal:** This factor is related to the attraction, charm, appeal, pleasantness or homeliness of the interior spaces. interiors.

Spaciousness Factor 2. **Planning:** This factor is related to the planning aspects of interiors; organization, balance, coordination, fitness of the room to its function.

Spaciousness Factors 3. **Space Freedom:** This factor is made up of two aspects:1. Size (roomy, large) and 2. Clutteredness (crowding).

For not spacious interiors, the factors chosen are the following:

Crampedness Factor 1. **Planning:** This factor shows the planning and organization dimensions of an interior.

Crampedness Factor 2. **Physical Size:** This factor is

related mostly to the size and perhaps the shape of interiors.

Crampedness Factor 3. **Clutteredness:** Thid factor corresponds to the fullness and emptiness dimensions of rooms, regarding either to the number of people (social crowding) to the number of furniture items (density).

Crampedness Factor 4. **Appeal:** This factor indicates the feeling of coziness, comfort, liveableness, attraction, charming or appeal felt for interiors.

Spaciousness judgments of interiors by the help of S-C-S considers not only the affective aspects, such as how people feel and think about an interior, the emotional states resulting preference and choice between alternative interiors, but also their functional aspects such as fit between functional and physical requirements and spaces.

Operational Use of Spaciousness-Crampedness Scale: In a study involving S-C-S, the following steps are used:

1. For each spaciousness/crampedness factor, subjects give numeric values to the related adjective pairs, from 1 to 7, where 1 represents the negative end of scale and 7 represents the positive end of scale for spaciousness factors. The reverse is valid for crampedness factors.

2. For each spaciousness/crampedness factor, the given numeric values are added-up and divided into the number of adjective pairs related to each spaciousness-crampedness factors.

Steps 1 and 2 are then repeated for each subject's rating, for each of the spaciousness/crampedness factors.

4. TWO EXPERIMENTAL STUDIES ON SPACIOUSNESS

4.1. Hypotheses

From the previous studies discussed in section 3.2., two basic hypotheses can be generated for the relationship between the effects of furniture organization and spaciousness and for the relationship between the effects of the lighting arrangements and spaciousness.

For the first relationship, it can be hypothesized (H1) that:

The level of organization or "orderliness" of furniture in an interior space affects its perception and evaluation significantly in terms of spaciousness and crampedness factors. (İmamoğlu, 1976).

The general statement above, may be interpreted as implying that organized room will be perceived and evaluated significantly different than the disorganized and very disorganized rooms.

Furthermore, it can be hypothesized that as the room becomes more orderly, it will be perceived as being more

spacious but as the room became more disorderly, it will be evaluated as being more cramped.

For the second relationship, it can be hypothesized (H2) that:

The perception and evaluation of spaciousness in an interior space is affected by differences in the lighting arrangement systems in an interior space. (Flynn, 1988).

With peripheral wall-lighting systems, an interior space is perceived as being more spacious. It can be hypothesized that the perceived volume of an interior space is reinforced by uniform peripheral wall-washing lighting which causes an overall room brightness. (Smith and Bertholone, 1986).

With overhead downlighting arrangement an interior space is expected to be perceived as being less spacious than the ones having peripheral wall-lighting or combination lighting.

With combination lighting, an interior space is perceived as being more spacious than the ones having peripheral wall-lighting and overhead down lighting. (Martyniuk et.al., 1973; Hendrick et.al., 1973).

It can also be hypothesized that the brightness difference

between vertical and horizontal surfaces affects subjective impressions of an interior space such as openness/closedness or spaciousness/crampedness.

Spaciousness is enhanced when vertical surfaces and/or ceiling surfaces are relatively bright.

Crampedness is enhanced when vertical surfaces and/or ceiling surfaces are quite dark, compared to the lower horizontal plane. (Steffy, 1990).

In order to examine the validity of these hypotheses, two case studies have been conducted and are presented in the remainder of this chapter by using the Spaciousness-Crampedness Scale as a measurement tool for data.

4.2. Case Studies

Apart from the studies which İmamoğlu (1973, 1976, 1979, 1986) has carried out, a direct study of spaciousness in interiors has, so far, been undertaken only by Inui and Miyata (1973, 1977). Using a uni-polar scale, their experiments have mainly studied spaciousness in relation to sky luminance, horizontal illuminance, room size and window width, using various scale models. (İmamoğlu, 1973).

The experimental studies to be reported here aim to define and explore the concept of spaciousness in relation to two variables, namely furniture organization and lighting arrangement.

4.2.1. Case Study 1. The Effect of Furniture Organization on the Perception and Evaluation of Spaciousness

Many researchers have used rooms in their studies that were somewhat orderly and in general the effect of furniture organization on the way that rooms are perceived and evaluated has not received direct research attention. It is stated that when in use, the order of the furniture in a room changes, at times becoming quite disorderly. (İmamoğlu, 1976). The change in the furniture organization may have an effect on the perception of the spaciousness of the room.

Thus, as a first case study, the effect of three different furniture organizations on the assessment and evaluation of spaciousness-crampedness in an interior space has been studied.

Method of Study

Subjects:

Eighteen volunteer instructors and graduate assistants from the department of Interior Architecture and

Environmental Design of Bilkent University were used as subjects. The mean age of the subjects was 35 years.

Stimuli:

The arrangement of furniture in a pentagonally shaped room was used as the stimulus. The room serves as an informal room for social intercourse, mainly for having tea or coffee during tea breaks. The floor is 48.62 square meters in area, and the ceiling height is 3.80 meters. It has two windows on one wall, each having a length of 190 cm, and the distance between them is 240 cm. Its windows face north-west, and it has a view of a very close adjacent building through the windows. The floor is covered by a grey, speckled wall-to-wall carpet. The room has white painted walls and ceiling, and has windows with black vertical louvers. It is furnished with seventeen 50x65 cm dark-brown seats, nine 50x50 cm brown small tables, 60x120 cm tea table in gray, 30x80 cm gray shelves, 50x90 cm brown book shelf, a brown round table having a diameter of 130cm, and finally five black tubular chairs. (see Figure 10 and Figures 18 to 29).

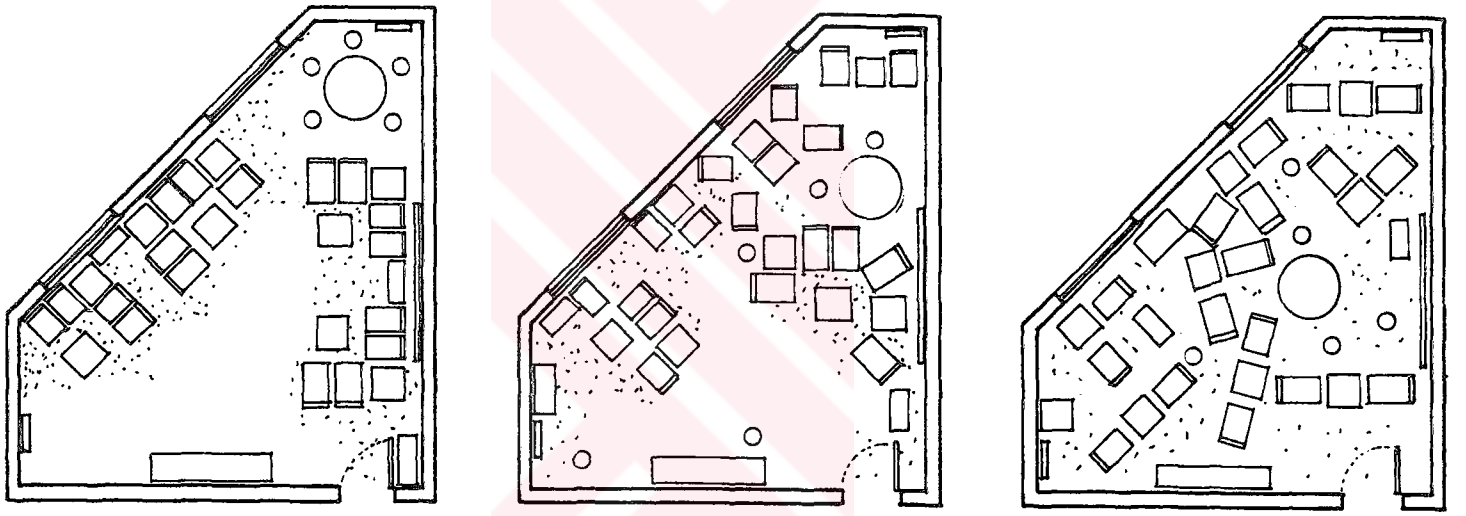
The arrangement of the furniture has been altered in the study in three different organizations. As can be seen in Figure 10, in the first condition, the room (the organized one) had an empty space at the center of the room, with the three furniture groupings. In the second condition

(disorganized), the room had the same furniture, in a random order. The third layout shown in the figure refers to the very disorganized condition; the furniture was arranged in the room in a more or less haphazardl manner.

Procedure:

Subjects were asked to take part in an experiment which aimed to explore the effect of three different furniture organizations on the assessment and evaluation of spaciousness (so the crampedness) of the tea room using a 7 point-bipolar rating scale. Each subject was given instruction papers on the nature and set-up of the experiment. (See Appendix A.1) Upon ensuring that the subjects understood how to use the rating scales, they were asked to evaluate the room using the Spaciousness-Crampedness Scale developed by Imamoglu (1986).

The subjects were led to the room, asked to do the evaluations from any point in the room that they liked and were left alone in the room. After all subjects evaluated the room with a certain organization, the furniture arrangement was altered and the subjects were asked to re-evaluate the room using the same rating scales and procedure. The same procedure was repeated for the third arrangement. Each subject took less than 10 minutes to do a single evaluation and for each room organization the evaluations of the 18 subjects on the instruction sheets were completed within two weeks.



Organized room Disorganized room Very disorganized room

Figure 10 Altered arrangements of furniture in the room:

1. Organized; 2. Disorganized; 3. Very disorganized

Data Analysis:

Each of the 18 subjects' evaluations on the 19 adjective pairs were converted into two sets of numerical scores of 1 to 7, where 1 represents the negative end of scale, e.g. poorly organized, tiny, closed etc. and 7 refers to the positive one, e.g. well organized, open, huge etc. for spaciousness factors. The reverse is true crampedness factors. Then for each subject, the mean scores of the adjective pairs for the three spaciousness and four crampedness factors were calculated. Table 19 and Table 20 and Figure 31 and Figure 32 in Appendix B shows these mean scores respectively.

These two sets of scores were then used in the two separate multivariate analysis of variance (MANOVA) for spaciousness and crampedness factors by using the SPSS (Statistical Package for Social Sciences) Statistical Analysis Package.

Results related to Spaciousness Factors:

Table 2 and Figure 12 show the mean scores for the spaciousness factors of appeal (F1); planning (F2) and space freedom (F3) of the organized room. These were 3,64, 3,56 and 4.61 respectively; and those of the disorganized room were 2.40, 2,13, 2.82 and finally those of the very

disorganized room were 2.51, 2.34, and 2.31, respectively.

Table 2 Mean scores for the spaciousness Factors F1, F2, F3 in different room organizations.

	Organized	Disorganized	Very Disorganized
F1:Appeal	3.64	2.40	2.51
F2:Planning	3.56	2.13	2.34
F3:Space freedom	4.61	2.82	2.31

The differences between the three experimental conditions of the room were analyzed by a 3 (organized / disorganized / very disorganized) x 3 (Appeal/planning/space freedom) multivariate analysis of variance (MANOVA) with repeated measures design on two variables, namely furniture organization and spaciousness factors. Table 3 summarizes the results of this analysis.

Table 3 Summary table, 3 x 3 multivariate analysis of variance (MANOVA)

Source	df	SS	ms	F	P
Within cells	34	617989.28	18176.16		
Factor	2	821304.94	410652.47	22.59	0.000
Within cells	34	154425.62	4541.93		
Organization	2	83529.94	41764.97	9.20	0.001
Within cells	68	253715.23	3731.11		
Factor x Organization	4	68159.88	17039.97	4.57	0.003

As can be seen in the table, main effects of spaciousness factors, organization and their interaction were found to be statistically significant. ($p=0.000$, $p<0.001$, $p<0.003$ respectively).

Main effect of organizations: The main effect of room organizations (organized, disorganized and very disorganized) indicated that the mean spaciousness evaluations varied in the three experimental conditions. As can be seen in Figure 11, as the room became more and more disorganized it was evaluated as being less spacious. The mean values for organized, disorganized and very disorganized conditions were 3.94, 2.45 and 2.39 respectively (see table 4).

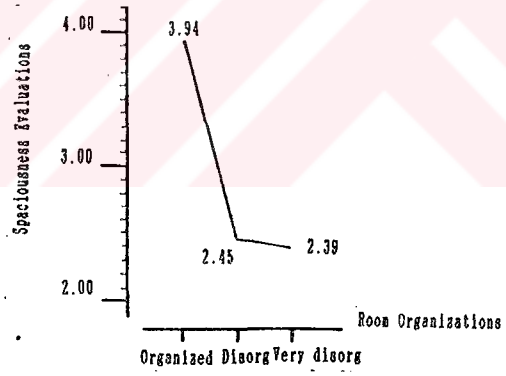


Figure 11 Mean evaluations as a function of the levels of organization and spaciousness

Pairwise t-test analyses indicated that the differences between organized versus disorganized room, and organized versus very disorganized room were found to be significant. ($p=0.0000$), but there was not any significant difference between disorganized versus very disorganized

conditions. ($p<0.29$) This shows that organized condition of the room varied significantly from both the disorganized and very disorganized conditions. The decrease in the mean values between organized and disorganized was more substantial than the decrease in the values between disorganized and very disorganized conditions.

Table 4 Mean values for the main effect of organization

Organized	Disorganized	Very Disorganized
3.94	2.45	2.39

Main effect of spaciousness factors: The main effect of spaciousness factors indicated that the mean spaciousness evaluations generally varied significantly in terms of spaciousness factors. The mean values for the main effect of spaciousness factors F1, F2 and F3 were 2.85, 2.68 and 3.25 respectively. (see Table 5). Pairwise t-test analysis for these values indicated that the difference between the factors of planning and space-freedom was statistically significant ($p<0.015$), but there were no significant differences between the factor of appeal versus planning, and appeal versus space-freedom. ($p<0.45$; $p<0.094$ respectively).

Table 5 Mean values for the main effect of spaciousness factors

F1:Appeal	2.85
F2:Planning	2.68
F3:Space freedom	3.25

Main Effect of Interaction: The interaction of furniture organization and spaciousness factors can be seen in Figure 12 (which refers to the values in Table 2). An examination of Figure 12 and Table 2 shows that, in general, the means for all spaciousness factors decreased as the room became more disorganized. The decrease observed in space freedom factor (F3) was relatively more than in factors appeal and planning.

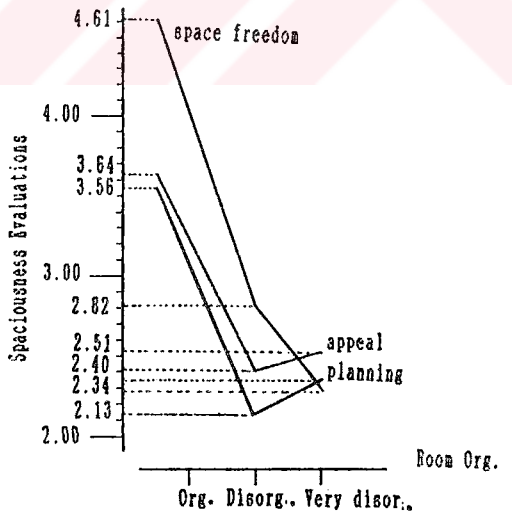


Figure 12 Mean scores for spaciousness factors F1, F2, F3 of the organized, disorganized and very disorganized rooms

The interaction between furniture organization and spaciousness factors were analyzed by a pairwise t-test analysis which can be seen in Table 6 and in Table 7.

Table 6 Levels of significance between room conditions for spaciousness factors.

	O - DO	O- V.DO	DO - V.DO
F1:Appeal	p=0.000	p<0.009	p<0.762
F2:Planning	p=0.000	p<0.014	p<0.519
F3:Space freedom	p=0.000	p=0.000	p<0.107

Table 7 Levels of significance between spaciousness factors in the three conditions of the room.

	O	DO	V.DO
F1-F2	p<0.682	p<0.047	p<0.475
F1-F3	p=0.000	p<0.035	p<0.581
F2-F3	p<0.001	p<0.004	p<1.000

As can be seen from Figure 12 and Table 6, the difference between organized versus disorganized and organized versus very disorganized conditions of the room was found to be significant for all spaciousness factors. (p=0.000, p=0.000, p=0.000 and p<0.009, p<0.014, p<0.107

respectively) whereas the means for all the three spaciousness factors did not show any significant difference between organized and very disorganized conditions of the room. ($p<0.762$, $p<0.519$, $p<0.107$ respectively). As is clearly seen from Figure 12, the least affected factor by very disorganized condition and the most affected factor by organized condition of the room was the space freedom factor. The interaction showed that in the organized and disorganized condition the room was evaluated relatively higher on space freedom factor than factors appeal and planning. This means that the room was evaluated as being less cluttered and less crowded in organized condition of the room when compared to very disorganized condition of the room.

Figure 12 indicates that the means for the factors of appeal (F1) and planning (F2) decreased between organized and disorganized conditions, whereas there was an increase between disorganized and very disorganized conditions. The decrease as well as the increase of the means were almost parallel to each other, although the means of these two factors were close to each other and did not show any significant difference in the organized condition ($p<0.682$, see Table 7), in the disorganized condition the means were very close to being significant ($p<0.047$). In the very disorganized condition of the room, the factors of appeal and planning did not show any significant change

($p<0.475$).

Table 7 and Figure 12 show the interaction between spaciousness factors of appeal (F1), planning (F2) and space freedom (F3). As is clearly seen there were significant differences observed between F3 and F1 and between F3 and F2 in organized and disorganized conditions, whereas there were not any significant differences observed in very disorganized condition of the room.

As for the appeal factor (F1), Table 6 shows that the differences between organized and disorganized conditions in addition to the differences between organized and very disorganized conditions of the room were significant ($p=0.000$, $p<0.009$ respectively), whereas the difference between disorganized and very disorganized conditions was not found to be significant ($p<0.762$). This indicates that both the disorganized and very disorganized conditions of the room were rated almost the same, both being less appealing than the organized one.

As regards planning factor (F2), Table 6 shows that the differences between organized and disorganized conditions, in addition to the differences between organized and very disorganized conditions of the room the room were significant ($p=0.000$, $p<0.014$ respectively), whereas the

difference between disorganized and very disorganized conditions of the room was not found to be significant ($p<0.519$), hence indicating that disorganized and very disorganized rooms were evaluated almost the same, being poorly planned and failing to satisfy the functional requirements when compared to organized room.

As regards space freedom factor (F3), Table 6 indicates that the differences between organized and very disorganized rooms, in addition to the differences between organized and very disorganized rooms were significant ($p=0.000$, $p=0.000$ respectively), whereas the difference between disorganized and very disorganized rooms was not found to be significant ($p<0.107$). This shows that disorganized and very disorganized rooms were evaluated as being cluttered (cramped) when compared to organized one.

Results related to Crampedness Factors:

Table 8 and Figure 14 show that the mean scores for the crampedness factors of planning (F1), physical size (F2), clutteredness (F3) and appeal (F4) of the organized room were 4.50, 3.61, 3.47 and 4.37, respectively. Those of the disorganized room were 6.01, 4 46, 5.60 and 5.67, and those of the very disorganized room were 5.76, 5.22, 6.12 and 5.43, all respectively.

Table 8 Mean scores for the crampedness factors F1, F2, F3, F4 in different room organizations

	Organized	Disorganized	Very Disorganized
F1:Planning	4.50	6.01	5.76
F2:Physical size	3.61	4.46	5.22
F3:Clutteredness	3.47	5.60	6.12
F4:Appeal	4.37	5.67	5.43

The differences between these three experimental conditions of the room were analyzed by a 3 (organized / disorganized / very disorganized) x 4 (planning / physical size / clutteredness / appeal) multivariate analysis of variance (MANOVA) with repeated measures design on two variables, namely furniture organization and crampedness factors, the results of this analysis is which have been summarized in Table 9.

Table 9 Summary table, 3 x 4 multivariate analysis of variance (MANOVA)

Source	df	SS	ms	F	P
Within cells	51	218531.96	4284.94		
Factor	3	30275.79	10091.93	2.36	0.083
Within cells	34	137305.64	4038.40		
Organization	2	183033.86	91516.93	2.66	0.000
Within cells	102	1047602.81	10270.62		
Factor x Organization	6	1427631.69	237938.62	23.17	0.000

As can be seen in the table, the main effects of organization and interaction (factor x organization) were found to be statistically significant (p=0.000, p=0.000), whereas there was not any significancy observed for crampedness factors, (p<0.083).

Main effect of organizations: The main effect of room organizations (organized, disorganized, very disorganized) indicated that the mean crampedness evaluations varied in the three experimental conditions. In Figure 13 it can be seen that, as the room became more and more disorganized, it was evaluated as being more cramped. The mean values for organized, disorganized and very disorganized conditions in Table 10 of the room were 3.99, 5.44 and 5.63 respectively.

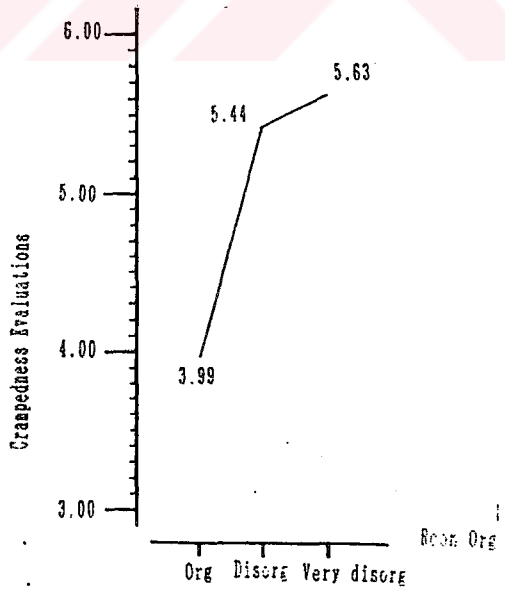


Figure 13 Mean evaluations as a function of the levels of organization and crampedness

Pairwise t-test analyses for these values indicated that the differences between the organized versus disorganized conditions and organized versus very disorganized conditions were significant. ($p<0.0000$, for both), but the difference between the disorganized versus very disorganized conditions was not, ($p<0.29$). Note that the increase in the values between organized and disorganized conditions was much more than the increase in the values between disorganized and very disorganized conditions. There was a little difference in the crampedness evaluations of the last two conditions of the room, in other words, the organized condition varied significantly from the disorganized and very disorganized conditions. As a general trend, as the degree of organization of a room decreased it was perceived as being more cramped.

Table 10 Mean values for the main effect of organization

Organized	Disorganized	Very Disorganized
3.99	5.44	5.63

Main effect of interaction: The interaction of organization and crampedness factors can be seen in Figure 14 (which refers to the values in Table 8)

An examination of Figure 14 and Table 8 shows that, in

general, the means for all crampedness factors increased as the room became more disorganized. However, the increase observed in the means of physical size factor was relatively less than in the appeal, planning and clutteredness factors.

The interaction between furniture organization and crampedness factors were analyzed by a pairwise t-test, analysis which can be seen in Table 11 and in Table 12.

Table 11 Levels of significance between room conditions for crampedness factors

	O - DO	O -V.DO	DO - V.DO
F1:Planning	p=0.000	p<0.007	p<0.407
F2:Physical size	p<0.001	p=0.000	p<0.021
F3:Clutteredness	p=0.000	p=0.000	p<0.022
F4:Appeal	p=0.000	p<0.023	p<0.486

Table 12 Levels of significance between crampedness factors in the three conditions of the room

	O	DO	V.DO
F1-F2	p<0.003	p=0.000	p<0.094
F1-F3	p<0.001	p<0.012	p<0.212
F1-F4	p<0.554	p<0.030	p<0.059
F2-F3	p<0.516	p=0.000	p=0.000
F2-F4	p<0.013	p=0.000	p<0.537
F3-F4	p=0.000	p<0.675	p<0.051

As can be seen from Figure 14 and Table 11, the difference between organized versus disorganized and organized versus very disorganized conditions of the room was found to be

significant for all crampedness factors ($p=0.000$, $p<0.001$, $p=0.000$, $p=0.000$ and $p<0.007$, $p=0.000$, $p=0.000$, $p<0.023$ respectively), whereas for factors planning (F1) and appeal (F4) there was not any significant difference observed between disorganized and very disorganized conditions of the room. For factors clutteredness (F3) and physical size (F4), on the other hand, significant differences observed between disorganized and very disorganized conditions of the room ($p<0.021$, $p<0.022$ respectively). As is clearly seen from Figure 14, the least affected factor by organized condition and the most affected factor by very disorganized condition of the room was the clutteredness factor.

The interaction showed that in the organized and disorganized condition the room was evaluated relatively higher on planning factor than the other factors which means that the room was evaluated as being well planned (well organized) in the organized condition whereas in the disorganized condition it was evaluated as being poorly planned and failed to satisfy the functional requirements.

Table 12 indicated that although the mean values of factors physical size (F2) and clutteredness (F3) were close to each other in the organized condition of the room whereas in disorganized and very disorganized conditions the differences between the means were significantly

different ($p=0.000$, $p=0.000$).

Regarding the physical size factor, as can be seen in Table 11, the differences between organized versus disorganized, organized versus very disorganized and disorganized versus very disorganized conditions of the room were found to be significant ($p<0.001$, $p=0.000$, $p<0.021$ respectively). Thus, when the room became more disorganized it is evaluated as being smaller, narrow and tiny. It can be concluded that a room becomes most cramped in the very disorganized condition.

As for the clutteredness factor, in addition to the significance of the difference between organized versus disorganized and organized versus very disorganized, also that between disorganized and very disorganized conditions were significant ($p=0.000$, $p=0.000$, $p<0.022$ respectively). Thus when the room became more disorganized, the interior appeared to be more cluttered than organized one.

The means for the planning and appeal factors increased between organized and disorganized conditions whereas there was a decrease in the means of these two factors between disorganized and very disorganized conditions.

We have to note that the increase and decrease of planning and appeal factors was almost parallel to each other,

although the mean values of these two factors were close to each other in the organized condition which means that there was not any significant difference observed ($p<0.554$, see Table 12), in the disorganized condition the difference between the means was somewhat significant ($p<0.030$). In the very disorganized condition the difference between the means were not also significant ($p<0.059$).

As for the planning factor, Table 11 indicates that the differences between organized and disorganized in addition to the difference between organized and very disorganized conditions of the room were significant ($p=0.000$, $p<0.007$ respectively), however the difference between disorganized and very disorganized rooms was not found to be significant. This indicates that both the disorganized and very disorganized conditions of the rooms appeared to be less well-planned and seemed to fail to satisfy the functional requirements.

As regards the appeal factor, Table 11 shows that the difference between organized and disorganized, in addition to the difference between organized and very disorganized rooms were significant ($p=0.000$, $p<0.023$ respectively), whereas the differences between disorganized and very disorganized rooms was not. This indicates that both the disorganized and very disorganized rooms were evaluated as

being less appealing than the organized one.

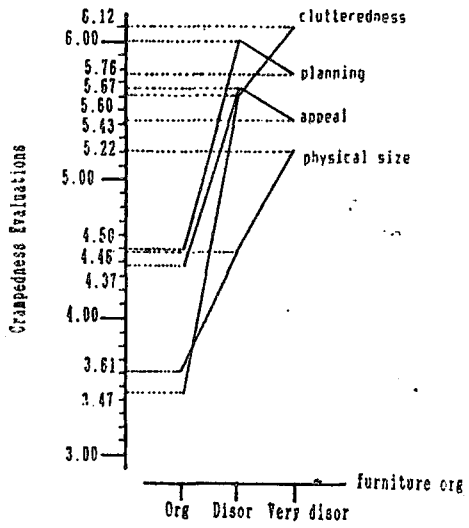


Figure 14 Mean scores for crampedness factors F1, F2, F3, F4 of the organized, disorganized and very disorganized rooms

4.2.2. Case Study 2. The Effect of Lighting Arrangement on the Perception and Evaluation of Spaciousness

As a second case study, the effects of three lighting arrangements on the assessment and evaluation of spaciousness / crampedness in an interior space has been studied.

In parallel with a study performed by Hendrick et.al., (1977), three lighting arrangements were selected as the three different conditions of the room: peripheral lighting (wall-washing), overhead direct lighting-high

intensity (a type of the downlighting system) and a combination of the two.

Method of Study

Subjects:

Seventeen volunteer instructors and graduate assistants from the department of interior Architecture and Environmental Design of Bilkent University were used as subjects. The overall mean age of the subjects was 35 years.

Stimuli:

The same room was used as in the first case study. The furniture and its arrangement was kept constant throughout the study. The furniture arrangement was kept constant as in the actual condition.

Treatment of The Room According to the Lighting Arrangements: For peripheral lighting arrangement (wall-washing), the junction of the ceiling with the walls of the room was lined with 40 watt(120cm) "warm white" fluorescent lamps. 19 fluorescent lamps were fixed in a linearly continuous manner underneath a plywood housing, the inner and outer surfaces of which were painted in white in order to increase the reflectance and to create a diffuse lighting on the walls. (see Figure 15).

For the overhead direct lighting , 40 watt (120 cm) fluorescent lamps were used again, the quantity of lamps and their power consumption remaining the same, (19 fluorescent lamps). Structural mounting fixtures were used, in which the fluorescent lamps were grouped in five plywood boxes. The inner surfaces of the boxes were covered with black matte papers in order to reduce reflection and to direct all the light downward as much as possible to give a downlighting effect. (see Figure 16). Those five boxes were fixed on top of each seating location as shown in Figure 17 and in Figures 18 to 29.

For combination lighting, the peripheral lighting system and overhead down lighting sytem were used together with a total of 18 fluorescent lamps.

Rating Scales:

The same rating scales for Spaciousness and Crampedness Factors were used for the three different lighting conditions of the room as in the first case study.

Procedure:

The same procedure was used as in the first case study, apart from the change of the nature of the stimulus.

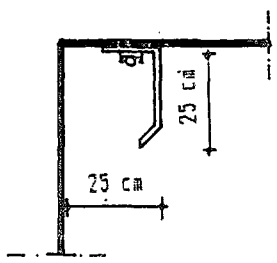


Figure 15

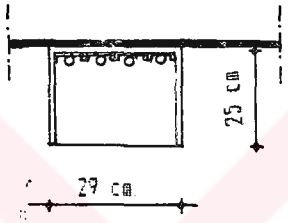
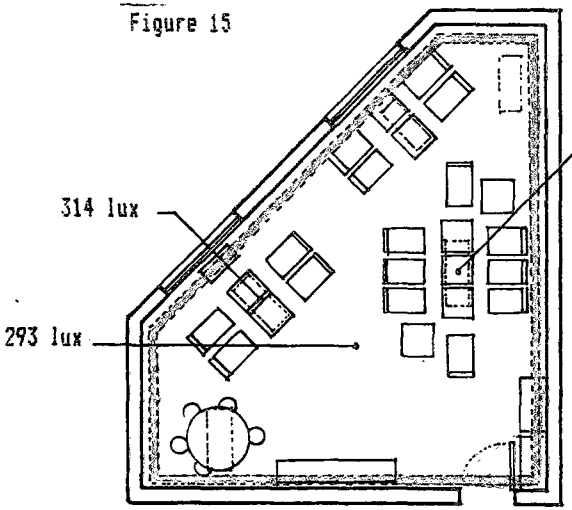
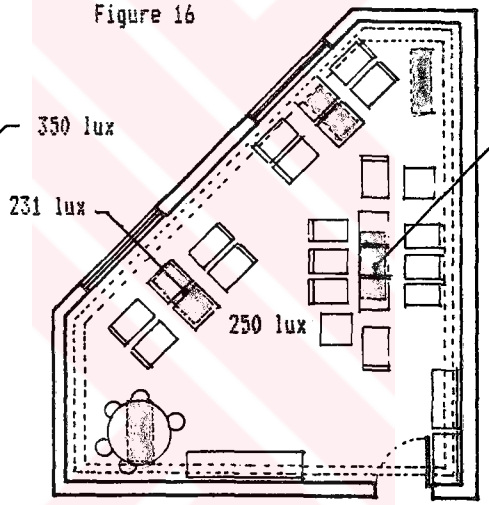


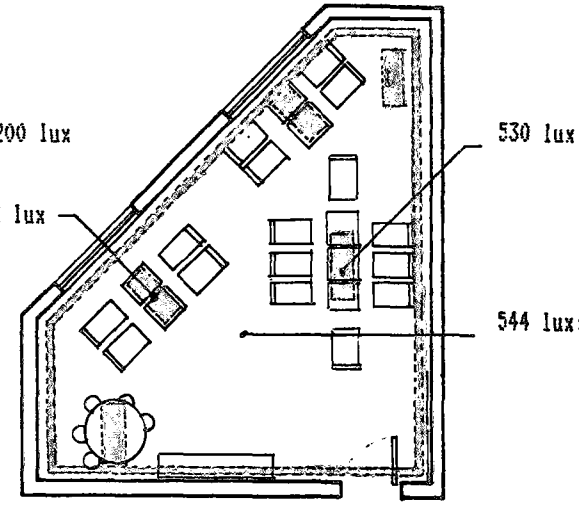
Figure 16



Peripheral lighting



Overhead down lighting



Combination lighting

Figure 17 Plan drawings for room conditions with 1. peripheral lighting, 2. overhead down lighting, 3. combination lighting

Figure 18 Peripheral lighting from position 1

Figure 19 Overhead down lighting from position 1

Figure 20 Combination lighting from position 1

Figure 21 Peripheral lighitng from position 2

Figure 22 Overhead down lighting from position 2

Figure 23 Combination lighting from position 2

Figure 24 Peripheral lighting from position 3

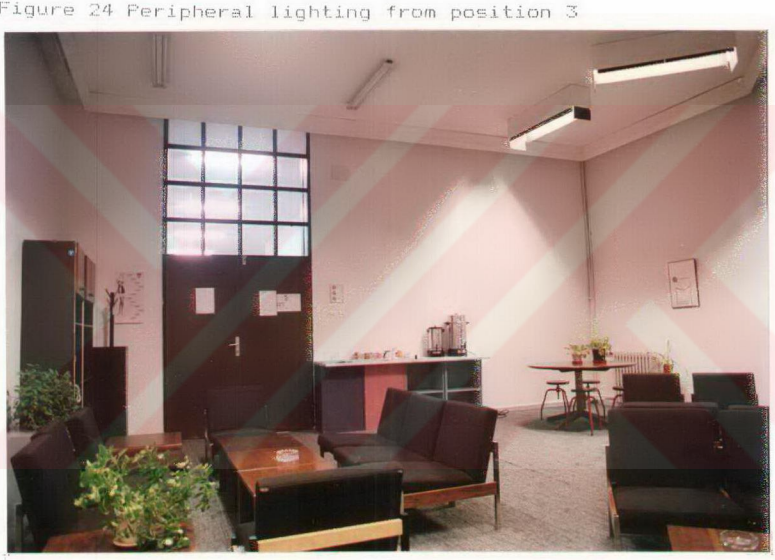


Figure 25 Overhead down lighitng from position 3

Figure 26 Combination lighting from position 3

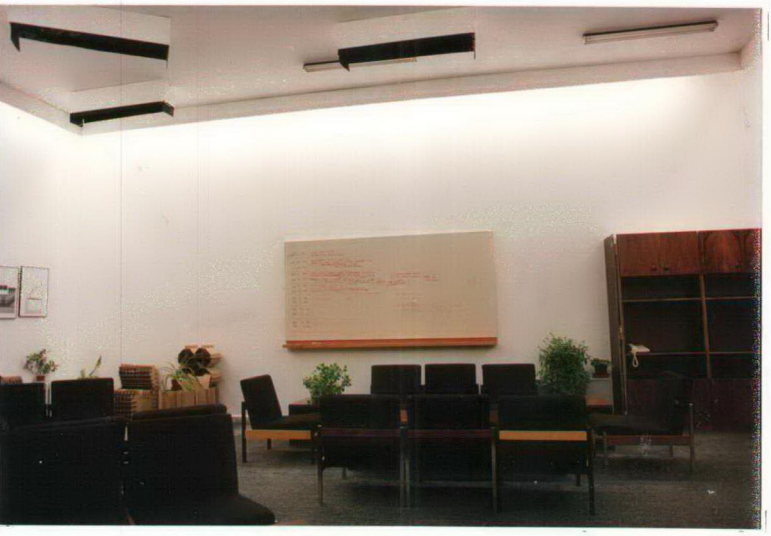


Figure 27 Peripheral lighting from position 4

Figure 28 Overhead down lighting from position 4

Figure 29 Combination lighting from position 4

Data Analyses:

Each of the seventeen subjects' evaluations on the 19 adjective pairs were converted into two sets of numerical scores 1 to 7 with 1 representing the negative end of the scale, e.g. small, cluttered, repelling etc., and 7 referring to the positive one, e.g. large, uncluttered, inviting, etc. for spaciousness factors. The reverse was true for the crampedness factors. For each subject, the mean scores of the adjective pairs for each of the three spaciousness and four crampedness factors were calculated. Table 21 and Table 22 and Figure 33 and Figure 34 in Appendix B, show the results of this calculation.

These two sets of scores were then used in the two separate multivariate analyses of variance (MANOVA) for spaciousness and crampedness factors by using the SPSS (Statistical Package for Social Sciences) Statistical Analysis Package.

Results Related to Spaciousness:

Table 13 shows the mean scores for the three spaciousness factors of appeal (F1), planning (F2) and space freedom (F3) of the peripheral lighting arrangement which were 4.85, 4.02 and 4.29, respectively. Those of the overhead downlighting arrangement were 3.81, 3.99 and 3.85 and

finally those of the combination of peripheral lighting and overhead direct-high intensity lighting were 4.65, 4.42, and 4.60 all respectively.

Table 13 Mean scores for the spaciousness factors F1, F2, F3 in different lighting arrangements.

	Peripheral L.	Overhead D.L.	Combi. L.
F1:Appeal	4.85	3.81	4.65
F2:Planning	4.02	3.99	4.42
F3:Space freedom	4.29	3.85	4.60

The differences between the three experimental conditions of the room were analyzed by a 3 (peripheral / overhead direct / combination) x 3 (appeal / planning / space freedom) multivariate analysis of variance (MANOVA) with repeated measures design on two variables. Table 14 summarizes the results of this analyses.

As can be seen in the table, neither the main effects of spaciousness factors and lighting organizations nor their interaction were found to be statistically significant at the 0.05 level, ($p<0.093$, $p<0.057$, $p<0.059$ respectively). Thus, it was found that different lighting arrangements in the room did not affect its evaluation in terms of spaciousness factors.

Table 14 Summary table, 3 x 3 multivariate analysis of variance (MANOVA)

Source	df	SS	ms	F	P
Within cells	32	141479.12	4421.22		
Factor	2	22593.10	11296.55	2.56	0.093
Within cells	32	636055.67	19876.74		
Light. Arran.	2	124663.88	62331.94	3.14	0.057
Within cells	64	313129.54	4892.65		
Factor x Light. Arran.	4	46976.90	11744.23	2.40	0.059

Results Related to Crampedness Factors:

Table 15 Mean scores for the crampedness factors F1, F2, F3, F4 in different lighting arrangements

	Peripheral L.	Overhead D.L.	Combi. L.
F1:Planning	3.79	4.00	3.53
F2:Physical size	3.28	4.03	3.16
F3:Clutteredness	3.85	4.06	3.49
F4:Appeal	3.22	4.20	3.39

Table 15 shows the mean scores for the four crampedness factors of planning (F1), physical size (F2), clutteredness (F3) and appeal (F4). For the peripheral lighting arrangement they were 3.79, 3.28, 3.85 and 3.22, respectively. Those in downlighting were 4.00, 4.03, 4.06 and 4.20, and finally those in the combination were 3.53, 3.16, 3.49 and 3.39, respectively.

The differences between these three experimental conditions of the room were analyzed by a 3 (peripheral / overhead down / combination) x 4 (planning /physical size / clutteredness / appeal) multivariate analysis of variance (MANOVA) with repeated measures on two variables, namely lighting arrangement and crampedness factors. The results of this analyses are summarized in Table 16.

Table 16 Summary table, 3 x 4 multivariate analysis of variance (MANOVA)

Source	df	SS	ms	F	P
Within cells	48	247784.81	5162.18		
Factor	3	33795.27	11265.09	2.18	0.102
Within cells	32	669011.51	20906.61		
Light. Arran.	2	173867.32	86933.66	4.16	0.025
Within cells	96	585148.22	6095.29		
Factor x Light. Arran.	6	41854.95	6975.83	1.14	0.343

As it is seen in the table, only the main effect of lighting arrangements (organization) was significant ($p=0.025$) whereas crampedness factors and the interaction (of organization and crampedness factors) did not show any significance. ($p<0.102$, $p<0.343$ respectively).

Main Effect of Lighting Arrangements: The main effect of lighting arrangements indicated that the mean crampedness

evaluations varied in the three experimental conditions. As can be seen in Table 17 and Figure 30 in the peripheral lighting the overall mean evaluation of the four crampedness factors were 3.54; in the downlighting it increased to 4.07; whereas in the combination it was lowest, 3.39.

Table 17 Mean values for the main effect of lighting arrangements

Peripheral L.	Overhead D.L.	Combi. L.
3.54	4.07	3.39

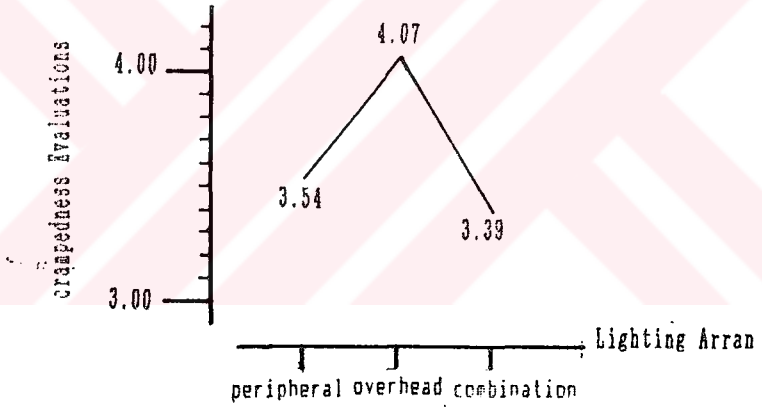


Figure 30 Mean evaluations as a function of the levels of lighting arrangements and crampedness

Pairwise t-test analysis for these values shows that the difference between peripheral lighting versus overhead direct lighting and overhead direct lighting versus combination lighting was found to be significant ($p<0.0072$; $p<0.0001$), whereas, the difference between

peripheral lighting and combination lighting was not found to be significant. ($p<0.44$). This means that when the lighting condition changed from peripheral to overhead direct lighting, the room was evaluated as being more cramped. When the lighting arrangement was changed from overhead direct lighting to combination, the room was evaluated as being less cramped. Moreover, it seems that the difference between overhead direct lighting and combination lighting is much more significant than the difference between peripheral lighting and overhead direct lighting. In addition, the room was perceived as being most cramped when overhead down lighting system was used, whereas it was evaluated as being least cramped only when combination lighting system was in use.

In addition to all these findings, it was indicated through comments made by participants during and after experiment briefing, that, they found some of the conditions of room either pleasant or unpleasant with respect to the differences in modifications of the tested variables, however these feelings or emotions have not yielded definite behavioral outcomes towards the space.

4.3. Discussion

This section contains an overall discussion of the findings of the two case studies variables.

Case Study 1. The Effect of Furniture Organization on The Perception and Evaluation of Spaciousness

This experimental study tested the effects of various furniture organizations in a room on spaciousness and crampedness as measured by the S-C-S. Thus, it examined a "relation question."

The results obtained in the study partially supported the first hypothesis (H1). They indicated that the organization (orderliness) of furniture in the room affected its perception and evaluation significantly, only in terms of spaciousness factors. This finding is in general, supportive of the findings of an earlier study conducted by İmamoğlu (1976).

As far as the spaciousness evaluations were concerned the study showed that perception and evaluation of spaciousness varied mainly as a function of the room organization. The main effect of organization and interaction confirmed an extension of H1 that organized condition of the room was perceived and evaluated to be significantly different than disorganized and very disorganized conditions of the room. This indicated that as the room became more organized, it was evaluated as being significantly more spacious thus less cramped than the disorganized and very disorganized rooms. This general

result could be said of all the spaciousness factors (appeal, planning, space freedom).

It can be said that levels of organizations were found to be effective in measuring and evaluating spaciousness in interiors where the three spaciousness factors were used as the means.

As far as the crampedness evaluations were concerned, the study showed that perception and evaluation of crampedness varied mainly as a function of the room organization. The main effect of organization and interaction confirmed an extension of H1 that the organized room was perceived and evaluated to be significantly different than the disorganized and very disorganized ones. This means that as the room became more disorganized, it was evaluated as being more cramped.

Besides the results discussed above it was also found that crampedness factors failed to be effective in measuring crampedness of interiors. This contradicts the findings of the study which Imamoglu had carried out in 1976.

When comparing the spaciousness and crampedness evaluations it seems that the spaciousness factors are to be regarded as more powerful tools than the crampedness factors in assessing interiors in terms of orderliness of furniture in interior spaces. This result could also be

explained as follows: the orderliness of interior spaces were evaluated and measured more effectively by the means of spaciousness factors rather than crampedness factors

Case Study 2. The Effect of Lighting Arrangements on The Perception and Evaluation of Spaciousness

This experimental study on the other hand, tested the effects of differences between three types of lighting arrangement systems in a room. Thus, it has examined a "difference question." Table 18 and Figure 17 shows the intensity measurements which were taken from the three points in the room.

Table 18 Illuminance measurements

	Peripheral lighting.	Overhead down lighting	Combination lighting
1st position	350 lux	200 lux	530 lux
2nd position	314 lux	231 lux	532 lux
3rd position	293 lux	250 lux	544 lux

The results partially supported the hypothesis (H2) that different lighting arrangement systems in an interior space affect its perception and evaluation in terms of spaciousness and crampedness.

As far as the spaciousness evaluations were concerned, the results indicated that different lighting arrangements in the room did not affect its perception and evaluation in terms of spaciousness because neither the main effects of spaciousness factors and lighting arrangements nor their interaction were found to be significant.

As far as the crampedness evaluations were concerned, the three lighting conditions resulted in different crampedness evaluations. It can be stated that in crampedness evaluations, the results showed that perception and evaluation of spaciousness / crampedness varied significantly as a function of the three different lighting arrangement systems. Both the rooms with peripheral lighting and combination lighting were assessed as being less cramped than the room with overhead down lighting.

As regards peripheral lighting arrangement, the hypothesis (Steffy, 1990) that a room seems to be more spacious / less cramped with peripheral lighting-all walls, was supported.

As for overhead direct lighting, the hypothesis that the room was perceived and evaluated as being less spacious/more cramped was supported.

In the combination lighting arrangement, the room was

perceived and evaluated as being the most spacious/least cramped. The reason was that the room had a fairly uniform lighting and peripheral areas as well as the center area of the space obtained the most illuminance values when compared to the other room conditions. The perceived brightness of the space was at the highest value and as a result the effect has been assessed as the most spacious / least cramped.

The room with overhead direct lighting was assessed to be significantly different than the rooms having either peripheral lighting or combination lighting. Both the rooms having peripheral lighting or combination lighting arrangements assessed to be almost the same in terms of spaciousness and crampedness. In addition, it was also found that in crampedness evaluations, the difference between overhead down lighting and combination lighting was much more significant than the difference between overhead direct lighting and peripheral lighting.

Different lighting arrangements in the room, resulted in differences in illumination measurements. As regards the measurement taken at three points in the room (see Table 18 and Figure 17), it was found that peripheral lighting and combination lighting arrangements differed substantially in terms of illumination, whereas there was not any significant differences observed between these two

lighting arrangements in crampedness evaluations. This finding could be interpreted to mean that measurements on visual impressions in terms of crampedness evaluations and measurements of illumination levels of different lighting arrangements may not give the same result.

It could be concluded that when comparing spaciousness and crampedness evaluations, it seems that crampedness evaluations are to be regarded as more powerful and expressive tools in evaluations a room's spaciousness \ crampedness in terms of the three different lighting arrangements. This can also be explained as follows: the differences between the three lighting arrangements can be evaluated and measured more effectively by the means of crampedness evaluations rather than spaciousness evaluations.

5. CONCLUSION

Contributions to the understanding of man-environment relationships have increased rapidly in recent years. The actual and potential importance of this type of research should be found evident in such values as environmental qualities, person-based variables and behavioral outcomes. Nevertheless, work in this field has not attained its full potential through definitions, objectives and mechanisms for applying research results to the needs of environmental planning and decision making. Thus, studies in this field require a more systematically organized and theoretical base.

Research in man-environment relationship mainly concentrates on one particular parameter of human response; environmental preference, environmental judgment, environmental behavior. Unfortunately, little effort has been made in studying and exploring the connections between them. Thus this thesis has attempted to explore , theoretically, the relevance between various person-based variables and interior spaces, particularly, in terms of perception-evaluation processes and spaciousness, which refers to functional, aesthetic and psychological aspects of interior spaces.

Many researchers have directly or indirectly studied the effects of various architectural variables on spaciousness assessments. A general statement can be made to the effect that architectural variables affect both visual and subjective impressions of interior spaces. This perception may be studied by one particular evaluative factor: the spatial enclosedness factor which is closely related to spaciousness. Other factors such as pleasantness evaluations, social evaluations, factors of complexity and unity may be regarded as means which effect the outcome of experimental studies related to spaciousness.

What has been discussed theoretically in man-environment-behavior relationship should be supported visually on a particular factor structure. In this light, another contribution of this thesis has been to clarify the general notion that discrete manipulations of architectural spaces through variations in architectural variables cause differences in the subjective ratings of these spaces by individuals.

Previous studies have concentrated especially on the effects of five major architectural variables, namely, room geometry, color, lighting, window and furniture on perception and evaluation of spaciousness. The results of these studies show the following:

a. Various features of room geometry such as vertical elements, size and shape, room proportions (height/depth ratio) affect the openness-closedness of the room itself.

b. Variations in the color variables hue, chroma and value have been found to affect the perceived volume of interiors.

c. Three lighting arrangements, such as peripheral, downlighting and combination lighting systems affect spaciousness.

d. The size and shape of windows on the vertical surfaces affect the perceived spaciousness of interiors.

e. Orderliness of the furniture and other items items in a room affect its spaciousness.

Two of these general findings have been supported experimentally in this thesis within context of the two case studies. The first study investigated the relationship between the effects of three different furniture organizations on the spaciousness assessments. It was found that organization of furniture in the room affected its perception and evaluation in terms of spaciousness. Furthermore, spaciousness varied as a function of the three different room organizations. The

second study investigated the effects of differences between three types of lighting arrangements on the assessment of interior spaces. It was found that in general, perception and evaluation of crampedness varied as a function of different lighting arrangements. Nevertheless this finding could not be said for spaciousness.

On the basis of the results obtained throughout the two case studies it can be said that when an interior becomes more disorganized it is perceived as being smaller, more cramped and cluttered as well as poorly planned and failing to satisfy the functional requirement; in addition to these it looks unappealing. This common conclusion confirms a statement that:

> ...every interior must at least score low on crampedness scale (not cramped); the failure of this condition means the failure of proper functioning of the space. On the other hand, high values on the spaciousness scale means that the particular interior not only fits functional and physical requirements, but also gives some emotional satisfaction or comfort to the occupants. (İmamoğlu, 1986, p.132)

With regard to the modifications in the room studied, whereas significant differences were observed in the assessment of spaciousness, there were not any changes observed in the attitudes of the individuals towards the

room. Thus, perception and evaluation of interiors in terms of spaciousness is found to be directly related to the process of interaction between man and interior spaces (with various architectural variables), whereas it is found to be related indirectly with the process between interior spaces and behavioral outcomes. This could be the reason why throughout the study, immediate impressions were observed in a very limited time interval rather than a vast period of time. The study was designed to aim at observing immediate visual impressions rather than affecting certain behavior types.

One potential pitfall pointed out by experiments in this thesis lies in studying lighting as an isolated variable. It should be noted, for example, that for an interior in which color is used more actively than the interior in our studies, light can never be studied alone without considering its relationship to color. It is well known that color and light have a mutual relationship each affecting the other. A general statement can be drawn out of this is that light can never be effective on measuring spaciousness without consideration of other architectural variables.

One extension of the results of this experiment show that illumination values obtained at working plane level should be regarded as one of the important factors which

have an effect on the perception and evaluation of interior spaces. For further studies, in which the illumination levels could be kept constant for different lighting arrangements by altering the illumination through the use of a dimmer, the effects of differences in lighting arrangements on perception and evaluation of spaciousness / crampedness may lead to a more reliable conclusion.

The scope, thus the validity of this study has been limited by the actual circumstances in which the experiments took place. It should be noted that studies focused only on the case of a single room.

Another limitations of these studies is explained by the characteristics of the method and scale used in the experiment. The studies which have previously used the s-c-s scale have implied that:

> ...spaciousness is a powerful and reliable construct bringing together important aspects of an interior space...In other words, spaciousness judgments of interiors take into account not only the affective aspects but also their intricate functional sides. Hence, the spaciousness scale can be considered a general evaluation scale for interior spaces. (İmamoğlu, 1986, p.136).

In the final analysis, this thesis may be interpreted as an exploration of importance as well as the validity of the Spaciousness-Crampedness scale.

APPENDIX A

A.1. Instruction Sheet

The studies conducted in the thesis were introduced to the subjects by the instruction sheet which was prepared by İmamoğlu given below:

The purpose of this study is to understand how people perceive and evaluate ceratin interiors. You will be shown a particular interior (the coffee room) and will be asked to judge it in terms of some bipolar adjective pairs.

Please indicate your judgement of the interior on each of the adjective pairs using 7-point scale. Here is how you are to use the scales:

If you feel that the interior you see is very closely related to one end of the scale, tou should tick as follows:

beautiful --:--:--: -- :--:--:--✓ ugly

beautiful ✓--:--:--: -- :--:--:-- ugly

If you feel that the interior is quite closely related to

one or other end of the scale (but not extremely), you should tick as follows:

beautiful --:--:--: -- :--:✓--:-- ugly

beautiful --:✓--:--: -- :--:--:-- ugly

If the interior seems only slightly related to one or the other side (but is not really neutral), then you should tick as follows:

beautiful --:--:--: -- :✓--:--:-- ugly

beautiful --:--:✓--: -- :--:--:-- ugly

The direction toward which you tick, ofcourse, depends upon which of the two ends of the scale seem most characteristic of the interior you are judging

If you consider the interior to be neutral on the scale, or if the sscale is completely irrelevant to the interior you see, then tou should tick the line in the middle.

Tick only one line on each bipolar adjective.

Be sure to tick every adjective pair.

Make a separate and independent judgement for each adjective pair.

Do not worry or puzzle over individual adjective pairs. It is your immediate feelings about the interior that I want.

Bipolar adjevtive pairs are as follows:

Uncoordinated	--:--:--: -- :--:--:--	Coordinated
Comfortable	--:--:--: -- :--:--:--	Uncomfortable
Tiny	--:--:--: -- :--:--:--	Huge
Restful	--:--:--: -- :--:--:--	Disturbing
Small	--:--:--: -- :--:--:--	Large
Well planned	--:--:--: -- :--:--:--	Poorly planned
Closed	--:--:--: -- :--:--:--	Open
Repelling	--:--:--: -- :--:--:--	Inviting
Poorly scaled	--:--:--: -- :--:--:--	Well scaled
Wide	--:--:--: -- :--:--:--	Narrow
Unlivable	--:--:--: -- :--:--:--	Livable
Roomy	--:--:--: -- :--:--:--	Cramped
Crowded	--:--:--: -- :--:--:--	Uncrowded
Inadequate size	--:--:--: -- :--:--:--	Adequate size
Full	--:--:--: -- :--:--:--	Empty
Uncluttered	--:--:--: -- :--:--:--	Cluttered
Well organized	--:--:--: -- :--:--:--	Poorly organized
Poorly balanced	--:--:--: -- :--:--:--	Well balanced
Restricted space	--:--:--: -- :--:--:--	Free space

A.2. Related Adjective Pairs for Three Spaciousness and Four Crampedness

The Spaciousness-Crampedness Scale consists of 19 adjective pairs. Taken seperately, the three spaciousness factors are consisted of 17 items while the four crampedness factors are consisted of 15 items; 13 items are common to both scales. (İmamoğlu, 1986).

The 19 adjective pairs given below can be regarded as workable and meaningful lexicon of architectural descriptors, a vocabularly which includes terms that are relevant and appropriate to describe architectural spaces. (Kasmar, 1970).

1.For spaciousness factors:

Factor 1. APPEAL

Repelling - Inviting

Uncomfortable - Comfortable

Disturbing - Restful

Unlivable - Livable

Factor 2. PLANNING

Poorly organized - Well organized

Poorly scales - Well scaled

Poorly balanced - Well balanced

Uncoordinated - Coordinated

Poorly planned - Well planned

Factor 3. SPACE FREEDOM

Cramped - Roomy

Tiny - Huge

Small - Large

Restricted soace - Free space

Cluttered - Uncluttered

Crowded - Uncrowded

Closed - Open

Narrow - Wide

2. For crampedness factors:

Factor 1. PLANNING

Poorly planned - Well planned

Poorly organized - Well organized

Uncoordinated - Coordinated

Poorly balanced - Well balanced

Factor 2. PHYSICAL SIZE

Small - Large

Tiny - Huge

Narrow - Wide

Factor 3. CLUTTEREDNESS

Full - Empty

Crowded - Uncrowded

Cluttered - Uncluttered

Cramped - Roomy

Inadequate size - Adequate size

Factor 4. APPEAL

Uncomfortable - Comfortable

Unlivable - Livable

Disturbing - Restful

APPENDIX B

B.1. Table 19 For each subject, mean scores of the adjective pairs of the three spaciousness F1, F2, F3 for furniture organization.

# of subjects	Organized	Disorganized	Very Disorganized
s1	3.50	2.25	5.25
s2	4.25	1.50	2.75
s3	4.00	2.50	4.25
s4	1.25	1.00	2.25
s5	3.25	3.00	4.25
s6	5.00	3.25	2.25
s7	5.00	4.00	2.25
s8	3.00	2.00	1.00
s9	3.50	3.50	4.25
s10	2.00	2.00	1.00
s11	3.75	1.00	1.00
s12	3.75	2.50	2.00
s13	2.75	3.00	2.25
s14	4.75	2.50	1.75
s15	4.00	2.25	3.00
s16	5.50	1.50	1.75
s17	2.50	2.00	2.50
s18	3.75	3.50	1.25

F1: Appeal

Repelling-Inviting
Disturbing-Restfull
Uncomfortable-Comfortable
Unlivable-Livable

# of subjects	Organized	Disorganized	Very Disorganized
s1	3.40	2.40	3.20
s2	4.20	1.40	3.20
s3	4.40	3.80	2.80
s4	3.00	1.00	4.40
s5	1.60	2.60	4.20
s6	3.60	2.00	1.80
s7	5.60	3.00	1.60
s8	3.20	1.80	1.00
s9	3.80	2.60	3.80
s10	2.40	1.80	1.00
s11	5.00	1.00	1.00
s12	3.80	2.20	1.20
s13	2.60	2.80	3.00
s14	4.00	2.20	2.40
s15	3.20	2.00	3.60
s16	4.60	1.00	1.00
s17	2.20	1.80	2.80
s18	3.40	3.00	1.20

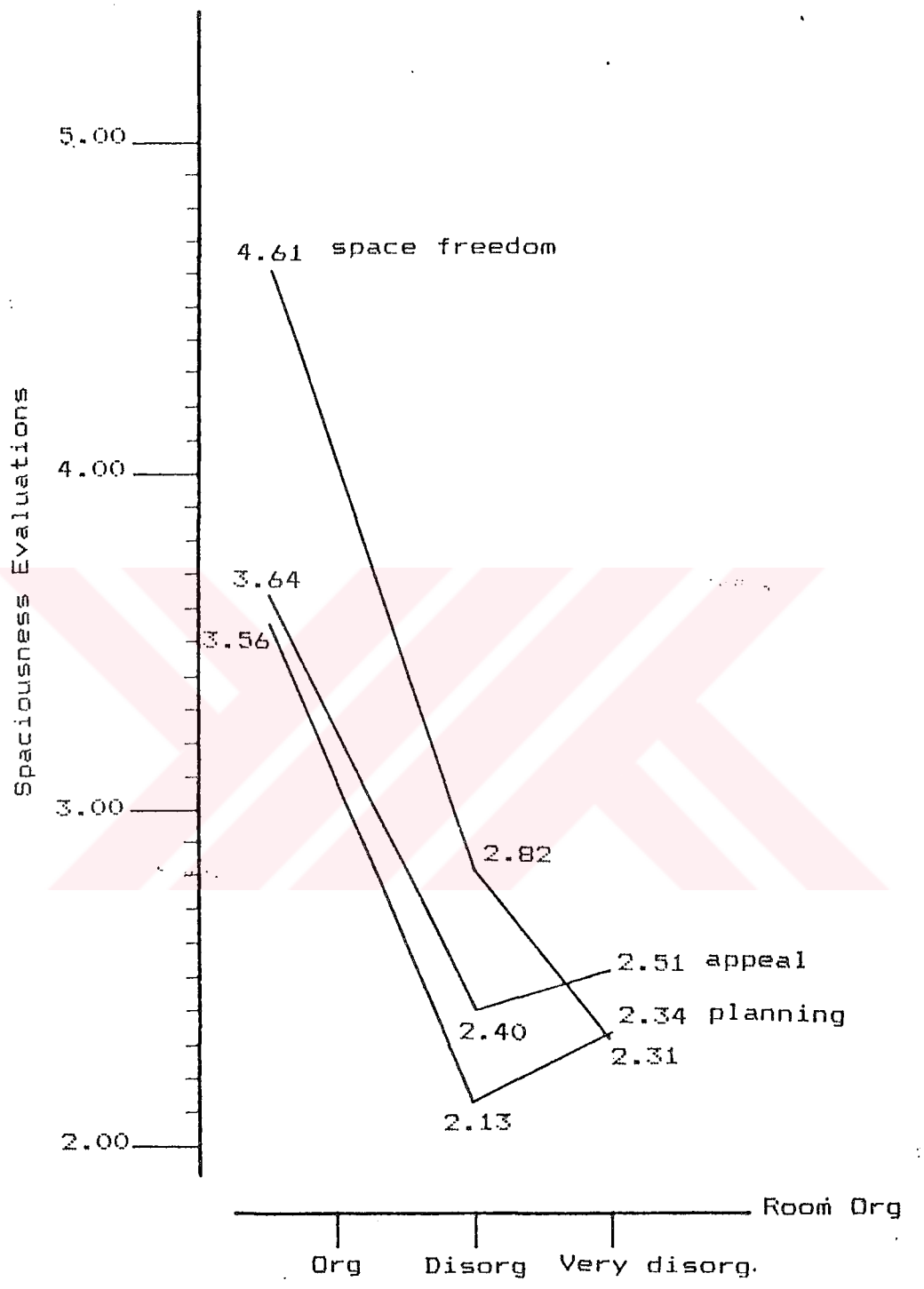
F2: Planning

Poorly organized-Well organized
Poorly scaled-Well scaled
Poorly balanced-Well balanced
Uncoordinated-Coordinated
Poorly planned-Well planned

# of subjects	Organized	Disorganized	Very Disorganized
s1	5.00	2.88	3.25
s2	3.88	2.00	3.37
s3	4.25	3.63	2.12
s4	3.63	2.37	2.75
s5	4.38	3.37	1.37
s6	5.63	3.50	1.62
s7	5.38	3.50	1.87
s8	4.13	3.50	2.87
s9	5.50	4.00	3.00
s10	4.13	2.12	1.12
s11	4.50	1.25	2.25
s12	4.25	2.38	1.75
s13	5.00	3.75	2.62
s14	5.00	2.37	1.25
s15	5.00	2.87	3.12
s16	5.38	2.60	2.25
s17	3.88	2.25	3.12
s18	4.00	2.37	1.87

F3: Space freedom

Small-Large
Crowded-Uncrowded
Cramped-Roomy
Tiny-Huge
Closed-Open
Restricted space-Free space
Cluttered-Uncluttered
Narrow-Wide



B.2. Figure 31 Mean scores for spaciousness factors F1, F2, F3 of the organized, disorganized and very disorganized rooms.

B.3. Table 20 For each subject, mean scores of the adjective pairs of the four carmpedness factors F1, F2, F3, F4 for furniture organization.

# of subjects	Organized	Disorganized	Very Disorganized
s1	4.25	5.50	4.50
s2	3.75	6.75	5.00
s3	3.25	4.25	5.00
s4	5.00	7.00	4.25
s5	6.25	5.75	4.25
s6	4.75	6.00	6.25
s7	2.50	5.25	6.75
s8	4.75	6.25	7.00
s9	4.50	5.75	4.00
s10	6.00	6.00	7.00
s11	3.25	7.00	7.00
s12	4.00	6.25	7.00
s13	5.50	5.25	5.00
s14	4.50	6.75	6.75
s15	4.75	5.75	4.50
s16	3.50	7.00	7.00
s17	5.75	6.50	5.50
s18	4.75	5.25	7.00

F1: Planning

Poorly planned-Well planned
Poorly organized-Well organized
Uncoordinated-Coordinated
Poorly balanced-Well balanced

# of subjects	Organized	Disorganized	Very Disorganized
s1	3.00	4.00	3.33
s2	4.33	5.00	4.33
s3	4.00	4.00	5.33
s4	3.67	3.33	6.67
s5	4.00	3.67	6.00
s6	2.33	4.33	5.67
s7	3.67	4.33	5.67
s8	4.00	4.00	4.00
s9	2.67	3.33	4.33
s10	4.33	5.33	6.67
s11	3.00	6.67	4.67
s12	4.00	5.00	5.67
s13	3.00	3.33	5.33
s14	3.67	5.00	6.33
s15	4.00	4.00	4.00
s16	3.33	4.67	5.33
s17	4.00	5.33	4.67
s18	4.00	5.00	6.00

F2: Physical size

Small-Large
Tiny-Huge
Narrow-Wide

# of subjects	Organized	Disorganized	Very Disorganized
s1	4.40	5.80	6.20
s2	4.40	6.60	5.20
s3	4.00	4.80	6.00
s4	5.60	6.40	6.40
s5	4.60	5.80	7.00
s6	2.60	5.40	7.00
s7	2.00	4.60	6.50
s8	3.80	4.20	5.40
s9	2.80	4.40	5.69
s10	4.00	5.80	7.00
s11	2.60	7.00	7.00
s12	3.20	6.00	6.20
s13	2.80	5.00	5.40
s14	2.60	6.00	7.00
s15	2.20	5.40	5.20
s16	2.60	6.40	6.00
s17	4.20	5.60	4.80
s18	4.00	5.60	6.20

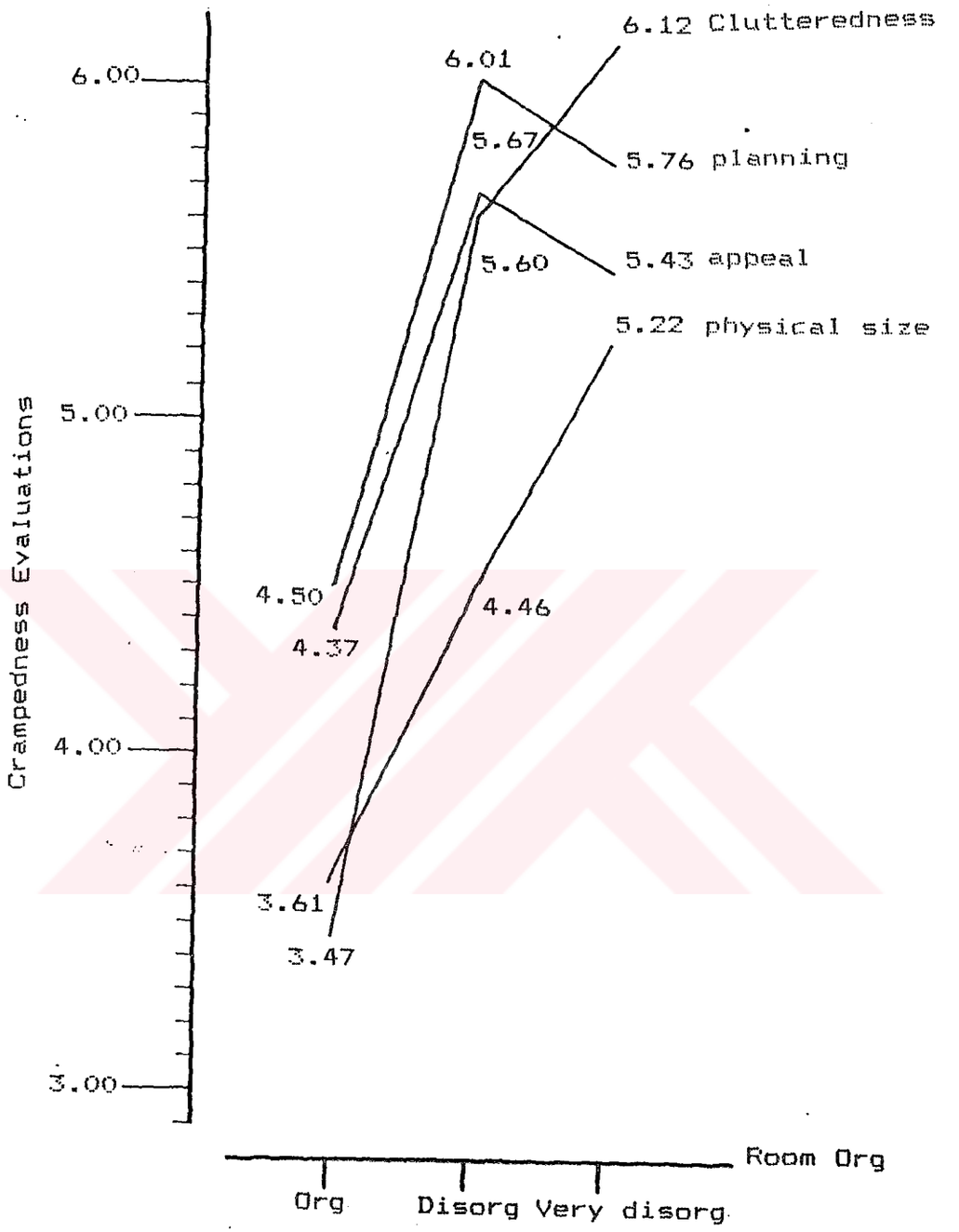
F3: Clutteredness

Full-Empty
Crowded-Uncrowded
Cluttered-Roomy
Inadequate size-Adequate size

# of subjects	Organized	Disorganized	Very Disorganized
s1	4.67	5.67	3.00
s2	3.67	6.33	5.00
s3	4.00	5.67	3.33
s4	7.00	7.00	5.00
s5	5.00	5.33	3.33
s6	3.00	5.00	5.67
s7	2.67	4.00	6.00
s8	5.00	6.00	7.00
s9	4.67	5.00	4.00
s10	6.33	6.00	7.00
s11	4.33	7.00	7.00
s12	4.00	5.33	5.67
s13	5.00	5.00	5.67
s14	3.33	5.67	6.33
s15	4.00	6.00	5.00
s16	2.67	6.33	6.33
s17	5.00	6.00	5.67
s18	4.33	4.67	6.67

F4: Appeal

Uncomfortable-Comfortable
Unlivable-Livable
Disturbing-Restfull



B.4. Figure 32 Mean scores for the crampedness F1,F2, F3, F4 of the organized, disorganized and very disorganized rooms.

B.5. Table 21 for each subject, mean scores of the adjective pairs of three spaciousness factors F1, F2, F3, for lighting arrangements.

# of subjects	Peripheral Lighting	Overhead Down Lighting	Combination Lighting
s1	5.75	2.00	3.50
s2	6.25	3.00	5.25
s3	6.00	5.75	4.25
s4	2.00	2.50	5.00
s5	5.75	4.50	4.00
s6	4.25	1.75	3.50
s7	3.75	2.75	5.25
s8	5.25	3.25	4.50
s9	4.00	3.00	5.25
s10	3.25	4.25	3.00
s11	5.00	5.25	3.25
s12	7.00	4.50	5.50
s13	5.00	3.50	4.50
s14	6.25	5.00	6.25
s15	1.50	6.25	4.25
s16	5.50	4.50	5.75
s17	6.00	3.00	6.00

F1: Appeal

Repelling-Inviting
Disturbing-Restfull
Uncomfortable-Comfortable
Unlivable-Livable

# of subjects	Peripheral Lighting	Overhead Down Lighting	Combination Lighting
s1	4.60	3.20	4.20
s2	5.20	3.20	5.20
s3	5.80	5.80	4.20
s4	3.40	4.60	4.80
s5	4.40	4.20	3.80
s6	2.67	4.00	4.20
s7	3.40	2.40	5.20
s8	2.80	3.60	3.80
s9	2.40	3.40	3.60
s10	2.40	3.00	2.60
s11	4.60	5.20	3.80
s12	5.80	4.60	4.80
s13	4.20	3.60	4.00
s14	5.20	5.20	6.20
s15	2.00	5.60	3.80
s16	5.20	3.80	5.20
s17	4.20	2.40	5.80

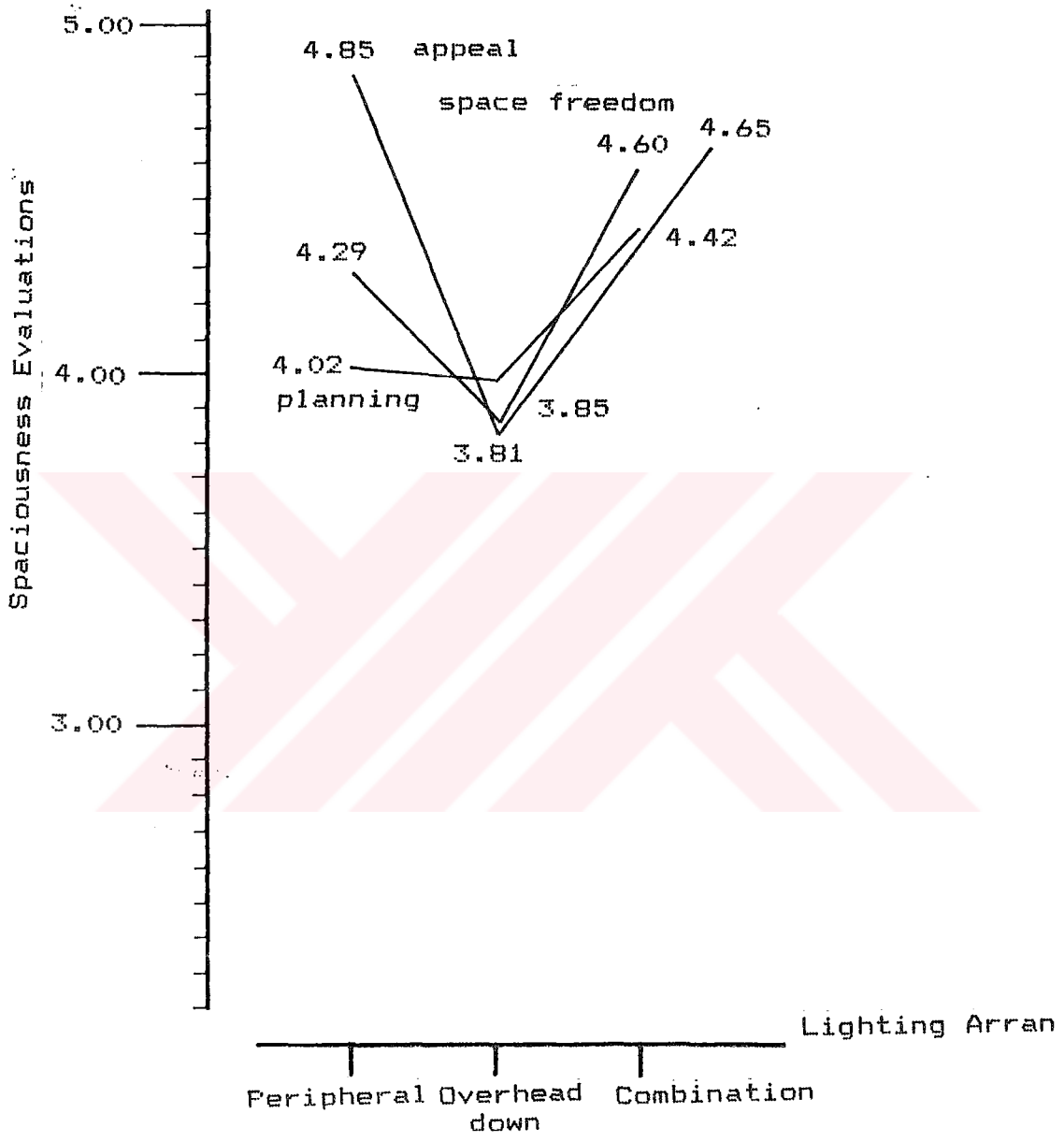
F2: Planning

Poorly organized-Well organized
Poorly scaled-Well scaled
Poorly balanced-Well balanced
Uncoordinated-Coordinated
Poorly planned-Well planned

# of subjects	Peripheral Lighting	Overhead Down Lighting	Combination Lighting
s1	3.25	5.00	5.63
s2	4.63	3.13	4.13
s3	4.38	4.50	4.00
s4	3.25	4.75	4.50
s5	4.38	4.63	4.50
s6	3.25	3.00	4.63
s7	4.00	3.25	3.50
s8	2.88	3.63	3.88
s9	4.88	2.50	5.00
s10	3.13	3.63	3.13
s11	4.63	3.25	4.63
s12	5.88	4.50	5.13
s13	4.38	3.50	3.75
s14	5.75	5.00	6.25
s15	4.13	4.88	4.38
s16	5.00	3.63	5.13
s17	5.13	2.75	6.00

F3: Space freedom

Small-Large
Crowded-Uncrowded
Cramped-Roomy
Tiny-Huge
Closed-Open
Restricted space-Free space
Cluttered-Uncluttered
Narrow-Wide



B.6. Figure 33 mean scores for spaciousness factors F1, F2, F3, of room conditions having peripheral wall lighting, overhead direct lighting and combination lighting arrangements.

B.7. Table 22 For each subject, mean scores of the adjective pairs of four crampedness factors F1, F2, F3, F4 for lighting arrangements.

# of subjects	Peripheral Lighting	Overhead Down Lighting	Combination Lighting
s1	2.75	4.75	3.50
s2	2.75	4.75	3.00
s3	2.00	2.25	3.75
s4	4.50	3.75	3.50
s5	4.00	3.75	4.25
s6	5.00	3.75	3.75
s7	4.50	5.50	2.75
s8	5.25	4.50	4.00
s9	5.75	4.50	4.00
s10	4.75	5.00	5.50
s11	3.25	2.75	4.00
s12	2.00	3.50	3.25
s13	3.25	4.25	3.75
s14	2.75	2.75	1.75
s15	6.25	2.25	4.25
s16	2.75	4.25	2.75
s17	3.00	5.75	2.25

F1: Planning

Poorly planned-Well planned
Poorly organized-Well organized
Uncoordinated-Coordinated
Poorly balanced-Well balanced

# of subjects	Peripheral Lighting	Overhead Down Lighting	Combination Lighting
s1	4.67	3.33	2.67
s2	3.00	3.00	2.67
s3	4.00	3.33	3.67
s4	4.33	3.33	3.33
s5	3.67	4.00	3.00
s6	4.33	4.67	3.67
s7	3.00	5.20	3.00
s8	4.33	4.33	4.00
s9	1.67	6.00	2.67
s10	3.67	4.33	4.33
s11	3.33	4.00	3.67
s12	1.67	3.33	3.00
s13	4.00	4.67	4.67
s14	2.67	2.33	1.67
s15	2.00	4.00	2.67
s16	2.67	3.67	2.67
s17	2.67	5.00	2.33

F2: Physical size

Small-Large
Tiny-Huge
Narrow-Wide

# of subjects	Peripheral Lighting	Overhead Down Lighting	Combination Lighting
s1	3.80	2.80	2.00
s2	3.60	4.40	3.40
s3	3.20	3.00	4.20
s4	4.60	2.60	4.20
s5	3.60	3.60	3.60
s6	4.80	4.80	3.60
s7	3.80	5.00	3.00
s8	4.33	4.40	4.00
s9	3.80	4.80	3.60
s10	5.60	4.60	4.80
s11	3.40	4.40	3.80
s12	3.40	3.60	2.80
s13	3.20	4.80	4.40
s14	3.00	2.60	2.00
s15	5.20	3.40	4.60
s16	3.80	5.00	3.20
s17	2.40	5.20	2.20

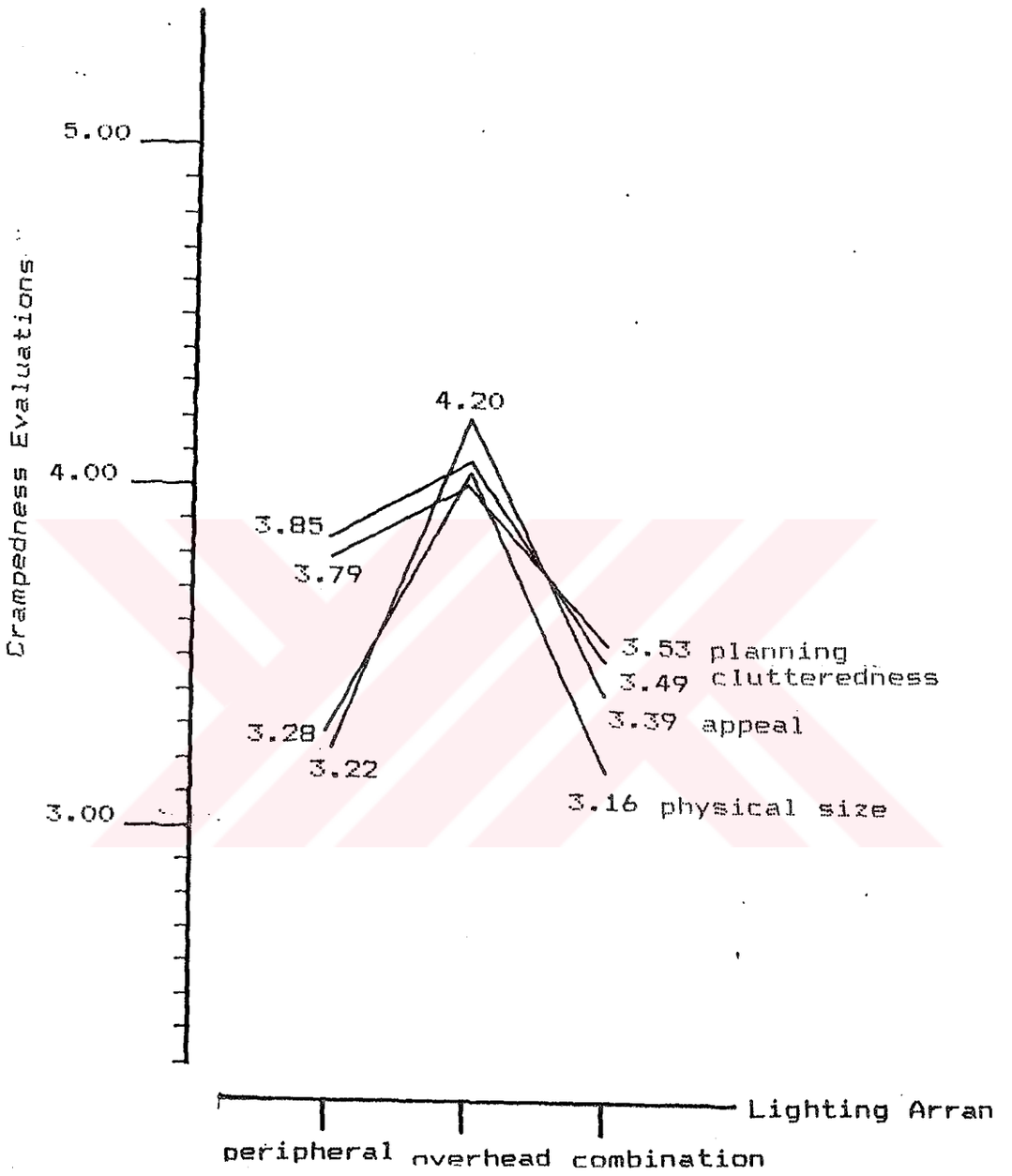
F3: Clutteredness

Full-Empty
Crowded-Uncrowded
Cluttered-Roomy
Inadequate size-Adequate size

# of subjects	Peripheral Lighting	Overhead Down Lighting	Combination Lighting
s1	2.00	6.00	4.33
s2	1.67	5.00	2.67
s3	2.00	2.33	4.00
s4	6.00	5.67	3.00
s5	2.33	3.33	3.67
s6	4.00	6.33	4.33
s7	4.33	5.33	3.00
s8	2.67	4.67	3.33
s9	4.00	4.67	2.67
s10	5.00	4.00	5.00
s11	3.00	2.67	4.67
s12	1.00	3.33	2.33
s13	2.67	5.00	3.67
s14	2.67	3.00	1.67
s15	7.00	1.33	3.67
s16	2.33	3.67	2.33
s17	2.00	5.00	3.33

F4: Appeal

Uncomfortable-Comfortable
Unlivable-Livable
Disturbing-Restfull



B.8. Figure 34 Mean scores for crampedness factors F1, F2, F3, F4 of room conditions having peripheral wall lighting, overhead direct lighting and combination lighting arrangements.

REFERENCES

ALTMAN, I. and CHRISTENSEN, K. Environment and Behavior Studies: Emergence of Intellectual Traditions. Vol.11 New York: Plenum Press, 1990.

ACKING, C. A. and Kuller, R. "The Perception of an Interior as a Function of its Color". Ergonomics. 15.16 (1972): 645-654.

BAIRD, J.C., et.al. "Room Preferences as A Function of Architectural Features and User Activities." Journal of Applied Psychology. 63.6 (1978): 719-727.

BARKER, R. Ecological Psychology. Stanford, Calif:Stanford University Press, 1968.

BIRREN, F. Light, Color and Environment. 2nd. ed. Pennsylvania: Schiffer Publishing Ltd., 1988.

BLOOMER, C.M. Principles of Visual Perception.New York: Design Press, 1990.

BOUBEKRI, M. et.al. "Impact of Window size and Sunlight Penetration on Office Worker's Mood and Satisfaction: A Novel Way of Assessing Sunlight." Environment and Behavior. 23:4 July (1991):474-493.

BUTTLER, D. and BINER, M. "Effects of Setting on Window Preferences and Factors Associated with those Preferences." Environment and Behavior Studies. 21:1 (1989):17-31

BUTTLER, D. and STEUERWALD, B.L. "Effects of View and Room size on Window size Preferences Made in Models." Environment and Behavior. 23:3 July (1991):334-358.

CANTER, D. "Evaluating Buildings: Emerging Scales and The Salience of Building Elements Over Constructs." Architectural Psychology: Proceedings of The Lund Conference, Stroudsbourg. Ed. Rikard Kuller. Pennsylvania: Dowden, Hutchinson and Ross Inc., 1973. 214-238.

DEMİRÖRS, M. Color In Interior Spaces. (an unpublished master thesis). Ankara, Department of Interior Architecture and Environmental Design and the Institutes of Fine Arts of Bilkent University, 1992.

FLYNN, J. E. Architectural Interior Systems. New York: Van Nostrand Reinhold, 1988.

HAYWARD, S. and FRANKLIN, S.S. "Percieved Openness-Enclosure of Architectural Space." Environment and Behavior. 6.1 (1974): 37-52.

HEIMSTRA, N. W., and McFARLING, L. H. Environmental Psychology. California: Wadsworth Publishing Company, 1974.

HENDRICK, C. et.al. "Procedures for Investigating the Effect of Light on Impression: Simulation of a Real Space by Slides". Environment and Behavior 9.4. (1977): 491-510.

HESSELGREN, S. Man's Perception of Man-Made Environment. Pennsylvania: Dowen, Hutchinson and Ross Inc., 1975.

İMAMOGLU, V. "İç Mekan Tasarımı, Donatımı ve Ferahlık," Hacettepe Üniversitesi, Güzel Sanatlar Fakültesi, İç Mekan Donatım Elemanlari ve Tasarım Sempozyumu Tebliğleri. Ankara: Hacettepe University, 1987. 33-42.

İMAMOĞLU, V. "Pencere ve İnsan Yaşami". Pencere ve Energy 84, Sempozyum Bildirileri. İstanbul: Dilek Matbaasi, 1984. 55-63.

İMAMOĞLU, V. "Room Assessment by Users and Non-Users". Human Requirements in Building, and User Studies: Proceedings of the 7th CIB Congress, Section G. , 1979. 85-90.

İMAMOĞLU, V. "Assessment of Living-rooms by Householders and Architects". Metu Building Science and Environmental Design 1. (1979): 1-12.

İMAMOĞLU, V. "Pencerenin Uzam Algılamasında Oynadığı Rol ve Psikolojik Açıdan Uygun Pencere Arayişında Bir Deneme". Ankara: METU Department of Building, Science and Environmental Design. Report no 8, (1981):1-10.

İMAMOĞLU, V. "The Effect of Furniture Density on the Subjective Evaluation of Spaciousness and Estimation of Size of Rooms". Architectural Psychology: Proceedings of the Lund Conference, Stroudsburg. Ed. R. Kuller. Pennsylvania: Dowden, Hutchinson and Ross Inc., 1973.

İMAMOĞLU, V. "The Relation Between Room Organization and Spaciousness". METU Journal of the Faculty of Architecture. 2 (1976): 205-214.

İMAMOĞLU, V. "Assessing the Spaciousness of Interiors". Journal of Metu 7.2 (1986):127-142.

INUI, M. and MIYATA, T. "Spaciousness in Interiors". Lighting Research and Technology 5.2 (1973): 103-111.

INUI, M. and MIYATA, T. "Spaciousness, Behavior and the Visual Environment". Journal of Lighting and Visual Environment 1.1 (1977):59-63.

ITTELSON, W. H., et.al. An Introduction to Environmental Psychology. U.S.A.: Holt, Reinhart and Winston Inc., 1974.

KAPLAN, S. "A Model of Person-Environment Compatibility." Environment and Behavior. 15.3 (1983): 311-322.

KASHMAR, J. V. "The Developement of Usable Lexicon of Environmental Descriptors". Environment and Behavior 2.2 (1970): 153-169.

KAYE, S. and MURRAY, M. A. "Evaluations of an Architectural space as a Function of Variations in Furniture Arrangement, Furniture Density and Windows." Human Factors. 24.5 (1982):609-618.

KULLER, R. "Beyond Semantic Measurement." Architectural Psychology: Proceedings of Lund Conference, Stroudsbourg. Ed. R. Kuller. Pennsylvania: Dowden, Hutchinson and Ross Inc., 1973: 181-197.

KUNISHIMA, M. and YANASE, T. "Visual Effects of Wall Colors in Living Rooms". Ergonomics. 28.6 (1985): 869-882.

LAM, W.M.C. Perception and Lighting: As Form givers for Architecture. Ed. C. H. Ripman. New York: Van Nostrand Reinhold, 1992.

LANG, J. Creating Architectural Theory: The Role of the Behavioral Sciences in Environmental Design. New York: Van Nostrand Reinhold, 1987.

LEE, S. A. " Environmental Perception, Preferences and the Designer." Architectural Psychology: Proceedings of the Lund Conference, Stroudsbourg. Ed. R. Kuller. Pennsylvania: Dowden, Hutchinson and Ross Inc., 1973: 112-126.

LOWENTHAL, D. "Research in Environmental Perception and Behavior: Perspectives on Current Problems." Environment and Behavior. Sept. 1972: 333-342.

MAHNKE, F.H. Color and Light in Man-made Environments. New York: Van Nostrand Reinhold, 1987.

MANDEL, D., et.al. " Room Utilization and Dimension of Density: Effects of Height and View." Environment and Behavior. 12.3 (1980): 308-319.

MARTYNIUK, O. et.al. "Effect of Environmenttal Lighting on Impression and Behavior." Architectural Psychology: Proceedings of the Lund Conference, Stroudsbourg. Ed. R. Kuller. Pennsylvania: Dowden, Hutchinson and Ross Inc., 1973: 51-63.

MEHRABIAN, A. Public Places and Private Spaces: The Psychology of Work, Play and Living Environments. New York: Basic Books Inc., 1976.

PRAK, N. L. The Language of Architecture: A Contribution to Architectural Theory. N.Y.: Mouton and Co, 1968.

RAPOPORT, A. The Meaning of the Built Environment: A Nonverbal Communication Approach. U.S.A: The University of Arizona Press, 1990.

SADALLA, E. K. and OXLEY, D. "The Perception of Room Size: The Rectangularity Illusion." Environment and Behavior 16.3 (1984): 394-395

SAMUELSON, D. J. and LINDAUER, M. S. "Perception, Evaluation and Performance in a Neat and Messy Room by High and Low Sensation Seekers." Environment and Behavior 8.2. (1976): 291-306.

SMITH, F. K. and BERTOLONE, F. T. Bringing Interiors to Light: The Principles and Practices of Lighting Design. New York: Whitney Library of Design, 1986.

SOMMER, R. Personal Space. New Jersey: Prentice-Hall Inc., 1969.

SOMMER, R. and BECKER, F. D. "Satisfaction." Environment and Behavior. 1971: 412-417.

SPACE HUMAN FACTORS OFFICE. Space Station Habitability: Interior Color Team: Nasa, 1986.

STEFFY, G. R. Architectural Lighting Design. New York: Van Nostrand Reinhold, 1990.

SUNDSTROM, E. Workplaces, the Psychology of the Physical Environment in Offices and Factories. Cambridge: Cambridge University Press, 1986.

THIEL, P. et.al. "The Perception of Spatial Enclosure as a Function of the Position of Architectural Spaces". Environment and Behavior 18.2 (1986): 227-244.

UCHIDA, S. "An Experimental Study of the Sense of Visualy-closed Spaces". II. Transactions of the Architectural Institute of Japan. 282. (1979a): 113-122.

UCHIDA, S. "An Experimental Study of the Sense of Visually-closed Spaces." II. Transactions of the Architectural Institute of Japan. 285. (1979b): 117-125.

WADE, N. and SWANSTON, M. Visual Perception: An Introduction. London: Routledge?, 1991.

WERNER, C. M. "Home Interior: A Time and Place for Interpersonal Relationships." Environment and Behavior. 19.2 (1987): 169-179.

ZEVI, B. Architecture As Space. New York: Horizon Press, 1957.

SELECTED BIBLIOGRAPHY

BRODIN, C. "A Study of Preferences for Simulated Outdoor Environments with Different Intensities of Feeling of Enclosed Space". Architectural Psychology:Proceedings of the Lund Conference, Stroudsbourg. Ed. Rickard Kuller. Pennsylvania: Dowden, Hutchinson and Ross Inc., 1973.

CANTER, D. "The Purposive Evaluation of Places: A Facet Approach." Environment and Behavior. 15.6 (1983):659-698.

CANTER, D. "An Intergroup Comparison of Connotative Dimensions in Architecture." Environment and Behavior. 1 (1969): 37-48.

CANTER, D. Psychology for Architects. England: Applied Science Publishers Ltd., 1974.

CANTER, D. and Lee, T. eds. Psychology and The Built Environment. New York: Wiley, 1974.

ÇAKIN, S. "Çevrenin Değerlendirilmesinde Yöntem Bilimi." Çevre, Yapi ve Tasarım. Ed. M. Pultar. Ankara: Çevre ve Mimarlık Bilimleri Derneği, 1979: 129-141.

DREW, J. C. and Hardman, M. Designing and Conducting Behavioral Research. U.S.A.: Pergamon Press, 1985.

HALL, R. et al. "Multidimensional Scaling Analysis of Interior, Designed Spaces". Environment and Behavior. 8.6. (1986): 595- 609.

HESSELGREN, S. On Architecture: An Architectural Theory Based on Psychological Research. Sweden: Studentlitteratur, Lund, 1987.

HESSELGREN, S. Language of Architecture. Lund Sweden: Studentlitteratur, 1967.

IMAMOGLU, V. "Ic Uzamlar icin Genel Bir Degerlendirme Olcegi". METU Building Science and Environmental Design 7. (1979): 1-9.

LOMBARDO, T. J. The Reciprocity of Perceiver and Environment: The Evolution of James J. Gibsons's Ecological Psychology. Diss. Loyola University. London: Lawrence Erlbaum Associates, 1987.

MAHNKE, F. H. and Mahnke, R. H. Color and Light in Man-made Environments. New York: Van Nostrand Reinhold,

1993.

MALNAR, J. M. and VODVARKA, F. The Interior Dimension: A Theoretical Approach to Enclosed Space. ,1992.

MEHRABIAN, A. and RUSSELL, J. A. "A Verbal Measure on Information Rate for Studies in Environmental Psychology." Environment and Behavior. 6.2 (1974): 233-252.