SPATIAL FAMILIARITY AS A DIMENSION OF WAYFINDING

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By

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September, 2001

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ABSTRACT

SPATIAL FAMILIARITY AS A DIMENSION OF WAYFINDING

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September 2001

Spatial familiarity is a significant, yet insufficiently investigated factor that affects wayfinding. The aim of this thesis is to explore spatial familiarity as a dimension of wayfinding, and explain how it affects human behavior within the built environment. Factors affecting wayfinding are defined under two categories; environmental information and individual characteristics. Spatial familiarity is a concept that comprises these two characteristics and thus, is analyzed separately. Factors affecting spatial familiarity apart from those mentioned above are defined as experience, spatial ability, meaning and expectancy, and environmental complexity. The effects of individual and group differences on spatial familiarity are identified and assessed through an empirical study conducted in two buildings of the Faculty of Art, Design, and Architecture, of Bilkent University. Spatial ability tests, wayfinding tasks, and interviews were administered to subjects from the Department of Interior Architecture and Environmental Design and the Department of Graphic Design. The findings indicate that spatial and individual factors affect spatial familiarity with the built environment.

Keywords: Wayfinding, spatial familiarity, environmental information, individual characteristics.

ÖZET

YOL BULMA BAĞLAMINDA MEKANSAL TANIŞIKLIK

Güler Ufuk Doğu Demibaş
İç Mimarlık ve Çevre Tasarımı Bölümü Doktora Çalışması
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Mekansal tanışıklık yol bulmayı etkileyen önemli, ancak yeterince araştırılmamış bir etkendir. Bu tezin amacı, mekansal tanışıklığı yol bulma bağlamında araştırmak ve iç mekanlarda insan davranışını nasıl etkilediğini incelemektir. Yol bulmayı etkileyen etkenler iki başlık altında incelenmiştir: mekansal bilgilendirme ve kişisel özellikler. Mekansal tanışıklık bu iki konuyu birleştiren bir kavramdır ve deneyim, mekansal beceri, anlam ve beklenti, ve mekansal karışıklık kavramlarıyla birlikte ele alınacaktır. Kişisel ve grup farklılıklarının mekansal tanışıklık üzerindeki etkileri Güzel Sanatlar, Tasarım ve Mimarlık Fakültesinde yürütülen bir alan çalışması sonucunda belirlenmiş ve değerlendirilmiştir. İç Mimarlık ve Çevre Tasarımı ile Grafik Bölümlerinden öğrencilerle mekansal beceri testleri, yol bulma çalışmaları ve karşılıklı görüşmeler yapılmıştır. Bulgular, mekansal ve kişisel etkenlerin iç mekanlarla olan tanışıklığı etkilediğini göstermektedir.

Anahtar Kelimeler: Yol bulma, mekansal tanışıklık, mekansal bilgilendirme, kişisel özellikler.

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1. INTRODUCTION

Seldom do we think about the cognitive processes undertaken as we move about in the environment. This daily routine, wayfinding in particular, in its smallest scale begins as we move around in our homes, and continues as we leave for work or school, as we walk through buildings, and as we return to home. During these activities, we receive environmental information, decode and process them, and recall them when necessary. Most of the time, this routine activity is an unconscious process and we tend to ignore the fact that even the simplest decisions we make to reach a destination are determined by our wayfinding ability. This ability affects us physically and psychologically as the brain and body reacts to stimuli emitted from the environment.

Most of our activities take place in large-scale built environments where wayfinding becomes an important design issue. Sometimes it can be quite difficult to find our way in such settings. Four characteristics of the built environment generally accepted to affect wayfinding are visual accessibility, sign system, architectural differentiation, and building plan configuration. Another factor affecting wayfinding is the degree of familiarity one has with the setting. How well we know the environment that surrounds us clearly is an important factor that affects our wayfinding behaviour and the perception of the setting as well as the facilities it offers. Throughout this dissertation the term “Spatial Familiarity” will be used in order to emphasise the difference between general familiarity that includes activities such as the habit of chewing a gum or being accustomed to a certain computer program and having knowledge about a particular environment or setting.

Spatial familiarity is basically how well we know a place. When we have prior knowledge about an environment, we eliminate most of the cognitive processes that are necessary to find our way within novel settings. Despite the fact that spatial familiarity is commonly accepted to be an important aspect of wayfinding, research on the subject remains limited. This study focuses on the concept of spatial familiarity and investigates its dimensions in relation to wayfinding.

Chapter 2 compiles a literature review on wayfinding. In the first section of this chapter, spatial cognition, the psychological concepts underlying the representations we have about our environments, and types of environmental knowledge will be discussed. The second section explores the dimensions of wayfinding: cognitive mapping and legibility and makes a brief introduction to wayfinding styles. Factors affecting wayfinding constitutes the third section, this section investigates environmental information, namely, the impact of visual accessibility, building configuration, architectural differentiation, and signage. The last section focuses on individual characteristics affecting wayfinding and its styles such as age, gender and disabilities.

Chapter 3 reviews the literature on spatial familiarity, and discusses the importance of spatial familiarity in relation to wayfinding. In the first section of this chapter, theories of perception are discussed in relation to spatial familiarity. The second section explores the dimensions of spatial familiarity and focuses on experiences, spatial ability, meaning and expectancy and environmental complexity.

Chapter 4 aims to explore spatial familiarity as a dimension of wayfinding, and to categorise factors affecting spatial familiarity through a case study. This study was held in two buildings with different spatial characteristics, namely, the building of the Department of Interior Architecture and Environmental Design, and the building of the Department of Graphic Design at the main campus of University of Bilkent, Ankara. Subjects were requested to take spatial ability tests and participate in a target-reaching task, followed by interviews where they were asked questions regarding the spatial and individual factors affecting their spatial familiarity with the built environment.

The dissertation concludes with Chapter 5, wherein the findings of the research are discussed and implications for future studies are given.

2. WAYFINDING

Wayfinding is the ability to identify one's location and arrive at destinations or navigate in spatial environments, both cognitively and behaviourally (Passini, 1984a; Rovine and Weisman, 1989). We select the necessary bits of information among a vast amount of stimuli consciously or unconsciously going through some cognitive processes. During the wayfinding activity, we extract information from the environment, store it, process it, and recall it when necessary. Wayfinding ability which is based on three distinct performances, decision-making, decision execution and information processing, is a spatial problem solving ability, and is essential for everyday living, as almost everyone has a need to find their way to a new location, such as a classroom, store, or school (Passini, 1995). All of the information we receive from the environment during the wayfinding activity is called environmental information. In recent years, the effects of environmental information on people's wayfinding behaviour in complex buildings have been subject to numerous research studies (see Doğu and Erkip, 2000; Passini et al., 1998; Abu - Ghazzeh, 1996; Wright et al., 1993; O'Neill, 1991a; Garling et al., 1983). Environmental information is the architectural and graphic expression of information necessary to solve the wayfinding problems (Passini *et al*., 1998). Both decision-making and decision execution are based on environmental information. Information has to be identified in the setting and has to be understood and used in the decision - related processes. For a thorough understanding of the processes we go through during wayfinding, it is essential to understand the cognitive and environmental factors that influence it.

2.1. Spatial Cognition

Much of our environmental perception and knowledge derive from external information from the environment, this is just as true for the required actions. Thus the durable theme of spatial cognition plays a central role in the study of person-environment compatibility (S. Kaplan, 1983). “Spatial cognition” is the term introduced to explore the cognitive processes we undertake during our activities such as navigation. The study of spatial cognition, particularly when addressing representations of macro-spaces, has always been closely associated with spatial orientation and wayfinding. In respect to spatial cognition, it is possible to identify three different types of environmental knowledge: landmark, route, and survey knowledge.

2.1.1. Landmark knowledge

There are different ways of coping with the environments in which our activities take place. Experience of a space differs according to the information resources we have at hand and the ones the environment provides us with. During our exposure to a new space, we learn to recognise landmarks or salient features in the environment (Golledge, 1991). Properties such as the texture, shape and orientation of certain objects are stored in declarative knowledge structures, allowing us to access this knowledge (Bliss et. al, 1997). For example, when arriving at a new college campus, students may learn how to identify the library, administrative and important classroom buildings.

As our experience in the new environment increases, we may learn how to identify these landmarks from new perspectives, essentially building our ability to mentally rotate them to visualise how we expect them to look from different viewpoints. However, their initial formation is linked to the perspective from which we are most familiar.

2.1.2. Route Knowledge

Declarative landmark knowledge becomes increasingly valuable as we learn to relate spatially individual landmarks to others in the environment. In so doing, we construct distance and orientation relationships that enable us to identify routes connecting landmarks. In essence, we systematise and build upon the declarative knowledge as we learn the interconnections thereby forming new knowledge structures in stimulus-response pairings or event-action formats (Golledge, 1991; Thorndyke and Hayes-Roth, 1982). Route (or procedural) knowledge typically refers to knowledge about the movements necessary to get from one point to another (Rossano et al., 1999).

Since navigation is usually purposeful, it may be asserted that route knowledge is probably more valuable than landmark knowledge because it helps people accomplish desired tasks. Key features of route knowledge representations are: 1) they are learned in the context of accomplishing specific tasks (ie. getting from the library to the classroom), 2) they are represented from the egocentric perspective (left and right turns are learned with respect to the body's orientation and direction of travel), 3) they are perspective-dependent, meaning that they are most useful when employed from the same viewing perspective as they are learned (usually from the ground-plane for the pedestrian travel). Finally, when faced with the task of finding alternative routes to destinations, we rely on informal algebraic and geometric computations, based upon the directional changes and distances that describe the known routes.

The creation of decision plans during wayfinding and the identification of the organisation principle underlying complex settings allow a person to structure environmental information spatially and thereby facilitate storage and retrieval. Decision plans are the basis of linearly and temporally organised route-type representations, while spatial organisation principles lead to spatial and survey-like representations (Passini, 1995).

2.1.3. Survey Knowledge

As familiarity with an environment is gained, a more flexible, configurational representation of that space can be developed (Golledge, 1991). This new structure spatially relates landmarks independently of the routes that connect them, converting the mathematical, route-defined representations into more globally defined relationships, based upon a world coordinate system (Golledge, 1991). Breaking the route knowledge dependencies on ground-based and egocentric perspectives, survey representations of a space are typically described from a "bird's eye" viewpoint as if the person builds a cognitive map of the environment. Rather than structuring the relationship between the college library and classroom in terms of the connecting legs of the route between them, the student may regard the spatial relationships between the buildings as, “the classroom is located about 200m, as a crow flies, to the southwest of the library”. Since the world coordinates are references for the knowledge, the ability to use survey knowledge is referred to as one’s sense of direction.

This kind of representation can be built through two primary methods differentiated by the perspective used during learning (Darken, 1996; Golledge, 1991). The first method occurs when spatial representations are learned through map study, where the viewpoint is not ground-based but from an altitude above the environment. The second method is described by the continued exploration and navigation of the space from the pedestrian’s viewpoint. While both methods result in survey representations, when employed to serve wayfinding tasks, the latter method results in more robust, useable knowledge (Tlauka and Wilson, 1996). Oftentimes, it seems that the development of survey knowledge is not required for satisfactory and completely efficient travels. Route knowledge suffices for this purpose (Peterson, 1998).

Because survey knowledge is more flexible than route knowledge, in that its employment is not as rigidly perspective-based, it can be more valuable for certain wayfinding tasks. The practical value of survey representations is evident in cases when the wayfinding task requires the person either to find alternative routes through familiar territory, to find primary routes through unfamiliar territory, or when task performance requires route optimisation through familiar and unfamiliar territory.

Survey representations facilitate spatial influences that can be quite useful during wayfinding through large spaces (Infield, 1991). The content of large spaces cannot be viewed from one viewpoint, while the content of small spaces can be (Peterson, 1998). Survey knowledge refers to an integrated understanding of the layout of a space and the interrelationships of the elements contained therein (Rossano et al., 1999).

So, in essence, the relative value of survey representations compared to route representations depends upon many factors, still in many cases survey development is desirable and will not detract from the use of route representations. The development of survey representations is most worthwhile and therefore likely under the following circumstances: when the learned routes are very complex, the learned routes are blocked, and the learned routes are suboptimal.

2.2. Dimensions of Wayfinding

The following sections analyse cognitive mapping and legibility as the indications of individual and physical factors in wayfinding respectively.

2.2.1. Cognitive Mapping

Cognitive mapping is a major component of spatial knowledge that comprises the processes an individual must undertake consciously or unconsciously during wayfinding. At this stage, information extracted from space and architecture is used not only for decision-making, decision execution, and the interpretation of environmental situations. The information may also be incorporated into an overall cognitive map that allows the person to understand the place he is in with regard to space. Cognitive mapping subsumes an additional information-processing capacity that is particular to the spatial representation of places not perceived at once. Environmental information extracted from a cognitive map allows a person to develop decision plans in accordance to routes chosen. In order to be of maximum use, cognitive maps must represent a spatial ensemble in a continuous manner. Frequently, images do not exist as an integrated whole, but as disparate, unrelated elements or partial maps. Spatial correspondence summarises the environmental characteristics that facilitate the development of comprehensive cognitive maps reflecting the continuity of space. There are a variety of maps developed by people and they are usually categorised as sequential and spatial (see Figure 2.1. for the examples of the map styles).

Figure 2.1. Examples of Map Styles (Kaplan, S. and Kaplan, R., 1982: 75).

Finding one's way around with the aid of cognitive map requires several things such as the development of landmark, route or survey knowledge according to the degree of information one has about the setting. It should first be recognised that, in general, movement in an environment is goal-directed and thus should be pre-planned to some degree. The cognitive map, then, should help the traveller to plan his movement ahead. In order to do that, the cognitive map must be keyed to the environment (ie. features of the environment represented in the cognitive map must be recognised in some way and the cognitive map translated into the environment). When the traveller then moves about, he or she needs to keep track of the movements that have taken place. This task of maintaining one's orientation in the environment may be accomplished by recognising places, but should also involve the ability to keep track of one's location relative to points or systems of reference (Garling et al., 1984).

Cognitive maps also reflect information about the hierarchical arrangement of points in space, with respect to relative distance and size. They also contain information about the degree of interconnectedness among points in the geographic environment (Stea, 1969). Montello (1991) states that spatial orientation typically depends on perception of the structure of the environment, on knowledge stored in memory, and on processes used to access that knowledge. The structure of the environment must influence the structure of perception and memory; otherwise, stored knowledge would be of little use for locomotion and other forms of orientational behaviour. Conversely, memory will influence attention to and of various aspects of environmental structure. Both memory and environmental structure influence the ease and accuracy with which people acquire new spatial knowledge.

Two types of spatial representations should be distinguished; the representation of a space perceived from one vantage point and the representation of a space that cannot be seen from a vantage point alone, but has to be composed of a number of views perceived at different points in a setting (ie. survey knowledge). Cognitive maps refer to the latter. Combining different views requires a mental structuring process. The representation of a city or a complex building cannot usually be obtained from a single vantage point, but it has to be structured into an ensemble from independent views (Passini, 1996).

Some people find their way efficiently on the basis of what appears to be rudimentary or cartographically distorted representations of spatial settings. This is explained by the fact that decision making on new routes tends to be an ongoing process, which relies not only on spatial representations but also on information perceived or recognised during the trip and similar experiences of previous trips. Decision execution, the only operation required on familiar trips, relies on recognition rather than recall (Passini, 1995). When individuals draw maps of familiar settings, certain systematic distortions occur, which suggests the influence of prototypic biases in the configuration of geographic settings. Among some of the more commonly noted distortions are the straightening of long, gradual curves, the squaring of non-perpendicular intersections, and the aligning of non-parallel streets

(Appleyard, 1969, 1970; Lynch, 1960). Evans et al. (1981) assessed changes in adults' sketch maps of their residential environment over a one-year period. Subjects from two independent samples recalled significantly more paths and nodes after one year's residence but the same number of landmarks. The landmarks recalled were nearly identical to those recalled during the first week. Furthermore, path systems were elaborated with the initial landmark structure with most of the increases in paths reflecting alternative routes between already established landmarks.

The individual differences that appear in people's cognitive representations of the real-world and the strategies they devise to cope with wayfinding problems necessitate a better understanding of the issue. Basic cognitive structures are understood to be common to all human beings although the level of performance with respect to cognitive operations varies and people have preferences in dealing with particular issues such as spatial representations. In other words, people have different wayfinding styles. The idea of wayfinding styles is supported by the research on cognitive mapping. Map typology reflects important differences in the representation of macro-spaces, one type being linearly organised, the route map, the other type being spatially organised, the survey map, as mentioned in the previous sections (see also Figure 2.1.). While cognitive maps relate the organisation and the structure of the environmental information retained, wayfinding styles specify the information a person seeks and uses when solving wayfinding problems. The link between the two is established if one remembers that people actively and selectively seek information. What is newly acquired has to make sense with what is known. The selection criterion will be the relevance of that information to the body of knowledge already acquired, which, in terms of the physical environment, is characterised by the cognitive map. If wayfinding styles are indeed linked to a typology of cognitive maps, certain aspects of wayfinding behaviour could be anticipated on the basis of a person's type of cognitive map. Wayfinding styles will be discussed further within the section on individual characteristics (see section 2.3.2.).

There are some quite persuasive reasons for geographers to study cognitive mapping not least its basic appeal to understand how and why people behave in space as they do. Other applications include the planning of environments that are easy to remember, improving the teaching of wayfinding and orientation skills, and general classroom geographically-based exercises such as map reading, improving geographic material such as You-Are-Here maps so they are more easily understood, and improving the databases and interfaces of geographical information systems (Kitchin, 1994a, p. 47).

Kitchin (1994a) distinguishes nine main groups of variables that can affect cognitive mapping ability:

1. environmental deterministic sources (unalterable, eg. general physical topography)
2. environmental deterministic sources (alterable, eg. number of turns and intersections along a route)
3. environmental interaction sources (eg. familiarity, mode of travel, travel time)
4. social circumstances and interaction sources (eg. education, socioeconomic status, media, experience of map use)

5. perceptual filters, perceptual context and anticipatory schemata (eg. senses current emotion state, expectancy)
6. characteristics of the mapper (determined, eg. age, gender)
7. characteristics of the mapper (undetermined, eg. beliefs, needs, emotions, personality, self-confidence)
8. cognitive style (ie. how a subject approaches a problem of wayfinding)
9. the form, function, structure, and contents of the information in the brain.

2.2.2. Legibility:

Lynch's (1960) concept of legibility has had a profound influence on the fields of planning and architecture. *Legibility* is "the ease with which its [the city's] parts can be recognised and can be organised into a coherent pattern" (Lynch, 1960, pp. 2-3). A person's information-processing capabilities can be identified as it relates to architectural elements and space. Difficulties may arise when a person is taking in information from the environment, trying to comprehend/decipher, then process the acquired information. Wayfinders trying to reach their destinations are often confronted with complex, ambiguous or irrelevant information within buildings too large to be perceived in their entirety. Although the architecture itself, ie. the spatial configuration of a structure may contain the information to generate a "wayfinding" system, certain spaces lend themselves better to extracting and comprehending the relevant information. This quality is referred to as "legibility". A place that facilitates obtaining and understanding of environmental information has a high legibility factor. O'Neill and Jasper (1992, p. 411) define architectural legibility as "the degree to which the designed features of the environment aid people in creating an effective mental image or "cognitive map" of the spatial relationships within a building, and the subsequent ease of wayfinding within the environment".

The legibility of key architectural elements, such as entrances, horizontal and vertical circulation, the ability to see through the building and major landmarks are a pre-requisite to understanding the spatial organisation of a building. If the space does not have a clear spatial organisation, it is not understood, hence has a low legibility factor and does not help with wayfinding. The principle of the spatial organisation has to be communicated to the wayfinding users (Arthur and Passini, 1992). The legibility of an architectural environment has been found to affect the usefulness of a wide range of building types. It's effect goes beyond mere "ease-of-use" of a building but includes other variables such as personal comfort. Legibility of a place can be manipulated by the addition or deletion of certain architectural elements (ie. Signage). However, even the graphics of signage systems, the choice of lettering, the contrast created by black, white, and coloured elements, the size, the position and illumination of a sign all contribute to its comprehension, hence to the legibility of a space (Passini, 1984b). Arthur and Passini (1992) state that the articulation of paths is a fundamental aspect of wayfinding communication. Proper articulation not only indicates the direction of movement and facilitates an understanding of the circulation system, it also gives users an indication of the importance of the destination and whether or not they have access to it.

The legibility of the architectural environment is an important design issue that influences the ease of wayfinding for many people. Evans (1982) noted that the illegibility of a setting may induce stress by producing confusion and a feeling of incompetence, and suggested that legibility should be “considered a criterion for useable habitats” for all users (p.94). Wener and Kaminoff (1983) found that legibility in a correctional centre significantly reduced user confusion, anger, perceived crowding, and overall emotional discomfort.

Weisman (1987) suggested that the degree of architectural legibility can affect the degree of activity, sense of control, and safety in emergency situations for institutionalised elderly. For wayfinding at the building scale, it is important to know the connections between places, because this information is necessary for selecting successful routes from start to destination (O’Neill, 1991b). A number of design features are thought to influence legibility, such as signage, visual access to the outside, architectural differentiation, and floor plan configuration (Weisman, 1981). Garling et al. (1983) state that orientation within a building is likely to be much easier if visual accessibility is provided.

Furthermore, building designs with greater visual differentiation among various subsections and with more regular floor plans (eg., interior hallways and stairs parallel on all floors) are more easily remembered by adults (Weisman, 1981). Colour-coding of building interiors also enhances legibility. Individuals who learned the interior of an unfamiliar building that had been colour-coded performed better on actual wayfinding tasks in the building, floor plan recall and recognition tasks, and target sighting tasks using a surveyors transit than did persons who learned the building interior without colour-coding (Evans et al., 1980).

Lynch (1960), an urban planner, reasoned that cognitive maps of cities function primarily as orientation aids and reflect basic elements of the physical city form. His own research and that of several other planners (Appleyard, 1969, 1970; De Jonge, 1962; Francescato & Mebane, 1973) suggested five key features that comprise cognitive maps of urban settings: paths, nodes (intersections), landmarks, districts, and boundaries (edges).

“Paths” at the city scale are defined as “the channels along which the observer customarily, occasionally, or potentially moves” by Lynch (1960, p. 47). Passini (1984a) found corridors, promenades, walks on galleries etc. to be equivalent at the building scale. Specific to buildings was vertical circulation: stairs, escalators, and elevators.

“Landmarks” at the city scale are defined as “a type of point-reference, …a rather simply defined object: building, sign, store or mountain” (Lynch, 1960, p. 48). Appleyard (1969, 1970, 1976) stated that landmarks are often noticed and remembered because of dominance of visible form, peculiarity of shape or structure, or because of socio-cultural significance. Golledge (1999) states that some places and features accrue landmark significance in an idiosyncratic way (eg, one’s home or place of work). In other words, places or features may accrue salience for an individual at a level equivalent to the salience attached to the most widely known and recognised landmark in the area.

Indoors, Passini (1984a) found much information that fitted the landmark definition as being at the same time a clearly remembered element that is well-localised in space. The high number of indoor reference points can be explained by reduced visual accessibility of major landmarks. Examples of landmarks in buildings are particular shops, bars, cinemas, information booths, sculptures, and also structural and decorative elements. Sometimes there are not so many objects in space but the space itself serves as a reference point. The characteristic that would give a space landmark value is its distinctive character from other spaces. Evans et al. (1982) suggest that landmarks are used as initial anchor points in the environment, followed by paths that link the landmarks into a network.

“Nodes” are “the strategic spots in a city into which an observer can enter, and which are the intensive foci to and from which he is travelling” (Lynch, 1960, p. 47). The equivalent points at the building scale are important circulation intersections, halls, and indoor squares.

“Edges” are “the linear elements not used or considered as paths by the observer. They are boundaries…edges may be barriers” (Lynch, 1960, p. 47). Walls appear to be the building equivalents, as they have the impermeability of edges. Doors represent points where the barriers are broken and can take on the character of a landmark or a path.

“Districts” are described as “medium to large sections of the city, conceived of as having a two-dimensional extent…which are recognisable as having some common identifying character" (Lynch, 1960, p. 47). Equivalent homogeneous areas are also found in buildings. A public shopping zone, an office zone, or a residential zone are the examples of uniform district-like areas. In buildings, changes in function and floor numbers often coincide. In such cases, district-like characteristics may be associated with floors.

The distinction between these five elements is not always easy; furthermore, certain features of the environment may take on more than one meaning. If five key elements are extracted from the environment and used to construct a cognitive map of a city or a building, the planner should take care to emphasise them in his spatial conceptions. In doing so, he would increase the quality of legibility and imageability of a place (Passini, 1984a). Provision of these qualities is essential to create comprehensive and satisfying environments for users with different physical and mental capabilities.

Finally, when "legibility is just measured as a spatial or functional form, it fails to analyse the influence of social meanings on spatial cognition because investigations generally isolate the social or cultural context of the relationship between individuals and surroundings" (Ramadier and Moser, 1998, p. 317). Along with various spatial characteristics, it is necessary to analyse the person-environment relationship also with the social and individualistic dimensions. Familiarity is also an important factor that may shed light on how and why some aspects of environments are recalled easily and some are not.

2.3. Factors Affecting Wayfinding

We can identify two distinct dimensions of wayfinding. The first dimension is of a functional nature; it corresponds to the reaching of destinations within acceptable limits of time and energy. The aim of wayfinding design in this respect is to provide the environmental information necessary for decision making and decision execution while respecting user ability to deal with basic perceptual and cognitive tasks. The second dimension is of an evaluative nature; it corresponds to the experience gained during wayfinding. We evaluate most things we do, and we like or dislike certain activities and situations, finding them more or less satisfying in retrospect (Passini, 1984a). A wayfinding experience is somewhat different. It establishes a very strong relation with the environment and the spatial characteristics distinguishing it. Wayfinding is a fundamental key to environmental appreciation. Wayfinding is an activity that, like few others, demands a complete involvement with the environment. Perceptual and cognitive processes are constantly in action when a person sets out to reach a destination. The environment is scrutinised in order to extract information selectively. The information describing the setting is not just passively retained, it is interpreted, structured, and integrated to the already existing body of knowledge. Sometimes, information is extrapolated from inconclusive evidence and verified at a later stage. This is particularly true when trying to gain an overall representation of complex layouts. It is important to stress that the environment in this process is not just “seen” but dealt with, subjugated, and above all experienced (Passini, 1984a).

In relation to the environment, the wayfinding person tries to understand the setting she/he is in, and then uses the information obtained; makes decisions and structures these into an overall plan of action. She/he will predict the consequences of certain decisions and assess their merits. In executing the decisions, she/he will formulate predictions about the environmental features and compare them with the information she/he obtained. She/he will do all things while moving through the environment and experiencing its character in an active, participatory and dynamic fashion (Passini, 1984a). Therefore, it can be said that the processes involved in the wayfinding activity becomes an organic development, fed by information which, in turn, returns the absorbed information as the achievement of a task.

It is commonly agreed that in many cases, it would benefit both employees and employers to know which factors best predict wayfinding ability, so that an employee may be matched with an appropriate job position or vice versa. However, it is difficult to predict a person's ease at wayfinding because many factors, both individual (internal) and spatial (external), contribute to wayfinding ability (Garling et al., 1986; Kitchin, 1994b).

Spatial factors include characteristics of a situation or environment such as the density of buildings in the area, the availability of meaningful landmarks, and the pattern of streets and intersections. Individual factors include characteristics of people, such as age, gender, familiarity with the environment, and the types of strategies one typically uses to navigate through an environment. Unfortunately, there is little agreement in the literature about which factors may be most important for predicting wayfinding ability (Prestopnik and Roskos-Ewoldsen, 2000). Therefore, it seems important to analyse the concept of spatial familiarity as it is involved in many factors mentioned above.

It is assumed that most architectural settings, as with larger scale environments, are too extensive to be perceived in their entirety from any one location. In those circumstances, information regarding specific locations, spatial relationships among those locations, and those locations in relationship to the rest of the building must be stored easily in one's head. These spatial factors which people rely on differ from one individual to another. Factors such as age, gender, occupation, individual psychology, familiarity with the environment etc. have also been found to affect the way people find their way and orient themselves in the environment (see Prestopnik and Roskos- Ewoldsen, 2000; O'Neill, 1991a; Peponis et al., 1990; Mainardi-Peron et al., 1990; Moeser, 1988; Weisman, 1981; etc). It would be appropriate to note that processing the information received from the environment is a stage where the environmental and individual attributes are comprised all together in order to solve the wayfinding problem. Thus, individual factors affecting wayfinding are also analysed in the following section 2.3.2.

Almost all the difficulties a person may experience in wayfinding have their sources in some phase of this information processing. The problems with finding relevant information in public settings like hospitals, shopping complexes or schools etc. at the urban scale are common impediments to efficient wayfinding. The information can be ambiguous or incomplete, or it may not be appropriate for individuals coming from different backgrounds, requiring a particular effort of interpretation. Even if the information is obtained and the message understood, the wayfinding person is not necessarily safe. Part of the information might be forgotten when it comes to be reused after a certain lapse of time (Passini, 1996, p. 89).

2.3.1. Environmental Information

All relevant information available to a person when completing a wayfinding task may be described by the term "Environmental Information". Environmental information includes a descriptive, a locational, and a time component. Environmental information plays a central role in the conceptualisation of wayfinding. It is used in all phases of spatial problem solving; it contributes to the identification of a wayfinding problem and to the elaboration of the solution. Environmental information is fundamental in the making of decisions and decision plans as well as in their execution. Furthermore, the provision of adequate environmental information is a crucial design issue. Signs, maps, verbal descriptions, as well as architectural and urban space can be seen as information support systems to wayfinding (Passini, 1996). The existence or inexistence of these aids contributes significantly to efficient wayfinding in the environment as well as safety and satisfaction.

In respect to a completed wayfinding task, the information a person needs is contained in the decision plans. If the information perceived and not perceived in the setting is analysed with respect to these plans, an interesting correspondence emerges. While a person executes part of a decision plan, he tends to perceive information relevant to that part of the plan. Any information relevant to a more general task that does not apply to the immediate plan being executed has much less chance of being seen. For example, a person looking for a telephone booth will be scanning through signs for either the word “telephone” or the pictograph of a telephone, while eliminating all other types of information that may be necessary later on.

A wayfinding task is affected by two major physical factors; the layout of the setting and the quality of the environmental communication. Form, spatial content, organisation, and circulation are the elements that define the layout of an environment. Environmental communication includes all of the architectural, audible, and graphic expressions that provide the essential information for wayfinding (Arthur and Passini, 1992). Weisman (1981) has identified the spatial factors that affect wayfinding in four categories: 1) the ability to see through or out of a setting, 2) type of signage provided, 3) the extension one location looks different from others, and 4) the overall plan or layout of a setting.

Wayfinding design is described as a set of tools devised to help people reach their destination in an unfamiliar environment. With the emergence of large public spaces that are above the scale of human perception, the need for wayfinding designs has increased greatly. Information can be obtained from various wayfinding support systems such as information booths, signs, maps, as well as the architectural and spatial characteristics of a setting (Passini, 1984a). Although it is universally acknowledged that putting up signs is an acceptable effort to prevent people from getting lost, it does not always get the desired result. People can often be as lost with the signs, as they are without them for a variety of reasons. In respect to wayfinding, the form of a building's volume is particularly instructive. It provides the users with cues about the internal organisation and the circulation system. The circulation is of course the key organising force of a layout; it is also the space in which people move and in which they have to find their way. Thus, it is this space that we try to understand and it is in this space that we have to make our wayfinding decisions (Arthur and Passini, 1992).

Despite the fact that wayfinding design is basically a design tool and guide for architects, environmental and urban designers that should be taken into consideration in the early steps of the design process, it is still an issue recognised only when confronted with the complaints received through post-occupancy evaluations. As Abu-Ghazzeh (1996) states, most of the extant studies consider the specific environmental context within which visual/spatial features of architectural settings may contribute to, or help resolve, problems of wayfinding. The ease and accuracy of finding one's way within and out of the built environment is an important criterion that should overrule the design of complex buildings. If the spatial organisation and the circulation system of a complex building is the core of the problems wayfinders have to solve, environmental information provides the aid necessary to solve these problems. Wayfinding can be enhanced by the use of orientation aids such as cartographic maps and (road) signs.

Wayfinding difficulties are usually explained by inadequate signage. Quite often, though, the deficiency is architectural. Wayfinding difficulties might be due to a confusing layout that cannot be understood and no signage can fully remedy that shortcoming. Wayfinding difficulties may also be due to poor articulation of architectural features such as the indication of entrances, exits, horizontal paths, stairs, lifts and elevators, landmarks serving as anchor points and the circulation system which cannot always be compensated by signage systems (Passini, 1996).

Environmental information may be divided into four categories:

a) Architectural information is contained or inherent in the built environment, whether the user is in the building or outside.

b) A building shape or layout may be difficult or easy to read. However even difficult buildings have a wealth of information present in its details such as stairs, lifts, corridors, doorways, floor finishing are all landmarks used to determine the way to a given destination (Sims, 1991).

c) Graphic information may be further subdivided into general information about building tenants, directions to destinations in a building and the identification of those destinations.

d) Verbal information includes the sorts of information that can be conveyed to passers-by, security guards, and occupants through the use of self-help telephones.

Also, Passini (1996) states that wayfinding design concerns all features of the environment which are related to purposeful circulation of people and their ability to mentally situate themselves in a setting. He categorises these design features as spatial layouts, architectural features related to circulation and graphic displays including audible and tactile supports. To pick up existing wayfinding information in highly active and complex settings may cause considerable difficulty. The factors responsible are in summary:

1) a general overload of stimuli and information;
2) insufficient distinctiveness among signs that have different functions or that address different populations;
3) inconsistent placement of wayfinding signs; and
4) inconsistent use of recognisable design characteristics.

A most important part of understanding people's information-processing behaviour is to conceptualise perception as an interactive relation between a person and his environment. The viewer not only receives but also looks for information. If a person knows what to look for, she/he will be able to proceed by a matching process similar to the one proposed for decision execution. This will spare the person the effort of scrutinising a multitude of potentially relevant signs. If a person knows where to look for the desired information, she/he will simply reduce his field of search in space. Instead of having to sample the whole setting, she/he will be able to focus on a particular area, such as the ceilings of corridors, on particular architectural elements, such as columns, panels on kiosks. Visual accessibility is one of the factors that contribute to accessing the desired information.

2.3.1.1. Visual Accessibility

As buildings become larger, some architectural impediments due to the complexity of spatial organisations such as intersections, dead-ends, obstacles preventing visual accessibility to see through and out of the building arise. Visual accessibility is an important dimension of wayfinding in the built environment as it provides the users with information about the circulation system, the horizontal (ie. corridors) and vertical paths (ie. stairs, elevators, escalators), spaces adjacent to these paths, etc. The legibility of key architectural elements is a prerequisite to understanding the spatial organisation. It is obviously not enough - even if possible - to have a clear spatial organisation if it is not understood. The principle of the organisation has to be communicated to the wayfinding users (Arthur and Passini, 1992). Visual accessibility gains an important role at this point. Openings and galleries are instructive about the interior systems. Buildings containing a central open space are generally well understood and lead to clean representations, they have the advantage of providing the users with a visual and sometimes auditory access to the form of the circulation system. Visual access to different floors of the building allows one to sense at least part of the building volume. A single perspective of the space may contain so much information in an enclosed floor arrangement that it has to be organised from a number of separate experiences at individual floors due to corners and walls that prevent visual access to the other side. When visual information is easily accessible, the legibility of the space is enhanced. In addition, much of the mental organisation and map building becomes redundant. The person already perceives a spatially organised entity of at least a section of the building. Buildings that are accessible only in parts tend to leave disconnected images and a generally confused cognitive map. Even a strong barrier between two sections of a building can leave unincorporated images. The school of architecture at the University of Montreal that is housed in an old convent is a good example for this (Passini, 1984a). During a transition period, the school and the religious order shared the building. All links between the section occupied by the school and the one occupied by the order were walled in. When the school expanded and took over the whole building, the two sections remained separate. In order to go from the administration area to the studios located on the same floor, it was necessary to go up or down one level to make the link. Even after using the building for five years, instructors still thought they were going up or down to the studios. After some reflection, they could figure out that both must be at the same level. Nevertheless, the initial reaction shows that their cognitive map of that floor is discontinuous (Passini, 1984a). Passini (1996) also found that interconnected buildings, typical of large hospitals and educational settings, were generally not understood as forms.

In addition, Lawton et al. (1996) state that factors found to affect acquisition of configurational knowledge in buildings include design features such as the degree of visual access and floor plan complexity (see also Garling et al., 1983; Moeser, 1988; O'Neill, 1991b). Orientation in a building is likely to be much easier if every part of a building can be seen from every other part.

Obviously, visual accessibility communicates important information within a building.

Garling et al. (1983) examined the influence of visual access, familiarity, and availability of a floor plan map on measures of orientation within a university building. The setting afforded a high level of visual access. A low visual access condition was created by artificially restricting participants' vision. The low visual access group learned significantly more slowly than people with visual access. When given access to a floor plan map, the low visual access group learned as quickly as the visual access group. Accuracy in locating “building targets” was positively correlated with familiarity and with “free-viewing-access”. They (1983) suggested that You-Are-Here maps are able to overcome the negative effects of buildings designed with low visual access.

Buildings with external forms that architecturally express the interior system are particularly instructive for users once they enter inside. Arthur and Passini (1992) claim that settings underground, including garages, subways, and shopping malls are among the most difficult to understand because these types of settings do not have an object-like character to tell people about what is going on inside. It may be easier for people to orient themselves according to the direction they enter from especially when they can maintain visual access from the inside of the building to the outside. Butcher and Parnell (1983, p. 307) claim that "people normally try to leave a building by the way they came in unless there are strong visual clues to an alternative - such as a door in a wall which also has window through which the ground outside can be seen". In addition, Peponis et al. (1990) suggest that after relatively brief exposure to a building, people tend to consistently direct themselves toward spaces from which the rest of the building is more easily accessible. Thus, they seem to acquire an understanding of configurational properties rather than merely relying on landmarks, signs, or other cues.

Visual accessibility may also provide information about the physical accessibility of a space as well as the continuity and transition of the circulation system. Barriers may be created to partially restrict the perception of an area (ie. plants, stained glass, etc.) implying the privacy of a space relatively to other parts of the building. Feelings such as mystery and excitement can be architecturally expressed with the provision of visual accessibility in different ways. For example, luminous openings that give clues about a space which can be perceived from a relatively darker space may become mystical, if it is not directly accessible but the circulation system allows the viewer with information just enough to reach it.

Visual accessibility also has a major role in emergency conditions, being able to see signs, landmarks and certain parts of the built environment is an important factor that affects the behaviours of wayfinders. Stress and panic are feelings often accompanying people trying to exit a setting in a hurry. In case of a fire, for example, smoke is most likely to hinder the visibility of the circulation system to a certain degree. The existence of visual accessibility to alternative routes and sign systems that are not obstructed by architectural barriers such as walls and corners hiding possible exits should be prerequisites for design. Without visual access to a certain degree, interiors are nothing more than labyrinths.

2.3.1.2. Building Configuration

Configuration refers to the way in which spaces are related to one another as well as with respect to the overall pattern that they constitute. Overall configuration is influential in wayfinding and understanding of configuration is often the final developmental stage of learning of settings (Peponis et al., 1990). The organisation principle has an important role in the construction of a cognitive map at the building scale. To establish such an organisation principle is a means to come cognitively to grips with the quantity of information contained in the environment, that is, to make sense of that information, and to retain what is needed and thus, to become familiar with that setting. Peponis et al. (1990) claim that navigation through any complex architectural environment cannot depend wholly upon direct visual perception which is comparatively localised but requires a more abstract understanding of the way in which local parts are interrelated into a whole pattern.

The perception of an organisation principle provides a person with the possibility of reducing the amount of information to be retained at a particular moment, and it establishes a rule by which to retrieve that information. It is no doubt easier to retain the position of some key elements in conjunction with a rule by which other subordinate elements can be reached than to remember the position of each and every element individually.

Weisman (1981) states that the overall plan configuration of a building, particularly the ease and accuracy with which one can build a mental image of it has some considerable impact on wayfinding behaviour. Passini, (1984a) also claims that the comprehension of the principle by which spaces are organised appears as the most important factor in facilitating image formation of a building. A number of studies suggest that the complexity of a floor plan configuration is the primary influence on wayfinding performance (O'Neill, 1991a; Peponis et al., 1990). Weisman (1981) found that students reported being lost less frequently in university buildings whose floor plans they judged "simpler" and more "legible". This effect remained consistent even for people who were very familiar with the buildings. Bronzaft and Dobrow (1984) suggest that simplicity and regularity of floor plans aid people in learning about the layout of a setting. However, it is common among wayfinders to get lost in spaces that are too much alike and hard to differentiate. On the other hand, O'Neill (1991a) found that even with incremental increases in floor plan complexity, people have significantly greater problems with understanding spatial layout, and reduced wayfinding performance. He suggested that the complexity of a floor plan form influences wayfinding performance negatively. Additionally, Weisman (1981) found that the most serious disorientation problems occurred in buildings judged as being complex and difficult to describe by user groups.

O'Neill (1991a) conducted an experiment to evaluate the influence of topological floor plan complexity on measure of accuracy of the cognitive map and actual wayfinding performance. As topological floor plan complexity increased, people tended to experience greater difficulty in terms of absolute performance as measured by the amount of time it took to reach the destination and accuracy in map sketches decreased. As people experience an environment, topological knowledge about the connections between places is acquired prior to an understanding of the distance and direction between locations (O'Neill, 1991a).

The main assumption behind floor plans (as in the case of You-Are-Here maps) is that they convey information about the layout of a building that cannot be mentally represented until the building is repeatedly traversed, or until the individual traversing the paths gets familiar with the built environment. A floor plan must be read correctly and translated to the building, since the plan is usually stationary, the information obtained must be remembered (Garling et al., 1983). Levine *et al*. (1984) point out the importance of placing You-Are-Here maps so that they are aligned with the terrain, because aligned maps are easier to use and understand.
Evans and Mc Coy (1998) state that exposure to visual and acoustic information is strongly influenced by layout, circulation systems, and the individual's location in space. The shape and orientation of an interior space directly influence stimulation levels. Adjacencies to sources of stimulation and proximity to circulation paths can influence the amount of information obtained. Paths are important elements that constitute the internal organisation of the built environment. Regarding this aspect, Arthur and Passini (1992) distinguish between two aspects in wayfinding communication; perception of a path, its use, and accessibility and

understanding the configuration of the circulation system. The articulation of paths facilitates an understanding of the circulation system and gives users an indication of the direction of movement and the importance of the destination and whether or not there is access to it (Arthur and Passini, 1992). Proper articulation of paths is a fundamental aspect of wayfinding communication. A path is perceived by markings on the ground, a guiding structure on the side or above, or by a combination of these elements. The path defining elements can be continuous or repetitive. The textured marking improves the legibility of the key paths and allows them to be used by the visually impaired population for whom open-space arrangements are particularly difficult (Arthur and Passini, 1992, p. 127).

The form of the circulation system may not necessarily be visible to the users of a setting. Buildings organised around an open core have the advantage of providing the users with access to the form of the circulation system (Arthur and Passini, 1992). The architectural expression of the circulation system makes a building easier to understand. The building form can express the spatial organisation of the setting and also the connecting circulation system. The well-articulated buildings tell us everything about the internal central organisation. A person perceiving a well-articulated building is in possession of valuable wayfinding information. The perceived spatial organisation serves as a framework for constructing a cognitive map and, for integrating information that will be obtained once inside (Arthur and Passini, 1992). According to Gestalt way of thinking, regular, symmetric and continuous rectilinear floor plans are good forms that are easier to remember, and which are believed to facilitate forming cognitive maps and to aid people's orientation (Abu-Obeid, 1998).

2.3.1.3. Architectural Differentiation

People find their way in complex settings by trying to understand what the setting contains and how it is organised. As buildings become larger in scale and their complexity increase, it becomes difficult to perceive the setting as a whole. In order to form a mental map of the setting, spatial clues must be identified. Among the basic building blocks of cognitive mapping are spatial entities. People can only map these spatial entities if they are distinct, ie. if they have an identity that distinguishes them from surrounding spaces (Arthur and Passini, 1992). Decision-making can only be sustained if destinations and intermediate sub-destinations have an identity distinguishing them from other spaces. The same applies to decision execution. A place has to be recognised before a decision can be transformed into behaviour. Distinctiveness giving places their identity, thus is a major requirement for wayfinding. Distinctiveness can be achieved by the form and volume of the space that define architectural and decorative elements, by the use of finishes, providing visual impact by structural and decorative elements of walls, columns, ceilings and floors, creating special illumination, colours, and graphics (Arthur and Passini, 1992).

Although, Darken (1996) states that organisational principles are intended to provide the necessary structure by which an observer can mentally organise the environment into a spatial hierarchy capable of supporting wayfinding tasks, different parts of the environment become increasingly difficult to recall and differentiate especially when they follow the same organisational principle without any differentiation among them. In such environments, architectural differentiation becomes a major factor that influences wayfinding positively or negatively. Arthur and Passini (1992) state that using colour, material and texture differences in spatial features such as structures above or below paths articulate the building organisation. Colour helps with the differentiation between elements in a setting and / or between settings themselves (Lang, 1987). To make perception of objects easier they can be of a contrasting colour to their backgrounds. On the other hand, large brightly coloured areas may fatigue the eye and produce after images, especially when there is variation in the brightness of the surfaces of the environments (Peponis et al., 1990).

Monotony in architectural composition leading to repetitive environments, even if they are simple, is another factor that renders wayfinding more difficult. Labyrinths are difficult because of their repeated sameness (Passini et al., 2000). Thus, a certain degree of environmental complexity is required. Uniform corridors and lack of landmarks to enhance the legibility of decision points have a negative impact on wayfinding. Wright et al. (1993), state that finding a particular destination can be difficult in many modern building complexes, where the corridors on different floors and the offices on different corridors can look very much alike. Passini et al. (1998) emphasise the importance of distinguishing a zone; they suggest that a zone with a strong character might favour a certain spatial identification, if only in the sense of being somewhere distinct. Uniformity, after all, is the secret of labyrinths and getting people lost. An additional point worth mentioning is that uniformity alone does not create wayfinding problems, lack of distinction between elements used in a setting does. De Jonge (1962) showed that even in rather uniform residential environments, where no major landmarks are apparent, people pick up small details like the colour of curtains, a particular design of doors, or trees, and use these as landmarks. As long as the environment has some distinct features, it is possible for the person to create his own landmarks.

It should be noted that exaggeration of architectural differentiation can be as perilous as the lack of it. Designers in favour of extravagant, interesting, unique, and exciting public spaces need to be cautious of the dilemma of creating ambiguous, labyrinth-like configurations where spaces merge into each other without appropriate indication of what is where, namely, sign systems or sufficient visual accessibility. Architectural differentiation is a means of conveying environmental information to users, to prevent the mishap of getting confused between spaces with different functions, not to create misconceptions about the accessibility or privacy of spaces.

2.3.1.4. Signage System

Signs communicate environmental information, they tell the viewer what is where and, when they refer to an event, signs may also specify when and how likely it is to occur. Graphic information includes directional signs designating a place, an object, or event in the form of names, symbols, pictographs, and arrows; or reassurance signs (see Appendix A for examples of signs) providing the environmental information needed to make wayfinding decisions presenting a message verbally, symbolically, or pictorially (Passini, 1984a).

Directional signs are the most common process descriptions. They typically designate a place, an object, or an event in form of a name, a symbol, or a pictograph and an arrow. A process description is composed of a coherent ensemble of directional signs positioned on a path to a destination (such as a corridor). Such a description of location is the equivalent of a decision plan spaced along a path, with each directional sign corresponding to a decision that leads directly or indirectly to behavioural action (Passini, 1984a). Passini (1984a) states that identification signs are the most important state description of location. They identify an object, a place, or a person in space. The advertising sign above a creamery and the increasingly used letter *i* that indicates an information booth, are examples of such state descriptions. Identification signs are only one form of state description. Once they are perceived, the destination is usually reached. Other state descriptions provide the information necessary to develop decision plans. This information has to be read within some generally understood reference system. An example of a state description based on an abstract reference system is the commonly accepted numbering of doors and floors in high-rise buildings. State descriptions are meaningful only if the reference system is shared and comprehended by people receiving that information.

The key function of signs is to provide the environmental information needed to make wayfinding decisions. Some signs address themselves to the post-decision phase, when they act as checkpoints. These signs are referred as reassurance signs, and they are frequently encountered on highways, where they reassure the traveller that he is still on the right road (Passini, 1984a).

The capacity to process information naturally has a limit that may vary according to the individual, to his disposition at a particular time, and the perceptual channels involved. Conditions of stimulation that exceed processing capacities are referred to as “stimulation overloads”. Excessive stimulation can inhibit information processing. Public settings typically exhibit a variety of signs for different functions. The wayfinding person must extract from this display of information that relevant to his task. A factor facilitating the discovery of wayfinding information in a complex setting is the consistent location signs. A certain predictability of the sign’s location is an important factor in efficient information processing (Passini, 1984a). Sign perception is further improved if the person is familiar with its overall form and design. The act of becoming familiar with a sign is an act of learning that occurs without effort if the same sign type is frequently encountered. Application and design standards are most important to get people to understand, use, and depend on the signage system. Standardisation of signs is still far from being implemented. The common confusion created by floor identifications of ground levels, split levels, as well as by array of symbols used for buildings on slopes that have more than one ground floor is an indication for urgent need to develop and implement a generally recognised nomenclature

(Passini, 1984a).

The graphic conception of signs, the choice of lettering, the contrast created by black, white, and coloured elements, the size of signs, their position and illumination, all these factors contribute to legibility and to the relative ease of finding information (Passini, 1984a). Time spent on reading a sign is an important aspect. Passini (1996) notes that people are annoyed and frequently become impatient when they have to read through lists of names or study unstructured information on signs and maps. Often they give up looking even if they believe the required information to be there. If signs are provided, the information they try to convey should surely be presented so as to facilitate easy detection. Glances are of very short duration. Attached to a glance is a short-term visual memory. This memory, which is referred to as an iconic memory, may last from one to two seconds only. For the information to be retained, it has to be coded into a memory of longer duration, and that is where the problems occur. In fact, people are only capable of coding three to four elements in that particular context. Difficulties in interpreting sign messages are due to a number of factors, which can be summarised as;

1) imprecise information on signs with respect to what they mean and whom they concern;
2) inconsistent application of sign type and symbol;
3) application of sign elements, generally understood in a familiar context to new situations in which part of the original meaning is no longer relevant;

and

4) introduction of new symbols, codes, and sign systems without accounting for the learning process necessary to efficiently use an innovation.

When building directories are a part of a particular wayfinding system, they are generally and properly associated with maps. Too often however, they compound to wayfinding difficulties instead of helping solve them (Arthur and Passini, 1992). They may, for example, be organised by bureaucratic hierarchy in the structure of departments ie. largest stores being number “1” etc. and not by shopper needs.

Directories, You-Are-Here maps, and information boards as well as emergency and utility signs are also part of the graphic information (see Appendix B for examples of directories and You-Are-Here maps). Devlin and Bernstein (1997), draw attention to the presentation of the visual display of information. The use of colour, level of detail represented, and location of information are among important variables of graphic information. They make the following statements; legibility varies with type styles, the contrast of dark on light background is more legible than the reverse, italics are difficult to read, perceptibility of print increases with increasing thickness to a point and then declines, the use of colour is complicated and poorly understood. The use of colour to transmit information in maps and graphs has a mixed reputation. While the use of colour has potential benefits, it has been called a complex symbol for map use. The use of colour is still debated, but Devlin and Bernstein (1997) note that people like colour displays better than those in black and white.

Overall, people make fewer wrong turns in settings with signage than in those without (O'Neill, 1991a). Findings suggest that graphic and textual signage may be applied to optimise different aspects of wayfinding. As buildings get larger and more complex, it becomes increasingly difficult to provide adequate wayfinding simply with signs and other cues, if the suggested pattern of movement ignores the ways people use and understand the configuration of the space.

Hirtle and Sorrows (1998) address the importance of constructing a tool that allows individuals of different cognitive abilities to exert necessary information that would aid wayfinding and orientation. Environmental graphic designers and architects need to work together as wayfinding designers. On a practical level architecture should not be considered as one element, and signage quite another, but the role should be complementary. Contrary to the belief of many architects, the addition of signs to an environment is not consistent with a lack of architectural integrity or design failure (Sims, 1991). As Peponis *et al*. (1990) suggest wayfinding, assisted by proper signage and considerations of parameters, seems natural rather than forced when important facilities and key points, such as the entrance, are carefully positioned with respect to the integration core and when the latter is carefully designed. Graphic information has to be designed for adequate environmental perception that consists of the scanning and glancing processes. People tend to ignore information displays that are not designed appropriately, or to walk away from such displays after spending a minimum of time in futile search (Arthur and Passini, 1992). Graphic standards aim to provide an optimum level of information to serve the maximum amount of individuals with different types of information processing capacities and knowledge structures.

2.3.2. Individual Characteristics

Apart from the spatial characteristics of the built environment, individual factors such as gender, age, cultural background, and disability affect wayfinding and its styles. Spatial ability is another factor that affects wayfinding; the impact of this factor will be discussed in the following chapter in respect to spatial familiarity.

People proceed and behave in environments in different manners and the information they use differ for a variety of reasons. Among the individual factors, wayfinding styles affect the way people cognitively structure a representation of the environment. We can assume that certain places lend themselves better to cognitive mapping than others; comprehension and representation in the form of a cognitive map or an overall image require the organisation of bits and pieces of environmental information gathered at various points over an extended period of time. If cognitive maps require an organisation or structuring of information, it can be assumed that not everything seen and heard is used but that a selection process takes place through which a certain type of information becomes more important and generally relied upon. Thus, the type of information relied upon can vary according to the wayfinding style of the individual as mentioned previously.

In terms of wayfinding styles, conflicting data suggest two hypotheses on the physical cues people use to learn to orient in a new setting. Some studies (see Appleyard, 1969; Siegel and White, 1975; Evans et. al, 1981) suggest initial reliance on landmarks as orientation aids with subsequent path learning embedded within the initial landmark network. Other researchers (see Thorndyke and Hayes-Roth, 1982; Garling et. al, 1982) have found the opposite sequence. At least two logical possibilities for resolving the contradictory data are apparent. First, the type of orientation cues used to learn a setting may depend on the physical configuration of the physical environment itself. Certain physical cues in a setting may direct our spatial learning strategies by the opportunities they provide. For example, visually distinctive buildings placed near major path intersections may lend themselves to a landmark-dominant learning strategy. A second logical possibility for resolving the competing learning hypothesis is that perhaps some people are landmark dependent in their learning strategies, whereas others are path dependent (Evans, 1980).

In having people compare buildings in terms of wayfinding difficulties, Passini (1984a) found strong opposing views among the sample of subjects. A compilation of assessments and their underlying reasons led to the identification of two independent groups, one stressing the problem of obtaining information from the sign system and the difficulties in understanding the meaning of the messages contained; and the other relating their problems to the understanding of the spatial properties of the setting and their position within it. Both groups were equally familiar with the buildings visited and generally agreed on the level of sign quality. The assessment of the two groups can be seen to reflect the difficulty each group experienced in finding the information it was looking for. It can therefore be assumed that some people rely on linearly organised information as it is presented by directional signing, while other people tend to rely on spatially organised information that permits an understanding of the setting as a spatial ensemble. The tendency to rely on one type of information more than another marks two distinct wayfinding styles. The first can be called linear, the second spatial.

People adhering to a spatial style may find a setting difficult although the signs are considered adequate. At the same time, it has also been observed that people who adhere to a linear style may find a setting difficult, even if the spatial properties are readily accessible. Wayfinding is therefore facilitated if both types of information are accessible to the user. As a general rule, it is suggested that designers plan information systems of a spatial nature as well as a sign system of a linear nature to facilitate both styles of wayfinding (Passini, 1984a).

It is of interest to determine whether gender differences occur in wayfinding behaviour. Many researchers are interested in the differences in wayfinding styles and behaviour between males and females (see Lawton, 1994, 1996; Malinowski and Gillespie, 2001). Popular stereotype holds that men are superior to women in navigational ability. While some studies indicate that gender differences favour men in two types of spatial ability, mental rotation and spatial perception (see Bryant, 1982; Lawton, 1996; 1994), some studies report slight gender differences only in confidence ratings (Cornell et al., 1999). Studies (Bryant, 1982; Golledge, 1991; Lawton, 1994) that have found a relationship between gender and directional knowledge, report that males show higher accuracy than females. Lawton (1996) found gender to be one type of individual difference associated with wayfinding strategy, pointing accuracy and anxiety. Women tended to have less confidence in their spatial abilities than did men. Malinowski and Gillespie (2001) also found sex differences in their experiment where males found, on average, more points than females overall, within time quartiles, within lanes, within similar levels of previous experience, and within the same category of map reading skill. But, they still state that the results do not answer the question of whether these differences are originated from sex or gender differences. Differential performance of men and women may suggest different wayfinding strategies used. Lawton (1996) notes that biological factors may be included in the explanation of these differences. Evolutionary psychologists claim that this characteristic is due to the traditional role of men as explorers and hunters of game – activities that often took them to distant unfamiliar places and required large-scale environmental knowledge acquisition. In comparison, the traditional gathering activities of women produced very detailed local area knowledge, but little experience with distant places except when tribal seasonal wanderings occurred (Golledge, 1999).

The effects of age on difference in wayfinding behaviour and mental processes taking place during this activity has been subject to numerous studies (see Weisman, 1987; Lawton, 1994; Cornell et al., 1999; Passini et. al, 1995; 1998; 2000) over the years. For example, Lawton (1996) found that orientation strategies differed among older and younger subjects. On the other hand, Evans (1980) reported that with greater experience, the age differences diminished significantly in wayfinding accuracy. Studies indicate wayfinding behaviour and accuracy are affected by the outcomes of aging such as lack of concentration and memory disorders as in dementia of alzheimer type (DAT) (see Passini et al., 1998; 2000).

Background is also influential in wayfinding. People are socialised differently, growing up as they do in different geographical and social environments, the way they perceive and use the environment differ according to their cultural backgrounds. Evans (1980) states that few gender or class / cultural differences found in the environmental knowledge may be explained by individuals' daily activity patterns. Differences in wayfinding behaviour may also be due to factors such as education, occupation, and previous experiences in different types of settings, or different modes of travelling. A taxi driver, for instance, is a person who is professionally engaged with travelling. Because his route changes daily, he has a broad knowledge about streets and districts compared to people with different occupations (i.e. housewife, teacher, etc.).

Asking and receiving directions from others may, however, present a problem to those newcomers who have some language difficulties (Ng, 1998). Education, prior experience, language abilities, and urban - living experiences have been predictors of low stress (Berry and Kostovich, 1983). Those with more education may have more resources to deal with the changes (Ng, 1998).

Research indicates that wayfinding difficulties in the built environment are magnified for the handicapped population (Arthur and Passini, 1992, Kitchin, 1994a). Wheelchair users, visually impaired or blind people, and DAT patients partially represent the population which require special aids within the built environment. Generally, the built environment is designed with little consideration for people with different capabilities and this becomes a major problem. The routes provided for wheelchair users for example, may become the reason of negative experiences such as stress, anxiety and loss of time. Visually impaired or blind people also demand special treatment in the built environment in order to find their way around it. Signs that are hung from the ceilings that only the visually able can make use of, and interiors with no tactile support are insufficient orientation aids. People with mental disabilities are easily disoriented and need reassurance in the built environment with the use of distinct elements and signage.

The case of mental disabilities is an important issue in the study of wayfinding. Many people around the world suffer dementia that restricts the cognitive abilities of patients. Disorientation and loss of memory are the two key factors to interfere with social adaptation of DAT. They are also considered among the first and clearest signs of dementia (Passini et. al, 1995). DAT renders the ability to recall and memorise even the most crucial events and places. Therefore, the effect of spatial familiarity with the setting varies among the patients, as well as daily and even during the day for each individual (Passini et. al, 1998).

It is obvious that the built environment has a different impact on wayfinding for the handicapped population in terms of accessing the environmental information. This is true for familiarising with the setting as well. Without the information provided in the correct format, it is almost impossible for a handicapped person to become spatially oriented and thus, familiar with a setting. People with different disabilities require different orientation aids within the environments provided for all of us. Fortunately, studies are conducted to eliminate problems the handicapped population has to bare within the built environment. Buildings are becoming more accessible to the handicapped by the use of regulations and building codes. Although the use of tactile and verbal signage is not widely spread, designers are becoming more conscious and aware of the demand.

In sum, although a variety of guidance instruments and materials are available for users with different abilities and disabilities, humans tend to use cognitively stored and recalled information more than anything else for assistance in wayfinding. This is because the majority of trips are made in familiar or partly familiar environments as Golledge (1999) states. When new to an environment, an individual will tend to use information from other people and from common representations (maps, photographs, etc.) to begin and facilitate the process of accumulating environmental information. The key processes relate to skills and abilities to read maps, to match real-world features against knowledge schemas of those features (or vice versa), to comprehend scale transforms and to understand the symbols commonly used to represent real features on maps or models (Golledge, 1999). As familiarity with an environment increases, there develops a tendency to use cognitively stored information. As one learns a chosen route, the tendency to use a map or to ask for directions decreases. More reliance is therefore placed on a cognitive representation of an environment. This representation may be incomplete and may include many errors, but human competence is often great in terms of their wayfinding ability (Golledge, 1999).

Thus, spatial familiarity in the context of wayfinding gains importance in terms of differences that occur in the knowledge acquisition and strategies followed when the environment is learned more and more and becomes familiar to the user. In search of a detailed interpretation of wayfinding and all factors affecting it, the following chapter focuses on spatial familiarity.

3. SPATIAL FAMILIARITY

Spatial familiarity is a poorly defined term in the geography and environmental psychology literature and has received relatively little research attention. Spatial familiarity is interpreted as simply "how well a place is known" (Chalmers and Knight, 1985), and being familiar with an environment asserts that one has increased knowledge concerning objects or locations in the environment, relative to unfamiliar environments (Thorndyke and Hayes – Roth, 1982). As familiarity with an environment increases, performances on wayfinding and spatial orientation tasks improve both in accuracy and latency, and the degree of complexity of the layout of the environment becomes less important (O'Neill, 1992).

The acquisition of spatial knowledge in large-scale environments is of interest to both environmental and cognitive psychologists. Until recently, studies of spatial learning have generally used either maps or direct experience as the primary means of exposure to an environment. Although a number on studies have documented the differences associated with the modes of experience (see Thorndyke and Hayes-Roth, 1982; Appleyard, 1969 for example), few empirical data are available at present on possible differences in the cognitive representation of large-scale environments of different degrees of familiarity. Gale et al (1990b) state that there appears to be no adequate substitute for field work, without field testing one can never really know how behaviour in the lab relates to behaviour in actual large-scale environments.

This is due to the fact that familiarity is a poorly defined concept, as Gale et al. (1990a, 1990b) have stressed. They present both a theoretical and experimental contribution to the definition of spatial familiarity, which appears to have four main dimensions; locational knowledge, visual recognition, place name recognition, and interaction with the place. With respect to the last dimension, the authors argue that “the most familiar places may be those that people visit or use most often’’ (1990a, p. 67). But people do not always have an excellent memory of places even if they visit them on a daily basis. As for the last issue, Mainardi-Peron et al. (1985) distinguish between what they call ‘acquaintance’ familiarity and ‘functional’ familiarity. The first refers to repeated exposures to a place not linked to a specific aim (ie. when a person has to cross a square in order to reach the work place or students passing in front of a lecture room, to reach another room). Functional familiarity, on the other hand, refers to coming into contact with a place in order to reach one’s goals through some activity occurring in that place. Such is the case, for example, when a person sweeps that same square as part of his/her daily work (Mainardi-Peron et al., 1990).

Spatial familiarity is a judgment that may express “the degree to which residents feel that they have control of their local environment” (Beguin and Romero, 1996, p. 687). Knowledge of a place may be measured in terms of spontaneous recalls as in the case of items included in a sketch-map, or in terms of recognition, as in the identification of scenes represented by photographs (Chalmers and Knight, 1985). Evans (1980) has identified two major issues. One of these issues is concerned with changes that occur in the accuracy of cognitive maps as familiarity for an environment increases. The second issue concerns the kinds of physical elements relied upon by individuals when learning new environments. There are two positions concerning the physical elements; one argues that "paths" play a dominant role in this regard, with "landmarks" taking on greater importance as familiarity increases. The other argues the reverse. Chalmers and Knight (1985) argue that knowledge of what physical elements people rely on to learn an environment is not sufficient to explain why certain locations become familiar and others not. Appleyard (1969, p. 113) discovered some attributes of the environment "that capture attention and hold a place in the inhabitant's mental representation of his city". He examined four factors that he hypothesised would be involved in the recall of places: distinctiveness of physical form, visibility, use, and cultural significance. The attributes of physical form that were found to correlate most significantly with recall were those associated with movement, contrast with surroundings, height and bulk, complexity of shape, and brightness, coarseness, and complexity of surface. Evans et al. (1982) confirmed the findings of Appleyard (1969) and, also found that building complexity, naturalness of surroundings, uniqueness of architectural style, and directness of access all correlate significantly with recall.

Spatial familiarity is complex in nature; it is difficult to identify and measure because it contains spatial and non-spatial components. Familiarity goes beyond just an awareness of a place as it also contains affective components such as feelings of warmth, safety, and security that complicate its meaning.

Some people claim to be familiar with a place if they know its name, others if they recognise images of it, others if they have visited or passed through a place frequently, and others if they know about a places geographic position or history. Due to this complex nature, spatial familiarity is thought to be multi-dimensional (Gale et. al, 1990a; in Kitchin, 1994a).

Finally, two additional familiarity issues warranting research should be discussed. The first issue concerns the operationalisation of environmental familiarity. Many researchers have equated familiarity with time periods (months, years), ignoring experiential differences in setting exposure across different persons. We need to examine more carefully the relationships between actual setting contact and the acquisition of knowledge. It is the actual amount and kind of setting exploration that really matters and not simply how long we have lived in a place (Evans et al., 1980). Second, most of the familiarity research to date has examined large cross-sectional differences in time (see Banerjee, 1971; Appleyard, 1969; Gale et. al, 1990a,1990b; Kitchin, 1994a; Mainardi-Peron et. al, 1990,1984,1985). There is need for more fine-grained, longitudinal analysis that examines the same individual's environmental learning over smaller periods of time.

Concerning the validity and reliability of spatial familiarity, familiarity with the built environment is certainly a factor affecting wayfinding, but we are unsure of how to measure this factor and the degree of its influence. Some buildings are easier to become familiar with, while some others are not; also some people are better at learning new places than others. It is the potential multi-dimensional nature which makes spatial familiarity difficult to study and operationalise to use as a variable in other studies. Gale et al. (1990a) hypothesised that there were four dimensions of familiarity which can be used to aid research design by making the term operational. The first of these is the ability to identify a place by recognising its name. Knowing a place name though carries no spatial identity. Second is the ability to recognise a place when shown a picture of it. This requires no locational reference, no background information. The third type of familiarity is knowing where a place is located. This can be either egocentric (in relation to one's self), topological (relative to other places), or Euclidean (in relation to coordinates or another abstract system). Fourth, is being familiar through frequent interaction. A fifth dimension which Gale et al. (1990a) have not considered is the familiarity gained through having additional knowledge about the place such as the history and current affairs, and these can be acquired from secondary sources such as media and education (Kitchin, 1994a).

Kitchin (1994a) tested whether spatial familiarity is a significant factor in configurational knowledge using a filter in conventional bi-dimensional regression of respondents' configurational exercises. He found that spatial familiarity is a significant variable; although he points out that only with additional analyses can it be determined if it is the most influential factor, although it seems likely. The conclusions that can be drawn from Kitchin's work (1994a) is that spatial familiarity is a multifaceted concept which can be successfully studied through the use of surrogate measures, although it is difficult to define and operationalise. These measures although measuring slightly different facets of familiarity are interchangeable and valid as reliable measures of spatial familiarity (Kitchin, 1994a).

3.1. Theories of Perception

In order to gain a better understanding of how we become familiar with the environment, it is necessary to understand the perceptual and cognitive processes that take place. Theories of perception shed a light on the issue of spatial familiarity as they explain the way we acquire and recall information. Knowledge of the environment (degree of spatial familiarity) that may be expressed in verbal form or in images and cognitive maps directs a person's perception, his information processing. The perception of the environment is directed by what a person knows (previous experience) as well as by what he needs. Environmental information is obtained through perceptual processes that are guided by schemata motivated by needs (see Figure 3.1.). These schemata are partially innate and partially learned (Lang, 1987). They form the linkage between perception and cognition. They guide not only the perceptual processes but also emotional responses and actions, which in turn affect the schemata as the outcomes of behaviour that are discerned. Human feelings and actions are limited by the affordances of the natural and built environments, the cultural environment, and the intrapsychic states of the people concerned. The explanation of these processes of behaviour is guided by an overall concept called the "environmental perception and behaviour approach". Within this approach there are different theories of perception. Three major interpretations of the processes of perception are

Gestalt, Transactional, and Ecological Theory.

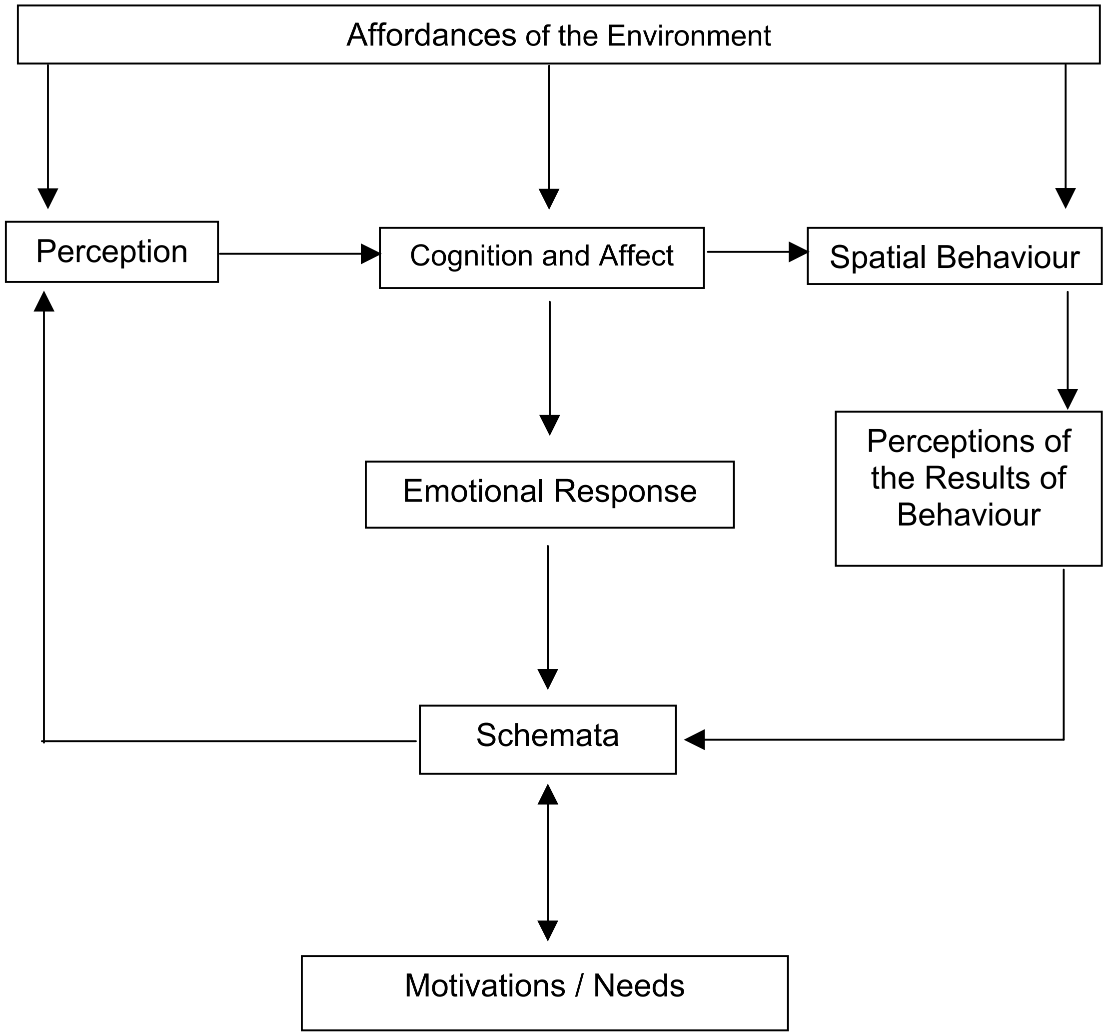


Figure 3.1. Perceptual Processes (Lang, 1987, p. 84).

Gestalt theory has most influenced the ideas of environmental designers more than any other perception theory. Gestalt psychologists compiled a list of factors that influence the perception of form. These factors are the laws of proximity, similarity, closure, good continuance, closedness, area, and symmetry. According to Gestalt theory, objects that are close together tend to be grouped together visually, this is the law of proximity. The law of similarity applies if elements have similar qualities - size, texture, colour, and so forth. The law of closure states that optical units tend to be shaped into closed wholes. The law of good continuance states that people tend to perceive continuous elements as single units. The law of area suggests that the smaller a closed area the more it tends to be seen as a figure. The law of symmetry claims that the more symmetrical a closed area the more it tends to be seen as a figure. The law of closedness suggests that areas with closed contours tend to be seen as units more generally than those without them (Lang, 1987).

Transactional theory emphasises the role of experience in perception and focuses on the dynamic relationship between person and environment. Perception is considered to be a transaction in which the environment, the observer, and the perception are mutually dependent on each other (Lang, 1987). Transactional theory makes a number of assumptions about the processes of perception. These are as follows:

1) perception is multi-modal,
2) perception is an active process,
3) perception cannot be explained by separating behaviour into the perceiver and the perceived,
4) perception cannot be explained in terms of conditioned responses to stimuli,
5) the person - environment relationship is a dynamic one,
6) the image of the environment that an observer depends on past experiences as well as on present motives and attitudes,
7) past experiences are projected onto the present situation in relationship to one's needs,
8) perception is governed by expectancies and predispositions (Lang, 1987, p. 90).

The important contribution of transactional theory to environmental design theory is the recognition that experience shapes what people pay attention to in the environment and what is important to them.

The ecological approach to perception contradicts with Gestalt theory and the transactional interpretation of the role of experience in perception. Instead of considering the senses as channels of sensation, it regards the senses as perceptual systems (Lang, 1987). People explore the environment to perceive the finer details by moving their eyes, heads, and bodies. With experience, a person is able to identify the finer details of the world and broader relationships, and learns to pay attention to details of the world that were not attended to before. In order to perceive the structure of the environment, it is important to recognise that some surfaces of the world hide others. When a person moves through the environment, one vista after another is seen. This occurs in moving from room to room in a building, or when reaching the corner of a street. The psychological analysis of the role of movement is one of Gibson's major contribution to ecological perception theory (see Gibson, 1979).

Lang (1987) notes that the ability to perceive some of the affordances of the environment seems to be innate or a function of physiological maturation of people. Others are learned through experience or by having one's attention brought to them. To detect meaning, an observer does not have to attend to every variable contained in the optic array. Attention is selective, people attend to what they know about and what they are motivated to recognise.

This depends on prior experiences. The linkages of the processes of perception to cognition are unclear in transactional theory of perception. It is believed that the cognitive structures crucial for perception are anticipatory schemata. People can only perceive what they know how to find.

Cognitive psychology deals with the acquisition, organisation, and storage of knowledge. It focuses on issues of thinking, learning, remembering, and mental development. Human behaviour is highly plastic. People have a large capacity to adapt to new built environments, to adapt the built environments to their needs, and to learn new aesthetic values. The processes central to this adaptive ability are learning, remembering, and generalising. Learning takes place when an individual associates a new response to a given stimulus, resulting in a permanent change in behaviour (Lang, 1987). What we learn involves either internal or external reinforcement. This applies to environmental attitudes that affect future behaviour as well as to activity patterns. Some things are forgotten while others endure in memory.

Remembering and forgetting are serious concerns; the way we use buildings and cities depends partially on how well their structures are remembered from past visits (Lynch, 1960; Appleyard, 1969; Passini, 1984a). Lang (1987) states that some things are easier to remember than others; the rate at which we forget things depends on their importance to us, how well categorised or organised they are, and how deviant they are from the norm. Also, the way we categorise things can either aid or distort memory; and the ability to learn how to use categories depends on the cognitive processes of generalisation made from past experiences. Golledge (1999) states that repeated path-following facilitates remembering the path components and recalling them for later use (ie, route learning). Paths or routes are represented as one-dimensional linked segments or, after integration with other paths, as networked configurations. The latter, along with landmarks, the spatial relations among them, and other spatial and non-spatial features of places, make up the remembered layout of an experienced environment. In terms of spatial familiarity, how well we remember features of the built environment depends on the design principles considered in the setting, as well as our individual ability to learn, memorise, categorise, and generalise what we have learnt previously.

3.2. Factors Affecting Spatial Familiarity

The positive effect of enhancing the knowledge an individual has about the environment is of common knowledge. As the number of travels within the space increase, the individual is expected to gain experience and knowledge about certain cues the space lends. Evans et al. (1982) report that the ability of people to recall a building and its location in an urban context depends on a wide range of factors including shape, the number of persons moving around the building (ie. crowd), the physical properties and height of spaces. This variety may also be due to factors such as age, gender, experience, interest, and attention etc. But the degree of their effects, and how they affect familiarity need to be further investigated.

Wayfinders traversing within the built environment pick cues about the spatial organisation, these cues are stored in one's head and recalled during the decision-making or execution process. One important point is that humans do not necessarily "know" an environment through which a learned route passes. Only some features of the route itself may be learned, stored, and used; the traveller may be ignorant of the environmental surrounds. Such a traveller would not be able to make accurate judgements about the location, distribution, pattern, connectivity, or other spatial relations of features occurring within such an environment. Once an environment has been experienced either partly or completely, fragments of environmental information (including locations and connections between places) are encoded, stored, decoded, recalled, and used in various tasks. Memories may be fuzzy and imprecise or extremely inaccurate. Different degrees of precision may be evidence when different spatial products are developed to externally summarise what is known (Golledge, 1999).

It is important to identify the differences among individuals generated from their familiarity with the built environment in order to find design solutions that will be of use to all individuals within the same setting. There are two categories of influence on spatial familiarity that are also valid for wayfinding: influence of environmental information and that of individual characteristics. Environmental information includes visual accessibility, architectural differentiation, sign systems, and building configuration; and individual characteristics include gender, spatial ability, disabilities concerning mental processes and psychological bonds the individuals develop, as discussed in sections 2.3. and 2.4. Amount of experience with the environment is probably the most important factor that affects spatial familiarity. This factor falls between spatial and individual characteristics because it is the outcome of the interaction between the two. The role of experience is discussed in the following section.

In the context of spatial familiarity, experience, spatial ability, meaning and expectancy, and environmental complexity become important factors that determine the amount of environmental knowledge as well as the experience with place. In order to conduct a thorough investigation on spatial familiarity, the influence of these attributes on individuals should be analysed.

3.2.1. Experience

The degree of familiarity an individual has with a given setting is an obvious influence on wayfinding. Familiarity with a setting is gained by experiencing it in a systematic fashion, either consciously or unconsciously. When in a new environment, we gather information with all our senses and then code and sort them into meaningful categories. At the beginning, we learn about our new environment by associating cues with choice-points and in a chain-like manner, ie., response learning. Over time, an integrated knowledge of the spatial relations between many starting points and destinations is developed. This is place learning, which is a superior and more flexible approach to spatial problem solving (Downs and Stea, 1977). The graduation from response to place learning is influenced by several major factors such as structure of the physical environment, type of spatial experience, and length of experience.

Spatial knowledge is acquired by individuals as a function of their experience within a given environment. At the simplest level, an individual must have knowledge of important objects and/or places, generally referred to as landmark knowledge (Heft, 1979). This knowledge includes the ability to state with certainty that an object or place exists and the ability to recognise it when it is within the perceptual field. Spatial knowledge also includes information about the relationships among objects, procedures (ie. landmark, route or survey knowledge) for moving from a given location to another location, and an ability to identify the routes that facilitate such actions (Gale et al., 1990b).

In the earlier stages of acquisition, keeping track of one's location, predicting where one is heading (ie., anticipating), and trying to restore one's orientation are likely to dominate. However, later, when the environment has become familiar, it seems likely that places are easily recognised and that the number of known places (reference points) increases to the point where it is almost superfluous for the traveller to monitor his or her location. The traveller then has a great deal of space capacity, may engage in other mental activities, and as a consequence, is only dimly aware of monitoring the execution of a travel plan (Garling et al., 1984).

The acquisition of spatial knowledge is based, for the most part, upon direct environmental experience. Indirect experience may occur through a variety of media, such as maps, graphic or visual representations (such as photographs), verbal or written descriptions (Gale et al., 1990a), or by learning the layout from an overlooking vantage point (Golledge, 1999). But direct experience with the large-scale environment is usually sustained by actually moving through it. The role of travel, and by necessity route navigation, are therefore considered fundamental in the process of the development and acquisition of a spatial knowledge base (Gale et al., 1990b).

It is now established that people are able to accurately recall the spatial layout of their environments, but there may also be an upper limit to how much information they manage to represent. Accuracy has furthermore been found to increase with the amount of previous experience (Evans et al., 1981; Garling et al., 1982), and there are possibly qualitative changes in the cognitive maps as a function of previous experience (Garling et al., 1984). Cognitive maps tend to become similar to cartographic maps when an environment becomes more familiar (Evans et al., 1981; Garling et al., 1982), and this is likely to take place earlier in the acquisition process if the environment to be learned is more limited.

Experiencing an environment will result in some spatial information being stored in long-term memory. Although there is ongoing debate about how and when such information is stored, accessed, and used, it does appear that spatial learning corrects errors and inconsistencies in initially encoded spatial information. It further appears that the degree of knowledge about places, locations, or points along a route varies among people, that is, there are individual differences in the context of environmental knowing. Further, it seems that humans do not all behave the same in the same environments, that different people have different levels of familiarity with different environmental settings, and that they give salience to different environmental features. Often the result is that different spatial products of the same area can incorporate substantially different features and produce different types of errors; for example, one person may have dominantly direction errors, another dominantly inter-point distance errors, and yet another predominantly locational errors. Greater knowledge is achieved by actively rather than passively experiencing a space through You-Are-Here maps, photographs, verbal descriptions, etc.

Past experience in visiting new places helps to develop a set of useful rules for learning to map new places cognitively and for solving a range of spatial problems. Such heuristics, once formed, can be transferred from one place to another sharing some common structural characteristics, eg. a grid pattern (Downs and Stea, 1977). Length of experience is another factor, as people spend their time in an environment, their spatial knowledge about it grows. Not only does the amount of information about the setting increase, but the accuracy of locations as well (Evans et al., 1981).

Amount of experience in a setting is an important variable and many of the gender and cross-cultural differences found in environmental cognition research can be more parsimoniously explained by the extent of actual setting exploration permitted to various subgroups of populations. Although it is clear that we gain knowledge of a place with continued exposure through perception, we cannot precisely describe these increments in knowledge. Most studies of cognitive mapping bare on the question of how orientation is maintained in familiar environments (see Aitken et. al, 1990; 1993). Their relevance is, however, in most cases only indirect because in these studies subjects have been interviewed in a neutral setting rather than being requested to demonstrate how they use the cognitive map for navigation and orientation (Evans, 1980). It is plausible to assume that recognition plays a more important role for orientation in familiar environments. Reference points presumably are recognised so that their spatial relations to other reference points are stored in the cognitive map become available systems of reference. They are also likely to be employed more often than single points of reference, because the points of reference are spatially interrelated in the cognitive map. Monitoring movement may still play a role. Few environments are altogether familiar, and there are sometimes extreme conditions, such as darkness, fog, or noise, making monitoring movement necessary (Garling et al., 1984). Maps, sign posting, and other media may, however, play an important role for orientation in such environments. The use of media in such cases is likely to involve recognition processes. Familiar examples are recognition of places specified by path descriptions, translating symbols in maps to the environment, and so forth (Garling et al., 1984).

The environmental learning sequences posited by Hart and Moore (1973) and Siegel and White (1975) may be extended to shifts in accuracy with experience that resemble the ontogenesis of spatial cognition. Preliminary contact with an environment provides comprehension of the relative positions and items in space with respect to the body. Thus the relative location of objects close in space can be correctly processed, provided no perspective shifts are demanded. Projective accuracy follows with items comprehended in terms of their relative positions with respect to various fixed points in space. Finally, Euclidean comprehension emerges wherein space is encoded as a unit in which items are located with respect to their position in two-or three-dimensional space.

Thorndyke and Hayes-Roth (1982) compared subjects with up to 2 years of direct experience working inside an office building with those who studied a floor-plan map of the building. Map subjects were generally better at Euclidean distance and object location judgments, while direct learners were better at route distance estimates and orientation (see also Rossano et al., 1999). Here, lies a question in regard to the comparability of the two groups, because the map-studying group had a motive to learn the building, while the direct experience group did not have such a motive. Such a motive would direct the attention of the direct experience group as well as the map learner group. Also, is there a limit for direct experience, how would subjects perform if they had 4 years of experience in the building?

The relative locations of home, work, schools, and shopping areas strongly affect the extent of individuals' knowledge of the immediate geographic environment. There is also evidence that recognition memory for components of settings is related to actual experience as well as to general residential history. Banerjee (1971) reported that the longer a person lived in Boston, the greater the number of photographs of the city they could correctly identify and locate.

Montello (1991) measured pointing speed and direction to establish the possible disorienting effects of oblique routes in a field study. He asserted that direction is a measure of the accuracy of spatial behaviour, and pointing speed was included as a response measure because response time reflects the accessibility of stored information, including the strength of its encoding in long-term memory and the occurrence of any working-memory processes that must be brought to bear on the information to produce a behavioural response. Results of the study indicated that subjects who claimed to know the area better responded faster, and that subjects who had lived in the area for a longer period of time responded both faster and pointed with greater accuracy. The latter finding replicates a relationship between length of residency and metric accuracy of environmental knowledge found by several investigators (Evans et al., 1981; Garling et al., 1982), and it adds to the existing literature a relationship between long-term residency and the speed with which environmental knowledge is accessed.

The main outcome is the differentiation of familiar and unfamiliar subjects in recalling the different types of environmental elements. Familiar subjects, in fact, recalled structural elements better than movable objects and also better than fixed objects. According to Axia et al. (1988), when asked to recall a known place, subjects are more likely to report elements which are more strictly connected with the place schema and which are fixed constraints to action in space; that is to say, for instance, corridors and doors in an interior, and pavement and gates in an exterior.

3.2.2. Spatial Ability

It is obvious that one's capacity to perceive the visual world accurately is directly related with the wayfinding activity, and the amount of experience with the built environment has considerable impact on this activity. Obviously, wayfinding as purposive behaviour involves interactions between attributes of the traveller and attributes of the environment. Because of short-term variations and long-term changes in these attributes, it is reasonable to posit that at some level of consideration no two wayfinding attempts are exactly alike, even those involving repeated travel between familiar destinations. Ultimately, successful wayfinding is reflected in the traveller's ability to achieve a specific destination within the confines of pertinent spatial or temporal constraints and despite the uncertainty that exists (Allen, 1999, p. 47). Therefore, as the wayfinder in the built environment receives information, the information is transformed into knowledge according to the degree of spatial ability. This does not mean that one with a low level of spatial ability is incapable of wayfinding, but it refers to the idea that high spatial ability eliminates loss of time caused by trying to process environmental information over and over again. Also, spatial ability may not be sufficient to assess the awareness of the wayfinder. One may get around using environmental information – that is if the environmental aids provided are sufficient – without major problems. Briefly, as Satalich (1996, p. 4) defines, “spatial ability is perceiving the environment through our senses, the cognitive process of how we learn our environment, and the relationships between objects. Wayfinding is the dynamic process of using our spatial ability and navigational awareness of an environment to reach a desired destination”.

Allen (1999) states that an examination of individual differences in wayfinding will necessarily focus on the attributes of the traveller and that this focus is not meant to downplay the role of environmental attributes or to suggest an oversimplification of wayfinding tasks. Indeed, it is the case that the abilities exhibited by humans and other species are quite obviously adaptations to environmental demands and opportunities.

The term spatial ability carries with it a variety of connotations because this rubric has been used in different empirical traditions that are tangentially related at all. Seeking common conceptual or empirical threads among these traditions is a formidable challenge. The study of spatial abilities has long been part of the psychometric tradition in psychology. This tradition, which is the conceptual home of the term “individual differences”, has provided a delineation of abilities using factor analysis and various schemes derived through multi-dimensional scaling or cluster analyses to explicate how abilities are related to each other. Psychometric research has clearly identified a domain of spatial ability consisting of a number of different factors, all reflecting facility in perceiving, remembering, or mentally transforming figure stimuli (Allen, 1999).

Gardner (1983) argues that there exist several ways to assess one's spatial intelligence using a variety of tasks. He states that central to spatial intelligence are the capacities to perceive the visual world accurately to perform transformations and modifications upon one's initial perceptions, and to be able to recreate aspects of one's visual experience, even in the absence of relevant physical stimuli.

It should be noted that the nature of spatial ability may be affected by age, experience, culture and all individual characteristics mentioned before. The transition from childhood to adulthood involves changes in spatial skills, and we can improve our skills over time with experience. Also, culture influences our activities, and sometimes sets the boundaries of our lives, determining what we may or may not do, or which skills we may improve (ie. cooking for women, driving for men). Lang (1987) states that much of our behaviour is culture-bound and depends on how we have been socialised to like and dislike patterns of the environment and the successes that we have had in the past in dealing with them.

The preceding overview of spatial abilities suggests a potentially informative adaptation of an interactive sources framework that would include perceptual capabilities, fundamental information-processing capabilities, previously acquired knowledge, and motor capabilities. Perceptual capabilities refer to sensitivity to visual, auditory, vestibular, tactile, and proprioceptive sources of information about self-produced movement or environmental structure. Fundamental information-processing capabilities include speed, internal timing, and working memory, both spatial and verbal. Previously acquired knowledge can serve as a resource in several ways. Obviously, memory of specific environments and memory for specific routes can be considered resources. In addition, there are generalisable concepts, strategies, and skills that can be pressed into service during various wayfinding tasks (Allen, 1999).

Findings suggest that high spatial ability leads to greater participation in spatial activities (Newcomb and Dubas, 1992). For example, travellers who are good at attending to events along a route may also be good at navigation based on immediate cues. The identification of such general spatial abilities is important for applications in personnel selection, training, environmental design, and robotics (Cornell et al., 1999).

Allen (1999) states that few studies have been concerned directly with relationships among spatial abilities, spatial knowledge, and wayfinding behaviour. The typical finding is that spatial abilities as measured with psychometric tests have little in common with spatial performance on tasks in large-scale space. The studies that have been done have not sampled spatial abilities or wayfinding tasks in an ordered or systematic way. Filling this research void represents an informative future research agenda. Such research will be most useful if it involves a comprehensive framework featuring a taxonomy of abilities and tasks (Allen, 1999).

Several authors (Malinowski and Gillespie, 2001; Golledge and Stimpson, 1997; Self et al., 1992) characterise three major dimensions of spatial ability. These are the spatial visualisation, the ability to mentally rotate, invert or otherwise manipulate two-dimensional or three-dimensional objects presented visually; spatial orientation, the ability to imagine how an object would look from different perspectives; and spatial relations, which includes relational or associational components of spatial ability covering tasks such as wayfinding, shortcutting, and sketch-mapping (Malinowski and Gillespie, 2001). Basically, research in spatial aptitude seems to indicate that, theoretically at least, spatial abilities can be summarised by two dominant dimensions – spatial rotation and spatial orientation (Golledge, 1999).

3.2.3. Meaning and Expectancy

The meaning attached to a setting is an important factor that varies from one individual to another, and determines the amount and detail of information stored in one’s memory that may be used later on. The amount and detail of knowledge stored affects spatial familiarity, therefore it is important to understand how this is maintained.

Moore (1979) suggests that different social groups conceive space differently. Some research on spatial cognition has examined social factors. Stokols and Schumaker (1981) propose a concept that they call “social imageability”, which suggests that the perception of the environment is altered by the social function that occur there, goals of the group, and their evaluations of the place. Lang (1987) states that the built environment communicates a variety of meanings, from its utility to its symbolism. The symbolism of the built environment is a major concern of environmental designers for it is an important factor in people’s liking or disliking their surroundings (Lang, 1987). For example, it is possible that hospital staff actually perceive and structure their work environment differently than patients or visitors. The staff may attend to objects in the hospital environment that visitors never notice, for instance, using the staff meeting room as a functional landmark (O’Neill and Jasper, 1992). The way students and instructors perceive the built environment may also differ. For instance, the emotional response of students to the school environment may vary from unwillingly attending classes, to anticipating the hours spent with classmates outside the classroom. The instructors may conceive the built environment quite differently too, their offices may become depicters of status.

Although the physical and spatial characteristics of an environment are foremost in clear image formation, the rather neglected dimension of environmental meaning has been recognised to be an important contributor to imageability (Appleyard, 1969). Certain places stand out in people’s minds because of their meaning and not their architectural features. Meaning can be of a functional nature. A post office, or a restaurant might be remembered for their use significance. Meaning can also be of a socio-symbolic nature. Another form of meaning derives from a person’s sensory experience of a place. An interesting setting is more imageable than a dull, monotonous one. Curiosity is more stimulating to the cognitive abilities than boredom.

Expectancies also affect the way we behave in the environment. Expectancies during travel can take a variety of forms, but a useful distinction is between general and specific expectancies. General expectancies are based on world knowledge, such as the expectancy that parks have trees, and that suburbs have rows of similar houses. General expectancies can be used to check that travel is appropriate in a new area, and seem especially prominent when an unusual environmental feature is encountered. Expectancies during travel can be much more specific, based on memories of map study, verbal directions, or direct experience. When repeating a previously travelled route, a basic example is the recall of a right turn that is cued prior to arrival at the intersection where alternative paths can be seen. In this case, anticipatory recall indicates knowledge about the identity of an action and knowledge of its serial or spatial position along the route. Another form of expectancy occurs when a landmark is recognised with more confidence because its memory has been primed by a preceding landmark (Cornell et al., 1999)

There is evidence that familiarity with places accrues even when attention has been divided during route learning (Lindberg and Garling, 1982) and that wayfinding can often be accomplished by approaching familiar places

(Cornell et al., 1999). This evidence suggests that feelings of knowing when events along the route are encountered may serve to guide travel when explicit memories – verbal descriptions, images, or other symbolic representations of the route – are incomplete.

It seems likely that expectancies can be constructed as a back-up strategy, establishing predictions when immediate recognition is uncertain. The role of expectancies in this view is to provide associations that can be confirmed or corrected during navigation. Route expectancies may often be inadequate for wayfinding along an incidentally learned route, or one that has been planned from maps or directions. Hence, several processes may account for variance in measures of navigation accuracy. As an example, certain events along a route may not trigger clear expectancies of what lies ahead, but may provide immediate information for recognising that the route is familiar (Cornell et al., 1999). The process of confirming and elaborating details of expectations would help travellers stay on route and could subsequently be reflected in the explicitness of their route descriptions.

Delving into the factors influencing memory for places, three broad classes of variables may be distinguished: variables concerning the person, variables concerning the environment and variables concerning the interaction between the two. Without attempting to provide an exhaustive taxonomy, within each of the above classes further distinctions may be possible (Mainardi-Peron et al., 1985). For the variables concerning the person, memory structure and processes, attention, and motivation, along with other psychological factors play certainly a role. Motivation to learn affects environmental learning which is a goal-directed process. When one is motivated, the spatial properties of large-scale environments may be acquired very quickly (Garling et al., 1981) by paying more attention to the environment (Cohen et al., 1979). As far as the environment is concerned, two main distinctions seem psychologically salient. One arises from functional and/or structural factors and on this basis we may distinguish, for example, internal vs. external places, or different types of internal (eg. corridors vs. living rooms) and external (eg. streets vs. courtyards) places; distinctions can also be made with reference to dimensions, form and location, either jointly or singly considered (eg. balcony vs. terrace, basement vs. attic). The other distinction arises from the places' conceptual definitions. On this basis, we can distinguish between places at different levels of abstraction in environmental taxonomy (a high level 'house' vs. a low level 'Mr. Smith's living room'), or places with typically associated elements (eg. a stove in a kitchen, trees in a park), and places for which this is true to a lesser extent (eg. an esplanade) (Mainardi-Peron et al., 1985). As far as the interaction between persons and environments is concerned, familiarity and subject's aims are relevant. The two cannot easily or always be separately considered, as familiarity is often the result of reaching one's goals through some activity occurring in a given place. Taking familiarity in this sense, one could argue that the functional aspects of the place in question – and consequently items related to them – should become more available for the subject.

Hayes-Roth and Hayes-Roth (1979) proposed a model that accounts for planning as a cognitive activity. They define planning as the predetermination of a course of action having some specified goal. It is assumed that people form travel plans with the general goal of reaching desired destinations without having to invest too much effort. To attain this goal, information about important properties of the environment must be gained. These properties include the functions of places, where the places are located, and how one can travel to the places. This information may often be obtainable from media (eg., street maps, face-to-face communications, and such written texts as brochures). If the environment is familiar, it should be possible to retrieve the information from the cognitive map (Garling et al., 1984). In this context, the goals that motivate people to go to a place are important because of the different levels of attention devoted to the place itself. For example, a goal can be achieved within a certain place, as is the case when one buys something in a shop; or it can be achieved in a different place which can be reached only by passing through another one, as is the case when one has to cross a square in order to reach the shop where one wants to buy something. As a consequence, one should expect to find a better memory for the place where the goal is achieved than for the one where it is not.

3.2.4. Environmental Complexity

The components of environmental complexity in relation to wayfinding should also be discussed in relation to spatial familiarity. When one thinks about an interesting, complex environment, the first image to emerge is probably composed of an intricate arrangement of space highlighted by unusual architectural features, executed with a tasteful use of material and colour. An additional component of environmental complexity, which is most important in experiencing a setting, is density and depth of meaning. Meaning can take many forms. It can express a function, a social and cultural identity, a historical heritage; it can also communicate political, religious, and life-style values. It is argued that ambiguity, which is defined as the multiple interpretation of architectural form, assures density of meaning and through it, environmental complexity (Passini, 1984).

Learned routes vary in complexity, and as this complexity increases so does the mental effort required to utilise the route knowledge. The route complexity increases as each of the following factors increases – the length of each component leg; the magnitudes of the directional changes required at each decision point; the quantity of connecting route legs; cumulative directional changes required along the route (Bliss et al., 1997). As the route's mental effort requirement increases, a survey representation of the same space can be more useful.

A place that is used and appropriated by its occupants is enriched by a meaning that represents the nature of the users as well as their activities. Environmental complexity in its full sense has to include people and all the signs that are associated with the relations they establish with a place over time. New developments are often architecturally innovative and spatially diverse, but without human activity and involvement, they tend to be perceived as dead and sterile.

The opportunity and ability to solve problems, which are fundamental to wayfinding, are sources of satisfaction in themselves. The motivation derived from successful problem solving is evident in much of our working life. We are generous with the time we allocate to problem solving; the writing of a book is a good example. Wayfinding is problem solving. In order to be rewarding the problem has to be of a certain interest. This interest is achieved if the setting reflects a certain architectural and spatial complexity, which explains a first link between complexity and the satisfaction derived from wayfinding. Wayfinding might be a game at times, but once you have had enough, you can put a game away, whereas in wayfinding, you have to stick with it until a destination is reached.

A second major source of satisfaction linking wayfinding to environmental complexity is exploration, which motivates much of our endeavours. We may explore in order to seek change and break with the familiar. We may also explore to seek new information and acquire knowledge. The pleasure of solving problems, the pleasure of being entertained, and the pleasure of acquiring new knowledge are three major sources of satisfaction derived from wayfinding in complex environments (Passini, 1984b). The experience associated with wayfinding is a deeply felt one. Satisfaction is derived from problem solving and from exploration. When the wayfinder is satisfied, he attributes certain meanings to the environment that may become of key importance in becoming familiar with the setting, thus providing a clear representation for other episodes of wayfinding in the same setting.

Under emergency conditions, such as fire evacuation, the only thing that counts is reaching the destination as fast and as easily as possible. Lack of time, stress and the possible impairment of information-processing and decision-making capacities, determine that nothing can be too simple or too "straightforward" (Sime, 1985). Most wayfinding does not take place under emergency conditions; even so, efficiency in reaching destinations is required. Meeting a person at a given address, finding a restaurant or a hotel, doing the shopping, in fact, most of our daily tasks can be regrouped into what may be called a resolute wayfinding condition. The feelings experienced when reaching a destination is as important as the functional aspect of wayfinding that usually has priority. Environmental complexity is desirable as long as the design of the setting, including the wayfinding support systems, guarantees efficient information processing performances (see Evans and Mc Coy, 1998). The motivation gained from an enriching experience facilitates the wayfinding process. Thus, it is not necessarily the oversimplified, dull building that is most successful for efficient wayfinding. After all, interest and curiosity lead to a heightened understanding and easy learning, whereas boredom does not.

4. RESEARCH

The issue of wayfinding incorporates a variety of factors that affect the behaviours of individuals. Spatial familiarity is one important, yet insufficiently investigated variable in the field of environmental behaviour that has no well-defined technical interpretation, and is directly related to the wayfinding behaviour.

As the main aim of this thesis is to explore spatial familiarity and to investigate its dimensions in relation to wayfinding, assessment of individual and group differences, the identification of these differences and their effect on spatial familiarity are considered as an important step in understanding the process of wayfinding. Thus, spatial familiarity has been tested and assessed in an empirical study by performance on navigation, wayfinding tasks in real environments, spatial ability tests, and interviews. Individual and group differences have been investigated through statistical tests.

4.1. Research Questions and Hypotheses

Research Questions:

1. What are the factors affecting spatial familiarity? In particular;
    - 1.1. Do the spatial characteristics of the building affect spatial familiarity?
    - 1.2. Does spatial ability affect spatial familiarity? (ie. Does high spatial

ability predict high self-rated spatial familiarity and wayfinding performance?)

1.3. Do meaning and purpose affect spatial familiarity?

1.4. Does gender affect spatial familiarity?

1.5. Does the length of time spent in the built environment affect the level of spatial familiarity?

1.6. Does time and amount of trials in the built environment affect spatial familiarity?

2. Does spatial familiarity affect wayfinding?

Hypotheses:

1. SPATIAL CHARACTERISTICS OF BUILDINGS AFFECT SPATIAL FAMILIARITY
    1.1. Legibility (spatial organisation) affects level of spatial familiarity.
        1.1.1. Landmarks affect level of spatial familiarity.
        1.1.2. Signage affects level of spatial familiarity.
        1.1.3. Visual accessibility affects spatial familiarity.

2. INDIVIDUAL CHARACTERISTICS AFFECT SPATIAL FAMILIARITY
    2.1. Spatial ability (scores of subjects categorised as: above the average / average / below the average) affects spatial familiarity.
    2.2. Spatial ability affects amount and type of elements recalled in the built environment.

2.3. Type of education (Interior Architecture / Graphic Design) affects spatial familiarity and types of elements recalled.

2.4. Meaning and purpose affect spatial familiarity (students of Interior Architecture/ students of Graphic Design).

2.5. Gender affects spatial familiarity.

3. INTERACTION WITH SPACE AFFECTS SPATIAL FAMILIARITY

3.1. The total amount of time spent in an environment (in months or years) since the first encounter affects spatial familiarity.

3.2. Interaction frequency (total amount of visits per week) with the built environment affects spatial familiarity.

4. SPATIAL FAMILIARITY AFFECTS WAYFINDING PERFORMANCE

4.1. Spatial familiarity affects wayfinding performance. (Subject's familiarity with the built environment predicts wayfinding performance.)

4.2. Self-evaluation of subjects' familiarity predicts wayfinding performance.

4.3. Subject's evaluation of buildings from wayfinding point of view predicts wayfinding performance.

4.2. Setting and Subjects

In order to test and observe different levels of spatial familiarity and assess wayfinding behaviour under these conditions, two buildings on the campus of

Bilkent University in Ankara, Turkey were chosen as the settings for the study. In order to provide a better understanding of the buildings, the building profiles have been described below.

4.2.1. Building Descriptions

4.2.1.1. IAED Building

The first building (designated IAED) is occupied by the department of Interior Architecture and Environmental Design and Communication and Design of the Faculty of Art, Design, and Architecture. The IAED building is a multi-storey large-scale building(see Appendix C1 for exterior and C2 for interior view). It has two almost symmetrical wings which are interconnected by 4 corridors (see Appendix D1 for floor plans and D2 for sections). These four corridors are repeated on each floor in a uniform manner. The corridors on the first floor are dead-ends. There are two separate main entrances to each wing. Apart from the main entrance, one wing has a second entrance which links the building to the academic parking lot (see Appendix D1). Although there is a third entrance to the building on the same wing, it is locked at all times therefore it is not used. One other difference between the two wings is that the spiral staircase on one wing goes down to the basement whereas the other does not.

Each wing has three floors on one side, and five floors on the other (see Appendix C2). These two parts serve for different purposes. The part that is three storey - high has the studios, classrooms, elevators, and toilets used by the students (designated studio floors) (see Appendix E1). The offices are located in the five storey high part (designated office floors) (see Appendix E2). Here are 12 offices (six on one wing and six on the other), one toilet on each floor and an elevator used only by the academic and administrative staff. There are three studios, four classrooms, two toilets on each studio floor and one elevator on each wing used by the students. The connection between the office and studio floors are maintained through intersections on which the corridors of the office floors join the spiral staircases at the far end of each wing. In order to pass from an office floor to a studio floor one has to ascend or descend half a level except for the third floor; this is the only floor that has no level difference between the two parts of the building.

The spiral staircases are not visually accessible from the studio floors, they are placed behind walls and one has to walk close enough to perceive the entrance (see Appendix E3). Also, they are hidden behind the doors at the end of each wing on the office floors. Although these stairs are the only nodes where the offices, studios and the vertical access to all floors intersect, there is no indication of this important function. There are also stairs on the studio floors, the main staircases are at the entrance of each wing, and connect the ground floor to the first floor. They are visually accessible because the stairs transform into ramps half way to the first floors and cross the space diagonally (see Appendix E4). On the first and second floor, the stairs are located next to the studios (see Appendix E5) and are not as significant as the main staircases. This is because they are not well illuminated and are hidden behind 1m high parapets that are the same colour with the walls. The elevators, on the other hand, are not placed symmetrically on each wing. One of the elevators is located straight across the main entrance and therefore is visually accessible (see Appendix E6), whereas the elevator on the other wing is located parallel to the entrance axis and therefore is more difficult to perceive (see Appendix E7).

The entrance area of each wing has a high vaulted ceiling (almost 20 meters), and has visual accessibility to two of the studio floors (see Appendix E8), the third studio floor of one wing has a circular opening which has a partial view of the studio floors below (see Appendix E9). There are square shaped openings on the wall that divides the studio and office floors from the first floor to the third floor. These openings provide partial visual accessibility from the office corridors to the studio floors, and are used for display purposes from time to time (see Appendix E2 and E8). When viewed from the studio floors, these openings suggest that there is a space behind the walls, but not the purpose of those spaces. As mentioned before, the intersections of the two spaces are not visually accessible, therefore, there is no indication of how connection is maintained from the studios to the offices. It should also be mentioned that there is no indication that one can pass from one wing to the other through the office corridors.

From the architectural differentiation point of view, uniform floor patterns are repeated on almost every floor. There is no colour or formally applied code to provide architectural differentiation of the spaces with different functions or a hierarchical system for the use of the studios, classrooms or offices in the building. For instance, the first and fourth year studios are on one wing and the second and third year studios are on the other wing. This also applies for the classrooms and the offices. A third year studio instructor's room can be located on the fifth floor.

The signage system lacks an organisational principle. Door numbers do not follow a systematic order, studio and classroom numbers do not follow each other although they are on the same floor, but they continue from one wing to the other. For example, there is a staff room on the third studio floor; it is at the centre of the two wings. The studio F309 is the last studio on the third floor and is followed by the staff room where no students are allowed (see Appendix E10). F310 is the studio that follows this room on the other wing but there is no indication of this fact. There are no You-Are-Here Maps or directories at the entrance areas but there are computer output directories beside the doors that open to the office corridors (see Appendix F and E11). As the floor plans are uniform, it is difficult to understand which floor it is when one gets off the elevator, and there are no signs placed across the elevators.

The ramps, the BCC labs, a painting on the first studio floor, the skylights and plants (see Appendix E11) on the fifth office floor are referred as landmarks in the building. This is because they are unique and eye-catching but from the wayfinding point of view, they are not clear reference points and do not correspond to specific areas.

4.2.1.2. GRA Building

The second building (designated GRA) is a three - storey high large-scale building that integrates three blocks and is occupied by three departments: Landscape Architecture and Urban Design (LAUD), Graphic Design (GRA), and Fine Arts (FA). The LAUD department is located on A-Block. A-Block is connected to B-Block through staircases where the GRA department is located. Finally, C-block, where the FA department is located, is once again connected to B-Block through staircases. Two of the blocks (A Block and B Block) are almost identical (see Appendix G1 for floor plans and G2 for sections). The plan configuration is repeated on each floor in a uniform manner. There are three main entrances to each block (see Appendix H1 and H2). One of the differences between the three blocks is that only A block has access to the basement floor.

Each block is separated into two parts that serve for different purposes. The studios, classrooms, and toilets used by the students (designated studio floors) are on one side and the offices are located on the other side (designated office floors). Here are 6 offices, and one toilet at the end of each office corridor used only by the academic and administrative staff. There are three or four studios, two or three classrooms depending on the floor they are on, and a toilet on the mid-level in each block used by the students. The connection between the office and studio floors are maintained through the main staircase (see Appendix H3). In order to pass from an office floor to a studio floor one has to ascend or descend half a level except for the third floor because there is no level difference on the last floor.

The entrances of A block and B block are beneath the main staircases. The main staircase in C block is located across the entrance. These staircases and the office floors are visually accessible from the studio floors. There are also staircases on the studio floors other than the three main staircases. Two of these staircases connect the three blocks to each other (A block to B block, and B block to C block), and three of them are the vertical paths that connect the three floors to each other as well as being the only access to the toilets (see Appendix H4). They are not visually accessible because they are around the corners of each block.

From the architectural differentiation point of view, uniform floor patterns are repeated on almost every floor. There is no colour or formally applied code to provide architectural differentiation of the spaces with different functions. But, there is a hierarchical system for the use of the studios and offices in the building. For instance, the first and fourth year studios are on the ground floor, the second year studios are on the second floor, and the third year studios are on the third floor. This also applies for the offices. The first and fourth year studio instructors' rooms are located on the first floor, and second year studio instructors' rooms are on the second office floor, and the third year studio instructors' rooms are on the third floor.

The signage system follows an order; the offices, studios and classroom numbers follow each other except for the storage rooms. Although they are on the same floor, their door numbers do not follow the correct sequence. There are no You-Are-Here Maps or directories at the entrance areas or on any of the floors, and there is no indication of the connections from one block to the other. Although the floor plans are uniform, it is easy to understand which floor it is because almost every part of each block is visually accessible.

As landmarks, the student models and site plans in A block, the drawings and paintings in B block, and the installations in C block function as reference points (see Appendix H5, H6, and H7). Obviously, they are unique and eye-catching, but they indicate differences between the blocks that can only be corresponded to specific areas by users who have at least a general idea about the departments occupying the blocks. When compared to IAED, this building certainly has advantages in terms of wayfinding, although it also has similar deficiencies.

4.2.2. Subjects

146 students of the IAED and GRA department were selected for the experiment. Table 4.1. displays the number of subjects according to their department, year, and sex. The participation was on a voluntary basis.

Table 4.1. Subjects' Number According to Their Department, Class, and Sex

	IAED			GRA		
Class	Male	Female	Total	Male	Female	Total
1	12	6	18	5	9	14
2	7	8	15	8	8	16
3	10	13	23	5	11	16
4	11	13	24	10	10	20
TOTAL	40	40	80	28	38	66

4.3. Procedure

Initially, all subjects were required to complete two tests. The first test (Cards Rotation Test) is a test of ability to see differences in figures; it is used to test spatial orientation, a factor used to determine the subjects' ability to perceive spatial patterns or to maintain orientation with respect to objects in space. The second test (Maze Tracing Speed Test) tests the ability of subjects to find a path through a maze quickly; it is used to test the spatial scanning factor which determines subjects' speed in exploring visually a wide or complicated spatial field space (Kit of Factor-Referenced Cognitive Tests, 1976). Each test took 6 minutes at most, thus a maximum of 12 minutes were spent to complete the tests in total.

Following the tests, the subjects were interviewed in correspondence to a list of specified questions (See Appendix I1 and I2 for the questions). They were asked to rate their familiarity for both buildings on a 7-point scale; to rate both buildings regarding ease of wayfinding on a 7-point scale, how long they have been using each building, and their interaction frequency with each building. In order to gain a better understanding of spatial familiarity, subjects were asked to specify the areas and floors they used most frequently in each building. In addition, they were asked to recall as many items as they could that belonged to the IAED building and the GRA building.

When the tests were completed, two tasks of reaching a specific destination in IAED and GRA were given to the subjects. The subjects were asked to find the room F311 in IAED (see Appendix C) and the room B322 in GRA (see Appendix G). These rooms were selected in order to avoid unfairness regarding the number of floors subjects had to climb, and number of turns around corners taken to reach them. Subjects' wayfinding behaviours were recorded and timed, the shortest trial took one minute, and the longest took six minutes. During the trials, comments made by subjects in regard to the ease or difficulty of wayfinding, and means of aiding the difficulties in the two buildings were noted. Subjects' performance differences were marked and evaluated on the basis of

a) initial preference for the direction to follow,
b) total number of errors and backtracking subjects made,
c) indications of confusion and uncertainty,
d) and shortcutting.

4.4. Statistical Analyses and Results

In the search for an answer to the question of how spatial familiarity affects wayfinding, spatial familiarity that has a multi-dimensional nature, must be decomposed into its units. As a result of the information gathered from tests, interviews and wayfinding tasks, a total of 39 variables were specified for the sample group. These variables were determined in order to acquire information about sex, age, department, class, frequency of visit to each building, areas most used in each building, rating of wayfinding and familiarity for each building, number and type of elements recalled in each building, number of errors in each building, time taken to reach target rooms in each building, results of spatial ability tests, etc. (see Appendix J for the list of variables).

For the first hypothesis considering the buildings, t-tests reveal a significant difference between the mean of evaluation of IAED building ($\mu IAED=1.81$) and the mean of evaluation of GRA building ($\mu GRA= 1.29$) by most of the subjects ($t=10.469$, $df= 290$, $p= .000$). IAED building was mostly rated as complex, while GRA building was evaluated as simple. t-tests also reveal significant differences between the two buildings for type of elements recalled , where landmarks were recalled more for IAED building ($\mu IAED= 1.62$), and paths were more frequently recalled for GRA building ($\mu GRA= 2.08$). There was a significant difference between the types of elements recalled ($t= -3.90$, $df= 290$, $p= .000$) for each building in general. In terms of visual accessibility, subjects stated that it existed in IAED building ($\mu IAED= 1.41$) significantly ($t= 3.01$, $df= 290$, $p= .003$) more than it existed in GRA building ($\mu GRA= 1.25$) although the results indicate that visual accessibility is found insufficient by a majority. The evaluation of sufficiency of signage in IAED ($\mu IAED= 1.74$), and GRA buildings ($\mu GRA= 1.35$) was significantly ($t= 7.26$, $df= 290$, $p=.000$) different. Likewise, architectural differentiation was found to exist in IAED ($\mu IAED= 1.65$) significantly more ($t= 4.61$, $df= 290$, $p= .000$), than in GRA building ($\mu GRA= 1.35$). Number of elements recalled in IAED ($\mu IAED= 2.01$) was significantly higher ($t= 3.52$, $df= 290$, $p= .000$) than the number of elements recalled in GRA building ($\mu GRA= 1.69$) by the subjects in general. The reason for this is because despite its complexity, IAED building has considerably more elements to remember.

The t- tests (see Table 4.2.) also display a significant mean difference for IAED and GRA students regarding the following variables. The mean familiarity ratings of IAED students (μIAED= 4.58) is significantly higher ($t= 6.585$, $df= 144$, two-tailed $p= .000$) than that of GRA students (μGRA= 2.95) for IAED building. Unsurprisingly, the mean familiarity ratings of GRA students (μGRA= 5.25) is significantly higher ($t= -3.222$, $df= 144$, 2-tailed $p= .002$) than that of IAED students (μIAED= 4.08) for GRA building. Regarding wayfinding ratings, the only significant difference was for IAED building where IAED students rated significantly higher than GRA students for wayfinding (2-tailed $p < 0.05$, μIAED= 1.82, μGRA= 1.59, $t= 2.228$, $df= 144$, $p= .027$).

The mean number of elements recalled by IAED students (μIAED= 10.68) in IAED building were significantly different ($t= 4,133$, $df=144$, 2-tailed $p= .000$) from that of GRA students (μGRA= 8.60). And as expected, number of elements recalled in GRA building by GRA students (μGRA= 9.78) were significantly different ($t= -4.168$, $df= 144$, 2-tailed $p=0.00$) from that of IAED students (μIAED= 7.45).

Table 4.2. Mean Values of IAED and GRA students

	Dept.	N	Mean	SD
Familiarity rating for IAED	IAED	80	4.5875	1.4729
	GRA	66	2.9545	1.5133
Familiarity rating for GRA	IAED	80	4.0875	1.9304
	GRA	66	5.2576	.8825
Wayfinding Rating for IAED	IAED	80	1.8250	.6517
	GRA	66	1.5909	.6071
Number of Elements Recalled in IAED	IAED	80	10.6875	2.6270
	GRA	66	8.6061	3.4547
Number of Elements Recalled in GRA	IAED	80	7.4500	2.6333
	GRA	66	9.7879	4.0970

The variables have been tested by chi-square test in order to determine the variables that have a significant relation between them. Regarding the first hypothesis, the chi-square test revealed a significant relationship between the following variables. There was a significant association between evaluation of plan configuration and wayfinding rating for IAED building ($\chi2$=48.019, df=2 p= .000). Similarly, evaluation of plan configuration and wayfinding rating for GRA building revealed a significant association ($\chi2$=44.853, df= 2, p= .000). Finally, there was a significant relationship between evaluation of plan configuration and familiarity rating for GRA building ($\chi2$= 17.269, df= 2, p= .000). Chi-square tests also revealed that there were significant associations between type of elements recalled and familiarity rating for IAED building ($\chi2$= 10.236, df= 4, p= .037), as well as that between evaluation of signage and task completion time in IAED building ($\chi2$= 12.298, df= 4, p= .015). Evaluation of visual accessibility and wayfinding rating in IAED building was also significantly related ($\chi2$=5.896, df= 2, p= .50). Similarly, there was a significant association between evaluation of visual accessibility and Familiarity rating in GRA ($\chi2$=14.317, df= 2, p= .001).

Findings reveal that familiarity rating for IAED building and evaluation of atmosphere in IAED building are significantly associated ($\chi 2=10.828$, df=4, p= .029).

These findings reveal that there are significant relations between individual perception and judgements of the built environment and self-evaluation of familiarity and wayfinding. Interestingly, although ratings for wayfinding and evaluation of plan configuration are significantly associated for both buildings, this is not valid for the association between familiarity and plan configuration. Evaluation of plan configuration and familiarity ratings of the subjects for IAED building was not statistically related. This may be because subjects evaluated the building as complex in general, but this evaluation is not necessarily an indication of familiarity. Therefore self-judgement of familiarity is not a sufficient criterion to determine how well a place is known, other factors must be included as well.

The second hypothesis was that individual characteristics affect spatial familiarity. Related findings gained from t-test and chi square test reveal significant relations for the following variables:

The results of the spatial aptitude tests were analysed using t-test to see whether there existed a significant difference between the means of male vs. female, IAED vs. GRA students, and different classes (i.e. IAED 1st year students vs. IAED 2nd year students). The results of the t-tests revealed a significant difference (t= 3.126, df = 144, two tailed p= .002) between the means of males ($M= 32.897$, $SD= 7.27$) and females ($M= 28.898$, $SD= 8.07$) for the maze tracing speed test, and a significant difference ($t= 4.529$, $df= 144$, two tailed $p= .000$) for means of males ($M= 121.29$, $SD= 25.36$) and females ($M= 101.13$, $SD= 28.06$) for the cards rotation tests. Maze tracing speed test and evaluation of signage in GRA building was significantly related ($\chi2=6.096$, $df= 2$, $p= .047$) and also, there was a significant relationship between "Cards rotation test" and evaluation of architectural difference in IAED building ($\chi2=11.386$, $df= 4$, $p= .023$). Department was a variable that was significantly related to many variables. Department and familiarity rating for both IAED ($\chi2=28.366$, $df= 2$, $p= .000$) and GRA ($\chi2=19.122$, $df= 2$, $p= .000$) buildings were significantly related. Also, there was a significant association between department and number of elements recalled in both IAED ($\chi2= 26.672$, $df= 2$, $p= .000$) and GRA ($\chi2= 17.534$, $df= 2$, $p= .000$) buildings. Department and types of elements recalled in IAED ($\chi2= 15.369$, $df= 2$, $p= .000$), and GRA ($\chi2= 20.373$, $df= 2$, $p= .000$) buildings were also among those that were significantly associated. Department and evaluation of plan configuration of GRA building was significantly associated ($\chi2=3.936$, $df= 1$, $p= .047$). An additional finding revealed a significant relationship ($\chi2= 32.40$, $df= 4$, $p= .000$) between number of elements recalled in IAED and GRA building.

Sex was another variable that accounted for differences between individuals. There was a significant relation between sex and familiarity rating for IAED building ($\chi2=7.990$, $df= 2$, $p= .018$), as well as sex and types of elements recalled in IAED building (IAED$\chi 2$=6.537, df= 2, p= .038). Also, sex and shortcuts taken in IAED was significantly related ($\chi 2$=10.371, df= 1, p= .001). Sex and number of errors in IAED building ($\chi 2$= 6.737, df= 2, p= .034), sex and evaluation of atmosphere in IAED building ($\chi 2$= 6.242, df= 2, p= .044), sex and wayfinding rating in IAED building ($\chi 2$=9.221, df= 2, p= .010), and finally sex and Cards rotation test ($\chi 2$=8.570, df= 2, p= .014) were all significantly associated. Except for the last one, all of the associations regarding sex have appeared in the IAED building.

This is an interesting finding because it draws attention to the effect of complexity of the built environment on perception of spatial familiarity and wayfinding among different sexes. Obviously, sex differences are revealed in the building that is evaluated as complex. This means that as complexity increases, sex becomes a predicting variable for the factors mentioned above.

The third hypothesis is that interaction with space affects spatial familiarity. Chi-square tests were conducted and significant relations were found for the variables listed below.

Frequency of visit and familiarity rating for both IAED ($\chi 2$=28.442, df=4, p= .000), and GRA ($\chi 2$=16.566, df= 4, p= .002) buildings were significantly related. Frequency of visit and number of elements recalled in both IAED ($\chi 2$= 30.608, df= 4, p= .000) and GRA ($\chi 2$=19.603, df= 4, p= .001) buildings were significantly related. Also, there was a significant association between frequency of visit and types of elements recalled in both IAED ($\chi 2$= 16.168, df= 4, p= .003) and GRA ($\chi 2$= 14.270, df= 4, p= .006) buildings. Class was significantly associated with familiarity rating for GRA building regardless of department difference ($\chi 2$=30.682, df= 6, p= .000), this proved that regardless of their background, the more time they spent in the faculty, the more subjects rated themselves familiar with the building evaluated as "simple". In addition, there was significant association between class and number of elements recalled in IAED ($\chi 2$= 17.491, df= 6, p= .008) and GRA ($\chi 2$= 15.838, df=6, p= .015) buildings. Years spent in the environment also affects wayfinding rating and evaluation of plan configuration, but not for all settings, our findings reveal that class is significantly associated with wayfinding rating ($\chi 2$=19.135, df= 6, p= .004) and evaluation of plan configuration ($\chi 2$=18.153, df=3, p= .000) only for GRA but not for IAED building.

The last hypothesis is that spatial familiarity affects wayfinding. This hypothesis was tested by chi-square test and there were significant relations between the following variables regarding this final hypothesis. Familiarity rating for IAED building and wayfinding rating for IAED building was significantly associated ($\chi 2$= 28.712, df= 4, p= .000). Also, familiarity rating for GRA building and wayfinding rating for GRA building was significantly associated ($\chi 2$= 48.513, df=4, p= .000). Familiarity rating for GRA building and number of elements recalled in GRA building ($\chi 2$=20.322, df=4, p= .000) and familiarity rating for GRA building and initial preference for GRA building ($\chi 2$=15.749, df= 2, p= .000) were significantly related.

The results seem to point to an important aspect of spatial familiarity that does not necessarily reveal the true knowledge the subjects have about their environment, but rather their "perception" of spatial familiarity. As the environment becomes complex, users rate themselves on the lower part of the familiarity scale. Definitely, one factor alone cannot predict spatial familiarity.

4.5. Observations on Wayfinding and Evaluations of the Buildings

As the last part of the procedure, destinations were given in both of the buildings. F311 - a room used by part-time instructors - was the target in IAED building (see Appendix C for its location), and B322 - a storage room - was the target in GRA building (see Appendix G). It is believed that legibility has a profound affect on spatial familiarity. Passini (1984) explored additional and alternative factors increasing legibility. He identified buildings or sections of buildings that led to very clear or very confused images and tried to find out what each group had in common. Secondly, he asked each subject to comment on the environmental characteristics they thought had facilitated image formation or rendered it more difficult. A similar experiment was conducted in this study. Passini (1984) observed that some subjects on the underground metro level, assumed that their destination - the offices - were generally higher up than shops. They took the escalators to reach the upper floors. On the ground level they passed under a sign pointing to the offices without seeing it. They perceived only the information relevant to their plan to go higher in the buildings. All subjects who at that time had not formulated a specific plan, saw the sign. The subjects of the first group, when returning to the ground floor after a fruitless search perceived the sign without any difficulty. A similar observation was made among subjects in the present study in the IAED building. When given a specific destination (F311 in IAED building), it was assumed that subjects rating themselves on the upper half of the familiarity scale would at least be able to locate F311 within general areas such as "it is on this wing of the building", even though they did not know exactly where it was. On the contrary, subjects who had more experience with the building assumed that the destination was on the office floors, thus, they disregarded the letter "A" following F311 written on the entrance of each office floor, whereas what was asked (F311) was on the studio floor, without the letter "A". It was observed that less familiar subjects were more selective in the information processing. They were open to the possibility that they could be mistaken, so most of them asked more than once if the destination was F311 and not F311A; they proceeded after F311 was confirmed.

This observation has design implications. Signs, plans, and indeed all types of environmental information can be placed so that they are directly relevant to the wayfinding plan. Passini (1984b) states that if the information pertains to a higher-order decision, that is, to a task or subtask, it should occur once the previous part of the decision plan has been executed. This criterion is essential in determining the optimum location of environmental information in an existing or in a planned setting. Although application and design standards are most important to get people to understand, use, and depend on signs, none of the subjects from IAED - except for a couple of the freshman students - depended on the signage system in this building because they found it unreliable. Subjects stated that because the information system is not well designed in IAED, subjects who are usually in a hurry tend to miss relevant information as well as general information. Standardisation of signs was found to be far from being implemented. In that respect, GRA building is more coherent, subjects usually resorted to the sign system; and when they did, they were usually able to make sense of it. Although there were times they suggested that the system could have been better, they found it adequate comparing to the IAED building (see figure 4.1. for the evaluation of signage in the IAED and GRA buildings by the students).

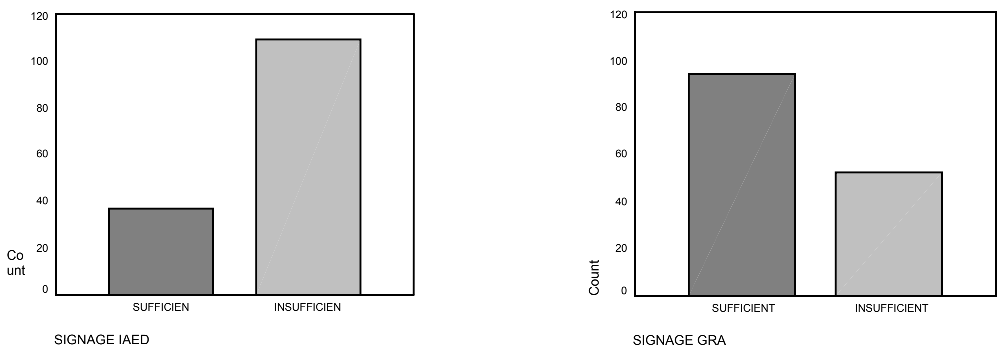


Figure 4.1. Signage in IAED and GRA Buildings

Findings indicate that spatial characteristics of the built environment affect the level of spatial familiarity one has with the setting. It seems that spatial familiarity also affects the amount and type of information received from the environment. It is generally believed that people who are more familiar with a setting are more selective and seek for particular information at certain phases of their search, and they disregard general information about the overall plan configuration.

The observations made in IAED building suggest that subjects who rated themselves more familiar usually created a decision plan and followed it either until they reached the target, or until they realised they were wrong. Thus, there were no statistically significant differences between the fourth year students and the first, second, and third year students, with respect to the number of errors made. There were only slight differences among the groups (1st year, 2nd year, 3rd year, and 4th year) regarding the errors made during the tours, where freshman students made less errors than senior students. This is because less familiar subjects spent more time deciding which way to go, while more familiar subjects did not. Familiar subjects were sure they knew where F311 was, so they kept on moving in the environment, until they realised they were far from reaching the target. This has equated the time it took to reach the target, there were no significant differences between the subjects considering the time factor. Considering the time it took to reach the target B322 in GRA building, regardless of the department, 4^{th} year subjects reached the target faster than the rest of the subjects which indicates the role of increasing familiarity with the time spent. However, the

GRA building provided sufficient information for less familiar subjects as well as for the familiar subjects, and therefore they did not lose time looking for relevant information (see Table 4.3. for a comparison of task reaching times in the two buildings).

Table 4.3. Target reaching times in IAED and GRA Buildings.

Class		Seconds in GRA Building	Seconds in IAED Building
1	Mean	98.0625	179.3750
	N	32	32
	Std. Deviation	32.4852	83.4107
2	Mean	111.3548	194.7742
	N	31	31
	Std. Deviation	58.6797	79.8059
3	Mean	94.2051	165.7436
	N	39	39
	Std. Deviation	29.3922	58.9160
4	Mean	84.7955	171.6591
	N	44	44
	Std. Deviation	20.3568	54.4259
Total	Mean	95.8562	176.6781
	N	146	146
	Std. Deviation	37.1160	68.5906

Also, there were no gender differences among the subjects in respect to the time it took to reach the target rooms, the only variable gender difference accounted for was the number of errors made in IAED building. Females made significantly ($\chi 2= 6.737$, df= 2, p= .034) more errors than did males (see Table 4.4.).

Table 4.4. Number of errors made in IAED and GRA Buildings

	0 ERROR		1-2 ERRORS		3 OR MORE ERRORS	
	IAED	GRA	IAED	GRA	IAED	GRA
MALE	7	15	30	35	31	18
FEMALE	6	13	20	47	52	18
TOTAL	13	28	50	82	83	36

People do not automatically acquire survey knowledge. Researchers have found that even after years of daily navigation through environments, individuals may not develop survey representations (Moeser, 1988). In cases when the learned routes are open, optimal and simple, there is likely little need for the development of a survey representation. This is similar to the case in IAED building where subjects learn the basic routes, but not the general layout. In case of a fire, what would happen if the familiar routes were trapped? Thus, the sign system must provide a clear representation of the setting for alternative routes in case of emergency. Even in those cases where a survey representation would prove beneficial, it may never develop. When a person is travelling in familiar territory, and the learned routes are always accessible, route knowledge may be highly appropriate, making the development of survey representations both less valuable and less likely. Subjects in the IAED building seem to use route knowledge, because it is a complex setting and it is easier for the subjects to learn the paths that lead to their own classrooms and studios rather than the overall configuration.

It has been stated previously that as the route's mental effort requirement increases, a survey representation of the same space can be more useful. In the IAED building, this is almost certainly a necessity, but still even the 4th year students do not develop survey knowledge. That is, they either rate themselves on the lower half of the familiarity scale, or they reach the destination in the IAED building after many errors and back tracking. In the GRA building the only prerequisite in order to find B322 was to understand that the starting point was in A block and the target was in B block which was the adjacent block. Subjects seemed to experience either little or no trouble at all in GRA building (see Table 4.4. for a comparison of number of errors made in IAED and GRA buildings).

Although the familiarity ratings of IAED students were generally on the lower half of the scale (μIAED= 4.58), there were no significant differences between the students of the other department (μGRA= 4.08).

O'Neill and Jasper (1992) state that the amount of knowledge possessed by the consumer in a shopping environment influences spatial behaviour. Thus, shopping patterns are initially restricted to areas on which information is available. The scope of this pattern enlarges as the consumer learns more about the environment. Consumers are thought to have a certain territory, or area containing stores that they are familiar with and might patronise (O'Neill and Jasper, 1992). The same approach may be used to explain how students familiarise with a certain setting. Students of certain departments have certain territories in buildings, and also students of different years (ie. freshman vs. senior) use different parts of buildings. Preference is an important variable although only a few studies have attempted to link environmental preference to the processes of spatial cognition and wayfinding (Kaplan, R., 1975,1977). People are thought to prefer environmental features that aid spatial understanding and provide cues for additional learning about the environment (Kaplan, S. 1975), although there is little empirical work to substantiate this notion (see O'Neill and Jasper, 1992).

Acredolo (1982) suggests that high emotional arousal is related to the degree of attention paid to the spatial information in the environment. This idea may be applied to the university students; complex built environments may become extremely stressing for students who are stressed most of the time struggling with their homework and exams.

When they were asked to comment on the atmosphere of each building, most subjects regarded IAED as monumental, luxurious, well illuminated, but also complex and labyrinth-like. Some of the less general comments were cold and uninviting, probably by subjects who associated crowding in spaces with a sense of warmth and hospitality. And the GRA building was referred as a dull, dark and old as well as cosy and simple in that respect (see figure 4.2. for comparison of plan configuration of IAED and GRA buildings).

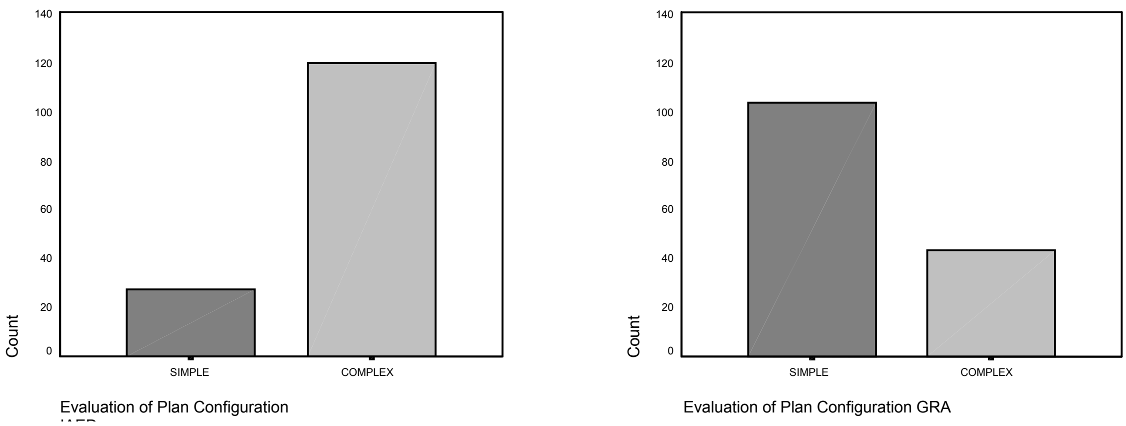


Figure 4.2. Plan Configuration of IAED and GRA Buildings.

Subjects tended to comment on the housekeeping and maintenance of the WC's, how dark the studios were, and the heating of the building although they knew the research was about wayfinding and spatial familiarity. The results of the chi square tests show that evaluation of atmosphere was significantly associated with familiarity ratings for both IAED and GRA buildings (see section 4.4. for the results of the statistical tests).

For the IAED building, the most recalled elements were the ramps, columns, the vault, and the corridors. The most recalled elements in the GRA building were the steps, the security desk, and public telephone at the entrance, the notice board, and the paintings done by the students hung on the wall across the entrance. Different types of elements (landmark, path, district) recalled and the comments made about the atmosphere of each building suggest that the spatial and psychological characteristics affect the way subjects familiarise with the environment (see Figure 4.3. for a comparison of types of elements recalled in IAED and GRA buildings).

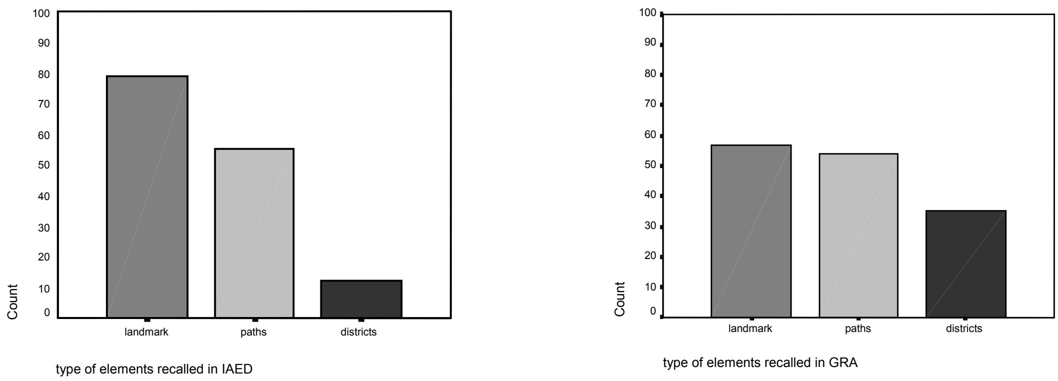


Figure 4.3. Types of Elements Recalled in IAED and GRA Buildings.

Interestingly, chi square test revealed a significant correlation (see section 4.4.) between number of elements recalled in the IAED building and number of elements recalled in the GRA building which indicate the role of individual characteristics (see Table 4.5. for numbers of elements recalled in both buildings).

Table 4.5. Cross table of number of elements recalled in IAED and GRA buildings.

		Number of elements recalled in ABC			
		3-7	8-11	12+	Total
Number of elements Recalled in IAED	3-7	27	14	1	42
	8-11	33	21	6	60
	12+	10	15	19	44
	Total	70	50	26	146

Although the results of the tests were expected, that is, subjects recalled more elements for the setting they used more, it is interesting to find that types of elements recalled by subjects differ according to the building they visit and use more. While IAED students were "Landmark" dependent in IAED building, and "Path" dependent in GRA building, GRA students were "Landmark" dependent in their own building and "Path" dependent in IAED building which may indicate the dominance of route learning in an unfamiliar environment. It should be noted that elements such as columns or corridors did not provide an aid for wayfinding in either of the buildings, stairs and ramps were generally perceived as vertical paths that lead to certain destinations in the settings. The provision and visual accessibility of suitable wayfinding aids close to significant elements make it easier to recall information when necessary. The atmosphere of the built environment affects the decisions made either to enter a space or perceive it as an inaccessible area, thus eliminating the chances of becoming familiar with it.

5. CONCLUSION

This thesis has aimed to explore spatial familiarity to define factors affecting it in relation to wayfinding in real environments. It has been found that the complexity, visual accessibility and the amount of interaction with the built environment have influence on spatial familiarity and thus wayfinding. It has also been found that the type of elements (i.e. landmarks, paths, districts, etc.) differ according to the building design; the adequacy of the signage system can be compensated by the plan configuration; and spatial ability as a factor influencing spatial familiarity also affects evaluation of the buildings. It can be suggested that spatial familiarity can be distinguished into three main parts:

1. spatial characteristics of the built environment (existence of useful landmarks, signage, and visual accessibility),
2) individual characteristics (gender, spatial ability, field of education),
3) and interaction with the built environment (amount of time spent in the built environment and frequency of interaction).

The results of the study have pointed out that spatial familiarity has a complicated structure that affects the way individuals perceive the space surrounding them and that these individual differences cannot be explained by the self-evaluations of the subjects alone. It is necessary to take into account the individual evaluations (familiarity ratings, evaluation of building configuration, etc.) as well as the demographic (age, sex, etc.) means to assess spatial familiarity. Familiarity ratings for the buildings were significantly correlated with wayfinding ratings, number of elements recalled and initial preference in the GRA building, and evaluation of the atmosphere of the IAED building.

The findings of this study have interesting implications for further studies. For example, although the skylights, plants and paintings on the fifth office floor in IAED building were thought as landmarks prior to the study, they were not recognised as reference points by most of the subjects. A reason for this may be that this floor is not visited by the majority of the subjects, it is visually inaccessible, and is mostly used by the instructors. Here the question of whether this is a design impediment or not arises. Is it a necessity for the users to know the building by all means? When one rates him or her self as "very familiar" or "not familiar at all" with a setting, is this a plausible statement? Are we using the same criteria for the evaluation of spatial familiarity? The findings seem to indicate that we are not. Self-evaluation for familiarity did not predict number of errors made during the target reaching task; it only predicted number of elements recalled for IAED building, but not for GRA building. On the other hand, frequency of visit and number and type of elements recalled were significantly correlated. Once again, there were differences between the subjects of the two different departments regarding the number and type of elements recalled in each building due to variables such as frequency of visit and time spent in each building. These findings point that spatial familiarity cannot be evaluated strictly through subjects' self-evaluation, because ratings are not objective. People can under - or over-estimate their performances when confronted with the idea of being tested.

Also, the ramps at the entrances of the two wings of IAED building were recalled as a landmark by most of the subjects because they were unique and visually accessible. But, because they did not lead the subjects to any specific destination, they did not meet the exact function of a landmark. Therefore, it is suggested that all aspects of a built environment that are unique and well remembered do not serve as a functional wayfinding aid.

The atmosphere of the built environment can be interpreted in different ways by the users, sometimes appealing, inviting, encouraging to investigate, and sometimes aversive, restrictive, distant and inaccessible. Materials, colours, plan configuration and boundaries of the built environment impose different feelings on the users. These feelings are part of the cognitive process that take place during wayfinding and affect the individuals' decision plans. During the task reaching experiments a majority of the subjects did not use the tearoom used by the instructors although it was a shortcut to the final destination either because they knew (students of IAED) or felt (students of GRA) that the area was restricted (see Appendix E10). Another interesting point that deserves attention is that the majority of the subjects that used the tearoom as a shortcut were females, it seems necessary to focus on why more females than males have intruded a restricted space. Most studies (see Lawton, 1994; Malinowski and Gillespie, 2001) point that males are superior to females in wayfinding tasks, this study did not find such a result.

The interviews revealed that most of the subjects referred to the IAED building as a luxurious setting. While some of the subjects suggested that this characteristic created a warm and inviting atmosphere, some stated that the very same characteristic made them feel unwanted. One common point about the building was that most of the subjects rated the building as complex and difficult from wayfinding point of view. These different feelings about this setting may explain the differential results obtained from the experiment regardless of the frequency of interaction with the building. Although the GRA building was usually referred as a dark and dull environment, it was still evaluated as easy for wayfinding, and simple from plan configuration point. It is not possible to make a final statement how the atmosphere of the built environment affects wayfinding. It is obvious that the atmosphere creates different feelings for individuals, but the degree of this effect on spatial familiarity and thus wayfinding needs further investigation.

The issue of repetitive floor plans in the built environments is quite interesting; while it is accepted as a positive design decision to provide uniform plans on different floors of a setting, it is also perilous to create standard configurations for spaces with different functions. This study took place in two different settings with a common point of having uniform floor plans; subjects reported that the uniformity of the office floors of IAED made it difficult to differentiate, while the same design attitude did not create too many problems in GRA building comparing to IAED. Student paintings, sculptures, models etc. were found beneficial in creating architectural differentiation between the spaces in the GRA building. Visual accessibility was also found a positive attribute of the GRA building that provided a wayfinding aid when architectural differentiation of the spaces were less.

The analyses and results of the study suggest that spatial familiarity with the built environment is a complex issue that cannot be measured by self-evaluations of subjects alone. Rather, the issue should be handled in collaboration with a variety of factors such as spatial ability, experience in related tasks, sex, frequency of visit to the space, plan configuration, amount of useful landmarks, architectural differentiation, visual accessibility and atmosphere of the building. Designers should provide the users with psychologically and physically satisfying, comfortable, and safe environments. Of course not all users have to become spatially familiar with the spaces they use, but aiming for environments that are browsed without getting lost and easily remembered create spaces that prevent unnecessary loss of time caused by trying to reach a destination and are easy to exit at times of emergency. This is a hard task to be accomplished when the issue of creating a satisfactory design solution for the built environment from the aesthetical and functional point of view is considered. Designing a legible and appealing environment all together requires a deeper consideration of many issues, including spatial familiarity and wayfinding. An optimum level of design solutions for spatial familiarity and wayfinding can be achieved by simultaneously involving the interior architects and graphic designers along with the architects in the beginning of the design phase of settings.

6. REFERENCES

Abu-Ghazzeh, T. M. (1996). Movement and Wayfinding in the King Saud University Built Environment: A look at Freshman Orientation and Environmental Information. *Journal of Environmental Psychology, 16*, 303-318.

Abu-Obeid, N. (1998). Abstract and Scenographic Imagery: The Effect of Environmental Form on Wayfinding. *Journal of Environmental Psychology, 18*, 159-173.

Acredolo, L. P. (1982). The Familiarity Factor in Spatial Research. In R. Cohen (Ed.), *Children's Conceptions of Spatial Relationships.* San Francisco: Josey-Bass.

Aitken, S. C. and Prosser, R. (1990). Residents' spatial knowledge of neighbourhood continuity and form. *Geographical Analysis, 22* (4), 301-325.

Aitken, S. C., Stutz, F., Prosser, R., and Chandler, R. (1993). Neighbourhood integrity and residents' familiarity: Using geographic information system to investigate place identity. *Tijdschrift voor Economische en Sociale Geographie, 84* (1), 2-12.

Allen, G. L. (1999). Spatial Abilities, Cognitive Maps and Wayfinding: Bases for Individual Differences in Spatial Cognition and Behavior. In R. G. Golledge (Ed.), *Wayfinding Behavior: Cognitive Mapping and Other Spatial Processes* (pp. 46-80). Baltimore: The Johns Hopkins University Press.

Appleyard, D. (1969). Styles and Methods of Structuring a City. *Environment and Behavior, 2*, 100-117.

Appleyard, D. (1970). Why Buildings are Known: A Predictive Tool for Architects and Planners. *Environment and Behavior, 1*, 131-156.

Appleyard, D. (1976) *Planning a Pluralistic City: Conflicting Realities in Ciudad Guyana*. Cambridge, MA: MIT Press.

Arthur, P, and R. Passini. (1992). *Way-finding: People, Signs and Architecture*. New York : Mc. Graw-Hill.

Axia, G., Baroni, M. R., and Mainardi Peron, E. (1988). Representation of familiar places in children and adults: Verbal reports as a method for studying environmental knowledge. *Journal of Environmental Psychology, 8*, 123-139.

Banerjee, T. K. (1972). *Urban Experience and the Development of City Image: A study in Environmental Perception and Learning*. (Doctoral Dissertation, Massachusetts Institute of Technology, 1971). Dissertation Abstracts International, 32.335.

Beguin, H. and , L. V. Romero. (1996). Individual Cognition of Urban Neighbourhoods Over Space and Time: A Case Study. *Environmental and Planning A, 28*, 687-708.

Berry, J. W. and N. Kostovich. (1983). *Psychological Adaptation of Malay Students in Canada*. Paper presented at third Asian Regional Conference of IACCP, Kuala Lumpur.

Bliss, J. P., Tidwell, P. D., and Guest, M. A. (1997). The effectiveness of virtual reality for administering spatial navigation training for firefighters. *Presence, 6*, 73-86.

Bronzaft, A and S. Dobrow. (1984). Improving Transit Information. *Journal of Environmental Systems, 13*, 365-375.

Bryant, K. J. (1982). Personality Correlates of Sense of Direction and Geographical Orientation. *Journal of Personality and Social Psychology, 43*, 1318-1324.

Butcher, E. G. and Parnell, A. C. (1983). *Designing for Fire Safety*. New York: John Wiley.

Chalmers, D. J. and Knight, R. G. (1985). The Reliability of Ratings of Familiarity of Environmental Stimuli: A Generalizability Analysis. *Environment and Behavior, 17* (2), 223-238.

Cohen, R., D. L. Weatherford, T. Lomenick and Koeller, K. (1979). Development of Spatial Representations: Role of Task Demands and Familiarity with the Environment. *Child Development, 50*, 1257-1260.

Cornell, E. H., C. D. Heth, and Skoczylas, M. J. (1999). The Nature and Use of Route Expectancies Following Incidental Learning. *Journal of Environmental Psychology, 19*, 209-229.

Darken, R. P. and Sibert, J. L. (1996). *Wayfinding Strategies and Behaviors in Large Virtual Worlds*. submitted to ACM SIGCHI. Retrieved November 9, 1999, from http://www.seas.gwu.edu/faculty/sibert/d...ublications/strategies_CHI96/method.html.

De Jonge, D. (1962). Images of Urban Areas: Their Structure and Psychological Foundations. *Journal of American Institute of Planners, 28*, 266-276.

Devlin, A. S. and Bernstein, J. (1997). Interactive Way-finding: Map Style and Effectiveness. *Journal of Environmental Psychology, 17*, 99-110.

Doğu, U. and Erkip, F. (2000). Spatial Factors Affecting Wayfinding and Orientation: A Case Study in a Shopping Mall. *Environment and Behavior, 32* (6), 731-755.

Downs, R. M. and Stea, D. (1977). *Maps in Minds: Reflections on Cognitive Mapping*. New York: Harper and Row.

Evans, G. W. (1980). Environmental Cognition. *Psychological Bulletin, 88* (2), 259-287.

Evans, G. W. (1982). *Environmental Stress.* New York: Cambridge University Press.

Evans, G. W. and Mc Coy, J. M. (1998). When Buildings Don't Work: The Role of Architecture in Human Health. *Journal of Environmental Psychology*, *18*, 85-94.

Evans, G W, Smith, C., and Pezdek, K. (1982). Cognitive Maps and Urban Forms. *Journal of the American Planning Association, 48*, 232-244.

Evans, G. W., Marrero, D. G., and Butler, P. A. (1981). Environmental Learning and Cognitive Mapping. *Environment and Behavior, 13* (1), 232-244.

Evans, G. W., Fellows, J., Zorn, M., and Doty, K. (1980). Cognitive Mapping and Architecture. *Journal of Applied Psychology, 65* (4), 474-478.

Francescato, D. and Mebane, W. (1973). How Citizens View Two Great Cities: Milan and Rome. In R. Downs and D. Stea (Eds.), *Image and Environment*. Chicago: Aldine.

Gale, N., Golledge, R. G., Halperin, W. C., and Couclelis, H. (1990a). Exploring Spatial Familiarity. *Professional Geographer, 42* (3) 299-313.

Gale, N., Golledge, R. G., Pellegrino, J. W., and Doherty, S. E. (1990b). The Acquisition and Integration of Route Knowledge in an Unfamiliar Neighbourhood. *Journal of Environmental Psychology, 10*, 3-25.

Gardner, H. (1983). *Frames of Mind*. New York: Basic Books.

Garling, T., Book, A., and Ergezen, N. (1982). Memory for Spatial Layout of the Everyday Physical Environment: Differential Types of Information. *Journal of Environmental Psychology, 23*, 23-35.

Garling, T., E. Lindberg, and Mantyla, T. (1983). Orientation in Buildings: Effects of Familiarity, Visual Access, and Orientation Aids. *Journal of Applied Psychology, 68*, 177-186.

Garling, T., Book, A., and Lindberg, E. (1984). Cognitive Mapping of Large-scale Environments: The Interrelationship of Action Plans, Acquisition, and Orientation. *Environment and Behavior, 16* (1), 3-34.

Garling, T., Book, A., and Lindberg, E. (1986). Spatial Orientation and Wayfinding in the Designed Environment. *Journal of Architectural Planning Research, 3*, 55-64.

Gibson, J. J. (1979). *The Ecological Approach to Visual Perception*. Boston: Houghton Mifflin.

Golledge, R. G. (1991). Cognition of physical and built environments. In T. A. Garling and W. Evans (Eds.), *Environment, Cognition and Action: An Integrated Approach.* (pp. 35-62). New York: Oxford University Press.

Golledge, R. G. (1999). Human Wayfinding and Cognitive Maps. *Wayfinding Behavior:* In R. G. Golledge (Ed.), *Cognitive Mapping and Other Spatial Processes*. Baltimore: The Johns Hopkins University Press.

Golledge, R. G. and Stimpson, R. J. (1997). *Spatial Behavior: A Geographic Perspective*. New York: Guild Press.

Hart, R. and Moore, G. T. (1973). The Development of Spatial Cognition: A Review. In R. M. Downs and D. Stea (Eds.), *Image and Environment* (pp. 246-288). Chicago: Aldine.

Hayes-Roth, B. and Hayes-Roth, F. (1979). A Cognitive Model of Planning. *Cognitive Science, 3*, 275-310.

Heft, H. (1979). Wayfinding as the Perception of Information over time. *Population and Environment*, *6*, 133-150.

Hirtle, S. C. and Sorrows, M. E. (1998). Designing a Multi-Modal Tool for Locating Buildings on a College Campus. *Journal of Environmental Psychology, 18*, 265-276.

Infield, S. D. (1991). An Investigation into the Relationship Between Navigation Skill and Spatial Abilities. Doctoral Dissertation. University of Washington.

Kaplan R. (1975). Some Methods and Strategies in the Prediction of Preference. In E. Zube, R. O. Brush, and J. G. Fabos (Eds.), *Landscape Assessment: Values, Perceptions, and Resources* (pp. 118-129). Stroudsburg, PA: Dowden, Hutchinson and Ross.

Kaplan, R. (1977). Preference and the Everyday Nature: Method and Application. In D. Stockols (Ed.), *Perspectives on Environment and Behavior: Theory, Research, and Application* (pp. 235-250). New York: Plenum.

Kaplan, S. (1975). An Informal Model for the Prediction of Preference. In E. Zube, R. O. Brush, and J. G. Fabos (Eds.), *Landscape Assessment: Values, Perceptions, and Resources* (pp. 130-145). Stroudsburg, PA: Dowden, Hutchinson and Ross.

Kaplan, S. (1983). A Model of Person – Environment Compatibility. *Environment and Behavior, 15* (3), 311-332.

Kaplan, S. and Kaplan, R. (1982). *Humanscape: Environments for people*. Ann Arbor, MI: Ulrich's Books, Inc.

Kit of Factor-Referenced Cognitive Tests. (1976). Princeton, NJ: Educational Testing Service.

Kitchin, R. M. (1994a). Spatial Familiarity as a Variable in Cognitive Mapping. *Swansea Geographer, 31*, 42-52.

Kitchin, R. M. (1994b). Cognitive Maps: What Are They and Why Study Them? *Journal of Environmental Psychology, 14*, 1-19.

Lang, J. (1987). *Creating Architectural Theory*. New York: Van Nostrand Reinhold.

Lawton, C. A. (1994). Gender Differences in Way-finding strategies: Relationship to Spatial Ability and Spatial Anxiety. *Sex Roles, 30* (11/12), 177-193.

Lawton, C. A. (1996). Strategies for Indoor Way-finding: The Role of Orientation. *Journal of Environmental Psychology, 16*, 137-145.

Lawton, C. A., Charleston, S. I., and Zieles, A. S. (1996). Individual -and Gender-Related Differences in Indoor Wayfinding. *Environment and Behavior, 16* (2), 139-157.

Levine, M., Marchon, I., and Hanley, G. (1984). The Placement and Misplacement of You-Are-Here Maps. *Environment and Behavior, 28* (2), 204-219.

Lindberg, E. and Garling, T. (1982). Acquisition of Locational Information About Reference Points During Locomotion: The Role of Central Information Processing. *Scandinavian Journal of Psychology, 23*, 207-218.

Lynch, K. (1960). *The Image of the City*. Cambridge, MA: The Technology Press and Harvard University Press.

Mainardi-Peron, E., Baroni, M. R., Job, R., and Salmaso, P. (1984). Cognitive Strategies in Remembering and Describing Unfamiliar Places. Paper presented at IAPS 8 (International Association for the Study of People and Their Physical Surroundings), West Berlin.

Mainardi-Peron, E., Baroni, M. R., Job, R., and Salmaso, P. (1985). Cognitive Factors and Communicative Strategies in Recalling Unfamiliar Places. *Journal of Environmental Psychology, 5*, 325-333.

Mainardi-Peron, E., Baroni, M. R., Job, R., and Salmaso, P. (1990) Effects of Familiarity in Recalling Interiors and External Places. *Journal of Environmental Psychology, 10*, 255-271.

Malinowski, J. C. and Gillespie, W. T. (2001). Individual Differences in Performance on a Large-scale, Real-world Wayfinding Task. *Journal of Environmental Psychology, 21*, 73-82.

Moeser, S. D. (1988). Cognitive Mapping in a Complex Building. *Environment and Behavior, 20* (1), 21-49.

Montello, D. (1991). Spatial Orientation and the Angularity of Urban Routes: A Field Study. *Environment and Behavior, 23* (1), 47-69.

Moore, G. T. (1979). Knowing About Environmental Knowing: The Current State of Theory and Research on Environmental Cognition. *Environment and Behavior*, *11*, 33-70.

Newcomb, N. and Dubas, J. S. (1992). A Longitudinal Study of Predictors of Spatial Ability in Adolescent Females. *Child Development, 63*, 37-46.

Ng, C. F. (1998). Canada as a New Place: The Immigrants' Experience. *Journal of Environmental Psychology, 18*, 55-67.

O' Neill, M. J. (1992). Effects of Familiarity and Plan Complexity on Wayfinding in Simulated Buildings. *Journal of Environmental Psychology, 12*, 319-327.

O' Neill, M. J. (1991a). Effects of Signage and Floor Plan Configuration on Way-finding Accuracy. *Environment and Behavior, 23* (5), 553-574.

O' Neill, M. J. (1991b). Evaluation of a Conceptual Model of Architectural Legibility. *Environment and Behavior, 23* (3), 259-284.

O`Neill, M. J. and Jasper, C. R. (1992). An Evaluation of Models of Consumer Spatial Behaviour Using the Environment-Behaviour Paradigm. *Environment and Behaviour, 24* (4), 411-440.

Passini, R. (1984a). *Way-finding in Architecture* New York: Van Nostrand Reinhold.

Passini, R. (1984b). Spatial Representations: A Wayfinding Perspective. *Journal of Environmental Psychology, 4*, 153-164.

Passini, R. (1995). Spatial representations, a Wayfinding Perspective. In T. Garling (Ed.), *Readings in Environmental Psychology: Urban Cognition* (pp. 139-150). London: Academic Press.

Passini, R. (1996). Wayfinding Design: Logic, Application and Some Thoughts on Universality. *Design Studies, 17*, 319-331.

Passini, R., Joanette Y., Rainville C., and Marchand, N. (1995). Dementia of the Alzheimer Type and spatial disorientation. *Brain and Cognition*, *28*, 109-117.

Passini, R., Pigot, H., Rainville, C., and Tetreault, M. H. (2000). Wayfinding in a Nursing Home for Advanced Dementia of the Alzheimer's Type. *Environment and Behavior, 32* (5), 684-710.

Passini, R., Rainville, C., Marchand, N., and Joanette, Y. (1998). Wayfinding and Dementia: Some Research Findings and a New Look at Design. *Journal of Architectural and Planning Research, 15* (2), 133-151.

Peponis, J., Zimring, C., and Choi, Y. K. (1990). Finding the Building in Way-finding. *Environment and Behavior, 22*, 555-590.

Peterson, B. (1998). The Influence of Whole-Body Interaction of Wayfinding in Virtual Reality. Masters Thesis, University of Washington: Seattle.

Prestopnik J. L. and Roskos-Ewoldsen, B. (2000). The Relations Among Wayfinding Strategy Use, Sense of Direction, Sex, Familiarity, and Wayfinding Ability. *Journal of Environmental Psychology, 20*, 177-191.

Ramadier, T. and Moser, G. (1998). Social Legibility, The Cognitive Map and Urban Behaviour. *Journal of Environmental Psychology, 18*, 307-319.

Rossano, M. J., West, S. O., Robertson, T. J., Wayne, M. C., and Chase, R. B. (1999). The Acquisition of Route and Survey Knowledge from Computer Models. *Journal of Environmental Psychology, 19*, 101-115.

Rovine, M. and Weisman, G. D. (1989). Sketch-map Variables as Predictors of Wayfinding Performance. *Journal of Environmental Psychology, 9*, 217-232.

Satalich, G. A. (1996). *Navigation and Wayfinding in Virtual reality: Finding Proper Tools and Cues to Enhance Navigation Awareness*. Retrieved November 9, 1999, from http://www.hitl.washington.edu/publications/satalich/home.html.

Self, C. M., Gopal, S., Golledge, R. G. and Fenstermaker, S. (1992). Gender-related differences in spatial abilities. *Progress in Human Geography, 16*, 315-342.

Siegel, A. and White, S. (1975). The Development of Spatial Representations of Large-Scale Environments. *Advances in Child Development and Behavior*. Ed. H. W. Reese. New York: Academic Press, *10*, 9-55.

Sime, J. (1985). Movement Toward the Familiar: Person and Place Affiliation in a Fire Entrapment Setting. *Environment and Behavior*, *17* (6), 697-724.

Sims, M. (1991). *Sign Design – Graphics, Materials, Techniques.* New York: Thames and Hudson.

Stea, D. (1969). Environmental Perception and Cognition: Toward a Model for Mental Maps. In G. Coates, and K. Moffett (Eds.), *Response to Environment*. Raleigh: North Carolina State University Press.

Stockols, D. and Schumaker, S. A. (1981). People in Places: A Transactional View of Settings. In J. Harvey (Ed.), *Cognition and Social Behavior, and the Environment*. Hillsdale, NJ: Erlbaum.

Thorndyke, P. W. and Hayes-Roth, B. (1982). Differences in Spatial Knowledge Acquired From Maps and Navigation. *Cognitive Psychology, 14*, 560-589.

Tlauka, M. and Wilson, P. N. (1996). Orientation-Free Representations from Navigation Through a Computer-Simulated Environment. *Environment and Behavior, 28*, 647-664.

Weisman, J. (1981). Evaluating Architectural Legibility. *Environment and Behavior, 13* (2), 189-204.

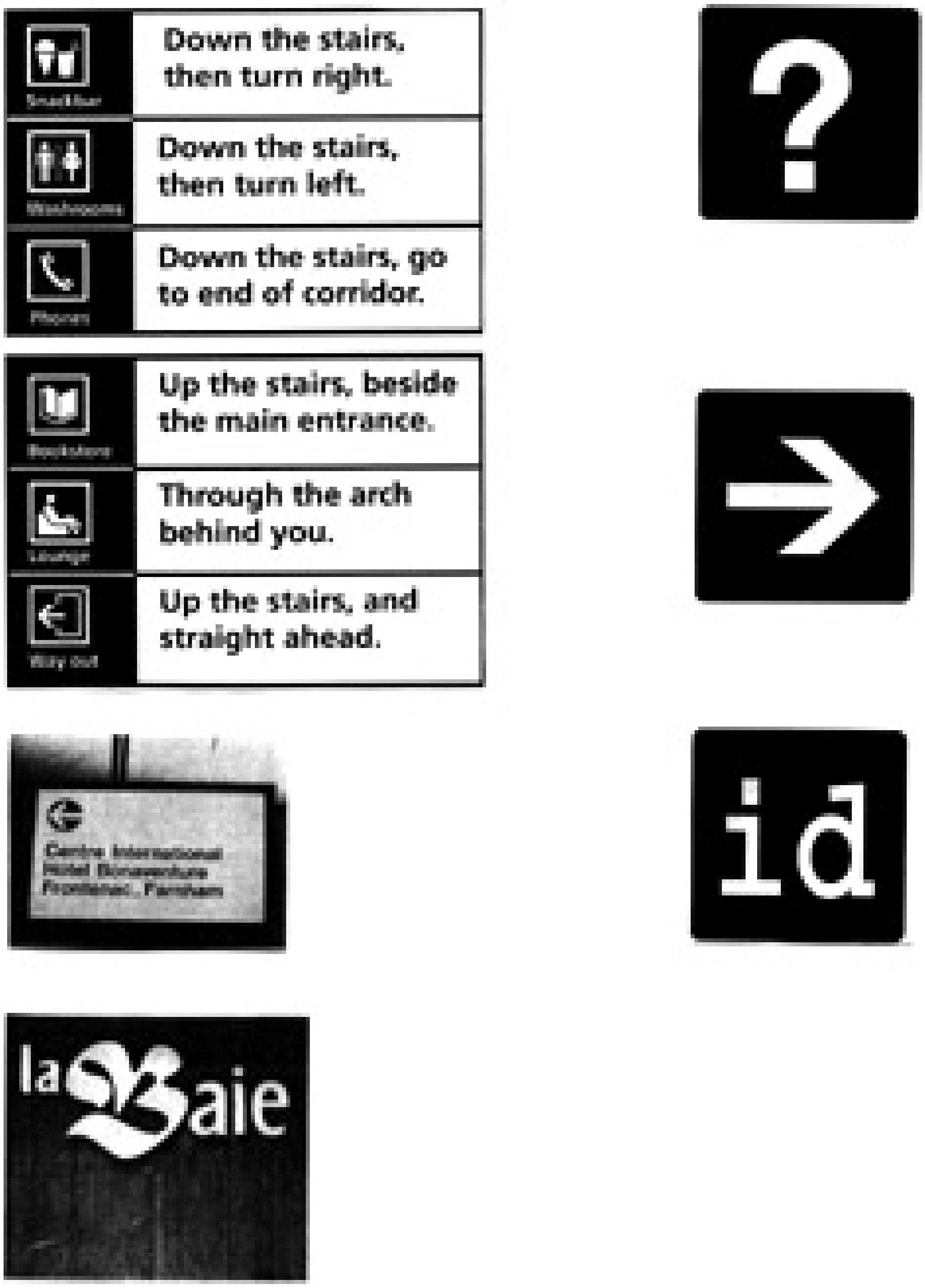
Weisman, J. (1987). Improving Way-finding and Architectural Legibility in Housing for the Elderly. In V. Regnier and J. Pynoos (Eds.), *Housing the Aged: Design Directives and Policy Considerations* (pp.441-464). New York: Elseiver.

Wener, R. and Kaminoff, R. (1983). Improving Environmental Information: Effects of Signs on Perceived Crowding and Behaviour. *Environment and Behavior, 15*, 3-20.

Wright, P., Hull, A. J., and Lickorish, A. (1993). Navigating in a Hospital Outpatients' Department: The Merits of Maps and Wall Signs. *Journal of Architectural and Planning Research, 10* (1), 76-89.

APPENDICES

APPENDIX A



Examples of Signs (Passini, 1984a).

APPENDIX B

Examples of Directories and You-Are-Here Maps (All photographs taken by Ö. Osman Demirbaş).

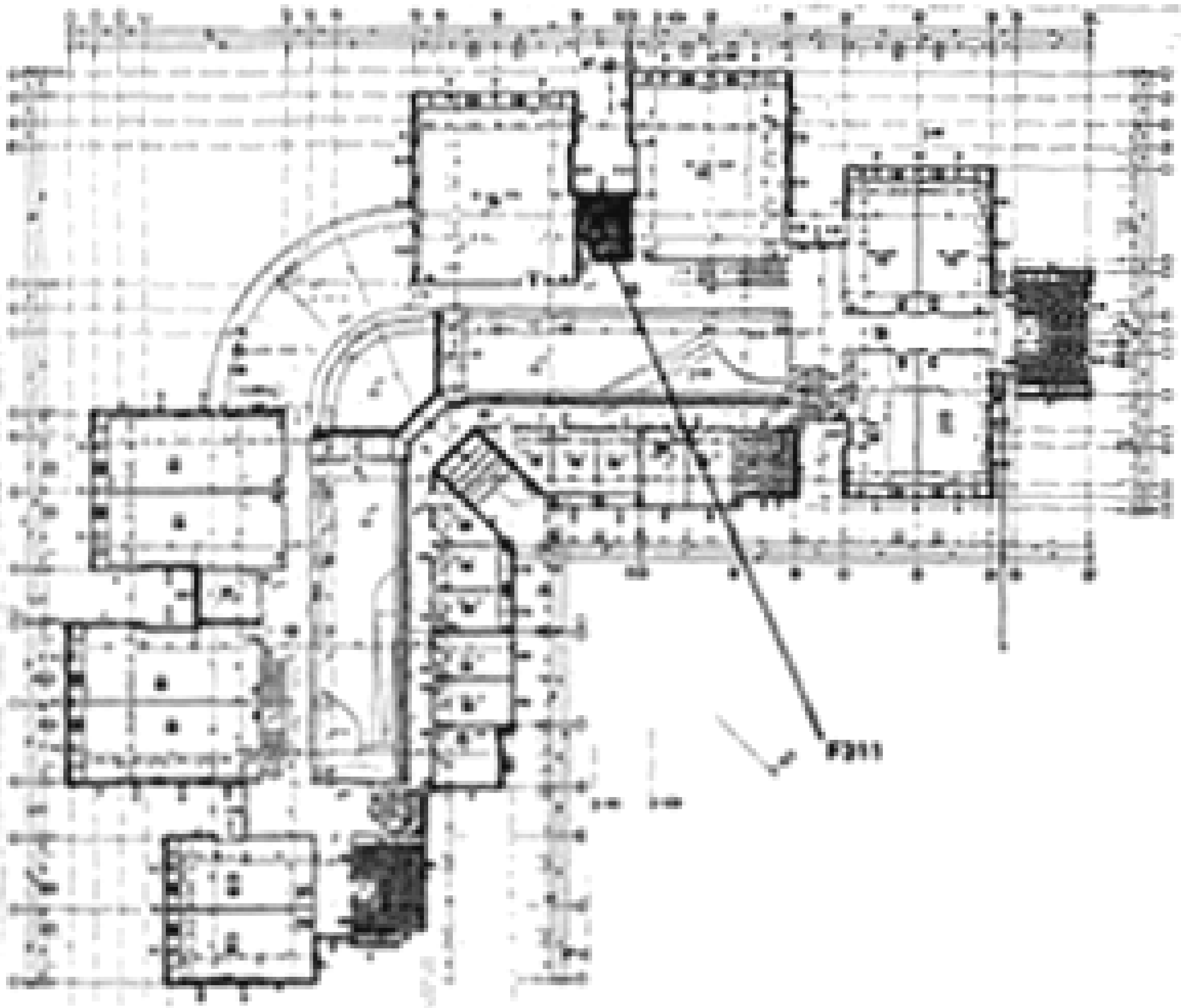
APPENDIX C1

Exterior View of IAED Building (Photograph retrieved from http:// www.art.bilkent.edu.tr/graduate/bilkentpictures/binp-guzel1.html)

APPENDIX C2

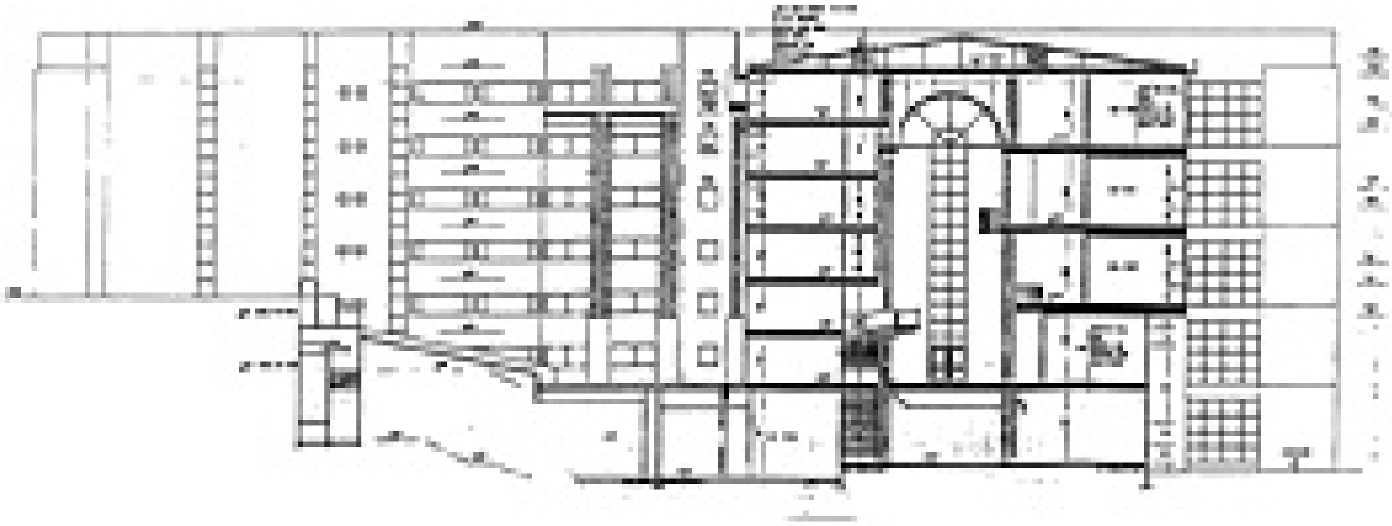
Interior View of IAED Building

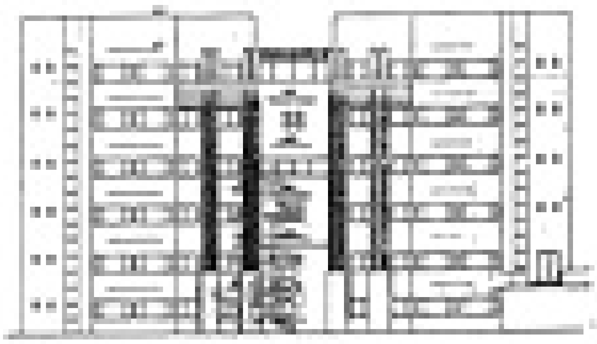
APPENDIX D1



Floor Plan of IAED Building

APPENDIX D2





Sections of IAED Building

APPENDIX E1

A View From Studio Floors

APPENDIX E2

A View From Office Floors

APPENDIX E3

Entrances to the Spiral Staircase

APPENDIX E4

A View to the Stairs Transforming into a Ramp

APPENDIX E5

Stairs Located Next to the Studios

APPENDIX E6

Elevator Located Across the Main Entrance

APPENDIX E7

Elevator Located Parallel to the Main Entrance Axis

APPENDIX E8

A View from the Entrance Area

APPENDIX E9

View From the Third Floor of IAED Building

APPENDIX E10

Staff Room

APPENDIX E11

Fifth Office Floor

APPENDIX F

2nd OFFICE FLOOR

FF 203 A
FF 204 A HALİME DEMİRKAN
FF 205 A DEPARTMENT OF INTERIOR
ARCHITECTURE &
ENVIRONMENTAL DESIGN
FF 206 A PHOTOCOPY ROOM
FF 207 A PRINTER ROOM
FF 209 A BURÇ ARPAT
FF 210 A JOHN ROCH
FF 211 A MİNE ÜÇOK
FF 212 A ANDREAS TRESKE
FF 213 A

3rd OFFICE FLOOR

FF 301 WC (GENTLEMEN)
FF 302 TOMRİS YARDIMCI
FF 303 YAPRAK SAĞDIÇ
FF 304 İNCİ BASA
FF 305 SİBEL ERTEZ URAL
FF 306 ZAFER BİLDA
FF 307 A BURÇAK ALTAY
FF 308 A ELİF ERDEMİR
FF 309 A MARKUS WILSING
FF 310 A MELTEM GÜREL
FF 311 A BURCU ŞENYAPILI
FF 312 A NUR ÜNSALAN

4th OFFICE FLOOR

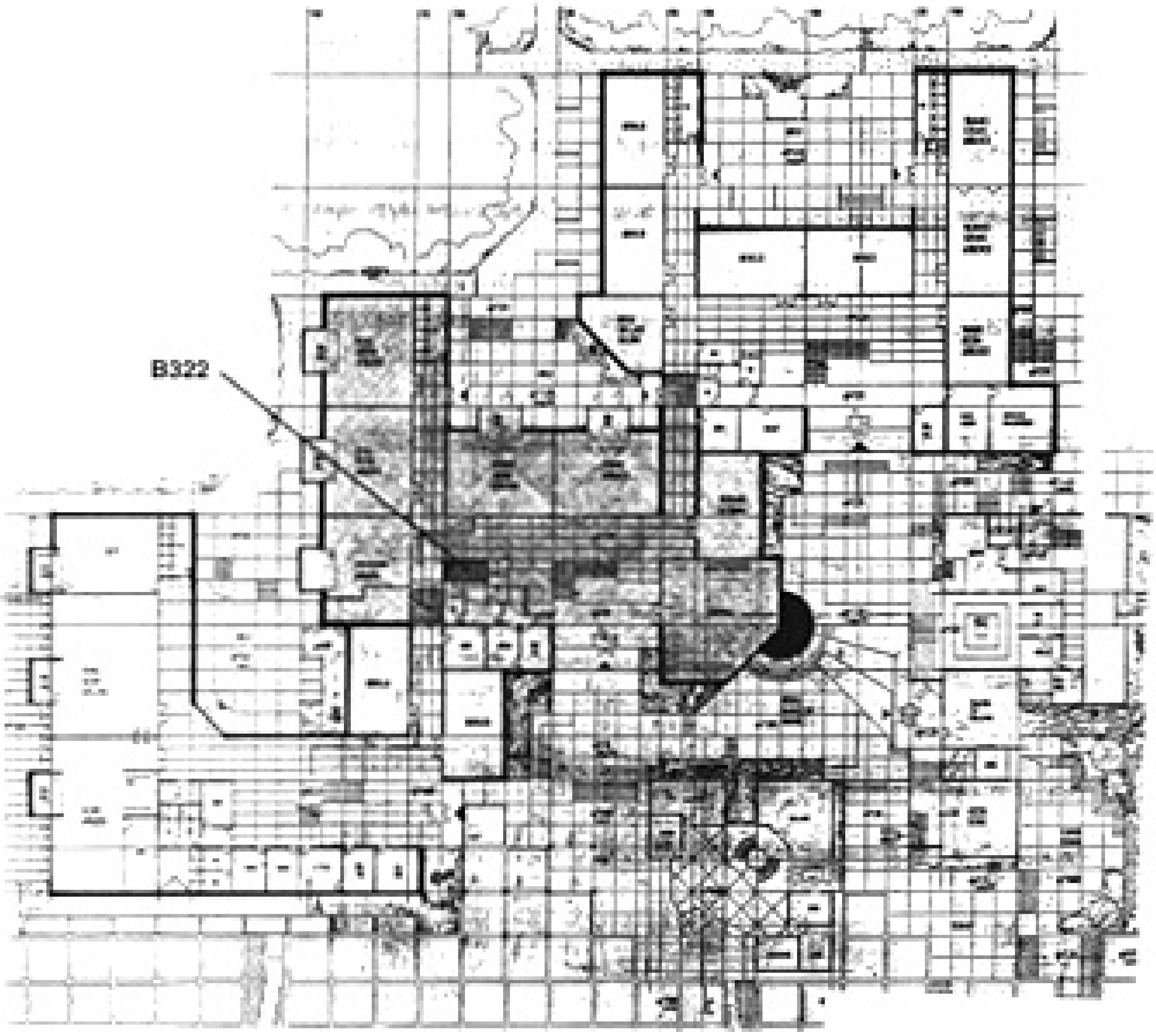
FF 401 WC (LADIES)
FF 402 SERPİL ALTAY
FF 403 SEMİHA YILMAZER
FF 404 SERPİL MERZİ
FF 405 NERKİS KURAL
FF 406 ŞULE TAŞLI
FF 407 A ŞAFAK UYSAL
FF 408 A FEYZAN ERKİP
FF 409 A GÜLSÜM B. NALBANTOĞLU
FF 410 A TİJEN SONKAN
FF 411 A MAYA ÖZTÜRK
FF 412 A CENGİZ YENER

5th OFFICE FLOOR

FF 501 WC (GENTLEMAN)
FF 502 ALPER KÜÇÜK
FF 503 ŞULE BATIBAY
FF 504 CHRİSTOPHER S. WILSON
FF 505 JAN HOFFITZ
FF 506 AYSU SAGUN
FF 507 A DENİZ HASIRCI
FF 508 A MUSTAFA PULTAR
FF 509 A TURHAN KAYASÜ
FF 510 A NUR ALTINYILDIZ
FF 511 A NİLGÜN ÇARKACI
FF 512 A UFUK DOĞU DEMİRBAŞ
OSMAN DEMİRBAŞ

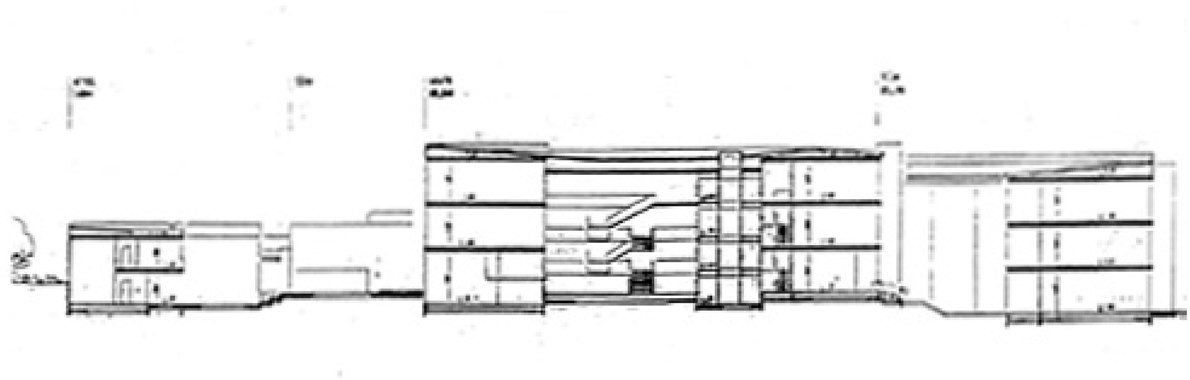
Directories Used in IAED Building

APPENDIX G1



Floor Plan of GRA Building

APPENDIX G2



Section of GRA Building

APPENDIX H1

Entrance to A Block in GRA Building

APPENDIX H2

Entrance to B Block (to the right) and C Block (to the left) in GRA Building

APPENDIX H3

Main Staircase in GRA Building

APPENDIX H4

Stairs Connecting the Floors in GRA Building

APPENDIX H5

Student Works in GRA Building

APPENDIX H6

Student Works in GRA Building

APPENDIX H7

Installations in GRA Building

APPENDIX I1

LIST OF QUESTIONS

1. Age:
2. Sex:
3. Department:
4. Year:

5. When was the first time you visited
   a) IAED?
   b) ABC?
6. How often do you visit:
   a) IAED ?
   b) ABC ?
7. Which area of the building do you use most often in:
   a) IAED ?
   b) ABC ?
8. Which floor do you use most often in:
   a) IAED ?
   b) ABC ?

9. Rate your familiarity over 7 (1 being “not familiar at all”, 7 being “extremely familiar”) with
   a) IAED
   b) ABC
10. Evaluate the buildings over 7 in terms of wayfinding (1 being “extremely poor”, 7 being “excellent”)
    a) IAED
    b) ABC
11. What kind of information do you generally use when you enter a building you have never been to before?

12. Describe the buildings naming as many spatial features as possible:
    a) in IAED
    b) in ABC
13. Please comment on the atmosphere of:
    a) IAED
    b) ABC

14. Do you think that visual accessibility exists in:
    a) IAED ?
    b) ABC ?
15. Is signage sufficient in:
    a) IAED ?
    b) ABC ?
16. Is the building configuration simple or complex in:
    a) IAED
    b) ABC
17. Does architectural differentiation among different parts of the building exist in:
    a) IAED ?
    b) ABC ?

APPENDIX I2

TASK:

<u>F311</u>

TIME:
INITIAL PREFERENCE:
ROUTE DESCRIPTION:

SHORTCUT:
NUMBER OF ERRORS:

<u>FB322</u>

TIME:
INITIAL PREFERENCE:
ROUTE DESCRIPTION:

SHORTCUT:
NUMBER OF ERRORS:

APPENDIX J

List of Variables

1. Sex
2. Age
3. Department
4. Class
5. Familiarity Rating for IAED
6. Familiarity Rating for GRA
7. Number of Elements Recalled in IAED
8. Number of Elements Recalled in GRA
9. Type of Elements Recalled in IAED
10. Type of Elements Recalled in GRA
11. Frequency of Visit to IAED
12. Frequency of Visit to GRA
13. Areas Used Most in IAED
14. Areas Used Most in GRA
15. Floors Used Most in IAED
16. Floors Used Most in GRA
17. Elements Used Generally
18. Number of Errors in IAED
19. Number of Errors in GRA
20. Initial Preference in IAED
21. Initial Preference in GRA
22. Shortcuts Taken in IAED
23. Shortcuts Taken in ABC
24. Time IAED
25. Time GRA
26. Wayfinding Rating for IAED
27. Wayfinding Rating for GRA
28. Atmosphere IAED
29. Atmosphere GRA
30. Cards Rotation Test
31. Maze Tracing Speed Test
32. Visual Accessibility IAED
33. Visual Accessibility GRA
34. Signage IAED
35. Signage GRA
36. Plan Configuration IAED
37. Plan Configuration GRA
38. Architectural Differentiation IAED
39. Architectural Differentiation GRA