

THE DEMYSTIFICATION OF CHARACTER

Character is promoted as a desired physical asset and outcome in planning and design literature. It implies that a 'high quality' (ie pleasant, interesting, healthy...) environment is sought, which relates to enhancing quality of life. As much as we are asked to respect it, create it and promote it, there is scant guidance on what 'it' actually is!

Character arises from the interplay of two variables: coherence and complexity. Where space or form contains too much unity it can be perceived as dull: lacking stimulation. Too much variety results in an assortment of objects or elements, rather than a holistic space (or form).

In evolutionary terms, it is advantageous to prefer environments that provide affordances to our purposes, which are twofold. Directed behaviour prefers coherence and legibility. Non-directed behaviour prefers complexity and mystique. Where the environment supports both cognitive mapping and sensual stimulation, we call the overall effect 'character'. Innate tendencies are satisfied.

To create character across the built environment planning methods need to ensure that the coherence-complexity interplay is created, maintained and/or enhanced. Public spaces need to be placed at the centre of planning units. Planning methods need to deal with spatio-physical elements at the structural level. Then, a fluid structural pattern needs to be established within which complexity and diversity is promoted. Analysing spatial morphology may provide clues to the spatial skeleton that sets the foundation for character.

THE CHARACTER GOAL

Local planning documents delineate 'character areas' and ask developers to respect character, especially within Conservation Areas. The place-making agenda, popular in professional literature (eg Department of Environment Transport and the Regions 2000, Cowan 2000), has defined places as 'spaces with an identifiable character'. However, this thing called 'character' is not defined either for the space concerned, the whole plan area, or in general. The quest for character in individual forms and whole spaces is a particular manifestation or variation of the universal desire for environmental quality.

Environmental quality, and character, are spatio-physical outcomes. Town planning, meanwhile, misdirects the powerful zoning tool for the segregation of land-uses. Separating activities originated with the purist aims of the modern movement (Lozano 1988: 420; Prak 1977: 71). It detracts from local variety and complexity and, ultimately, character. A rich environment is diverse in its functions, complemented by complexity of form that cohere to an overall spatial pattern. The focus of local planning needs to be changed from zoning by use to zoning by spatio-physical units - or areas of intended spatial character.

There is an increasing consensus that our perceptual tendencies and basic environmental preferences are shared (e.g. Kaplan 1988, Gibson 1950; 1977, Heath 1988, Berleant 1988). While there are undoubtedly individual, regional and cultural differences in opinion and taste, this rests on a prevailing hard-wired physiological foundation from a shared evolution. Tourism demand, cross-culturally, to experience particular (especially historic) built environments for their pleasure qualities provides anecdotal evidence of our shared aesthetic values. Tourists will frequent even rather 'ordinary' examples of towns and regions due to their spatial beauty – not just particular architectural monuments. We generally agree that historic cities and spaces are desirable and nowadays seek to conserve their character through planning laws.

The historical concern for personal idiosyncrasies, or taste, by built form designers and regulators is misguided. While perceptions are not all the same, there are striking commonalities. Life experience leads to adaptive differences in judgement. Consequently, the greatest differences in preference occur between experts in a field (eg architects and artists - who manipulate forms daily), and everyone else (Berlyne 1960, Kaplan 1988: 53). Built-form professionals can therefore not be 'impartial' judges of the aesthetics of proposed developments. Other than these people, there is a remarkable degree of preference constancy across people and cultures for different scenes, indicating some element of universality (Nasar 1988a, 1988b; Prak 1977: 69).

EVOLUTION & CHARACTER

The brain is the primary organ of perception and our instrument of judgement. It is a product of evolution to survive within our surrounding ecosystem(s). Its physiology was developed well before the arrival of *homo sapiens*. According to Dawkins (1976), we are but a complicated gene-propagating device and our advanced brain gives us advantages to this end. Our evolution was influenced by our surrounding ecological systems over millions of years, while we are now increasingly influencing it. For over 99% of human existence, we have survived from hunting, and a hunter, predominantly, of big game. Besides being the major source of food on-the-hoof in Africa, where we travelled we have contributed to the demise of the largest species' first (eg the Woolly Mammoth, the Diprotodon of Australia, or the Moa of New Zealand (Flannery 1994)). The danger involved in this food source, where our tools were only effective to around 30 metres, has also influenced the growth of our perceptual system.

As an animal of limited speed or strength, humans have relied on intelligence and skill. The arboreal environment helped us develop excellent spatial vision and a grasping hand – but these needed to be combined with complicated analyses and plans to ensure survival. The requirement for planning and anticipation favoured the development of still larger and more flexible information-handling capacity. Kaplan (1973) suggests that there are four types of knowledge required for our survival. We needed to know (1) where we were; (2) what is likely to happen next; (3) whether it will be good or bad, and; (4) be able to decide upon and take responsive action. The first point requires perception of the immediate stimulus array and implies memory schemas of preceding events. The latter points require a highly efficient predictive and decision making capability.

The most efficient mechanism, or structure, that is able to meet these requirements is the neural network – a three-dimensional lattice of message sending/receiving devices. Linear, chainlike, hierarchical or treelike structures are not sufficient to utilise knowledge of a common object across a wide range of situations. Associations cannot be limited on the input or output side.

The nervous system is indeed composed of 15-20 billion electrically conducting neurons. Each neuron has many connections, via axons, to other neurons. Messages, as electrical quanta, called the action potential, travel along the axons and stimulate the dendrites of target neuron(s) (Carlson 1998: 21). When the stimulation reaches a threshold, the neuron is switched from 'off' to 'on'. Attributes in the external environment that cause this neuronal switching are said to *correspond* to those neuronal elements. The associative pattern of external attributes to neuronal elements is rich and unrestrained so that complex correspondences can occur. Similarly, collections of associated neurons imperfectly and flexibly correspond to objects (with multiple attributes) in the external environment. Internal representations of the world will develop through experience with objects and situations – or learning. Representations are categorised in complex schemas and stored as memories. This tendency of perception toward categorisation is one of the

reasons behind the human tendency toward discrimination and thence prejudice.

Active representations can be linked with inactive representations to determine likely futures. The centres of pain and pleasure, located in the lateral hypothalamus, give motivational coding to the associated representations, or possible events. Pleasure and pain are treated like other sensory properties (Olds and Milner 1954). The neural network properties of generic perceptions and associative networks provide the human organism with a highly efficient decision making capability. The same network associations that are necessary for short-range decision-making allow for the emergent capacity of long-range contemplative thought.

When many possible representations are stored in the mind along with the relations between them, this is a cognitive map. Spatial cognitive maps are a special case of cognitive maps, and are intertwined with those other cognitive structures. Spatial cognitive maps have been defined as:

“a construct which encompasses those cognitive processes which enable people to acquire, code, store, recall, and manipulate information about the nature of their spatial environment” (Downs and Stea 1973: xiv).

They are an essential component in the adaptive process of spatial decision making and operability.

The human has been evolutionary selected for cerebral speed – one who is quick to perceive and quick to decide. There must be a bias towards action and against internal rumination because of the possibility for elaborate representations of possible circumstances. Because of this, humans tend toward oversimplification along with making decisions, and acting, on incomplete information. Contrary to a behaviourist rationality (eg Skinner 1980), where we would simply laze about when our primary drives are fulfilled, humans are intolerant of boredom. We are eager to learn, explore and act – exemplified by the innate behaviour of children to explore and understand. Our evolutionary advantage has been the successful use of information as derived from the environment and our ability to make decisions from this information. Environments that are not rich in information or possibilities, or that are not sensually restorative, will usually be perceived as uninteresting, or lacking character.

Perception is related to the information we pick up from the environment – as well as information possibilities as far as human purposes are concerned. Gibson (1977) calls these possibilities *affordances*: what an object or visual field has to offer the perceiver. In evolutionary terms, animals, including humans, must be able to recognise and, importantly, prefer environments in which they will flourish and survive. Environmental preferences must relate to functional appropriateness. It would not be efficient for animals to dwell in inappropriate environments for half of their life cycle, only to realise that an adjacent environment would have afforded a richer, easier and more productive (eg in terms of offspring) life. These preference judgements therefore need to be innate, rather than learned. Random or idiosyncratic environmental preference judgements would be disadvantageous in the

evolution of a species. Perception is linked to human purposes and purposes are linked to preference (Kaplan 1988a: 46). We will be looking for affordances that increase one's sense of comprehension and affordances for involvement – especially those that are rich in possibility.

DICHOTOMIES IN THE NERVOUS SYSTEM

Dichotomies are present within the central nervous system and, further, dichotomies within dichotomies. There is the somatic and autonomic nervous systems, dealing with information regarding the external and internal environments respectively. These systems have afferent and efferent nerves sending information to and from the central nervous system respectively. The autonomic system is further subdivided into the sympathetic and parasympathetic systems – the former used in situations needing energy and arousal, and the latter for de-arousal and preservation of energy. The discussion here, however, focuses on the cooperative differences between the older limbic system and the newer cerebral hemispheres themselves, which act both as a unit with bipolar tendencies.

The *telencephalon*, the largest and most important division of the brain, includes most of the two symmetrical cerebral hemispheres that make up the cerebrum. The two hemispheres are mostly covered by a convoluted cerebral cortex (**Figure 1**) – also called the neocortex ('new cortex'). The convolutions triple the surface area of the 3mm

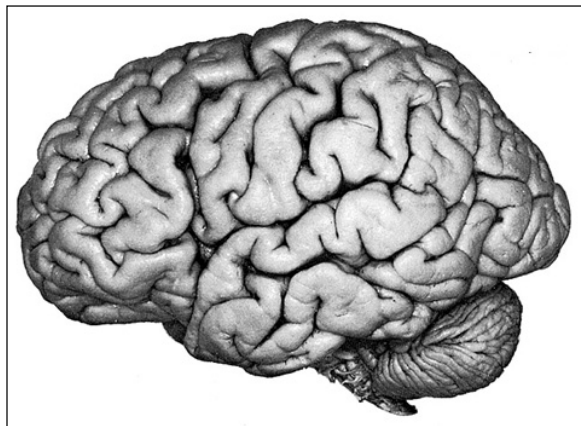


Figure 1 - The Cerebral Cortex of the Left Hemisphere

thick grey matter (to 2.36sqm.) upon which the surface of the body, including the retinas, are mapped (Carlson 1998). Because the neocortex, as a whole, works with complex memory schemas, place-attachment can occur in severely limited urban settings from repeated use and experience (ie memories). An example might be a poor quality estate that, while uninteresting to most people, may be rich in character for a resident.

The two cerebral hemispheres cooperate and coordinate, through the corpus callosum joining them, but exhibit functional lateralisation (see **Table 1**). The left hemisphere predominates in the *analysis* of information – or dealing with specific informational elements. This ability makes the left hemisphere particularly good at recognising and controlling serial events and behaviours – such as talking, understanding speech, writing and reading. It is also good with mathematical ability and logical and rational deduction. In the built environment, it identifies functions and perhaps styles of buildings from logical memory schemas. It deals with verbal information (advertising, names and signs) and semantically sorts this information into related

concepts. The left hemisphere enjoys details and intricacies of particular façades and scenes. It establishes a cognitive fix in space by using landmarks with verbal identification.

The right hemisphere specialises in *synthesis*. It is capable of simultaneous, as compared to linear, processing. Its forté is putting isolated elements together to perceive things as a whole. The ability to draw, especially three-dimensionally, read maps and construct complex objects from smaller parts, relies heavily on the right hemisphere. This hemisphere has a bias toward pattern and coherence. It is selective of abstracts such as shape, relative location, colour, texture, tone and rhythm. The shapes of buildings and spaces and their components (gables, windows, doors...) are of great significance. However, the right hemisphere is inarticulate and therefore communicates to consciousness non-linguistically.

HEMISPHERIC LATERALISATION	
Left Hemisphere dominance	Right Hemisphere dominance
Words	Faces
Letters	Emotional expression
Verbal memory	Non-verbal memory
All language skills	Spatial abilities
Arithmetic	Music
Complex movements	Movement in spatial patterns

Table 1 - Hemispheric Lateralisation (after Eysenck 2000: 86)

Conscious response to the urban field is a dialogue between the left and right cerebral hemispheres (Smith 1977). That is, between the response of verbal concepts and sequential issues (left), and the response to abstract information about space and form, especially elements contributing to pattern and unity (right). When these tensions are balanced – such that both halves of the cerebral cortex are 'entertained', or stimulated, a positive response is elicited.

The limbic cortex, also part of the telencephalon, occurs around the edge (*limbus* meaning border) of the cerebral hemispheres, mostly in subcortical areas. It is the first and simplest form of cortex. The limbic system is a group of brain regions, including parts of the hypothalamus, involved in the regulation of 'motivated behaviours'. The hypothalamus in particular organises behaviour related to species survival ("the four F's") – fighting, feeding, fleeing and mating. The evolution of the system coincided with the development of emotion, though parts of it are also known to be involved with learning and memory (Carlson 1998: 74). The limbic system holds the raw material of conscious awareness and will seek a return to homeostasis once motivated behaviours have been executed (Smith 1977). A primitive complex optic nerve connects directly to the limbic system allowing rapid automatic reactions to external stimuli to occur. This system has a wider

scanning capacity, with judgements related to a larger field of information, as well as a higher neuronal transmission rate than the cerebral cortex. Unconscious reactions therefore can occur up to seconds before one has 'time to think', or use the conscious part of the brain. Kaplan concurs that "preference judgements are often made so rapidly that they precede rather than follow conscious thought" (Kaplan 1988: 57). Experience of and reactions to the built environment is mostly subliminal and is therefore likely to be limbic-intensive.

The limbic processes would relate to the fundamental desire for 'refuge' (Appleton 1975), Kaplan's (1988) 'making sense' aspect of purpose (see below), or the 'orientation response' (Lozano 1988) in the built environment. Hall (1966) states that "man's feeling about being properly oriented in space runs deep. Such knowledge is ultimately linked to survival and sanity. To be disoriented in space is to be psychotic" (p105).

The limbic system will find pleasure in environments offering safety, predictability and defensibility. As an organism under time pressure to respond in the natural world, efficient perception depends on the predictable recurrence of environmental properties (Kaplan 1973). This may be achieved through rhythms and patterns in the urban milieu. Personal security may be achieved through the enclosure of space, for protection, longer glimpses for orientation and direction and multiple entrances/exits for flight routes. The limbic system will prefer the presence of natural daylight and fresh air; the sight and sound of moving water; options for levels of activity and rest in a space; as well as enjoying the sights and smells of food and drink (Smith 1977: 32). These are some of the fundamental pleasures of human life. One behavioural manifestation of limbic tendencies may be the ubiquitous enjoyment derived from sitting at the edge of a space overlooking the activity of people.

7

A discussion of interactions simultaneously occurring between the limbic system and the cerebral hemispheres in the urban milieu is provided by Smith (1977):

"the basis for rapport between the right cerebral hemisphere and the limbic system [is] in the matters of colour, pattern and rhythm. The limbic system reacts to primary hues of maximum saturation and brightness. The right hemisphere of the neocortex responds to colours further down the scale of chroma and brightness, the subtle, sophisticated colours. The limbic system responds to pattern for reasons associated with de-arousal and homeostasis, whereas the right hemisphere derives intrinsic satisfaction from the contemplation of pattern and coherence. The limbic brain responds very positively to simple serial rhythm (beat) or repeated simple pattern. The right hemisphere enjoys complex rhythm, especially when it contributes to a whole which is complex and elegant. At the same time a dialectic rhythm is established with the left cerebral hemisphere which analyses the mathematical system behind rhythm and pattern" (Smith 1977, p89).

The limbic system enjoys the rhythmic simplicity of life for the purposes of survival at the most fundamental level – to maintain homeostasis. The higher cortical areas enjoy the intricacy and complexity of environmental stimulation

that is a by-product of our superior information-handling capabilities that evolved for survival advantages. Not all of the dichotomies are as clear-cut as presented, but can be considered 'fuzzy' (Kosko 1994) – a duality as compared to binary. It is well known, for example, that left-handed people exhibit some reversal in hemispheric lateralisation.

To perceive character within the spaces of the built environment, the different needs of the limbic system and the cerebral hemispheres, as a single information-hungry entity with inherent bipolar properties, need to be simultaneously fulfilled. While this may sound a complex task, many spaces achieve this level of satisfaction. We usually say these spaces possess character.

P E R C E P T I O N O F F O R M S

Working within the complex array of processes in the nervous system, is the visual process itself. Judgements of the built environment are overwhelmingly derived through this sense, as is most information about the world. Planning at the human scale needs to be related to the vagaries of the visual system from whose impressions we judge the quality of built environments and spatial character. It is found, again, that a dichotomy is required for vision in itself to actually occur (figure-ground), and, besides this, visual dichotomies between unity and diversity are preferred.

Amazingly, from tiny, distorted and inverted two-dimensional retinal images, the visual system produces a richly detailed and accurate three-dimensional perception of space and forms (Pinel 1997: 151). The eyes move at 50-150 oscillations/second over half an arc minute with selected images stored in short-term memory. This memory system compares and contrasts variables of the perceptual field (such as colour, size, movement, intensity) to discern the objects. Visual perception is therefore based on the difference between what is known and what is new. It is based on difference and comparison. Consequently, visual perception requires a certain level of redundancy, or familiarity. There must be a 'ground' against which a 'figure' can stand out. "Perceptions without redundancy are just as uninteresting as highly redundant ones" (Prak 1977, p17). Moving parts in the built environment, such as people, trees and water, add to the enjoyment of the environment as the visual system has evolved for the detection of change against a redundant background. Redundancies in form (eg repetition, texture, uniform colour, continuity, simplicity of bounding surfaces), are used for the perception of objects.

Visual fields in the built environment need to possess a level of redundancy or similarity for interest to arise. Where a collection of buildings are disconnected in shape, placement, pattern, arrangement, materials and so forth, there will probably be a lack of perceptual interest. There is an inability to assimilate disparate elements. We could call the resultant space characterless, meaningless and incoherent. Toffler (1970) warns against 'future shock' in this manner – where too much change and information, without maintaining continuity and similarity temporally and spatially, will be psychologically damaging.

The perception of an environment will lead to the responses of either congruence or arousal (eg stress, reactance) – the latter will be followed by either successful or unsuccessful coping mechanisms by the organism (Bell *et. al.* 2001: 402). If there is constant arousal and unsuccessful coping, maladaptive and dysfunctional behaviour may result. In general terms, people who spend large amounts of time in environments that have either too much or too little information redundancy or coherence will experience repeated physiological arousal – this may be called stress. Where these people have mechanisms of coping or can experience 'restorative environments' (usually a piece of nature) – the environmental stress may be managed. However, constant over-arousal without adequate coping mechanisms will lead to antisocial and maladaptive behaviour.

The Gestalt-laws of formperception established that the mind has a level of attunement to pattern (Koffka 1935). The efficient use of redundancies and patterns frees our perceptual system to concentrate on information – the new and different. This ability is obviously necessary for survival in the natural world. Four of the non-hierarchical Gestalt inclinations, relating to the perception of the built environment, are listed in **Table 2**.

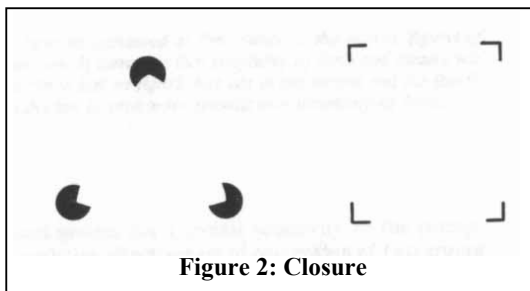
The Gestalt laws are often overlooked in modern building practices. For example, buildings with plain smooth façades show no play of light and shade and exhibit far less movement parallax than heavily moulded facades. Two major cues for space perception are thus missing. This makes the perception of distance and position more difficult and contributes to the abstract, unrealistic effect of these buildings (Prak 1977: 46). The Gestalt law of continuity implies that a smooth facade will look more like one continuous surface than one with heavy mouldings and strongly projecting members. A flat smooth facade is a 'hard Gestalt': its simplicity as a surface makes it an absolute form, comparable to a straight line or circle. Consequently, smooth façades look impenetrable, even if made of glass. Moulded façades seem more accessible, open and softer, because of this lack of continuity. Attaching projections, such as balconies and staircases, is also easier on a moulded façade because the perception of a single plane surface is not possible.

<ul style="list-style-type: none"> ♦ <i>Law of Prägnanz</i>: the visual system integrates separate visual stimuli into a (meaningful) whole. For spatially contiguous forms, perception organises visual stimuli in as large and as simple forms as possible. This is called <i>Simplicity of form</i>, where 'simple' may mean regular, symmetrical, minimal reentrant corners, etc.
<ul style="list-style-type: none"> ♦ <i>Law of Proximity</i>: forms that are close together tend to be perceived as a coherent group. Grouping elements together is more efficient than seeing them as separate elements; hence this is an extension of <i>Prägnanz</i>.
<ul style="list-style-type: none"> ♦ <i>Law of Equality</i>: Equalities and similarities, especially in patterns, are immediately recognised.
<ul style="list-style-type: none"> ♦ <i>Law of Continuity</i>: A figure is continued as it starts – new information will not be added (eg a line continues as a line, a zigzag a zigzag, a plane a plane, etc.). Information is concentrated at changes in direction (eg angles) and therefore the effect of <i>closure</i> occurs even if only the angles of a form are given.

Table 2 - Gestalt Laws of form-perception

The *Law of Prägnanz* says that the human visual system divides a form (eg building or streetscape) into chunks that are at the same time as large and as simple as possible. Modern multistorey residential buildings are not perceived as large combinations of flats, but always as simple rectangular blocks with repetitive patterns (eg of windows, doors, lines). These, too, are hard Gestalts. Because of the effect of *closure* projecting balconies or features will change little in this perception, as long as the corners are left intact. In the streetscape, closure is experienced when projecting eaves of approximately

10



the same height give an impression of a street 'ceiling'. The visual system completes the shape that is implicated only by the 'corners' of the space (**Figure 2**). Where buildings are contiguous in a street, the laws of *Prägnanz* and *Proximity* implies that they will be perceived as a 'streetscape' (one unit) rather than a collection of individual

objects. One whole unit is an easier percept to manage, ie is more redundant, and is thus more comfortable to the eye. The visual system will be further satiated when this percept contains internal complexity – preferably with articulated shapes, patterns and rhythms.

However, too much redundancy, or similarity, is not desirable. Variety is achieved in form by opposing the simplicity. Variety is akin to complexity. Complexity is achieved by creating contrasts in form, dimension, materials and so on. Yet too much variety is perceived as disparate parts rather than

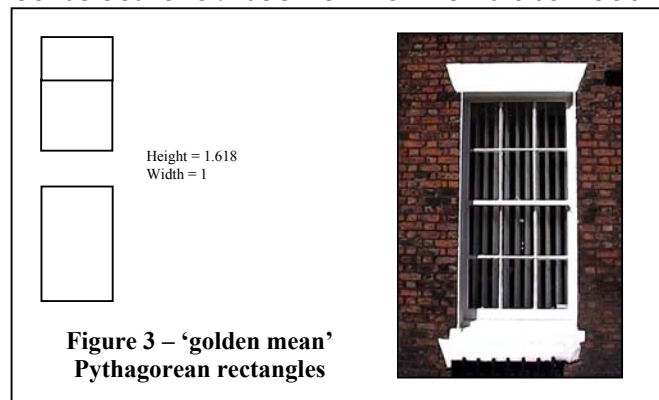
of a whole design. A tension between coherence and contrast therefore must exist. Contrasts may be set up in one variable, such as materials, whilst coherence is maintained along other variables, such as forms or dimensions. Modern buildings of complex forms generally use a common material to indicate coherence. Where the form is simple, such as a house, diverse materials may be used. In the traditional inner urban area or high street, relative coherence is maintained in spatial dimensions (height, width, rhythm), while diversity is present in the higher-resolution variables, such as materials, styles, uses etc.

Arrested development occurs in highly redundant environments (Dember 1966). Sensory deprivation, such as isolation torture, becomes unbearable after two or three days. However, perceptual deprivation, where information cannot be coded or decoded, is the hardest to endure and causes even more severe mental disturbances (Schultz 1965). During the war, orphaned babies were left lying in hospital cots without toys or human interactions and immersed in a white environment (ie white sheets/ceilings/clothes/walls etc.) These babies became retarded, listless and an abnormally high number died (Spitz 1945). Chimpanzees do not learn to perceive in visually deprived conditions over extended periods, and actually unlearn adaptive behaviour when placed in deprived conditions after learning in non-deprived environments (Riesen 1950). Rats and monkeys actually choose more complex and varied environmental stimulation even if it requires more work for their rewards (Dember *et. al.* 1957, Butler and Harlow 1954). Further, in a famous experiment by Held and Hein (1963) it is found that visual variety must be linked with physical interactivity to develop full adaptive behaviour. Kittens that could not physically interact with their environment, by being strapped into a caboose, did not learn to move or react to stimuli appropriately in comparison to their twins who could interact. This may have some implications for the modern behaviour of 'experiencing' the environment strapped in a seat and looking through the car window.

11

While the connection between perceptual deprivation and psychological damage caused by simple modern environments can be overstated, as experimental conditions have been extreme, it is demonstrable that there is a need for variety in general for adaptive development of humans (Prak 1977: 71). The most psychologically beneficial environment, i.e. that produces the greatest psychological well-being, has a degree of complexity within a unified coherent pattern. This pattern and unity may be barely recognisable at the conscious level. Such environments also need to

encourage muscular interactivity (i.e. walking) to maximise behavioural adaptivity. The opposite of this is the environment with disconnected highly redundant forms, interspersed by distances that require constant vehicle use.



Smith (1983) argues that the ideal 'amount' of tension between redundancy and information is the Pythagorean golden section (1.00 : 1.618). (Georgian windows often possess the 'aesthetically perfect' rectangle (**Figure 3**)). He argues that our mind will make slight adjustments even in highly complex scenes, such as the high street, in favour of the 40% to 60% split between complexity and coherence.

Physical variety in the urban realm is also useful and efficient. It is difficult to find one's way around where it all looks the same. Lynch (1960) demonstrated how differences in the environment help us create cognitive maps of urban regions. Such environments are said to have imageability. This feature may be particularly important to children, who are developing cognitively through their interactions with their environment (Winkel 1978; Moore 1972).

PERCEPTION OF SPACE

It is at the third dimension that our ancestors thrived or perished. Given the evolutionary importance of space, especially from an arboreal heritage, it is not surprising that humans are highly effective at perceiving depth. To perceive spatial character we must be able to perceive, consciously or not, a space as a unit or 'thing'. The Gestalt laws, which have been derived through experiment on two-dimensional forms, can be applied to three-dimensional space when combined with the principles of space-perception (Prak 1977: 33, Ittleson 1960). The eye cannot estimate the distance to a point along a light ray reflected from an object, which is projected as a point onto the retina. Furthermore, many different objects can produce the same two-dimensional retinal image. Therefore, we have to use weighted perceptual cues to perceive depth (see **Table 3**).

Space-perception does not depend on binocular vision. Closing one eye does not make the world go flat, and paintings or photographs, which are monocular, could not illustrate depth if this were the case. Binocular disparity produces more visual data between the optical arrays of the same scene, similar to the effect of movement parallax (see **Table 2**). When all of the space cues are used, the perception of space is still an educated guess. Each cue in the visual world provides some information about its spatial structure. When we test these cues, through touch and movement, all the cues add up and usually agree with each other. Since the Renaissance, pictures have used depth-effect by

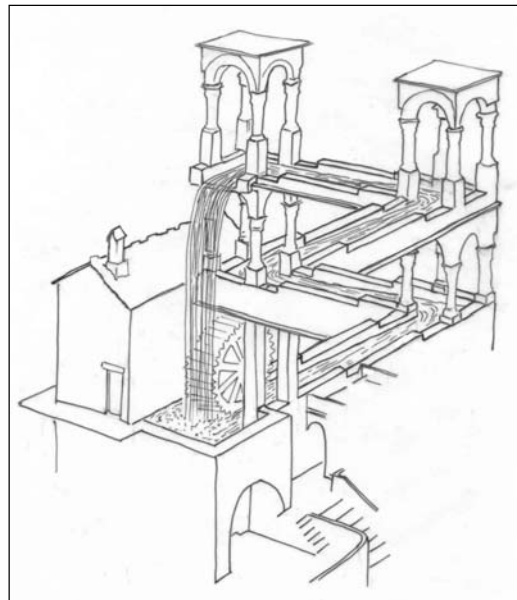


Figure 4: Escher's (1961) Waterfall illusion

setting some cues against others to create, sometimes illusionary, situations (eg **Figure 4**). Space perception is also heavily dependent on memory and eventually becomes redundant – happening without conscious thought.

Edges are the most informative feature of any visual field because they define the extent and position of elements within the scene (Pinel 1997: 163). The strongest edges in the urban environment occur along the skyline, eaves and, vertically, between buildings. To perceive edges there needs to be contrasts between them. Contrast enhancement occurs through a process of lateral inhibition of retinal receptors (Eysenck 2000, p88). This process is strong for vertical edges and lines, but stronger still for spatial frequency (DeValois Albrecht and Thorell 1978). Periodic patterns of light and dark tones produce extreme sensitivity to deviations in some cells of the visual cortex (Von der Heydt *et al* 1992). These patterns relate to the perception of surfaces which, in nature, are mostly rough textured with a repeating pattern. Some surfaces differ only in their texture, while texture gradients are an important cue for the perception of distance (eg a pebble beach) and thus of great survival significance. On the larger scale of the street wall, texture gradients may be similarly important for the perception of distance. Our evolutionary environment was, and is, inhabited by vertical forms of primary interest (eg people, animals and trees) spread across the visual array. Visual gratings may be an efficient method to rapidly perceive the primarily vertical array. Consequently, built environments expressing vertical rhythm would resonate with the visual cortex most efficiently. Arnheim (1977: 35) asserts that due to the overwhelming verticality of terrestrial life, we have come to associate this direction with life – detaching oneself from the horizontality of the earth, and death.

<ul style="list-style-type: none"> ♦ <i>Colour</i>: helps distinguish between adjacent objects and objects against their background. Colour vision also makes it easy to make fine discrimination among objects (eg between ripe and unripe fruit).
<ul style="list-style-type: none"> ♦ <i>Overlay or interposition</i>: where an overlapping object appears to be nearer than an overlapped object.
<ul style="list-style-type: none"> ♦ <i>Size</i>: our discrimination of distances is dependant on the size of the retinal image provided by the object. The angle of the optical array (between the top and bottom of the object) decreases as distance increases and this difference causes perspective. Experiments have shown that perception prefers constant size over constant distance, which may be because our everyday experience of the world filled with objects of fixed sizes but at varying distances.
<ul style="list-style-type: none"> ♦ <i>Light and Shade</i>: different combinations of shadow and highlight are reported with objects having different proportions and distances. Surfaces require differences in light and shade to contain depth. This is why photos are best taken side-lit, as front- or back-lit photos look flat due to reduced light tones.
<ul style="list-style-type: none"> ♦ <i>Linear Perspective</i>: a constant distance between points subtends a smaller and smaller angle at the eye as the points reced from the subject.
<ul style="list-style-type: none"> ♦ <i>Atmospheric Perspective</i>: over long distances, where the absorption effects of the atmosphere are relevant, objects usually look hazier and more bluish than those nearby.
<ul style="list-style-type: none"> ♦ <i>Movement Parallax</i>: is due to the amount of shift difference in near objects to far objects. When moving one's head from left to right, objects in the distance will move little while objects nearby will move further in the retinal image.
<ul style="list-style-type: none"> ♦ <i>Object Movement</i>: movement of one or more objects against an immobile ground.

Table 3 – Monocular cues for space perception

Space is separate from form but is dependent upon it, because it is only known through its material boundaries. The image of the space around us, a room, street or district or region, is primarily *conceptual* and therefore heavily dependent on memory. Conceptual space is continuously supported and/or corrected by the perceptions of visual space – the observed visual field at any one time. By taking a large number of separate images and views we create topological schemes of a space or structure (analogous to the 50-60 frames per second of the movie picture). The work of Lynch (1960) confirmed the spatial, rather than metric, primacy of memory schemas for people in their own neighbourhoods and cities. There was a good correspondence to reality in the relative location of streets and landmarks etc., but the proportions were strongly distorted.

In outdoor spaces the full range of bounding surfaces that help define space inside buildings are often missing. Space formation must be supported by the placement of forms – usually buildings, structures (eg walls) and vegetation. If the shape of a space is *simple*, the bounding surfaces are in alignment (*continuity*), the buildings have similar height eaves (*continuity* and *similarity*), and the objects sufficiently close to each other (*proximity*) conceptual spaces can be derived. These spatial cues are referred to in townscape analyses. For example, in the discussion of a market town streetscape: "there are sufficient linkages in height, plot width and scale to help the group 'hang together', even though there are diverse elements such as style and material..." (Tugnutt and Robertson 1987: 48). In contrast to Venturi's (1966) call for complexity and ambiguity in architecture, both clarity and relative complexity are preferred in evaluations of residential and urban street scenes (Nasar 1988a; 1988b, Prak 1977: 69).

15

In cities with narrow streets, attached buildings and enclosed squares, the formation of spatial concepts is more easily facilitated. The number of possibilities for the formation of conceptual space in 'open' built environments is greatly reduced. The localisation of objects in space, an inherent perceptual desire, depends on the possibility of relating them to a (redundant) background, particularly to some kind of patterned floorsurface (Gibson 1950). When many large and modern buildings are spread across a landscape, in the image of Le Corbusier's Radiant City, only the cue of *overlay* is at our disposal. This cue reveals that one building stands behind another, but not how far behind. Intervening masses can prevent the perception of the connecting ground, and the often large building sizes prevents a simultaneous view of front- and side- elevations, which might supply some depth perspective. This lack of perceptual cues makes the formation of conceptual space, as well as distance and localisation, almost impossible - making them visually uncomfortable (Prak 1977: 53). Curved streets give much more information about the location of buildings and other objects in space; this is one of the visually attractive aspects of such streets.

P R E F E R E N C E

Parts of the built environment will be interpreted as supportive or inhibitory to our purposes depending largely on whether it fulfils human psychophysiological inclinations. These inclinations derive primarily from our biology and secondarily from cultural and individual learning. The greater part of our environmental requirements, in terms of the arrangement of space and form, are shared.

Human purposes are not random and scattered in reference to the external environment, but can be grouped into two types. One of these purposes is to 'make sense' of the environment and the other is for 'involvement' in the environment (Kaplan and Kaplan 1978, Kaplan 1988). Making sense refers to keeping one's bearings and understanding what is occurring in the immediate and wider environment. Involvement refers to stimulation: to learn and to decipher. Environments that support these purposes – that will work in conjunction with the particular purpose for a successful conclusion – will be preferred.

These purposes are commonly classified into two types of behavioural objective in the built environment (Heath 1988: 7; Bonnes and Secchiaroli 1995: 183). One behaviour type is *instrumental* (or *specific*). This involves doing a thing, getting to a place, achieving an aim etc. The built environment is here sought to efficiently facilitate one's present and specific aims. The other behaviour category is called *diversive* (or *aspecific*). The stroller, the tourist or window shopper seeking engagement and stimulation from their setting typifies this. Ideally, built environments will be able to satisfy both behavioural objectives, allowing people to move from one behaviour mode to the other.

Environmental satisfaction may also be derived from the enjoyment of natural qualities. Such is our hard-wired affinity with nature that even rather mundane examples of it (eg grass and trees), or indirect experiences of it (eg view from a window) can have a restorative effect (Kuo and Sullivan 2001, Korpela *et al* 2001, Kaplan 2001). As Kuo and Sullivan (2001) found, a lack of nature in and around the home can lead to increased mental fatigue and aggressive behaviour. The aesthetic argument, based on economic theory of scarcity, that the 'unusualness' or novelty of a design or feature is proportionate to its value is incorrect. People's positive reaction to ordinary experiences of nature is an example of noneconomic value. Meanwhile, a unique statue or feature may not be valued at all.

Kaplan (1988a) provides a preference matrix (**Table 4**) based on the theory that people perceive information from their environment from the two-dimensional visual array as well as three-dimensional space. The visual array relates to the two-dimensional 'picture plane' (comparable to a photograph) and just as a photo can have little or much to see, scenes can vary at this level of analysis. Complexity is the involvement component and maybe referred to as diversity or richness. Coherence relates to the making-sense component and relates to the ability to organise the patterns of light and dark into a manageable number of information units, regions or areas. It is found that people store about five information units, or chunks, in a short term

'working memory' (Simon 1974, Baddeley and Hitch 1974), so scenes that can be divided into around five major units will aid comprehension.

Level of interpretation	Making Sense	Involvement
The visual array (2D)	Coherence	Complexity
Three-dimensional (3D) space	Legibility	Mystery

Table 4 – S. Kaplan's (1988: 51) Preference Matrix

There is a strong preference for scenes that offer a sense of what has been termed 'mystery' implying the promise of new information if one could go further into the scene. "Mystery embodies the attraction of the bend in the road, the view partially obscured by foliage, the temptation to follow the path 'just a little farther'" (Kaplan 1988a: 50). Mystery evokes curiosity through suggestion. It implies opportunities and potentials for information revelations. Mystery is ideally controlled by the perceiver as there should be a connection between what is seen and what is hidden. One's rate and direction of travel controls the rate at which new information is revealed. This is an ideal situation for a creature who is easily bored with the familiar, yet fearful of the strange. Legibility relates to making sense and Appleton's (1975) 'refuge', or safety, in the three-dimensional space. Rather than the promise to learn, as with mystery, it is the promise to function – to be able to find one's way both there and, importantly, back again. It is similar to coherence in this manner, but involves the organisation of the ground plane rather than the picture plane. A highly legible scene is one that supports the ready production of a cognitive map. Legibility is aided by apparent depth and a well-defined space; smooth textures and distributed landmarks as well as easily perceived subareas or regions. These analyses by humans are generally automatic and nonconscious processes – they happen automatically and effortlessly which would be expected for a far-ranging spatially oriented species.

17

The two levels of the preference matrix may not have equal weight. While both coherence and complexity are required to some degree within the visual array, high levels of these variables do not produce always high preference ratings. Conversely, legibility and mystery influence preference throughout their entire range (Kaplan 1988a: 52). While the visual array is important, "a substantial portion of the human response to landscape turns out to depend on the sort of space involved and the way the individual envisions moving in that space" (Kaplan 1988a: 54). However, for a scene to be legible, it must contain levels of coherence and variety in the spatial, rather than the picture, plane. Similarly, mystery implies some level of, hidden or suggested, information stimulation and complexity.

CONCLUSION

The call for creating character in the built environment, in individual forms and in whole spaces, is now near universally preached in the local planning system. The concept of character has here been related to the wider concepts of preference and perception, with which town planning must satisfy. The term 'character' relates strongly to the desire to produce environmental quality, a sense-of-place, and economic and social sustainability.

To have character it must be perceived. Perception occurs predominantly through the eyes. The visual cortex is part of the central nervous system. Our brain evolved and adapted in consonance with our surrounding ecosystem in which we had to survive: eat, reproduce and avoid danger. This ecosystem is itself constructed of spaces and physical elements within which occurred opportunities and dangers. Thus we are familiar with space at a deep physiological level. Our system is hard-wired to learn about it and operate within it. Our judgements of spatial quality, and character, are rapid to the extent of being subliminal. To perceive these spaces and the information within them we grew mechanisms to segregate figure and ground. The background needs to be provided by predictable patterns of physical elements that construct the space in which we operate. The information is provided by diverse higher-resolution details that occur within those spaces.

To produce high quality built environments, those with physical character, therefore implies that a structural coherence must firstly present itself. The Gestalt laws have given some indication at how this coherence is provided. However, as a superior information processing organism, we crave variety, complexity and diversity within that coherence. The coherence itself can be complex and fluid as our system is so geared toward perceiving it that we make subliminal adjustments to perceive its presence. In fact, an articulated and complicated coherence itself stimulates the advanced processing mechanisms of the cerebral hemispheres.

For town planning to inherently manifest physical character at the human scale, it needs to delineate spatio-physical units of (existing or intended) structural coherence. These units will be the public spaces of our towns, cities and villages through which we move and in which we act. Within these units great complexity and diversity, in land-uses, materials, styles, forms etc., can, and should, be promoted.

This paper has been drafted as a theoretical basis for a local planning method that has been developed by the author to achieve such ends. The format is based on the derivation of spatial units, focussing on the public arena, through analysing low-resolution spatial morphology.

BIBLIOGRAPHY

- Appleton, J. (1975). *The Experience of Landscape*. Wiley: London and New York.
- Arnheim, R. (1977). *The Dynamics of Architectural Form*. University of California Press: Berkeley.
- Baddeley, A.D. & Hitch, G.J. (1974). Working memory. In G.H. Bower (Ed.), *The psychology of learning and motivation*, Vol. 8. Academic Press: London.
- Bell, P.A., Greene, T.C., Fisher J.D. and Baum, A. (2001). *Environmental Psychology*. 5th Edn. Harcourt College Publishers: Orlando.
- Berleant, A. (1988). Aesthetic Perception in Environmental Design, in *Environmental Aesthetics: Theory, Research and Applications*. Nasar, J.L. (Ed.). Cambridge University Press.
- Berlyne, D.E. (1960). *Conflict arousal and curiosity*. McGraw-Hill. New York
- Bonnes, M. and Secchiaroli, G. (1995). *Environmental Psychology: a psycho-social introduction*. (Translated by Claire Montagna). Sage: London.
- Butler, R.A. and Harlow, H.F. (1954). Persistence of Visual Exploration in Monkeys. *Journal of Comparative Physiology and Psychology*, **47**: 247-249.
- Carlson, N. R. (1998). *Physiology of Behaviour*. 6th Edn. Allyn and Bacon: Massachusetts.
- Cowan, R. (2000). *Placecheck User's Guide and Placecheck Information Brochure*. Urban Design Alliance. London.
- Dawkins, R. (1976). *The Selfish Gene*. Oxford University Press.
- Dember, W.N., Earl, R.W. and Paradise, N. (1957). Response by Rats to Differential Stimulus Complexity. *Journal of Comparative Physiology and Psychology*, **50**, 514-518.
- Department of Environment Transport and the Regions (2000). *Our Towns and Cities: The Future - Delivering an Urban Renaissance*. Urban White Paper. Available from <http://www.regeneration.detr.gov.uk/policies/ourtowns/cm4911/06.htm>. [Accessed 18/12/2000].
- DeValois, R.L., Albrecht, D.G. and Thorell, L. (1978). Cortical cells: Bar detectors or spatial frequency filters? In *Frontiers in Visual Science*, Cool, S.J. & Smith, E.L. (Eds.). Springer-Verlag: Berlin.
- Downs, R.M., and Stea, D. (Eds.) (1973). *Image and Environment: Cognitive Mapping and Spatial Behavior*. Aldine Publishing: Chicago.
- Escher (M.C.) Foundation. (2000). *The Magic of M.C. Escher*. Joost Effers Books. Thames and Hudson. London.
- Eysenck, M. W. (2000). *Psychology: A Student's Handbook*. Psychology Press. Sussex, U.K.
- Flannery, T. F. (1994). *The future eaters : an ecological history of the Australasian lands and people*. Reed Books: Melbourne.
- Gibson, J.J. (1950). *The Perception of the Visual World*. Boston: Houghton Mifflin.
- Gibson, J.J. (1977). The theory of affordances. In Shaw, R. and Bransford, J. (Eds.) *Perceiving, acting and knowing*. 76-82. Erlbaum: New Jersey.
- Hall, E.T. (1966). *The Hidden Dimension*. Garden City, N.Y. Doubleday.
- Heath, T.F. (1988): Behavioural and Perceptual Aspects of the Aesthetics of Urban Environments, in *Environmental Aesthetics: Theory, Research and Applications*. Nasar, J.L. (Ed.). Cambridge University Press.
- Held, R. and Hein, A. (1963). Movement-produced stimulation in the development of visually guided behaviour. *Journal of Comparative Physiology and Psychology*, **56**: 872-876.

- Ittelson, W.H. (1960). *Visual Space Perception*. Springer: New York.
- Kaplan, S. (1973). Cognitive Mapping and Spatial Behaviour. In R. M. Downs & D. Stea (Eds.), *Image and Environment*. Edward Arnold: London.
- Kaplan, S. (1988). Where Cognition and Affect Meet: a Theoretical Analysis of Preference. In *Environmental Aesthetics: Theory, Research and Applications*. Nasar, J.L. (Ed.). Cambridge University Press.
- Kaplan R. (2001). The Nature of the View From Home: Psychological Benefits. *Environment & Behavior*, July 2001. **33**(4): 507-542. Sage Publications Inc.
- Kaplan, S. and Kaplan, R. (Eds.) (1978). *Humanscape: environments for people*. Duxbury: Belmont, California.
- Koffka, K. (1935). *Principles of Gestalt Psychology*. London.
- Korpela, K.M., Hartig, T., Kaiser, F.G., & Fuhrer, U. (2001). Restorative Experience and Self-Regulation in Favorite Places. *Environment & Behavior*, July 2001. **33** (4): 572-589. Sage Publications Inc.
- Kosko, B. (1994). *Fuzzy Thinking: the new science of fuzzy logic*. Harper Collins: London.
- Kuo, F.E., and Sullivan W.C. (2001). Aggression and Violence in the Inner City: Effects of Environment via Mental Fatigue. In *Environment & Behavior*, July 2001. **33** (4): 543-571. Sage Publications Inc.
- Lozano, E. E. (1988). Visual Needs in Urban Environments and Physical Planning. In *Environmental Aesthetics: Theory, Research and Applications*. Nasar, J.L. (Ed.). Cambridge University Press.
- Lynch, K. (1960). *The Image of the City*, Cambridge, Mass.: MIT Press.
- Moore, G. (1972). Conceptual Issues in the study of environmental cognition: an introduction. In Mitchell W. (Ed.) *Proceedings of the Environmental Design Research Association*. Los Angeles: University of California, Department of Architecture.
- Nasar, J.L. (1988a). Visual Preferences in Urban Street Scenes: a Cross-cultural Comparison Between Japan and the United States. In *Environmental Aesthetics: Theory, Research and Applications*. J. Nasar (Ed.). Cambridge University Press. 260-274.
- Nasar, J.L. (1988b). Perception and Evaluation of Residential Street Scenes. In *Environmental Aesthetics: Theory, Research and Applications*. J. Nasar (Ed.). Cambridge University Press. 274-289.
- Olds, J. & Milner, P. (1954). Positive reinforcement produced by electrical stimulation of septal areas and other regions of rat brain. *Journal of Comparative and Physiological Psychology*, **47**: 419-427.
- Pinel, J.P.J. (1997). *Biopsychology (3rd Edn.)*. Allyn & Bacon: Boston.
- Prak, N. L. (1977). *The Visual Perception of the Built Environment*. Delft University Press, Delft.
- Riesen, A.H. (1950). *Arrested Vision*. Scientific American, **183**: 16-19.
- Schultz, D.P. (1965). *Sensory Restriction*. London.
- Simon, H.A. (1974). How big is a chunk? *Science*, **183**, 482-488.
- Skinner, B.F. (1980). *The shaping of a behaviourist*. Holdan Books: Oxford.
- Smith, P. F. (1977). *The Syntax of Cities*. Hutchison: London.
- Smith, P. F. (1983). Human habitat and aesthetic values. In *City Landscape: a contribution to the Council of Europe's European Campaign for Urban Renaissance*, A.B. Grove & R.W. Cresswell (Eds.). Butterworths: London. 31-46.
- Spitz, R.A. (1945). *Hospitalism*. New York.
- Toffler, Alvin (1970). *Future Shock*. Pan Books Ltd: London.

- Tugnut, A. and Robertson, M. (1987). *Making Townscape: a contextual approach to building in an urban setting*. Mitchell: London.
- Venturi, R. (1966). *Complexity and Contradiction in Architecture*. Museum of Modern Art: New York.
- von der Heydt, R., Peterhans, E., & Duersteler, M.R. (1992). Periodic-pattern-selective cells in monkey visual cortex. *Journal of Neuroscience*, **12**: 1416-1434.
- Winkel, G. H. (1978). Some Human Dimensions of Urban Design. In S. Anderson (Ed.) *On Streets*. The Institute for Architecture and Urban Studies. The MIT Press: Massachusetts. 241-248.