CHAPTER 5
ENVIRONMENTAL PERCEPTION
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INTRODUCTION

Science has come a long way to provide rigorous neurophysiological explanations of visual perception. This is to say that the knowledge of perception related to the physics of vision, the physiology of the eye, and the dynamics of single visual neurons are now relatively well understood. While the sophistication of this microknowledge is rather great, we are unable to answer the question “How are the neural and the mental domains linked?” (Utall 1981, 28). The science of psychology as it relates to perceptual and cognitive processes is still in a very descriptive phase. In his review of more than a dozen macrotheories, Utall (1981, 68) identifies three dimensions to characterize the range of descriptions proposed to explain the perceptual and cognitive processes associated with vision.

1. Is perception mainly innate or is it mainly learned?
2. Is perception mainly a directed and automated outcome of the stimulus information acting on a passive perceptual system, or is it mainly mediated by deductive, epistemic, logical, symbolic, inferential, or rational processes in a highly active way?
3. Is perception mainly influenced by the overall configuration of stimuli, or are percepts mainly the results of processes more sensitive to the individual features or parts of stimuli?

Most of the possible combinations are represented in Utall’s review and the reader with an interest in more detail is referred to his work.

A macrotheory of perception useful as a heuristic for those conducting landscape assessment is somewhat more limited problem, however, and has some special requirements. Visual landscape assessment is an applied field with a primary task of describing the perceived or perceivable environmental condition. Most perceptual and cognitive psychological investigations concentrate on the workings of isolated organs or individuals in contrived laboratory settings. However, visual assessments must evaluate real, or at least potential, environments. The holistic study of the relationship between living organisms and their normal environment is generally termed the ecological or environmental approach. Proshansky (1976) has articulated the need for an environmentally based psychology. The past two decades have seen substantial interest and some activity but relatively little in the way of ecologically based psychological theory. Barker (1968) provides a notable exception in the area of social psychology and Gibson (1966) in perceptual psychology.

Gibson has consciously developed his ecological theory as an alternative to the abstract physical analogies that predate most of psychology.

The world of physical reality does not consist of meaningful things. The world of ecological reality, as I have been trying to describe it, does. If what we perceived were the entities of physics and mathematics, meaning would have to be imposed on them. But if what we perceive are the entities of environmental science, their meanings can be discovered. (Gibson 1979, 33)

Gibson has evolved his theory of ecological perception over the past 20 years. Using Utall’s scheme of classification, it would be considered in the middle of the innate-learned dimension, actively rather than passively directed but certainly not mediated or rational, and very holistic in its orientation. Gibson capsulizes his theory in this way:

To perceive is to be aware of the surfaces of the environment and of oneself in it. The interchange between hidden and unknown surfaces is essential to this awareness. These are existing surfaces; they are specified at some points of observation. Perceiving gets wider and finer and longer and richer and fuller as the observer explores the environment. The full awareness of surfaces includes their layout, their substances, their events, their affordances. Note how this definition includes with perception a part of memory, expectation, knowledge, and meaning—some part but not all of those mental processes in each case. (Gibson 1979, 255)

If Utall is correct in his survey of the field, then none of the available cognitive or perceptual theories have advanced beyond the hypothetical descriptive phase of science. However, among the available theories, Gibson’s holds the most prom-
ise for environmental professionals seeking to understand the possible relationships between psychology and their own field because he attempts to describe the phenomenon of perception as we encounter it. If at some future date scientific evidence is forthcoming that indicates these ideas wrong in some absolute sense, they would still have value to us. This is much the same situation as a ship's navigator finds herself. The earth may no longer be considered the center around which the universe turns, but it still provides a very useful and workable heuristic for navigation.

The following chapter is derived from Gibson's latter work, particularly The Ecological Approach to Visual Perception (Gibson 1979). While it is a radical departure from current perceptual theories, Gibson makes a persuasive case incorporating experimental findings and theoretical points. The present author must accept any shortcomings of the synopsis presented in this chapter. The first section presents a description of the environmental structure as we experience it—a medium surrounding substances and surfaces. The second section describes the types of ecological meaning that the environment has for us—its layout, events, and affordances. It also describes how light makes information available to us in an ambient optic array and discusses some notions about how active perception takes place. The third section considers four theories concerning pictures and picture perception. The final section reviews the principles associated with creating perspective pictures, line drawings, and motion pictures.

**ENVIRONMENTAL STRUCTURE**

The environment refers to our surroundings or more properly that which surrounds any perceiving and behaving organisms in the environment. Similarly, the environment requires the presence of an animal. This mutuality of animal and environment is not implied by the physical sciences which concentrates on the basic concepts of space, time, matter, and energy. The difference between these two approaches provides the key to answering the child's riddle: "Does a tree falling in an uninhabited forest make any sound?" The answer is: "Of course not, it only makes energy waves because someone must be there to hear it before it becomes sound." As this question highlights, the reality of physics does not necessarily provide a proper understanding of perception. The structure of physical reality ranges from atomic to cosmic. Within this range is the intermediate or terrestrial scale that we can perceive. Our environment consists of valleys nestled within mountains, trees growing within valleys, leaves growing on trees, and cells within leaves. The environment has this nested structure where things are components of other things. Gibson (1979, 16–32) proposes that this perceivable environment is most meaningfully described in terms of the medium, substances, and surfaces.

**Medium**

Air is the medium of the terrestrial environment. It is insubstantial and therefore affords animals locomotion. It is also important that a medium is usually transparent or transmits light, while substances are generally opaque and reflect light. Light is also absorbed by substances and needs to be continually replenished to maintain the environment's ambient level of illumination. The normal condition of illumination is termed ambient because, as illustrated in Figure 5.1, it reverberates through and fills the medium so that light is normally coming to any point from all directions. This light is not random, however, but is structured and contains information that affords seeing. Other important characteristics of the medium are that it transmits vibrations such as sound waves and allows rapid chemical diffusion. Therefore, the medium also affords hearing and smelling. The medium is relatively homogenous and constant in its makeup. This characteristic assures the availability of oxygen for breathing; it also assures there will not be any sharp transitions or surfaces to affect the travel of light or sound waves. Finally, gravity provides an intrinsic polarity so that there is an up and a down within the medium. Radiant light normally comes from the upper hemisphere or sky. The sun also rises and sets, providing another referent axis. These axes in the medium are related to the environment in an absolute sense. This is in contrast to the concept of physical space where the reference axes are arbitrarily oriented.

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1Since plants are generally not considered perceiving organisms, for the purposes of this discussion, they will be considered as only part of the environment.
Substances

In contrast to the insubstantial medium are the substantial portions of the environment. Substances are characterized as more or less solid, rigid, resistant to deformation, impenetrable by other substances, and permanent in shape. Substances usually do not transmit light; they are opaque. Finally, most substances are normally heterogeneous mixtures of elements and compounds. While substances have a more or less specific composition, they are generally aggregates rather than pure compounds. This brief characterization refers to substances at the ecological state. There are, of course, other levels of analysis for substances, but they need not concern us now.

Surfaces

The medium is separated from environmental substances by surfaces. Most ecological action happens at the surface. Light is reflected or absorbed by the surface, not by the interior substance. We touch the surface, not the interior substance of objects. We do not see the medium or substances; what we see is information available at their interface, the surface. Gibson (1979, 23–31) has begun to formalize a set of principles or ecological laws of surfaces:

1. All persisting substances have surfaces, and all surfaces have a layout. Layout refers to the persisting arrangement of surfaces relative to one another and to the ground. The perception of layout takes the place of space and depth in the traditional terminology of abstract geometry.

2. Any surface has resistance to deformation, depending on the viscosity of the substance. Viscosity is the resistance of a substance, the penetrability of the surface. Some substances are very fluid and can be poured or slashed; others are simply plastic and can be easily molded or smeared, while others are quite rigid, such as steel. Combined with the first law, this explains why we can walk on the ground and cannot walk through walls or other objects. It also explains why a light animal is easily supported by a bog and a water spider by a still pond’s surface, but why a heavy animal cannot be supported by either.
3. Any surface has resistance to disintegration depending on the cohesion of the substance. Some substances disintegrate easily, such as sugar cubes and sand castles, while others do not. In general, viscoelastic substances will stretch and remain continuous with the application of pressure while rigid substances may be disrupted and made discontinuous.

4. Any surface has a characteristic texture, depending on the composition of the substance. It generally has both a layout texture and a pigment texture. The environment is structured, as previously mentioned, with units nested within each other. Texture is the term used to describe structure at the scale of centimeters and millimeters when viewed at arm’s length. Natural substances are seldom homogeneous but are composed of an aggregate or conglomerate with various chemical and physical properties. This gives rise to the fact that speckled surfaces have pigment texture and rough surfaces have layout texture. The relative size of these aggregated units determines whether the texture is fine or coarse.

5. Any substance has a characteristic shape, or large-scale layout. If texture refers to the microstructure of surfaces, then shape refers to the macrostructure at the scale of environmental enclosures and objects. Obviously, different shapes afford different possibilities for manipulation and behavior. The analysis of an object’s facets or the ground’s slope aspect describes whether a portion of the surface is or is not facing a point of observation or a source of illumination. Complex geometrical solids can be analyzed in terms of faces, edges, and vertices. These terms also have important implications for understanding perception.

6. A surface may be strongly or weakly illuminated in light or shade. The intensity of incident light falling on a surface may be high or low, intense or dim. In the natural environment, there is normally some illumination, even if it is night. Incident light is also ambient, that is, more or less omnidirectional. However, there is normally a prevailing illumination or a direction from which incident light is most intense. A surface facing the prevailing illumination will be more brightly lit, while one not facing it will be relatively shaded. Since the sun normally determines the prevailing direction of illumination, the pattern of bright and shaded illumination changes throughout the day as the sun traverses the sky.

7. An illuminated surface may absorb either much or little of the illumination falling on it. The chemical composition of a substance determines whether more or less of the illumination falling on the surface will be absorbed. Substances that absorb much light, such as coal, are black, while those that absorb little, such as chalk, are white. Light that is not absorbed is either transmitted or reflected. There are not perfectly transmitting substances, and relatively few that are as transparent as optical glass or pure, still water.

8. A surface has a characteristic reflectance, depending on the substance. Normally light that is not absorbed is reflected. Each homogenous compound has a characteristic proportion of incident light that is reflected. A conglomerated substance, such as granite, therefore appears speckled or mottled. This is pigment texture.

9. A surface has a characteristic distribution of the reflectance ratios of the different wavelengths of the light, depending on the substance. This property is what I will call color, in the sense that different distributions constitute different colors. Color, here, refers to hue or chroma rather than variations in white, gray and black. The color and texture of a surface provide the information that specifies the composition of a substance or what it is made of.

This section presents the basic concepts and vocabulary Gibson uses to describe the environment. The next section outlines what there is in the environment for us to perceive and why we perceive it.

ENVIRONMENTAL MEANING

The environment is most simply conceived as being composed of medium, substances, and surfaces. Yet, these terms do not really describe what
we see or why we see it. Surfaces in the environment must be patterned in ways that have intrinsic meaning for animal behavior. In particular, environmental meaning can be understood from the layout of surfaces, from changes in this layout or events, and from what the environment offers or affords animals. Once these concepts are understood, the ambient optic array that carries visual information can be introduced. Finally, the question of how we perceive this information can be addressed.

Layout

The theory of layout is proposed as a way to describe environmental arrangement. It is not based on abstract geometry but on the world as we experience it. Therefore, we refer to surfaces which have color and texture rather than planes which have neither. In geometry, the initial placement of coordinate axis is arbitrary, but in the environment, the vertical axis is determined by gravity and one horizontal axis by the passage of the sun. In the vocabulary of layout, the surface of the earth is referred to as ground. It is generally horizontal and serves as a reference for all other surfaces. Objects are surfaces that are more or less surrounded by the medium. A detached object is completely surrounded by the medium and can be moved without breaking the continuity of its surface. An attached object is not completely surrounded by the medium and may even be a simple convexity or protruberance. It is continuous with the substance of another surface and generally not movable. A weed in a garden is an attached object, but once pulled its continuity with the ground is broken and it becomes a detached object.

When a surface more or less surrounds the medium, it is termed an enclosure. A concavity that partly encloses the medium is a partial enclosure, such as an overhang that provides shelter in the rain. In a hollow object, such as a vase, part of the total surface faces outside like an object, while part faces inside like an enclosure.

A place is an extended surface in the environment. It is a location, but not in the sense of a point in geometry. Places do not move around; rather, locomotion consists of going from place to place. At one level, what can be seen from here or hereabouts is a place. Places can be nested, so a home place may consist of a sleeping place and an eating place. Places also have an order of adjacency that cannot be rearranged in the environment. Way-finding is, therefore, possible.

Events

In general, an event refers to any change in an object, place, or surface. It is tempting to consider events in terms of mechanics, time, and space. However, time constitutes an even, linear flow while ecological events are differentiated into parts and are perceived to flow in an uneven fashion. Some of the differences between geometry and ecological layout have already been suggested. Another difference concerns the treatment of time as a fourth dimension by modern physics. However, time is an order of events and spatial layout concerns the order of objects. These types of order are not even analogous since objects can be shuffled or reordered while events cannot.

Events can take several forms. One type of event concerns the reshaping or repositioning of surfaces. For instance, surfaces can be rotated or translated. They can be deformed, such as waves or the complex movements of animals. There can be collisions of objects and even disruptions such as cracking or disintegration. Some of these events are reversible, such as a pendulum swing, while others are not, such as a plate breaking.

Another class of events concerns change in color or texture. For instance, iron rusts, leaves turn color in the Fall, and fur becomes less thick in the summer. Many of these changes correspond to chemical reactions, such as a ripening apple turning red. A final type of event concerns a change in state of matter. For instance, water can turn from liquid to gas through evaporation or to a solid by freezing. These chemical changes and changes in state are not perceptually reversible. Ripening, rusting, and burning are progressive events without meaningful reciprocals; the process of water evaporating is ecologically not the reverse of steam condensing.

Affordances

In order to survive, animals must be able to interpret their environment. Affordances are what the environment offers an animal: what to approach and what to avoid. The medium, sub-
stances, and surfaces of the environment are the same for all animals. However, their meaning is different to different animals. Water affords support to a spider, but not to the elephant for whom it affords a cool bath. The concept of affordances draws our attention to Gibson's view of mutuality between animal and environment. He suggests that the ecologist's concept of niche is similar to a set of affordances—to how an animal lives. This is in contrast, though related, to where an animal lives—the collection of places that constitute its habitat.

Some examples might prove instructive. The medium, air, affords us respiration. When supported by our feet on the ground, it affords us unimpeded walking, while for the bird it affords flight. It also affords us visual, sound, and odor perceptions. Substances afford us different things. Water affords drinking, pouring, and bathing. Some solid substances afford manufacture, such as clay being molded into a pot. Some solids afford nutrition while others do not, depending on the type of animal. Such perceptions are made on the basis of ecological characteristics such as surface color and shape. Even so, animals can frequently misconstrue the food value of substances. Surfaces are particularly important to affordance perception. The ground, a rigid surface, affords support. Walking is guided away from surfaces that indicate barriers towards openings that indicate the medium. A surface with a sharp edge, a knife, affords cutting. An elongated flexible surface, such as string, affords tying. Finally, animals interact with each other; behavior affords behavior.

The theory of affordances is a radical departure from other theories that describe perception as value-free. Perception includes apprehension of the value-richness of ecological objects. This perception is not of subjective values such as feelings of pleasure or pain, but of positive and negative properties of the environment in reference to the perceiving animal.

**Ambient Optic Array**

It now becomes necessary to describe how this information is made available to the observer. Ecological optics are quite different from the optical realities described by physics, geometry and physiology. The orthodox description (see Chapter 3) of vision begins with a ray of radiant light that is focused by the eye to form a retinal image. These focused rays stimulate sensors on the retina and the image is transmitted along the optic nerve to be perceived or processed by the brain. The perception of motion is simply the perception of a series of images processed in sequence. It is a theory appropriate for an image-oriented culture. Vision becomes analogous to light being projected from the physical world, focused by the lens of the eye onto the screen of the retina and perceived by the brain. Various experiments demonstrate these processes. For instance, one can see an image focused onto the transparent retina of a dissected open eye. But Gibson cautions against drawing hasty conclusions. Who is there to "see" the image projected onto our retina? Is there a homunculus, a little man in our brain that perceives this image as we perceive the image through an open eye? Who sees for the homunculus, Decartes asked? And even more awkward, what system of optics do we use for insects that see through compound eyes without lenses?

Gibson's alternative is an ecological theory of optics and visual perception. Its central concept is the ambient optic array. Each of the words in this term has a particular meaning that contrasts with the orthodox theory. Light in the environment is unlike the simplified focused rays of radiant energy studied by physicists. The nature of light in the environment is ambient. Light may begin as radiant energy from the sun, but it is scattered by the atmosphere and reflected by surfaces to such an extent that it becomes omnidirectional or ambient. This reverberation of radiant light is so extensive that even shelters not open to the sun or sky can be illuminated.

This theory only concerns light as it converges at a point of observation, or a point where an observer could potentially be. In this sense, it is an optical theory, one that is only concerned with light as it reaches the eyes of an observer.

The flow of light in the environment normally has structure, as schematically represented in Figure 5.2. At the point of observation, it is an array composed of densely packed solid angles nested into a spherical angle. The envelope of each solid angle intercepts a face, facet, or aperture in the layout; it is that portion of the ambient light projected to the point of observation. The pattern of nested solid angles provides the structure that we perceive. Light without struc-
ture, such as the perfectly diffuse light of a dense fog, cannot provide information about the environment.

**Perception**

Visual perception is not just an activity of the eyes. Rather, it results from using a visual system: the eyes-in-the-head-on-the-body-resting-on-the-ground. This visual system does not passively receive light stimuli. Instead, perception is an act of attention. People actively scan the visual field to obtain foveal detail as well as actively sampling the ambient array by moving their head and body.

In general, perception involves the concurrent awareness of persistence and change in the ambient array. Information concerning persistence comes from various invariants such as ratios, gradients, discontinuities, and other relationships in the ambient array that are due to persisting features of the environment.

Change in the ambient array is indicated by three forms of going out of and coming into sight. First, surfaces may cease to be illuminated, that is, the solid angles become dark. Surfaces in darkness have not disappeared or ceased to exist, but we are not able to see them. Second, surfaces go out of sight at great distances. This occurs because their projected solid angle is of insufficient size to be seen at the point of vision. Finally, surfaces can go out of sight, as shown by Figure 5.3, because of occlusion. This is specified by progressive decrements of structure along the leading edge of the contour of an ambient array. Coming into sight is similarly specified by accretion. In all three cases, the change in structure of the ambient array may be reversed. That is, surfaces may go into and come out of darkness. They may pass out of sight in the distance and come into sight from the distance; and occlusion may involve both decretion and accretion.

Perception is not simply the geometric analysis of change and invariants in the ambient array. Perception is an achievement of the individual, a keeping in touch with the world. Information about the observer's environment is specified by the ambient array. This information is not communicated to the observer. The world does not speak to us or convey information in the way of words or pictures. It is simply there, specifying the qualities of the environment. Moreover, the active picking up of information happens in an unbroken stream. Animals perceive places, objects, and substances together with events which are changes in these things. Information in ambient light is also inexhaustible. There is no threshold of information; the observer can notice new facts without reaching a limit. This is the most decisive difference between mediated perception such as in an image and environmental information from ambient light. The observer cannot gain more information from a picture by
changing his or her position relative to the illustrated objects. Finally, knowing is simply an extension of perceiving. They both are processes of extracting and abstracting environmental information from the ambient array, different only in degree rather than kind. Therefore, the basic affordances are usually perceived directly from the environment once we learn to attend to the information available in the ambient array.

THEORIES OF PICTURE PERCEPTION

The previous two sections attempt to describe visual perception as an ecological phenomenon. It is important that those who would assess and evaluate landscape visual quality appreciate the ecological nature of perception. This is because actual or potential environments are often visually simulated in order to conduct these assessments (see Chapter 11). It is improbable that a reader of this book would believe an object and an image of that object to be identical. Pictures are not duplications, but merely visual representations. However, it is our responsibility to provide simulations that provide sufficient information to make reasonable judgments.

There seem to be four useful types of explanations concerning how images can represent objects (Gibson 1971; Kennedy 1974). These four theories respectively consider pictures as (1) being mere conventions, (2) being similar to what they depict, (3) providing the same elements of light as the actual scene, and (4) providing the same optic information as the actual scene. There are clear lessons to be learned from each of these explanations.

Conventions

The first theory proposes that pictures are merely conventions—composed of symbols arranged according to rules similar to the grammar and syntax of a language. It is advocated primarily by artists, art critics, and art historians. Arnheim clearly represents this view in stating:

As a rule in a given cultural context, the familiar style of pictorial representation is not perceived at all—the image looks simply like a faithful reproduction of the object itself. [To

attuned observers] the Picassos, the Braques, or the Klee look exactly like the things they represent. Anyone who is concerned with modern art will find it increasingly difficult to remain aware of the deviations from realistic rendition that strike the newcomer so forcefully... As far as the artists themselves are concerned, there seems to be little doubt that they see their works as nothing but the exact equivalent of the object... Pictorial representations that come from the observer's own cultural environment appear to him as "stiliness," that is, as done in the only natural and correct way. (Arnheim 1954, 117–119)

On its surface, most of us would reject this position as contradicting everyday experience. Most pictures do transmit some information, even to the very young who could not possibly have yet been trained to read them (Hochberg and Brooks 1962). Gibson (1971) dismisses the adherents to the convention theory as artists who reject projective perspective because “it seems to prescribe and constrain what they should do.”

However, the literature in cross-cultural perception does lend some credence to the acceptance of picture perception as an convention. For instance, Serpell and Deregowski (1980) review a study where adults shown pictures of local animals for the first time “sniffed at them, licked them and explored them manually as well as visually, showing no signs of recognition of the items represented in them.” When we look at a photograph, by convention, we ignore many of its most striking aspects: the glossiness of the surface, the white band around the picture, and the sharp rectangular shape of the paper. Training in photographic conventions has provided us the insight that important visual information is available if we attend to the fuzzy contours and blotches of contrasting tones. Further investigation of the use and acceptance of pictoral conventions could provide useful information for landscape simulation and assessment.

Similarity

The second theory defines picture as a “likeness” to that which they depict. The general notion is that pictures have common qualities or represent the essential character of an object. This position is represented by Langer (1951, 68) when she
states that “the only characteristic that a picture must have in order to be a picture ... is an arrangement of elements analogous to the arrangement of salient visual elements in the object.” This conception begins to address representational issues such as caricatures which can obviously be powerful portrayals even though they are not projective, perspective representations. However, it suffers from a lack of specificity that leads to circularity.

**Elements of Light**

The third theory of pictoral representation is based on principles of projective geometry. This approach was well capsulated by Taylor, the eighteenth-century mathematician, who asserted that in a perfect painting “the light ought to come from the Picture to the spectator’s Eye in the very same manner as it would do from the Objects themselves” (Gibson 1971). Instant credibility is given this approach because light can be focused by the eye’s lens to form a projected image on the retina.

True pictures, in the sense of this theory, have been created only under very special controlled circumstances (Gibson 1960; Hochberg 1962). However, the normal conditions for viewing a picture do not even approximate the assumptions of this theory (Gibson 1971). For instance, a particular station point is specified by the projective perspective. When viewed from any other point, the picture should become distorted. Another limitation is that light intensities from the viewed picture cannot match the range of the real scene. In addition, the faithfulness of color cannot be matched even by the best photograph while a line drawing does not even portray color or brightness. Finally, the problem of caricature arises once again. The whole point of caricature is to distort the image to better portray the object’s significant aspects.

As argued earlier in this chapter, the credibility of perspective images seems to be based on the confusion caused by the analogy between projecting light onto a screen and into the “mind’s eye.” There are, for instance, repeated examples in the cross-cultural literature of cultural groups with a pictoral tradition that have difficulty interpreting perspective clues such as depth (Miller 1973; Pick and Pick 1978; Serpell and Dere-gowski 1980). However, the power of projective perspective cannot be denied and experience has shown that its principles are quickly learned (Miller 1973).

**Optic Information**

The final theory of pictures is derived from Gibson’s concept of ecological perception.

> In short the optic array from a picture and the optic array from a world can provide the same information without providing the same stimulation. (Gibson 1971)

It is important not to be limited by thinking of a picture as simply a cross-section of a frozen optic array, though it may be that.

> A picture is not an imitation of past seeing. It is not a substitute for going back and looking again. What it records, registers, or consolidates is information, not sense data. (Gibson 1979, 280)

Information is available from the invariants of the ambient optic array; perception and knowing are the processes of extracting and abstracting this information. These invariants are preserved under transformation, which includes pictoral recording as well as changes during the flow of the optic array.

It should now be obvious that the reason we are not misled by caricatures is because they convey the essential information. Kennedy (1974, 144–145) reviews several studies where caricatures or cartoon drawings provided viewers a better understanding than photographs or high-fidelity line drawings. In his review of the cross-cultural literature, Miller (1973, 139) also found that “too much non-essential detail detracts from comprehension.” However, it is also possible to oversimplify: “the recognition of single objects is dependent upon there being enough cues which characterize that object, and which are relevant within the environment of the viewer.” These same principles led Cuff (1979) to construct a “conglomerate drawing” representing distinctive elements of a site in a hypothetical perspective rendering to better communicate the sense of place.
PRINCIPLES OF PICTORAL DEPICTION

The use of visual simulations to depict existing or potential environmental conditions is a major concern in landscape assessment. This section reviews the pictorial or graphic principles that make it possible to perceive three-dimensional relationships from a two-dimensional depiction. The methods for creating different types of simulations and issues associated with their use are described by Sheppard in Chapter 11. Vining and Stevens, in Chapter 10, present the procedures for people to evaluate landscape quality using these simulations.

In actuality, a picture is simply pigment on a sheet of paper or film. How is it that we are able to make the sensory shift from awareness of markings on a paper to an awareness of a depicted environment? The principles or clues of perspective are used to depict in two dimensions the three-dimensional space, or in Gibson’s terminology, surface layout. These clues are derived in part from projective geometry and therefore tend to be thought of as natural rules or laws. They have been used in performance or to simulate real environments in most of the perceptual psychology research. There is some evidence from cross-cultural studies that the ability to interpret a perspective picture is an acquired skill. However, it is reasonable to expect that anyone from a middle-class Western cultural background will appropriately interpret perspective images using various media and degrees of abstraction. Their use among other populations should be with caution, however. Gibson (1950) has described in detail the stationary monocular clues of perspective representation as they would apply to photographs or other “realistic” depictions. Kennedy (1974) has shown that many of these clues can be abstracted and represented by line drawings. Finally, the perspective clues related to motion or parallax (Gibson 1950) and the perception of motion pictures (Hochberg and Brooks 1978) are considered.

**Stationary Monocular Perspective**

The following depth or layout clues are present even when all the objects are stationary and viewed with only one eye—the type of situation represented in a photograph or perspective painting. Figure 5.4 schematically represents each of these perspective clues.

1. **Texture perspective.** As the texture of a depicted surface gradually becomes finer and denser, it appears to recede from the observer. This is true for both pigment and layout textures.

2. **Size perspective.** As objects are depicted in relatively decreasing size, they appear to recede from the observer.

![Figure 5.4](image-url)
cede from the observer. This condition presupposes the perception of the objects as contours or figures on a background.

3. **Linear perspective.** The spacing of equidistant edges or objects is depicted as decreasing and converging toward a point on the horizon as they recede from the observer. This phenomenon is commonly illustrated by a view looking down a highway or railroad tracks. It was one of the most favored and highly developed techniques of Renaissance painters and has since become equated by the public with the meaning of perspective. It is possible that persons in Western cultures have become overly reliant on this clue and are more sensitive to it than individuals from other cultures.

4. **Aerial perspective.** As the distance of objects from the observer increases, they are depicted as hazy with less detail and loss of sharp outline. In addition, color desaturation and bluishness is associated with increasing distance. In Chapter 4, Felleman discusses the atmospheric causes of aerial perspective. It has not been as precisely described as the other clues because it is affected by variations in illumination and atmospheric quality. While it may be difficult to measure for these reasons, it will nevertheless be an important consideration when preparing project simulations that relate to air quality (for example, EPA 1979).

5. **Relative upward location in the visual field.** The ground plane is depicted as rising from the picture’s lower margin as distance from the observer increases. It is as if the surface climbs from one’s feet to eye level. The implication for objects resting on the ground is that their bases will raise in the picture or approach the horizon line as their distance from the observer increases.

6. **Shift of texture density.** An occluding edge is indicated by a sudden rather than gradual shift in pigment or layout texture. The overall effect is like looking at a valley beyond the edge of a cliff on which the observer is standing.

7. **Completeness or continuity of outline.** When depicted objects overlap, the tendency is to perceive the one with a regular outline and simpler form as being nearer the observer. This clue of overlaying is associated with the Gestalt laws of continuity and simplicity. The perception of a figure and ground relationship is a special case of this principle.

8. **Transitions between light and shade.** Sharp contrasts in light and shade or abrupt shifts in brightness indicate an edge. Gradual shifts in brightness are the principle indication of roundness or surface modeling. These transitions are determined by the degree of brightness or direct light. Cast shadows do not indicate overall layout, but at their contour, they are important indications of surface relief.

### Line Drawings

When thinking of “realistic” pictures, photographs or detailed paintings usually come to mind. Yet our everyday experience indicates that a few simple lines can frequently convey a significant amount of environmental information. How is it that mere lines can be so versatile? The answer lies in Gibson’s suggestion that information lies in the invariants and change apparently in the optic array. In a sense, the lines represent the envelope or outline of the intercepted solid angles in the arrest of or frozen optic array represented by the picture. In particular, a line drawing can specify the following invariants of surface layout (Gibson 1979; Kennedy 1974).

1. **A corner.** The concave intersection of two planes forms a corner and may be represented by one line. The intersection of three perpendicular planes, such as the floor and two walls of a room, is represented by three lines meeting at the apex of the joint intersection.

2. **An edge.** The convex intersection of two planes forms an edge. The information whether a line represents an edge and a corner is provided by the context of the drawing. An ambiguous context is the basis for one type of optical illusion.

3. **An occluding edge.** A line may also represent the occluding edge where an object
visually obscures another object. Properly speaking, if the line of occlusion represents a sharp transition, such as the peak of a roof, then it is an edge. However, if the line represents an occlusion defined by a surface with gradual transition, such as the brow of a hill, it is termed a bound.

4. A fiber. The substance of a thin fiber, such as a wire, is represented by a single line. However, as extended substances become thicker, it is expected that their outline will be represented.

5. A fissure. A thin crack in a surface, such as a closed mouth, is also represented by a line. However, as cracks become wider, such as an open mouth, it is represented by its inlines.

6. Skyline. The bound between earth and sky is also represented by a line. In a sense, this is occlusion of the medium, without the presence of an obscured background object.

The following invariants cannot be fully represented by a line. However, a line can specify abrupt discontinuity if it exists.

7. Change in reflectance. Abrupt changes in color are indicated by a line, though information about the particular colors cannot be indicated.

8. Shading on a curved surface. A line can be used to outline highlights on a curved surface.

9. Cast shadows. The penumbra of a cast shadow can be outlined.

10. Changes in texture. The abrupt change in texture, such as the juncture between mown and unmown grass, is indicated by a line.

Figure 5.5 demonstrates the pictorial richness that simple lines can represent; the use of lines to represent these invariants follows certain rules or laws. For instance, the lines must connect as they divide the picture into superordinate and subordinate areas. While all the monocural stationary perspective clues cannot be fully and unambiguously specified by lines, our knowledge about the environment and/or skill in reading line drawings makes this a powerful form of depiction.

Some people must work where it is very cold. Circle who is not working where it is cold.

FIGURE 5.5. Simple line drawings are part of our everyday experience. Advertisements and children’s coloring books provide instructive examples. Can you identify lines used to indicate corners, edges, occluding edges, fibers, fissures, skyline and changes in color, texture or shading?

Motion Perspective and Motion Pictures

Three additional clues of perspective are made possible by motion parallax. This is depicted information made available by a sequence of pictures, or pictures seen from slightly different points.

1. Binocular perspective. It is possible to provide some information about surface layout by preparing two monocular depictions, one specified for each eye. This technique is used in photogrammetry to interpret depth using stereo pairs of aerial photographs. Stereoscopic depiction was once popular in American parlors as a way to represent stereoscopic landscape scenes, and more recently, it has been the basis of so-called “3-D movies.” However, it is not particularly useful unless the depictions are viewed at a specified distance.
2. **Motion perspective.** As one moves forward, stationary objects appear to move toward you. As the distance between objects and viewer decreases, this motion appears to become faster. Likewise, if two objects are moving at equal speeds, the one closer to the observer will move more rapidly across the visual field. These phenomena are respectively recorded in moving pictures by dolly shots where the camera is moved toward an object and by tracking shots where the camera is moved laterally across a scene.

3. **Shift in the rate of motion.** Additional perspective clues are provided when the observer moves his or her head or body. At an occluding edge, the texture of a more distant object is displaced more rapidly than it is for a nearer object. This information is recorded by a motion picture through a panning action of the camera. This is distinct from a zoom shot which only magnifies but does not have displacement along occluding edges.

The use of motion pictures, either film or video, has yet to be extensively explored for either landscape documentation or simulation. Hochberg and Brooks (1978, 260) list at least five things that moving pictures can portray, but still pictures cannot.

1. They can provide movement-dependent information about tri-dimensional spatial arrangement (motion depth cues) that are unavailable in still pictures and that contradict by their absence whatever depth is otherwise portrayed in stills.

2. Scenes that are very much larger than the size of the motion picture screen (or television tube) can be represented by successive views, calling upon a storage capacity for visual information that we must use in normal perceptual integration, as well.

3. The motion picture characteristically permits—in fact, depends on—change per se, making possible a level of interest-maintenance that cannot be sustained in an equivalent still picture.

4. Motion pictures permit scenes and events to be represented piecemeal, by juxtaposing views of objects that were not in the same place when they were photographed.

5. Redundant sections of actions, periods of time, or extents of space can be elided, and series of events can thereby be reduced to their minimal communicative features.

From a perceptual aspect, moving pictures provide a special experience because the camera is moving in relation to the scene, whereas the viewer is stationary with respect to the projection screen. The viewer’s initial glances are directed toward parts of the field that are likely to be informative or prominent. However, interest rapidly declines as information is apprehended and the viewer becomes aware of not being able to redirect his or her view. One way to maintain visual momentum is through discontinuous cuts between places that are separated in space, time, or both. The cutting rate presumably affects interest by introducing an element of surprise or information arousal. In addition, visual momentum can be maintained through substantive content. Shots that are more meaningful, more unexpected, or more complex require longer presentation times and therefore can sustain a lower cutting rate. Hochberg and Brooks (1978, 297) report that “film editors say, in fact, that good, rapidly comprehended cuts are those that provide the viewer with the answer to the visual question he would normally be free to answer for himself.” This is the question we will have to learn to answer in order to create effective motion picture simulations.

**SUMMARY**

This chapter discusses an ecological approach to understanding visual perception and cognition. It is presented in a general and descriptive way because a reasonably comprehensive prescriptive theory for this material has yet to be developed. Much of the detailed cognitive research that exists has not been brought out of the laboratory and evaluated in an everyday setting. However, our application requires a framework to help us understand how people as perceivers fit into the everyday environment. The following table lists the major perception topics discussed and some of their major implications of landscape analyses and assessment.
<table>
<thead>
<tr>
<th>Perception Topic</th>
<th>Analysis Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecological approach</td>
<td>Study definition and context</td>
</tr>
<tr>
<td>Surfaces</td>
<td>Visual characteristics</td>
</tr>
<tr>
<td>Layout</td>
<td>Visibility; spatial notation</td>
</tr>
<tr>
<td>Events</td>
<td>Route analysis and notation</td>
</tr>
<tr>
<td>Affordances</td>
<td>Environmental meaning</td>
</tr>
<tr>
<td>Ambient optic array and perception</td>
<td>Simulatable condition</td>
</tr>
<tr>
<td>Pictures as convention</td>
<td>Sampling of respondents, media limitations</td>
</tr>
<tr>
<td>Pictures as light</td>
<td>Construction of simulation</td>
</tr>
<tr>
<td>Pictures as information</td>
<td>Sampling environments and character simulating</td>
</tr>
<tr>
<td>Monocular perspective</td>
<td>Photographic and pictoral simulation</td>
</tr>
<tr>
<td>Line drawings</td>
<td>Line-drawn simulations</td>
</tr>
<tr>
<td>Motion perspective</td>
<td>Video and film simulations</td>
</tr>
</tbody>
</table>
PART 3
LANDSCAPE DESCRIPTION AND ANALYSIS

This section contains three chapters (6, 7, and 8) addressing visual landscape inventory and analysis—each for a different landscape context. Chenoweth and Gobster address wildland landscapes; Schauman addresses the rural countryside, and Smardon et al. address urban landscape inventory and analysis.

Chenoweth and Gobster start their chapter by defining wildlands and wilderness landscape and by giving the reader some background on legislation, ownership, distribution, and management of wildlands in the United States. The next section of Chapter 6 reviews the purposes, methods of choice, and criteria for wildland description and analysis. The latter includes discussions on professionally based versus publicly based landscape analysis methods and quantitative versus nonquantitative approaches. Chapter 6 ends with discussion of sets of landscape analysis criteria for choosing and guidance for selection of a procedure.

Sally Schauman’s Chapter 7, on countryside landscape analysis, begins by setting an assessment context, for example, why the landscape is heavily laden with cultural associations, and a short exploration of attitudes toward rural countryside held by different groups
of users. Schauman then describes some of the unique physical attributes of countryside landscapes, then summarizes concepts for evaluation of countryside landscape quality. An overall process for countryside landscape assessment concludes Chapter 7.

The final chapter by Smardon, Costello, and Eggink addresses visual inventory and analysis of urban landscapes. Chapter 8 starts with a brief history of urban physical planning, then addresses five types of decisions or applications for which visual analysis could be used. A brief history of recent professional approaches to urban image analysis is followed by a professional step-by-step approach to visual inventory and analysis using case study material. The latter includes a discussion of positive and negative attributes of qualities of light, including glare analysis. The professional approach is then contrasted to a public assessment/social science approach. Potential combinations of professional and public participation approaches are discussed. Procedural guidance for urban visual studies and a brief discussion of new technologies and techniques closes Chapter 8.