A Psychology of Picture Perception

Images and Information
Chapter One

Pictures as Information

As a means of communicating, pictures are as old as history, for they were among the first recording devices ever used. Pictures have been as common as the wheel and fire in past cultures, and today they are more common than ever: in magazines, textbooks, and albums, outdoors as signs, and in our homes as entertainment. As coins are to economics, pictures are to communication.

What enables a picture to communicate, to give us information? Do we recognize only pictures from our own culture? In the profusion of photographs and drawings in magazines, we may see pictures from the Stone Age alongside pictures from the twentieth century, or pictures from other countries whose languages are beyond our imitation because their roots are so different from our own. How do we react to a picture from an alien culture—say, a
culture whose language is totally uncommunicative to us? Often the alien picture is much more meaningful than the alien language that describes it. Often we can tell precisely what the picture depicts, even if it seems oddly stylized, or distorted, whereas the language of its maker leaves us totally perplexed. Often too we can tell the shape of a depicted object even though the object itself is foreign to us, as a photograph can show us some unusual creature from far Patagonia.

How can we tell what a picture is showing us? Can a child raised in a nonpictorial milieu recognize pictures? Unusual types of pictures might tempt a theorist to suppose that only careful training can make us understand pictures. Some pictures depict imaginary objects, such as unicorns. Some depict objects full of strange distortions, fooling the eyes and amazing the mind. Some caricatures show objects elongated, altered. These are strange representations, but are they typical? Do children need careful tutoring before they can appreciate any pictures? What lessons emerge from research in other cultures and from child psychology?

Psychology has made some progress in understanding perception of pictures and has garnered evidence from adults, children, and animals. It is my purpose to account for some ways pictures give us information, drawing on this evidence. As a background I offer a theory drawn from the psychology of perception. I apply the psychology of perception to the problem of understanding pictures. Then I pull the Discussion around in a full circle by applying the lessons learned from pictures back again to the psychology of perception. In other words, my account flows from the study of perception to the study of pictures and then back again to the study of perception.

Pictures and Paintings

I focus on the idea that pictures give information, although pictures are also, of course, frequently aesthetic or expressive, and I do not wish to deny the importance of these aspects. I ask how pictures are useful for telling the observer about the location, shape, and color of an object or scene. But I am not forgetting that pictures can be attractive and provocative, that they can give pleasure and give the viewer a sense of awe at the technical skills and conceptions of their makers. Pictures can be pleasing by being balanced, rhythmic, and ornate; or by being distinctive, unusual. Pictures can fascinate, be odd, without harmony, yet indicative of something important, maybe even tragic. They can puzzle, through being contradictory.

These aesthetic qualities are undeniable, but whether a picture is aesthetic may be a different question from whether it is informative. I try to keep the two questions separate and concentrate on the second—how a picture can provide information. The other question, what makes a picture aesthetic, has been examined in fair measure (see, for example, Hogg, 1969), both as it applies directly to pictures (notably by Armheim, 1949, 1954, 1966) and as it arises with objects other than pictures (notably by Berlyne, 1972). The aesthetics of pictures has been a rich and prominent topic for research. In contrast, the psychology of the informative uses of pictures lies scattered, its pieces needing to be brought together, introduced to one another, and reconciled if they begin to dispute each other (as indeed they will, for they are siblings who have been reared too long apart).

It may be that a psychology of information and pictures will seem helpful to aesthetics. In a narrow view, aesthetics is the study of taste and preference. In its broad sense, however, aesthetics only begins with questions of merit before ranging into all the relations between the meanings and manners of a work. Meaning and style can never be completely isolated from one another; to say where style leaves off and subject matter begins is difficult, maybe even impossible. Is the Mona Lisa a special person or are the delicate shades in which she is drawn indissolubly a part of her? If what a work shows us and the treatment by the artist belong together, then my analysis of information in pictures may reveal some of the interesting mechanics linking the effects and devices of paintings. Probably many paintings rely heavily on simply representing significant objects and features of objects, the kind of representation that I will dig into, though perhaps I will cultivate my topic more prosaically than an artist would desire.

Also, some people believe the merit in depicting anything lies in finding suitable real-world subjects and "getting them right"; they are still swayed, that is, by the feeling that paintings have to be
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In theories of form perception offer clear ideas about the informative functions of pictures. Sifting and discussing the evidence from adults, children, and animals help to separate the issues where little or no debate is necessary any longer from the issues that remain unsolved.

Studying Ordinary Pictures

To many Western adults, pictures are instantly recognizable, and one might conclude that most pictures are so obvious that understanding them is trivially easy. The temptation is to overlook skills that seem facile and to examine what is gaudy or remarkable. For example, at first, a vaudeville memory man seems more interesting than a laboratory experiment on recognition, and dramatic pictures by Dali more important than a line sketch in a geography textbook. Dali troubles our eyes and seems to require an explanation, whereas, one is tempted to conclude, the simple sketch is unambiguous and easy to recognize and so does not require an explanation.

What could be interesting about a sketch that anyone can recognize? The answer is almost paradoxical and is a lesson for every generation of psychologists: in psychology we study the ordinary. To understand the commonplace is one of the main aims of psychology. If we are to understand human activity, we must study that which occurs most of the time and that is, naturally, the ordinary. Psychologists must describe and explain whatever is normal, straightforward, and obvious to the man in the street. For our subject matter is people in the streets-their skills, their commonplace activities, and how they become that way, able to do what they do effortlessly and casually without a second's thought. If something is easy for an ordinary man to understand, and does not require his serious study, then we have to take this as a sign of a well-practiced skill that we should try to describe, not as evidence that the something is obvious and so not worthy of study.

For these reasons, a considerable effort needs to be made describing and analyzing ordinary pictures. Consider three aspects of line drawings, for example, to see how puzzling the ordinary can be.

First, line pictures are often only a few marks on a piece of
paper. They are easy to make and comprehensible in a single glance. At the same time, they are also one of the least understood devices imaginable. How can a line (a thin ribbon of pigment) depict an edge of an object (the change created by two abutting surfaces)?

Second, in the past, the laws of vision have been explored with line displays. Often researchers paid no heed to the fact that some of the line displays they used were pictures and others were merely random markings. I try to show here that confusions have arisen precisely because researchers failed to distinguish perception of line displays as pictures from perception of the displays as non-pictorial deposits of pigment on a flat surface. A fresh analysis of line drawings allows us later to reinterpret a chapter in the history of psychology.

Third, line pictures are important in the history of psychology and have a wider history besides. In the caves of prehistory, the earliest drawings are often a mixture of painted areas of solid color (contour drawings) and heavily accented outlines. In those drawings, single lines often represent limbs or torsos or spears --exactly the same things we depict today by outline. Throughout the development of Western art and illustration, outline drawings have been present as casual preliminary sketches and as finished woodcuts or etchings-as serviceable, practical drawings and as works in their own right. From West and East, if a society has pictures, it has outline drawings. The outline drawing may be as useful and efficient a form of picturing as can be conceived. Color, texture, and size all become irrelevant, and the object is recognized in a few quick lines. Much is omitted, yet much is conveyed. The technology for making the line display is almost irrelevant--the lines can be cracks in glass, shadows on a screen, deposits on paper, cuts in wood-as long as the light to the eye is structured by the display.

Line drawings almost deserve seniority in a psychology of pictures. They are common, efficient, and as old as picture making itself. I show here that they suggest important basic visual processes -- and maybe even some processes that go beyond vision, some processes common to both sighted and blind people, for I report some work on raised-line drawings that blind people can feel.

Newspapers, magazines, and comics are crowded with pictures. Billboards are displays for cars, bottles, any of a thousand objects. While leafing through a newspaper we may barely glimpse an advertisement, but in that instant we may have registered the identity, orientation, and location of the pictured things. Sometimes we read a label or caption before looking at the picture, but more often, probably, we notice the picture first and recognize the pictured object without any help from the accompanying words. As often as not, the captions could accompany any of a number of pictured scenes. All in all, it seems we do not need captions to help us identify the pictured items.

The evidence of our daily life, then, is that pictures are usually fairly precise and unambiguous in their referent. The represented objects are usually clear and specific. Guess work is unnecessary; usually we have to do is notice what is depicted. We normally have no impression whatsoever of anything complicated and indirect in identifying the contents of a picture—no feeling of possible uncertainty or error, no awareness of picking up inadequate clues and deducing the possible origins of the clues, no apparent need to check our identification as though the task were fraught with ambiguities and confusions. When we ask companions what they see in some pictures we are all looking at, usually they either see the same thing we do or notice other things. The point is, we rarely actually disagree (unless we are asked specifically to give interpretations or a considerable time has passed and we have to rely on memory). In the usual case, different observers are all correct, but each notices slightly different portions of the picture.

The evidence of every day is that pictures provide us with new information. Not only can we recognize familiar scenes, we can also make sense of pictures of unfamiliar things. We learn about things from pictures. We learn the form of an ardvaark, the shape of a cous-cous, the layout of the far side of the moon. Parents show the new baby in a photograph. A caricature of the President shows us how like a salesman he can be. Reference works, textbooks, encyclopedias, and dictionaries use pictures to inform the reader.

**Constructive Versus Registration Theory**

We do not seem to need to guess and deduce in order to understand the content of most pictures. Paradoxically, many theorists have argued almost the reverse. They say that perception...
in general—including perception of pictures—is very like guess work. They feel that our impression that perception copes straightforwardly with new information is somehow misleading. From their point of view, the central hypothesis is that we do guess and deduce, but for some reason we are blissfully unaware of the hard work of our senses, their guess work and their deductions. That is, supposedly, unconscious processes of inference occur in the brain prior to conscious perception.

An unconscious-inference theory was offered by Hermann von Helmholtz in the nineteenth century, and it is still a popular theory. The theory cannot be tested directly because one cannot ask an observer to describe his unconscious processes. But it is possible to consider what happens in special cases—for example, when information is provided in part but not completely and the observer is forced, willy-nilly, to guess and deduce. Such special cases are considered later.

The unconscious-inference theory contrasts directly with the impression we have of simply "registering" when perceiving. In our everyday experience, we open our eyes, look around, and simply "register" our surroundings. Some theories try to account for our ability to readily "register" the perceptible world. The theorists most closely associated with research supporting and explaining the basis for a "registration" theory are J. J. Gibson and E. J. Gibson, whose research provides the basis of several vital parts of this book.

The Gibsons' registration theory is founded on the hypothesis that perception is determined by the data available to the perceiver, not by processes that alter or supplement the available data. In contrast, the unconscious-inference theory was initially proposed on the presumption that the information available to perception is typically inadequate and perception has to supplement it. The idea is that perception may seem to be a system for picking up information, but it has to be a "constructive" system, for its data are often insufficient and imprecise.

The unconscious-inference theory and other constructive theories are popular today, as in Gregory's words (1970): "The same data can always 'mean' any of several alternative objects...the number of possibilities is infinite" (p. 26). Sensory information is so incomplete...the slenderest clues to the nature of surrounding objects" (p. 11).

As a result, in the view of Neisser (1967), one should compare "the perceiver with a palaeontologist, who carefully extracts a few fragments of what might be bones from a mass of irrelevant rubble and 'reconstructs' the dinosaur that will eventually stand in the Museum of Natural History. In this sense it is important to think of perception as a constructive synthetic activity...One does not simply examine the input and make a decision, one builds. ...Perception is basically a constructive act rather than a receptive or simply analytic one" (p. 94).

Possibly, the foundations of this constructive view of sensory information and the resulting perceptual activity are basically shaky. The constructive theory is usually jerry-built, as it were, for the fundamental assertion that sensory information is inadequate is not established correctly. Proponents typically assert the point without describing the conditions for testing its validity, yet no meaningful theory can be asserted without stating the conditions under which the theory is to be tested. Familiar from high school science are such conditions as "NTP"-- we say that $X$ is true if tested under Normal Temperature and Pressure. Or "elastic limits"--$Y$ is true for any test made without stretching the material beyond its elastic limits. There are relevant conditions for establishing the truth of any claim. We do not try to test the claim that "objects fall to the ground" with metal objects below a strong magnet. But the claim that sensory information is always incomplete and infinite in ambiguity is always asserted without mentioning the conditions for testing its validity.

The claim that optics provides, at best, ambiguous information is derived from the important fact (made much of by Bishop Berkeley, among others) that after light originates from a particular source it travels independently of its source, being then dependent only on the media through which it passes. Because of this fact light that has left a source can be altered by varying the media through which it passes. As a result, an identical ray of light to the eye can be produced in many ways, and any existing relationship between light and its source can be altered and yet leave the light
at the eye unchanged. A particular light ray can originate in any of several locations or sources and it may be deviated by a lens, reflected off a mirror, or filtered by colored glass before arriving at the eye. How can the perceiver then assert what its true direction of origin or type of source might have been? The conclusion is that the science of optics is a science of ambiguity.

The conclusion that light is ambiguous about its origins is often supported by empirical demonstrations with "distorted rooms." Seen from one particular point of view, cleverly distorted rooms are indistinguishable from normal rooms. Thus, the laws of perception, once understood, can be manipulated (by artificial means) to give false impressions. As to whether perception usually works on in adequate data, the demonstration is irrelevant. The demonstration has to be shown to be a sample of our usual data before any claims can be made about its being typical of anything.

The theoretical point that optics is ambiguous is conceived in an empty way, and it is easy to see how foolish the point is if the claim is restated as follows: If one allows light to the eye to be infinitely alterable in its course and characteristics, then no necessary relation holds between the light and its origins. The claim is as true as any tautology. But it is irrelevant to the daily business of picking up information about our normal environment, where usually there are relations between light and its source. The assertion that optics is ambiguous is foolish because our daily environment sets boundary conditions on the behavior of light—and one must look inside those boundary conditions to find any relations between light and its origin. Optics can be ambiguous, but is it ambiguous when circumscribed by our everyday world? That is the critical question.

What are some conditions governing the behavior of light in our environment? By and large, in our daily environment light travels in straight paths from the origins to our eyes. Although in specific pockets of the environment light is deviated from a straight path by lenses and mirrors, these pockets are well marked by, for example, the frames of the mirrors or the casings of the lenses or the optical effects when the lenses are moved. As a result, light is rectilinear except in exceptional cases where optical devices are present, and it is possible to distinguish the exceptional cases from the simpler normal cases. Here, then, is one role governing light in our environment. Perhaps, this one example suggests, there is a distinctive "ecology" of light and a clear-cut, orderly relationship of light to its origin.

To understand the nature of any informative relation between light and its origin, it is necessary to study the ecology of light—"ecological optics," in Gibson's phrase (1966). Rectilinear travel is one ecological condition, and there are others. The next chapter in this book describes an ecology of optics and analyzes the ways light can be informative about its origins, for once ecological optics is understood it is possible to begin to understand how a picture can capitalize on informative properties of ecological light.

The theory of perception contained in the notions of unconscious inference or constructive activity cannot be dismissed by re-analyzing the idea of optical information. The inference, or constructive, view of perception arose when it was thought that light was often uninformative, which may be mistaken, but it just might still be true that perception operates according to laws of inference and construction. Worthy ideas can arise for mistaken reasons. So it is interesting to cast a suspicious eye over the practical demonstrations that are supposed to support a constructive view of perception. For instance, what happens when information is deliberately degraded and made ambiguous—even if this is an artificial case? What happens when pictures are ill formed or incomplete? Do we "project," as a constructive view of perception would predict, a fully formed object onto the ill-formed displays? Do we see incomplete pictures as though they were complete? These are questions debated in later chapters.

**Scope of Analysis**

The theme of this book is that pictures provide useful information. Thus, we must first understand how anything can ever provide information and then examine how light in particular typically provides us with information. Only then can it be shown how pictures make use of the ways in which information is normally available. It is also useful to consider various definitions of a picture and then to examine some pictures in detail to see which definitions are
well conceived. Once the definitions are clarified, research evidence on children and other cultures falls into place, and we see that the research evidence supports one definition over another. So let us begin by understanding the ecology of light, then philosophize about representation, then analyze detailed characteristics of pictures and research evidence on subjects using pictures.

A well-rounded analysis of pictures has to consider many aspects of the problems. But it is necessary to omit some topics. To discuss "cuts" and "pans" in motion pictures or children's understanding of "fades" and "zooms" or the processes involved in holography and perception of holographs, or the relationship between painting and personality, or a psychological history of art—all these are too much, unfortunately, for one book. The basic function of pictures is surely to allow us to see objects and scenes that are not in our immediate surroundings, yet until recently that function was rarely discussed by psychologists. Topics such as artistic merit, the history of perspective, and aesthetics are treated at splendid length however. Accordingly, I can concentrate on a neglected topic—the informative function of pictures.

Regretably taking this one focus means neglecting the work of many students of pictures. I have benefited from Goodman's analysis (1968) of the ways pictures can be considered as symbol systems, Gombrich's detailed analysis (1961) of the relationship between "knowing" and "seeing," Gardner's intriguing attempt (1973) to place perception into an overall theory of child development, and Arnheim's work in an entire career devoted to a Gestalt approach to pictures. These men and their works are having considerable influence in philosophy and psychology. Their ideas help shape my analysis, but my treatment of parts of their work is all too brief and rarely represents their major themes. But if I am to be fair to my own theme—the information supplied by depictions—there is not space to discuss everyone else's hobby horse, too.

The psychology of pictorial representations was neglected for a long time by most psychologists, at the core of some confusion in the psychology of perception. In the 1960s picture perception as an area of study came into its own and has begun to influence ideas about the eyes of adults and the developing minds of children. I hope this book will contribute to psychology in general by dealing