Chapter Eight

Using the Language of Lines

To claim that light and pictures can be informative is not to deny that light and pictures can puzzle, too. In this chapter I will try to account for some of the puzzles and trickery in pictures. I will pry into ambiguity and into the workings of "reversible" displays, and I will try to explain "impossible" pictures yet show that the language of outlines is not violated by ambiguity, reversibility, and impossibility. Just as verbal language is systematic and yet capable of puzzling ambiguity, so is light and outline drawing.

Probing into the comparison between language and picturing, this chapter will consider whether the language of outline is restricted to vision. Experiments on touch with blind subjects will show what meanings outlines can have for the hand as well as the eye.

Words and sentences can have many meanings. "Bow" can mean a ribbon, a part of a ship, or a posture. In "They are cooking apples," the word "cooking" can be a verb or an adjective. Similarly, an individual line can depict any of the basic features of the visible environment. Usually the pattern around the line determines what is referent is, just as the phrase around "bow" limits it to "the colorful bow in someone's hair," or "the proud bow of a courtier."

One can ask what meaning the word "bow" could have on its own. And, similarly, one can take a simple line pattern and ask what it could depict. A circle can depict a hoop, ball, or coin, a fact that suggests depiction is a matter of will and choice. But closer examination leads to a different conclusion. When a hoop is depicted, the line forming the circle depicts a wire. When a ball is depicted, the line depicts an occluding bound. To depict a coin, the line depicts the occluding edge of a disc. Notice that the referents are part of the language of outline.

A highly detailed drawing may be unambiguous in its referent, just as a full sentence around the word "bow" restricts the referent of the word. Ambiguity in perception results when only a few elements are considered, be they words or lines. And the perceiver then selects from a set of possible referents. In the case of language, the possible referents are an arbitrarily chosen set. In the case of lines, the referents are drawn from a language of outline depiction that is not arbitrary, for training is not necessary for recognition. It may be necessary to have some experience with detailed, high-fidelity pictures before one can treat simple drawings as pictures of many possible things; discovering ambiguities in figure-ground drawings is a skill that increases with age, and it is more developed in more intelligent children (Elkind and Scott, 1962). But the skill makes use of the language of outlines and does not introduce completely new referents. In this vein, consider the displays that demonstrate one-sided shaping effects.

At first, the incomplete letters in Fig. 40 are not seen. Shapes are visible, but not the shapes that could form parts of letters.
Meaningless blocks are seen at first. With a hint, one can reverse the figure. Then the lines no longer shape only the blocks; one notices the shapes on the other side of the lines. At first, the spaces between blocks seem like distant background behind occluding edges of surfaces. The enclosed areas seem like flat foreground surfaces, and the lines depict the edges of surfaces. When reversed, with letters visible, the lines still depict edges, but the flat foreground areas are now on the other side of the lines. In sum, the side where surface seems to be alternates in Fig. 40, yielding blocks or letters.

Another case of reversibility, one of the most famous, is Rubin's vase faces figure (Fig. 41). As a vase, the left and right lines represent rounded surfaces—that is, occluding bounds—with the bounded surface enclosed by the lines. The top line represents an occluding edge with surface below the line, and the bottom line depicts an occluding edge with surface above the line. As a face, each of the two sides again depict occluding bounds, but now they are occluding in the reverse direction. The top and bottom lines are irrelevant to the faces, and do not depict at all; that is, they are seen simply as lines on paper.

The figure-ground reversibility of Figs. 40 and 41 involves reversing the direction of occlusion. A circle depicting a disc at one moment and a window at the next involves the same kind of reversibility. However, if the circle depicts first a disc and then later a ball, it is not the direction of occlusion that changes. Instead, the line depicts first an occluding edge and later an occluding bound, a demonstration that reversals need not interchange figure and ground, the sides where shape is.

A beautiful example of a reversal that does not affect figure-ground is Fig. 42. At first the lines depict a billowing sail—and the sail may bow into the page or out of the page. With a switch of attention the lines can depict a kite, symmetrical about a diagonal axis. The figure is almost unrecognizably different as a sail and a kite, a reversal that is not figure-ground in type.

Yet another reversal, pointed out by Necker in 1832, is evident in depictions of wire objects or transparent objects. A Necker cube (Fig. 43) reverses so that its front face and its back face alternate. Its oblique lines reorient as the figure reverses. Another figure giving rise to remarkable orientation reversals is a triangle like that in Fig. 44, which can be taken as a depiction of an isosceles triangle in depth. The orientation of the depicted triangle can be switched radically. The Necker cube is more complicated than the triangle. In the cube, there is change of occlusion as well as change of orientation. The wires "in front" where two lines cross usually switch as the obliques reorient. The ""in front" changes reveal important aspects of depicting wires by lines. Usually, when a wire is depicted by a single line, features of wires are omitted, like information for their rounded cylindrical shape and their surface textures. (Similarly, the triangle is depicted without information for its orientation, and a circular line seen as a depiction of a hole does not provide information for the depth in the hole.) In some ways, the results of omission control Necker cube reversal. Where the wires overlap, it is not evident which line is "in front." But if the cube is
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al cubes made of real wires at the same rate (about twenty-two times per minute in a period of two and a half minutes). Even making the front face a different color (black) than the back face (grey, as in Fig. 46) did not affect the rates of reversals. Similarly, Pandina, Zeller, and Lawson (1971) found a three-dimensional cube reversed as often as did a pictured cube. It seems that information for occlusion or depth is unimportant once reversals have begun. Only in the period before reversals have started--before the reversed appearance is discovered--is such information significant.

FIGURE 46. A wire cube made of wires of different shades.

Kennedy and Brust’s finding makes sense if one thinks of reversals as involving a kind of attention, where the subject takes the display as depicting one thing and then another. Seeing something as a depiction involves a kind of attention, found in its purest form in looking at a simple figure like a circle and taking it to be a picture of a hoop. There is nothing about the circle that specifies a hoop rather than a hole, so it requires a special kind of pictorial attention to see the circle as a hoop depiction.

To suggest an attention mechanism here is to imply that the subject has two problems: first, he must discover what to attend to (the circle as a hole, or the reversed appearance of the Necker cube) and, second, he must reattend to what he has once discovered.
It is the first phase—discovery—that is influenced by information for depth and occlusion, in Necker cubes. The second phase—reattending—is influenced only by the attention mechanism, and so is almost independent of the ecological information for depth and occlusion.

Compare: In daily life we may not discover some aspect of an object directly in front of us, but if the aspect is once discovered, it is easy to attend to it again. (If one had to repeat the discovery process, it would take as long again!) A useful case in point is an incomplete picture, like that in Fig. 47. At first the lines seem meaningless, but once an incomplete object has been found, the object can be seen again at will. In Fig. 47 the original is a fork—once the incomplete fork is found, there is no trouble seeing it a second time.

FIGURE 47. An incomplete picture of a familiar object.

When a real wire Cube is made to reverse, as the subjects in Kennedy and Brust's study succeeded in doing, information for depth and occlusion is being held in abeyance as irrelevant. Similarly, the flatness of the layout of lines in Fig. 42 is irrelevant to the perception of a cube. The key skill in picture perception is to simultaneously notice the relevant and use the irrelevant only to avoid "trompe l'oeil." The Necker-cube studies suggest depth can be held in abeyance with ease, by adults and twelve-year-olds, who see reversals at a constant rate despite the presence of stronger cues to depth.

Oddly enough, blasting the subject with sound, or confining him in a super heated room, or strenuously exercising him increase the rate of reversals of cubes (Vickers, 1972). Why these external factors change the subjects' attention in a particular way is a mystery, but many factors can affect control over attention. Some factors should follow common sense. To speed the subject's perception of a pictured object, ambiguity should probably be removed by the addition of relevant details—otherwise, for instance, a circle meant as a disc might be seen as a hole. Irrelevance should be kept to a minimum, otherwise the observer may overlook the relevant object. Not all the influences are so obvious, however. In the next section, I will consider some of the factors present in the picture.

Guiding Pictorial Perception

Understanding what is relevant and what is irrelevant in a picture is not always plain sailing. Some factors impede perception of others; some distortions do not mislead the observer.

In this light, let us reconsider the incomplete-fork picture (Fig. 47). One might conjecture that any form that had been altered would be recognized by a perceiver only if he could replace missing parts or (in general) reverse any alterations. Indeed, many authors have concluded that incomplete pictures call on the perceiver to set hypothetical completion processes into action, reversing the fragmentation that produced the incomplete picture. Street (1935) said that "in order to perceive the picture it is necessary to complete the structure, that is, to bring about a 'closure.' One of the requirements placed upon a subject is that in order to perceive the figure in its entirety, he supply, in his own mind at least, the missing parts." Leeper (1935) said of Street's displays "some figures ...can be seen as pictures of certain familiar forms, provided you 'fill in,' as it were, the spaces between the fragments shown."

Taken literally, Street and Leeper are suggesting that one's seeing Fig. 47 as a fork produces an impression that some extra lines are added or filled in. But, of course, the figure does not seem to suddenly acquire new lines when the identity of the represented object becomes apparent. A more acceptable explanation is that incomplete pictures like that in Fig. 47 are difficult to identify because of special problems in distinguishing relevant features from irrelevant rubble. Note that when Fig. 47 was made incomplete, extra lines not relevant to the fork were added. If the relevant and irrelevant lines are clearly distinguished, as in Fig. 48, the fork becomes much easier to identify, without any more relevant information being added (Kennedy, 1971). It is easier to separate the relevant from the irrelevant in Fig. 48.
Pirenne noted that pictures are surprisingly unaffected by being viewed from awkward angles. Consider viewing a photograph from directly in front and from an awkward side angle. Imagine the central patch in the photograph is a circle—a globe of the world depicted by a circular form. To the front, the circle casts a symmetrical cone of light. To the side it casts an elliptical cone of light. Pirenne notes that the depicted globe still looks spherical when viewed from the side. Somehow, vision can accommodate for askew observation angles and the change of forms in the light to various viewing positions. Pirenne theorizes that the eye takes into account the information for the surface of the picture and computes the shape of the forms on the surface. The observer becomes aware of the depicting forms and thus of the depicted forms. Viewing from any angle, the observer realizes that the form on the picture surface is a circle and takes a circle as a depiction of a sphere.

Pirenne's theory makes appealing use of an awareness of the physical reality of the picture, a reality that is overlooked only in trompe l'oeil. But the theory has an Achilles' heel. Imagine again viewing the photograph from directly in front. But suppose two spheres are depicted, one in the middle of the picture and one off to the side, both projecting symmetrical cones of light to the eye. Now, if the eye were to compute the shapes of the patches on the surface, one patch would be circular and the other would be elliptical. Pirenne's theory would predict that only the circular patch would allow the observer to see a sphere depicted. But Pirenne finds that both the elliptical and the circular patches give the impression of a spherical object. As a result, a theory meant to explain correct perception despite awkward viewing angles cannot predict the perception that occurs from simple, direct viewing positions.

With Pirenne, we may conclude that an awareness of the surface is important to avoid trompe l'oeil, if nothing else. But the details of how that awareness guides us in perceiving forms remains an open question.

Differences in elements can speed recognition of an incomplete figure. Surface perception may aid perception from indirect viewing angles. Also, the overall pattern in the display must aid the observer in identifying what is depicted by particular elements, otherwise any element would be ambiguous. In some cases, the overall pattern can act like sleight of hand, making the elements almost undetectable. This lesson is often emphasized by Gestalt psychologists, and it is particularly relevant to outline depiction.

Consider Fig. 49. This figure is usually seen as a hand or glove with fingers outstretched and touching one another all along the sides. The drawing is an outline drawing, and so there are two contours, one for each side of the line. Since the figure is closed—it completely surrounds the enclosed area—there is an inner contour and an outer contour. The outer contour has exactly the same shape as the contour shown in Fig. 50. The inner contour has exactly the same shape as the contour shown in Fig. 51.

Fig. 50 shows a mitten, with bulges for the tips of fingers. Fig. 51 shows a glove with its fingers separated. So Fig. 49 depicts a glove, fingers together, but neither of the contours of its line depict a glove, fingers together.

Fig. 49 contains the contours shown in Figs. 50 and 51, but no one normally sees the shapes depicted by these contours. That is, the line figure does not depict the sum of the things depicted by its contours! One sees the structure of the line figure, not structures made by its elements.

The glove and mitten fingers are not reversible like Necker
Ryan and Schwartz found the caricatures needed less exposure time than any of the other kinds of pictures. The photographs and shaded drawings were about equal. The high-fidelity line drawings needed the longest times. So, some distortions--ones used in caricatures and cartoons--can aid perception more than strict adherence to geometrical fidelity.

Ryan and Schwartz found that perception was speeded by caricature. Perkins (1970, personal communication) found caricatures to be especially accurate for recognition. Perkins had subjects trace photographs of well-known people-politicians, especially. The drawings the subjects made were mostly unrecognizable. Then Perkins told his subjects to exaggerate features of the sitter: if the politician's nose was large, in the drawing it should be made enormous; if the hairline receded, the drawing should show it as being even higher. The second set of drawings--besides being more entertaining to make and look at--were much more recognizable than the first.

In like vein, Dwyer (1967) found that realistic photographs of organs added nothing to students' understanding of a medical lecture, whereas cartoon drawings of the same organs contributed significantly. (In Dwyer's study, shaded line drawings were as effective as the cartoon. Perhaps sensitive measurements would have proved the superiority of the cartoons demonstrated by Perkins and by Ryan and Schwartz.)

Caricatures. One might think that the most easily understood picture of an object should be in strict geometric correspondence with the object. But this is not so, for in some cases departure from fidelity seems to aid perception.

Ryan and Schwartz (1956) made different kinds of pictures of the same objects: black-and-white photographs, ink-and-wash drawings (drawings with shading), outline drawings, and cartoon drawings (that is, caricatures). Individual pictures were exposed for short periods, in a tachistoscope, and subjects had to report the positions of parts of the objects—for example, the posture of fingers when a hand was depicted, or the positions of switches when electrical controls were shown. In the caricature drawings, a hand had a thumb and three fingers, like that of a Disney character, and the digits were drawn with smooth curves, omitting details such as knuckles and wrinkles (cartoon conventions, these are called).

In "sleighting" figures, the elements are overshadowed by the overall pattern; their relevance is to the production of the overall impression, not as shapes in their own right. In caricatures, comparable results are produced. There are many relations between forms in caricatures that are there for effect rather than for accurate depiction. Do caricatures therefore make the depicted object less obvious? Do caricatures mislead the eye?

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aspects of the features are displayed accurately. We are not misled by the caricature, any more than we are by hyperbole. Indeed, it just might be that mundane, high-fidelity passport photos may mislead us more and tell us less than would a good caricature—that is what the research suggests!

*Impossibles.* There is another parallel to be drawn between language and depiction. Combining incompatible words makes an "impossible" sentence, a sentence that can have no direct referent in reality. An example is, “Colorless green ideas sleep furiously.” The sentence is grammatical—it is not nonsense like "furiously sleep ideas green colorless." A drawing, too, can show impossible things, things that cannot have a direct equivalent in reality. Fig. 52 shows an impossible object, affectionately known as the Devil's tuning fork.

The reason for the fork's impossibility is that it combines features in incompatible ways, many authors have pointed out. What is the root of the impossibility? It is sometimes said that the flaw in the fork is the combination of depth cues. Perhaps that is misleading, for the fork could not be made of flat sheets of card or metal, all in one depth plane, as I will show. It is sometimes said that the flaw is that "the middle prong appears in two places at the same time... [but] one part of an object cannot exist in two places at the same time. The middle prong cannot both be at the same depth as the outer two and [be] below them" (Gregory, 1970, p. 57). That, too, is misleading. First, a middle prong could slant down to be below an outer prong at one end and above an outer prong at another end. Second, there simply is no evidence for one part of the middle prong being in two places at the same time. The figure looks uncertain, and parts of it reverse occasionally—but reversibility is not impossibility or being in two places at the same time.

Another possible explanation of the fork's impossibility is that there are two limbs at one end and three at the other. That is not the key either, for limbs can bifurcate, like the limbs of a tree, so one can start one end with two limbs and have as many as he liked at the other end.

There is no paradox in the lines themselves; the fact that they are on paper before us shows that. Paradox can only arise when the lines are taken as something else—that is, seen as picturing boundaries of surfaces. A line-by-line check should show 'how the fork violates rules governing boundaries of surfaces. That is, if nature arranges solid surfaces and intervening air spaces in only a few ways, it should be possible to show that the fork abuses those ways.

![Fig. 52](image1.png)

**FIGURE 52.** An impossible object known as the Devil's tuning fork.

**FIGURE 53.** A candlestick, round at the top, square at the base, whose outermost edges begin as sharp and, as the stick tapers, become rounded.

The outermost lines of the limbs begin by representing occluding edges and finish by depicting occluding bounds. Does that violate nature? The answer is no. As Fig. 53 shows, a line can depict an occluding bound at one end and an occluding edge at the other to show an object like a candlestick, round at the top and square at the base. The lesson is that some changes of representation along the length of a continuous line are quite acceptable. If the outline is to seem paradoxical, it is the kind of change—not change itself—that must be the flaw.

In the Devil's tuning fork, the first pair of lines in from the outermost show at one end a convex corner, made by the two sides of the square limbs. At the other end they depict occluding bounds;
with surfaces on one side and air space in between. Here is the heart of the paradox. In a violation of nature, what was surface has become air space. Similarly, the innermost lines depict occluding bounds at one end (enclosing surface) and occluding bounds at the other end (enclosing air space). The direction of occlusion has reversed, from one end of the line to the other, so that surface and air space have interchanged.

The fork is impossible because of the kinds of changes depicted. What is impossible is that a boundary between surface and air should reverse so that air is on the same side of a boundary as a surface. The direction of occlusion, in nature, cannot reverse as it does in the innermost pair of lines of the fork, and occlusion cannot appear where previously there was a convex corner, as in the middle pair of lines.

Similarly, a wire (air on both sides) cannot turn into an occluding edge (air on one side), as in Fig. 54. Surface cannot simply cease to exist, as it does in Fig. 55 (after Josef Albers). Nor can a crack (surface on both sides) turn into edges or wires (air on one or both sides), as in Fig. 56 (after Lochlan Magee). None of these paradoxical figures could be cut from flat sheets (solid surfaces), for the rules of solidity are violated, though all of these figures can be drawn with lines or made from wires. It is as depictions of surfaces with edges that they show impossible objects. In language, the rule sounds as implausible as the objects look—"passing from surface to air we find ourselves passing from air to surface."

In impossibles, each part is ecological, but the combination of the parts violates nature. They could not exist, so they are imaginary, but the fact that they are imaginary does not make them im-

FIGURE 54. In reality, a wire cannot become an edge, as it does here.

FIGURE 55. In this anomalous drawing, surfaces are initiated but not terminated.

FIGURE 56. In reality, a crack cannot become an edge or a wire, as here.
possible. To make an imaginary object, parts are combined in possible ways. The combination can be possible but be a combination that does not exist. For example, there is nothing about surfaces and air spaces that rules out a horse with a horn, like a unicorn. Nature has not seen fit to evolve unicorns, but it could do so without contravening its own ways with surfaces and air. The parts of a unicorn are ecological. The combination of parts breaks no laws of solidity. In language, one may claim "I saw a unicorn, a horse with a horn." In language, as in pictures, to be imaginative is to combine familiar parts in possible but novel ways, whereas to be impossible is to combine the parts in novel ways that violate rules of nature.

**Depiction Without Vision**

At first thought, picturing may seem inherently something for the eye and language may seem much freer than depiction. Language comes spoken, written, semaphored, or tapped in Morse. Language seems above and beyond any one sense. Must picturing be locked in one modality, owned solely by vision?

Many of the things found depicted in visual displays are not inherently visual. Space and form are not inherently visual. The geometry of edges and surrounding air--the world of corners and wires--is actual as well as visual. This geometrical world, research indicates, is linked to lines in the untutored eyes of children, people of other cultures, and members of widely different species, all of whom understand line depiction with little or no training. Perhaps the link between lines and edges does not only belong to the eye, but goes beyond vision to an intuitive understanding of form and structure that belongs to many senses; it is amodal in the sense that it is not restricted to one modality.

That the link between objects and pictures is far from the eye is suggested by research reported by White et al. (1969), who found that skin (on the back) can act as a kind of retina. White et al. used a television apparatus to press silhouettes of objects onto backs of blind and sighted subjects. With a little practice, subjects could identify the silhouettes. To some extent, this may be simply the identification of an object physically pressed on one's skin, which is not a pictorial task. But there are some suggestions in White's work that genuine pictorial skills were involved. For example, sometimes an expanding silhouette was "felt" as an object receding. Shrinkage felt like distance, not diminution. So, features of the Bat array on the back were understood as representing features of a three-dimensional world.

If the flat displays show objects with overlap (occlusion) present, not simply silhouettes, and are drawn as lines flat on a sheet, then pictorial skills are necessary for one to identify the objects. The lines would have to be understood as representing boundaries of surfaces, sometimes with occluded background. Accordingly, Kennedy and Fox (in press) attempted to establish whether there is an untutored link between solid objects and flat outlines for blind subjects. Eight blind subjects were asked to explore raised lines with their fingers. The subjects were told that the displays--shown in Figs. 57 and 58--represented objects or parts of objects. The displays were pretested on thirty-four sighted subjects, all of whom recognized the displays correctly at first glance. The task, the blind subjects were told, was to identify the pictured object within two minutes.

The blind subjects had never used line drawings of objects before, they said. All used braille or readers as sources of information. All were at college, and were between eighteen and twenty-four years old. With one exception, they all had been blind since birth or within a few months of birth. The exception had lost his sight at the age of six.

Was the task meaningless to the subjects? The extreme hypothesis that all pictures are conventions predicts that the subjects would be totally lost. Being asked to compare lines with real objects should be as meaningless as comparing octopi and paychecks, if only a convention ties the two together.

Were any displays identified? Which should be more difficult? One might expect flattish objects to be easiest to identify--that is, objects that can make a recognizable imprint on a flat surface because they have little depth or overlapping parts. So the fork, hand, flag, and man with upraised arm should be easier than three-dimensional figures like the three-quarter-view face, the table, the man with his arms crossed, and the cup. The three-dimensional figures have overlapping parts and result in projective distortions.
like a circular cup projecting an elliptical brim and a table projecting a parallelogram. If occluding edges and bounds, with background, mean little to the blind, projections should be difficult to identify.

Some subjects did not identify any of the eight displays, and some identified half. Two of the subjects identified four displays each (five each, if calling a cup a "container" or first labeling the fork correctly, and then retracting the name, are considered acceptable). Two identified one display each. Four identified no displays.

The occasional successes suggest some untutored links between lines and solid forms, in touch. The displays that were recognized included the hand (three times), the fork (twice), the cup (twice), the table (twice), and the face (once). Interestingly, there is no hint that plane imprints are easier than projective forms, for an equal number of imprints and projections were identified (five each). In later testing, four high-school blind subjects identified two or three displays each, usually the cup, table, and hand, but once including the flag and once including the man with his arms crossed. Evidently, lines depicting boundaries of surfaces, sometimes with background behind occluding edges and bounds, seem appropriate to some blind subjects.

The failure to pick out the correct label for the form does not mean the lines are meaningless, for the kinds of errors subjects made were curiously appropriate. Subjects misidentified the fork as an arm and a hand, which almost fits the display to vision. Equally reasonable to vision was misidentifying the fork as a tulip with a thick stem, as "an ice-cream cone with an unusual bottom," or as a bell on a kind of chain. Similarly reasonable are misidentification of
the table as a house with a slanted roof or the man with upraised arm as a kind of teapot. Each of these errors makes pictorial sense to vision, suggesting new, appropriate ways of seeing the figures. The line marking the interior of the handle of the cup bothered some subjects, who took the line to be a solid form rather than a hole; again this is an appropriate error, suggesting figure-ground effects in touch.

At the end of testing, subjects were told the correct referents for each display. In most cases, the picture was then understood; given just the label (for example, "a cup") the subjects could pick out the parts, proving they did understand. At this point too, subjects were sometimes able to comment on how to make the displays more identifiable. Two said the reason the fork was difficult was trivial—the prongs were too close to be readily distinguished by touch. One said the man with his arms crossed was too round shouldered, which is visibly true, too, though sighted subjects usually do not notice how exaggerated the roundness is. Three said that a line was missing on the cup, that there should be a line marking where the handle joins the body of the cup.

The number of correct identifications is impressive on its own. But the numerical data is only the tip of iceberg of consistent comments and suggestions. The blind subjects found the idea of line depiction meaningful, could identify outline depictions without hints, could identify the parts of depictions given one-word hints, and could suggest uses of line in keeping with the use of outline in vision. There seems to be some deeply rooted human capacity to understand outline depiction of features of solid objects, a capacity that applies the same rules to vision and to touch. A box of brain cells, as it were, out of the visual pathways and out of the touch pathways but with access to vision and touch, deals with discontinuities in either vision or touch and accepts lines as equivalents of the discontinuities.

**Conclusion**

Outlines are useful for presenting essential details with a minimum of irrelevancy. In an outline drawing, key facts about the sizes, shapes, and locations of objects can be shown in a form of representation that requires less training than any code or language, less time than listening to a description, and little if any translation for its message to be universally understood. Outline pictures are representations—calling on a basic understanding of the nature of signs. Like language, they make use of meaningless units, for as outline pictures have their simple strips of line, so language has its phonemes. Both outline pictures and language put together their basic units to form meaningful packages (patterns and sentences). Accordingly, they should have much in common and this chapter has described the similar roles played by ambiguity and impossibility in both language and depiction, and shown how hyperbole and caricature have allied effects.

Language is meaningful to many modalities, many of our sensory systems. Looking for comparable properties of pictures, this chapter has presented research on pictures for blind people.

Picturing seems to be a form of communication meaningful to both vision and touch, without tuition. Picturing was discovered by early men, not invented and passed on by careful inculcation. To make pictures is an art, but recognition of depictions is largely a gift the environment and nature allows us gratis. In discovering outline picturing, early man capitalized on a capacity that is present because of an intuitive, amodal understanding of line and form, a capacity, usually invoked visually, but with a potential for untutored touch.