Wolfgang Metzger: Laws of Seeing

Chapter 1. Ambiguous figures in our daily environment

Speaker: Chia-Yao Lin

October 6, 2009

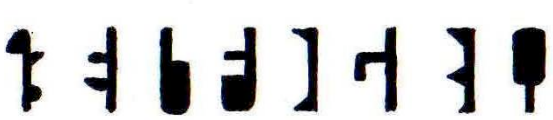


Figure 1

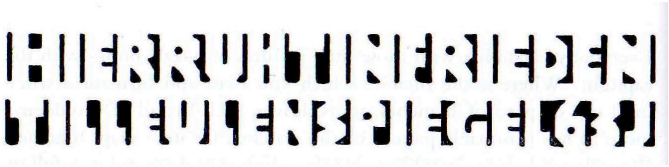


Figure 2

Figure 3

Wolfgang Metzger: Laws of Seeing

Chapter 1. Ambiguous figures in our daily environment

Speaker: Chia-Yao Lin (Cara) **October 6, 2009**

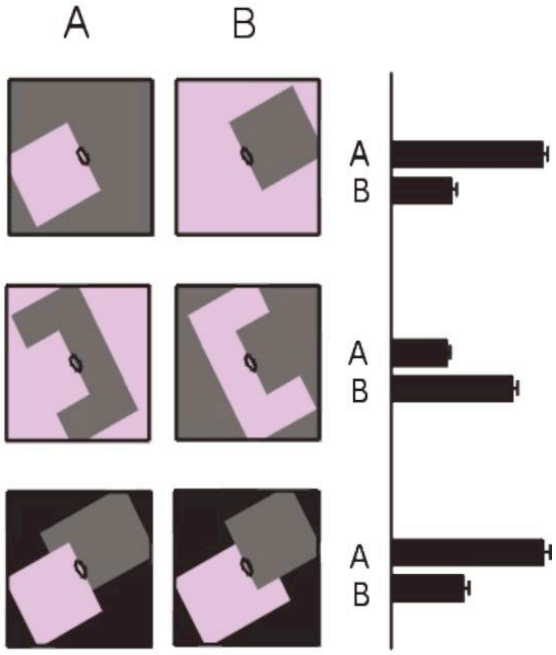
In this chapter Metzger tells us that there are many ambiguous figures in our world. Figures 1 and 2 are examples of such ambiguity. Here the letters of the alphabet are not seen, unless they are pointed out to us. We are "blind" for them, because perceptually they are part of the white background. In contrast, the black interspaces, which are normally "invisible", are perceived as figures, due to the Gestalt factor of *closure.* If we would close the white letters by a black line on top and at the bottom, we might be able to see them more easily. Try it. (See Bruno Breitmeyer: Blind Spots, Oxford University Press.)

Figure 3 shows the ambiguity more clearly and in the time domain. This figure can be seen either as a goblet or two faces, although the stimulus is the same. Without the square box, we would see only the goblet, because the white area surrounding it has no shape of its own and thus becomes background. It even appears to pass behind the goblet. Yet, with the box present, the white region attains figure-status, and as a result we see two percepts alternating with each other.

Question: Do we need different subpopulations of neurons in the brain to represent these two percepts? What determines which figure is present in our vision at any given time? How often do the two percepts alternate? Can you force one or the other by will? There are many other examples of reversible or ambiguous figures, such as old woman/young woman, Necker cube. Can you find them on the Internet? A rich source of artful illustrations of ambiguous scenes can be found in the work of the Dutch painter Maurits Escher. (Sabrina, please bring the book.)

There is another observation to be made in Figure 3. When we see the goblet, the border belongs to it. Conversely, when we see the two faces, the border belongs to them. This tells us that the border is always owned by the figure. The fact that the border has only one side is called border ownership. Rüdiger von der Heydt and collaborators have found that neurons in Area V2 of the monkey respond strongly when an edge delineates a figure; when it delineates the background, the response is weaker (see below).

These same neurons also respond to depth cues, which is consistent with the perception that a figure appears to lie in front of the background. Thus it appears as though figure-ground segregation occurs already in mid-vision.



Reference: Zhou, Friedman, von der Heydt: J. Neuro-Sci. 20, 6594 (2000).

The Danish psychologist Rubin (1915/21) was the first to describe the properties of figure and ground. He wrote:

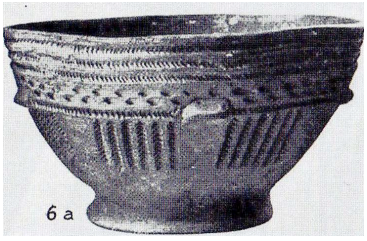
A figure

- has object character (it is a "thing")
- is small
- is "compact"
- appears closer to the observer
- is surrounded by a contour (unilateral)
- possesses a form (often symmetrical)
- is superimposed onto a background, which it partly occludes.

In comparison, the background

- has a lose structure ("stuff")
- appears further
- is partly occluded by the figure
- continues behind the figure
- has no particular shape (formless)
- is larger than the figure

Figure 4



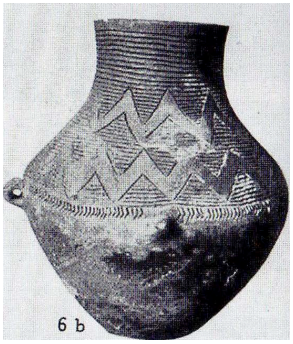


Figure 6

Figure 7

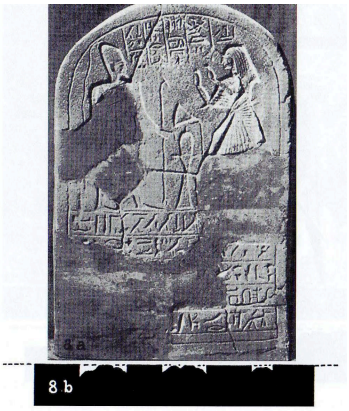


Figure 8

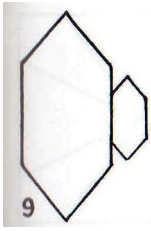


Figure 9

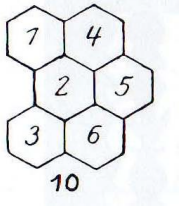


Figure 10

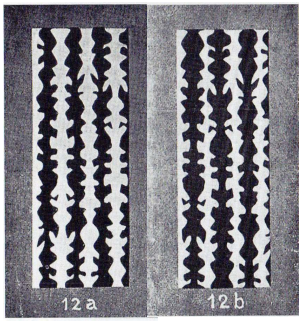


Figure 12

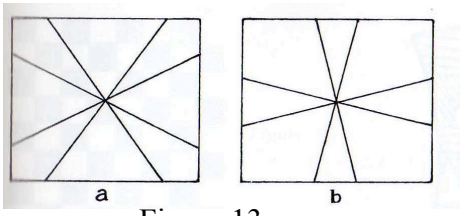


Figure 13

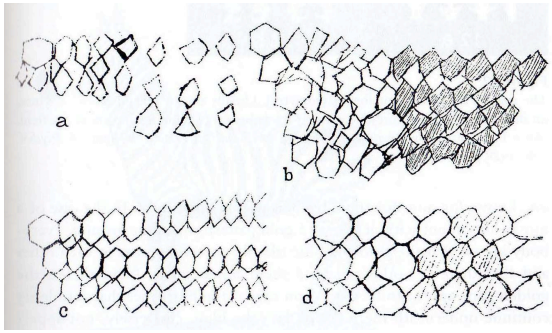


Figure 11

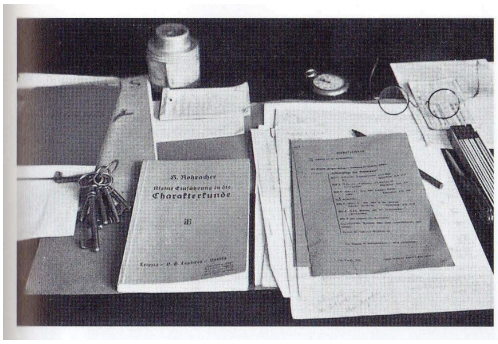


Figure 5

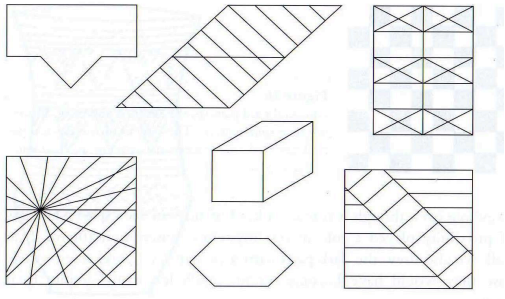


Figure 16A

When people draw Figure 4 from memory, they typically reproduce the cross and the little squares fairly accurately, but they do not normally reproduce the distances correctly. Just think of the spaces between the clouds in the sky and whether you can remember their shape and size. These are "negative" percepts of which we are not normally aware. We usually see only the figures, not the background – and neurons seem to determine, why. They prefer closed or bounded surfaces to open surfaces.

Metzger shows this to be true for ancient pottery as well as old tombstones. Whether figures are protruding from the background or receding into it, they are typically closed (Figure 6-8).

He also gives two striking examples of the "invisible" background in daily life: on the soccer field, when the player shoots the ball into the arms of the goalie instead of into the large empty goal next to him; and on the road, when a car that is out of control is steered towards a tree, rather than the wide open spaces next to it. Metzger writes: "Our gaze is by nature directed towards objects; one has to learn to direct it towards the intermediate spaces, the empty environment."

In Figure 9 the border belongs to the large hexagon, not the small one, illustrating one-sidedness. For comparison, Figure 10 shows a rare example where the boundary belongs to both sides of the cells of a honeycomb. Yet, handicapped children draw two boundaries instead of one (Figure 11), suggesting that one common border for two adjacent figures is the exception and may evolve later in life.

In Figure 12, the Gestalt factor of *symmetry* determines what we see: the white figures on the left and the black ones on the right. Symmetry is a ubiquitous feature of animals and plants; thus, it is not surprising that we are sensitive to symmetrical stimulus patterns.

Figure 13 demonstrates the factor of *proximity*. In "a" we see a lying cross, in "b" a standing cross, and in "c" alternation between one and the other. The sectors compete because they are equally wide. Even then, the cross as a good Gestalt remains intact. Adjacent sectors do not group together.

Figure 16A shows the power of the Gestalt factor of *smooth continuation*. Simple geometric figures become virtually invisible if they are embedded in a larger context, where the corners are no longer defined and auxiliary lines break up boundaries. Here, it becomes very difficult to perceptually isolate a figure. This fact is being used by the military in camouflage. (Search the Internet for the book by Roy Behrens on camouflage.) Figure 5 demonstrates hidden objects in everyday life.