Wolfgang Metzger: Laws of Seeing

Chapter 7. Gestalt Laws in the Spatial Effect of Perspective Drawings

Speaker: Ming-Kuan Lin (Plato)

November 24, 2009

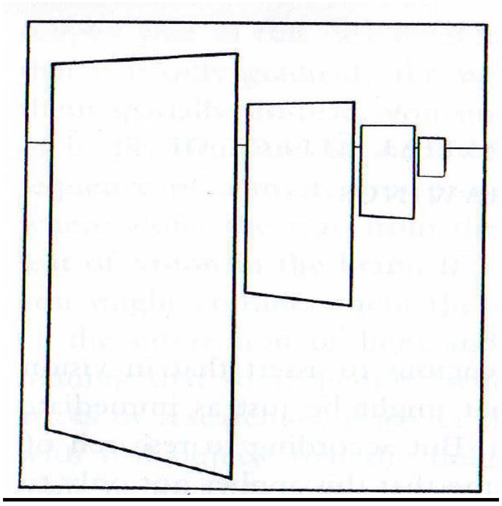

Figure 112

Demonstration of size constancy

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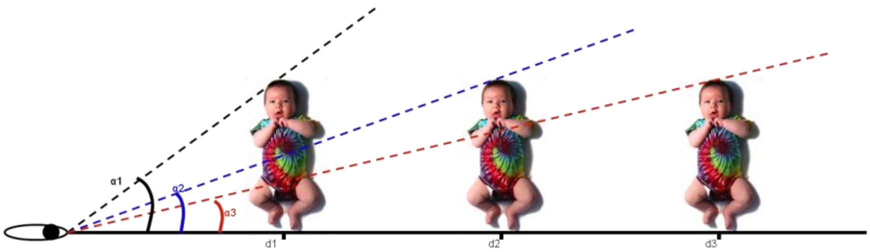
Perhaps the most important monocular depth cue is perspective. Figure 112 shows four trapezoids of different sizes next to each other, but instead one perceives four rectangular surfaces stacked in depth, one after another. All four of them have the same apparent size i.e., *size constancy*.

The size of an object's image on the retina changes continuously as the observer (or the object) moves around; but the perception of the object appears stable and size-invariant. This is called *size constancy*. The following figure illustrates the relationship between visual angle and distance of the object (here a child) from the eye. The size of the child always looks the same, but the visual angle subtended by it becomes smaller as the distance of the child from the observer becomes larger. Size constancy ensures that the apparent size of the child remains constant. There are limits to it when the distance from the observer becomes too large and, as a consequence, objects appear to shrink in size. Look down from a mountain or a plane and people and houses will be quite small. It would be a nice experiment to measure the threshold at which size constancy breaks down (check the literature).



The effect of size constancy was beautifully demonstrated in class using an animation in a natural perspective setting. A person from the background was transplanted from the back to the front, and to everybody's surprise it looked like a dwarf. Then this same figure slowly "walked" back again and while doing so appeared to grow to its former size.

A second demonstration used an afterimage to illustrate *Emmert's Law.* Observers fixated the picture of a black Venus for 20 sec and immediately thereafter projected the negative afterimage on a distant wall. As a result they now perceived the Venus in approximately twice its former size. This is to be expected if the visual system takes distance into consideration. Because the visual angle subtended by the afterimage remained the same, its apparent size would have to change.

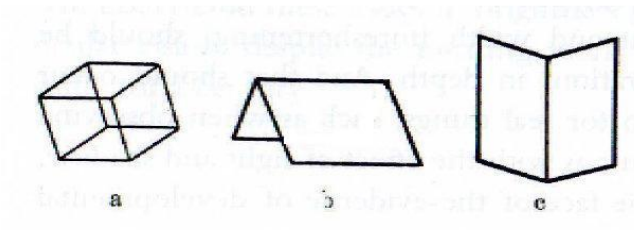


Figure 113

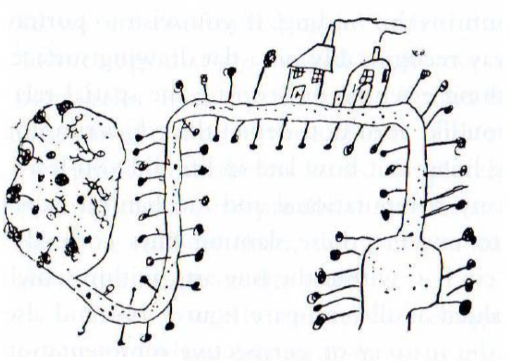


Figure 113B

Figure 113A

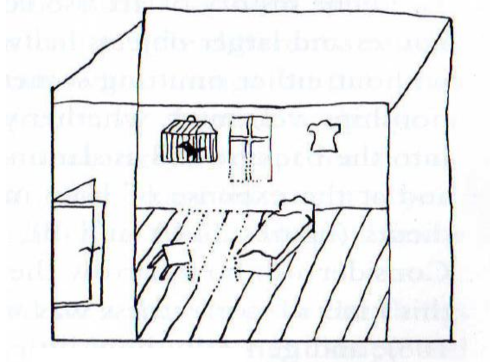


Figure 113C

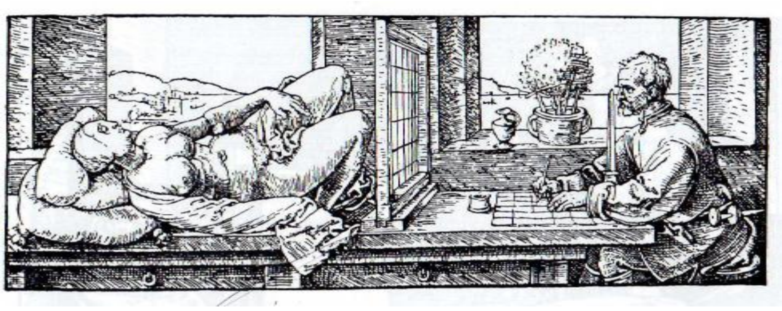


Figure 114

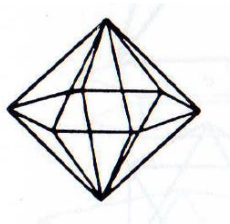


Figure 115

Size constancy is an important mechanism for establishing object identity and, thus, experience of objects in the world. An object presented to a baby at various distances must a keep its apparent size to be the same. This requirement also applies to perceived shape. To keep its identity, the apparent shape of an object presented in different views must not change, i.e., *shape constancy*. The answer to the question, whether *perceived invariance* of size and shape is acquired, that is, learned by interaction with other sense modalities, or whether it is inborn is still open. However, it is likely that both mechanisms are innate (hard-wired), as animal species must also have these abilities early in life in order to survive. For example, a young bird that leaves its nest for the first time must be able to correctly perceive both the shape and size of its nest in order to be able to return.

In Figure113, we perceive a cube, a roof and a book in depth, although all three figures are given as two-dimensional outlines only. This is because of the oblique angles, which are actually perceived as right angles (except for c).

Figure 113A-C illustrates how children 10-12 years of age depict the world. In B, the trees and houses drawn by a nine-year old are right side up and up-side down, corresponding to the different sides of the street; this child cannot yet draw perspectively. In Figure A, a ten-year old also draws the houses and trees in various orientations, but it would be false to conclude that for this child the house actually “lies down” or “hangs upside down”. In comparison (C), a twelve-year old draws his/her room largely correct, but manages only the beginnings of perspective.

Figure114A illustrates a device as used by painters in the renaissance for geometric projection. The point where the line from the target to the eye intersects with the vertical grid on the glass plate is entered on the horizontal grid lying on the table. It can be easily seen that spatial depth is largely lost using this technique. Also the artist does not have to draw a given object; the device does it for him.

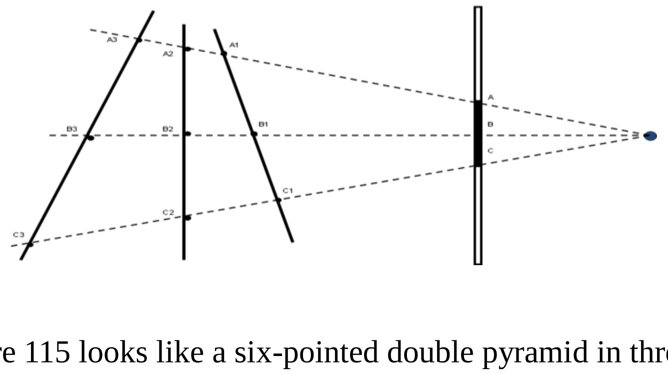


Figure 115 looks like a six-pointed double pyramid in three-dimensions, although it is depicted on a two-dimensional page. The problem of how depth can be represented on a planar surface such as to be correctly perceived is one of the most difficult questions in painting. Wolfgang Metzger (the author of this book) had lost

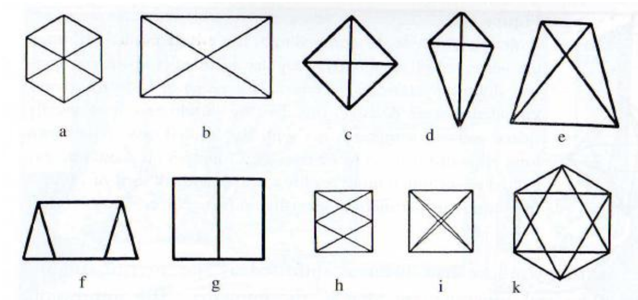
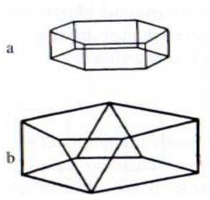


Figure 116



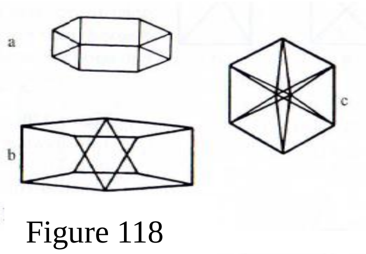
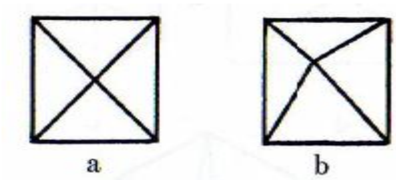


Figure 117 Figure 118



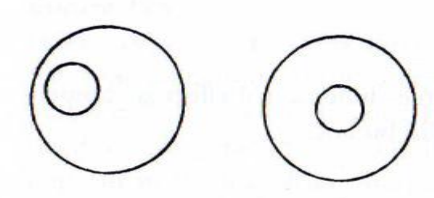


Figure 119 Figure 120

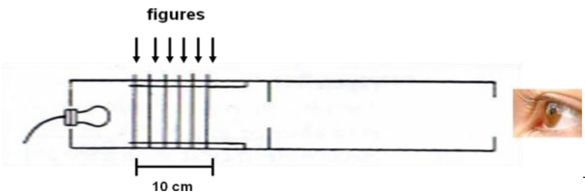


Figure 124

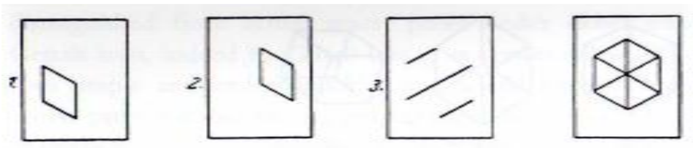


Figure 126

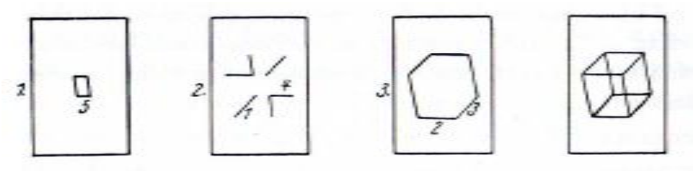


Figure 127

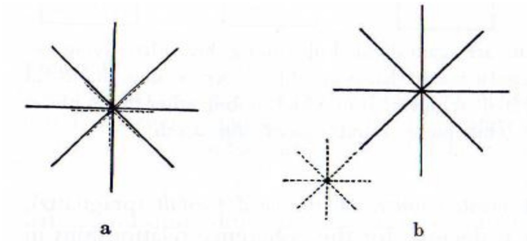


Figure 129

one eye in WWI and throughout his life was interested in this question. Figure 116 shows a number of two-dimensional figures that are actually projections of solid bodies. However, we perceive them as flat because of a number of features. These are: regular arrangement, symmetry, straight continuous lines and (in some of the figures) right angles. Figures 117 and 118 juxtapose three-dimensional and two-dimensional percepts of the same objects. On the left depth is seen because it affords a more regular percept (or a better Gestalt). The same statement can be made for Figures 119 and 120. The Italian psychologist Cesare Musatti demonstrated that Figure 120 (left) will elicit a dramatic percept of a rotating lamp shape, when it is spun around its center. After a few seconds of observation, the small eccentric circle will perceptually “lift itself” out of the plane of the large spinning disk to resemble the top of a revolving truncated cone. Try it. This is called *kinetic depth effect*.

Figure 124 shoes a device invented by Kopfermann to demonstrate that the tendency for a *good Gestalt* can overrule lateral disparity in *binocular* vision. Glass slides of the three components shown in Figure 126 were inserted into different slots of the apparatus, and thus at different depths from the observer, but were perceived as a regular star-shaped object in one and the same plane. This is also true for the components in Figure 127, which combine into a cube. Remarkably, despite the fact that real depth is discounted, the cube has a (perspective) depth of its own.

Figure128 shows the transition from a regular two-dimensional object to a regular three-dimensional object. Metzger says: “The more a flat drawing avoids regularity and tautness of structure, mirror symmetry, and inner balance in its two-dimensional configuration, the surer and more compelling the three-dimensional effect becomes.” (See also Figures 116 and 120).

Finally, Figure 129 tells us about the difference between radial expansion (in the same plane) and looming (in depth). Two star-shaped figures are presented in succession, the first smaller and the second larger. When both figures are spatially coincident (centered), the percept becomes larger. However, when they are slightly out of register (laterally displaced), the combined figure appears to come forward. Looming is already perceived by young babies as was shown by Eleanor Gibson. Another experiment by this researcher used a visual cliff (a submerged checkerboard seen through a glass plate) to demonstrate that young babies can perceive depth.

A list of *monocular depth* cues includes: perspective, occlusion, texture gradient, motion parallax, shading, brightness perspective, and atmosphere (haziness). Metzger adds to these cues the tendency to a good Gestalt. One-eyed drivers must be careful when approaching objects in front of them, as they are lacking stereo-depth and vergence.