Wolfgang Metzger: Laws of Seeing

Chapter 4. Developmental stages in shape formation

Speaker: Wei-Ming Huang (William)

October 27, 2009

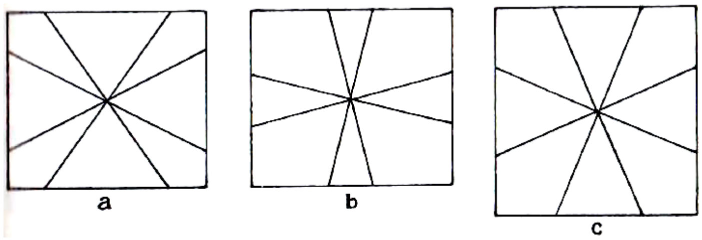


Figure 13

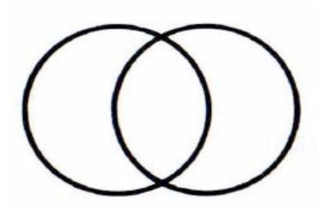


Figure 17

Figure 53 A

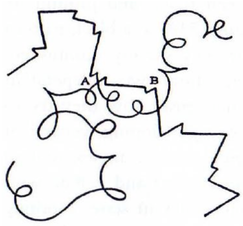


Figure 45

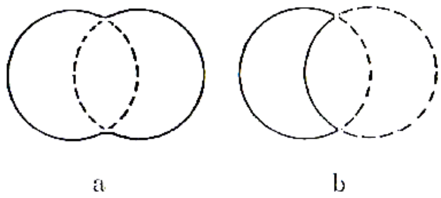


Figure 18

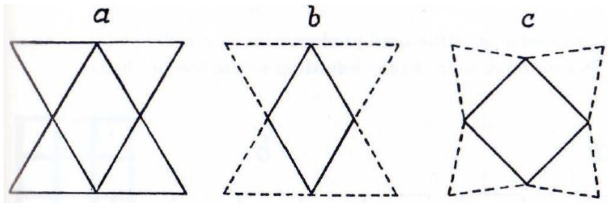


Figure 55

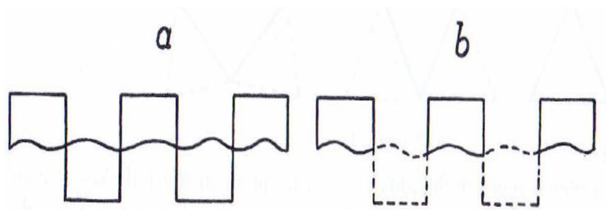
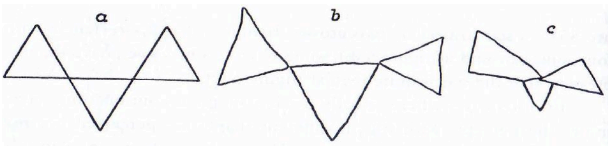


Figure 56



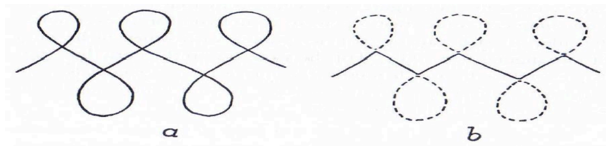


Figure 57

Figure58

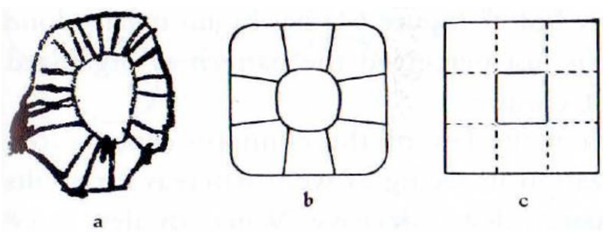


Figure 60

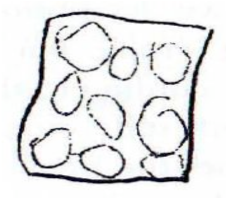


Figure 61

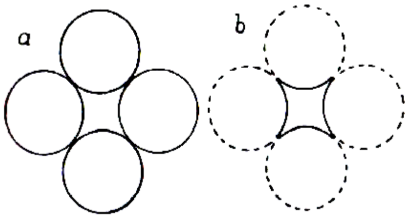


Figure 62

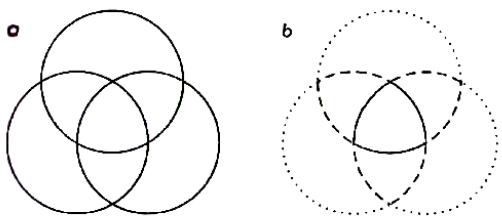


Figure 63

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In this chapter, Metzger reinforces his earlier statement that stimuli are always ambiguous (see Figures 13, 17), but as a rule are uniquely perceived according to the laws of seeing. We can influence the percept by attention, yet it takes effort.

For example, Figure 53A can be perceptually organized in smaller or larger diamonds, squares with a center dot or a grid of diagonal lines; however, the organization is unstable. Similarly, in Figure 54 one can see the curly line connected to the zigzagging line when one looks at A. But the two lines group effortlessly according to their “nature”, when one looks at B or anywhere else.

From Figure 18, we already inferred that the relative strength of the Gestalt factors is different in vision and touch. There is more evidence here. In Figure 55, the law of the *common center* dominates in the tactile sense. In touch, one *feels* a central core surrounded by four corners, i.e. the Gestalt factor of *closure*, whereas in vision one *sees* two intersecting triangles, i.e. the factor of *good continuation*. Similarly, in Figures 56-58 one perceives closed cells in the tactile sense instead of continuous lines.

In children, the factor of closure dominates even more. Figures 60 and 61 illustrate how 4-6 yr old children organize a grid in touch. The center is emphasized relative to the straight lines. Figure 61 even suggests figure-ground reversal, an array of holes versus a grid. The same dominance of the common center is observed in Figures 62 and 63 for even younger children. It appears as if the sense of touch has been arrested at a more primitive stage of development.

Metzger draws a comparison between fine touch at the finger tip and the high visual acuity in the fovea. Outside of the area of highest resolution, borders both in touch and vision become blurred giving way to material properties. Yet, it seems as though we can see sharply even to the edge of the visual field although our peripheral acuity is much reduced (see the previous discussion). The same is true for color. Figure 65 shows the boundaries for color: narrowest for green followed by red, blue, yellow and white.

The strongest segregating factor in vision is motion, i.e. the Gestalt factor of *common fate*. A small object in the periphery (such as an ant) will instantly become visible when it moves. On the other hand, a stationary object will fade and disappear

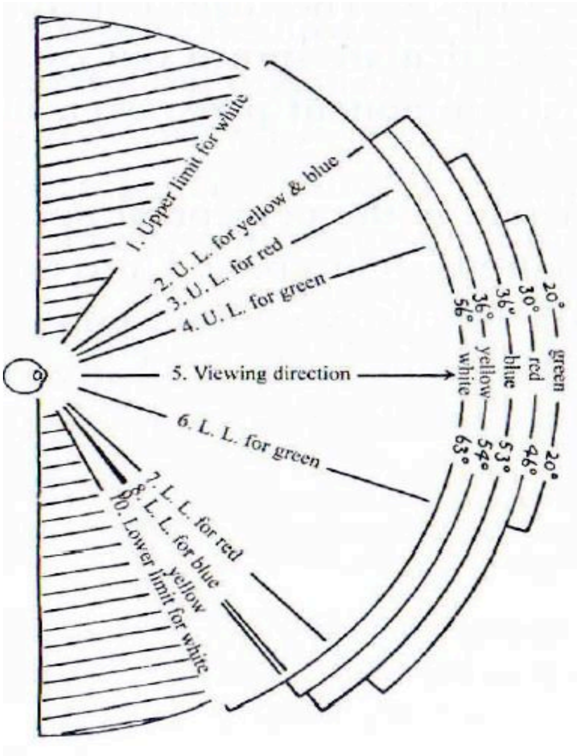

Figure 65

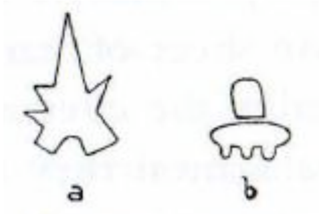

Figure 69

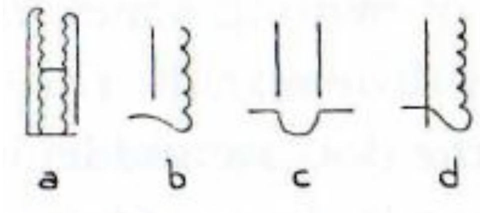

Figure 70

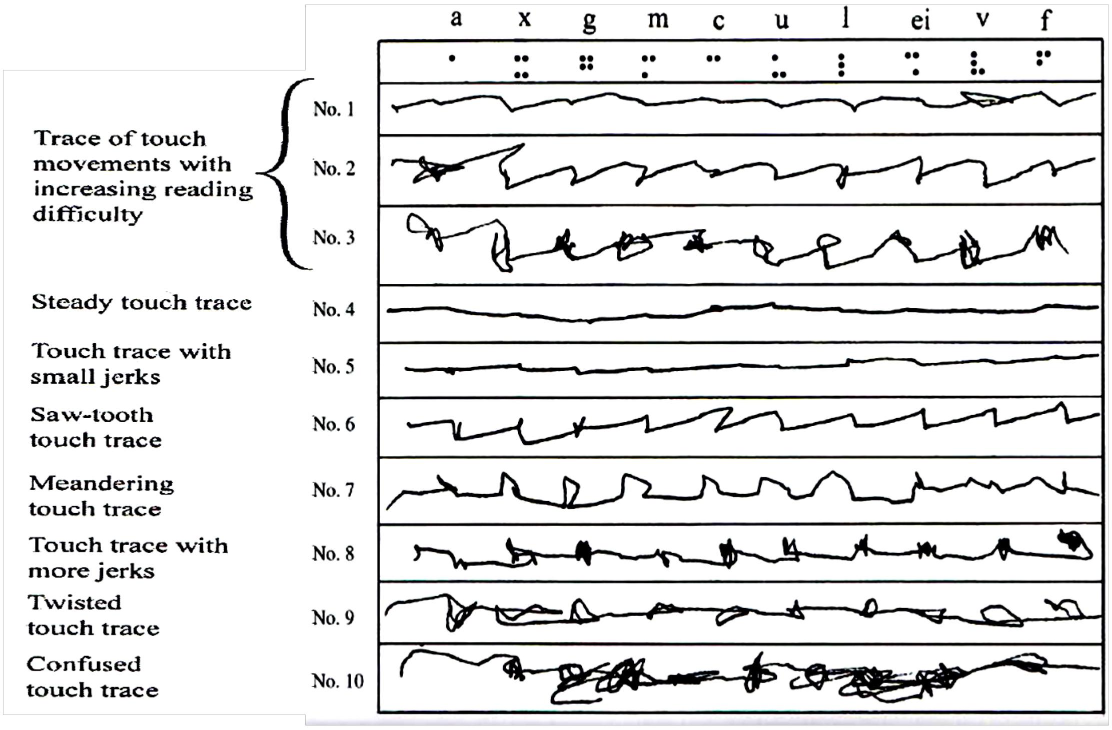

Figure 66

from view. The frog depends on this trigger and will immediately eject its tongue when an insect sits down in its visual field. Metzger makes reference to directional indicators on cars which can be seen better when moving. All of you can drive perfectly well through a narrow alley without looking to the side. This shows you the importance of peripheral vision for navigation and orientation. Without it you would be left with tunnel vision such as occurring in retinitis pigmentosa or hemianopia and hemineglect. Motion is also important in touch as is known from blind readers using Braille. Figure 66 shows traces of tactile movements for various subjects.

When an object is reduced in size, it can no longer be seen properly. Instead one perceives degraded versions as shown in Figures 69-70. A similar loss of detail occurs when the stimulus is presented with low contrast or in the far periphery. This suggests that on the way towards a percept, we do not combine an assembly of smaller sensations into a larger whole, but rather we structure our sensory field into subwholes and subdivide them with boundaries from within.

A video movie by Bernd Lingelbach was shown to give us an impression of life-size illusions (see also Shin Shimojo's paper in Spatial Vision, 2008). In the Ames Room two people look vastly different in height, one tall, the other small. But when they exchange their positions on the right and left, their relative heights reverse. Chia Yao attributed this effect to *size contrast*, suggesting that the two hind corners of the room look equal, but are actually low and high. In addition, the ground floor is distorted, receding further on one side than on the other. Therefore, we see the rear wall not only as rectangular, but also as frontoparallel, whereas, in fact, it is actually distorted. A person standing further away will thus appear to be smaller than an equally large person standing closer.

The video also demonstrates misapplied *size constancy* by showing a person seemingly sitting on a chair up front, whereas he is actually sitting on the floor further away. However, from a unique viewpoint, it appears as though the chair and the person are at the same distance from the observer. Because the person subtends a smaller visual angle, but is seen up front, he looks like a dwarf, as his actual distance in depth is misperceived. This shows that the visual brain must take distance into account for us to see the size of objects correctly.

Both effects, relative size and size constancy, are powerful mechanisms. Size constancy is crucial for acquiring experience in childhood, as without it an object of variable distance would never look the same. This also applies to illumination in the fields of brightness and color constancy. All these invariances are relational, that is, without context or a reference they do not work. Try to select a colored tie on a black table under narrow-band lighting. (Also, check the book by Alan Gilchrist on Black and White.)

The limits of size constancy do not appear to have been studied. At some point, a human being no longer LOOKS of realistic height and neither does a car and house, even though we KNOW that they have not become toy-sized. (Feel free to do a cursory study to find out when size constancy breaks down. Do it for both monocular and binocular viewing.)

When wearing goggles that reversed the contrast polarity of all objects in his environment, Stuart Anstis was unable to recognize a person, as is known from looking at photographic negatives. (Also read the recent paper by Pawan Sinha in PNAS.) However, he could tell whether a given face was happy, sad, pleasant or angry. This suggests that there are two centers in the brain for human face perception, one for recognition and the other for emotional expression. Such centers have indeed been found in face-blind (or prosopagnosic) patients, using functional magnetic resonance imaging (fMRI). The phylogenetically older and possibly more robust center for emotional expressions is subcortical, while the presumably younger center for recognition is located in the inferotemporal cortex. Face blindness after a stroke is often associated with cortical color blindness (achromatospia), suggesting primary damage to area V4.

Face blindness can also arise from a genetic origin. Nakayama and Duchaine have found a surprisingly high number of face blind school children in the larger Boston area. The social implications of this impairment in children are considerable, similar perhaps to those of children suffering from dyslexia. As far as I know, no population study has been done in Taiwan. (Read the paper by Spillmann, Laskowski et al)