Visual illusions – sensory filtering or knowledge of the world

Figure 1.

The Kanizsa Triangle. Is there actually a triangle in this picture, or is it simply made up of three incomplete circles? The above figure is known as the Kanizsa triangle. What it actually consists of is three black circles with a segment cut out of each of them, however, what we see when we look at it is a white triangle against a background of three black circles. This is one of a number of pictures that deceive the brain, known collectively as visual illusions. The process that defines what we see is called perception. Illusions are known as perceptual errors, the brain sees an image that doesn't actually exist.

There are two main explanations for illusions, these are known as the ' top down' approach, and the ' bottom up' approach. The top down approach is one supported by traditionalists, such as Gregory, Bruner and Neisser. According to the top down theorists, perception consists of processing the information received about the current environment and filling in any gaps with ideas and information already stored in the brain about what we know of the world. For example, doors and windows often project trapezoid shaped images, yet we still perceive them to be rectangular, based on pre-conceived ideas. This is an example of shape and size constancy, the " ability to perceive objects as we know them to be despite changes in the sensory stimulation which they produce" 1. The main focus of the top down theories is that perception allows our brains to go beyond the information given and fill in any gaps that may be missing with our own knowledge of the world.

An example of how this process is used to ‘ decode’ visual illusions uses the Ponzo illusion, as illustrated below. Figure 2. The Ponzo illusion: which horizontal line is longer? In the above example, the perceptual cues conflict, so the brain must ‘ bet’ on which the correct response is. 2 For example, it can either accept that the two horizontal lines are equal in length, and therefore both at the same distance away from the observer, or it can interpret the picture as a railway track, with each of the horizontal lines representing sleepers with the top one further away from the observer.

Therefore, the top one must be longer to produce the same size retinal image as the lower line. The second explanation is obviously false, since the picture is drawn on a flat piece of paper, hence the visual illusion; the brain is filling in perceived gaps in the information where actually none exist. Figure 3. The Muller-Lyer Illusion: which line is longest? The Muller-Lyer illusion is probably one of the most famous visual illusions.

According to Gregory, the reason this illusion occurs is because of what he calls depth cues. 3 Gregory says that the arrow with the ingoing fins provides perspective cues which suggest it could be the outside of a building, and the outgoing fins suggest the inside corner of a room. The ingoing fins are seen as walls going away from us, therefore the arrow is, in a sense, closer to us. The outgoing fins are seen as walls coming towards us, so the shaft is further away from us.

However, the retinal images produced by the shaft are equal, and according to size constancy if two objects produce equal sized retinal images, and one is further away, the further away one must be longer. This process is all

taking place unconsciously however, so the illusion is seen immediately. This is all very well for a theory, but if the depth cues are removed, then according to Gregory, the illusion should not be seen. However, this is not the case.

(See below for example.)Figure 4. The Muller-Lyer illusion with depth cues removed. As can be seen above, the illusion still persists with the depth cues removed.

This suggests that not all illusions can be explained using one simple principle. Another argument against the top down theory of perception is that illusions still occur with full knowledge of why they do, why doesn't out knowledge of why the illusions occur enable us to reconstruct our hypotheses and therefore not be fooled by visual illusions? An alternative to Gregory's theory is one proposed by Gibson, known as bottom up processing. The basis of Gibson's theory is that the input from the outside world is much richer and full of sensory information than simply one picture at a time. For most empiricists (top down theorists) the starting point is the retinal image, however, for Gibson the starting point is a " pattern of light extended over time and space..

. an optical array containing all the visual information from the environment striking the eye" 4. The information takes three main forms: optic flow patterns, texture gradient and affordances. Gibson defined a series of cues, to which the same rules can always be applied. For example, smaller objects are seen to be more distant, brighter objects are seen to be nearer, as is an

object which blocks the view of another one. Optic flow refers to the phenomenon that occurs when a person is moving towards a certain point.

The point towards which they are moving is seen to be static, and everything else is seen to move away from that point, like a radial expansion of textures. 5 Textures seem to expand as you get closer to them, for example, grains of sand up close have a lot of texture, but looking at a beach in the distance it looks smooth. When a person is moving the textures are continually expanding and contracting around them (as they perceive it), these are known as texture gradients. The final point Gibson makes is that objects are not judged in isolation, but in relation to their environment. This he calls affordances.

For example, an object is judged as being further away in relation to a closer object, or in relation to the horizon. The concept of affordances is al part of Gibson’s idea that all the information needed to make sense of the visual environment is directly available in the visual input, hence bottom up processing; building up a picture from only the information received. The problem with this theory is that human beings don’t just live in a physical environment, but a cultural one as well, for example, we need knowledge of writing and the postal system to know that a pen is used for writing and a letterbox is for posting a letter. 6The fact that we live in a cultural environment can be further illustrated by cross-cultural studies. The studies of visual perception have mainly focused on testing different cultural groups with similar materials.

Early cross-cultural studies suggested there were cultural differences in susceptibility to perceptual line illusions, suggesting that physical environment might be a factor in susceptibility to illusions. 7 Segall et al (1963)8 studied many different cultural groups, including black Africans, white Africans, Americans and Filipinos and discovered a number of cultural differences in susceptibility to visual illusions. African tribes who lived in open country giving long lines of vision were more likely to be susceptible to visual illusions than tribes who lived in a jungle environment, with its short lines of vision, suggesting environment is linked to our perceptual abilities. Segall et all also found support for their argument when comparing various cultures living in rural or urban environments. Rural African Zulus were less likely to be fooled by angular illusions than urban Europeans. Segall et al attempted to explain these differences by suggesting that past experience is central to perceptual abilities, which is determined by our physical environment.

In Western culture, the physical environment is mainly artificial and uses more straight lines than the natural world; therefore this information is used to interpret perceptual input. 9 This supports Gregory’s top down theory of perception. As always, there are many studies carried out which contradict any theory suggested, as there are many supporting it. Jahoda (1966), Gregor and McPherson (1965) found no support of Segall et al’s work. 10 Another valid point to consider is research using visual illusions relies in introspective reports, which are always susceptible to bias, if the relationship between thought and language is hazy.

The best conclusion in this case, is that although there are some biological factors involved in perception, some aspects of it are influenced by the environment.