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PSY 27 - Perception
Blog #1

Stereograms

A stereogram is a two-dimensional image that can be perceived in three dimensions due to an illusion of depth. Stereoscopy, the technique for creating stereograms, involves overlapping or placing two nearly identical images side-by-side to manipulate our binocular vision. Binocular vision is how individuals with two eyes perceive depth: the right eye focuses on the left image, the left eye focuses on the right image, and those two images merge to form one cohesive proximal image. When the two images are slightly altered, the difference between them causes aspects of the combined image to protrude or project backwards, as if it is in a different dimension.

Although we have yet to discuss stereograms, binocular vision, or depth perception in class, when we discussed the Chevreul Illusion, I thought of the poster on my bedroom wall—a “Magic Eye” stereogram—and its illusion of depth. I wondered what process might create such an illusion. I thought about how an image can be focused in different places of the eye, such as in front of the retina (myopia) and behind the retina (hyperopia). In trying to view a stereogram, my eyes allow the image to come in and out of focus. Am I relocating the proximal stimulus in front of or behind my retina in order to find a specific point of focus? Or is the proximal stimulus at my retina, where it should be, and the intermittent focusing is from the accommodation of my lenses? Is this constant accommodation why I cannot stare at my stereogram for an extended period of time without experiencing eye fatigue? Who discovered the stereogram, anyway? And why are some stereograms easier to perceive in three dimensions than others? Finally, are stereograms processed in the occipital cortex like other visual stimuli?

I was pleasantly surprised to find a number of articles about stereograms. Originally I was planning on writing about visual illusions in a more general sense, but I find many visual illusions to be quite frustrating (e.g., the Ponzo Illusion), and I wanted the opportunity to research one specific illusion in more depth (no pun intended). I know many people do not appreciate stereograms (on account of the eyestrain), but I think stereograms are incredible. And without further ado, here's what I learned.

Who discovered the stereogram? The answer is unclear. Some people believe that Leonardo da Vinci's *Mona Lisa* is the first stereogram, and others believe the first stereogram was created centuries later. However, what is apparently undisputed is that the stereogram became *popular* in 1838 thanks to a Sir Charles Wheatstone, inventor of the stereoscope. (Brooks, 2017)

Why are some stereograms easier to perceive in three dimensions than others? The answer is simple: adding depth cues enhances 3-D perception. An example of a depth cue is binocular disparity, which is the distance between the two images that are to be merged. This cue explains why people recommend staring at a stereogram from a few inches away (at a high binocular disparity) and then slowly moving backwards (decreasing the binocular disparity) in order to perceive the illusion. Another depth cue is provided by shading; however, this cue is not involved in random-dot stereograms, which are stereograms that appear to be made up of random dots. In fact, the dots are far from random; on the contrary, they are placed strategically to form a pattern. (Dövencioglu, Ban, Schofield, & Welchman, 2013)

Finally, are stereograms processed in the occipital cortex like other visual stimuli? Here the results are somewhat mixed. In monkeys, researchers using micro electrode recordings and fMRI studies found that the *temporal cortex* is associated with depth perception processing (Verhoef, Decramer, van Loon, Goffin, Van Paesschen, Janssen, & Theys, 2016). However, by testing epilepsy surgery patients before and after an anterior temporal lobectomy, researchers found no effect on depth perception ability, suggesting that depth perception is processed in a different brain region in humans than in monkeys (Verhoef et al., 2016). By studying fMRI responses (in humans), some researchers found that the *dorsal visual cortex* was most activated during depth perception processing (Dövencioglu et al., 2013). And, using functional near infrared spectroscopy (fNIRS) to study the haemodynamic response (i.e., changes in blood flow) in the brain while (human) participants viewed stereograms, other researchers narrowed down the *right parieto-occipital cortex* as being most associated with depth perception processing (Ward, Morison, Simpson, Simmers, & Shahani, 2016).

Whenever stereograms came to exist, however they work, and wherever in the brain they are processed, I will still think they are amazing. The highlight of my annual visit to my optometrist is staring at his stereogram of the Statue of Liberty. Finding the hidden image is thrilling, and if you have not yet seen a stereogram, I would recommend enduring the temporary eye strain to experience the thrill yourself.

References

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