Exercises in Three Dimensions

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About 3D

Due to mechanical and functional limitations, our eyes can take in only a fraction of external reality. For example, we can't see microwaves or ultraviolet light because the photoreceptors (rods and cones) in the back of our retinas can process only a limited range of light wavelengths.

The fact that the lenses of our eyes are flat (2D) further limits the amount of information we can perceive with our eyes. Each eye reads the world as a flat image, not as a three-dimensional one. It is only when our brain combines the flat images into one that we see depth (3D).

Fortunately, our brains can work with the 2D information available to construct 3D images. It is easy to overlook this fact because we are not consciously aware of the process by which information is coded and transmitted from our eyes to our midbrains to our cortex. For example, our brains might extract information about depth by comparing what the right eye sees to what the left eye sees from its unique anatomical position. This process of extracting depth cues by comparing information provided by the right vs. the left eye is called stereopsis.

Just because stereopsis is beneath conscious awareness does not mean that artists cannot take advantage of it. Consider, first, that artists are already in the practice of using techniques such as shading and perspective to create the illusion of depth. Adding a stereopsis-based technique to the artist toolkit requires an interesting prop: traditional red and cyan tinted 3D glasses (cyan = blue-green).

It's not an accident that the colors chosen for traditional 3D glasses are red and cyan. Our vision processing systems use red and cyan comparisons, as well as blue and yellow, to determine the color and contours of objects. These two comparisons, in addition to information about luminance, can be used to create millions of internal color combinations.

With red and cyan tinted 3D glasses one eye sees a world in which red appears to be whitish and cyan appears to be dark, and the other eye sees a world in which cyan appears to be whitish and red appears to be dark. (You can test this for yourself by wearing the 3D glasses and then closing one eye at a time.) When we look at overlapping red and cyan images through red and cyan filtered lenses, our brains are tricked into seeing depth. In reality, the difference between what the right eye sees and what the left eye sees is due to 3D glasses, not depth.

Another way to understand this phenomenon is to consider that we always see (when looking at the world with both eyes) two images that are separated from each other by a slight distance. It is only because our brains combine the two different images into one that we see the world in three dimensions. In these exercises, we are actually presenting the brain with two images—one in red and one in cyan, with occasional overlapping of the images—but because of red and cyan filtration only the left eye can see one of the images and only the right eye can see the other. Our brains try to make sense of the differences between the two images by interpreting those differences as representing physical distance.

References

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