

Perceptual Optics — 7. Ten Trillion Voxels in Perceptual Space?

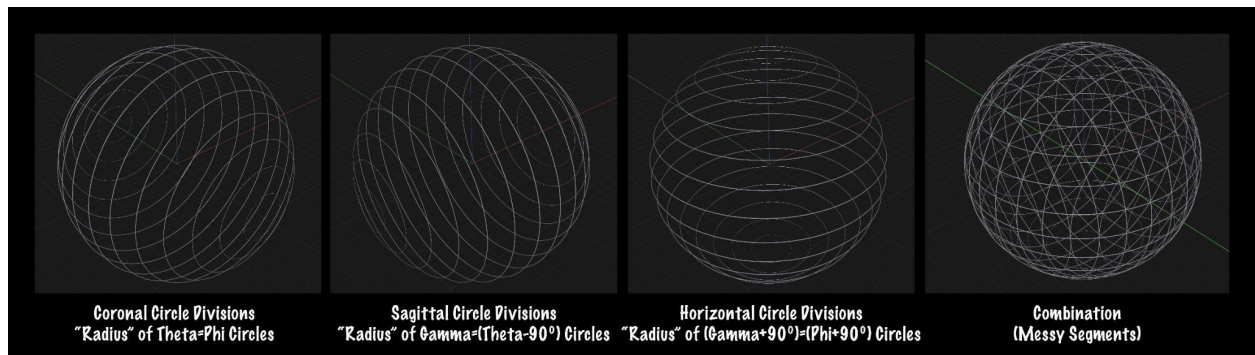
Brad Caldwell

A main takeaway from lesson six is that it may be that the brain builds 3D perceptual space from the foveal object outwards, rather than starting with painting the body or eyeball. Or, it may go further and simply tether your foveal object voxel or the back of your body to the centroid of perceptual space. This would allow some movement, some give, some “hysteresis.” I am not sure which is true, or if something slightly different is true.

Nevertheless, as with lesson five, if we are ever going to learn how consciousness (and visual perception) works, we must go forth into uncertain territory boldly.

At a minimum, geometry dictates that there is a sphere of environment around us, perceptually. That is, there are 360° of theta (yaw), 360° of phi (pitch), and 360° of gamma (roll). Or, more concisely, there are 41,253 square degrees which the solid angle of the sphere of perception can be divided into, like a bunch of tiny cones forming a Christmas star cluster ornament.

The surface of a sphere is a funny thing. It does not allow a large number of points to be evenly distributed over its surface. Rather, one must place points at hexagon intervals while throwing in perhaps twelve pentagons. So any way you divide the space up, it won't be nice and neat.



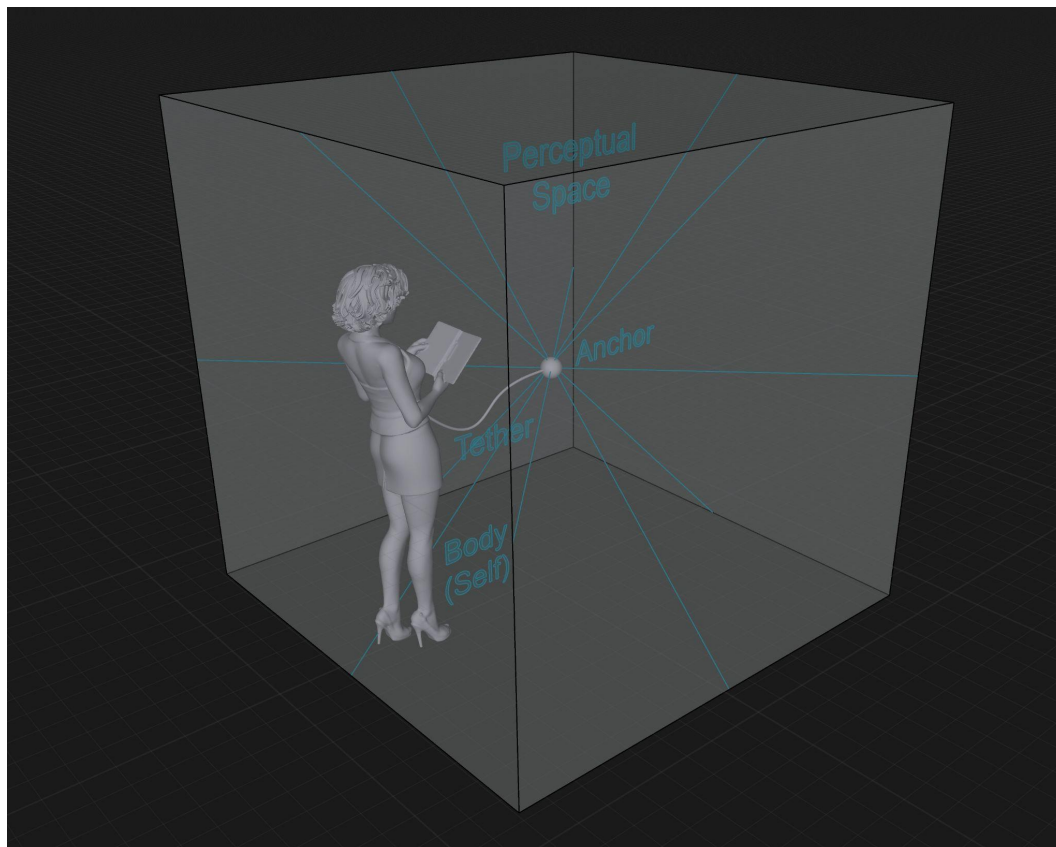
I think it is true that perceptual space is fixed. Or, stated another way, the “TV screen” that shows the “story” of consciousness is fixed and never moves.

What I am unsure of is whether your foveal fixation point stays fixed to the center of this 3D “TV screen” your entire life. If it did, then when you move your physical eyes, the brain would paint a changed scene that “kicks out” the older stuff by the distance between the old voxel and the new voxel. Perhaps a separate “bank” is given (by the greater hippocampal region) to the (perceptual) “world” to ensure it is always “held together” as an immutable 3D raised relief topo skin.

But it also seems possible to me that where you are looking (the foveal fixation voxel) is allowed to have a little slack (like a steering wheel that must be turned a certain amount left before you can recover from it having been turned right) with a different centroid point of the most fundamental perception bank.

In favor of the foveal fixation point always being by definition the centroid of the 3D “TV screen” of consciousness, the same neurons in the visual cortex are always called upon to represent foveal stimulus.

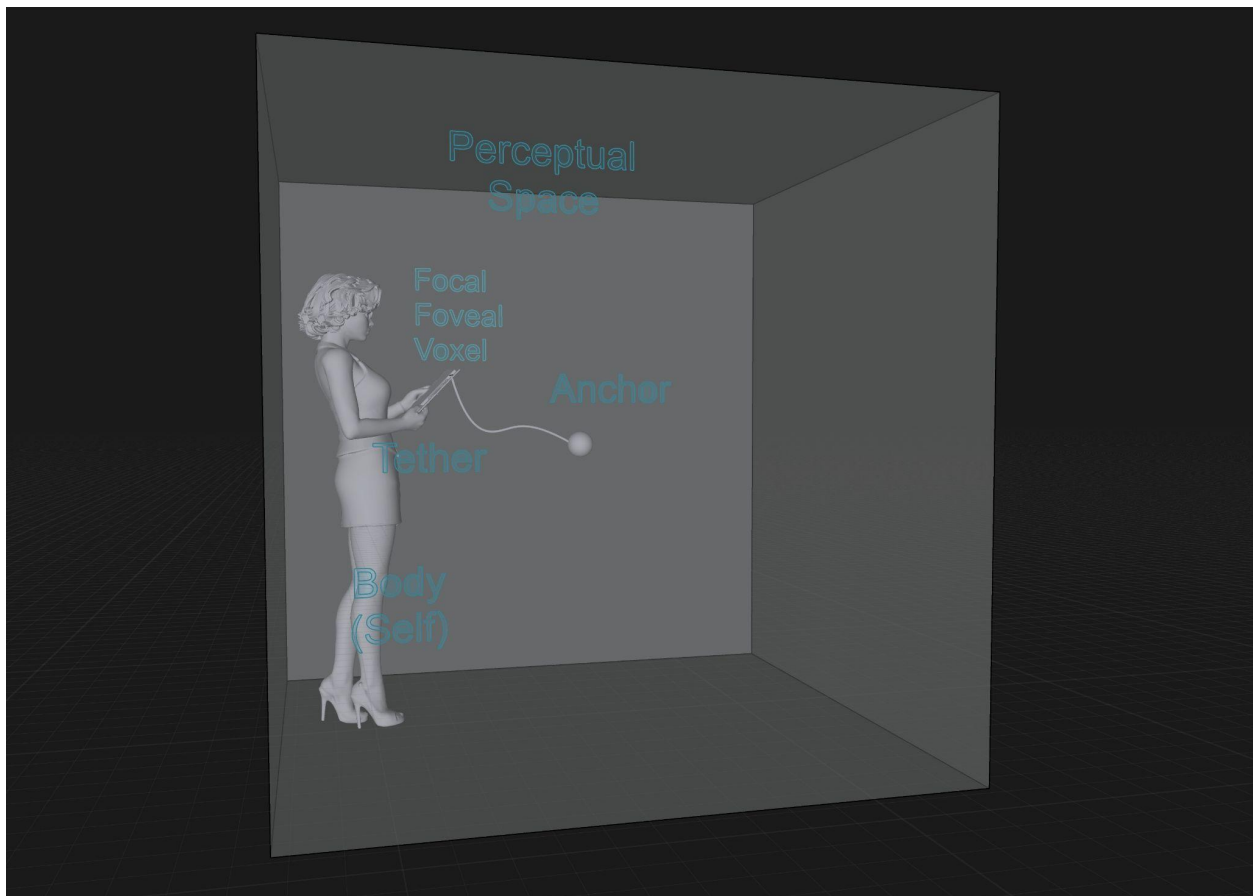
In favor of having a “random” centroid that never moves, and simply tethering your foveal fixation point or the back of your body to this centroid, it would allow for perhaps more sense of stability in the world as you dart your fovea (eyes) back and forth.



In the image to the left, the “tether” of the perceptual body (the back in particular) to the perceptual 3D “screen” is depicted. Some hysteresis in this model is allowed, although movements greater than three feet trigger a repainting of

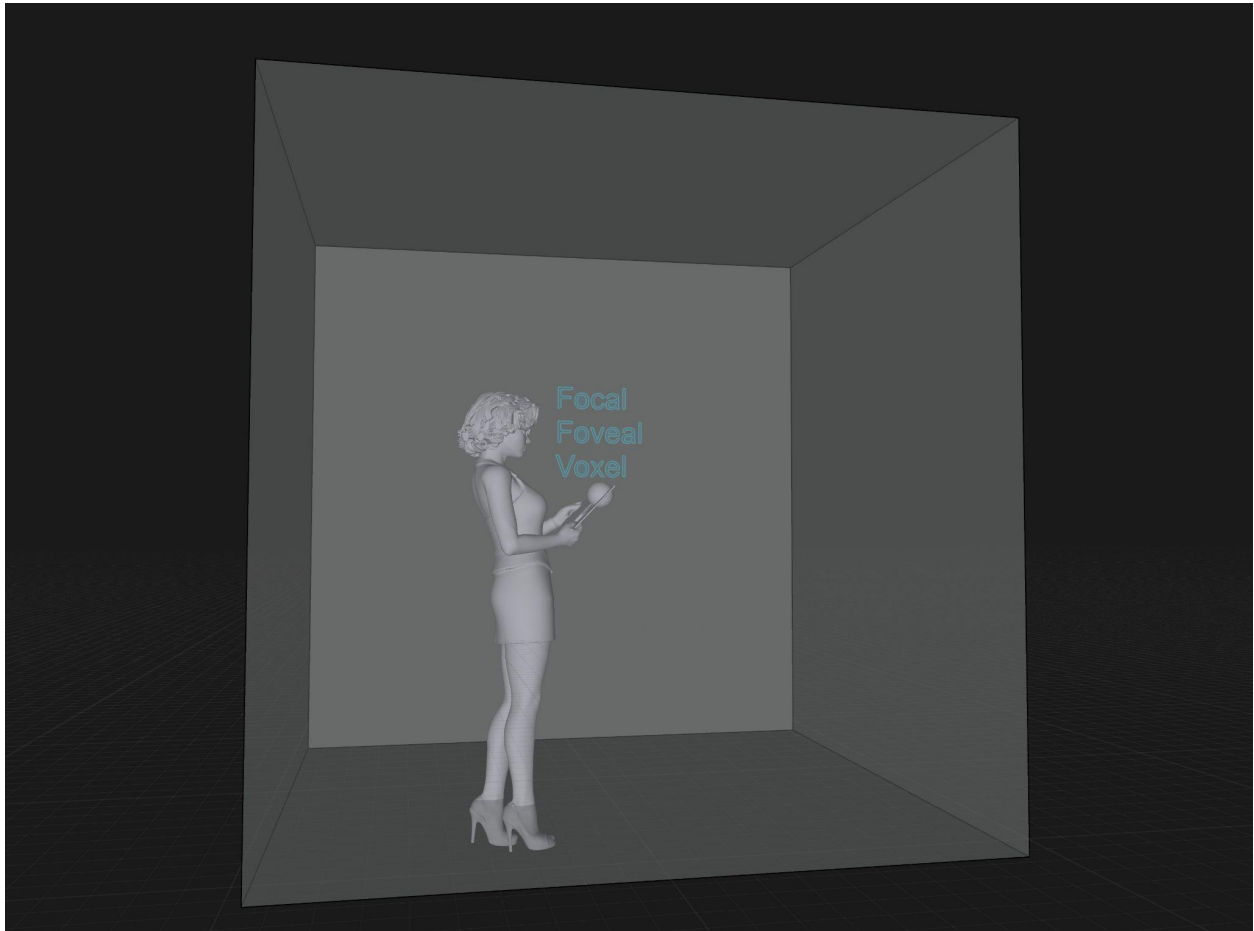
the perceptual world and a recentering of that perceptual world relative to the “anchor.”

In the next image, the tether is attached to the focal foveal voxel. Of course, this “tether” is a functional, not a spatial or actual, one. It is a “rule” of “keep focal foveal voxel close to “centroid anchor” of 3D “consciousness TV screen.” Or a rule of “keep back of perceptual human tethered close to the centroid of the 3D screen.” Anyway, below is the tether attached to focal foveal voxel.

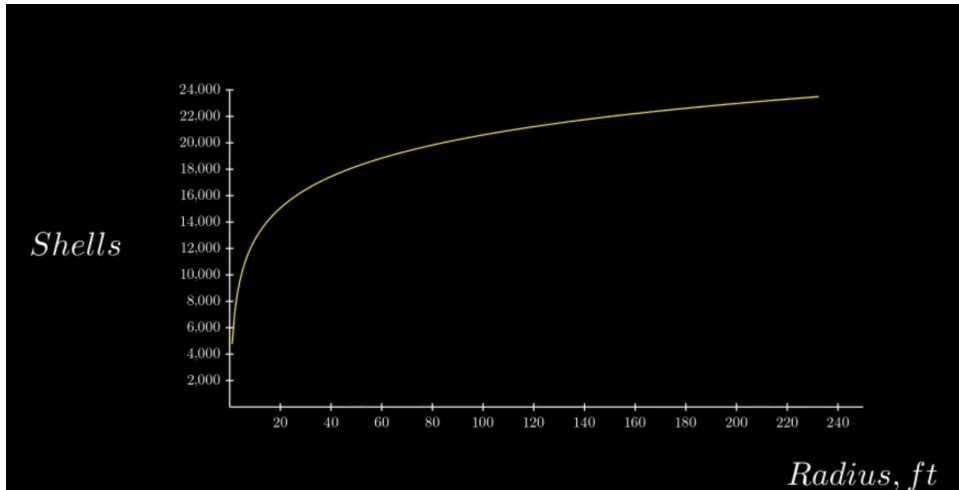


Finally, I will show the anchor being eidetic with the focal foveal voxel, a third exploratory possibility (see image next page).

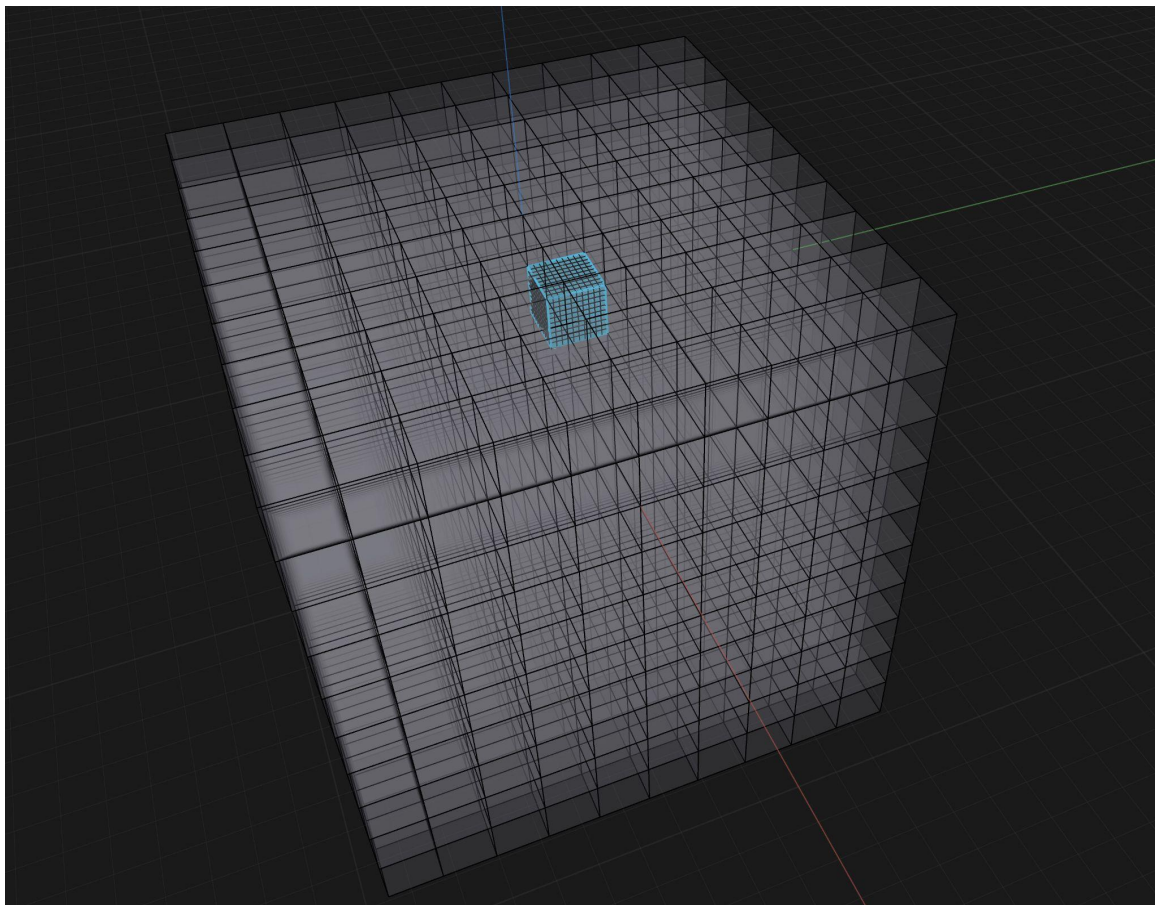
If the focal foveal voxel is indeed the center of the 3D perceptual “screen,” then the (perceptual) world gets “man-handled” and spun around like a spider and stretched in all sorts of ways, just by the geometrical fact that farther items are compressed spatially when made into a perspective image. If this is true, the brain probably devotes another “copy” of the “bank” to the perceptual world so as to keep it adhered together as a single unified whole. The “bank” seems similar to, or eidetic with, the 3D perceptual “screen.”



In any event, we know the fovea has incredible resolution, being able to discriminate a single arc-minute (one-sixtieth of a degree of theta/phi/gamma). That means it can discriminate 50 million pixels in the human's typical field of view, if allowed to move around. This is roughly $\frac{1}{4}$ of perceptual space or $\frac{1}{4}$ of the entire sphere solid angle surrounding you. If we assume similar capabilities of depth resolution (at 2', we could discern well under a millimeter of width [theta] or height [phi]), we get a distribution of "sphere shells" as depicted in the figure on the next page. Assuming about 100 feet of depth is in view, that would be roughly 20,000 steps of depth discrimination, or 1 trillion voxels. For there, it is each enough to allow the head to rotate around and up and down so as to allow the fovea to look in any direction outward from the center of a sphere. If we allow a larger scene (say, 10,000 feet of depth), we could theoretically discriminate 36,420 steps of depth, yielding nearly 7.5 trillion voxels without ever moving (translating)! I'd say that's pretty close to ten trillion!



That gets us to another question. Surely the brain is smart and saves resources. If you only need to precisely know the locations of voxels of one area, it could use a bank with 10x10x10 subdivisions of a 10' cube, then select the right cube, and subdivide it into 10x10x10 voxels, then find the right voxel there, and subdivide it into 10x10x10 smaller voxels. The “basic location” of objects could be given first, then “honed in” to greater and greater resolution until you reach that maximal single arc-minute of theta/phi (/radial depth?) resolution.



The image on the previous page shows *two* orders of magnitude of 10x10x10 division of a cube of perceptual space. The image below shows *three* orders of magnitude of 10x10x10 division. Theoretically, this could go on as much as desired. This is theorized to be the 3D “screen” on which consciousness is painted (includes perceptual world and perceptual body).

