Creative Minds: Reverse Engineering Vision

Originally researched and written by Dr. Francis Collins

The big picture

Dr. Gregory Schwartz works in total darkness. Only in total darkness can Dr. Schwartz isolate cells in the eye and stimulate them with the natural input—light—to get them to fire electrical signals. Watching these signals allow vision researchers, like Dr. Schwartz, to learn how the eye functions. These researchers are not designing a new eye. These researchers are looking at how a functioning eye works to understand it better.

The retina is the part of the eye that is light-sensitive. The retina lines the back of the eye. It is about the size of a postage stamp, but has an estimated 130 MILLION CELLS! These cells create many information pathways that absorb light and translate it into electrical signals.

Caption: Networks of neurons in the mouse retina. Green cells move electricity between cells. The red and blue cells are two types cells they are studying.

Credit: Jason Jacoby and Gregory Schwartz, Northwestern University

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Reverse Engineering

The Problem
Like other parts of the eye, the retina can break down, or fall apart. Diseases in the retinal diseases are the leading causes of vision loss and blindness worldwide. The National Eye Institute predicts 2 million people will technically be blind by 2030 (the study is here). If Dr. Schwartz can learn more about how the eye works, he may be able to fix these problems that cause blindness.

The Solution
Dr. Schwartz works at his lab in Chicago with Dr. Jillian Goetz, Dr. Adam Mani, Amurta Nath, and others. Dr. Schwartz is part of a large group working together to assemble a parts list that accounts for all the cell types needed to make a retina. When Schwartz and others get closer to wrapping up this list, the next step will be to work out the details of the internal wiring of the retina to understand better how it generates visual signals. It’s the kind of information that holds the key for detecting retinal diseases earlier. The research could also help doctors fix miswired circuits that affect vision. In the future, they may be able to create a working retina in a lab. Like people with prosthetic legs, some people could have a prosthetic retina that allows them to see.