

# Color Perception is in the Retina

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**Abstract**—My assumption is that sensing of light, color light probably is in the retina, namely in the cones. In the cones as receptors, the photo-pigment undergoes alteration proportional to the intensity of radiation. We are proposing that some of the new compounds originated have the ability to produce - within the cone - a "flash", i.e. a sense of light. The three different cones near to each other give a flash, blue, green and red according to the intensity of radiation and these three flashes should be accepted as the middle hue and brightness. The large number (6-8 million) of cones can give an image with good resolution.

**Index Terms**—Color,color-vision, cones, eye, image,perception, photoreceptor, receptor, resolution, retina, sense, image, resolution.

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## 1 MY REASONS ARE

1. Each cone contains several thousands of photo-pigments. The degree of excitation of pigments is proportional to the intensity of radiation. Greater intensity excites, at the same time, more pigment molecules and - in compliance with this - cause potential-alterations in the cell, and when the potential arrives at the level of hyper-polarization, the cell gives a signal to the bipolar cell. If more pigments are excited, or altered, the same intensity of radiation can excite fewer pigments. This way the number of excited molecules will represent the intensity of radiation in certain functions, which are not linear and will result in a function of saturation and a given intensity of radiation will create equilibrium between exciting and restored pigment molecules. The density of impulses, given by the cone cell, isn't proportional with the intensity of radiation, and so the impulse can't represent the intensity of radiation. [1], [2], [3], [4].

2. The information of 120 million rods and 6-8 million cones, contained in the retina is transmitted with the help of 1 million optic nerves to the LGN and further to Visual Cortex. Near to fovea, in a circle of about 4 mm, 1-2 cone are synapse to a bipolar cell, further to the periphery 3 cones are connected to bipolar cell and further 3 bipolar are synapse to a ganglion cell. But in this case, it is not probable that every ganglion cell is connected only to the same cone type. This means, that in this case there isn't any color information. Thus from bigger part of retina there is no color information to the brain. [5], [6].

3.Experiments made for the study show that the mechanism of color vision can give information to several neurons in retina, LGN, Visual Cortex and on which type of radiation, arriving the eye (cones) give electric signal. A given neuron can show that some hue or wave-length of radiation gives electric signal in the cell, but other wave-length do not. Based on these data it was presumed, probably by mistake, that the given cell is sensible to the given hue, wave-length, brightness and many other features. Is it possible that a given neuron (bipolar, ganglion cell) can

have contact with cones 1, 2, and 3 of the same type, but they can also be two or three different cone types. If the neuron are synapse to one or more cones of the same type, they can respond only to the given wave-length interval. But if synapses are different, two or three types, the neuron will reply to all the intervals. Probably, these types of neurons are called opponent cells. But the other possibility may also occur. If a neuron shows sign from a blue and a yellow monochromatic light, than really (strictly speaking) can't be known, that beside S cone this neuron get data from L or M cone, or from both. It is so, because (570 nm) the yellow beam will excite both M and L cones. Presumably it is the reason why the blue-yellow opponency is considered very important. From experimental data conclusions are drawn that there are neurons, sensible to lines, edges, movements, etc. But the information got the neuron in form of impulses give only yes or no sign, and also it might be ON (positive) or OFF (negative) sign. So these signs cannot transmit color data, data for form, movement and the impulses do not contain other information.[7], [8], [9], [10].

4. The cones and rods are external receptors. It means that they contain the photo-pigment, which is capable to an alteration from the electromagnetic radiation which arrived. It can be considered a camera, which gives electric signal to the brain. But on the other end, we have to find a so called monitor. The "monitor" neuron ("representing" neuron) has to react on the signal from the optic tract and give a sense of "flash". We have to presume, that the reaction can't be an electric alteration, because in the neuron cell there is every time some potential level, and it alters several times. We have to consider, that this representing neuron also has to be a type of receptor, which contains some specific molecule producing the feeling of sight. Thus we can consider the cone as the needed receptors. [11], [12].

5. The visible field we see with two eyes can be divided into three parts of nearly the same size. The middle part we see with two eyes, this is the field of stereo sight. The two outside parts we see only with one eye; the left part with the left eye and the right part with the right eye. The size of

these parts is nearly the half of field we see with one eye. The optic chiasm transports the data of the outer half (temporal side) of the retina to the same side LGN, but data of inner half (nasal side) cross and go to the other side LGN. As the lens give reversed picture, the temporal half of left retina see the middle part of the visual field and the nasal part of the right retina see the right third of the visual field. It means that the left LGN and the left Visual Cortex get the data of the two third, which we see with the right eye. The problem is, that the two third parts come from different points of view and their form does not give a picture we see with one eye (closed other eye). So the question remains: what can we see if the image evolves in the Visual Cortex when one eye is closed? The only answer to this question can be that in LGN and Visual Cortex the image we see with one eye does not appear. [13], [14].

6. As our eye can distinguish nearly 1 million hues, brightness, perhaps we can say that one representing neuron isn't capable to represent this. An electric sign, detected, measured in a neuron didn't show that in the neuron the sense of light appears. So, perhaps experimental data couldn't prove (or it is not easy to prove) when and where the sense, the illusion of "vision" appears.

7. For the good resolution of image many pixels are needed. One million axons transmit the data of 6-8 million cones and 120 million rods. But many axons transmit the data of 9 or more cones to the LGN, without color and intensity information and it means, that these information can't be enough to produce image with known resolution.

8. In connection with the perception of color, a very strange question can be asked. Color can't be characterized with words. We learn it seeing a given sample and we are told, it is red, yellow, etc. But it doesn't verify, that we - people with different proportion of S, M, L cones - perceive quite the same hue sense. It is quite likely that people with different proportions of S, M, L cones perceive the same sense. But observing a given color sample we will say the learned color name. The examinations of color vision are made subjectively and this can cause misunderstandings. [15], [16], [17], [18], [19], [20].

## 2 CONCLUSION

The listed reasons show, that only in the cones exist the conditions that can result in the sense of sight, color vision and can produce the whole image.

The supposition that the sensation of seen image evolve in the retina, in the cones was made without direct experiments. But based on data from the literature and taking into consideration the great number of distinguishing color hues and brightness, the observed good resolution of seen picture, the independent

appearance of image in two eye give the only solution to the problem. On the basis of all these we can declare that this model for the mechanism of color vision is acceptable, presumable and that the mechanism of vision is this, or very similar to this.

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