

What is the purpose of color for living beings? A Theory of Color Organization

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Phylogenetic and paleontological evidence indicates that in the animal kingdom the ability to perceive colors evolved independently several times and has existed for at least half a billion years. The color system is also considered newer and independent from a luminance system. This implies a high evolutionary neural investment and suggests that color vision has some fundamental and specialized functions providing biological advantages. What are these advantages? What is the purpose of color for living beings? Why are fruits usually narrow band? How is color organized in flowers? Why are animals so colorful? What are the adaptive and perceptual meanings of polychromatism?

To answer these questions, we studied psychophysically new conditions of the watercolor illusion related to color filling-in; that is, the process of whole completion due to color that creates the uniqueness and distinctiveness of the visual objects. We studied conditions where color filling-in is satisfied and conditions where it is violated. This suggests that, next to the filling-in process, there is a chromatic parcelling-out process of separation, division and breaking of a whole object into unconnected and ungrouped elements. This process destroys the amodal completion of color (Pinna, 2008) that creates the uniqueness and distinctiveness of the object. Our data suggest several principles of color filling-in and parcelling out that can be subsumed within a more general theory of color organization. This theory explains (i) how to creates a hierarchical structure within the same object, then favoring the emergence of several components (e.g., the central region of a flower) on the whole object, (ii) how a chromatic part-whole organization emerges, and (iii) how colors create a hierarchy of perceptual meanings that in biology can be related to higher adaptive fitness. This happens with organisms, like plants, whose aim is to be seen, but also with organisms whose aim is to be concealed.

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