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{Khan, 2011 #18659}

Are color categories innate or learned?

Color categories are a fundamental part of experience that allow humans to parse visual and conceptual information. Children play games grouping objects by color; cities organize subway systems with color-coded lines; and cultures distinguish their members by skin-color categories. Following Galileo, the empiricist philosopher John Locke identified color as a prototypical example of a “secondary property”—a property that is “in some way—metaphysically, epistemically, linguistically—derivative, less than fully real, or otherwise metaphysically feeble; or misleading, subjective, ambiguous, or otherwise not perspicuous” (<https://plato.stanford.edu/entries/qualities-prim-sec/>)

underwriting the popular aphorism that “color is in the mind”. This realization

Representations of the structure of particular causal hypotheses, and of the nature of the variables and relationships involved in those causal networks. Higher-level generalizations can be learned. Griffiths and Tenenbaum (2007,2009; Tenenbaum, et ai., 2011),

Beginning early in life, children learn abstract generalizations about causal structure, and color is an important way this is done, for the colors of things relate to their behavioral relevance: the state of the banana, whether it is ripe or not, is signaled by its color. The knowledge is necessarily abstract because color is lower dimensional than the space of objects and concepts—one color can map only many shapes, while one shape generally maps onto a more limited set of colors. Because the abstract framework of color-mapped concepts is sophisticated, it requires training and time to develop, which might explain why color concepts develop surprisingly late in childhood.

What has made color an especially useful playground to work out the origin of concepts is that the physical (and photoreceptor) basis for color is known, yet this knowledge clearly does not account for color. the same triplet code of activation of the L, M, and S cone types can appear very different colors depending on spatial and temporal context, adaptation, and expectation

“In order to study the origin of concepts, one must characterize their developmental and evolutionary trajectories, and to do that one must discover what kinds of mental representations and which specific concepts nonhuman animals and human infants and children have”.

Different types of concepts may have different origins.

Color has been an important paradigm throughout history for understanding concepts. As with all concepts, color has a relationship to the physical world, but the physical world is insufficient as explanation. Indeed, there is a double dissociation between the physical basis for color and color concepts. A given spectrum of light can appear different colors (consider #thedress, {Brainard, 2015 #8635;Lafer-Sousa, 2015 #8172;Gegenfurtner, 2015 #8162;Winkler, 2015 #8245}), and two different physical spectra can appear the same color (consider metamers). The idea that color is a “mind-dependent” property is ancient, evident in the work of the Socratic philosophers (Ierodiakonou, 2015; 2018; Kalderon, 2016) and instrumental in arguments about human agency by Galileo and John Locke during the scientific revolution. That color is conceptual continues to fascinate scholars (Liu, 2021; Cohen and Matthen, 2010; Silva 2017) {Witzel, 2018 #16170}, and this realization often marks the philosophical development of children when they ask, “is your red the same as my red?”. Children learn color concepts relatively late, after they have learned concepts of object shape, which implies that color is a sophisticated representational system with relatively more expressive power.

William James, Piaget, and Quine “believed that nonhuman animals, just like human babies, do not entertain conceptual representations” [as distinguished from sensory/perceptual representations) (Crary, pg. 17). Work on human infants suggests that human infants are born with color concepts (Franklin).

The status of color as conceptual is evident in the categorization of human populations by skin color, where racial designations often lead to judgements that lack any sensory evidence.

“What are the relevant innate representational resources bequeathed to us by evolution” (Crary, pg. 3).

Colors have other hallmarks of concepts: they fall into discrete categories, contrary to the continuous physical variable that constitutes the sensory stimulus. (e.g. see Crary, pg. 19); and they “involve social

interactions among people and metaphysically necessary features of the entities they refer to.”

“color differences are rarely associated with significant physical differences. Aliens probably have concepts for length and electric charge, but not for color. To see the world correctly we must avoid colors and secondary qualities”. (W.V.O. Quine Theories and Things, Cambridge/MA 1986, pg. 120); color “is not a concept: because it is nothing definite like square and not a particular color. Instead there is the concept of a color word – i.e. “’Red’ is a color word” (is language-specific). A bad way to phrase it is: “Red is a color”. Because, for example, red and blue are as different as people whose phone number is a prime number…There is no designating property here. What are red and blue to have in common?) (W.V.O. Quine The Roots of Reference, La Salle/Illinois 1974, pg. 104).

It has been said that “almost nothing else follows from the fact that something is red, whereas rich inferences are licensed by identifying something as an agent or identifying the substance a given entity is made of” (Crary, 20). This strikes me as not quite true. The ripeness of a banana, the health of an infant, all follow from their color. Indeed, it is the link between the color-state of the object and its likely behavioral relevance that makes color such a vital concept.

One question is whether knowledge of the terms themselves impacts color categorization behavior. Evidence that categorization requires color-term knowledge would support a Whorfian hypothesis {Roberson, 2004 #6896;Goldstein, 2009 #6998;Davidoff, 2009 #18684} but needn't exclude the possibility that there is an innate contribution to color categories. On the other hand, evidence that categorization does not require color-term knowledge, would support a nativist position that categories are innately endowed {Franklin, 2005 #7003}{Franklin, 2009 #6997}. It's hard to think of an experiment that would prove that there is no innate contribution, except one in which it is shown that newborns show no category effect (and such a null result in infants would be hard to defend against the criticism that there is insufficient power).

There are two explanations for the CP effects in toddlers that do not require an innate mechanism. One is preferences, and the other is the budding impact of language.

{Franklin, 2009 #18681}