Color

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Color has been of interest to anthropologists of the 20th century as the empirical domain par excellence in which to argue for (and against) the linguistic relativity thesis. In the nineteenth century, classicists, anthropologists and opthalmologists were aware that all languages do not reflect identical lexical classifications of color. Some, such as the classicist (and politician) William Gladstone, concluded that differences in color lexicons reflect differences in perceptual abilities, specifically, "... that the organ of color and its impressions were but partially developed among the Greeks of the heroic age." Others, like the opthalmologist Hugo Magnus, recognized that failure to distinguish colors lexically need not indicate inability to distinguish them perceptually. Magnus conducted a world survey in which he sent about a dozen color samples (of the standard colors: black, white, red, yellow, green, blue,...) to missionaries and traders all over the world, insisting that the ability to name two colors differently and the ability to distinguish them perceptually are distinct and need to be tested independently. These and other late nineteenth century scholars tended strongly to view differences in color lexicons in evolutionary terms.

Late nineteenth and early twentitieth century evolutionism had by the mid-twentieth century run its course in the U.S. Beginning with Boas and Sapir in the twenties and thirties the tide of cultural and linguistic relativity was on the rise. In 1940, Whorf – Sapir's student, as Sapir was Boas's – wrote that the world presents itself to us "in a kaleidoscopic flux of impressions which have to be organized in our minds." The categories in which this organization takes place, Whorf said, are largely supplied by our language. Directly implied by this view is the doctrine that language shapes not only cognition but perception. Indirectly implied by this view is the thesis that semantic universals are non-existent or very rare, and in any case uninteresting.

The idea of semantic universals induced by perceptual universals runs directly counter to the rhetorical thrust of Whorfian relativism, although there is no necessary contradiction between language sometimes influencing perception and perception sometimes influencing language. It seems likely, in fact, that phenomena of both types exist: Whorfian phenomena in which interlinguistically varying lexical categorizations induce corresponding variations in non-linguistic mentation *and* constraints on lexical semantics determined by pan-human perceptual processes. Indeed, it is somewhat ironic that the early Whorfians chose color as their parade example. Color is one of the very few lexical domains for which humans possess dedicated peripheral receptors. In the retina, the rods and (at least) three different families of cones are devoted to detecting variations in wavelength and luminance information. Color should be the last place where one would expect *a priori* for language to influence perception. That the relativists of the fifties and sixties chose color as their empirical battleground stands as a tribute to their self-confidence and a rebuke to their common sense. Of course, if the relativist case *could* be made in the domain of color, then *a fortiori* it should hold everywhere else. Perhaps it was this idea of sweeping the board in a single dramatic move which emboldened the mid-century Whorfians to bet so heavily on color.

There have been two major traditions of empirical research on color language stemming from the relativity thesis: a within-language, correlational line of research and a cross-language, descriptive one.

In the '50s and '60s, a series of studies was initiated by Eric Lenneberg, Roger Brown and John M. Roberts which attempted to establish a correlation between a linguistic variable distinguishing colors (for example, how easy different colors are to name or how easy they are to communicate about) and a non-linguistic cognitive variable over colors: memorability. Discovery of such a correlation was interpreted as support for the Sapir-Whorf view that linguistic categorization influences non-linguistic perception/cognition in the domain of color. Such correlations were fairly extensively reported within English and, to quite a limited extent, in other languages. Since it was *assumed* at the time that the linguistic variable (codability or communication accuracy) would vary across languages, correlation between a linguistic and the non-linguistic variable within a single language (almost always English) was taken to validate the docrine that the coding systems of different languages induce differences in the non-linguistic cognition of their speakers.

In 1972, Eleanor Rosch challenged this assumption on the basis of the apparent universal lexical salience of certain 'focal' colors. Working among the Dani of New Guinea, Rosch showed that universal perceptual salience determines both the non-linguistic and the linguistic variables of the correlational approach, thus undercutting the logic of this line of research. Rosch's view was criticized by Lucy and Shweder in 1979; these workers also challenged Rosch's experimental procedure. Lucy and Shweder's own experimental procedure was in turn challenged in 1984 by Kay and Kempton, who supported Rosch's original view of the matter. However, Kay and Kempton, using a non-correlational, cross-linguistic experimental procedure, showed that certain non-linguistic color similarity judgments do appear to be influenced by the lexical classification of color in a language, although others are not so influenced. The Kay and Kempton results of both Whorfian and anti-Whorfian effects in color similarity judgments have recently been replicated in unpublished work of Jules Davidoff, Ian Davies and Debi Roberson.

In the tradition of cross-language description, the studies of the '50's and '60's likewise reflected the dominance of radical linguistic relativity These studies sought to discover and celebrate the differences among color lexicons. In 1969, using the original stimulus set of Lenneberg and Roberts, Berlin and Kay compared the denotations of basic color terms in twenty languages and, based on these findings, examined decriptions of seventy-eight additional languages from the literature. They reported that there are universals in the semantics of color: the major color terms of all languages being focussed on one of eleven landmark colors. Further, they postulated an evolutionary sequence for the development of basic color lexicons according to which black and white precede red, red precedes green and yellow, green and yellow precede blue, blue precedes brown and brown precedes purple, pink, orange and gray.

These results were challenged on methodological grounds, primarily by anthropologists, and largely embraced by psychologists and linguists. Subsequent field studies confirmed the main lines of the universal and evolutionary theory, but challenged details of the specific formulation of Berlin and Kay. Taking into account both the new data on cross-language color naming and what was known about color perception from the vision literature, Kay and Chad K. McDaniel formulated in 1978 a reconceptualization of the model of evolution of color lexicons, based in part on earlier, unpublished work of McDaniel which had established the identity of some of the universal semantic foci of Berlin and Kay with the psychophysically determined unique hues. Kay and McDaniel introduced the notion of fuzzy set into a formal model of the typology and evolution of color lexicons and shifted the emphasis away from the eleven universal color foci of Berlin and Kay to (i) the six primary colors of the Hering opponent process model (black, white, red, yellow, green, and blue), (ii) certain categories present in early color terminology systems which consist in fuzzy *unions* of two or more primaries (e.g., [green OR blue]) and (iii) categories occurring mostly in later color terminology systems based on fuzzy *intersections* of Hering primaries (e.g., orange = [red AND yellow]).

Kay and McDaniel also related the universal semantics of color to the neurophysiological results of Russell De Valois and his associates. The De Valois findings of the sixties, based on individual cell recordings from the lateral geniculte nucleus of the macaque, were at the time widely interpreted to have revealed the neurological locus of the opponent system. It was subsequently recognized that (1) the cells studied by the De Valois group provided no account of the long wavelength red response observed in humans psychophysically and (2) the specific crossover points between between exitation and inhibition for these cells did not correspond closely enough to the the psychophysically determined unique hue points. Current vision science continues to employ the opponent process model, as determined by many kinds of psychophysical and other experimental procedures, although the notion that the neurological substrate for this model has been isolated is no longer widely entertained.

Since 1978, two important surveys of color lexicons have been conducted, both supporting the two broad B&K hypotheses of semantic universals and evolutionary sequence in the lexical encoding of colors: the World Color Survey of Berlin, Kay and William Merrifield and the Middle American Color Survey of Robert MacLaury. Kay and Luisa Maffi, in recent work, have proposed, on the basis of the World Color Survey data, a model of the evolution of color terminology systems which attempts to derive the typology and evolutionary trajectories of basic color term systems from facts of color appearance, in so far as possible. This model also takes account of the "Emergence Hypothesis," according to which not all languages necessarily have a basic color term system in the Berlin and Kay sense: that is, not all languages necessarily have a small set of words (or word senses) of pure color meaning whose denotations jointly partition the perceptual color space.

Relativist objections have continued to the universal/evolutionary tradition of research on color categorization, expressed most emphatically by John Lucy and the team of B.A.C. Saunders and J. van Brakel, emphasis shifting away from criticism of the rigor with which the procedures of mapping words to colors are applied toward challenging the legitimacy of any such procedures.

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