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Color Naming is Near Optimal

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One of the central “nature versus nurture” debates in cognitive science concerns color naming in the world’s languages. On one influential view, color categories are organized around the universal focal colors *black*, *white*, *red*, *green*, *yellow*, and *blue* (Berlin & Kay, 1969); on the opposing view, color categories are defined by largely arbitrary linguistic convention (Roberson et al., 2000). Both of these views are partly supported by – and partly challenged by – existing data, which show universal tendencies in color naming (e.g. Regier et al., 2005), coupled with interesting cross-language variation in just where category boundaries are drawn (e.g. Roberson et al., 2005).

In an attempt to resolve this tension, we argue here for a third view, based on a proposal by Jameson and D’Andrade (1997): that color naming across languages reflects optimal or near-optimal partitions of an irregularly shaped perceptual color space. We formalize this proposal in terms of a *well-formedness* measure that captures the extent to which a given categorical partition of color space maximizes perceptual similarity within color categories and minimizes it across categories (Garner, 1974). We propose that the color naming systems of the world’s languages correspond to maxima or near-maxima in well-formedness – i.e. to theoretically optimal color naming systems.

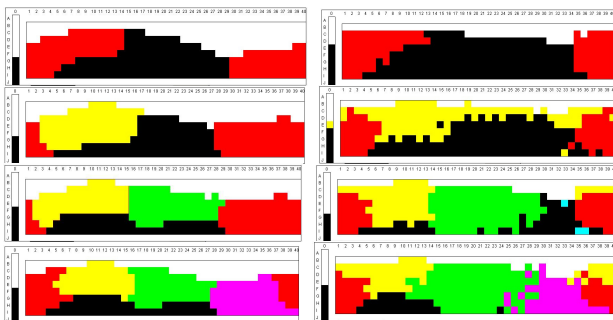


Figure 1. Model prediction (left) compared with selected WCS languages (right), for $n=3,4,5,6$ categories.

We used simulations to create such theoretically optimal color naming systems, with $n=3,4,5,6$ categories. We initialized each simulation by randomly assigning each of a

discrete set of points in color space to one of the n categories; we then adjusted these category labels through steepest ascent in well-formedness, until a maximum was reached. The results are displayed in Figure 1, together with selected languages from the World Color Survey (WCS) database (Cook et al., 2005). Each color naming system is displayed on a standard color grid in which columns represent hues, and rows lightness. More broadly, we found that across the 110 languages of the WCS, color naming tended to be shaped in part by well-formedness. At the same time, our model also suggests where linguistic convention may get some wiggle room: there are often several similar but different partitions that are roughly equally well-formed. Thus, the model suggests a specific middle ground between “nature” and “nurture” in color naming across languages.

Notes and acknowledgments

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References

- Berlin, B., & Kay, P. (1969). *Basic Color Terms: Their Universality and Evolution*. Berkeley, CA: University of California Press.
- Cook, R. S., Kay, P., & Regier, T. (2005). The World Color Survey database: History and use. In H. Cohen and C. Lefebvre (Eds.), *Handbook of Categorization in Cognitive Science* (pp. 223-242). Amsterdam: Elsevier.
- Garner, W. (1974). *The Processing of Information and Structure*. Potomac, MD: Erlbaum.
- Jameson, K., & D’Andrade, R. (1997). It’s not really red, green, yellow, blue: An inquiry into cognitive color space. In C. L. Hardin & L. Maffi (Eds.), *Color categories in thought and language* (pp. 295-319). Cambridge, UK: Cambridge University Press.
- Regier, T., Kay, P., & Khetarpal, N. (2007). Color naming reflects optimal partitions of color space. *PNAS* 104, 1436-1441.
- Roberson, D., Davies, I., & Davidoff, J. (2000). Color categories are not universal: Replications and new evidence from a stone-age culture. *Journal of Experimental Psychology: General* 129, 369-398.
- Roberson, D., Davidoff, J., Davies, I., & Shapiro, L. (2005). Color categories: Evidence for the cultural relativity hypothesis. *Cognitive Psychology* 50, 378-411.