



Brief article

Color naming universals: The case of Berinmo

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Abstract

Proponents of a self-identified ‘relativist’ view of cross-language color naming have confounded two questions: (1) Is color naming largely subject to local linguistic convention? and (2) Are cross-language color naming differences reflected in comparable differences in color cognition by their speakers? The ‘relativist’ position holds that the correct answer to both questions is Yes, based on data from the Berinmo language of Papua New Guinea. It is shown here that the Berinmo facts instead support a more complex view – that cross-language color naming follows non-trivial universal tendencies, while cross-language color-naming differences do indeed correlate with differences in color cognition. The rhetoric of ‘relativity’ versus ‘universalism’ impedes understanding of cross-language color naming and cognition.

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1. Introduction

The ‘linguistic relativity’ versus ‘linguistic universals’ debate in the color domain has revolved around two questions, often insufficiently distinguished.

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1. Do the languages of the world lexically carve up the color space largely arbitrarily?
2. Where color-naming differences among languages occur, do they correlate with corresponding differences in memory, learning, and discrimination of colors?

A committed relativist wants the answers to be Yes and Yes; a committed universalist wants the answers to be No and No. In our view, currently available evidence points strongly toward the answers No and Yes, providing aid and comfort to neither extreme position. There are non-trivial universal tendencies in cross-language color naming (Berlin & Kay, 1969; Kay & McDaniel, 1978; Boynton & Olson, 1987; Uchikawa & Boynton, 1987; MacLaury, 1997; Kay & Maffi, 1999; Lindsey & Brown, 2002; Kay & Regier, 2003; Regier & Kay, 2004; Regier, Kay, & Cook, 2005) but at the same time color-naming differences occur and do correlate with color memory, learning, and discrimination (Kay & Kempton, 1984; Uchikawa & Shinoda, 1996; Roberson & Davidoff, 2000; Roberson, Davies, & Davidoff, 2000; Özgen & Davies, 2002; Witthoft et al., 2003; Roberson, Davidoff, Davies, & Shapiro, 2005). It appears that both the universalist and relativist dogmas obscure an interestingly complex situation.

The Berinmo language (Sepik-Ramu family, Papua New Guinea)² has been involved in the confusion just noted. Berinmo has a color naming system that clearly differs from that of English (Davidoff, Davies, & Roberson, 1999; Roberson et al., 2000), as can be seen in Fig. 1.³

With regard to question (2), Debi Roberson and colleagues have shown that the differences between Berinmo and English color category boundaries correlate with, and presumably cause, differences in memory, learning, and discrimination of colors in speakers of the two languages (Davidoff et al., 1999; Roberson et al., 2000; Roberson et al., 2005). They also failed to replicate Rosch's well-known finding of better color memory for proposed universal focal colors (Heider, 1972; Heider & Olivier, 1972). These focal colors have been understood to be the cognitive underpinning for cross-language naming universals; to challenge their existence or effectiveness

² Berinmo is spoken in the Bitara and Kagiru villages (possibly amongst others) located near the Sepik River in northeast Papua New Guinea. (Roberson p.c.). The Ethnologue identifies the language spoken in these villages as Berinomo. We have retained Roberson's spelling but wished to point to the identical reference of "Berinmo" and "Berinomo".

³ The Berinmo data were gathered using a reduced, 160-chip, version of the 320 chromatic chip Munsell palette used by Lenneberg and Roberts (1956), Berlin and Kay (1969), the World Color Survey [WCS] (Kay & Regier, 2003; Regier et al., 2005), and the Mesoamerican Color Survey (MacLaury, 1997). The reduced version was originally used by Eleanor Rosch in her study of the Dani (Trans-New Guinea family, Papua New Guinea, Heider, 1972; Heider & Olivier, 1972), with which the Berinmo data were compared in detail (Davidoff et al., 1999; Roberson et al., 2000). The 160-chip array was created from the 320-chip array by removing every other (hue) column. In the comparisons we make below between the Berinmo data and WCS data, we use the 320-chip format, treating each "missing" Berinmo hue column as if every chip in that column was named like the chip to its right. Diagrams like those in Fig. 1 (among others) represent for each stimulus chip in the palette the name most frequently given to that chip. We refer to such diagrams as "mode maps". A reasonable approximation to the colors seen in the full palette may be viewed at <http://www.icsi.berkeley.edu/wcs/study.html>.

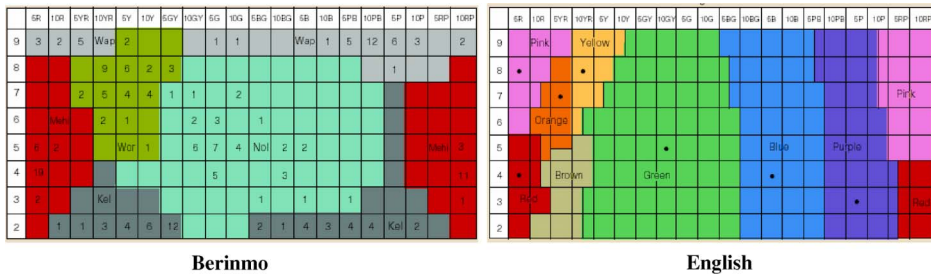


Fig. 1. Color categories in Berinmo and English (Source: Davidoff et al., 1999).

is implicitly to challenge one of the bases for universals of color naming. Perhaps for this reason, Roberson and associates take their results to be relevant to question (1) as well, proposing an uncompromisingly anti-universalist account of color naming. Although they do occasionally acknowledge that the Berinmo color naming system is similar to that of some other languages (e.g., Roberson et al., 2005, p. 402), the broad conclusions they draw have quite the opposite flavor:

[C]olor categories [are] a function of cultural experience and only, at most, loosely constrained by the default neural organization (Roberson et al., 2000).

[W]e propose that color categories are formed from boundary demarcation based predominantly on language. Thus, in a substantial way we present evidence in favor of linguistic relativity (Roberson et al., 2000, Italics added).

They explicitly mention only one constraint on color naming across languages, ‘grouping by similarity’, an idea they emphasize repeatedly:

The most important [non-linguistic] constraint [on color terminologies] would be that similar items (as defined by perceptual discrimination) are universally grouped together. Thus, no language would exhibit categories that include two areas of color space but excludes [sic] an area between them (Roberson et al., 2000).

Whilst Berinmo speakers, like those of all other languages hitherto investigated, appear to group contiguous areas of the color space together, no evidence was found for these sections to correspond to a limited set of universal basic color categories (Roberson, Davies, & Davidoff, 2002).

No language has ever been reported to have a category that includes two areas of color space (e.g., yellow and blue) but excludes an area between them (green). There is no associative chain of similarity that could connect yellow to blue without passing through green. Grouping always follows principles of similarity (as defined by perceptual discrimination) and the only free parameter appears to be the placement of boundaries between categories (Roberson, 2005, italics added).

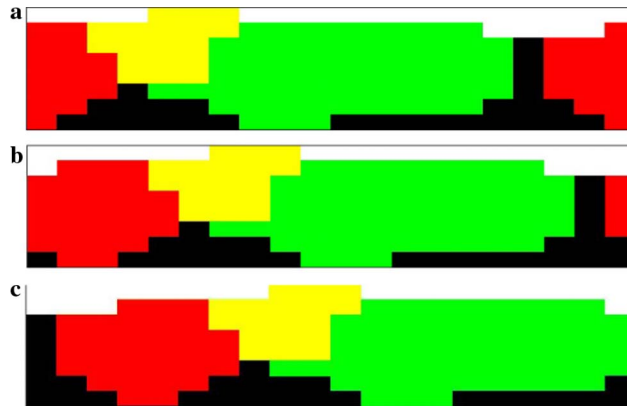


Fig. 2. Berinmo (a) unrotated, and rotated (b) four and (c) eight columns.

By implication, so long as similar colors are grouped together, anything goes in cross-language color naming. In particular, on this view, the actual *location* of categories in color space is apparently not constrained: the placement of boundaries is considered a ‘free parameter’ under control of local linguistic convention. Here, we test this view of color naming against the language that suggested it in the first place – Berinmo. We show, contra Roberson and associates, that Berinmo color naming fits a pattern that is both narrowly specified and widely distributed. While linguistic category boundaries do affect color discrimination and memory in speakers of Berinmo and other languages, the placement of those boundaries is constrained by universal forces.

2. Grouping by similarity

If color categories are constrained primarily by the ‘grouping by similarity’ principle, and boundaries are demarcated by local linguistic convention, there should be nothing privileged about the locations of color category boundaries in Berinmo – the boundaries could just as easily have been drawn elsewhere. To pursue this idea, we considered the actual Berinmo data, and 19 hypothetical variants of it, obtained by rotating the original data by 2, 4, 6, etc. Munsell hue columns (the 320 chip Munsell palette contains 40 columns, nominally of psychologically equal hue steps). Fig. 2 illustrates unrotated Berinmo, and two of the rotated hypothetical variants.⁴

This yields a set of hypothetical Berinmo-based languages that all obey the ‘grouping by similarity’ principle, that also all maintain the shape of the categories and their positions relative to each other, and that vary only in *where* in color space these categories are located. If the locations of Berinmo boundaries are constrained

⁴ Roberson et al.’s (2000) figures of the Berinmo data appear less elongated than ours because they report data for only every other column of the stimulus array, while we display all 40 columns, filling in “missing” columns as described above.

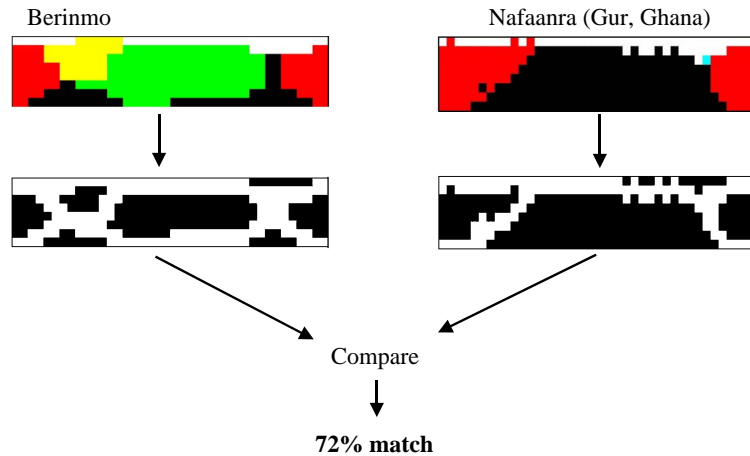


Fig. 3. Comparison of Berinmo and Nafaanra boundaries.

by universal forces, then boundaries in other (actual) languages should align more closely with boundaries in the unrotated (actual) version of Berinmo than with those in the hypothetical rotated versions. However, if ‘grouping by similarity’ is the only substantial constraining force in color naming, we would not expect the unrotated version of Berinmo to be privileged in this manner.

We compared color category boundaries in the real and hypothetical versions of Berinmo with those in the 110 languages of the World Color Survey (Cook, Kay, & Regier, in press). To do this, we first constructed, for Berinmo and all rotated variants, and for each of the WCS languages, a ‘boundary map’ indicating where category boundaries fall in that language. This was done by scoring each chip in the mode map as a ‘boundary chip’ if any of its four neighbors (directly above, below, to the left, or to the right) was given a different name.⁵ Fig. 3 illustrates how boundaries are compared across two languages: first the mode map for each language is converted to a boundary map; here, boundary chips are shown in white and non-boundary chips in black. Then the two boundary maps are compared by simply counting the proportion of chips with the same scoring (black or white). We refer to the degree of alignment as the ‘boundary match’ between the two languages.

For Berinmo and each of its rotated variants, we calculated the boundary match to each WCS language and averaged these matches across all WCS languages, yield-

⁵ For purposes of determining neighbors, all chips in the row of Value (lightness) 9 were taken to be adjacent to a neutral (achromatic) white chip of Value 9.5; analogously, all chips in row 2 were taken to be adjacent to a neutral black chip of Value 1.5. No other chromatic chips were taken to be neighbors of any neutral chips. Roberson et al. (2000) do not report Berinmo names for the neutral chips in the array, which are not displayed here; however, for comparison with other languages which do have values for these chips, we have assumed that the Berinmo “black” term (*kel*) would cover neutral chips of Values 1.5–5, and the “white” term (*wap*) neutral chips of Values 6–9.5. This assumption is a matter of convenience and not critical to the test we pursue here.

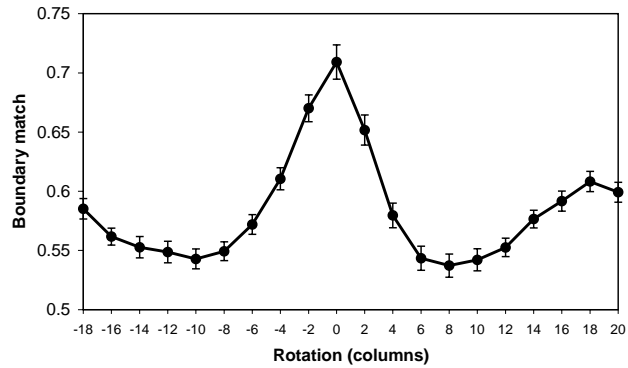


Fig. 4. Boundary match with WCS of various rotated versions of Berinmo, including no rotation. For each version of Berinmo, the dot shows the mean boundary match with all WCS languages, and the bar shows the 95% confidence interval of the mean.

ing a measure, for each variant of Berinmo, of how well that version of Berinmo matches boundaries in the WCS overall. The results are shown in Fig. 4.

Actual Berinmo boundaries (zero rotation) are more typical of WCS boundaries in general than are those of any hypothetical five-term language with the same shape as Berinmo but rotated to any degree in the Munsell hue plane. Moreover, in the neighborhood of true Berinmo, the greater the degree of rotation the less correspondence with WCS boundaries.⁶ This suggests that the locations of Berinmo category boundaries reflect universal constraints stronger than ‘grouping by similarity’.

3. Taking a closer look

The above demonstration shows that Berinmo is more similar to other languages when unrotated than when rotated – suggesting that Berinmo obeys universal constraints. But just how great is this similarity? Are there languages with boundaries quite similar to Berinmo? Or is Berinmo in fact quite dissimilar from other languages, despite the fact that rotated Berinmo is even more dissimilar? Let us look first at Roberson and associates’ comparative data. Roberson and colleagues have studied color naming and cognition in two languages with five basic color terms: Berinmo and Himba, the latter identified by Roberson et al. (2005) as a historically isolated dialect of Herero, a Bantu language of Namibia. ‘... the Himba are semi-nomadic tribesmen inhabiting an arid region: their visual diet of open desert, scrubland, and mountain is radically different to that of Berinmo speakers’ deeply shaded and lush forest territory’ (Roberson et al., 2005). Yet, if we look at the color naming

⁶ The secondary maximum near 180° rotation is apparently caused by the fact that such a rotation brings the boundary of Berinmo grue into rough coincidence with parts of the boundaries of general WCS red and yellow and vice versa. In effect, 180° rotation causes Berinmo cool (grue) and WCS average warm boundaries (red or yellow) to roughly coincide.

systems of Berinmo and Himba, as recorded by Roberson and associates, we see they are quite similar. Fig. 5 is reproduced directly from Roberson et al. (2005).

Each language has a black term, *zoozu, kel*, which extends well into purples; a white term, *vapa, wap*, which extends over all the lightest hues (Munsell Value 9) except those named by the yellow term; a red term, *serandu, mehi*, that extends to pink and light purples; an extended yellow term, *dumbu, wor*, that also covers orange, yellowish greens, light browns, and olives; and a grue term, *burou, nol*, that lacks some yellowish greens and extends somewhat into purple. The major area of disagreement in these plots of modal naming judgments is the brown area, which is mostly covered by downward extension of the yellow term in Himba and upward extension of the black term in Berinmo. This area is singled out by Roberson et al. (2005) as one of the two with the lowest consensus in Himba. ‘A few areas have very low agreement on naming. . . one corresponds roughly to English *brown*, the other to English *purple*’.

To extend the comparison, it may be instructive to compare Berinmo visually to some other five-term systems, these from the WCS. Fig. 6 presents a visual comparison of modal responses on the color-naming task of Berinmo with eight languages from the WCS.

The eight comparison languages shown in Fig. 6 represent seven different language families and one language isolate: Bauzi, Geelvink Bay family, Irian Jaya; Paya, Chibchan family, Honduras; Sirionó, Tupi family, Bolivia; Iwam, Sepik-Ramu

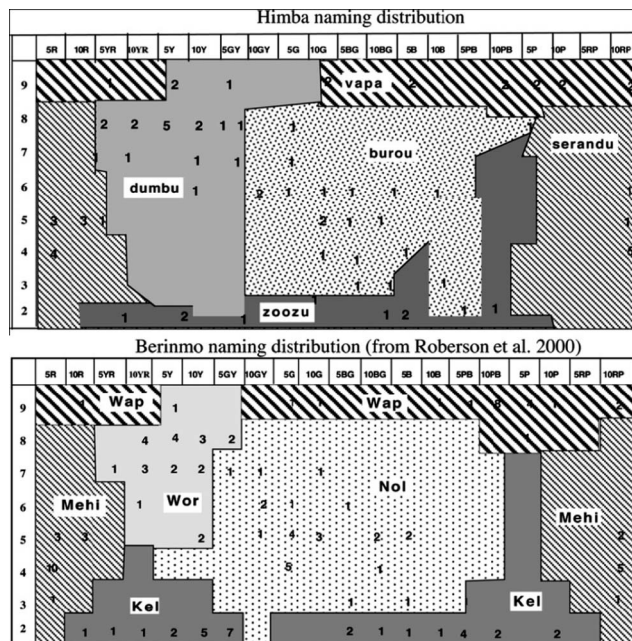


Fig. 5. Himba (above) and Berinmo (below) mode maps (source: Roberson et al., 2005).

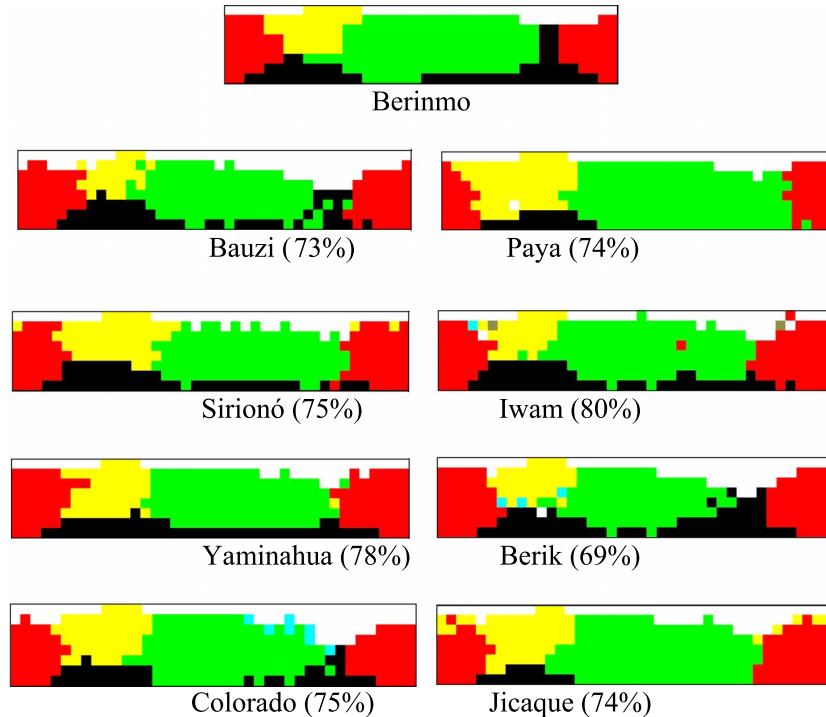


Fig. 6. Modal naming responses of Berinmo speakers and those of eight languages from the WCS, each with five basic color terms. The percentage following each WCS language name is the boundary match with Berinmo. The data from which these mode maps were derived are available at <http://www.icsi.berkeley.edu/wcs/data.html>.

family, Papua New Guinea; Yaminahua, Panoan family, Peru; Berik, Trans New Guinea family, Irian Jaya; Colorado, Paezan family, Ecuador; Jicaque, Isolate, Honduras. Qualitatively, Berinmo color naming appears to be quite similar to that of other five-term languages from a range of genetically and geographically separated language families, all of which show clear similarities to each other.

4. Conclusion

As we have noted above (and previously, Regier et al., 2005), there is ample evidence that differences in color category boundaries between languages may influence color memory, learning, or discrimination (Kay & Kempton, 1984; Uchikawa & Shinoda, 1996; Roberson & Davidoff, 2000; Roberson et al., 2000; Özgen & Davies, 2002; Witthoft et al., 2003; Roberson et al., 2005). These results have for the most part been established by comparing a behavioral color response between speakers of English and a given language that differs from English in the placement of some

lexical color category boundary. The general pattern of these studies is that the nominally non-linguistic, behavioral response function exhibits an inflection point or discontinuity at the speakers' lexical boundary, distinguishing the two subject-groups' non-linguistic behavior in parallel with the lexical difference.

Berinmo has been perhaps the most intensively studied of this small group of languages. Independently of this fact, Roberson et al. (2000) were unable to replicate in Berinmo Rosch's Dani results regarding the apparent salience of the focal points of English color terms with respect to memorability in a language with a different color lexicon (Heider, 1972; Heider & Olivier, 1972). Since Rosch had made universal focal colors a cornerstone of her explanation of universal color naming, Roberson and her associates were apparently led to conclude from their inability to replicate Rosch's Dani experiments with the Berinmo that (1) the defining features of color categories are boundaries rather than foci and (2) there are no universal constraints on color term boundaries, other than grouping similar colors together.

We do not agree that these conclusions follow from the observations on which they are based. This study has been devoted to assessing the empirical status of the second conclusion. To this end, we have accepted for the purposes of comparison the equation of color categories with their boundaries. Using this criterion, we have compared Berinmo color categories to the 110 WCS languages as a whole, to eight selected five-term WCS languages and to Himba, the other five-term language studied by Roberson and associates. In each case, Berinmo color category boundaries appear to be typical of the comparison class. Furthermore, best example choices in Berinmo similarly appear to align closely with those of WCS languages (Regier et al., 2005). There is no evidence in Berinmo color naming to challenge the findings of universal constraints on color naming.

More broadly, we argue that the separate questions of (1) the existence of universal constraints on color naming and (2) the influence of color-naming differences on differences in color cognition should not be confounded under a rhetoric of 'relativism' versus 'universalism'. Current evidence supports *both* the existence of universal constraints on color naming *and* the influence of color-naming difference on color memory and discrimination.

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