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World Color Survey

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Definition

The World Color Survey collected comprehensive color-naming data from an average of 24 speakers of each of 110 unwritten languages from around the world. Analysis of these data has resulted in a number of research publications. The data are available at http://www1.icsi.berkeley.edu/wcs/data.html.

Introduction

The World Color Survey (WCS) was undertaken to investigate the main findings of Berlin and Kay (B&K) [1]. These were (A) that there exist universal crosslinguistic constraints on color naming and (B) that basic color terminology systems tend to develop in a partially fixed order. To this end, the WCS collected color-naming data from speakers of 110 unwritten languages. The WCS data are available in the WCS Data Archive. This entry reviews the history of the WCS, including the creation of the online data archive, and describes some recent uses of the archive to investigate constraints on color naming across languages.

The WCS: History and Methodology

The WCS was begun in 1976 to evaluate the findings of B&K in a full-scale field study. B&K had investigated the color terminology systems of 20 languages in the following way. The stimulus palette used by Erik Lenneberg and John Roberts [2], consisting of 320 Munsell chips of 40 equally spaced hues and eight levels of lightness (value) at maximum saturation (chroma) for each (hue, value) pair, was supplemented by nine Munsell achromatic chips (black through gray to white) – an approximation of the resulting stimulus palette is shown in Fig. 1a and the corresponding Munsell coordinates in Fig. 1b.

First, without the stimulus palette present, the major color terms of the collaborator's native language were elicited by questioning that was designed to find the smallest number of simple words with which the speaker could name any color (*basic color terms*). Once this set of terms was established, the collaborator was asked to perform two tasks. In the *naming* task the stimulus palette was placed before the speaker, and for each color term *t*, a piece of clear acetate was placed over the stimulus board, and the collaborator was asked to indicate, with a grease pencil on the acetate sheet, all the chips that he or she could call *t*. In the *focus* task the stimulus palette was shown as before, and the collaborator was asked to indicate the best example(s) of *t* for each basic color term *t*. B&K concluded that

> [1] The referents for the basic color terms of all languages appear to be drawn from a set of eleven universal perceptual categories, and [2] these categories become encoded in the history of a given language in a partially fixed order. [1]

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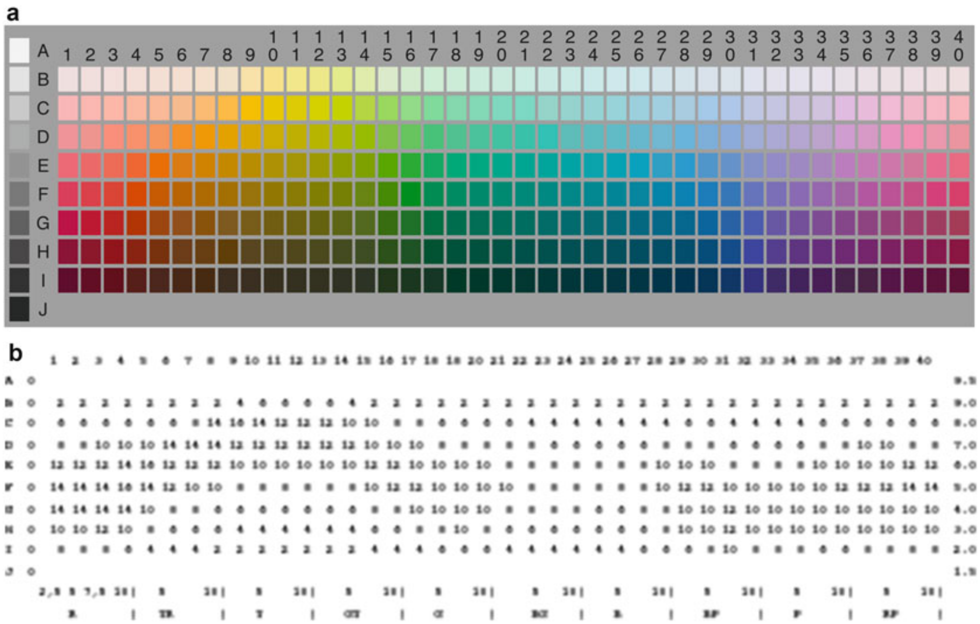

Fig. 1 (**a**) The WCS stimulus palette. (**b**) Munsell and WCS coordinates for stimulus palette of (**a**). The leftmost column and the top row give the WCS coordinates for lightness and hue, respectively. The rightmost column and the bottom two rows give the Munsell coordinates for value and hue, respectively. Entries in the body of the table show the corresponding Munsell chroma numbers. (With regard to the A and J rows, there are no Munsell hues at the extremes of value (lightness): 9.5 (*white*) and 1.5 (*black*))

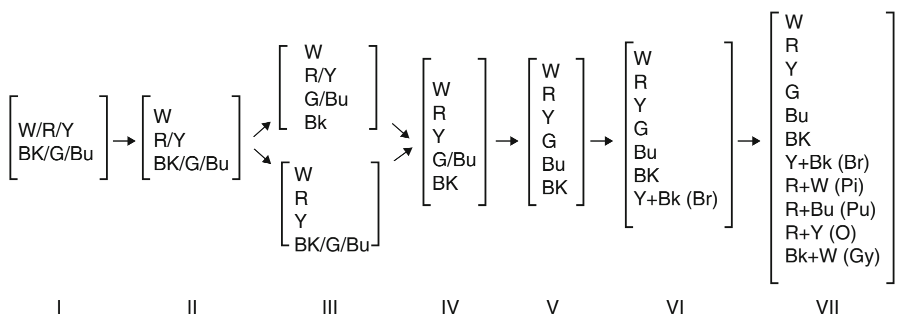

Fig. 2 Original B&K evolutionary sequence of color term development

The original universal evolutionary sequence of color term development postulated by B&K is shown in Fig. 2. It has subsequently been revised in detail as more data has become available, but the main outlines of the original sequence have remained intact (see Fig. 3, for the most recent revision).

The B&K results were immediately challenged by anthropologists on the grounds that the sample of experimental languages was too small, too few collaborators per language were questioned (sometimes only one), all native collaborators also spoke English, the data were collected in the San Francisco Bay area rather than in the homelands of the target languages, many regions of the world and language families were underrepresented or overrepresented in the sample of 20, and that the sample of 20 had too few unwritten languages of low technology cultures [3–6]. The results were nevertheless supported by various

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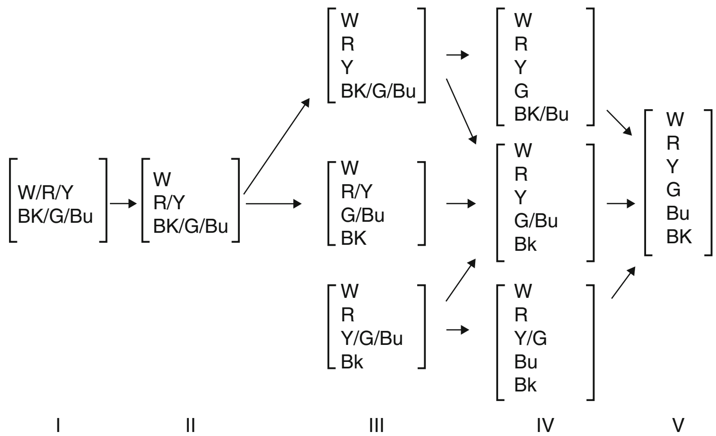

Fig. 3 Revised (2009) evolutionary sequence of color term development

ethnographic and experimental studies conducted after 1969 and were from the start largely accepted by psychologists and vision researchers (e.g., [7–9]. See also [10], 498ff, [11], 133 ff).

Work on the WCS was begun in the late 1970s. Through the cooperation of SIL International (then the Summer Institute of Linguistics), which maintains a network of linguist-missionaries around the world, data on the basic color term systems of speakers of 110 unwritten languages representing 45 different families and several major linguistic stocks were gathered in situ. Fieldworkers were provided with a kit containing the stimulus materials (330 individual chips in glass 35-mm slide sleeves for the naming task and the full stimulus palette for the focus task) as well as coding sheets on which to record collaborators' responses. The included instructions requested that fieldworkers collect data from at least 25 speakers, both males and females, and urged them to seek out monolingual speakers insofar as possible. The modal number of speakers actually assessed per language was 25, and the average number was 24. (A facsimile of the WCS instructions to fieldworkers and of the original coding sheets is available on the WCS website.) The aim was to obtain names, category extent, and best examples of basic color terms in each language – basic color terms being described in the instructions as "the smallest set of simple words with which the speaker can name any color."

The WCS methodology coincided with that of the B&K study in the use of essentially the same set of Munsell color chips. One white chip was added in the WCS study that was whiter than any chip available at the time of the B&K study, making for a total of ten achromatic chips and an overall total of 330 chips, as shown in Fig. 1.

The WCS differed from B&K in the technique for eliciting naming responses. In the WCS procedure, no preliminary interview was administered to establish a set of basic color terms, and in the naming task the 330 individual color stimuli were shown to each cooperating speaker, one by one, according to a fixed, pseudorandom order, and a name elicited for each (in contrast with the B&K procedure of presenting the entire stimulus palette at once in eliciting naming responses). Fieldworkers were instructed to urge observers to respond with short names (although, depending on the morphology of the language, particular field circumstances, and local culture, there was considerable variation in the degree to which the field investigators were able to satisfy these desiderata). Identification of basic color terms, therefore, was done by the fieldworker as a result of the naming task itself, rather than through prior elicitation. The best example (focus) responses were elicited in the same way in both studies: once a set of basic color terms was isolated, the native observer was presented with the full palette and asked to indicate the chip or chips that represented the best example of each term, one by one.

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Initial Analysis

Originally, the naming and best example data of the WCS were entered into separate files for each language; they were not compiled into a unified database until the early 2000s. In 2009, a monograph [13] appeared, based on analysis of data in this form. It contains a separate chapter for the color-naming system of each language, identifying the basic terms of the language through a variety of ways of summarizing and displaying the data. An updated version of the original B&K evolutionary sequence was postulated and is depicted in Fig. 3.

Uses of the WCS Archive

The WCS data archive has been used in investigating two broad questions, one concerning *universals* and other concerning *variation*, of color naming, corresponding to the two major conclusions of B&K [1]. Numerous statistical studies utilizing the WCS online have been conducted.

Universals of Color Naming

Since B&K found evidence for universals in color naming across languages, the existence of such constraints has generally been accepted in the scientific community. However, there have always been dissenters from this consensus (e.g., [2, 3]), and this dissenting view has recently gained prominence (e.g., [14–19]). Criticisms of the universalist position have come in two major varieties. The first points out that B&K's findings were never objectively tested, as they relied on visual inspection of color-naming data. Lucy [15] challenges such a methodology as hopelessly subjective:

> [Work in the B&K tradition] not only seeks universals, but sets up a procedure which guarantees both their discovery and their form. . . . when a category is identified . . . it is really the investigator who decides which 'color' it will count as . . . What appears to be objective - in this case, a statement of statistical odds - is [not]. ([15], p. 334)

On this view, B&K's subjective methodology allowed them to impose their own universalistic assumptions on their data – so the universals are actually in the minds of the investigators, not in the languages of the world. The second strand of criticism points out that B&K's data were drawn primarily from written languages and thus may not be representative. This point is coupled with analyses of particular unwritten languages, which are claimed to counterexemplify universal constraints (e.g., Berinmo: [18, 19]; Hanunóo and Zuni: [15]). Subsequent, more detailed analyses of each of these languages have found that each fits the universal pattern [20]. Disputes of this sort over conflicting interpretations of individual color-naming systems could continue indefinitely. Objective statistical studies were needed to resolve the issue.

The WCS database has been used in a number of independent statistical studies to test the hypothesis that there are statistical constraints on the basic color-naming systems of languages. The weight of the evidence supports the conclusion that such universal statistical constraints exist. The centroids of the naming responses to all color categories documented in the survey were found to cluster in color space more closely than chance would dictate; in a Monte Carlo simulation of the WCS, in which on each of 1,000 trials the modal color-naming pattern of every WCS language was rotated a random hue angle, the actual WCS naming centroids were found to cluster more tightly than the naming centroids in any of the 1,000 hypothetical (rotated) versions of the WCSs [21]. Figure 4 presents a contour plot of the WCS naming centroids compared to those of English.

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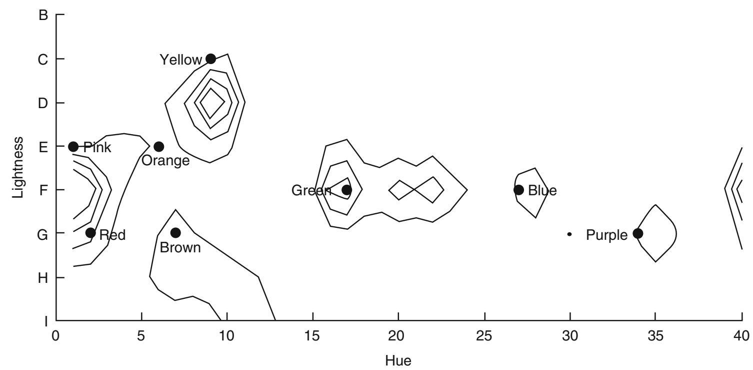

Fig. 4 Contour plot of WCS speakers' naming centroids, compared with English naming centroids (*black dots*); source for English naming centroids: [22]. The outermost contour represents a height of 100 centroids, and each subsequent contour represents an increment in height of 100 centroids (Source of figure: [21])

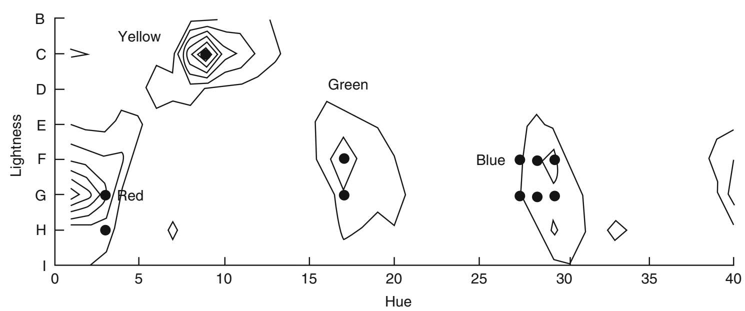

Fig. 5 Contour plot of focal color responses from WCS languages, with superimposed focal responses from English (B&K data, shown as dots), plotted against the stimulus palette (Source: [23])

The best example choices (foci) of all WCS color terms were found to also cluster more tightly than the centroids of naming categories, suggesting an intimate relation between "focal" colors and universal tendencies of color naming [23]; further, the WCS focal choices were found to cluster closely to those of English or other familiar written languages, as shown in Fig. 5.

Whereas the studies just discussed relied on color naming and focus choice data grouped by language, a clustering and concordance study based on the naming patterns of individual participants independently supports the conclusion that the WCS languages largely partition the color space in ways that, although often having fewer basic terms than English and hence fewer boundaries in their lexical "map" of color space, tend strongly to place boundaries in the same locations as do English and other familiar written languages [24]. This study also detected a hierarchical order in the lexical partitions of color space compatible with that depicted in Fig. 3. The question naturally arises regarding the degree to which WCS "focus" judgments, that is, participants' judgments of the most typical examples of named categories, will agree with judgments of unique hues. For example, to what extent do people's judgments of the best example of green agree with their (actually, in this case, with other people's) judgments of a green that contains neither blue nor yellow. In a study that pruned the WCS data to consider 38 languages that yield unequivocal results for the Hering fundamental hues, red, yellow, green, and blue, it was found that the focal judgments of the WCS participant speakers of unwritten languages agreed well with unique hue judgments of 300 speakers of several written languages [25]. Systematic, statistical comparison with the WCS database of languages claimed to violate universal color-naming tendencies has refuted that claim;

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however, a small number of other languages, not the object of such claims, have in fact been found to violate universal tendencies [26]. In a different study, languages with terms roughly equivalent to red, yellow, green, and blue nevertheless were found to differ slightly in their average focus placements, although this variation was greatly exceeded by that found among speakers of the same language [27]. A tentative explanation of the universal tendencies in color naming was found in a study that modeled hypothetical color-naming systems minimizing within-category distance in color space; good fit between the data generated by this model and the WCS data was achieved [28]. One explanation for variation across speakers within a given language is that there appear to be a small number of patterns of naming that occur among some speakers of many languages, with the speakers of few languages all following the same naming pattern [29]. Analysis of the WCS database has revealed that the categories named by basic color terms in the world's languages tend to be convex sets in color space [30]. An iterated learning study in which a stable color-naming system is achieved by interacting hypothetical agent has shown that equipping such hypothetical agents with the human just noticeable difference function at the start is sufficient to produce a final output that matches the WCS data well [31]. An iterated learning study using actual human learners showed that limiting a given simulation to just the number of color terms also produced systems of color naming that were statistically close to corresponding systems in the WCS [32]. Extensive narrative descriptions of the color-naming systems of each WCS language, supported by charts and tables and keyed to the overall universal classification scheme, are available in monograph form [13].

Cross-References

► Berlin and Kay Theory
► Centroid and Boundary Colors
► Color Categorical Perception
► Color Vision, Opponent Theory
► Comparative Color Categories (Humans/Non-Human Primates/Animals)
► Dynamics of Color Category Formation and Boundaries
► Effect of Color Terms on Color Perception
► Infant Color Categories
► Multilingual/Bilingual Color Naming/Categories
► Unique Hues
► Vantage Theory of Color

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