Universal Aspects of Learning Color Codes: A Study in Two Cultures

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INTRODUCTION

The recent work of Berlin and Kay (1969) on the "universality and evolution of basic color terms" has recast a long-standing interest of anthropologists in how colors are named in different cultures. Ethnographers have noted that cultures varied in the number of color terms they ordinarily used, and have noted as well that roughly corresponding color terms (e.g., "green") seemed to apply to differing perceptual ranges (see for instance Rivers 1902; Conklin 1955). The speculation as to whether this variation in categorizing led to differences in the way people actually *saw* colors was formalized under the Whorfian hypothesis, and tested by workers in several

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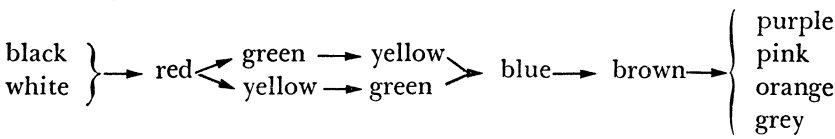
I would like to thank the many people whose friendly collaboration and support helped to shape this research. Dr. Robert Klein and the staff of the

cultures (Brown and Lenneberg 1954; Lenneberg and Roberts 1956; Stefflre, Castillo, and Morley 1966).

Berlin and Kay have approached the problem by seeking universals rather than variations in color naming. Their research with informants from twenty different languages has suggested that the focal points, or "best examples" of color terms are universally shared. Thus, if two cultures both have a term for "red," informants will agree on what color is the "best red," in a large array of colors, even though they may disagree on drawing boundaries for the whole area to be called red. When Berlin and Kay found that individual informants were unable to maintain a steady criterion for drawing color boundaries on different occasions, they abandoned the study of color boundaries.

In addition to finding universal focal points, Berlin and Kay also produced a hypothesis based on a survey of color lexicons in 98 languages, as described by the ethnographic literature. They found that the occurrence of "basic color terms" (which they defined as monolexemic, salient terms of general usage, whose meaning is not contained within any other term) was ordered and predictable. Specifically, *which* basic color terms a language encoded could be predicted from their number, and the presence of any given color term in a language predicted the presence of certain other terms. They found a total of eleven basic color terms, ordered cross-culturally as follows:



Human Development Division of INCAP (Institute for Nutrition of Central America and Panama) were generous hosts to the fieldwork in Guatemala. Professor A. Kimball Romney worked extensively with the author in Guatemala and was instrumental in working out the conceptualization and experimental design of the project. Lawrence M. Baldwin and Charles M. Super gave massive assistance on the data analysis. Dr. Donald Olivier gave many helpful suggestions on the manuscript. Professors John W. M. Whiting and Jerome Kagan have supported and guided the research through its various stages. Finally, I would like to thank members of the Seminar on Cross-Cultural Issues in Child Development, particularly Professors Keith and Claudia Kernan and Dr. Patricia M. Greenfield, for their ideas on the evolution of basic color terms.

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Berlin and Kay suggested that the color lexicon of any given language may evolve in this same order, and that languages can be classified in "stages" of development. Thus, for example, a language which encodes all terms through Yellow is a "Stage IV" language.

Berlin and Kay's theories on universality and evolution of basic color terms have raised several questions. At the simplest level is the question of the reliability of their results on universality of color naming, given that most of their informants were living in California and, furthermore, represented Stage VII languages. Could similar results be obtained from large samples of informants from two (or more) cultures at markedly different stages? Another question concerns the particular ordering of basic color terms. Berlin and Kay extrapolated the idea of evolution of basic color terms from their patterning among different cultures today. If color lexicons do evolve in a stable order, then might there be some cognitive logic behind it? For instance, do children in different cultures learn colors in "evolutionary order?" Are there differences in adults' knowledge of color terms in their own language? How do various colors "function" cognitively for both children and adults? Finally, there was the question of why some cultures should have more basic color terms than others. What exactly might happen to color naming systems to produce their "evolution," and what might be the impetus for such a development? The research to be described here addressed itself to these questions.

SAMPLING AND PROCEDURES

Subjects for this study were drawn from two small rural communities in Guatemala, one speaking Spanish and the other speaking Mam (a Mayan language). Basic color terms in Spanish include the whole Stage VII list, with the addition (at least in the community sampled) of "celeste," or light blue. Mam has a five-term color lexicon (White, Black, Red, Green, and Yellow), which classifies it as a Stage IV language in Berlin and Kay's terms.

Conacaste, the Spanish community, is a subcenter of the municipality of Sanarate, about two hours by car east of Guatemala City. At the time of the study, Conacaste was an experimental community for INCAP (Institute for Nutrition of Central America and Panama). Santiago Chimaltenango, the Mam community, is a small municipality inaccessible by car in the northern department of

Huehuetanango, approaching the Mexican border. Subjects in Conacaste were recruited through the local INCAP field station, while subjects in the Santiago Chimaltenango sample were students in a bilingual pre-first-grade class and their parents. An effort was made in the second group to find the most purely monolingual subjects available. Three age groups (seven- and eight-year-olds [7–8's], eleven- and twelve-year-olds [11–12's], and adults) of twenty subjects each, evenly divided by sex, comprised the Spanish sample. The Mam sample consisted of two age groups (seven- and eight-year-olds [7–8's] and adults) of twenty subjects each, evenly divided by sex. Testing in Spanish was done by the author. Testing in Mam was done by the author and a local bilingual assistant, working together.

Testing materials were 5/8″ x 13/16″ Munsell color chips, in glossy finish.[1] Chips were mounted on white cardboard and covered with clear acetate for protection. Three of the four tasks used chips from a 160-chip array made up of every other column of Berlin and Kay's array (the 5 and 10 columns, with 2.5 and 7.5 columns omitted). This is the same array that Heider (1971) used for her research on color naming among the Dani of New Guinea. Berlin and Kay's original array is Munsell's representation of the "outer shell" of the color solid, which includes the most highly saturated chips of all hues and values. The array used here was an 8 by 20-chip matrix, with hue the horizontal dimension (20 columns) and value, or brightness, the vertical dimension (8 rows). An added column of 10 neutral values was placed on one side, as in Berlin and Kay's array. The remaining task used chips identified by Heider (1971) as "focal chips." (Heider's choice of "focal chips" was based on their central location in each of the eleven basic color term areas mapped by Berlin and Kay's study). Subjects were shown chips that were thought to correspond to each of the basic color terms in their own language. For Spanish, eleven chips for the eleven Spanish basic color terms were used. Munsell notations for these chips are: N9/ (white), N1/ (black), 5R4/14 (red), 7.5G5/10 (green), 2.5Y8/16 (yellow), 2.5PB5/12 (blue), 5YR3/6 (brown), 5R8/6 (pink), 5P3/10

1. These are painted chips manufactured by the Munsell Color Company, 2441 North Calvert St., Baltimore, Maryland 21218. Testing was done using good natural light in predominantly white rooms. For tristimulus specifications of the Munsell chips, see Kelly, Gibson, and Nickerson (1943).

(purple), 2.5YR6/16 (orange), and N6/ (grey). Mam subjects were shown the first five chips in this list, corresponding to their five-term basic color lexicon.

The test consisted of four tasks. In the first ("basic color chip"), the subject (S) was shown the basic color term chips appropriate to his language, one at a time in a fixed order. S was asked to name each chip as it was shown; verbal responses and response latencies were recorded.

For the second ("40-chip") task, the array of 160 color chips was divided into four random samples of 40 chips each, with each individual chip mounted separately. Each 40-chip series was shown to equal numbers of subjects, except for the Spanish adults who were exposed somewhat unevenly. Consequently, except among the Spanish adults, each of the 160 chips was viewed by five subjects in each of the age groups. The task consisted of showing the subject the 40 chips one at a time, and recording the name given to it and the response latency.

In the third ("preference") task, each column of the 160-chip array was randomly reorganized into a new column, and the columns were in turn randomly reorganized into a new order. The subject was shown each column one at a time and asked which chip he liked best in each. He was then asked the name of the preferred chip.

In the last ("best example") task, the subject was shown the whole array of 160 chips, with the extra column of neutral hues (N1–9.5) on one side. Here he was asked to point to the chip which best represented each basic color term in his own language. The color terms were named by the experimenter in a fixed order.

Only the naming tasks are reported here (omitting the third, "preference," task). Also, response latencies are not reported since it was found that the data were redundant to naming agreement and were a less sensitive indicator for a large number of chips.

RESULTS

Universality of Color Names

It appears that best examples of corresponding comparable basic color terms from two languages may match even when their boundaries vary substantially. Figures 1 and 2 illustrate this finding for the adult Spanish and Mam samples. Color areas for the five terms

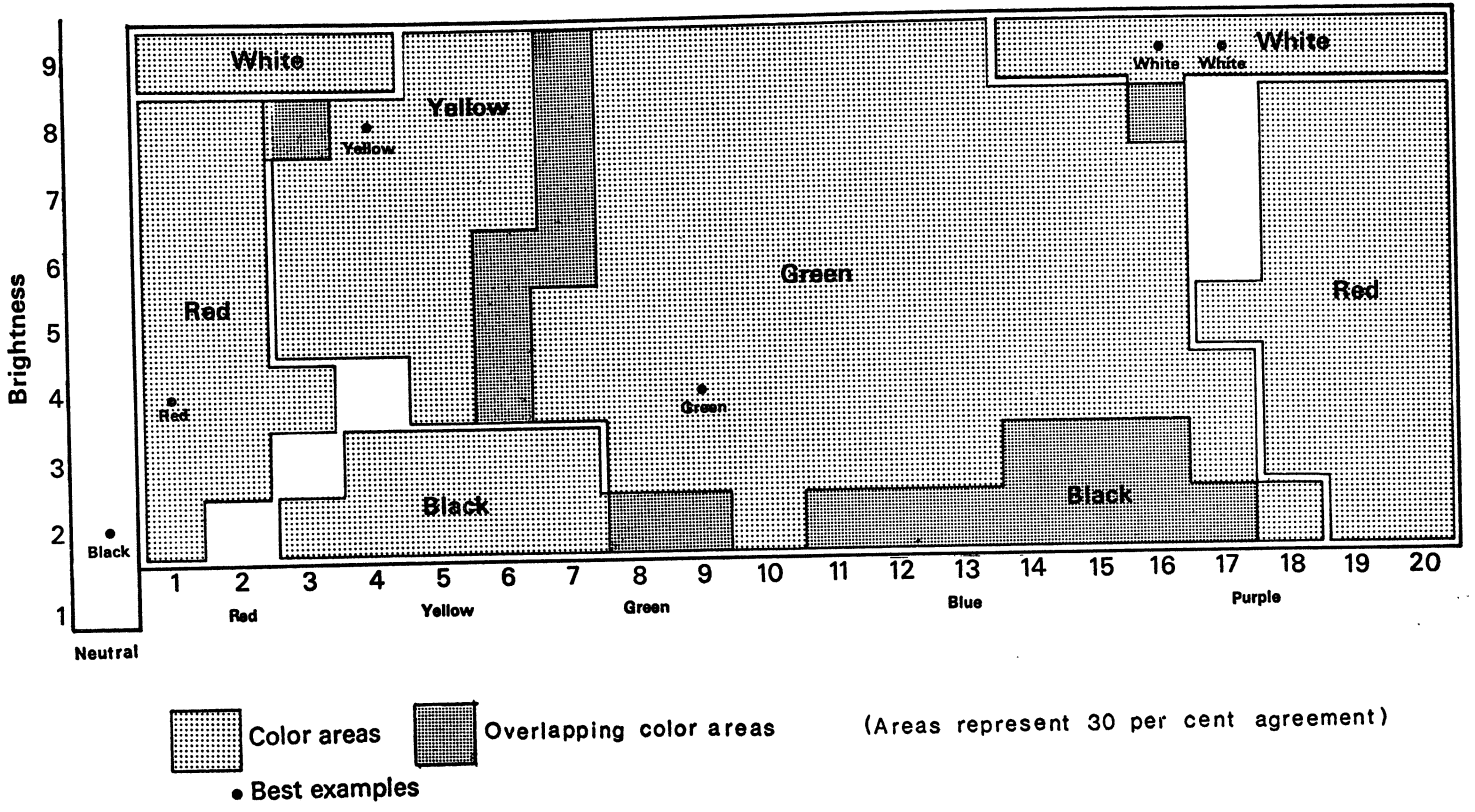

FIGURE 1. Boundaries and best examples of color terms shared by Mam and Spanish: Mam adults.

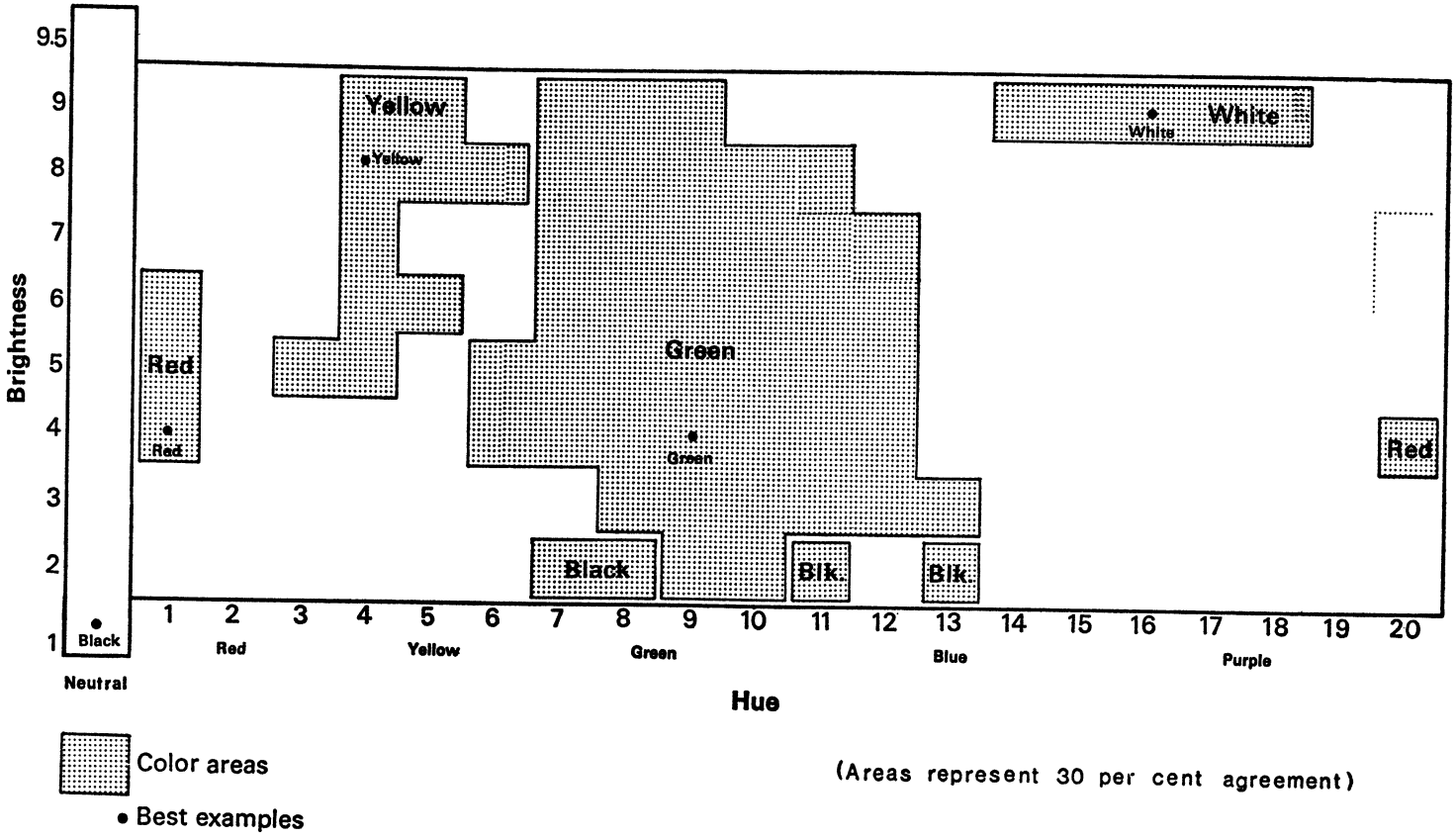

FIGURE 2. Boundaries and best examples of color terms shared by Mam and Spanish: Spanish adults.

Spanish and Mam share have been reconstructed from the second ("40-chip") task. Since there are several responses to each chip in each subsample, it is possible to judge degree of agreement among subjects about how to name all the chips in the 160-chip matrix. Mapping the results onto the 160-chip matrix shows areas of high agreement which may correspond to "focal areas" for each basic color term. Agreement on what to call chips falls off with increasing distance from the focal areas, although the decrease is not consistent in all directions, contrary to Brown's suggestion (1954). Color areas are maximally bounded by chips on which there is very low naming agreement, or by the outer edges of other color areas. Varying the criterion for naming agreement produces different sorts of maps, which may show the broadest extent of color areas or more limited areas of high consensus. It was found that by drawing contour lines (occasionally smoothed for visual comprehension) around all chips that were chosen by at least 30% of the adult samples in each culture for each of their shared color terms, it was possible to construct maps that combine maximum coverage with minumum overlap of color areas. These maps might be said to represent the "maximum boundaries" of color terms that occur in both Spanish and Mam. Best example chips are simply the chip or chips chosen most frequently for each color term in the fourth (best example) task. A minimum of three choices on one or more chips was deemed necessary for a best example to exist at all.

Figures 1 and 2 show that best examples for Red, Green, and Yellow in the Spanish and Mam adult samples correspond exactly. The choice of best examples of White and Black was complicated by the extra column of neutral hues at one side of the color array. Many subjects apparently did not notice this extra column. Despite this extraneous factor, Spanish and Mam adults agreed substantially on best examples for White and Black. Best examples for both terms are identical and/or adjacent chips. (Note that the best example for Black in the Mam sample was the *second* to bottom in the column of neutral hues.)

In contrast to the agreement on best examples, color areas in Spanish and Mam vary markedly. The difference is particularly sharp for Green, where Mam Green extends to include areas that are called Blue or Purple in Spanish. The location of best examples of Green in Spanish and Mam relative to their whole color areas in-

dicates that best examples of color terms need not be centrally placed within their referent domain. The relationship of best examples to color areas lends credence to Berlin and Kay's phrase "green emerges" in describing the development of color naming stages. If color lexicons do develop in the manner suggested by Berlin and Kay, then it seems probable that development involves the linguistic recognition of certain points on the color solid and not merely progressive subdivision of areas. The question of whether the "meaning" of color names resides in their respective best examples or in their boundaries (as suggested by Collier 1970) still remains. The "universality" hypothesis assumes that meaning resides in best examples. Within the bounds of this assumption, this study lends support to the universality hypothesis.

Cognition and the "Evolutionary" Hypothesis

The first question asked here was whether there are any parallels between the learning of color names and Berlin and Kay's proposed "evolutionary order" of color terms. Data from the first (basic color chip) task as well as from the other two tasks already described were applied to consideration of this question.

The basic color chip task was instituted after the beginning of testing, and there was some doubt as to whether the chips would correspond well to color names in the communities sampled. Subsequent analysis indicated that the basic color chips fall within the areas of highest agreement on the color map, and therefore should be good examples of color terms for both languages. Results for the two pairs of comparable age groups from Spanish and Mam are presented in figures 3 and 4.

Figures 3 and 4 present percentages of correct color naming in relation to the evolutionary order of color terms. As figure 3 shows, agreement on naming "basic color chips" was high in the Mam sample for both adults and the 7–8's. Adults named all five terms correctly, while the 7–8's departed only slightly from total agreement on the last color, yellow. The Spanish samples (fig. 4) also did relatively well on naming the first five colors, but agreement on naming subsequent colors decreased markedly. For the 7–8's there was a small decline in correct naming after Red followed by a sharp decline after Yellow. Adults, for the most part, correctly named all terms through Brown but did not agree on naming subsequent

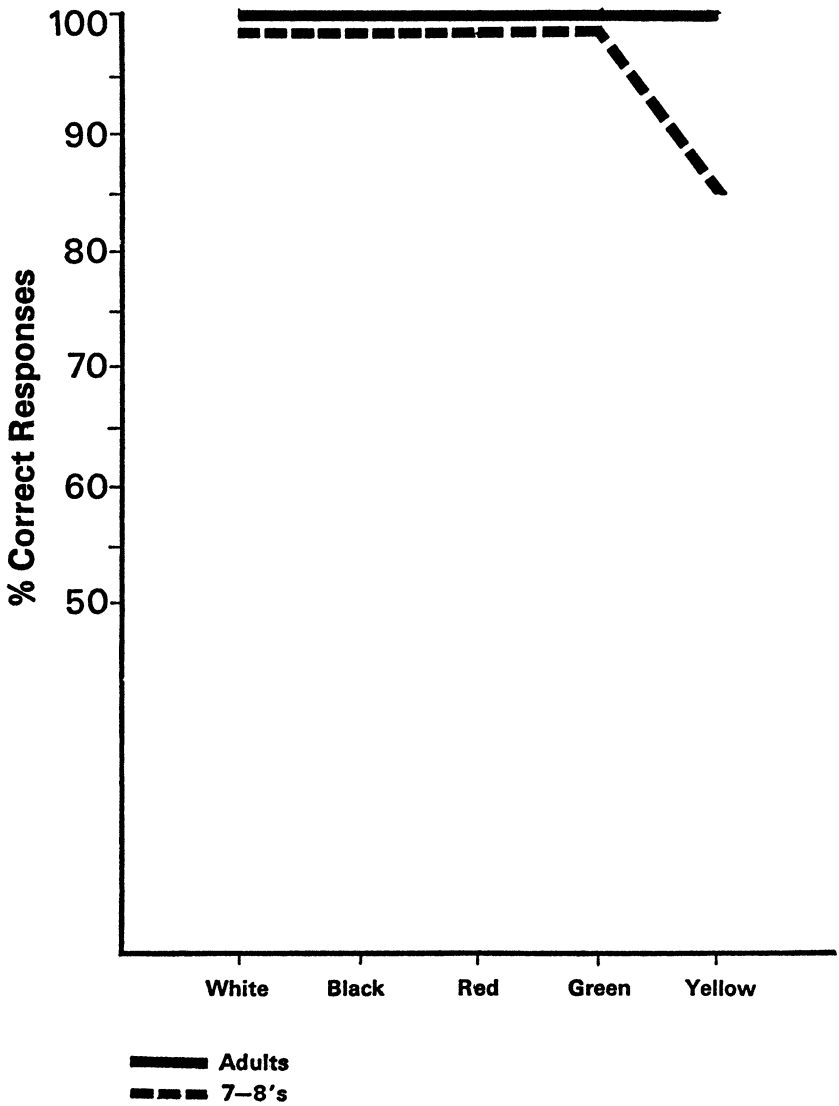

FIGURE 3. Correct naming of "basic color chips": Mam.

terms. The 11–12 curve (not shown here) fell between the 7–8 and adult curves, with a small decline after Yellow followed by a pronounced drop-off after Brown. These curves suggest that for the Spanish sample not all of the "basic color terms" are equally basic. Further, those chips that were correctly named least often were precisely those at the end of the "evolutionary order." The repertoire of highly agreed-on chips for Spanish adults corresponds to a

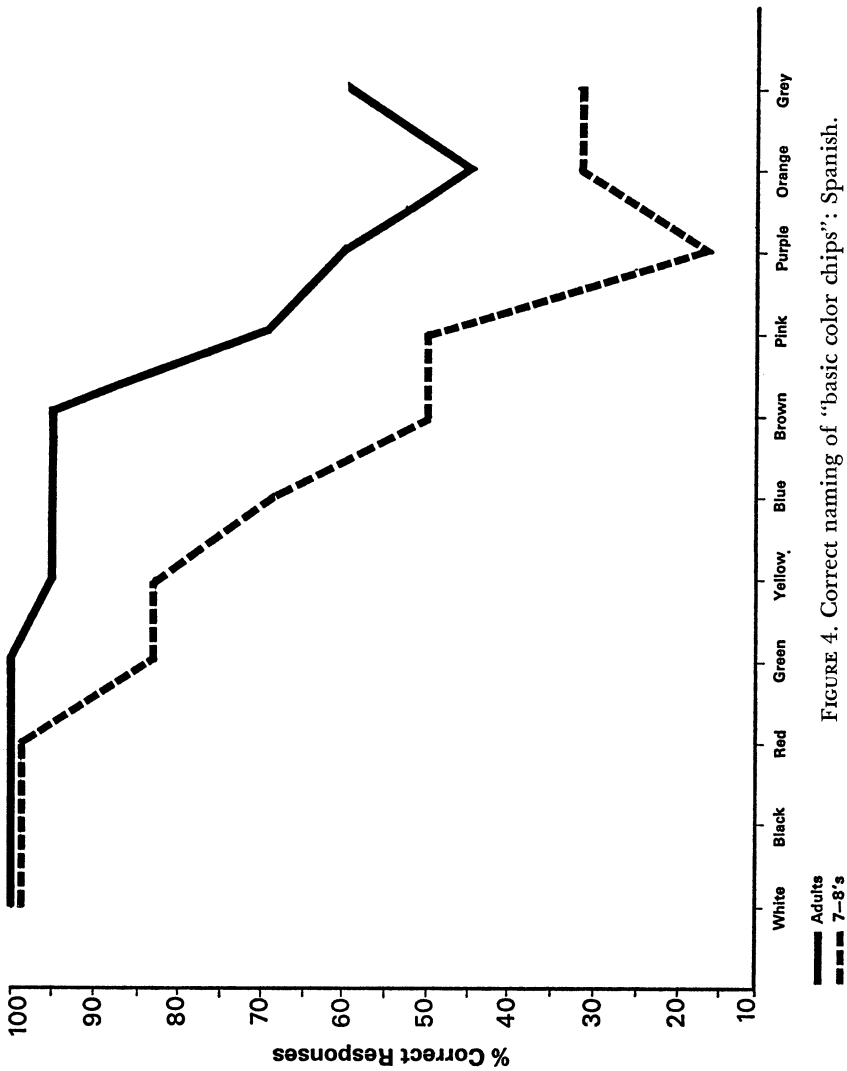

FIGURE 4. Correct naming of "basic color chips": Spanish.

Stage VI lexicon, while the 7–8 repertoire corresponds to Stage IV. Interestingly, the Mam sample, with fewer color names in its lexicon, had high agreement on all its color terms.

Developmental trends in best examples and boundaries of color terms were examined for possible parallels to the proposed "evolutionary" development. In addition, this information suggested some other differences among the cognitive functioning of various color terms.

Figures 5 and 6 show developmental trends in best examples and

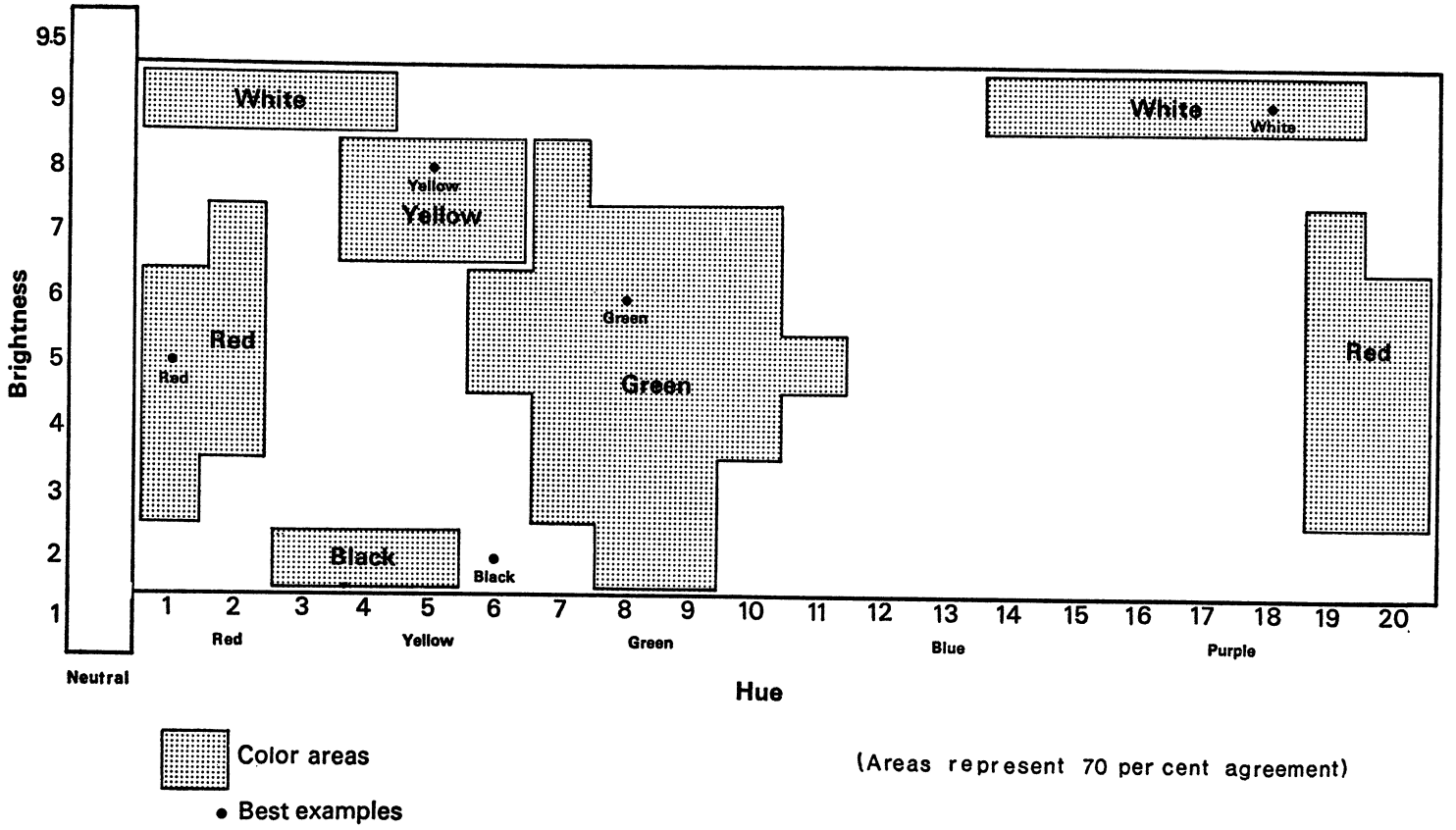

FIGURE 5. Developmental trends in boundaries and best examples: Mam 7–8's.

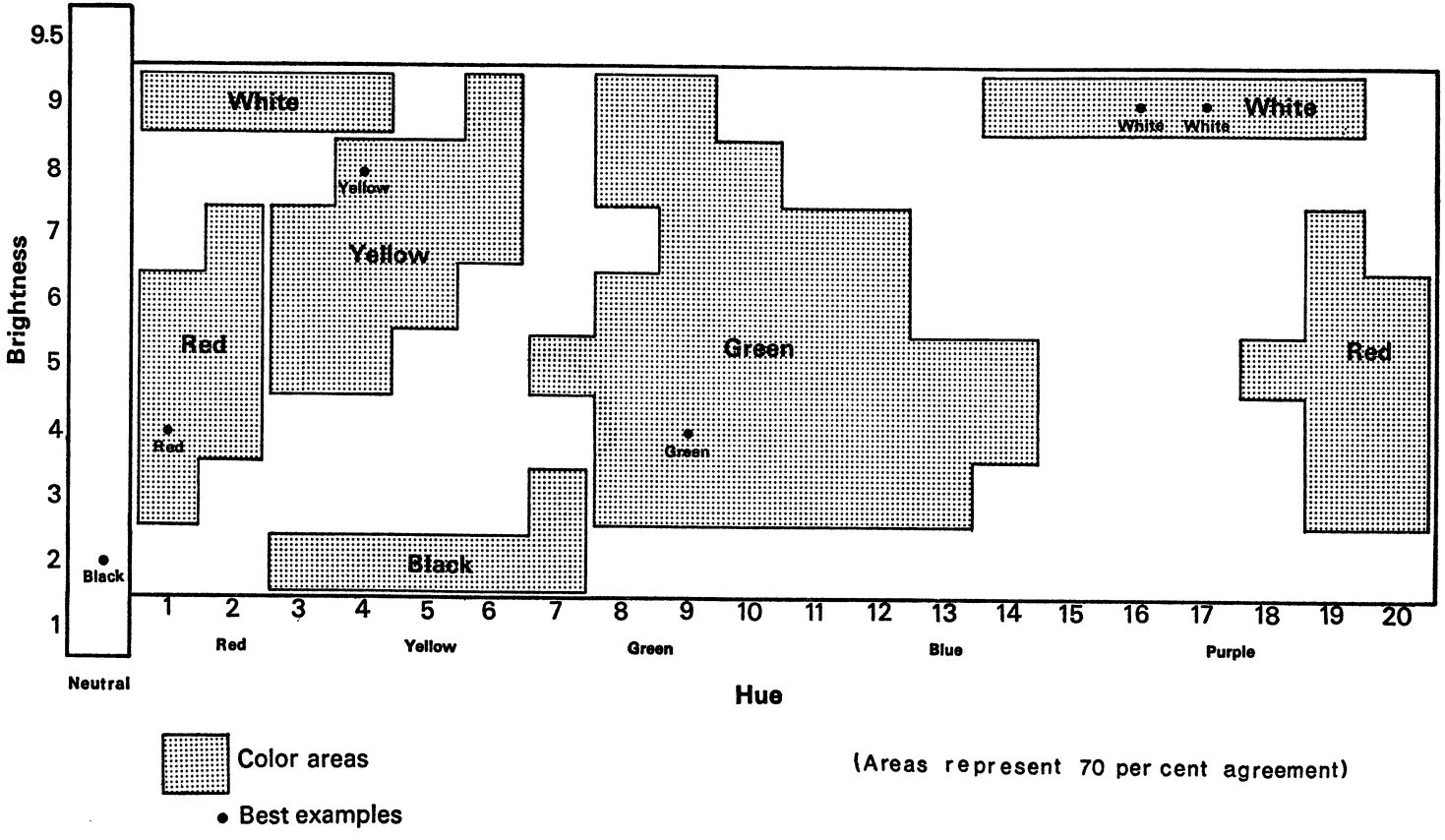

FIGURE 6. Developmental trends in boundaries and best examples: Mam adults.

color areas for the Mam sample. Color areas for the developmental analysis have been mapped on the stricter criterion of 70% agreement (as opposed to the 30% criterion used previously). The reason is that, in the younger age groups, many scattered chips reach 30% criterion for various color terms. Also, the 70% criterion seems to be a more sensitive indicator of developmental change. In the Mam sample the locations of best example chips shift slightly from the 7–8's (fig. 5) to the adults (fig. 6). I believe, however, that these changes are not meaningful—first, because some allowance for error variance must be made in a measure of this sort, and second, because best example choices for Green (where the greatest shift occurs) remain diffuse in the adult sample. The variation in saturation levels for different colors may be responsible for this phenomenon. Color areas including high saturation chips, such as Red and Yellow, showed consistent high agreement on one or two best example chips in all subsamples. Other colors such as Green, whose maximum saturation is considerably lower, showed agreement divided among more chips (but still within a small area). Thus, my interpretation of these data suggests that the 7–8's had concepts of best examples of all the basic color terms in Mam which did not differ significantly from those of the adults. Change in the Mam sample seems to be taking place mainly in relation to the boundaries of two colors, Green and Yellow. The form of development for both colors is interesting in relation to the evolutionary hypothesis: Green expands to include the areas corresponding to Blue and Purple, while Yellow expands to include the Orange area. It is also noteworthy that White, Black, and Red, which are the first colors on the evolutionary list, have apparently reached full definition in the 7–8's and are not altered by the adults.

Developmental trends in the Spanish sample, shown here for all three age groups, (figs. 7, 8, 9) look considerably more complex. Part of the visual complexity can be ascribed to the number of basic color terms to be represented. Also, the three age groups do not show a consistent developmental movement. It might be asked here why there were three Spanish age groups and only two Mam. The reason was simply that most 11–12's in the Mam community were strongly bilingual. The middle Spanish group is included here because the results seem interesting even though they add to the general complexity of the results. The Spanish data seem to show

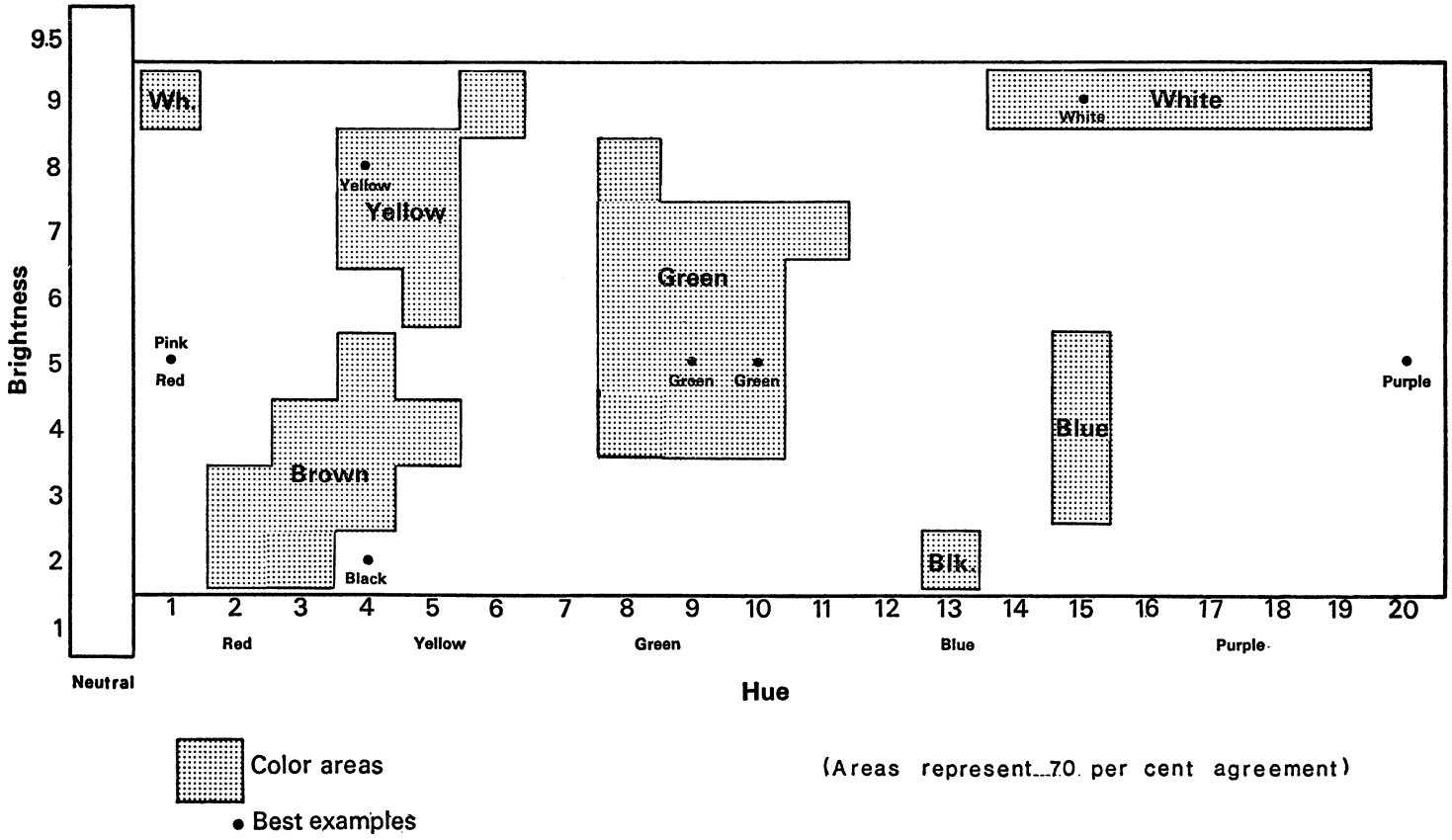

FIGURE 7. Developmental trends in boundaries and best examples: Spanish 7–8's.

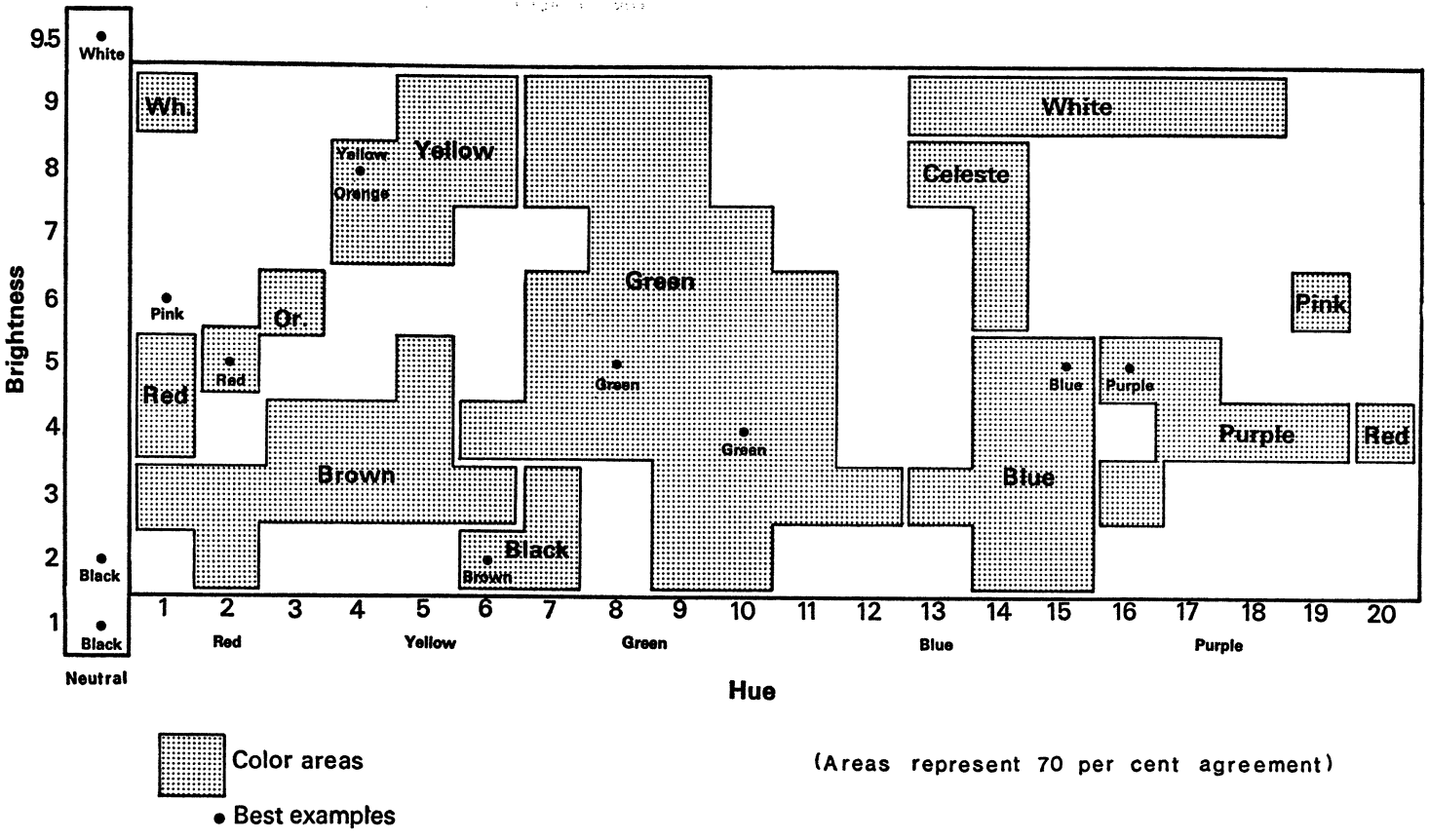

FIGURE 8. Developmental trends in boundaries and best examples: Spanish 11–12's.

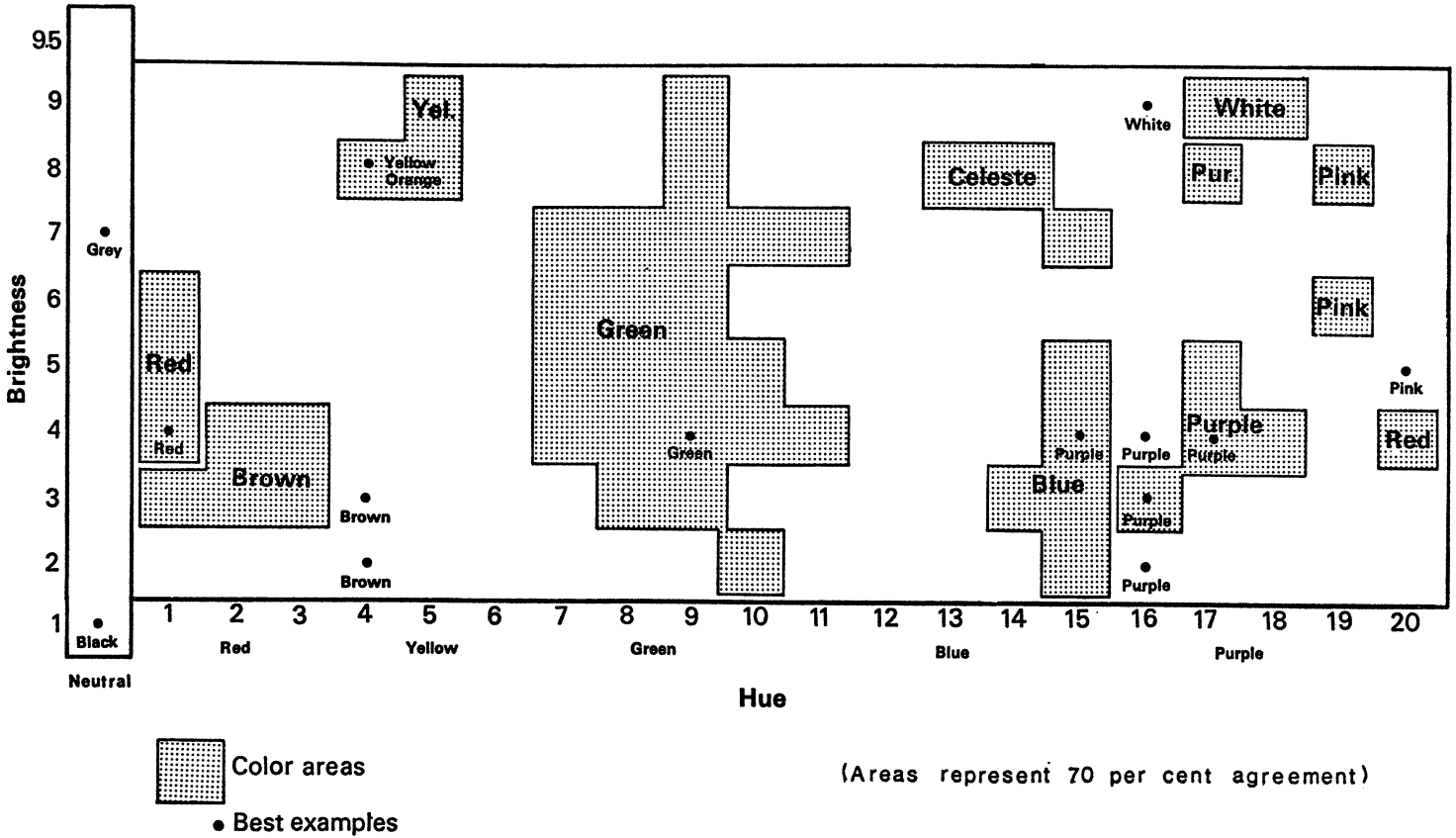

FIGURE 9. Developmental trends in boundaries and best examples: Spanish adults.

clearly that best examples of color terms need not coincide with areas of highest agreement resulting from an individual chip-naming task (e.g., the "40-chip" task). Some of the discrepancy can be ascribed to error variance, as in the difference between adult best examples and color area for Purple. The occurrence of the same chip as best example for two terms, while both terms are represented by distinct color areas, is more puzzling. Such is the case with Yellow and Orange for the 11–12's (fig. 8). A similar situation seems to hold for Red and Pink: best examples fall on the same chip for the 7–8's (fig. 7) and remain close even in the adult sample (fig. 9), where separate color areas for Red and Pink have been established. Blue and Purple best examples are adjacent chips in the 11–12's and adult samples even though the extent of their respective color areas would permit greater differentiation. It is suggested that the thinking that has produced these results might be as follows: When shown a color chip in the Pink area, the subject thinks, "This isn't red and it isn't white; I'll call it pink." But when asked to point to the *best example* of Pink, he feels free to choose a chip which may correspond closely to his own, or other subjects', concept of Red. It is noteworthy, particularly in view of the evolutionary hypothesis, that where best examples of two color terms coincide, the choice falls on the locus of the "earlier" color. This suggests that Pink and Orange might function as cognitive outgrowths of Red and Yellow. The case for Blue and Purple is unclear but might be similar. The near coincidence of best examples of Brown (11–12's and adults) with best example of Black (7–8's) and Black color area is also suggestive.

As with the Mam sample, developmental shifts of the location of Spanish best examples seem insignificant. The one exception to this is Purple, which is located in the Red area by the 7–8's, and then shifted to the Purple areas by the 11–12's. The Spanish development differs from Mam, however, in that some color terms do not meet the minimum best example criterion of having three choices (out of 20) on one chip. Thus the Spanish development includes addition of best examples of those terms not represented by the youngest age group. The order of development corresponds with some qualification to the evolutionary order: the 7–8's best examples are the Stage IV colors—White, Black, Red-Pink (and Purple), Green, and Yellow. The 11–12's best examples include all

basic color terms except Grey, which is added by the adults. The qualification to this description of development is that even for the adult sample, the number of points chosen as best examples continues to be smaller than the number of basic color terms, because the choice of the same chip or adjacent chips sometimes represents more than one term. This discrepancy suggests that in some sense the number of color term *concepts* may be smaller than the number of color terms for the sample studied. Throughout Spanish development, agreement on choosing best example chips was lower on the average than it was for the Mam sample. Agreement on specific chips as best examples of each color term, however, increased with age in both cultures.

Lower agreement among members of the Spanish sample is also reflected in the development of color boundaries. As with the best examples, minimum criterion for color boundaries (70% agreement on naming individual chips) was not met by any chips for some colors. Similarly, the color areas left out of the 7–8 map are the "later" colors. The greatest peculiarity of this map, in relation to the evolutionary hypothesis, is the absence of a Red area. Reference to the raw data reveals that the 7–8's were using the terms Red and Pink interchangeably to name the red area. The data indicate that the 7–8's had a well developed concept of the red area as a nameable color, but were divided about *which* name to apply to it. Development to the 11–12 map includes addition of all the missing color terms, including Celeste (the Stage VIII color). The Green and Blue areas also expanded. Development to the Spanish adult color area map, however, is marked by diminution or even disappearance of color areas. This trend seems at first blush the most troublesome in the data. We have been considering increased agreement on naming color chips as an index of color learning. Do the adults know colors less well than the 11–12's? One could make a sociological argument that, for example, 11–12's are closer than the adults to schooling experience, including teaching of colors. The data already presented on basic color term chips, however, and agreement on best examples suggests that the adults agree more on color concepts than both the younger age groups. Therefore, I suggest that the shrinking of the Spanish adult color areas may be the result of increased use of secondary color terms. These are color terms such as "pea," "violet," "beige," or "mud-colored," which do not meet

the criteria for basic color terms (most of them simply because they were not used often enough). Usage of such terms increased dramatically with age: from five occurrences in the 7–8's, to 36 in the 11–12's, to 94 in the adults. Thus, almost one-eighth of the responses on the 40-chip task in the adult subsample were secondary terms. It may be that on naming colors, the use of secondary terms was sufficient to lower "agreement," as I have been using that term, without necessarily implying less knowledge of color naming.

The other trend in development of Spanish color areas is the increasing use of modifiers. This strongly differentiates the Spanish development from the Mam, where modified basic color terms were not used. Modified basic color terms (such as "light green" or "dark yellow") have been included in the area maps, but the frequency of their occurrence is tabulated separately in table 1. As can be seen,

TABLE 1
OCCURRENCE OF MODIFIED BASIC COLOR TERMS IN THE SPANISH SAMPLE (40-CHIP TASK)

	7–8's	11–12's	Adults
White	0	0	0
Black	0	1	2
Red	0	3	7
Green	3	38	43
Yellow	2	9	21
Blue	0	0	8
Brown	1	4	15
Pink	0	7	16
Purple	0	13	12
Orange	0	0	0
Grey	0	0	2
Celeste	0	6	9
Totals	6	81	135
Secondary terms	5	36	94

the use of modifiers by the 7–8's was a rare occurrence. The 11–12's modified primarily Green. In the adult sample, Green continued to be modified more than other colors, but increase in occurrences of modification centered mainly on other colors. It may be that Green had reached its maximum development in the middle age group, while other color terms continued to be developed. Modified terms tended to occur around the edges of color areas, predominantly on the light or dark edges. I suggest that the use of modifiers permits a speaker to include perceptually distant stimuli in a color

category without violating his central concept of that category, which rests on the best example.

Despite the general developmental trend toward increased use of modifiers, it is evident that some terms are consistently modified less than others. The terms that were modified least by the Spanish sample are White, Black, Red, Blue, and Orange. (Grey is not included here because the term itself was hardly known.) It appears that certain colors may be well known but are not modified because they are considered "absolutes"; they refer to perceptually limited areas, and therefore do not require modifiers. Both Red and Blue seem to be in this category in Spanish, perhaps because they have counterparts for naming lighter versions of the same hue (Pink and Celeste). Orange is even more limited because of taking up only a small area between Red and Yellow. For Black and White, we find not only an absence of modifiers but also a trend to restrict application of the terms themselves.

Evolution of Basic Color Terms

This study did not propose to investigate Berlin and Kay's idea of cultural evolution per se. But some evidence for an actual ongoing expansion of the basic color term repertoire in Mam was found in the use of Spanish color terms by Mam speakers. Subjects in the Mam sample were chosen on the basis of monolingualism, but nevertheless, their familiarity with Spanish varied considerably. Also, Mam as spoken by the residents of Santiago Chimaltenango has absorbed a number of Spanish words. Thus, although subjects were instructed to answer the color test in their own language, many of them naturally used some Spanish color terms as well as Mam color terms.

In the process of tabulating the use of Spanish color terms by Mam speakers, it was found that this linguistic borrowing is quite strongly patterned. First, it was found that Blue and Brown were being borrowed more often than any of the other color terms: of the 65 Spanish color term borrowings, 46 borrowings were accounted for by Blue (azul and celeste) and Brown. The remainder of the borrowings was divided among all the other Spanish color terms, with Pink predominating slightly. A tabulation was then constructed of the borrowing patterns of individual subjects. It was felt that borrowing three or more terms by any given subject indicated

a degree of bilingualism in which terms might be borrowed indiscriminately. Therefore the tabulation presented in table 2 includes only borrowers of one or two terms.

TABLE 2
USE OF SPANISH TERMS BY MAM SPEAKERS

Number of Burrows	7–8's		Adults	
	Colors	*Number of Subjects*	*Colors*	*Number of Subjects*
0		5		6
1	Blue	8	Blue	1
	Green	1	Brown	2
2	Blue and Brown	4	Blue and Brown	6
			Blue and Pink	1

Table 2 shows varying but consistent borrowing patterns for the two age groups in the Mam sample. About one-fourth of the subjects in both groups did not borrow any terms at all. Almost half of the 7–8's borrowed one Spanish term; in all cases but one, that term was Blue (either azul or celeste, used synonymously). Only three of the adults borrowed exactly one term; in all cases the term was Blue or Brown. Four of the 7–8's borrowed two terms, which were always Blue and Brown, while seven of the adults borrowed two terms, which were Blue and Brown in all cases but one. Although not shown in table 2, the patterns of subjects who borrowed three or more terms were similar. Two of the 7–8's and four of the adults borrowed three or more terms. In these borrowings, the strongest consistency was the presence of Blue in all subjects, with Brown also present in the adults. In summary, then, the strongest tendency among the 7–8 borrowers was to borrow just one term, Blue; while among the adults there was a stronger tendency to borrow two or more terms among which Blue and Brown predominated strongly.

As is evident from Berlin and Kay's evolutionary order of color terms, the addition of Blue to the Mam color repertoire would move Mam from Stage IV to Stage V, while the further addition of Brown would bring it to Stage VI. If the incorporation of Spanish color terms into the Mam language can be considered as part of the evolution of the Mam language itself, then one could suggest that Mam is in fact changing along the lines hypothesized by Berlin and Kay.

Basic Color Terms and the Shape of the Color Solid: A Hypothesis

Evidence has been offered here for the validity of Berlin and Kay's findings on the universality of basic color terms and for cognitive correlates to the evolutionary hypothesis in learning color terms, and in borrowing them. But this only raises more basic questions. If there does indeed exist some sort of cognitive ordering of basic color terms, why this particular order? A partial answer may be found in the shape of the color solid, combined with current knowledge of human color perception. It has been shown (MacNichol 1964) that red, green, yellow, and blue wavelengths are the most powerful stimulants of nerves in the visual system at different stages of color reception. One might argue that the total absence of light (black), and its presence (white), have an even more basic function as end-points on a continuum of stimulation of the rods in the visual system. When one translates these ideas from the realm of physiology to the shape of the color solid as it has been conceptualized, it is evident that salience is an important characteristic of basic color terms. Black and White are the end-points of the vertical brightness dimension, while the best examples of red, green, yellow, and blue all occur along a "wave" of most highly saturated colors which encircles the color solid. It would seem that these colors (which represent Stages I–V in Berlin and Kay's evolutionary scheme) function as cognitive anchors for color naming. One could speculate further that Green and Blue are the last terms distinguished within these because they are relatively less highly saturated (hence less salient) than Red and Yellow. The remaining basic color terms appear to be related to these more basic ones in one of two ways: either they appear along the high saturation wave between previously named color areas, or they are vertically related to them. Thus, Orange and Purple occur along the high saturation wave between previously named areas, while Brown, Pink, and Celeste are directly above or below previous basic color terms. If these relationships indicate a rule for the placement of basic color terms, then other terms that might someday reach basic color term status would be violet and single terms for yellow-green and light green. Figure 10 illustrates the relationships suggested.

What causes the growth of basic color term lexicons, either in individuals or in entire cultures? Although cultural complexity has

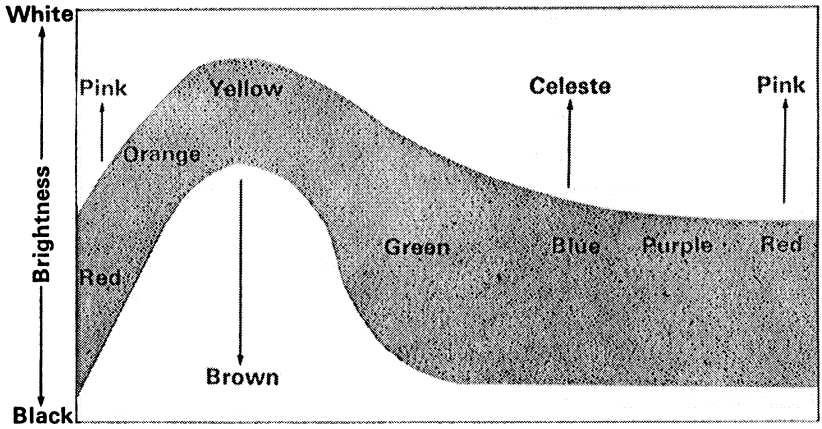

FIGURE 10. Hypothetical evolution of basic color terms in relationship to saturation and brightness.

been correlated with the size of basic color term lexicons for whole cultures (Naroll 1970), the concept in itself does not seem to have much value for explaining cognitive patterns. In considering this question, it should be remembered that many words in a descriptive color vocabulary are linked directly to objects in the environment. Color words used by the Spanish sample in this study included "sky," "cream," and "yolk," while Mam color words included "blood" and "fawn." Obviously, some of the words in the Spanish basic color lexicon (i.e., *cafe,*–"coffee," *naranja,*–"orange," and *celeste*–"sky") refer to objects also. Yet it appears that they function as abstract categories in that they do not conjure up the image of the referent object (just as the color term "orange" in English probably does not produce the image of a fruit in the speaker's mind). Chafe (1970) suggests the development of abstract concepts through process of "idiomaticization." The development of basic color terms appears to fit this model, as basic color terms depend on generalization of color words from their original specific referent objects. Use of general, or abstract, terms becomes necessary to the extent that speakers do not share the same sociocultural background. To take a specific cultural example, marketplaces where people come from various areas to sell things to each other might encourage the expansion of basic color term repertoires. By the same token, it may be that basic color terms are developed mainly to describe manufactured articles, which are not universally known.

CONCLUSIONS

The results reported here give strong support to Berlin and Kay's finding on the universality of best examples of basic color terms. Large samples of speakers from languages at two different "stages" of color lexicon development agreed substantially on best examples of shared color terms. This was particularly striking in that the boundaries of the same color terms varied markedly between cultures. While cultural differences in boundaries of color terms have long been noted and are supported by these data, it may be that the cognitive meaning of color terms is connected not to boundaries but to foci, or best examples. In fact, it would seem that best examples have been the basis for translation of color terms from one language to another, as witnessed by the uniformity of color terms found by Berlin and Kay in their survey of the ethnographic literature. Developmental trends in color naming, which show extension of color boundaries while best examples remain stable in location, also suggest cognitive primacy of best examples over boundaries in color concepts.

It has been found that the evolutionary order of basic color terms is substantially paralleled by the learning of color terms in both languages studied as well as by the degree of familiarity of adults with different color terms in their own language. This finding was particularly strong in the Spanish sample, which had a larger basic color term repertoire. Location of best examples of Red and Pink in the red area, and Yellow and Orange in the yellow area suggested, in addition, that Pink and Orange (both Stage VII terms) may be cognitive outgrowths of the "earlier" Red and Yellow. I would guess that the overlapping of best examples in the Spanish sample might be related to the less elaborated communicative requirements of a small village, and that urban Spanish informants would produce separate best examples for all the basic color terms.

This study also produced unexpected evidence for an actual ongoing evolution of the Mam basic color term lexicon, along the lines proposed by Berlin and Kay. Borrowing of color terms from Spanish by Mam children and adults suggested expansion to a Stage V lexicon by the children, and to Stage VI by the adults. Unfortunately for the study of color terms, this development will probably soon be erased by bilingualism in the whole population.

Finally, this study has shown differences among the ways that

different color terms appear to function cognitively. Some color terms are learned earlier than others, some are more precisely defined both in boundaries and in foci than others, some are often modified whereas others appear to have restricted, "absolute" meanings. Thus, it would seem that while basic color terms do represent "natural categories" (Heider 1971), they are neither a closed nor a uniform set. Rather, the cognitive representation of basic color terms appears to mirror a process of growth towards increased abstraction along apparently universal dimensions.

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