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THE EMERGENCE OF BASIC COLOR LEXICONS HYPOTHESIS: A COMMENT ON "THE VOCABULARY OF COLOUR WITH PARTICULAR REFERENCE TO ANCIENT GREEK AND CLASSICAL LATIN," BY JOHN LYONS

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§ 0 Introduction

The opportunity to comment on John Lyons' paper (hereafter L) is most welcome. There is much to applaud and also some points to which I will take exception. Since it would serve no purpose to parrot the former, the tenor of my comments may appear negative, but that fact should not obscure my overall appreciation of L. Comparing certain texts germane to the color lexicons of Ancient Greek and Classical Latin with the classic report on Hanunóo color terminology by Harold Conklin (1955), L presents a hypothesis that should prove important if it is confirmed. I state this hypothesis in my own terms. Berlin and Kay (1969, hereafter BCT) operated with the tacit assumption that every language contains a small set of words[1]—the basic color terms—each of whose significatum is a color concept and whose significata jointly partition the psychological color space. Subsequent research in the tradition stemming from BCT made that assumption explicit.[2] The essence of the hypothesis I take L to advance is that this assumption is wrong, that is, that not all languages possess a small set of words (or word senses) each of whose significatum is a color concept and whose significata jointly partition the psychological color space. Put slightly differently, the hypothesis is that not all languages have basic color term systems in the B&K[3] sense. The hypothesis is not that some languages don't have basic color systems that fit the B&K typology, it is rather that some languages don't have basic color term systems. For convenience of reference, I will call this the **Emergence Hypothesis (EH)**. What is intended by this name is that not only may the basic color term system of a given language evolve from one stage

1 More carefully, word senses. This distinction becomes important in §1.2.

2 For example, "There is an intuitive use of the word partition in which it is obvious that every color terminology 'partitions' the universe of color percepts ... This intuitive usage can be explicated as follows ..." (Kay and MacDaniel 1978: 641).

3 I will use the abbreviation B&K to stand for a research tradition that includes, in addition to BCT, subsequent works which develop and modify the findings and hypotheses of BCT.

to the next, à la B&K, but before this can happen (and perhaps also while it is happening) a language may bear witness to the emergence of a true basic color term system from a state in which the language can not properly be said to have one.[4]

Accepting the value of the EH as a welcome stimulus to future research, I differ with Lyons on two counts. First, Lyons considers his thesis to be proven. The final sentence of L is, *"Quod erat demonstrandum!"* The arguments of L, based on certain Ancient Greek and Classical Latin texts (and parallels drawn with Conklin's report on Hanonóo) provide proof neither of the EH specifically nor, in my view, of the more general, relativistic position advanced by Lyons.[5] As regards the EH in particular, the data of L raise an interesting question. If this question is to receive a satisfactory answer, that answer will come from research on living languages, employing controlled experimentation, involving living speakers, and conducted with the EH specifically in mind.[6] As regards the generally relativistic view proposed in L, neither the Greek/Latin/Hanunóo facts nor the ancillary considerations adduced by Lyons are persuasive. In §1 it is argued that the EH is unproven but should serve as a stimulus to controlled research on living speakers, designed specifically to test it. In §2 the broader, relativistic view of L is shown not to be supported by the facts, including those presented in L. Some conclusions are presented §3, including a discussion of the role that the EH, if confirmed, might play in a universalistic and evolutionary theory of basic color term systems.

§1. Evidence Presented for the Emergence Hypothesis

Before arguing directly from language data, Lyons makes some general theoretical and methodological comments, which invite clarification. The first of these is the distinction which Lyons refers to as 'first order reference' versus 'second order reference.' Lyons points correctly to the ambiguity of a sentence like (1), "... which under one interpretation means 'That colour is brown' and under another interpretation means 'That object (or substance) is brown'."

(1) That's brown.

Unfortunately, the continuation of this passage is confusing: "The fact that this [sentence] is ambiguous in this way depends, in particular,

4 Essentially the same idea is raised by Maffi and Hardin (in press) and in earlier unpublished work by Luisa Maffi (1990a).

5 In, for example, the penultimate sentence of L: "Colours then, as we know them, are the product of language under the influence of culture."

6 Conklin's work on Hanunóo was, of course, not conducted with the EH specifically in mind.

on the syntactic ambivalence of colour-terms in English: it depends on the fact that they can be used both as nouns (more specifically, in this instance, as count-nouns) and adjectives." One source of confusion in the sentence just quoted is the fact that in their ordinary nominal use, English color terms are syntactically mass nouns, not count nouns.[7] For example, mass nouns, including color nouns, along with plural count nouns, can occur without determiners in argument positions (i.e., as full fledged noun phrases), as illustrated in (2) while singular count nouns cannot so occur, as illustrated in (3).

(2) a **Scarlet** is a kind of **red**. (mass, singular: color)
b **Misery** loves **company**. (mass, singular: non-color)
c **Children** like **toys**. (count, plural)

(3) a ***Child** likes toys. (count, singular)
b *Children like **toy**. (count, singular)
c ***Child** likes **toy**. (count, singular)

Also, mass nouns cannot normally be pluralized, as illustrated in (4)a.

(4) a *Boys like **muds**. (mass, plural)
b *Boys like **reds**. (mass, plural)
c Boys like **puddles**. (count, plural)
d Boys like **mud**. (mass, singular)

There are, to be sure, special constructions in which mass nouns, including color nouns, can be pluralized (and hence counted), but these constructions impose special semantic interpretations, usually involving either the notion 'kind of', as in (5)a,b or 'portion of', as in (5)c. These constructions impose a reinterpretation of something which is notionally unbounded (e.g., soil, yellow, beer), hence unpluralizable and uncountable, as something bounded (e.g., a kind, a serving, etc.).

(5) a Tobacco thrives in a wide variety of **soils**. ('kinds of soil')
b Vermeer used more **yellows** than many of his contemporaries. ('kinds of yellow')
c We had several **beers**. ('bottles/glasses of beer')

A more serious source of confusion in L's treatment of the semantic distinction between first order (adjectival) color description and second order (nominal) color description, is the fact that L states that the B&K approach is "weighted in favour of the use of colour-terms for context-independent (second-order) reference, rather than their use for the (first-order) description of entities and substances of this or that

7 Notionally, color nouns are abstract nouns, like *size, shape, weight, anger, tyranny* and the noun *color* itself. The notionally abstract nouns in English have the same gross syntactic behavior as the notionally mass nouns, such as *sand, water, wood,* etc., and the syntactic class is ordinarily denoted by the term 'mass'.

colour." This is not the case. Workers in the B&K tradition have not, to my knowledge, studied color nouns, whose significata are predicates over properties of physical objects, as against color adjectives (or intransitive verbs or verb roots), whose significata are simply predicates over physical objects.[8] This is an unfortunate misinterpretation because it justifies concentration in L on the use of second order color nouns in texts representing theoretical discussions of color by Greek and Roman philosophers. The use of abstract color nouns in these texts bears an uncertain relation to the way color adjectives were used by ordinary Greek and Latin speakers. But it is only the latter sort of data that is directly relevant to determining the basic color terms of a language, since the B&K model is concerned only with first order terms.

The unique support L provides for the 'second order' interpretation of B&K is the supposition that it was the interpretation of color words as second-order predicates that led the authors of BCT (p. 6) to specify as part of the definition of a basic color term that its application must not be restricted to a narrow class of objects (eliminating terms like *blond*). An expanded citation of the passage just cited from L presents the only justification I can find in L for the surprising inference that B&K are mainly concerned—or concerned at all—with second order color words:

> It seems to be because the Berlin-Kay approach to the investigation of colour vocabulary was weighted in favour of the use of colour-terms for context-independent (second-order) reference, rather than their use for the (first-order) description of entities and substances of this or that colour, that condition (4) [no restriction to a narrow class of objects] was imposed [in the definition of basic color term].

Contrary to the implication of the parenthetical appositive "context-independent (second-order) reference," there is no necessary connection between context-independent reference and second-order reference (or predication). All the basic color terms of English, for example, (*black, red, ...*) are both first order and context independent predicates. Thus, context independence can co-occur with first order predication. Words like *blondness* and *swarthiness* denote second order predicates whose first order correspondents—*blond*, *swarthy*—bear context restrictions to narrow classes like hair, skin, and so on. Thus, second order predication can co-occur with restriction of arguments to a narrow class of objects. The first order/second order

8 I need not recapitulate in detail L's useful discussion of color as probably 'not a real property', which notes, correctly I think, that the philosophical, and even scientific, question whether (first order) colors are truly properties of physical objects (as against properties of our nervous systems, etc.) is irrelevant to the linguistic fact that the semantics of natural languages work as if they were.

distinction and the context restriction/free reference distinction vary independently of each other, so even if Berlin and Kay had wanted to study second order color predicates, which was not the case, that desire would have provided no impetus to rule out restricted color predicates. Workers in the B&K tradition have not assumed that most languages, especially most unwritten languages, have a large number of words which reify color properties as suitable subjects for second order, philosophical discussion, let alone taken words of this kind to be the basic color terms.[9] The B&K tradition of research is not about second order color words. It is about ordinary color adjectives (or verbs), which signify properties of familiar material objects.[10]

This confusion eliminated, Lyons' observations regarding restriction of reference of major color words remain intriguing (if unproven, as we will see). Berlin and Kay tacitly assumed that there is a small set of pure color words (or word senses) in every language that partitions the color space. This set does not, by definition, include color words which apply to a restricted class of objects, containing both color and non-color information in their significata. Lyons' main point is to challenge this assumption on the basis of Greek, Latin, and Hanunóo data, and to suggest that some (many?) languages contain no set of pure (i.e., unrestricted) color terms whose denotata jointly exhaust all the color sensations.

Lyons advances three arguments to show that Ancient Greek (and, to some extent, Classical Latin and Hanunóo) fail to contain any lexical set which constitutes a B&K basic color term system. (1) Ancient Greek (and to some extent Latin) seems to have contained a lot of color synonyms. (2) Hanunóo (and by inference Ancient Greek and perhaps Latin) contains color words which have no color superordinates but which are seemingly not pure color words in that they also denote non-color properties, such as degree of succulence or desiccation. (3) Greek and Hanunóo color terms (and those of Latin to a lesser degree) are more clearly dedicated to expressing distinctions in lightness ("luminosity") than to expressing distinctions in hue. I will conclude that separately and jointly these arguments add up to a plausible hypothesis, deserving empirical test, but not to a proven finding.

9 Nor did Berlin and Kay fail to notice the fact, often cited by critics of B&K despite its irrelevance to the B&K model, that most languages don't have an abstract noun meaning 'color'.

10 This statement overgeneralizes the English facts. In other languages the semantic-syntactic correlation of first/second order with syntactic category need not be so neat. For example, in Somali, the (first order) words for black, white and red are intransitive verbs, the words for yellow and green are denominal adjectives and the word for blue (*buluug*), also a first order basic color term, is a noun. To say that something is blue, one has to say that it "has" blue (Maffi 1990).

§ 1.1 Synonymy

An example of color synonymy that can stand for several others presented in L involves the Greek words for red *eruthros*, *porphureos* and *phoinikeos*. Lyons writes:

> The first problem is that [Ancient Greek] had more than one word for ... red ..., none of which is obviously a context-independent level-1 word: i.e., a more general word to which the others are, in all contexts, subordinate (or hyponymous), as *scarlet* and *crimson* are subordinate to *red* in English. Most classicists, if asked, would probably say that the basic, or general word for red is *eruthros* and that such words as *phoinikeos* and *porphoreos* are indeed subordinate to it. This view is not wholly erroneous. There are indeed certain passages in which *phoinikeos* is used with a more specific meaning in explicit or implicit contrast with *eruthros*. But there are others, notably in Aristotle, where it is used to refer to what he identifies as one of the four most basic colours; and there are some passages, in certain authors, in which it alternates with *porphureos*. Although there are passages, then, in which *phoinikeos* or *porphureos* have a more specific meaning than *eruthros*, there are others where they do not ... Any one of these words can be used to refer more generally to what we can reasonably assume to be BK-red.

There are several weakness with this argument (which is typical of arguments from synonymy in L). The data come from the second order nominal usage by philosophers who are elaborating conscious theories of color, not from ordinary folk using first order color adjectives to describe ordinary things, which is the data of direct interest. This circumstance causes two problems: (1) second order, rather than first order predicates, serve as the data and (2) uncontrolled bias enters as a result of each philosopher's attempt to defend his theory of color against the competition, and probably spurious variation as well.[11]

A third and more telling objection to the argument from synonymy is that the existence of synonymy—especially in grouped data, as any corpus deriving from more than a single author represents—presents no challenge to the B&K approach. In the course of time, a color word, like any word, may be replaced by another word for the same category. Lyons himself cites some examples of this involving Latin and the modern romance languages. In North American English during my lifetime, although this process of lexical replacement without semantic change cannot be illustrated with basic color terms, it can be illustrated with three cases of salient, non-basic terms. The colors that I learned to call *tan*, *chartreuse* and *turquoise* are called by members of my

11 Lyons makes it clear that he is aware of this kind of problem and says, broadly, that one must be judicious in using such sources, but there remains no way to ascertain in precisely what respects and to what extent the data are degraded by such effects.

children's generation *beige*, *lime* and *aqua*, respectively.[12] A representative corpus that spanned the last few decades would show the synonym pairs (*tan, beige*), (*chartreuse, lime*), and (*turquoise, aqua*). In my speech each of these pairs now occurs, as far as I can tell, in free variation and there are doubtless other North American speakers in the same boat. In most (not all) regions of France *marron* has now replaced *brun* as the basic, all purpose, term for brown, with *brun* restricted to hair, skin, beer, and a few other things (Forbes 1986). A representative corpus of European French over the last century, say, would doubtless show extensive evidence for synonymy of *brun* and *marron* for all-purpose description (of such things as automobiles and houses: that is, things that don't fall under the context-restricted usage of contemporary *brun*), while also showing *brun* as maintaining its exclusive claim to hair, skin, etc., throughout the period—perhaps presenting a picture not entirely unlike that described by Lyons for Ancient Greek *eruthros*, *porphureos* and *phoinikeos*. To sum up, well established basic color terms systems often display synonymy. Color synonymy—that is, free variation between two or more words denoting a single color category—presents no challenge to the B&K model, especially when this free variation is observed across speakers or over time, or both.

§ 1.2 Non-Pure Level-1 Color Words?

Lyons follows Conklin (1955) in referring to color words that have no color superordinates as 'level-1' and I will continue that practice. The strongest evidence for the EH comes from the (alleged) existence of level-1 color words that include both color and non-color information in their signification. The classic, and still most convincing case, remains Conklin's description of Hanunóo color words, specifically the words *(ma)rara'* 'maroon, red, orange, yellow, and mixtures in which these qualities are seen to predominate' and *(ma)latuy*' 'light green and mixtures of green, yellow, and light brown'. "... there is an opposition between dryness or desiccation and wetness or freshness (succulence) in visible components of the natural environment which are reflected in the terms *rara'* and *latuy*, respectively... A shiny, wet, brown-colored section of newly-cut bamboo is *malatuy* (not *marara'*)..."(Conklin 1955: 191). This passage is alluded to in L in the following:

> Of particular interest to us here is [the Ancient Greek word] *khlôros*, which is used more particularly of plants and foliage. It was this word that I had in

12 There will of course be speakers who, aware of all six words, will invent idiosyncratic differences of denotation between each pair of synonyms, according to the process which, for example, causes North Americans who know *faucet* and learn *spigot* (or vice versa) to dream up an idiosyncratic meaning difference between them.

> mind when I said that Ancient Greek was similar to Hanunóo. Standard dictionaries of Greek will say that *khlôros*, like the English word *green*, has two meanings, in one of which it denotes a colour and in the other of which it can be paraphrased by such words as fresh, unripe or even moist and full of sap, according to context. But this is not so. The colour-term sense of *khlôros* is inseparable from its more general sense in which it is used typically, to describe fresh, green foliage. That is to say, the Greek equivalent of a phrase that would be translated into English as 'green foliage' is not ambiguous: when it is used descriptively, and with its prototypical meaning.

L offers no support for the claim that "the colour-term sense of *khlôros* is inseparable from its more general sense." We are entitled to ask what evidence Lyons has that *khlôros* is not ambiguous in the way English *green* is or French *vert*, or perhaps, for that matter, Hanunóo *latuy*. We are told, in effect, that the speakers of Ancient Greek would not be comfortable applying *khlôros* to, say, both a fruit that is ripe and colored green and to one that is unripe and colored yellow. But we are not told how Lyons has reached this conclusion. Suppose for a moment that there is a sense of the word *khlôros* (or *latuy*) which denotes only the color 'green' and there is a distinct sense, or distinct senses, denoting 'unripe', 'fresh', 'succulent', or metaphorically 'callow', 'spry', etc., as in English or French. If *khlôros* and *latuy* should be ambiguous in this way, Ancient Greek and Hanunóo are no more counterexamples to the B&K model than are English and French—or medieval Welsh[13], or Gugu-Yalanji[14]. (Both of the latter have grue words that also mean unripe or fresh.) Lyons is aware of the ambiguity problem, but he faces it with nothing more than the unsupported claim of monosemy for *khlôros* and, by implication, *latuy*.[15] What if the standard dictionaries of Ancient Greek were actually right? Could there exist a widespread metonymy according to which the color green is lexically associated with youth, freshness, etc. in the vocabularies of many languages, creating in each language several senses for the color word green (or grue)? This is mere speculation. What is certain is that no evidence or argument is presented in L to establish that *khlôros* (and *latuy*) are monosemous.[16]

13 Eve Sweetser [personal communication].

14 An Australian language represented in the World Color Survey, an ongoing research project.

15 Conklin does not explicitly consider the ambiguity issue.

16 Moreover, there is some suggestive evidence to the contrary. Eve Sweetser [personal communication] writes:

> *Glas* (the 'grue' word, which does in all Celtic languages refer to the color of leaves, *inter alia*) has the meanings of 'unripe' (as of fruit and also of grain) and of 'immature' (as of an inexperienced person, **not** a physically immature one) in Irish, Welsh and Breton. Old Irish has examples where it is used to mean 'incompletely trained' (of a soldier and a lawyer), as does older Welsh (which also refers to un-aged mead as *glas* mead) ...

§ 1.3 The Argument from Lightness[17]

Considerable emphasis is put in L on the role of lightness (versus hue) in color vocabularies of Ancient Greek and Hanunóo:

> As we have seen, both Gladstone and Plautner came to the conclusion (as did Conklin for Hanunóo) that luminosity is more important than hue in the colour vocabulary of Greek.

Actually, Conklin gives us more detail about the denotation of Hanunóo *(ma)bi:ru* 'black' and *(ma)lagti'* 'white' than Lyons does about Ancient Greek *melas* and *leukos*. "In general terms, *mabi:ru* includes the range usually covered in English by black, violet, indigo, blue, dark green, dark gray, and deep shades of other colors and mixtures; *(ma)lagti'*, white and very light tints of other colors and mixtures" (Conklin 1955: 190). The greater range of the black/dark term than the white/light term is characteristic of B&K stage III systems, where red and yellow have become separated from white while some or all of the original composite black/green/blue is retained (Kay, Berlin and Merrifield 1991: 19, Kay, Berlin, Maffi, and Merrifield 1997 [KBM&M]). In the typology of KBM&M, Hanunóo fits unproblematically as a recently emerged stage $III_{Bk/Bu}$ system, with basic terms for white and light shades *(ma)lagti'*, black and blue (including purple) *(ma)bi:ru*, red and yellow (including orange and pink) *(ma)rara'*, and green *(ma)latuy*. The restriction of *(ma)latuy* to light green in Hanunóo suggests this term's recent emergence from the original black-or-green-or-blue composite of stage II systems,[18] hence the recency of stage III status for Hanunóo.

The facts given in the preceding paragraph show that Hanunóo is a readily classifiable B&K system, but they show something more general as well. These observations remind us that according to B&K the terms including white and black tend to be widely extended in early-stage languages. In BCT, a stage I system was defined as having two terms: one for white and all light shades and one for black and all dark shades (p. 17). Later (Heider 1972a,b, Kay 1975), it was discovered that this

> Sweetser makes the interesting point that this breadth of signification of *glas* can not represent a single general sense, covering several aspects of a prototypical referent, since all indications are that *glas* never referred to humans who are simply chronologically young. There must be a metaphorical transfer here, not mediated by a stage of general reference over several aspects of a typical referent: "... there seems to be zero evidence that this word ever meant 'young' (or 'young and vigorous' or 'young and still not fully physically mature') when applied to people in any of the [Celtic] languages." But if we are forced to posit separate senses, only metaphorically related, in these Celtic cases, separate senses which are only metonymically related remains a significant possibility for cases such as *khlôros* and *latuy*.

17 I will use 'lightness' for what Lyons terms 'luminosity', the subjective dimension whose poles are represented by the sensations white and black.

18 And of stage I systems as well.

wasn't quite right, rather that the white-including term tends to include as well the so-called 'warm' colors (red and yellow principally) while the black-including term tends to include the so-called 'cool' colors (green and blue principally). Both versions of the B&K sequence shows lightness considerations to dominate early stage systems. All the developments up to stage V (where each of the Hering primaries [black, white, red, yellow, green, blue] gets a separate basic color term) can be viewed as breaking down the original white-warm and dark-cool channels to their separate chromatic and achromatic components [KBM&M]. In short the B&K approach emphasizes the neutralization of lightness and hue information in the basic color terms of early systems and so the discovery of 'lightness emphasis', broadly described, in early systems supports the B&K model, rather than the reverse.

§ 2. Relativism and Color Semantics

Lyons characterizes the philosophical position he brings to bear on color semantics as one of "post-Saussurean structuralism combined with a modified or moderate version of naive realism and a similarly modified or moderate version of relativism." Lyons goes on to say that work in the B&K tradition has had something to do with the modification of his earlier position on relativism. After this gracious acknowledgment it may appear mean spirited for me to dispute certain statements in L that I find overly relativistic. I hope it will be noted, however, that my remarks in this section are not addressed to Lyons' broad philosophical position, nor even to a general position on the semantics of natural languages, but quite strictly to the meanings of basic color words. I have no argument to present against a position of moderate relativism with regard to lexical semantics in general, but in the domain of color specifically there is empirical evidence that is hard to reconcile with certain statements in L.

Among several relativistic claims in L to which one might object, I will restrict this discussion to two. One of these, I have already cited: "Colours then, as we know them, are the product of language under the influence of culture." This statement fails to recognize existing evidence that major aspects of the color experience of adult humans is the same as the color experience of pre-linguistic human infants and the color experience of macaque monkeys and of chimpanzees. The other statement, much along the same lines, also appears to ignore a body of experimental results which have not, to my knowledge, been challenged. Lyons writes:

> I have made explicit the fact that the perception of colour, and of perception in general, is species-specific; that is to say, the way the world appears to members of one species, more particularly to human beings, is specific to that species.

Free of context, the term 'species-specific' is subject to a potential ambiguity. To say, with regard to a species s, that a property p is 'species-specific', might be intended to mean no more than that p is common to all members of s. On this uninteresting interpretation, binocular vision, warm-bloodedness and possession of a backbone are species-specific to humans. The other possible signification of 'species-specific' is that p is restricted to members of s, that is, that p does not characterize species other than s. This is the sense in which the term was popularized by Chomsky, restricting the property of possessing language to human beings. It is clearly in this latter sense that Lyons intends the term species-specific with regard to the human perception of color. The following section summarizes a fraction of the evidence that human color vision is not species-specific but rather is shared with several other higher primate forms, possibly with all apes and Old World monkeys.

§ 2.1. Color Vision Among Humans and Some Other Higher Primates

In introducing his study of multivariate (principal-component) analysis of the firing patterns of optic nerve (LGN) cells of macaque monkeys, Young (1986: 1735) writes, "Because behavioral color responses of humans and macaque monkeys are virtually identical, the physiological knowledge is, by inference, applicable to humans as well." As authority for the virtual identity of behavioral color responses in humans and macaques, Young cites the classic study of De Valois et al., (1974) which summarized the results of an extensive program of psychophysical testing of macaque monkeys in the middle and late sixties. Those studies showed that on a variety of measures, macaque color vision is essentially the same as that of normal human observers and radically different from several types of color-blind humans (protanamalous and deuteranomalous dichromats and anomalous trichromats). Without going into excessive technicalities, I quote from the summary of this landmark study.

> In these sensitivity experiments we have tested some of the basic characteristics of visual sensitivity in macaques and man and also the way in which the visual system processes temporally-changing stimuli under various circumstances. These tests are sensitive to a number of different characteristics of the visual system: the spectral absorption functions of the underlying pigments, the way in which different receptor pigment systems are combined neurally in the brightness system, and the time constants of the scotopic [dim light/rod driven] and photopic [bright light/cone driven] systems. The results show a striking similarity between macaque monkeys and normal human observers: not only were the relative sensitivity functions found to be virtually identical, but the absolute sensitivities and the slopes of the flicker-frequency-intensity functions were all virtually the same ... (De Valois et al. 1974: 65).
>
> The color vision experiments have confirmed what was already widely accepted on the basis of the experiments by Tredelenberg and Schmidt (1930),

> by Grether (1939), and from our earlier reports of these experiments, namely that macaque monkeys have excellent color vision and that their color vision is very similar to that of normal human trichromats ... (De Valois et al. 1974: 65).
>
> ... the color vision of the New World monkeys appears to be quite different from that of macaques ... it would not be surprising to find that many Old World monkeys, to say nothing of the apes, would be the same as man in this regard, since man is an Old World primate ... (De Valois et al. 1974: 66)
>
> The essential identity of macaque and human brightness and color systems shown in these experiments ... support the validity of generalizing the results of the physiological investigations of macaques to explain human psychophysical behavior, as far as brightness and color vision are concerned (De Valois et al. 1974: 66).

I will discuss only one more study. This series of experiments deals directly with color categories rather than sensitivity functions. It shows that macaques make the same fundamental division of the spectrum as humans into the Hering primary hue classes red, yellow, green and blue. This division cannot represent a reflection of categories encoded in macaque language.[19]

> The many explanations of the perceptual categorization of hue may be divided into those that attribute categorization to language and culture and those that attribute categorization to the native properties of the visual system ... If the first, or experiential, explanation of hue categorization were valid, then macaques would not be expected to show the same basic four-fold division of the spectrum as man (Sandell et al. 1979: 628).
>
> In the present study, we trained monkeys to respond in the presence of one color and tested them for generalization to colors in both the same and different human hue categories. In all four experiments, the generalization curves showed a marked discontinuity across the boundaries between the human hue categories of blue, green, yellow, or red. The monkeys made more responses to colors in the same hue category as the training stimulus than in an adjacent hue category. This was true even when the physical difference between the training stimulus and a stimulus in the same human hue category was greater than that between the training stimulus and a stimulus in a different category. Furthermore, this result was found at different luminance levels, at different stages of extinction, and independent of the animals' prior experience with color-discrimination training. Thus [macaque] monkeys appear to partition the spectrum into the same basic hue categories as do humans. By a category we mean a class of stimuli that are grouped as perceptually similar although they may be discriminable from one another (Sandell et al. 1979: 634).

To conclude this section, I point out briefly that analogous findings have been made with chimpanzees. For example Essok (1977) found that the chimpanzee Lana "classifies colors as human beings do" (Sandell at al. 1979: 634). In a review article, Grether (1940) concludes

19 Again, to avoid technical detail which would be inappropriate here, I quote only from the introduction and conclusion of the study.

that chimpanzee color vision is similar to human color vision. Matsuzawa (1985) found that after training a chimpanzee to match with a name, in the form of a visual symbol, eleven colors closely approximating the B&K focal colors, the animal applied these names to a large array of colors in much the same way as a human observer faced with the same task and in a way that rather closely reproduced the chart shown in Figure 3 of BCT: "Normalized Foci of Basic Color Terms in Twenty Languages" (Berlin and Kay 1969: 9).

The experiments cited in this section call into question Lyons unsupported statement that "the perception of colour ... is species-specific; that is to say, the way the world appears to members of one species, more particularly to human beings, is specific to that species." Since monkeys and apes don't have language, their colors can't be "the product of language under the influence of culture." The same observation may be made with respect to pre-linguistic human infants, who have also been shown to possess the Hering primary hue categories blue, green, yellow and red (Bornstein et al. 1976).

§ 2.2. The EH in a Universalistic and Evolutionary Model of Color Naming

In closing I will make two brief points, one methodological and one theoretical. The methodological point is that it is difficult, even under the ideal conditions in which the linguist has available his or her own native judgments and those of fellow native speakers, to decide in cases of multiple readings of a word whether these multiple readings represent polysemy (ambiguity) or generality (vagueness). Some linguists have even argued that this issue is undecidable in principle (e.g., Cruse 1986, Chapter 3). To review such discussions would take us too far afield, but the mere fact that this theoretical claim has been made points out that if we are ever to settle the issues that have been raised regarding the monosemy/polysemy of words meaning both, say, 'green color' and 'succulent/fresh', as in Ancient Greek *khlôros* or Hanunóo *latuy*, we will need hands-on field observation and experiment devoted precisely to this question, where living speakers of living languages are subjected to experimental probes devoted precisely to clarifying the issue of monosemy versus polysemy for one or more color words of their language. The reason such investigations are crucial to the EH is that examples like Hanunóo *latuy* and Ancient Greek *khlôros* constitute the best published evidence in favor of the EH, and this evidence is not compelling.

Having established that the Emergence Hypothesis is just that: a hypothesis, we may take a moment to consider what implications the EH might have for the B&K model if it were found to be correct. It seems to me part of the general tenor of L that the B&K model fails to

the extent that the EH holds.[20] But it seems that an empirically established EH might more likely serve to extend the B&K model than refute it. Under such a view, there would be not only the evolution of more extensive basic color term systems from less extensive ones (B&K) but also the emergence of basic color term systems as lexical sets specialized to color from earlier stages of a language in which there is no set of word senses which partitions the perceptual color space (EH). If the EH is correct, there may be interesting things to find out with regard to universal constraints on which kinds of meanings get mixed with color meanings in pre-basic-color-term systems. For example, if L should be right about notions of freshness and green color being expressed in a single word-sense in Hanunóo and Ancient Greek, that particular neutralization might turn out to be a popular one in the languages of the world. On the other hand, neutralization in a single word-sense of the notions 'blue' and 'fingernail' would be surprising. Empirical field research on living languages, devoted directly to investigating the EH, might reveal interactions between the processes of basic color term evolution and basic color term emergence. For example, there are hints—and I emphasize hints—in the data of the World Color Survey (Berlin, Kay and Merifield 1985, Kay, Berlin and Merrifield 1991, Kay, Berlin, Maffi and Merrifield in press, Kay and Berlin 1997) that some languages may develop terms for true color concepts focused in black, white and red while still using terms whose significata are not devoted exclusively to color to describe the surface appearance of objects whose surface appearance is not describable with the true color terms. I emphasize the word 'hint' because the WCS data, like the Ancient Greek data and Hanunóo data discussed above, were not systematically gathered with the EH in mind and only data gathered *in situ* with the EH specifically in mind are likely to shed more than pallid light on this hypothesis.[21]

20 I cannot support this interpretation of L with direct citations. If I am in error here, I will welcome correction.

21 In recent, unpublished work, Stephen Levinson (1997) provides detailed analysis of a system whose study was conducted with the EH in mind. Briefly, in the non-Austronesian language of Rossel Island, Papua New Guinea, (i) there are reliable single-word designations for NON-composite black, white and red, (ii) there are descriptive phrases for green, yellow and blue (in steeply descending order of conventionalization), and (iii) about half the color space is unnamed for most speakers.

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