Asymmetries in the distribution of composite and derived basic color categories (web version)

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[THIS IS A COMMENT ON A MS. BY STEPHEN E. PALMER, ENTITLED COLOR, CONSCIOUSNESS AND THE ISOMORPHISM CONSTRAINT, TO APPEAR IN *BEHAVIORAL AND BRAIN SCIENCES*.]

Abstract

PURPLE (RED-and-BLUE) is the most frequently occurring derived (binary) basic color term (BCT), but there is never a named composite BCT meaning RED-or-BLUE. GREEN-or-BLUE is the most frequently named composite color category, but there is never a BCT for the corresponding derived (binary) category CYAN (BLUE-and-GREEN). Why?

Palmer notes that the naming of some but not all of the possible composite and derived basic color categories constitutes a puzzling set of asymmetries in color experience, assuming these categories are in fact reflections of color experience. He continues (p. 8 of ms.), "I am not aware, however, of any behvioral data that directly support these asymmetries for derived and composite color categories in color experience." I think such behavioral data exist, though they are admittedly few. I return to this point presently. Meanwhile, I would like to flesh out further the question of which possible composite and derived categories actually occur, what their relative frequencies are, and what significance may be attached to these relative frequencies. I will restrict my attention to the 110 languages of the World Color Survey (WCS. See Kay and Berlin 1997).

Figure 1 summarizes much – not all – of the WCS data on composite and derived categories. It also displays the number of jnds separating each pair of non-opponent hue primaries (RED, YELLOW), (YELLOW, GREEN), GREEN, BLUE), and (BLUE, RED). Palmer raises the issue of the relevance of jnd separations: "For example, if for some reason there are more just-noticeable-differences (jnds) between unique red and unique yellow than between unique green and unique blue, the wider psychological gap might explain why there are BCTs for ORANGE in many languages, but not for CYAN (blue-green)" (p. 7). Although I am not certain that the number of jnds separating two unique hues measures a psychologically real distance, this information has been included in Figure 1 to allow its possible relation to variations in the popularity of corresponding composite and derived categories to be assessed.

The immediately striking facts observable in Figure 1 are (1) that the most popular composite category, B-or-G, is composed of primaries whose corresponding derived category, CYAN (B-and-G), never receives a BCT and that (2) the most popular derived category R-and-B (PURPLE) combines primaries whose potential composite category, R-or-B, never receives a BCT. One is tempted to speculate that BLUE and GREEN are in some yet-to-be-determined sense "similar." If similarity promotes the recognition of a composite category and dissimilarity promotes the recognition of an intervening, derived category, we have an explanation why BLUE and GREEN are readily lumped into a composite BCT and never separated by a derived BCT. If BLUE and RED are dissimilar, the same logic explains why BLUE and RED are most frequently separated by a derived BCT and never lumped into a composite.

Unfortunately, neither the behavior of the remaining two pairs of non-opponent hue primaries nor the jnd separation data support the similarity conjecture. With respect to the pair (RED, YELLOW), there are 12 instance of the corresponding composite, R-or-Y, and 7 instances of the corresponding derived category (R-and-Y = ORANGE). With the pair (GREEN, YELLOW) we have a tiny number of composites and no instances of the corresponding derived category (CHARTREUSE). So while it might be attractive to speculate that non-occurrence of CYAN as a BCT coupled with the great popularity of B-or-G makes sense in terms of the "similarity" of BLUE and GREEN and that the "dissimilarity" of BLUE and RED accounts analogously for the popularity of PURPLE and the non-occurrence of a B-or-R composite, the hypothetical negative correlation between the number of composite and derived categories, for pairs of primaries, breaks down with the (GREEN, YELLOW) and (YELLOW, RED) pairs. Both the (GREEN, YELLOW) pair and the (YELLOW, RED) pair show slightly higher incidence of the composite than the derived category, with inconclusively small absolute numbers.

With regard to jnd separation, the comparison of only the (BLUE, GREEN) and (RED, BLUE) pairs, 84 jnds and 124 jnds, respectively, appears to support the similarity hypothesis. BLUE and GREEN are indeed separated by fewer jnds than are YELLOW and RED. But looking now at the jnd data for the other two pairs, (RED, YELLOW) and (GREEN, YELLOW), we note both of these jnd separations far exceed those of either of the first two pairs, destroying any hope of jnd separation being able to explain the relative popularity of composite and/or derived categories among different pairs of non-opponent hue primaries.

We have not been able to explain the striking fact that in the WCS data the most frequent two-primary composite BCT, G-or-B, corresponds to a derived category, (G-and-B = CYAN), which never gets a BCT and the most frequent derived BCT, (B-and-R = PURPLE), corresponds to a composite, B-or-R, which is never accorded a BCT. When the 98 languages of the Berlin and

Kay (1969) study are added to the 110 languages of the WCS, this observation still holds. The negative correlation between the liklihood of a pair of non-opponent hue primaries being combined in a composite and in a derived category is confirmed in a large number of languages, but only in the extreme cases of the most popular composite and derived categories.

Returning to the question of whether there are behavioral data supporting asymmetries regarding composite colors, two experiments carried out by James Boster (1986) have been summarized as follows:

> The strength of the association of warm hues with W[HITE] and of cool hues with Bk is reinforced by experiments performed by James Boster (1986). In one experiment Boster gave twenty-one naive English-speaking subjects eight color chips, representing focal examples of the categories black, white, red, orange, yellow, green, blue and purple. The initial instruction was to sort the chips into two groups "on the basis of which colors you think are most similar to each other..." (Boster 1986: 64). The overwhelming preference was to put white, red, orange and yellow into one group and green, blue and black and purple into the other. Two thirds of Boster's subjects chose this exact division into two subsets. (There are 2,080 ways a set of eight elements can be divided into two non-empty subsets.) In a second experiment, the same instruction was given to a group of eighteen subjects, using as stimuli the eight color words rather than the colored chips. Substantially the same result was obtained (Kay and Maffi. In Press).

In subsequent sorts, Boster's subjects also showed strong preferences for keeping together the pairs (RED, YELLOW) and (GREEN, BLUE), the latter more strongly than the former.

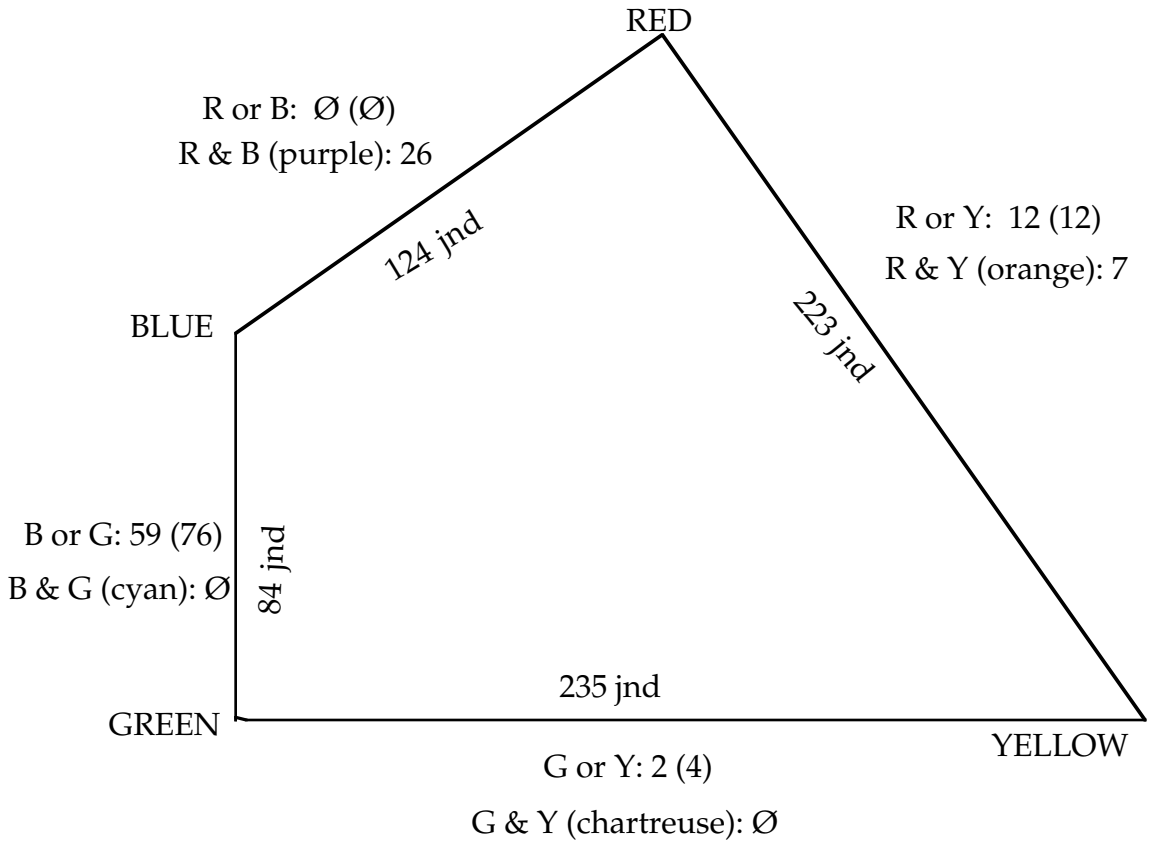

Figure 1. Frequencies among 110 WCS languages of binary composite and derived categories, with the number of jnds separating the two primary categores of which they are composed. The first number given for a composite category records the frequency of that category. The second number (in parentheses) records the frequency of all composite categories containing the two indicated primaries. For example, 59 of the 110 WCS languages contain a B-or-G category; 76 languages contain either a B-or-G, or a B-or-G-or-Bk, or a B-or-G-or-Y category. (Source for jnd separations: MacLaury 1997: 88)

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