Perception, 1997, volume 26, pages 367 – 370

Note: Half-a-million basic colour words: Berlin and Kay and the usage of colour words in literature and science

Ian C McManus
Department of Psychology, University College London, Gower Street, London WC1E 6BT, UK;
e-mail: i.mcmanus@ucl.ac.uk
Received 23 January 1996, in revised form 27 November 1996

Abstract. Berlin and Kay have proposed that the order of evolution of colour words is highly conserved *across* languages. Previously I have suggested that the same order of colour words, with black, white, and red first, and pink, purple, orange, and grey last, is found in the rate of usage of colour words *within* languages. That hypothesis is now further supported by the frequencies of the eleven English basic colour words in 507 256 cases in eight large computerised data bases, there being a rank correlation of 0.802 with the Berlin and Kay order.

Berlin and Kay (1969) have suggested that basic colour words show a remarkably consistent pattern across languages (figure 1). In languages with only two basic colour words they are always black and white; if a third is present it is always red; and if a

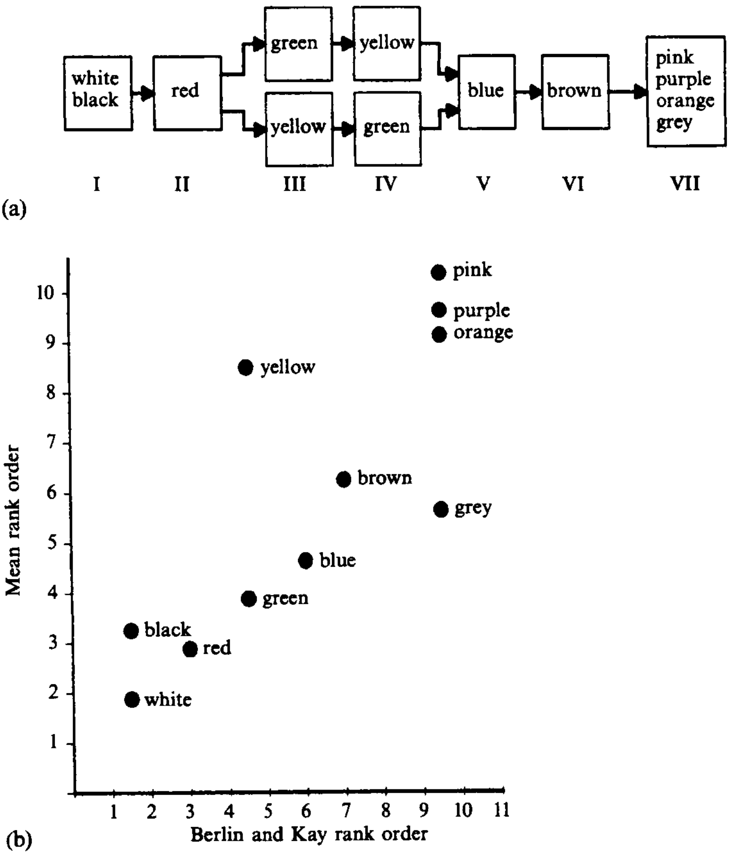

Figure 1. (a) Schematic representation of the order of evolution of basic colour terms in the Berlin and Kay (1969) theory; (b) relationship between the rank order of basic colour terms in the Berlin and Kay theory (abscissa) and the mean rank order of the frequency of colour words in the eight databases shown in table 1 (ordinate).

fourth is present it is always green or yellow and the fifth is then always yellow or green; the sixth is always blue; the seventh is brown; and then pink, purple, orange, and grey follow in no particular order (figure 1a). In subsequent work Berlin and Kay and their colleagues have made minor modifications to this formulation (Kay 1975; Kay and McDaniel 1978; Kay et al 1991), although the substantive hypothesis remains unchanged. Other workers have attempted to find explanations for the particular ordering of colours in terms of the physical properties of colour (Sun 1983) or the ecological properties of pigments such as red ochre (Wreschner 1980). There are also critics of the entire theoretical approach of Berlin and Kay, of which a notable recent example is Saunders and van Brakel (1997).

Elsewhere (McManus 1983) I have previously hypothesised that if the Berlin and Kay sequence represents a true evolutionary order then the most ancient colour words should also have richer semantic associations and hence tend to be used more frequently and in a broader range of contexts within a single language, and I showed that the Berlin and Kay order correlated with frequency of usage in English poetry, in English novels, and in Chinese poetry, as well as a range of other measures such as length of dictionary entry and semantic differential characteristics. A similar proposal had also been tested in a different way by Hays et al (1972) by using frequency of colour-word usage in seven different languages. In this brief note I use several large computerised databases to test the hypothesis further against the frequency of usage of over half-a-million colour words used in a variety of contexts, both literary and scientific, and again show a close relationship between colour-word frequency and postulated evolutionary age.

Eight different databases (two literary, five scientific, and one of dissertations across a range of disciplines—see table 1) were scanned for the eleven English basic colour words: white, black, red, green, yellow, blue, brown, purple, pink, orange, and grey/gray. In all eight databases there was a positive Spearman rank-order correlation

Table 1. The rank order of each colour (actual n in parentheses) for each of the eight databases and the mean rank across the eight databases. The rank of the colour in Berlin and Kay's (1969) evolutionary model and its correlation (Spearman correlation r_S, and Kendall correlation, r_K; $n = 11$) with the rank order in the databases is also shown (actual ranks used for computations in the cases of ties are show in square brackets). Databases used: *Biological Abstracts* (1993 – 6/1995);

	White	Black	Red	Green	Yellow	Blue
Berlin and Kay model	1= [1.5]	1= [1.5]	3	4= [4.5]	4= [4.5]	6
Biological Abstracts ($n = 76\,064$)	3 (12 481)	7 (5 505)	1 (12 952)	6 (5 669)	9 (3 329)	5 (5 860)
Dissertation Abstracts ($n = 59\,573$)	1 (17 866)	2 (16 409)	3 (7 572)	4 (4 505)	8 (1 877)	5 (4 240)
English Poetry ($n = 82\,808$)	1 (14 710)	6 (8 144)	4 (10 481)	2 (14 459)	9 (3 488)	3 (11 037)
English Verse Drama ($n = 5\,962$)	2 (1 261)	1 (1 691)	3 (794)	4 (501)	9 (194)	5 (401)
GeoRef ($n = 16\,580$)	3 (1 837)	1 (4 915)	2 (3 955)	4 (1 742)	7 (613)	5 (1 524)
MathSci ($n = 13\,190$)	2 (2 555)	3 (2 549)	6 (531)	1 (4 824)	10 (9)	7 (306)
MedLine ($n = 220\,208$)	2 (58 113)	4 (20 900)	1 (62 711)	5 (12 850)	8 (8 907)	3 (26 459)
PsycLit ($n = 32\,871$)	1 (13 908)	2 (9 621)	3 (2 579)	5 (1 483)	8 (710)	4 (1 623)
Mean	1.88	3.25	2.88	3.88	8.50	4.63

between the order of colour-word frequency and order in the Berlin and Kay evolutionary scheme (binomial test; $p < 0.05$); in six of the databases the correlation was individually significant with $p < 0.05$. Similar results are also found when Kendall's rank-order correlation is used. Meta-analytic procedures (Rosenthal 1984) showed no evidence of heterogeneity in the Spearman correlations ($\chi^2_7 = 11.40$, ns) around a mean Spearman correlation of 0.780, which was highly significantly different from zero ($\chi^2_{16} = 88.78$, $p < 10^{-6}$). The correlation between the mean rank order across the databases and the Berlin and Kay rank ordering was also significant ($r = 0.802$, $p = 0.003$), the plot (figure 1b) showing a close relationship between the two rank orders with only a few minor exceptions; grey/gray is more common than expected and yellow is less common than expected. It is possible that grey/gray is anomalous because of its usage as a proper name, although Black, White, Green, and Brown are also common proper names. The anomaly for yellow may be related to the problem of whether the appropriate description at stages III and IV is yellow/green or yellow/'grue' (green/blue), although the mechanism is not clear.

The somewhat lower incidence of black as compared with white perhaps reflects another phenomenon, known as the 'Pollyanna hypothesis' (Boucher and Osgood 1969), in which positive terms are used more frequently than negative terms. Tuohy and Stradling (1987) have speculated that the frequency of the minor term may relate to a golden-section division ($1 - 0.6180 = 0.3820$) or to a principle of maximum salience, at the maximum of the information function, $-p \log p$, with probability $e^{-1} = 0.3679$. It is intriguing that, in the present data set, of the 192 465 usages of black and white, 36.23% are black and 63.77% are white. However, because of the huge sample size the 95% confidence interval for the percentage of black is 36.02% to 36.45%, which does not include either the golden section or e^{-1}.

Table 1 (continued)
Dissertation Abstracts (1961–6/1995); *English Poetry* (disks 3–5, 1603–1900); *English Verse Drama* (1585–1913); *GeoRef* [disk 2 and disk 3 (1988–6/1995)]; *MathSci* (1980–6/1995); *MedLine* (1966–8/1995); and *PsycLit* (articles, 1974–6/1995).

Brown	Purple	Pink	Orange	Grey	Correlation	
					r_S	r_K
7	8=	8=	8=	8=		
	[9.5]	[9.5]	[9.5]	[9.5]		
6	11	10	9	8	0.379, $p = 0.25$	0.234, $p = 0.336$
(10 171)	(2 022)	(1 179)	(4 359)	(12 537)		
6	10	11	9	7	0.927, $p < 0.001$	0.778, $p < 0.001$
(2 877)	(490)	(296)	(1 350)	(2 091)		
8	7	11	10	5	0.581, $p = 0.061$	0.428, $p = 0.078$
(4 069)	(5 313)	(924)	(936)	(9 247)		
8	7	11	10	6	0.800, $p = 0.003$	0.701, $p = 0.004$
(312)	(330)	(24)	(93)	(361)		
6	11	10	9	8	0.924, $p < 0.001$	0.817, $p < 0.001$
(883)	(37)	(67)	(425)	(582)		
4	11	8	9	5	0.585, $p = 0.059$	0.428, $p = 0.078$
(1 681)	(1)	(28)	(17)	(689)		
7	10	11	9	6	0.773, $p = 0.005$	0.584, $p = 0.016$
(10 171)	(2 022)	(1 179)	(4 359)	(12 537)		
7	11	10	9	6	0.850, $p = 0.001$	0.701, $p = 0.004$
(1 212)	(83)	(99)	(256)	(1 297)		
6.25	9.63	10.38	9.13	5.63	0.802, $p = 0.003$	0.662, $p = 0.006$

Given their size, the present data sets provide a strong replication of the similar effects reported previously (Hays et al 1972; McManus 1983) on the basis of much smaller sample sizes, albeit that the current data sets were highly disparate, and as such provide strong corroboration from a different source for the Berlin and Kay approach (McManus 1997). Although in the present analysis the original formulation of the Berlin and Kay ranking has been used, the generally robust nature of the findings means that minor alterations of the sequence (such as using 'grue') are unlikely to alter the pattern of correlations substantially.

Potential problems for the method occur in the wide range of other words which may be used to describe colour: turquoise, cream, mauve, lilac, tan, gold, etc. Insofar as they are not primary colour terms in the technical sense of the Berlin and Kay formulation they are not relevant to the immediate hypothesis being tested here. However, if they are being used as synonyms for the eleven basic colour terms (perhaps gold for yellow, or lilac for purple) then they could alter the results to some extent, and in particular might provide some explanation for the minor anomaly of yellow in figure 1b.

It seems inescapable from data such as these that the usage of colour words is highly systematic across a range of different subject matters within languages and, from other studies, across a range of languages. The strong relationship with the Berlin and Kay sequence makes an evolutionary hypothesis attractive, although of course it cannot prove it. Nevertheless, in the absence of any clear alternative explanation, an evolutionary explanation is attractive, and deserves further study.

References

Berlin B, Kay P, 1969 *Basic Color Terms: Their Universality and Evolution* (Berkeley, CA: University of California Press)

Boucher J, Osgood C E, 1969 "The Pollyanna hypothesis" *Journal of Verbal Learning and Verbal Behaviour* **8** 1 – 8

Hays D G, Margolis E, Naroll R, Perkins D R, 1972 "Color term salience" *American Anthropologist* **74** 1107 – 1121

Kay P, 1975 "Synchronic variability and diachronic range in basic color terms" *Language in Society* **4** 257 – 270

Kay P, Berlin B, Merrifield W, 1991 "Biocultural implications of systems of color naming" *Journal of Linguistic Anthropology* **1** 12 – 25

Kay P, McDaniel C K, 1978 "The linguistic significance of the meanings of basic color terms" *Language* **4** 610 – 646

McManus I C, 1983 "Basic colour terms in literature" *Language and Speech* **26** 247 – 252

McManus I C, 1997 "A monochrome view of colour" *Behavioral and Brain Sciences* (in press)

Rosenthal R, 1984 *Meta-analytic Procedures for Social Research* (London: Sage)

Saunders B A C, Brakel J van, 1997 "Are there nontrivial constraints on colour categorisation?" *Behavioral and Brain Sciences* (in press)

Sun R K, 1983 "Perceptual distances and the basic color term encoding sequence" *American Anthropologist* **85** 337 – 391

Tuohy A P, Stradling S G, 1987 "Maximum salience vs golden section proportions in judgemental asymmetry" *British Journal of Psychology* **78** 457 – 464

Wreschner E E, 1980 "Red ochre and human evolution: A case for discussion" *Current Anthropology* **21** 631 – 644