

Abstract

Berlin and Kay (1969) suggest that languages have a maximum of 11 basic color terms. Russian may be an exception in that it appears to have twelve basic color terms, including two for the blue region of color space. We report a study of Russian color terms, which was carried out to establish the inventory of basic color terms as a test of Berlin and Kay's theory and to clarify the status of the two blue terms. A large representative sample of speakers of Russian performed two tasks: a list task (77 subjects) and a color-naming task (54 subjects). The results from the two tasks converge to indicate that Russian does indeed have twelve basic color terms including the two terms for blue. In addition, plotting the Russian terms in color space and comparing the results with similar work on English allows us to define certain Russian terms more accurately than has been the case previously.

1. Introduction

Berlin and Kay's (1969) theory of color universals is one of the most important theories in the field of color categorization. By and large most languages described since their monograph was published fit the theory to at least a first approximation. However, Russian is of particular interest, in that it appears to have more basic color terms than permitted by the theory, and they have evolved in an order inconsistent with the theory. The study we report here seeks to establish basic Russian color terms using performance measures to see whether Russian is truly an exception to the theory. In this introduction we outline the theory briefly and describe Russian color terms as established using linguistic criteria. Then we consider various behavioral measures of basicness and present the current study, based on a large sample of Russian speakers. This

study confirms the status of Russian as exceptional with respect to the Berlin and Kay hierarchy.

Berlin and Kay claimed that, rather than varying without constraint, "basic" color-term inventories were drawn from a relatively small subset of all possible color-term inventories, as illustrated in Figure 1. The hierarchy constrains basic color-term inventories diachronically and synchronically. Languages evolve from a state with just two basic color terms and gain terms up to a possible 11 basic color terms, as described by left to right progression in Figure 1. Thus if a language possesses a term denoting a particular color, then it should have all the terms to the left of it in the hierarchy. For example, if a language has two basic color terms, they will be white and black (light and dark); if it has three basic color terms they will be white, black, and red; if it has four basic color terms they will be white, black, red, and either green or yellow; if a language has five basic color terms they will be white, black, red, green, and yellow; and so on up to the theoretical maximum of 11 basic color terms.

The concept of basic color terms is central to the theory; they are terms whose meaning is not derivable from their parts, whose signification is not included in that of another term, whose use is not restricted to a narrow range of objects, and that are psychologically salient. What is common across color-term inventories has been ascribed to the basic terms and much of the residual variation ascribed to the nonbasic terms; but this maneuver has not been without its critics (see Crawford 1982; Moss 1989a; Ratner 1989). The insight that made the move from variation without constraint to the heavily constrained hierarchy possible was as follows: although there is marked variation across languages in the boundaries of color categories, there is much less variation in the foci — the best examples — of color categories (although this claim has also been disputed; Ratner 1989). Its significance in the current context is that it implies that one property of basic color terms is that there should at least be good agreement across speakers as to the foci of their referents.

There have been several major developments to the theory since its inception (see Kay et al. [1991] for a concise statement of their current

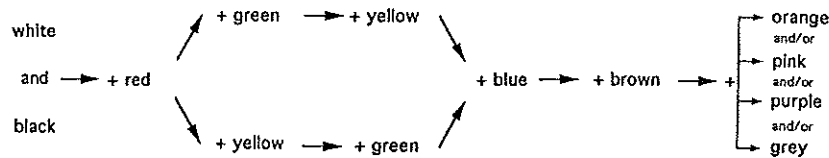


Figure 1. The Berlin and Kay hierarchy of basic color terms

position; MacLaury [1991] for some important field studies; and MacLaury [1992] for a theory of how color-term inventories change). For our current purposes the most important development is the distinction that separates off "primary" basic color terms — the first six terms in the hierarchy (Kay and McDaniel 1978). We shall call the remaining five basic terms "secondary basic." This distinction was in part based on visual physiology, which lent support to Hering's (1964 [1920]) opponent process theory of color vision (see Jameson [1985] for further detail). This ascribed central status to the six primary colors as "perceptual primitives," which were irreducible to other colors. Secondary colors are perceptual "blends" of two primary colors; for example, orange is a blend of red and yellow. Kay and McDaniel used the formalism of fuzzy set theory to describe the evolution of basic color terms, but this is not central to our current purposes.

Little attention has been paid to the possibility that languages might develop further than those described by Berlin and Kay and acquire more than 11 basic terms, although this was not ruled out by Kay and McDaniel (1978). There is prima-facie evidence that this has happened in Russian with the emergence of two terms for the blue region, *sinij* 'dark blue' and *goluboj* 'light blue', both of which seem to meet the criteria for basicness. This gives an inventory of 12 basic terms:

belyj 'white', *černyj* 'black', *krasnyj* 'red', *zelenyj* 'green', *želtij* 'yellow', *sinij* 'dark blue', *goluboj* 'light blue', *koričnevyyj* 'brown', *fioletovyyj* 'purple', *rozovyyj* 'pink', *oranževyyj* 'orange', *seryj* 'gray'.

The possibility that there were two basic terms for blue was noted by Berlin and Kay (1969: 99) and Kay and McDaniel (1978: 640); the latter suggest that *goluboj* 'light blue' may possibly be a twelfth basic term for some Russian speakers but not others. Russian is probably the clearest counterexample in this regard.¹ Given the importance of this case, a considerable effort has gone into checking whether the two terms are indeed basic, and our work to date suggests strongly that both are. Corbett and Morgan (1988) used straightforward linguistic measures, and the data there are clear cut. A major indicator is frequency in texts, in which test both terms have high scores. On the basis of this test, Vamling (1986) had earlier made a similar claim for the basicness of the two terms for blue. She quoted the list of basic color terms proposed by Kulick and Vamling (1984), which corresponds exactly to the 12 given above, having been established independently. She noted, however, (Vamling 1986: 226) that *fioletovyyj* 'purple' and *oranževyyj* 'orange' "seem to have a less certain status as basic colour terms." Further discussion of the status of the "two blues" can be found in Moss (1989a). Differences

between the two blues are considered from the perspective of translation by Alimpieva (1982a); a diachronic view can be found in Alimpieva (1982b), and examples from early texts are given in Baxilina (1975: 174–207). For comparative data on the entire Slavonic language family see Comrie and Corbett (1993).

The case for the basicness of both blue terms is supported not only by linguistic but also by behavioral measures. Morgan and Corbett (1989) used a “list” procedure in which subjects are asked to list the color terms they know. It yields measures of Berlin and Kay’s fourth criterion of basicness — psychological salience. Both blue terms were among the most frequent terms offered, which is consistent with both terms being basic. Moss et al. (1990) used a color-naming task based on Boynton and Olson’s (1987) work. The procedure permits the derivation of a variety of measures, such as speed of naming, consistency of use, and consensus across respondents; both blue terms ranked high among the accepted basic terms on all measures, which is again consistent with both terms being basic. For an evaluation of these different measures see Corbett and Davies (i.p.).

The evidence we have considered so far suggests strongly that both blue terms are basic, but while the linguistic evidence is secure, the impression gained from the behavioral evidence needs tempering to some degree for the following reasons. First, the representativeness of Morgan and Corbett’s (1989) sample, and the size of Moss et al.’s (1990) are insufficient to bear the weight of a conclusion about Russian speakers in general. Morgan and Corbett tested 31 (mostly female) students of English; it would be of value to test the generality of their findings on a sample that was more representative of Russian speakers. Moss et al. used just seven subjects; although this compares favorably with the numbers used by Boynton and Olson (1987), the latter were working in the tradition of low-level psychophysics where secure conclusions about the population are often possible on the basis of very small samples; it is likely that color categorization and naming are subject to much greater intersubject variability than low-level perceptual processes, and larger samples are needed accordingly. This reasoning, as with our comments on Morgan and Corbett above, leads to the need to test Moss et al.’s findings further.

We therefore decided to test a larger and more representative sample of native speakers on a list task and on a color-naming task. The naming task was a simplified version of the task used by Moss et al., which did not require the use of a laboratory or technically advanced apparatus. This was done because we wanted to develop a reliable procedure that could be used in the field as part of a large cross-cultural study on color

categorization. (We report on the use of the procedure in the bush in Botswana in Davies et al. 1992, i.p.) Although simplified, the task still permitted the derivation of a set of indicators of basicness and yielded data that established the loci of the referents of color terms in color space.

As a secondary concern we wished to investigate the purple area. There has been some question over whether Russian has a basic term for purple, and over which of the several contenders for the basic slot has the strongest case (Corbett and Morgan 1988); but there is now good evidence that *fioletovyy* is the basic term for purple (Morgan and Corbett 1989; Moss 1989b), and so we included *fioletovyy* as the term for purple in our original list. The mapping procedure allows us to give a clearer account of the purple region than has been available to date. Further, as we have equivalent data for English, we have been able to suggest more appropriate glosses than are normally given; we give an account of these in the results section, while, with the benefit of hindsight, we also use them throughout the paper.

2. Method

2.1. Subjects

There were 77 subjects in total, 24 men and 53 women, whose ages ranged from 18 to 65 years with a mean of 34 years. All were native speakers of Russian living in Moscow. All subjects did the list task, but only 54 did the tile-naming task.

2.2. Stimuli

In the naming task, 65 colored “tiles” were used as stimuli. Each tile was 5 cm square and 0.4 cm thick and consisted of a rigid wooden base covered with colored paper selected from the Color-Aid corporation range of colors. The colors were an evenly spread sample of color space. Their color-aid codes and CIE coordinates are shown in Table 1 and their distribution in CIE chromaticity space shown in Figure 2 (see Newhall et al. [1943] for tables that convert CIE coordinates into Munsell codes). Figure 2 also includes the loci of the 11 “universal” color foci — the best examples of the 11 universal terms — taken from Heider (1971). The tiles were used in a large cross-cultural study of color categorization, and further details of the rationale for their selection can be found in Davies et al. (1992).

Table 1. Color-aid codes and CIE coordinates for the tile colors

Color-aid code	na	C.I.E. coordinates		
		Y brightness	x redness	y greenness
Y	HUE	64.77	.47	.48
	S2	16.99	.41	.44
YOY	HUE	47.48	.50	.43
	T4	55.63	.45	.41
	S2	22.08	.36	.38
YO	HUE	39.52	.51	.41
	T3	47.02	.48	.41
	S3	10.72	.36	.41
OYO	HUE	26.51	.54	.37
O	HUE	25.00	.54	.37
	S1	14.34	.50	.37
	S3	9.15	.42	.36
ORO	HUE	18.87	.57	.34
	T3	36.88	.46	.35
	S3	26.51	.33	.32
RO	HUE	16.22	.58	.33
	T3	32.66	.45	.32
	S3	4.19	.37	.34
ROR	HUE	15.23	.53	.31
	T3	29.82	.42	.30
	S3	20.71	.34	.28
R	HUE	11.71	.50	.29
	T4	24.34	.40	.27
	S3	4.81	.33	.30
RVR	HUE	9.11	.42	.24
	S1	12.79	.35	.25
	S3	28.43	.36	.28
RV	HUE	6.97	.33	.19
	T2	14.51	.31	.19
VRV	HUE	6.71	.30	.19
	S3	28.42	.36	.28
V	HUE	4.67	.26	.17
VBV	HUE	4.13	.24	.17
	T4	19.05	.25	.20
BV	HUE	4.21	.22	.19
	S2	7.88	.25	.26
BVB	HUE	4.80	.19	.13
	S3	26.65	.26	.23
B	HUE	9.51	.18	.16
	T1	19.02	.20	.19
BGB	HUE	9.62	.19	.19
	T3	23.08	.20	.23
BG	HUE	8.93	.20	.25
	T1	16.57	.19	.25

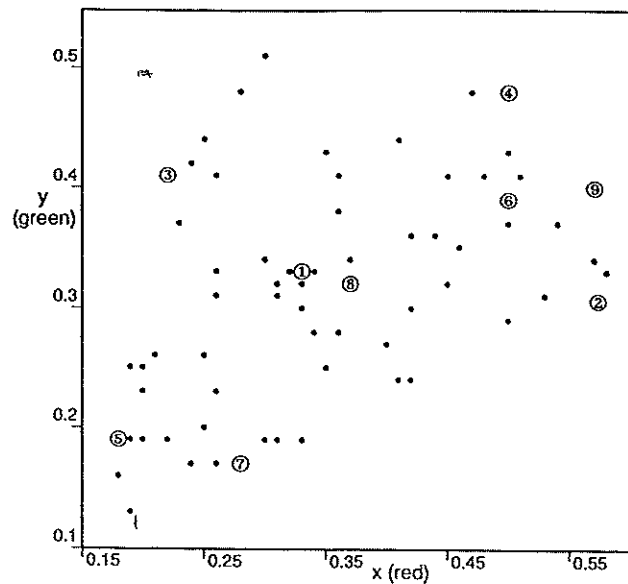
Table 1. continued

Color-aid code		C.I.E. coordinates		
		Y brightness	x redness	y greenness
	S2	7.42	.21	.26
GBG	HUE	10.69	.23	.37
	S2	20.79	.20	.25
G	HUE	11.99	.24	.42
	S3	6.10	.26	.33
GYG	HUE	12.89	.25	.44
	T4	31.14	.26	.41
	S1	15.59	.26	.31
YG	HUE	14.66	.28	.48
	S3	5.78	.30	.34
YGY	HUE	18.92	.30	.51
	S3	35.87	.35	.43
ROSE RED		17.63	.41	.24
WHITE		81.40	.32	.33
SIENNA		13.31	.44	.36
BLACK		3.59	.34	.33
GRAY 2		30.59	.32	.33
GRAY 1		47.55	.32	.33
GRAY 4		18.88	.31	.31
GRAY 6		11.20	.31	.31
GRAY 8		4.53	.31	.32

2.3. Procedure

There were two experimenters: one was a Russian national who tested 54 subjects on both tasks; the other was British, but lived in Moscow and spoke Russian; he tested 23 subjects on the list task only.

All subjects did the list task first. They were asked, in Russian, to write down as many color terms as they knew, in columns so that the order they wrote them in could be extracted. The maximum time allowed was five minutes, but in practice most subjects finished within two minutes. In the tile-naming task subjects were shown one tile at a time in a random sequence and asked to name the tile. The tiles were shown on gray cloth in natural daylight indoors, avoiding direct sunlight or deep shade. The experimenter recorded the subject's response, removed the tile, and then displayed the next tile, and so on until all 65 tiles had been displayed.



Symbols for the universal foci:

- 1 = achromatic
 2 = red
 3 = green
 4 = yellow
 5 = blue
 6 = brown
 7 = purple
 8 = pink
 9 = orange

Figure 2. CIE coordinates for the tile colors and the "universal" foci (where tiles have identical x, y coordinates, only one "dot" is shown)

3. Results

3.1. The list task

The pattern of the results was essentially the same for the two experimenters, and we therefore report the combined results only. There were 126 different terms offered in total; these included some "modified" color terms such as *bledno-zelenyj* 'pale green', but no particular modified term was offered by more than three people. The mean number of terms offered was 19.94 and the total number of responses across subjects was 1535. The total number of times the subjects offered each color term was calculated, together with the mean across subjects of the serial position in the lists for each term. These data are shown in Table 2 ordered by

Table 2. Frequency, mean position, and their corresponding rank orders for color terms offered by four or more respondents in the elicitation task

Term	Gloss	Frequency	Rank of freq.	Mean position	Rank of M.P.
sinij	dark blue	76	1	6.16	3
krasnyj	red	75	2.5	3.32	1
zelenyj	green	75	2.5	6.35	4
želtyj	yellow	73	4.5	5.97	2
goluboj	light blue	73	4.5	7.50	5
černyj	black	71	6	8.92	8
fioletovyj	purple	69	7	8.15	6.5
oranževyj	orange	67	8	8.15	6.5
belyj	white	66	9.5	9.14	9
koričnevyyj	brown	66	9.5	11.76	16
seryj	gray	60	11	13.10	20
rozovyj	pink	53	12	9.83	10
sirenevyyj	mauve	40	13.5	11.35	13
salatovyj	salad green	40	13.5	13.47	23
bordovyj	bordeaux	38	15	10.57	11
malinovyyj	raspberry	37	16.5	11.97	17
beževyyj	beige	37	16.5	14.97	32
birjuzovyj	turquoise	34	18	13.06	19
limonnyj	lemon	21	19	14.10	26
purpurnyj	purplish red	20	20	11.10	12
morskoj-volny	sea wave	18	21	15.00	33.5
lilovyj	lilac	16	22	11.62	14
zolotoj	gold	15	23	19.93	50
višnevyyj	cherry red	14	24.5	16.00	41
serebrjanyj	silver	14	24.5	20.92	53
ultramarinovyj	ultramarine	13	26	14.38	27
izumrudnyj	emerald	12	28	15.25	36
bolotnyj	marsh green	12	28	15.83	39
serebristyj	silvery	12	28	17.75	48
alyj	scarlet	11	31.5	11.73	15
fistaškovyyj	pistachio	11	31.5	13.27	21
vasil'kovyyj	cornflower blue	11	31.5	16.18	42
oxra	ochre	11	31.5	18.09	49
zolistyj	golden	10	34	15.00	33.5
terrakotovyj	terracotta	9	37	14.00	25
marengo	grayish black	9	37	15.43	37
lazurnyj	azure	9	37	15.44	38
xaki	khaki	9	37	17.56	46
stal'noj	steel	9	37	24.22	56
samo	salmon pink	8	41.5	13.38	22
palevyj	pale yellow	8	41.5	14.88	31
kremovyj	cream	8	41.5	15.13	35
buryj	brown red	8	41.5	21.38	55
temno-zelenyj	dark green	7	45.5	13.71	24

Table 2. *continued*

Term	Gloss	Frequency	Rank of freq.	Mean position	Rank of M.P.
travjanoj	grass green	7	45.5	14.72	29
gorčičnyj	mustard	7	45.5	15.86	40
ryžij	ginger	7	45.5	17.29	45
brusničnyj	cranberry red	5	50	14.80	30
nebesno-goluboj	sky blue	5	50	16.20	43
kirpičnyj	brick red	5	50	17.60	47
apel'sinovyj	orange	5	50	20.00	51
pesočnyj	sandy	5	50	20.60	52
bagrianyj	purplish red	4	54.5	12.00	18
malaxitovyj	malachite	4	54.5	14.50	28
elektrik	electric blue	4	54.5	16.25	44
kofejnyj	coffee	4	54.5	21.00	54

the frequency with which terms were offered, for those terms that were offered by at least four people.

It can be seen from Table 2 that the 11 standard basic terms plus *goluboj* 'light blue' form the first 12 terms according to the frequency measure, and the total number of times these terms are offered — 824 — is over half of the total responses. There is also a relatively neat separation between the first 12 terms and the rest: *sirenevyy* 'mauve', the most frequent of the remaining terms, is offered 13 times less than *rozovyj* 'pink', the least frequent of the first 12 terms. The disputed basic term, *goluboj* 'light blue', shares the fourth rank with *želtij* 'yellow'. Furthermore, *fioletovyj* 'purple' is much more frequent than *sirenevyy* 'mauve', *purpurnyj* 'purplish red', or *lilovyj* 'violet', which have sometimes been considered contenders for the basic purple slot.

The data on the mean serial position of the terms shows a similar albeit less clearcut pattern. Most of the first 12 terms on the frequency measure also have low scores on the position measure, but the separation between these terms and the remainder is now not complete; *koričnevyy* 'brown' and *seryj* 'gray' have lower mean serial positions than several of the less frequent terms: *sirenevyy* 'mauve', *bordovyj* 'claret', *malinovyj* 'raspberry', *birjuzovyj* 'turquoise', *limonnyj* 'lemon', *purpurnyj* 'purplish red', *lilovyj* 'violet', and *alyj* 'scarlet'.

In addition to separating the basic terms from the nonbasic terms, there is some degree of correspondence of the rank orders of the basic terms on both measures to the Berlin and Kay hierarchy. The primary basic terms tend to score higher than the secondary basic terms; the exceptions are the achromatic terms *černyj* 'black' and *belyj* 'white', which

score lower on the mean position measure than the secondary basic terms *fioletovyj* 'purple' and *oranževyj* 'orange'; *belyj* 'white' also scores lower than the same secondary basic terms on the frequency measure. The degree of correspondence with the hierarchy can be assessed by the rank order correlation coefficient between the rank orders of the terms on the measure and the hierarchy ranks. But as the hierarchy has 11 terms and Russian probably has 12 basic terms, we have to decide what rank to assign the additional blue term on the hierarchy. We have calculated the correlation in two ways: first by assigning *goluboj* and *sinij* equal positions after green and yellow; and second, by assigning *goluboj* the lowest position on the hierarchy, along with purple, pink, orange, and gray, as though *goluboj* were a secondary basic term. In practice it makes little difference which assignment of *goluboj* is used: the correlations for the frequency measure are $\tau = .67$ and $.64$, and for the list position measure $\tau = .59$ and $.56$; in all cases the correlations are significant at $p < .001$ (which means that this degree of association would arise by chance less frequently than once in a thousand instances), and the first figure in each pair is for the assignment of equal ranks to the two blue terms.

3.2. Tile naming

Table 3 shows the two most frequent terms given to each tile, provided that a term was used by at least three subjects, together with the number of subjects that used each term.

The 12 most frequent terms in the list task account for over half of the total responses: they are used 1984 times out of a total of 3510 responses. These terms are also the most frequently used terms for 46 out of the 65 tiles. The only other terms that are the most frequently used terms for particular tiles are given here (together with the number of tiles to which this applies given in parentheses): *sirenevyy* 'mauve' (7); *malinovyj* 'raspberry' (1); *morskaj volny* 'sea wave' (2); *bolotnyj* 'marsh' (1); *xaki* 'khaki' (2); *salatovyj* 'salad' (2); *zelenyj-seryj* 'green-grey' (1); *sero-sinij* 'gray-dark-blue' (1); *rozovo-oranževyj* 'pink-orange' (1); and *rozovo-sirenevyy* 'pink-mauve' (1). Although these terms are the most frequent terms for 19 tiles, none of them is used by more than half of the respondents to name a given tile, whereas all of the 12 basic terms are used to name at least one tile by more than half of the respondents.

These patterns become clearer in Tables 4 and 5, which summarize the full tile-by-term response matrix. Table 4 shows the overall frequency with which each term was used for those terms that were used on at least 11 occasions, ordered by frequency of use, and the number of tiles for

Table 3. Distribution of most frequent terms and their corresponding frequencies

Y	Hue	želtij	32				S2	xaki	23
YOY	Hue	limonnyj	20					bolotnyj	16
YO	Hue	želtij	32	T4	želtij	31	S2	xaki	12
OYO	Hue	oranževyj	11		oranževyj	7		bolotnyj	10
O	Hue	oranževyj	30	T3	želtij	26	S3	bolotnyj	20
ORO	Hue	želtij-oranževyj	12		oranževyj	23		xaki	15
RO	Hue	oranževyj	45						
ROR	Hue	želtij-oranževyj	3	S1	koričnevij	28	S3	koričnevij	52
R	Hue	oranževyj	41		koričnevij-ryžij	7			
RVR	Hue	krasnij-oranževyj	5	T3	rozovij-oranževyj	18	S3	seryj-sirenevij	10
RV	Hue	krasnij	14		oranževyj	12		seryj	10
VRV	Hue	krasnij-oranževyj	14	T3	rozovij	29	S3	koričnevij	22
V	Hue	krasnij	37		rozovij-oranževyj	7		černyj-koričnevij	15
VBV	Hue	alyj	7	T3	rozovij	38	S3	sirenevij	21
BV	Hue	krasnij	33	T4	rozovij-oyranževyj	3		il'ovij	5
	Hue	krasnij	4		rozovij	32	S3	fiioletovij	18
	Hue	malinovij	23	S1	malinovij	7		černyj-fiioletovij	16
	Hue	malinovij	17	T2	sirenevij	14		rozovij-sirenevij	14
	Hue	malinovij	24		fiioletovij	5		rozovij	14
	Hue	bordovij	8		il'ovij	16			
	Hue	sirenevij	8			7			
	Hue	fiioletovij	7						
	Hue	fiioletovij	20						
	Hue	fiioletovij	13						
	Hue	sirenevij	42						
	Hue	fiioletovij	3						
	Hue	fiioletovij	37	T4	sirenevij	27			
	Hue	sinij-fiioletovij	7		fiioletovij	14			
	Hue	sinij	34						
	Hue	fiioletovij	7						
BVB	Hue	sinij	29						
B	Hue	fiioletovij-sinij	9	T1	goluboj	33	S3	sirenevij	22
BGB	Hue	sinij	37		sinij	9		fiioletovij	11
BG	Hue	vasil'kovij	4	T3	goluboj	39			
GBG	Hue	sinij	38		nebesno-goluboj	6			
G	Hue	goluboj	6	T1	goluboj	26	S2	morskoi volny	20
GYG	Hue	morskoi volny	21		birjuzovij	9		zelenyj-sinij	16
YG	Hue	sinij-želenyj	12					goluboj	21
YGY	Hue	zelenyj	38					morskoi volny	11
SIENNA	Hue	sinij	8					zelenyj	30
ROSE RED	Hue	zelenyj	50					sinij-zelenyj	7
WHITE	Hue	zelenyj	41	T4	zelenyj	22	S1	zelenyj-seryj	19
BLACK	Hue	zelenyj	47		salatovij	16		morskoi volny	8
GRAY	Hue	zelenyj	3					zelenyj	19
	Hue	malaxitovij	40					černyj-zelenyj	13
	Hue	zelenyj	7					salatovij	22
	Hue	salatovij	42					zelenyj	12
	Hue	koričnevij	23						
	Hue	rozovij	22						
	Hue	malinovij	54						
	Hue	belyj	41						
	Hue	černyj	47	4	seryj	47	1	seryj	46
	Hue	seryj	40	2	mišinij	4			
	Hue	seryj	40		seryj	48			

Table 4. The most frequent terms in the naming task, their total frequency, the number of tiles for which they were the most frequent term, and the frequency/tile ratio

Term	Gloss	Total frequency	No. of tiles	Frequency/no. of tiles
zelenyj	green	314	12	26.17
seryj	gray	245	9	27.22
sinij	dark blue	181	12	15.08
oranževyj	orange	178	8	22.25
fioletovyj	purple	172	13	13.23
rozovyj	pink	161	9	17.89
sirenevij	mauve	158	11	14.36
koričnevij	brown	148	5	29.60
želtij	yellow	131	5	26.20
goluboj	light blue	126	6	21.00
krasnij	red	108	5	21.60
malinovij	raspberry	81	7	11.57
morskoj volny	sea wave	80	7	11.43
belyj	white	54	1	54.00
bolotnyj	marsh green	51	4	12.75
xaki	khaki	50	3	16.67 ^a
seryj-zelenyj	gray-green	46	5	9.20
salatovyj	salad green	45	3	15.00
černyj	black	43	2	21.50
lilovyj	lilac	42	8	5.25
birjuzovyj	turquoise	35	7	5.00
sinij-zelenyj	dark blue-green	33	6	5.50
rozovyj-oranževyj	pink-orange	28	3	9.33
krasnij-oranževyj	red-orange	28	5	5.60
seryj-sinij	gray-dark blue	26	3	8.67
želtij-oranževyj	yellow-orange	26	4	6.50
limonnyj	lemon	20	1	20.00
alyj	scarlet	19	4	4.75
rozovyj-sirenevij	pink-mauve	17	2	8.50
zelenyj-sinij	green-dark blue	17	2	8.50
černyj-fioletovyj	black-purple	16	1	16.00
černyj-koričnevij	black-brown	15	1	15.00
černyj-zelenyj	black-green	15	2	7.50
seryj-sirenevij	gray-mauve	15	2	7.50
bordovyj	bordeaux	11	2	5.50
samo	salmon pink	11	3	3.67
sinij-fioletovyj	dark blue-purple	11	2	5.50

which that term was used at least once. The final column of Table 4 shows the ratio of the total frequency of use of each color term to the number of tiles for which it was used at least once; this score is an index of consensus of use, which is partially independent of the frequency of

use: the higher the score the greater the consensus. For example, although *belyj* 'white' is only ranked 14 on the frequency measure, it scores highest on the consensus measure, reflecting high agreement for the single tile that it was used to name. In contrast, *malinovij* 'raspberry' was used more frequently than *belyj* 'white' and for more tiles but scores lower on the consensus measure, reflecting lack of agreement about its referents.

In general the basic terms have the highest total frequencies; the exceptions are that the two achromatic terms, *belyj* 'white' and *černyj* 'black' are ranked 14 and 19 respectively and *sirenevij* 'mauve', a nonbasic term, ranks seven. On the consensus measure the basic terms occupy 12 out of the 13 top positions; the "intruder" is again *sirenevij* 'mauve', which scores higher than *fioletovij* 'purple'. Table 5 shows the "dominance" index for all terms that were dominant for at least one tile; a term is dominant if at least half of the respondents use the same term for a given tile, and the dominance index is the total number of tiles for which a term is dominant. Table 5 also shows the total frequency of use for each of the terms, the total frequency for those tiles that a term was dominant, and the ratio of the two — the specificity index — another measure of consensus that is independent of overall frequency of use. These scores may range from zero to one, and the higher the score the greater the agreement as to what a term designates.

It can be seen that each of the basic terms has at least one tile for which it is dominant, but *sirenevij* 'mauve' is the only nonbasic term to have a nonzero dominance index with a score of 1. However, *sirenevij* 'mauve'

Table 5. Total frequency, dominance frequency, dominance index, and specificity index for those terms that were dominant for at least one tile

Term	Gloss	Total frequency	Dominance frequency	Dominance index	Specificity index
belyj	white	54	54	1	1.00
černyj	black	42	41	1	0.98
krasnij	red	108	67	2	0.62
zelenyj	green	314	246	6	0.78
želtij	yellow	131	95	3	0.73
sinij	dark blue	181	138	3	0.76
goluboj	light blue	126	72	4	0.57
koričnevij	brown	148	122	2	0.82
fioletovyj	purple	172	79	2	0.46
rozovyj	pink	161	99	3	0.62
oranževyj	orange	178	116	3	0.65
seryj	gray	245	228	5	0.93
sirenevij	mauve	158	27	1	0.17

only just achieves this dominance score; half of the respondents, the minimum required, used the term for the same tile, and this is reflected in the very low specificity index. It appears that although many people know the term *sirenevyy* 'mauve', there is relatively low agreement over its use.

3.3. Combined analysis of all measures

Table 6 shows the rank orders on each of the measures given in the previous sections, for the 18 most frequent terms offered in the list experiment (terms offered by more than a third of the sample) together with the two versions of the rank orders on the hierarchy for each term, depending on whether *goluboj* 'light blue' is accorded equal rank with *sinij* 'dark blue' — column 10 — or whether it is treated as a secondary basic term — column 11. In addition to the assumptions we have made about *goluboj*'s position, we have also assigned the probable nonbasic terms equal ranks, with scores lower than all those of the basic terms. The final two columns of Table 6 give the mean of the ranks across the measures for each term, and the rank order of these mean scores.

It can be seen that just two of the measures are successful at separating the basic from the nonbasic terms: both for frequencies in lists and for specificity, the highest ranked nonbasic term has a lower rank than the lowest ranked basic term. These two measures also have the highest correlations with the hierarchy scores given in columns 8 and 9: the correlations range from $\tau = .64$ for the second hierarchy measure with the list frequency measure, to $\tau = .73$ for the second hierarchy measure paired with specificity; all four correlations are significant at $p < .0009$ at least.

3.4. The purple region

As we noted earlier, there are several Russian terms used for the purple region. Their range has not been well understood, and indeed the glosses given in standard dictionaries are often unsatisfactory. In this section we investigate the purple region in more detail and compare the terms used to the terms used by a monolingual English-speaking sample for the same set of colors, taken from Davies and Corbett (forthcoming). We will also make use of the data from a list task done by the same subjects and reported in the same paper.

There were 14 tiles that were called by a "purple" term by at least three people from either sample. The purple terms used by Russian

Table 6. Rank orders on all measures for the most frequent terms, the mean of the ranks, the rank order of the means, and two 'Berlin and Kay' rank orders. (Freq = frequency, Mean Pos = mean position, No. of tiles = number of tiles for which the term was offered, D.I. = dominance index, S.I. = specificity index; for Berlin and Kay order 1 both blues are ranked 6.5 sharing the position of blue on the hierarchy, whereas, for Berlin and Kay order 2, *sinij* 'dark blue' is given the rank for blue and *goluboj* 'light blue' is given the same rank as purple pink, orange, and gray)

Term	Gloss	List task Freq	Mean pos	Naming task Freq	No. of tiles	Freq/ no. of tiles	D.I.	S.I.	Mean rank	Rank of means	Berlin & Kay order 1	Berlin & Kay order 2
<i>sinij</i>	dark blue	1	3	4	2.5	11	3.5	6	4.43	2	6.5	6
<i>zelenyj</i>	green	2.5	1	11	12	7	9	9.5	7.43	8	4.5	4.5
<i>krasnij</i>	red	2.5	4	1	2.5	5	1	5	3.00	1	3	3
<i>želtij</i>	yellow	4.5	2	9	12	4	6	7	6.36	4	4.5	4.5
<i>goluboj</i>	light blue	4.5	5	10	10	9	9	11	6.93	7	6.5	10
<i>černyj</i>	black	6	8	15	15.5	8	12	2	9.50	12	1.5	1.5
<i>fioletovij</i>	purple	7	6.5	6	1	14	9	12	7.93	9	10.5	10
<i>oranževij</i>	orange	8	6.5	5	7	6	6	8	6.64	5	10.5	10
<i>belyj</i>	white	9.5	9	13	17.5	1	12	1	9.00	11	1.5	1.5
<i>koričnevij</i>	brown	9.5	13	3	12	2	3.5	4	6.71	6	8	7
<i>seryj</i>	gray	11	16	2	5.5	3	2	3	6.07	3	10.5	10
<i>rozovij</i>	pink	12	10	7	5.5	10	6	9.5	8.57	10	10.5	10
<i>sirenevij</i>	mauve	13.5	12	8	4	13	12	13	10.79	13	15.5	15.5
<i>salatovij</i>	salad green	13.5	17	14	14	12	16	16	14.64	16	15.5	15.5
<i>boršovij</i>	bordeaux	15	11	17	15.5	6	16	16	12.36	14	15.5	15.5
<i>malinovij</i>	raspberry	16.5	14	12	8.5	15	16	16	14.00	15	15.5	15.5
<i>beževij</i>	beige	16.5	18	18	17.5	17.5	16	16	17.07	18	15.5	15.5
<i>birjuzovij</i>	turquoise	18	15	16	8.5	17.5	16	16	15.29	17	15.5	15.5

subjects were *fioletovyy* 'purple', *sirenevyy* 'mauve', and *lilovyy* 'lilac'; and the purple terms used by English subjects were *purple*, *mauve*, *lilac*, and *violet*. Table 7 shows the terms used for each of the fourteen tiles, for both samples, together with the frequencies with which they were used. It can be seen that *fioletovyy* 'purple' is the most frequent Russian term overall, and *purple* is the most frequent English term. Further, the use of these terms overlaps more than for any other pair of terms. This can be seen more clearly in Table 8; here we give the "cooccurrence" matrix

Table 7. Frequency of Russian and English terms given to tiles in the purple region

Color-aid codes	Russian terms and scores	English terms and scores
1 RORS3	sir 21, lil 5	pink 15, mauve 8
2 RS3	fiol 18, černyj-fiol 16	brown 12, black 8, purple 6
3 RVR31	sir 14, fiol 5, lil 4	purple 9, mauve 9, pink 8
4 RVRS3	roz-sir 14, roz 14, sir 13	pink 37
5 RVHUE	sir 8, fiol 7, mal 4	purple 28, mauve 8
6 RVT2	sir 16, lil 7	purple 15, mauve 11, violet 2
7 VRVHUE	fiol 20 sir 13, lil 10	purple 34, mauve 11, violet 4
8 VRVS3	sir 17, roz 10	pink 37
9 VHUE	fiol 42, sir 3, lil 3	purple 37, mauve 3, violet 1
10 VBVHUE	fiol 37, sinij-fiol 7	purple 28, blue 8, violet 3
11 VBVT4	sir 27, fiol 14, lil 6	mauve 21, lilac 13
12 BVHUE	sinij 34, fiol 7, sinij-fiol 9	blue 30, purple 7
13 BVBHUE	sinij 29, fiol-sinij 9, fiol 5	blue 35, purple 7, mauve 1
14 BVBS3	sir 22, fiol 11, lil 5	lilac 19, mauve 17, purple 2

Key: sir = *sirenevyy* 'mauve'; lil = *lilovyy* 'lilac'; fiol = *fioletovyy* 'purple'; roz = *rozovyy* 'pink'; sinij = 'dark blue'. (The numbers in the first column are used to denote the colors in Figures 3 and 4.)

Table 8. The cooccurrence matrix for Russian and English terms for the "purple" region; cell entries are the frequency of cooccurrence for each pair of terms

	fioletovyy	sirenevyy	lilovyy	rozovyy	sinij	purple	mauve	lilac	pink	blue
sirenevyy	53									
lilovyy	28	33								
rozovyy	0	23	0							
sinij	12	0	0	0						
purple	125	50	32	0	7					
mauve	48	84	32	0	1	40				
lilac	24	32	11	0	0	2	30			
pink	8	53	9	24	0	8	8	0		
blue	13	0	0	0	29	22	1	0	0	
violet	8	7	0	0	0	7	7	0	0	8

for the terms used to describe the 14 tiles. The cell entries are the total number of times a given pair of terms cooccurred. For example, for tile RORS3, *sirenevyy* 'mauve' was used 21 times and *lilovyy* 'lilac' was used five times; we have taken the smaller of these two frequencies as the index of cooccurrence or overlap for those terms, giving a score of 5. The overall cooccurrence score is derived by summing the cooccurrence scores for a given pair across the 14 tiles. Thus there are three kinds of cooccurrence scores within the matrix: scores for the Russian terms; scores for the English terms; and cross-language cooccurrence scores. It can be seen that the highest cross-language cooccurrence score for *fioletovyy* is with *purple*: they overlap 125 times, whereas *fioletovyy* and *mauve* — the next highest scoring pair — overlap 53 times. This supports the case we made earlier for *fioletovyy* being the basic term for purple and for its gloss being 'purple'.

Sirenevyy (though derived from *siren* 'lilac') most closely matches English *mauve*, although less strongly than for the *fioletovyy*-*purple* match. Both are the second most frequent and both frequently occur as a name for the same tiles. Their cooccurrence score is 84, compared to 50 for the *sirenevyy*-*purple* overlap and 32 for the *lilovyy*-*mauve* overlap. Both *sirenevyy* and *mauve* are often the second most frequent term after *fioletovyy* and *purple*, although the Russians show a greater willingness to use *sirenevyy* in these cases than the English do with *mauve*. For those tiles for which *sirenevyy* is the majority choice for the Russians it is almost always the case that *mauve* is one of the main choices of the English subjects. There was only one tile (RVR S1) for which *mauve* was a majority choice (equal with *purple*), and for this the majority of Russians chose *sirenevyy*.

Lilovyy is much less frequent than the other two Russian terms and is never the most frequent choice for any tile. (Indeed Moss [1989b: 150], who asked informants to pick a tile that was the best example of this color, found the responses were "almost completely random"). It overlaps equally with *purple* and *mauve* (scores of 32). We gloss it, somewhat arbitrarily, as 'lilac', since this term is a little-favored English term and it has a status equivalent to *lilovyy* as the third most common purple term, which overlaps with purple and mauve. However, the match here is poor, since *lilac* was the majority choice for the tile BVB S3, which Russians named *sirenevyy* or *fioletovyy*.

Figures 3 and 4 show the loci of the tile colors in CIE chromaticity space with code numbers for the tiles as given in Table 7. Recall that CIE space is three-dimensional: Y (brightness or reflectance), x (the proportion of red), and y (the proportion of green). Thus good reds have high scores on x, good greens have high scores on y, good blues

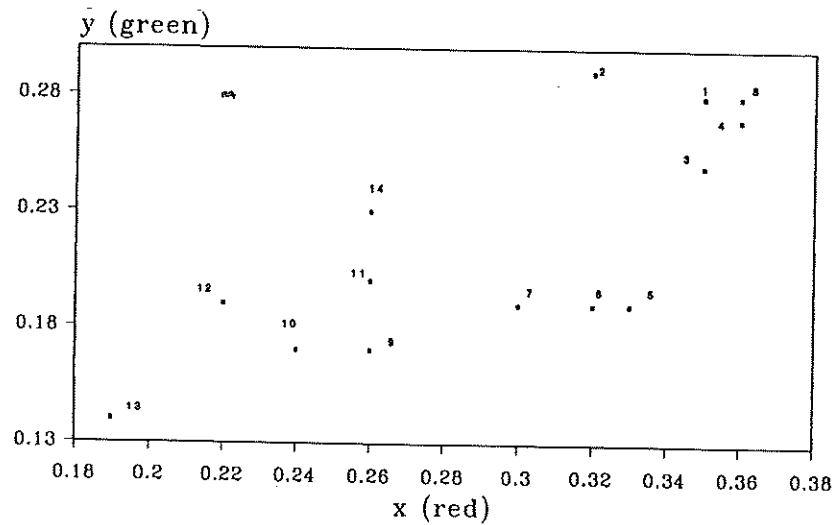


Figure 3. The purple region in CIE chromaticity space (the numbers refer to the color codes in Table 7)

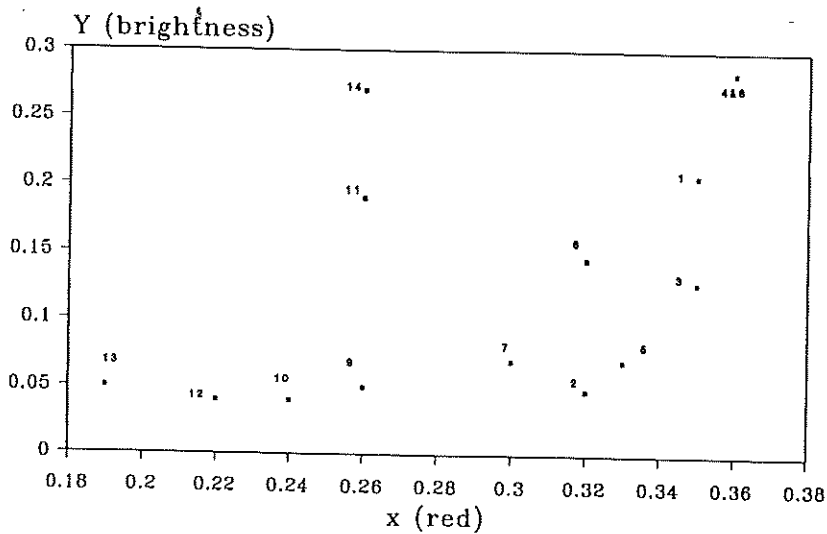


Figure 4. The purple region in CIE (x, Y: red v. brightness) space (the numbers refer to the color codes in Table 7)

have low scores on x and y (and by implication have high scores on z, the proportion of blue light). As well as varying along the chromatic dimensions, colors can vary in brightness: the higher the Y value the brighter the color. Figure 3 shows the 14 tiles in the chromaticity coordinates (x and y: red and green), and Figure 4 shows the equivalent data but plotted in the Y and x coordinates (brightness against redness). It can be seen that for the Russians there is a region toward the bottom center of the plot where the dominant name is *fioletovyy* 'purple'. At the bottom left of the plot, the dominant term is *sinij* 'dark blue', with *fioletovyy* 'purple' as the subordinate term. There is then a large region extending from the center up toward the top right of the plot in which *sirenevyy* 'mauve' is used relatively frequently. This region merges with pink in the upper right-hand section. Good purples, then, for the Russians are bluer and less red than the colors denoted as *sirenevyy* 'mauve'. The English categories overlap with the Russian ones to some extent. The best *purple* is the same tile as the best Russian *fioletovyy* 'purple', but the region denoted *purple* extends further toward the red for the British than for the Russians. Conversely, the region denoted *mauve* is smaller than for the Russian region *sirenevyy*, and in general the consensus over *mauve* is lower.

Considering Figure 4 it becomes apparent that an additional feature that distinguishes *purple* from *mauve* or *lilac* is that *purple* is much darker (loci toward the bottom of the plot) and less red (loci toward the left of the plot) than *mauve*.

Comparing the Russian and English data, it is apparent that although the boundaries of the purple regions differ for the two groups, the focus is about the same: the tile V HUE (.26, .17 in Figure 3) shows the highest consensus for both languages, and this color corresponds well to the universal purple shown in Figure 2. This agreement over the focus but disagreement over boundaries is characteristic of basic terms within Berlin and Kay's theory. In contrast, while there is overlap between the two mauve regions there is never quite agreement over the focus, which is consistent with both terms being nonbasic.

There were other purple terms offered in the list task. *Purpurnyy* 'purplish red' was offered 20 times, *bagrjanyj* 'purplish red' only four times, and *bagrovyy* 'purplish red' just three times. When it came to tile naming they were never used. These are rather literary words. When Moss (1989b) required informants to choose the best example of these, all three had the same tile as their best exemplar (RED HUE), showing that they all denote a very reddish color (hence the identical glosses). When simply asked to name the tile, our informants called it *krasnyj* 'red' or *malinovyj* 'raspberry'. There was one purple term — *violet* — that was offered

relatively frequently in the list task by the British — almost half the sample offered it — but used infrequently in the naming task. Even when it was used, it was with little consensus, as indicated by its wide distribution of cooccurrence scores in Table 8.

4. Discussion

In the introduction we said that the probable basic color terms of Russian are the following:

belyj 'white', *černyj* 'black', *krasnyj* 'red', *zelenyj* 'green', *želtij* 'yellow', *sinij* 'dark blue', *goluboj* 'light blue', *koričnevyyj* 'brown', *fioletovyyj* 'purple', *rozovyyj* 'pink', *oranževyyj* 'orange', *seryj* 'gray'.

The main questions were whether *sinij* 'dark blue' and *goluboj* 'light blue' were both basic, and whether *fioletovyyj* 'purple' was definitely the basic term for the purple region. Our data support the claim that the 12 terms we give above are all basic, including *goluboj* and *fioletovyyj*. However, *sirenevyyj* 'mauve' also achieves high scores.

This claim for the basic status of the 12 terms given above is most clearly supported by the data from the list task. These terms are each offered by more people than any other term, and there is a reasonably clear "step" between the least frequent of these twelve — *seryj* 'gray' — which was offered by 69% of the sample, and the most frequent of the remaining terms — *sirenevyyj* 'mauve' — which was offered by 52% of the sample. The list position measure does not achieve such a clean separation between the 12 terms we claim are basic and the rest, but even so it is just *koričnevyyj* 'brown' and *seryj* 'gray' that have lower mean positions than a few nonbasic terms, such as *sirenevyyj* 'mauve' and *bordovyyj* 'claret'. The list position measure is perhaps less reliable than the list frequency measure, because a term with a low frequency can still achieve a high list position if the few people who do offer it offer it early in their lists.

Most of the 12 putative basic terms also have high frequency of naming scores. The exceptions are *belyj* 'white' and *černyj* 'black'. In addition, however, *sirenevyyj* 'mauve' has the seventh highest frequency of use in tile naming. But what indicates that the two achromatic terms are definitely basic, whereas *sirenevyyj* is probably not, are the measures of consensus across respondents. There are just 13 terms that have dominance scores greater than zero; that is, there is at least one tile for which half or more of the sample use a given term; these are the 12 putative basic terms plus *sirenevyyj* 'mauve'. But *sirenevyyj* 'mauve' only just achieves

this criterion — exactly half of the sample called one tile *sirenevyyj* 'mauve'; its frequent use is thinly spread as indicated by its low specificity score (Table 5) and by the large region it covers in color space (Figures 3 and 4). People know the term *sirenevyyj* 'mauve' but do not agree what it denotes: this lack of agreement suggests that it is not a basic color term.

Our exploration of the purple region further supports *fioletovyyj* 'purple' as a basic term and justifies the use of the gloss 'purple'. The same procedure also indicated that the most apt gloss for *sirenevyyj* was 'mauve'. *Sirenevyyj* 'mauve' denotes lighter and redder colors than *fioletovyyj* 'purple', although with not quite enough consensus to admit it to the inventory of basic terms. However, it is tempting to speculate that the relatively high status of *sirenevyyj* 'mauve' has something to do with the presence of two basic terms for blue. It is almost as though having acquired two basic terms for blue before it acquired a basic term for purple (*goluboj* 'light blue' was established before *fioletovyyj* 'purple'), Russian might acquire two purple terms: one is the intersection of *sinij* 'dark blue' with red to give *fioletovyyj* 'purple', and the other is the intersection of *goluboj* 'light blue' with red to give *sirenevyyj* 'mauve'. Even as *goluboj* might be considered to be less basic than *sinij*, so *sirenevyyj* is less basic than *fioletovyyj*.

5. Conclusion

Overall our data support Berlin and Kay's synchronic predictions, provided it is accepted that basic color-term inventories can be extended beyond the upper limit of 11. *Goluboj* 'light blue' and *sinij* 'dark blue' are among the highest scoring terms on every measure; they denote nonoverlapping regions of color space rather than *goluboj* 'light blue' being included in the domain of *sinij* 'dark blue', as Berlin and Kay originally thought. Provided our measures are valid indicators of basicness, then we must accept that both terms are basic. In addition, *fioletovyyj* is established as the basic term for 'purple', which confirms that Russian indeed has 12 basic terms.

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Notes

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1. Note, however, that Bolton et al. (1980:317) state that in their work on Nepali *akāshi* 'sky, light blue' was "the most commonly elicited secondary term," and that there is evidence that *celeste* 'light blue' may be acquiring basic status in Guatemalan Spanish (Harkness 1973:177) and Peruvian Spanish (Bolton 1978: 293-294).

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