MAPPING RUSSIAN BASIC COLOUR TERMS USING BEHAVIOURAL MEASURES*

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Progress in research on colour terms in the Berlin and Kay tradition requires clearer definition of the notion 'basic' and investigation of languages which constitute exceptions to the Berlin and Kay hierarchy.

According to linguistic criteria Russian is unusual in having two basic terms for 'blue'. This study investigates whether these terms also meet certain psychological criteria for basicness. Seven native Russian speakers were asked to name 219 colour samples. Several behavioral measures, such as consistency within subjects, consensus between subjects and reaction time were found to differentiate basic and non-basic terms to a reasonable first approximation. However, a measure of stability of reference differentiates the two classes most clearly. The scores obtained for these measures by Russian 'blue' terms were comparable with those for other, well-established basic terms suggesting that Russian does indeed have two, independent, basic terms for 'blue'.

1. Introduction

The work of Berlin and Kay (1969) on colour terms is widely known and continues to stimulate research. We focus on two problematic areas. The first is the difficulty of determining which are the basic colour terms in a given language. And the second is the question of apparent exceptions to Berlin and Kay's claims. We evaluate a behavioural procedure as a potential test for basicness. And we apply it to Russian, which is perhaps the best studied of the claimed exceptions. Before discussing the procedure, we outline the Berlin and Kay hierarchy and consider the special interest of Russian.

According to Berlin and Kay (1969), basic colour terms in all languages develop in a certain fixed order, comprising seven stages and up to a total

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possible number of eleven basic terms, which can be represented in the following hierarchy:

I	II	III	IV	V	VI	VII
						Purple
White		Yellow	Green			Orange
	Red	or	or	Blue	Brown	
						Pink
Black		Green	Yellow			Grey

Berlin and Kay claim that all languages have basic terms for white and black (light and dark). If a language has a third term it will be red, a fourth will be yellow or green, the fifth will be the missing one out of green and yellow, and so on. Thus, the hierarchy constrains possible sets of basic colour terms, and so the possible stages of development. There have been several modifications, notably in Kay and McDaniel (1978). For the purposes of this paper the hierarchy as given is a convenient starting point.

Russian is an interesting language in that it presents a possible exception to the Berlin and Kay hypothesis. Instead of the supposed maximum of eleven basic terms, it has twelve, including two basic terms for 'blue': *sinij* 'dark blue', and *goluboj* 'light blue'.[1] Moreover, the second term for 'blue' cannot be treated as simply the latest addition to the hierarchy, making Russian the first known example of the latest (eighth) stage in the development of basic colour terms (Kay and McDaniel (1978)). For *fioletovyj* 'purple' emerged as a basic term at least five hundred years later than either *sinij* or *goluboj*. We are therefore forced to the conclusion that Russian has not only more basic terms than the maximum allowed by the theory, but has also developed them in a different order from that predicted by the theory (Moss (1989a, b)).

Given the special interest of Russian, it makes sense to investigate empirically the foci and ranges of all the basic and as many as possible of the non-basic colours. This has been done by Frumkina (1984). However, her research, important and significant as it is, has not been conducted in the context of Berlin and Kay's hypothesis, and therefore cannot easily be compared with the large corpus of work in this context on other languages.

A more promising procedure has been employed by Boynton and Olson

[1] The terms taken to be basic, from the evidence in Corbett and Morgan (1988) and Morgan and Corbett (1989) are: *belyj* 'white', *černyj* 'black', *krasnyj* 'red', *zelenyj* 'green', *želtyj* 'yellow', *sinij* 'dark blue', *goluboj* 'light blue', *koričnevyj* 'brown', *fioletovyj* 'purple', *rozovyj* 'pink', *oranževyj* 'orange' and *seryj* 'grey'.

(1987) on English-speaking subjects and then by Uchikawa and Boynton (1987) and Uchikawa, Uchikawa and Boynton (1989) on Japanese-speaking subjects, in which they used 424 colour specimens developed by the OSA Committee on Uniform Colour Scales. Three separate behavioural measures were used by these authors: consistency of naming within subjects, consensus between subjects and response time. Their results were in broad agreement with the Berlin and Kay hypothesis for both languages, each of the three measures serving to differentiate the basic colour-terms from the non-basic terms – although some evidence emerged that in Japanese, as in Russian, there is an extra basic term for 'blue' (Moss (1989a)).

In addition to helping us understand more about the position of the two Russian blues in the Russian colour system as a whole, an equivalent study on Russian speakers should help towards clarifying the crucial question of what counts as a basic colour term. Berlin and Kay (1969: 6) propose four main criteria. These are that the meaning of the colour term should not be predictable from that of its parts; that its signification should not fall within that of another colour term; that its use must not be restricted to a small class of objects; and that it must be psychologically salient for informants. Thus both linguistic and psychological factors are called into play. Berlin and Kay propose three indices of psychological salience, but explicitly leave the way open for others. Given that there are problems in establishing the inventory of basic colour terms in some languages on the basis of these criteria it makes sense to look for procedures of a behavioural type, in the hope of finding a clearer indicator of basicness. Boynton and his colleagues found that consistency, consensus and response time all serve to distinguish basic from non-basic colour terms in English and Japanese. If such a result could be replicated for Russian – and in particular if these behavioural indices were to agree with the linguistic criteria in attributing two basic terms for blue to Russian – then we would have greater confidence in using these behavioural indices as tests of linguistic basicness. We have recently discussed different types of basicness (Moss (1989a)). This paper is part of our continuing effort to reach a common understanding of linguistic and psychological basicness.

2. Method

2.1. Subjects

The subjects were five female students and two female teachers of English visiting the University of Surrey on an exchange from the Lenin Pedagogical Institute, Moscow. All were in the age range 20–40, all were native Russian speakers, and all had normal colour vision.

2.2. *Apparatus*

219 colours were used, supplied by the Color-aid Corporation, whose classification system is based on the Ostwald Colour Solid (Smith (1965)). The Color-aid grid comprises 192 specimens made up from 24 hues each in four 'tints' (T1–T4) and three 'shades' (S1–S3) plus 12 further shades and 15 additional grey shades. The main matrix of 192 colours appears to provide a reasonably spaced sample of colour space, although the inclusion of the 15 grey shades has arguably over-sampled this region. The appendix gives their CIE coordinates and their Color-aid classification. Each stimulus measured 6 inches by 4 inches, was mounted on stiff card, and illuminated by fluorescent light such that the surface received 5 foot-Lamberts. The stimuli were presented in a Cambridge-type tachistoscope (BRD Electronics) such that they subtended an angle of 15° horizontally and 9° vertically at the eyes.

2.3. *Procedure*

Each subject saw each colour twice with an exposure time of two seconds. For each sequence and for each subject the order of stimuli was randomised. The subjects were told to name the colour as quickly as possible, avoiding compound terms. The instructions were given in Russian. Each trial consisted of a verbal warning signal, followed by the exposure of the stimulus for two seconds. The onset of the stimulus started a timer, and a voice activated switch stopped the timer. The response time (RT) and name were recorded.

3. Results

3.1. *Basic data*

Tables 1a and 1b show the most frequently used name for each of the colours, together with its frequency (maximum 14); in addition, when there was a second name used more frequently than any remaining term, and used at least twice, this is given together with its frequency.

Table 1a
Distribution of name responses (maximum 14) to each colour stimulus in the main grid.

	Y	YOY	YO	OYO	O	ORO	RO	ROR	R	RVR	RV	VRV	V	VBV	BV	BVB	B	BGB	BG	GBG	G	GYG	YG	YGY
HUE	želt 9	želt 12	želt 7	oran 12	oran 10	kras 12	kras 12	kras 11	kras 6 bord 3	mal 3 fiol 3	fiol 6 lil 5	fiol 8	fiol 10	fiol 7 sin 4	sin 14	sin 14	sin 13	sin 10	sin 11	zel 10	zel 11	zel 14	zel 13	zel 9
T1	želt 8	želt 10	želt 7 oran 4	oran 14	oran 9	kras 10	kras 10	kras 9	kras 7 brus 2	mal 4 brus 3	lil 7 fiol 4	fiol 9	fiol 8	fiol 8	fiol 8	fiol 5 sir 3	gol 11	gol 10	gol 10	gol 7 mor 3	zel 10	zel 12	zel 12	zel 12
T2	želt 7 lim 4	želt 11	želt 7 oran 5	oran 12	oran 9	oran 5 kras 4	kras 8	roz 7 kras 4	roz 6 brus 5	roz 7 brus 4	fiol 8	fiol 5 sir 5	fiol 7 sir 5	sir 6 fiol 5	fiol 6 sir 4	fiol 6 sir 6	gol 7 sin 6	gol 11	gol 11	gol 9	zel 11	zel 12	zel 12	zel 7 trav 4
T3	želt 6 lim 6	želt 11	želt 10	oran 9	oran 9	roz 9	roz 11	roz 11	roz 7 brus 5	roz 9	lil 5 sit 5	lil 5 sir 5	fiol 6 sir 4	sir 5 fiol 4	fiol 6 sir 5	sir 6 fiol 4	gol 9	gol 14	gol 12	gol 8	zel 9	zel 12	zel 8	zel 8
T4	želt 6 lim 6	želt 9	želt 10	oran 6 želt 6	roz 5 oran 4	roz 10	roz 9	roz 10	roz 9	roz 9	roz 4 lil 4	lil 5 sir 5	fiol 5	sir 7 fiol 5	sir 7 fiol 4	sir 7 fiol 4	gol 8	gol 7 neb 5	gol 10	gol 10	zel 11	zel 9	zel 9	zel 7 sal 6
S1	lim 5 želt 3	bol 5	bol 5 zašč 2	kor 9	oran 4 kor 3	kor 11	kor 5 kir 3	roz 5 lil 3	lil 4 kor 3	roz 5	fiol 8	lil 6 fiol 5	fiol 9	sir 6	sin 14	sir 5 sin 4	sin 14	sin 7 gol 6	sin 10	gol 5 sin 4	zel 11	gol 8	zel 11	zel 5 sal 5
S2	bol 5 sal 2	bol 4	xak 4 bol 4	kor 4 bež 3	kor 9	roz 5 kor 4	kor 14	roz 8	lil 4	roz 7 lil 4	fiol 9	roz 6 lil 5	lil 3	sir 7 fiol 5	sin 9	fiol 4 sir 4	sin 14	gol 7 sin 6	sin 12	gol 10	zel 13	ser 8	zel 11	sal 5
S3	bol 6 xak 2	bol 6	bol 7	pes 3	kor 13	ser 5 roz 3	kor 12	roz 7 lil 3	kor 8	roz 10	fiol 6 lil 4	roz 11	roz 8	sir 8	gol 6 sin 5	sir 8	sin 11	gol 10	sin 14	gol 9	zel 9	ser 8	zel 6 mor 3	sal 5 zel 4

Note: The abbreviations Y, YOY etc. at the top of the columns refer to the Color-aid hues, T1–T4 the tints, and S1–S3 the shades. See the Appendix for their CIE coordinates. Abbreviations: želt–želtyj; oran–oranževyj; kras–krasnyj; bord–bordovyj; mal–malinovyj; fiol–fioletovyj; lil–lilovyj; brus–brusničnyj; lim–limonnyj; roz–rozovyj; sir–sirenevj; bol–bolotnyj; zašč–zaščitnyj; kor–koričnevyj; kir–kirpičnyj; xak–xaki; sal–salatovyj; bež–beževyj; pes–pesočnyj; ser–seryj; sin–sinij; gol–goluboj; zel–zelenyj; mor–morskoj; neb–nebesnyj; trav–travjanoj; bel–belyj; čern–černyj.

Table 1b
Distribution of responses (maximum 14) to the 27 non-grid colour-stimuli.

BLACK	WHITE	PRIMROSE YELLOW		LIFE RED		ROSE RED	MAGENTA	MAROON
kor	bel	lim		kras		mal 6	fiol 6	mal 2
9	10	8		9		roz 3	lil 5	lil 2
SIENNA BROWN		BURNT UMBER		COBALT BLUE		NAVYBLUE	CYAN BLUE	
kor		kor		sin		sin	gol	
10		12		12		8	8	
GREY A	GREY B	GREY C	GREY D	GREY E	GREY F			
ser	ser	ser	ser	ser	ser			
8	12	11	7	8	7			
GREY 4	GREY 5	GREY 5A	GREY 6	GREY 6A	GREY 7	GREY 7A	GREY 8	GREY 8A
ser	ser	ser	ser	ser	ser	ser	čern	ser 6
14	13	14	11	13	8	12	9	čern 4

The tables are laid out as in the Color-aid grid for convenience; the data in both parts are of exactly the same type. It can be seen that the 12 basic terms are all represented; in addition subjects used 44 non-basic terms (though not all qualify for inclusion in the table). For the bulk of the stimuli there is some variation in the terms used. Only for 11 stimuli was there complete consensus (i.e. a score of 14 in the tables). It is interesting to note that 6 of these were called *sinij* 'dark blue', 2 were *seryj* 'grey', and one each *goluboj* 'light blue', *zelenyj* 'green', and *oranževyj* 'orange'.

3.2. *Behavioural indices of basicness*

Boynton and Olson (1987) used a number of converging performance indices to characterise colour terms: frequency of occurrence (F), mean naming time (RT) and two indices of what we might term 'reliability', namely the degree of consensus, and the degree of consistency. Responses were said to show consensus if the same term was used by all subjects for both presentations of a stimulus. In our case, as there were seven subjects and two presentations of each stimulus, unanimity for that stimulus would contribute a score of 14 to the total consensus score for that term. Consistency was a weaker measure based only on intra-subject rather than inter-subject reliability. If a given subject used the same term on both presentations of a stimulus, those two responses were said to show consistency. (It follows that a term which shows consensus necessarily shows consistency.) Since consistency

Table 2
Frequency of occurrence, mean response times and associated measures for all colour terms used at least 0.5 percent of total.

Colour	Total responses			Inconsistent responses		Dominance index	Stability ratio
	Frequency of occurrence (F)	Percentage	Mean RT (milliseconds)	No. of inconsistent judgements	Percentage of total usage		
zelenyj 'green'	298	9.7	1596	62	20.8	24	2.5
fioletovyj 'purple'	256	8.4	1916	108	42.2	10	1.2
sinij 'dark blue'	254	8.3	1531	54	21.2	13	1.6
goluboj 'light blue'	244	8.0	1509	74	30.3	15	1.9
rozovyj 'pink'	222	7.2	1991	60	27.0	13	1.8
seryj 'grey'	204	6.7	1578	54	26.5	13	1.9
lilovyj 'mauve'	198	6.5	2024	90	45.5	0	0
sirenevyj 'lilac'	160	5.2	2152	50	31.3	2	0.4
želtyj 'yellow'	155	5.1	1503	39	25.2	9	1.8
oranževyj 'orange'	137	4.5	1958	31	22.6	8	1.8
koričnevyj 'brown'	137	4.5	1628	37	27.0	10	2.2
krasnyj 'red'	111	3.6	1776	37	33.3	8	2.2
salatovyj 'salad green'	79	2.6	2114	37	46.8	0	0
bolotnyj 'marsh'	52	1.7	2059	34	65.4	0	0
brusničnyj 'bilberry'	51	1.7	2763	33	64.7	0	0
limonnyj 'lemon'	36	1.2	1542	14	38.9	1	0.8
nebesnyj 'sky blue'	27	0.9	2516	19	70.4	0	0
stal'noj 'steel'	27	0.9	2191	15	55.6	0	0
černyj 'black'	26	0.9	1892	16	61.5	1	1.1
belyj 'white'	26	0.9	1949	14	53.4	1	1.1
malinovyj 'raspberry'	25	0.8	3358	17	68.0	0	0
zaščitnyj 'camouflage'	25	0.8	2061	13	52.0	0	0
xaki 'khaki'	24	0.8	2635	16	66.7	0	0
travjanoj 'grass green'	21	0.7	2254	8	38.1	0	0

can thus be shown only by a pair of responses, each instance of consistent use (by any subject) contributes a score of two to the total consistency score for the particular colour term. Finally, the difference between the total number of responses and the consistency score yields the number of inconsistent responses. Hence, each colour term has a consensus score, a consistency score, and its inverse, an inconsistency score.

Table 2 shows the colour names in rank order of frequency of occurrence, the corresponding frequencies, the percentage frequency, mean RT's, number of inconsistent judgements, and the percentage of inconsistent judgements, for the names that occurred at least 0.5 percent of the total. It can be seen that basic colour terms tend to be the most frequent, the fastest to name, and have the lowest percentages of inconsistent use. The positions of *lilovyj* 'mauve' and *sirenevyj* 'lilac' are surprisingly high, but they also have relatively high degrees of inconsistent use.

The final two columns of table 2 show the dominance score (D) and the stability ratio (S). A term was counted as dominant when it was used for more than half of the responses to a particular stimulus (i.e. 8 or more responses from a possible 14). The dominance score for a particular colour term is then the total number of stimuli for which that name was dominant. The stability ratio was calculated by dividing the dominance score by the percentage occurrence for that name; it is an index of how specifically a name was used, and how stable the reference was. It can be seen that each of the chromatic basic terms has a higher dominance score than all the non-basic terms, and that the stability index for all the basic terms ranges between 1.1 and 2.5, whereas the scores for *lilovyj* 'mauve' and *sirenevj* 'lilac' are much lower and more similar to the ratios for the rest of the non-basic terms.

If this set of behavioural measures are indeed all indices of basicness, strong intercorrelations between them would be expected. Calculation of Pearson's product moment correlations support this position. RT and F were negatively correlated ($r = -0.57$, $p < 0.002$); that is the most frequent responses tend to have the fastest naming times. RT and percentage of inconsistent use were positively correlated ($r = 0.75$, $p < 0.001$); that is, the greater the degree of inconsistency, the slower the naming time; whereas F and percentage of inconsistent use were negatively correlated ($r = -0.75$, $p < 0.001$); that is the more frequent the name, the more likely it was to be used consistently. Dominance and stability were positively correlated, ($r = 0.88$, $p < 0.001$), they both correlated, positively with F ($r = 0.86$ and 0.69, $p < 0.001$), and negatively with RT and I (minimum $r = -0.7$, $p < 0.001$). That is, the most frequent

Table 3
Rank orders of colour terms according to Berlin and Kay, RT, Percentage inconsistency, dominance and stability.

Colour terms ranked by stability[a]	Berlin and Kay	RT	Percentage inconsistency	Dominance	Stability
zelenyj 'green'	4.5	6	1	1	1
koričnevyj 'brown'	8	7	6.5	6.5	2.5
krasnyj 'red'	3	8	10	9.5	2.5
goloboj 'light blue'	6.5	2	8	2	4.5
seryj 'grey'	10.5	5	5	4	4.5
želtyj 'yellow'	4.5	1	4	8	7
rozovyj 'pink'	10.5	13	6.5	4	7
oranževyj 'orange'	10.5	12	3	9.5	7
sinij 'dark blue'	6.5	3	2	4	9
fioletovyj 'purple'	10.5	10	13	6.5	10
černyj 'black'	1.5	9	19	13	11.5
belyj 'white'	1.5	11	17	13	11.5
limonnyj 'lemon'		4	12	13	13
sirenevyj 'lilac'		18	9	11	14
lilovyj 'mauve'		14	14	19.5	19.5
travjanoj 'grass green'		20	11	19.5	19.5
salatovyj 'salad green'		17	15	19.5	19.5
zaščitnyj 'camouflage'		16	16	19.5	19.5
bolotnyj 'marsh'		15	21	19.5	19.5
stal'noj 'steel'		19	18	19.5	19.5
brusničnyj 'bilberry'		23	20	19.5	19.5
xaki 'khaki'		22	22	19.5	19.5
nebesnyj 'sky blue'		21	24	19.5	19.5
malinovyj 'raspberry'		24	23	19.5	19.5

[a] Terms are ranked primarily by stability. When two terms are of equal rank they are ordered according to the mean of the other three measures.

responses tended to be used more dominantly, more specifically, made more quickly and with greater consistency.

The strong inter-correlations between the behavioural measures support the argument that they converge to provide indices of basicness, but their effectiveness at predicting the Berlin and Kay hierarchy is less persuasive. Table 3 shows the colour terms ranked with respect to the stability ratio as described in the account of Table 2, together with their rank order according to RT, dominance and percentage inconsistency. In addition to the basic terms, the first twelve terms are shown with their rank in the Berlin and Kay sequence. The stability ratio is the only index that perfectly segregates the basic and non-basic terms, but in common with the other measures, black and white are much lower in the rank ordering than expected.

Another approach to assessing the usefulness of Boynton and Olson's (1987) measure is to see if the combined scores of the set of basic terms are different with respect to frequency, RT, consensus and consistency scores, to the combined scores for the set of non-basic terms. It would be expected that basic terms would show greater frequencies of consensus and consistent responses, greater overall frequency of occurrence, and faster RT's.

Table 4 shows the total consensus, consistency and inconsistency scores as well as the total occurrences, for basic and non-basic terms. In addition the mean RT is shown for each kind of response classification. The total scores were derived by summing the appropriate individual scores for the basic terms, and then for the non-basic terms. However, to avoid counting responses twice, the consistency score excluded those consistent responses which also showed consensus.

Table 4
Frequency of occurrence of consensus, consistent and inconsistent responses with RT (msecs) in brackets.

	Consensus	Consistent but not consensus	Inconsistent	Total occurrences	Percent
Basic terms	154 (1210)	1330 (1557)	586 (1960)	2070 (1646)	68
Non-basic terms	0	450 (1847)	536 (2429)	986 (2169)	32

Recall that each subject saw each colour stimulus twice. Following Boynton and Olson (1987), a response showed consensus if used unanimously for both presentations of a stimulus; it showed consistency if a respondent used the same term for both presentations of the stimulus. It can be seen that subjects used basic terms 68% of the time, more than twice as often as the non-basic terms. Basic terms clearly showed a higher degree of consensus (154–0). They also showed greater consistency (1330–450, which is proportionately greater than would result from the higher (68%) use of basic terms). In each grouping basic colour terms were used with greater speed (the overall average being 1646 ms as compared to 2169 ms). In addition, the RT's for consensus responses were quicker than for consistent responses, which in turn were quicker than for inconsistent responses.

3.3. Relationship between behavioural and physical variables

Although it would seem that Boynton and Olson's indices might help to differentiate basic from non-basic terms, it is possible that basicness per se was not the influence on these variables, but that some fundamental physical variable such as degree of brightness or saturation was responsible for variation in naming time. Briefly, although the hue of a coloured stimulus will be determined by the relative proportion of wavelengths of light reflected from its surface, the colour perceived also depends on a complex interaction between this and other physical characteristics: the saturation or purity of these wavelengths, and the brightness or intensity of the light. It is possible that perhaps bright saturated colours, for example, were more quickly detected by the visual system, making access to the 'naming system' quicker. In order to investigate this possibility correlations between RT and the frequency of use of a name, as shown in tables 1a and 1b, and saturation and brightness were calculated. There were no significant correlations, which suggests that the physical variables were not responsible for the variation on the behavioural measures.

3.4. Alternative colour names

When two or more names were used for stimulus, the most typical combination was a basic term and a non-basic term. The most common combinations of two basic terms were *sinij* 'dark blue' and *goluboj* 'light blue' (24 stimuli), *rozovyj* 'pink' and *fioletovyj* 'purple' (19) and *rozovyj* 'pink' and *krasnyj* 'red' (11) stimuli. The most frequent combinations overall were for *fioletovyj* 'purple' and *lilovyj* 'mauve' (51) and *fioletovyj* 'purple' and *sirenevyj* 'lilac' (33).

3.5. Position of colour names in colour space

Those stimuli for which there was a high degree of agreement in the responses ten or more out of fourteen) were plotted in CIE 1931 coordinates. This represents each stimulus as a point in a three-dimensional space (Y x y), which can be thought of as lightness, proportion of redness and proportion of greenness. It was revealed that those points sharing a common name occupied a unique region in each possible two-dimensional space (xy, Yx, yY), with the exception of *goluboj* 'light blue' and *sinij* 'dark blue', which occupied unique regions only in full three-dimensional space (Y x y).

4. Discussion and conclusion

Our results for Russian-speaking subjects provide interesting comparisons with Boynton and Olson's for English-speaking subjects:

(1) Mean response times were faster (i) for basic terms than for non-basic terms, (ii) for consistent than for inconsistent responses and (iii) for consensus than for non-consensus responses (table 4). In general, the Russians responded faster than the Americans for basic terms, but slower for non-basic terms (cf. Boynton and Olson (1987: 95, table 1)).

(2) Basic colour-terms were used about 68% of the time in our experiment, compared to 88% of the time in Boynton and Olson's.

(3) All the chromatic basic colour terms were used more frequently than all of the non-basic colour terms by both the Russians and the Americans, except that the non-basic terms *lilovyj* 'mauve' and *sirenevyj* 'lilac' rank higher than four of the basic terms in the Russian list. When we consider response time, we see that basic colour terms have mean response times of under two seconds, while *lilovyj* 'mauve', *sirenevyj* 'lilac' and most other non-basics have mean response times of over two seconds. However, some portion of this effect is probably directly due to the greater response frequency of the basic terms; it is generally established that response time declines with increase in the probability of a response. As with Boynton and Olson's subjects, the commonest response of our subjects was *zelenyj* 'green'. Also comparable with the Boynton and Olson results was the comparatively 'poor' ranking of *krasnyj* 'red' in our experiment.

Our data provides strong confirmation for the view that Russian has two independent basic terms for blue, *sinij* 'dark blue' and *goluboj* 'light blue'. Both terms figure very highly on both response time and frequency of response. Moreover, even in that part of the spectrum where we would expect maximum confusion between the two terms, we find a high degree of agreement between subjects and few 'split votes' – most subjects are agreed on whether a colour sample should be labelled *sinij* or *goluboj* (table 1a, BV-BGB, Hue-T4). This is so, despite the fact that it is also *sinij* and *goluboj* which most commonly of the basic colour terms occur together in 'split votes' in table 1a. It was found, in agreement with Frumkina (1984) and Morgan and Moss (1989), that the samples labelled *goluboj* are typically lighter and greener than those labelled *sinij*.[2]

A surprising result of our data is the high rank obtained in frequency of response by the non-basic terms *lilovyj* 'mauve' and *sirenevyj* 'lilac'. Against this, however, should be set their relatively slow response time, particularly in the case of *sirenevyj* 'lilac'. Three factors may contribute to their high rank: (i) in the case of *lilovyj* 'mauve' it lacks a well-defined focal point, enabling it to act as a label, not only for a wide variety of purple shades (Moss (1989b)), but also for colours as distant as green and yellow (Frumkina and Mixeev (1983: 58); Corbett and Morgan (1988: 60)); *sirenevyj* 'lilac' also has a wide distribution (see table 1a); (ii) the relatively recent emergence of the Russian basic term for purple, *fioletovyj*, admitting of some 'competition' for the basic purple slot from other terms (Corbett and Morgan (1988); Moss (1989b)); and (iii) the fact that there are two basic terms for blue, adding further to the competition. If we were to take frequency of response as our sole criterion, we would be tempted to consider *lilovyj* 'mauve' and *sirenevyj* 'lilac' as basic, whereas *lilovyj* has been shown to be definitely not basic according, not only to Berlin and Kay's, but also Crawford's (1982) criteria (Moss (1989b)), and *sirenevyj* 'lilac' can be argued against on the grounds that it is morphologically derived (from *siren'* 'lilac').

It is here that the additional measures given in table 2 and presented again in table 3 are particularly relevant. Recall that the 'stability ratio' is an attempt to measure stability of reference across informants. On this measure, all the basic terms have scores in excess of 1, while *sirenevyj* 'lilac' achieves only 0.4 and *lilovyj* 'mauve' scores zero. Thus while these two terms might appear to have a claim to basicness on the basis of frequency of response,

[2] Uchikawa et al. (1989) found that two out of three of their Japanese subjects changed their response from *ao* 'dark blue' to *mizu* 'light blue' when the achromatic surround to the colour sample was removed. This may be because samples without surrounds look lighter. However, increasing the general level of luminance was found to have no effect on colour naming.

they can be eliminated because of their low stability ratio. We see then that our behavioural indices converge to provide a measure of basicness.

We have seen that the behavioural procedure investigated is of value in distinguishing basic from non-basic colour terms. However, perhaps not surprisingly, it is not sufficiently sensitive to decide each individual case. In the case of Russian *sinij* 'dark blue ' and *goluboj* 'light blue' it does indicate strongly, in confirmation of the linguistic data, that both are basic. But there is an interesting twist to the story in that, unlike the other basic colour terms, the regions covered by *sinij* 'dark blue' and *goluboj* 'light blue' are unique only in full three-dimensional space; the psychological and linguistic data do not correspond in the way we might have expected.

Appendix: CIE coordinates for the colour-stimuli used in the experiment

Colour-stimulus (Color-aid classification)	CIE coordinates			
	Hue (Y) (Brightness)	Value (x) (red light)	Chroma (y) (green light)	Excitation purity (Saturation)
Y Hue	64.77	0.47	0.48	0.81
Y T1	66.73	0.46	0.47	0.78
Y T2	68.18	0.45	0.47	0.77
Y T3	70.55	0.44	0.46	0.77
Y T4	72.17	0.42	0.45	0.73
Y S1	39.32	0.43	0.48	0.77
Y S2	16.99	0.41	0.44	0.71
Y S3	14.68	0.42	0.42	0.67
YOY Hue	47.48	0.50	0.43	0.82
YOY T1	46.78	0.49	0.43	0.82
YOY T2	47.99	0.48	0.41	0.69
YOY T3	52.15	0.46	0.41	0.65
YOY T4	55.63	0.45	0.41	0.63
YOY S1	20.45	0.38	0.41	0.46
YOY S2	22.08	0.36	0.38	0.31
YOY S3	27.81	0.36	0.39	0.31
YO Hue	39.52	0.51	0.41	0.85
YO T1	40.93	0.50	0.40	0.77
YO T2	43.45	0.49	0.41	0.73
YO T3	47.02	0.48	0.41	0.69
YO T4	49.85	0.47	0.40	0.64
YO S1	15.98	0.41	0.42	0.50

Appendix: (*Continued*)

Colour-stimulus (Color-aid classification)	CIE coordinates			
	Hue (Y) (Brightness)	Value (x) (red light)	Chroma (y) (green light)	Excitation purity (Saturation)
YO S2	15.51	0.39	0.42	0.46
YO S3	10.72	0.36	0.41	0.40
OYO Hue	26.51	0.54	0.37	0.77
OYO T1	31.88	0.53	0.38	0.70
OYO T2	35.02	0.51	0.38	0.68
OYO T3	40.50	0.48	0.38	0.62
OYO T4	43.11	0.48	0.39	0.62
OYO S1	15.71	0.38	0.35	0.26
OYO S2	20.37	0.38	0.36	0.27
OYO S3	29.57	0.39	0.39	0.26
O Hue	85.97	0.54	0.37	0.72
O T1	25.90	0.52	0.36	0.66
O T2	32.69	0.51	0.36	0.65
O T3	35.21	0.49	0.36	0.58
O T4	37.62	0.48	0.35	0.56
O S1	14.34	0.50	0.37	0.61
O S2	10.37	0.44	0.36	0.44
O S3	9.15	0.42	0.36	0.40
ORO Hue	18.87	0.57	0.34	0.74
ORO T1	25.04	0.51	0.33	0.56
ORO T2	27.64	0.50	0.33	0.53
ORO T3	36.88	0.46	0.35	0.39
ORO T4	34.00	0.46	0.33	0.40
ORO S1	10.04	0.45	0.37	0.52
ORO S2	18.51	0.37	0.32	0.15
ORO S3	26.51	0.33	0.32	0.06
RO Hue	16.22	0.58	0.33	0.77
RO T1	24.37	0.50	0.33	0.56
RO T2	26.28	0.49	0.33	0.53
RO T3	32.66	0.45	0.32	0.37
RO T4	31.95	0.46	0.32	0.40
RO S1	9.48	0.46	0.33	0.44
RO S2	5.21	0.41	0.35	0.33
RO S3	4.19	0.37	0.34	0.18
ROR Hue	15.23	0.53	0.31	0.55
ROR T1	20.96	0.51	0.32	0.51
ROR T2	24.01	0.46	0.30	0.37

Appendix: (*Continued*)

Colour-stimulus (Color-aid classification)	CIE coordinates			
	Hue (Y) (Brightness)	Value (x) (red light)	Chroma (y) (green light)	Excitation purity (Saturation)
ROR T3	29.82	0.42	0.30	0.30
ROR T4	28.16	0.44	0.30	0.33
ROR S1	13.95	0.37	0.28	0.49
ROR S2	18.81	0.38	0.29	0.27
ROR S3	20.71	0.34	0.28	0.22
R Hue	11.17	0.50	0.29	0.50
R T1	17.56	0.49	0.30	0.44
R T2	18.94	0.44	0.28	0.42
R T3	23.52	0.41	0.28	0.36
R T4	24.34	0.40	0.27	0.40
R S1	7.50	0.37	0.28	0.29
R S2	7.48	0.31	0.27	0.22
R S3	4.81	0.33	0.30	0.12
RVR Hue	9.11	0.42	0.24	0.54
RVR T1	13.75	0.39	0.25	0.44
RVR T2	20.42	0.40	0.26	0.42
RVR T3	25.17	0.35	0.25	0.40
RVR T4	25.12	0.36	0.26	0.33
RVR S1	12.79	0.35	0.25	0.40
RVR S2	16.68	0.35	0.25	0.40
RVR S3	28.43	0.36	0.28	0.30
RV Hue	6.97	0.33	0.19	0.59
RV T1	11.13	0.31	0.18	0.58
RV T2	14.51	0.31	0.19	0.52
RV T3	23.53	0.31	0.22	0.42
RV T4	27.32	0.32	0.23	0.36
RV S1	6.40	0.30	0.19	0.52
RV S2	5.46	0.30	0.22	0.39
RV S3	5.30	0.30	0.25	0.29
VRV Hue	6.71	0.30	0.19	0.52
VRV T1	9.10	0.29	0.17	0.50
VRV T2	12.88	0.30	0.19	0.48
VRV T3	16.08	0.31	0.21	0.37
VRV T4	19.47	0.30	0.20	0.40
VRV S1	13.83	0.31	0.22	0.38
VRV S2	18.81	0.34	0.25	0.35
VRV S3	28.42	0.36	0.28	0.25

Appendix: (*Continued*)

Colour-stimulus (Color-aid classification)	CIE coordinates			
	Hue (Y) (Brightness)	Value (x) (red light)	Chroma (y) (green light)	Excitation purity (Saturation)
V Hue	4.67	0.26	0.17	0.52
V T1	8.34	0.26	0.16	0.54
V T2	12.32	0.26	0.17	0.52
V T3	15.61	0.29	0.19	0.47
V T4	17.69	0.27	0.18	0.50
V S1	5.87	0.29	0.19	0.47
V S2	8.37	0.36	0.27	0.30
V S3	14.57	0.44	0.32	0.33
VBV Hue	4.13	0.24	0.17	0.50
VBV T1	8.64	0.24	0.17	0.50
VBV T2	11.57	0.25	0.19	0.44
VBV T3	13.32	0.25	0.17	0.53
VBV T4	19.05	0.25	0.20	0.40
VBV S1	15.59	0.27	0.22	0.57
VBV S2	19.36	0.26	0.21	0.40
VBV S3	24.46	0.28	0.24	0.30
BV Hue	4.21	0.22	0.19	0.52
BV T1	9.86	0.22	0.15	0.51
BV T2	11.91	0.23	0.16	0.51
BV T3	14.58	0.24	0.17	0.50
BV T4	17.03	0.24	0.18	0.43
BV S1	4.79	0.23	0.21	0.40
BV S2	7.88	0.25	0.26	0.29
BV S3	11.03	0.24	0.29	0.27
BVB Hue	4.80	0.19	0.13	0.70
BVB T1	10.95	0.23	0.16	0.52
BVB T2	15.10	0.23	0.18	0.50
BVB T3	19.18	0.23	0.19	0.48
BVB T4	26.63	0.24	0.21	0.44
BVB S1	15.25	0.24	0.23	0.37
BVB S2	24.33	0.24	0.23	0.37
BVB S3	26.65	0.26	0.23	0.32
B Hue	9.51	0.18	0.16	0.66
B T1	19.02	0.20	0.19	0.56
B T2	18.75	0.20	0.20	0.55
B T3	22.81	0.21	0.22	0.52
B T4	28.98	0.22	0.25	0.40
B S1	8.87	0.20	0.18	0.56

Appendix: (*Continued*)

Colour-stimulus (Color-aid classification)	CIE coordinates			
	Hue (Y) (Brightness)	Value (x) (red light)	Chroma (y) (green light)	Excitation purity (Saturation)
B S2	6.23	0.22	0.20	0.50
B S3	5.37	0.25	0.24	0.33
BGB Hue	9.62	0.19	0.19	0.61
BGB T1	17.95	0.19	0.23	0.51
BGB T2	22.10	0.20	0.23	0.49
BGB T3	23.08	0.20	0.23	0.49
BGB T4	30.40	0.21	0.25	0.50
BGB S1	14.96	0.20	0.22	0.50
BGB S2	19.62	0.20	0.22	0.46
BGB S3	26.61	0.21	0.23	0.43
BG Hue	8.93	0.20	0.25	0.48
BG T1	16.57	0.19	0.25	0.53
BG T2	21.09	0.20	0.24	0.49
BG T3	22.93	0.20	0.25	0.48
BG T4	24.27	0.20	0.25	0.48
BG S1	9.60	0.21	0.26	0.43
BG S2	7.42	0.21	0.26	0.43
BG S3	6.55	0.22	0.25	0.41
GBG Hue	10.69	0.23	0.37	0.28
GBG T1	14.86	0.20	0.28	0.55
GBG T2	17.24	0.21	0.27	0.42
GBG T3	22.58	0.21	0.29	0.39
GBG T4	25.77	0.21	0.28	0.41
GBG S1	16.48	0.21	0.28	0.41
GBG S2	20.79	0.20	0.25	0.48
GBG S3	28.07	0.22	0.28	0.37
G Hue	11.99	0.24	0.42	0.24
G T1	15.88	0.23	0.40	0.26
G T2	19.79	0.23	0.40	0.26
G T3	23.14	0.23	0.38	0.27
G T4	28.77	0.24	0.37	0.23
G S1	11.20	0.25	0.40	0.20
G S2	8.62	0.24	0.38	0.23
G S3	6.10	0.26	0.33	0.22
GYG Hue	12.89	0.25	0.44	0.23
GYG T1	17.06	0.25	0.43	0.22
GYG T2	22.69	0.26	0.44	0.21

Appendix: (*Continued*)

Colour-stimulus (Color-aid classification)	CIE coordinates			
	Hue (Y) (Brightness)	Value (x) (red light)	Chroma (y) (green light)	Excitation purity (Saturation)
GYG T3	24.55	0.27	0.42	0.18
GYG T4	31.14	0.26	0.41	0.18
GYG S1	15.59	0.26	0.31	0.19
GYG S2	19.00	0.27	0.32	0.15
GYG S3	24.98	0.28	0.35	0.09
YG Hue	14.66	0.28	0.48	0.35
YG T1	20.13	0.26	0.43	0.21
YG T2	25.14	0.27	0.45	0.24
YG T3	33.94	0.29	0.44	0.24
YG T4	33.51	0.29	0.43	0.24
YG S1	16.79	0.31	0.40	0.19
YG S2	8.10	0.30	0.40	0.20
YG S3	5.78	0.30	0.34	0.11
YGY Hue	18.92	0.30	0.51	0.49
YGY T1	22.86	0.30	0.49	0.41
YGY T2	29.82	0.31	0.48	0.42
YGY T3	30.53	0.31	0.46	0.37
YGY T4	36.42	0.32	0.46	0.37
YGY S1	24.24	0.36	0.43	0.41
YGY S2	26.89	0.36	0.42	0.40
YGY S3	35.87	0.35	0.43	0.40
Black	3.59	0.34	0.33	0.07
White	81.40	0.32	0.33	0.08
Primrose Yellow	67.97	0.43	0.47	0.77
Life Red	16.97	0.58	0.34	0.77
Rose Red	17.63	0.41	0.24	0.52
Magenta	7.42	0.35	0.20	0.57
Maroon	8.42	0.44	0.27	0.48
Sienna Brown	13.31	0.44	0.36	0.43
Burnt Umber	6.02	0.36	0.33	0.14
Cobalt Blue	8.10	0.18	0.13	0.63
Navy Blue	3.18	0.27	0.26	0.23
Cyan Blue	22.77	0.20	0.25	0.47
Grey A	51.26	0.31	0.33	0.01
Grey B	22.10	0.31	0.32	0.04
Grey C	24.79	0.31	0.32	0.04
Grey D	30.59	0.32	0.33	0.03
Grey E	38.54	0.32	0.32	0.02

Appendix: (*Continued*)

Colour-stimulus (Color-aid classification)	CIE coordinates			
	Hue (Y) (Brightness)	Value (x) (red light)	Chroma (y) (green light)	Excitation purity (Saturation)
Grey F	47.55	0.32	0.33	0.03
Grey 4	18.88	0.31	0.31	0.02
Grey 5A	17.83	0.31	0.31	0.02
Grey 5	13.43	0.31	0.31	0.02
Grey 6A	14.74	0.31	0.32	0.04
Grey 6	11.20	0.31	0.31	0.02
Grey 7A	10.35	0.30	0.30	0.03
Grey 7	8.93	0.30	0.31	0.03
Grey 8A	7.49	0.30	0.30	0.03
Grey 8	4.53	0.31	0.32	0.04

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