Turkish color terms: tests of Berlin and Kay's theory of color universals and linguistic relativity*

EMRE ÖZGEN and IAN R. L. DAVIES

Abstract

We report a study of Turkish color terms with four main aims: to establish the inventory of BASIC *color terms; to compare this inventory with Berlin and Kay's 11 color universals; to see if Turkish is an exception to the theory by having two basic terms for blue; and if it is, to explore whether there are cognitive effects of the two blue terms. Eighty children aged from eight to 14 years and 153 adults performed a color-term list task (write down as many color terms as you can) and a subset of these two samples went on to perform a color-naming task. In the naming task, they were asked to name 65 representative color "tiles." Measures of salience and consensus derived from the two tasks converge to suggest that Turkish has 12 basic color terms. The denotations of these terms and the glosses provided by dictionaries and Turkish-speaking consultants are consistent with 11 of the terms being Turkish tokens of Berlin and Kay's 11 universal categories. The twelfth term —* lacivert *'dark blue'—lies between the foci of the universal blue and purple and its range overlaps with the dark-blue term of Russian,* sinij. *However, in a third phase of the investigation, the majority of informants said that* lacivert *'dark blue' was a kind of* mavi *'blue'. thus violating one of Berlin and Kay's criteria (noninclusion) for basicness. Thus we have the unusual, but logically possible, case of a term being used with prevalence, consensus, and specificity, while at the same time being acknowledged as a subset of another term. Whatever the status of the two blue terms, however, we found evidence that the cognitive representation of the blue region of color space may reflect the salience of the two blue terms using color grouping, similarity judgments, and same–different tasks.*

1. Introduction

Cultural relativism and perceptual constructionism are natural allies. Among the claims of the former are that linguistic categories are primarily

Linguistics 36–5 (1998), 919–956 0024–3949/98/0036–0919

determined by cultural needs (the utilitarian position) and that learning a language ensures that a culture's categories are widely shared. The central claim of constructionism is that perception (appearances) results from mental constructions. The alliance between the two positions arises because language is an important potential mental influence on perception: linguistic categories may influence perception — a variant of the linguistic relativity hypothesis (Whorf 1956; see also Davies and Corbett 1997). Color language and color cognition have been the natural testing ground in the debate over relativism versus universalism. The debate has consisted of two main phases (Brown 1976). In the first phase, which lasted until about 1970, relativism was the dominant view, whereas in the second phase, universalism became dominant. Berlin and Kay's (1969) theory of color universals was one of the main causes of relativism losing favor. The main focus of the present paper is a test of Berlin and Kay's theory. Pilot work suggested that Turkish was an exception to the theory: it has two basic terms for blue. We establish what the basic color terms of Turkish are and we consider the implications of the two blue terms for color cognition.

1.1. *The Berlin and Kay theory*

Berlin and Kay's (1969) seminal theory of color universals continues to provide a "benchmark" in the cross-cultural study of color categories. Before 1969, the prevalent view was that languages encoded color "without constraint" (Gleason 1961). This relativist view was consistent with the apparent diversity of color categories across languages. In contrast, Berlin and Kay argued that, rather than varying without constraint, "basic" color terms (the most important, and henceforth BCTs) in all languages were drawn from a universal inventory of just 11 color categories as shown by the hierarchy in Figure 1. According to the theory, every language should have between two and 11 BCTs, and the hierarchy specifies a limited number of evolutionary paths that languages can take

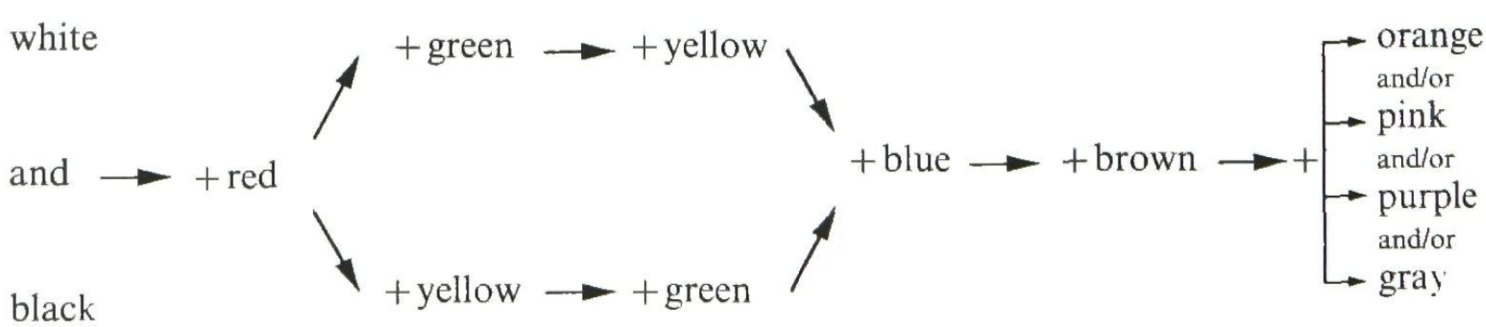

Figure 1. *The Berlin and Kay hierarchy of basic color terms*

when adding new color categories. The theory has been tested extensively over the last 25 years, and although there are exceptions to the theory,[1] the data fit the theory reasonably well.

There were two crucial conceptual maneuvers that allowed Berlin and Kay to reconcile the apparent diversity of color terms with the notion of a heavily constrained set of 11 universal color categories. The first was to restrict the theory of a subset of color terms: the BASIC color terms. The second was to define color categories in terms of their foci (their best exemplars) rather than their boundaries. Both maneuvers place much of the color-category variation across languages outside the scope of the theory: the boundaries of basic color categories, and the number and kind of secondary (nonbasic) color terms are free to vary across languages. Another kind of variation is at the heart of the theory, however. Languages can vary in the number of BCTs they have. The permitted range in the number of basic color terms is from two to 11 BCTs as encapsulated in the hierarchy in Figure 1.

BCTs are, in essence, the consensual core of a language's color-term inventory. Put more formally, according to Berlin and Kay, BCTs 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 which are psychologically salient. Or, as summed up by Hardin and Maffi (1997), BCTs are "simple and salient."[2] Our methods for establishing BCTs are derived from these definitions, as we shall see (see also Corbett and Davies 1995; Davies and Corbett 1995).

The hierarchy shown in Figure 1 represents the order in which languages acquire BCTs in the following way. Languages start with two BCTs: BLACK and WHITE (we use capitals to denote the hypothetical universal color categories); the third term to be acquired is RED; the fourth term is either GREEN or YELLOW; the fifth term is whichever of GREEN or YELLOW is missing; and so on, up to the theoretical maximum of 11 BCTs. As well as this diachronic constraint, the hierarchy also constrains possible sets of BCTs synchronically. If a language has a particular basic color term, then it should also have all of the BCTs earlier on the hierarchy than the particular term.[3]

1.2. *Developments to the theory*

Kay and McDaniel (1978) extended the 1969 theory in two important ways. First, they proposed that the origin of the universal color categories lay in universal perceptual physiology. Second, they proposed a model of the mechanism underlying color-category evolution based on the link with perceptual physiology in combination with the formalism of fuzzy logic. One advantage of the model is that it clarifies what colors, other than the universal foci, are likely to be included in the universal categories. A second benefit, particularly for our current purpose, is that it is implicit in the model that more than 11 BCTs are possible.

The perceptual physiology of the time suggested that there were six neurological color "primitives" organized in three opponent process pairs: black–white; red–green; and blue–yellow. The colors corresponding to the peak sensitivities of the neurological primitives also seemed to fit Hering's (1964 [1920]) opponent process theory of color vision (see Jameson 1985). Kay and McDaniel defined the categories based on the neurological primitives as PRIMARY color categories. According to the theory, there are two other kinds of basic color categories: COMPOSITE categories and DERIVED categories. Composite color categories are the fuzzy-set UNION of two or more primary categories: the composite category includes the colors belonging to its constituent primaries. Derived color categories are the fuzzy set INTERSECTION of two primary categories: a derived category "breaks away" from the parent primaries taking with it some of the colors lying between the two parents.

In fuzzy set theory, category members vary in their strength of membership in the category, whereas in traditional logic, category membership is all or nothing. This graded membership accords with the nature of natural categories (see Rosch 1973), and further, it is consonant with the notion of defining the category by its focus (one of the crucial Berlin and Kay [1969] proposals): the focus is the exemplar with the strongest membership in the category.

Within this new version of the theory, the first stage of the hierarchy was recast as the two composite categories: BLACK–BLUE–GREEN (cool and dark) and WHITE–RED–YELLOW (warm and light). These two composite categories shared all of color space between them, rather than leaving much of color space unnamed, as implied by the 1969 theory. Stages two through to five were recast as the successive decomposition of the two original composite categories into the six primary categories. Further, stages five to seven of the hierarchy were recast as the development of the five derived color categories through the intersection of two primary categories: ORANGE = RED–YELLOW; BROWN = BLACK–YELLOW; PINK = RED–WHITE; PURPLE = RED–BLUE; GRAY = BLACK–WHITE. Note that there are several logically possible derived terms that are not present in the universal set of 11 basic color categories. For instance, none of the derived terms involves an intersection with GREEN, such as GREEN–BLUE or

GREEN–YELLOW. And BLUE is conjoined in just one derived term (PURPLE = BLUE–RED). It is not clear from the theory why some intersections have occurred whereas others, of equal potential within the theory, have not. It is, though, these "missing" derived terms that provide a potential route for languages to acquire more than 11 BCTs.[4]

1.3. *Two basic terms for blue*

Most exceptions to the theory are languages at early stages on the hierarchy — those with relatively few color terms. Russian, on the other hand, is particularly interesting because it is a late-stage language with 12 BCTs, one more than allowed by the theory (Corbett and Morgan 1988; Morgan and Corbett 1989; Davies and Corbett 1994; Davies et al. 1998). The "extra" color term is a second basic term for blue (but see MacLaury 1997 for a counterargument; we will return to this in the discussion). The extra blue term may reflect the significance of particular blues in iconography (Moss 1988) and be peculiar to Russian, or it may be a natural extension to the 11 universal color categories. Within Kay and McDaniel's framework, the extra blue term could be either the intersection of BLUE–BLACK, to give *sinij* 'dark blue' or the intersection of WHITE–BLUE to give *goluboj* 'light blue' Other languages are close to dividing the blue region into two basic categories, which supports the natural-extension conjecture.[5] Even so, no language other than Russian has two clearly attested basic terms for blue, and it is important to establish whether Russian is unique in this respect.

Pilot work suggested that Turkish, like Russian, might have two BCTs for the blue region of color space. *Mavi* 'blue' seemed to have its focus at the universal blue, whereas the second blue term — *lacivert* 'dark blue' — was also prevalent. Our first hunch was that *lacivert* would correspond with the dark blue term of Russian — *sinij* 'dark blue'. If our earlier conjecture that novel derived terms can arise from logically possible, but rare, intersections of primary color categories, then we would expect the dark-blue terms of Russian and Turkish to correspond with each other. However, before this conjecture is evaluated, it is necessary to establish that there are two basic terms for blue in Turkish.

1.4. *The current study*

The procedures we use concentrate on establishing which color terms form the consensual core of the language's color-term inventory. BCTs should be salient — readily available to the majority of the language group. We assess this availability in several ways. First, we use a list task (tell me as many color terms as you can). BCTs should be more available (come to mind more easily) than non-BCTs, and thus, one index of basicness is the proportion of the sample that offer a given term. The second task we use is a color-naming task. From this we derive further measures of salience — the relative frequency with which color terms are used in response to a standard set of colors. But the main function of this color-naming task is to establish levels of consensus across the sample over what a term denotes. A minimum requirement for a term to be basic is that there should be a clear consensus about what the focus of a category should be called: the majority of speakers should use the same term for at least one exemplar of the category. In addition, if the data are consistent with the Berlin and Kay theory, these best exemplars should be close to the loci of the hypothetical universal foci in color space. As we shall see, the two criteria for basicness tend to converge: terms that are salient are almost always simple.[6]

We used the two basic procedures on three samples of Turkish speakers: a monolingual child sample aged from eight to 14 years; a bilingual Turkish-English sample of university students; and a sample of adult monolinguals. The three samples were used to allow us to assess the level of consistency with which color terms were used across different ages and different levels of education. In addition, we explored the relationship between *mavi* 'blue' and *lacivert* 'dark blue' to see whether the latter is included in the former. If *lacivert* is included in *mavi*, then it fails to meet Berlin and Kay's second criterion for basicness. We first asked a sample of students to give as many examples of types of *mavi* 'blue' as possible, and then we asked them explicitly whether *lacivert* is a kind of *mavi*.

Having established that Turkish is different from English in how the blue region is categorized, we go on to look for possible cognitive consequences of this difference by comparing an English-speaking sample with a Turkish-speaking sample using first a color-grouping task; second, a similarity-judgments task; and third, a same–different discrimination task. We summarize the results of these experiments in an addendum to the main paper (section 6) in order to place the significance of the linguistic data in a broader context.

2. Experiment 1

2.1. *Method*

2.1.1. *Subjects.* There were three groups of informants: the *child* group; the *student* group; and the *adult* group. The sample sizes, the number of males and females, and the age ranges of each group were as follows. child: n = 80; age = 8 to 14 years; 46 boys, 34 girls. Students: n = 118, age = 19 to 25 years; 36 men, 82 women. Adults: n = 35; age = 20 to 38 years; 18 men, 17 women. Most of the children were from a primary school in a poor area of Istanbul. All were monolingual Turkish speakers. The students were from the University of Bogazici in Istanbul but their family homes were widely dispersed around Turkey. They were all native Turkish speakers, but they all had some knowledge of English. The adult sample consisted of 17 monolingual Turkish speakers and 18 people with some knowledge of English.

2.1.2. *Procedure.* The data were collected by a native Turkish speaker (Özgen) and all instructions were given in Turkish. The child and student samples were tested in groups in classrooms or lecture theaters. The adult sample were tested individually. Each informant was given a sheet of paper, and they were asked to write down all the color names they could think of. They were told that they had five minutes to complete the task, but most of them finished in less time.

2.2. *Results*

The majority of terms offered in all cases were monolexemic. However, it was also common to combine the simple form with a general modifier such as *acik* 'light' and *koyu* 'dark' The most frequent occurrence of a simple form plus modifier was *acik mavi* 'light blue' Here we have collapsed all such constructions onto the simple form. The glosses we use in subsequent tables were provided by the Turkish-speaking author, and they are consistent with the *Oxford Turkish Dictionary* (Iz et al. 1992). We will see later that these glosses are also consistent with the way informants labeled colors in the second phase of the study.

2.2.1. *Child lists.* The mean number of terms offered by the children was 10.9 and the range was from five to 16 terms. Table 1 shows the terms offered by at least 5% of the child sample (column 1), together with their English glosses (column 2). The terms are ordered by their frequency across the sample, as can be seen from column 3, which shows the percentage of respondents that offered each term. It can be seen that the six most frequent terms were *yesil* 'green', *mavi* 'blue', *sari* 'yellow', *kirmizi* 'red', *beyaz* 'white', and *siyah* 'black'. These six terms were all offered by over 90% of the sample and they are the Turkish tokens of the six universal primary categories. The Turkish tokens for three of the

Table 1. *Child list task ($n = 80$): terms offered in the list task by at least 5% of the child sample, their English glosses, and the percentage of respondents that offered each term*

Term	Gloss	Percentage
yesil	green	100.00
mavi	blue	98.75
sari	yellow	98.75
kirmizi	red	97.50
beyaz	white	95.00
siyah	black	91.25
pembe	pink	82.50
mor	purple	81.25
kahverengi	brown	73.75
turuncu	orange	50.00
lacivert	dark blue	47.50
kavunici	orange	38.75
gri	gray	33.75
bordo	claret	18.75
eflatun	lilac	17.50
yavruagzi	peach	11.25
krem	cream	10.00
turkuaz	turquoise	6.25
bej	taupe	5.00

universal derived terms — *pembe* 'pink', *mor* 'purple' and *kahverengi* 'brown' were the next most frequent terms, each offered by almost 75% of the sample. *Turuncu* 'orange' was the next most frequent term; it was given by half of the sample. However, there was a further term *kavunici* that was given by about 40% of the sample that we have also glossed as 'orange'. Of the children that offered at least one of these orange terms, only three offered both. This suggests that the two terms are alternatives for ORANGE. The final derived term, *gri* 'gray , appears in the thirteenth slot, and it was offered by about one-third of the sample. There is then a relatively sharp drop in the frequency scores to the next term, *bordo* 'claret' with a score of less than 20%. The term we are particularly interested in — *lacivert* 'dark blue' appears at position 11 in the rank order and was offered by about half of the sample.

2.2.2. *Adult lists.* The pattern of results from the student and the adult samples was essentially the same, and so we have combined the data and it is summarized in Table 2 (the table is structured in the same way as for the child data in Table 1). As expected, the adults offered more terms on average than the children. The mean number of terms for adults was 14.2 (range: 7 to 23), compared to the children's mean of 10.9.

Table 2. *Adult list task (n = 33): terms offered in the list task by at least 5% of the adult sample, their English glosses, and the percentage of respondents that offered each term*

Term	Gloss	Percentage
kirmizi	red	99.35
yesil	green	98.69
mavi	blue	98.69
sari	yellow	96.73
beyaz	white	95.42
siyah	black	95.42
mor	purple	90.20
pembe	pink	87.58
kahverengi	brown	86.93
gri	gray	83.66
turuncu	orange	79.74
lacivert	dark blue	72.55
bordo	claret	49.02
eflatun	lilac	45.10
bej	taupe	43.14
turkuaz	turquoise	37.25
krem	cream	24.18
lila	lilac	17.65
yavruagzi	peach	13.07
kizil	scarlet	12.42
fume	smoke	11.76
somon	salmon	11.76
haki	khaki	10.46
kavunici	orange	9.15
nefti	dark green	7.84

The pattern of results for the adult data is very similar to that for the children. The six most frequent terms all have scores over 95%, and they are the same terms as the six most frequent terms for the children: *kirmizi* 'red', *yesil* 'green', *mavi* 'blue', *sari* 'yellow', *beyaz* 'white', and *siyah* 'black'. *Kavunici* 'orange' is offered by just 9% of the adult sample with a rank of 24, whereas it was offered by almost 40% of the children. Apart from the latter difference, the next six terms for the adults match the seventh to twelfth terms for the children (albeit with some differences in rank order): *mor* 'purple', *pembe* 'pink', *kahverengi* 'brown', *gri* 'gray' *turuncu* 'orange' and *lacivert* 'dark blue' The scores for the adults for the latter six terms are all over 70%, and they are generally higher than the equivalent scores for the children. There is then a relatively sharp drop in the scores down to about 50% for *bordo* 'claret'

2.3. *Summary of the list task*

The salience measures derived from the list task from the two samples (adults and children) converge to suggest that the strongest contenders for the BCTs of Turkish are *yesil* 'green' *mavi* 'blue', *sari* 'yellow', *kirmizi* 'red', *beyaz* 'white' *siyah* 'black' *mor* 'purple' *pembe* 'pink', *kahverengi* 'brown' *gri* 'gray' *turuncu* 'orange' and *lacivert* 'dark blue'. In addition, there seem to be two terms vying for the basic ORANGE slot in the child sample — *turuncu* and *kavunici* 'orange' — but the former term is dominant for the adult sample. The first 11 of the terms just given seem to be the Turkish tokens of Berlin and Kay's 11 universal terms. In addition, the scores for the Turkish versions of the universal primary terms (the first six terms in the list) are all higher than the scores for the Turkish versions of the five universal derived terms (the next five terms in the list). *Lacivert* 'dark blue' has scores that place it among the derived terms for both samples, and it scores noticeably higher than the highest of the secondary terms, *bordo* 'claret' for both samples.

3. Experiment 2

3.1. *Method*

3.1.1. *Subjects.* A subset of the child and adult samples from phase 1 took part in the naming task. There were 17 children, 10 boys and seven girls, whose ages ranged from eight to 14 years. The adults in this phase all came from the adult sample of phase 1 rather than from the student sample. There were 33 adults, 16 men and 17 women, with an age range of 18 to 40 years. Nine of the adults were from Fethiye in southern Turkey, where the regional language is Turkish, and the remainder of the sample were from a range of locations in Istanbul. All subjects had normal color vision as assessed by the City University Color Vision Test (Fletcher 1980).

3.1.2. *Stimuli.* The stimuli used were those used in our general method for establishing BCTs (Davies and Corbett 1995). The stimuli were 65 colored "tiles," measuring 50 mm square, and 4 mm thick. They were made of rigid wood covered with colored paper selected from the Color-Aid Corporation range of colors.[7] The colors formed an evenly spread sample of "color space." Table 3 shows the Color-Aid codes and CIE coordinates of the stimuli (see Appendix for an outline of the CIE system). The distribution of the 65 colors in CIE uniform chromaticity

Table 3. *Color-Aid codes and CIE coordinates for the 65 tile colors*

Color-Aid code		CIE coordinates					
		Y	x	y	L*	u′	v′
Y	HUE	64.77	0.47	0.48	91.49	0.24	0.55
	S2	16.99	0.41	0.44	52.81	0.22	0.53
YOY	HUE	47.48	0.50	0.43	80.92	0.28	0.54
	T4	55.63	0.45	0.41	86.18	0.26	0.53
	S2	22.08	0.36	0.38	59.09	0.21	0.50
YO	HUE	39.52	0.51	0.41	75.17	0.30	0.53
	T3	47.02	0.48	0.41	80.61	0.28	0.53
	S3	10.72	0.36	0.41	43.02	0.20	0.51
OYO	HUE	26.51	0.54	0.37	63.81	0.34	0.52
O	HUE	25.00	0.54	0.37	62.26	0.34	0.52
	S1	14.34	0.50	0.37	49.03	0.31	0.52
	S3	9.15	0.42	0.36	39.98	0.26	0.50
ORO	HUE	18.87	0.57	0.34	55.26	0.38	0.52
	T3	36.88	0.46	0.35	73.09	0.29	0.50
	S3	26.51	0.33	0.32	63.81	0.21	0.47
RO	HUE	16.22	0.58	0.33	51.75	0.40	0.51
	T3	32.66	0.45	0.32	69.56	0.30	0.48
	S3	4.19	0.37	0.34	27.15	0.23	0.48
ROR	HUE	15.23	0.53	0.31	50.35	0.37	0.49
	T3	29.82	0.42	0.30	67.00	0.29	0.47
	S3	20.71	0.34	0.28	57.50	0.24	0.44
R	HUE	11.71	0.50	0.29	44.78	0.36	0.48
	T4	24.34	0.40	0.27	61.57	0.29	0.45
	S3	4.81	0.33	0.30	29.18	0.22	0.45
RVR	HUE	9.11	0.42	0.24	39.90	0.33	0.43
	S1	12.79	0.35	0.25	46.60	0.26	0.42
	S3	28.43	0.36	0.28	65.69	0.26	0.45
RV	HUE	6.97	0.33	0.19	35.13	0.29	0.37
	T2	14.51	0.31	0.19	49.28	0.27	0.37
VRV	HUE	6.71	0.30	0.19	34.48	0.26	0.37
	S3	8.42	0.36	0.28	65.68	0.26	0.45
V	HUE	4.67	0.26	0.17	28.74	0.23	0.34
VBV	HUE	4.13	0.24	0.17	26.94	0.21	0.34
	T4	19.05	0.25	0.20	55.49	0.20	0.37
BV	HUE	4.21	0.22	0.19	27.22	0.18	0.35
	S2	7.88	0.25	0.26	37.26	0.18	0.42
BVB	HUE	4.80	0.19	0.13	29.15	0.18	0.28
	S3	26.65	0.26	0.23	63.95	0.20	0.40
B	HUE	9.51	0.18	0.16	40.71	0.16	0.32
	T1	19.02	0.20	0.19	55.45	0.16	0.35
BGB	HUE	9.62	0.19	0.19	40.93	0.16	0.35
	T3	23.08	0.20	0.23	60.21	0.15	0.39
BG	HUE	8.93	0.20	0.25	39.53	0.14	0.40
	T1	16.57	0.19	0.25	52.24	0.14	0.40
	S2	7.42	0.21	0.26	36.21	0.15	0.41

Table 3. (*Continued*)

Color-Aid code		CIE coordinates Y	x	y	L*	u′	v′
GBG	HUE	10.69	0.23	0.37	42.96	0.13	0.48
	S2	20.79	0.20	0.25	57.60	0.14	0.40
G	HUE	11.99	0.24	0.42	45.26	0.13	0.50
	S3	6.10	0.26	0.33	32.91	0.16	0.46
GYG	HUE	12.89	0.25	0.44	46.76	0.13	0.51
	T4	31.14	0.26	0.41	68.21	0.14	0.50
	S1	15.59	0.26	0.31	50.86	0.17	0.45
YG	HUE	14.66	0.28	0.48	49.51	0.14	0.53
	S3	5.78	0.30	0.34	32.04	0.19	0.47
YGY	HUE	18.92	0.30	0.51	55.32	0.14	0.54
	S3	35.87	0.35	0.43	72.27	0.19	0.52
ROSE RED		17.63	0.41	0.24	53.66	0.32	0.43
SIENNA		13.31	0.44	0.36	47.43	0.27	0.50
WHITE		81.40	0.32	0.33	100.00	0.20	0.47
GRAY1		47.55	0.32	0.33	80.97	0.20	0.47
GRAY2		30.59	0.32	0.33	67.71	0.20	0.47
GRAY4		18.88	0.31	0.31	55.27	0.20	0.46
GRAY6		11.20	0.31	0.31	43.89	0.20	0.46
GRAY8		4.53	0.31	0.32	28.89	0.20	0.46
BLACK		3.59	0.34	0.33	24.98	0.22	0.47

space can be seen in Figure 2, along with the loci of the 11 "universal" color foci taken from Heider (1971). (Note that BLACK, WHITE, and GRAY have the same coordinates and are shown as a single data point labeled "achromatic." They differ on the lightness dimension not shown in this graph.)

3.1.3. *Procedure.* Subjects were tested individually outdoors in light shade. They first completed the City University Color Vision Test, which took about three minutes.[8] Then they were shown each of the 65 tiles in random order, on a neutral gray cloth, and asked in Turkish, "what do you call this color?" The tile-naming task took about 20 minutes.

3.2. *Results*

3.2.1. *Children.* Table 4 shows the most frequent response to each of the 65 tiles and the frequency (F) with which it was given. We also show the second most frequent term and its frequency, provided the term was given by more than one respondent. The children used a color term to

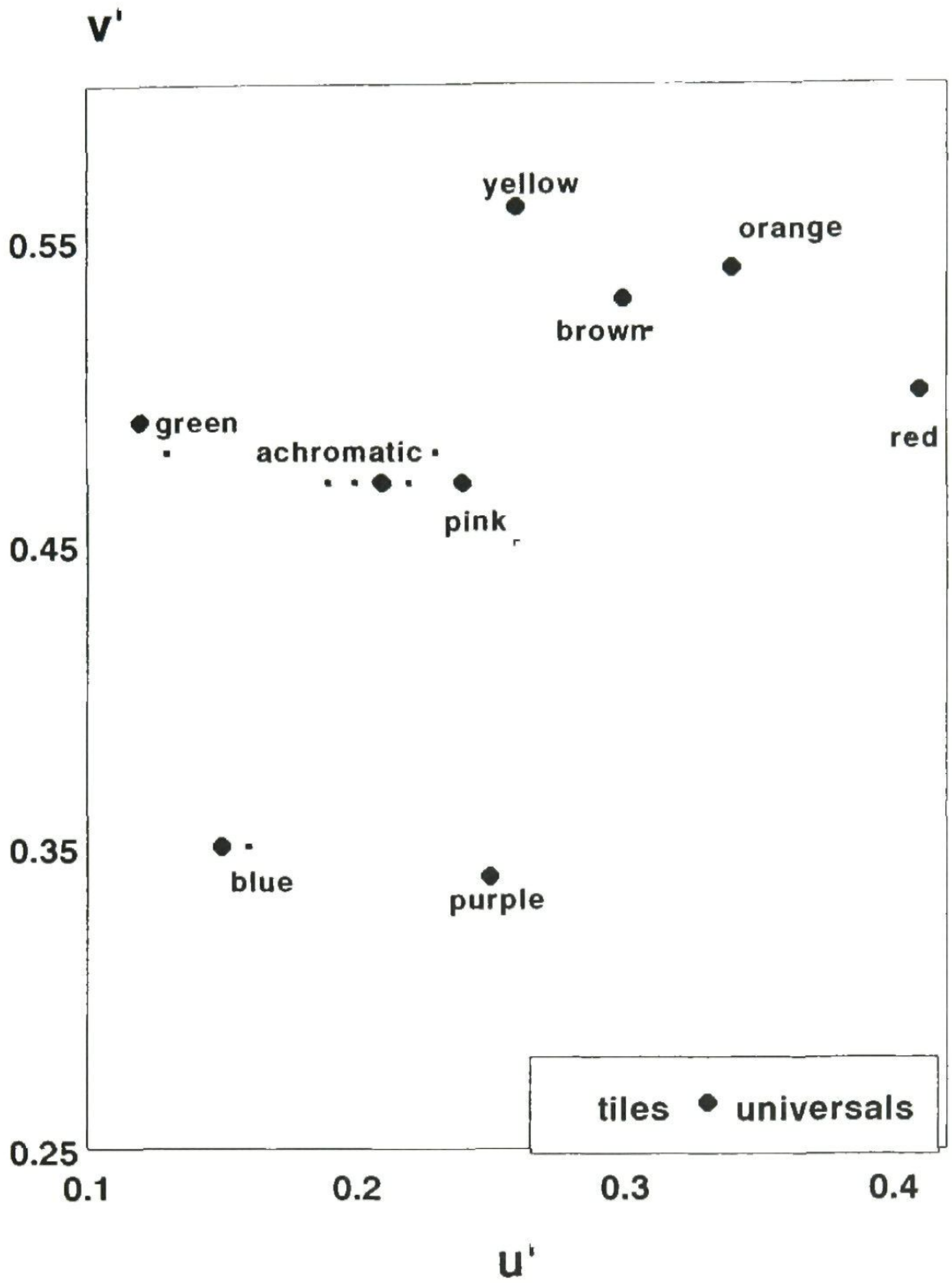

Figure 2. *Loci of the tile colors and the universal foci in CIE (1976) uniform chromaticity space*

name the tiles on 1011 out of a possible 1040 occasions (there were just 29 "don't know" responses).

Table 5 shows the results of various analyses of Table 4 aimed at distinguishing BCTs from secondary color terms. We first consider the overall frequency with which a term was used across tiles and respondents and express this as the percentage of the total responses (1040) for each term (column 3). The table is ordered by the frequency of occurrence of the terms starting with the most frequent term *yesil* 'green' with a score of 19.5%. The 13 most frequent terms are the same as the 13 most frequent terms found in the list task (Table 1). (Note, however, that *kavunici* 'orange', which had a high frequency in the list task, has a much lower frequency in the naming task).

Table 4. *Child tile naming ($n = 16$): the most frequent responses given to each "color tile" and the percentage with which they were given (Code = Color-Aid code, % = percentage of respondents who used a term for a given tile)*

Code	Terms	%	Code	Terms	%	Code	Terms	%
Y-HUE	sari	100.00				Y-S2	yesil	75.00
YOY-HUE	turuncu	56.25	YOY-T4	sari	37.50	YOY-S2	yesil	62.50
	sari	31.25		turuncu	37.50		gri	12.50
YO-HUE	turuncu	87.50	YO-T3	turuncu	87.50	YO-S3	yesil	87.50
OYO-HUE	turuncu	93.75						
O-HUE	turuncu	50.00	O-S1	kahverengi	75.00	O-S3	kahverengi	93.75
	kirmizi	43.75		turuncu	12.50			
				kirmizi	12.50			
ORO-HUE	kirmizi	93.75	ORO-T3	pembe	68.75	ORO-S3	gri	50.00
				turuncu	12.50		mor	18.75
				kirmizi	12.50			
RO-HUE	kirmizi	100.00	RO-T3	pembe	100.00	RO-S3	siyah	75.00
							kahverengi	18.75
ROR-HUE	kirmizi	100.00	ROR-T3	pembe	100.00	ROR-S3	pembe	50.00
							mor	37.50
R-HUE	kirmizi	75.00	R-T4	pembe	100.00	R-S3	siyah	68.75
	pembe	25.00					mor	18.75
RVR-HUE	pembe	68.75	RVR-S1	mor	50.00	RVR-S3	pembe	100.00
	mor	18.75		pembe	43.75			
RV-HUE	mor	81.25	RV-T2	mor	68.75			
	pembe	12.50		pembe	25.00			
VRV-HUE	mor	93.75				VRV-S3	pembe	100.00
V-HUE	mor	81.25						
VBV-HUE	mor	81.25	VBV-T4	mor	81.25			
	lacivert	12.50						

BV-HUE	lacivert	56.25					mavi	43.75
	mavi	43.75					yesil	18.75
BVB-HUE	mavi	68.75				BVB-S3	mor	62.50
	lacivert	31.25					eflatun	18.75
B-HUE	mavi	100.00	B-T1	mavi	100.00			
BGB-HUE	mavi	100.00	BGB-T3	mavi	100.00			
BG-HUE	mavi	56.25	BG-T1	mavi	100.00	BG-S2	mavi	50.00
	yesil	37.50					yesil	43.75
GBG-HUE	yesil	100.00				GBG-S2	mavi	87.50
							yesil	12.50
G-HUE	yesil	100.00				G-S3	yesil	93.75
GYG-HUE	yesil	100.00	GYG-T4	yesil	100.00	GYG-S1	yesil	75.00
							mavi	12.50
YG-HUE	yesil	100.00				YG-S3	yesil	87.50
YGY-HUE	yesil	100.00				YGY-S3	yesil	100.00
ROSE RED	pembe	93.75	SIENNA	kahverengi	93.75	WHITE	beyaz	100.00
GRAY 1	gri	75.00	GRAY 2	gri	93.75	GRAY 4	gri	93.75
	beyaz	18.75						
GRAY 6	gri	50.00	GRAY 8	siyah	100.00	BLACK	siyah	100.00
	siyah	43.47						

Table 5. *Child tile-naming summary (n = 16): terms used more than once in the tile-naming task by children. English glosses, the percentage of total usage, the number of tiles for which a term was the most frequent, and the dominance and specificity indices*

Term	Gloss	%	No. of tiles most frequent (nmf)	No. of tiles dominant $D_{0.50}$	No. of tiles dominant $D_{0.75}$	No. of tiles dominant $D_{0.90}$	Specificity index S
yesil	green	19.9	13	13	12	8	0.91
pembe	pink	13.8	9	9	6	4	0.87
mavi	blue	13.6	10	9	6	5	0.87
mor	purple	10.7	8	8	5	1	0.86
kirmizi	red	6.9	4	4	4	3	0.82
turuncu	orange	6.8	6	5	3	1	0.85
siyah	black	6.1	4	4	3	2	0.87
gri	gray	5.9	5	5	3	2	0.95
kahverengi	brown	4.3	3	3	3	2	0.93
sari	yellow	2.7	2	1	1	1	0.57
lacivert	dark blue	2.1	1	1	0	0	0.41
bcyaz	white	1.9	1	1	1	1	0.80
kavunici	orange	1.0	0	0	0	0	0.00
eflatun	lilac	0.4	0	0	0	0	0.00
lavanta	lavender	0.3	0	0	0	0	0.00
ten r.	tan	0.3	0	0	0	0	0.00
krem	cream	0.2	0	0	0	0	0.00
turkuaz	turquoise	0.2	0	0	0	0	0.00
bordo	claret	0.1	0	0	0	0	0.00
leylak	lilac	0.1	0	0	0	0	0.00
DK	don't know	2.8	0	0	0	0	0.00
Total	–	100.0	66	63	47	30	–

The frequency measure is an index of salience, but it is constrained by the selection of stimuli in the stimulus set. For instance, *beyaz* 'white' is indubitably basic but it constitutes just 1.4% of the total responses. This low score reflects the restricted opportunity to use the term correctly — there is just one white tile in the set. A critical requirement for basicness is that basic terms should be used with consensus across respondents, as well as being salient. Table 5 shows a number of other indices of consensus as well as the overall frequency. First, in column 4, we give the number of tiles for which each term was the most frequent term (*nmf*) across the 16 respondents. Thus, for instance, *yesil* 'green' was the most frequent term for 13 out of the 65 tiles. It can be seen that there are just 12 terms that achieve this *nmf* criterion: the Turkish tokens of the 11 "universals," and *lacivert* 'dark blue'

One quirk of using the *nmf* index is that a term can be the most frequent response even though it is not used by the majority of the respondents. This could happen when the consensus across respondents is low, and several terms are used to name a tile. We can circumvent this problem by using stricter criterion for consensus, which we do with the "dominance indices" (*D*) shown in columns 5 and 6. We say a term is dominant for a particular tile if the proportion of the sample using it exceeds a given threshold. Here we use three thresholds: 0.5 in column 5, 0.75 in column 6, and 0.9 in column 7. Each *D* column shows the number of tiles for which a term was dominant at a given level. The pattern for $D_{0.50}$ (column 5) is essentially the same as shown by the *nmf* index. There are 12 terms that achieved dominance at the 0.5 level: the 11 universals, and *lacivert* 'dark blue', which was dominant for one tile. However, *lacivert* 'dark blue' is not dominant at the 0.75 or 0.9 level, whereas the 11 universals each have at least one tile for which it is dominant at these levels.

The dominance indices capture one aspect of consensus well. The index is sensitive to "local consensus." That is, it reflects consensus for particular tiles, but the index is not diminished by "profligacy." A term could be dominant for a particular tile, while at the same time being used frequently, but with low consensus across the remaining tiles. in addition to local dominance, however, basic terms should be used with "specificity." Their distribution across color space (the 65 tiles) should consist of restricted regions of high density. Column 7 shows the scores for each term on a specificity index (*S*). *S* for a given term is the frequency of use of that term summed across the tile(s) for which it was dominant (at $D_{0.50}$), divided by the total number of times that it was used across all 65 tiles. Thus if a term was used only to name the tile it was dominant for, it would have an *S* of one (the maximum), whereas the index would tend toward zero as the level of indiscriminate use increased. It can be seen that the nine most frequent terms all have values for *S* greater than 0.8. In addition, *beyaz* 'white' scores 0.8, despite its low overall frequency (1.9%). However, the term we are most interested in — *lacivert* 'dark blue' — scores just 0.41, the lowest score for a term with a nonzero dominance index. *Sari* 'yellow' also has a relatively low score of 0.57.

Thus, in summary, the data from the child sample on the naming task are by and large consistent with the list-task data. These data suggest that the strongest contenders for basic status in Turkish are the Turkish tokens of the 11 universal categories; *siyah* 'black', *beyaz* 'white'. *kirmizi* 'red', *yesil* 'green', *sari* 'yellow' *mavi* 'blue', *kahverengi* 'brown', *mor* 'purple', *pembe* 'pink', *turuncu* 'orange' and *gri* 'gray' There is some uncertainty over the term for ORANGE, because in the list task there seemed to be two alternatives for this slot: *turuncu* and *kavunci*. However,

Table 6. *Adult tile naming ($n = 33$): the most frequent responses given to each "color tile" and the percentage with which they were given (Code = Color-Aid code, % = percentage of respondents who used a term for a given tile)*

Code	Terms	%	Code	Terms	%	Code	Terms	%
Y-HUE	sari	100.00				Y-S2	yesil	90.91
							haki	9.09
YOY-HUE	turuncu	39.39	YOY-T4	sari	57.58	YOY-S2	yesil	75.76
	sari	36.36		turuncu	21.21		haki	15.15
YO-HUE	turuncu	54.55	YO-T3	turuncu	69.70	YO-S3	yesil	84.85
	sari	21.21		sari	15.15		haki	15.15
OYO-HUE	turuncu	69.70						
	portakal	12.12						
O-HUE	turuncu	54.55	O-S1	kahverengi	57.58	O-S3	kahverengi	100.00
	kirmizi	15.15		turuncu	18.18			
ORO-HUE	kirmizi	90.91	ORO-T3	pembe	30.30	ORO-S3	gri	57.58
	turuncu	6.06		yavruagzi	21.21		bej	12.12
RO-HUE	kirmizi	96.97	RO-T3	pembe	69.70	RO-S3	siyah	54.55
				kirmizi	9.09		kahverengi	45.45
ROR-HUE	kirmizi	100.00	ROR-T3	pembe	96.97	ROR-S3	pembe	30.30
							eflatun	24.24
R-HUE	kirmizi	84.85	R-T4	pembe	93.94	R-S3	siyah	48.48
	pembe	9.09					mor	27.27
RVR-HUE	pembe	30.30	RVR-S1	mor	42.42	RVR-S3	pembe	96.97
	bordo	21.21		eflatun	21.21			
RV-HUE	mor	81.82	RV-T2	eflatun	42.42			
	eflatun	9.09		mor	33.33			
VRV-HUE	mor	90.91				S3	pembe	96.97
	eflatun	9.09						
V-HUE	mor	87.88						
	eflatun	6.06						

VBV-HUE	mor	78.79
	lacivert	15.15
BV-HUE	lacivert	93.94
	mavi	6.06
BVB-HUE	lacivert	66.67
	mavi	30.30
B-HUE	mavi	100.00
BGB-HUE	mavi	100.00
BG-HUE	mavi	57.58
	yesil	24.24
GBG-HUE	yesil	100.00
G-HUE	yesil	100.00
GYG-HUE	yesil	100.00
YG-HUE	yesil	100.00
YGY-HUE	yesil	100.00
ROSE RED	pembe	87.88
	kirmizi	6.06
GRAY 1	gri	90.91
	krem	6.06
GRAY 6	gri	57.58
	siyah	24.24

VBV-T4	eflatun	45.45
	mor	36.36
B-T1	mavi	100.00
BGB-T3	mavi	100.00
BG-T1	mavı	96.97
GYG-T4	yesil	100.00
SIENNA	kahverengi	93.94
GRAY 2	gri	100.00
GRAY 8	siyah	90.91
	gri	6.06

BV-S2	mavi	54.55
	lacivert	18.18
BVB-S3	eflatun	54.55
	mor	30.30
BG-S2	mavi	51.52
	yesil	33.33
GBG-S2	mavi	93.94
G-S3	yesil	90.91
	nefti	6.06
GYG-S1	yesil	72.73
	mavi	12.12
YG-S3	yesil	84.85
	haki	6.06
	nefti	6.06
YGY-S3	yesil	100.00
WHITE	beyaz	93.94
	krem	6.06
GRAY 4	gri	100.00
BLACK	siyah	100.00

the latter term was used only rarely in the naming task, and as we shall see, it was also used rarely by the adult samples. In addition to the tokens of the 11 universal categories, *lacivert* 'dark blue' was dominant for one tile at the 0.5 level, but it had the lowest specificity index of all terms with a nonzero dominance index. Nevertheless, in terms of claims on basic status, it had the twelfth-strongest claim.

3.2.2. *Adults.* The description and analysis of the adult data follow the same format and use the same indices as the child data. Table 6 shows the terms used to describe each of the 65 tiles. The total number of possible color-term responses was 2145 (33×65) and there were just 43 (2%) "don't know" responses. Further, it can be seen that the overall level of consensus was high: 57 of the 65 tiles had a dominant term at the $D_{0.50}$ level, and 41 tiles had a dominant term at the $D_{0.75}$ level. However, these scores are lower than for the child sample; the corresponding figures are 63 tiles at $D_{0.50}$ and 47 tiles at $D_{0.75}$.

Table 7 shows the percentage of total responses (*F*) and the *nmf*, *D*, and *S* indices for each color term in the equivalent form as Table 5 for the child data. The pattern shown by the percentage frequency data is basically the same as for the child data. There are differences in the rank order of terms, but the major difference is that *eflatun* 'lilac' has the eleventh-highest score (3.4%), above both *lacivert* 'dark blue' (3.3%) and *beyaz* 'white' (1.4%). Thus the 13 most frequent terms are the Turkish tokens for the 11 universal terms, plus *lacivert* 'dark blue' and *eflatun* 'lilac'

The pattern shown by the $D_{0.50}$ index is the same as for the *nmf* index: there are 13 terms with at least one tile for which they were dominant. Using the stricter threshold of $D_{0.75}$, two terms drop out of contention: neither *turuncu* 'orange' nor *eflatun* 'lilac' exceeds this threshold. However, *lacivert* 'dark blue' does. In fact, the 11 terms that meet the $D_{0.75}$ criterion also meet a yet-stricter criterion of $D_{0.90}$, as shown in column 7.

Finally, considering the *S* index (column 8), it is clear that *eflatun* 'lilac' has the lowest score (0.24), suggesting that although the term is prevalent, it is not used with precision. In contrast, *lacivert* 'dark blue' has an *S* of 0.76, which is higher than those for *mor* 'purple', *turuncu* 'orange' *sari* 'yellow'; further, the score for *lacivert* 'dark blue' is the same as for *siyah* 'black' The pattern of the *S* scores is similar to the child data. The two main differences are for *mor* 'purple' and for *lacivert* 'dark blue'. In the former case the score for the adults is lower than that for the children (0.62 compared to 0.86), while in the latter case the score for the adults is higher than that for the children (0.76 compared

Table 7. *Adult title-naming summary (n = 33): terms used more than once in the tile-naming task by adults. English glosses, the percentage of total usage, the number of tiles for which a term was the most frequent, and the dominance and specificity indices*

Term	Gloss	%	No. of tiles most frequent (nmf)	No. of tiles dominant $D_{0.50}$	No. of tiles dominant $D_{0.75}$	No. of tiles dominant $D_{0.90}$	Specificity index S
yesil	green	19.5	13	13	12	9	0.95
mavi	blue	12.4	9	9	6	6	0.94
pembe	pink	10.4	9	6	5	4	0.80
mor	purple	8.4	5	4	4	1	0.62
kirmizi	red	6.5	4	4	4	3	0.88
gri	gray	6.3	5	5	3	3	0.99
turuncu	orange	5.5	5	4	0	0	0.70
siyah	black	4.9	4	3	2	2	0.76
kahverengi	brown	4.8	3	3	2	2	0.81
sari	yellow	3.5	2	2	1	1	0.68
eflatun	lilac	3.4	3	1	0	0	0.24
lacivert	dark blue	3.3	2	2	1	1	0.76
beyaz	white	1.4	1	1	1	1	1.00
haki	khaki	0.7	0	0	0	0	0.00
kavunici	orange	0.7	0	0	0	0	0.00
portakal	orange	0.7	0	0	0	0	0.00
bordo	claret	0.6	0	0	0	0	0.00
turkuaz	turquoise	0.5	0	0	0	0	0.00
yavruagzi	peach	0.5	0	0	0	0	0.00
siklamen	cyclamen	0.4	0	0	0	0	0.00
bej	taupe	0.4	0	0	0	0	0.00
fume	smoke	0.4	0	0	0	0	0.00
oranj	orange	0.4	0	0	0	0	0.00
leylak	lilac	0.3	0	0	0	0	0.00
lila	lilac	0.3	0	0	0	0	0.00
taba	peach	0.3	0	0	0	0	0.00
krem	cream	0.2	0	0	0	0	0.00
nefti	dark green	0.2	0	0	0	0	0.00
somon	salmon	0.2	0	0	0	0	0.00
fusya	fuchsia	0.1	0	0	0	0	0.00
kiremit	brick	0.1	0	0	0	0	0.00
DK	don't know	2.0	0	0	0	0	0.00
Total	–	100.0	65	57	41	33	–

to 0.41). The difference for *mor* 'purple' probably reflects the adults' greater use of an alternative PURPLE term, namely *eflatun* 'lilac', which was used rarely by the children. We will reserve speculation over the difference in the *S* scores until the discussion.

In summary, the adult naming data suggest that the 12 major contenders for basic-color-term status are the Turkish tokens of the 11 universal categories plus *lacivert* 'dark blue'. *Lacivert* 'dark blue' is at least as strong a contender on the *S* index as three of the Turkish tokens of the 11 universal categories.

3.2.3. *Location of Turkish color terms in color space.* Figure 3 shows the location of each tile color that was named with consensus by the majority of the child sample (dominant at $D_{0.50}$) in the CIE uniform chromaticity diagram. The dominant names given to the tiles are indicated by the various symbols, and the loci of the 11 universal foci are also shown. (BLACK, WHITE, and GRAY have the same coordinates and

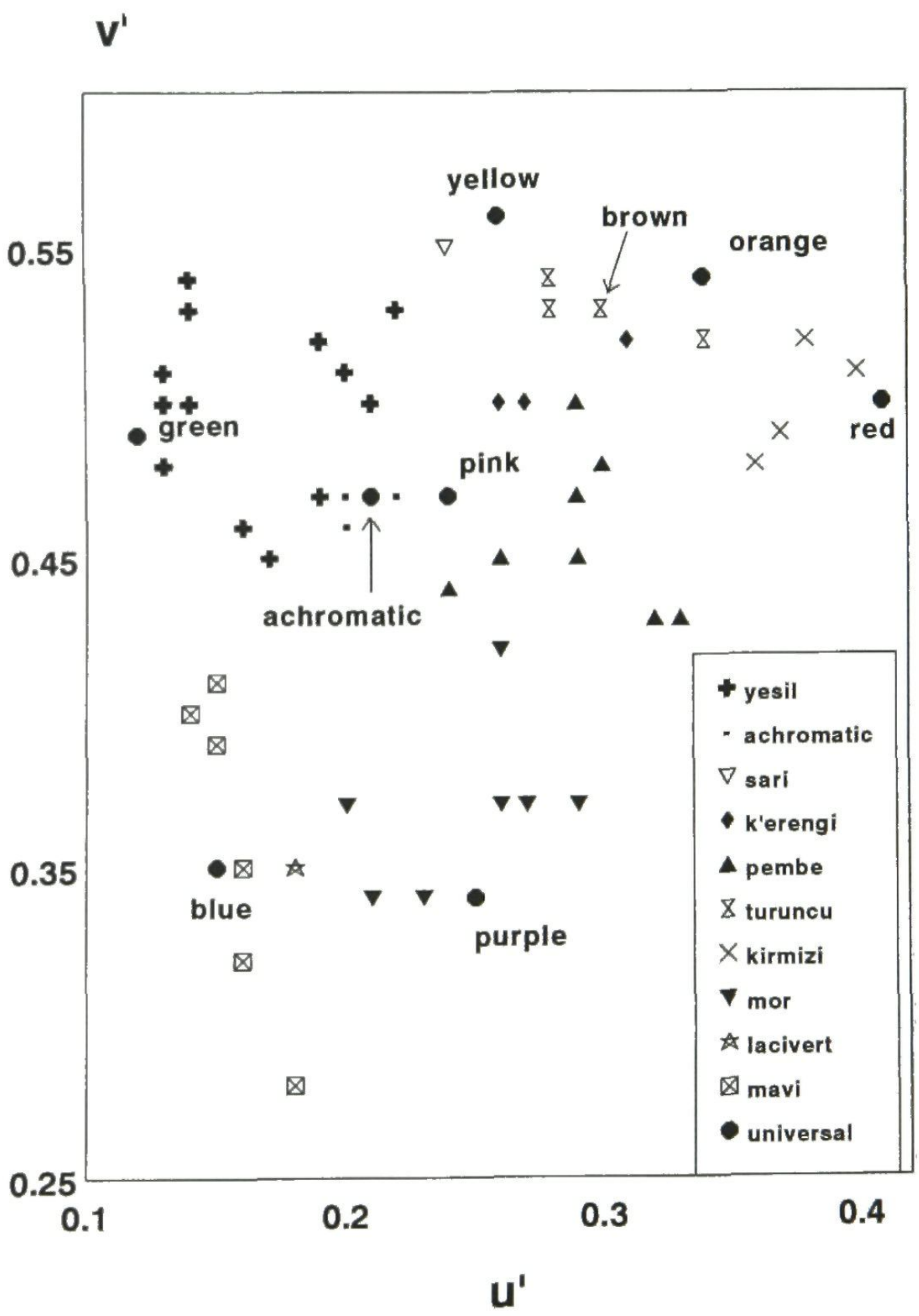

Figure 3. *Loci of Turkish basic color terms and the universal foci in CIE uniform chromaticity space (children)*

are shown as a single data point, but they differ on the third dimension — L* [lightness]; similarly, BROWN has the same coordinate as a tile for which *turuncu* 'orange' is dominant, but BROWN is much darker than the corresponding 'orange' tile.) It can be seen in most cases that the universal foci lie close to the regions of color space for which their Turkish tokens are dominant. The universal foci are often displaced centrifugally from the centers of their corresponding Turkish regions. This occurs because the foci tend to be the most saturated instances of a particular category, and saturation increases with distances from the center of the plot. Thus, for instance, the universal RED is adjacent to the *kirmizi* 'red' region, but it is displaced outward (high u'). Figure 4 shows the equivalent data for the adults. The pattern for adults and

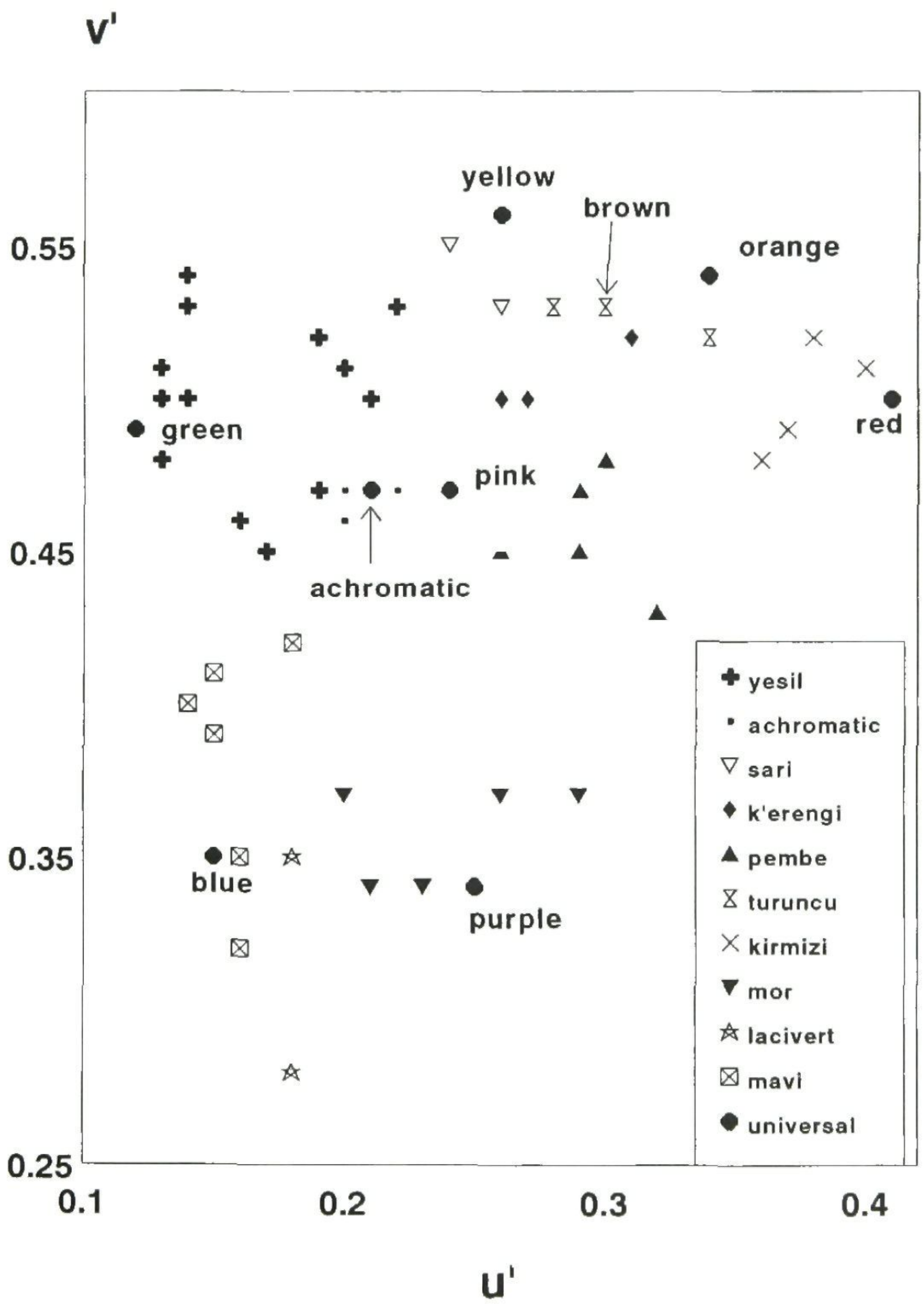

Figure 4. *Loci of Turkish basic color terms and the universal foci in CIE uniform chromaticity space (adults)*

children is very similar. There is some variation in how many tiles achieve dominance; for instance, there are more tiles with *pembe* 'pink' as the dominant term for the child sample than for the adult sample. However, the overall mapping of terms onto color space is broadly the same. The tile with the highest *lacivert* score (BV-HUE), lies between BLUE and PURPLE. In addition, this tile, and the other with *lacivert* as its dominant term for adults (BVB-HUE), have very low lightness scores (see Table 3).

4. Experiment 3

4.1. *Method*

4.1.1. *Subjects.* One hundred and twenty-four students from the University of Bogazici (109 women and 15 men) with ages ranging from 19 to 24 years participated in phase 3. They were all native Turkish speakers, but they all spoke English reasonably well.

4.1.2. *Procedure.* The students were tested during a class at the university. They were asked to write down as many kinds of *mavi* as they could think of. When they had finished they were asked to write down whether *lacivert* is a kind of *mavi*.

4.2. *Results*

The mean number of types of *mavi* offered by the students was 5.6. Seventy-one of the sample (57%) included *lacivert* in their lists of types of *mavi*. One hundred and six of the respondents (85.5%) indicated that they thought *lacivert* was a kind of *mavi*.

5. Discussion

The findings from the list task and the naming task converge to suggest that Turkish has 11 BCTs corresponding to Berlin and Kay's 11 universal terms. In addition, there is some support for *lacivert* 'dark blue' being a basic color term. In order to allow evaluation of these claims we summarize the results of the various measures of salience derived from the list and naming tasks in Table 8. The table summarizes the performance of the 15 strongest contenders for basic-color-term status. The rank orders for each term are shown separately for the child and adult sample for

Table 8. *Summary of Tables 1, 2, 5, and 7: rank order for the 15 most salient terms on the list tasks, frequency in naming, dominance, and specificity indices for the child and adult samples*

Term	Gloss	List task		Frequency in naming		$D_{0.50}$		Specificity index		Mean			
	see Tables:	(1, 2)		(6, 7)		(6, 7)		(6, 7)					
		child	adult	child	adult	child	adult	child	adult	child	rank	adult	rank
yesil	green	1	2	1	1	1	1	3	3	1.5	1	1.8	1
mavi	blue	2	3	3	2	2	2	4	4	2.8	2	2.8	2
sari	yellow	3	4	10	10	10	10	11	11	8.5	10	8.8	11
kirmizi	red	4	1	5	5	7	7	9	5	6.3	5	4.5	3
beyaz	white	5	5	12	13	12	13	10	1	9.8	11	8.0	8
siyah	black	6	6	7	8	8	8	6	8	6.8	6	7.5	7
pembe	pink	7	8	2	3	3	3	5	7	4.3	3	5.3	4
mor	purple	8	7	4	4	4	4	7	12	5.8	4	6.8	6
kahverengi	brown	9	9	9	9	9	9	2	6	7.3	8	8.3	9
turuncu	orange	10	11	6	7	5	6	8	10	7.3	8	8.5	10
lacivert	dark blue	11	12	11	12	11	11	12	9	11.3	12	11.0	12
kavunici	orange	12	24	13	15	13	14	13	14	12.8	13	16.8	15
gri	gray	13	10	8	6	6	5	1	2	7.0	7	5.8	5
bordo	claret	14	13	19	17	13	14	13	14	14.8	15	14.5	14
eflatun	lilac	15	14	14	11	13	12	13	13	13.8	14	12.5	13

the following indices: frequency in lists; frequency of naming, number of tiles dominant at $D_{0.50}$, and the *S* index (we include just one of the *nmf* and *D* measures as the pattern across terms is essentially the same for these indices). Note that the rank orders for each measure are with respect to all the terms that occurred in a particular task; they are not ranked with respect to just the 15 terms in the table. Thus for instance, *kavunici* 'orange' has a rank of 24 for the adult list task, because it had the twenty-fourth highest frequency in that task. It can be seen that *siyah* 'black' *beyaz* 'white', *kirmizi* 'red', *yesil* 'green', *sari* 'yellow' *mavi* 'blue', *kahverengi* 'brown', *mor* 'purple', *pembe* 'pink', *turuncu* 'orange', and *gri* 'gray' tend to occupy the 11 highest ranks on most measures for both samples. In addition, *lacivert* 'dark blue' has either rank 11 or 12 on most measures. There are some inconsistencies either across samples or across measures. First, *kavunici* 'orange' was offered relatively often in the child list task (rank 12) but was offered infrequently in the adult list task (rank 24). Second, *beyaz* 'white' has relatively high scores on the list task and on the *S* index, but lower scores on frequency of naming and on *D*. We argued earlier that the low scores on the latter two measures result from the nature of the stimulus set rather than indicating low salience. There was just one tile that could be called *beyaz*, and thus the naming and dominance scores were "capped" by this constraint. The maximum possible scores for all terms are affected by the distribution of colors in the stimulus set. Some such as *yesil* 'green' have a high maximum, while others such as *lacivert* 'dark blue' have a low maximum. Our stimulus set was approximately evenly distributed across color space, and thus these variations in the opportunity to use a color name reflect the uneven mapping of color terms onto color space.

Table 8 also shows the mean rank across the measures for each term for the child and the adult samples (columns 11 and 13) and the rank order of the mean ranks (columns 12 and 14). It can be seen again that this composite measure indicates that the Turkish tokens of Berlin and Kay's universal terms have the 11 highest scores. Further, *lacivert* 'dark blue' has the twelfth-highest score.

If it is taken as axiomatic that there can be just 11 BCTs, then we would have to say that *lacivert* 'dark blue' was not basic. However, if we allow the possibility that there could be more than 11 BCTs, then *lacivert* has some claim to basic status. As well as having relatively high salience, it scores higher than *turuncu* 'orange', *sari* 'yellow', and *mor* 'purple' on the *S* index — the measure most independent of the color sample — and there is some evidence that there is a focal *lacivert* around which the category could form. There are two tiles for the adults, and one tile for the children, that have *lacivert* as their dominant term. The case for *lacivert* being basic is stronger for the adults than for the children. This may reflect the late acquisition of *lacivert*, or it may mean that the status of *lacivert* is changing, and it is being relegated to secondary status. We are investigating this further by looking at younger children.

5.1. *Comparison of the blue regions of Russian and Turkish*

Russian also has two blue terms: *sinij* 'dark blue' and *goluboj* 'light blue' In the introduction we suggested that Kay and McDaniel's fuzzy set theory of color universals could easily accommodate "extra" color terms. In particular, two basic terms for blue could arise as either the intersection of BLUE with BLACK to give DARK BLUE, or as the intersection of WHITE with BLUE to give LIGHT BLUE. In terms of the CIE representation of color space, either intersection could be achieved by the new term occupying the space between the BLUE focus and either the BLACK or WHITE focus in the lightness dimension (L*). Table 9 shows the terms used for the BLUE region of color space by Russian and Turkish speakers. The BLUE region is defined as those tiles whose most frequent name was either *sinij* 'dark blue', or *goluboj* 'light blue', for the Russian sample, or *mavi* 'blue' or *lacivert* 'dark blue', for the Turkish sample (the Russian data is taken from Davies and Corbett 1994; the Russian sample did the

Table 9. *Comparison of Turkish and Russian blue region tile naming: Color-Aid codes of tiles that were named using one of the "blue" terms by Russian and Turkish respondents, the terms used, and the percentage of the sample that offered each term*

Color-Aid code		Russian		Turkish Children		Adults	
		term	%	term	%	term	%
BV	HUE	sinij	63	lacivert	56	lacivert	94
BV	S2	(seryj)-sinij	43	mavi	44	mavi	53
BVB	HUE	sinij	54	mavi	69	lacivert	67
B	HUE	sinij	63	mavi	100	mavi	100
B	T1	goluboj	61	mavi	100	mavi	100
BGB	HUE	sinij	70	mavi	100	mavi	100
BGB	T3	goluboj	72	mavi	100	mavi	100
BG	HUE	morskoj	39	mavi	56	mavi	58
BG	S2	morskoj	37	mavi	50	mavi	52
BG	T1	goluboj	48	mavi	100	mavi	97
GBG	S2	goluboj	39	mavi	88	mavi	97
Mean			53.55		78.45		83.45

tile-naming task on the same stimuli as reported here). It is evident that the level of consensus for the Turkish sample is much greater than for the Russian sample: the mean scores for Turkish are about 80%, whereas the mean score for Russian is about 50%. There are four tiles that are called *mavi* 'blue' by all of the child and the adult Turkish samples. In contrast, the highest score for the Russian sample is 72% (*goluboj* 'light blue' for BGB-T3). On the other hand *sinij* 'dark blue' and *goluboj* 'light blue' have stronger claims to basic status than *lacivert* 'dark blue'. *Sinij* 'dark blue' has the second-highest mean rank and *goluboj* 'light blue' has the seventh-highest mean rank across the various measures of salience for Russian color terms (Davies and Corbett 1994: 81, Table 6). In contrast, with the exception of the *S* index, *lacivert* ranks 11 or 12 on most measures among Turkish color terms.

It can be seen from Table 9 that while there is some overlap in the range of the two dark-blue terms (*lacivert* and *sinij*), the correspondence is partial. In particular, the tiles with the two highest scores in Russian for *sinij* (B-HUE and BGB-HUE) both have *mavi* 'blue' as their dominant term in Turkish. On the other hand, the tiles with the two highest scores for *lacivert* 'dark blue' in Turkish (BV-HUE and BVB-HUE) both have relatively high scores for *sinij* 'dark blue' in Russian. Figures 5 and 6 show the loci of these blue tiles in the CIE (v′, L*) plane for Russian and Turkish respectively. The graphs also show how various blue terms map onto color space. Perhaps the most interesting feature of these maps is that although the *sinij–goluboj* boundary and the *lacivert–mavi* boundary lie in different regions, the core difference between the terms in both languages lies on the L* dimension (lightness). In both cases, the dark-blue term occupies darker (lower L*) regions than the other blue term.

Figures 5 and 6 also show the locus of the universal BLUE. It can be seen that there is an interesting difference between the two languages in how BLUE maps onto the category structure. Focal BLUE is included in *sinij* 'dark blue' in Russian, whereas it is included in *mavi* 'blue' in Turkish. In the introduction we said that within Kay and McDaniel's (1978) theory of the origin of color categories, there were two possible routes for the development of a second blue term. First, BLUE and WHITE could develop a fuzzy set intersection, allowing some of the region between the two parent foci to "bud"; or BLACK and BLUE could intersect, allowing some of the region between their foci to bud. In either case the parent foci should be left unaffected. Within this framework, it appears that *goluboj* 'light blue' is the breakaway term in Russian, whereas *lacivert* 'dark blue' is the breakaway term in Turkish. We say this because, first, as BLUE is left in *sinij* and *mavi*, these must have been the core of the original primary categories; and second, because

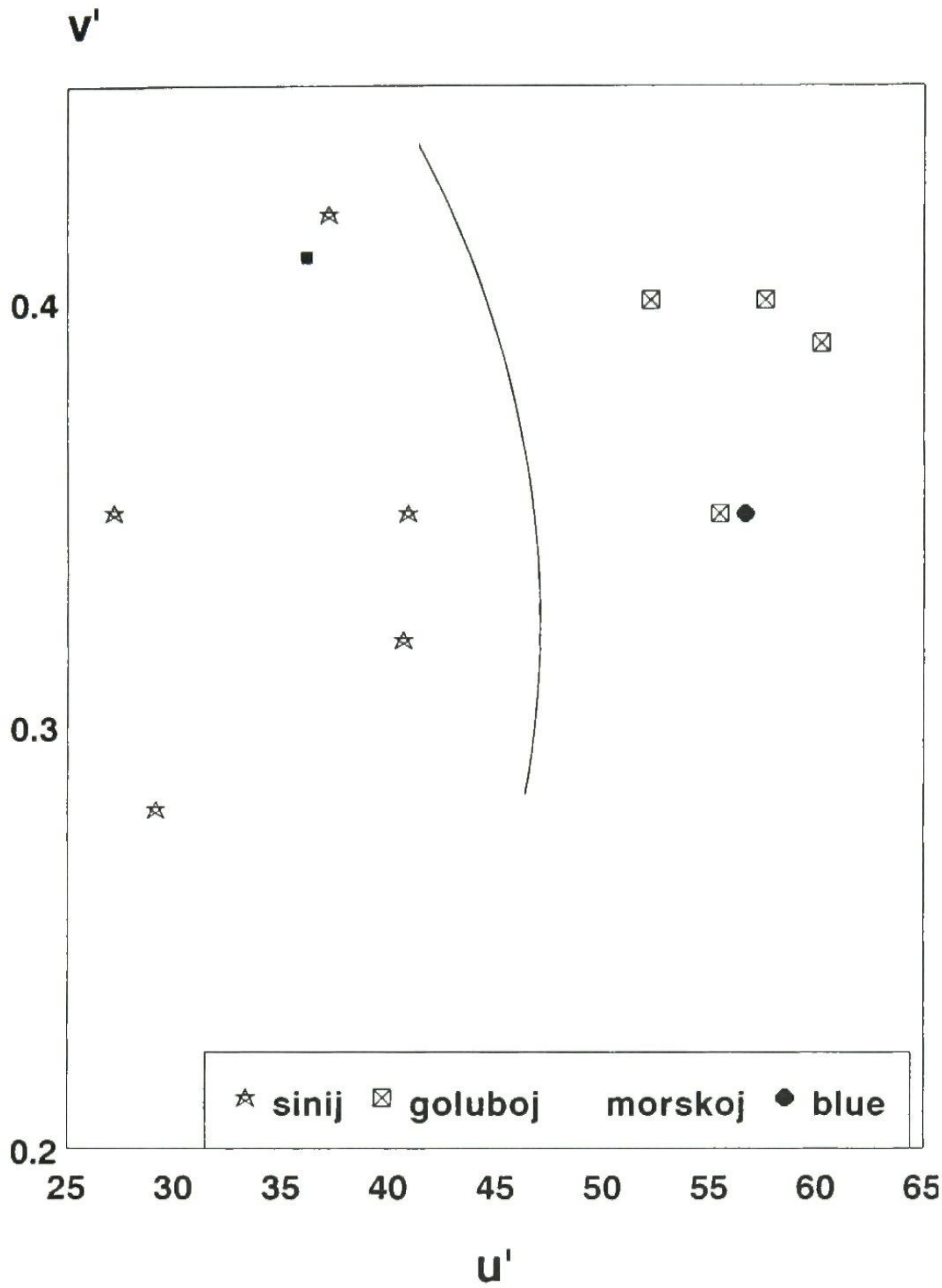

Figure 5. *Loci of Russian blue terms and the universal foci in CIE uniform chromaticity space*

goluboj is lighter than *sinij* (it has "captured" space between BLUE and WHITE), whereas *lacivert* is darker than *mavi* (it has captured space between BLUE and BLACK).

So far we have argued that *lacivert* deserves consideration as a basic color term, but we have ignored the findings from phase 3. There, almost three-fifths of students gave *lacivert* as an example of a kind of *mavi*. Further, when they were asked explicitly whether *lacivert* was a kind of *mavi*, over four-fifths of them agreed that it was. On the latter measures at least, it appears that *lacivert* is included in *mavi*, and this excludes *lacivert* from being a basic color term according to Berlin and Kay's original criteria. Maffi (1990) reviews post-1969 modifications to the criteria for basicness and concludes that the two key criteria are generality of reference and noninclusion.[9] Normally, measures of basicness converge: basic terms tend to be simple, salient, and not included in the

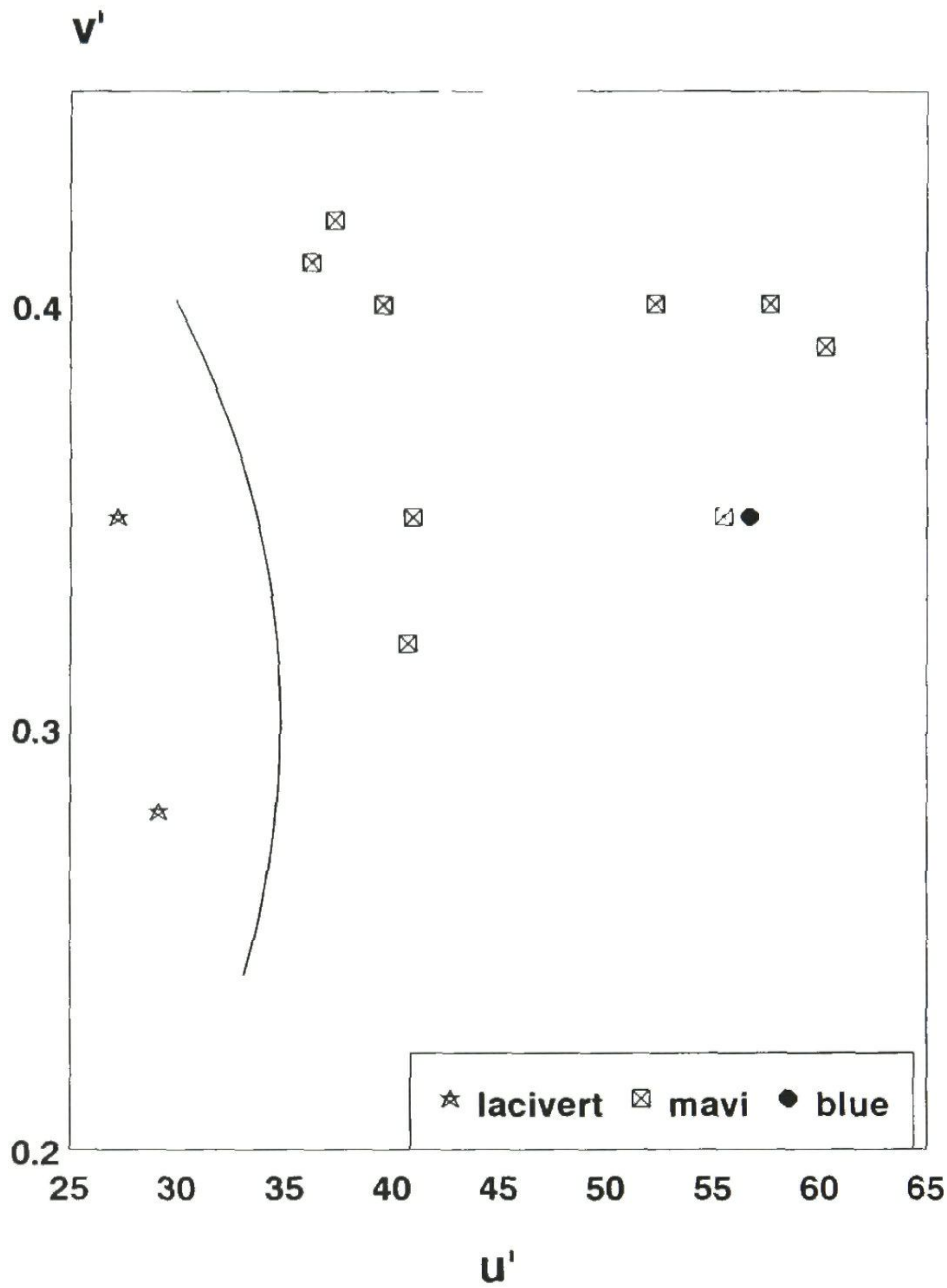

Figure 6. *Loci of Turkish blue terms and the universal foci in CIE uniform chromaticity space*

referential range of another term. However, *lacivert* appears to be at the boundary between basic and secondary terms. The marginal status of some of the measures may reflect a transition in the status of the term, but if so, it is unclear from our data what direction the transition is taking. The claim to basic status was weaker for the child data than for the adult data. However, the implication of this is not clear, as we have said: it could mean that *lacivert* is becoming a secondary term, or, that as a late derived term, it is not mastered until relatively late. We need to test less coarse age samples to try to unravel these possibilities.

We said in the Introduction that MacLaury (1997) disagrees with our claim that Russian has two basic terms for blue. He believes that *goluboj* is included in *sinij*, thus excluding it from being a BCT. If this is so, then the relationship may be like the *lacivert–mavi* relationship. MacLaury (1997) reports data suggesting a continuum of relationships between independence and inclusion. And it may be that the *lacivert–mavi* relationship fits his interpretation. However, it may also be that the way that category relations present is very sensitive to the measurement procedure. We asked our Turkish-speaking informants if "*lacivert* was a kind of *mavi*." Subsequently we ask English-speakers if "*pink* was a kind of *red*." Virtually all respondents said that it was. Under most measurement procedures *pink* is a BCT, and it is not included in *red*. The import of this example is that we may have distorted the relationship between the two Turkish blues by the form of the question we asked. We plan to take other measures of the relationship between the two Turkish blues, and we also intend doing so on the two blues of Russian. Whatever the relationship between the two pairs of blue terms turns out to be, it is clear that the terms in both languages have levels of salience and consensus comparable with BCTs. The significance of their formal relationship (inclusion or independence) is relative to theories of category development: it may be crucial or it may be trivial. We look forward to finding out.

6. Addendum: color and linguistic relativity

There are substantial variations across languages in how color is categorized. However, the evidence for corresponding differences in color cognition is relatively weak. Thus despite initial acceptance of the linguistic-relativity hypothesis (LRH) in the domain of color, current support for it is sparse (see Brown 1976). Heider's (1972) work on the Dani of New Guinea (together with Berlin and Kay 1969) is largely responsible for the demise of the LRH. In a series of important papers she reports that despite having just two BCTs, the Dani's performance on a range of color memory and learning tasks mirrored that of Americans, with 11 BCTs (but see Lucy 1992; Saunders and van Brakel 1997).[10] However, along with Lucy, we believe that it is still important to test the LRH. The magnitude of any linguistic effect is likely to be small in the color domain, but of considerable theoretical importance. We (Davies and Corbett 1997; Davies et al. 1998) have found evidence for such small-scale effects comparing an African language (Setswana) with English. Similarly, Kay and Kempton (1984) found equivalent effects comparing American-English speakers to Tarahumara speakers from Mexico.

In what follows, because of space limitations, we summarize three experiments comparing Turkish-speakers with English-speakers that looked for cognitive consequences of Turkish having two BCTs for BLUE.[11] If we find differences related to the language differences, this would be important, as apart from the BLUE region, the two color languages are very similar. Evidence for linguistic effects on color cognition has hitherto been based on comparisons of languages with much larger differences, as referred to above.

6.1. *The experiments*

We carried out three experiments comparing Turkish-speaking adults with English-speaking adults: a grouping task; a similarity judgments task; and a same–different judgment task. The sample sizes were at least 34, 16, and 8 for the three tasks respectively. All differences we report were statistically significant.

In the grouping task, informants were asked to sort the 65 stimuli used in the naming task into groups on the basis of their apparent similarity. We were particularly interested in whether Turkish speakers would be more likely than English speakers to form separate dark-blue and light-blue groups corresponding to *lacivert* and *mavi*. The results showed that English-speakers were more likely than Turkish-speakers to put dark-blue and light-blue tiles in the same group.

In the similarity-judgments task, informants were asked to rate the similarity of each possible pair of 12 blue tiles. Half of the tiles were exemplars of *mavi* 'blue' and the other half were exemplars of *lacivert* 'dark blue' We compared the mean similarity of the *lacivert* pairs, the *mavi* pairs, and the cross-category *lacivert–mavi* pairs. Turkish speakers rated the cross-category pairs as less similar than did the English speakers, while there were no differences between the intracategory scores.

In the same–different task informants were asked to judge whether two successively presented blue colors were physically identical or not. The task was difficult because the stimulus pairs were often very similar; the stimuli were presented only briefly (50 ms); and there was a five-second interstimulus interval. We were particularly interested in whether there would be a cross-category (*lacivert–mavi*) advantage in accuracy for the Turkish speakers. We found no significant differences between the two language groups.

6.2. *Discussion*

Two out of the three tasks showed cognitive-behavioral differences that parallel linguistic differences. Perhaps the least interesting interpretation of these data is that informants used a direct language-based strategy:

they grouped stimuli on the basis of shared labels, or they judged stimuli to be similar (or dissimilar) on the basis of shared labels (or nonshared labels). On the other hand, the results could reflect linguistic influences on perception: learning to use *lacivert* and *mavi* influences perceptual-similarity space. The fact that we found no differences in the same–different task (probably the task least likely to invite a language-based strategy) weakens the perceptual interpretation, but it does not rule it out. What is needed is to investigate the relationship between language and color cognition using a wide range of tasks so that the pattern of results across tasks will allow us to establish the locus of any linguistic effects within the cognitive system.

7. Summary

On balance, the safest conclusion is that Turkish has 11 BCTs. These 11 terms are the Turkish tokens of Berlin and Kay's 11 universal terms. The status of *lacivert* 'dark blue' is equivocal. On the one hand there seems to be a small region of color space that evokes the label *lacivert* for the majority of our adult sample. This is consistent with there being a dark-blue category defined by its focus. On the other hand, the evidence for this claim is weaker among children. In addition, the student sample in experiment 3 showed that they thought of *lacivert* 'dark blue' as being included in *mavi* 'blue' There appears to be a partial dissociation between naming real colors and thinking about the terms in the abstract. Whatever the status of *lacivert* 'dark blue', its referential range is not identical to *sinij*, the dark-blue term of Russian. There is the intriguing possibility that we may be witnessing the formation of a twelfth basic color term by the intersection of BLUE–BLACK, in contrast to the second blue term of Russian, *goluboj* 'light blue', which, within Kay & McDaniel's theory, seems to be the intersection of BLUE–WHITE. We are continuing to investigate the status of *lacivert* using other samples of Turkish speakers and a range of additional tasks. Even so, though the difference between English and Turkish might not warrant quite saying that Turkish has an extra term for blue, the difference may still be strong enough to produce nonlinguistic cognitive effects, consistent with the LRH.

Received 17 June 1997
Revised version received
18 May 1998

University of Surrey

Appendix. The CIE system

There are several CIE color spaces. Here we briefly describe two: the CIE (Y, x, y) space, and the CIE uniform chromaticity space. The former is useful because there are published tables of Munsell and OSA colors that give their (Y, x, y) coordinates (e.g. Newhall et al. 1943 on Munsell). Colors with the same CIE coordinates will appear the same, whether from Munsell, OSA, Color-Aid, or any other system. Thus this allows "translation" between different systems: colors from one system with similar (Y, x, y) coordinates will be perceived as similar colors. Most commercial colorimeters measure color in these CIE coordinates. However, the CIE uniform chromaticity space is more useful psychologically. It represents colors in a readily interpretable spatial format that maps onto the phenomenology of color space more closely than CIE (Y, x, y). The basic structure of both spaces is similar to Newton's classic color circle.

Within the CIE system the total color is made up from red, green, and blue components, and the proportions of these three must sum to one. The CIE chromaticity coordinates can thus be thought of as the proportions of red (x) and green (y) in each color; a third coordinate, lightness (Y), makes up the CIE tristimulus values. By implication, the proportion of blue light (z) is given by $1-(x+y)$. Stimuli with the same coordinates will look the same. The main drawback of the CIE (Y, x, y) space is that it is not a perceptually equal space; that is, equal distances in the space do not correspond to equal perceptual distances. The CIE (L^*, u', v') system represents colors in a transformed space that is approximately perceptually equal. In this uniform chromaticity space u' is a transformation of x, and v' is a transformation of y. For instance, in Figure 2, the universal blue has coordinates of ($u'=1.8$, $v'=0.19$). The proportion of blue is thus $1-(0.18+0.19)=0.63$. Thus, as would be expected, the universal blue has a high proportion of blue in it, and blue colors are to be found toward the origin of the graph (low u' [red] and v' [green]). On the other hand, red colors have high proportions of red in them (u') and are to be found toward the right of the space. The positions of the eight chromatic universal foci in Figure 2 can be used to interpret the remaining regions of the CIE chromaticity diagram.

Notes

This work was supported by the Economic and Social Science Research Council (grant number R000236750) and we are grateful for their support. We are also grateful to two anonymous reviewers. One suggested that we set the findings in the general context of the effect of language on cognition and we therefore added the final Addendum (section 6) and broadened the Introduction. The other suggested that we consider the form of the relationship between the two blue terms more fully, and we have done so in the discussion. Correspondence address: Ian Davies, Department of Psychology, University of Surrey, Guildford, Surrey, GU2 5QH, UK. E-mail: i.davies@surrey.ac.uk.

1. See MacLaury (1991a, 1991b, 1992) for examples of exceptions to the theory and an interesting account of the development of color categories. MacLaury remains broadly sympathetic to the Berlin and Kay theory. See Saunders and van Brakel (1997) for a less sympathetic review.
2. The concept of basic color terms has received considerable criticism (see Crawford 1982; Lucy 1992; Moss 1989; Ratner 1989; and Saunders and van Brakel 1997, among others). However, the major force of the criticism is that the definition of basic color terms, by excluding color terms associated with the names of objects, tends to place many languages at an early stage of evolution (early in the hierarchy). For our present concerns, we shall see that Turkish, in Berlin and Kay's framework, is at a late stage of development and may have 12 basic color terms even on the strict original definition of basicness. We therefore accept the original definition as a useful framework.
3. Kay et al. (1991) report that post-1969 field studies have found several exceptions to the synchronic order specified by the hierarchy. The most common exceptions were BROWN, GRAY, and PURPLE occurring too early. Kay et al. accommodate these exceptions in their revised theory by according the three terms "wildcard" status. The terms remain in the set of 11 universal color categories, but their order of appearance now falls outside the domain of the theory. However, as Turkish almost certainly includes tokens of the 11 universal color categories, the status of these wildcard terms is not germane to the present study.
4. Zollinger (1984) pointed out that there was ample room in color space between focal BLUE and GREEN for the development of a derived term. He further conjectured that *turkis* 'turquoise' in German and *turquoise* in English would both become basic.
5. Bolton et al. (1980: 317) report that, in Nepali, *akāshi* 'sky light blue' was "the most commonly elicited secondary term." Similarly, 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). Further, European Spanish, and other Romance languages, such as Italian and Catalan, have at least two terms for blue that are close to being basic (Kristol 1978: 250–263, 1979, 1980; Davies et al. 1995; and Vincent 1983).
6. The key term we are interested in — *lacivert* 'dark blue' — is the name of a stone found in the region. But most Turks are unaware of this connection (including Özgen), and although the stone color may be the origin of the term, it is now used as an abstract term to cover any dark-blue color. Most of Turkish originates from either Arabic or Persian. *Lacivert* seems to have been borrowed from Persian. However, in modern Persian, *lacivert* appears to mean 'azure' or 'sky blue'.
7. Color-Aid supply a set of several hundred colors. Their system is based on the Ostwald color solid (see Foss et al. 1944). There are 24 hues made up from six cardinal hues: Y (yellow), O (orange), R (red), V (violet), B (blue), and G (green) and intermediate hues such as OYO (orange yellow orange). Each hue has seven variants, four tints (T1-T4), and three shades (S1-S3). For instance, Y-T1 has the hue yellow but is lighter than Y-HUE. For tints, the higher the index number, the lighter the color. Shades are created by "adding black" to the hue. Thus Y-S1 will be darker than Y-HUE. The full set of CIE (Commission L'Eclairage International) tristimulus values is published in Moss et al. (1990). These CIE coordinates allow "translation" from Color-Aid to more well known systems such as Munsell or OSA (Optical Society of America); see, for instance, Foss et al. (1944).
8. One child and one adult (both males) were found to have deuteranopia (a red–green anomaly), and they are not included in the data we report here.

9. Roberson (1997) reports an interesting case where inclusion depends on the context. In Berinemo (spoken in Papua New Guinea) the red region and the blue–green–purple region are named by independent terms (*mehi* 'red' and *nol* 'blue-green') when assessed with Munsell color chips. However, the blood from an open wound is called *nol* rather than *mehi*. *Nol* means 'live' as well as denoting color, and it is this former aspect of its sematic field that is being deployed when confronted with fresh blood.
10. We (Davidoff, Davies, and Corbett) are currently attempting to replicate and extend Rosch–Heider's studies in Papua-New Guinea (PNG). Our researcher (Debbi Roberson) has so far spent about nine months in PNG, and her results appear first to support Rosch–Heider, but with some interesting differences.
11. These results were presented at the European Conference on Visual Perception (Özgen and Davies 1997); we will report them more fully elsewhere.

References

Berlin, Brent; and Kay, Paul (1969). *Basic Color Terms: Their Universality and Evolution.* Berkeley and Los Angeles: University of California Press. (Reprinted [1991], with additional bibliography of color categorization research 1970–1990 by Luisa Maffi.)

Bolton, Ralph (1978). Black, white, and red all over: the riddle of color term salience. *Ethnology* 17, 287–311.

—; Curtis, Anne; and Thomas, Lynne L. (1980). Nepali color terms: salience on a listing task. *Journal of the Steward Anthropological Society* 12, 309–322.

Brown, Roger (1976). In memorial tribute to Eric Lenneberge. *Cognition* 4, 125–153.

Corbett, Greville G.; and Davies, Ian R. L. (1995). Linguistic and behavioural measures for ranking basic color terms. *Studies in Language* 19(2), 301–357.

—; and Morgan, Gerry (1988). Color terms in Russian: reflections of typological constraints in a single language. *Journal of Linguistics* 24, 31–64.

Crawford, T. D. (1982). Defining "basic color term." *Anthropological Linguistics* 24, 338–343.

Davies, Ian R. L.; Bayo Margalef, José; and Corbett, Greville G. (1995). Color terms in Catalan: an investigation of eighty informants concentrating on the purple and blue regions. *Transactions of the Philological Society* 93(1), 17–49.

—; and Corbett, Greville G. (1994). The basic color terms of Russian. *Linguistics* 32, 63–89.

—; and Corbett, Greville G. (1995). A practical field method for identifying possible basic color terms. *Languages of the World* 9(1), 25–36.

—; and Corbett, Greville G. (1997). A cross-cultural study of color grouping: evidence for weak linguistic relativity. *British Journal of Psychology* 88, 493–517.

—; Corbett, Greville G.; McGurk, Harry; and MacDermid, Catriona (1998). A developmental study of the acquisition of Russian color terms. *Journal of Child Language* 25.

—; Sowden, Paul T.; Jerrett, David T.; Jerrett, Tiny; and Corbett, Greville G. (1998). A cross-cultural study of English and Setswana speakers on a color triads task: a test of the Sapir–Whorf hypothesis. *British Journal of Psychology* 89.

Fletcher, Robert (1980). *The City University Color Vision Test*, 2nd ed. London: Keeler.

Foss, Carl E.; Nickerson, Dorothy; and Granville, Walter C. (1944). Analysis of the Ostwald Color System. *Journal of the Optical Society of America* 34(7), 361–381.

Gleason, Henry A. (1961). *An Introduction to Descriptive Linguistics.* New York: Holt, Rinehart and Winston.

Hardin, Clyde Larry; and Maffi, Luisa (1997). Editors' Introduction. In *Color Categories in Thought and Language*, 1–18. Cambridge: Cambridge University Press.

Harkness, Sara (1973). Universal aspects of naming color codes: a study in two cultures. *Ethos* 1, 175–200.

Heider, Eleanor Rosch (1971). "Focal" color areas and the development of color names. *Developmental Psychology* 4, 447–455.

(1972). Universals in color naming and memory. *Journal of Experimental Psychology* 93, 10–20.

Hering, Edvard (1964 [1920]). *Outlines of a Theory of the Light Sense*, Leo Hurvich and Dorothea Jameson (trans.). Cambridge, MA: Harvard University Press.

Iz, Fahir; Hony, H. C.; and Alderson, A. D. (1992). *The Oxford Turkish Dictionary*. New York: Oxford University Press.

Jameson, Dorothea (1985). Opponent-colors theory in the light of physiological findings. In *Central and Peripheral Mechanisms of Color Vision*, D. Ottosson and Semir Zeki (eds.). London: Macmillan.

Kay, Paul; Berlin, Brent; and Merrifield, William (1991). Biocultural implications of systems of color naming. *Journal of Linguistic Anthropology* 1(1), 12–25.

—; and Kempton, Willard (1984). What is the Sapir–Whorf hypothesis? *American Anthropologist* 86, 65–79.

—; and McDaniel, Chad K. (1978). The linguistic significance of the meanings of basic color terms. *Language* 54, 610–646.

Kristol, Andres M. (1978). *COLOR. Les langues romanes devant le phénomène de la couleur*. Romanica Helvetica 88. Berne: Francke.

—(1979). Il colore azzurro nei dialetti italiani. *Vox Romanica* 38, 85–99.

—(1980). Color systems in southern Italy. A case of regression. *Language* 56, 137–145.

Lucy, John A. (1992). *Language Diversity and Thought: A Reformulation of the Linguistic Relativity Hypothesis*. Cambridge: Cambridge University Press.

MacLaury, Robert E. (1991a). Social and cognitive motivations of change: measuring variability in color semantics. *Language* 67, 34–62.

—(1991b). Exotic color categories: linguistic relativity to what extent. *Journal of Linguistic Relativity* 1, 26–51.

—(1992). From brightness to hue: an explanatory model of color-category evolution. *Current Anthropology* 33, 137–186.

—(1997). *Color and Cognition in Meso America. Constructing Categories as Vantages*. Austin: University of Texas Press.

Maffi, Luisa (1990). Cognitive anthropology and human categorisation research: the case of color. Unpublished field statement.

Morgan, Gerry; and Corbett, Greville G. (1989). Russian color term salience. *Russian Linguistics* 13, 125–141.

Moss, Anthony E. St. G. (1988). Russian blues and purples: a tentative hypothesis. *Quinquereme* 11, 164–177.

—(1989). Basic color terms: problems and hypotheses. *Lingua* 82, 313–320.

—; Davies, Ian R. L.; Corbett, Greville G.; and Laws, Glynis (1990). Mapping Russian basic color terms using behavioural measures. *Lingua* 82, 313–332.

Özgen, E.; and Davies, I. R. L. (1997). Do linguistic categories affect color perception? A comparison of English and Turkish perception of blue. *Perception* 26, 129.

Newhall, Sidney M.; Nickerson, Dorothy; and Judd, Deane B. (1943). Final report of the OSA Subcommittee on the spacing of the Munsell colors. *Journal of the Optical Society of America* 33(7), 385–418.

Ratner, Carl (1989). A sociohistorical critique of naturalistic theories of color perception. *Journal of Mind and Behaviour* 10, 361–372.

Roberson, Deborah (1997). Rosch revisited: a cross-cultural study of colour categorisation. Paper presented at The Colour Group of Great Britain meeting, London, March.

Rosch, Eleanor (1973). Natural categories. *Cognitive Psychology* 4(3), 328–350.

Saunders, Barbara. A. C.; and van Brakel, Jaap (1997). Are there nontrivial constraints on colour categorisation? *Behavioral and Brain Sciences* 20, 167–228.

Vincent, J. M. (1983). Categorizzazione e strategie di denominazione dei colori: aspetti metodologici e problemi relativi all'inglese e all'italiano. In *Linguistica e antropologia, Atti del XIV Congresso Internazionale della SLI, Roma*, Gruppo di Lecce (ed.), 161–171.

Whorf, Benjamin L. (1956). *Language, Thought and Reality*. Cambridge, MA: MIT Press.

Zollinger, Heinrich (1984). Why just turquoise? Remarks on the evolution of colour terms. *Psychological Research* 46(4), 403–409.