Color terms in Setswana: a linguistic and perceptual approach¹

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Abstract

A field study of the color lexicon of Setswana, a Bantu language spoken in Botswana in Southern Africa, was designed to establish what the "basic" terms of Setswana are, in order to further test Berlin and Kay's (1969) theory of color universals. Our informants were monolingual rural adults, tested in their villages. The study was in two stages; in stage one we elicited color terms using a list procedure and tried to establish their range and focus in color space. The 11 most frequently offered terms that also had unrestricted range of reference (for example, excluding terms only used to describe cattle) were used in the second stage, a color-mapping procedure. A combination of perceptual and linguistic measures converged to suggest that Setswana probably has six basic terms, which may be glossed as 'white', 'black', 'red', 'grue' (blue and green), 'brown', and 'yellow'. In addition, there is a rich vocabulary of restricted terms that mainly describe cattle. The basic terms established are consistent with the Berlin and Kay hierarchy, except that there is no suggestion of separate blue and green terms, even though 'brown' is definitely present.

1. Introduction

Before Berlin and Kay's (1969) influential monograph, the diversity of color terminology across languages was taken as *prima facie* evidence for the constructive nature of perception, and of cultural relativism. After Berlin and Kay, the variations in color lexicons were seen as products of different stages of a universal evolutionary path determined by a common physiology (Ratner 1989). Berlin and Kay seemed to have shown that underlying the diversity of color lexicons, there was a simple constraining structure, which also made sense in terms of the known neurophysiology of color vision (Kay and McDaniel 1978). The underlying structure that

they posited was organized hierarchically and specified which particular color terms should be present in a language with a given number of basic terms. The hierarchy is shown below. A language with two terms would have the terms black and white (dark and light); a language with three terms would have black, white, and red. A language with four terms would have white, black, red, and either yellow or green, and a language with five terms would have the first five terms in the hierarchy, white, black, red, yellow, and green, and so on. The hierarchy imposes the important constraint that no language should exist that has a given term without also possessing all those terms to its left in the hierarchy.

The theory that Berlin and Kay offered was based on two insights. The first of these was that although most languages possess a large number (perhaps hundreds) of color terms, there were relatively few terms, the basic terms, that were the most important. Berlin and Kay proposed four main criteria of basicness. These were that the meaning of a color term should not be predictable from that of its parts; that its signification should not fall within that of another color term; that its use must not be restricted to a small class of objects; and that it must be psychologically salient. Thus the concept of basicness includes linguistic and psychological factors. Berlin and Kay's second insight was that, although there was considerable variation across languages in the boundaries in color space that terms referred to, there was marked agreement over the foci or best examples of color terms.

New evidence subsequently led Kay (1975) to modify the hierarchy. The essential changes from Berlin and Kay (1969) are that the composite category "grue" (green and blue) was substituted for green, and gray was given a "wild card" status; that is, the theory no longer specified where in the hierarchy it would appear. Kay and McDaniel (1978) further developed the theory by trying to explain the order of the appearance of the categories in terms of the neurophysiology of color vision and fuzzy set theory. However, with the proviso that the range of the categories in the hierarchies might be broader than indicated by the English range of reference, the 1975 and 1978 versions of the hierarchy are equivalent for our purposes. The Kay (1975) version is shown below. We will take this hierarchy as the most current derivative of the original Berlin and Kay proposal. Henceforth we will refer to it as "the hierarchy."

white			grue		green		purple
	<	red	<		&	<	pink
black			yellow		blue		orange
							gray

Berlin and Kay's theory has been criticized on two main grounds, one conceptual and one empirical. The conceptual criticism has been focused on the concept of basicness (for example Crawford 1982), and the empirical criticism has focused on the small samples of speakers of many of the languages studied, and the fact that the majority of the informants were bilingual and resident in the San Francisco bay area. The work we report here is mostly concerned with the empirical basis of the Berlin and Kay hypothesis, and we hold back on any reservations about the concept of basicness that we might have.

Collier et al. (1976) reported that there were just seven post-1969 studies of monolinguals in their own culture that Kay knew of, but all supported the Berlin and Kay position. Although there have been more such studies since then, for example, Senft (1987), there remains a need to broaden the empirical base with careful field studies using standardized procedures on as wide a range of languages as possible. The work reported here is part of a field study of color language and color behavior of the people of Botswana in Southern Africa; we endeavor to describe the color vocabulary of their language, Setswana, to establish how many basic color terms it has and where they lie in color space.

As well as just broadening the empirical base, a particular benefit of studying Setswana is that there is some suggestion that it might, along with other African languages, be an exception to the hierarchy. A preliminary pilot study, supported by Cole (1955), suggested that the language appears to have terms for 'brown' and for 'purple', but no separate single term for blue (that is, blue and green are described by a single term). If brown and purple were basic terms, this would mean that Setswana was an exception to the Berlin and Kay theory. Similarly Tornay (1973: 83-84) considers Nyangatom (Sudan and Ethiopia: Nilotic), Dasenech (Ethiopia and Kenya: Cushitic), and Kalenjin (Kenya: Nilotic), each of which appears to have no separate term for blue but does have basic terms lower on the hierarchy.

As we shall see, Setswana has a highly developed color vocabulary specifically for describing cattle. And within the color terms for describing cattle there is a special form for female cattle. This was remarked on by David Livingstone in his description of Sechuana (Setswana) printed for private circulation among the members of his Zambesi Expedition (1858:

18): "... with respect to all domestic animals, when the colours are mentioned, the females are invariably put in the diminutive form. ..." When discussing basicness, it is important to try to establish which terms are restricted to cattle and which can be used of other objects.

The data we report were collected in two stages. In the first stage we attempted to elicit all those terms that might have the status of basic terms. And in the second stage we endeavored to map out the range and focus of each term in color space. We then attempted to establish the basic color terms of Setswana by combining a variety of linguistic and behavioral measures.

2. Method

Stage 1: Term elicitation and identification

Subjects. The sample was drawn from the Bangwaketse tribe living in the bush around Kanye, SE Botswana. The subjects were 44 adults, 22 men and 22 women aged 26–82. They all spoke Setswana as their first language and knew only a few words of English or Afrikaans.

Materials. 65 color samples were selected from the Color Aid Corporation's range of 219 colors based on the Ostwald Colour Solid (Foss et al. 1944). Three-dimensional color space was systematically sampled by reference to the CIE coordinates of the colors (see Appendix 1). The 65 color stimuli were each mounted on 5 cm × 5 cm × 0.4 cm wooden tiles and varnished to protect the paper from dust. CIE measurements of the varnished tiles did not differ significantly from those of the unvarnished paper, which are listed in Appendix 1.

Instructions. The instructions were translated into Setswana by a bilingual native speaker (the experimenter) and backtranslated by a bilingual native English speaker. The instructions then underwent modifications until the backtranslation was acceptable.

Procedure. Each subject performed four tasks (term elicitation, color classification, tile naming, and a color-vision test) in the order indicated. All instructions were given in Setswana. Subjects were tested individually in natural daylight, out of the full sun. Before testing began, subjects were put at their ease by the experimenter. Experimenters wore only black, white, or gray clothing during testing.

Task 1: Term elicitation. The final backtranslation of the instructions was "I am interested in the names people use for colors. Please tell me as many color names as you can — OK?"

For Task 1, the experimenter tape-recorded the subject's responses and noted on a response sheet all color terms used.

Task 2: Color classification. The color-classification task (a nonverbal color-sorting task) is not described here as it was not intended as part of the procedure for establishing possible basic terms.

Task 3: Tile naming. The final backtranslation of the instructions was "Now I want you to pick out and hand to me any of these colors that you can give a name to. Please tell me the name you use for each color you pick out — OK?"

For Task 3, the 65 colored tiles were displayed randomly on a board covered with gray cloth, and subjects picked as many tiles as they wished to name. The term given for each tile was noted on the response sheet beside the tile code.

Task 4: City University Colour Vision Test. This test was chosen for three reasons: (a) it does not require literacy to respond to it; (b) it tests for red-green deficiencies (protanopia and deuteranopia) and the blue-yellow deficiency (tritanopia), whereas the Ishihara test, the most common test for color blindness, does not test for tritanopia; (c) it is very quick to administer, although not as stringent as the Ishihara. Subjects have to judge which of four colored spots is most similar to the spot in the center of the page on each of ten plates (Fletcher 1980).

The final backtranslation of the instructions was "Here are four colored spots surrounding one in the middle. Please tell me which of the four spots looks most like the one in the middle; the one at the top, bottom, right, or left. Please do not touch the page." Responses in this test were also noted on the response sheet.

Stage 2: Term mapping

Subjects. A second sample of 40 subjects from the population described above participated in stage 2; none of them had participated in stage 1.

Materials. The 65 colored tiles and gray board used in stage 1 were also used in stage 2.

Selection of terms. Those terms that appeared to be the most likely contenders for the basic terms of Setswana on the basis of performance in stage 1 were selected for use in stage 2. The terms were selected on the basis of two criteria: (a) the frequency of production in name elicitation (at least six subjects producing the term); (b) the frequency of use in tile naming (at least nine occurrences). Only terms passing both criteria were included. This yielded 11 terms: *bontsho* 'black', *bosweu* 'white', *bosettha* 'yellow', *bohhibidu* 'red', *botala* 'grue', *borokwa* 'brown', *botuba* 'dun, fawn', *selaole* 'purple', *mathubapula* 'sand', *sethunya* 'yellow blossom', and *howebu* 'gray roan'.

Procedure. Testing conditions were as for stage 1. The 65 stimuli were randomly arranged on a gray board in front of the subject, and they were asked in Setswana, "Which of these tiles is 'X'?" The tiles the subject selected were then arranged before them and the subject was asked, "Which tile in particular represents 'X'?"

The selected tiles were noted on a response form and the best exemplar indicated. If the subject indicated more than one tile as the best examples, they were asked to select one of these as the best example. The tiles were then returned to the set of 65 tiles and the procedure was repeated using a different randomly chosen color term, until all 11 color terms had been tested.

3. Results

City University color-blindness test

Three subjects were excluded because of their performance on the test; two showed marked red-green anomaly, and one appeared not to understand the instructions. In addition, 13 of the remainder made one or two out of a possible ten tritanopic errors; that is, an error associated with yellow-blue weakness. These subjects were retained in the sample.

Term variations

In both parts of stage 1, variant forms of color terms were offered by different respondents. These took two main forms: dialect variations and grammatically distinct forms. Dialect differences involved variants such as *bohala* and *bofala*, both meaning 'pinkish (as of cattle)'. We have treated such minor variants as equivalent. The grammatically distinct

forms subdivided into two further types. First, color terms were given with different prefixes: thus for *-hibidu* 'red', informants might use the forms *mo-hibidu*, *k-hibidu*, or *bo-hibidu*. The prefix *bo-* is found on a group of nouns that includes abstract nouns (Bantu noun class 14); thus *bo-hibidu* may be glossed as 'redness'. These variations in prefix are not directly relevant to our study, and so forms with variants will normally be quoted with the *bo-* prefix in the text (except where a term is associated with a particular prefix, such as *Ma-thubapula* 'sand'). The tables for stage 1 show the stem form to indicate that various prefixes were given by respondents, but for stage 2, the tables reflect the fact that the *bo-* prefix was used throughout. There is a second type of grammatical variant, which can be illustrated by the forms *bosetlha* and *bosetlhana*, both meaning 'yellow'. The diminutive suffix *-ana* is used with color terms to signify female sex when denoting animals, particularly domestic animals. Thus *bosetlha* (with the appropriate prefix) would be used of male animals and *bosetlhana* of female animals. This is an unusual and interesting feature of Setswana, but one which is shared with other members of the Sotho (or Sotho-Tswana) group (Cole 1955: 141, 145). While the specialization of the color vocabulary in the area of domestic animals in various languages has been studied to some extent (see Evans-Pritchard 1940: 41–45; Lienhardt 1961: 10–16, 19, 46; Tornay 1973: 87–91; Reichmuth 1981; Turton 1980 and references there), this intersection of sex and color in Setswana is interesting in a language that, as is normal in Bantu languages, has a well-developed gender/noun-class system but in which sex is not a defining characteristic (see Sandilands 1953: 344–349). Thus nouns denoting 'man' and 'woman' would take the same agreements. In the important area of cattle description the distinction is introduced by means of the suffix *-ana*. Given the interest of this usage we give the data in two forms. In Table 1 we treat doublets like *bosetlha* 'yellow' and *bosetlhana* 'yellow (female)' as separate terms. Then in Table 2 we arrange the data treating these two forms as instances of the same term; we label the unsuffixed form as "male" and the suffixed form as "female."

The translations of the terms we give are based on Cole (1955), Snyman et al. (1990), and our Setswana-speaking consultants. Observations of the way terms are used suggest that the definitions in some cases need refining, and we indicate this when we discuss the terms.

3.1. *Term elicitation*

Some respondents required prompting before producing any color terms. They replied, for example, "I don't know any colors" or "Do you mean

Table 1. Setswana color-term elicitation (*N.B.* list position indicates the median, weighted such that terms not elicited from a respondent have been counted as occurring after their final term)

Term	Gloss	Frequency	List position
-ntsho	'black'	31	5.0
-setlha	'yellow'	25	6.0
-sweu	'white'	24	7.0
-hibidu	'red'	23	5.0
-tala	'grue' (never of animals)	21	6.0
-rokwa	'brown'	19	7.0
-hunwana	'reddish-brown' (f. cattle)	13	8.0
-webu	'gray roan' (m. cattle)	12	8.0
-naana	'red and white' (f. cattle)	11	8.0
-nala	'red and white' (m. cattle)	11	8.0
selaole	'purple'	10	8.0
-hunohu	'reddish-brown' (m. cattle)	9	8.0
-nkgwe	'white-backed' (m. cattle)	9	8.0
-gweba	'red and white spotted' (m. cattle)	8	8.0
-tuba	'dun, fawn' (m. cattle); see section 3.2	7	8.0
-phatshwa	'black and white patches' (m. cattle)	7	8.0
-kotswana	'gray roan' (f. cattle)	7	8.0
sethumya sa			
mookana	'yellow mimosa blossom'	6	8.0
mathubapula	'sand'	6	8.0
	'darkish' (dim. <i>bontsho</i>) or 'black'		
-tshwana	(f. cattle)	6	8.0
-tlhabana	'dark brown on muzzle' (f. cattle)	6	8.0
-tala jwa			
tlhaga	'grass-grue'	6	8.0
-setlhana	'yellow' (f. cattle)	6	8.0
-tlhaba	'dark brown on muzzle' (m. cattle)	6	8.0
-phatshwana	'black and white patches' (f. cattle)	5	8.0
lephutshe	'pumpkin'	5	9.0
-tilodi	'black and white spotted' (m. cattle)	5	9.0
-tilotsana	'black and white spotted' (f. cattle)	4	9.0
-ramaga	'mottled red/brown and white' (m. cattle)	4	8.0
-gwana	'white-backed' (f. cattle)	4	9.0
-gwebana	'red and white spotted' (f. cattle)	4	9.0
nkgwe phihadu	'black with white back' (m. cattle)	4	9.0
-phihadu	'black' (m. cattle)	4	9.0
-swaana	'white' (f. cattle)	3	9.0
-tala jwa			
legodimo	'sky-grue'	3	9.0
-ramagana	'mottled red/brown and white' (f. cattle)	3	9.0
-sumu	'white face' (m. cattle)	2	9.0
lephoi	'dove'	2	9.0
-shampa	'red and white streaked' (m. cattle)	2	9.0
-khukhwana	'dark brown muzzle' (f. goat)	2	9.0
-hibidu jobo			
mokgona	'dirty-red'	2	9.0
tshega	'belted' (m. cattle)	2	9.0
-pudutshwana	'blue-gray' (f. cattle)	2	9.0

colors of cows or colors of goats?" All respondents, however, did produce a list without requiring the observer to offer examples. The number of respondents who offered each term was calculated, and all the terms that were offered by more than one subject are shown in Table 1. (The terms offered by a single informant are given in Appendix 2.) The data in Table 1 are ordered by the frequency with which they were used, together with their translation, the frequency, and an average across subjects of the positions in the list that each term occurred. The average chosen was the median; that is, the value that has half the scores above it and half below it. The median was chosen to reduce the effect of extreme scores. If a subject did not produce a term it was assumed that the term might eventually have been produced but it would have had a list position lower than the final term they actually produced. Accordingly, "missing" terms were given the value one greater than the final term for each subject. This procedure was thought to provide a more valid indicator of salience than only averaging the list positions across those people who produced a given term; the latter could have resulted in some terms having high list positions because they were produced by a few people, but early in their lists.

3.2. *Classification of terms*

a. *"Abstract" color terms.* The terms *bontsho* 'black', *bosetlha* 'yellow', *bosweu* 'white', *bohibidu* 'red', *borokwa* 'brown', and *botala* 'grue' (green and blue) appear to be pure color terms with an unrestricted reference and were produced by the majority of the respondents.

b. *Restricted terms.* Many of the terms used have restricted reference. The clearest examples are "cattle terms," such as *bohunohu* 'reddish brown', which are at least primarily used to describe cattle. A less clear case is *botuba*, which Cole (1955) glosses as 'dun, fawn (of cattle)'. There is some disagreement about this gloss; for example, Snyman et al. (1990) gloss it as 'black-gray'. Anticipating our later results, our informants used *botuba* to label tiles that were predominantly gray and, to a lesser extent, olive. Our CIE data (Figure 3) would also suggest a gray color identified. The fact that informants used *botuba* spontaneously of colored tiles indicates that it is not exclusively a cattle term.

The term *selaole* 'purple' is glossed by Snyman et al. (1990) as 'purple berry (lantana)', but our informants knew the term simply as 'a purple color' and were unaware of a particular referent. Therefore, we treat it as having unrestricted reference.

c. *Object names.* Some terms, such as *mathubapula* 'sand', *lephutshe* 'pumpkin', clearly refer to an object, and at this stage it is not clear to what extent they are also used to describe appropriately colored objects in general. Most have a low frequency of occurrence, which is consistent with a restricted range of application.

3.3. Analysis of the elicited lists

There are two striking features of Table 1. First, there are only six terms offered by half the sample or more, and these terms belong high in the hierarchy. They are *bontsho* 'black', *bosetlha* 'yellow', *bosweu* 'white', *bohibidu* 'red', *borokwa* 'brown', and *botala* 'grue' (green and blue). This pattern is supported by the list-position data; the six most frequent terms also have the lowest median positions. Second, after these first six terms, the great majority of terms are "cattle terms"; many of these terms do not refer to surfaces with a uniform hue, but rather describe combinations of color patterns, like *bogweba* 'red and white spotted', used only of male cattle.

Table 2 shows the frequency data from Table 1, but with male and female cattle terms combined. For each term, the table shows how many respondents gave the male form, how many gave the female form, and how many gave both. The final column of Table 2 shows how often the term was given in at least one of these forms. So, for example, for *-ntsho* 'black', 31 people gave the male form and six gave the female form; but only four people gave both forms. The number of people who offered at least one term is obtained by summing the first two columns, to give the total occurrence of both forms, and subtracting the third column, the number of joint occurrences. It can be seen that the male forms are more commonly used than the female forms, and that it is rare for a person to give both forms. This is consistent with the interpretation that the two forms are exemplars of the same underlying color concept. Comparing the final columns of Tables 1 and 2 shows that the rank orders of the two frequencies are by and large the same across the tables.

Table 3 shows the mean number of cattle terms and noncattle terms produced by men and women, and this is represented in the histograms in Figures 1 and 2. It can be seen that men produce more terms than women, but that this is due to the men producing many more cattle terms than the women. Both these effects are highly statistically significant: for the sex-of-speaker difference ($f = 10.7$; $df = 1,39$; $p < .002$) and for the interaction between the sex of speaker and type of term ($f = 14.1$; $df = 1,39$ $p < .001$).

Table 2. *Setswana color-term elicitation combining male and female cattle terms*

Term	Gloss	Frequency			
		male	female	both	at least 1
-ntsho	'black'	31	6	4	33
-setlha	'yellow'	25	6	3	28
-sweu	'white'	24	3	0	27
-hibidu	'red'	23	0	0	23
-tala	'grue'	21	—	—	21
-rokwa	'brown'	19	0	0	19
-humohu	'reddish-brown'	9	13	4	18
-webu	'gray roan'	12	7	5	14
-nala	'red and white'	11	11	6	16
selaole	'purple'	10	—	—	10
-nkgwe	'white-backed'	9	4	1	12
-gweba	'red and white spotted'	8	4	4	8
-tuba	'dun, fawn'	7	0	0	7
-phatshwa	'black and white patches'	7	5	1	11
sethunya sa					
mookana	'yellow blossom (mimosa)'	6	—	—	6
mathubapula	'sand'	6	—	—	6
-tlhaba	'dark brown on muzzle'	6	6	2	10
-tala jwa tlhaga	'grass-grue'	6	—	—	6
lephutshe	'pumpkin'	5	—	—	5
-tilodi	'black and white spotted'	5	4	0	9
-ramaga	'mottled red/brown and white'	4	3	2	5
-nkgwe phihadu	'black with white back'	4	0	0	4
-phihadu	'black'	4	0	0	4
-tala jwa legodimo	'sky-grue'	3	—	—	3
-sumu	'white face'	2	0	0	2
lephoi	'dove'	2	0	0	2
-shampa	'red and white streaked'	2	0	0	2
-khukhwa	'dark brown muzzle' (goat)	0	2	0	2
-hibidu jobo mokgona	'dirty-red'	2	0	0	2
-shega	'belted'	2	0	0	2
pududu	'blue-gray'	0	2	0	2

Table 3. *Number of cattle/noncattle terms produced by men/women*

	Cattle	Noncattle	Total
Men	6.4	4.6	11.0
Women	1.9	5.4	7.3

Figure 1. Color-term elicitation by sex: (a) all color terms

Figure 2. Color-term elicitation by sex: (b) cattle terms excluded

3.4. Tile naming

Table 4 shows the terms given to the color samples with the most frequent term used for each tile, the number of informants who used it, and the second most frequent term, where there was one, together with the number of informants using it. The final figure is the total number of times that the tile was named.

The column labeled Hue refers to the most saturated colors and progresses from yellow (Y) through orange (O), red (R), violet (V), and blue (B), to green (G). The letter combinations refer to intermediary hues, so for example YOY is slightly more orange than Y, and OYO is more orange still. In addition to varying in hue, the colors may also vary in tint (T) and shade (S); for the current purpose they may be thought of as variations in brightness, and of the "richness" of color. Each hue in the full Color-Aid Chart has four levels of tint, T1 to T4, and three levels of shade, S1 to S3. In addition to the main chart, there is a gray scale; the stimuli there are achromatic varying only in brightness. And there are a few additional colors with specific significance to artists, such as sienna brown. In order to save space we have compressed the full Color-Aid Chart to show only the stimuli we actually used; so the first row of Table 4 indicates that we used Y Hue and Y S2, the second row indicates that we used YOY Hue, YOY T4, and YOY S2, and so on.

Overall, respondents did not name many tiles. The mean number named was 15.7. There were only a few tiles to which the majority of subjects assigned the same name. These were *borokwa*, 'brown' to O S3, *bontsho*, 'black' to Gray 8, and *bosweu*, 'white' to White. But within the constraint of the low response rate, it appears that the most frequent terms are by and large the same as those produced in the term-elicitation task.

This can be seen more clearly in Table 5. It shows the total number of occasions summed across tiles and respondents on which each term occurred, and the rank order of these frequencies. It can be seen that the most frequently used terms by and large correspond with the most frequent terms in the term-elicitation exercise. The six most frequent terms in Table 1 are, with one exception, also the six most frequent in Table 5. The exception *botuba* 'dun, fawn' is ranked 6.5 with *bosweu* 'white'.

In general, the cattle terms are not used to describe the tiles. However, *botuba* 'dun, fawn' is used quite often and is the sixth most frequent term, and *bowebu* 'gray roan' is the next most frequent cattle term, with rank 11.5. If the other cattle terms are excluded from Table 1 then *botuba* 'dun, fawn', *mathubapula* 'sand', and *selaole* 'purple', all of which have a

Table 4. *Distribution of name responses to the 65 stimuli*

Hue								
Y	sethunya	6	S2	botuba	4			
	mathubapula	5			4			
		24						
YOY	bosetlha	5	T4	bosetlha	11	S2	botuba	3
		14			15		bosetlha	2
								6
YO	bosetlha	3	T3	bosetlha	6	S3	botuba	3
	bohibidu	2			11			6
		8						
OYO	bohibidu	5						
		6						
O	bohibidu	4	S1	borokwa	3	S3	borokwa	23
		7			3			25
ORO	bohibidu	11	T3	bosetlha	2	S3	bosetlha	5
		12		bohibidu	2			9
					5			
RO	bohibidu	17	T3	bohibidu	2	S3	borokwa	12
		17			4		bontsho	10
								24
ROR	bohibidu	16	T3	bosetlha	1	S3	bosetlha	2
		16		bohibidu	1		borokwa	1
					2			3
R	bohibidu	19	T4	bohibidu	4	S3	bontsho	5
		19			5		borokwa	4
								12
RVR	bohibidu	7	S1	bohibidu	2	S3	"pinkie"	3
		8		selaole	2			5
					4			
RV	selaole	4	T2	selaole	2			
	bohibidu	2			5			
		7						
VRV	selaole	5	S3	bosetlha	1			
		7		bohibidu	1			
				"pinkie"	1			
					3			
V	selaole	3						
	"blue"	2						
		6						
VBV	selaole	2	T4	selaole	5			
		4			6			
BV	botala	2	S2	botala	2			
		3			4			
BVB	botala	5	S3	selaole	2			
		7			4			
B	botala	10	T1	botala	8			
		11			8			
BGB	botala	11	T3	botala	11			
		11			11			

Table 4. (continued)

Hue								
BG	botala	5	T1	botala	9	S2	botala	3
		5			9			3
GBG	botala	14	S2	botala	9			
		14			9			
G	botala	12	S3	botala	9			
		12			9			
GYG	botala	19	T4	botala	7	S1	botala	3
		19			7			3
YG	botala	16	S3	botala	2			
		16			7			
YGY	botala	7	S3	botuba	1			
		7		bosetlha	1			
					2			
Sienna brown	borokwa	6		Gray 4			botuba	9
		9					bowebu	3
								16
Rose red	bohibidu	4		Gray 2			bosetlha	8
	"pinkie"	2					botuba	4
		7						18
Black	bontsho	15		Gray 1			bosetlha	5
	borokwa	1					bosweu	3
		16						15
Gray 8	bontsho	24		White			bosweu	24
		27						28
Gray 6	bontsho	3						
	borokwa	2						
		8						

reasonably high rank in Table 5, can also be seen to have similar ranks in Table 1.

The frequencies of tile naming shown in Table 5 are partly a function of the salience of availability of color terms, and partly a function of the opportunity to apply the name; that is the nature of color space itself and the particular color samples. Following Moss et al. (1990), purer measures of consensus and specificity across respondents were calculated, namely a dominance index and a specificity ratio. The dominance index is the number of tiles for which a given term was used by more than half the people naming those tiles. So, for example, there were 18 tiles for which the term *botala* was used by more than half the people who named those tiles. The dominance index is shown in column 4 of Table 5. It can

Table 5. Setswana tile-naming stability (stage 1)

Term	Gloss	1 Freq	2 % Freq	3 Rank	4 Dom ^b	5 Specificity ^c
-ntsho	'black'	58	9.11	5	2	0.67
-setlha	'yellow'	67	10.52	3	4	0.36
-sweu	'white'	32	5.02	6.5	1	0.75
-hibidu	'red'	107	16.8	2	9	0.81
-tala	'grue'	172	27.0	1	18	0.93
-rokwa	'brown'	64	10.05	4	3	0.5
-hunohu	'reddish-brown' ^a	4	0.63	16.5	0	0.0
-webu	'gray roan' ^a	9	1.41	11.5	0	0.0
selaole	'purple'	26	4.08	8	3	0.54
-tuba	'dun, fawn' ^a	32	5.02	6.5	2	0.41
<i>sethunya</i>						
sa mookana	'yellow blossom'	12	1.88	10	0	0.0
mathubapula	'sand'	13	2.04	9	0	0.0
-tlhaba	'brown mix' ^a	5	0.78	14.5	0	0.0
lephutshe	'pumpkin'	9	1.41	11.5	0	0.0
lephoi	'dove'	2	0.31	19.5	0	0.0
tae ya koko	'egg yolk'	5	0.78	14.5	0	0.0
balabolele	'purple flower'	1	0.16	23	0	0.0
boloisele	'blue mineral'	1	0.16	23	0	0.0
loapi	'sky, firmament'	1	0.16	23	0	0.0
pink	('pink')	6	0.94	13	0	0.0
yellow	('yellow')	4	0.63	16.5	0	0.0
blue	('blue')	3	0.47	18	0	0.0
ink	('ink')	2	0.31	19.5	0	0.0
orange	('orange')	1	0.16	23	0	0.0
gray	('gray')	1	0.16	23	0	0.0
Total		637	100.0			

a. Cattle terms.

b. Dominance: number of tiles for which more than 50% of responses were the given term.

c. Specificity: frequency within dominant tiles divided by overall frequency of term.

be seen that in general the most frequently used names also have the highest dominance indices.

The final column of Table 5 shows a measure of stability or specificity.² It is the total number of dominant responses, divided by the total number of responses for each term. So, for example, *bosweu* 'white' was dominant for one tile: 24 out of 28 respondents named the tile *bosweu*. *Bosweu* was used a total number of 32 times across the whole sample, and the final column of Table 5 is 24 divided by 32. It can be seen that terms with high frequencies (column 1) also tend to have high specificity; the major

discrepancy is that *bosetlha* 'yellow' has lower specificity than *selaole* 'purple' and *botuba* 'dun, fawn', whereas it had the third-highest frequency.

3.5. *Alternative color terms*

Table 6 shows a "confusion matrix" between all terms used by at least two people. The entries in the matrix are the number of occasions when a given pair of terms was used by different respondents to name the same tile, summed across tiles; that is, the total cooccurrences of pairs of terms. So, for example, *bo-ntsho* 'black' cooccurred with *bo-setlha* 'yellow' once, and never with *bo-sweu* 'white'.

It can be seen from Table 6 that there are some cooccurrences among terms with high frequencies in the term-elicitation task; that is, among terms that are contenders for the basic classification. *Borokwa* 'brown' and *bontsho* 'black' cooccur 22 times; *bosetlha* 'yellow' cooccurs 9 times with *bosweu* 'white', 13 times with *bohibidu* 'red', and 10 times with *borokwa* 'brown'. In most other cases the majority of cooccurrences are between the contenders for basicness, and the lower-order color terms.

3.6. *Stage 2: Term mapping*

Table 7 shows the equivalent data to Table 4 for the second sample; that is, those who were asked to indicate which tiles were examples of a given term. The table is laid out as for Table 4. Each cell entry shows the terms that were used by more than one person for that tile, together with the number of people who used each term. The final number is the number of times that the tile was named; but note that the total could be more than 40 because a subject could say a tile was an example of, say, *bohibidu* 'red' and it was also an example of, say, *bosetlha* 'yellow'.

The first point to note about Table 7 is that naming frequency is much higher than for the first sample. Asking questions of the type "Which of these tiles are 'X'?" produces more responses than the single question "Which of these tiles can you name?"

The overall pattern of term usage can be seen more clearly in Table 8. This shows the total frequency with which each term was used for the whole set of tiles. The first seven columns of Table 8 show equivalent measures for term mapping as Table 5 showed for tile naming in stage 1.

It can be seen that *botala* 'grue' and *bohibidu* 'red' have the two highest frequencies, as they did in stage 1. *Borokwa* 'brown', *bontsho* 'black', and

Table 6. Setswana tile naming — confusion matrix (stage 1)

Term	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	Freq
A -niso	-	1	0	0	1	22	4	0	0	3	0	0	0	0	0	3	0	0	0	0	58
B -setlha	1	-	9	13	4	10	0	8	2	14	7	10	1	5	2	2	4	3	0	0	67
C -sweu	0	9	-	0	0	2	0	3	0	2	0	0	0	0	1	0	0	0	0	0	32
D -hibidu	0	13	0	-	5	1	0	0	7	1	5	6	0	6	0	4	3	2	0	0	107
E -tala	1	4	0	5	-	1	0	0	3	4	1	1	2	2	0	1	2	1	0	2	172
F -rokwa	22	10	2	1	1	-	3	5	3	11	0	0	4	0	2	0	0	0	2	0	64
G -hunohu	3	0	0	0	0	3	-	0	0	2	0	0	2	0	0	0	0	0	0	0	4
H -webu	0	8	3	0	0	5	0	-	0	8	0	0	0	0	2	0	0	0	0	0	9
I -setaole	0	2	0	7	3	3	0	0	-	0	0	0	0	0	0	0	0	0	3	0	26
J -tuba	3	14	2	1	4	11	0	8	0	-	0	0	3	0	2	0	0	0	0	0	32
K -sethunya	0	7	0	5	1	0	0	0	0	0	-	9	0	6	0	0	4	0	0	0	12
L mathubapula	0	10	0	6	1	0	0	0	0	0	9	-	0	6	0	0	3	4	0	0	13
M -tlhaba	4	1	0	0	2	4	2	0	0	3	0	0	-	0	0	0	0	0	0	0	5
N lephutshe	0	5	0	6	2	0	0	0	0	0	6	0	0	0	0	0	4	0	0	0	9
O lephoi	0	2	1	0	0	2	0	2	0	2	0	0	0	-	0	0	0	0	0	0	2
P pinki	0	2	0	4	1	0	0	0	0	0	0	0	0	0	0	-	0	0	0	0	6
Q tae ya koko	0	4	0	3	2	0	0	0	0	0	4	3	0	4	0	0	-	3	0	0	5
R yellow	0	3	0	2	1	0	0	0	0	0	4	4	0	4	0	0	3	-	0	0	4
S blue	0	0	0	0	0	2	0	0	3	0	0	0	0	0	0	0	0	0	-	0	3
T ink	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	2

Notes:

- Figures indicate cooccurrences of two terms in naming colored tiles.
- Terms shown include qualifiers, thus *-tala* 'grue' includes *-tala jwa tlhaga* 'grass-grue'.
- Terms elicited only once have been excluded from the matrix.

Table 7. *Distribution of name responses (maximum 40 unless otherwise indicated) to each color in the 65-tile set*

Hue								
Y	sethunya	37	S2	botuba	4			
	mathubapula	15		bosetlha	2			
	bosetlha	2			7			
		55						
YOY	sethunya	19	T4	bosetlha	18	S1	botuba	6
	mathubapula	18		mathubapula	16		bosetlha	3
	bosetlha	8		sethunya	12			10
		47			49			
YO	mathubapula	18	T3	mathubapula	20	S3	botuba	4
	sethunya	12		bosetlha	12		borokwa	2
	bosetlha	5		sethunya	11			
		36			45			7
OYO	bohibidu	8						
	sethunya	2						
	mathubapula	2						
		14						
O	bohibidu	24	S1	borokwa	14	S3	borokwa	31
		25		bohibidu	3			33
					18			
ORO	bohibidu	28	T3	bosetlha	2	S3	botuba	15
		29		mathubapula	2		bosetlha	14
					6		bowebu	13
							bosweu	3
RO	bohibidu	39	T3	bosetlha	2	S3	borokwa	46
		40		mathubapula	2		bontsho	26
					6			13
								43
ROR	bohibidu	38	T3	bosetlha	2			
		39			5			
R	bohibidu	33	T4	botuba	2	S3	borokwa	14
		34		selaole	2		bontsho	9
					6		botuba	2
								27
RVR	bohibidu	7	S1	selaole	8	S3	mathubapula	3
	selaole	6			9		botuba	2
		13						6
RV	selaole	12	T2	selaole	7			
		13			8			
VRV	selaole	14	S3	mathubapula	4			
	botala	2			7			
		16						
V	selaole	16						
	botala	3						
VBV	selaole	14	T4	selaole	10			
	bowebu	4		bowebu	2			

Table 7 (continued)

Hue							
	botala	3		botala	2		
		21		bowebu	2		
					16		
BV	botala	10	S2	bowebu	4		
	selaole	2		botala	2		
		13			7		
BVB	botala	15	S3	bowebu	5		
	selaole	3		selaole	4		
		19		botuba	2		
B					13		
	botala	25	T1	botala	25		
		27			26		
BGB	botala	24	T3	botala	20		
		26			21		
BG	botala	20	T1	botala	19	S2	botala
		22			20		15
GBG	botala	29	S2	botala	21		16
		29			22		
G	botala	33	S3	botala	13		
		34			25		
GYG	botala	33	T4	botala	16	S1	botala
		34			20		6
							2
YG	botala	32	S3	botuba	6		9
		33		bowebu	3		
					13		
YGY	botala	21	S3	bosetlha	3		
		21			4		
Sienna brown	borokwa	18		Gray 4		botuba	27
		20				bowebu	22
Rose red	bohhibidu	9				bosetlha	2
		10					53
Black	bontsho	36		Gray 2		botuba	21
	borokwa	4				bowebu	19
	boebu	4				bosetlha	17
	botuba	2				bosweu	5
		46					62
Gray 8	bontsho	40		Gray 1		bosweu	19
	borokwa	4				bosetlha	12
Gray 6		45				bowebu	7
	bowebu	17				botuba	7
	botuba	16					45
	bontsho	12		White		bosweu	40
	borokwa	5					
		50					

Table 8. *Setswana tile-naming stability (stage 2); color terms were presented using the prefixes indicated*

Term	Gloss	1 Freq	2 % Freq	3 Rank	4 Dom ^a	5 Specif ^b	6 Consist ^c
<i>bontsho</i>	'black'	112	7.12	6	2	.67	.81
<i>bosetlha</i>	'yellow'	109	6.93	8	1	.03	.43
<i>bosweu</i>	'white'	69	4.39	11	1	.58	.87
<i>bohibidu</i>	'red'	197	12.52	2	8	.94	.97
<i>botala</i>	'grue'	391	24.86	1	18	.96	.97
<i>borokwa</i>	'brown'	124	7.88	4	5	.83	.81
<i>bowebu</i>	'gray roan'	110	6.99	7	0	.00	.38
<i>selaole</i>	'purple'	117	7.44	5	7	.69	.85
<i>mathubapula</i>	'sand'	103	6.55	10	4	.44	.38
<i>botuba</i>	'dun, fawn'	135	8.58	3	5	.35	.40
<i>sethunya sa mookana</i>	'yellow blossom'	106	6.74	9	1	.35	.51
Total		1573	100.0				

a. Dominance: number of tiles for which more than 50% of responses were the given term.

b. Specificity: frequency within dominant tiles divided by overall frequency of term.

c. Consistency: proportion of consistent use to overall frequency of term (see text).

bosweu 'white' retain similar high positions to stage 1. However, *bosetlha* 'yellow' has a much lower rank than in stage 1, and *botuba* 'dun, fawn' and *selaole* 'purple' have much higher rank frequencies than in stage 1. The pattern shown by the dominance index is similar to the frequency data and is also remarkably similar to the dominance-index data in Table 5; that is, the absolute number of tiles for which each term was dominant is very similar in the two stages. The major difference between the two stages is that *selaole* 'purple', *mathubapula* 'sand', and *botuba* 'dun, fawn' have higher dominance indices in stage 2.

The specificity index again shows a similar pattern to Table 5, and to the dominance index and frequency measures in Table 8. The terms with the highest specificity measures in stage 1 retain high measures in stage 2, but the terms *sethunya* 'yellow blossom', *mathubapula* 'sand', and *bowebu* 'gray roan' show significant increases.

As each respondent could name each tile with more than one term, it is possible to derive a measure of consistency of use, analogous to Boynton and Olson (1987). In their case, their respondents were required to name each color sample twice; if they used the same term on both occasions this was deemed a consistent response. Basic terms were used more consistently than nonbasic terms. In this case we have defined

consistent use as when a term is used to describe a tile by a given individual, and the same tile is not described by any other name by the same individual. For a given individual, the proportion of consistent use across tiles was calculated, and our index of consistency is the mean of these proportions across respondents. This yields an index with values ranging from 0 to 1. High scores indicate that the majority of subjects used a term and with high consistency; low scores indicate either that subjects used the term inconsistently or that only a few subjects used the term even though consistently. Note that the index is independent of the breadth of use; a high score could arise because just one tile was consistently named by many subjects, or because several tiles were so named. Consideration of the frequency and dominance scores along with the specificity scores would clarify the origin of a particular specificity score. This consistency index is shown in the final column of Table 8. It can be seen that *bohbidu* 'red', *botala* 'grue', *bosweu* 'white', *bontsho* 'black', *selaole* 'purple', and *borokwa* 'brown' all have very high consistency indices. The remaining terms have much lower scores.

3.7. *Positions of color terms in color space*

One criterion of basicness is that speakers should show consensus over what the appropriate examples of a given term are. Our dominance measures, the number of tiles for which a given term was applied to a stimulus by more than half the people who named that tile, is related to consensus but fails to distinguish between tiles that were named by only a few people and tiles that were named by many people. An alternative measure is to count a tile as evoking consensus naming when the majority of the respondents name the tile with the same term. Figures 3–5 show the loci of tiles given a particular color term by more than half of the sample, in CIE coordinates (see Appendix 1 for explanation). Superimposed are the coordinates of the focal examples of the basic terms of the hierarchy as given by Rosch Heider (1972: 9), based on Berlin and Kay (1969: 9), who give normalized foci of basic color terms in 20 languages. The CIE system represents colors in a three-dimensional space whose coordinates are roughly brightness (Y), proportion of redness (x), and proportion of greenness (y); by implication the proportion of blueness is present as $1 - (x + y)$. In Figure 3 the x – y dimensions are illustrated; regions close to the origin correspond to good blues, those high on y but low on x to greens, and those high on x but low on y to red.

Figures 4 and 5 show the other two planes of space, brightness against redness and brightness against greenness. It is not so simple to describe what color a given point in these two spaces would be. Irrespective of

Figure 3. Location of consensus colors in CIE space

hue, the further to the right, the brighter the stimulus would be, but apart from the extreme values (red or green = 1), each point is consistent with several hues; for example if redness was .33 the remaining proportion could be all "green," which would give a greeny-yellow, or all blue, which would give a blue-purple, or any combination of the two. These two spaces are therefore best read in conjunction with the x-y space (Figure 3) and can be thought of as adding brightness information.

From Figure 3, it can be seen that *botala* 'grue' occupies a large swathe extending from blue through to green; *bohibidu* 'red' similarly occupies a distinct area in the red region. Consideration of the other two figures shows that these two terms occupy regions of low lightness. There are two other distinct regions, albeit with few members, in Figure 3: *borokwa* 'brown', and *sethunya* 'yellow blossom'. The remaining four terms cluster together but emerge more distinctively when the lightness dimension is considered. *Bosweu* 'white' and *bontsho* 'black' occupy their expected high Y and low Y locations, with the term *botuba* 'dun, fawn' situated between them.

Figure 4. Location of consensus colors in CIE space

3.8. Interrelationships between the measures

The 11 terms studied in stage 2 were a subset of the terms elicited in stage 1. Each of these terms was assessed on nine major indices across the stages: frequency in elicited lists, median position in the list (Table 1); frequency of tile naming, dominance, and specificity in stage 1 (Table 5); and frequency of tile naming, dominance, specificity, and consistency in stage 2 (Table 8). The correlation coefficients between these nine measures for the 11 terms were calculated and are shown in Table 9.

Of the 37 correlations, 18 are significant at the .05 level or lower. There is a striking pattern among the significant correlations. Each of the frequency of tile naming and dominance measures strongly intercorrelates; the coefficients range from .86 to .97. Similarly the two specificity measures and the consistency measure strongly intercorrelate, with coefficients between 0.80 and 0.91. There is also a consistent but less strong pattern of correlations between the dominance measures, the specificity measures, and the consistency measure; coefficients range from 0.50 to 0.70. In contrast the frequency in elicited lists correlates only with

● = Setswana consensus colors

△ = Heider's "universal foci"

1 = *bontsho* 'black'

2 = *bosweu* 'white'

3 = *bohhibidu* 'red'

4 = *botala* 'grue'

5 = *sethunya* 'yellow blossom'

6 = *borokwa* 'brown'

7 = *botuba* 'dun, fawn'

Figure 5. Location of consensus colors in CIE space

the first specificity measure and the median list position measure. Similarly, the median list position only correlates with frequency in the lists, the first specificity measure, and the frequency of naming in the first stage.

In order to check this impression of an underlying structure to the pattern of relationships, the scores were standardized and subjected to a correspondence analysis (Greenacre 1984).³ In essence, correspondence analysis is useful in this case for three reasons: it provides an analysis of the interrelationship between the measures in terms of a small number of underlying "vectors," the vectors representing a more fundamental structure than the surface structure; it provides a measure of the statistical significance for each of the vectors it reveals; and finally, it provides an estimate of the strength with which each of the measures contributes to each of the vectors.

The analysis revealed that there was one major highly significant vector ($p < .0001$) underlying the data. There was also a second vector approaching statistical significance ($p < .08$). The results are plotted in Figure 6 in a two-dimensional space such that the coordinates in space

Table 9. *Setswana color terms: correlations across measures*

	freq	pos	%freq1	dom1	spec1	%freq2	dom2	spec2
pos	-.89 ^c							
%freq	.55	-.7 ^a						
dom1	.36	-.54	.97 ^c					
spec1	.69 ^a	-.7 ^a	.76 ^b	.7 ^a				
%freq2	.17	-.38	.89 ^c	.96 ^c	.54			
dom2	.12	-.32	.86 ^c	.95 ^c	.59	.95 ^c		
spec2	.41	-.55	.71 ^a	.66 ^a	.8 ^b	.57	.65 ^a	
cons2	.57	-.58	.64 ^a	.6 ^a	.88 ^c	.47	.51	.91 ^c

a. $p < .05$.b. $p < .01$.c. $p < .001$.

Dominance = number of tiles for which more than 50% of responses were the given term.

Specificity = frequency within dominant tiles divided by overall frequency of term.

Consistency = proportion of consistent use to overall frequency of term.

Key:

freq = frequency in term elicitation.

pos = median list position in term elicitation.

%freq1 = tile-naming percent frequency (stage 1).

dom1 = tile-naming dominance (stage 1).

spec1 = tile-naming specificity (stage 1).

%freq2 = tile-naming percent frequency (stage 2).

dom2 = tile-naming dominance (stage 2).

spec2 = tile-naming specificity (stage 2).

cons2 = tile-naming consistency (stage 2).

correspond to the values on these two vectors. The vector with the high level of statistical significance is on the horizontal axis: measures close to each other in the space are similar to each other, and measures distant from each other are dissimilar. It can be seen that the frequency of tile naming and the dominance measures tend to cluster together; similarly the specificity and the consistency measures cluster together; and, very noticeably, the list-position measure is isolated.

3.9. Combining measures to estimate basicness

3.9.1. *The hurdles model.* A useful way of thinking about Berlin and Kay's (1969) idea of basicness is that in order to be basic, a term has to have each of a given set of attributes, such as high psychological salience. Possession of the attribute is rather like exceeding a threshold or jumping

1 = frequency (term elicitation)	6 = percent frequency (tile naming, stage 2)
2 = list position (term elicitation)	7 = dominance (tile naming, stage 2)
3 = percent frequency (tile naming, stage 1)	8 = specificity (tile naming, stage 2)
4 = dominance (tile naming, stage 1)	9 = consistency (tile naming, stage 2)
5 = specificity (tile naming, stage 1)	

Figure 6. Correspondence analysis of nine measures

a hurdle. The measures we have derived are all intended as assessments of basicness that relate to Berlin and Kay's original criteria. We would therefore expect a term that was clearly basic to jump the hurdle of each of our measures.

The problem with the hurdle model in this case is that we have measured the attributes on a continuous scale, and deciding what value should constitute the threshold is at least to some extent arbitrary. We offer in Table 10 a first attempt to show the pattern of hurdle clearance for each term and measure taken from Table 9. The basis for selecting the terms that were used in all phases of the study was that they had exceeded the threshold for frequency in elicited lists and passed the unrestricted domain of reference criterion; that is, terms such as *bohunohu* 'reddish-brown (of cattle)' were not selected for the second part of the study because they were only used to refer to cattle. However, for illustration, the criterion of unrestricted domain has been included in Table 10, and those terms from Table 1 that passed the frequency in list criterion are also shown. Question marks are shown against some of these terms, because although *bowebu* 'gray roan' and *botuba* 'dun, fawn' were described as cattle terms,

Table 10. Setswana color-term hurdle clearance

Term	Gloss	1	2	3	4	5	6	7	8	9	10	Sum
-ntsho	'black'	+	+	+	+	+	+	+	+	+	+	10
-setlha	'yellow'	+	+	+	+	+	+	+	+	-	+	9
-sweu	'white'	+	+	+	+	+	+	-	+	+	+	9
-hibidu	'red'	+	+	+	+	+	+	+	+	+	+	10
-tala	'grue'	+	+	+	+	+	+	+	+	+	+	10
-rokwa	'brown'	+	+	+	+	+	+	+	+	+	+	10
-hunohu	'reddish-brown' (cattle)	-	+	-	-	-	-	/	/	/	/	1
-webu	'gray roan' (cattle)	?	-	-	-	-	-	+	+	-	+	3
-nala	'red and white' (cattle)	-	+	-	-	-	-	/	/	/	/	1
-selaole	'purple'	+	-	-	-	+	+	+	+	+	+	7
-tuba	'dun, fawn' (cattle)	?	-	-	+	+	+	+	+	+	+	7
mathubapula	'sand'	?	-	-	-	-	-	+	+	+	+	4
sethunya sa mookana	'yellow blossom' (mimosa)	?	-	-	-	-	-	+	+	+	+	4

Hurdles:

- 1 = unrestricted domain of reference.
- 2 = frequency in term elicitation of more than 33% of sample combined male and female cattle terms (see Table 2).
- 3 = median list position in Table 1 less than 8.
- 4 = tile-naming frequency (stage 1) of more than 5% of total.
- 5 = dominance (stage 1) greater than 0.
- 6 = specificity (stage 1) greater than 0.
- 7 = tile-naming frequency (stage 2) of more than 5% of total.
- 8 = dominance (stage 2) greater than 1.
- 9 = specificity (stage 2) greater than .25.
- 10 = consistency (stage 2) greater than .25.

Sum = total number of hurdles cleared.

"/" indicates term not included in stage 2 through failure at hurdle 1.

they were used to describe tiles in both stages of the study with no hesitation.⁴ Similarly, although *mathubapula* 'sand' and *sethunya* 'blossom' looked as though they might be restricted terms, they were used freely in stage 2.

The final column shows the total number of hurdles cleared. Four terms, *bontsho* 'black', *bohhibidu* 'red', *botala* 'grue', and *borokwa* 'brown', clear all hurdles, and two others, *bosweu* 'white' and *bosetlha* 'yellow', fail only one each. The putative cattle term *botuba* 'dun, fawn' fails only two hurdles; these were the measures derived from term elicitation. *Selaole*

'purple' has the next highest number of clearances, failing the list measures and the stage 1 tile-naming frequency measure.

In the spirit of the hurdle model, failure on even one criterion excludes that term from basicness. On that basis there are only four basic terms. However, the nine measures might not have equal status. But we postpone this consideration until other models for combining measures have been discussed.

3.9.2. *The unweighted mean model.* The rank order of each of the 11 terms on each of the nine measures in Table 9 was calculated, and the mean of the ranks across the measures was calculated for each term. These mean ranks are shown in Table 11, with the terms themselves presented by order of the mean rank.

It can be seen that the four terms that passed all ten criteria in Table 10 have the four highest ranks; similarly *bosetlha* 'yellow' and *bosweu* 'white' are among the next terms in rank order, but they have been overtaken by *selaole* 'purple'. On the basis of this model, *botala* 'grue' and *bohibidu* 'red' establish themselves as the clear leaders, followed by *bontsho* 'black' and *borokwa* 'brown', with *selaole* 'purple', *bosetlha* 'yellow', and *bosweu* 'white' in the next group.

3.9.3. *The weighted combination model.* The correspondence analysis yielded one major underlying vector with high statistical significance.

Table 11. *Setswana color terms: mean rank across all measures*

Term	Gloss	Mean rank
-tala	'grue'	1.78
-hibidu	'red'	2.11
-ntsho	'black'	4.72
-rokwa	'brown'	4.78
selaole	'purple'	5.61
-setlha	'yellow'	5.78
-sweu	'white'	6.22
-tuba	'dun, fawn' (cattle)	7.00
mathubapula	'sand'	9.17
sethunya sa mookana	'yellow blossom' (mimosa)	9.33
-webu	'gray roan' (cattle)	9.50

Measures used:

term elicitation: frequency, weighted median list position.

tile naming: percent frequency, dominance, specificity, consistency.

Dominance = number of tiles for which more than 50% of responses were the given term.

Specificity = frequency within dominant tiles divided by overall frequency of term.

Consistency = proportion of consistent use to overall frequency of term (see text).

Table 12 shows the weights for each of the nine measures on this underlying vector. These values can be thought of as a measure of the relative importance of each measure on the underlying structural vector. The next column in the table shows the value of each term on the vector (effectively a weighted sum or mean), and the final column shows the rank order of the weighted sum.

The striking property of Table 12 is that the ranks for the terms correspond very closely to the hierarchy ranks; *bosweu* 'white' at rank 5 is lower than it ought to be, but each of the remaining terms in the hierarchy occupies the appropriate relative position. There are no terms that clearly translate as gray, orange, or pink, the remaining terms in the hierarchy, but the terms *bowebeu* 'gray roan' and/or *botuba* 'dun, fawn', which at least originated as cattle terms, are contenders for the gray slot. It is interesting to note the possibility that very specialized terms might graduate to basic status. Pink and orange, however, are clearly missing.

Table 12. *Setswana color terms: correspondence analysis*

Term	Gloss	Vector score	Rank	Berlin and Kay rank
<i>bontsho</i>	'black'	14.4	1	1.5
<i>bohibidu</i>	'red'	13.8	2	3
<i>botala</i>	'grue'	8.5	3	4.5
<i>bosetlha</i>	'yellow'	4.4	4	4.5
<i>bosweu</i>	'white'	3.5	5	1.5
<i>borokwa</i>	'brown'	1.9	6	7
<i>selaole</i>	'purple'	-5.6	7	9.5
<i>botuba</i>	'dun, fawn'	-10.6	8	-
<i>sethunya sa mookana</i>	'yellow blossom'	-13.2	9	-
<i>mathubapula</i>	'sand'	-13.8	10	-
<i>bowebeu</i>	'gray roan'	-13.9	11	-

Dominance = number of tiles for which more than 50% of responses were the given term.

Specificity = frequency within dominant tiles divided by overall frequency of term.

Consistency = proportion of consistent use to overall frequency of term (see text).

Measure	Weight
frequency in term elicitation	8.5
median list position in term elicitation	-27.6
tile-naming frequency (stage 1)	4.8
tile-naming dominance (stage 1)	1.7
tile-naming specificity (stage 1)	7.2
tile-naming frequency (stage 2)	-1.9
tile-naming dominance (stage 2)	-2.0
tile-naming specificity (stage 2)	4.0
tile-naming consistency (stage 2)	5.4

4. Discussion

The primary aims of this study were to describe the color lexicon of Setswana; to establish which color terms are basic and to compare the basic terms with Berlin and Kay's 'permitted' inventories. But in the process of gathering and analyzing the data to address these questions it became evident that the Batswana concept of color is rather different from, and less salient than, that of many other languages that have been investigated. The difference in the concept of color is indicated by the prevalence and large number of terms used to describe the "surface patterns" of cattle, and to some extent of other domestic animals such as goats. The lower salience of the concept is indicated by the initial hesitancy in offering color terms in the term-elicitation exercise, and by the small number of tiles named in response to the question, "Which of these tiles can you name?" In contrast our work (in preparation) indicates that English and Russian speakers produce color lists with no hesitation or questioning and name the majority of the tiles. In addition, the number of color terms produced is on average much lower for the Batswana than for a British or a Russian sample (see for example Morgan and Corbett 1989). Data from a pilot study on Batswana children also support this position; five-year-old Batswana appear not to understand the color concept, as indicated by a variety of measures, whereas, in contrast, an American four-year-old will generally be familiar with and can correctly use the 11 basic color terms (Andrick and Tager-Flusburg 1986). Dougherty (1978) has similarly reported the relatively late acquisition of color terms in New Hebridian children, who live in a society where color has low salience.

Despite the difference in range of application and the low salience of color, it is clear that Setswana has a richly diverse color lexicon. However, there are fewer basic terms than the maximum of 11 posited by Berlin and Kay: there are no terms for "pink," "orange," or "blue." On the other hand there are at least four basic terms: *bontsho* 'black', *bohhibidu* 'red', *botala* 'grue', and *borokwa* 'brown'; these terms jump all the hurdles and have the highest mean ranks. In terms of weighted means they achieve positions close to those predicted on the hierarchy. In addition, the terms *bosweu* 'white' and *bosetlha* 'yellow' are probably basic; they fail to jump only one hurdle and score high on the mean ranks model, and both appear in the first six terms on the weighted means model. *Bosweu* 'white' appears lower than expected primarily because the sample of color tiles contained only one tile that the Batswana and a British comparison group called white. Thus its low position in frequency of naming is due to the color sample and also the nature of color space. The phenomenon of

color contrast restricts the number of simultaneously viewed colors that will appear white; the "whitest white" will make other "whites" appear gray (something well known to washing-powder advertisers). Thus there is little doubt but that *bosweu* 'white' is basic. There is more uncertainty surrounding *bosetlha* 'yellow'. There are other terms that have overlapping reference and whose meaning represents bright yellows, and the agreement on the best example of *bosetlha* 'yellow' is not perfect. An equal number of people choose colors in the light gray region and in the yellow/orange region.

In addition to these six terms, *selaole* 'purple' appears to be the next most likely basic term. We cannot decide with certainty here because the approach we adopted implies a concept of basicness that varies on a continuum, rather than being an all-or-nothing category. To classify positions on a continuum into categories requires the imposition of a threshold criterion, and we are unsure exactly where this should fall. However, what is clear is that *selaole* 'purple' and *borokwa* 'brown' are more basic than any possible term for 'blue', and they are narrow in reference, neither encompassing the blue color region. This supports the possibility suggested in the Introduction that Setswana might be an exception to the Berlin and Kay theory.

An unexpected finding was that about a third of the first sample of respondents showed yellow-blue (tritanopic) errors on one or two plates in the City University Colour Vision Test. Such choices would be extremely rare in a European sample, particularly if the lighting conditions were controlled. It is possible that the Batswana results are due to deviations from ideal lighting resulting from testing in the field, and this possibility is currently being investigated. However, more extreme tritanopic choice was shown by a sample of Xhosa speakers in rural South Africa; their degree of tritanopic choice is less likely to be due solely to the lighting conditions. If there is genuinely a degree of either congenital or acquired tritanopia in these African populations, this would be consistent with Bornstein's (1973) theory that, in part, variations in color terminology are due to reduced sensitivity to short-wavelength light, the blue region, among people living in climates with high sunshine levels. We are following up this intriguing possibility by extending our samples to include other countries, and by comparing children with adults, and rural with urbanized samples.

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Appendix 1. The stimuli and color description systems

The tiles used in this study were a subset of the 219 colors supplied in paper form by the Color-Aid Corporation. These colors are arranged in 24 "hues" varying from Y (yellow), through O (orange), R (red), V (violet), B (blue) to G (green), with intermediate colors designated by combinations of these letters; so YOY, YO, OYO are the colors between yellow and orange. In addition, there are seven variants of each hue: four tints (T_1 to T_4) and three shades (S_1 to S_3), giving 168 colors in the main grid. The tints and shades are meant to maintain the same hue but vary in brightness and "richness" from the parent hue. Thus YT1 is a yellow but lighter than YHue. As well as the main grid, there is a separate "gray scale" of seven achromatic colors ranging from white through gray to black; and 15 colors of particular significance to artists, such as sienna brown and rose red.

Our 65 stimuli were a subset of the Color-Aid set, and their Color-Aid designation is shown in Table i together with their CIE coordinates. The Color-Aid papers provide a convenient and reliable way of obtaining samples of colors that are a reasonable selection of all possible colors. However, there are many such systems of color samples, such as Munsell, as used, for example, by Berlin and Kay (1969), and the OSA samples described by Nickerson (1981) and used by workers such as Boynton and Olson (1987). Direct translation between such systems is not always possible (compare Boynton et al. 1989), and we have therefore provided the CIE measurements of our stimuli; these may be used as an intermediate step, to convert our stimuli to, say, the Munsell system (see, for example, Newhall et al. 1943).

Our experience of color is determined primarily by two physical factors: the wavelengths of light and the intensity (the amount) of light. Short wavelengths are experienced as blues, long ones as reds, and intermediate ones range from green through to orange. But the exact experience varies as well with intensity: more intense lights seem lighter. It is a consequence of our physiology that mixtures of single wavelengths of light are experienced as having the same hue as some single wavelength; so, for example, a mixture of red light and green light is perceived as yellow. In fact, all colors can be produced by mixing just the three "primary" colors, red, blue, and green, in appropriate proportions. It is this consequence of physiology that is the basis for color photography and television.

The CIE system for describing color exploits this phenomenon of color mixing. Every possible color can be described uniquely in terms of just three parameters $Y\ x\ y$. The first refers to light intensity (or, alternatively, the reflectance of the surface); x is the proportion of red light and y is the proportion of green light in a given stimulus. By implication there is a fourth parameter involved, z , the amount of blue light, but this is derived from x and y ($z = 1 - (x + y)$) as they are proportions and must therefore sum to 1. Colors may be represented in a chromaticity diagram, a graph of the y -against- x coordinates, and the stimuli from our experiment are shown in such a graph in Figure i. We also show the loci of the "universal colors" of Rosch Heider (1972) to aid interpretation. Basically, colors high on x and low on y are reds; those high on y but low on x

Table i. *Color-Aid codes and C.I.E. coordinates of the 65 color-tiles used in the study*

Color-Aid code		C.I.E. coordinates Y brightness	x redness	y greenness
Y	HUE	64.77	.47	.48
	S2	16.99	.41	.44
YOY	HUE	47.48	.50	.43
	T4	55.63	.45	.41
YO	S2	22.08	.36	.38
	HUE	39.52	.51	.41
	T3	47.02	.48	.41
OYO	S3	10.72	.36	.41
	HUE	26.51	.54	.37
O	HUE	25.00	.54	.37
	S1	14.34	.50	.37
	S3	9.15	.42	.36
ORO	HUE	18.87	.57	.34
	T3	36.88	.46	.35
	S3	26.51	.33	.32
RO	HUE	16.22	.58	.33
	T3	32.66	.45	.32
	S3	4.19	.37	.34
ROR	HUE	15.23	.53	.31
	T3	29.82	.42	.30
	S3	20.71	.34	.28
R	HUE	11.71	.50	.29
	T4	24.34	.40	.27
	S3	4.81	.33	.30
RVR	HUE	9.11	.42	.24
	S1	12.79	.35	.25
	S3	28.43	.36	.28
RV	HUE	6.97	.33	.19
	T2	14.51	.31	.19
VRV	HUE	6.71	.30	.19
	S3	28.42	.36	.28
V	HUE	4.67	.26	.17
VBV	HUE	4.13	.24	.17
	T4	19.05	.25	.20
BV	HUE	4.21	.22	.19
	S2	7.88	.25	.26
BVB	HUE	4.80	.19	.13
	S3	26.65	.26	.23
B	HUE	9.51	.18	.16
	T1	19.02	.20	.19
BGB	HUE	9.62	.19	.19
	T3	23.08	.20	.23
BG	HUE	8.93	.20	.25
	T1	16.57	.19	.25
	S2	7.42	.21	.26

Table i. (continued)

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

are greens; and those low on x and y, and therefore high on z, are blues. Colors that have about one third each of x, y, and z will be achromatic and will appear as some shade of gray. In terms of the x, y chromaticity diagram they will occupy the same locus, but they can differ on Y, the intensity dimension. Thus white is really just a bright gray, and black a dark gray. Colors around the periphery of the diagram are saturated (rich or high chromaticity); colors closer to the center are less saturated; for example, pink is closer to the center than a good red. Thus it can be seen that the universal loci are in general very saturated.

As well as uniquely specifying each possible color and allowing translation between color systems, the chromaticity diagram provides a useful spatial portrayal of the relationship between colors that is based on their physical properties. For example, in such a chromaticity diagram it is easy to see how close the region of CIE space designated by a common name is to the postulated universal colors of Berlin and Kay; similarly, it is easy to see how large the regions of color space described by a particular term are, and whether the difference between colors is due to brightness, saturation, or dominant red, green, or blue components.

Heider's "universal foci"

1. achromatic

2. red

3. green

4. yellow

5. blue

6. brown

7. purple

8. pink

9. orange

Note: Some colors have identical x , y , coordinates but differ on Y (brightness); where this occurs only a single "dot" is shown.

Figure 1. CIE coordinates for 65 colors and Heider's "universal foci"

Appendix 2. Setswana term elicitation — terms elicited only once

Name	Translation	
kgaka	'(like a) guineafowl'	
morobise	'(like an) owl'	
mastete	foreign term: 'mustard'	
pinche	foreign term: 'pink'	
boshaloba	'green/white clay'	
botae ya koko	'egg yolk'	
bohala	'pinkish'	(m. cattle)
bohunohu fela	'red all over'	(m. cattle)
khudugana	'pied'	(f. cattle)
kwiba	'pied'	(goats)
ngolwana	'black stripe on head'	(f. cattle)

Name	Translation	
pududu	'blue-gray'	(m. cattle)
bosegana	'white with black/red hindquarters'	(f. cattle)
tilwana	'pied'	(sheep)
tshunyana	'white face'	(f. cattle)
botubana	'dun, fawn'	(f. cattle)
Combinations		
botala jwa sethunya	'yellow-grue'	
bohibidu jobo sebola	'r. d and light-colored patch'	(m. cattle)
nkgwe ee bogato	'white-backed and sole of foot'	(m. cattle)
nkgwe ee bogwate	'white-backed and shaggy'	(m. cattle)
kgwana ee makiska		
(makuka?)	'white-backed and ?'	(f. cattle)
nkgwe ee makuka	'white-backed and red/black patches'	(m. cattle)
nkgwe ee motadi	'white-backed and ridge'	(m. cattle)
nkgwe ee botlhaba	'white-backed and brown muzzle'	(m. cattle)
nkgwe ee sethunya	'white-backed and yellow'	(m. cattle)
bonkgwe jobo sethunya	'white-backed and yellow'	(m. cattle)
kgwana sethunya	'white-backed and yellow'	(f. cattle)
nkgwe khibidu	'white-backed and red'	(m. cattle)
bontsho jobo bosumu	'black with white face'	(m. cattle)
bosumu jobo phihadu	'black with white face'	(m. cattle)
tshumo phihadu	'black with white face'	(m. cattle)
tshumo ee bosetlha	'white face and yellow'	(m. cattle)
bohunohu jobo bohala	'pinkish red'	(m. cattle)
khunwana jobo moretlwa	'red, color of berries'	(f. cattle)
kgweba ee boshampa	'black/red and white streaked'	(m. cattle)
phatshwa ee tshega	'black and white patches, belted'	(m. cattle)
mola ee tshega	'line, belted'	(m. cattle)
tlhabana ee mechalo	'brown muzzle and ?'	(f. cattle)

Notes

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2. This is analogous to Moss et al.'s (1990) stability ratio. The identical formula could not be used in the current case because respondents could choose whether to name a tile, whereas in Moss et al.'s case each respondent had to name each tile.

3. The scores were standardized in order to ensure that the range of scores on each measure was comparable. The scores were standardized by converting to z scores such that the transformed scores each had a mean of 0 and a standard deviation of 1.
4. In contrast, in an informal experiment, respondents who were asked "Which of these chips is *bohunohu* 'reddish-brown (of cattle)'?" looked surprised or laughed; on being pressed, they did, however, select a red tile.

References

- Andrick, Gail Rex; and Tager-Flusberg, Helen (1986). The acquisition of colour terms. *Journal of Child Language* 13, 119–134.
- Berlin, Brent; and Kay, Paul (1969). *Basic Colour Terms: Their Universality and Evolution*. Baltimore: University of California Press.
- Bornstein, Marc H. (1973). Color vision and color naming: a psychophysiological hypothesis of cultural difference. *Psychological Bulletin* 80 (4), 257–285.
- Boynton, Robert M.; MacLaury, Robert E.; and Uchikawa, Keiji (1989). Centroids of color categories compared by two methods. *Color Research and Application* 14, 6–15.
- ; and Olson, Conrad X. (1987). Locating basic colors in the OSA space. *Color Research and Application* 12, 94–105.
- Cole, Desmond T. (1955). *An Introduction to Tswana Grammar*. London: Longmans, Green.
- Collier, George A.; Dorflinger, Geoffrey K.; Gulick, Thomas, A.; Johnson, Diane L.; McCorkle, Constance; Meyer, Mele A.; Wood, David D.; and Yip, Lynn (1976). Further evidence for universal color categories. *Language* 52 (4), 884–890.
- Crawford, T. D. (1982). Defining "basic color term." *Anthropological Linguistics* 24 (3), 338–343.
- Dougherty, Janet W. D. (1978). On the significance of a sequence in the acquisition of basic colour terms. In *Recent Advances in the Psychology of Language*, Robin N. Campbell and Philip T. Smith (eds.), 133–148. New York: Plenum.
- Evans-Pritchard, E. E. (1940). *The Nuer: A Description of the Modes of Livelihood and Political Institutions of a Nilotic People*. Oxford: Oxford University Press.
- Fletcher, Robert (1980). *The City University Colour Vision Test*, 2nd ed. London: Keeler.
- Foss, Carl E.; Nickerson, Dorothy; and Granville, Walter C. (1944). Analysis of the Ostwald Colour System. *Journal of the Optical Society of America* 34 (7), 361–381.
- Greenacre, Michael J. (1984). *Theory and Application of Correspondence Analysis*. London: Academic Press.
- Kay, Paul (1975). Synchronic variability and diachronic change in basic colour terms. *Language in Society* 4, 257–270.
- ; and McDaniel, Chad K. (1978). The linguistic significance of the meanings of basic colour terms. *Language* 54 (3), 610–646.
- Lienhardt, Godfrey (1961). *Divinity and Experience: The Religion of the Dinka*. Oxford: Clarendon.
- Livingstone, David (1858). *Analysis of the Language of the Bechuanas*. London: Clowes.
- Morgan, Gerry; and Corbett, Greville (1989). Russian colour term salience. *Russian Linguistics* 13, 125–141.
- Moss, A. E. St. G.; Davies, Ian; Corbett, Greville G.; and Laws, Glynis (1990). Mapping Russian basic colour terms using behavioural measures. *Lingua* 82, 313–332.
- Newhall, Sydney 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.
- Nickerson, Dorothy (1981). OSA color scale samples: a unique set. *Color Research and Application* 6, 7–33.
- Ratner, Carl (1989). A sociohistorical critique of naturalistic theories of color perception. *Journal of Mind and Behavior* 10 (4), 361–372.
- Reichmuth, Stefan (1981). Die Farbbezeichnungen in sudanesisch-arabischen Dialekten. *Zeitschrift für arabische Linguistik* 6, 56–68.
- Rosch Heider, Eleanor (1972). Universals in color naming and memory. *Journal of Experimental Psychology* 93 (1), 10–20.
- Sandilands, Alexander (1953). *An Introduction to Tswana*. Tigerkloof: London Missionary Society.
- Senft, Gunter (1987). Kilivila colour terms. *Studies in Language* 11 (2), 313–346.
- Snyman, J.W.; Shole, J.S.; and Le Roux, J. C. (1990). *Setswana–English–Afrikaans Dictionary*. Pretoria: Via Africa.
- Tornay, Serge (1973). Langage et perception: La dénomination des couleurs chez les Nyan-gatom du Sud-Ouest éthiopien. *Homme* 13 (4), 66–94.
- Turton, David (1980). There's no such beast: cattle and colour naming among the Mursi. *Man* (ns) 15, 320–338.