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A developmental study of the acquisition of colour terms in Setswana*

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ABSTRACT

We report a study of the acquisition of colour terms by speakers of Setswana, the language of Botswana in Southern Africa. This was carried out as a test of Berlin & Kay's theory of colour term universals, on a language with less than the maximum complement of eleven basic colour terms, and in order to document changes in Setswana under the impact of economic development. Seventy-seven five- to nine-year-olds were studied on two colour tasks: elicited lists and colour naming. In general the data were consistent with Berlin & Kay's theory: the rank order of frequency of correct use of colour terms was similar to the order of the Berlin & Kay hierarchy; and primary colour terms were offered more frequently and were more likely to be used correctly than secondary colour terms. The use of English colour terms was prevalent, especially amongst the younger groups, but they functioned as substitutes for Setswana terms, rather than as a means to fill the vacant basic colour term slots.

INTRODUCTION

The striking variation in colour lexicons across languages has been established since at least the turn of the century, when Rivers (1901) reported the observations of the Cambridge expedition to the Torres Straits. Although Rivers interpreted his observations in terms of biological differences between peoples, they rapidly came to be regarded as the epitome of evidence for cultural relativism, see for example, Gleason (1961). Since Berlin & Kay's (1969) seminal monograph, however, evidence has accumulated in favour of colour universals. We first of all outline their original theory, and later

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describe some of the important revisions. Berlin & Kay noticed that although there are variations in colour lexicons, observed colour term inventories are drawn from a severely restricted sub-set of all possible inventories, which is encapsulated in Fig. 1.

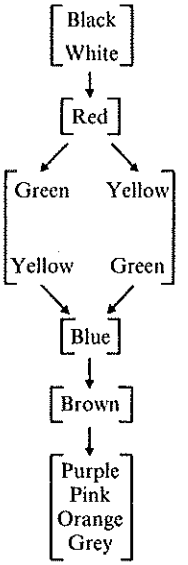

Fig. 1. The Berlin & Kay hierarchy for basic colour terms.

Berlin & Kay argued that the basic colour terms in all languages denoted categories whose foci (the best examples) were drawn from a universal set of just eleven colours, which could be characterized by the denotations of the English terms given in the hierarchy. The hierarchy specifies which combinations of colour terms are 'permissible'; if a language possesses a given term it implies that all terms higher on the hierarchy should also be present in the language. Thus a language with two terms should have terms denoting 'white' and 'black' (light and dark); a three-term language should add a term denoting 'red'; a four-term language should add a term for 'yellow' or 'green', and so on up to the maximum of eleven basic terms.

The primacy of the first six terms in the hierarchy was given added legitimacy by appealing to visual physiology (Kay & McDaniel, 1978). There seemed to be 'fundamental neural response categories' (Kay, Berlin & Merrifield, 1991), underpinning the perception of colours denoted by these 'primary' terms. The remaining terms in the hierarchy, the 'derived' terms, were assumed to have more complex neurological substrates. Miller & Johnson-Laird (1976) make an equivalent distinction when referring to the first six colours as 'landmark' colours and this terminology has been adopted

by Boynton & Olson (1990). Although we do not wish to add to the lack of consensus, we have reservations about using the term 'derived', because it might imply accepting the fuzzy set formulation of Kay & McDaniel, and to linguists 'derived' might unintentionally imply morphological derivation. Corbett & Davies (1992) use 'primary' and 'secondary basic' and we use these terms throughout the rest of this paper.

Although the Berlin & Kay theory has undergone some modifications under the impact of the substantial number of field studies carried out under the auspices of the World Colour Survey, (Kay, Berlin & Merrifield, 1991) and of other work (see MacLaury, 1991:44, for key references), a large proportion of the languages studied by and large fit the original theory. The two most important developments of the theory, for our immediate purposes, are first, the idea of composite categories, and second the relaxation of the order of the hierarchy. A composite category includes the referents of two or more adjacent terms in the original hierarchy, such as red and yellow, or blue and green. Many of the languages at early stages of development exhibit such composite categories; Setswana, the language reported here, is one such language, in that it has a composite term *botala* 'grue' ('green' and 'blue') which covers the blue and green regions of colour space. The second modification, the relaxation of the strict order of the hierarchy, takes the form of 'permitting' 'brown', 'grey', and 'purple' to appear at earlier stages than given in the original hierarchy. Again Setswana is one such exception to the original hierarchy, in that it has a basic term for 'brown', but no separate 'blue' and 'green' terms.

Corbett & Davies (1992) reviewed measures of colour term basicness in languages with the full complement of basic terms. The measures we considered in that review varied in how strongly they were associated with the Berlin & Kay hierarchy. Some, such as frequency in texts, produced strong correlations between the scores for colour terms and their positions in the hierarchy; others such as frequency in elicited lists, separated the primary basics from the secondary basics, but did not reliably distinguish between the terms within these sub-groups. Both states of affairs are consistent with versions of the Berlin & Kay theory, particularly in view of the developments we described above. To the extent that a measure of basicness produces a marked association with the original hierarchy we say that this supports the strong version of the theory; whilst if a measure only discriminates between the primary and secondary terms we say it supports the weak version of the theory.

Most of the empirical support for the theory comes from studies of adult speakers, but additional support has come from the study of the acquisition of colour terms by children. Berlin & Kay speculated that children would acquire colour terms in the order of the hierarchy, as it reflects the conceptual structure of colour space. The converging influences of visual physiology,

and the salience to parents and teachers of terms early on the hierarchy, should lead to the order of acquisition of colour terms mirroring the order of the hierarchy.

In general such developmental studies, for example Heider (1971), Andrick & Tager-Flusberg (1986), provide some support for the hypothesis; acquisition of the terms occurs in a similar order to the hierarchy, although this tends to be more marked for production tasks ('What do you call this colour?') than for comprehension tasks ('Which of these is red?'). The majority of these studies have been carried out on English speakers, but as Abdrick & Tager-Flusberg (1986) conclude, studies of the acquisition of colour terms in other languages, particularly those with fewer basic colour terms, are needed to provide a more general test of the theory.

There are some developmental studies of languages with less than the full complement of basic terms: Dougherty (1978) studied colour term acquisition by Polynesian children in Western Futana. Adult speakers use 'four to six basic colour terms' (1978:139), but the children are exposed to a more extensive inventory of basic colour terms through primary education in English or French. Even so, the age of acquisition of the first colour terms was delayed compared to English speakers. Typically, reliable use of colour terms did not start until six years of age, and was not completed until twelve years of age. By and large the order of acquisition of colour terms was consistent with the Berlin & Kay hypothesis; the primary terms 'white', 'black', 'red', 'green', 'blue' and 'yellow', were the only terms used by the majority of the older children, and the rank order of their prevalance was in the order given above.

The work we report here is a developmental study of speakers of Setswana, the language of Botswana in Southern Africa. We have recently described the colour terms as used by rural adults (Davies *et al.* 1992). We used two main procedures, elicited colour term lists ('Tell me as many colour terms as you know'), and colour term mapping ('Which of these colours is x?'). On average the women offered about five colour terms, but the men offered considerably more, sometimes as many as thirty. But this difference was due to the men offering many 'cattle terms', terms largely confined to describing the appearance of cattle. Cattle are an important reservoir of wealth in Botswana and it is the men's role to look after the cattle. Excluding these cattle terms, the men also offered about five colour terms. On the basis of a number of measures taken from the two tasks, we concluded that there were probably six basic terms: *bosweu* 'white', *bontsho* 'black', *bohibidu* 'red', *botala* 'grue' (green with blue), *bosetlha* 'yellow' and *borokwa* 'brown'. Although we gloss *bosetlha* as 'yellow', it was also used to describe some 'brown' and 'grey' stimuli; and there was another term, *sethunya*, which was a contender for the 'yellow' slot, but which we rejected in favour of *bosetlha*, because it was not offered very frequently in elicited lists. There were a

number of other terms which we thought might be the seeds around which new basic terms could grow to fill the remaining basic slots: *bowebu* 'grey-roan', and *selaole* 'purple' looked as if they might come to fill the basic slots for 'grey' and 'purple;' and perhaps *sethunya*, or *mathubapula* 'sand', might eventually fill the 'orange' slot.

Our main reason for conducting a developmental study of the acquisition of Setswana colour terms was as a further test of the Berlin & Kay hypothesis on a language with less than the full inventory of basic colour terms. But in addition Setswana is interesting because it is a language in rapid transition. Botswana is probably the most quickly developing country in Africa; its infrastructure and education system are benefiting from the national income from recently discovered mineral resources. English has been adopted as the medium for education in secondary schools and is likely to have a major impact on the evolution of Setswana. In particular, the borrowing of colour terms from English, might be the way in which the vacant slots for basic colour terms are filled, rather than the development of existing Setswana terms, as suggested above.

We therefore decided to study the acquisition of colour terms by children in Botswana using two colour tasks, elicited lists and a production task, colour naming. In addition to the two colour tasks we used two other 'list' task as indicators of general vocabulary – animal term and body-part term listing. Pilot studies indicated that children under five had effectively no colour vocabulary at all (compare Dougherty, 1978), and we therefore selected five-year-olds as our youngest sample. Our oldest sample were nine-year-olds; the upper age limit was chosen because we estimated that learning of the basic colour terms would have been close to completion by then, and none of the children would yet have had much formal tuition in English.

METHOD

Subjects

The subjects all lived in Kanye, a large village in south-east Botswana. There were 77 children in total, divided into four age groups, aged five (5;1–5;10), six (6;1–6;8), seven (7;1–7;9) and eight to nine (8;1–9;7) years old. Some of the children in each group attended school, but it should be noted that in Botswana, age is only loosely related to time in education, and we report on this in the results section. Each group had either 19 or 20 children in it, and approximately equal numbers of boys and girls. They all spoke Setswana as their first language, but those who attended primary school had some elementary knowledge of English.

Stimuli

The stimuli in the colour naming task consisted of 12 five-centimetre square coloured 'tiles' presented on a neutral grey background. The colours were selected from the Color-Aid corporation range of coloured papers, as will be explained, on the basis of naming data from adult English, Russian and Setswana speakers. Table 1 shows the dominant name given to each of the

TABLE 1. *Dominant terms and tile specifications for the test stimuli*

English term	Setswana term	Color-Aid code	CIE coordinates		
			Y	x	y
White	Bosweu	White	0·81	0·32	0·33
Black	Bontsho	Black	0·04	0·34	0·33
Red	Bohibidu	RO Hue	0·16	0·58	0·33
Green	Botala	YG Hue	0·15	0·28	0·48
Blue[a]	Botala	B S1	0·09	0·20	0·18
Blue[b]	Botala	BGB T2	0·22	0·20	0·23
Yellow	Bosetlha	Y Hue	0·65	0·47	0·48
Brown	Borokwa	O S3	0·09	0·42	0·36
Orange	—	YO Hue	0·40	0·51	0·41
Pink	—	R T4	0·24	0·40	0·27
Purple	Selaole	V Hue	0·05	0·26	0·17
Grey	—	Gray 4	0·19	0·31	0·31

[a] = Dark blue; [b] = light blue.

tiles by English and Setswana speakers, their Color-Aid codes and their CIE co-ordinates.[1]

With the exception of the two 'blue' tiles, the co-ordinates of the colours were very close to the co-ordinates of the foci of the 'universal' Berlin & Kay terms, and were good examples of the basic colour terms of English and Setswana (see Davies *et al.* (1992) for a more detailed description of the Color-Aid system, the co-ordinates of the universal foci, and the naming data for adult Setswana speakers). The two blue stimuli were included because this study was part of a large cross-cultural study which included Russian adults and children; Russian has two basic terms focused in the blue region of colour space, *sinij* 'dark blue' and *goloboj* 'light blue', and the two blue stimuli were chosen as good examples of these basic Russian terms. They

[1] The CIE system specifies colours in terms of three co-ordinates, the tri-stimulus values: Y, brightness; x, the proportion of red light; and y, the proportion of green light; the proportion of blue light is given by $1-(x+y)$. These co-ordinates completely specify the colour and allow conversion into other colour description systems such as Munsell.

were, however, also clear examples of English *blue* and Setswana *botala* 'grue'.

Procedure

Each child performed four tasks: colour-term listing, colour naming, animal term listing and body part term listing, in that order. In most cases the experiment was carried out at the child's home, outside in light shade. The instructions were given in Setswana.

For the three list tasks the children were put at their ease and then asked to say as many colour, or animal, or body-part terms as they knew. The experimenter recorded the child's responses in the order they produced them, encouraged the child to offer more terms when they paused, and only moved on to the next task after the child had said they did not know any more terms. In most cases each list task lasted less than one minute.

In the colour naming task the children were shown each tile one at a time, in random order, and were asked what they called the colour. If they used an English term, they were asked if they knew the Setswana term.

RESULTS

The amount of schooling

Table 2 shows the mean number of years at school for each of the age groups and for boys and girls. It can be seen that although there is some increase in the number of years at school with age, there is little difference between the three younger groups. They had each had about one year at school on average, whereas the oldest age group, in contrast had had about two to three years at school on average.

The correlation between age and number of years at school was $r = 0{\cdot}56$; $p < 0{\cdot}0009$, which although it is highly significant, indicates that there was considerable overlap between the age groups.

Animal and body-part terms

The mean number of animal and body-part terms offered for each combination of age and sex is shown in Table 3. The data were subjected to a three way ANOVA, age by sex by type of term, with repeated measures on the last factor[2]. The effect of age was very significant, $F = 7{\cdot}1$; d.f. $= 3, 69$; $p < 0{\cdot}0009$, due to the older children offering more terms; the effect of sex was just significant, $F = 3{\cdot}95$; d.f. $= 1, 69$; $p < 0{\cdot}05$, indicating that girls offered more terms than boys; and the difference between the number of animal and body terms was highly significant, $F = 33{\cdot}22$; d.f. $= 1, 69$; $p < 0{\cdot}0009$, due to more body terms being offered than animal terms, as indicated in Table 3.

[2] In this and subsequent ANOVAs we report only significant effects in order to save space.

TABLE 2. *Mean number of years at school for each combination of age and sex*

	Age (years)				
	5	6	7	8 to 9	Overall
Male	0·89	1·44	1·00	2·50	1·47
Female	0·70	0·67	0·90	2·70	1·25
Overall	0·79	1·06	0·95	2·60	1·36

TABLE 3. *Mean number of body part and animal terms given by each sub-group*

	Age (years)									
	5		6		7		8 to 9		Means	
	Body parts	Animal names	Body parts	Animal names	Body parts	Animal names	Body parts	Animal names	Body parts	Animal names
Male	5·4	3·1	3·8	3·1	6·5	3·9	6·6	5·7	5·6	4·0
Female	5·5	2·1	6·8	4·1	6·5	4·7	11·1	6·7	7·5	4·1
Means	5·5	2·5	5·3	3·6	6·5	4·3	8·9	6·2	6·6	4·2
Combined means	4·00		4·45		5·40		7·55		5·40	

Performance on the two tasks was significantly correlated, $r = 0{\cdot}50$, $p < 0{\cdot}0009$, and in both cases the number of terms offered correlated with the number of years at school, $r = 0{\cdot}33$, $p < 0{\cdot}002$. However, the relationship between the two tasks strengthened with age; the correlation coefficients were: $-0{\cdot}20$, 0·29, 0·61 and 0·81 in order of increasing age, with only the last two being statistically significant.

Colour term lists

Table 4 shows each colour term offered, and the number of children in each age group that offered each term. Setswana terms are highlighted, and the term underneath is, in most cases, both the English gloss and an offered term in its own right; the exception is for *botala* 'grue', which does not have a monolexemic English equivalent term.

Overall there were more English terms offered (13) than Setswana terms (6); but where English and Setswana terms are more or less direct equivalents (*bosweu* and *white*, *bontsho* and *black*, *bohibidu* and *red*), the Setswana term was used more frequently in each case. These equivalent pairs were also used mutually exclusively; that is no child offered both members of any such pair

TABLE 4. *Frequencies of the colour terms offered by each age group*

Term	Age (years)			
	5	6	7	8 to 9
Bosweu[a]	3	2	10	10
White	5	5	2	3
Bontsho	6	4	10	10
Black	4	4	3	2
Bohibidu	4	3	8	10
Red	9	6	4	3
Botala	2	2	10	9
Green	11	10	10	8
Blue	10	8	4	9
Bosetlha	0	1	3	8
Yellow	12	9	10	14
Brown	6	6	6	6
Orange	8	8	3	6
Pink	6	5	3	6
Purple	7	9	5	7
Bowebu	0	0	1	0
Grey	1	2	1	3
Maroon	1	2	0	1
Metal	0	1	0	0

[a] Original Setswana terms are italicized.

even though they were explicitly asked if they knew the Setswana term if they offered the English term.

The term *botala* refers to the same region of colour space as the English terms *blue* and *green*. The relationship between the use of the Setswana and English terms is more complicated than for the equivalent pairs described above; now the Setswana term has a more or less mutually exclusive relationship with the combination of English terms; only one child offered all three terms, but of the possible pairs of terms offered by the same subject, the *blue* and *green* combination is the most frequent (18), followed by *botala* and *green* (9), with *botala* and *blue* being offered the least often (3).

Although the majority of children offered a mixture of English and Setswana terms, it is apparent from Table 4 that the two elder age groups tended to offer more Setswana terms, whereas the two younger groups tended to offer more English terms. Analysis of variance on the ratio of Setswana terms to the total number of terms offered confirmed that this impression was significant, $F = 3{\cdot}5$; d.f. $= 3, 69$; $p < 0{\cdot}03$.

As we mentioned in the Introduction, there was some uncertainty over the basic term for 'yellow', and the term we judged to fill this slot, *bosetlha*, was also used to denote parts of the 'brown' region of colour space. Its rival for the basic slot, *sethunya*, 'blossom', was virtually never offered by the

TABLE 5. *Overall frequencies and mean positions of each colour term in order of frequency of occurrence*

Term		Frequency	Mean position
Yellow	*[a]	45	2·22
Green	*	39	3·44
Blue	*	31	3·12
Bontsho[b]	*	30	2·93
Purple		28	3·96
Bosweu	*	25	2·72
Bohibidu	*	25	3·00
Orange		25	3·79
Brown		24	4·88
Botala	*	23	3·54
Red	*	22	3·00
Pink		20	4·57
White	*	15	5·07
Black	*	13	6·08
Bosetlha		12	3·91
Grey		7	6·28
Maroon		4	7·75
Metal		1	1·00
Bowebu		1	5·00

[a] Primary terms are denoted by an asterisk.
[b] Original Setswana terms are italicized.

TABLE 6. *Mean number of colour terms given in the list task for each combination of sex and age*

	Age (years)				
	5	6	7	8 to 9	Mean
Male	4·00	4·22	3·90	5·40	4·39
Female	5·90	5·56	5·40	6·20	5·77
Mean	5·00	4·89	4·65	5·80	5·09

children, and *bosetlha* itself, was offered by only 12 out of a sample of 77; its position as the basic term for 'yellow', appears to have been taken by *yellow*, which was the single most frequent term offered.

Table 5 shows the number of children offering each term and the mean position in the offered lists, for the total sample. In general the most frequent terms also tended to be offered early, which is consistent with the most frequent terms being the ones the children thought of first; the two measures correlate significantly, $r = -0{\cdot}50$, $p < 0{\cdot}05$. It can be seen that the primary terms (including *botala*) which are highlighted, tended to occur most

frequently, and to occur early in the lists. This becomes clearer if the frequencies of equivalent terms in the languages are combined; now '*red-bohibidu*' is the most frequent, followed by *yellow*, '*black-bontsho*', '*white-bosweu*', *green* and *blue* in that order.

The mean number of terms offered by each combination of age and sex is shown in Table 6. It can be seen that there is very little change with age, but girls seem to offer more terms than boys. This is supported by an ANOVA on age and sex; the only significant effect is for sex, $F = 6{\cdot}1$; d.f. = 1, 69; $p < 0{\cdot}02$.

The impression that primary terms were offered more frequently than other terms was tested by calculating the proportion of possible primary terms and the proportion of possible secondary terms offered by each child. Because children could offer both English and Setswana terms there is a problem in deciding how many 'slots' for primary and secondary terms were realistic possibilities. In view of the relationship of near mutual exclusiveness between English and Setswana equivalent pairs described above, a reasonable assumption seems that there are seven possible slots, whose foci were primary colours designated by: *black* or *bontsho*, *white* or *bosweu*, *red* or *bohibidu*, *yellow*, *green*, *blue* and *botala*. For comparison it was assumed that there were five slots for possible secondary terms: 'brown', 'purple', 'pink', 'orange' and 'grey', and that any term offered other than the primary terms listed above would count as an offered secondary term. Thus the proportional scores were calculated by summing the designated primary terms and dividing by seven; and by summing the remaining terms and dividing by five, to give the score for the secondary terms. The resulting mean scores across subjects for each combination of age and sex are shown in Table 7.

TABLE 7. *Mean proportional scores for primary*[a] *and secondary*[b] *colours for each combination of sex and age, in the list task*

	Age (years)									
	5		6		7		8 to 9		Mean	
	Prim.	Sec.	Prim.	Sec.	Prim.	Sec.	Prim.	Sec.	Prim.	Sec.
Male	0·46	0·20	0·41	0·31	0·43	0·16	0·62	0·24	0·48	0·23
Female	0·65	0·38	0·57	0·38	0·65	0·22	0·63	0·38	0·63	0·34
Mean	0·56	0·29	0·49	0·34	0·54	0·19	0·63	0·31	0·56	0·28

[a] Primary terms = Prim.; [b] Secondary terms = Sec.

These data were subjected to a three-way ANOVA on the factors of age, sex and primary-secondary terms, with repeated measures on the last factor. There were two significant main effects: sex, $F = 6{\cdot}70$; d.f. = 1, 69; $p < 0{\cdot}02$, due to girls offering more terms than boys; and primary-secondary terms,

TABLE 8. *Frequencies of terms given to each tile*

	Tile colour number[a]											
Colour terms	1	2	3	4	5	6	7	8	9	10	11	12
Bosweu[b]	**42**[c]	—	1	1	—	1	2	—	—	—	—	1
White	**19**	—	—	—	—	—	1	—	1	—	—	1
Bontsho	2	**45**	1	—	2	1	—	4	—	—	2	5
Black	—	**26**	—	—	—	1	—	3	2	—	1	4
Bohibidu	—	—	**35**	2	1	—	—	1	1	5	—	—
Red	1	—	**19**	2	—	—	—	—	1	2	—	—
Botala	—	—	1	**23**	**15**	**18**	3	1	1	2	7	3
Green	1	—	2	**23**	3	2	1	—	—	2	1	1
Blue	—	—	1	5	**17**	**23**	3	—	—	2	8	—
Bosetlha	3	—	—	—	—	—	—	**13**	1	—	—	5
Yellow	2	1	2	2	5	1	**50**	3	**13**	4	—	**11**
Borokwa	—	—	—	—	—	—	—	**2**	—	—	—	—
Brown	**01**	—	—	2	—	—	2	**30**	3	—	1	2
Orange	—	—	3	—	—	—	3	—	**28**	3	1	—
Pink	—	—	1	—	3	1	2	—	2	**23**	2	—
Purple	—	2	1	1	5	—	—	1	1	2	**19**	—
Bowebu	—	—	—	—	—	—	—	—	1	—	—	**1**
Grey	—	—	—	—	—	—	—	1	2	1	—	**8**

[a] Colour Number Key:
1 = White 5 = Dark blue 9 = Orange
2 = Black 6 = Light blue 10 = Pink
3 = Red 7 = Yellow 11 = Purple
4 = Green 8 = Brown 12 = Grey

[b] Original Setswana terms are italicized.

[c] Correct usage is shown in bold.

$F = 74{\cdot}38$; d.f. = 1, 69; $p < 0{\cdot}0009$, due to the proportion of primary terms offered being greater than the proportion of secondary terms. There was no significant effect of age.

Colour naming

Table 8 shows the response by tile-colour matrix; the cell entries are the number of times a given term was used to describe a given tile, summed across the total sample. A response was counted as correct if it matched the dominant adult responses in either language as shown in Table 1. Note that this means that some terms had more chances of being used correctly than others: *bosetlha* would have been counted as a correct response to either the 'brown' or 'yellow' tiles; *botala* was counted as a correct response to either the 'green' or the two 'blue' tiles; and *blue* as a correct response to either of the two 'blue' tiles.

The frequencies with which terms were used correctly are highlighted in Table 8; it can be seen that the most frequent term-colour combinations are

TABLE 9. *Overall frequency of use, correct frequency of use and the ratio of correct to total use in the naming task*

Term	Total frequency	Total frequency correct	Ratio of frequency correct to total frequency
Bosweu[a]	48	41	0·87
White	25	22	0·88
Bontsho	63	45	0·71
Black	36	26	0·72
Bohibidu	44	35	0·77
Red	25	20	0·80
Botala	75	57	0·76
Green	38	24	0·63
Blue	61	41	0·67
Bosetlha	22	13	0·59
Yellow	84	51	0·61
Borokwa	2	2	1·00
Brown	40	30	0·75
Orange	36	28	0·78
Pink	34	24	0·71
Purple	33	20	0·61
Bowebu	2	1	0·50
Grey	12	8	0·67

[a] Original Setswana terms are italicized.

always correct responses. What consistent confusions there are, are orderly, in that incorrect responses tend to be the use of a term to describe a 'perceptual neighbour' of the referent of the term; for example, *yellow* is used to describe the 'orange' tile 13 times, *blue* is used to describe the 'green' tile 5 times and the 'purple' tile 7 times, and *botala* is used to describe the 'purple' tile 7 times. The greatest spread of incorrect responses is for *yellow*, which is used at least once to describe every tile apart from the 'purple' one.

Table 9 summarizes the most pertinent features of the response by tile matrix; it shows the frequency of use, the frequency of correct use, and the ratio of correct to total use for each term, for the whole sample. It can be seen that, as with colour listing, the most frequent terms used are primary terms, but the rank orders of the frequencies in the two tasks differs somewhat; the main difference is that *green* and *blue*, allowing for the double opportunity of using them, are used less frequently than *bontsho*, *bosweu* and *bohibidu*. A similar pattern is shown by the frequency of correct use scores, in that primary terms tend to be used correctly more often than secondary terms, but *green* and *blue* (allowing for the two 'blue' tiles) slip even further down the rank order, scoring less than *orange* and *brown*. The final column in Table 9 shows that although *yellow* is the most frequently used term, and the term used most correctly, it has a relatively low proportion of correct use,

TABLE 10. *Frequency of correct use for each combination of sex and age, in the naming task*

	Age (years)								
	5		6		7		8 to 9		
Tile	Male	Female	Male	Female	Male	Female	Male	Female	Total
'White'	8	6	4	9	7	9	10	10	63
'Black'	9	9	6	8	10	10	10	9	71
'Red'	4	5	3	6	8	8	10	10	54
'Green'	3	5	4	6	7	5	7	10	47
'Dark Blue'	2	5	2	5	5	3	4	7	33
'Light Blue'	2	7	3	6	5	4	6	9	42
'Yellow'	3	9	5	6	6	6	7	9	51
'Brown'	5	5	2	5	4	6	8	10	45
'Orange'	3	6	3	3	1	2	5	5	28
'Pink'	2	6	4	3	1	1	3	4	24
'Purple'	2	3	2	3	1	3	2	4	20
'Grey'	0	2	1	1	1	1	1	2	9
	4·78	6·80	4·33	6·78	5·60	5·80	7·30	8·90	
Mean scores	5·84		5·56		5·70		8·10		6·32

TABLE 11. *Mean proportional scores for the correct use of primary and secondary colour terms, for each combination of sex and age*

	Age (years)									
	5		6		7		8 to 9		Mean	
	Prim.	Sec.	Prim.	Sec.	Prim.	Sec.	Prim.	Sec.	Prim.	Sec.
Male	0·49	0·27	0·43	0·27	0·69	0·16	0·77	0·38	0·60	0·27
Female	0·66	0·44	0·73	0·33	0·64	0·26	0·91	0·50	0·74	0·38
Mean	0·58	0·36	0·58	0·30	0·66	0·21	0·84	0·44	0·67	0·33

reflecting its 'profligate' spread in Table 8. *White*, *green*, and *purple* are the only other terms with proportions of correct use much less than 0·7.

Table 10 shows the number of correct responses to each tile for each combination of age and sex. There appears to be a trend for performance to improve with age, particularly for the primary coloured tiles: 'white', 'black', 'red', 'green' and 'yellow', together with 'brown' of the secondary colours, are named progressively more correctly with age, and are at, or close to, ceiling performance for the oldest group, whereas most of the secondary colours are named correctly by less than half the children, irrespective of age. The final column of Table 10 shows the number of correct responses to each tile; these are derived by summing the correct

English and Setswana responses for each tile. There is a striking correspondence between the rank order of these frequencies, and the rank order of the Berlin & Kay hierarchy. Apart from 'brown' being more frequent than the most frequent 'blue', the match is virtually perfect.

The proportion of primary colours and the proportion of secondary colours named correctly by each child was calculated, and the mean scores across subjects for each combination of age and sex are shown in Table 11. A three way ANOVA on age, sex and type of colour, with repeated measures on the last factor, confirmed that the effect of age was significant, $F = 3{\cdot}5$; d.f. $= 3, 69$; $p < 0{\cdot}02$; that girls scored more than boys, $F = 4{\cdot}1$; d.f. $= 1, 69$; $p < 0{\cdot}05$; and that primary colours were named correctly more frequently than secondary colours, $F = 120{\cdot}3$; d.f. $= 1, 69$; $p < 0{\cdot}0009$. In addition the interaction between age and the type of colour was signifcant $F = 2{\cdot}86$; d.f. $= 3, 69$; $p < 0{\cdot}05$, reflecting the greater improvement of primary colour naming than secondary colour naming with age. Again, as for the list task, it was the younger children who tended to use the English terms; the two younger groups used about 75% English terms, whereas the two older groups used just under 50% English terms, $F = 3{\cdot}5$; d.f. $= 1, 74$; $p < 0{\cdot}03$.

Comparison of elicited lists and naming

Comparing Tables 8 and 12 we see that scores are higher in the naming task than the list task. A four-way ANOVA on tasks (list and naming), type of colour (primary or secondary), sex and age, supported this impression. The effect of task was highly significant, $F = 18{\cdot}19$; d.f. $= 1, 69$; $p < 0{\cdot}0009$, as was the type of colour, $F = 141{\cdot}24$; d.f. $= 1, 69$; $p < 0{\cdot}009$, and sex was also significant, $F = 6{\cdot}14$; d.f. $= 1, 69$; $p < 0{\cdot}02$. In addition there were two significant interactions between: age and task, $F = 3{\cdot}4$; d.f. $= 3, 69$; $p < 0{\cdot}025$, and age and type of colour, $F = 3{\cdot}44$; d.f. $= 3, 69$; $p < 0{\cdot}025$. The first interaction is because for the three younger groups there is effectively no change with age on either task (all means about 0·4) but the mean for the proportion correct on the naming task for the eldest group rises to 0·64, whereas the equivalent change for the list task is much smaller. The second interaction is due to performance with the primary terms tending to increase with age (means increase from 0·58 to 0·84) whereas there is little if any improvement on the secondary terms with age (means are 0·36 for the youngest group and 0·44 for the eldest group).

Further explication of the degree of mastery of colour terms, and the relationship between overlapping terms in the two languages, may be gleaned by considering the contingencies between offering a term in the list phase, and whether that term is then used correctly in the naming phase. Three relationships are considered here. First, correct use: a term offered in the list phase is used correctly in the naming phase; second, incorrect use: the referent(s) of the offered term is not named correctly in the naming phase;

and finally, a 'switch': the offered term is not used to name the appropriate tile(s), but the tile is named correctly with a term from the other language.

The terms, by and large, fall into three groups, in terms of the possible relationships outlined above. First the 'black-white' terms: *bosweu* 'white', *white*, *bontsho* 'black' and *black*, were almost always used correctly. They were offered 83 times in the list phase, and used correctly 78 times in the naming phase. Second, the 'blue-green' group: *botala* 'grue', *blue* and *green* as well as a fair degree of correct use, also showed some errors and some switches. The three terms were offered a total of 93 times, and there were 170 opportunities to use them correctly. They were used correctly on 93 occasions; there were 59 opportunities to use them correctly which were not taken, and there were 18 switches. Of the switches, the great majority (15 out of 18) were from English to Setswana, and all of them were produced by the two oldest groups, even though the two younger groups only offered the English terms.

Finally, the terms: *bohibidu* 'red', *red*, *yellow*, *brown*, *orange*, *pink* and *purple* were offered by more than 20 of the sample, generally used correctly and switches were rare. The percentages of correct use were: *bohibidu* 84%, *red* 68%, *yellow* 87%, *brown* 83%, *orange* 72%, *pink* and *purple* 50%.

The inter-relationship between performance, age and schooling

The full correlation matrix between the four performance tasks, age and number of years at school is shown in Table 12. The performance tasks all

TABLE 12. *Correlation coefficients and significance levels between age, the amount of schooling, scores on the vocabulary tasks and scores on colour naming*

	Age	School	Colour lists	Animal lists	Body lists
School	0·56**				
Colour lists	0·10	0·15			
Animal lists	0·48**	0·31**	0·43**		
Body lists	0·29*	0·31**	0·31**	0·49**	
Colour naming	0·25*	0·30**	0·71**	0·44**	0·29**

* = significant at $p < 0{\cdot}05$. ** = significant at $p < 0{\cdot}01$.

inter-correlate significantly: the lowest correlation coefficient is between the number of body terms and the number of tiles named correctly, $r = 0{\cdot}27$, $p < 0{\cdot}05$, and the largest coefficient is between the two colour tasks, $r = 0{\cdot}70$, $p < 0{\cdot}001$.

All the performance task scores, except colour term listing, correlate significantly with age and with number of years at school: r ranges from 0·30 to 0·50, $p < 0{\cdot}01$. Recall that age and number of years at school also are

significantly correlated; in order to try to unravel this group of correlations, the partial correlations between age and performance, controlling for schooling, were calculated; age correlates significantly with the number of animal terms, $r = 0{\cdot}40$, $p < 0{\cdot}01$, but not with any of the other performance measures. Similarly, calculating the partial correlations between the performance measures and schooling, controlling for age, indicates that the number of body terms and the number correctly named significantly correlate with the number of years schooling, $r = 0{\cdot}20$ and $0{\cdot}22$ respectively, $p < 0{\cdot}05$ in both cases.

DISCUSSION

One of the main aims of the study was to test the Berlin & Kay speculation that the order of the acquisition of colour terms would mirror the order of the Berlin & Kay hierarchy. Our data is in general consistent with the theory, but the rationale underlying this test has been undermined somewhat, in that the anticipated developmental change was not found on the list task. In fact, the number of terms offered, about five (Table 4), was remarkably similar, on average, to the number of terms offered by adults (Davies *et al.* 1992).

This lack of the expected developmental trend may be partly due to the overlap between the age groups in the amount of schooling they had received; but even allowing for schooling, there was no correlation between the number of terms offered and age. In the two other list tasks, which had been included as approximate measures of general vocabulary, there was a strong increase in the number of terms offered with age (Table 3) and this appeared to be influenced by the number of years at school (Table 12). Similarly the fact that girls offered significantly more colour terms than boys suggests that the colour list task was sensitive enough to detect differences in the availability of colour terms. It may be that the children in all groups had acquired a term to cover the basic slots included in traditional Setswana, and that there were few influences on them to extend their repertoire further. In other words we may be observing a ceiling effect, and we need to include younger groups in order to detect the expected developmental change. However our choice of age groups was based on careful pilot work which had indicated that three- and four-year-olds seemed to have virtually no knowledge of colour terms. Most of the children had had some schooling (Table 2); it may then be that during their first year at school they acquire sufficient familiarity with colour terms to be able to offer four or five terms in the list task. There are still many children up to ten years of age in Botswana with no experience of school, and this speculation is therefore, in principle, testable.

Performance on the list task is just one indicator of knowledge of colour terms. Although there was no developmental trend on that task, there was on the colour naming task (Table 10): the older children named more tiles

correctly than the younger children. Further the developmental trend was consistent with at least the weak form of the Berlin & Kay hypothesis in that the improved performance with age was due mainly to an increase in the number of primary terms used correctly (Table 11).

The clearest support for Berlin & Kay's theory, is to be found across the whole sample, rather than in the patterns of change with age. At the weakest level, more primary terms than secondary terms were offered in the list task (Table 5), and more primary terms than secondary terms were used correctly in the naming task (Table 8). At a stronger level, the rank order of the frequencies of correct tile naming, correspond closely to the Berlin & Kay sequence (Table 10). The only deviation from the Berlin & Kay sequence is that the 'brown' tile was named correctly marginally more often than either of the 'blue' tiles. This may be due partly to neither of the 'blue' tiles being the 'universal' blue; but British children, in a similar study which will be reported elsewhere, named both tiles *blue*, more often than they named the brown tile *brown*, suggesting that the effect of not including the ideal blue was not very marked. On the other hand it may reflect some uncertainty in the use of the borrowed English term and the traditional Setswana term, *botala*. We discuss this further below.

Our second main reason for carrying out the study was to compare the children's colour vocabulary with the adults' that we had previously studied. We were particularly interested to see if the vacant basic slots had been filled by the deployment of existing non-basic Setswana terms or by borrowing from English. Perhaps the clearest feature of our data is the extent to which the children used English terms; overall more English terms were used than Setswana terms (Table 8), and some of the younger children only offered English terms. This is in marked contrast to the adults, who rarely used any English terms (Table 4). But the intrusion of English was not used to expand the basic colour term inventory; rather Engish terms were by and large substituted for Setswana terms. It was very rare for a child to use both members of English-Setswana equivalent pairs, and equally rare for children to use *orange*, *pink* or *grey*, as a way of filling the vacant basic slots in Setswana. Two basic Setswana terms, *bosetlha*, and *borokwa*, and *selaole* which we expected to become the basic term for 'purple', were used very little by the children. Instead, *yellow*, *brown* and *purple* had taken over from the Setswana terms. The one exception is that some children now used *blue* and *green* instead of the single term *botala*, and some used either *blue* or *green* along with *botala*. But this splitting of the composite category 'grue' is accompanied by some uncertainty; the great majority of the switches from offering an English term in the list phase to using a Setswana term in the naming phase, were switches from *blue* or *green* to *botala*.

Performance on the two colour tasks was quite strongly correlated, but the colour naming task, as well as showing the expected developmental trend,

which the colour listing task did not, produced higher scores than the colour listing task. That is, children were able to use terms correctly that they had not offered in the list task. Focal colours appear to be able to gain access to the cognitive colour lexicon more effectively than either the superordinate term colour or the particular colour terms offered early in the list. But the reverse is also the case; that is, children offered a term in the list phase but used it incorrectly in the naming phase, or used an alternative term in the naming phase. Offering a term is no guarantee of using it correctly, and not offering a term is no guarantee of not being able to use it correctly. However these asymmetries may be more common in children who have yet to develop full mastery of the colour lexicon than in adults, and may be useful measures of the stability of the colour lexicon.

One curious aspect of the data was that it was the younger children who tended to use the English terms. Our collaborators in Botswana report that using English has become 'fashionable' in Botswana in the last few years, especially amongst high status adults. It is possible that our younger children were more likely to be exposed to English colour terms at the time when they were learning colour terms and incorporated them into their vacant slots for basic colour terms. By the time the older children were exposed to English colour terms, their basic colour term slots were already filled with Setswana terms, and they therefore had little impact.

Although the younger children tended to use English colour terms they also tended to use them incorrectly. This is most clear for *blue* and *green*; it was common for children in the youngest group to offer these terms in the list phase and then use them incorrectly in the naming phase. In contrast, the older children, were more likely to switch to *botala* 'grue', in the naming phase, than to use *blue* or *green* incorrectly. However we cannot tell whether the younger children used the terms incorrectly because they are borrowed terms, or simply because they are younger children. As with trying to understand the lack of a developmental trend in the list task, a study of children from more remote rural areas, where they would be less likely to be exposed to any English colour terms, might help to reveal the reasons for these high error rates.

In general, girls performed better than boys on the colour tasks, and on body-part and animal-name listing (Table 3). Our sample of Russian children that we alluded to in the introduction showed similar sex differences. In both cases, this probably reflects girls' generally faster developmental rate for language than boys', which has been observed frequently, in the developed world at least (Halpern, 1992:64).

In summary, our data are broadly in accord with at least the weak version of the Berlin & Kay hypothesis: for the sample as a whole more primary than secondary terms are known and the rank order of terms by correct use is strikingly similar to the rank order of terms in the hierarchy. Further, to the

extent that terms are used more correctly by the older groups, the improvement is greater for primary terms than for secondary terms. The colour lexicon exhibited by these children has changed substantially compared to the rural adults we had previously observed, by importing English terms; but in general the borrowed terms have been used as substitutes for traditional Setswana terms rather than to fill the vacant slots for basic terms. There is some evidence that the composite category 'grue' is decomposing and being replaced by the English terms *blue* and *green*. Many of these changes are happening so quickly that if the traditional language is to be studied further and the transitions observed, action is needed now.

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