Colours in Tsakhur: First account of the basic colour terms of a Nakh-Daghestanian language

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Abstract

We report a study of the colour terms of the Nakh-Daghestanian language Tsakhur, designed to establish the inventory of basic colour terms (BCTs), and to test Berlin & Kay's theory of colour universals on a new language family. Twenty teenagers aged from 10 to 15 years and 19 adults did a colour term list task (write down as many colour terms as you can) and a colour naming task (name 65 representative colour "tiles"). Measures of salience and consensus derived from the two tasks converge to suggest that for adult speakers Tsakhur may have twelve BCTs. Eleven of these match Berlin & Kay's eleven universal terms perfectly, but the twelfth term—alnti:k'a—*is the first reported case of a possible BCT for 'turquoise'. While the latter is inconsistent with the original Berlin & Kay (1969) theory, it can easily be accommodated in later versions of the theory. Teenage speakers had just eight BCTs, a subset of the adult BCTs; they had no BCTs for 'brown', 'purple', 'grey', or 'turquoise'. The teenagers appear to be still learning BCTs, which contrasts with English and Russian children who have normally completed this process before they are ten years old.*

Keywords: *basic colour terms, language acquisition, lexical semantics, Tsakhur*

1. Introduction

There has been relatively little typological work on lexis, with one notable exception, namely work on colour categorisation, which has been extensive and fruitful. Colour categorisation has been used as a vehicle to debate three fundamental and interrelated questions. First, what is the ontological status of perception: is colour "in the head" or "in the world" (see, e.g., Locke 1690, Hardin 1988). Second, what is the relationship between language and thought: do different colour lexicons imply parallel differences in the perception of colour

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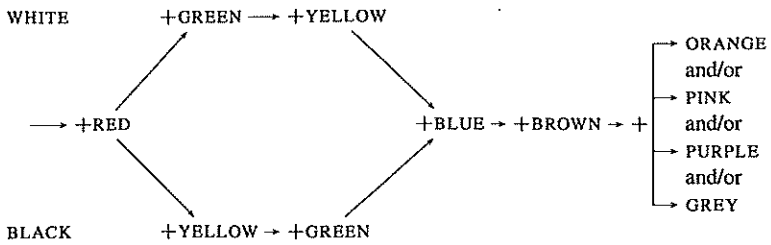

Figure 1. *The Berlin and Kay (1969) hierarchy of basic colour terms*

(see, e.g., Rivers 1901, Palmer forthcoming)? And third, are there linguistic universals: are colour lexicons drawn from a restricted universal set or do they vary without constraint (Geiger 1880; Berlin & Kay 1969; Saunders & van Brakel 1997)? In this paper we are primarily concerned with the third question (colour universals), but the study is part of a large cross-cultural research programme aimed at addressing the second question (linguistic relativity). In order to address the second question we needed to establish the colour term inventories of typologically diverse languages, and here we report the results from one language, Tsakhur, a Nakh-Daghestanian language of the Caucasus, whose colour inventory has not been studied previously. We establish what the "basic" colour terms of Tsakhur are, and compare these to Berlin & Kay's (1969) proposed set of eleven universals.

2. The theory and how to test it

2.1. *The Berlin & Kay (1969) theory*

Before 1969 the prevailing view was that languages could partition colour space without constraint. For instance, Ray wrote "Each culture has taken the spectral continuum and has divided it into units on a quite arbitrary basis" (1952: 258). Languages vary in their number of colour terms, and in the position of category boundaries, and this diversity is consistent with cultural relativism. In contrast, Berlin & Kay proposed that there were colour universals: all "basic" colour terms were drawn from a set of just eleven universal colour terms as shown in Figure 1.

The terms (shown in small capitals) are the hypothetical universal set, while terms such as *red* are the tokens of the universal terms in a particular language (in this case English). There were three crucial manoeuvres that allowed Berlin & Kay to reconcile the observed diversity of colour terms with their claim of universal colour terms. First, the theory was restricted to basic colour terms (frequent, salient, agreed reference); non-basic terms were outside the scope of the theory, and thus free to vary across languages. Second, the number of basic colour terms could vary from two to eleven, provided the terms were drawn from the universal set. Third, the colour categories labelled by basic terms were defined by their foci (the best exemplar), rather than by their boundaries; variation in the position of boundaries was consistent with the theory, provided the category foci matched the foci of the universal set. Thus, although the core of the theory is universalist, it achieves this by leaving scope for culture to influence the size of the colour lexicon, boundary positions, and secondary colour terms.

The concept of BASIC colour term (BCT) is central to the theory. BCTs are simple, in the sense that their meaning is not derivable from constituent parts; their signification is not included in that of another term; their use is not restricted to a narrow range of objects; and they are psychologically salient. These criteria have been contested by Crawford (1981), Moss (1989), Ratner (1989), and Saunders & van Brakel (1997) amongst others. However, Kay et al. (1997) state that the original 1969 criteria for basicness were more a set of guidelines than a formal definition. This concession would probably satisfy Crawford and Moss, but not Ratner or Saunders & van Brakel. For Tsakhur, at least these criteria covary. It will be seen that salient colour terms are also simple and general. We assume, as do most investigators, that a crucial property of a basic colour term is that there should be good agreement across speakers on the best instances of what a term denotes—its focus in other words; there will be less agreement among speakers in the boundary areas.

The theory has synchronic and diachronic implications. The eleven universal terms are ordered hierarchically with a strong implicational structure, as follows. If a language has a particular term, then it should also have all terms higher on the hierarchy. For instance, if a language has a term for BROWN then it should also have terms for BLUE, YELLOW, GREEN, RED, BLACK, and WHITE. Terms sharing a position on the hierarchy such as PURPLE, PINK, ORANGE, GREY were not differentiated in terms of the implicational structure. Thus, the relative order in which a language acquired tokens for terms sharing a position was not specified.

The hierarchy also represents a hypothetical "evolutionary structure". The order in which languages acquire BCTs should be consistent with the hierarchy. Thus languages should first acquire terms for BLACK and WHITE; then a term for RED; then a term for either GREEN or YELLOW; then whichever of GREEN or YELLOW was missing; and so on up to the theoretical maximum of eleven basic colour terms.

The theory has undergone a number of important developments (Kay 1975; Kay & McDaniel 1979; Kay et al. 1991). Kay & McDaniel argued that there are three different kinds of basic colour categories: "primary", "composite", and "derived" categories. The distinction between these three kinds of category

is based on perceptual physiology and the formalism of fuzzy logic. In fuzzy logic, the strength of category membership can vary continuously in contrast to the all-or-none category membership of more traditional logic. The exemplar with the strongest membership value is the category focus. The perceptual physiology of the time (De Valois & Jacobs 1968) suggested that there were six "fundamental neural responses" corresponding to the six colours of Hering's (1920) opponent process theory of colour vision: black–white, red–green, and blue–yellow (see Jameson 1985). Each of the six colours is a perceptual primitive with a correspondingly unique neuronal signal. These six colours form the basis of the six primary colour categories of Kay & McDaniel's theory.[1]

Composite categories are fuzzy-set unions (denoted here by {X ∪ Y}) of two or more primary categories. For instance, Setswana, like many Bantu languages, has a composite term *botala* 'blue or green'. The range of a composite category includes the ranges of its constituent primary categories. Thus *botala* includes the universal foci for BLUE and GREEN. The transitions between the early stages of the hierarchy consist of the successive division of the composite categories into their constituent primaries, so that by stage five the six terms are the lexicalisations of the six primary categories, each with a focus corresponding to one of the six Hering primaries.

Derived categories are the fuzzy set intersections (denoted here by {X ∩ Y}) of two primary categories. Thus, for instance, ORANGE is {RED ∩ YELLOW} (the intersection of RED and YELLOW) and it includes some of the region of colour space between the foci of the parent-primaries. All languages with more than six BCTs should have at least one derived colour category. The terms with the five lowest positions on the Berlin & Kay hierarchy can be thought of as fuzzy-set intersections as follows: {YELLOW ∩ BLACK}=BROWN; {RED ∩ BLUE}=PURPLE; {RED ∩ WHITE}=PINK; {RED ∩ YELLOW}=ORANGE; and {BLACK ∩ WHITE}=GREY. Note that this list does not include several possible intersections of primaries, for instance {GREEN ∩ YELLOW}, {BLUE ∩ GREEN}, {BLUE ∩ BLACK}, and {BLUE ∩ WHITE}. It remains to be explained why just some of the possible intersections are expressed as BCTs in natural languages. We believe that Russian has two basic terms for BLUE—*sinij* 'dark blue' and *goluboj* 'light blue' (Corbett & Morgan 1988; Davies & Corbett 1994). These two terms can be thought of as a derived term—*goluboj* 'light blue' BLUE ∩ WHITE—and the residual primary term—BLUE *sinij* 'dark blue'.

Although a twelve term language such as Russian, may at first seem inconsistent with the Berlin & Kay theory, it is not inconsistent with the formal structure of the theory. The five derived terms of the theory are based on an empirical generalisation: these terms are frequently found. But the formal theory does not distinguish among the five observed derived terms and the remaining possible derived terms. Thus a language with a new basic derived term such as TURQUOISE (GREEN ∩ BLUE) might necessitate modification of the empirical structure of the theory, without violating the formal structure. Zollinger (1984) conjectured that both English and German were on the verge of acquiring a basic term for TURQUOISE, and as we shall see, Tsakhur may have such a BCT.

There are precedents to modifying the empirical structure of the theory. Relaxations in the implicational structure of the hierarchy to accommodate departures from the hierarchy have been made. According to Kay et al. (1991), BROWN, PURPLE, and GREY are "wildcards" and can appear anywhere in the order. In the latest version of the theory (Kay et al. 1997) they suggest that this may be because partitioning of composite categories and acquisition of derived categories are partially independent processes. Thus the derived terms can appear before complete decomposition of the composite categories.

2.2. *Tests of the theory*

Once the set of basic colour terms is established, there are a number of tests of the theory that can be applied. First, are all the terms instances of the eleven universal terms? Second, if so, is the particular set consistent with the implicational structure of the hierarchy? For instance, a basic term for PINK without a basic term for say, YELLOW, would be inconsistent with the theory.

The theory provides a translation rule for matching observed categories to their corresponding universal category. The correspondence is based on the focus of the category: first determine the best example of the category, and then find the closest universal focus. This procedure may mean in practice, that "novel" categories are unlikely to be found, unless they are in addition to the eleven universal categories. For instance, a basic term for TURQUOISE, might look very much like either BLUE or GREEN with unusual boundaries, unless there were clear terms for BLUE and GREEN, including the appropriate foci, as well.

Our methods for determining BCTs are based, first, on linguistic analysis; second, on measures of salience; and third, on measures of consensus of reference. We use linguistic analysis to assess whether terms are simple and used generally. Our measures of salience and consensus are derived from the main tasks: a list task and a colour naming task. In the former, informants are asked to say as many colour terms as they know, and we use frequency of occurrence across informants as a measure of salience. In the naming task, informants are asked to name a standard set of colour-tiles. We use frequency of use as a further measure of salience, and derive various measures of consensus (the dominance indices). In most cases, the linguistic analysis, measures of salience and of consensus converge to indicate the basic colour terms.

2.3. *Pilot work on Tsakhur*

Tsakhur is a member of the Lezgic group of the Nakh-Daghestanian family; for a general description see Kibrik (1999). According to Ibragimov (1990: 3) there are around 30,000 Tsakhurs (though he does not indicate how many speak the language). More Tsakhurs live in Azerbajdjan than in Daghestan. Like other members of this family, it has an exceptionally rich phonemic inventory. A summary of the phonetics is given in Kibrik & Kodzasov (1990: 343–344); see also Ibragimov (1990: 19–41). In the orthography used by Aleksandr Kibrik and his colleagues, which we adopt here, the following conventions are used: ˤ indicates pharyngalization; for vowels, colon indicates length; and for consonants, ' marks ejectives, macron indicates intensive pronunciation, $_o$ indicates labialization; G is a voiced uvular stop, and X an unvoiced uvular fricative.

In 1995 Corbett joined Aleksandr Kibrik's team on a field trip to the village of Mishlesh in Daghestan. He carried out a preliminary study of Tsakhur colour terms. Ten Tsakhur speakers did a colour-term list task and a colour naming task using a standard set of 65 colour-tiles (versions of these tasks were also used in the main study). It is evident that investigating colour terms was timely, because on some occasions, when consultants did not immediately find a term, they would offer a Russian term and then consider possible Tsakhur equivalents. The data obtained then suggested that the most prominent Tsakhur colour terms were: *k'arin* 'black', *ǯag$_o$aran* 'white', *č'aran* 'red', *čiwan* 'green', *zirgin* 'yellow', *lagarin* 'blue', *muXak* 'brown', *Gilbin* 'orange', *nabatan* 'pink', *jilq̄in rang* 'grey', and *alnti:k'a* 'turquoise'. These terms were given by the majority of consultants in the list task, and there was reasonable consensus over what they denoted in the naming task. In addition *ǯangarin* 'purple' was offered by some consultants in the list task, but with low consensus in the naming task. The relationship among *zirgin* 'yellow', *Gilbin* 'orange', and *muXak* 'brown'—colours that are adjacent in colour space—was unusual. Thus, *Gilbin* 'orange' seemed to be a much larger category than *zirgin* 'yellow', which is unusual, and the status of *zirgin* 'yellow' was unclear. We planned to unravel these relationships using the larger data set to be collected in the main study.

In 1996 Aleksandr Kibrik's team returned to the village and as part of their programme administered a battery of colour tests to a sample of nineteen adults and twenty teenagers. These tests were part of a large cross-cultural study of the relationship between colour language and colour perception and cognition, most of which will be reported elsewhere. The test battery included the colour list task and naming task just described.

3. Method

3.1. *Consultants*

There were two samples of consultants: the "teenage" sample, and the "adult" sample. There were 20 people in the teenage sample, 8 boys and 12 girls, with ages ranging from 10 to 15 years ($\bar{x}$=12;4). There were 19 people in the adult sample, 8 men and 11 women, with ages ranging from 18 to 77 years ($\bar{x}$=36;4). All consultants were first-language Tsakhur speakers, but they also spoke Russian. The consultants lived in Mishlesh, the largest Tsakhur settlement, with about 1000 inhabitants.[2] Mishlesh is situated on the River Samur, somewhat higher up the valley than the settlement of Tsakhur itself, at about 1,800 metres. Tsakhur is the language normally heard in Mishlesh, though many people know Russian, to varying degrees, and some know other languages too, notably Azerbajdjani.

3.2. *Interviewers*

There were three interviewers: Tat'jana Borisovna Sosenskaja, Anna Rumšiskaja, and El'zara Orudževna Ibragimova. The first two are native Russian speakers, and they communicated with the consultants in Russian. The third is a first-language Tsakhur speaker who was born in the village. She was a third year psychology student at the University of Makhachkala, and she spoke Tsakhur to the consultants.

3.3. *Apparatus*

The City University Colour Vision Test was used to assess colour vision. 65 standard coloured "tiles" were used to elicit colour terms, and for two other tasks. Each tile was a 50 mm square of thin plywood covered with coloured paper. The colours were an evenly spread sample of "colour space" taken from the Color-Aid Corporation range. Figure 2 shows the location of the tile-colours in CIE uniform chromaticity space, and the loci of the universal foci. (In the Appendix we explain both the Color-Aid system and the CIE system. We use the latter to provide the technical specification of the colours, and these are also given.) The achromatic foci (WHITE, BLACK, and GREY) have the same coordinates in the two-dimensional u′, v′ space, labelled grey in the figure, but differ on the lightness dimension. Note that the loci of the universal foci, with the exception of BROWN, PINK, BLACK, WHITE, and GREY, are towards the outside of colour space. This is because the foci are the most saturated exemplars of these categories, and saturation increases centrifugally in the chromaticity diagram.

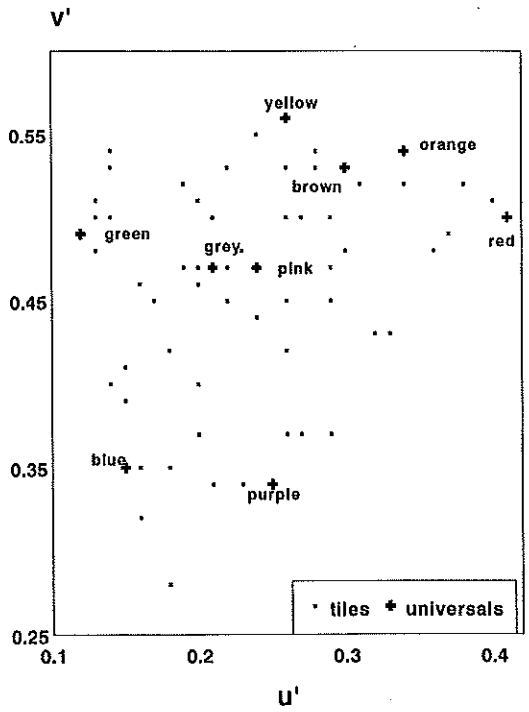

Figure 2. *Loci of the tile-colours and the universal foci in CIE (1976) uniform chromaticity space*

3.4. *Procedure*

The testing took place under natural light, either in a classroom close to a window, or on the terrace of El'zara Ibragimova's house. Direct sunlight was avoided. Potential consultants first did the City University Colour Vision Test, and only those with normal colour vision were included in the samples. Consultants in both samples did four tasks: colour lists; colour naming; colour grouping; and colour memory. The four tasks were performed in the order just given, but as we are only concerned here with the list and naming tasks, we will just describe these. In the list task, each consultant was asked to say as may colour terms as they knew, and the experimenter recorded these in the order in which the consultant said them. When the consultant paused, opportunity was given for them to continue until they were satisfied they could think of no further terms. In the naming task, the 65 tiles were presented one at a time

in a random sequence for each consultant, and they were asked to name the colour of the tile. If the consultant said they did not know, or whatever, this was accepted and recorded, as for any other response.

4. Results

4.1. *Glosses, forms, and variants*

In most cases, the glosses we give are based on the advice of our Tsakhur speaking colleagues (who gave Russian glosses). In addition, we used the tile naming data to assess the suitability of the glosses by comparing the best example of each Tsakhur term with what that tile-colour would be called in English. In general, the two criteria produced the same results.

There were three main kinds of variation across consultants in how terms were used. First, examples were given with or without the adjectival suffix, hence *lagar* ~ *lagarin* 'blue'. Such variants were used equivalently in the naming task, and therefore, here we just give the most common form of each term. Certain colour terms are also the names of objects: *muXak* 'cloves' and *nabat* is the name of a flower. These occurred with the adjectival suffix and without. Second, sometimes the colour term was used on its own, e.g., *k'arin* 'black', and sometimes it was used in the construction x-colour, e.g., *k'arin rang* (or *k'arin rangalin*) 'black colour'. We have collapsed these two variants onto whichever was the more frequent form. The most prevalent case where the construction x-colour was the most common form was for *jilq̄in rang* 'grey colour' (literally 'ash colour'). Third, there were "compound" terms, consisting of a general modifier plus the colour term; for instance *wuše lagarin* 'dark blue' and *ačuX čilwan* 'light green'. In reporting the list task we have treated compound terms as independent terms, and shown how often these forms were used. However, in the naming task, as the simple form was always used more frequently than the compound form, in summarising these data, we combined the compound forms with the simple form.

4.2. *List task*

The mean number of terms offered was 12.5 by the adults and 11.5 for the teenagers. There were no significant differences between the mean number of terms offered by men and women. Table 1 shows the colour terms offered by at least two consultants in either sample, and the percentage of each sample that offered each term. The terms are ordered by their frequency of use by the adult sample.

It can be seen that there are seven terms offered by the great majority of both samples (at least 85%): *k'arin* 'black', *čilwan* 'green', *č'aran* 'red', *ǯag$_o$aran* 'white', *Gilbin* 'orange', *zirgin* 'yellow', and *lagarin* 'blue'. 90% of the adults also offered *alnti:k'a* 'turquoise', but only 20% of the teenage sample did so.

Table 1. *List task: colour terms offered by at least two subjects in the adult or adolescent samples, and the percentage of each sample that offered that term*

Term	Gloss	Adult	Teenage
čɨlwan	green	100	100
karin	black	100	95
ǯag$_o$aran	white	95	100
č'aran	red	95	85
Gilbin	orange	95	75
zirgin	yellow	90	90
lagarin	blue	90	85
alnti:k'a	turquoise	90	20
muXak	brown	74	45
nabatan	pink	68	75
ǯangarin	purple	68	35
wuše lagarin	light blue	63	35
jilq̄in rang	grey	58	35
wuše č'aran	light red	42	45
wuše čɨlwan	light green	37	35
ačuX čɨlwan	dark green	26	30
badunǯan	lilac	11	20
Xanɨm-Xas	scarlet	11	0
wuše nabatan	light pink	0	20
ačuX nabatan	dark pink	0	10
wuše karin	light black	0	10
wuše zirgin	light yellow	0	10
bozin	grey	0	10

There were four further unmodified terms offered by over half of the adult sample: *muXak* 'brown', *ǯangarin* 'purple', *nabatan* 'pink', and *jilq̄in rang* 'grey'. These latter terms were also offered by the teenage sample, but in most cases with lower frequency (35–45%). The exception was *nabatan* 'pink', which was offered more frequently (75%) by the teenagers than by the adults (68%). There were also a number of compound terms offered. The modifier was either *wuše* 'dark' or *ačuX* 'light'. The most frequent compound term for the adults was *wuše lagarin* 'dark blue', and the most frequent compound form for the teenagers was *wuše č'aran* 'dark red'.

4.3. *Tile naming*

There were 2,535 possible responses in total (39 consultants times 65 tiles). About 6% of these responses were "don't know" while the remainder were

colour terms in either the simple form or compound form. The pattern of colour-term use was broadly similar for the two samples. The most frequent term given to a tile-colour was the same for 47 tiles. Further, for the remaining 18 tiles, the second most frequent term for one sample was the same as the most frequent term for the other sample. Therefore, in summarising the naming data, we combined the data from the two samples. However, we will also report some key differences between the two samples in the use of *alnti:k'a* 'turquoise', *muXak* 'brown', *ǯangarin* 'purple', and *jilq̄in rang* 'grey'.

The great majority of terms used were simple terms, and no compound term was ever the most frequent term used to name a tile-colour. In summarising the pattern of term use across the 65 tiles, we have collapsed compound versions of a term onto the simple form, to give a single score—the frequency (F)—for each term for each tile-colour. The frequency is the number of consultants that used a given term (in its simple or compound form) for each tile-colour. Table 2 shows the terms used to name each tile-colour by at least 2 people, together with the frequency with which a term was used. Next to the frequency scores we show how often compound versions of a term were used (in brackets). So, for instance, the first term in Table 2, *zirgin* 'yellow', was used to name the Y Hue tile by 38 out of the 39 consultants, and it was used in a compound form by one consultant (as shown in brackets).

Basic terms should be used frequently and with consensus over what they denote. Table 3 further summarises the distribution of terms across tiles by collapsing the scores across the 65 tiles. This allows us to establish the total frequency with which a term was used, and also to summarise the patterns of consensus in naming. The table shows, first, for the most prevalent colour terms (those used at least 0.5% of the total), the total frequency of use, summed across tiles and consultants, expressed as a percentage of the total number of responses. The terms are ordered by their frequency of use. So, for instance, the term with the highest score in the naming task was *čɨlwan* 'green' with a total score of 15.7%. It can be seen that the terms with the highest scores tend to be the same terms with high scores on the list task (Table 1). The major exceptions to this summary are that *k'arin* 'black' and *ǯag$_o$aran* 'white' have much lower relative positions on the total frequency measure than they have on the list task score. We will return to this discrepancy later.

Columns 4–6 of Table 3 show three indices of consensus with increasing "thresholds" for meeting the criterion for consensus. First, we give the number of tiles for which a term was the most frequent term (*nmf*). So, for instance, *čɨlwan* 'green' was the most frequent term for 11 out of the 65 tiles. It can be seen that there were just 12 terms that achieved this most frequent status (scores of 1 or greater). Further, these terms tend to be the those with high total frequencies (column 3), and with high scores on the list task (Table 1).

Table 2. *Naming task: terms given to the 65 tiles, the frequency of use, and the frequency with which the simple form was modified (in brackets)*

Code	Term	F	Code	Term	F	Code	Term	F
Y Hue	*zirgin*	38(1)				S2	*čilwan*	14(11)
	muXak	12(8)						
YOY Hue	*Gilbin*	26(2)	T4	*Gilbin*	22(15)	S2	*čilwan*	20(17)
	zirgin	6(2)		*zirgin*	16(1)		*jilq̄in rang*	5(2)
	č'aran	4					*muXak*	3(1)
YO Hue	*Gilbin*	37(3)	T3	*Gilbin*	26(3)	S3	*čilwan*	21(17)
	zirgin	2		*zirgin*	12(1)		*muXak*	9(1)
OYO Hue	*Gilbin*	37(4)						
O Hue	*Gilbin*	19(4)	S1	*muXak*	27(4)	S3	*muXak*	26(7)
	č'aran	17		*č'aran*	5(4)		*č'aran*	3(3)
	Xanim-Xas	2		*Gilbin*	2			
ORO Hue	*č'aran*	35(4)	T3	*Gilbin*	16(9)	S3	*jilq̄in rang*	14(2)
	Xanim-Xas	2		*č'aran*	12(10)		*karin*	3(1)
	nabatan	5(4)						
RO Hue	*č'aran*	38(2)	T3	*nabatan*	28(8)	S3	*karin*	19(1)
				č'aran	6(1)		*muXak*	16(1)
ROR Hue	*č'aran*	31(1)	T3	*nabatan*	25(8)	S3	*nabatan*	11(7)
	Xanim-Xas	7		*č'aran*	7(5)		*ǯangarin*	6(2)
R Hue	*č'aran*	21(6)	T4	*nabatan*	35(12)	S3	*karin*	18
	nabatan	15(6)		*č'aran*	2(2)		*muXak*	15(4)
	čplwan	2						
RVR Hue	*nabatan*	23(9)	S1	*nabatan*	15(6)	S3	*nabatan*	30(10)
	ǯangarin	5		*ǯangarin*	15		*čilwan*	2

Code	Term	F	Code	Term	F	Code	Term	F
	čilwan	4		*č'aran*	3(2)		*c'aryn*	2
	muXak	2						
	č'aran	2(2)						
	Xanim-Xas	2						
RV Hue	*nabatan*	15(6)	T2	*nabatan*	28(7)			
	ǯangarin	11(1)		*ǯangarin*	3(1)			
	lagarin	3(1)		*lagarin*	2(1)			
VRV Hue	*ǯangarin*	18(2)				S3	*nabatan*	30(12)
	nabatan	6(2)					*č'aran*	2(2)
	ǯag$_o$aran	3(1)						
	muXak	2						
V Hue	*ǯangarin*	17						
	lagarin	10(9)						
	ǯag$_o$aran	3(1)						
	alnti:k'a	3						
VBV Hue	*lagarin*	18(14)	T4	*lagarin*	15(10)			
	ǯangarin	11		*ǯangarin*	13(4)			
	ǯag$_o$aran	3(1)		*ǯag$_o$aran*	3(1)			
	alnti:k'a	2(1)						
BV Hue	*lagarin*	29(21)				S2	*lagarin*	10(7)
	ǯangarin	6					*alnti:k'a*	4
	alnti:k'a	2					*čilwan*	3(3)
							karin	2
BVB Hue	*lagarin*	28(19)				S3	*ǯangarin*	7(2)
	alnti:k'a	4(1)					*alnti:k'a*	7(2)
							lagarin	4(3)

Code	Term	F	Code	Term	F	Code	Term	F
B Hue	*lagarin*	36(8)	T1	*lagarin*	23(8)			
	alnti:k'a	2		*alnti:k'a*	7			
				Xa:ln rang	6			
				čilwan	2			
BGB Hue	*lagarin*	31(6)	T3	*lagarin*	19(8)			
	alnti:k'a	3(1)		*alnti:k'a*	17(1)			
BG Hue	*alnti:k'a*	22(1)	T1	*lagarin*	18(3)	S2	*lagarin*	13(6)
	lagarin	13(5)		*alnti:k'a*	16(1)		*alnti:k'a*	11(3)
	čilwan	2		*čilwan*	5(2)		*čilwan*	9(9)
							Xa:ln rang	2
GBG Hue	*čilwan*	37(6)				S2	*alnti:k'a*	20(3)
	lagarin	2					*lagarin*	12(3)
							čilwan	3
							gumus	2
G Hue	*čilwan*	37(5)				S3	*čilwan*	31(10)
							lagarin	6(3)
GYG Hue	*čilwan*	36(3)	T4	*čilwan*	35(17)	S1	*lagarin*	15(6)
				lagarin	2		*čilwan*	11(5)
							jilq̄in rang	8
YG Hue	*čilwan*	33(5)				S3	*karin*	21
							čilwan	11(10)
							muXak	3(2)
YGY Hue	*čilwan*	37(3)				S3	*čilwan*	35(22)
	lagarin	2						
Sienna	*muXak*	28(8)				Rose Red	*nabatan*	30(4)
	č'aran	5(1)					*č'aran*	3(1)

Code	Term	F	Code	Term	F	Code	Term	F
White	*ǯag$_o$aran*	39				Black	*karin*	38(2)
Gray 1	*jilq̄in rang*	25(3)	Gray 2	*jilq̄in rang*	29(3)	Gray 4	*jilq̄in rang*	26(3)
	ǯag$_o$aran	7(2)		*ǯag$_o$aran*	5		*karin*	5(1)
	bozin	2(1)		*bozin*	2		*ǯag$_o$aran*	4
				karin	2			
Gray 6	*jilq̄in rang*	13(1)				Gray 8	*karin*	37
	karin	11(1)						
	muXak	7						

Table 3. *Tile-naming summary: terms used in the tile-naming task, English glosses, the percentage of total usage, the number of tiles for which a term was the most frequent, and the dominance indices*

Term	Gloss	Percentage	Number of tiles most frequent (*nmf*)	Number of tiles dominant $D_{0.50}$	Number of tiles dominant $D_{0.75}$
čilwan	green	15.7	11	10	8
nabatan	pink	12.2	11	8	4
lagarin	blue	13.7	13	5	2
Gilbin	orange	9.2	7	4	2
č'aran	red	8.5	4	4	3
jilq̄in rang	grey	3.0	5	3	0
karin	black	6.5	5	3	2
muXak	brown	6.3	3	3	0
alnti:k'a	turquoise	5.2	2	2	0
zirgin	yellow	3.0	1	1	1
žag$_o$aran	white	2.2	1	1	1
žangarin	purple	4.8	2	0	0
badunžan	lilac	0.8	0	0	0
Xanim-Xas	scarlet	0.5	0	0	0
don't knows		6.1	–	–	–
Total		97.7	65	44	2

Column 5 gives a stricter measure of consensus: the DOMINANCE INDEX with a threshold of a half ($D_{0.50}$). It shows the number of tiles that were named with the same term by at least half the sample. Thus the scores in column 5 must be less than or equal to those in column 5 (*nmf*). It can be seen that all but one of the terms with non-zero *nmf* scores, also meet the $D_{0.50}$ criterion. The exception is *žangarin* 'purple'. Column 6 shows a yet stricter index of consensus: $D_{0.75}$. To score at this level, a term must be used by at least three-quarters of the sample for a given tile. Three of the terms that met the $D_{0.50}$ criterion fail to meet the $D_{0.75}$ criterion. These are: *jilq̄in rang* 'grey', *muXak* 'brown', and *alnti:k'a* 'turquoise'. However, if we just consider the adult sample, then all three of the latter terms achieve the $D_{0.75}$ threshold. In fact, as we shall see when we consider the best exemplars for each term, each of the three terms was used by about 90% of the adult sample to name at least one tile.

4.4. *Category foci*

Table 4 shows the tiles with the highest consensus in naming (the highest frequencies) for each of the most prevalent colour terms, for both samples. These

Table 4. *Tiles with the highest consensus in the naming task for the most prevalent terms, for the adult (n=19), adolescent (n=20) and combined groups (n=39)*

Term	Gloss	Tile	Max. adult score	Tile	Max. teenager score	Tile	Max. combined score
čilwan	green	G Hue	18	G Hue	19	G Hue	37
nabatan	pink	R T4	17	R T4	16	R T4	35
lagarin	blue	B Hue	17	B Hue	19	B Hue	36
Gilbin	orange	YO Hue	19	YO Hue	18	YO Hue	37
		OYO Hue	19	OYO Hue	18	OYO Hue	37
č'aran	red	RO Hue	18	RO Hue	20	RO Hue	38
jilq̄in rang	grey	Gray 4	18	Gray 2	13	Gray 2	29
k'arin	black	Black	19	Black	19	Black	38
muXak	brown	Sienna	17	Sienna	11	Sienna	28
		OS3	17	OS1	11		
alnti:k'a	turquoise	BG Hue	17	BG Hue	5	BG Hue	22
				GBG S2	5		
zirgin	yellow	Y Hue	19	Y Hue	19	Y Hue	38
žag$_o$aran	white	White	19	White	20	White	39
žangarin	purple	V Hue	11	VRV Hue	11	VRV Hue	18

tiles are the best estimate of the category foci that can be derived from our data, and we will later compare these to the universal category foci.

It can be seen that, with a few minor exceptions, the focal tiles are the same for two samples. The exceptions are *jilq̄in rang* 'grey', *muXak* 'brown', *alnti:k'a* 'turquoise', and *žangarin* 'purple'. They differ between the two samples in which tile has the highest consensus. Gray 4 has the highest score for *jilq̄in rang* 'grey' for the adults, while Gray 2 has the highest score for the teenagers. For *muXak* 'brown' two tiles share first place for both samples. In both cases one of the most frequent tiles is the Sienna, but the other tile is different for the two samples: it is OS3 for the adults and OS1 for the teenagers. For *alnti:k'a* 'turquoise' BG Hue has the highest score for the adults, but first place is shared between BG Hue and GBG S2 for the teenagers. In addition to these minor differences in category foci, for the three terms just given, the level of consensus is noticeably lower for the teenagers compared to the adults for these three terms. This is particularly so for *alnti:k'a* 'turquoise': the maximum score for the teenagers is just five, compared to 17 for the adults. Finally, the best exemplar of *žangarin* 'purple' is also different for the two samples, although in this case, the level of consensus is about the same for the two samples—the maximum frequency is eleven for both samples. The best exemplar for the adults is V Hue, while the best example for the teenagers is for

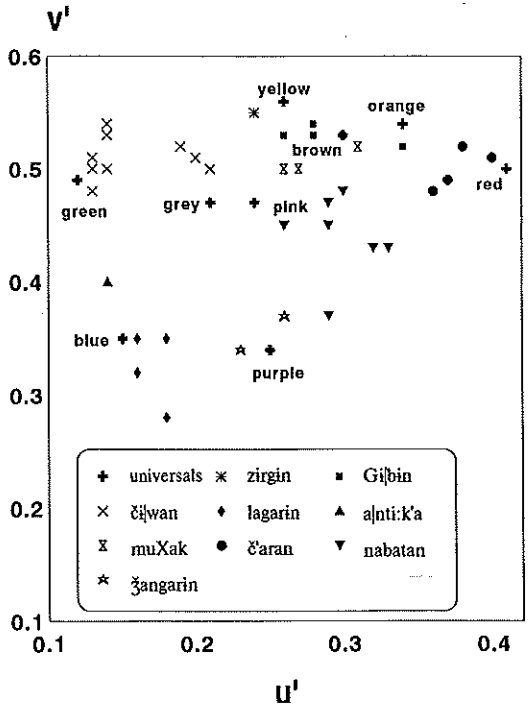

Figure 3. *Loci of Tsakhur colour categories and the universal foci in CIE (1976) uniform chromaticity space*

VRV Hue (colours close in colour space). This divergence in the best examples of *ǯangarin* 'purple' results in the term failing to meet the $D_{0.50}$ threshold for the combined samples, even though it would do for either sample considered alone. However, this 50% threshold is only just exceeded in either sample.

4.5. *Comparison of Tsakhur colour categories with the universal categories*

Figure 3 shows the locus of each tile which achieved the $D_{0.50}$ criterion for consensus in naming (see Table 3). The colour terms are represented by different symbols, and the loci of the universal foci are included for comparison. We do not show the loci for *k'arin* 'black', *ǯag$_o$aran* 'white', and *jilq̄in rang* 'grey'. These have approximately the same coordinates as the universal GREY (and WHITE and BLACK). They differ on the third dimension of the colour space L* (lightness): BLACK has the lowest L* value, WHITE has the highest L* value and GREY falls between the latter two.

Seven of the Tsakhur chromatic terms that meet the $D_{0.50}$ criterion (*č'aran* 'red', *čilwan* 'green', *zirgin* 'yellow', *lagarin* 'blue', *muXak* 'brown', *Gilbin* 'orange', and *nabatan* 'pink') occupy regions of colour space immediately adjacent to the loci of their respective universal foci. So for instance, the best exemplar of 'red' (RO Hue) falls just inside the locus of the universal RED, towards the top right of the diagram. This relationship also holds for *zirgin* 'yellow', *Gilbin* 'orange', and *muXak* 'brown', even though *Gilbin* 'orange' includes much of the colour space often included in YELLOW, for instance in English and Russian. The best examples of *Gilbin* 'orange' (YO Hue and OYO Hue) lie close to but just below ORANGE; similarly, the best exemplar of *zirgin* 'yellow' lies close to (below and left) of YELLOW. And *a|nti:k'a* 'turquoise', which has no corresponding universal focus, lies between the BLUE and GREEN regions, as would be expected. We also show the two best examples of *ǯangarin* 'purple': V Hue and VRV Hue, even though neither attains the $D_{0.50}$ criterion. It can be seen that both colours lie close to the focus of PURPLE.

5. Discussion

5.1. *The basic colour terms of Tsakhur*

Determining which colour terms are basic depends on which of the candidate terms meet key measures of simpleness and generality (linguistic criteria) and salience and consensus (behavioural criteria). We summarise some of these measures (derived in the most part from earlier tables) in Table 5 to make assessment of basicness easier. The first index is an assessment of whether the term satisfies the linguistic criteria: is the term simple and general? If the term passes both criteria, then this is indicated by a 1, and a failure to clearly meet these criteria is indicated by a 0. The second index is the frequency score on the list task, and this is shown for both samples (from Table 1). The third and fourth measures are both based on the naming task. They are, first, the percentage of total use, and second the $D_{0.50}$ score (both from Table 3).

There are five terms that meet the combined criteria for basicness unequivocally. These are (in order of the Berlin & Kay hierarchy): *č'aran* 'red', *čilwan* 'green', *lagarin* 'blue', *nabatan* 'pink', and *Gilbin* 'orange'. These terms meet the linguistic criteria (all score 1); they were offered by at least three quarters of both samples on the list task; they were used often in the naming task (at least 8% of total usage); and they all had $D_{0.50}$ scores greater than zero (this was also true of the $D_{0.75}$ criterion). In addition, *k'arin* 'black', *ǯag$_o$aran* 'white', and *zirgin* 'yellow' meet all the criteria except that their frequency scores in the naming task are relatively low compared to the six terms listed above. Even so, they score over 2% of the total. Low scores for BLACK and WHITE are found in most languages with no composite categories. This is due partly to

Table 5. *Terms, glosses, pass (1) or fail (0) the linguistic criterion, the percentage of the adult and teenage samples that offered the terms in the list task, the percentage of total usage in the naming task, and the number of tiles for which there was consensus of more than 50 per cent.*

Term	Gloss	Linguistic	List frequencies		Naming task	
			Adult	Teenager	Freq	$D_{0.50}$
karin	black	1	100	95	6.5	3
ǯag$_o$aran	white	1	95	100	2.2	1
č'aran	red	1	95	85	8.5	4
čɨlwan	green	1	100	100	15.7	10
zirgin	yellow	1	90	90	3.0	1
lagarin	blue	1	90	85	13.7	5
muXak	brown	1	74	45	6.3	3
ǯangarin	purple	1	68	35	4.8	0
nabatan	pink	1	68	75	12.2	8
Gɨlbin	orange	1	95	75	9.2	4
jilq̄in rang	grey	?	58	35	3.0	3
alnti:k'a	turquoise	1	90	20	5.2	2
Xanim-Xas	scarlet	0	11	0	0.5	0
badunǯan	lilac	0	11	20	0.8	0

the nature of our colour sample, and partly to the phenomena of colour contrast. The lightest colour in a set may appear white, but if a lighter colour is added, the "old-white" will now appear grey (the converse of this—the darkest tile appearing black—is also true). The combination of our colour sampling and the effect of colour contrast results in just one or two tiles being named *karin* 'black' or *ǯag$_o$aran* 'white'. But, critically, when the terms are used, they are used with high consensus, as reflected in their dominance scores. We conclude that *karin* 'black' and *ǯag$_o$aran* 'white' are BCTs. The low frequency score for *zirgin* 'yellow' is also in part due to the nature of the colour sample: there are not many yellow tiles in the sample. However, in addition, *Gɨlbin* 'orange' has an unusually large range, reflected in its frequency score of almost 10%. We glossed *zirgin* as 'yellow' and *Gɨlbin* as 'orange' following the translation rule we gave earlier, namely using the match between the category focus and the universal foci. Despite the relatively low frequency of use, *zirgin* 'yellow' is used with high consensus to name one tile and this tile is close to the universal YELLOW (see Figure 3). We conclude that *zirgin* 'yellow' is a BCT.

There are just four further terms that should be considered as serious candidates for BCTs. These are: *muXak* 'brown', *ǯangarin* 'purple', *jilq̄in rang* 'grey', and *alnti:k'a* 'turquoise'. One problem with these terms is the discrepancy between the adult and teenage samples. The adult scores for these four terms are much higher then for the teenagers, on all measures. Considering the adults alone, we would conclude that *muXak* 'brown' and *alnti:k'a* 'turquoise' are both basic: both terms are offered by almost three-quarters of the sample on the list task; they have high frequency scores on the naming task; and they meet the $D_{0.75}$ criterion. Further, *ǯangarin* 'purple' may also be a BCT for the adult sample, although the level of consensus over its use is lower than for other BCTs: it only just achieves the $D_{0.50}$ threshold. There is some doubt about *jilq̄in rang* 'grey'. It refers to the name of a "material" (viz., ash); and it occurred more often with *rang* 'colour' included than without, hence it is literally 'the colour of ash'. However, it does meet the criterion for generality of use (based on interviews with our consultants and its distribution of use in the naming task), and it meets all the behavioural criteria. In general, performance with respect to the criteria covary: terms with high salience and consensus of use also tend to be simple and general. Where there is a conflict, we give more weight to how a term is used, rather than to its origins. Terms failing the linguistic criteria need careful scrutiny, but they are not automatically disbarred from being BCTs (see Kay et al. 1997). Thus, for the adults, we conclude that *jilq̄in rang* 'grey' is a BCT.

In contrast, the four terms just considered (*muXak* 'brown', *ǯangarin* 'purple', *jilq̄in rang* 'grey', and *alnti:k'a* 'turquoise') are not BCTs for the teenage sample. The scores on the list task for the teenagers are low: they range from 20% (*alnti:k'a* 'turquoise') to 45% for *muXak* 'brown'. Similarly, with the exception of *ǯangarin* 'purple', they fail to meet the $D_{0.50}$ criterion for the teenage sample alone. Although *ǯangarin* 'purple' meets the $D_{0.50}$ criterion, it only just does so and its low salience is shown by a score of just 35% on the list task. We will return to the differences between the two samples later.

5.2. *Fit to the Berlin & Kay theory*

5.2.1. *Adult sample.* There are two key tests of the theory. First, do the foci of Tsakhur's BCTs correspond to the foci of the eleven universal foci? And second, does the set of BCTs form a set allowed by the theory? We saw earlier that the match among the Tsakhur foci and the universal foci was good, except of course for *alnti:k'a* 'turquoise'. However, the position of its focus (between BLUE and GREEN) is consistent with *alnti:k'a* 'turquoise' being the derived term {BLUE ∩ GREEN} (more on this later).

Turning to the second test of the theory—does the set of BCTs fit the implicational structure of the hierarchy?—there are two variants of this test to be considered. We can consider whether the observed set of BCTs fits the original, 1969 version of the theory (Figure 1). But, if the data are inconsistent with the 1969 theory, they may still fit the less constrained version of the theory (Kay

et al. 1991). Recall that in the latest version of the theory BROWN, PURPLE, and GREY are wildcards: they can appear anywhere on the hierarchy, or not at all. The latter three terms are three of the four Tsakhur terms (with 'turquoise') with the weakest claim to basic status. If we decided that they were not basic, the remaining set of eight BCTs would be consistent with the 1991 hierarchy: *karin* 'black', *ǯag$_o$aran* 'white', *č'aran* 'red', *čilwan* 'green', *zirgin* 'yellow', *lagarin* 'blue', *nabatan* 'pink', and *Gilbin* 'orange'. However, this set of eight terms does not fit the 1969 version of the theory: *nabatan* 'pink' and *Gilbin* 'orange' should not be BCTs unless there was also a term for BROWN. We concluded earlier, though, that *muXak* 'brown', *ǯangarin* 'purple', and *jilq̄in rang* 'grey' were BCTs for the adults, and adding these three terms to the set of BCTs yields a set of eleven BCTs that match the 1969 theory perfectly. The remaining problem is *alnti:k'a* 'turquoise'. It is clearly a BCT on linguistic and behavioural grounds, and this is inconsistent with both versions of the theory. However, although including this term as a BCT violates the empirical content of the theory, it does not violate the formal structure of the theory. As we said in the introduction, a BCT for TURQUOISE fits the formal theory as well as the empirically attested derived BCTs (BROWN, PURPLE, PINK, ORANGE, and GREY). Yet, although we say that a BCT for TURQUOISE fits the formal theory, Tsakhur is the only language reported to have a token of TURQUOISE. We know of no reason why this should be the case. It may be characteristic of this family of languages, and we are investigating this conjecture by studying Bagvalal. However, the status of *alnti:k'a* 'turquoise' as a BCT may be questioned because of the teenage data, and we turn to this next.

5.2.2. *Teenage sample.* There are eight terms that meet the criteria for BCTs: *karin* 'black', *ǯag$_o$aran* 'white', *č'aran* 'red', *čilwan* 'green', *zirgin* 'yellow', *lagarin* 'blue', *nabatan* 'pink', and *Gilbin* 'orange'. This set is inconsistent with the 1969 version of the theory: *nabatan* 'pink' and *Gilbin* 'orange' should not be BCTs unless there was also a term for BROWN. However, the set of eight BCTs is consistent with the 1991 theory.

5.3. *Differences between teenagers and adults*

The discrepancy between the two samples could be interpreted in two ways. First, the teenage sample may still be acquiring the full set of basic colour terms. The four discrepant terms—*muXak* 'brown', *ǯangarin* 'purple', *jilq̄in rang* 'grey', and *alnti:k'a* 'turquoise'—are derived BCTs in Kay & McDaniel's theory, and they have relatively low positions on the hierarchy. The acquisition literature suggests that derived terms tend to be learned after primary terms.[3] English or Russian children would have acquired their respective sets of BCTs by their teenage years, but it appears that colour term acquisition starts later for

Tsakhur speaking children than for their English or Russian counterparts. We tested samples of three to six year old Tsakhur speaking children, and found that even the oldest group knew just three or four colour terms. In contrast, many six year old English or Russian children would have already known the full set of BCTs (Davies et al. 1998; Johnson 1997).[4] Further data that are consistent with this late-onset conjecture are that the older teenagers perform more like the adult sample than the younger teenagers do. A second possible explanation is that the language is changing: the four discrepant terms used to be BCTs, but will cease to be so in the future. The latter conjecture seems unlikely. Language change in the colour domain seems to be unidirectional: colour categories tend to be added rather than lost (though the particular terms may change).

6. Conclusion

Tsakhur has at least eight BCTs: *karin* 'black', *ǯag$_o$aran* 'white', *č'aran* 'red', *čilwan* 'green', *zirgin* 'yellow', *lagarin* 'blue', *nabatan* 'pink', and *Gilbin* 'orange'. These eight terms meet the linguistic and behavioural criteria for basicness. In addition, the terms are consistent with Berlin &Kay's set of universal terms, as the foci of each of the eight Tsakhur terms match one of the foci of the universal set. Further, although this set is inconsistent with the original 1969 theory, it is consistent with the 1991 form of the theory. The terms *muXak* 'brown', *ǯangarin* 'purple', and *jilq̄in rang* 'grey' are also probably BCTs for the adults. There is some doubt about *jilq̄in rang* 'grey' as it is not a simple term. On the other hand, it was used generally, frequently, and with consensus; on balance we think it is a BCT. Adding these three terms to the set of BCTs yields a set of eleven BCTs that match the 1969 version of the theory perfectly. However, there is a further BCT for the adults, namely *alnti:k'a* 'turquoise'. This is a particularly interesting term, as this is the first time a token of TURQUOISE has been reported. Some relaxation to the empirical structure of the hierarchy is required to accommodate a BCT for TURQUOISE. However, the formal structure of the theory allows such a modification, and this set of twelve BCTs is also consistent with the theory.

The teenage sample appear to have just eight BCTs (the eight listed at the beginning of this section). This set is inconsistent with the 1969 version of the theory, because of the lack of a BCT for BROWN. However, it is consistent with the 1991 version of the theory, in which BROWN has wildcard status. The difference between the two samples is probably due to the teenage group not having completed their acquisition of BCTs.

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Appendix: The stimuli

1. The Color-Aid system

The Color-Aid range is based on the Ostwald colour solid (see Foss et al. 1944 for an outline of this system) and is made up from 24 "Hues": Y (yellow), O (orange), R (red), V (violet), B (blue), and G (green), and intermediate values designated by combinations of the previous codes; for instance YOY, YO, and OYO are the intermediate Hues between Y and O. In addition to the Hues, there are seven variants of each Hue consisting of four "Tints" T1 to T4, and three "Shades" S1 to S3; the Tints have increasing amounts of white added to the Hue as their index number increases, whereas the Shades have increasing amounts of black added as their index number increases. In addition, there is a grey-scale and several colours of particular significance to painters.

2. The CIE system

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

Within the CIE system the total colour is made up from red, green, and blue components, and the proportions of these three must sum to one. The CIE chromaticity coordinates can thus be thought of as the proportions of red (x) and green (y), in each colour; a third coordinate, lightness (Y), makes up the CIE tri-stimulus values. By implication, the proportion of blue light (z) is given by $1-(x+y)$. Stimuli with the same coordinates will look the same. The main drawback of the CIE (Y, x, y) space is that it is not a perceptually equal space; that is, equal distances in the space do not correspond to equal perceptual distances. The CIE (L*, u′, v′) system represents colours in a transformed space which is approximately perceptually equal. In this uniform chromaticity space u′ is a transformation of x, and v′ is a transformation of y. For instance, in Figure 2, the universal blue has coordinates of ($u'=0.18$, $v'=0.19$). The proportion of blue is thus: $1-(0.18+0.19)=0.63$. Thus, as would be expected, the universal blue has a high proportion of blue in it, and blue colours are to be found towards the origin of the graph (low u′ [red] and v′ [green]). On the other hand, red colours have high proportions of red in them (u′) and are to be found towards the right of the space. The positions of the eight chromatic universal foci in Figure 2 can be used to interpret the remaining regions of the CIE chromaticity diagram. (See Hunt 1987 for further information on the CIE system.)

3. The stimuli

The following table shows the Color-Aid codes and the CIE coordinates of the 65 tile colours used in this study.

Color-Aid code		CIE coordinates					
		Y	x	y	L*	u′	v′
Y	HUE	64.77	0.47	0.48	91.49	0.24	0.55
	S2	16.99	0.41	0.44	52.81	0.22	0.53
YOY	HUE	47.48	0.50	0.43	80.92	0.28	0.54
	T4	55.63	0.45	0.41	86.18	0.26	0.53
	S2	22.08	0.36	0.38	59.09	0.21	0.50
YO	HUE	39.52	0.51	0.41	75.17	0.30	0.53
	T3	47.02	0.48	0.41	80.61	0.28	0.53
	S3	10.72	0.36	0.41	43.02	0.20	0.51
OYO	HUE	26.51	0.54	0.37	63.81	0.34	0.52
O	HUE	25.00	0.54	0.37	62.26	0.34	0.52
	S1	14.34	0.50	0.37	49.03	0.31	0.52
	S3	9.15	0.42	0.36	39.98	0.26	0.50
ORO	HUE	18.87	0.57	0.34	55.26	0.38	0.52
	T3	36.88	0.46	0.35	73.09	0.29	0.50
	S3	26.51	0.33	0.32	63.81	0.21	0.47
RO	HUE	16.22	0.58	0.33	51.75	0.40	0.51
	T3	32.66	0.45	0.32	69.56	0.30	0.48
	S3	4.19	0.37	0.34	27.15	0.23	0.48
ROR	HUE	15.23	0.53	0.31	50.35	0.37	0.49
	T3	29.82	0.42	0.30	67.00	0.29	0.47
	S3	20.71	0.34	0.28	57.50	0.24	0.44
R	HUE	11.71	0.50	0.29	44.78	0.36	0.48
	T4	24.34	0.40	0.27	61.57	0.29	0.45
	S3	4.81	0.33	0.30	29.18	0.22	0.45
RVR	HUE	9.11	0.42	0.24	39.90	0.33	0.43
	S1	12.79	0.35	0.25	46.60	0.26	0.42
	S3	28.43	0.36	0.28	65.69	0.26	0.45
RV	HUE	6.97	0.33	0.19	35.13	0.29	0.37
	T2	14.51	0.31	0.19	49.28	0.27	0.37

continued from previous page

Color-Aid code		CIE coordinates					
		Y	x	y	L*	u′	v′
VRV	HUE	6.71	0.30	0.19	34.48	0.26	0.37
	S3	8.42	0.36	0.28	65.68	0.26	0.45
V	HUE	4.67	0.26	0.17	28.74	0.23	0.34
VBV	HUE	4.13	0.24	0.17	26.94	0.21	0.34
	T4	19.05	0.25	0.20	55.49	0.20	0.37
BV	HUE	4.21	0.22	0.19	27.22	0.18	0.35
	S2	7.88	0.25	0.26	37.26	0.18	0.42
BVB	HUE	4.80	0.19	0.13	29.15	0.18	0.28
	S3	26.65	0.26	0.23	63.95	0.20	0.40
B	HUE	9.51	0.18	0.16	40.71	0.16	0.32
	T1	19.02	0.20	0.19	55.45	0.16	0.35
BGB	HUE	9.62	0.19	0.19	40.93	0.16	0.35
	T3	23.08	0.20	0.23	60.21	0.15	0.39
BG	HUE	8.93	0.20	0.25	39.53	0.14	0.40
	T1	16.57	0.19	0.25	52.24	0.14	0.40
	S2	7.42	0.21	0.26	36.21	0.15	0.41
GBG	HUE	10.69	0.23	0.37	42.96	0.13	0.48
	S2	20.79	0.20	0.25	57.60	0.14	0.40
G	HUE	11.99	0.24	0.42	45.26	0.13	0.50
	S3	6.10	0.26	0.33	32.91	0.16	0.46
GYG	HUE	12.89	0.25	0.44	46.76	0.13	0.51
	T4	31.14	0.26	0.41	68.21	0.14	0.50
	S1	15.59	0.26	0.31	50.86	0.17	0.45
YG	HUE	14.66	0.28	0.48	49.51	0.14	0.53
	S3	5.78	0.30	0.34	32.04	0.19	0.47
YGY	HUE	18.92	0.30	0.51	55.32	0.14	0.54
	S3	35.87	0.35	0.43	72.27	0.19	0.52
ROSE RED		17.63	0.41	0.24	53.66	0.32	0.43
SIENNA		13.31	0.44	0.36	47.43	0.27	0.50
WHITE		81.40	0.32	0.33	100.00	0.20	0.47
GRAY1		47.55	0.32	0.33	80.97	0.20	0.47
GRAY2		30.59	0.32	0.33	67.71	0.20	0.47
GRAY4		18.88	0.31	0.31	55.27	0.20	0.46
GRAY6		11.20	0.31	0.31	43.89	0.20	0.46
GRAY8		4.53	0.31	0.32	28.89	0.20	0.46
BLACK		3.59	0.34	0.33	24.98	0.22	0.47

Notes

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1. In fact it has become clear that the correspondence between the neurophysiology and Hering's six primaries is poor (De Valois & De Valois 1993; Mollon & Jordan 1997).
2. There is considerable dialect variation in Tsakhur, and the Mishlesh dialect shows several interesting features. For instance, it has remarkably free word order. Speakers are well aware of differences, particularly lexical ones, and will identify particular words as belonging to other dialects and give the Mishlesh form.
3. Berlin & Kay (1969) suggested that children should acquire colour terms in the order of the hierarchy. This conjecture has some empirical support (see, e.g., Davies, Corbett, McGurk, & MacDermid 1998; Dougherty 1978; Harkness 1973; amongst others). On balance, however, these data are consistent with a weaker ordering than the hierarchy: primary terms tend to be mastered before derived terms. That generalisation also fits the teenage data reported here.
4. Similar developmental time-frames to the Tsakhur-speaking children have been reported in China (Lin Zhongxian et al. 1991) and Botswana (Davies, Corbett, McGurk, & Jerrett 1994).

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