The basic colour terms of Lower Sorbian and Upper Sorbian and their typological relevance [1]

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Abstract

Berlin and Kay's basic colour term framework claims that there is an ordering in the diachronic development of languages' colour systems. One generalisation is that *primary* colours, WHITE, BLACK, RED, YELLOW, GREEN, BLUE, are lexicalised before *derived* colours, which are perceptual blends, e.g. ORANGE is the blend of YELLOW and RED. The colour systems of Lower Sorbian and Upper Sorbian offer an important typological contribution. It is already known that primary colour space can retract upon the emergence of a basic derived term; our findings indicate that derived categories also shift as colour systems develop. Tsakhur offers corroborating evidence.

1 Introduction

Lower Sorbian and Upper Sorbian are part of the West Slavonic branch of languages which includes Polish, Czech and Slovak. Historically the Sorbs were an extreme part of the Slavs' push westward around about the 7th century, and their territory has gradually become encircled by German speakers. The consequence has been that these languages are isolated from the rest of the Slavonic family. According to Šatava (2005) there are between 20-25 000 Upper Sorbian speakers, but Lower Sorbian fares much worse with only 7 000 (based on a 1993-5 survey reported in Jodlbauer, Spieß and Steenwijk 2001)[2]. There are no monolingual speakers. This situation means that there is an urgency attached to any consultant-based study of the Sorbian language. In the summer of 2000 we carried out consultant work on the lexicon of Lower Sorbian and

[2] We are grateful to a referee for drawing our attention to the most recent surveys on Sorbian speakers. Compare the 1987 survey cited by Stone (1993: 594-95) which gives the number of Sorbian speakers as

Upper Sorbian. We specifically focused on the semantic field of colour for both methodological and theoretical reasons. On the one hand, there are well developed and well documented field methods for eliciting basic colour terms. And on the other, Berlin and Kay's Basic Colour Terms hierarchy represents a theory of colour universals that has been insightful to psychologists, anthropologists and linguists. Our findings suggest that, with reference to Berlin and Kay's theory, both languages lack the full inventory of basic colour terms. As a direct consequence of this, specifically the lack of a basic term for PINK, the perceptual colour space of one category, PURPLE, is larger than expected. This is of theoretical interest, and we compare these findings with the converse situation in Tsakhur, a Nakh-Daghestanian language spoken in Daghestan and Azerbaijan, where there is a basic term for PINK but not for PURPLE..

In section 2 we outline Berlin and Kay's theory about the diachronic changes in a language's colour lexicon: languages develop a core colour vocabulary, a set of *basic colour terms* which name the eleven perceptual colour categories, and the stages of development follow a set path, or range of paths. Our particular interest is in the development of basic colour terms to name derived colour categories which are the perceptual blends of the primary colours WHITE, BLACK, RED, YELLOW, GREEN, BLUE. Because of its importance for the model, we explicate the notion of basic colour term, and discuss various effective psycholinguistic tests for eliciting basic terms 'in the field' which we used in our investigation into the colour systems of the Sorbian languages. In section 3 we compare the claims made about the basic colour terms in Sorbian that arise from dictionary and text based research with the findings from consultant work using psycholinguistic tests. We conducted three tests: the 'list task', the 'colour naming task'

67000.

and the 'best example' task. In section 4 we look specifically at the PURPLE and PINK regions in the Sorbian languages. It is known that the structure of primary colour space is to some degree dependent on the absence / presence of derived colour categories. Given our results, we consider the possibility that derived categories can also determine the colour space of other derived categories. Finally we briefly question whether or not Upper Sorbian and Lower Sorbian have a second BLUE term, as has been claimed for certain other Slavonic languages.

2 Lexicalization of colour categories

Of the set of terms denoting colours in a language, there is an identifiable sub-set which could be described as the 'core' colour vocabulary, or the 'basic' set of terms. Working with the notion of basic colour term, Berlin and Kay (1969) developed a theory with universal claims about the lexical encoding of colour categories. According to the Basic Colour Terms Hierarchy there is a maximum of eleven basic colour terms, and their emergence is universally highly constrained. This is shown in Figure 1.

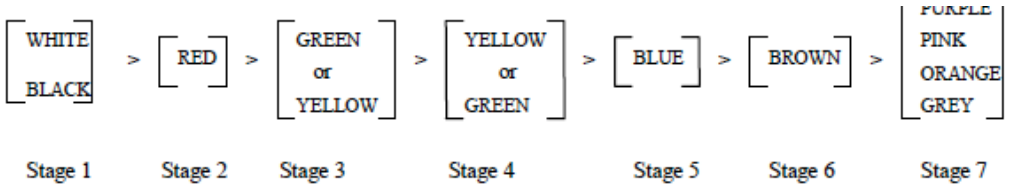

Figure 1. Original Basic Colour Terms Hierarchy (Berlin and Kay)

The hierarchy can be seen as a constraint on the diachronic development of a language's set of basic colour terms . In the lexicalization of basic colour categories, languages move through stages 1 to 7. The process is special in that it is monotonic: once a category is

lexicalised in a language, the lexicalisation cannot be subsequently reversed. Hence a stage 5 language with a BLUE term must have emerged from a stage 4 language which lacked a BLUE but had terms for WHITE, BLACK, RED, YELLOW and GREEN. This language may in turn move to stage 6 where a basic term for BROWN will be added. Note that at stage 7 there is no predicted ordering with respect to the lexicalization of PURPLE, PINK, ORANGE and GREY.

2.1 Primary and derived colour terms

Basic colour terms fall into three groups: those naming primary colour categories, those naming derived categories and those naming composite categories where one term simultaneously expresses several categories. We will discuss composite colour terms in section 2.1.2. The six primary colour categories (WHITE, BLACK, RED, YELLOW, GREEN, BLUE) are the six "purest-possible" colours that people perceive (MacLaury, 1991: 42). Within the Berlin & Kay theory, focal colours are the seeds around which categories form. They are points of local maximum perceptual salience within colour space whose privileged nature derives from presumed universal neurological processes in the visual system. Kay and McDaniel (1979) referred to these presumed underlying mechanisms as "six fundamental neural responses" corresponding to Hering's (1920) opponent process theory of colour vision. This claim was based on the apparent discovery of the neurological basis of the Hering opponent pairs (red-green, blue-yellow; and dark-light) by De Valois, Russell and Jacobs (1968). However, this has proved to be over-optimistic; nevertheless most vision scientists still regard the three axes as the "cardinal directions" in colour space (Krauskopf, Williams, and Heeley, 1982; Lennie and

D'Zmura, 1988) common to all with normal trichromatic colour vision, derived from low-level processes in the visual system. The derived categories are the perceptual blends of primaries, e.g. ORANGE is the blend of RED and YELLOW. Though the Berlin and Kay theory of the development of basic terms to name the categories has undergone a number of revisions, a general principle remains that primary colour categories are lexicalized before derived ones.

2.1.1 Reservations

Both the idea of a universal perceptual colour space and that of universal focal colours have been questioned. Proponents of the Whorfian hypothesis argue that colour space is at least shaped by language; thus speakers of languages with differing colour categories should also have differing colour perception. There is ample recent evidence that aspects of colour cognition co-vary with language (e.g., Davies & Corbett, 1997; Roberson, Davies & Davidoff, 2000), and that colour perception may be modified with relatively small amounts of training (Özgen and Davies, 2002). Nevertheless, such findings can be reconciled with the idea of a universal colour space that is invariant at a topological level: it may be 'shrunk' or 'stretched locally', but the relative positions of colours do not change. For example, Roberson, Davies, Corbett and Vanervyver (2005) found that perceptual similarity judgements for speakers of languages with markedly different colour categories could all be accommodated in a common colour space defined by the cardinal axes. That is, colours that seemed similar to speakers of one language were also seen as similar by speakers of other languages. On top of this overall similarity, there was also evidence of small scale language influences equivalent to differential stretching

or shrinking of the cardinal axes. However, although a colour space defined by the cardinal axes was sufficient to fit these data, it may not have been necessary: some other axes might have been at least as sufficient (see, Jameson and D'Andrade, 1997 and Saunders and van Brakel, 1997).

The idea of universal focal colours has been questioned because some argue that there is more scatter in the choice of best examples, both within and across languages than would be expected if the origin of these was universally 'hardwired' into the visual system (e.g., Ratner, 1989; Roberson, 2005; Saunders and van Brakel, 1997). However, Kay (2005), Kay and Regier (2003), Kay, Regier and Cook (2005) argue that while there is some scatter, there is still a strong tendency for best examples to fall in small 'privileged' regions of colour space. Thus best examples are determined by universal perceptual processes but these are modulated by other influences at the individual and society/cultural level producing the restricted variability seen in the World Colour Survey data (Kay and Regier 2003). When we compare the best examples of the Sorbian languages to the universals, operationally all we are really doing is asking whether they fall in the 11 regions reported by Kay and Regier (2003). The cognitive significance of focal colours has been questioned by Roberson et al. (2000) who, in contrast to Heider (1972), found that memory for focal colours was no better than for non-focal colours for the Berinmo of Papua New Guinea. However, as Dedrick (2005) points out, perceptual salience is unlikely to be the sole determinant of cognitive performance, and single counter examples are not sufficient to falsify the general rule. The central role of foci in category formation has also been questioned while accepting the idea of a broadly common perceptual colour space. Category formation might be based on general

cognitive principles, such as categories including only contiguous regions and maximising within-category similarity, and cross-category dissimilarity (e.g., Jameson, 2005; Roberson, 2005).

2.1.2 Revised theory

As perceptual blends, derived colour categories are predicated on the primary colour categories. In Figure 1 derived categories appear at stages that follow on from the primaries. Though the Berlin and Kay theory has undergone a number of revisions, the principle that derived categories only emerge at succeeding stages has remained. Figure 2 shows the revised model (Kay and McDaniel, 1978; Kay, Berlin, Maffi and Merrifield 1997).

[WHITE/RED/YELLOW (warm) BLACK/BLUE/GREEN (cool)] Stage 1
> **[WHITE RED/YELLOW** BLACK/BLUE/GREEN] Stage 2
> **[GREEN BLACK/BLUE** WHITE RED/YELLOW] Stage 3
> **[RED YELLOW** WHITE GREEN BLUE/BLACK] Stage 4
> **[BLACK BLUE** GREEN WHITE RED YELLOW] Stage 5
> **[BROWN** BLACK BLUE GREEN WHITE RED YELLOW] Stage 6
> **[PURPLE ORANGE PINK** BLACK BLUE GREEN WHITE RED YELLOW] Stage 7

Figure 2. Revised Berlin and Kay

At the early stages a language has composite terms, i.e. single colour terms that express more than one primary colour category. For example at stage 1 there is a term which denotes simultaneously the three primary focal colours WHITE, RED and YELLOW. The diachronic path is really "the progressive differentiation of color categories" (Kay and

McDaniel 1978: 617). The first step in this process is the division of each composite category into its distinct primary categories. This is the activity at stages one to five, at which point the first step is complete. The result of this partitioning is categories that are contiguous in colour space, for example RED and YELLOW. This means that for a stage five language, a term for Red denotes focal Red but also covers points up to, but not including, focal YELLOW. To capture the qualitative nature of colour terms, colour categories are viewed as fuzzy sets with the 'best' members closest to the focal point, and the 'worst' members furthest away.[3] The boundary of a colour category is fuzzy, and at this stage is ultimately set by the focal point of the contiguous category. The second step of category differentiation is to distinguish as separate categories the region where colours meet, and these are the derived categories. The category between YELLOW and RED is ORANGE. Again using fuzzy set theory, the 'best' ORANGE will be closest to the midpoint between RED and YELLOW.[4] This can be seen in Figure 3, a graphical representation of the distribution of English colour terms across the chromatic plane (u', v') of CIE colour space. CIE stands for Commission Internationale de l'Éclairage. Every colour has a location in the u´ v´ coordinate system and this can be understood by considering the locations of the universal foci which are also shown. Colours between the universals can be interpreted by interpolation; for instance, as the locus shifts from BLUE to GREEN, the colour gradually becomes greener passing through turquoise into the green category and on towards the best example of green. Colour also varies in

[3] See for example Zimmermann (2001) as a guide to fuzzy set theory.

[4] Note that whereas universal foci for primaries have an association with unique hue points, the same does not hold for secondaries; the association here is with the point that is equidistant between two unique hue points (Kay and McDaniel 1978: 638).

lightness, but this axis is orthogonal to the chromatic plane. This means that BLACK, WHITE and GREY have the same chromaticity coordinates and would all fall at the point labelled GREY. (See Appendix 1 for further details).

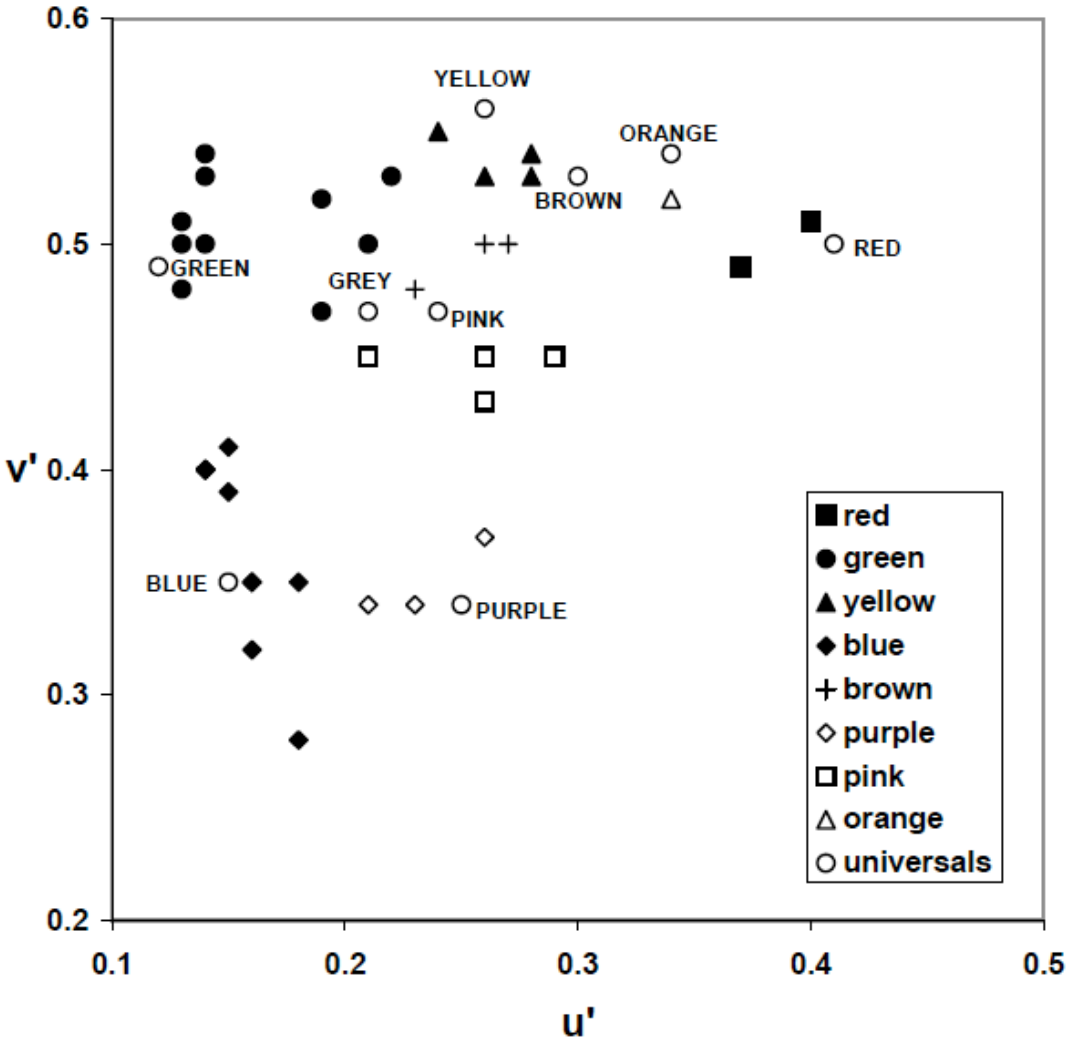

Figure 3. English: loci of tile-colours, with dominant names and the universal foci in the CIE (1976) chromaticity diagram

The O symbol shows the locus of the purported universal focal colours, the 'best' member of the category in fuzzy set terms. The symbols show the loci of the stimuli with a given name, (see legend on the right). The stimuli closer to the universal are better members of the category. For ORANGE the universal is clearly midpoint between universal

YELLOW and RED. A prediction from the model is that stage six and seven languages, which have developed derived basic colour terms, should have a retracted primary colour space. There appears to be exaggerated evidence of this from Tsakhur where though the term for YELLOW *zirgin* denotes focal YELLOW, much of the YELLOW space is covered by the ORANGE term *GilbIn*.[5] We will see that the data from Sorbian suggest that it is not only partitioning of primary colour space that is dependent on the presence of derived colour categories, but derived categories are affected by the absence / presence of other derived categories.

2.2 Determining basic colour terms

Since the typological claims about colour outlined above concern the lexicalization of colour categories as expressed by basic colour terms, it is important to have in place a method for eliciting the basic terms of a language's colour lexicon. Berlin and Kay (1969: 6-7) provide a list of criteria that can be used to characterize the basic terms. First, the term must be shown to be monolexemic, i.e. the meaning is not derivable from the sum of its parts. This would rule out *sky blue* as a candidate for basic status. Second, the colour it signifies must not be included in the signification of another basic term. The term *scarlet* is a kind of Red, and cannot therefore be basic. Third, it must apply generally, and not be restricted to a limited number of objects, as is the case with *blond* and *ginger* which denote hair colour. Fourth, the term must be 'psychologically salient'. Evidence for a term being psychologically salient is its prominence in an elicited list, its occurrence in the idiolects of all consultants, and the stability of its reference across

[5] The Tsakhur colour graph is presented in Figure 6, in section 4.

consultants (Berlin and Kay 1969: 6). These criteria tend to be strongly associated so that basic colour terms tend to be general, simple and salient.

A set of tests have been developed which have been widely used to assess the salience of colour terms in a language. Full details of these and other test are reported in Corbett and Davies (1995). To summarise, the tests fall into two broad categories. Linguistic tests include textual frequency of the terms, and the size of a term's derivational family. Behavioural tests, used with language consultants, include colour naming and colour-term eliciting tasks based on the original methods of Berlin & Kay, subsequently modified for the World Colour Survey (Kay, Berlin, Maffi and Merrifield 2003), and by MacLaury (1997). The data we present is the result of three behavioural tests, a 'list task', a 'colour naming task' and a 'best example task'. In the list task colour terms were elicited by asking consultants to list as many colour terms as they can think of within a specific stretch of time. The frequency of occurrence of a colour term across consultants, as well as the order in which it occurs on the questionnaires, are used as measures of the term's salience. Higher frequency and ordering correspond to greater likelihood that the term is basic. In the naming task, colour tiles representative of colour space were named by consultants. The salient terms are marked out by high frequency of occurrence and high degree of consensus in the tiles they denote. Finally in the best example task, consultants were asked to choose the best example of the most frequently used colour terms from the naming task. This measure is used to check: 1) whether tiles with high naming consensus tend to be chosen as the best examples; 2) the degree of variability across consultants in their choices; and 3) whether the best examples fall close to the purported universal foci.

3 Lower Sorbian and Upper Sorbian colour survey

The Sorbian languages are Slavonic languages spoken within Germany in a small area of Brandenburg and Saxony, West of the River Neisse, and East of a line drawn North to South from Calau, Senftenberg, Kamenz and Bischofswerda (Stone 1993: 593-94). The Sorbs of Upper and Lower Lusatia are the descendents of one of the many tribes of the Northwest Slavs who by the 7th century had spread as far west as the Baltic (Schenker 1995: 46-47). Within the Slavonic family the Sorbian languages belong to West Slavonic, sharing features with Czech, Slovak and Polish. All Sorbian speakers are bilingual in German. A candidate set of basic colour terms for Lower Sorbian and Upper Sorbian is given in Stone (1993: 677), deduced from dictionary searches. This is given in Table 1 and serves as a starting point for our consultant based study.

Table 1. Candidate basic colour terms of Lower Sorbian and Upper Sorbian

Lower Sorbian		**Upper Sorbian**	
primary terms		primary terms	
běły	'white'	běły	'white'
carny	'black'	čorny	'black'
cerwjeny	'red'	čerwjeny	'red'
zeleny	'green'	zeleny	'green'
žołty	'yellow'	žołty	'yellow'
modry	'blue'	módry	'blue'
derived terms		derived terms	
bruny	'brown'	bruny	'brown'
purpurowy	'purple?' (crimson)	fijałkowy	'purple'
rožowy[6]	'pink'	róžowy[7]	'pink'
oranžowy	orange	1. oranžowy	'orange'
		2. pomorančojty	
1. šery	'grey'	1. šěry	'grey'
2. šeźiwy		2. šědźiwy	

The list partially corroborates the Berlin and Kay theory in that the primary terms have roots in the (reconstructed) proto language, Proto-Slavonic (for details see Herne 1954, Schenker 1993: 111-12). The exception is Lower Sorbian *modry* and Upper Sorbian *módry* 'blue', cognates of which are found chiefly in West Slavonic suggesting a West Slavonic innovation (see Zaręba (1954: 47-49) and discussion in Hippisley (2001: 169-71)). Regarding the derived terms, the term for 'brown' *bruny* is the earliest attested form, and was most likely a fifteenth century borrowing from Middle High German (see Schuster-Šewc 1978: 74). Again BROWN as the first derived category to be lexicalised fits with the Berlin and Kay model (see Figures 1 and 2). As for the other derived terms there is some doubt over PURPLE since Lower Sorbian *purpurowy* denotes a crimson

[6]Stone lists the alternants *rožany* and *rožowaty*.

colour, according to Stone. The most recent Lower Sorbian - German dictionary (Starosta 1999) gives the German *purpurn* as the equivalent term, a term denoting 'crimson'. There are two terms with the sense 'grey' in both languages, and Stone notes that there is little distinction between them. There are also two terms which are glossed as 'orange' in Upper Sorbian. The psychological salience tests we carried out allow us to explore some of the questions raised by Stone's list. For example we will look to confirm basic status of the primary terms, and clarify the status of the terms for the derived categories PURPLE, PINK and ORANGE.

3.1 Results of the list task

The list task was carried out by 16 speakers of Lower Sorbian and 16 speakers of Upper Sorbian. For Lower Sorbian 6 consultants were female and 10 male, and the age ranged from forty-one to eight-five years; the task was carried out in Cottbus and the surrounding villages[8]. For Upper Sorbian nine consultants were female and seven male; ages ranged from thirty-three to fifty, as well as one seventeen year-old; all consultant work was carried out in Bautzen. The questionnaire for both groups was prepared in Lower Sorbian and Upper Sorbian respectively.[9] Tables 2 and 3 give those Sorbian terms which were offered by least three consultants, the gloss, the frequency of term across all consultants, and the rank frequency. Since the order in which terms are elicited serves as

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[7] Stone lists the alternants *różojty* and *różowaty*.

[8]Finding consultants was not easy, and we are very grateful to Madlena Norberg for helping coordinate the consultant work in Cotttbus and surrounding villages.

[9]We are also very grateful to Gerald Stone who provided the Lower Sorbian and Upper Sorbian translations for the questionnaire.

index of their salience we also give the mean list position of each term.[10] Modified terms are counted separately from their related bases, e.g. we show both *śamnozeleny* 'dark green' and *zeleny* 'green' (Table 2), but it should be noted that modified terms are treated differently in the other tasks. This is because in the list tasks modified terms were not substituting for their bases: nearly all consultants who offered a modified term also gave its unmodified version; and in almost every case the ranking of the modified term was lower. For the glosses we consulted Starosta (1999) for Lower Sorbian, and Jenč (1989) for Upper Sorbian. The way in which the consultants used the terms corroborates their definitions in the dictionary sources, with some notable exceptions discussed below.

[10]For mean position, the calculation gives all subjects a score for all terms. If a subject does not offer a particular term, then for this calculation it is given a 'worst score' equivalent to that of the lowest term actually given plus one.

Table 2. List task: Lower Sorbian consultants (N=16). MLP 'mean list position'.

Term	*Gloss*	*Frequency*		*Rank*	*MLP*
		occurr.	*as %*		
běły	white	16	100.00	2.5	4.31
carny	black	16	100.00	2.5	5.06
zeleny	green	16	100.00	2.5	5.75
žołty	yellow	16	100.00	2.5	4.81
bruny	brown	15	93.75	6.0	9.25
lylowy[11]	purple	15	93.75	6.0	9.50
šery	grey	15	93.75	6.0	8.87
cerwjeny	red	14	87.50	8.0	5.19
modry	blue	13	81.25	9.0	8.63
rožowy[12]	pink	9	56.25	10.5	11.00
płowy	blue[13]	9	56.25	10.5	12.06
swětłomodry	light blue	7	43.75	12.0	13.75
oranžowy	orange	6	37.50	13.0	14.50
śamnozeleny	dark green	4	25.00	15.5	16.06
śamnomodry	dark blue	4	25.00	15.5	15.88
swětłozeleny	light green	4	25.00	15.5	12.50
pisany	coloured	4	25.00	15.5	16.13
fijałkowy	purple	3	18.75	21.0	15.75
pinkowy	pink	3	18.75	21.0	15.56
śamnobruny	dark brown	3	18.75	21.0	16.75
śamnocerwjeny	dark red	3	18.75	21.0	16.88
nazeleny	greenish	3	18.75	21.0	18.19
swětłožołty	light yellow	3	18.75	21.0	16.00
nabruny	brownish	3	18.75	21.0	15.69
wioletny	purple	3	18.75	21.0	15.50
slobrany	silver	3	18.75	21.0	17.31

[11]The following alternants were also elicited: the indeclinable adjective *lyla*, and *lylany*. Neither appear in Starosta (1999).

[12] The alternants *rožany* and *rožojty* were also elicited.

[13] Starosta (1999) gives German equivalents *blassblau*, *graublau* 'pale blue, grey blue' as a derived dialectal meaning, with *fahl*, *blassgelb* 'pale yellow' as the primary meaning. However the way the term was used in the naming and 'best example' tasks suggests it only has a blue meaning in Lower Sorbian. For

The primary terms suggested by Stone are all placed within the eleven most frequent terms, and with the exception of terms for BLUE and RED are the highest ranking terms. From the mean list position scores they also tend to appear towards the top of a list. Though two of the sixteen candidates did not write *cerwjeny* 'red', those that did placed it near the top of the list (mean list position = 5.19). The mean list position index acts to separate primary from derived *terms*. The primary terms had a range of 4.31 (*běły* 'white') to 8.63 (*modry* 'blue'), while the derived terms fell in the range from with a range 8.87 (*šery* 'grey') to 11 (*rožowy* 'pink'). For the derived terms there appears to be confirmation that *bruny* is the basic BROWN term, and of the two GREY terms in Stone's list *šery* is within the eleven most frequent terms, and *šeźiwy* does not appear. The list task also suggests that the basic PURPLE term in Lower Sorbian is not *purpurowy* (in Stone's list) but *lylowy* which appears on every list bar one. The low frequency of *rožowy* 'pink' casts doubt on the basicness of this term, as does that of the term given for ORANGE, namely *oranžowy*. Another term for PINK, *pinkowy*, was offered by three consultants, but two of these also had *rožowy (rožojty*), which was ranked higher. Skipping ahead, for the tile most closely representing focal PINK the term *pink* was used by one of these, *rožowy* by another and *rosa* by the third. No single tile was named by the term by more than one consultant, pointing to lack of any consensus in the use of the rival term, an important test for basicness as we shall see in the next section. Finally we should note that there are two terms for BLUE in the list, *modry* and *płowy*. The latter is restricted to certain villages north west of Cottbus, and is reported in Fasske, Jentsch and Michałk (1972: 119) as being a dialectal variant of the term. The status of *płowy* is discussed in

some consultants it is the basic term for BLUE, as we discuss later in §5.

section 4.1. At this stage the conclusion would be that Lower Sorbian has nine Berlin and Kay basic colour terms, leaving PINK and ORANGE as emergent categories at best.

We turn now to Upper Sorbian where Table 3 gives the results of the list task.

Table 3. List task: Upper Sorbian consultants (N=16). MLP 'mean list position'

Term	*Gloss*	*Frequency*		*Rank*	*MLP*
		occurr.	*as %*		
běły	white	16	100.00	2.5	3.63
čorny	black	16	100.00	2.5	7.13
žołty	yellow	16	100.00	2.5	4.81
fijałkowy	purple	16	100.00	2.5	9.25
čerwjeny	red	15	93.75	6.0	2.75
zeleny	green	15	93.75	6.0	5.00
bruny	brown	15	93.75	6.0	8.81
módry	blue	13	81.25	8.5	4.88
šěry	grey	13	81.25	8.5	10.25
różowy[14]	pink	10	62.50	10.0	11.25
swětłomodry	light blue	8	50.0	11.0	12.63
swětłozeleny	light green	7	43.75	12.5	13.38
ćmowozeleny	dark green	7	43.75	12.5	13.31
ćmowomodry	dark blue	6	37.50	15.0	15.38
oranžowy	orange	6	37.50	15.0	12.88
swětłobruny	light brown	6	37.50	15.0	14.25
ćmowobruny	dark brown	5	31.25	17.0	15.63
złoty	gold	3	18.75	18.5	14.94

From Table 3 we can see that there are nine terms with a frequency of over 80%, and these are all terms appearing in Stone's list. As with Lower Sorbian the first of Stone's terms for GREY, *šěry*, has a high frequency. And as with Lower Sorbian the PINK term, *różowy*, is marginal with a frequency of 62.5% and a mean list position of 11.25; the

[14]Included in this term are the alternants noted by Stone, *różojty* and *różowaty*.

candidate ORANGE term, *oranžowy*, has a very low frequency of 37.5%, and there is no appearance of the alternate *pomorančojty*.

On the evidence so far we reach the following tentative conclusion. Both Lower Sorbian and Upper Sorbian have all Berlin and Kay basic colour terms except for a term for ORANGE, and possibly PINK. A difference between the languages concerns PURPLE where Lower Sorbian has the term *lylowy* and Upper Sorbian uses the term *fijałkowy*. The term and its cognates are not basic in any other West Slavonic language. For example Polish *liliowy* is recent (Zaręba 1954: 53), with the sense 'light purple'. Note German *lila* with the sense 'dark purple'. The term *fijałkowy* is the adjectival form of *fijałka* 'violet', a borrowing from Middle High German, according to Schuster-Šewc (1978: 74).

3.2. Results of the naming task

In the naming task consultants are asked on an individual basis to name sixty-five colour tiles chosen to represent the colour space. The sixty-five tiles give an even distribution in CIE uniform chromaticity space; see Appendix 1 for details about these stimuli. The tiles were shown to consultants in random order. Nearly all the consultants who took part in the list task also performed in the colour naming task.[15] Tables 4 and 5 summarise the results. In the tables the sixteen most frequently elicited terms are ranked in frequency order. Modified terms have been counted in with simple terms, e.g. *swětłocerwjeny* 'light red' is counted as an instance of *cerwjeny* 'red'.[16] Columns 4 to 9 are used to give a measure of consensus and are discussed below. For the exhaustive set of responses for each tile, see Appendix 2.

[15] One of the Upper Sorbian consultants who performed the list task did not take part in the colour naming task.

[16] For this task, unlike the list task, it is usual to combine the modified forms with the simple ones (see for example Davies et al. (1999: 187)). For example in Lower Sorbian morphologically complex *nazeleny* 'greenish' and *śamnozeleny* 'dark green' would both be treated as occurrences of the simple *zeleny* 'green', which is the head in both expressions. On the other hand, exocentric colour combinations, such as *rožojtocarwjeny* 'pink red', are counted separately. Thus although Appendix 2 lists 58 different colour terms for Lower Sorbian and 81 for Upper Sorbian, the actual number when including all modified terms is

3.2.1 Lower Sorbian naming task

Table 4. Colour naming summary: Lower Sorbian (N=16)

term	*gloss*	*freq.*	*nmf*	D_{50}	D_{75}	D_{90}	*dtf*	*Spec.*
zeleny	green	165	13	10	8	7	144	0.87
modry	blue	137	11	10	4	0	121	0.88
lylowy	purple	106	10	7	0	0	76	0.72
cerwjeny	red	101	5	4	2	1	50	0.50
šery	grey	77	5	4	4	2	57	0.74
różowy	pink	65	6	1	0	0	9	0.14
žołty	yellow	62	4	3	3	3	46	0.74
bruny	brown	62	5	4	3	2	55	0.89
carny	black	45	2	2	2	2	32	0.71
oranžowy	orange	32	3	0	0	0	0	0.00
płowy	blue	28	0	0	0	0	0	0.00
běły	white	16	1	1	1	1	15	0.94
other term	-	127		-	-	-	-	-
don't know	-	17		-	-	-	-	-

From the table we see that almost the same nine terms which performed well in the list task (Table 2) have the highest frequencies in this task. The exception is *běły* 'white', ranked 13th. This should be seen, however, as an artefact of the task, since only one tile in the sample could be described as pure white. Moreover this tile was given the same label, *běły*, by over 90% of all consultants. A simple frequency score is inadequate as a measure of salience; we also need to score consensus of use amongst consultants. To do this we calculate a term's 'dominance', i.e. the degree to which it is used for a particular tile. The number of tiles for which a term is the most frequently used is recorded in the *nmf* ('number for which most frequent') column (column 4), for example *zeleny* 'green' is used most frequently for 13 tiles. Amongst those tiles we distinguish those where the

125 for Lower Sorbian and 138 for Upper Sorbian.

term is dominant, meaning that the term in proportion to all terms used to name the tile is used more than 50%. A more fine- grained analysis is possible by distinguishing amongst tiles dominated by a term: we record separately the number of tiles where the proportion is greater than 50% (D_{50}), the number where it is greater than 75% (D_{75}), and where it is greater than 90%. (D_{90}). Thus for *zeleny* 'green' we see that it is the most frequent term for 13 tiles, but of these it is dominant for 10 tiles (this can be calculated form Appendix 2, Table A). Amongst the dominant tiles it has over 75% of the share of all terms offered for eight tiles, and over 90% for seven. Dominance is summarised in the last column using the specificity score, which is the proportion of its total use as a dominant term, i.e. the frequency of its uses for its dominant tiles, the *dtf* given in column 8, over the frequency of all its uses, given in column 3. For *zeleny* this is 0.87 meaning that 87% of all its occurrences represent high consensus of use amongst consultants. Returning to *běły* we see that though its frequency is lower than the other putative basic terms it has the highest specificity score (0.94).

We can view the results of the naming task as further evidence that Lower Sorbian has at least nine basic colour terms, the same as those suggested by the list task. These terms have high frequency rankings and / or high specificity scores. As in the list task the term for PURPLE is *lylowy*, the third most frequent term, and has a high consensus index (dominant for seven out of ten of the tiles for which it is the most frequent term, and having a specificity score of 0.72). Other PURPLE terms elicited are *wioletny* and *fijałkowy*, neither with any claim for basicness (low rank frequency, specificity scores of 0.00). The list task suggested that Lower Sorbian lacks basic terms for ORANGE and PINK and we find further evidence of this from the naming task. The term *oranžowy* 'orange'

has a low rank frequency, as well as a low consensus index. Though it is the most frequent term for three tiles, it is not dominant for any of them, and this is reflected in its specificity score of 0.00. The term *rožowy* 'pink', on the other hand, has a high rank frequency, but again it performs badly on the consensus index with a specificity of 0.14, i.e. there has been consensus in the term's use on only 14% of all the occasions it was used to name a tile. It is only dominant for one tile. From Appendix 2 Table A we see this is RVR S3; but as *rožowy* as used only nine times for this tile it is barely dominant at 56%.

The graphical representation of the distribution of the Lower Sorbian terms across the chromatic plane of CIE colour space is given in Figure 4.

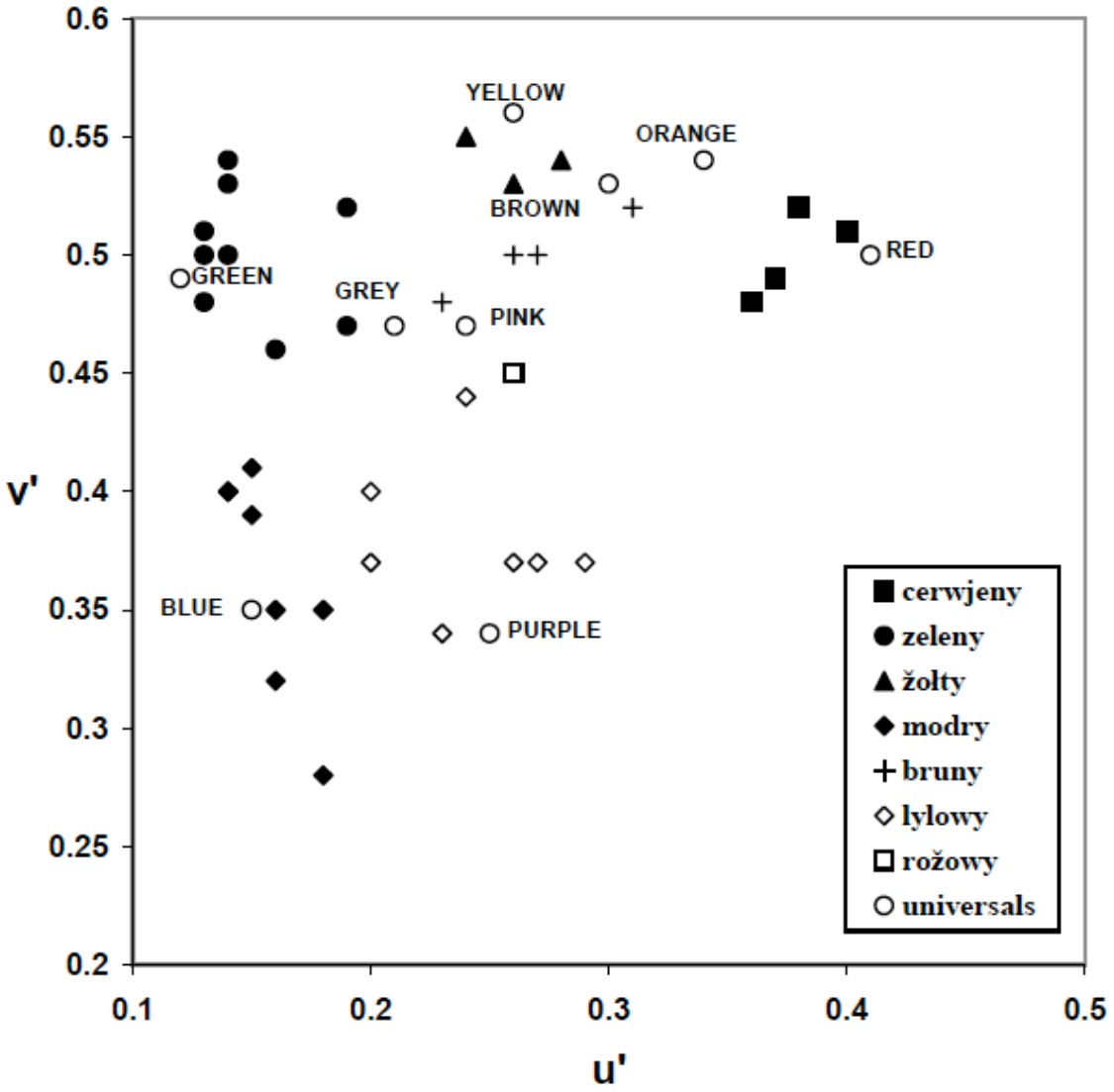


Figure 4. Lower Sorbian: loci of tile-colours, with dominant names and the universal foci in the CIE (1976) chromaticity diagram

The legend in the figure gives the names of the eleven candidate colour terms and a corresponding symbol. The symbols plot the coordinates of the tiles which the term dominates. Universal focal points are denoted by the symbol ○. The graph for Lower Sorbian is very similar to that of English discussed in section 2 (see Figure 3). The main differences are found in the PURPLE region, which for Lower Serbian extends nearly as far as focal PINK. The PURPLE space is much more restricted for English.

3.2.2 Upper Sorbian naming task

The results of the naming task for Upper Sorbian are given in Table 5.

Table 5. Colour naming summary: Upper Sorbian (N=15).

Term	*Gloss*	freq.	*nmf*	D_{50}	D_{75}	D_{90}	*dtf*	*Spec.*
zeleny	green	142	13	9	8	6	123	0.87
módry	blue	140	13	9	7	6	119	0.85
fijałkowy	purple	116	11	8	3	1	88	0.76
šěry	grey	75	5	5	4	2	66	0.88
čerwjeny	red	72	5	4	3	1	51	0.71
oranžowy	orange	55	4	3	2	0	35	0.64
bruny	brown	49	4	3	3	1	40	0.82
žołty	yellow	44	3	3	3	1	39	0.89
čorny	black	35	2	2	1	1	25	0.71
różowy	pink	32	6	1	0	0	8	0.25
běły	white	17	1	1	1	1	14	0.82
other term	-	180	-	-	-	-	-	-
don't know	-	18	-	-	-	-	-	-

The candidate basic terms suggested by the list task for Upper Sorbian also perform well in the naming task, when we take both frequency and consensus into account (see discussion above). There is strong evidence that the PURPLE term for Upper Sorbian is *fijałkowy*, based on both frequency, where it is third most frequent term, and consensus where it is dominant for eight tiles, and has a specificity score of 0.76. From the list task recall that as in Lower Sorbian doubts surrounded the basic status of terms for PINK and ORANGE. In the naming task the PINK term *różowy* has a low frequency and a low specificity score (0.25). It is dominant for one tile, but from Appendix 2 (Table B) we see that it is marginally dominant representing only eight out of fifteen responses (53%) for tile RO-T3. This is further evidence against a basic term for PINK in Upper Sorbian. In the

case of PINK evidence from both tests appears to line up, but this is not the case with ORANGE. Recall that in the list task (Table 3) *oranžowy* performed particularly badly: it had a frequency of 37.5% and ranking of 15, pushing it well beyond the bounds of the group of terms considered basic. From Table 5, however, we see that it has a strong frequency ranking of 6 and is dominant for three tiles, two of which it dominates at over 75%. This is reflected in a strong specificity score of 0.64.

The CIE chromaticity diagram for Upper Sorbian is given in Figure 5. It clearly shows an expansion of PURPLE into the PINK region, as with Lower Sorbian. It should also be noted that for ORANGE in Upper Sorbian, the term *oranžowy* was dominant for three tiles. We can see from the graph that one of these occupies a point in the colour space that is expected for a basic ORANGE term (comparing with English, figure 3), and the others are closer to YELLOW.

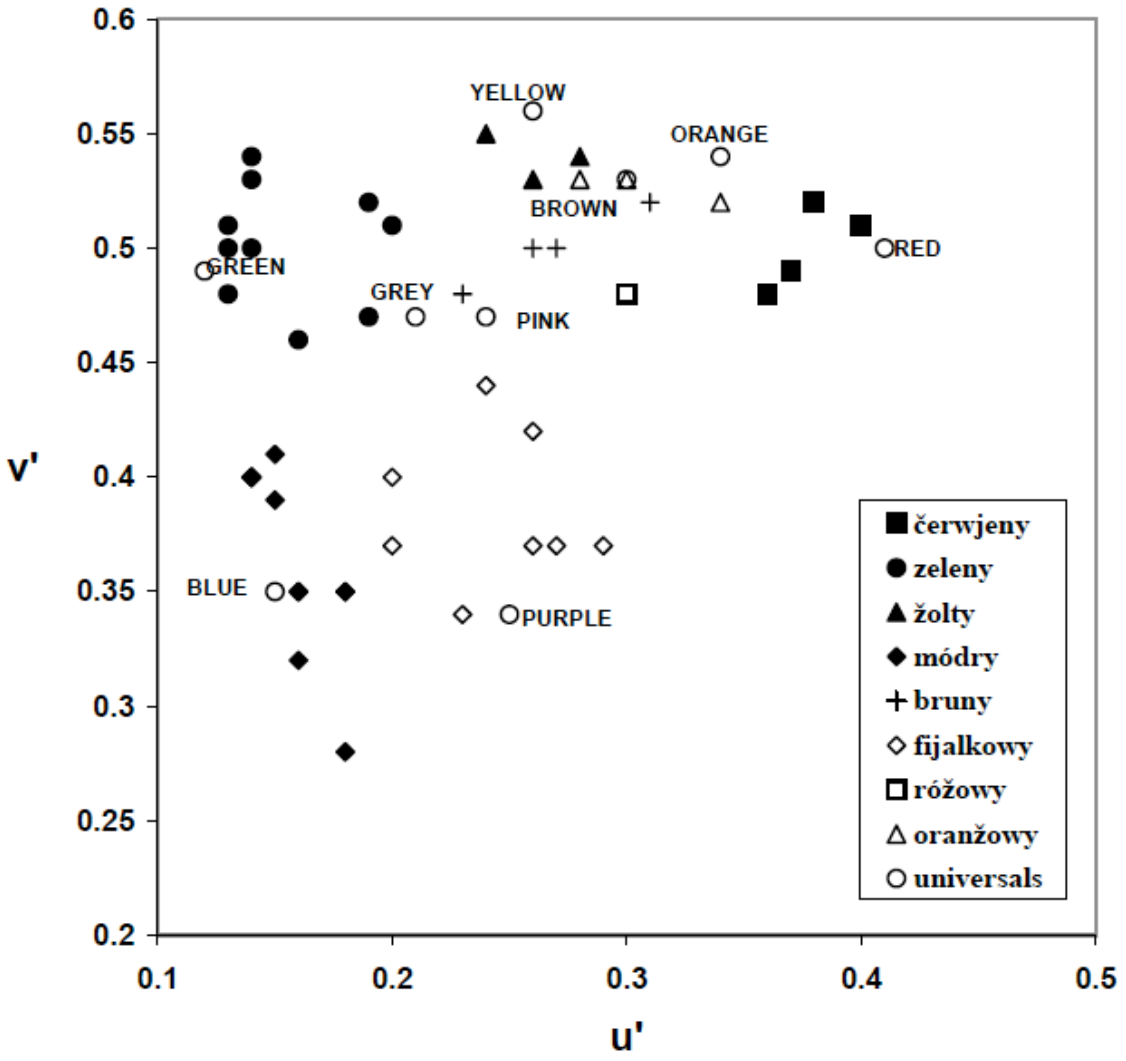


Figure 5. Upper Sorbian: loci of the tile-colours, with dominant names and the universal foci in the CIE (1976) chromaticity diagram

3.3 Results of the 'best example' task

The final elicitation task we report on is the 'best example' task, where consultants are asked to point to the tile which best exemplifies a particular colour term. All colour terms of interest were used for this task, in other words those which through the other tasks appeared to be basic, or at least were candidates for basicness. The full set of results is given in Appendix 3. For each language, we calculated the *centroids* for each candidate

basic term by averaging the CIE coordinates across the 16 respondents. Thus the centroid for each term is the spatial average in CIE coordinates of the 16 choices of best example. These centroids are shown in Figure 6 for Lower Sorbian and Figure 7 for Upper Sorbian together with the locations of the Berlin & Kay universals.

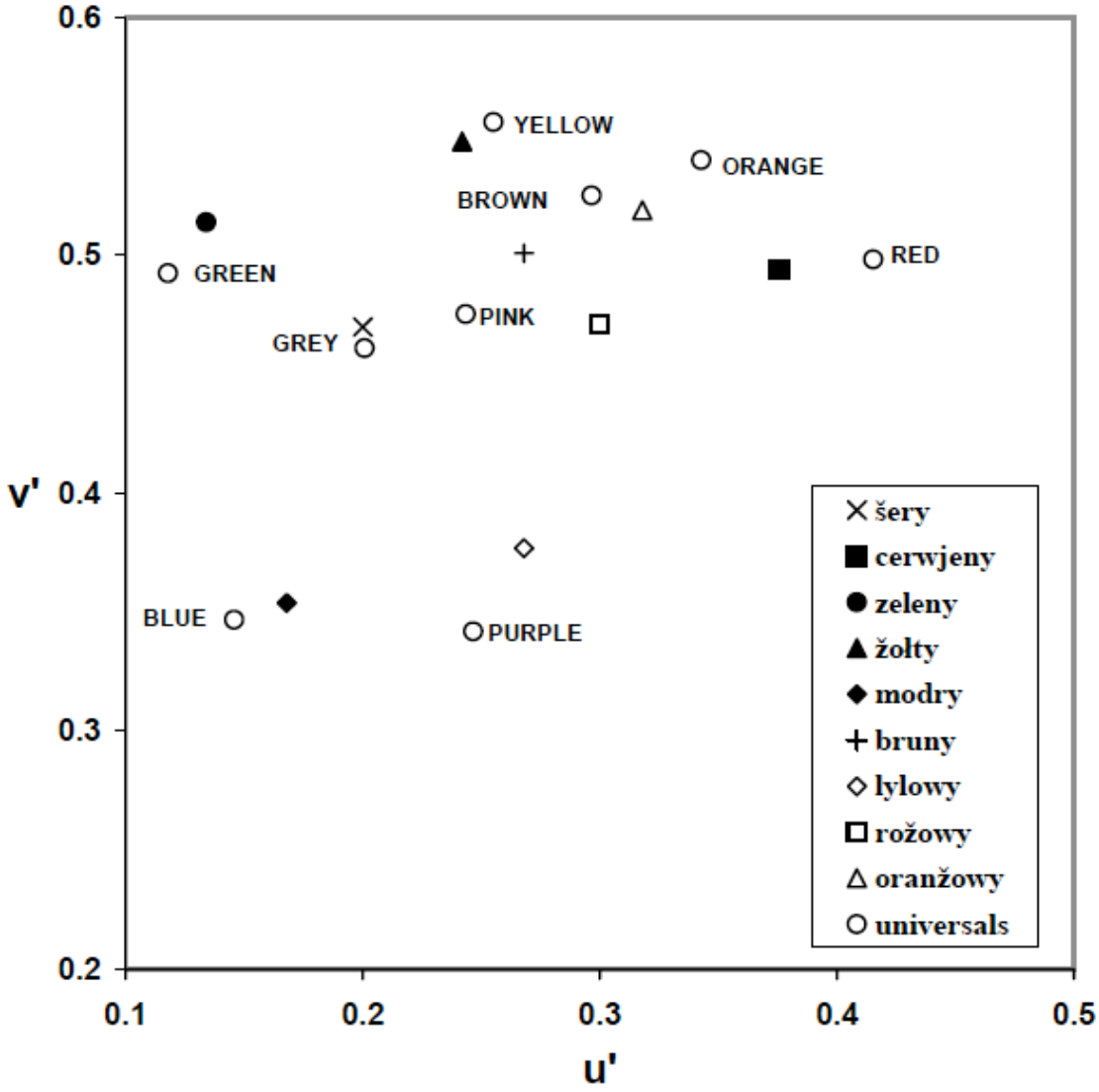


Figure 6. Lower Sorbian: loci of centroids for best examples of colour terms and the universal foci in the CIE (1976) chromaticity diagram

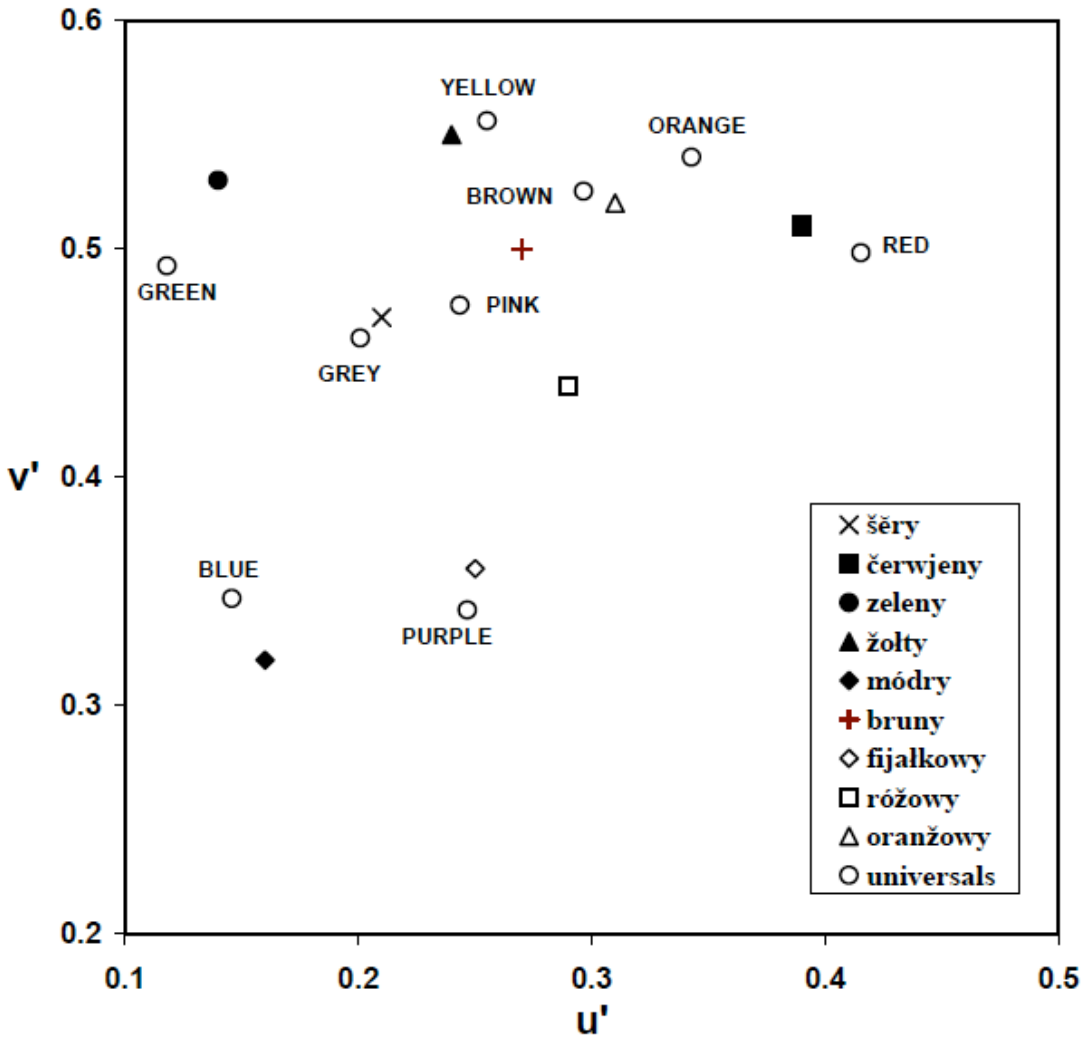


Figure 7. Upper Sorbian: loci of centroids for best examples of colour terms and the universal foci in the CIE (1976) chromaticity diagram

For both languages, it can be seen that the centroid is close to the appropriate universal, although there is a tendency for the centroids to be displaced towards the centre relative to the universals (less saturated). This displacement reflects a limitation of the colour samples in that maximum saturation Color-aid stimuli tend to be less saturated than the Berlin & Kay universals. Choice of best examples was almost invariably from among the colours that evoked high consensus across consultants. This can be seen by comparing the graphs of the location of dominant terms in CIE coordinates (Figures 4 and 5) with

their equivalent graph of best examples. It can be seen that the location of best examples tends towards the centre of the clusters of dominant terms, suggesting that estimating the best example by selecting the term with the highest consensus would give similar results to directly asking consultants. However, there were exceptions to this rule. The naming data suggests that Lower Sorbian does not have basic terms for PINK or ORANGE, and Upper Sorbian does not have a basic PINK term. However, although consultants do not use the latter terms reliably in naming, nevertheless, their choices of best example are still reasonably close to the appropriate universal.

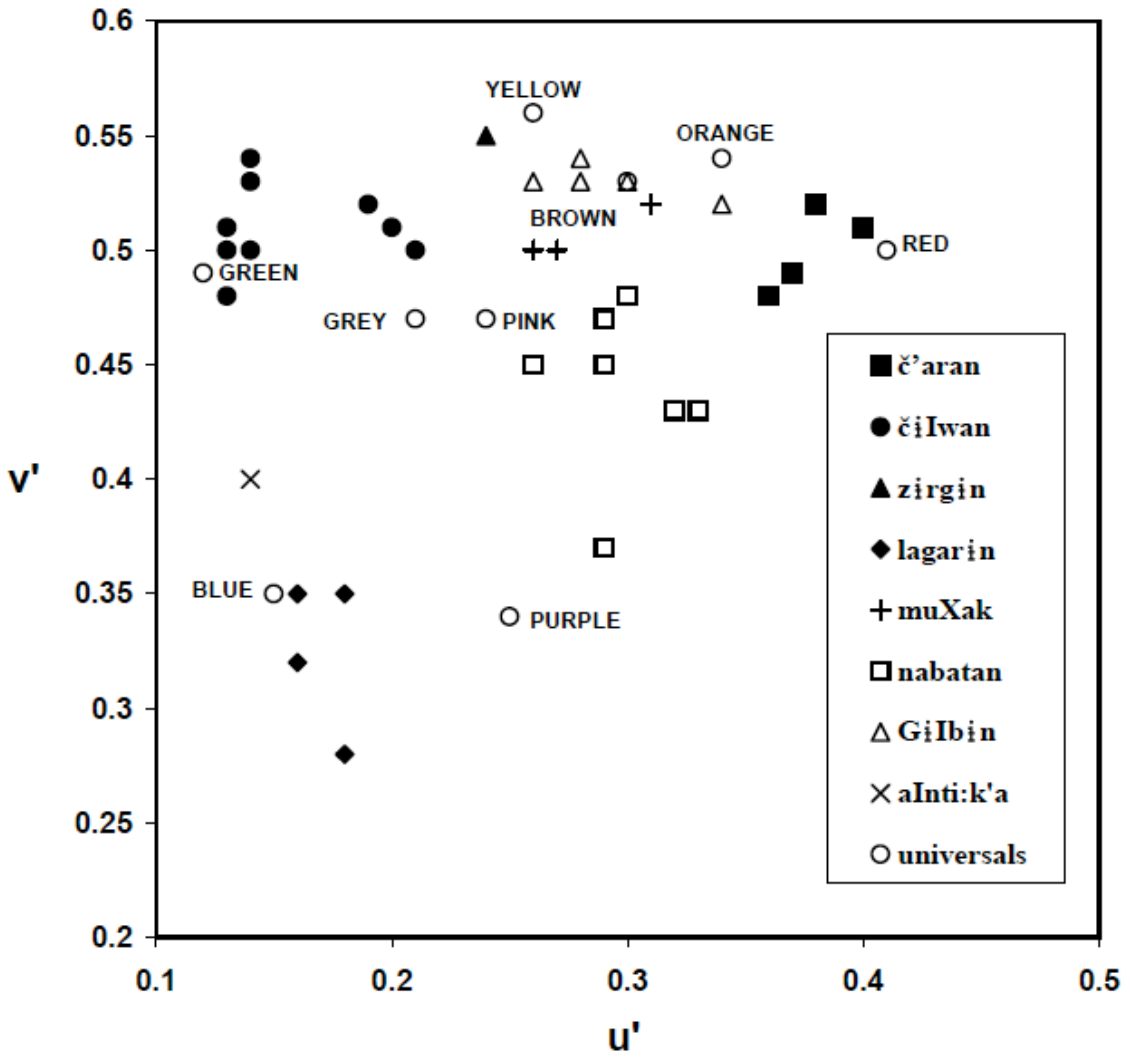
4 Discussion: colour category lexicalization and its effect on the colour space

The results of the tests outlined above suggest that the two languages under investigation lack a PINK term, and that Upper Sorbian probably has a basic ORANGE term, whereas in the Lower Sorbian this term is emergent at best. The most interesting finding, however, is the effect of a weak PINK on the partitioning of colour space. When we translated the results of the naming task into a graph representing the CIE uniform chromaticity space the Purple region appeared to be larger than expected (Figures 4 and 5). In section 2 we outlined the progressive differentiation approach to the development of a language's colour lexicon, and made the point that since primary categories are contiguous and fuzzy, the colour space of a primary term is larger in the absence of a related derived term. In the case of Lower Sorbian and Upper Sorbian, the absence of a derived term, a strong PINK, seems to be affecting the colour space of another derived term, PURPLE, and in the same way by letting it expand beyond its expected margins. The case for a basic PINK term is even weaker in Upper Sorbian. There is only one dominant PINK tile, and it

corresponds to a point that is wide of the focal point for PINK. The graph clearly shows that the expanded PURPLE region is even more exaggerated than for Lower Sorbian, strongly suggesting the expanded space is the effect of the weaker PINK.

The Sorbian data indicate a dependence of the PURPLE colour space on the presence of PINK. This raises the question whether for a colour system with basic PINK but not PURPLE there is a similar dependence for PINK on a PURPLE that is still emerging. Tsakhur[17] has such a colour system according to results using the same elicitation methods and the same tile set as were used for Upper Sorbian and Lower Sorbian (details reported in Davies et al. 1999). Figure 8 is the CIE graph of the results of the naming task where only dominant tiles have been plotted

17 Tsakhur is a Nakh-Daghestanian language. In the orthography developed in Kibrik (1999), the ’ marks ejectives, the I indicates pharyngealisation, G is a voiced uvular stop, and X an unvoiced uvular fricative.



Key: *č'aran* 'red', *čɨIwan* 'green', *zɨrgɨn* 'yellow', *lagarɨn* 'blue', *muXak* 'brown', *nabatan* 'pink', *GɨIbɨn* 'orange', *aInti:k'a* 'turquoise'

Figure 8. Tsakhur: loci of tile-colours, with dominant names and the universal foci in the CIE (1976) chromaticity diagram

Again using English as the point of comparison (see Figure 3), the colour space occupied by the Tsakhur terms is broadly similar. Where it differs is in regard to PURPLE and PINK. In Tsakhur the candidate term for PURPLE *žangarɨn* has no dominant tiles, hence no term covers the PURPLE space. And what we clearly see is the term for PINK *nabatan* extending well into the PURPLE space, as well as covering the PINK space in the expected way. The sample colour space used for the sixty-five stimuli leaves out parts of the PINK region, so

there might have been even stronger evidence of PINK extending into PURPLE had the sampling been different.

5 Basic BLUE in Lower Sorbian and Upper Sorbian

As an additional point of interest we briefly consider the status of BLUE in these languages, as at least three other Slavonic languages are claimed to have two basic BLUE terms. Using the elicitation tasks outlined here, Corbett and Davies and collaborators have produced evidence in a number of papers that Russian *goluboj* 'light blue' is basic, alongside *sinij* 'dark blue' (Corbett and Morgan 1988; Davies and Corbett 1994), and in a later paper Hippisley (2001) argued for two basic BLUE terms in Ukrainian and Belarusian: Ukrainian *synij* 'dark blue' and *blakytnyj* 'light blue'; Belarusian *sini* 'dark blue' and *blakitny* 'light blue'. Russian, Ukrainian, and Belarusian all belong to the sub-group known as East Slavonic, whereas Lower Sorbian and Upper Sorbian are West Slavonic. There is no evidence pointing to a second BLUE term in the West Slavonic sister languages, Polish, Czech, and Slovak (see Hippisley, Davies and Corbett 2006 for a recent investigation). And from the three consultant tasks carried out here we find no evidence of a second BLUE term in Lower Sorbian and Upper Sorbian. In the list task evidence against a second term for BLUE comes in the distribution of terms specifically meaning 'dark blue' and 'light blue', and the term meaning 'blue', without a lightness distinction. For both languages, terms were offered with the glosses 'dark blue' and 'light blue': in Lower Sorbian *šamnomodry* and *swětłomodry* respectively, and Upper Sorbian *ćmowomódry* and *swětłomódry*. However in nearly every case the morphologically simple term *módry* was offered as well, and where it was given it was almost always

ranked above the modified terms. For Lower Sorbian, nine consultants offered a modified term, and only one did not offer *modry* also. Of the eight who offered *modry* and a modified term, all except one ranked the modified term lower. Five offered *modry* only, and two offered no blue terms at all. For Upper Sorbian, ten gave modified terms, only two of whom did not also give *módry*. All of those who gave both terms ranked *módry* higher.

We end this section on Sorbian BLUE by considering the basic status of *płowy* 'blue' which was offered by nine consultants in the Lower Sorbian list (Table 2, section 3.1). There is evidence that *płowy* is basic for at least two of these, and this would fit with the claim that it is a dialectal variant for BLUE in a small region north west of Cottbus (Fasske et al. 1972: 119, 21) where some of the tests were carried out. Of the nine consultants who offered *płowy* in the list task, only three used it in the naming task where it was used to name tiles associated with the BLUE colour space. This is shown in Figure 9. While one of these three also used *modry* to name BLUE tiles, two used exclusively *płowy*.[18] Tiles named as *płowy* by all three consultants are represented as shaded crosses, those named by two of the three consultants by unshaded crosses.

18 For a discussion on *płowy* denoting BLUE in Lower Sorbian, including details on its etymology, see Steenwijk (2000).

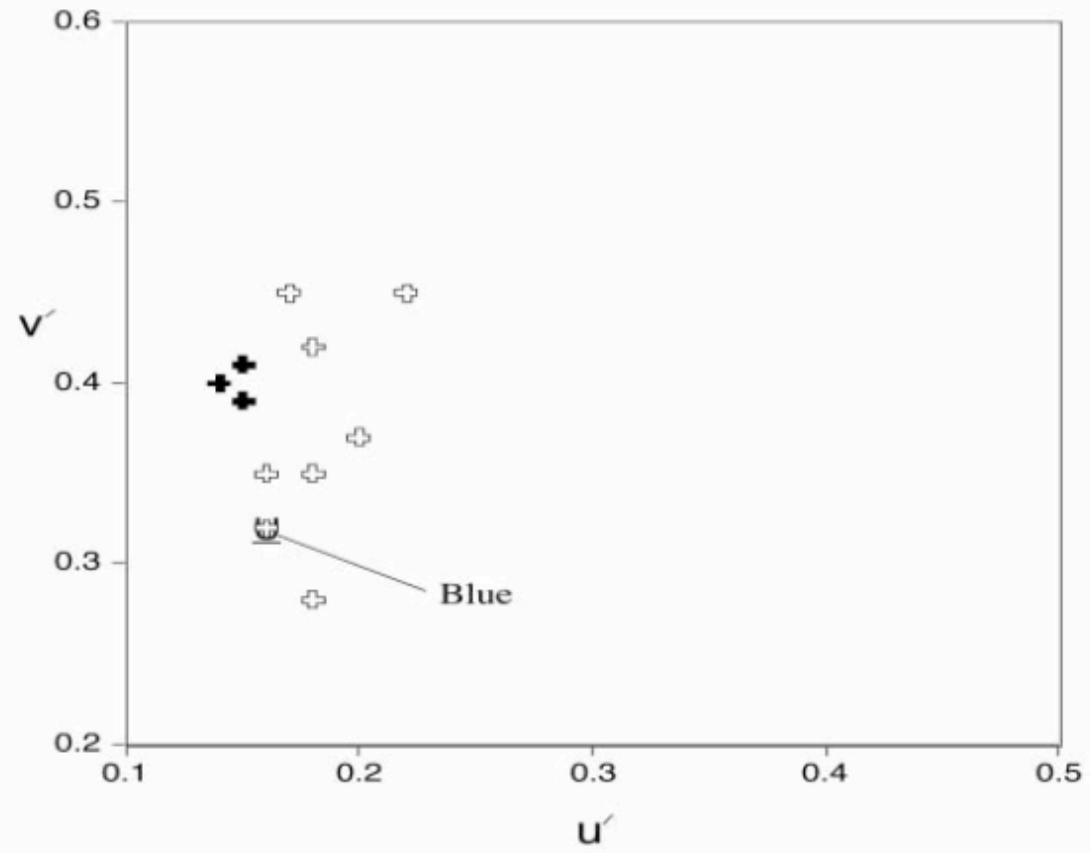


Figure 9. Tiles named as *plowy*

6 Conclusions

Analysis of our work with consultants suggests that Upper Sorbian and Lower Sorbian have colour systems that are still in development. Both lack a basic term for PINK, Lower Sorbian lacks a basic ORANGE, and Upper Sorbian seems to have recently acquired a basic ORANGE. Neither language has a second BLUE term, as is claimed to be the case with East Slavonic languages. An interesting theoretical finding is that the colour systems of two related languages (Upper Sorbian and Lower Sorbian) and one unrelated language, Tsakhur, appear to show the same phenomenon: the colour space of a derived term is a function of that of another derived term. In each case the derived terms in

question are PINK and PURPLE. It is already known that primary colour space can retract upon the emergence of a basic derived term; Figure 8 shows this dramatically for Tsakhur YELLOW in the face of a strong ORANGE term. Our findings suggest that the phenomenon is not restricted to primary terms. Rather the derived terms may also undergo further changes before they themselves are fully settled.

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Appendix 1. The Stimuli

The Color-aid system

The Color-aid corporation supplies a set of several hundred coloured papers that systematically sample colour space (Foss, Nickerson & Walter, 1944). The system is based on the Ostwald colour solid. There are 24 Hues made up from six cardinal Hues: Y (yellow), O (orange), R (red), V (violet), B (blue) and G (green), and intermediate Hues such as OYO (orange yellow orange). Each Hue has seven variants, four Tints (T1-T4) and three Shades (S1-S3). For instance, Y-T1 has the Hue yellow, but is lighter than Y-Hue. For Tints, the higher the index numbers the lighter the colour. Shades are created by 'adding black' to the Hue. For instance, Y-S1 is darker than Y-Hue. The table below lists the Color-aid codes of the 65 stimuli used in this study together with their CIE coordinates (see below). Other investigators have used different colour systems such as Munsell (e.g., Berlin & Kay. 1969) Optical Society of America (OSA; e.g., Boynton & Olson, 1987) and the Natural Colour System (NCS; e.g., Sivik & Taft, 1994). Provided colour space is sampled adequately, it does not matter much which colour samples are used. For instance, Androulaki, Gômez-Pestaña, Mitsakis, Lillo Jover, Coventry and Davies (2006) used NCS, Munsell and Color-aid in separate naming studies of Greek colour terms, and found the same set of basic colour terms in each study. We used Color-aid here as we have used it many times before and found the set sufficient to detect basic colour terms relatively efficiently (Corbett & Davies, 1995). The CIE co-ordinates allow 'translation' from Color-aid to their closest match in other systems.

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We show our stimuli in the CIE 1976 uniform chromaticity diagram (u' v'). This can be understood by considering the locations of good examples of Berlin & Kay's universal categories, and we show these in most figures. For instance, in Figure 3, focal red is towards the right of the diagram; focal green is towards the top-left of the diagram; focal blue is bottom-left; and focal yellow is top-centre. Achromatic colours (white, black and grey, labeled GREY) lie towards the centre of the diagram. Note that around the co-ordinate envelope, the sequence of hue changes resembles the traditional colour-circle; for instance, moving clockwise from GREEN gives the hue sequence: green-yellow-orange-red-purple-blue. BROWN and PINK lie inside this envelope (along with the achromatic colours) indicating that they have lower saturation than the main hues. Distances among the loci represent the perceptual similarity of the colours: the closer together the more similar they are. Colours between the focal can be interpreted by interpolation; for instance, turquoise lies between BLUE and GREEN.

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

Table 1: Color-aid codes and CIE coordinates for the tile-colours

Color-aid code		CIE coordinates					
		Y	x	y	L*	u′	v′
Y	HUE	64.77	0.47	0.48	91.49	0.24	0.55
	S2	16.99	0.41	0.44	52.81	0.22	0.53
YOY	HUE	47.48	0.50	0.43	80.92	0.28	0.54
	T4	55.63	0.45	0.41	86.18	0.26	0.53
	S2	22.08	0.36	0.38	59.09	0.21	0.50
YO	HUE	39.52	0.51	0.41	75.17	0.30	0.53
	T3	47.02	0.48	0.41	80.61	0.28	0.53
	S3	10.72	0.36	0.41	43.02	0.20	0.51
OYO	HUE	26.51	0.54	0.37	63.81	0.34	0.52
O	HUE	25.00	0.54	0.37	62.26	0.34	0.52
	S1	14.34	0.50	0.37	49.03	0.31	0.52
	S3	9.15	0.42	0.36	39.98	0.26	0.50
ORO	HUE	18.87	0.57	0.34	55.26	0.38	0.52
	T3	36.88	0.46	0.35	73.09	0.29	0.50
	S3	26.51	0.33	0.32	63.81	0.21	0.47
RO	HUE	16.22	0.58	0.33	51.75	0.40	0.51
	T3	32.66	0.45	0.32	69.56	0.30	0.48
	S3	4.19	0.37	0.34	27.15	0.23	0.48
ROR	HUE	15.23	0.53	0.31	50.35	0.37	0.49
	T3	29.82	0.42	0.30	67.00	0.29	0.47
	S3	20.71	0.34	0.28	57.50	0.24	0.44
R	HUE	11.71	0.50	0.29	44.78	0.36	0.48
	T4	24.34	0.40	0.27	61.57	0.29	0.45
	S3	4.81	0.33	0.30	29.18	0.22	0.45
RVR	HUE	9.11	0.42	0.24	39.90	0.33	0.43
	S1	12.79	0.35	0.25	46.60	0.26	0.42
	S3	28.43	0.36	0.28	65.69	0.26	0.45
RV	HUE	6.97	0.33	0.19	35.13	0.29	0.37
	T2	14.51	0.31	0.19	49.28	0.27	0.37
VRV	HUE	6.71	0.30	0.19	34.48	0.26	0.37
	S3	8.42	0.36	0.28	65.68	0.26	0.45

V	HUE	4.67	0.26	0.17	28.74	0.23	0.34
VBV	HUE	4.13	0.24	0.17	26.94	0.21	0.34
	T4	19.05	0.25	0.20	55.49	0.20	0.37
BV	HUE	4.21	0.22	0.19	27.22	0.18	0.35
	S2	7.88	0.25	0.26	37.26	0.18	0.42
BVB	HUE	4.80	0.19	0.13	29.15	0.18	0.28
	S3	26.65	0.26	0.23	63.95	0.20	0.40
B	HUE	9.51	0.18	0.16	40.71	0.16	0.32
	T1	19.02	0.20	0.19	55.45	0.16	0.35
BGB	HUE	9.62	0.19	0.19	40.93	0.16	0.35
	T3	23.08	0.20	0.23	60.21	0.15	0.39
BG	HUE	8.93	0.20	0.25	39.53	0.14	0.40
	T1	16.57	0.19	0.25	52.24	0.14	0.40
	S2	7.42	0.21	0.26	36.21	0.15	0.41
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	

Appendix 2. Detailed results of the colour naming task

Table A: Colour naming. Lower Sorbian informants (N=16). Note: ? indicates consultant is unwilling to offer a term for a given colour tile.

colour code	*term*	*freq.*	*colour code*	*term*	*freq.*
Y-HUE	žołty	16	RVR S3	rožowy	9
Y-S2	zeleny	7		lylowy	3
	oliwozeleny	2		cerwjeny	2
	šery	1		pink	1
	khakizeleny	1		swetłowioletnocerwjeny	1
	oliwny	1	RV-HUE	lylowy	11
	šerozeleny	1		fijałkowy	4
	zelenožołty	1		wioletny	1
	zelenošery	1	RV-T2	lylowy	11
	žołtozeleny	1		wioletny	3
YOY-HUE	žołty	15		?	1
	oranžowy	1		pink	1
YOY-T4	žołty	15	VRV-HUE	lylowy	12
	oker	1		fijałkowy	2
YOY-S2	zeleny	7		wioletny	2
	šerozeleny	4	VRV-S3	rožowy	8
	khakizeleny	2		cerwjeny	1
	šery	1		lylowy	1
	oliwny	1		płowy	1
	zelenooliwny	1		pink	1
YO-HUE	oranžowy	7		wioletny	1
	žołty	5		bež	1
	oker	2		cerwjenomodry	1
	cerwjeny	1		?	1
	rožowy	1	V-HUE	lylowy	12
YO-T3	žołty	8		wioletny	3
	oranžowy	5		płowy	1
	różowy	1	VBV-HUE	lylowy	8
	oker	1		modry	4
	cyglowy	1		wioletny	2
YO-S3	zeleny	10		płowy	1
	khakizeleny	1		modrolylowy	1

	šerozeleny	1
	oliwozeleny	1
	šamnošerozeleny	1
	militarnozeleny	1
	swětlooliwnozeleny	1
OYO-HUE	oranžowy	8
	rožowy	2
	cyglowy	2
	oker	2
	cerwjeny	1
	swětlobrunocerwjeny	1
O-HUE	oranžowy	6
	cerwjeny	5
	cyglowy	2
	žołty	1
	rožowy	1
	oranžocerwjeny	1
O-S1	bruny	14
	oranžowy	1
	cerwjenobruny	1
O-S3	bruny	16
ORO-HUE	cerwjeny	11
	?	3
	wišnowy	1
	cyglowy	1
ORO-T3	rožowy	7
	cerwjeny	3
	oranžowy	3
	žołty	1
	oker	1
	cygloworožowy	1
ORO-S3	šery	7
	carny	2
	?	1
	modry	1
	lylowy	1
	khakirozy	1
VBV-T4	lylowy	11
	płowy	2
	wioletny	2
	bazowy	1
BV-HUE	modry	12
	płowy	3
	wioletny	1
BV-S2	modry	7
	šery	3
	płowy	2
	?	1
	šerocarny	1
	šeromodry	1
	modrošery	1
BVB-HUE	modry	11
	lylowy	2
	płowy	2
	?	1
BVB-S3	lylowy	10
	wioletny	2
	modry	1
	šery	1
	modrolylowy	1
	bazowy	1
B-HUE	modry	13
	cerwjeny	3
B-T1	modry	13
	cerwjeny	3
BGB-HUE	modry	14
	płowy	2
BGB-T3	modry	12
	płowy	3
	?	1
BG-HUE	modry	13
	?	1
	płowy	1
	zelenomodry	1

	oker	1
	brunošery	1
	šerobruny	1
RO-HUE	cerwjeny	15
	cyglowy	1
RO-T3	rožowy	8
	cerwjeny	6
	?	1
	wioletny	1
RO-S3	bruny	10
	carny	6
ROR-HUE	cerwjeny	13
	różowy	1
	oranžowy	1
	wioletnocerwjeny	1
ROR-T3	rožowy	8
	cerwjeny	4
	pink	1
	rožojtocerwjeny	1
	wioletny	1
	nacerwjenooranžowy	1
ROR-S3	lylowy	9
	różowy	3
	wioletny	2
	cerwjeny	1
	bruny	1
R-HUE	cerwjeny	11
	modry	1
	wišnjowy	1
	wišnjowocerwjeny	1
	wioletny	1
	karmin	1
R-T4	rožowy	8
	cerwjeny	3
	wioletny	2
	lylowy	1
	lylowocerwjeny	1
BG-T1	modry	12
	płowy	3
	zelenomodry	1
BG-S2	modry	9
	płowy	3
	zelenomodry	2
	?	1
	modrozeleny	1
GBG-HUE	zeleny	15
	šerozeleny	1
GBG-S2	modry	12
	cerwjeny	3
	modrozeleny	1
G-HUE	zeleny	16
G-S3	zeleny	13
	modry	1
	płowy	1
	šerozeleny	1
GYG-HUE	zeleny	16
GYG-T4	zeleny	16
GYG-S1	zeleny	7
	?	3
	płowy	2
	šery	1
	zelenomodry	1
	modrozeleny	1
	šeromodry	1
YG-HUE	zeleny	16
YG-S3	zeleny	10
	cerwjeny	3
	šery	2
	modry	1
YGY-HUE	zeleny	16
YGY-S3	zeleny	16
ROSE-RED	cerwjeny	6
	rožowy	5
	pink	1

	różowocerwjeny	1		lilowocerwjeny	1
R-S3	bruny	5		rožowopink	1
	šery	4		wioletncerwjeny	1
	carny	3		ćmoworoza	1
	płowy	1	SIENNA	bruny	15
	wioletny	1		brunošery	1
	carnobruny	1	WHITE	běły	15
	?	1		žołty	1
RVR HUE	lylowy	7	GRAY 1	šery	13
	cerwjeny	5		běły	1
	różowy	1		bež	1
	pink	1		běłošery	1
	cerwjenolylowy	1	GRAY 2	šery	15
	?	1		šerozeleny	1
RVR-S1	lylowy	7	GRAY 4	šery	16
	rožowy	2	GRAY 6	šery	13
	wioletny	2		carny	2
	cerwjeny	1		oliwny	1
	bruny	1	GRAY 8	carny	16
	fijałkowy	1	BLACK	carny	16
	pink	1			
	bazowy	1			

Table B: Colour naming. Upper Sorbian informants (N=15). Note: ? indicates consultant is unwilling to offer a term for a given colour tile.

colour code	*term*	*freq.*	*colour code*	*term*	*freq.*
Y-HUE	žołty	15	RVR-S3	różowy	4
Y-S2	zeleny	5		pink	3
	oliwowy	3		?	2
	zelenožołty	2		čerwjeny	1
	okrowy	1		oranžowy	1
	oliwozeleny	1		lila	1
	šěrozeleny	1		różojtočerwjeny	1
	žołtobruny	1		ćmowofijałkowočorny	1
	kaki	1		purpurowy	1
YOY-HUE	žołty	12	RV-HUE	fijałkowy	11

	oranžowy	3		červjenofijałkowy	2
YOY-T4	žołty	12		lila	1
	okrowy	1		modrolila	1
	bež	1	RV-T2	fijałkowy	11
	swětłožołtooranžowy	1		lila	3
YOY-S2	zeleny	5		różowy	1
	šěry	3	VRV-HUE	fijałkowy	14
	zelenošěry	2		ćmowolila	1
	oliwowy	1	VRV-S3	różowy	3
	šěrozeleny	2		oranžowy	3
	okrowy	1		?	3
	nabrunoswětłozeleny	1		fijałkowy	2
YO-HUE	oranžowy	12		červjeny	1
	žołty	2		różofijałkowy	1
	žołtooranžowy	1		ćmoworoza	1
YO-T3	oranžowy	10		purpurowy	1
	žołty	3	V-HUE	fijałkowy	13
	oranžowožołty	1		lila	1
	brunožołty	1		modrolila	1
YO-S3	zeleny	10	VBV-HUE	módry	5
	šěrozeleny	2		fijałkowy	5
	?	1		lila	2
	zelenošěry	1		modrošěry	1
	kaki	1		ćmowomodrofijałkowy	2
OYO-HUE	oranžowy	13	VBV-T4	fijałkowy	12
	načerwjenooranžowy	1		lila	2
	žołtočerwjeny	1		modrofijałkowy	1
O-HUE	červjeny	7	BV-HUE	módry	12
	oranžowy	5		šěry	1
	žołtobruny	1		šěromodry	1
	brunočerwjeny	1		čornomodry	1
	červjenožołty	1	BV-S2	módry	5
O-S1	bruny	12		šěry	3
	oranžowy	1		šěromodry	2
	červjenobruny	1		modrošěry	2
	žołtobruny	1		modrozeleny	1
O-S3	bruny	15		ćmowomodrozeleny	1

ORO-HUE	červjeny	13		turkis-modry	1
	oranžowy	1	BVB-HUE	módry	13
	červjenooranžowy	1		modrošěry	1
ORO-T3	różowy	3		fijałkomodry	1
	červjeny	2	BVB-S3	fijałkowy	11
	?	1		?	1
	oranžowy	1		módry	1
	oranžowočerwjeny	1		lila	1
	rožojtooranžowy	1		červjenofijałkowy	1
	červjenooranžowy	2	B-HUE	módry	15
	ćmowofijałkowočorny	1	B-T1	módry	15
	oranžožołty	1	BGB-HUE	módry	14
	ćmoworoza	1		?	1
	červjenbež	1	BGB-T3	módry	15
ORO-S3	šěry	8	BG-HUE	módry	6
	šěrobruny	2		módrozeleny	2
	běły	1		ćmowomodrozeleny	2
	šěromodry	1		zelenomodry	1
	brunošěry	1		nazelenomodry	1
	modrošěry	1		turkis-modry	1
	roza-načerwjeny	1		turkis	1
RO-HUE	červjeny	13		ćmowoturkismodtry	1
	oranžowočerwjeny	1	BG-T1	módry	14
	červjenooranžowy	1		turkis-modry	1
RO-T3	różowy	8	BG-S2	módry	8
	červjeny	2		?	2
	oranžowy	2		modrozeleny	2
	ćmowofijałkowočorny	2		ćmowonazelenomodry	1
	?	1		ćmowomodrozeleny	1
RO-S3	bruny	7		turkis	1
	čorny	5	GBG-HUE	zeleny	14
	čornobruny	3		modrozeleny	1
ROR-HUE	červjeny	14	GBG-S2	módry	15
	červjenofijałkowy	1	G-HUE	zeleny	14
ROR-T3	różowy	5		modrozeleny	1
	červjeny	2	G-S3	zeleny	12
	?	1		modrozeleny	1

	fijałkowy	1
	oranžowy	1
	pink	1
	rožojtočerwjeny	1
	ćmoworoza	1
	čerwjenošěry	1
	purpurny	1
ROR-S3	fijałkowy	9
	lila	2
	?	1
	fijałkowobruny	1
	ćmoworoza	1
	čerwjenběły	1
R-HUE	čerwjeny	11
	?	1
	fijałkowy	1
	liločerwjeny	1
	čerwjenošěry	1
R-T4	rožowy	6
	čerwjeny	2
	fijałkowy	2
	oranžowy	1
	čerwjenolila	1
	rožowofijałkowy	1
	ćmoworoza	1
	purpurowy	1
R-S3	fijałkowy	6
	bruny	2
	šěry	2
	čorny	1
	lila	1
	ćmowofijałkowočorny	1
	fijałkojtočorny	1
	čerwjenošěry	1
RVR-HUE	fijałkowy	5
	čerwjeny	2
	purpurowy	2
	šěromodry	1
	zelenošěry	1
GYG-HUE	zeleny	15
GYG-T4	zeleny	15
GYG-S1	zeleny	2
	módry	2
	módrozeleny	2
	turkis	2
	modrošěry	2
	šěry	1
	zelenomodry	1
	oliw	1
	šěrymodry	1
	šěryzeleny	1
YG-HUE	zeleny	15
YG-S3	zeleny	7
	čornozeleny	4
	čorny	1
	modrozeleny	1
	zelenošěry	1
	ćmowozelenočorny	1
YGY-HUE	zeleny	15
YGY-S3	zeleny	13
	ćmowofijałkowočorny	1
	swětłozelenožołty	1
ROSE-RED	pink	4
	fijałkowy	3
	čerwjeny	2
	rožowy	2
	oranžowy	1
	rožojtočerwjeny	1
	ćmoworoza	1
	lipowozeleny	1
SIENNA	bruny	13
	brunošěry	1
	nabrunočerwjeny	1
WHITE	běły	14

	?	1		šěry	1
	lila	1	GRAY 1	šěry	13
	pink	1		běły	2
	čerwjenolila	1	GRAY 2	šěry	15
	čerwjenofijałkowy	1	GRAY 4	šěry	15
	pinkofijałkowy	1	GRAY 6	šěry	12
RVR-S1	fijałkowy	10		čorny	3
	lila	3	GRAY 8	čorny	11
	?	2		šěročorny	2
				šěry	1
				šěroćmowozeleny	1
			BLACK	čorny	14
				čornošěry	1

Appendix 3. ‘Best example’ results.

Table A. Lower Sorbian. N = 16

Term	*gloss*	*Tile*	*Freq.*	*Term*	*gloss*	*Tile*	*Freq.*
běły	white	WHITE	16	różowy	pink	ROSE-RED	3
carny	black	BLACK	14			RVR-S3	2
		GRAY-8	1			R-T4	2
		RS3	1			RO-T3	2
cerwjeny	red	ROR-HUE	7			ROR-T3	2
		RO-HUE	4			ORO-T3	2
		R HUE	4			ORO HUE	1
		ORO HUE	1			Y HUE	1
zeleny	green	G-HUE	9			R HUE	1
		YGY HUE	4	oranžowy	orange	OYO-HUE	5
		YG HUE	2			YO-HUE	5
		GYG HUE	1			O HUE	3
žołty	yellow	Y-HUE	14			RO T3	1
		YOY-T4	2			YOYHUE	1
modry	blue	B-HUE	4			ROR T3	1
		B-T1	4	šery	grey	GRAY-4	4
		BVB HUE	2			GRAY-2	4
		BG-T1	2			ORO S3	3
		GBG-S2	1			GRAY 6	3
		YO T3	1			GRAY 1	2
		BGB HUE	1	płowy	blue	not known	5
		GRAY 4	1			BGB T3	3
bruny	brown	O-S3	8			GBG S2	2
		SIENNA	5			BGB HUE	2
		O S1	2			GRAY 2	1
		RO S3	1			ORO S3	1
lylowy	purple	VRV-HUE	5			BVB HUE	1
		RV-T2	3			BG T1	1
		V HUE	2				
		RV HUE	2				
		ROSE	1				
		RED					
		RVR HUE	1				

RVR S1	1	
VBV T4	1	

Table B Upper Sorbian. N = 16

Term	gloss	Tile	Freq.	Term	gloss	Tile	Freq.
běły	white	WHITE	16	różowy	pink	R-T4	4
čorny	black	BLACK	11			RO-T3	2
		GRAY-8	5			ROR-HUE	2
čerwjeny	red	RO-HUE	8			ROR-T3	2
		ORO-HUE	6			ORO-T3	2
		ROR HUE	2			RVR S3	1
zeleny	green	YGY-HUE	6			ROSE RED	1
		GYG-HUE	5			O HUE	1
		YG HUE	4			R HUE	1
		G HUE	1	oranžowy	orange	YO-HUE	8
žołty	yellow	Y-HUE	16			OYO-HUE	3
módry	blue	B-HUE	13			O HUE	2
		BGB HUE	1			ORO HUE	1
		BVB HUE	1			YOY HUE	1
		BG T1	1			VRV HUE	1
bruny	brown	O-S3	9	šěry	grey	GRAY 2	7
		SIENNA	5			GRAY 4	6
		O S1	2			GRAY 1	2
fijałkowy	purple	V-HUE	5			ORO S3	1
		RV-T2	4	płowy	pale yellow	Not known	15
		VBV T4	3			GRAY 1	1
		VRV HUE	2				
		RV HUE	2				