Colours on hands: Phonological markedness of sign language color terms

Monica A. Haga-Schoonhoven, Roland Pfau & Bart de Boer
(University of Amsterdam – contact: r.pfau@uva.nl)

1 Introduction: Color terms

→ Intuitively, *purple* is a less 'basic' color term than *white*. One may wonder whether this 'basicness' of colors is reflected in natural languages in one way or the other.

→ Berlin & Kay (1969; henceforth: B&K) found an implicational hierarchy in the color term systems of different languages: if a language has a term for a 'lower ranked' color, it also has terms for the 'higher ranked' colors, cf. Figure 1.

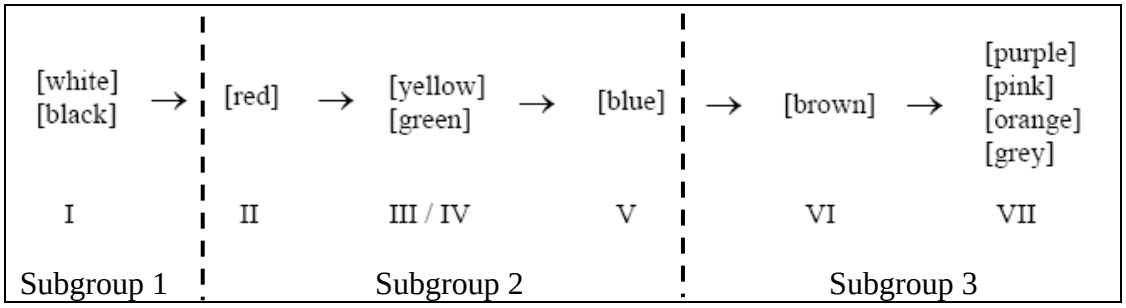

Figure 1: Hierarchical ordering of basic color terms as proposed by B&K (1969); divided into three subgroups according to later revisions (Kay & McDaniels, 1978; Kay & Regier, 2003; among others)

→ For instance, when the vocabulary of a language contains a term for 'blue', it will also contain terms for 'white', 'black', 'red', 'green', and 'yellow'.

→ In later versions (Kay & McDaniel 1978; and others), these seven stages were reduced to three subgroups: **1.** white, black -- **2.** red, green, yellow, blue -- **3.** brown, purple, pink, orange, grey.

→ The few studies on color terms in sign languages (SL) revealed methodological problems, since common SL strategies such as fingerspelling and pointing conflict with B&K's defining criteria (Nyst 2007; Woodward 1989).

→ The central question guiding our research is: Are there any (possibly modality-specific) characteristics in which SL color terms correspond to the proposed hierarchy?

2. Research Question & Hypothesis

→ **"Is there a correlation between the basicness of a color and the phonological markedness of the corresponding sign?"**

→ Hypothesis: Across the different stages of the hierarchy depicted in Figure 1, color terms increase in phonological markedness.

→ Hence, the lower a color is ranked on the hierarchy, the more complex the sign for that color term will be.

3. Phonological Markedness Score

→ In order to determine the phonological markedness of a given colour sign, we developed a Phonological Markedness Score (PMS) based on the following criteria.

→ **(i)** the phonological representation of signs as suggested by Sandler (1989, 1996; Sandler & Lillo-Martin 2006); Feature count:

- the more complex the phonological representation of a parameter (i.e. the more features are needed to describe it), the more marked it is;
- the parameters Hand Configuration (HC), Movement (M), and Place of Articulation (POA) were taken into account;
- the maximum feature count for each of the three parameters is 10 (the score for M is doubled); two-handedness and feature change were taken into account;
- default features such as the HC-feature [open], the POA-feature [neutral signing space (NSS)] and the M-feature [straight] receive 0 as value; see Figure 2 for two examples from SL of the Netherlands (NGT).

RED (NGT)

	features	N
HC	[one]	1
POA	[HEAD], [lo], [mid] [prox], [contact]	5
M	[repeat] (x2)	2

BLUE (NGT)

	features	N
HC	[all → one] [opp → radial] [joined] + 2x change	7
POA	([NSS]), [ipsi]	1
M	[pivot] (x2)	2

Figure 2: Feature count for the NGT signs RED and BLUE

→ **(ii)** evidence from the acquisition of parameters (Conlin et al. 2000):

- the scores determined on the basis of (i) were not simply added up;
- rather, the individual scores were weighted differently based on error rates in acquisition reported in Conlin et al. (2000): HC 56%, M 35%, POA 9%.

→ Combining (i) and (ii), we arrive at the PMS formula in (1) and the PMS scores for RED and BLUE in (2):

(1) $(N_{HC} \times 0.56) + (N_{M} \times 0.35) + (N_{POA} \times 0.09)$

(2) a. RED: $(1 \times 0{,}56) + (2 \times 0{,}35) + (5 \times 0{,}09) = \mathbf{1{,}71}$
b. BLUE: $(7 \times 0{,}56) + (2 \times 0{,}35) + (1 \times 0{,}09) = \mathbf{4{,}71}$

4. Data

→ Color terms from 14 SLs were extracted from online and print dictionaries. This resulted in a corpus of 184 color signs (see References for list of SLs and sources; see Figure 3 for their geographical distribution).

→ 33 color signs (from 10 different SL) show multiple variants: Turkish Sign Language e.g. has four signs for 'yellow'. All variants were included in the sample as separate signs.

→ 13 SLs can be classified as a "subgroup 3 languages" (i.e. they contain more then ten terms for different colors); only Adamorobe SL can be classified as a "subgroup 2 language", containing only (non-complex) signs for 'black', 'white', and 'red' (Nyst 2007).

Figure 3: World map indicating the geographical distribution of the SLs included in this study

5. Methodology: Bootstrapping

→ Bootstrapping is used to estimate how sensitive a statistic (here: the mean) is to the sample that happened to be selected. This is especially relevant when one only has a small sample from an unknown distribution.

→ Bootstrapping creates new "virtual" samples from the original sample, by drawing (with replacement) random elements from the original sample. We used "case resampling" where the virtual samples are the same size as the original sample (see Figure 4a).

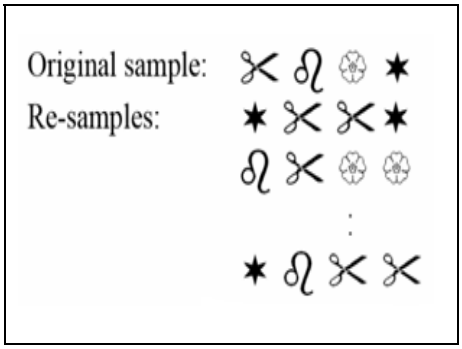

Figure 4a: Case resampling

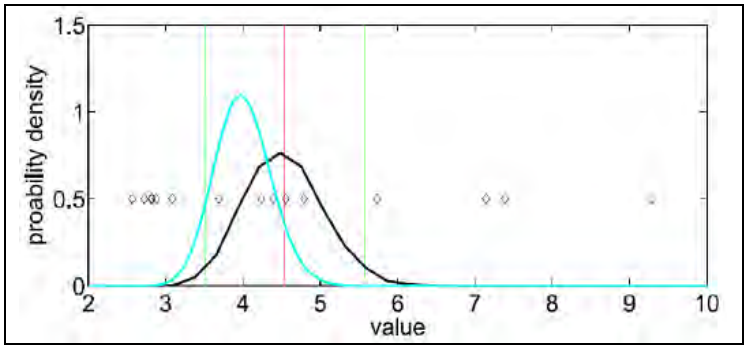

Figure 4b: Bootstrapping example (for explanation, see text)

→ Bootstrapping gives a more detailed picture of what the range of the statistic (the mean, the red line in Figure 4b) is than ordinary confidence intervals would (vertical green lines).

→ However, bootstrapping cannot do magic. As illustrated, when using a small sample (15 data points from the gamma (8, 0.5) distribution indicated with black diamonds), the spread of the mean calculated by bootstrapping (black line) can still be quite different from the spread of the mean calculated by really taking new samples (light blue line).

→ Interpretation of Figure 4b:

- highest point of the black curve indicates the most likely value of the mean: the further it is to the right, the higher the mean value;
- Width of the black curve indicates the spread of the mean: the wider the curve, the less certain the value of the mean is.

→ Applied to our study this implies: (i) the more the highest point is to the right, the more phonologically marked the color sign is; (ii) the less overlap there is between curves, the more certain we are that the difference in PMS between two colors is real.

6. Results & discussion

→ An analysis of the Phonological Markedness Scores of all 184 color signs (on a scale of 0-10) yields PMS scores between 0.8 and 6.0.

→ Across our sample, color terms increase in phonological markedness according to the three subgroups; see Figure 5.

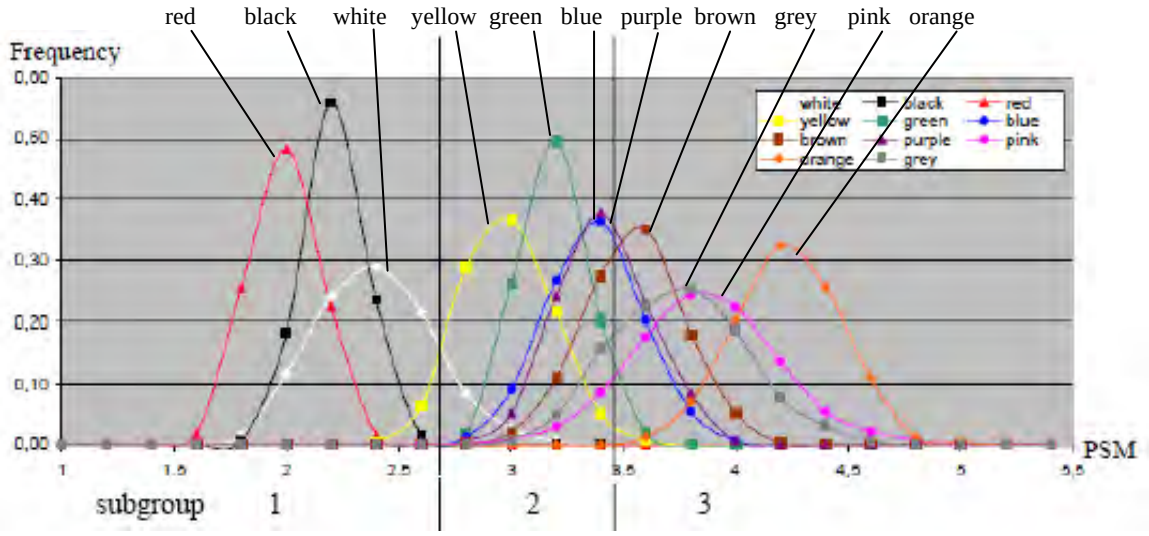

Figure 5: Result of bootstrapping for PMS of color terms from 14 sign languages

→ Remarkably, across SLs the signs for 'red' are exceptional in that in almost all SLs, RED was phonologically less marked than WHITE or BLACK. In SL of the Netherlands e.g. the score for RED is 1.71 (Figure 2), while WHITE has a PMS of 1.1 and BLACK of 1.53/2.09.

→ Possible explanation for the deviant behavior of RED: use of pointing signs.

→ Future research:

- What is the status of the color sign variants? Dialectal variation? Historical change?
- Does the same correlation between 'basicness' of a color term and its phonological markedness apply to spoken languages?

→ **The 'basicness' of a color term is reflected in the phonological markedness of the corresponding color sign: PMS increases as color terms are 'less basic'.**

References

Berlin, B. & P. Kay. (1969), *Basic color terms: their universality and evolution*. Berkeley: University of California Press.

Conlin, K.E., G.R. Mirus, C. Mauk & R.P. Meier (2000), The acquisition of first signs: place, handshape and movement. In: C. Chamberlain, J.P. Morford & R.I. Mayberry (eds.), *Language acquisition by eye*. Mahwah, NJ: Lawrence Erlbaum, 51-70.

Kay, P. & C.K. McDaniel (1978), The linguistic significance of the meanings of basic color terms. *Language* 54, 610-646.

Kay, P. & T. Regier (2003), Resolving the question of color naming universals. *Proceedings of the National Academy of Science* 100, 9085-9089.

Nyst, V.A.S. (2007), *A descriptive analysis of Adamorobe Sign Language (Ghana)*. Ph.D. dissertation. Utrecht: LOT.

Sandler, W. (1989), *Phonological representation of the sign. Linearity and nonlinearity in American Sign Language*. Dordrecht: Foris.

Sandler, W. (1996), Representing handshapes. In: W.H. Edmondson & R.B. Wilbur (eds.), *International review of sign linguistics*. Mahwah, NJ: Lawrence Erlbaum, 115-158.

Sandler, W. & D. Lillo-Martin (2006), *Sign languages and linguistic universals*. Cambridge: Cambridge University Press.

Woodward, J. (1989), Basic color term lexicalization across sign languages. *Sign Language Studies* 63, 145-52.

Sources for SL color terms

• Adamorobe SL >	Nyst (2007)
• American SL >	http://www.aslpro.com/cgi-bin/aslpro/aslpro.cgi
• Argentine SL >	http://manosquehablan.com.ar/diccionario/Colores/
• Bulgarian SL >	http://www.youtube.com/watch?v=vWhdNLQ6jVw
• Catalan SL >	http://lsc.wiksign.org/wiki/Categoria:Colors
• German SL >	http://www.sign-lang.uni-hamburg.de/alex/lemmata/oberbegr/farbe.htm
• Japanese SL >	http://ja.wikipedia.org/wiki/%E6%97%A5%E6%9C%AC%E6 http://www.youtube.com/watch?v=DwABn-iiLu8
• Latvian SL >	http://www.liis.lv/latval/zimval/vin.htm
• Namibian SL >	Namibian Signs. Sign language instruction DVD for families of hearing impaired children. British High Commission Windhoek CLaSH.
• New-Zealand SL >	http://homepages.ecs.vuw.ac.nz/~pondy/nzsl/home-vocab.html
• Russian SL >	http://www.stanford.edu/group/ll/data2/rsl/index9.html
• SL of the Netherlands >	http://www.kegg.nl/egg_gebaren.php
• Swedish SL >	http://130.237.171.78/fmi/iwp/cgi?db=Digital%20version%20av%20Svenskt%20 teckenspr%C3%A5 kslexikon&loadframes
• Tanzanian SL >	Kamahi ya lugha ya alama Tanzania: Tanzanian Sign Language dictionary: Swahili/English – sign language. Tanzania Association of the Deaf.
• Turkish SL >	http://turkisaretdili.ku.edu.tr/en/wordlist.aspx# http://turkisaretdili.ku.edu.tr/en/ wordlist/sozluk.aspx?Cat=4#

Appendix: some examples

(1) **American Sign Language**


WHITE (PMS 3.16)


BLACK (PMS 1.71)


RED (PMS 1.71)


YELLOW (PMS 3.26)


GREEN (PMS 4.29)


BROWN (PMS 2.27)

(2) **Argentine Sign Language**


WHITE (PMS 1.66)


BLACK (PMS 2.18)


RED (PMS 1.48)


YELLOW (PMS 2.27)


GREEN (PMS 2.27)


BROWN (PMS 3.86)

(3) **German Sign Language**


WHITE (PMS 1.01)


BLACK (PMS 1.01)


RED (PMS 1.71)


GREEN (PMS 2.74)


BROWN (PMS 4.0)


PINK (PMS 2.98)

(4) **Japanese Sign Language**


WHITE (PMS 1.01)


BLACK (PMS 2.27)


YELLOW (PMS 2.18)


BLUE (PMS 3.44)


BROWN (PMS 4.09)


ORANGE (PMS 4.38)

(5) **New Zealand Sign Language**


WHITE (PMS 3.53)


BLACK (PMS 2.27)

RED (PMS 1.71)


YELLOW (PMS 3.44)


GREEN (PMS 4.0)


BROWN (PMS 4.42)

(6) **Sign Language of the Netherlands**


WHITE (PMS 1.1)


BLACK (PMS 1.53)


RED (PMS 1.71)


YELLOW (PMS 3.68)


GREEN (PMS 3.39)


PINK (PMS 5.68)

(7) **Swedish Sign Language**

BLACK (PMS 2.18)

WHITE (PMS 1.8)

YELLOW (PMS 2.78)

GREEN (PMS 2.45)

PINK (PMS 4.42)
(involves handshape change)

ORANGE (PMS 4.42)

(8) **Tanzanian Sign Language**

WHITE (PMS 1.86)

BLACK (PMS 2.18)

RED (PMS 2.36)

YELLOW (PMS 2.23)

BROWN (PMS 2.59)

ORANGE (PMS 3.73)

(9) **Turkish Sign Language**

WHITE (PMS 2.04)

RED (PMS 1.62)

GREEN (PMS 2.83)

BLUE (PMS 4.47)

BROWN (PMS 5.03)

ORANGE (PMS 6.0)