Colour Words and Colour Categorization

(1) Does the number and the type of the basic colour words of a language determine how a subject sees the rain bow?
Answer 1: Yes (linguistic relativism, Sapir-Whorf)
Answer 2: No, almost no influence.

(2) Is for each decomposition of the spectrum of the rain bow a natural system of colour words possible?
Answer 1: Yes (arbitrariness, Sapir-Whorf)
Answer 2: No, there are very strict, universal constraints.

Content

- Colour categories

- The investigation of colour term typology
  - Early studies
  - Berlin & Kay (1969)
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  - Kay and Maffi (1999)

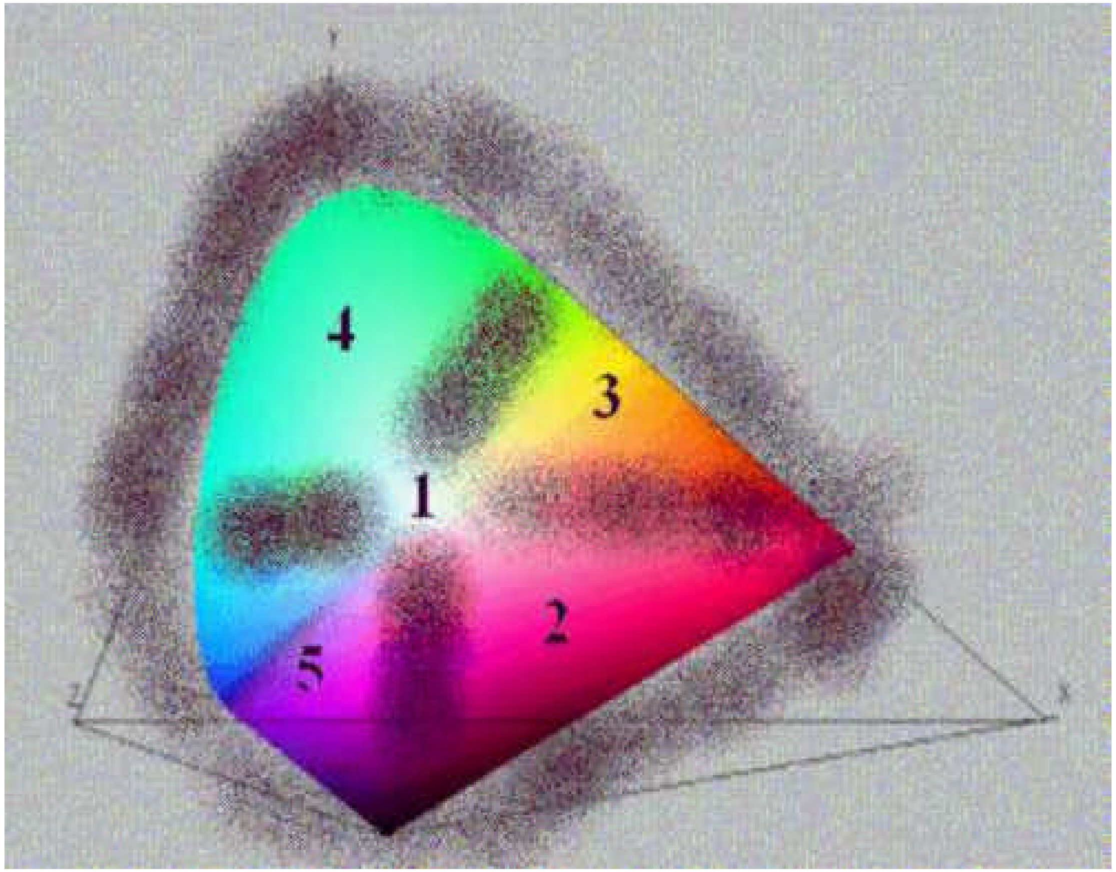
- Explaining colour term typology
  - Early approaches
  - Optimal partitions

Colour Categories

Colour categories decompose the colour space in partially overlapping subsets

Colour categories are prototype categories

E.g. Eleanor Rosch Heider (1973), Natural Categories. *Cognitive Psychology* 4, 328-350.

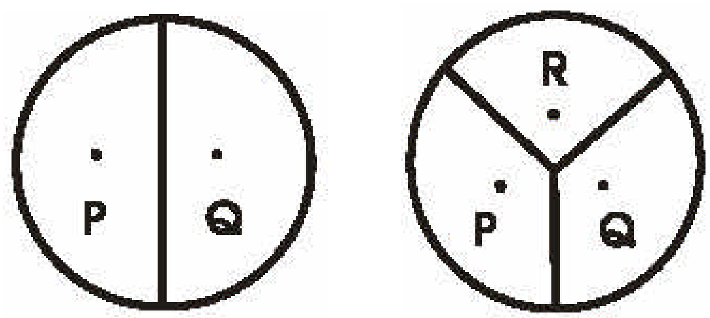


Prototype Categories

- Some colours are better examples of a given category than others are. We can say a good red, slightly red.
- There is usually a single colour which is the best example of the category (the *prototype*)
- The further a colour is from the prototype the less good it is as an example of the colour category.
- Colour categories have fuzzy boundaries. It's not clear exactly which colours are members of the category. Some colours are marginal members. Discriminate membership from prototypicality!

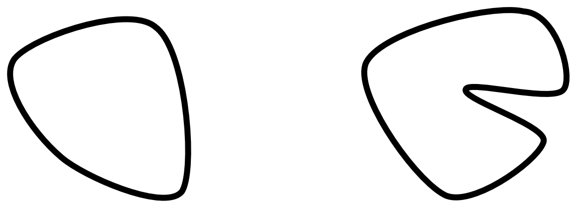
Voronoi tessellation

It defines a partitioning of some (abstract) space in terms of a given set of prototypes. The construction stipulates that the element x belongs to the same category as the closed prototype of the given set of prototypes.



It is evident that previously defined categories may change when we add new prototypes.

The categories determined by Voronoi tessellation are convex sets in the given (geometric) space (see Gärdenfors 2000).



Early ethnoscience studies of colour terms

- **Gladstone** (1858), *Studies on Homer and the Homeric a*ge. Colour vocabulary in ancient times was poorly developed.

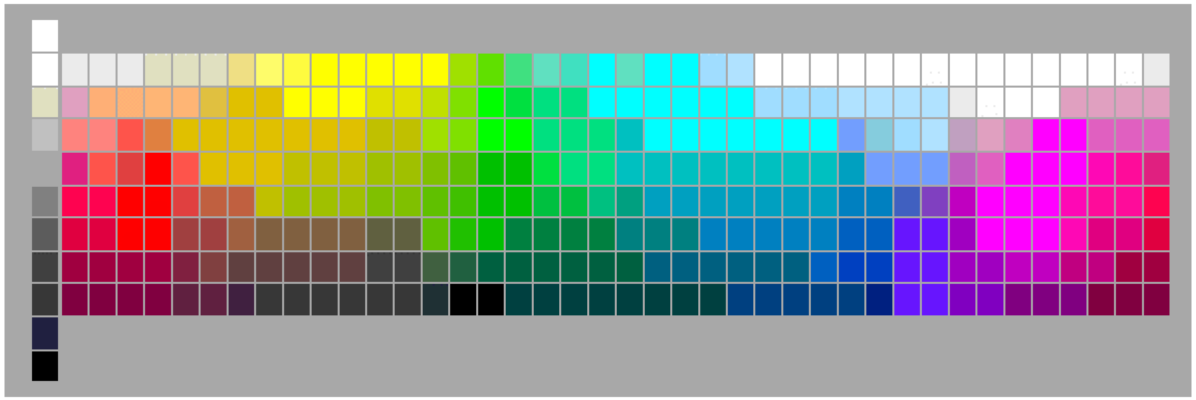
- **Geiger** (1868), *Ursprung und Entwicklung der menschlichen Sprache und Vernunft*. The diachronic encoding of colour categories in language seems to fit into the linear schema of spectral order: Nearly all languages have a term for red, most langs. have a term for yellow, less langs. have a term for green and still fewer langs. have a term for blue. He sees this as a consequence of the development of the perceptual system.

- **Magnus** (1877), *Die geschichtliche Entwicklung des Farbensinns*. He extends Geiger, performing empirical studies with the help of missionaries. He rejects Geiger's perceptual thesis. Colour perception and colour identification are different.

- **Marty** (1879), *Die Frage nach der geschichtlichen Entwicklung des Farbensinns*. Colour perception does not have a (Human) history.

The Berlin-Kay study (1969)

- Originally designed as an experimental test of linguistic relativity: each language performs the coding of experience into sound in a unique way (total arbitrariness)
- Methodological aspect 1: Concentrating on basic colour terms.
- Methodological aspect 2: Concentrating on the typical elements of a category.
- Methodological aspect 3: Standardized colour stimuli (329 Munsell chips)



Basic colour terms

Crimson, red, orange, scarlet, yellow, lemon-coloured, blond, green, blue-green, blue, bluish, purple, pink, brown, grey, black, white,

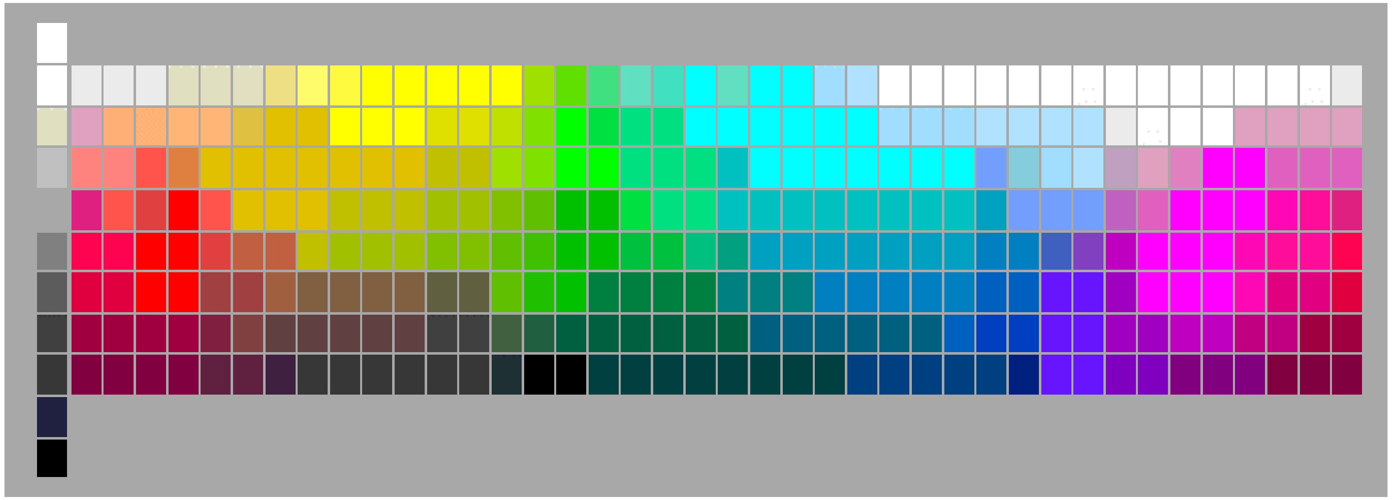
- Monolexemic (*lemon-coloured, *blue-green)
- Their extensions aren't included within those of any other colour terms (*crimson: red, *scarlet: red)
- Applications must not be restricted to a narrow class of objects (*blond: humans)
- psychologically salient for informants (*crimson, *scarlet, *bluish, …)

Hence, we have 11 basic colour terms in English: red, orange, yellow, green, blue, purple, pink, brown, grey, black and white.

Method (1969)

98 languages were investigated (20 in more detail)

(i) Basic colour words were elicited from the informants
(ii) Each subject was instructed to map both the focal point and the outer boundary of each of his basic colour terms on the presented Munsell table.



40 equally spaces hues

8 degrees of brightness (all 320 colours at maximum saturation)

9 chips of neutral hue

Results (1969)

- The number of basic colour terms is between 2 and 11(12).

- If a language has 11 basic colour terms, then the encoded categories are WHITE, BLACK, RED, GREEN, YELLOW, BLUE, BROWN, ORANGE, PINK, PURPLE, and GREY

Languages with 11 (12) basic colour terms: *Arabic (Lebanese)*, *Bulgarian*, *English*, *German*, *Hebrew*, *Hungarian (12!)*, *Japanese*, *Korean*, *Russian (12!)*, *Spanish*, *Zuni*, …

- If a language has fewer than 11 basic colour terms, then there are strict limitations on which categories it may encode.

Results (1969) cont.

- 22 actually occurring types of basic colour lexicon (= 22 types of categorization). This types can be described by 7 **implicative universals** that corresponds to 7 *stages*.

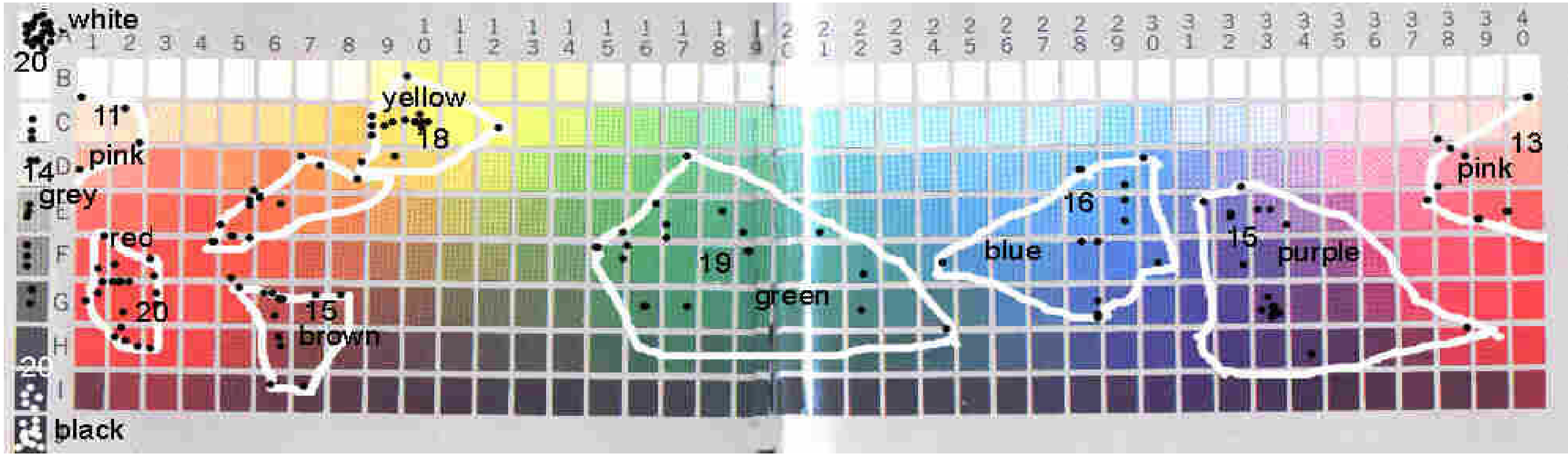
- (I) All languages contain terms for WHITE and BLACK: 1={W, B}
  (II) If a language contains three terms, then it contains a term for RED: 2={W, B, R}
  (III) If a language contains four terms, then it contains a term for either GREEN or YELLOW: 3={W, B, R, G}, 4= ={W, B, R, Y},

  …

WHITE BLACK	< RED <	GREEN YELLOW	< BLUE <	BROUWN	PURPLE PINK ORANGE GREY
I	II	III/IV	V	VI	VII

Results (1969) cont.

- ❖ The prototypes of basic terms from all languages fall into discrete clusters.
- ❖ People are very consistent in their choice of prototype (but not in where they place boundary colours). 11 foci were identified!



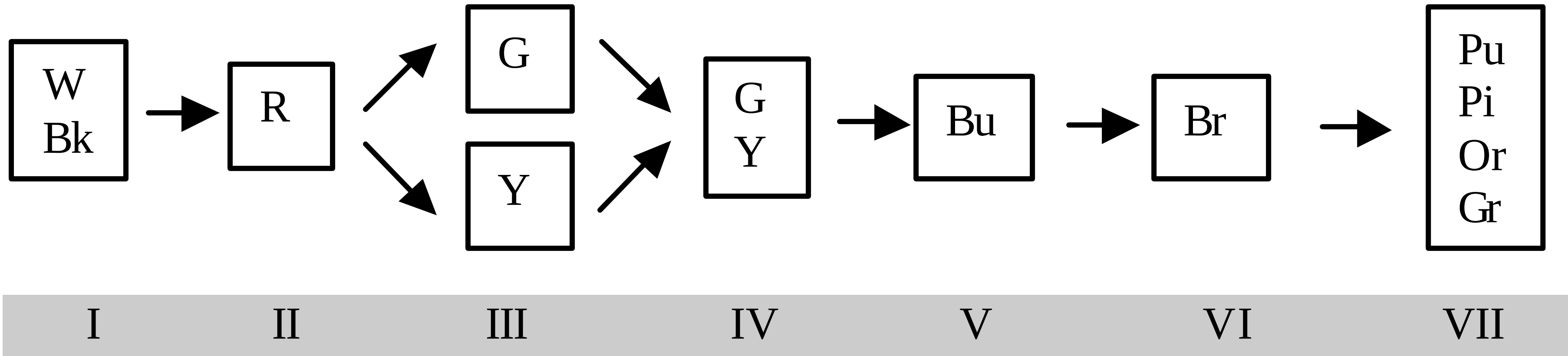
The figure shows the regions judged as typical for a term. The numbers correspond to the investigated languages (out of 20) which have a term falling into the indicated region.

Speculation about colour word evolution (language change)

- Languages evolved from having only 2 basic colour terms, and gradually added more over time until they reached a ceiling of a maximum of 11 basic terms.

- Languages never lose basic colour terms.

- The 7 stages introduced earlier can be taken as corresponding to basic evolutionary stages of colour lexicon (the logical ordering corresponds to a temporal ordering).



Berlin & Kay (1969): Basic conclusions

- The language system (colour lexicon) does not affect the perceptual system (colour discrimination, colour similarity judgements).

- Instead, the perceptual system restricts the language system, especially colour categorization. The fixed number of

- This refutes relativism (the assumption of Sapir and Whorf that the system of language has a strict influence on concept formation and perception): The constraints that determining colour naming are not linguistic ones but perceptual ones. Especially the existence of 11 foci is a perceptual phenomenon – quite independent on the existence of a language system. These foci were interpreted as the primary designata of a set of *universal semantic categories*.
  (This conclusion was challenged, for example, by Saunders & Brakel 1997)

Later Revisions

Kay & McDaniel (1978); Kay, Berlin, Maffi, & Merrifield (1997); Kay & Maffi (1999)

(1) The category GREY appears earlier than in stage VII, sometimes already in stage III (Mandarin, Tsonga, Hopi)

(2) There are many languages that do not have separate terms for GREEN and BLUE though they have terms for categories that were assumed to encode later. For example, Zulu and other Bantu-languages, have a term for BROWN but no separate terms for GREEN and BLUE

(3) The labels BLACK, RED etc. were confusingly used for referring (i) to a category having a particular focus, (ii) to a category having a particular extension. However, the extensions referred to were not constant across occasions of use of the CATEGORY LABEL.

Later Revisions cont. 1

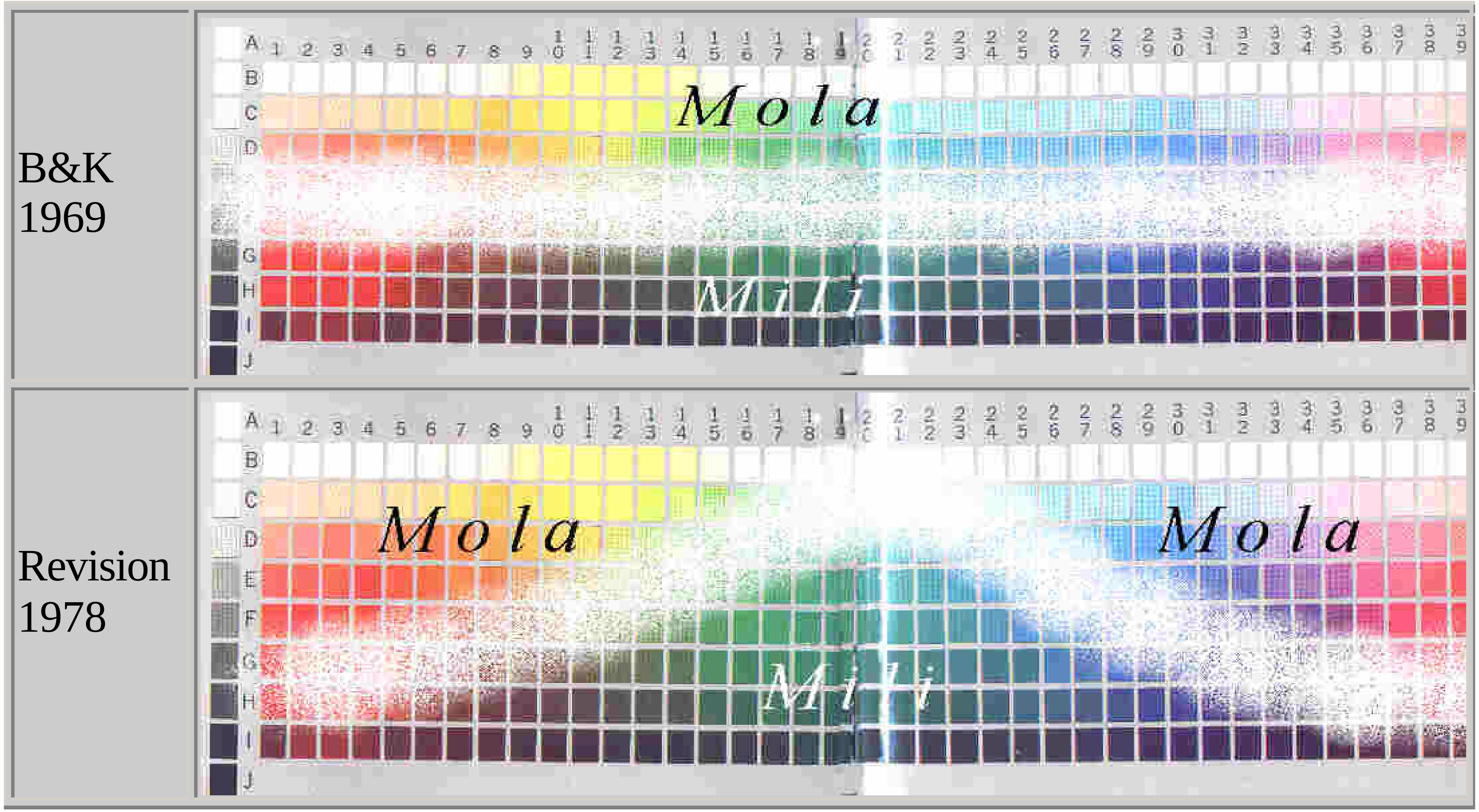
(4) There exists a small set of 6 perceptual landmarks (instead of 11 foci in B&K 1969). They can be identified with the Hering primary colours: black, white, red, yellow, green, blue) which individually or in combination *form the basis of the denotation of most of the major color terms* of most of the languages of world.

(5) The colour categories encoded in stage 1 are not achromatic (light/dark) but panchromatic. Heider Rosch investigated Dani (Highlands of New Guinea). They found that the Dani's two colour categories *mola* and *mili* were better labelled 'white-warm' and 'dark-cool' than simply WHITE and BLACK.

mola: WHITE/RED/YELLOW
mili: BLACK/GREEN/BLUE

Notice that these colour categories have three foci each!

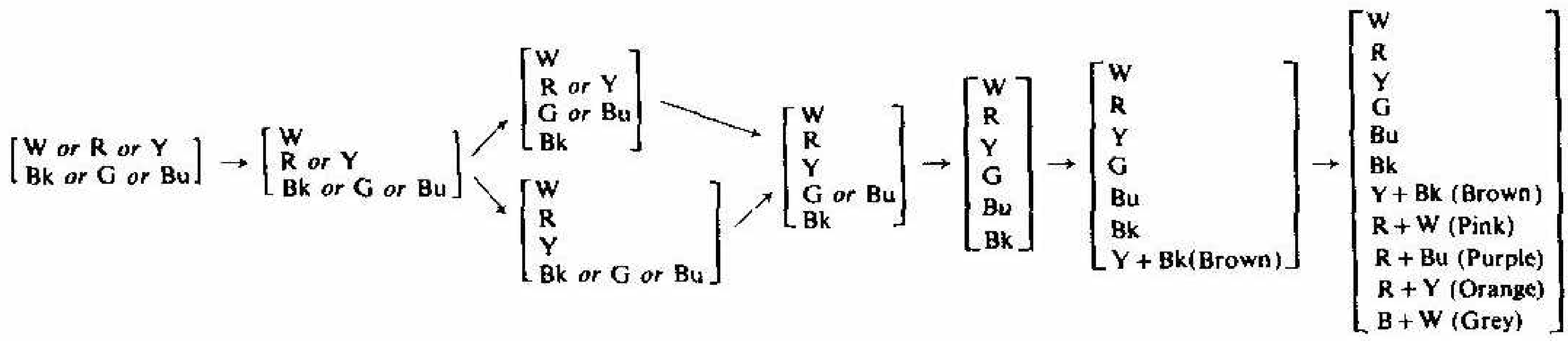
Mola and *Mili*



Later Revisions cont. 2

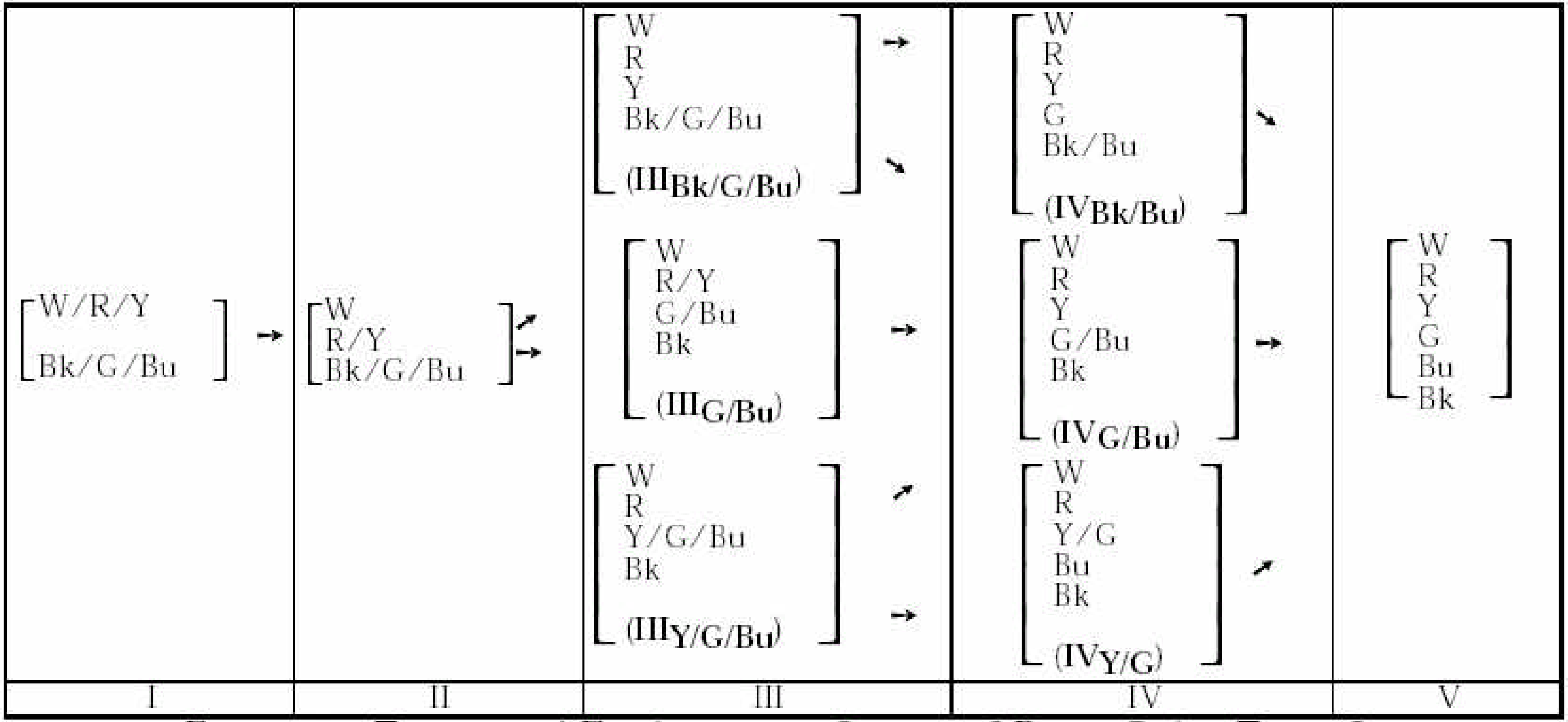
(6) Besides the 6 *primary* basic colour categories there are *derived* basic categories (based on fuzzy *intersection*) and *composite* basic categories (based on fuzzy *union*); e.g., ORANGE = YELLOW & RED (derived); WARM = RED OR YELLOW (composite)

(7) Each colour terminology partitions the universe of colour percepts. Evolutionary sequences are assumed as moving from coarser to finer partitions.



from Kay & McDaniel (1978), p. 639

Adapted from Kay, Berlin, Maffi, & Merrifield (1997), Figure 2.4, page 33



Criticism: MacLaury (1997)

(1) In languages with composite green-blue the focus is in green, other times in blue, and sometimes it is focussed in either green or blue.

(2) It's common for *purple*, *pink*, *orange* and *brown* to emerge before the *green-blue* term has split into *green* and *blue*, sometimes this even happens before *yellow-red* splits.

(3) The order of emergence of derived categories tends to be *purple*, *brown*, *pink*, *grey* then *orange*, but there's lots of variation in this order.

(4) Co-extension – sometimes two colour terms overlap, covering more or less the same range of colours, but with foci in different places.

(5) Different speakers of the same language can be at different evolutionary stages – and in some languages most speakers don't fit into any evolutionary classification.

(6) Some colour systems are based mainly on lightness, while most are based more on hue.

See also Saunders & Brakel (1997) and Kay's reply (in the online reader)

Explaining colour term typology

What needs explaining?

- Prototype properties of colour categories
- The range of colours denoted by each colour word varies between languages.
- The number of basic colour terms varies between languages, from 2 to 11 (12).
- But there are cross-linguistic regularities in colour term systems, described by a system of implicative universals. These universals describe the possible sequences of language evolution (historical/diachronic/cultural/glossogenetic change).
- The problem, thus, is one of reducing linguistic universals.

Ways of reducing linguistic universals

- Biological processes (e.g. Chomsky)
- Social processes (e.g. Grice)
- Interaction of biological and social processes (e.g. Hurford)

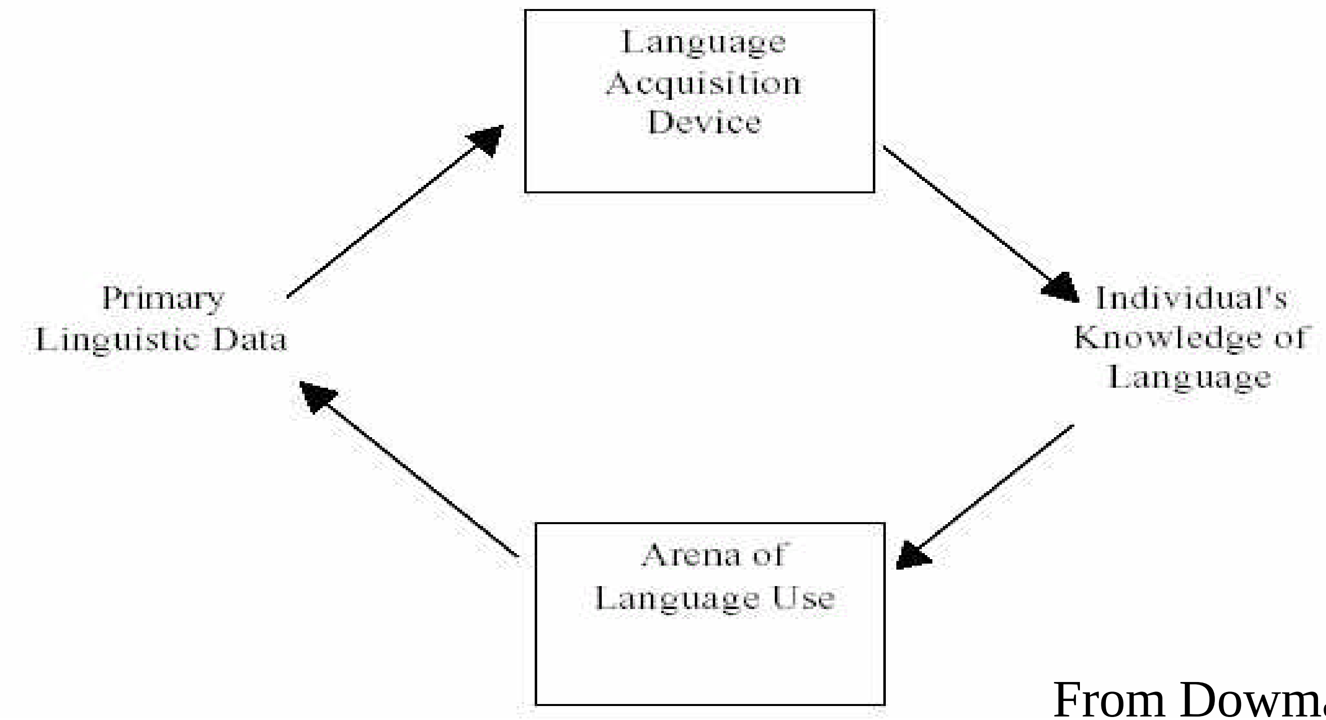
There are many variations and modifications of the three basic approaches.

LAD

Chomsky's LAD assumes biological prerequisites for learning. These basics explain which languages (and lexical systems) can be learned and which not.

Hurford's Diachronic Spiral

The interaction of biological (psychological) mechanisms of language learning and social processes is constitutive for creating and changing languages.



From Dowman, recent handout

The development of colour term typology

(A) Psychologically based devices

- Successive encoding of foci (Berlin & Kay 1969)
- Successive refinement of partitions by applying fuzzy operations (Kay & McDaniel 1978)
- Successive refinement of partitions by applying ranked partitioning principles determining optimal partitions (Kay & Maffi 1999)
- Bayes’ optimal classification (Dowman 2001

(B) Devices based on the diachronic spiral

- Future work, first steps in Dowman 2002

Successive encoding of foci

- Stage I languages universally encode the *bright/dark* distinction.
- The chromatic opponent colour pairs are encoded at stages II-V beginning with *red* and ending with *blue*.
- At the intermediate stage III and IV either *yellow* or *green* is encoded first

I	II	III/IV	V	VI	VII

- Problems
  - Confusion between foci and categories
  - The colour categories encoded in stage I are not achromatic but panchromatic
  - No causal inference possible from neuropsychology to the sequence of encoding!

Optimal partitions

- Kay & McDaniel (1978): unifocal categories (WHITE, BLACH, RED, GREEN, YELLOW, BLUE) are taken as fuzzy features and complex features are formed from them using fuzzy operations. This only leads to predictions about the successive refinement of natural partitions if the idea of *optimal partitions* is realized.

- Kay & Maffi (1999): Successive refinement of partitions by applying *ranked partitioning principles* determining optimal partitions. Interesting proposal, but a bit stipulative. What about the grounding of these principles? (In the online-reader)

- Dowman (2001): Optimal classification based on Bayes' theorem. Possible extensions realizing the diachronic spiral. (In the online-reader)