Color language

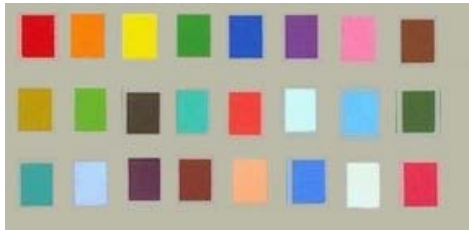
9.59J; 24.905J

Ted Gibson

Does language affect color perception?

Brown & Lennenberg (1954): codability of English color terms is correlated with recognition

Codability



Name each chip as quickly as possible

Codability = amount of consensus between names

Recognition

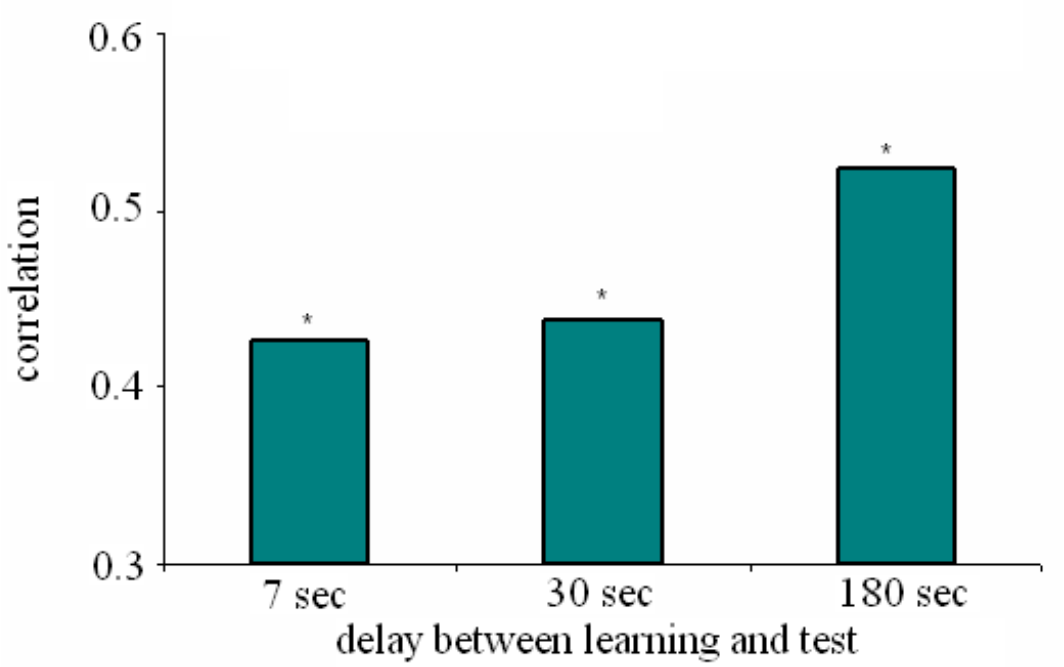
Shown a color 

Delay

Pick it from array

Does language affect color perception?

Brown & Lennenberg (1954): codability of English color terms is correlated with recognition



What does this mean?

- Language can affect color memory (perception?), even on a non-linguistic task

- Color perception can affect language: Focal colors are the most labelable ones

Does language affect color perception?

Before we can address this question:

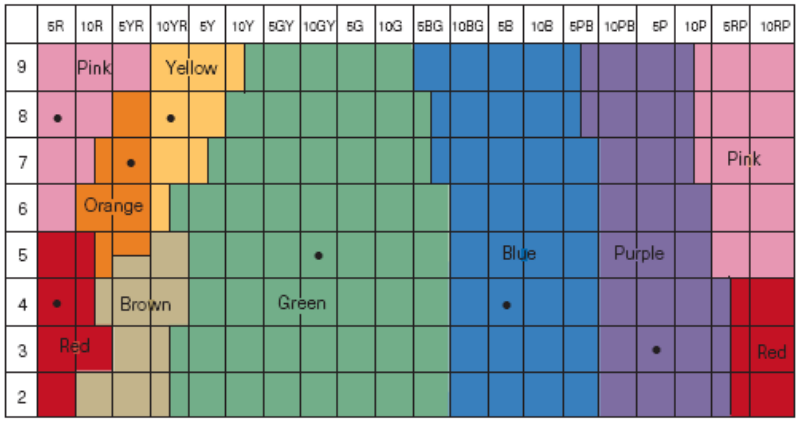
Observation: Languages vary widely in the number of color terms:

English: black, wide, red, blue, green, yellow, pink, brown, orange, purple /

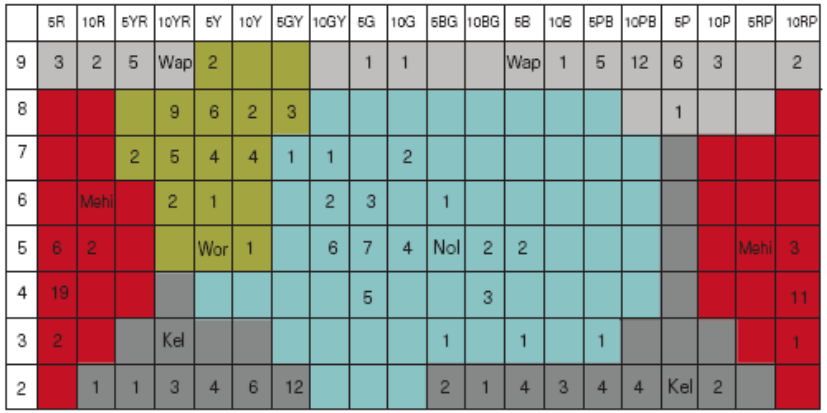
Berinmo: mehi, kel, wor, nol, wap (Roberson & Davies, 1999) /

Dani: 2 color terms (Rosch Heider 1972): dark / light or “black” / “white”

English



Berinmo /

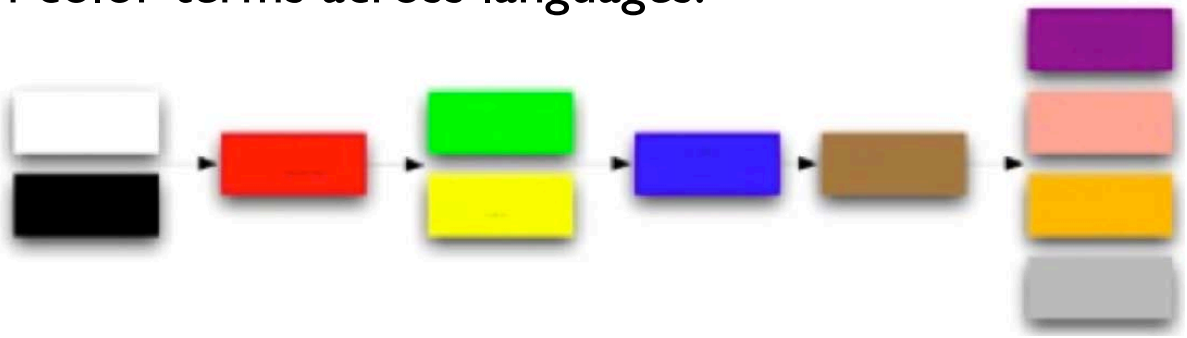


Reprinted by permission from Macmillan Publishers Ltd: Nature.

Source: Davidoff, Jules, Ian Davies, and Debi Roberson. "Colour categories in a stone-age tribe." Nature 398, no. 6724 (1999): 203-204. © 1999.

Berlin & Kay (1969): The World Color Survey (WCS)

330 colors in World Color Survey color grid: Approximately a subset relation among sets of color terms across languages:

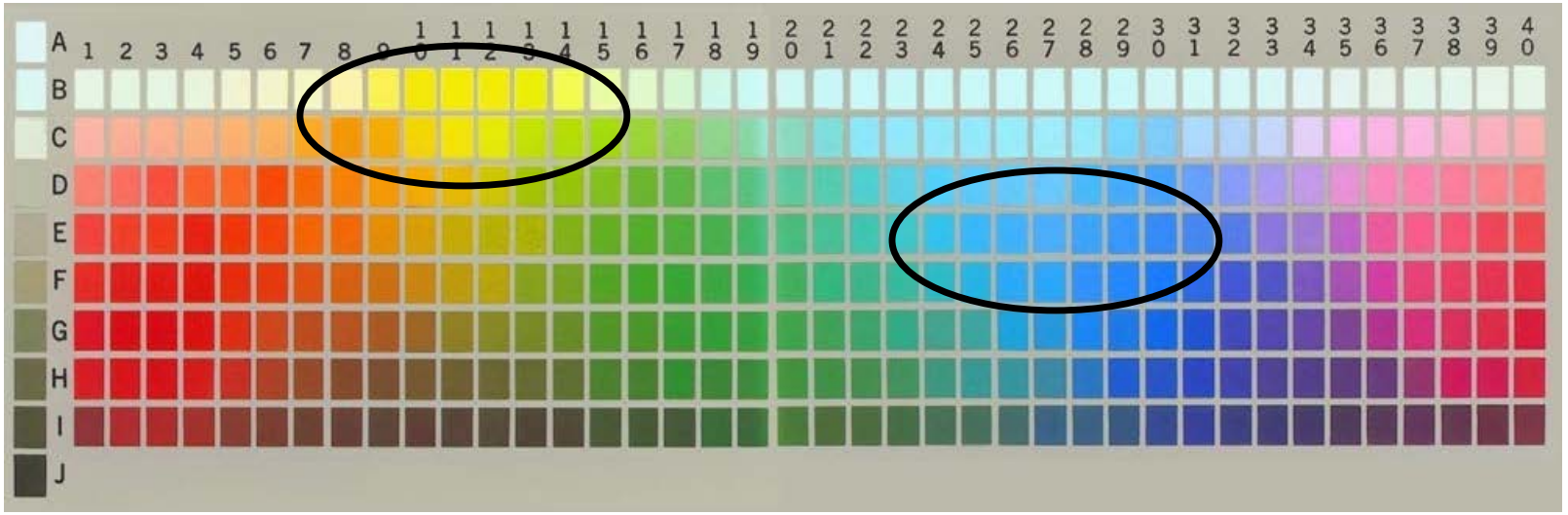


Berlin & Kay discuss the distribution of color terms in terms of "basic" color terms: basic color terms are thought to be **visual-perception** based: the most salient colors in the color space (e.g., Kay & Maffi, 1999)

These are the **modal color terms** in the WCS

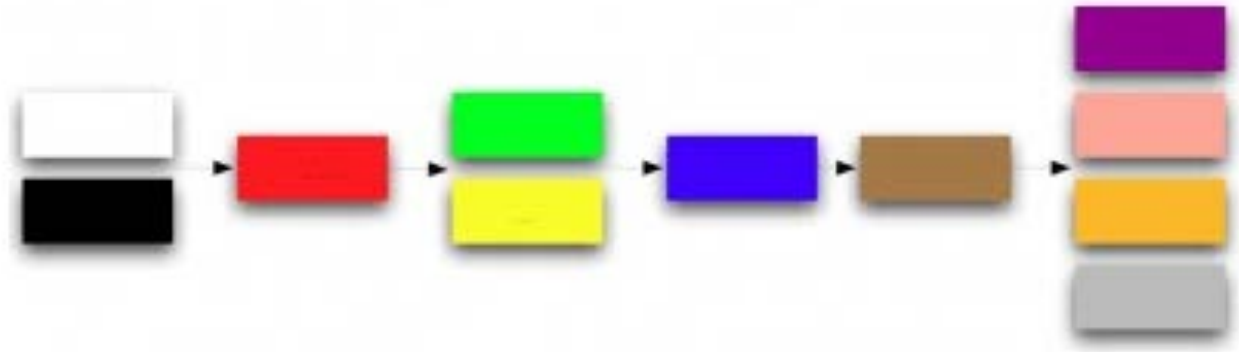
The approximate subset relationship across languages is suggestive evidence for the perceptual hypothesis for the source of the similarities / differences

Some color concepts never seem to appear



"Blellow"

Proposed universal distribution of color terms



Evolution by Stages

a

b

1975	I	II	IIIa-b	IV	V	VI	VII
Partition spectrum into ranges that include three, two, or one pure focus; finally partition blends between pure foci	light-warm	white warm	(a) white warm	white red	white red	-and- brown	-and- purple
	dark-cool	dark-cool	black cool	yellow black	yellow black		pink orange
			-or-	cool	green		
			(b) white red yellow		blue		
			dark-cool				
	| ---------- grey ---------- |						

Key: light-warm (white, red, yellow), dark-cool (black, green, blue), warm (red, yellow), cool (green, blue)

Berlin & Kay, 1969 /

Does color perception affect language?

A Universal distribution of color terms?

- Claim 1: Focal colors ("best examples") consistent across different speakers
- Claim 2: Speakers of all languages pick out the same kinds of groups of colors, based on the natural world
  - Light vs. dark (Yes, this is true)
  - 4 primary color foci: red, green, yellow, blue (Wait: this isn't true!)

Berlin & Kay, 1969 /

Why the wide variability among cultures? Puzzles for the perceptual hypothesis

1. What exactly is a "basic" color term? Is this term well-defined?

2. Why are there exceptions to the subset relationship (e.g., Berinmo)?

3. Why do more industrialized cultures have more color words?

Kay & Maffi, 1999: *"As technology develops, the increased importance of color as a distinguishing property of objects appears to be an important factor in causing languages to add basic color terms, i.e., to refine the lexical partition of the color domain (Casson 1997)."*

If we must appeal to culture to explain color distributions anyway, maybe we can do away with the notion of "basic" color term: Maybe color terms are just experience-based (Deutscher, 2010; cf. Gladstone, 1860)

People with different experiences with colors and color labeling will be different at their ability to use color words. E.g., painters, interior designers

Research question 2:
Does language affect color perception?

- Tentative answer for a long time: no

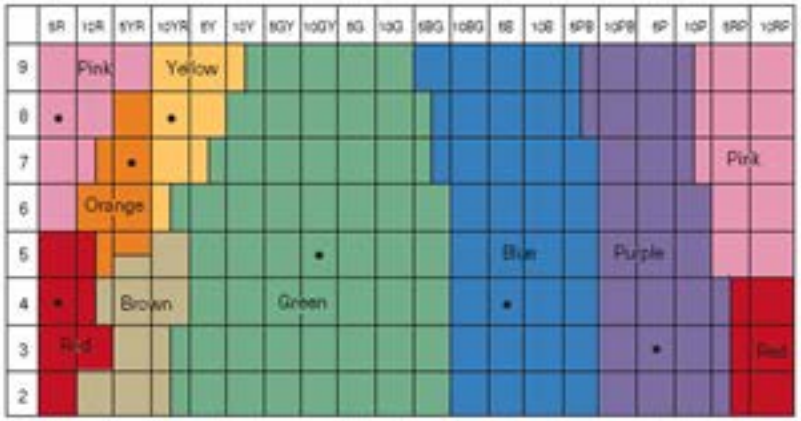
THEN….

- More cross-cultural evidence
- Exploration of more subtle effects
  - *How* might language affect color perception?

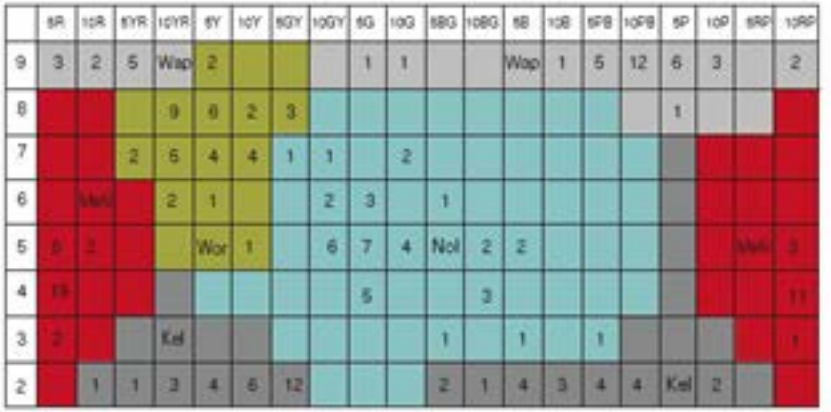
More cross-cultural evidence

- Comparison of English and Berinmo
  (Roberson, Davies, Davidoff, 2000; Davidoff et al, 1999, Nature)

English



Berinmo



More cross-cultural evidence

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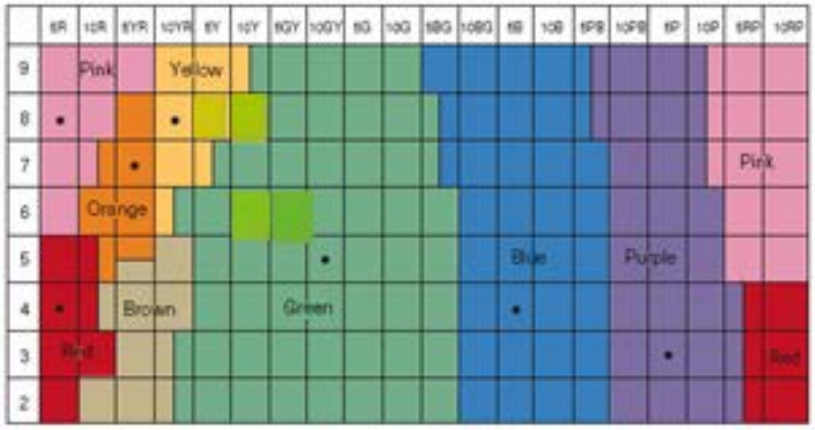
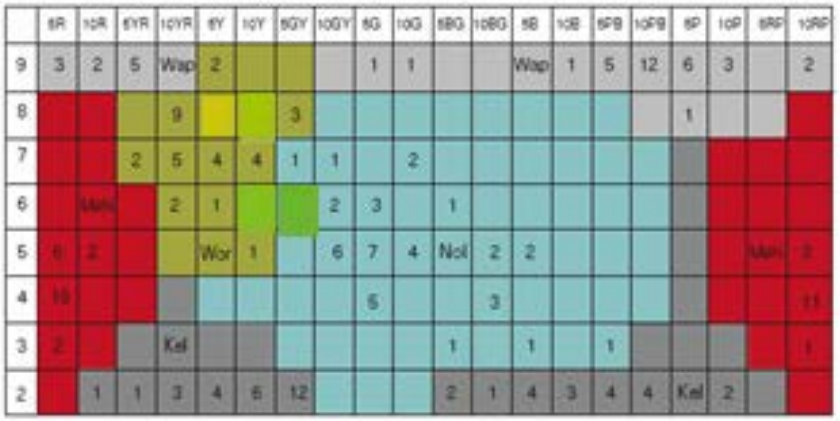
English

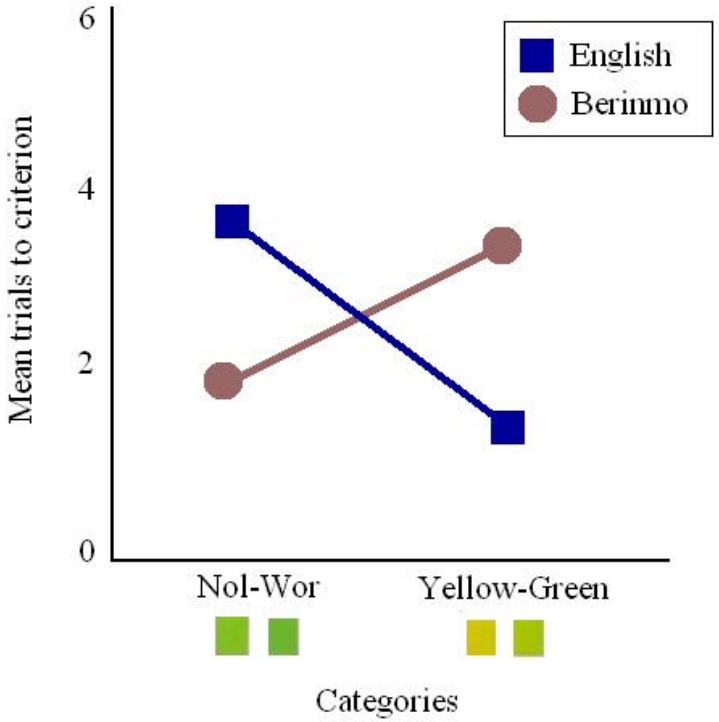


Berinmo



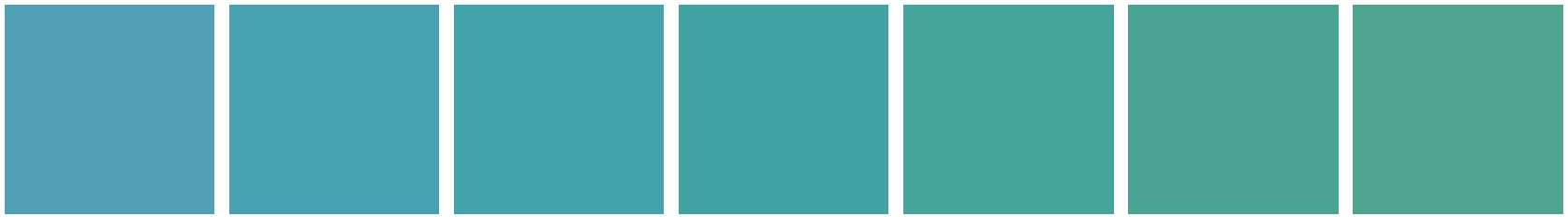
More cross-cultural evidence

- Berinmo and English speakers each had a harder time learning to sort chips into categories based on color contrasts that were not in their language



Language and color memory

Stimuli



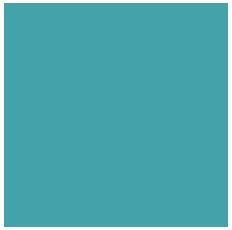
BLUE

GREEN

(Roberson, Davies, Davidoff, 2000)

Language and color memory

Method



(Roberson, Davies, Davidoff, 2000)

Language and color memory

Method

5 second delay

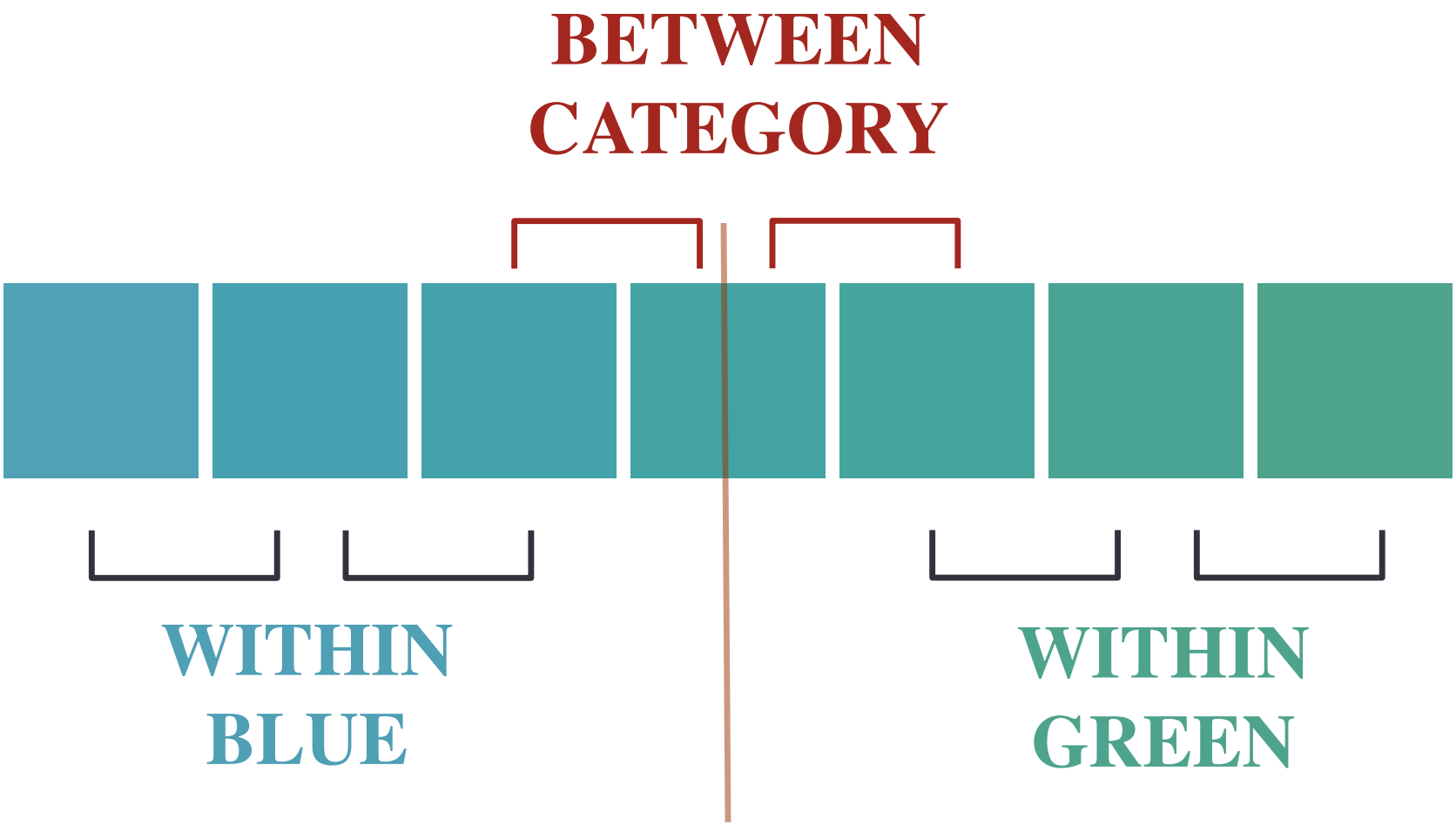
(Roberson, Davies, Davidoff, 2000)

Language and color memory

Method

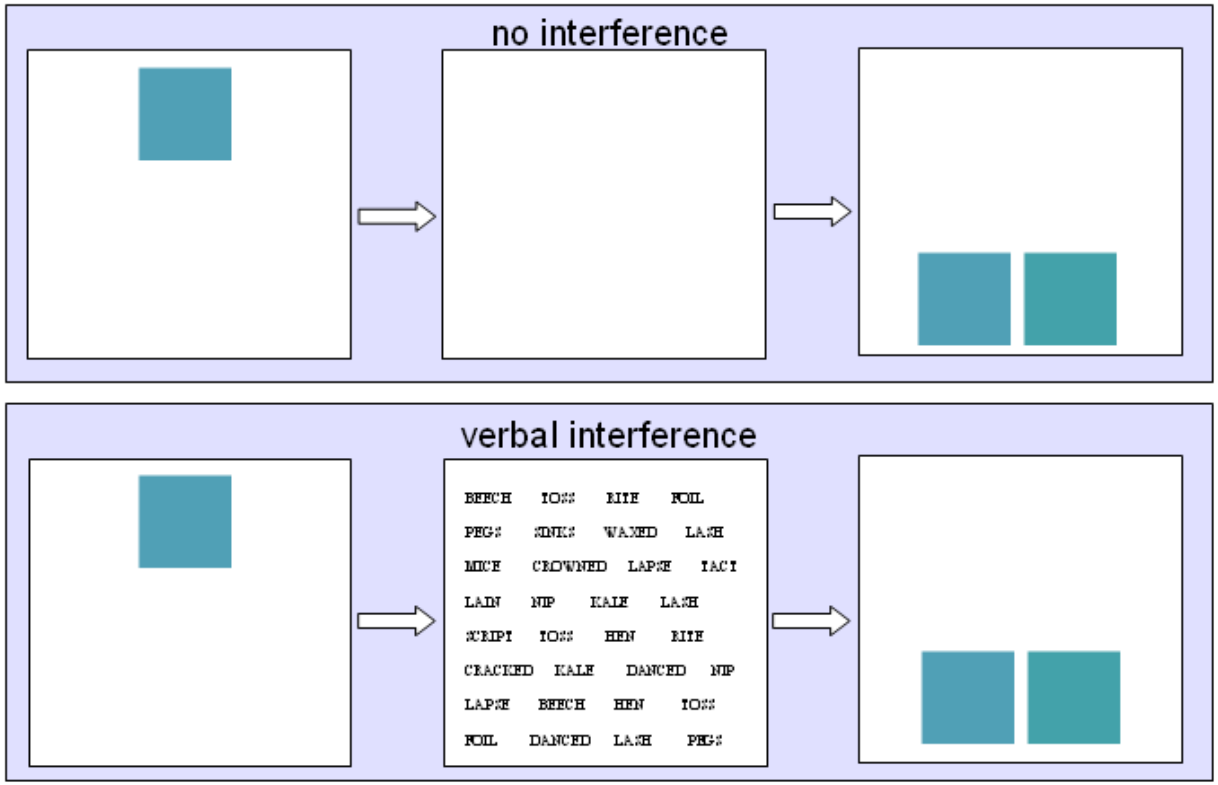
(Roberson, Davies, Davidoff, 2000)

Language and color memory



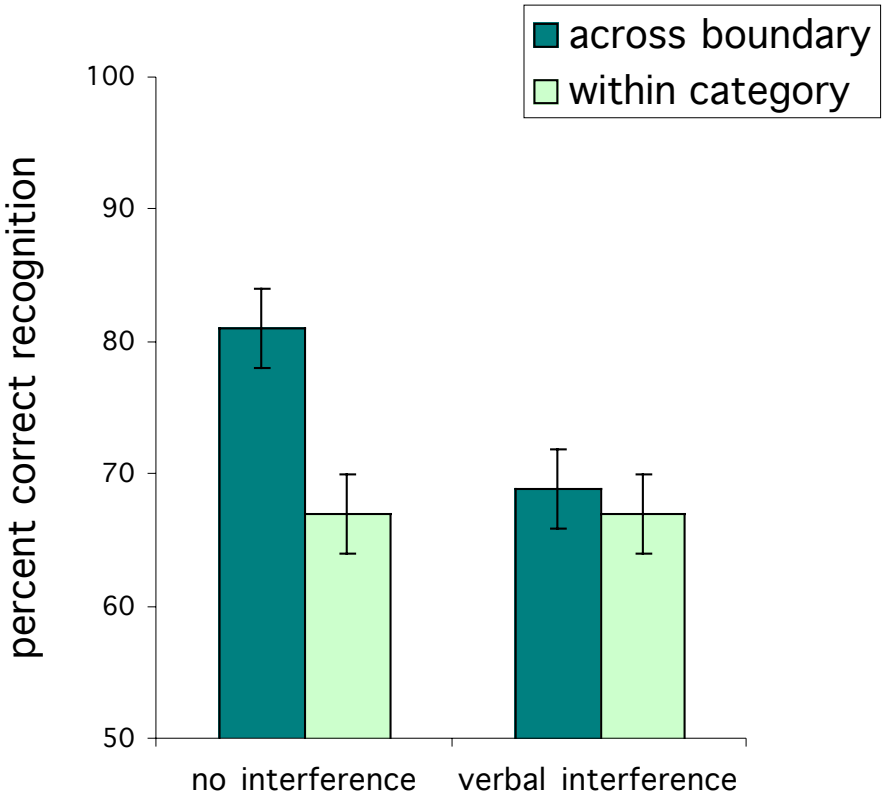
(Roberson, Davies, Davidoff, 2000)

Language and color memory



(Roberson, Davies, Davidoff, 2000)

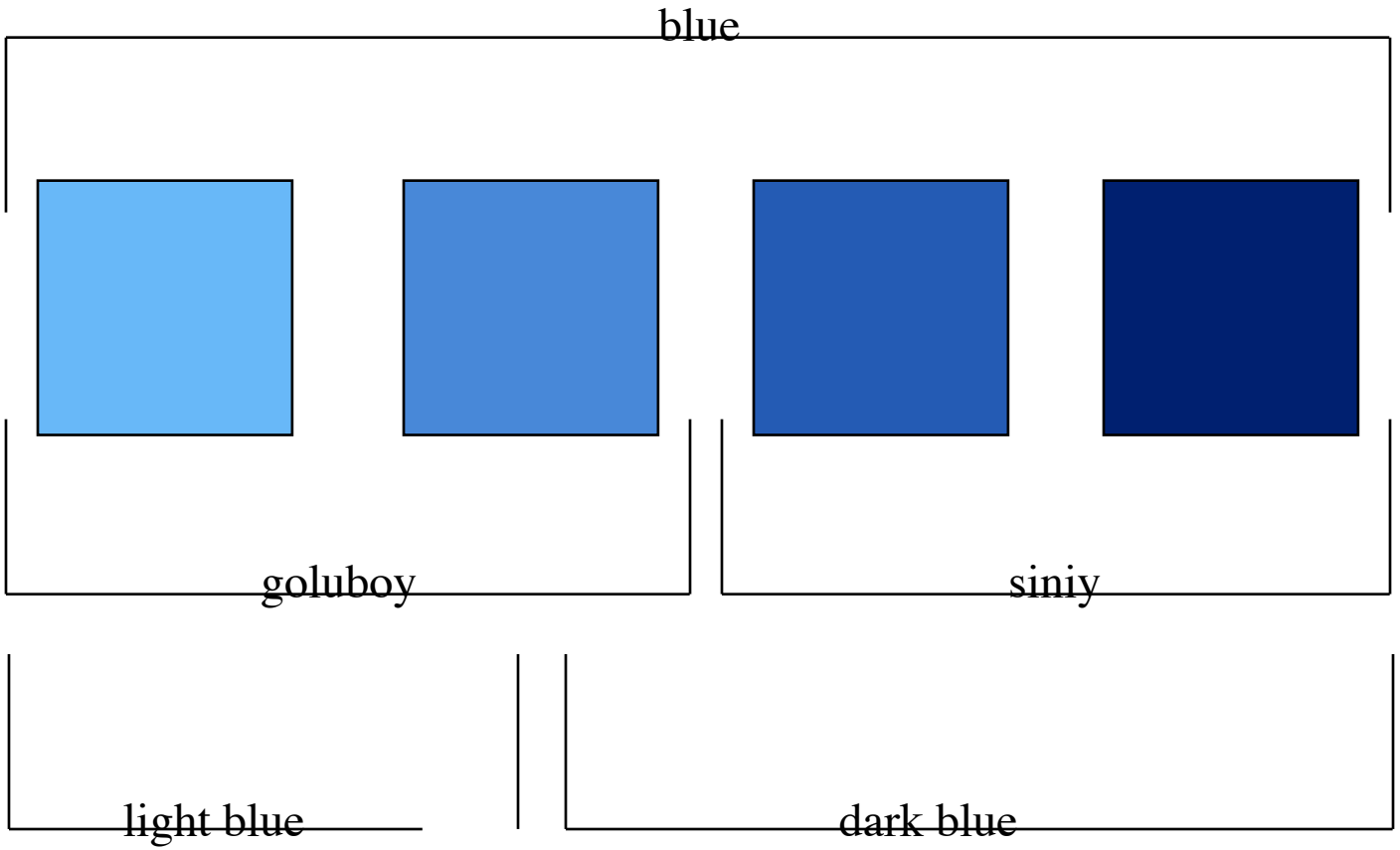
Language and color memory



(Roberson, Davies, Davidoff, 2000)

Does color perception really differ across languages?

Language and color perception: Russian



Winawer et. al. 2007

Language and color perception

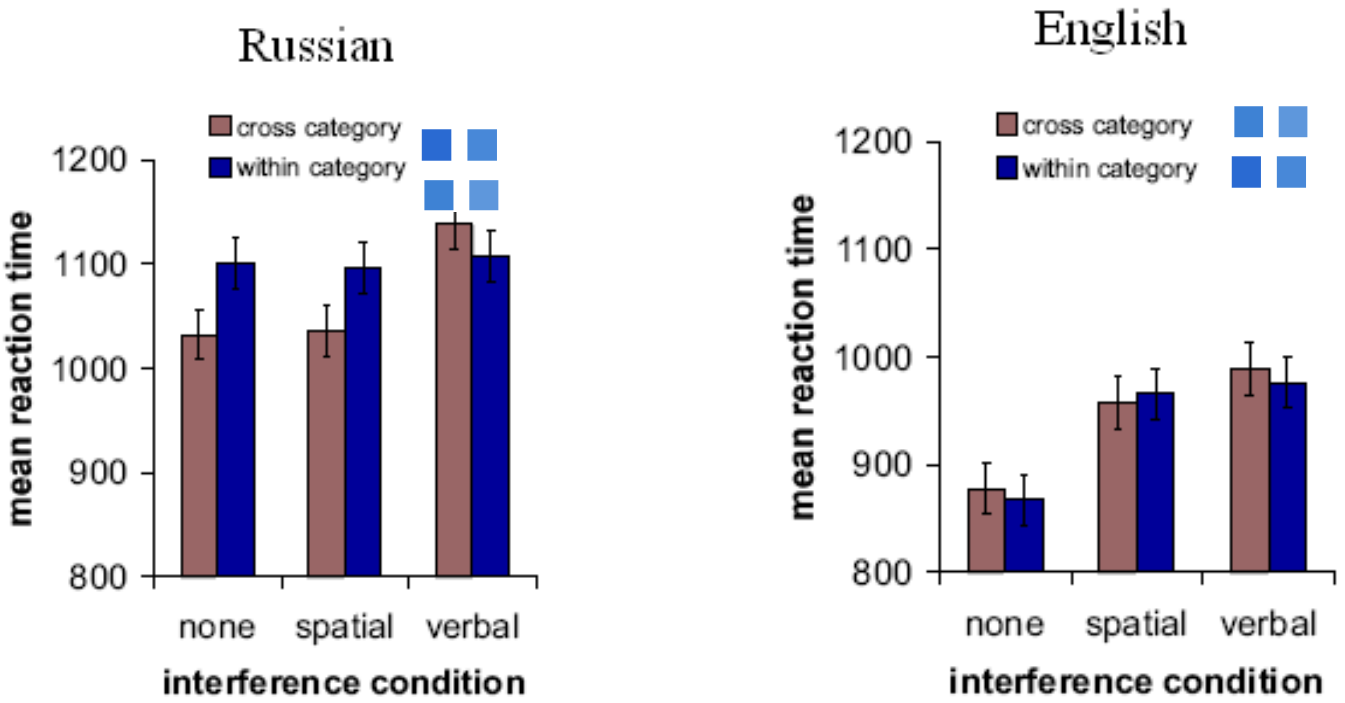
Which side is the edge on?

WITHIN CATEGORY

BETWEEN CATEGORY

Language and color perception: Russian

- Russian speakers have cross-category advantage, but English speakers don't



Winawer et. al. 2007

Language and color perception: Russian

- Potential issues with the Winawer et al. study:
  - /Main effect of language?
  - /Numerical effect in the reverse direction for verbal shadowing condition for Russian speakers: almost as large as the critical effect
  - /No penalty for spatial interference condition in Russian
  - /Only 24, 26 participants in English, Russian
- What control experiment(s) would you run?

Conclusions so far

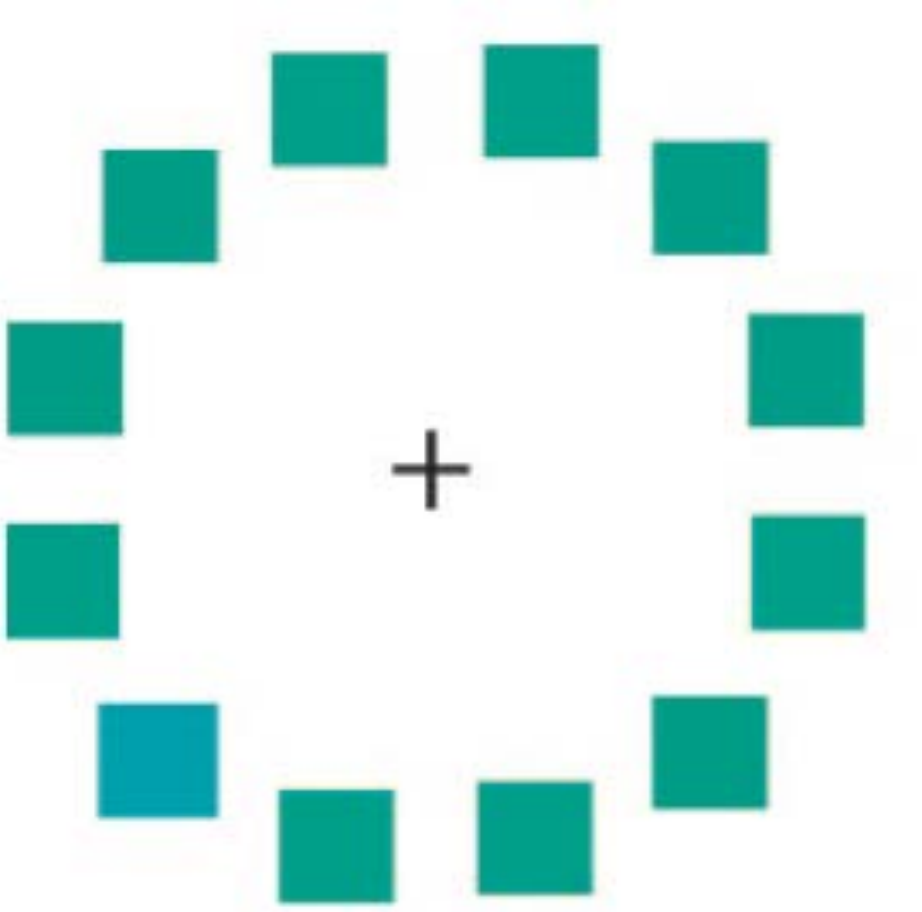
- There are cross-linguistic differences in perceptual discrimination, but the discrimination process seems to involve some language-related processing, because this part of the task can be interfered with

- Does language affect perception? Not to a large degree.
  - /Maybe only in difficult tasks where language processing might help too

- Further tests of effects of language on perception
  - /Test of this idea by Gilbert et al. (2005) uses the observation that language is processed on the left side of the brain

Language and color in the brain

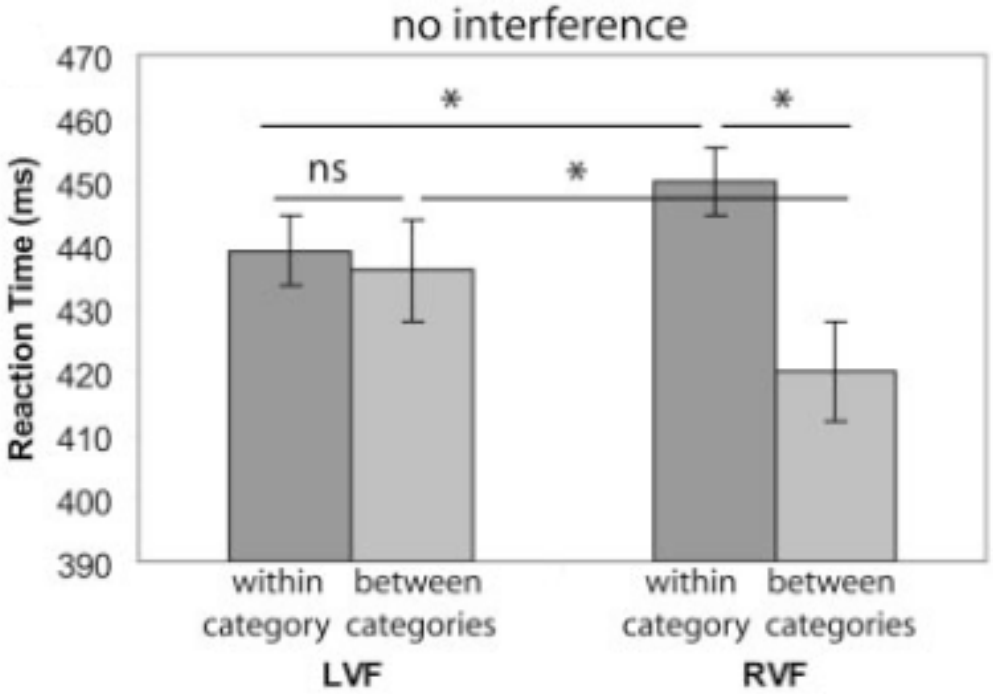
Visual search task:
identify the different item



Gilbert et. al. 2005

Language and color in the brain

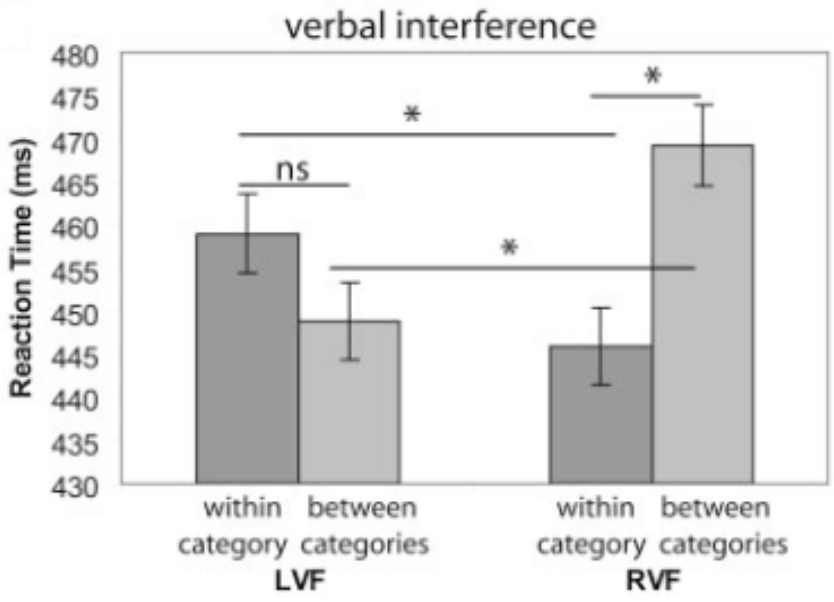
- Reaction times were faster between categories, but only for items presented in the right visual field

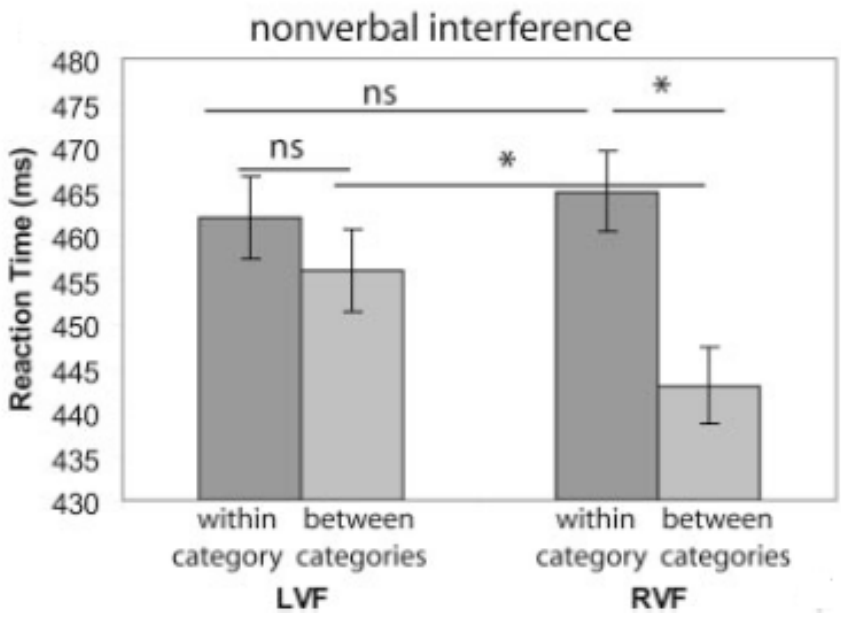


Gilbert et. al. 2005

Language and color in the brain

- Verbal (but not other) interference reversed the effects





Gilbert et. al. 2005 /

Language and color in the brain

- The language effect appears to be primarily in the part of the brain where language processing occurs

- Could be preprocessing (effects of language on perception over time) and/or post-perceptual (language makes an online difference in how you process color)
  - Verbal interference indicates that it's at least partly post-perceptual

Gilbert et. al. 2005 /

Language and thought: color perception

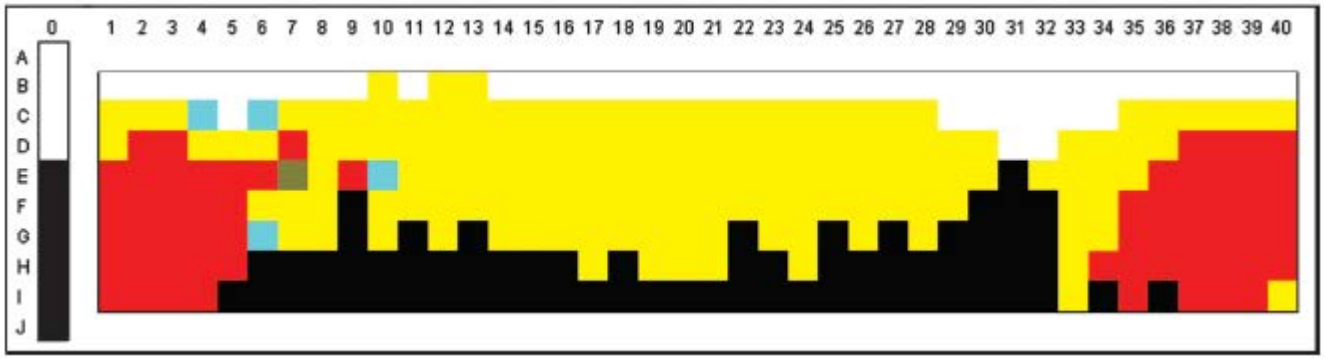
- *Language / words change the cognition of their speakers*: they help their speakers accomplish difficult cognitive tasks by creating abstractions for the efficient processing and storage of information

- *These abstractions complement rather than replace pre-existing non-verbal representations*: when linguistic abstractions are temporarily inaccessible, language users are able to fall back on the representations used by other animals, children, and speakers of languages without those abstractions.

If true, why?
Maybe it's the shape of the space?

- "One possible explanation [for universals in color naming] is . . . the irregular shape of the color space. . . . Hue interacts with saturation and lightness to produce several large ''bumps''; one large bump is at focal yellow, and another at focal red. . . .We assume that the names that get assigned to the color space . . . are likely to be those names which are most informative about color." Jameson & D'Andrade (1997)

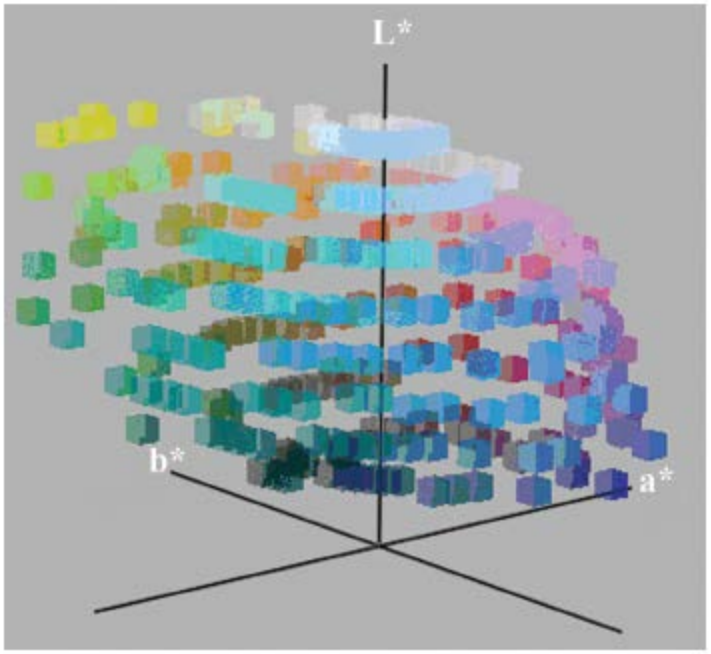
- Regier et al. (2007) evaluated this hypothesis on Color-naming data from the World Color Survey
  - 110 languages across the world
  - Recorded the modal color for each chip



Courtesy of Proceedings of the National Academy of Sciences. Used with permission. Source: Regier, Terry, Paul Kay, and Naveen Khetarpal. "Color naming reflects optimal partitions of color space." Proceedings of the National Academy of Sciences 104, no. 4 (2007): 1436-1441.

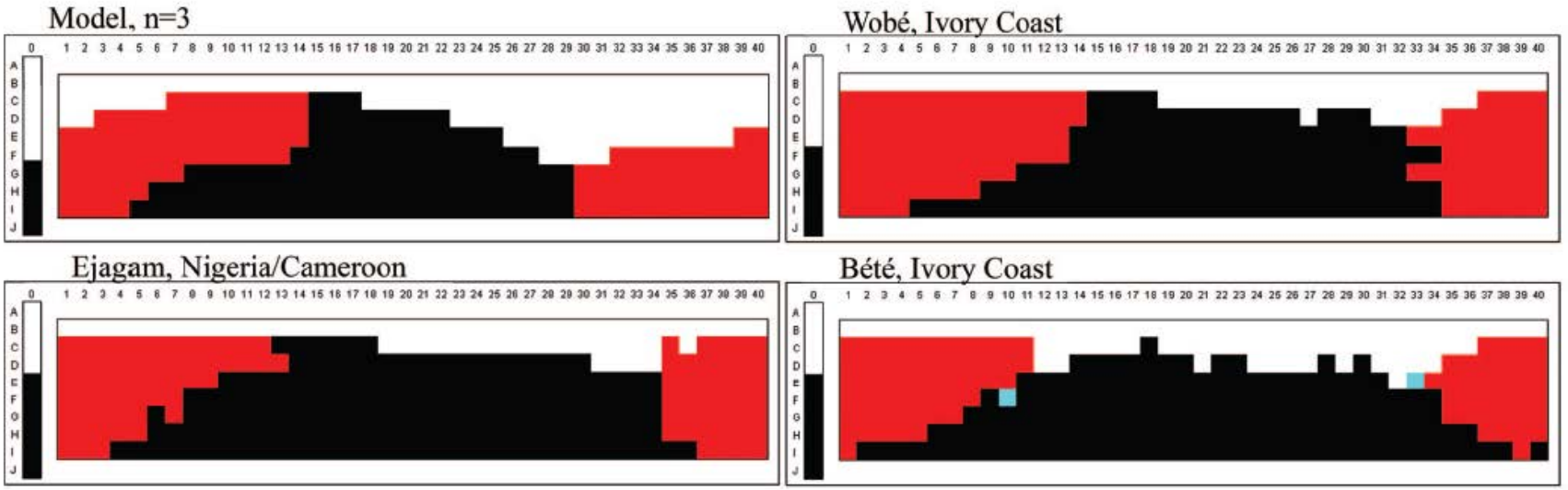
Maybe it's the shape of the space?

- 3D color-space for the Munsell color chips
  - Three dimensions of lightness, red/green, and yellow/blue
  - Approximate perceptual similarity in the human visual system
- Hypothesis: Color categories are clusters within this space
  - Optimal color categories should maximize perceptual similarity within categories, and minimize similarity between
  - Tested on the 110 languages

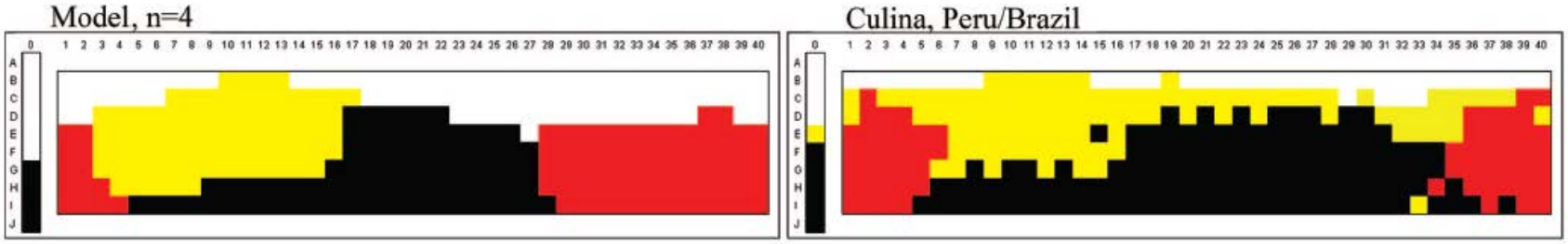


Regier et. al., 2007

Qualitative results



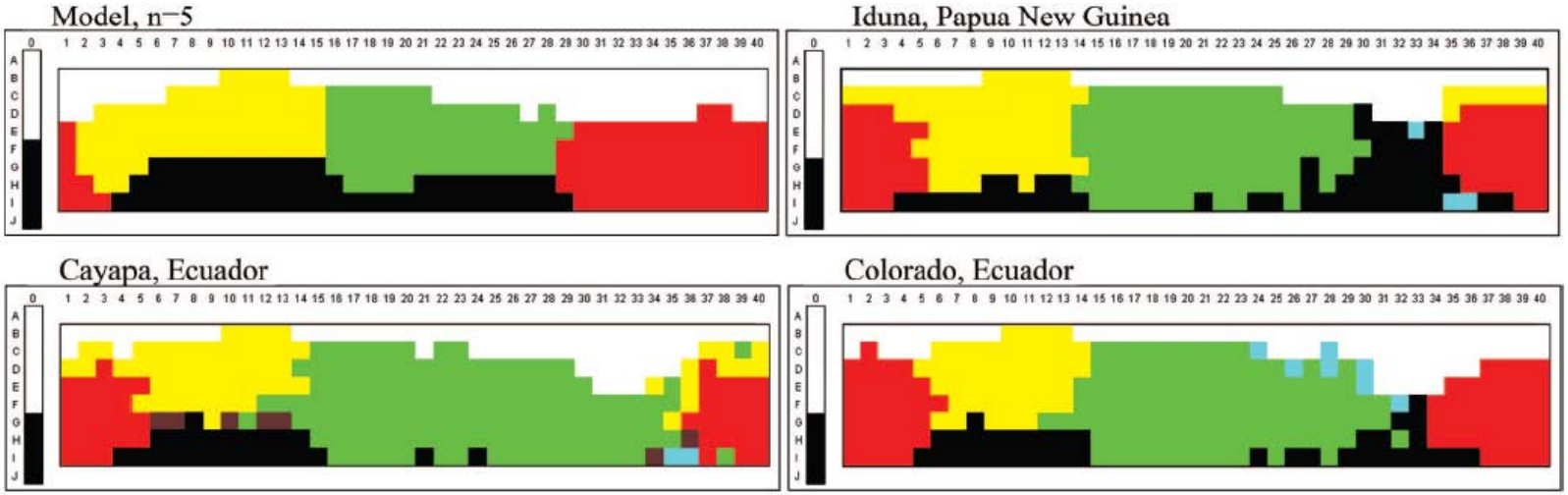
N=3



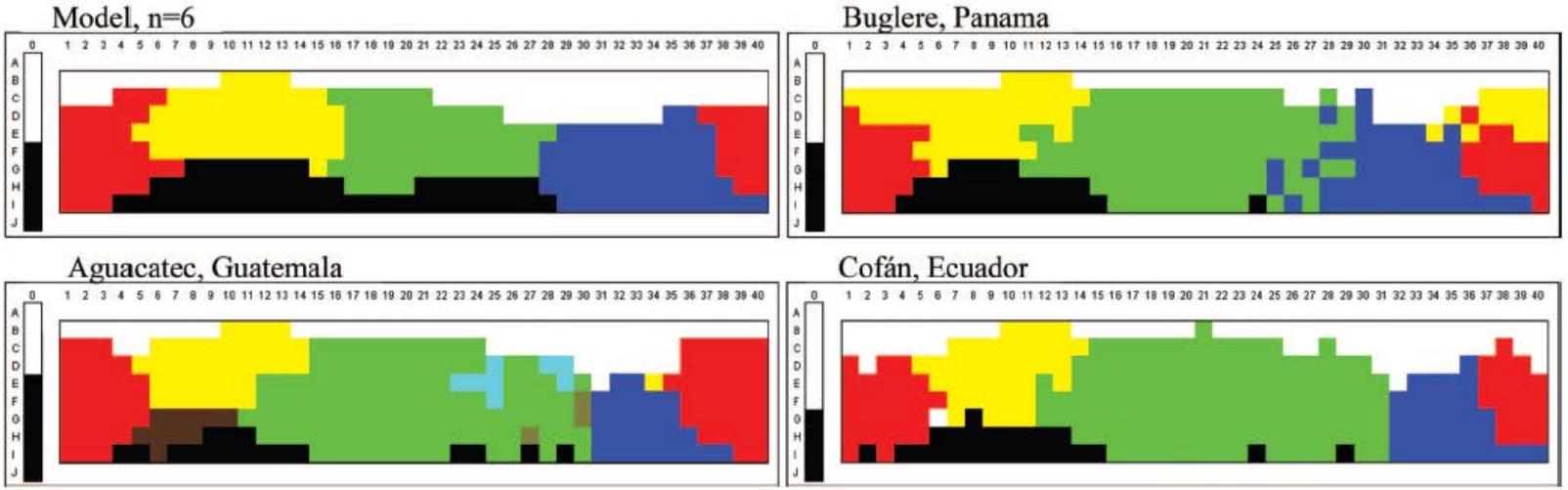
N=4

Regier et. al., 2007

Qualitative results



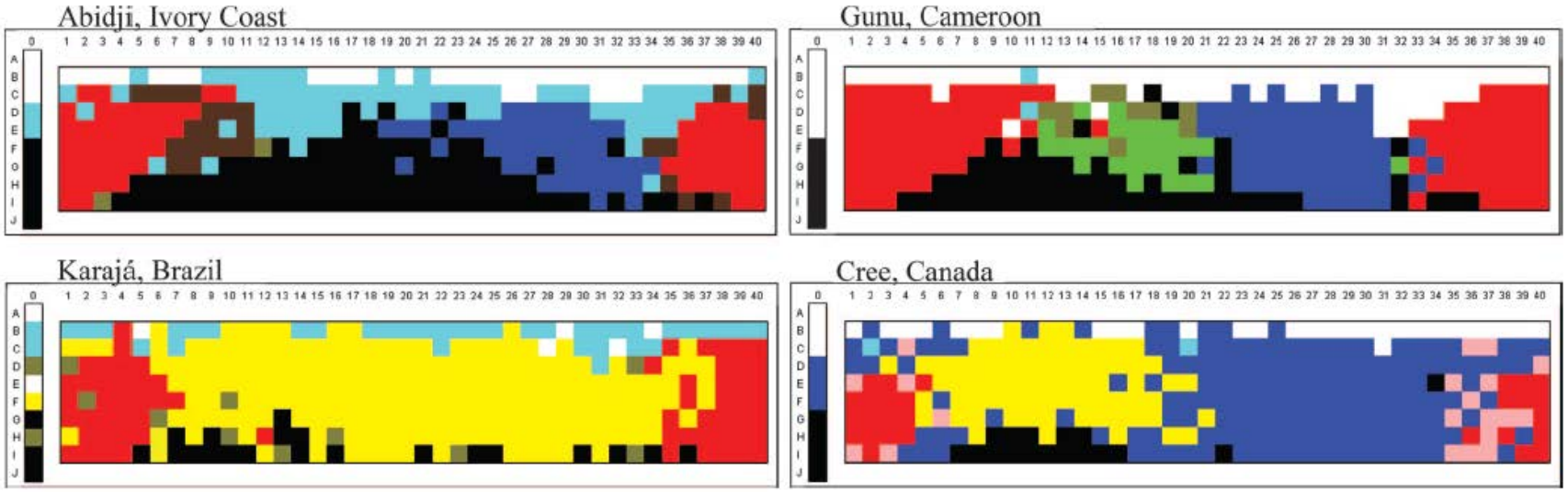
N=5



N=6 /

Regier et. al., 2007 /

Some exceptions…



Courtesy of Proceedings of the National Academy of Sciences. Used with permission. Source: Regier, Terry, Paul Kay, and Naveen Khetarpal. "Color naming reflects optimal partitions of color space." Proceedings of the National Academy of Sciences 104, no. 4 (2007): 1436-1441.

Regier et. al., 2007

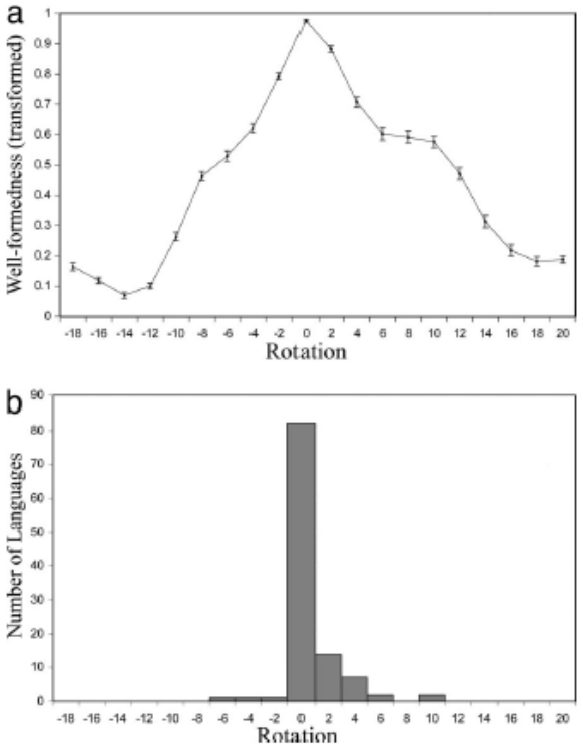
Quantitative results

Rotated each language's colors to see if they would match better in a different way

Regier et. al., 2007

Quantitative results

Rotated each language's colors to see if they would match better in a different way



Regier et. al., 2007

Color naming organization: Initial ideas

- Maybe color-naming is broadly universal, organized around perceptibility
- But there is some room for language or culture-specific idiosyncracies

9.59J/24.905J Lab in Psycholinguistics
Spring 2017