



# Colour naming for colour management

Dimitris Mylonas, Northeastern University London

# Why colour naming?

Witzel & Gegenfurtner, 2018



Yellow

# Why colour naming in colour management systems?

DfWG Jahrestagung, Bönningheim (09. – 10.10.2018)

## 1. Überblick und Zielsetzung



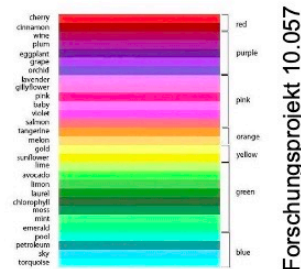
Existiert  
Common Colour  
Appearance?



... mit bereits  
vorhandenen  
Lösungen  
(Gamut Mapping  
Algorithmen)

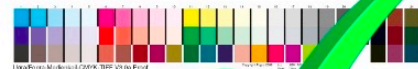
Messung von  
Common Colour  
Appearance

Farbnamen und  
andere Ansätze



Forschungsprojekt 10.057

Bewertungsmetrik  
für Common  
Colour  
Appearance

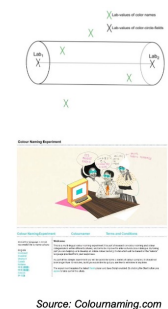


DPWG / Garching 2015  
Colour Naming (example)



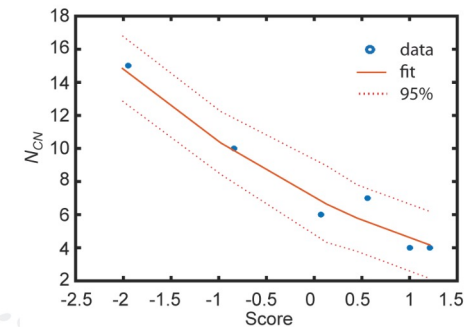
Experiment of Dimitris Mylonas (<http://cmul.academia.edu/DimitrisMylonas>)

Frequency Order	Mean in CELAB (RGB)	Mean RGB
Color Name	$m_{r,A}$ $m_{g,A}$ $m_{b,A}$	$m_{r,B}$ $m_{g,B}$ $m_{b,B}$
1 purple	35.959212 41.862212 -26.718512	118 51 186
2 pink	62.788512 27.868512 11.868512	228 151 173
3 blue	49.867312 7.864212 74.128672	45 117 186
4 green	57.220512 42.867712 28.875812	81 154 88
5 brown	15.879212 15.178805 11.865184	115 70 41
6 blue	62.145124 30.187776 -33.868512	174 133 211
7 orange	70.188512 18.468512 -8.867806	58 190 180
8 yellow	81.897312 -6.999607 44.507581	225 205 49
9 orange	61.868512 18.189607 52.263206	217 122 48
10 grey	54.782512 4.787805 -1.791101	136 137 140
11 white	45.188512 45.188512 45.188512	117 76 177
12 light_blue	70.788512 -12.288512 -23.1807	104 182 214
13 orange	48.868512 30.862127 -25.188512	146 93 161
14 black	30.868512 -12.288512 -23.1807	104 182 214
15 light_green	77.868512 17.862127 27.868512	121 209 138
16 red	43.112128 54.861124 27.867312	187 41 58
17 dark_purple	18.868512 -18.868512 -18.868512	72 23 80
18 dark_green	28.868512 -18.868512 18.868512	32 70 47
19 magenta	45.177805 34.868512 -18.868512	178 47 250
20 light_blue	66.868512 -7.868512 -28.868512	99 169 213
21 light_purple	58.868512 34.868512 18.868512	165 113 134
22 white	90.868512 1.868512 0.868512	229 226 228
23 dark_blue	27.868512 15.868512 -18.868512	38 41 101



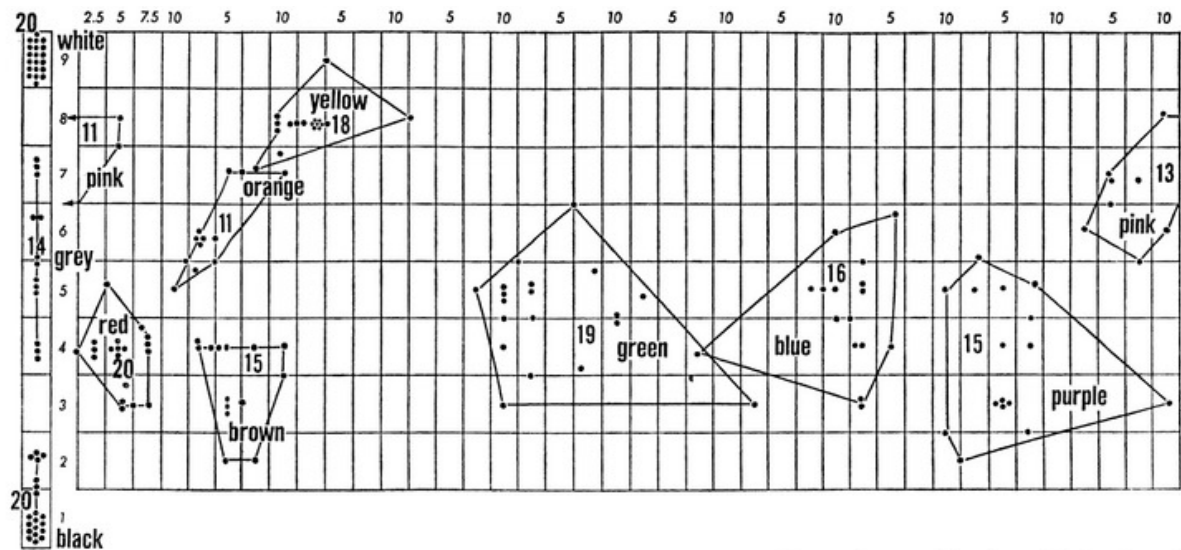
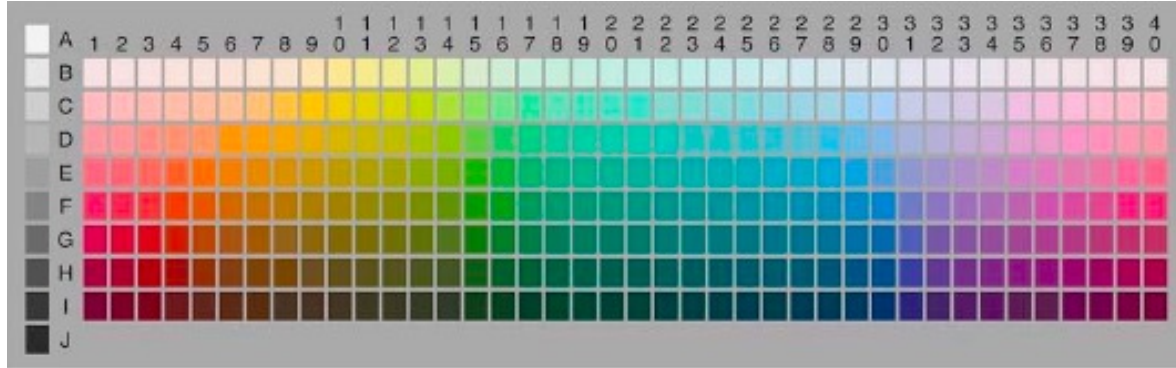
Source: Colournaming.com

### 3.3 Resulting correlation



Common Appearance workshop | Dr. Philipp Tröster

# World color survey



[white  
black] < [red] < [green  
yellow] < [blue] < [brown] < [purple  
pink  
orange  
grey]

Berlin & Kay, 1969/1991

# Online colour naming experiment (2009-?)



### Display Properties Task

Adjust the brightness of your display if necessary until you can see the differences between all 11 steps of the greyscale test image. Disable Night Shift mode or blue light filters if applicable.

Confirm how many steps you can see?

### Colour Naming Task

Name each colour sample with the best representative colour term that you remember. Press the Arrow button [→] or Enter on your keyboard once you have finished naming the colour for the next colour sample to appear. Name as many colour samples (20+) as you can for higher ranking on colour namers. You will need to press the Finish button to start the next task. Your response time will be recorded.

#1

Name

### Colour Vision Task

The movie below displays a moving 'coloured' square. The square changes colour as the movie plays. You may be able to see the colour for some or all of the time. The movie lasts for 90 secs and all you need to do is play it and remember if the 'coloured' square disappeared at any time during the movie.

Did the 'coloured' square disappear?

### Observer Information Task

Please provide us with some information about your background and viewing conditions. This will help us to better understand the context of your responses.

What is your age?

To which gender do you most identify?

Describe your experience working with colour

Describe your skill in the language used in this experiment

What is the highest level of education you have completed?

In which country did you grow up?

Where are you living?

What is your display device?

Describe the white graphic elements on your screen

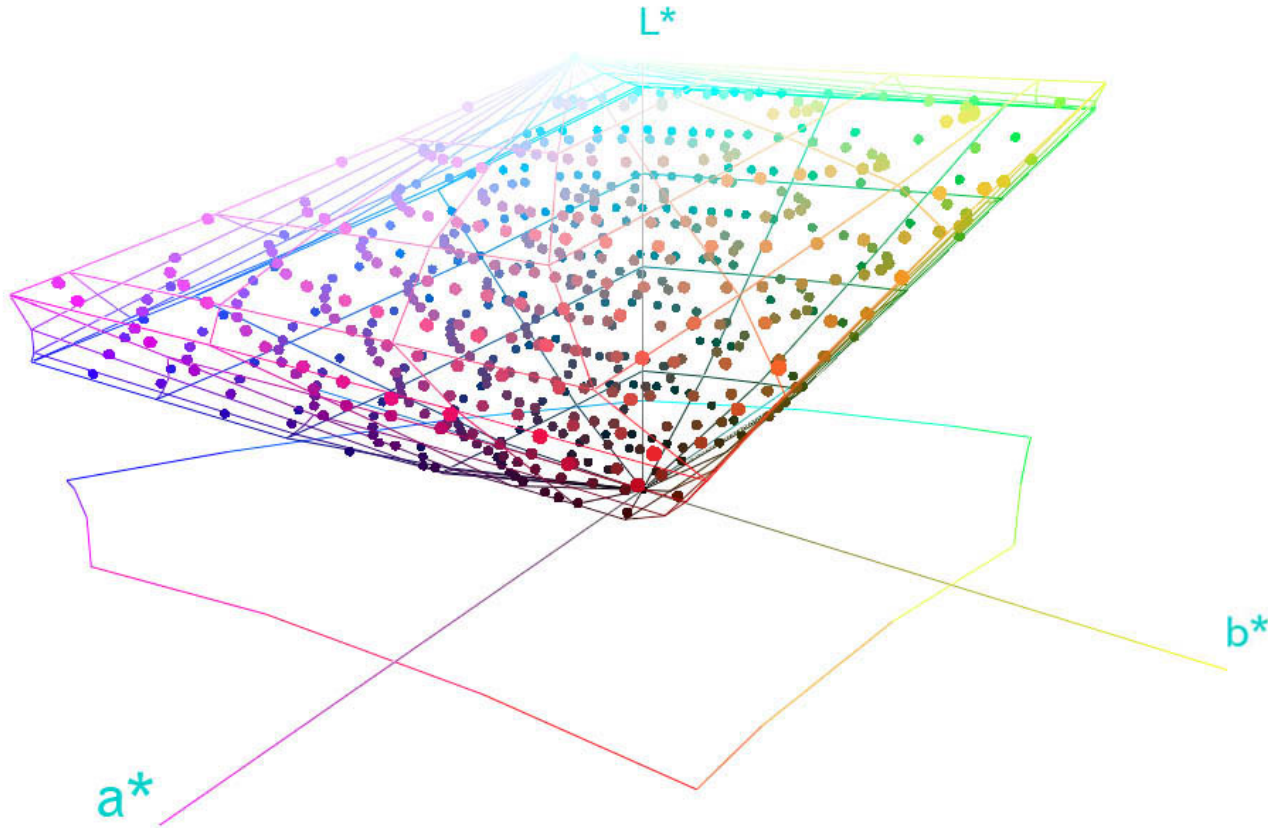
Describe the lighting conditions of your environment

Describe the surrounding environment behind your device

What distance are you from your monitor in cm?

<https://colournaming.com>

# Colour stimuli of online colour naming experiment

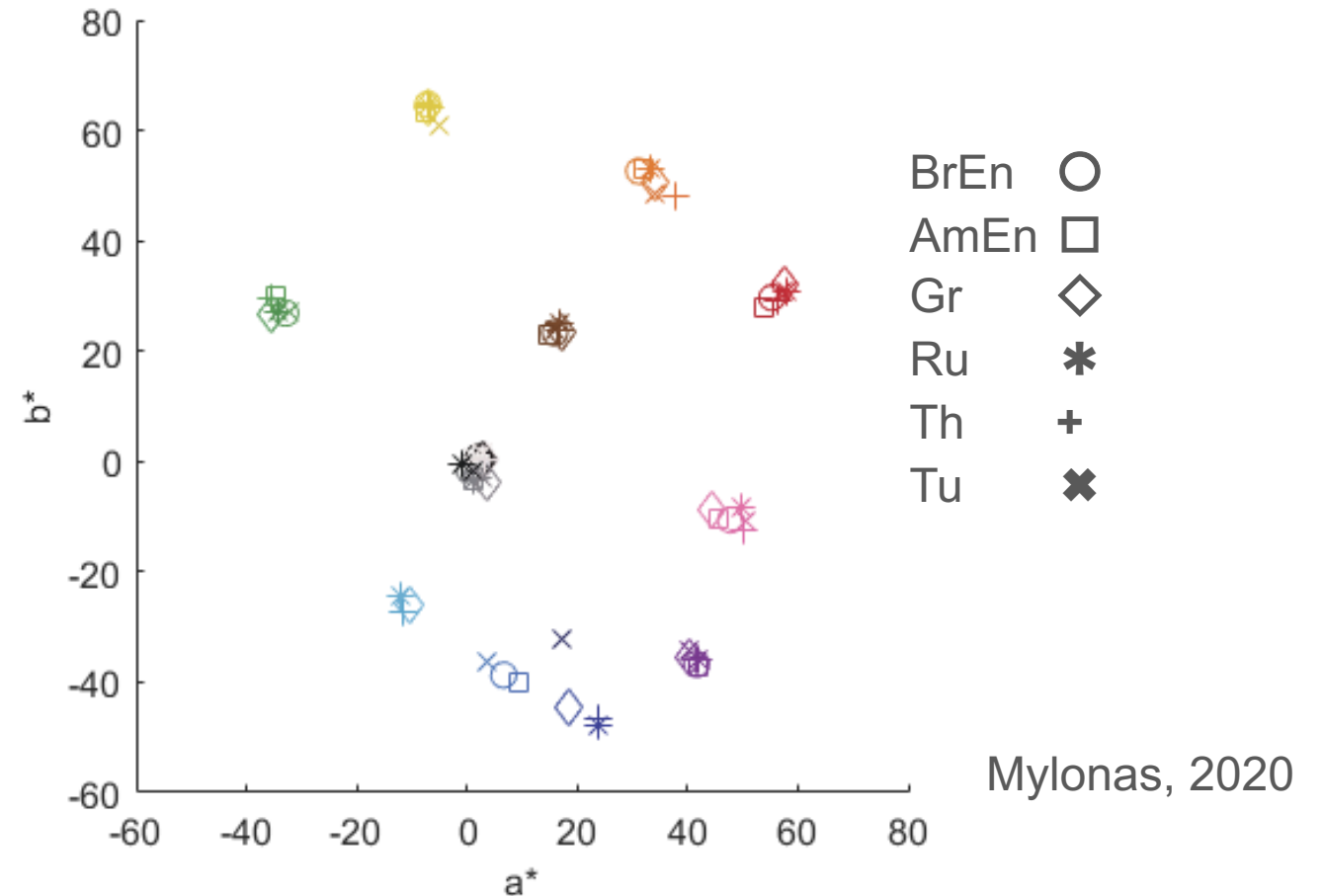


- 606 samples (589 Munsell samples + 11 Neutral + 6 corners of RGB cube)
- 3:1 ratio sub sampling of Munsell Renotation Data
- Gamut clipped in sRGB gamut



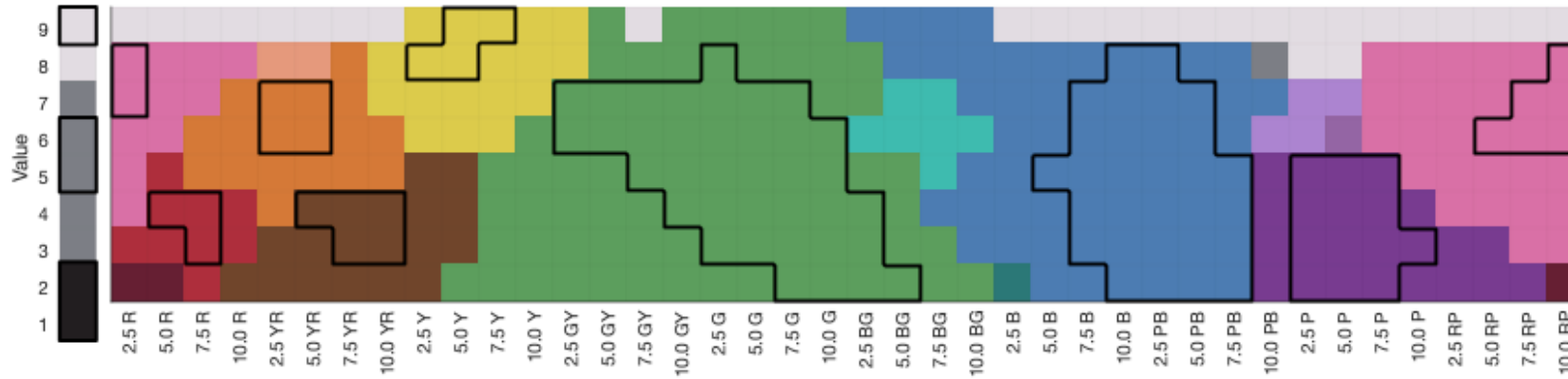
# Agreement of basic colour terms across languages

Languages	Mu ( $\Delta E_{00}$ )
BrEn vs. AmEn	1.5
BrEn vs Gr.	4.3
Br. vs. Ru.	4.8
Br. vs Th.	5.0
Br vs. Tu	4.3





# Computational color naming models (English)

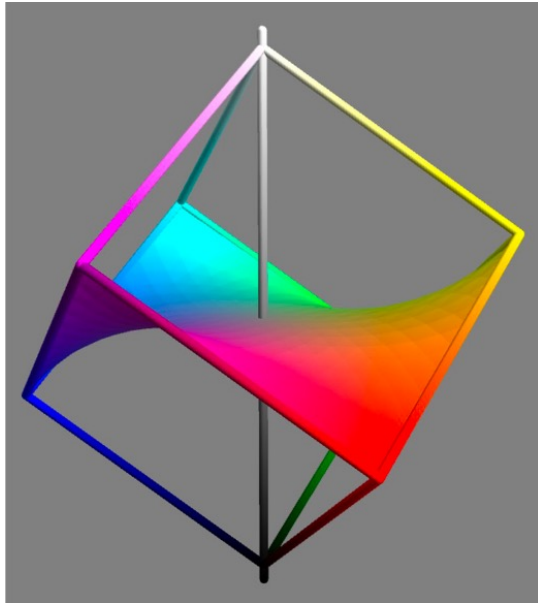


Against Sturges & Whitfield (1995)

	Coincidences	Errors	Colour Terms	%
LGM	92	19	11	17
SFKM	111	0	11	0
TSEM	111	0	11	0
PLSA	109	2	11	2
NICE	111	0	11	0
<b>MAP</b>	<b>110</b>	<b>1</b>	<b>17</b>	<b>1</b>
<b>RST</b>	<b>111</b>	<b>0</b>	<b>16</b>	<b>0</b>

Mylonas, 2020

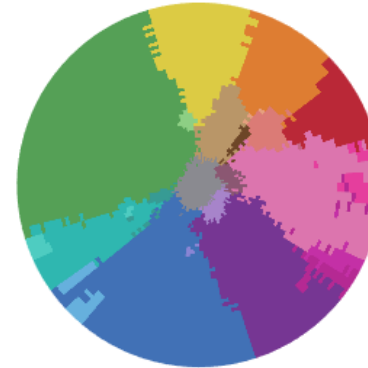
# Multilingual color naming model across the gamut (RST)



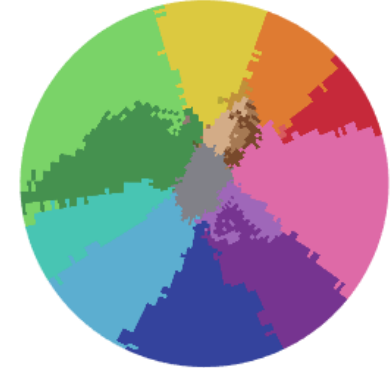
British English



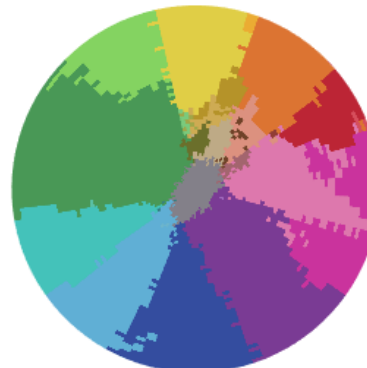
American English



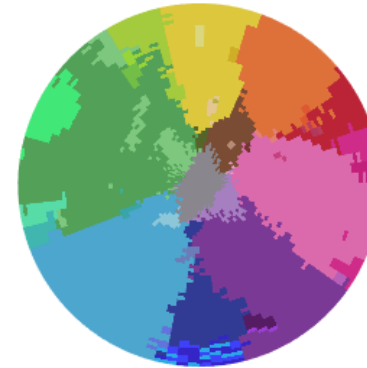
Russian



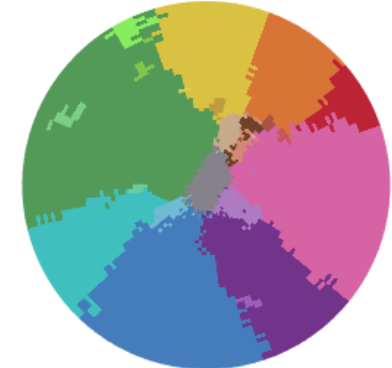
Greek



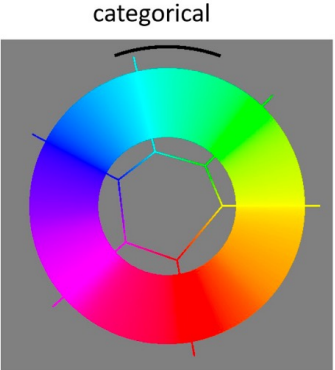
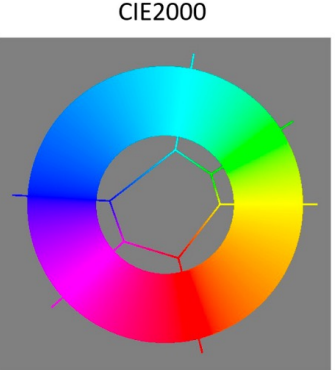
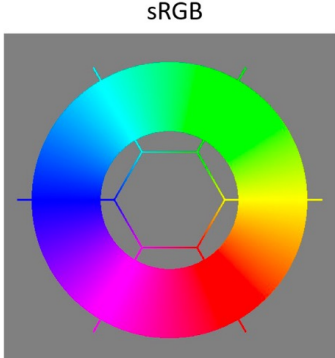
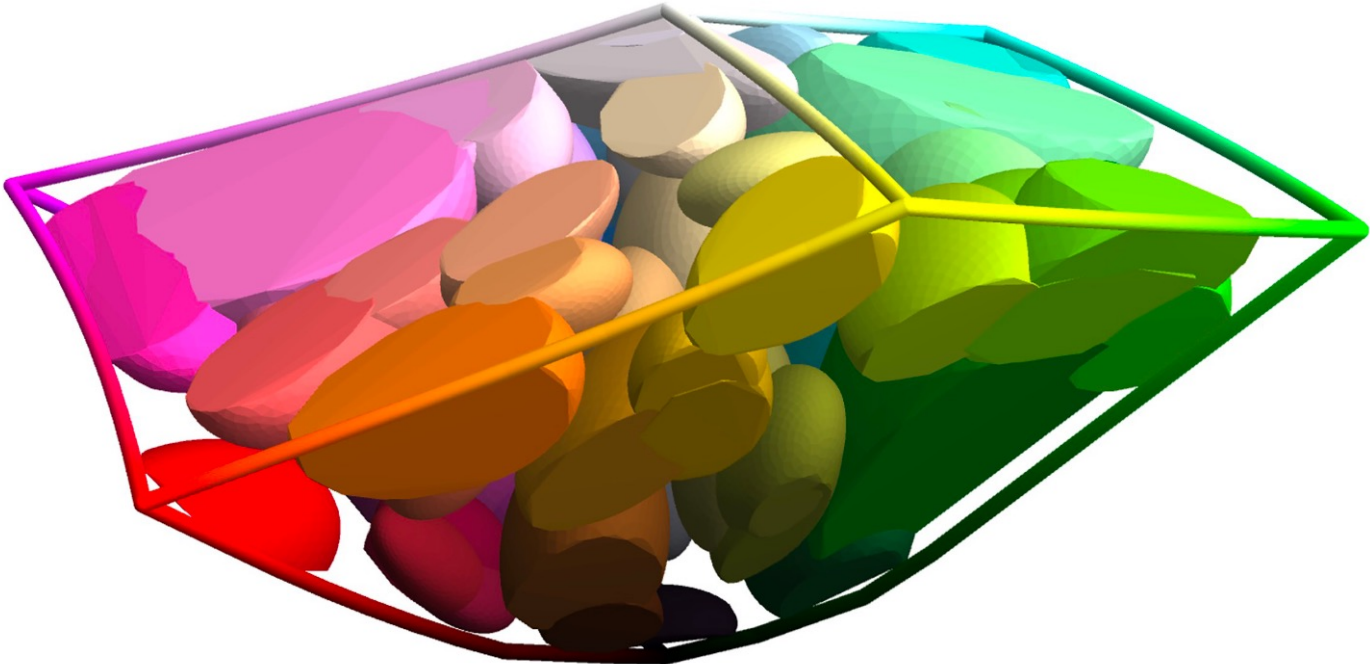
Thai



Turkish

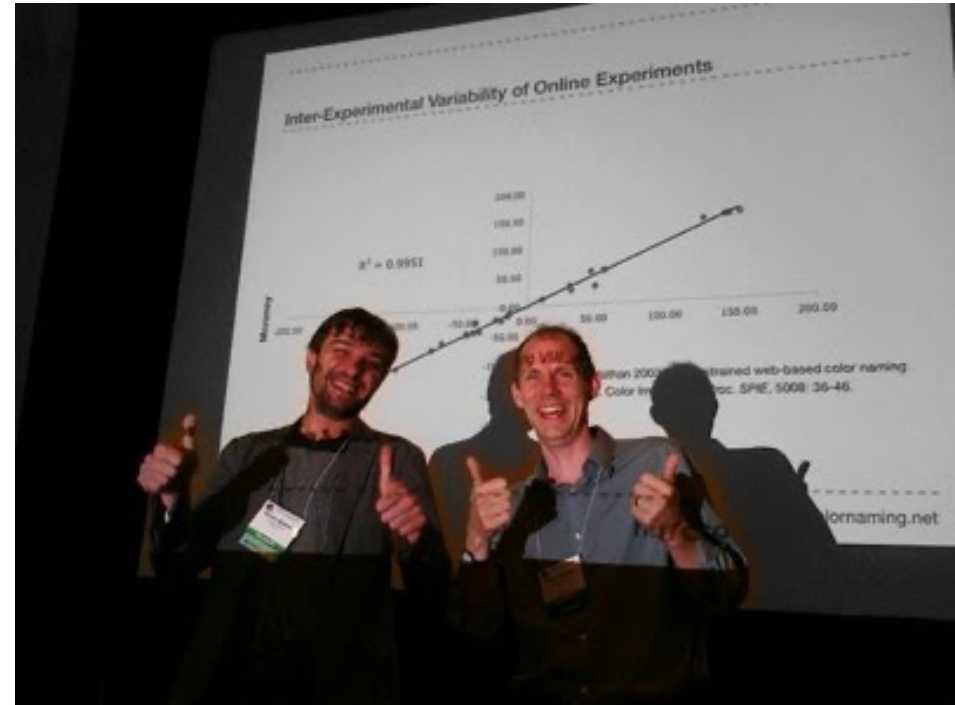
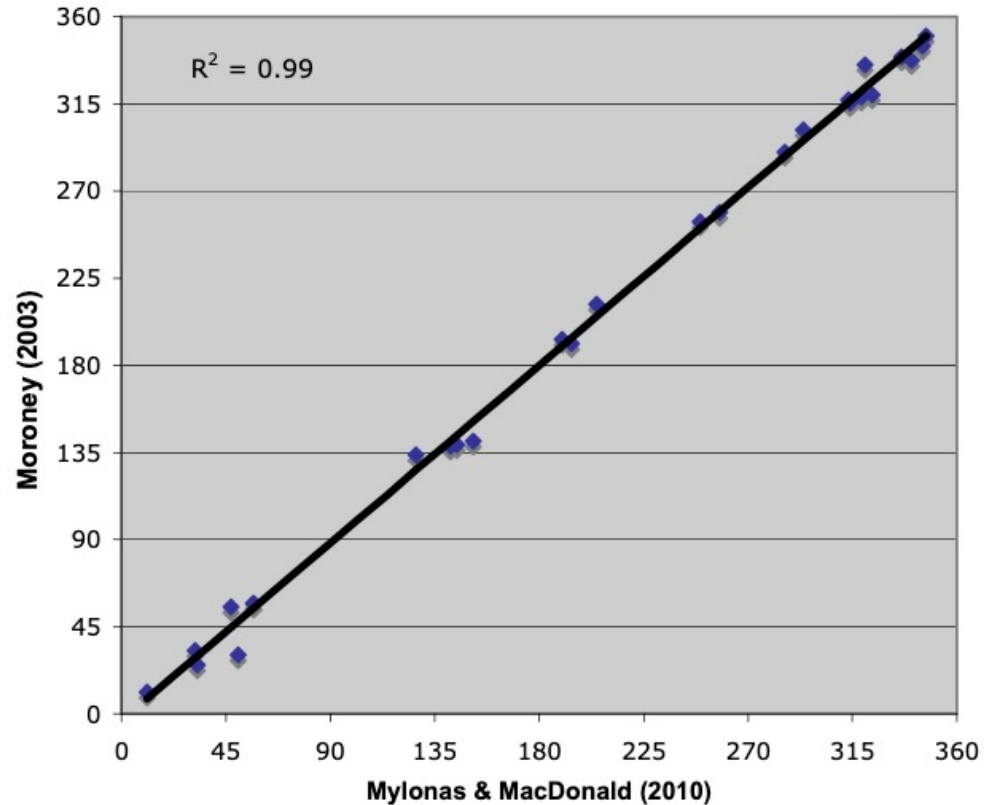


# Categorical colour geometry



# Agreement between online colour naming experiments

Top 27 Frequent Chromatic Colour Names  $h_{(ab)}$



Mylonas & Moroney (HP) at CIC 2010

# Laboratory-based Color Naming Experiment

**CRT Monitor:** Mitsubishi Diamond Pro 2070SB 22"

**Calibration instruments:** Radoma spectroradiometer  
ColorCal CRS colorimeter

**Video Hub:** DataPixx, Vpixx, 16bits R,G,B,

**Color Temperature:** 6507K

**CIE x,y (1931 2-deg):**  $x = 0.3126, y=0.3296$

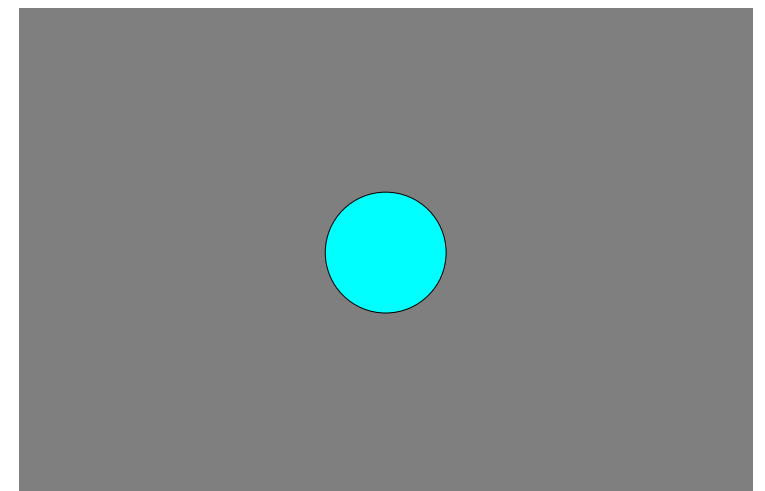
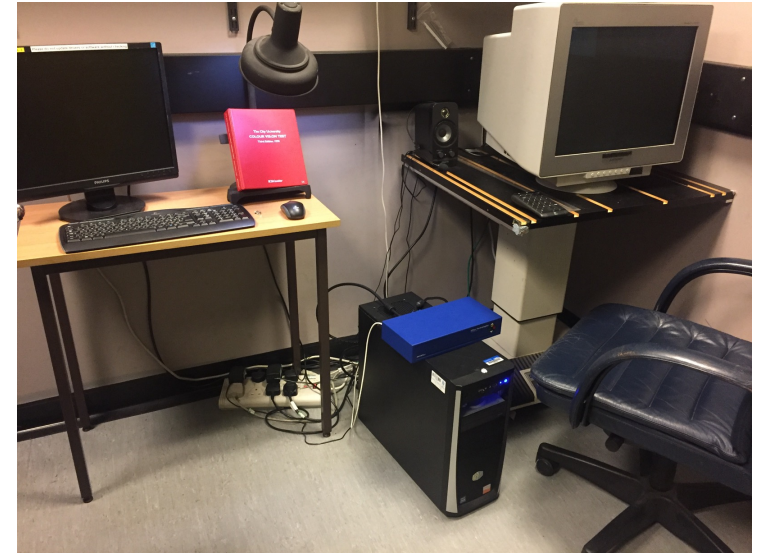
**Measured Luminance:**  $80.17 \text{ cd/m}^2$

**Color Vision Test:** City University Test

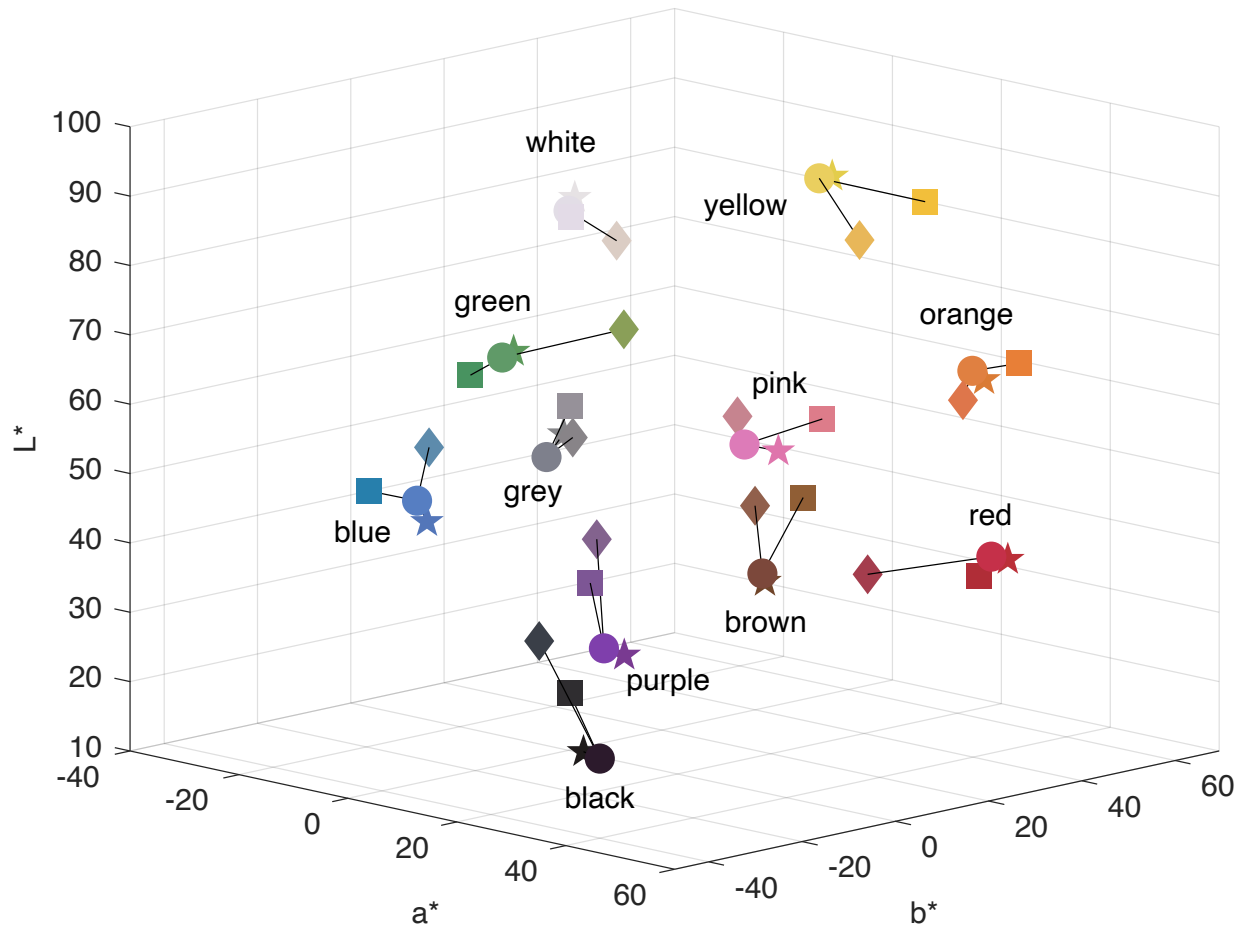
**Target Size:** 2-deg

**Observers:** 10 (7 F / 3 M)

**Observer Age:** Mean=46.5, STD=14.3



# Agreement between online and offline (lab) experiments



Lab (disks) vs. B&O <sup>1</sup> (diamonds)	17.6 $\Delta E_{ab}$
Lab vs. S&W <sup>2</sup> (squares)	13.7 $\Delta E_{ab}$
B&O <sup>1</sup> vs. S&W <sup>2</sup>	13.2 $\Delta E_{ab}$
<b>Lab vs. Web<sup>3</sup> (stars)</b>	<b>7.3 <math>\Delta E_{ab}</math></b>
Lab vs. mu-Imaginary (kmeans)	14.6 $\Delta E_{ab}$

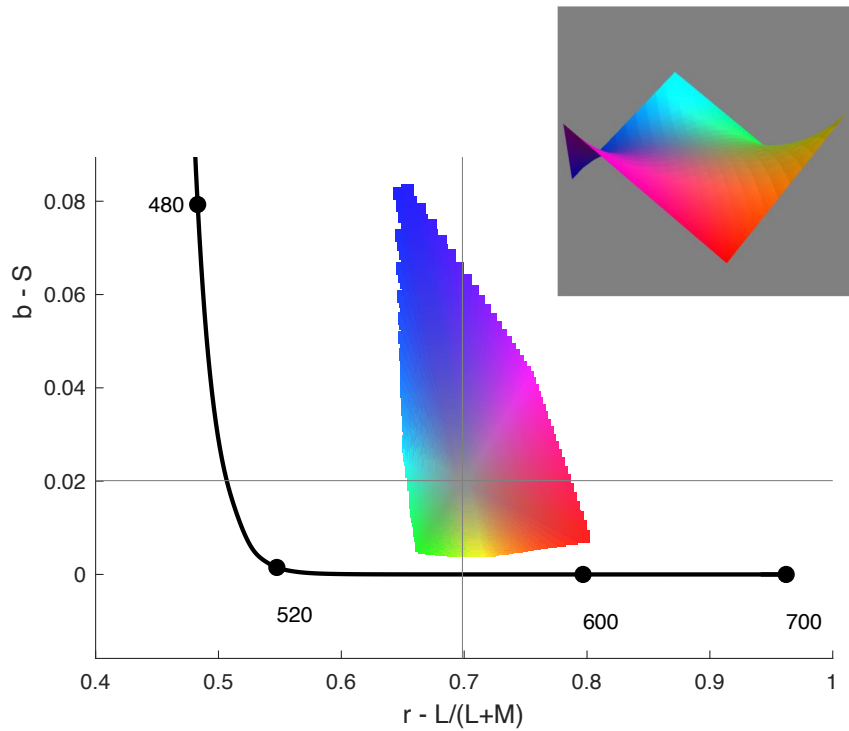
<sup>1</sup>Boynton & Olson, 1987 (B&O)

<sup>2</sup>Sturges & Whitfield, 1995 (S&W)

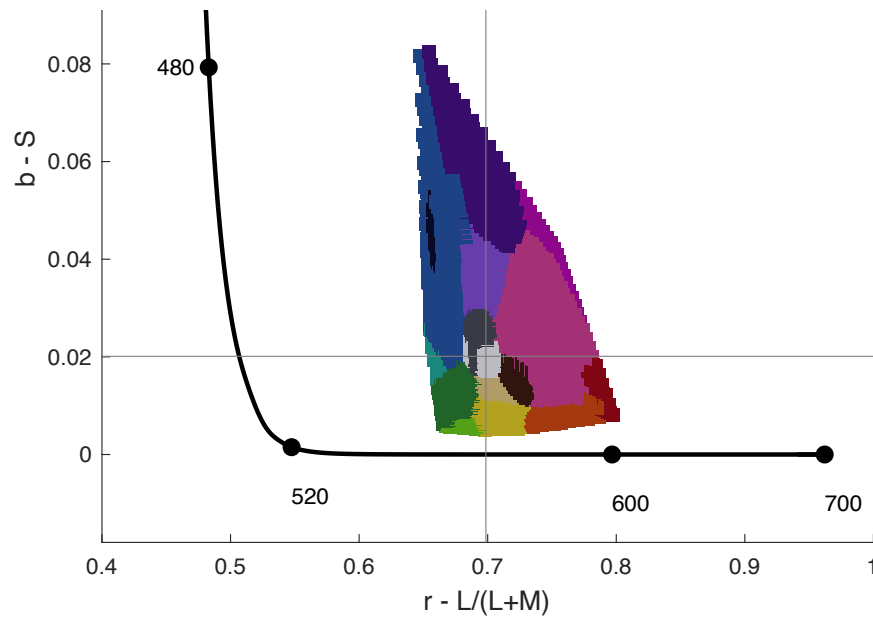
<sup>3</sup>Mylonas & MacDonald, 2010 (Web)

# Mapping color names in cone excitation space (CIE 2006, 2015)

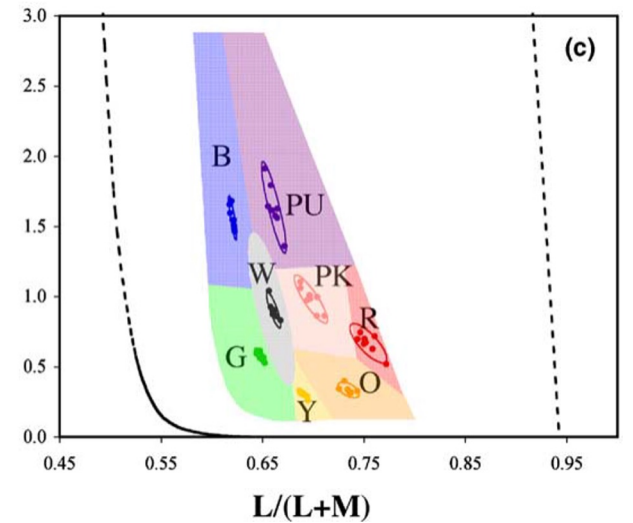
Synthetic Image



Mylonas & Stockman, 2019



Cao, Pokorny & Smith (2005)



Mylonas, Griffin, Stockman, 2019

# NamedProfiles.icc

```
C:\Users\dmiло\RepositorieS\DemoIccMAX\Tools\CmdLine\IccDumpProfile\x64\Debug>iccDumpProfile NamedColor.icc
Profile:      'NamedColor.icc'
Profile ID:   ce9583ab400f0737991a99fe3166db6c
Size:        3300(0xce4) bytes

Header
-----
Attributes:   Reflective | Glossy
Cmm:          Unknown NULL
Creation Date: 3/27/2018 11:23:23
Creator:      NULL
Data Color Space: NoData
Flags        EmbeddedProfileTrue | UseAnywhere
PCS Color Space: LabData
Platform:    Unknown
Rendering Intent: Perceptual
Profile Class: NamedColorClass
Profile SubClass: Not Defined
Version:     5.00
Illuminant:  X=0.9642, Y=1.0000, Z=0.8249
Spectral PCS: 0x0024ChannelReflectanceData
Spectral PCS Range: start=380.0nm, end=730.0nm, steps=36
BiSpectral Range: Not Defined
MCS Color Space: Not Defined

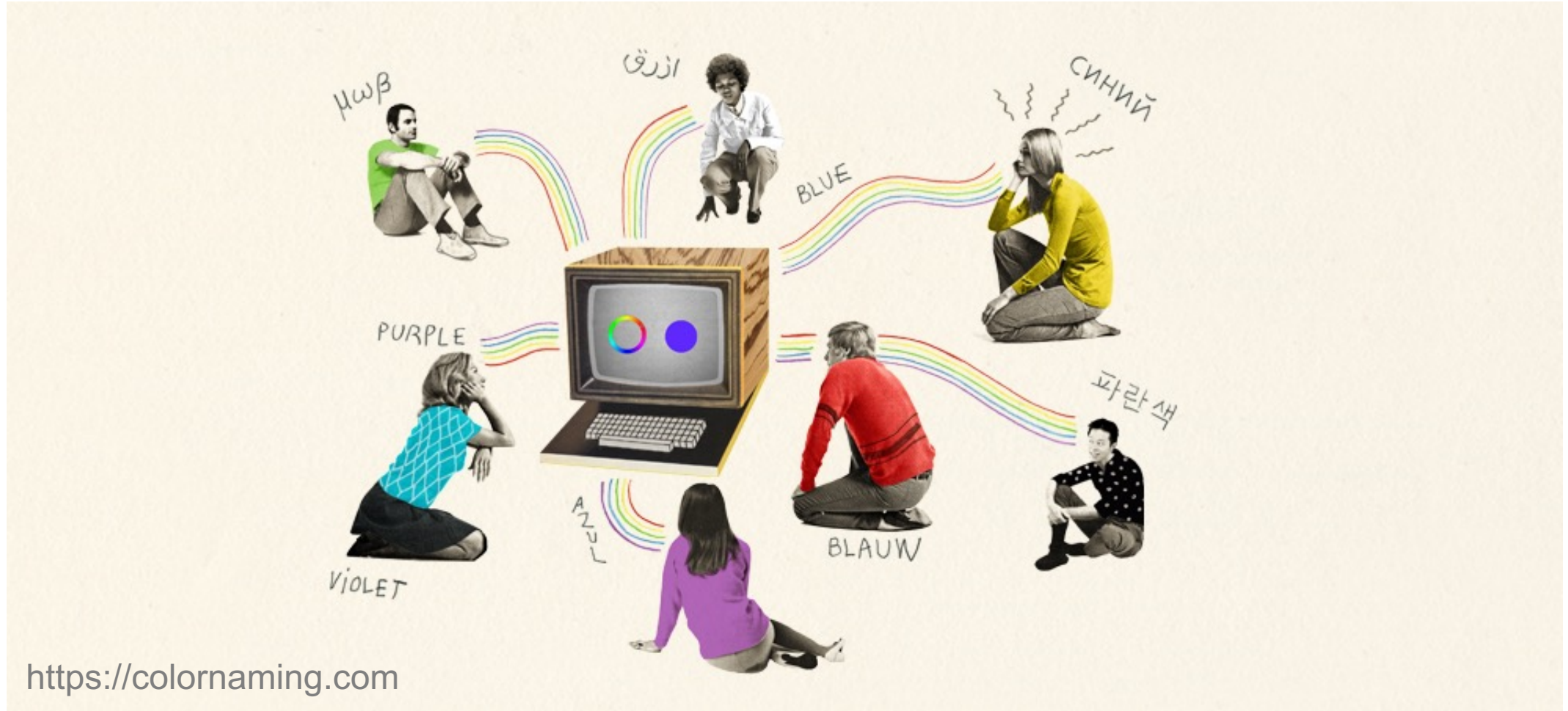
Profile Tags
-----
      Tag      ID      Offset      Size      Pad
-----
profileDescriptionTag 'desc'      204         84         0
namedColor2Tag      'ncl2'      288        2244         0
spectralViewingConditionsTag 'svcn'     2532         556         0
mediaWhitePointTag   'wtpt'     3088          20         0
Unknown 'smwp' = 73607770 'smwp'     3108          70         2
copyrightTag        'cpnt'     3180         118         2

C:\Users\dmiло\RepositorieS\DemoIccMAX\Tools\CmdLine\IccDumpProfile\x64\Debug>
```

```
<?xml version="1.0" encoding="UTF-8"?>
<NamedColors>
  <Color name="white" L="88.34" a="3.19" b="-2.39" />
  <Color name="black" L="11.15" a="4.36" b="-0.90" />
  <Color name="red" L="45.03" a="53.02" b="31.50" />
  ...
  <Color name="blue" L="46.77" a="13.15" b="-42.30"
/>
</NamedColors>
```



# Colornamer, a synthetic observer for colour communication



# Thank you



Let's play a game,  
how many colours can you name?  
<https://colournaming.com>

