

# Common Colour Appearance

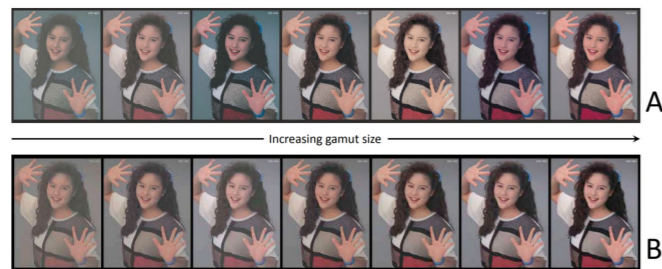
## – Status Update (12.11.2018)

# Agenda

1. Overview and objectives
2. Fogra Common Colour Appearance experiment
3. Evaluation of CCA by means of colour names
4. Outlook / next steps

# 1. Overview and objectives

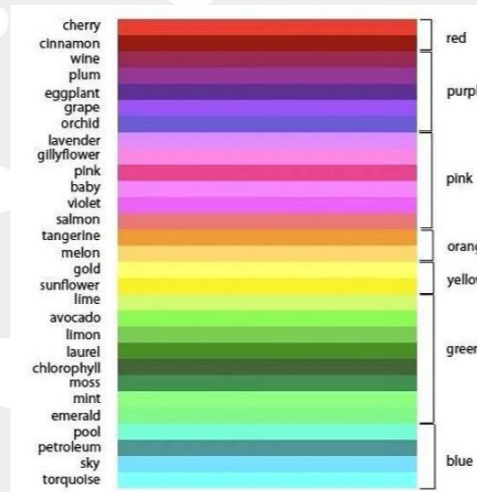
## Does Common Colour Appearance exist?



... using already available tools (gamut mapping algorithms)

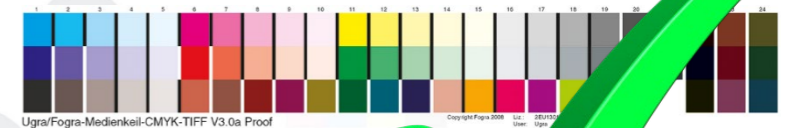
## Measuring Common Colour Appearance

Colour names and other approaches

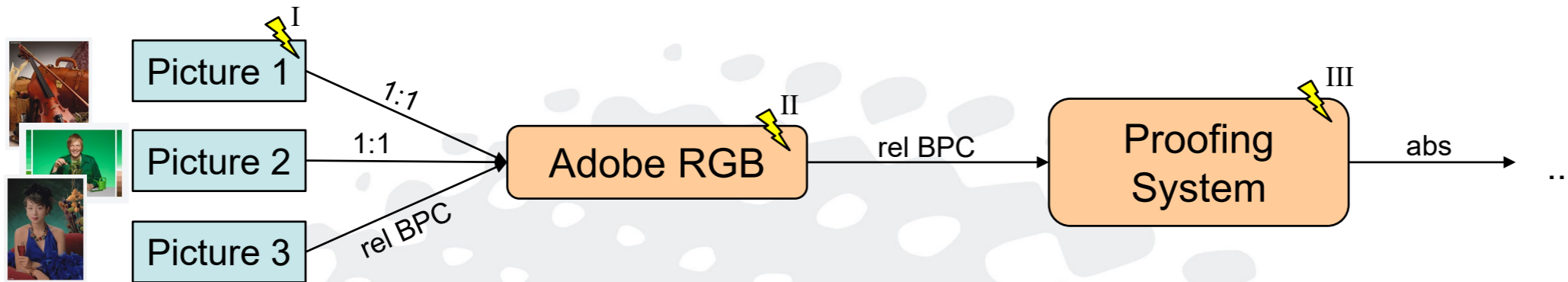


Research project 10.057

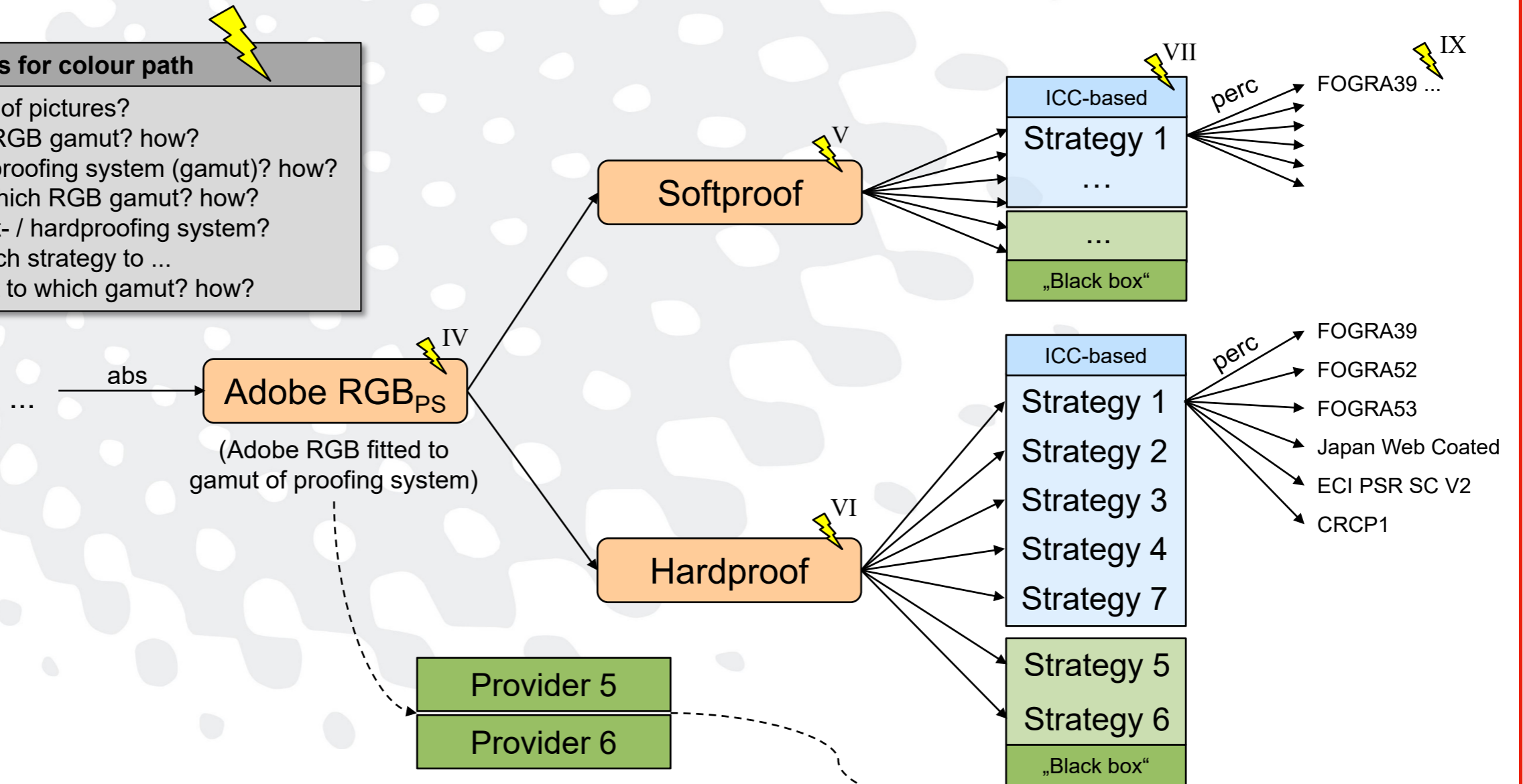
## Metric for evaluation of Common Colour Appearance



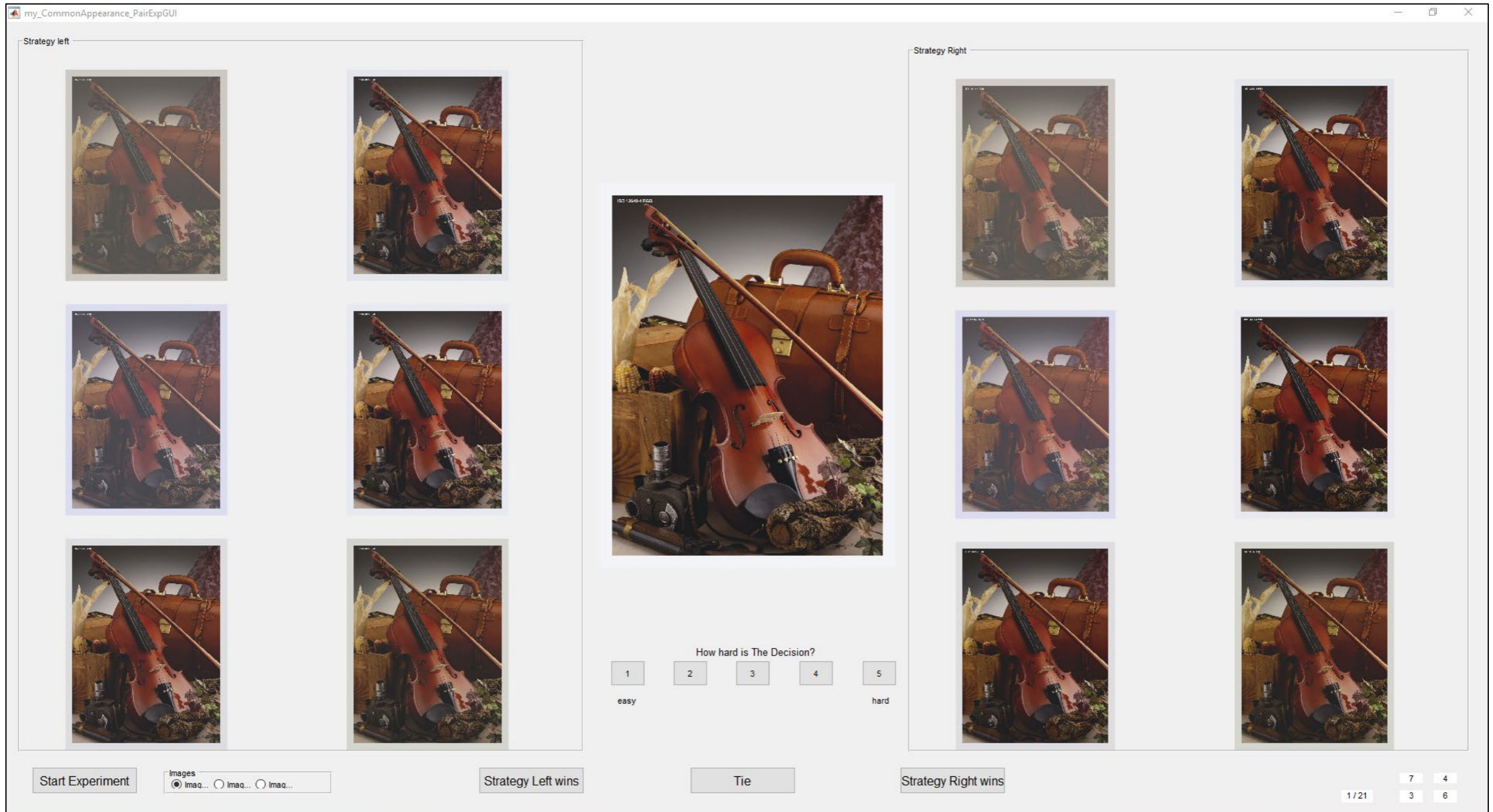
# 2. Fogra CCA experiment



Decision points for colour path	
I	which set of pictures?
II	to which RGB gamut? how?
III	to which proofing system (gamut)? how?
IV	back to which RGB gamut? how?
V/VI	which soft- / hardproofing system?
VII	using which strategy to ...
IX	... convert to which gamut? how?



# 2. Fogra CCA experiment



my\_CommonAppearance\_PairExpGUI

Strategy left

Strategy Right

How hard is The Decision?

1 2 3 4 5

easy hard

Start Experiment

Images

● Imaq... ○ Imaq... ○ Imaq...

Strategy Left wins

Tie

Strategy Right wins

1/21

7 4

3 6

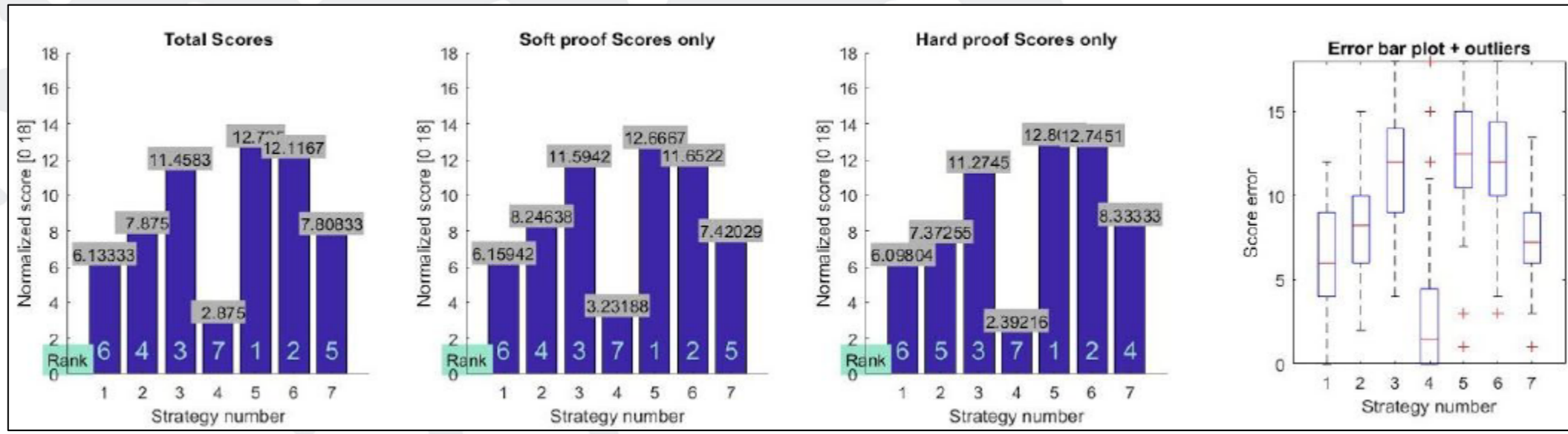
# 2. Fogra CCA experiment



**R** rank  
**S** strategy number  
**P** paired comparison experiments „played“  
**W** „win“  
**D** „draw“  
**L** „lose“  
**FP** „Football Game“ score in absolute points  
**SP** „Simple“ score in absolute points

Total scores for all experiments (raw data)							
R	S	P	W	D	L	FP	SP
1	5	720	485	72	163	1,527	322
2	6	720	457	83	180	1,454	277
3	3	720	431	82	207	1375	224
4	2	720	290	75	355	945	-65
5	7	720	288	73	359	937	-71
6	1	720	225	61	434	736	-209
7	4	720	103	36	581	345	-478

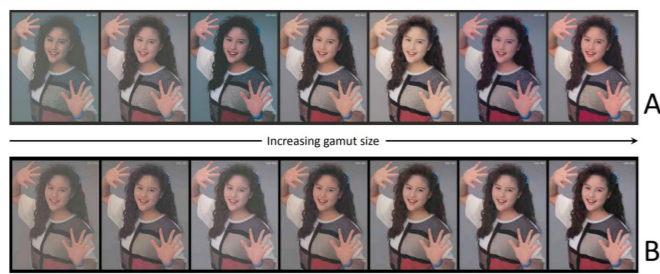
**Winners: Strategy 3, 5, 6**  
**Midfield: Strategy 1, 2, 7**  
**Loser: Strategy 4**



Visualisation of the ranking using the „Football Game“ method; more details in the whitepaper.

# 2. Fogra CCA experiment

## Does Common Colour Appearance exist?



... using already available tools (algorithms)

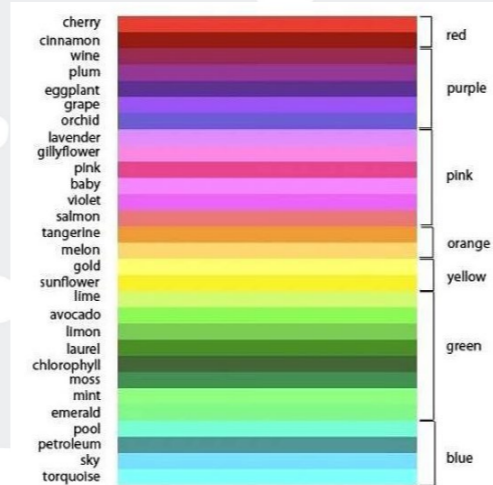
Based on our results

# YES



## Measuring Common Colour Appearance

Colour names and other approaches



Research project 10.057

## Metric for evaluation of Common Colour Appearance



# 3. Evaluation of „Common Colour Appearance“ through colour naming



# Evaluation of CCA

## Issue :

Conventional colorimetry is used to evaluate colour differences, but not different colours. Due to the oversized Colour spacing classical methods are not suitable to evaluate this.

## Solution:

Different colors are identified by different names.

Example:

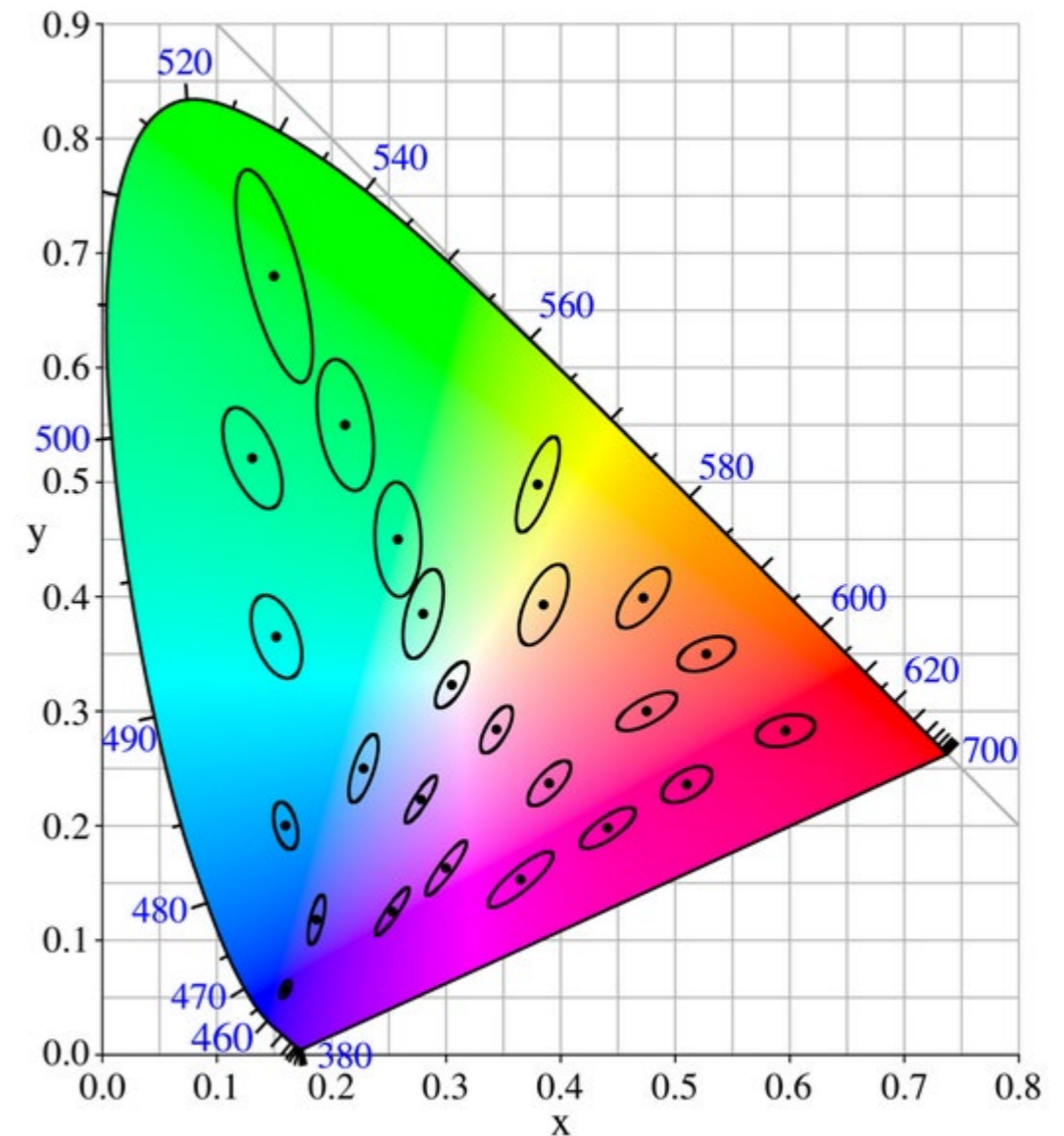
Reference: Fluorescent green

Cover of a magazine: "Apple Green",

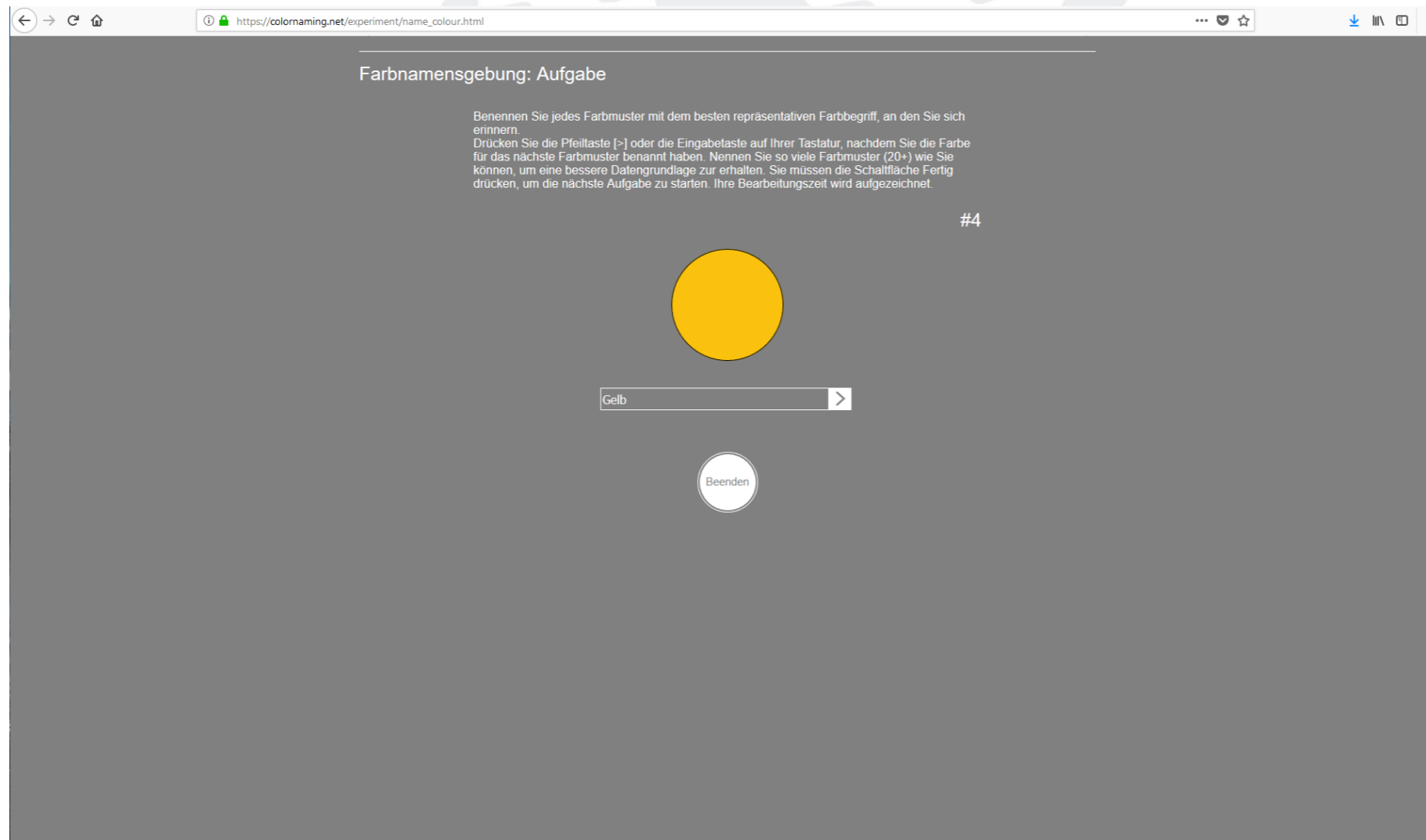
Inner part magazine: (on web offset paper) "Aquagrün"  
(aqua green)

Newspaper printing: "pale fern green."

Therefore development of a metric based on colour names.



# Where do the colour names come from?



Color psychology experiment from Mylonas, MacDonald and Griffin:

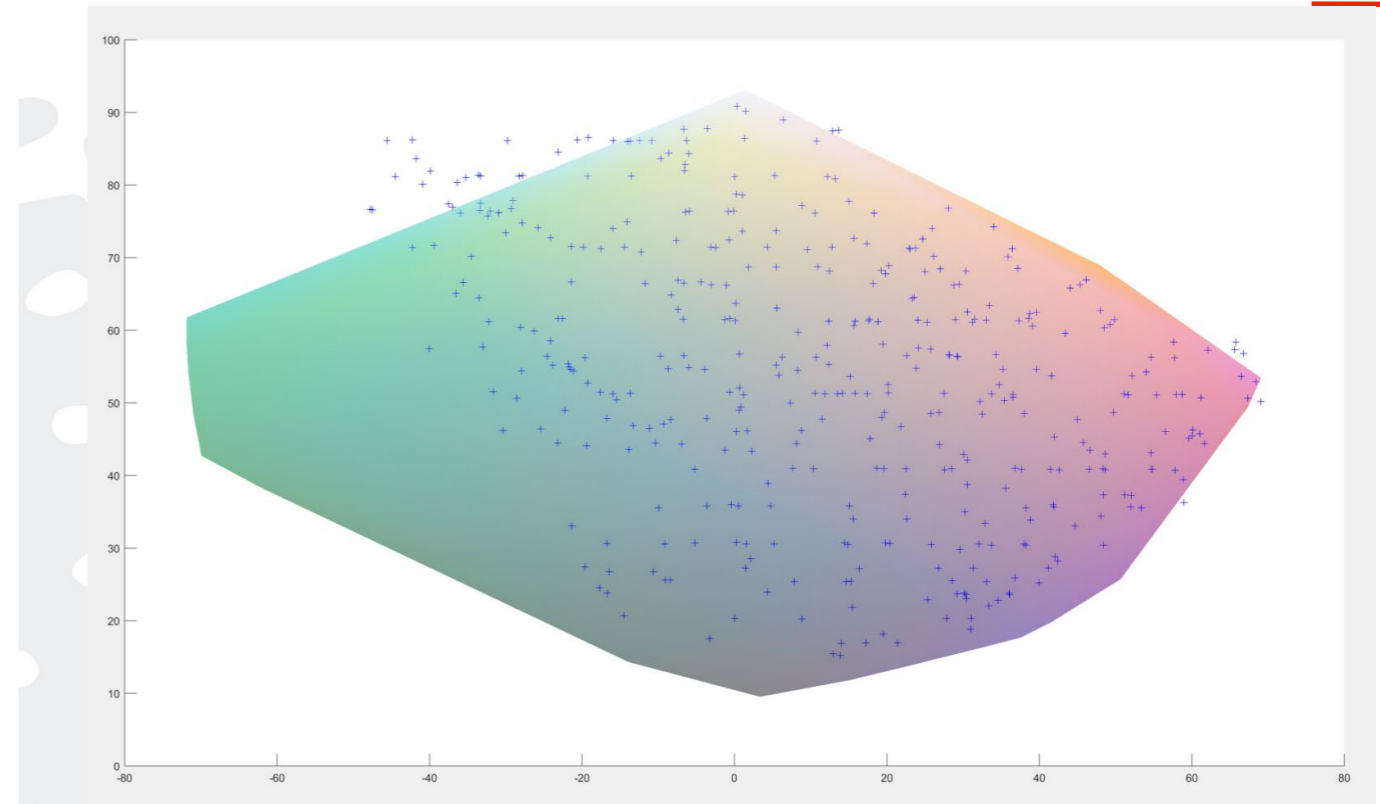
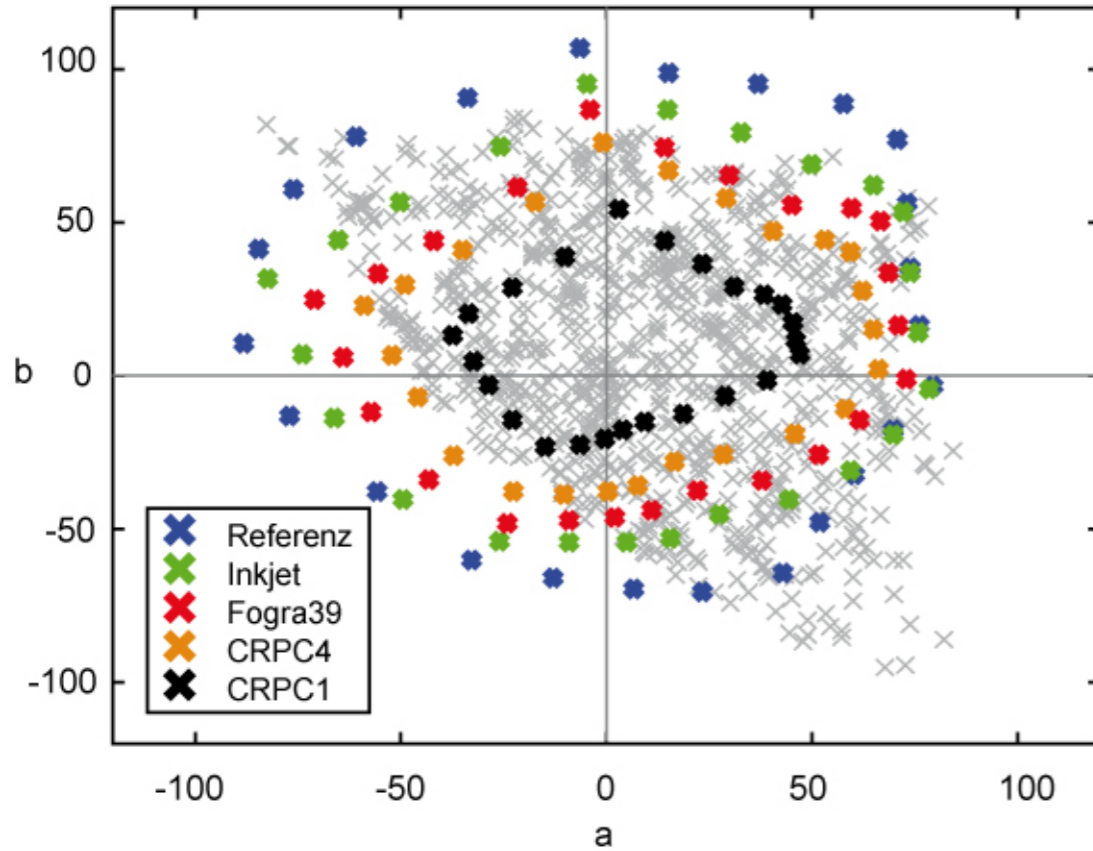
<https://colornaming.net/>

# Database for colour names

Source	colournaming.com						
Author	Dimitris Mylonas	<a href="mailto:dimitris.mylonas@yahoo.com">dimitris.mylonas@yahoo.com</a>					
Language	British English						
Date of Data	Jun 14						
To	Philipp Tröster - Fogra	Troester@fogra.org					
	<b>Frequency Order</b>	<b>Mean in CIELAB (sRGB)</b>			<b>Mean RGB</b>		
	<b>Colour Names</b>	<b>m_L*</b>	<b>m_a*</b>	<b>m_b*</b>	<b>m_R</b>	<b>m_G</b>	<b>m_B</b>
	1 purple	35,9536121	41,8622212	-36,714913	118	53	
	2 pink	62,7489121	47,9849469	-11,146343	220	111	
	3 blue	49,9673333	7,36421674	-39,103677	66	117	
	4 green	57,7320512	-32,987741	26,8739819	81	154	
	5 brown	33,9979074	15,5718095	23,8655843	113	70	
	6 lilac	62,5433264	30,5877706	-33,581615	174	133	

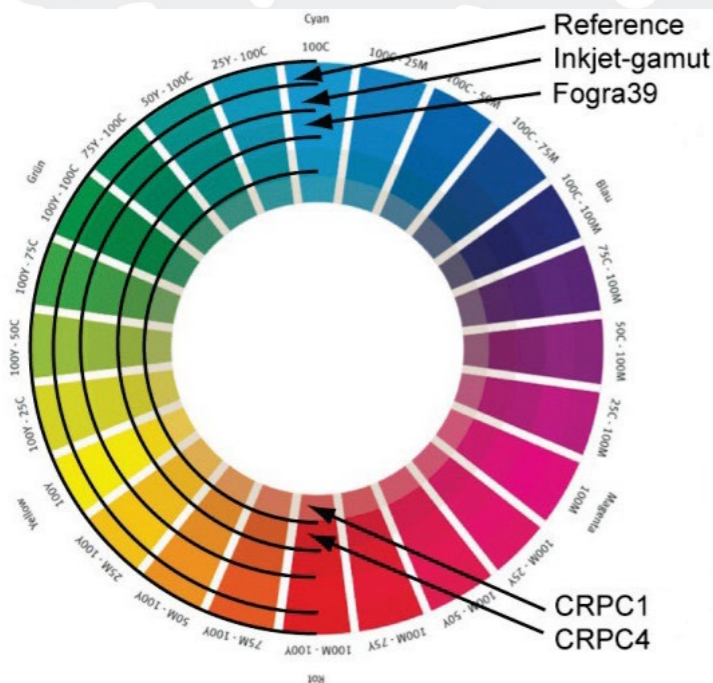
Tabel with 489 colour names

# Colour names



Example from Fogra research project 10.057

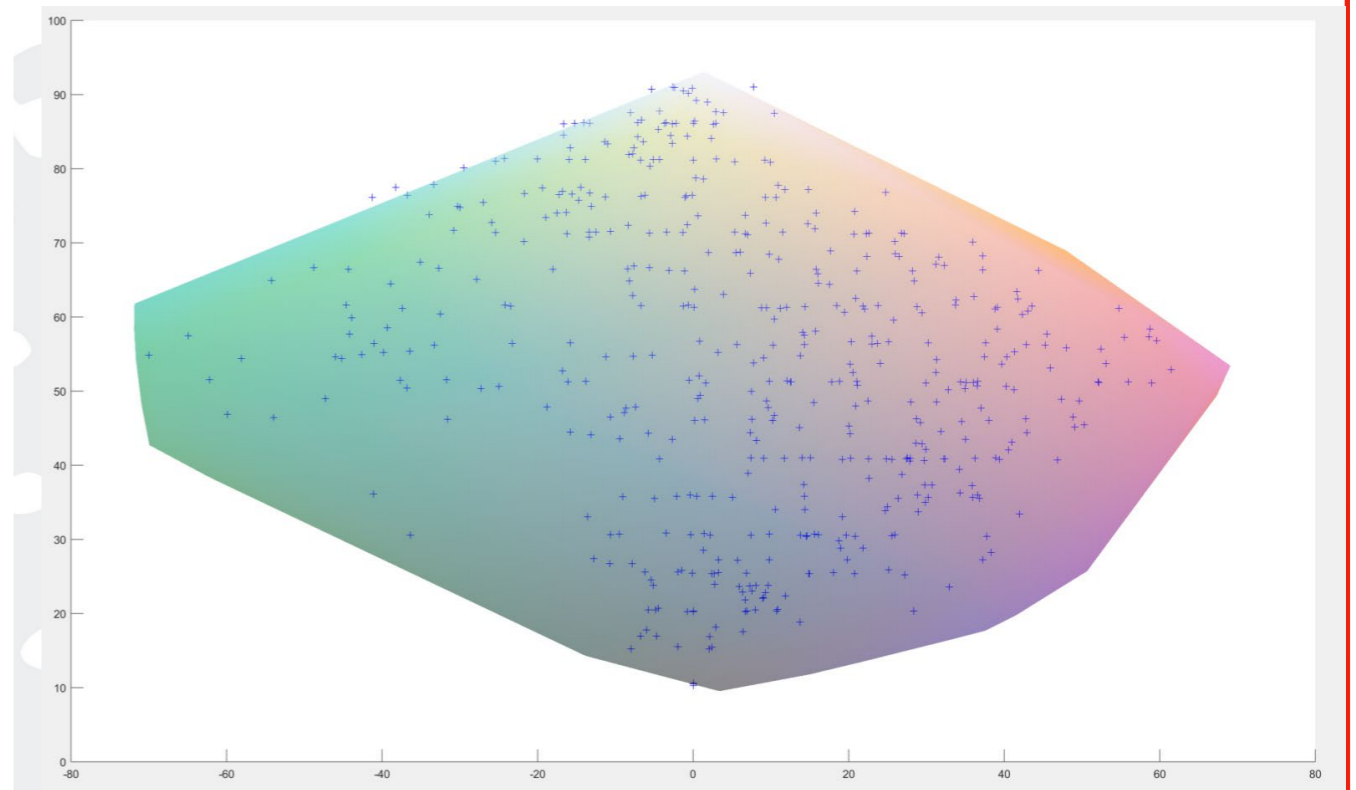
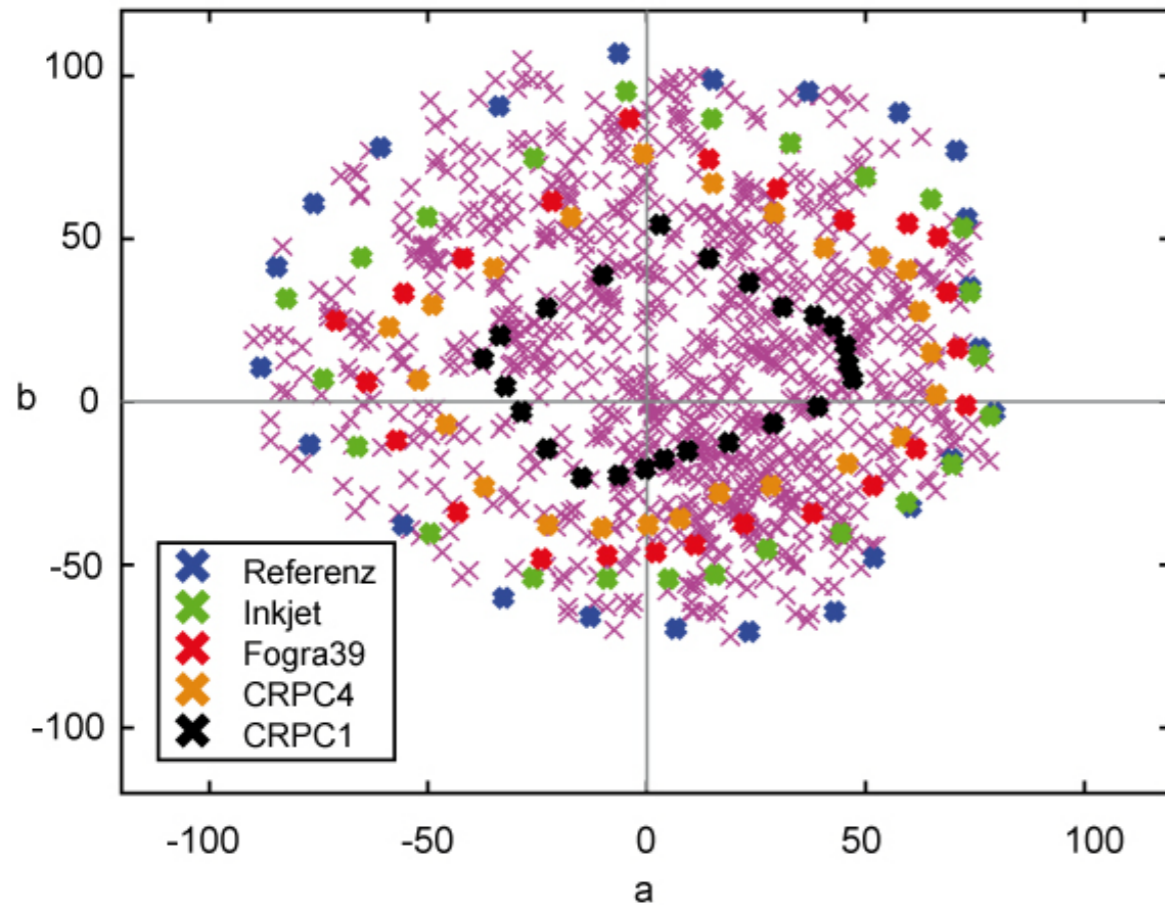
Abb.: Multicolour (7C) offset printing with 489 colour names



## Problem:

On typical CMYK color spaces there are large areas without overlapping -> counting of the color names is not goal-oriented

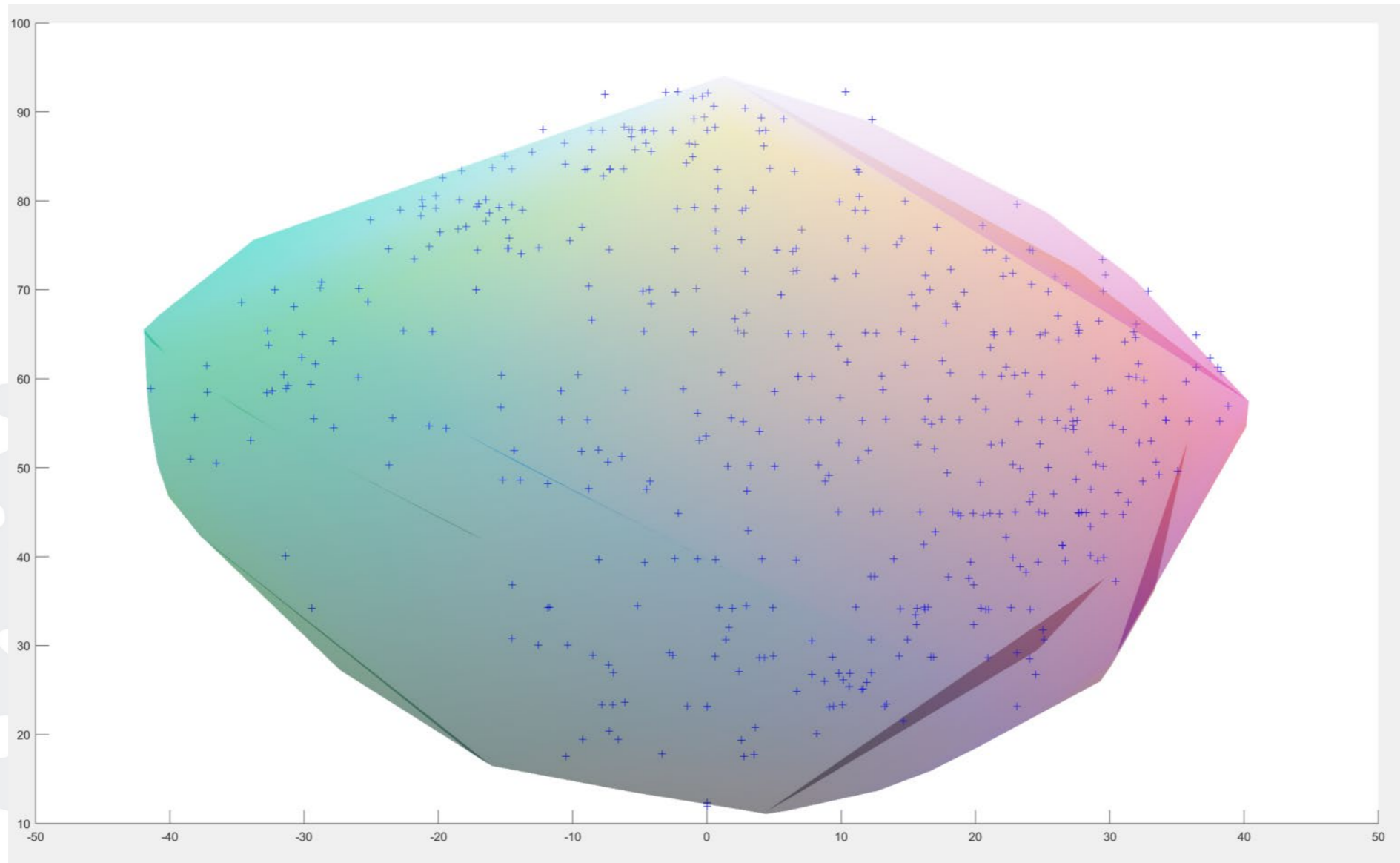
# Scaled colour names



Colour names are displayed in the CIE-LCh colour space. The chroma  $C_{FN} = C$  of each color name is rescaled by the following rule:

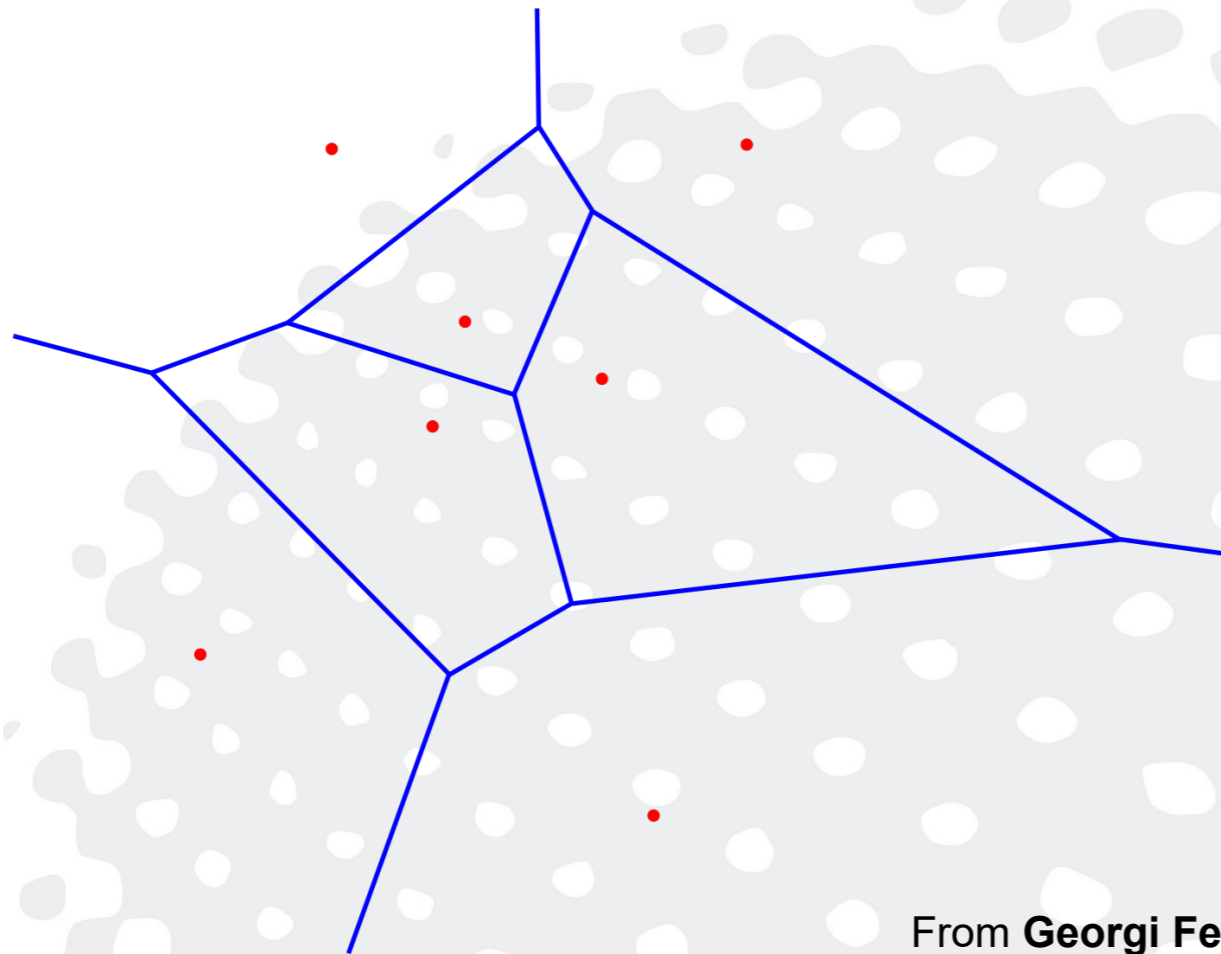
$$C_{FN} = C * \frac{C_{ref}}{C_{max}}$$

# Mapping to Din99oLAB



For the following steps, it makes sense to transform the colour names into a visually equidistant color space.

# Voronoi diagram



-**Voronoi diagram** or Dirichlet decomposition are available for all dimensions. Illustration here 2D.

By a given set of points a division of the space into separated regions is achieved.

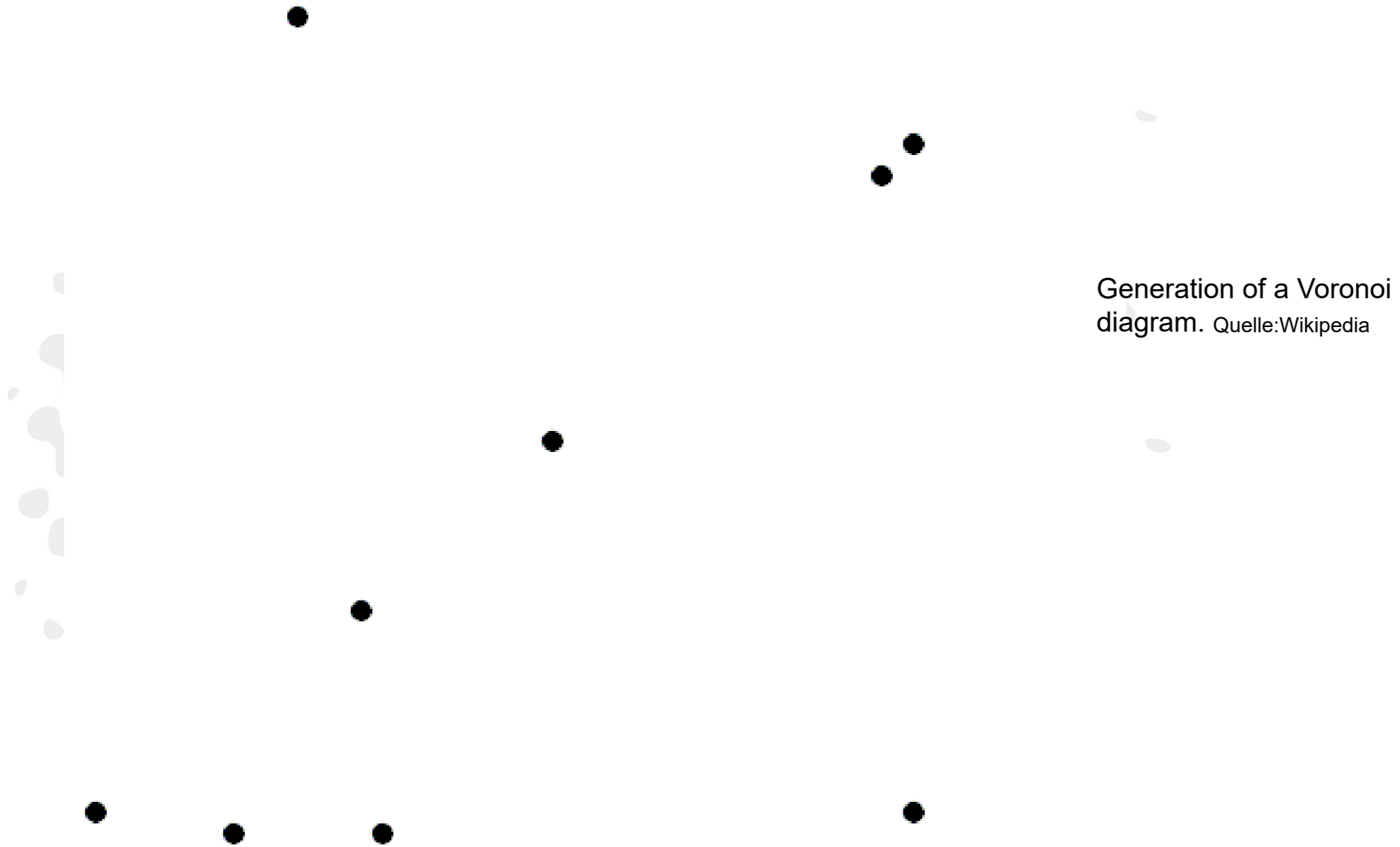
Points are called centers

- Regions are characterized in such a way that each point of a region is closer to its own center than to that of the other center.

From **Georgi Feodosjewitsch Woronoi** (1868-1908), Russian mathematician

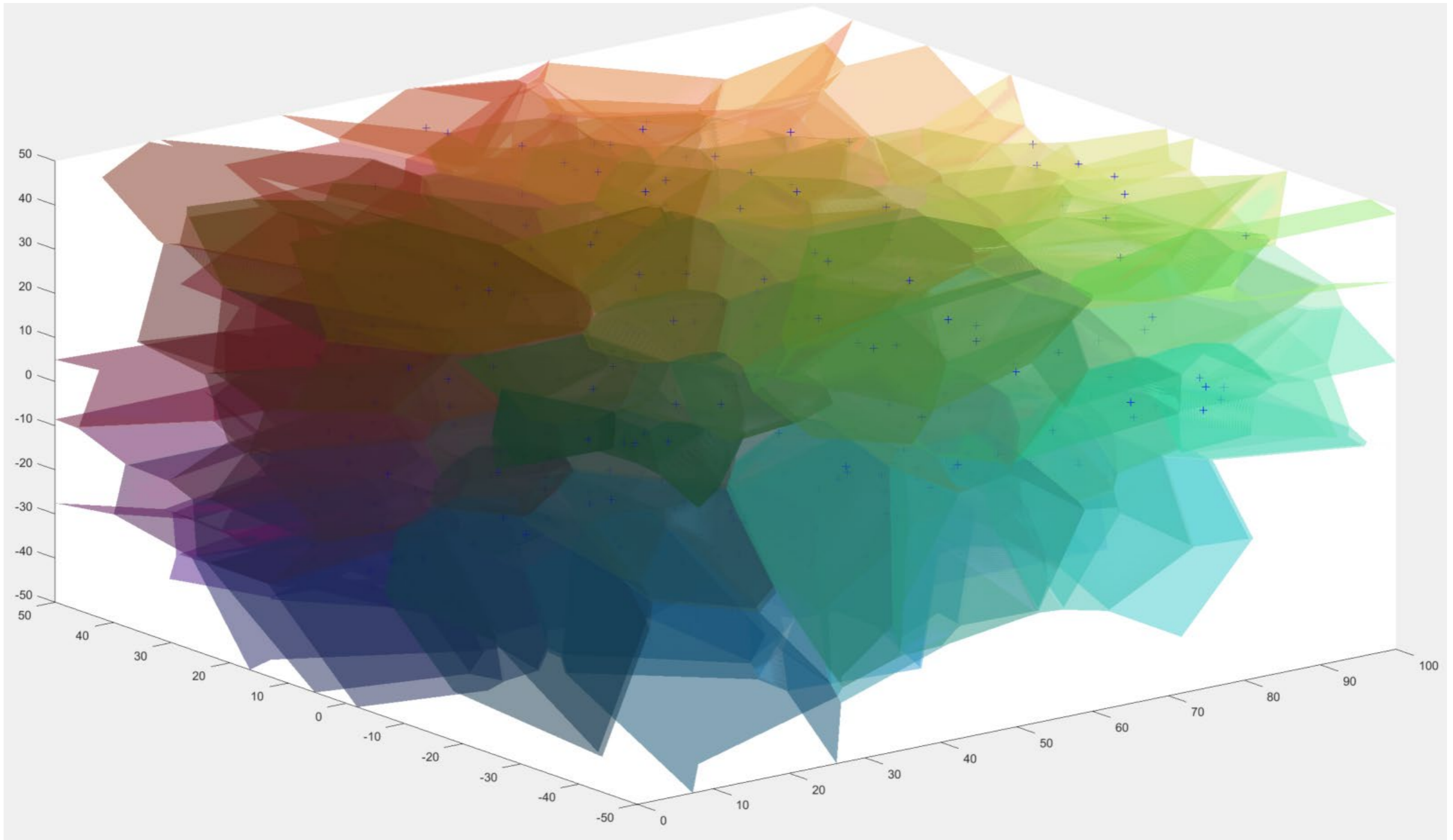


# Voronoi diagram





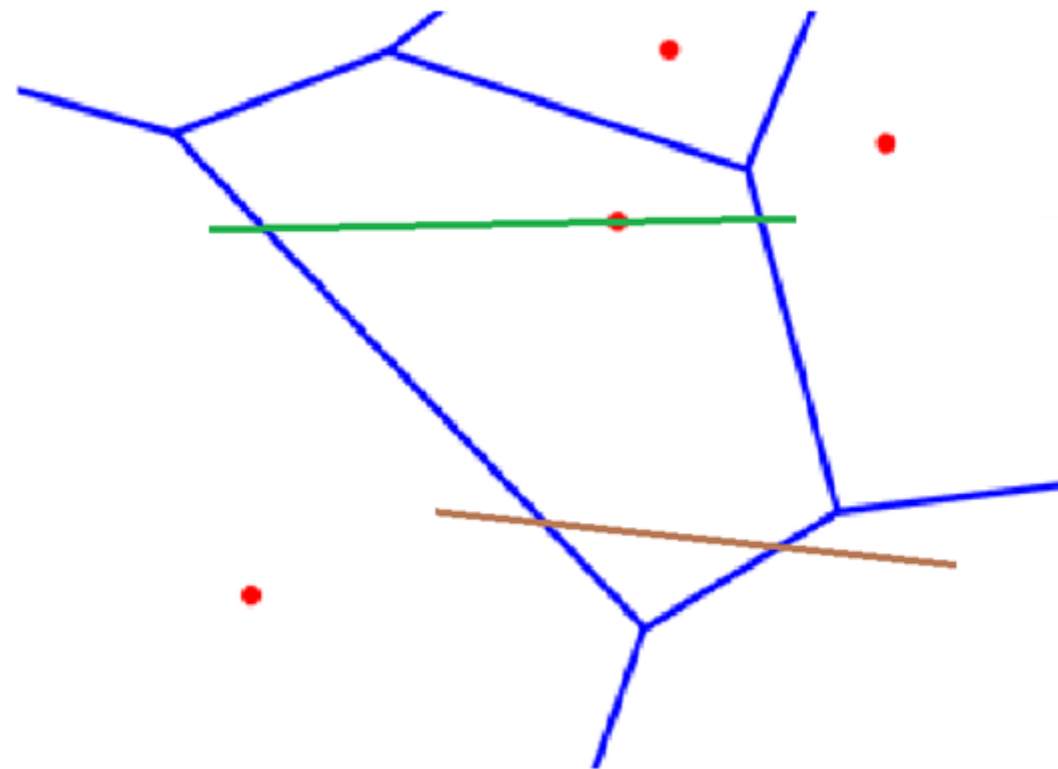
# Voronoi colour centres in CIE-LAB



3D Voronoi diagram in the CIELAB room. The fabnames are the centers.

## Example: How to count?

- One shall be counted for the **green way**.
- For the **brown path** only very little should be counted, since the path is far away from the centre relative to the region.



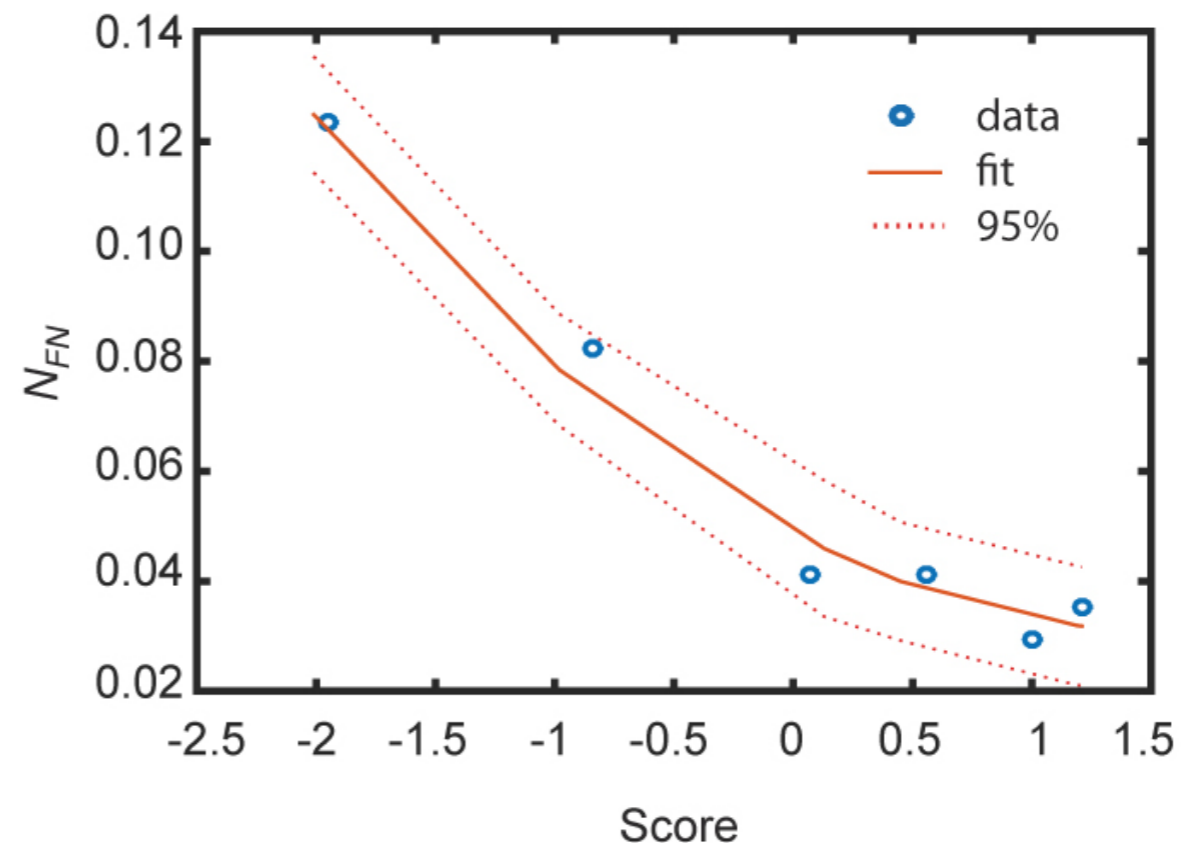
# Evaluation of the 7 strategies

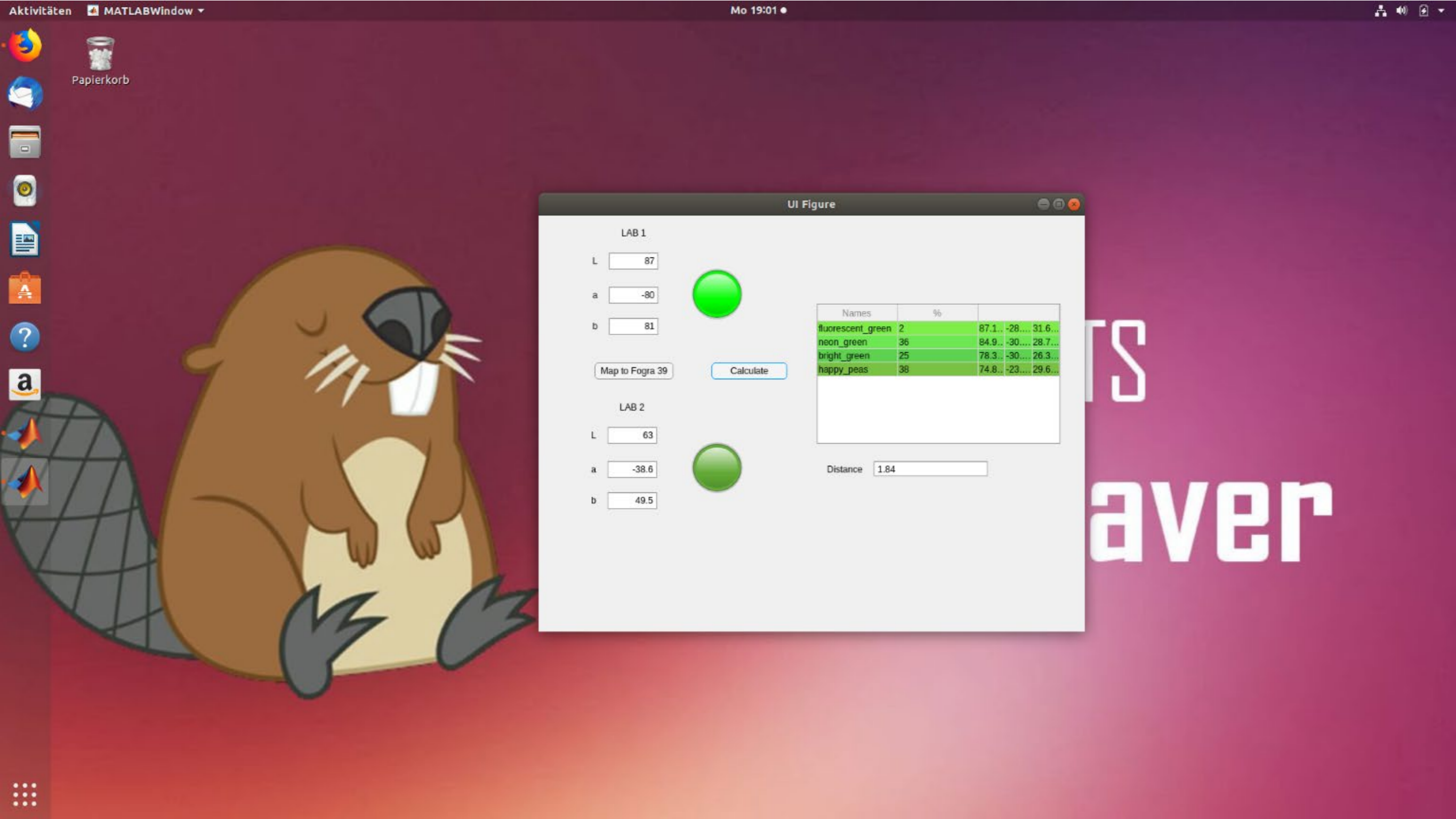
This basic principle of counting colour names between Lab values is used for applied any gamut mapping strategy S.

$$d_S(LAB) = \frac{\sum_{D \in \text{Druckbedingungen}} \Delta(LAB, S(LAB, D))}{|\text{Druckbedingungen}|} \approx \text{Anzahl traversierter Farbnamen}$$

Subsequently, it is checked whether there is a correlation to the colour psychological experiment of Fogra.

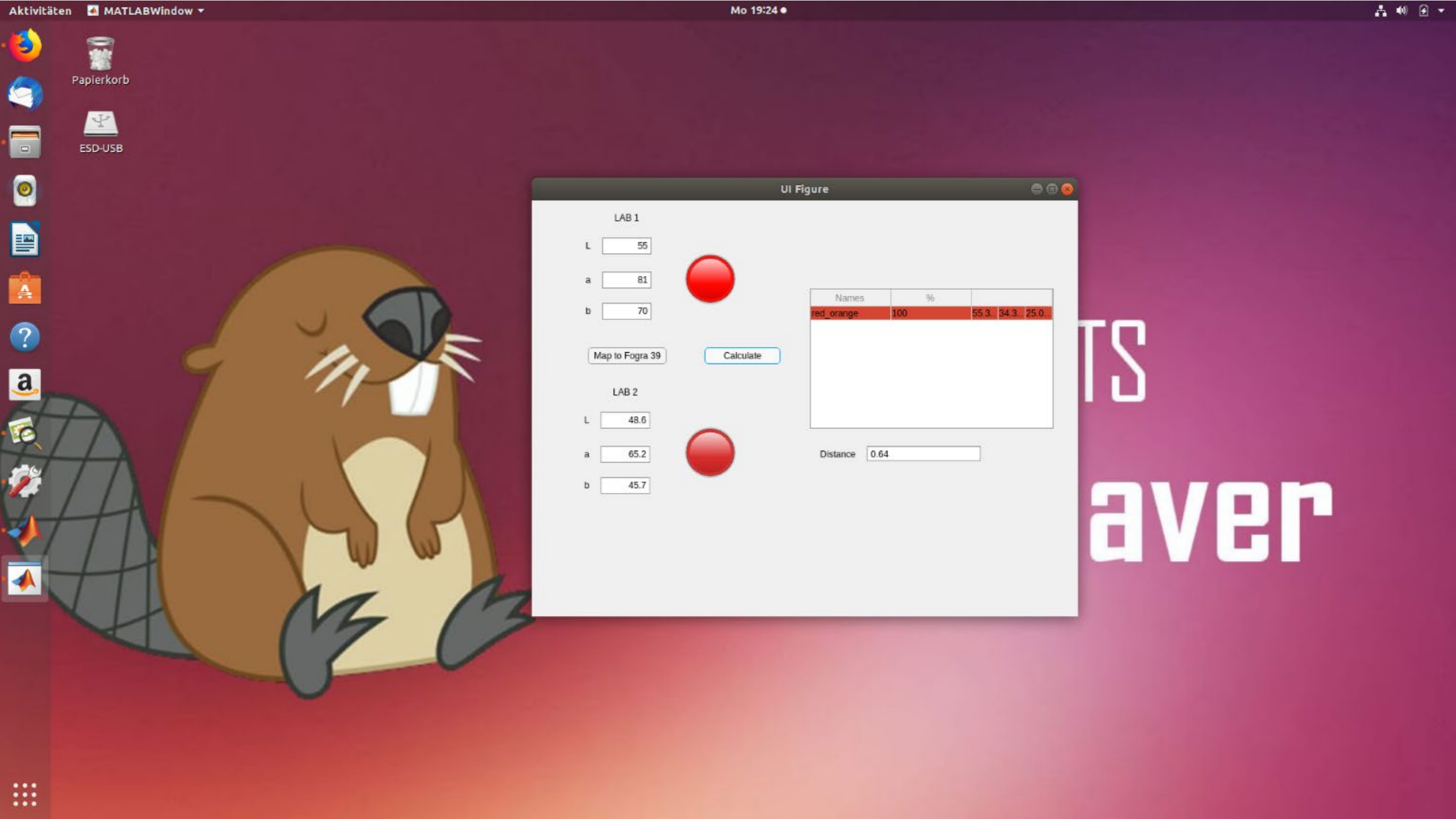
Compare with **10.057**:  
„ Concept for the colour management based data preparation and reproduction in the publishing industry “





The image shows a screenshot of an Ubuntu desktop environment. On the left, there is a vertical dock with various application icons including Firefox, a trash bin labeled 'Papierkorb', and several other icons. In the center, a large, cartoonish mole character is sitting. To the right, a MATLAB window titled 'UI Figure' is open. The window contains two sections for color calibration: 'LAB 1' and 'LAB 2'. Each section has input fields for L, a, and b values. A 'Calculate' button is present between the two sections. To the right of the 'Calculate' button is a table with columns 'Names', '%', and three numerical columns. Below the table is a 'Distance' input field showing the value '1.84'. The background of the desktop is a dark red color with the text 'TS' and 'aver' partially visible on the right side.

Names	%			
fluorescent_green	2	87.1..	-28....	31.6...
neon_green	36	84.9..	-30....	28.7...
bright_green	25	78.3..	-30....	26.3...
happy_peas	38	74.8..	-23....	29.6...

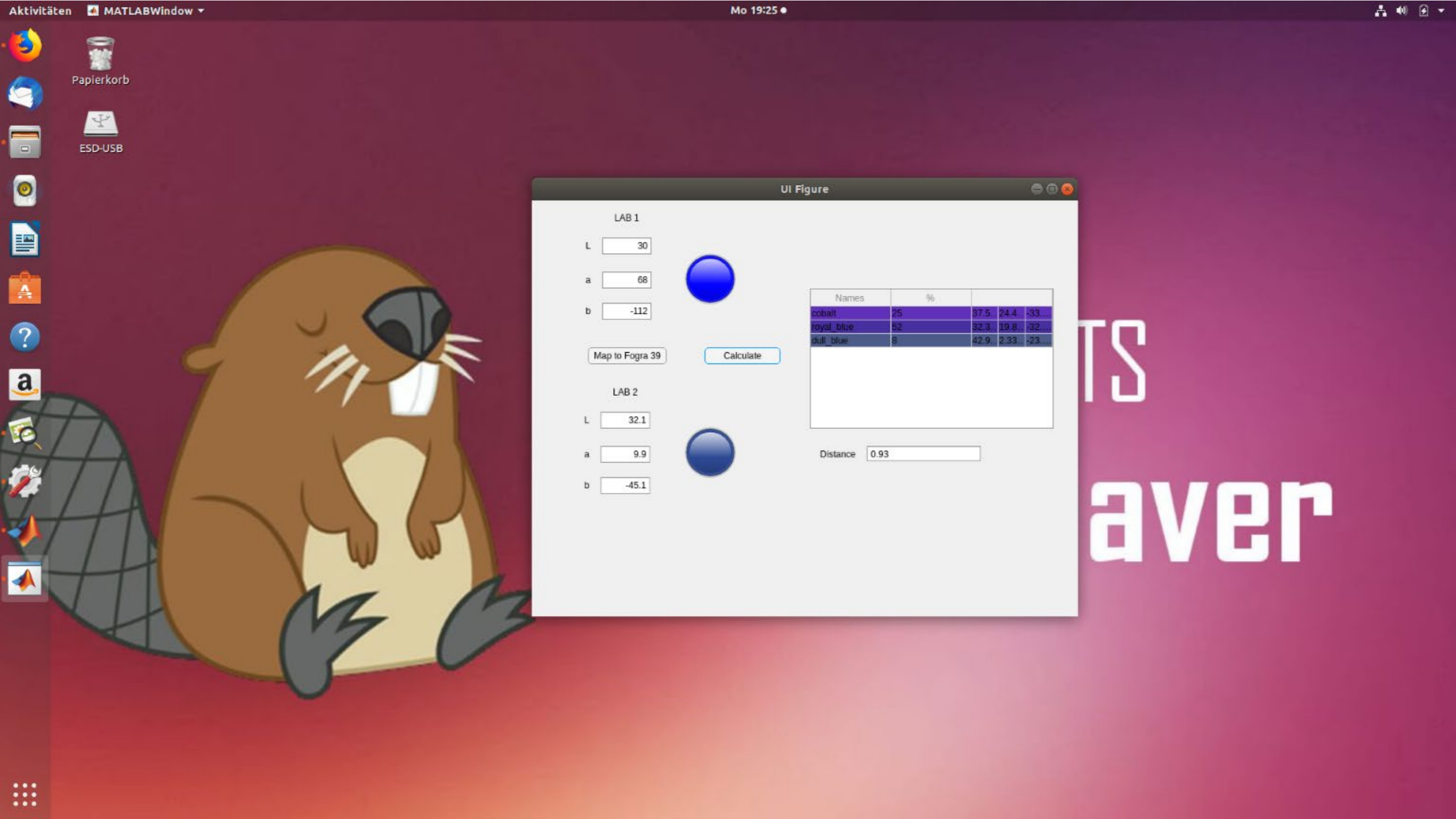


The image shows a screenshot of an Ubuntu desktop environment. On the left, there is a vertical dock with various application icons including Firefox, LibreOffice, and Amazon. The desktop background features a cartoon beaver mascot. In the center, a MATLAB window titled "UI Figure" is open. The window contains two sections for "LAB 1" and "LAB 2", each with input fields for parameters L, a, and b. There are also two red circular buttons and a "Calculate" button. A table is displayed on the right side of the window, and a "Distance" field is at the bottom.

Names	%			
red_orange	100	55.3	34.3	25.0

Distance: 0.64

TS  
aver



The image shows a screenshot of an Ubuntu desktop environment. On the left, there is a vertical dock with various application icons including Firefox, LibreOffice, and Amazon. A large, cartoonish mole character is positioned in the lower-left area. In the center, a MATLAB window titled "UI Figure" is open. The window contains two sections for color space data: "LAB 1" and "LAB 2".

**LAB 1**

L:   
a:   
b:

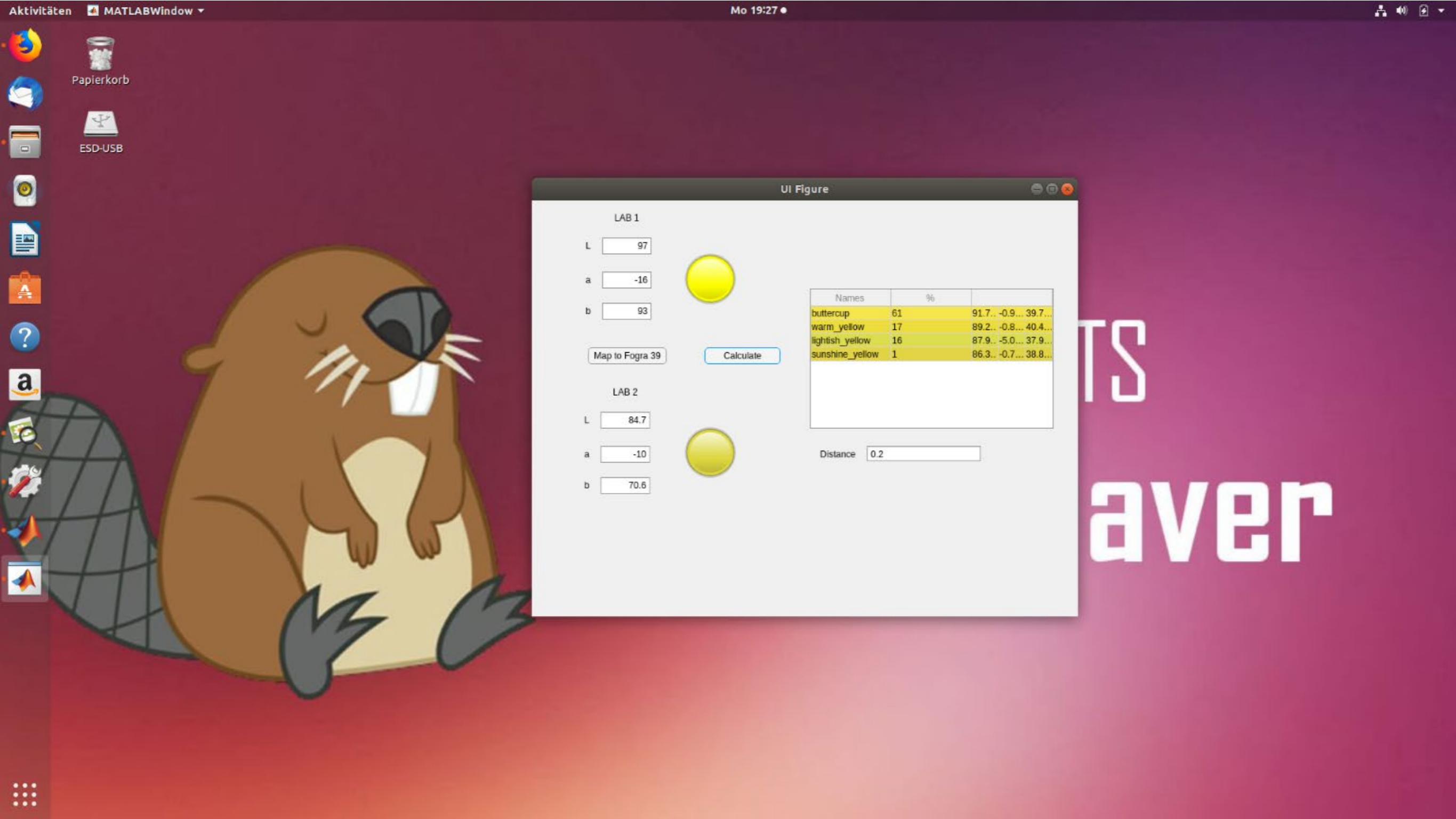
**LAB 2**

L:   
a:   
b:

Distance:

Names	%			
cobalt	25	37.5	24.4	-33...
royal blue	52	32.3	19.8	-32...
dull blue	8	42.9	2.33	-23...

TS  
aver



The screenshot shows a Linux desktop environment with a dark red background. On the left, there is a vertical dock with various application icons including Firefox, a trash can, ESD-USB, and Amazon. A large cartoon beaver is positioned on the left side of the desktop. In the center, a MATLAB window titled 'UI Figure' is open. The window contains two sections for color calibration: 'LAB 1' and 'LAB 2'. Each section has input fields for L, a, and b values. A 'Calculate' button is present between the two sections. To the right of the 'LAB 1' section is a table with columns 'Names', '%', and a third column with numerical values. Below the table is a 'Distance' input field.

Names	%	
buttercup	61	91.7... -0.9... 39.7...
warm_yellow	17	89.2... -0.8... 40.4...
lightish_yellow	16	87.9... -5.0... 37.9...
sunshine_yellow	1	86.3... -0.7... 38.8...

LAB 1

L

a

b

Map to Fogra 39

Calculate

LAB 2

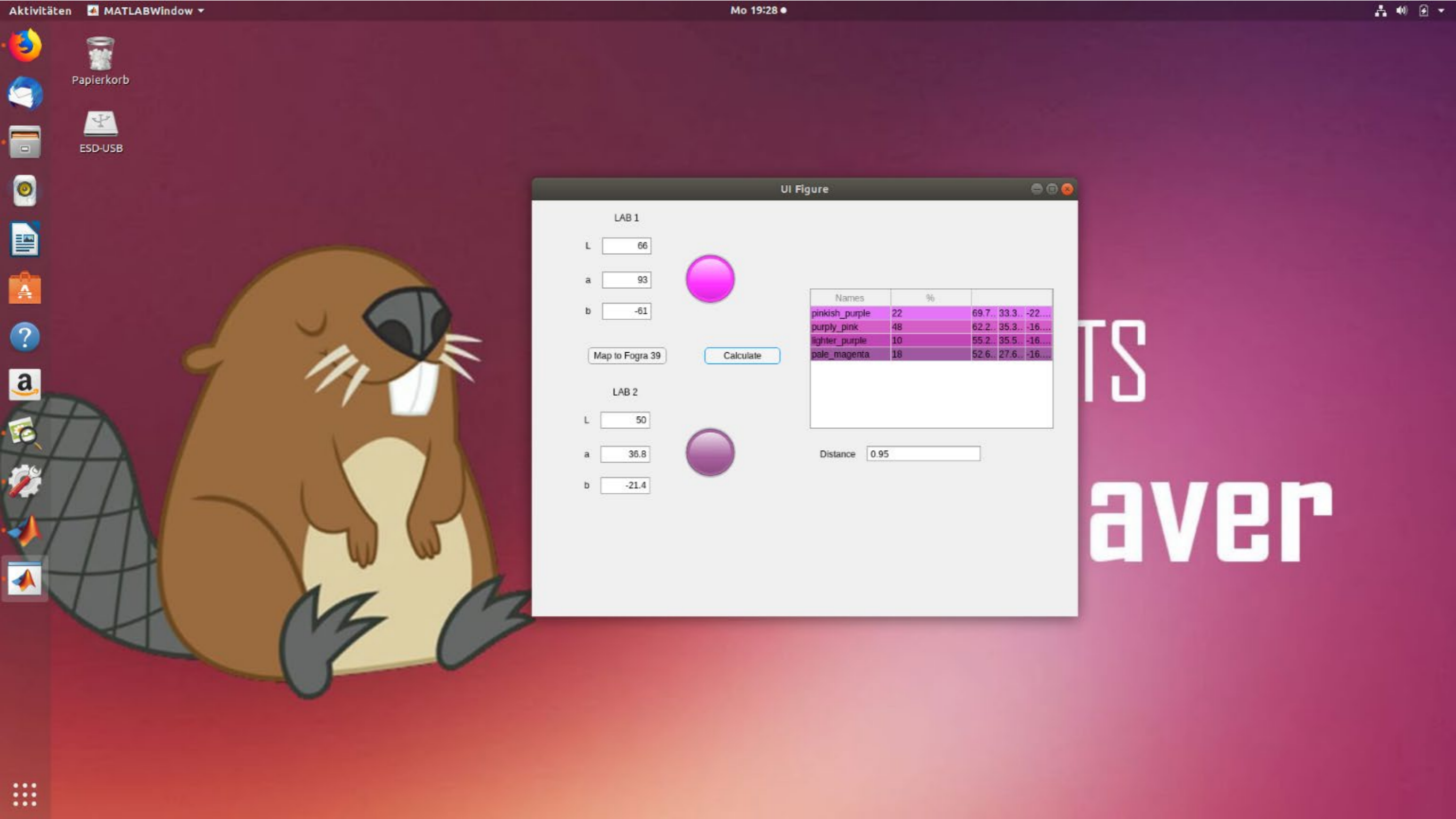
L

a

b

Distance

TS  
aver

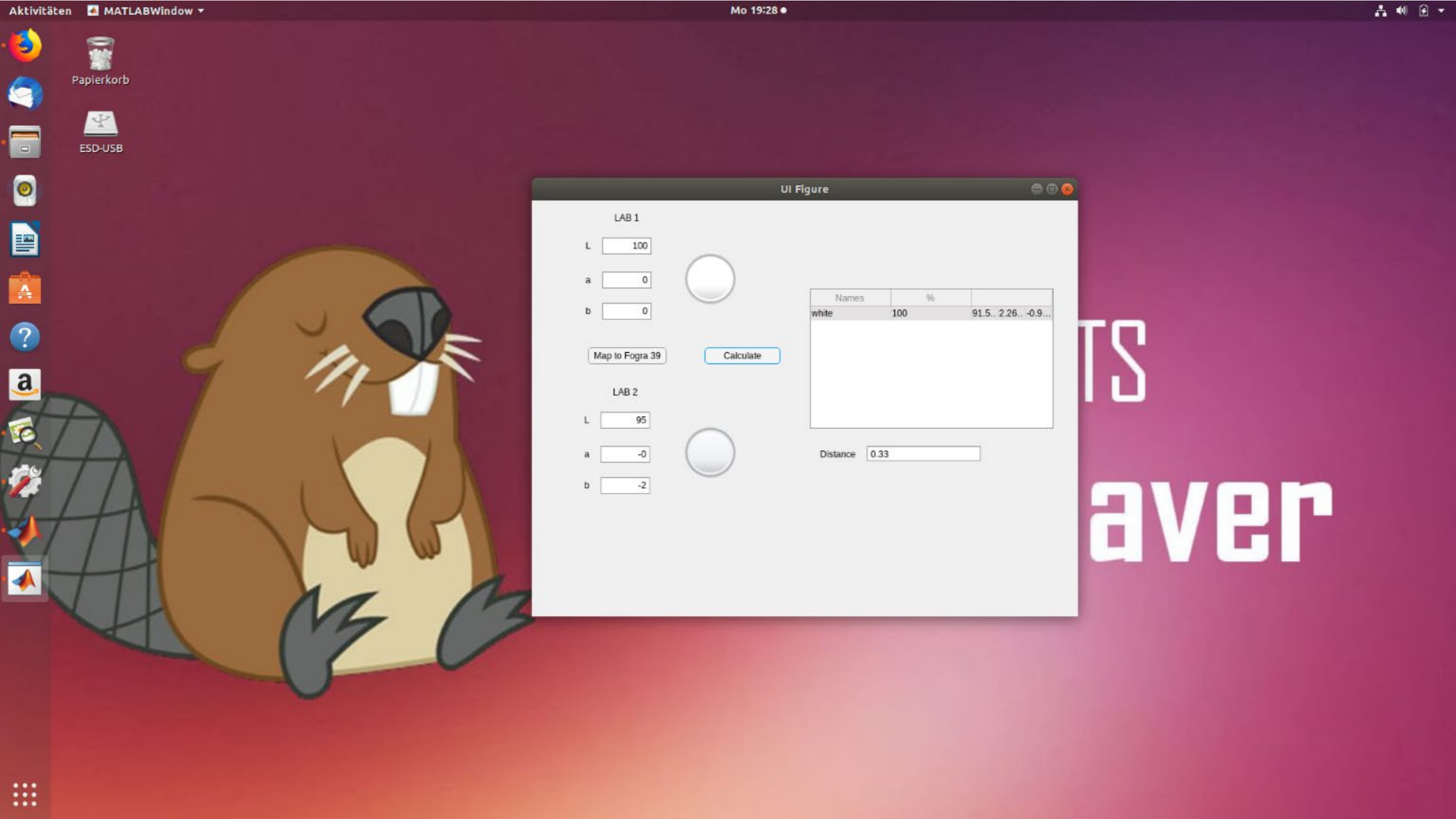


The screenshot shows a Linux desktop environment with a dark red background. On the left, there is a vertical dock with various application icons including Firefox, a trash bin, ESD-USB, and Amazon. A large cartoon mole character is positioned on the left side of the desktop. In the center, a MATLAB window titled "UI Figure" is open. The window contains two sections, "LAB 1" and "LAB 2", each with input fields for L, a, and b. A "Calculate" button is located between the two sections. To the right of the "Calculate" button is a table with columns "Names" and "%". Below the table is a "Distance" input field showing the value "0.95".

Names	%			
pinkish_purple	22	69.7..	33.3..	-22...
purply_pink	48	62.2..	35.3..	-16...
lighter_purple	10	55.2..	35.5..	-16...
pale_magenta	18	52.6..	27.6..	-16...

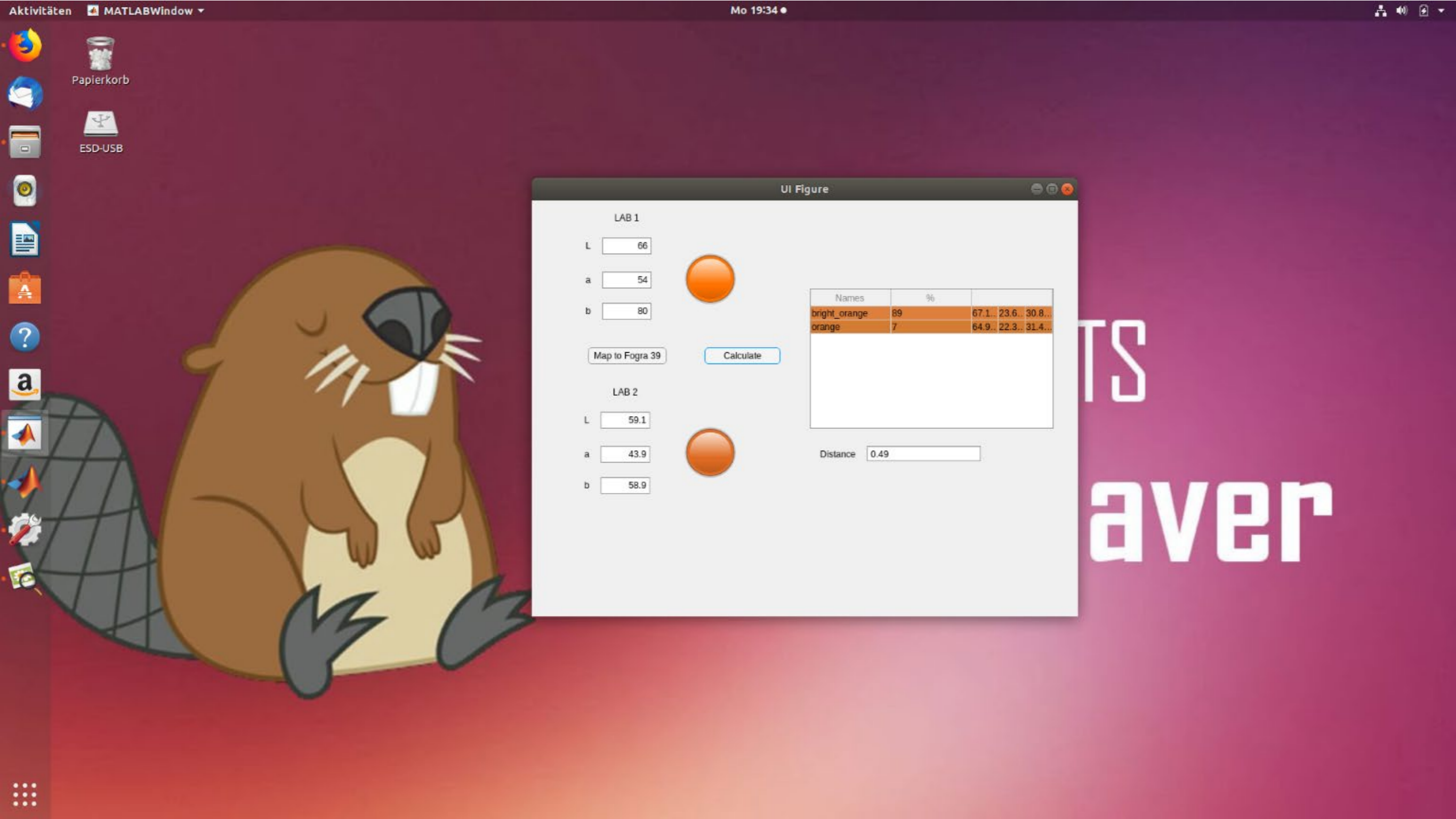
TS  
aver





The image shows a screenshot of an Ubuntu desktop environment. On the left, there is a vertical dock with various application icons including Firefox, a trash can labeled 'Papierkorb', an ESD-USB drive, and several other utility icons. In the center, a large cartoon mole character is sitting. To the right of the mole, a MATLAB 'UI Figure' window is open. The window contains two sections: 'LAB 1' and 'LAB 2'. Each section has three input fields for 'L', 'a', and 'b'. Below these fields are two buttons: 'Map to Fogra 39' and 'Calculate'. To the right of the input fields is a table with three columns: 'Names', '%', and an unlabeled column. The table contains one row with the value 'white' and numerical data. Below the table is a 'Distance' input field with the value '0.33'. The desktop background is a dark red color with a large white text overlay on the right side that reads 'TS' and 'aver'.

Names	%	
white	100	91.5.. 2.26.. -0.9...



The image shows a screenshot of an Ubuntu desktop environment. On the left, there is a vertical dock with various application icons including Firefox, LibreOffice, and Amazon. A large, cartoonish mole character is positioned in the lower-left area. In the center, a MATLAB window titled "UI Figure" is open. The window contains two sections for "LAB 1" and "LAB 2", each with input fields for parameters L, a, and b. There are also two orange circular buttons and a "Calculate" button. A table is displayed on the right side of the window, and a "Distance" field shows the value 0.49.

Names	%			
bright_orange	89	67.1..	23.6..	30.8..
orange	7	64.9..	22.3..	31.4..

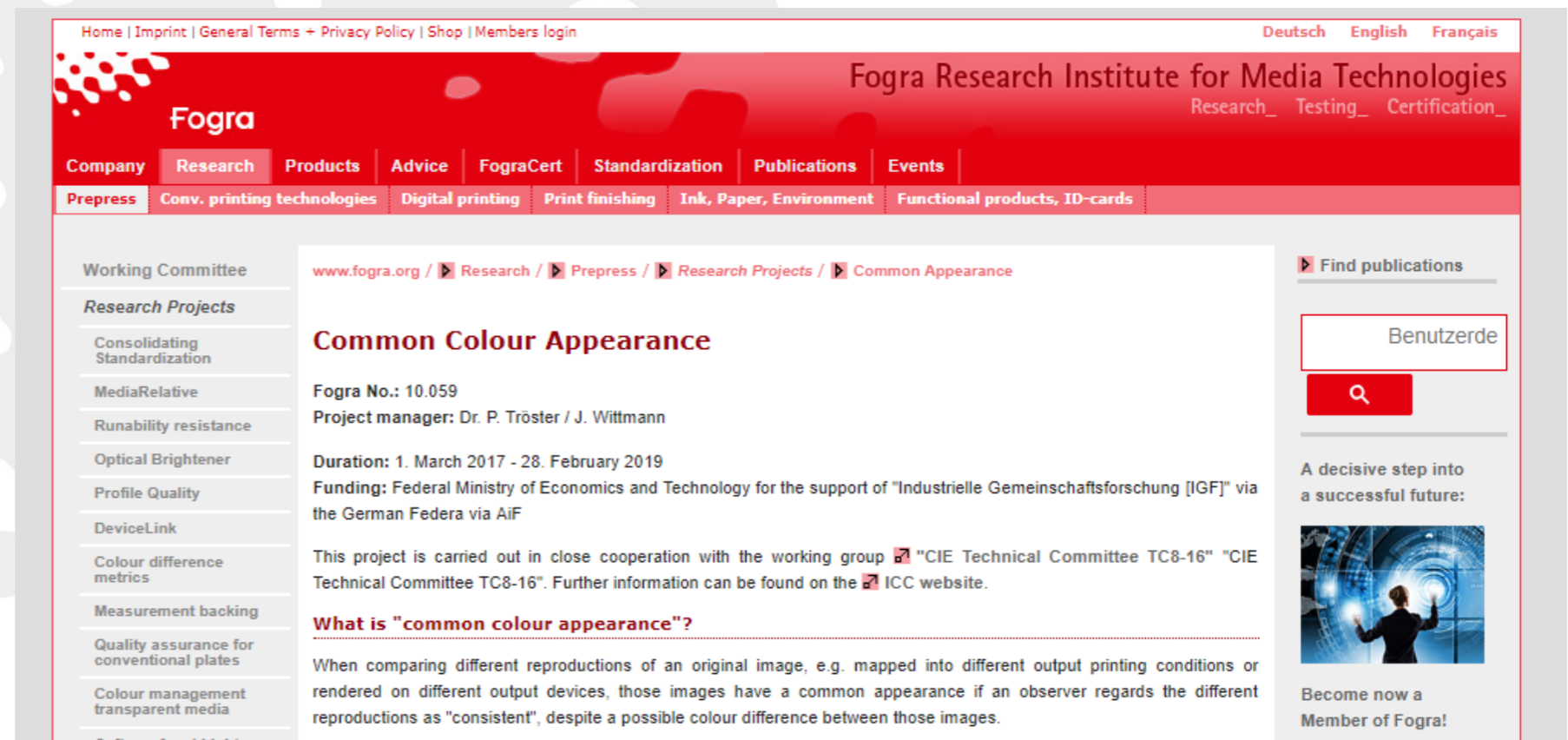
TS  
aver

## 4. Outlook / next steps

- ↪ Further development of the evaluation method based on colour names
- ↪ Development of web-based tool for evaluation of CCA by means of CIELAB measurements of a control wedge (Fogra Media Wedge „RGB“ V3.0)  
→ will be made available on the website
- ↪ Finalising the „official“ research project in Jan/Feb 2019

### Project website

<https://fogra.org/index.php?menuid=719&reporeid=456&getlang=en>



The screenshot shows the Fogra website interface. At the top, there is a navigation bar with links for Home, Imprint, General Terms + Privacy Policy, Shop, and Members login. The main header features the Fogra logo and the text 'Fogra Research Institute for Media Technologies' with subtext 'Research\_ Testing\_ Certification\_'. Below this is a secondary navigation bar with categories like Company, Research, Products, Advice, FograCert, Standardization, Publications, and Events. A third bar lists specific areas: Prepress, Conv. printing technologies, Digital printing, Print finishing, Ink, Paper, Environment, and Functional products, ID-cards.

The main content area is titled 'Common Colour Appearance' and includes the following information:

- Project manager: Dr. P. Tröster / J. Wittmann
- Duration: 1. March 2017 - 28. February 2019
- Funding: Federal Ministry of Economics and Technology for the support of "Industrielle Gemeinschaftsforschung [IGF]" via the German Federa via AiF
- Description: This project is carried out in close cooperation with the working group "CIE Technical Committee TC8-16" "CIE Technical Committee TC8-16". Further information can be found on the ICC website.
- Section: **What is "common colour appearance"?**
- Text: When comparing different reproductions of an original image, e.g. mapped into different output printing conditions or rendered on different output devices, those images have a common appearance if an observer regards the different reproductions as "consistent", despite a possible colour difference between those images.

On the right side of the page, there is a search bar labeled 'Benutzerde' and a section titled 'Find publications' with a search icon. Below that, there is a promotional message: 'A decisive step into a successful future:' followed by an image of a person looking at a globe and the text 'Become now a Member of Fogra!'.

# Questions?

