From Perception to Abstraction with Interaction and Visualization

Miguel A. Nacenta (nacenta@uvic.ca)

@ DFP, UBC – January 2021

Collaborators


Michael Mauderer


Gonzalo Mendez


Julian Petford


Xu Zhu


Simone Conte


Sebastien Vandenheste


Alice Lynch


Alexandra Lee


Guilherme Carneiro


Constant Manteau


Sheelagh Carpendale


John Brosz


Ricky Pausch


Uta Hinrichs


Alice Toniolo


Özgür Akgün


Christophe Hurter

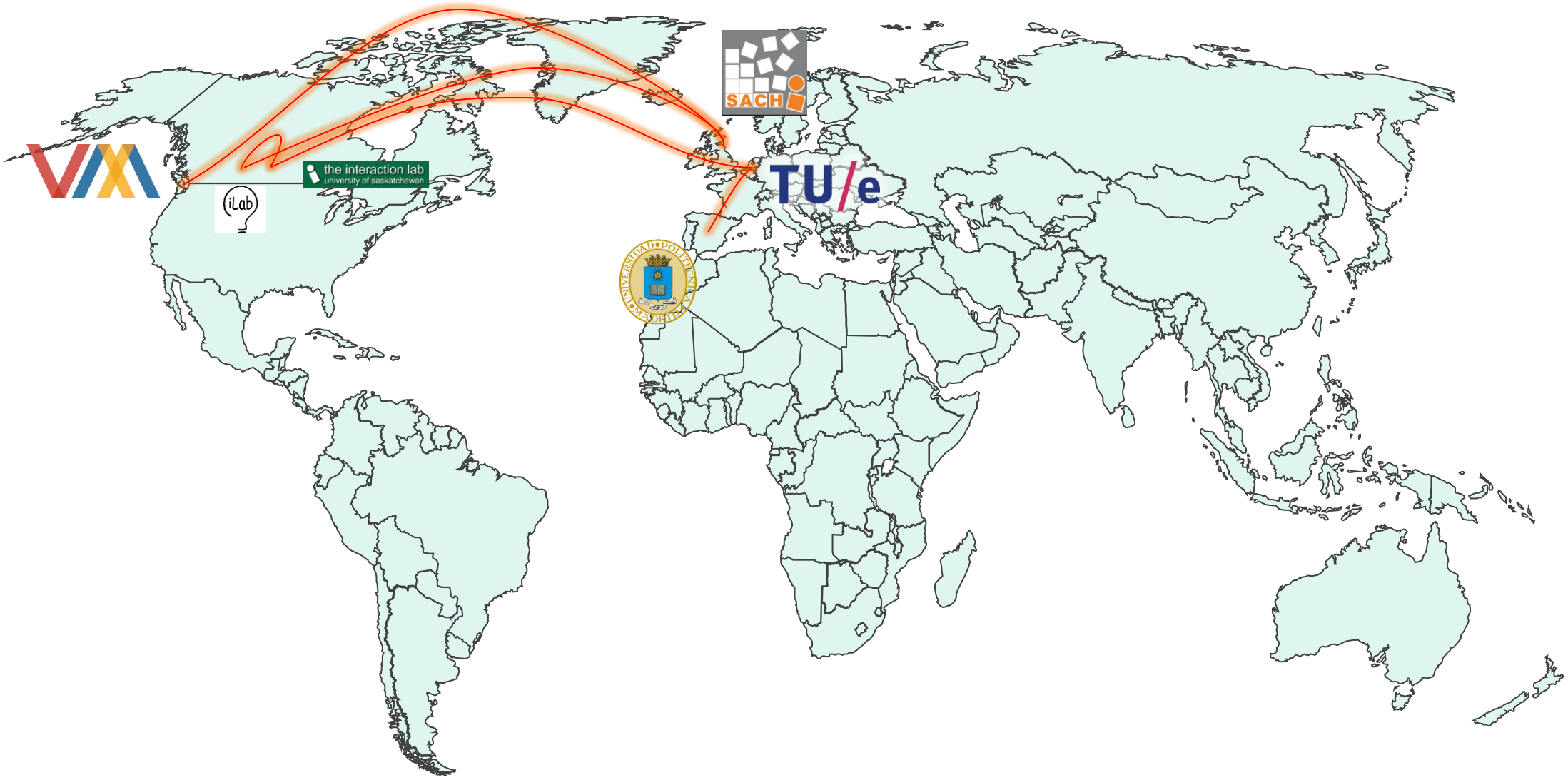

Dhanraj Vishwanath


Pete Nightingale


Daniel Archambault


Dave Flatla

Brief Personal Introduction



Victoria Interactive eXperiences with Information

Sowmya Somanath

Charles Perin

Miguel Nacenta

Territorial acknowledgements

- I *acknowledge* with respect the Lekwungen peoples on whose traditional *territory* the *University of Victoria* stands, and the Songhees, Esquimalt and W̱SÁNEĆ peoples whose historical relationships with the *land* continue to this day.
- I feel grateful for working and living in this beautiful place full of history.
- I also acknowledge that the UBC Point Grey campus, from where this virtual seminary is being organized, sits on the traditional, ancestral and unceded territory of the Musqueam people.

Goals

- Show you something that you find useful
- Show you something that you find fun/entertaining
- Preview some of my research interests
  (with an eye on collaboration)

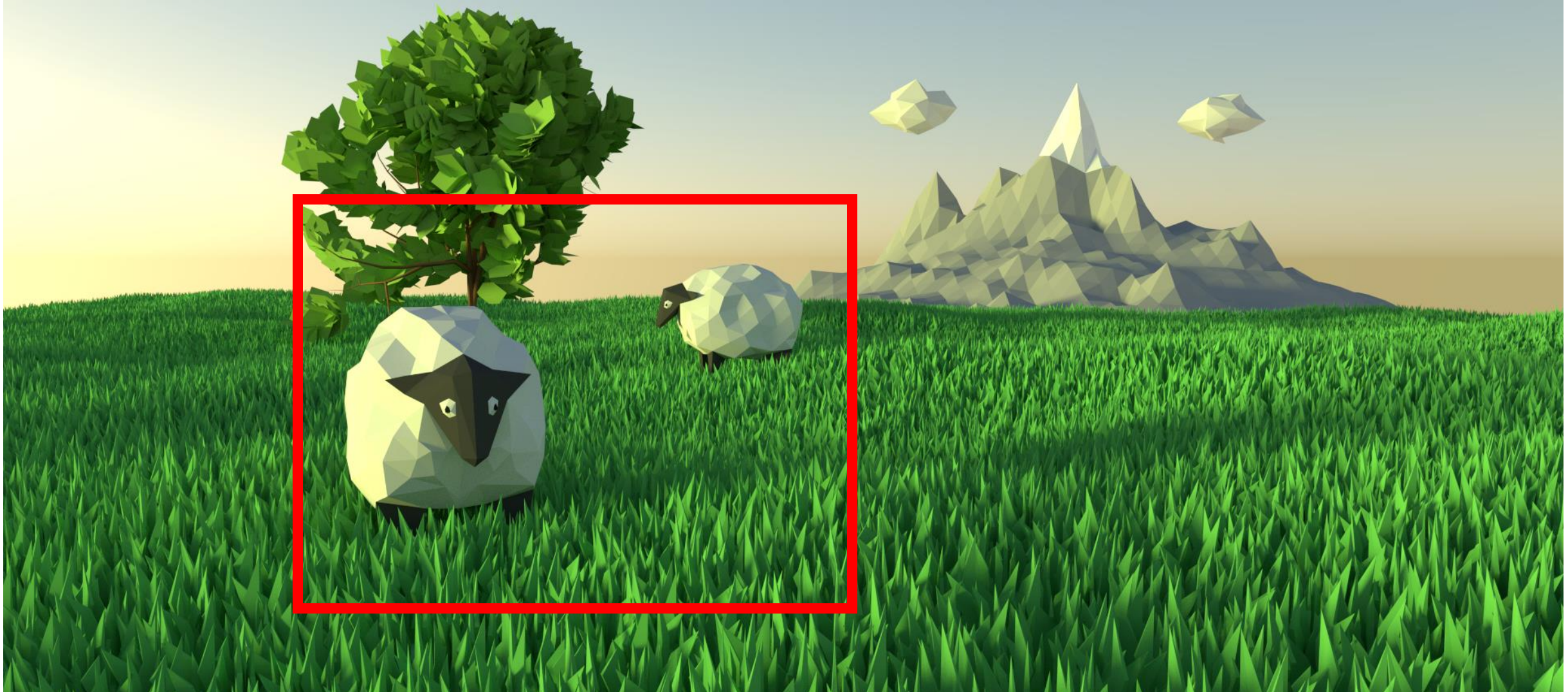
Deepview

Depth Cues in Images and Displays

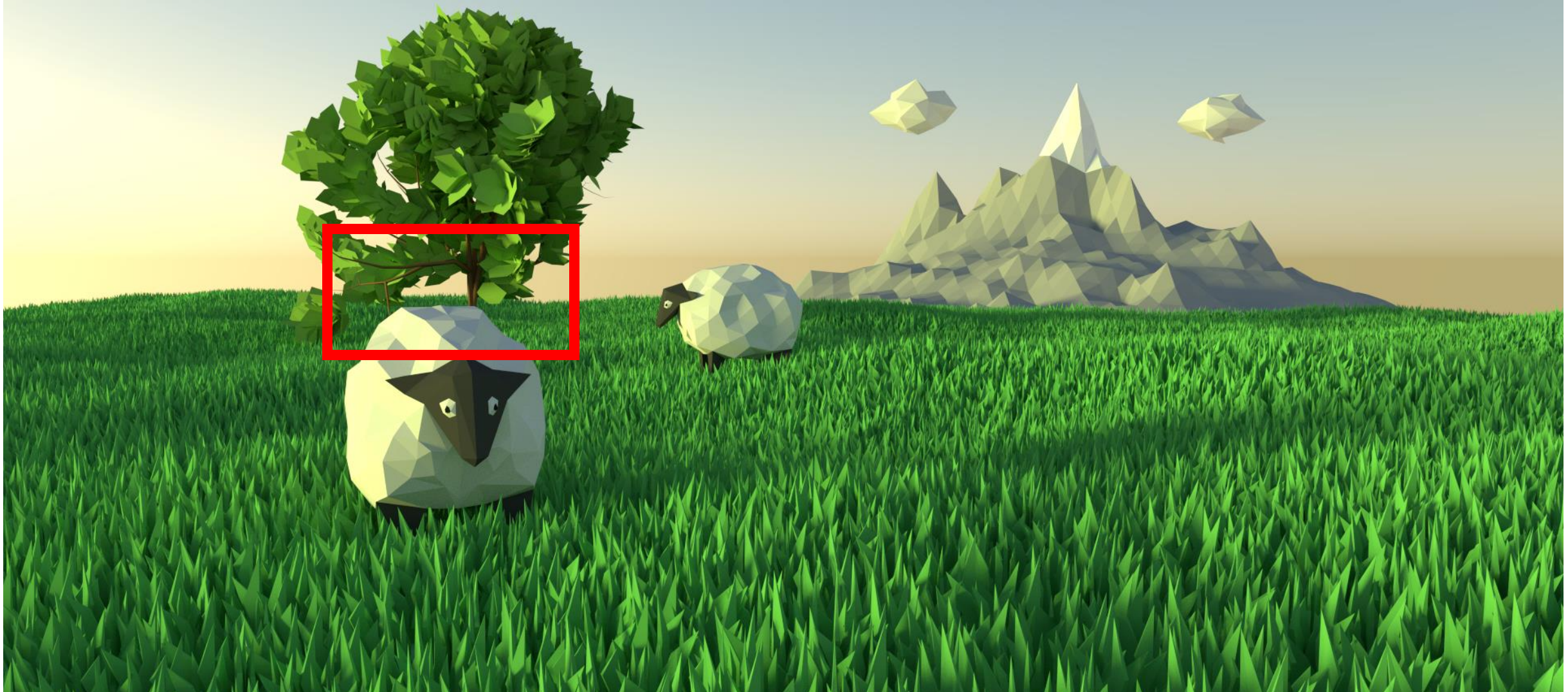
Depth Cues in Images and Displays

Stereoscopic ≠ Two eyes (binocular)

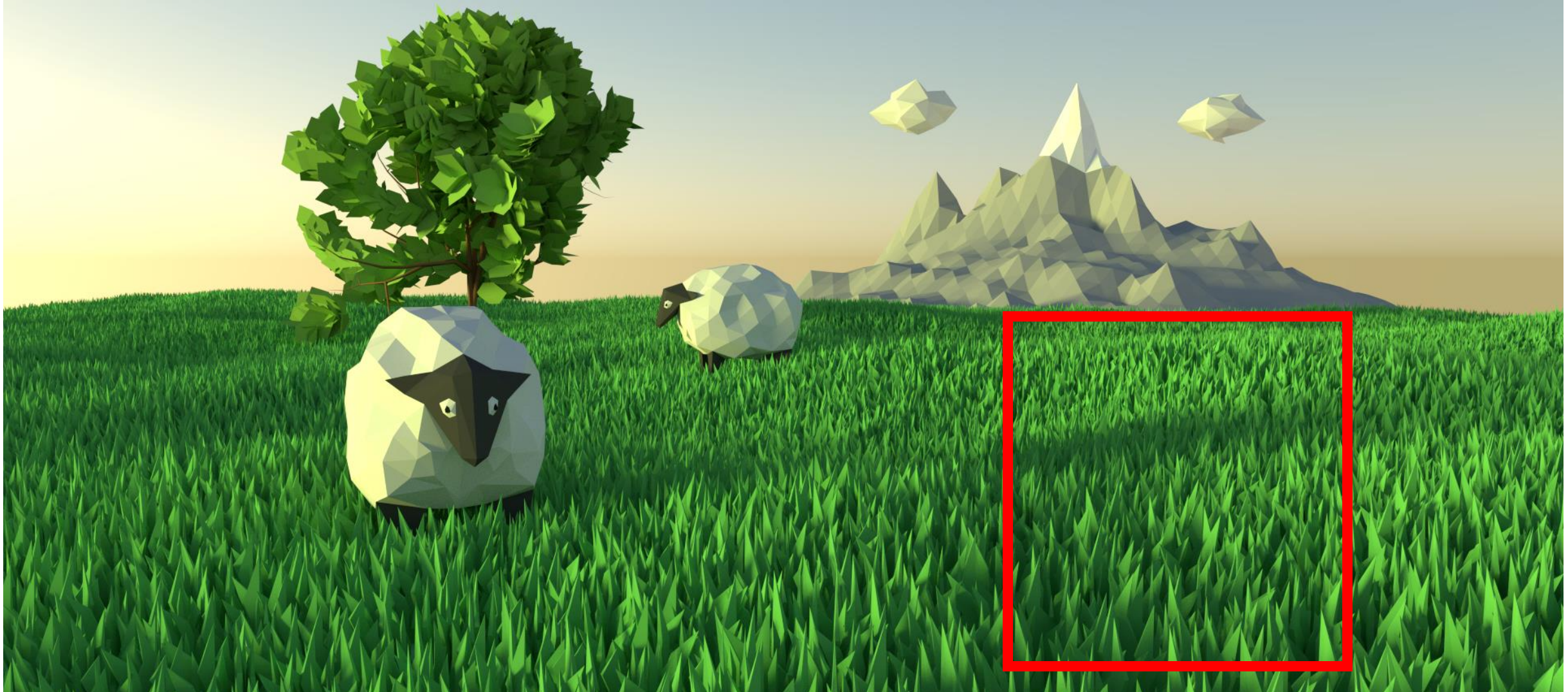
Depth Cues in Images and Displays



Depth Cues in Images and Displays



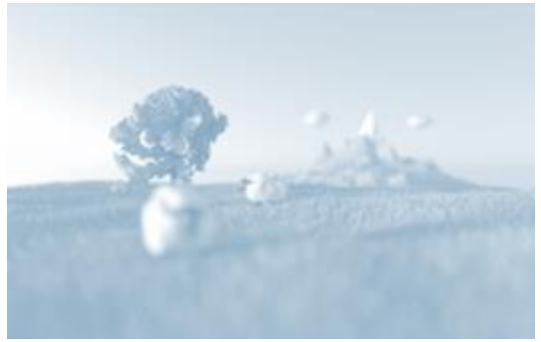
Depth Cues in Images and Displays

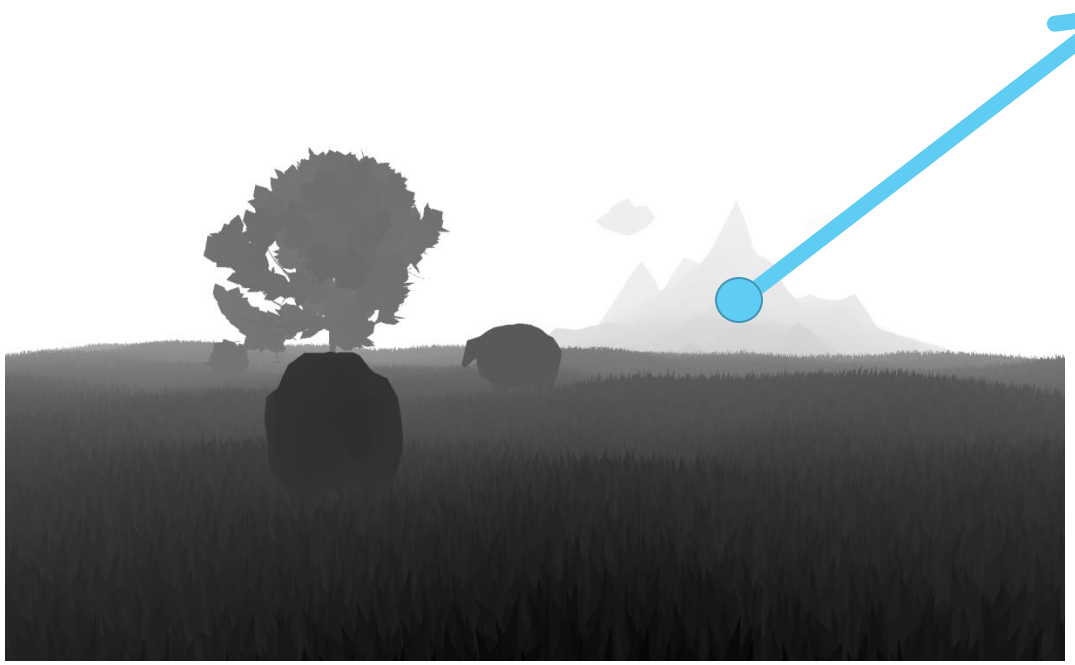


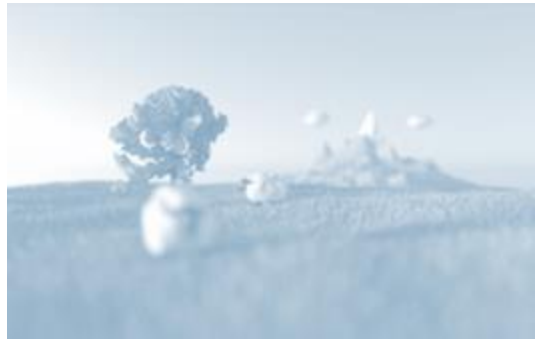
Depth Cues in Images and Displays

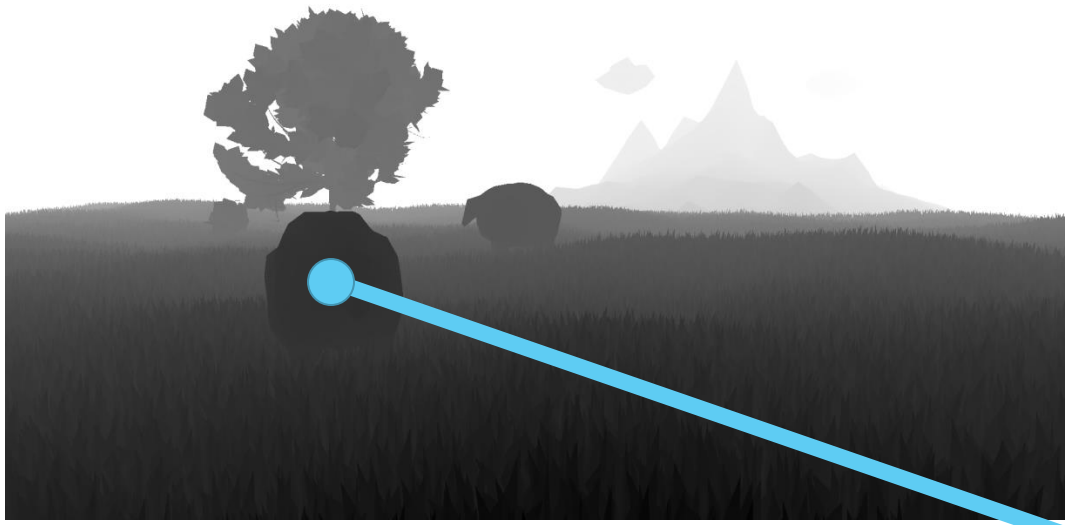
- Blur for depth perception
  - Known to influence perception of size and depth

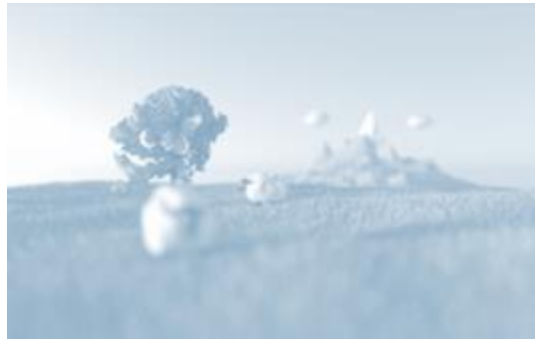
Simulating the eye's accommodation



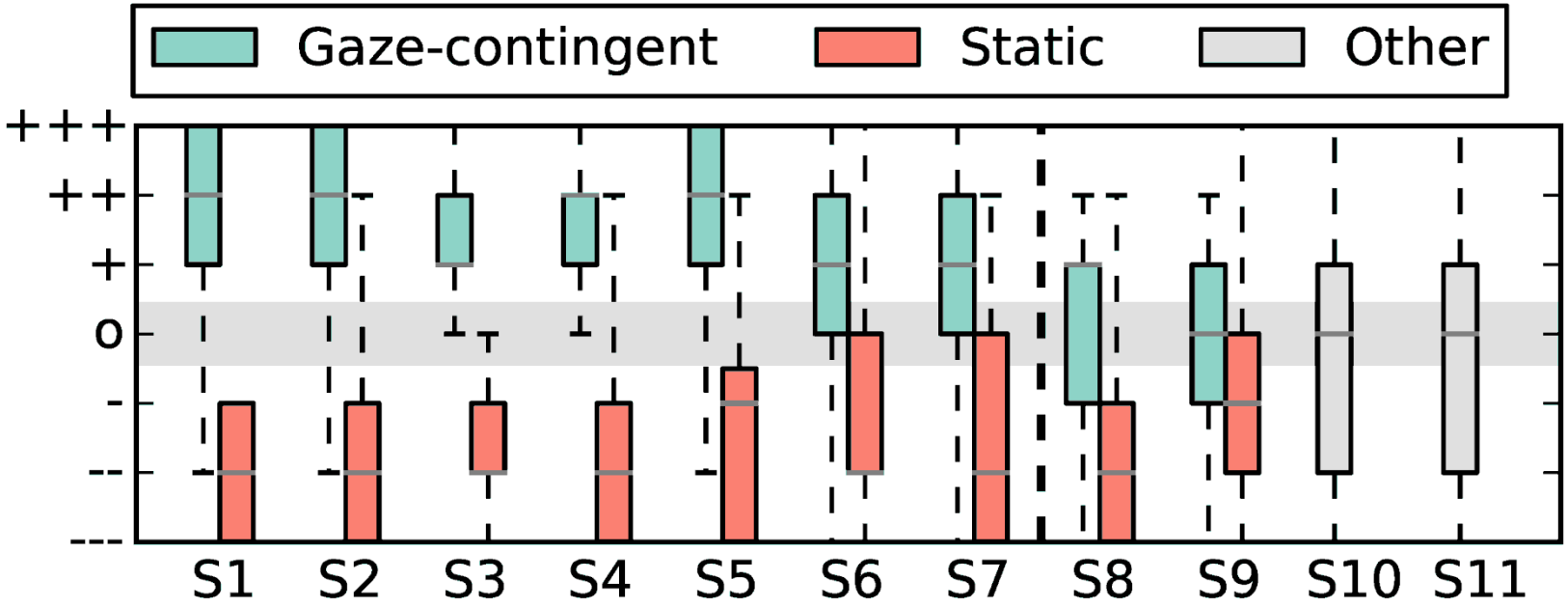






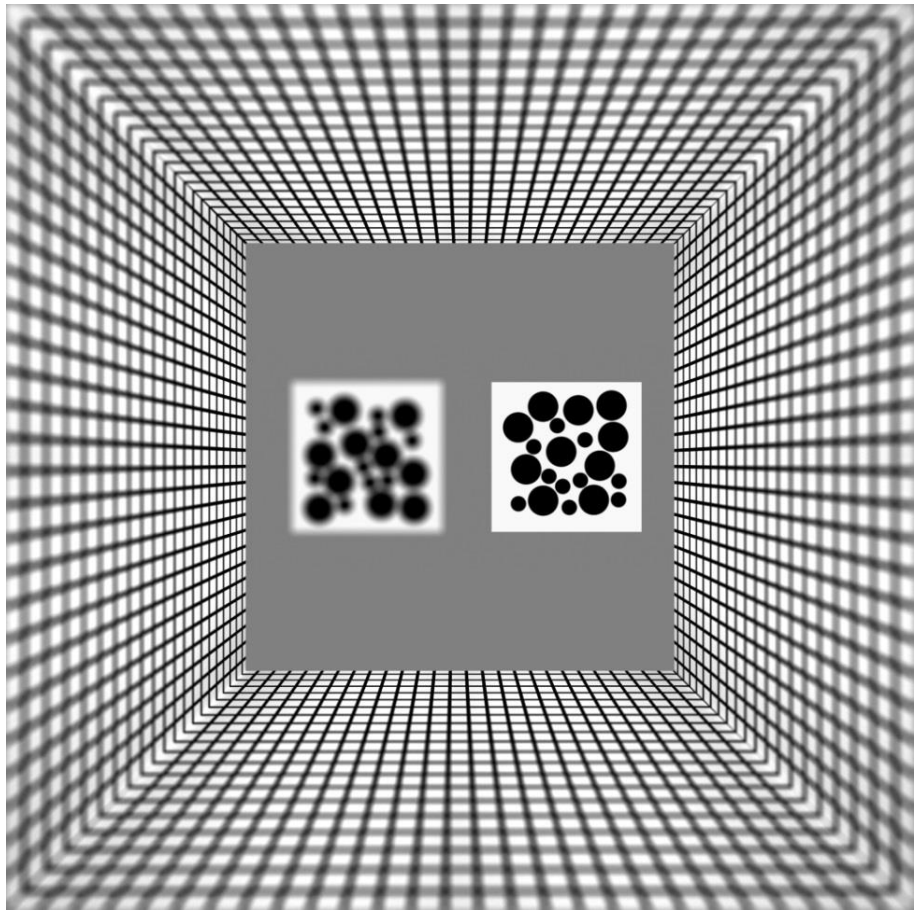


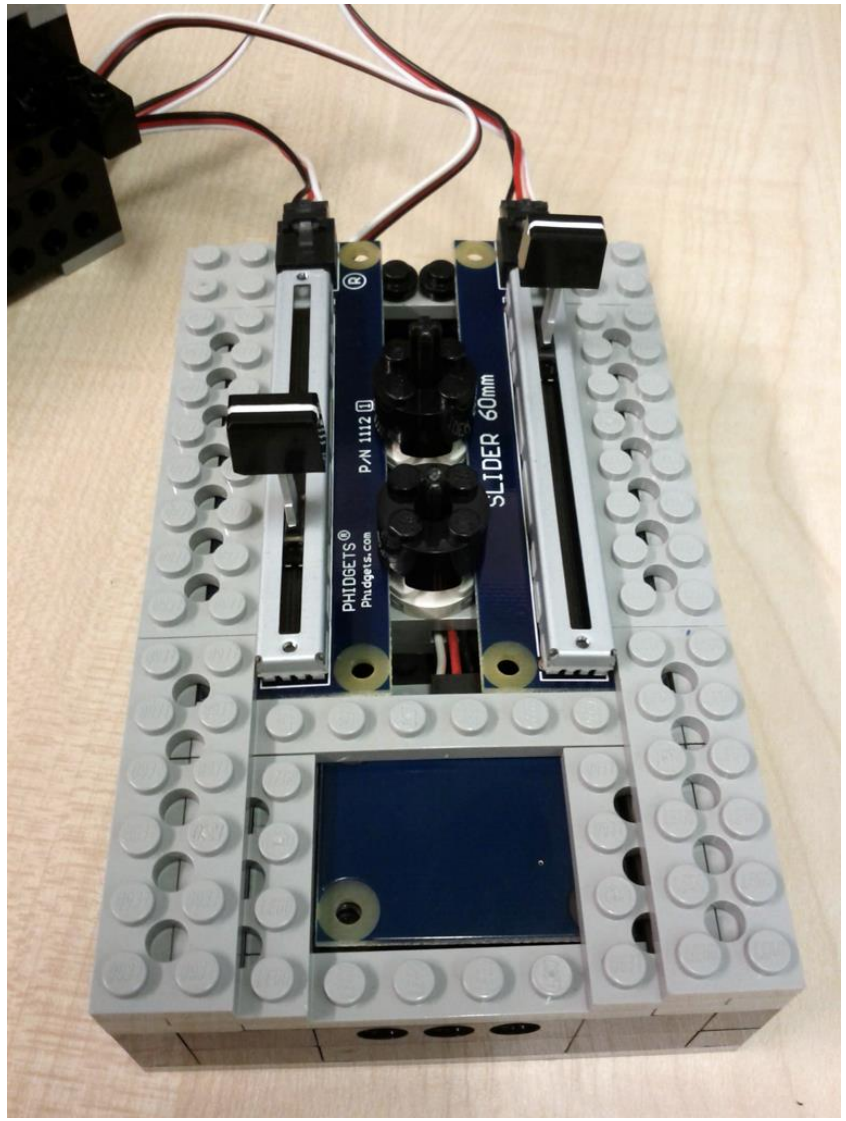
Experiment 1 - Results

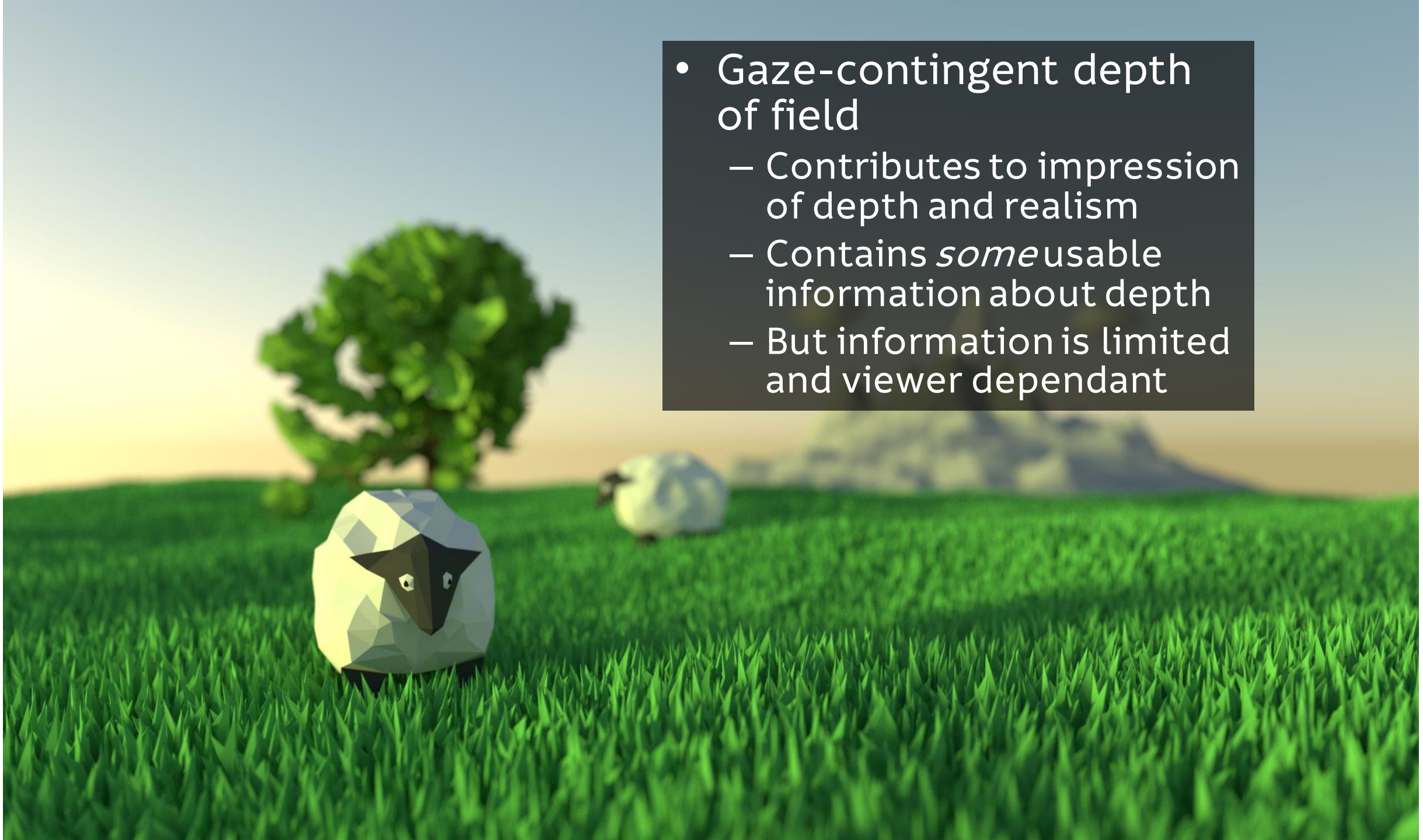


- Significant distinction between conditions in non-catch trials (S1-S7)
- No distinction in catch trials (S8-S11)

Experiment 2 - Description






• Gaze-contingent depth of field
– Contributes to impression of depth and realism
– Contains *some* usable information about depth
– But information is limited and viewer dependant

GaZeR Application

- Open Source, downloadable

- Tobii EyeX

  +

- Lytro Images

GAZER

Application to view gaze-contingent images, e.g., images with variable depth-of-field created from Lytro images.

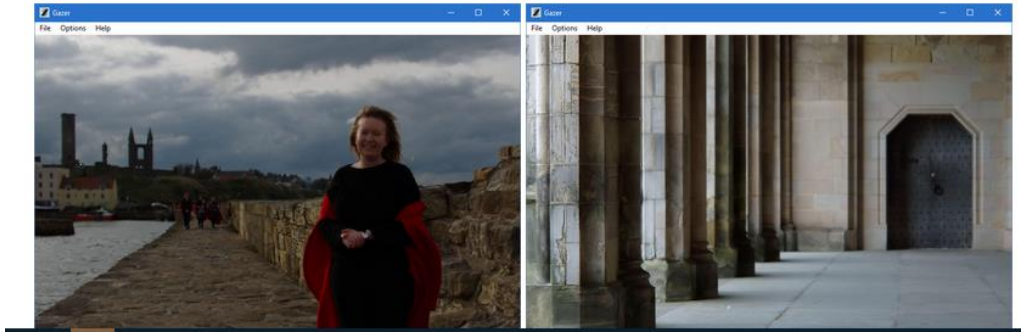
Features

- support for Tobii EyeX eye tracker
- importer for Lytro ILLUM images.
- Saving and loading of optimised custom file format that allows easy sharing of images with gaze-contingent depth-of-field.
- export and import of Image Stacks (combination of DOF slices and a depth map)

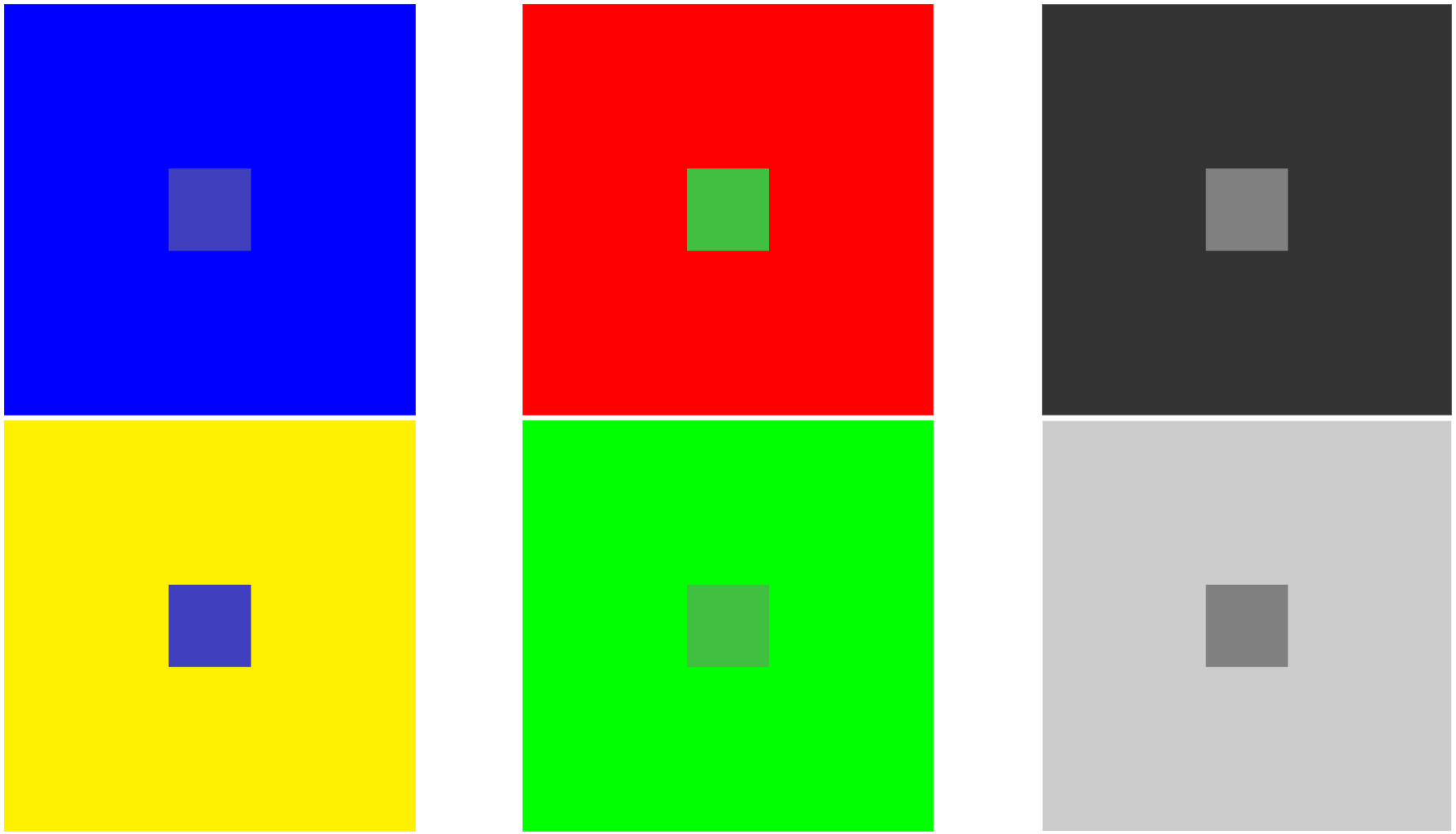
Usage

Running the UI from source requires the requirements described in the requirements.txt and the location of the Tobii.EyeX.Client.dll to be specified in the EYEX_LIB_PATH environment variable or be in the working dir the script is started from. We recommend setting it to '../lib' and putting the dll into the corresponding top level lib folder.

Example Images



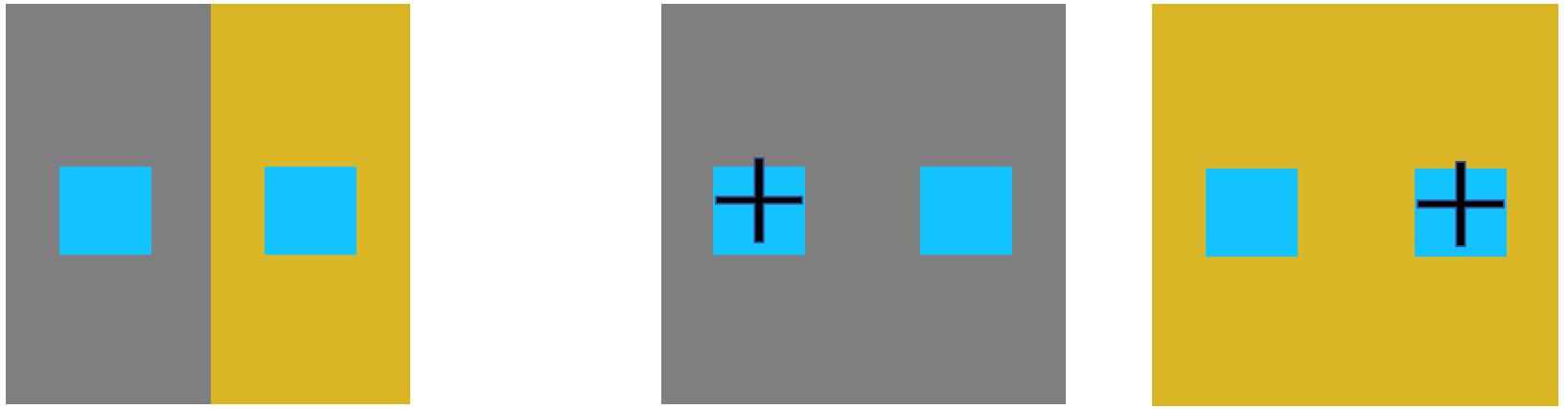
Gaze-dependent Gamut Expansion



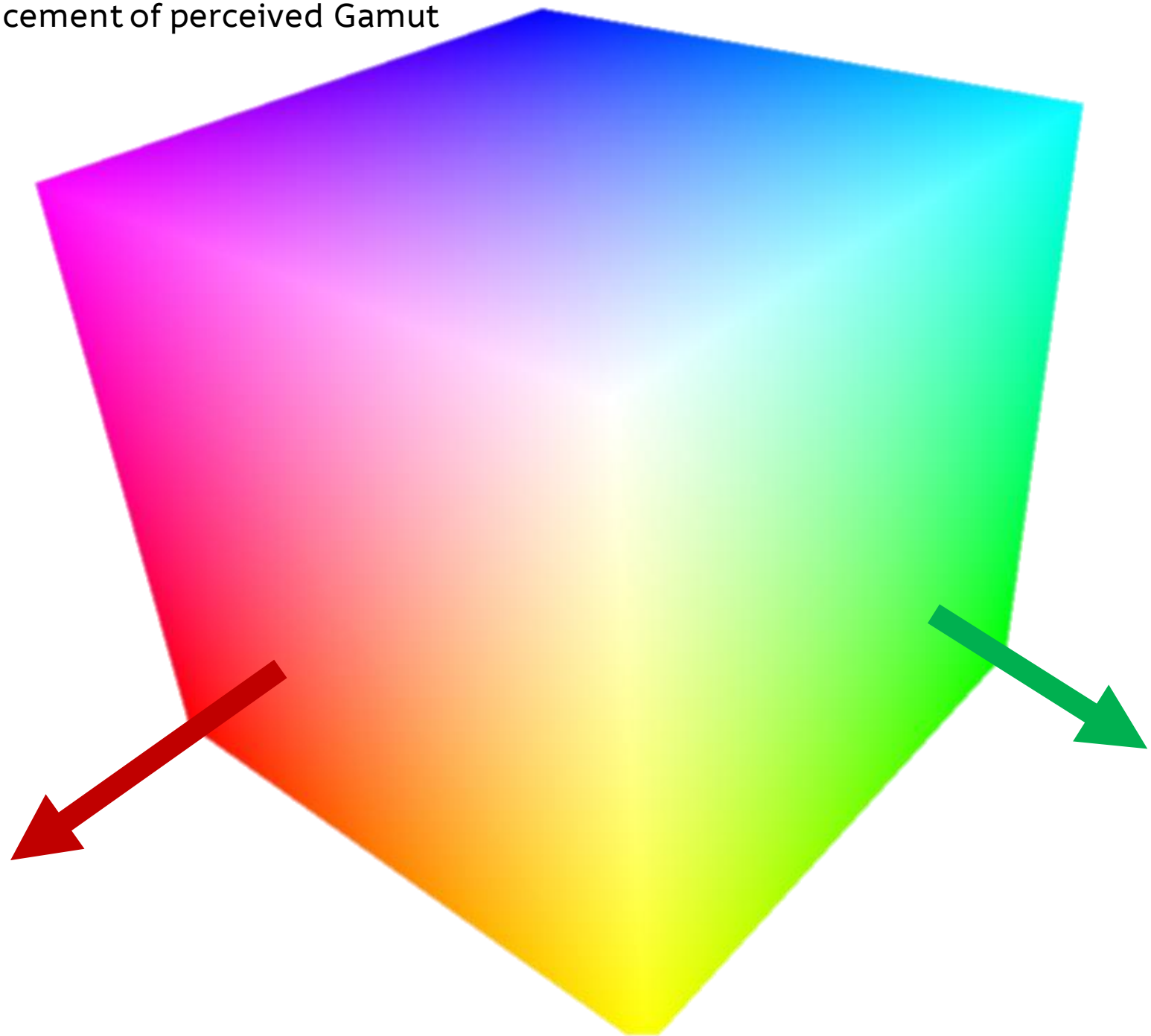
Can we use gaze-contingent simultaneous contrast ?

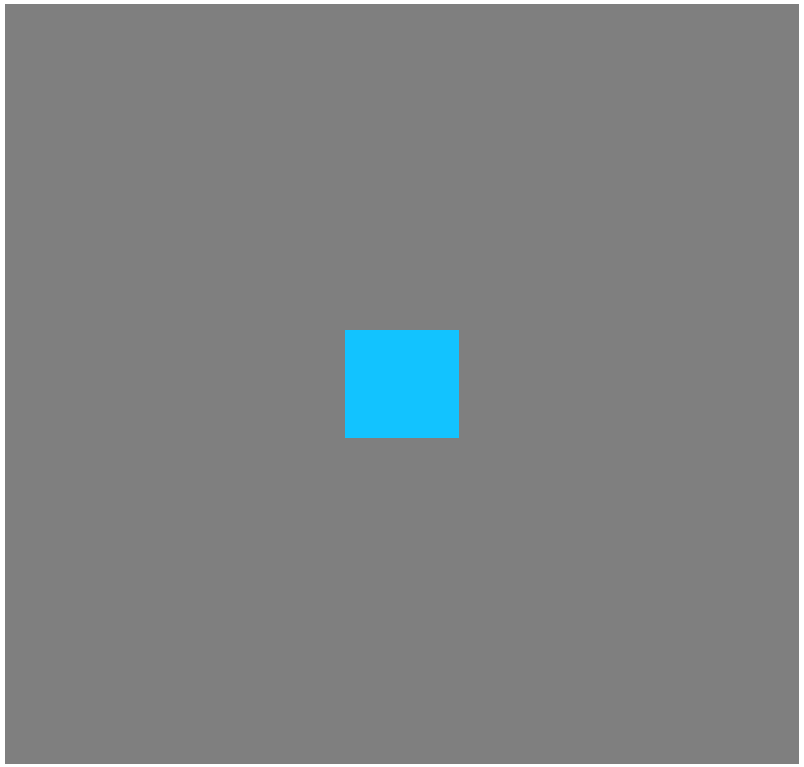
Can we use this to enhance the ability to discriminate colors?

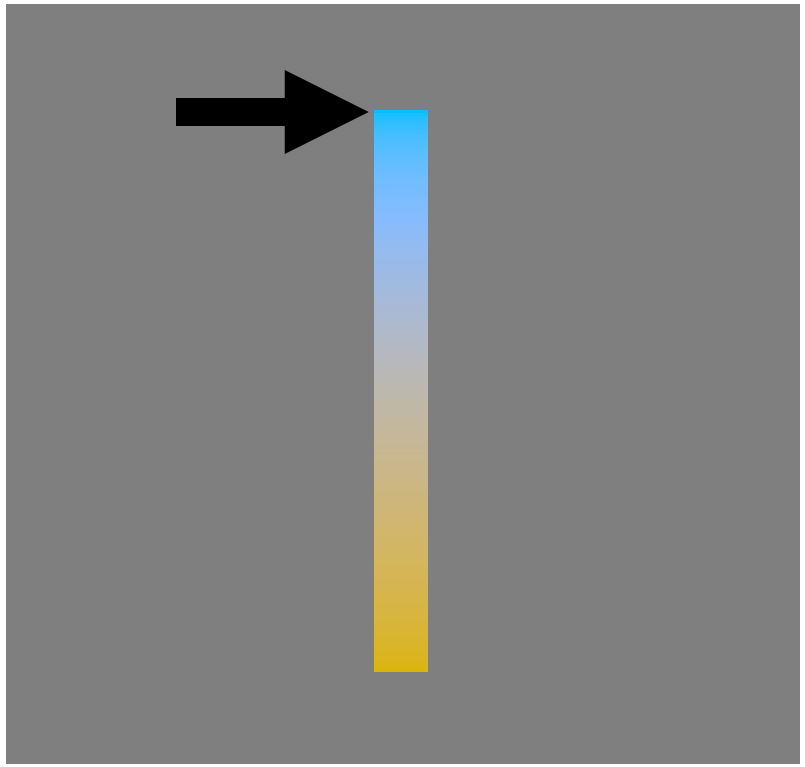
Experiment 1 - Stimuli

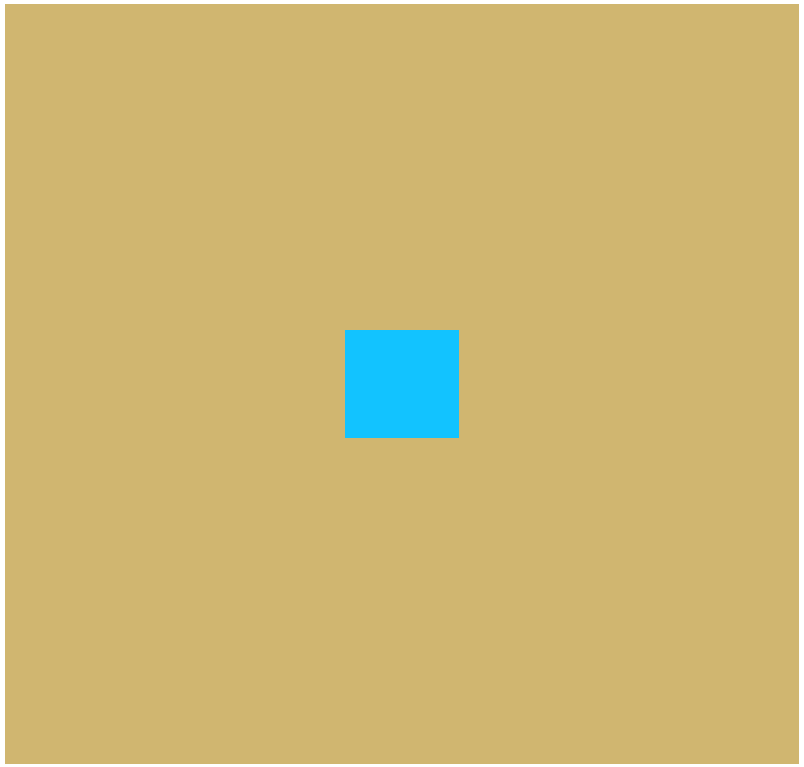


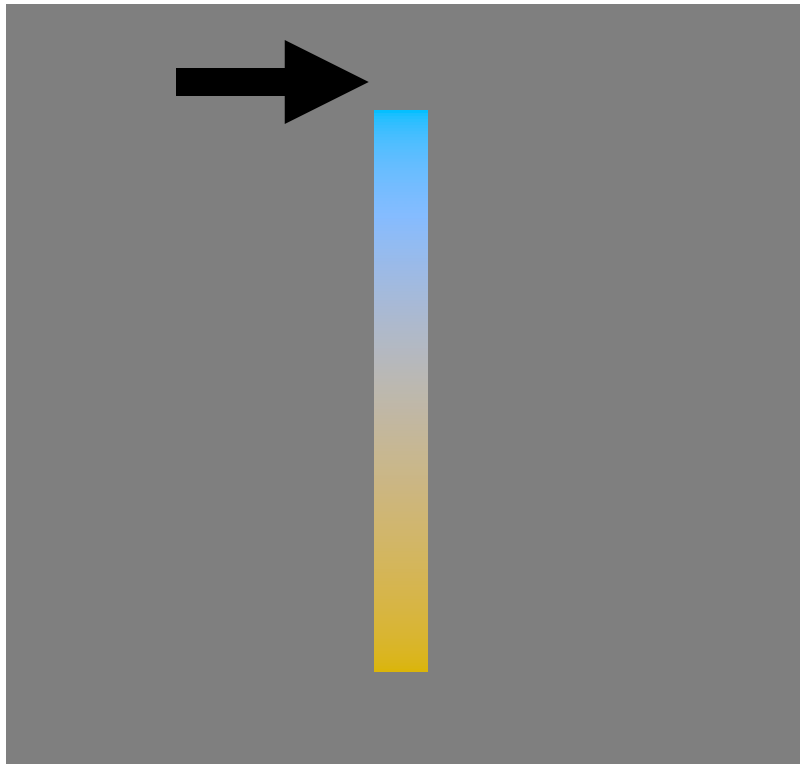
Non-hardware enhancement of perceived Gamut

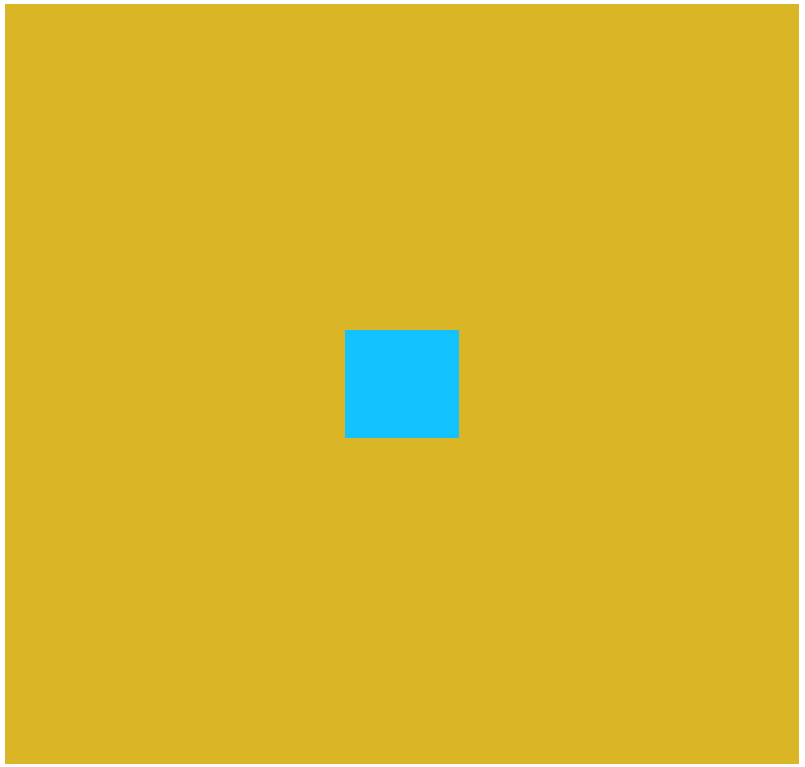


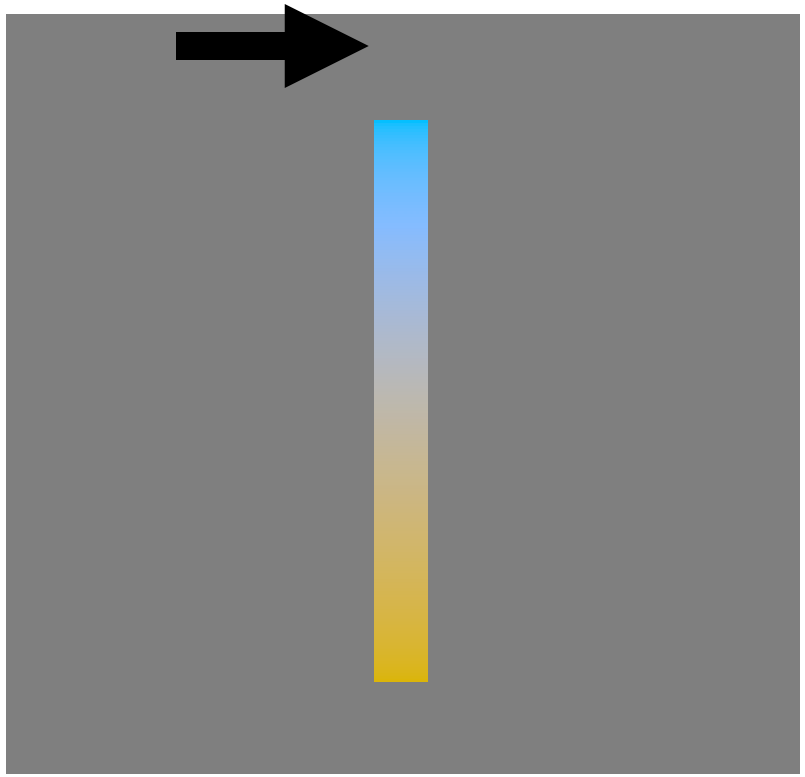












Can we use gaze-contingent simultaneous contrast ? ✓

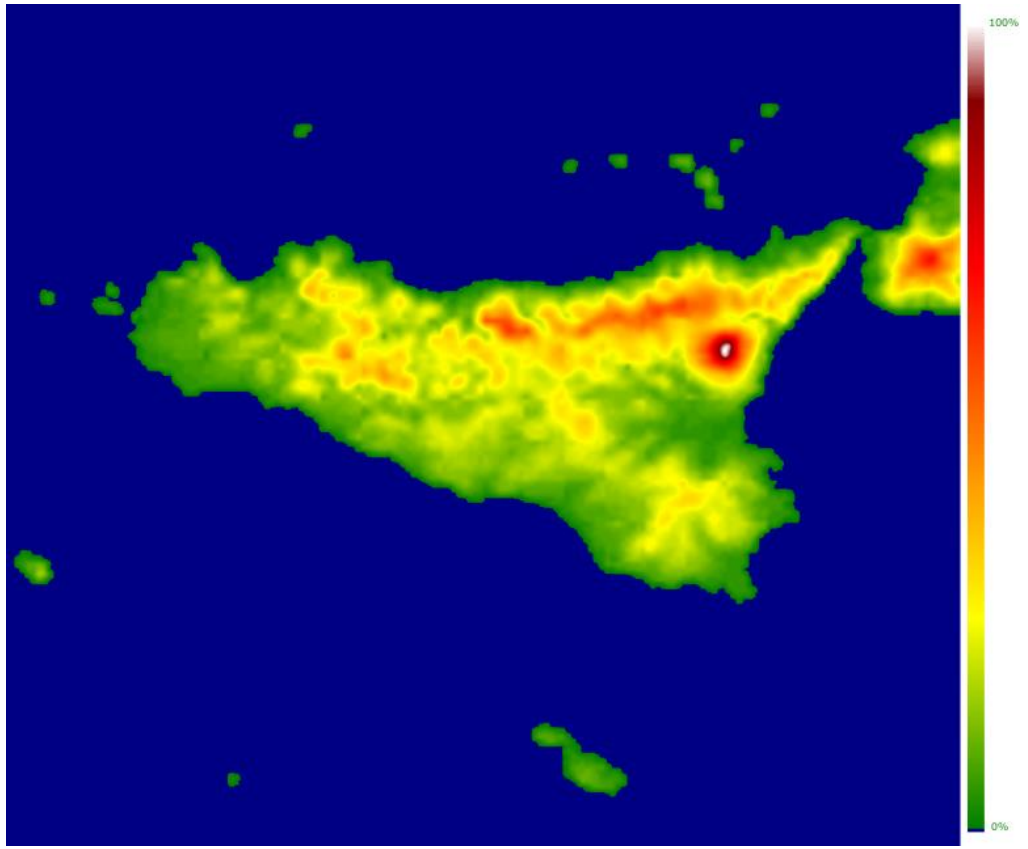
Can we use this to enhance the ability to discriminate colors? ✓

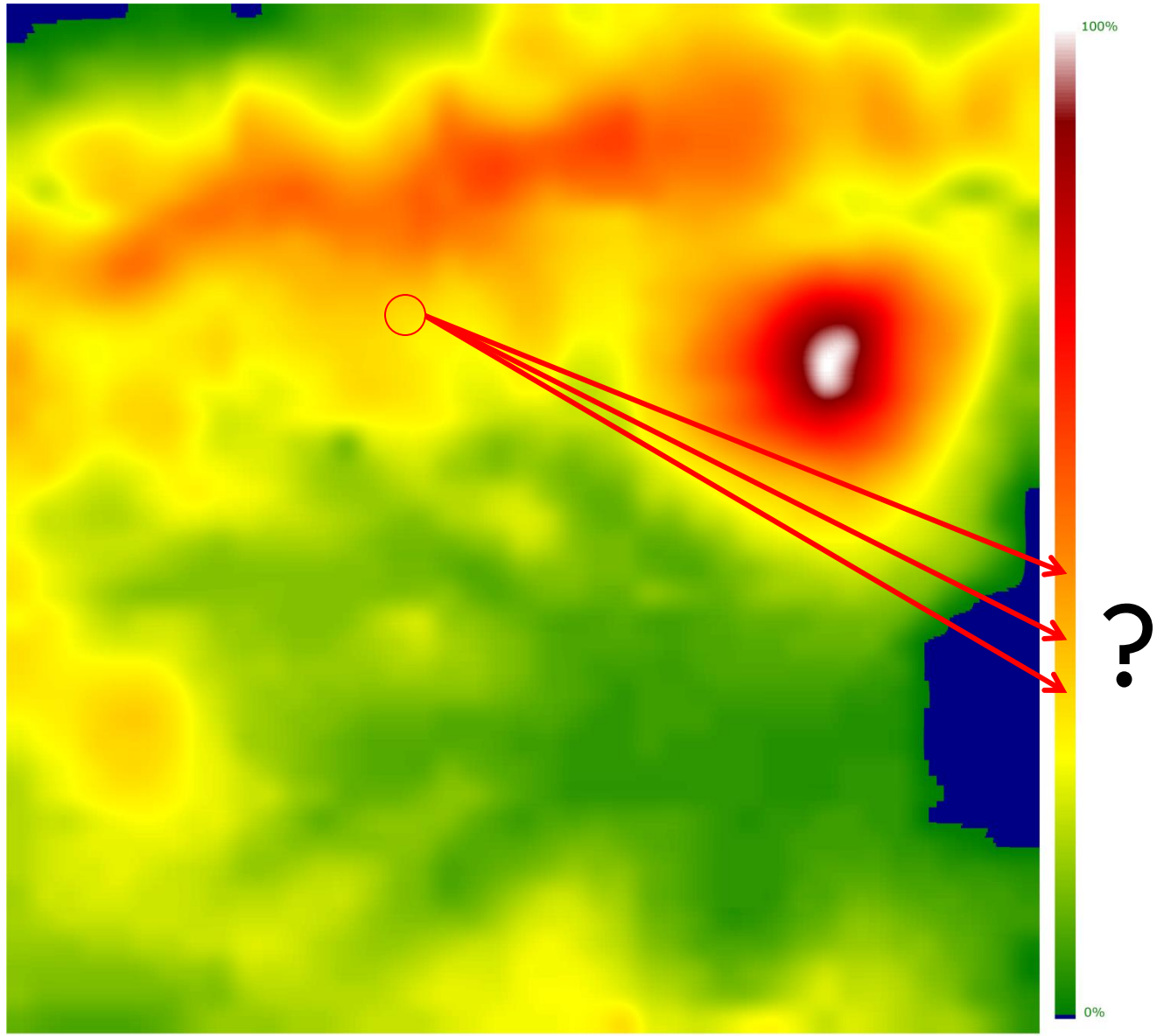
But it is tricky…

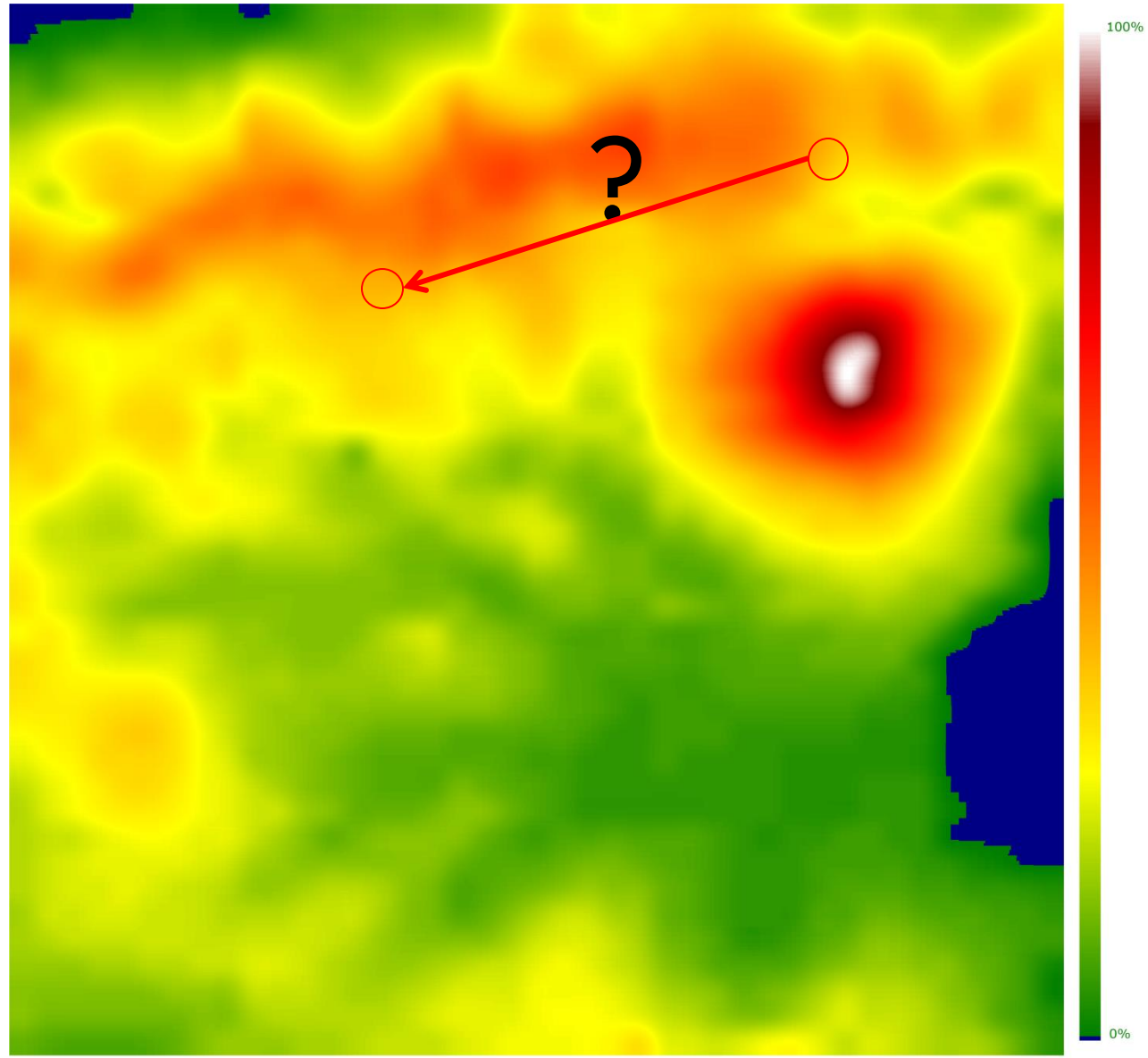
FatFonts

Representation in Visualization

47	62	74	85	92	94
34	49	64	77	87	93
22	37	53	68	80	90
13	27	43	58	72	83
7	18	33	48	62	74
4	12	24	38	51	63
4	8	17	28	39	50
5	5	11	20	28	37
8	5	8	13	19	25
11	7	7	10	13	16
16	10	9	10	10	10
22	16	14	14	12	9
29	24	22	22	18	13




100%
0%
?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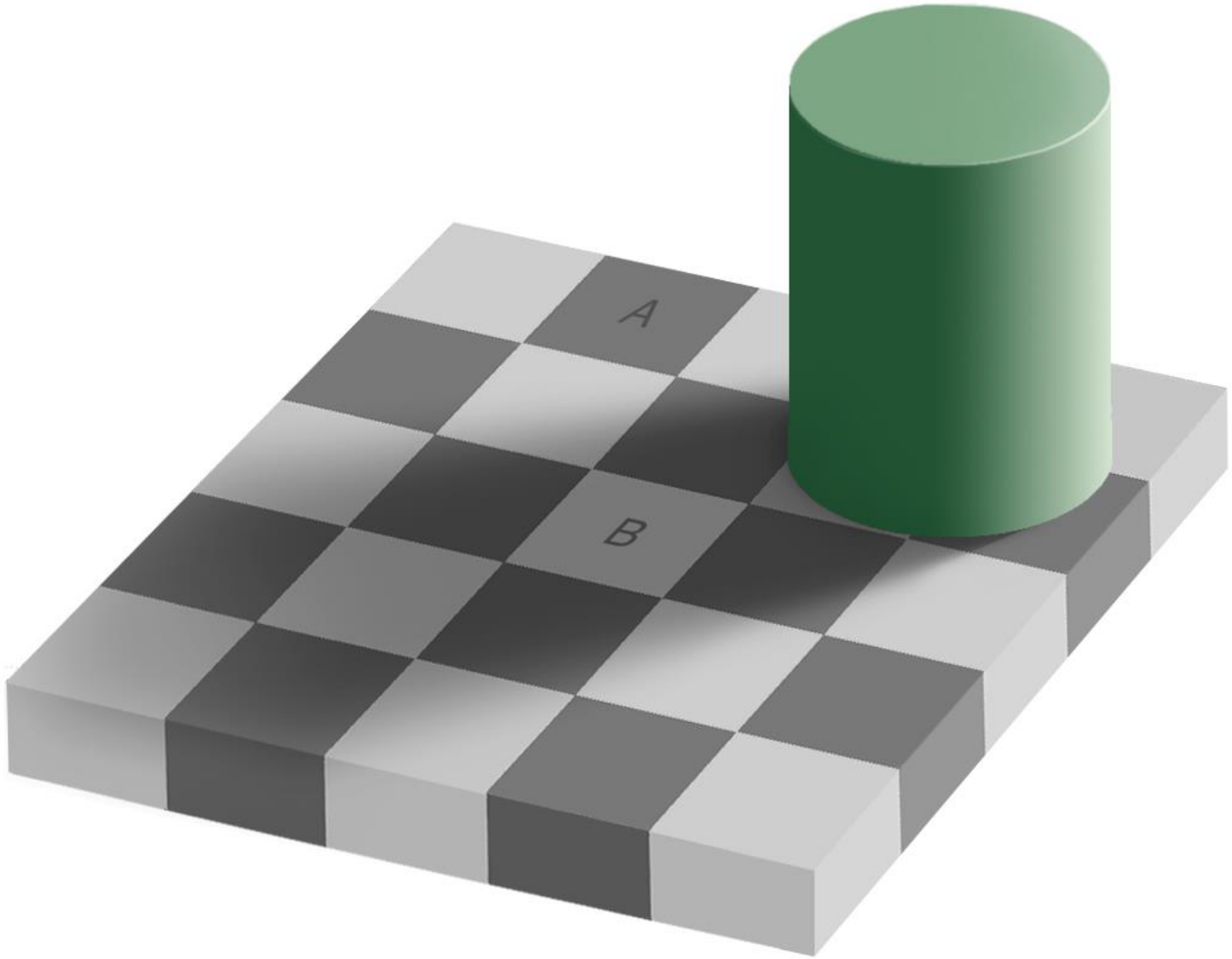
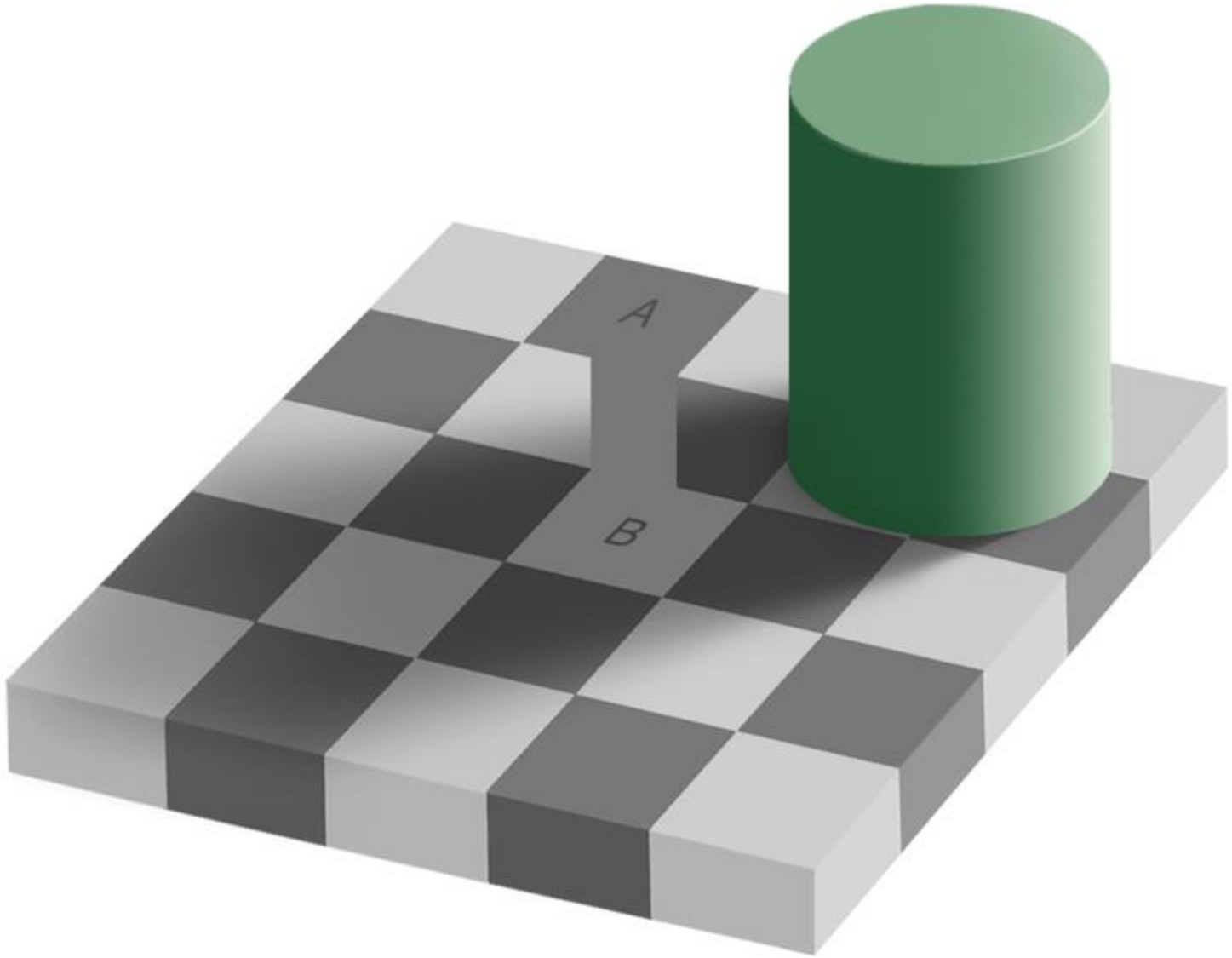


http://en.wikipedia.org/wiki/File:Same_color_illusion_proof2.png



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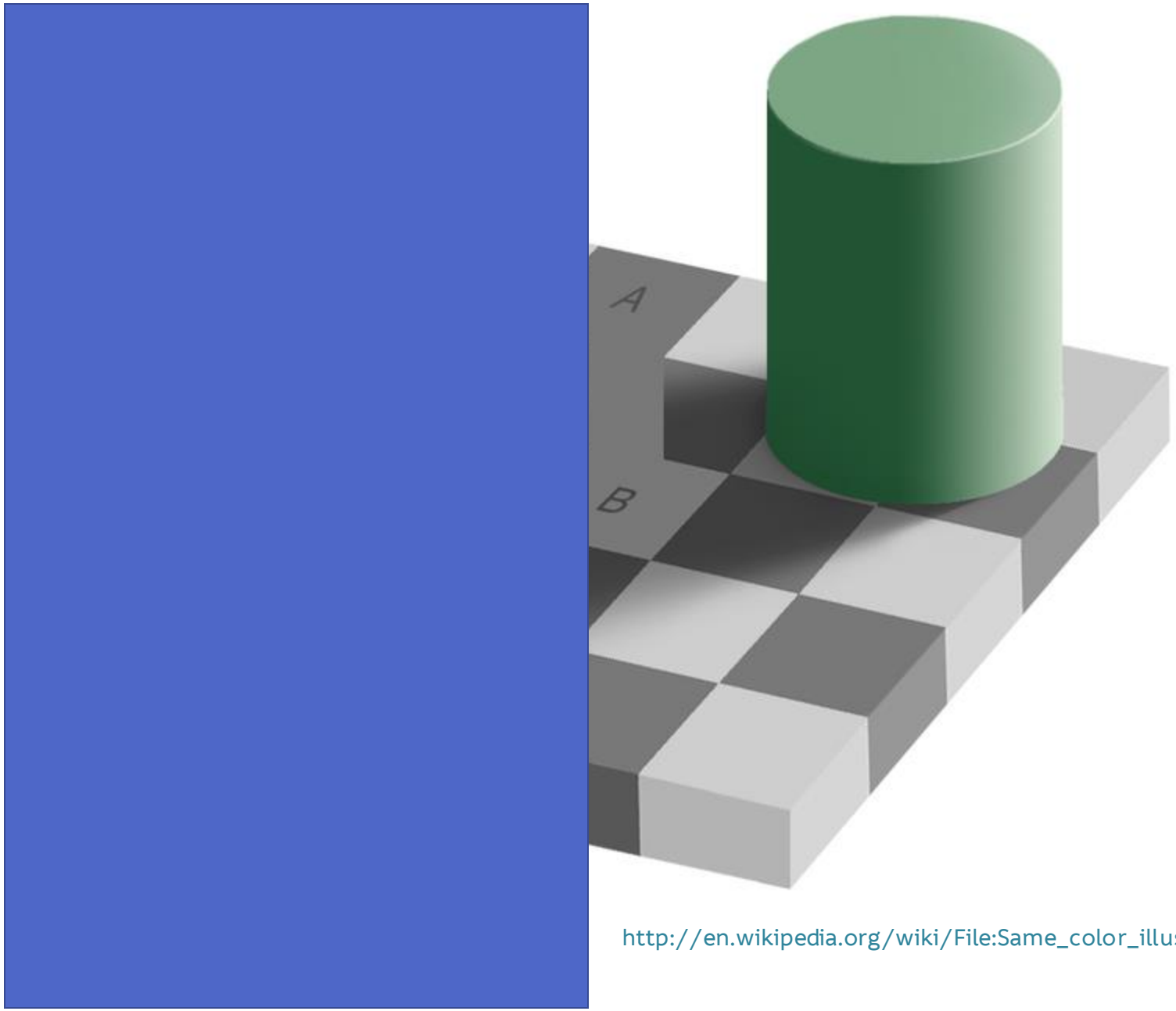
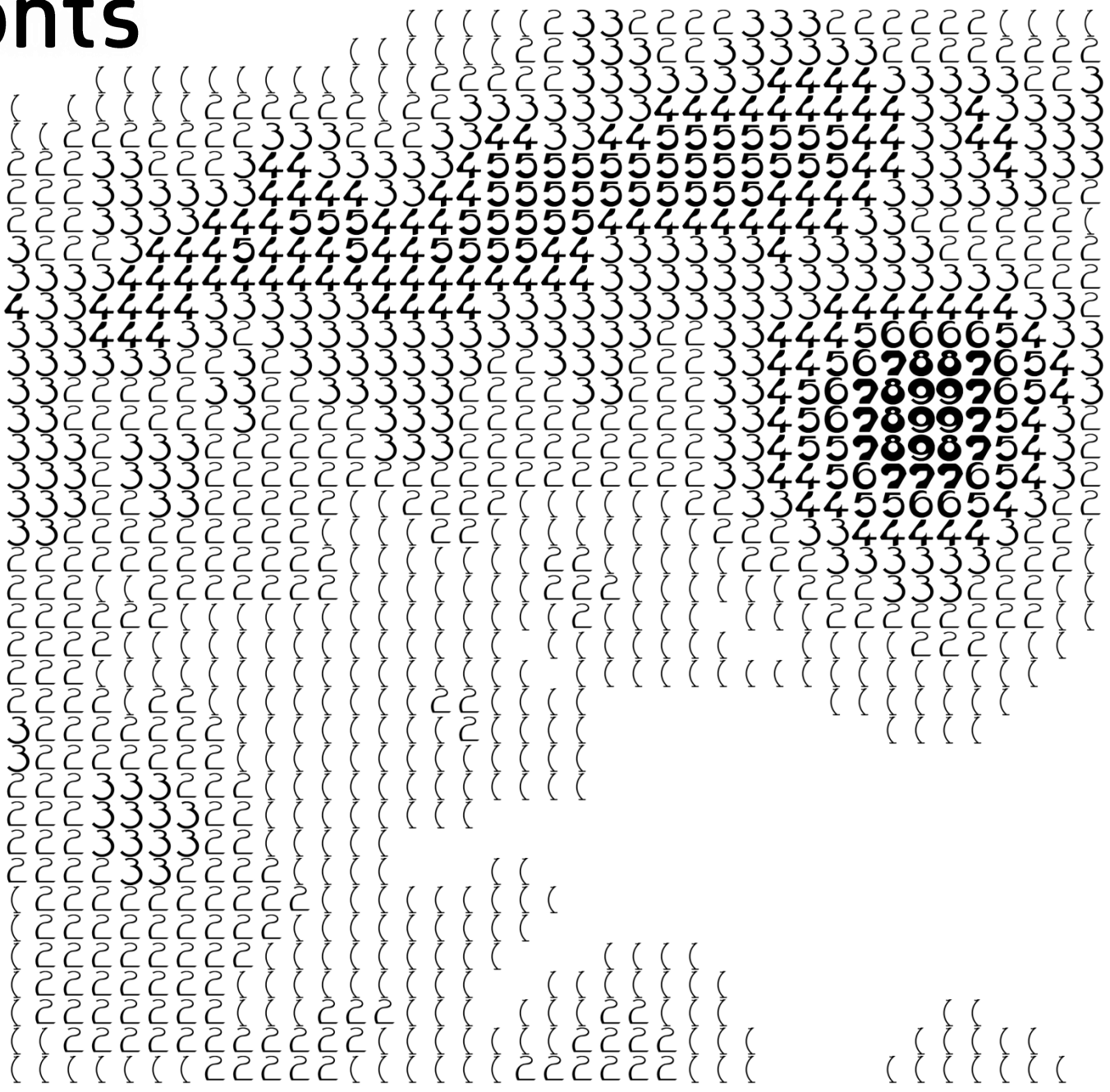


http://en.wikipedia.org/wiki/File:Same_color_illusion_proof2.png

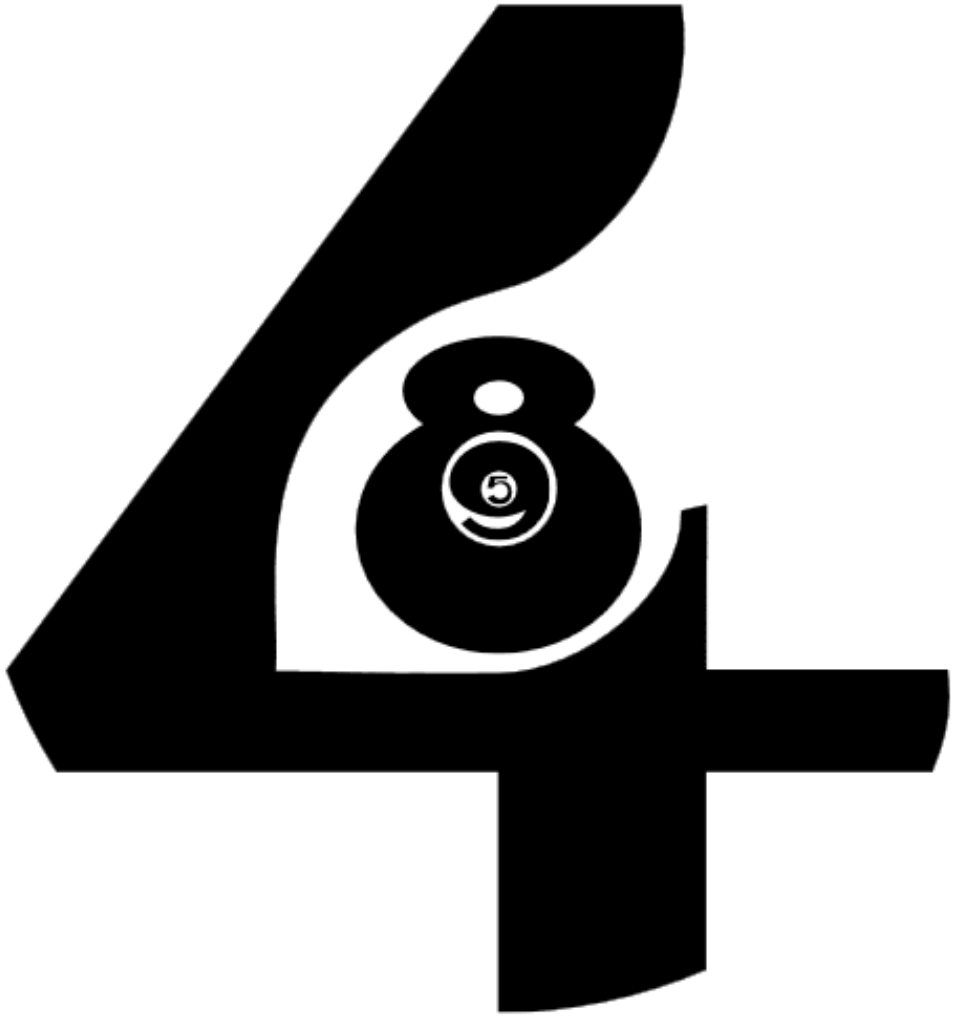
What are FatFonts?

FatFonts



FatFonts: How They Work

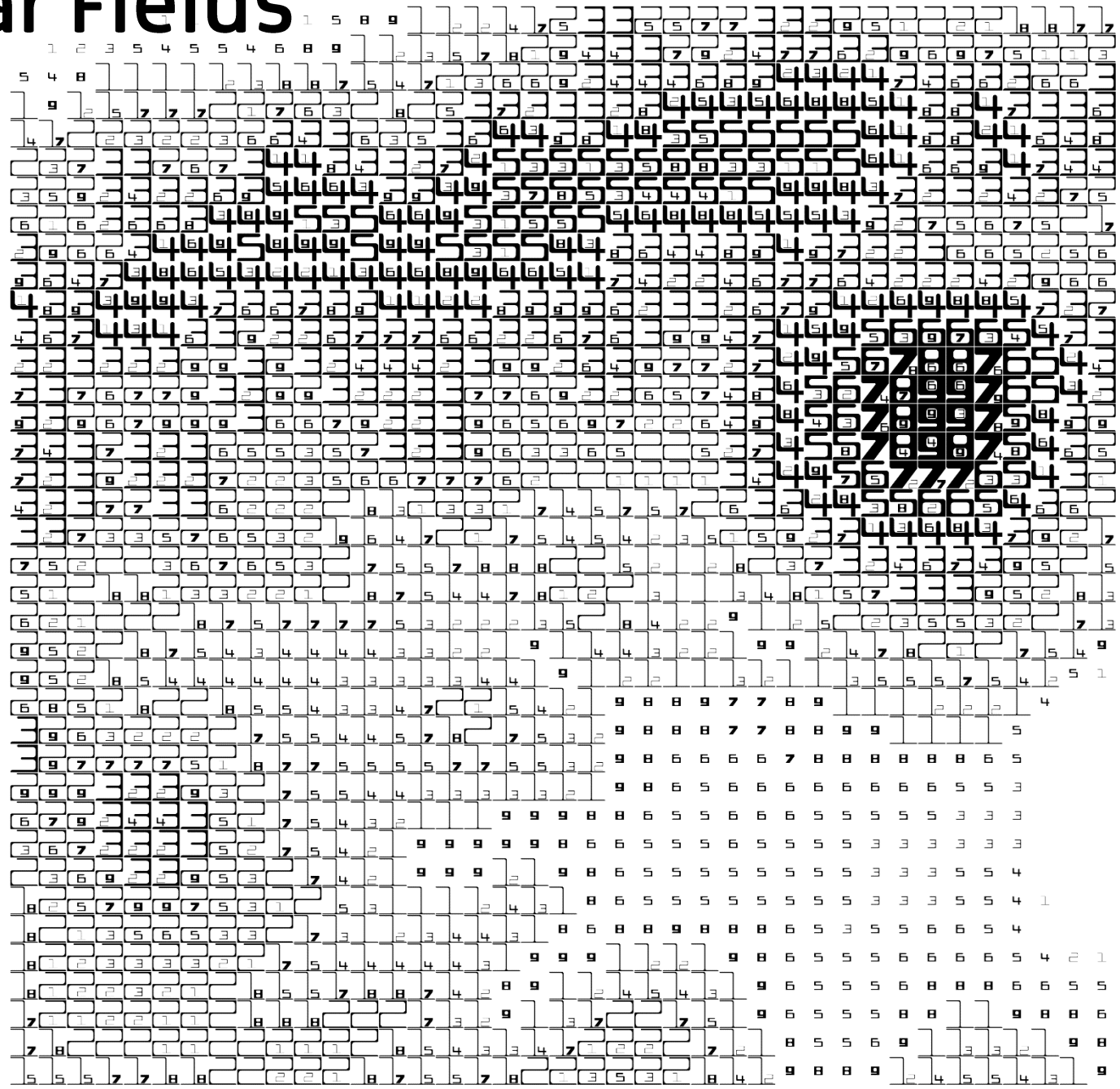
Nesting



FatFonts: How They Work

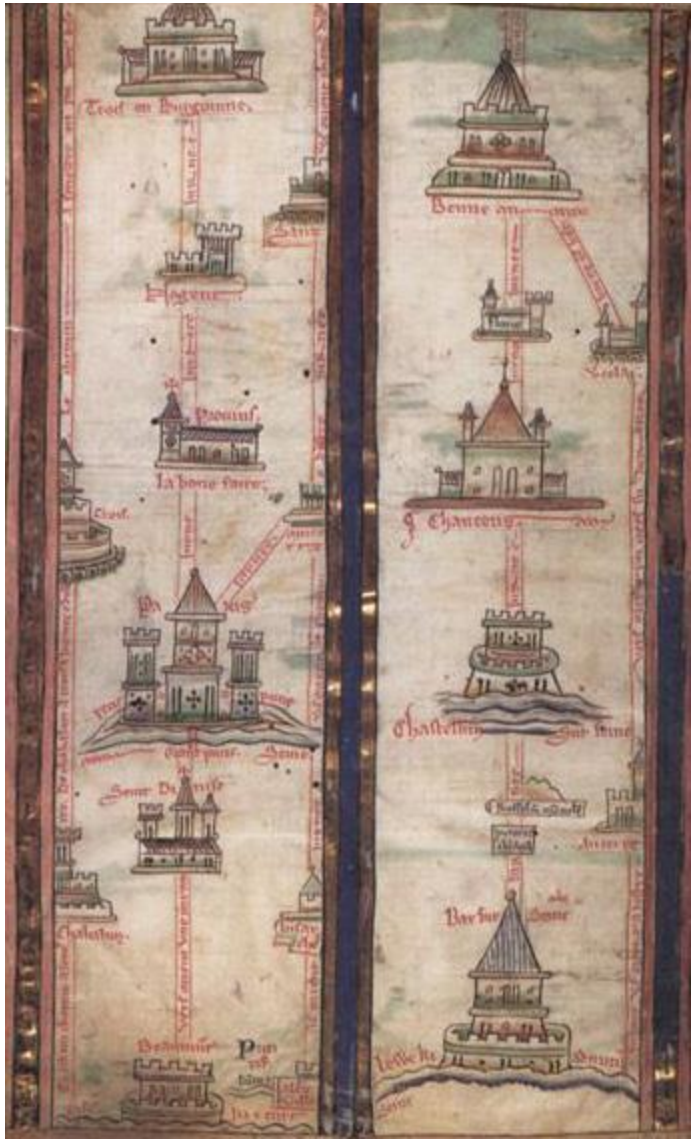
Nesting

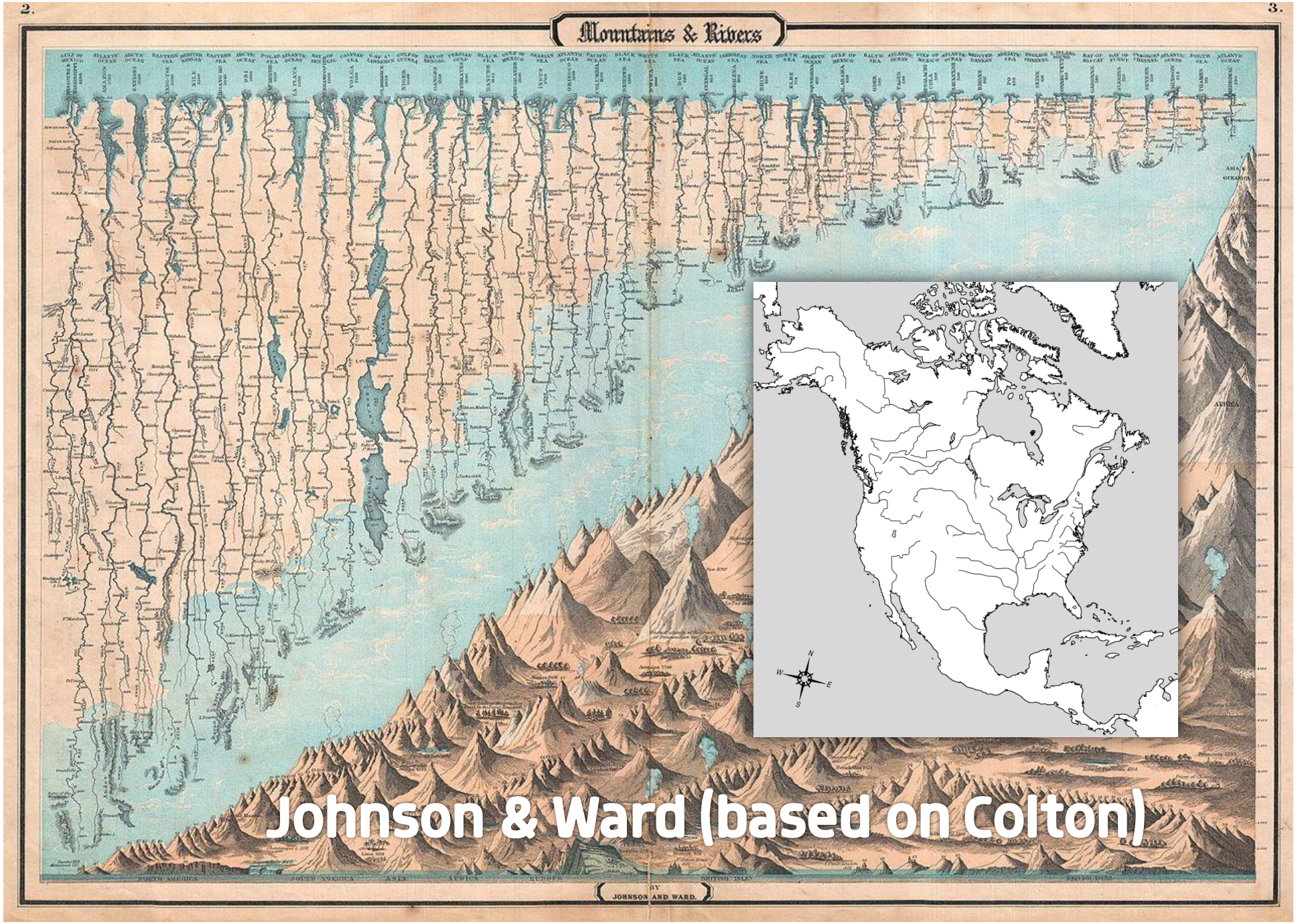
Scalar Fields



Transmogrifiers

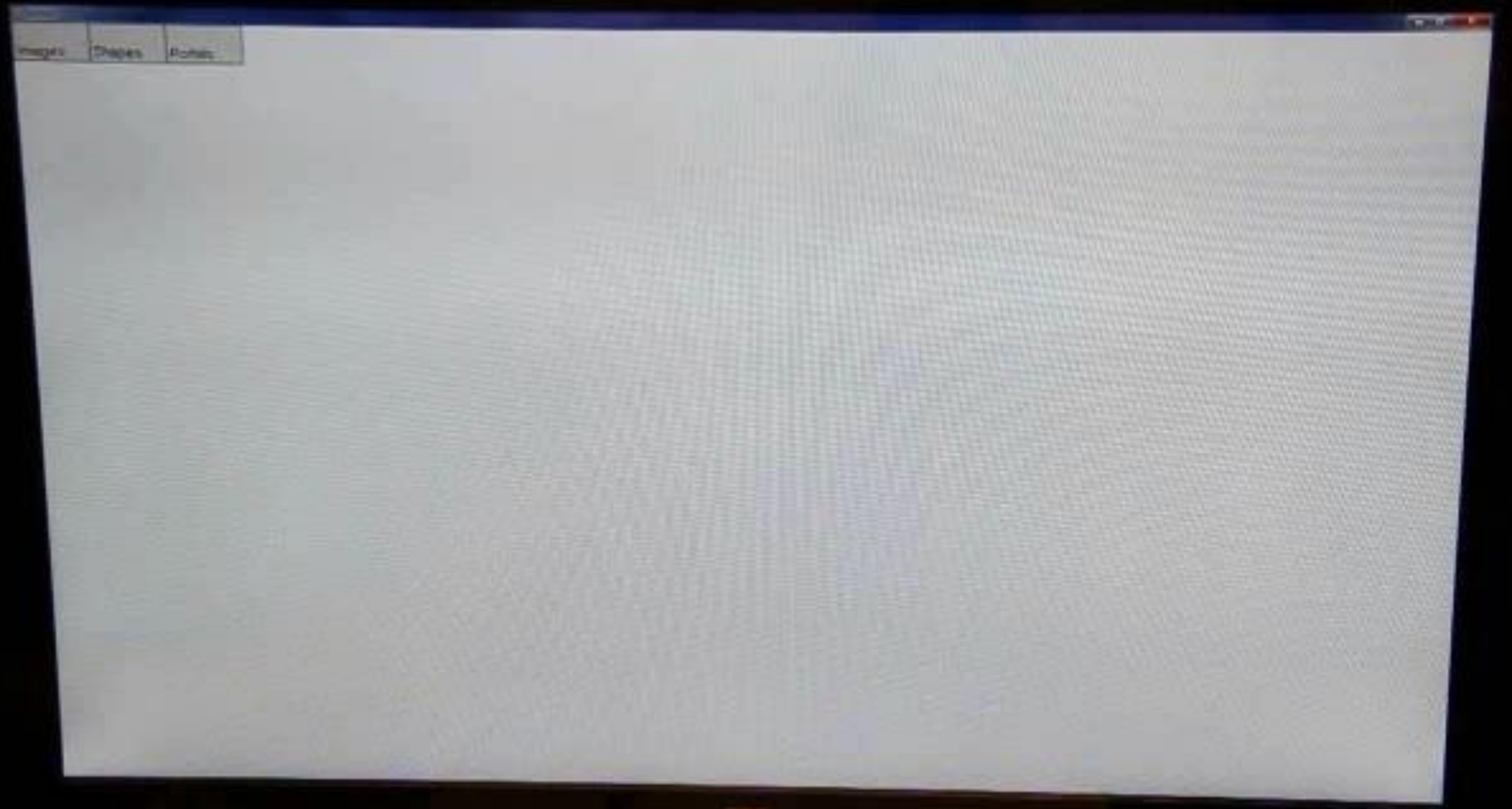
Matthew Paris

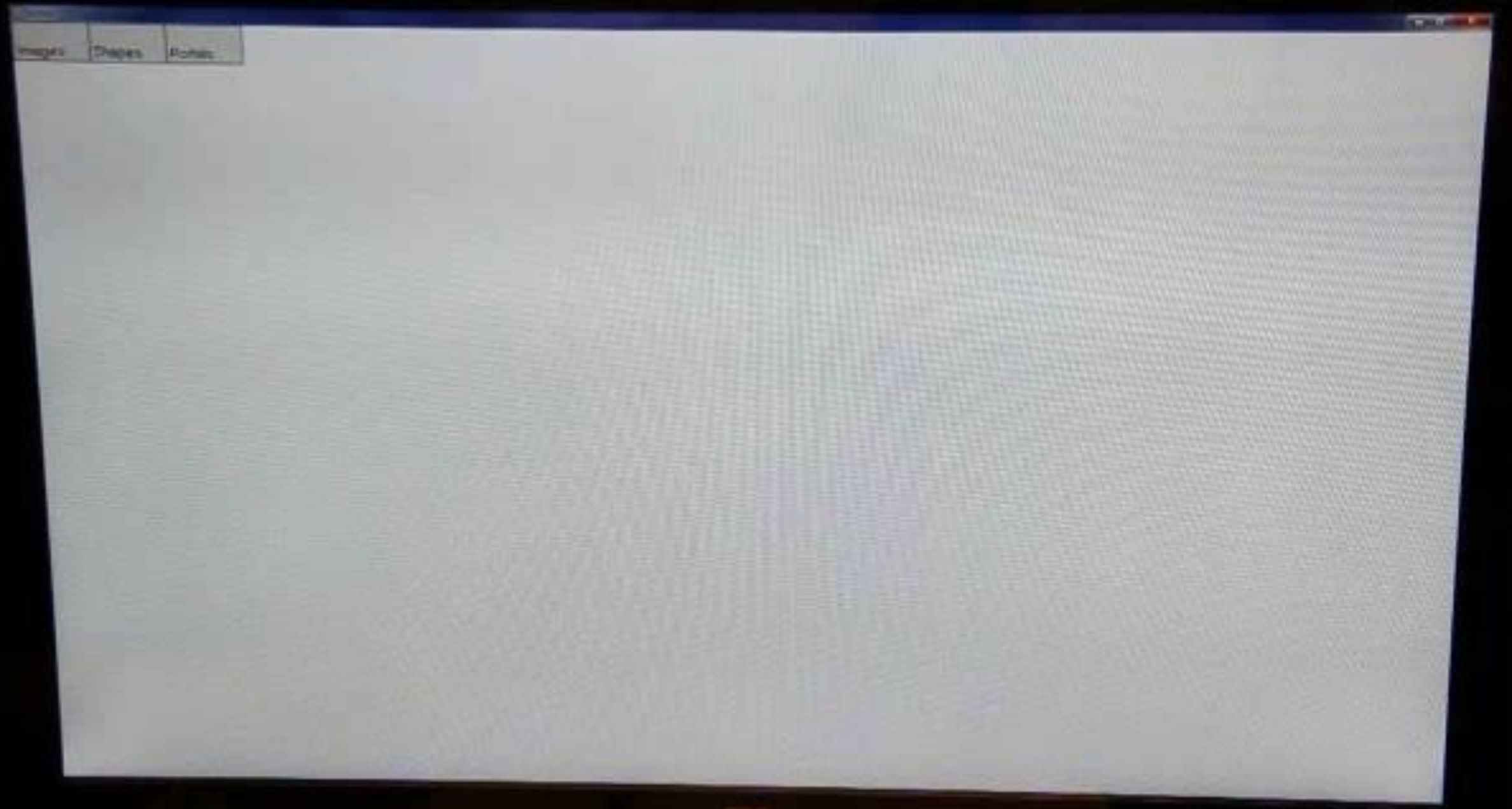



2.
3.
Mountains & Rivers
NORTH AMERICA
SOUTH AMERICA
ASIA
AFRICA
EUROPE
BRITISH ISLES
BY
JOHNSON AND WARD.
Johnson & Ward (based on Colton)

To Transmogrify

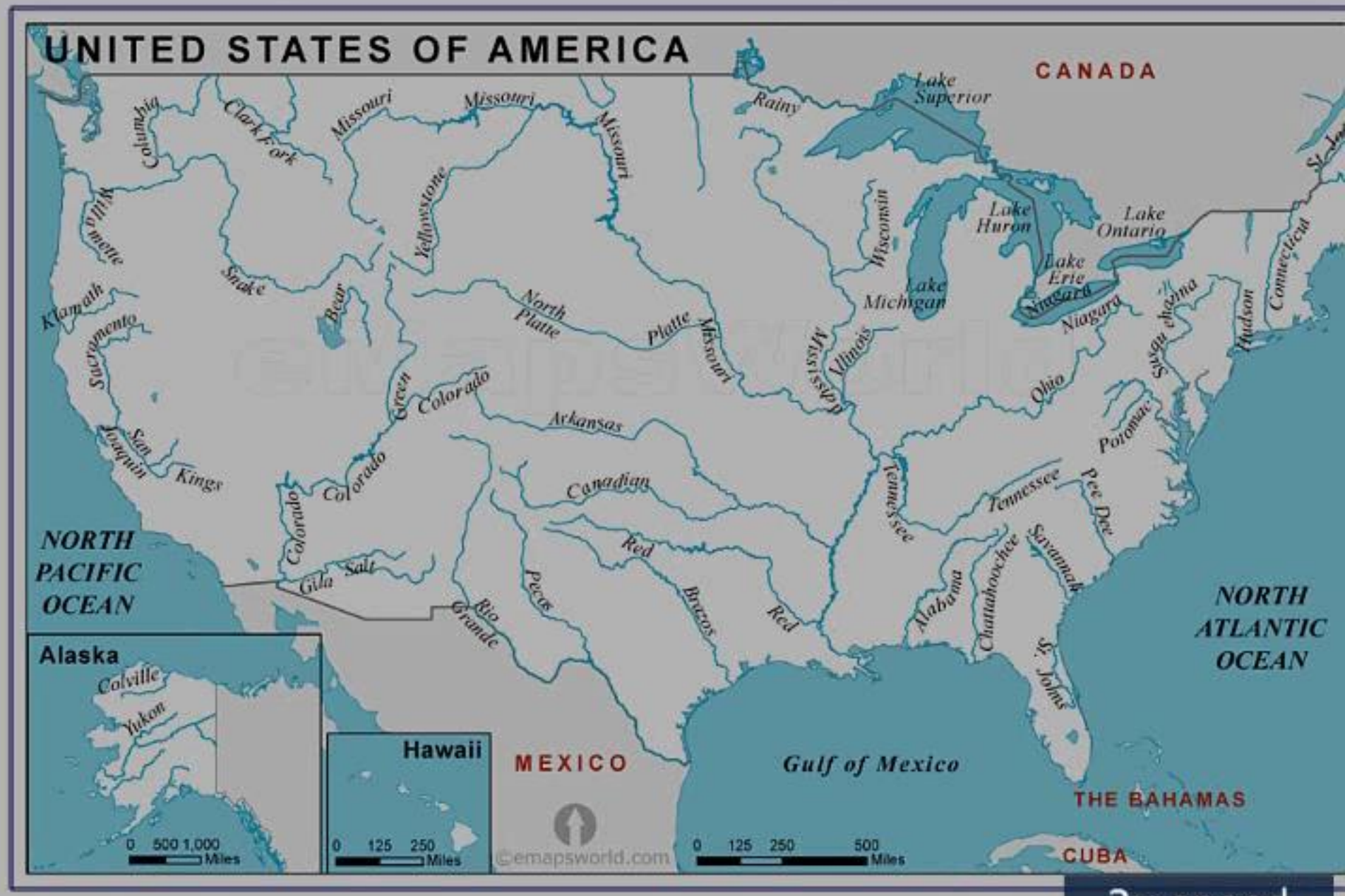
To transform in a magical way


Images
Shapes
Portals


Images
Shapes
Portals

Portals

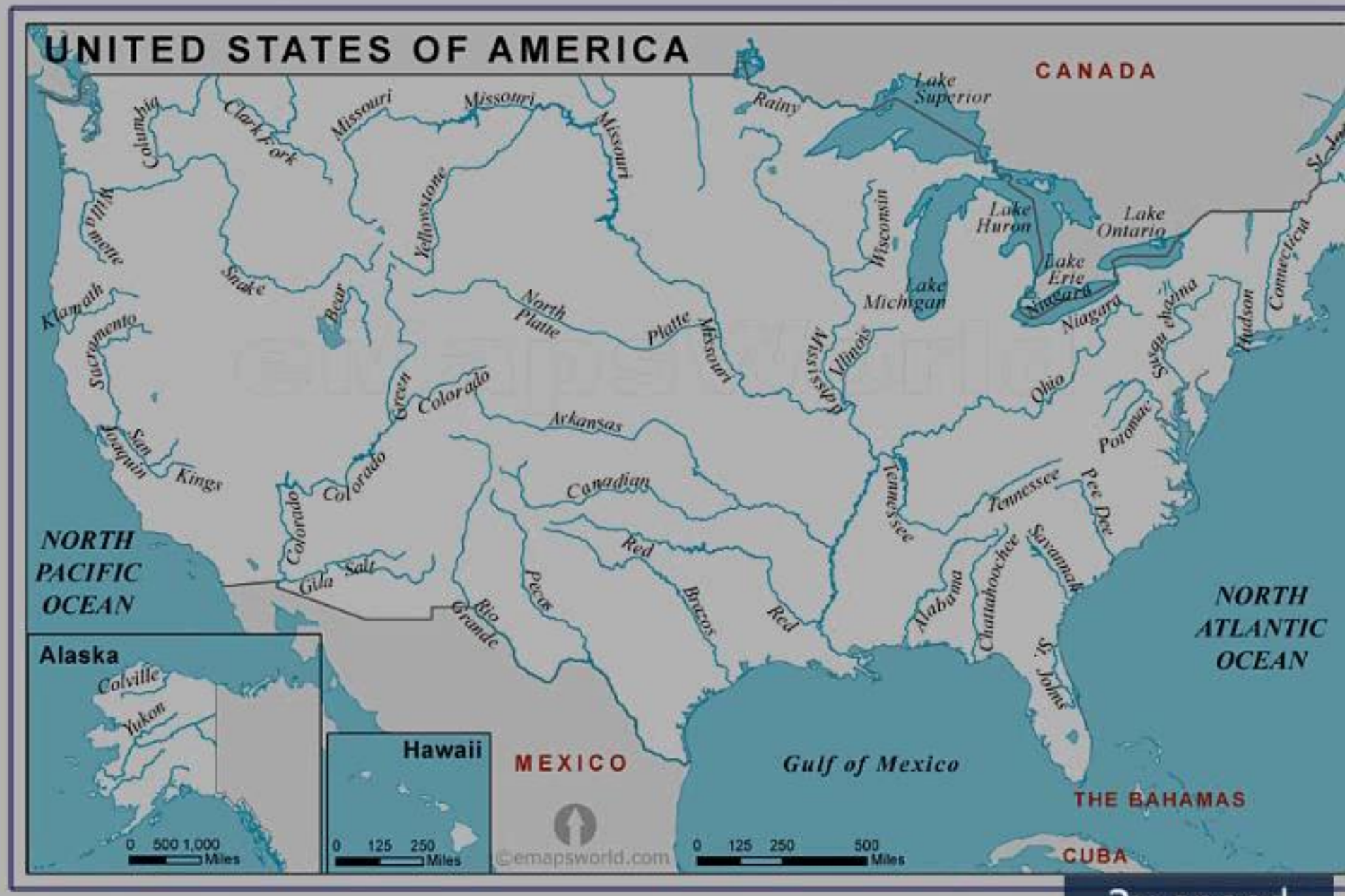
Images | Shapes | Portals



2x speed

Portals

Images | Shapes | Portals



2x speed

Images | Shapes | Transmog | Animation | Load...


Images
Shapes
Transmog
Animation
Load...
ST ANDREWS BAY
ST ANDREWS
Guardbridge
Kincaple
Strathkinness
Blebocraigs
Kemback
Dairsie or Osnaburgh
CUPAR
Pitscottie
Denhead
Cameron Reservoir
Ceres
Baldinnie
Kinkell Ness
Buddo Ness
Babbet Ness
Boarhills
Brownhills
Kingsbarns
Cambo Ness
Stravithie
Dunino
Balcomie
Kirklands
Craig
CRAIL
West Ness
Radernie
Lawhead
Peat Inn
Lathones
Largoward
Lochty
Drumrack
Woodside
New Gilston
Montrave
Lathallan Mill
Carnbee
Arncroach
Kellie Law
Kirkton of Largo or Upper Largo
Lundin Links
Lower Largo
LARGO BAY
LEVEN
Drumeldrie
Colinsburgh
Kilconquhar
Abercrombie
Kilrenny
ANSTRUTHER EASTER
ANSTRUTHER WESTER
PITTENWEEM
ST MONANS
ELIE
Earlsferry
Ruddons Point
Chapel Ness
Sauchar Point
A91
A914
A915
A917
B939
B940
B941
B942
B9131
B9171

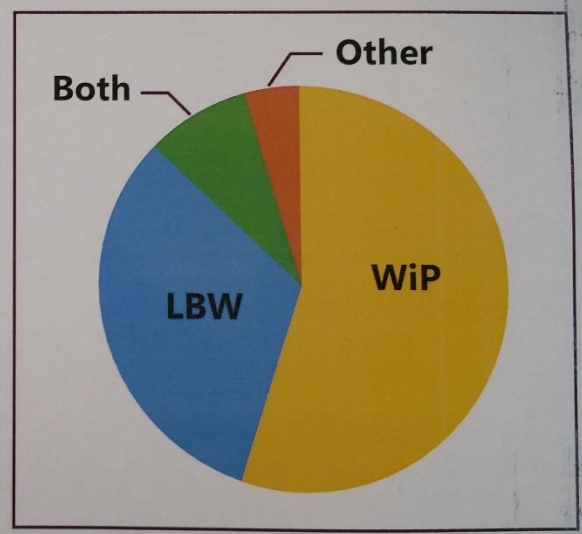
Images | Shapes | Transmog | Animation | Load...

iVoLVER

Submissions and Reviewing?

ow that the submission and review process is complete, is interesting to take a look at the numbers. This year, er the review process, we asked the ACs to characterize e papers as either a WiP, LBW, or Other (they could en add a comment as to why they deemed it an Other). ey could also choose more than one option. In total, Ws had 647 submissions. Of the 647 submitted, 281 %) were accepted. Table 1 is the breakdown of those missions by type and Table 2 is the breakdown of type Accept/Reject.

submissions we received clearly tended to favor k-in-progress, but we also had a substantial number of -breaking work as well. There does seem to be a clear d that work-in-progress were more likely to be reject



LBW Submissions by AC-described Type

Submissions and Reviewing?

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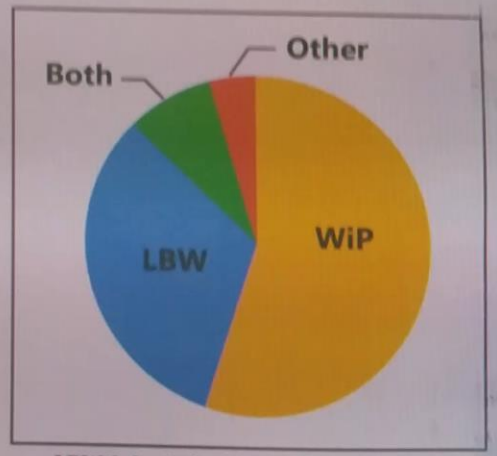

LBW Submissions by AC-described Type

Extractors
Marks
Values
Operators
Collections
Functions

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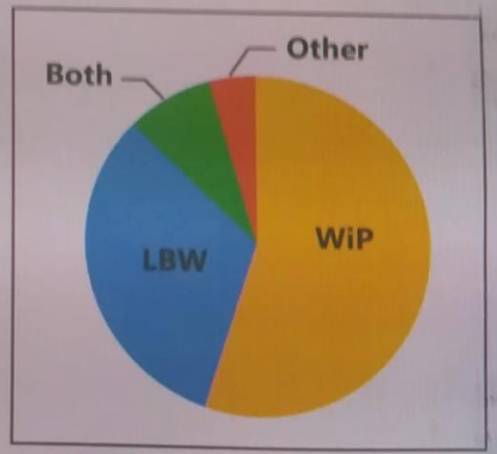
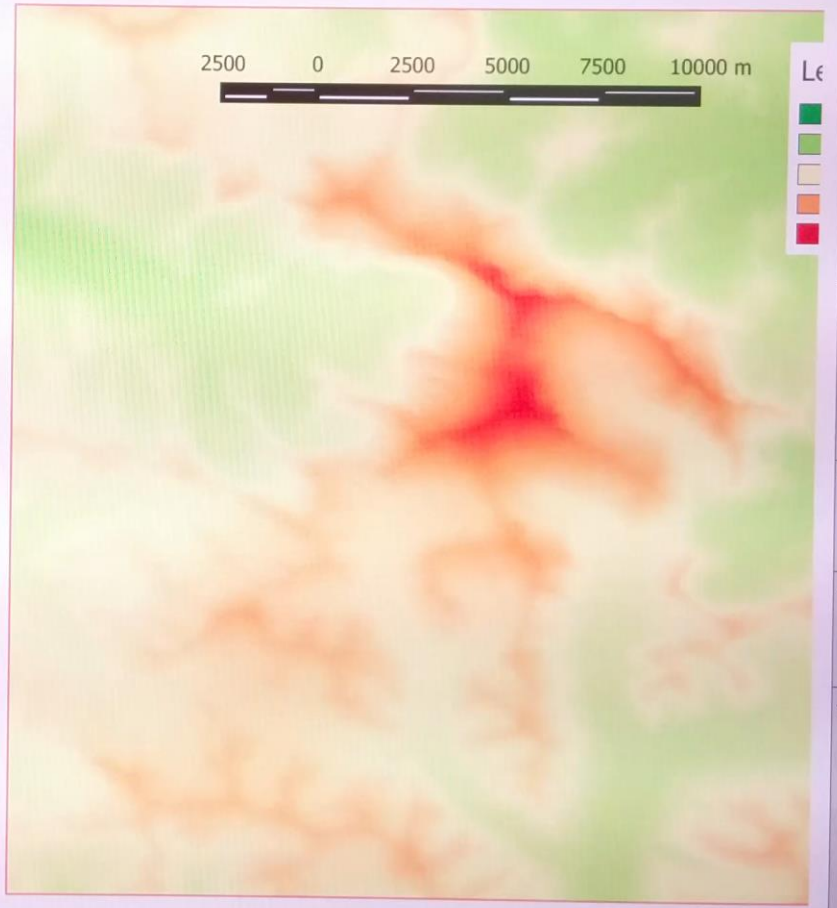


LBW Submissions by AC-described Type



Extractors

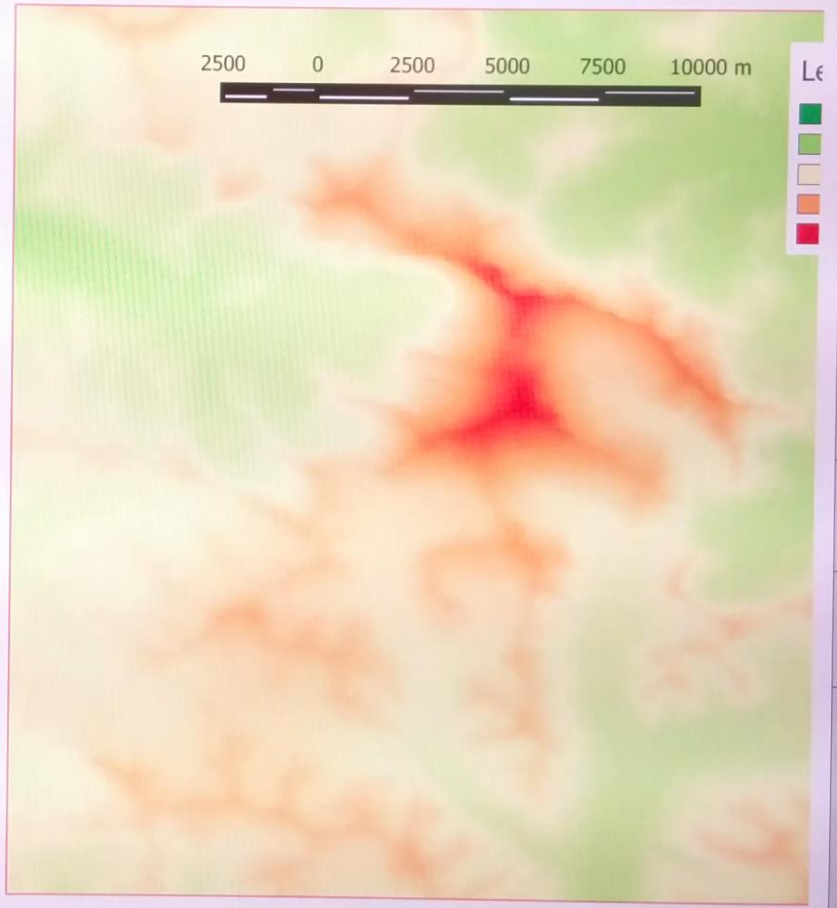
Marks

Values

Operators

Collections

Functions



Extractors

Marks

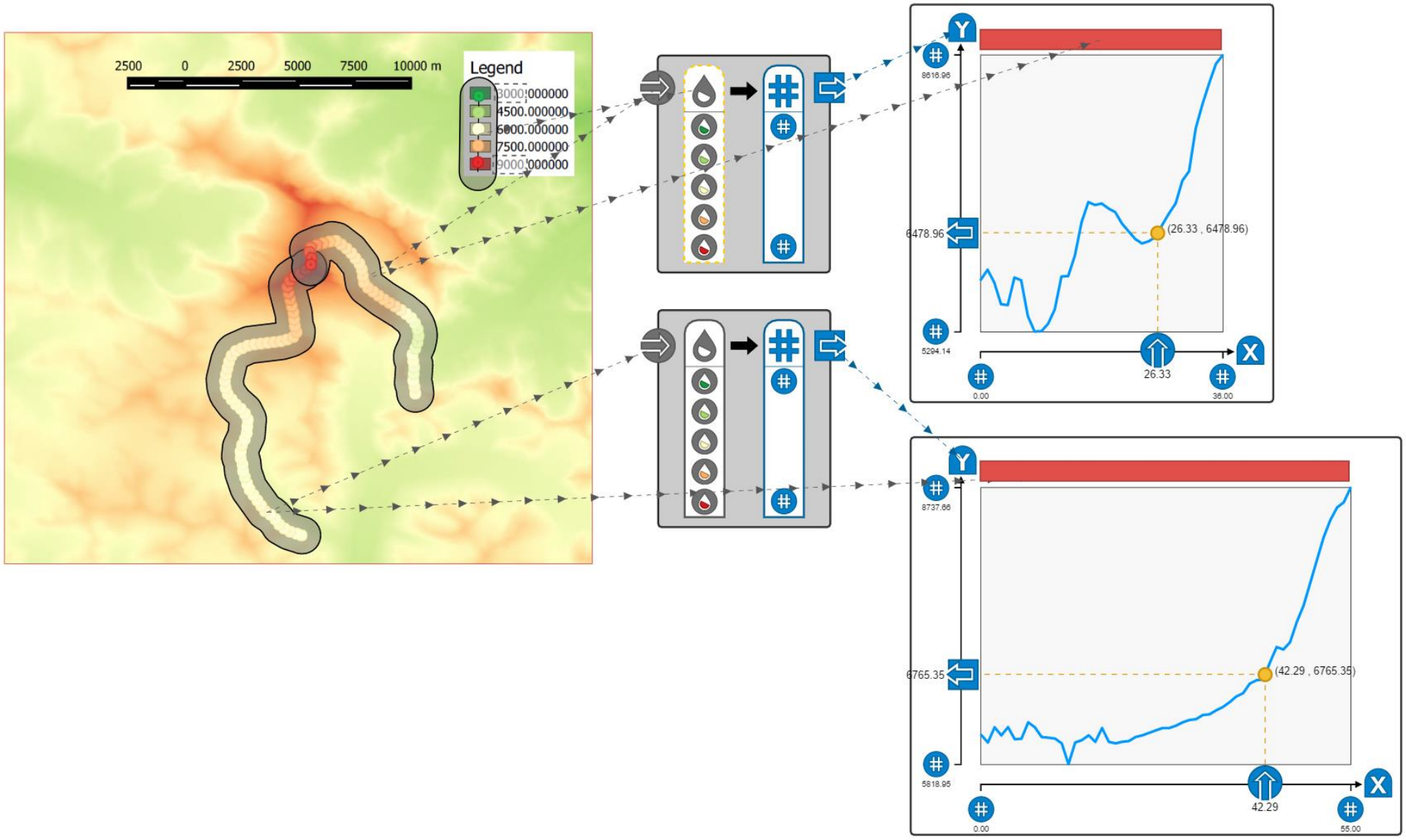
Values

Operators

Collections

Functions

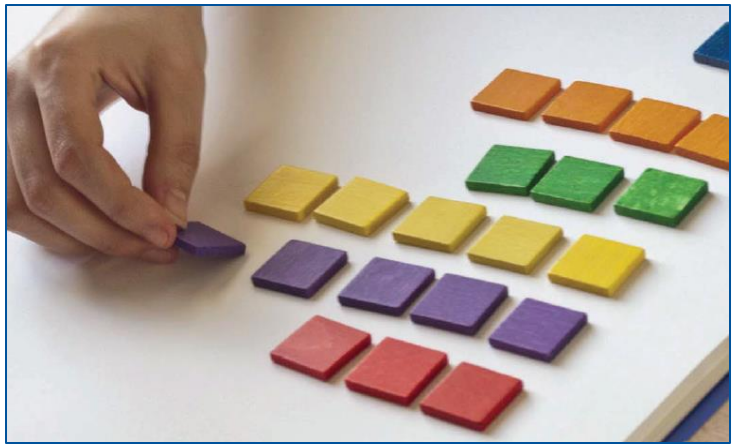
Final construction



Two aspects of note

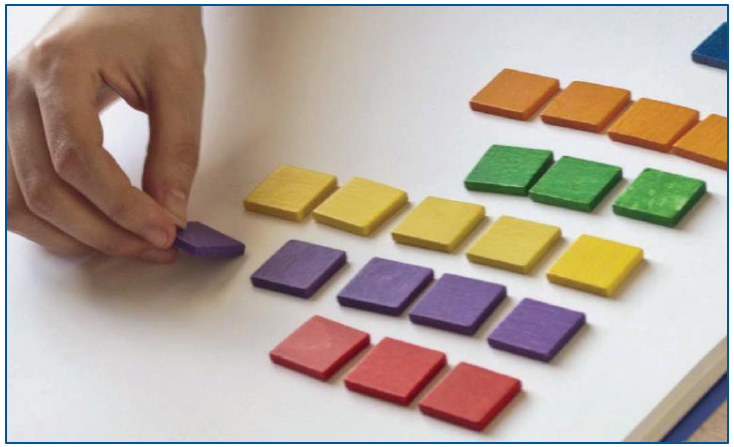
- Capture data from where it is

- Support personal visual representations

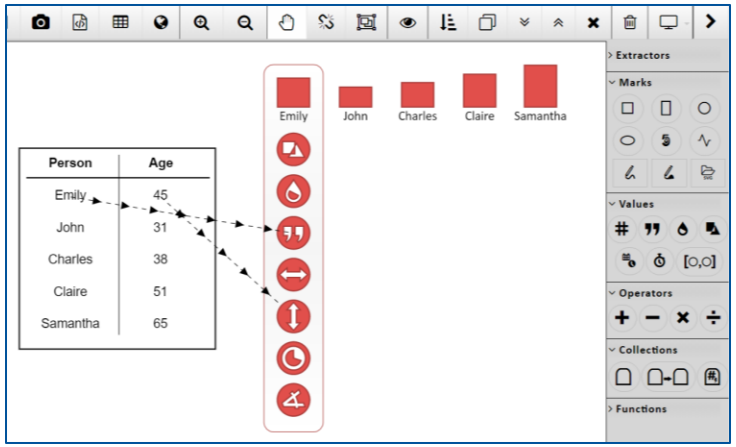


Constructive Visualization
(Huron et al., 2014)

Understanding Data Manipulation and Comprehension



Constructive Visualization
(Huron et al., 2014)



iVoLVER
(Méndez et al., 2016)

Result of many small-scale decisions and manipulations

Visualization is incrementally generated

Lower level access: data points

Bottom-up

Top-down

Attribute-level operations

Overall mapping between attributes and visuals first

Customization later

Shelf configuration

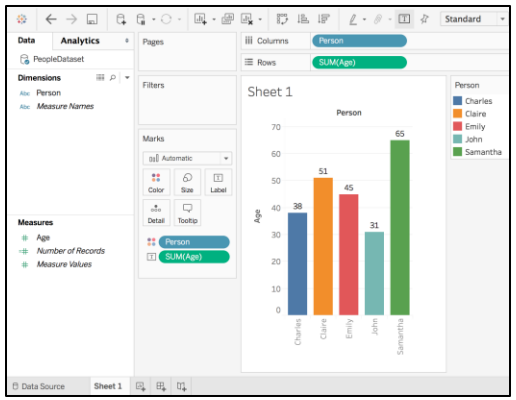
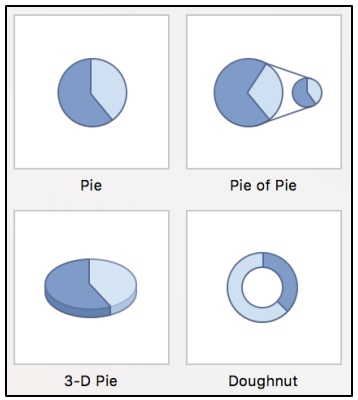


Tableau Desktop

Template-based



MS Excel

Tableau's *Show me*

Grammel, L., Bennett, C., Tory, M., & Storey, M. A. (2013). A survey of visualization construction user interfaces. *EuroVis-Short Papers*, 19-23.

Bottom-up vs. Top-down: Trade-offs in Efficiency, Understanding, Freedom and Creativity with InfoVis Tools (CHI 2017)

Pilot

In-classroom study

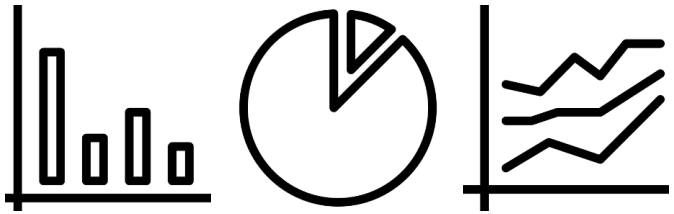
11 students of an introductory InfoVis university course

Main study

Within subjects design with visualization non-experts

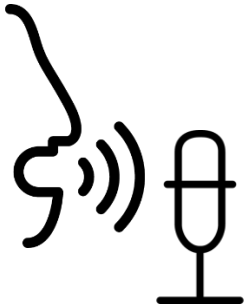
Controlled environment with interviews

Data and Analysis



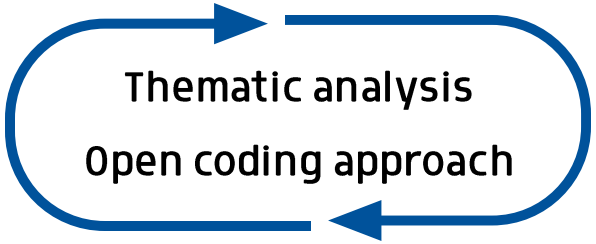
Visualization outcomes

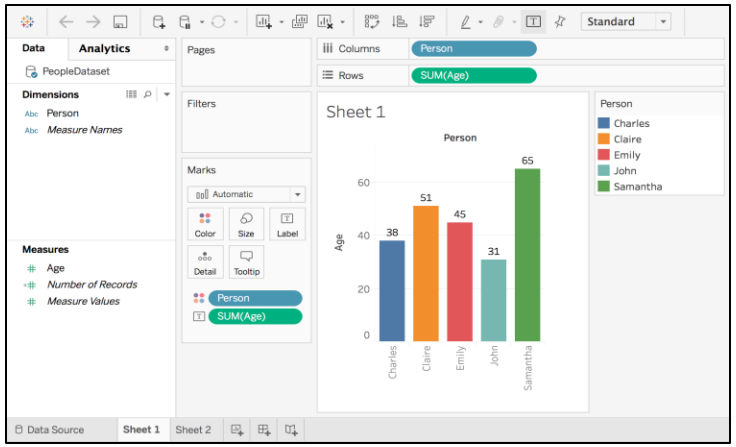
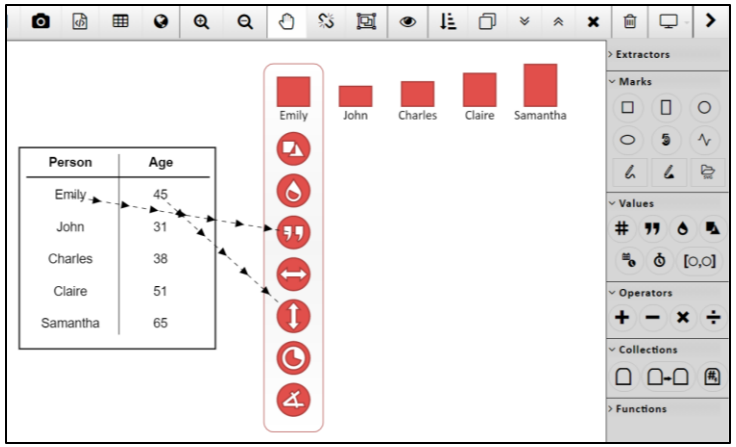
415 minutes screen captures



Interviews audio recordings

Qualitative analysis



		Benefits	Limitations
Top-down	 Tableau	More automated Rapid exploration	Tool-driven design Reduced transparency
Bottom-up	 iVoLVER	User-driven Transparent	Repetitive / Tedious Do not scale

Some interesting results

- Depth of understanding
  - Top-down is often “mindless”
- Authorship
  - What people said about their own designs “I did” vs “the system did”
- Variety
  - Bottom-up designs were less constrained and more varied

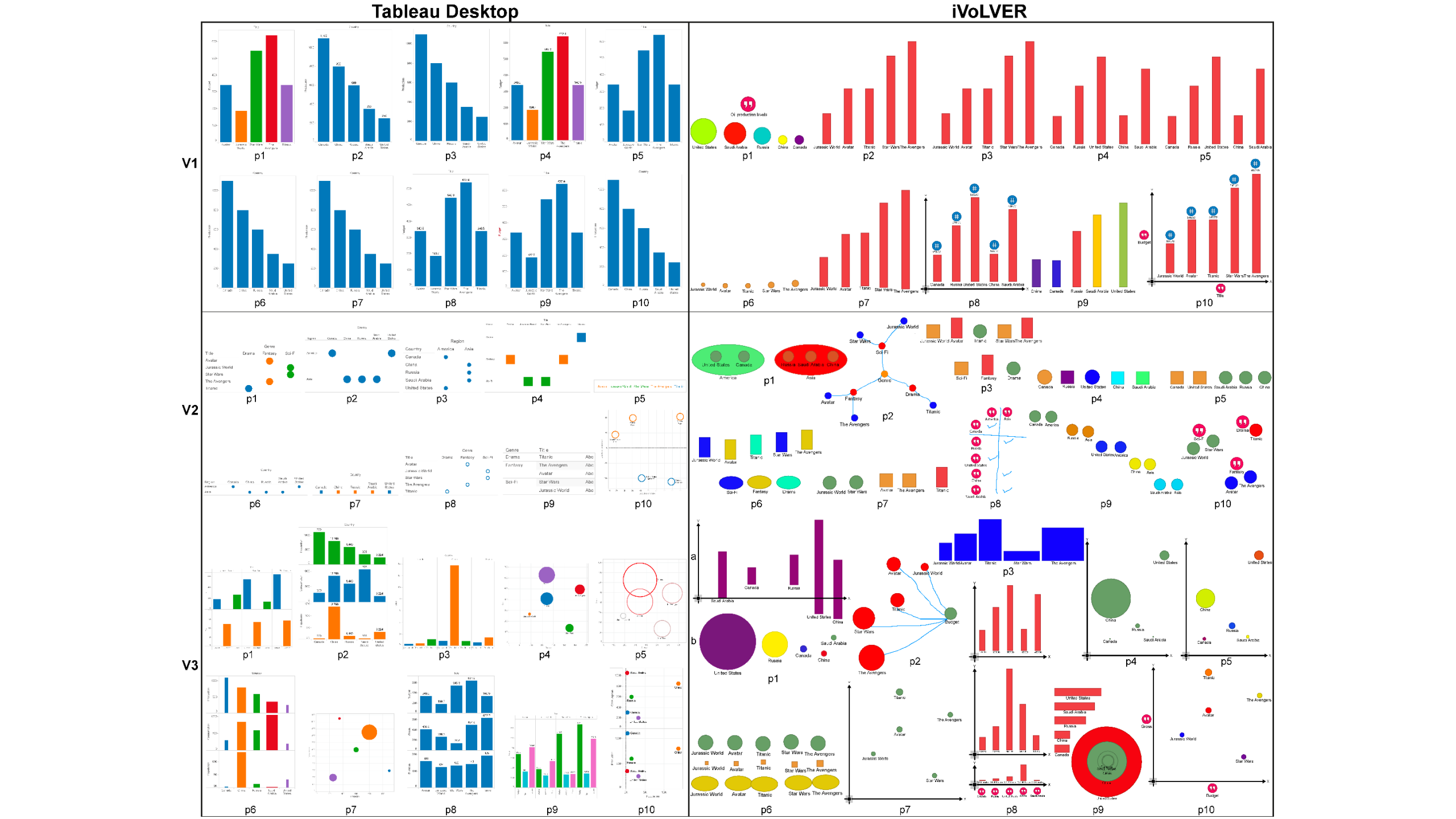


Tableau Desktop
iVoLVER
V1
V2
V3
p1
p2
p3
p4
p5
p6
p7
p8
p9
p10

Important trade-offs

Bottom-up (constructive)

- Slow, effortful
- Sense of authorship
- More open
- More transparent

Top-bottom (currently dominant)

- Scalable
- Quick and agile
- Sometimes “mindless”

Research Question

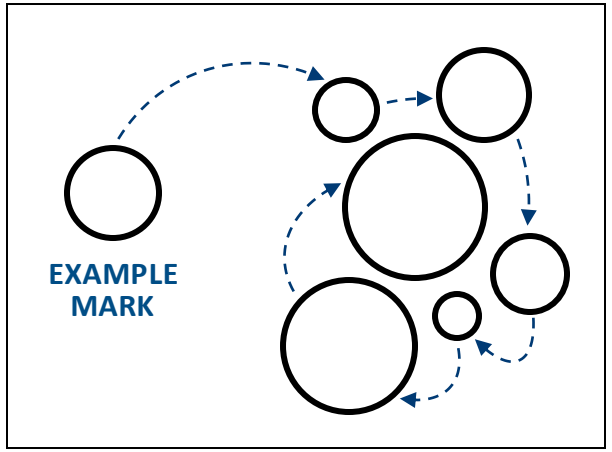
How to design bottom-up visualization tools that are also scalable?

(bringing together the best of both approaches)

Considering Agency and Data Granularity in the Design of Visualization Tools (CHI 2018)

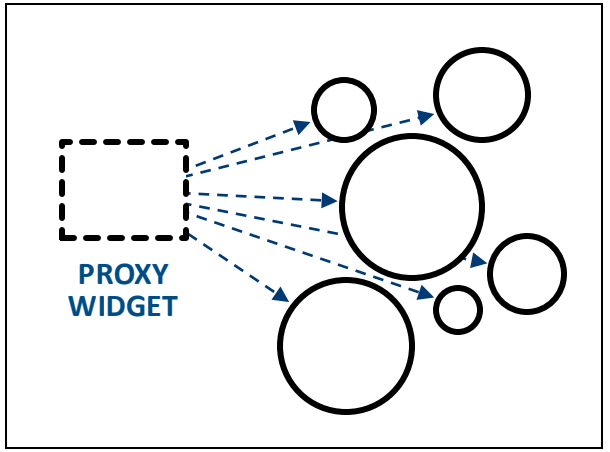
How do you get from one to the other?

Visualization by-example



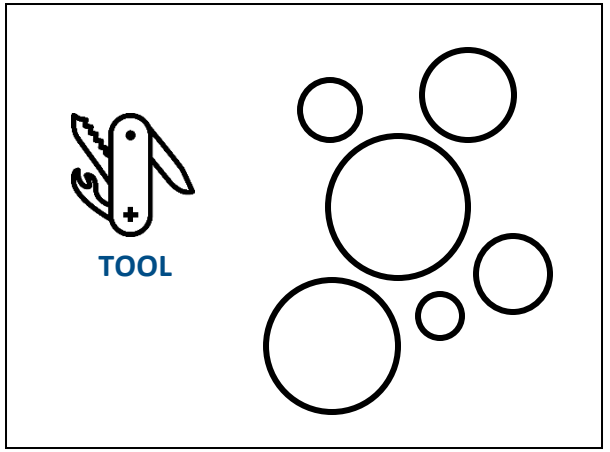
Automated Iteration

Collective Proxy Objects



Abstraction

Automated Principled Design



Automated Choices

Dimensions

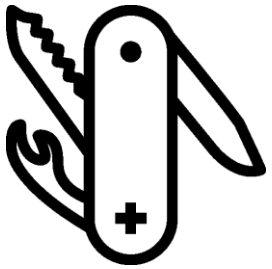
① Agency

② Granularity

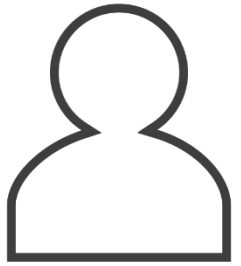
Dimensions

① Agency

Who carries out the process?



Tool



Designer

Decisions:

- Selecting the visualization type
- Data transformations
- Visual mappings

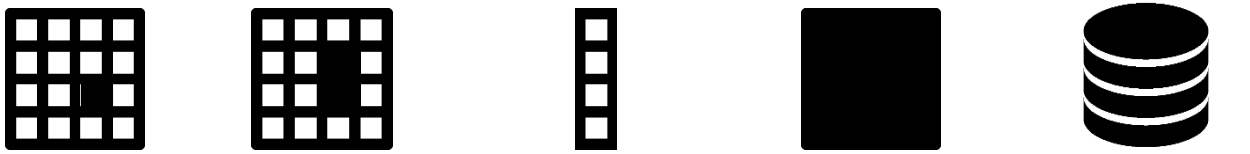
② Granularity

Dimensions

① Agency

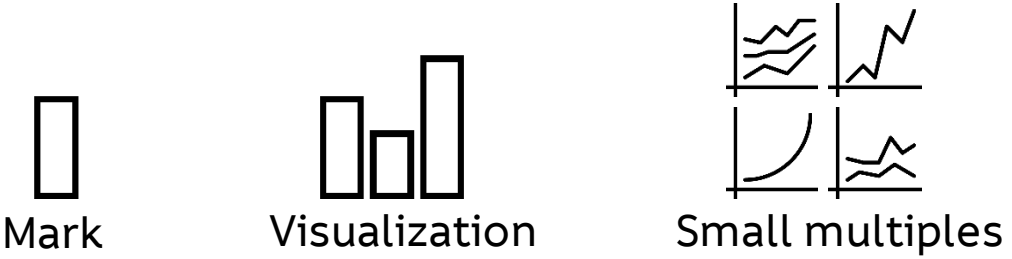
What do designers have access to?

Data

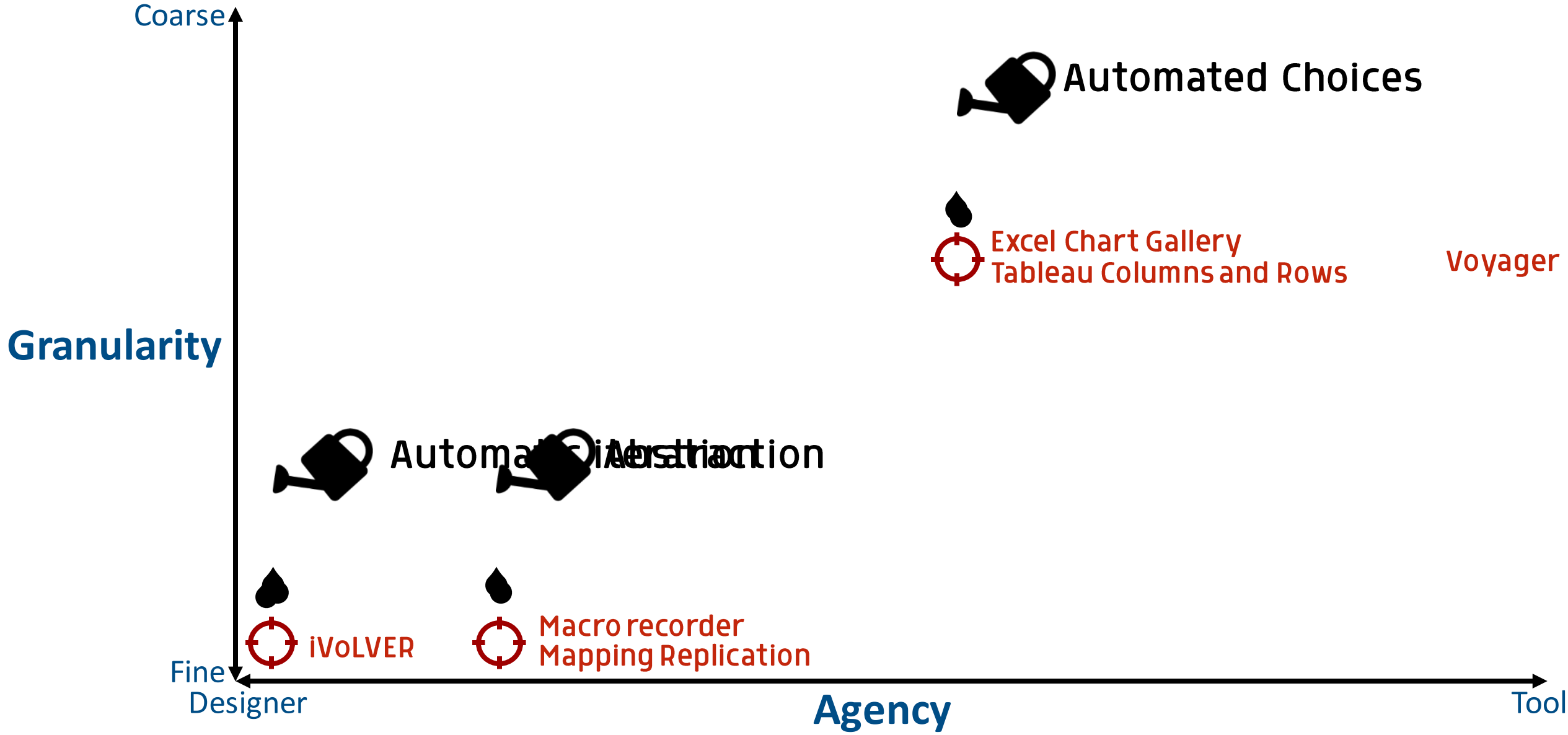


② **Granularity**

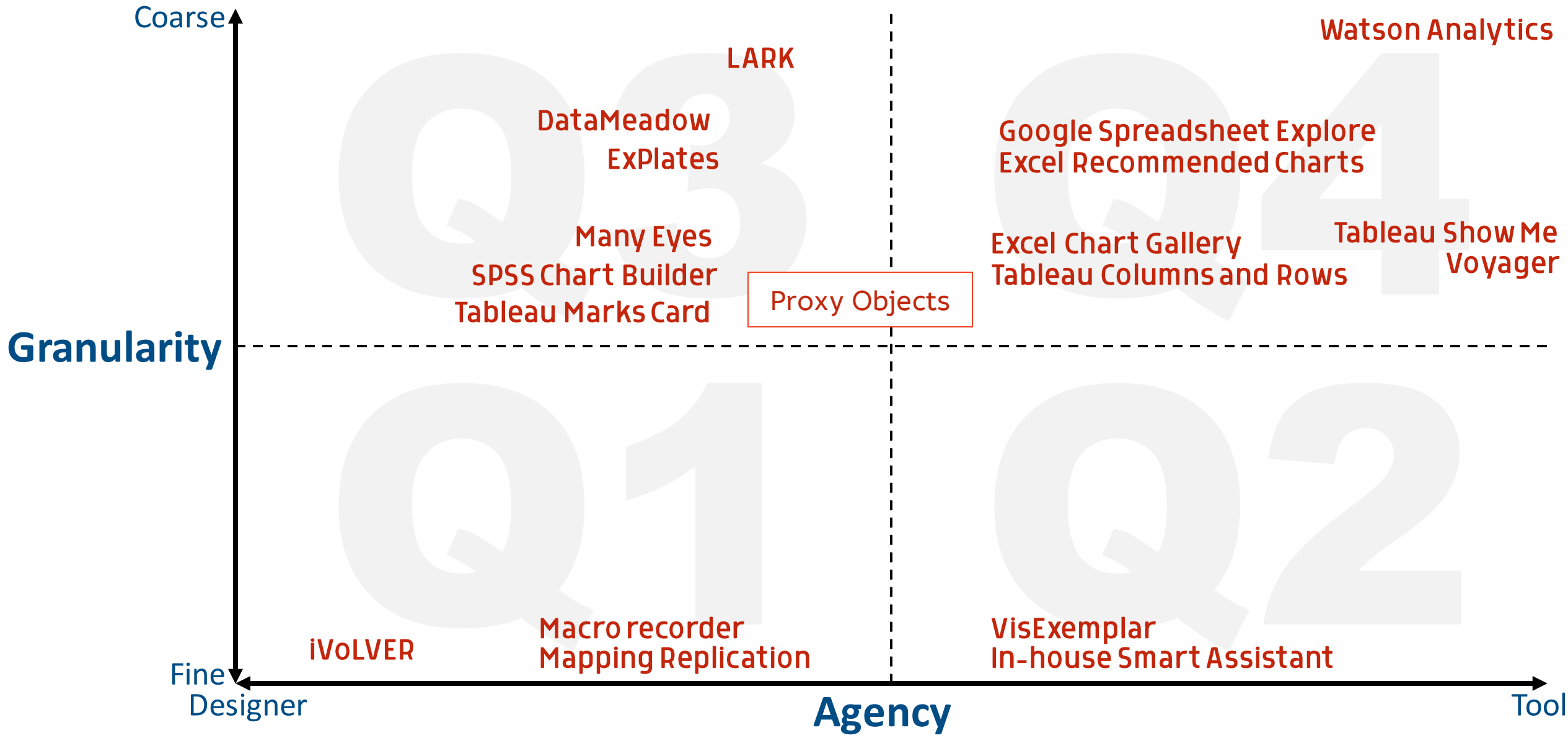
Visual representations



Design Space



Design Space



Research Directions

Going more cognitive

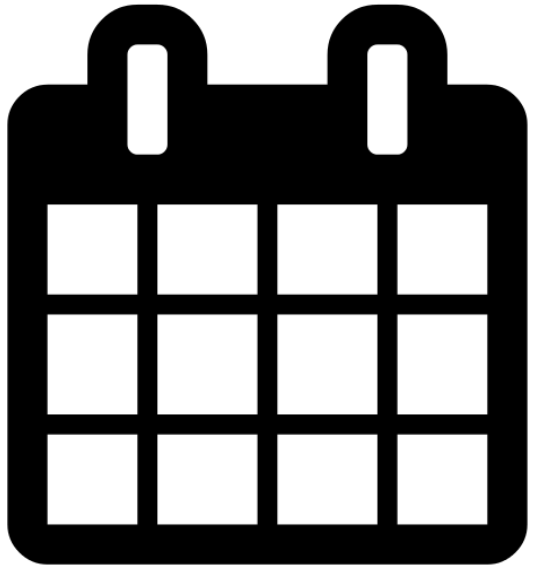
- How do people actually get to understanding from visuals?
- Applied to Constraint Programming (has lots of practical applications)
- What do people come up with visually when representing ***problems*** rather than data or solutions?

```
  S E N D
+ M O R E
---------
M O N E Y
```

Word Crypto

Set: 1, -3, 5, 6, -2, 5, -7

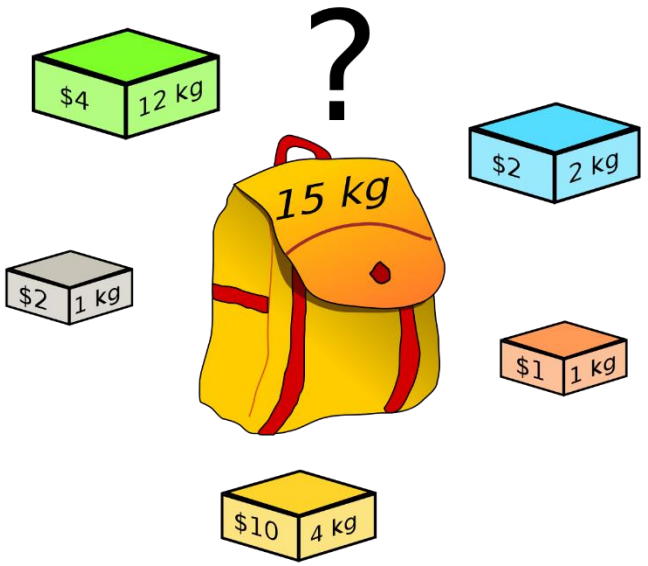
Subsum Set



Calendar

5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9

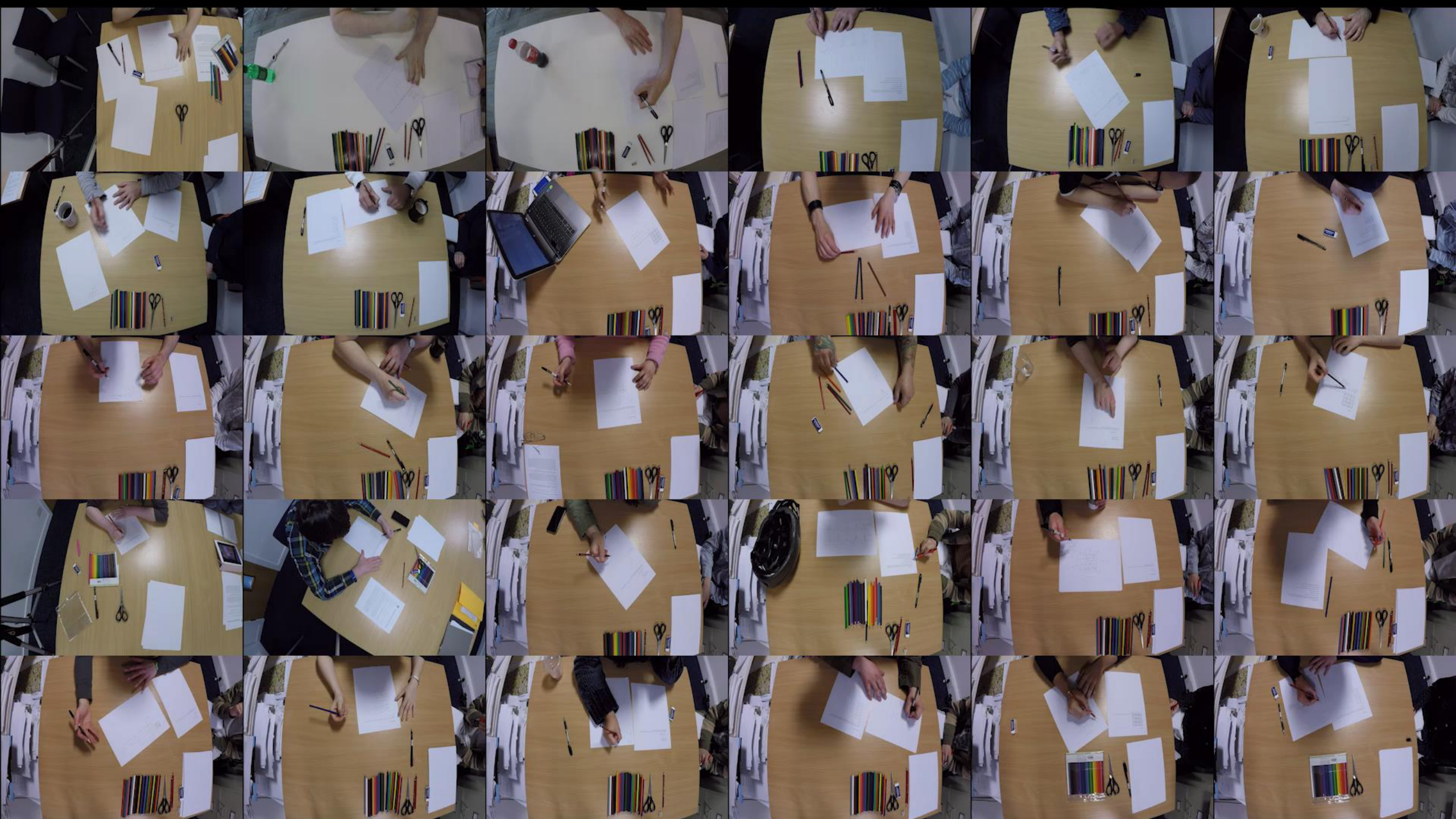
Sudoku



Knapsack

2	7	6	→15
9	5	1	→15
4	3	8	→15
↘	↓	↓	↓ ↙
15	15	15	15 15

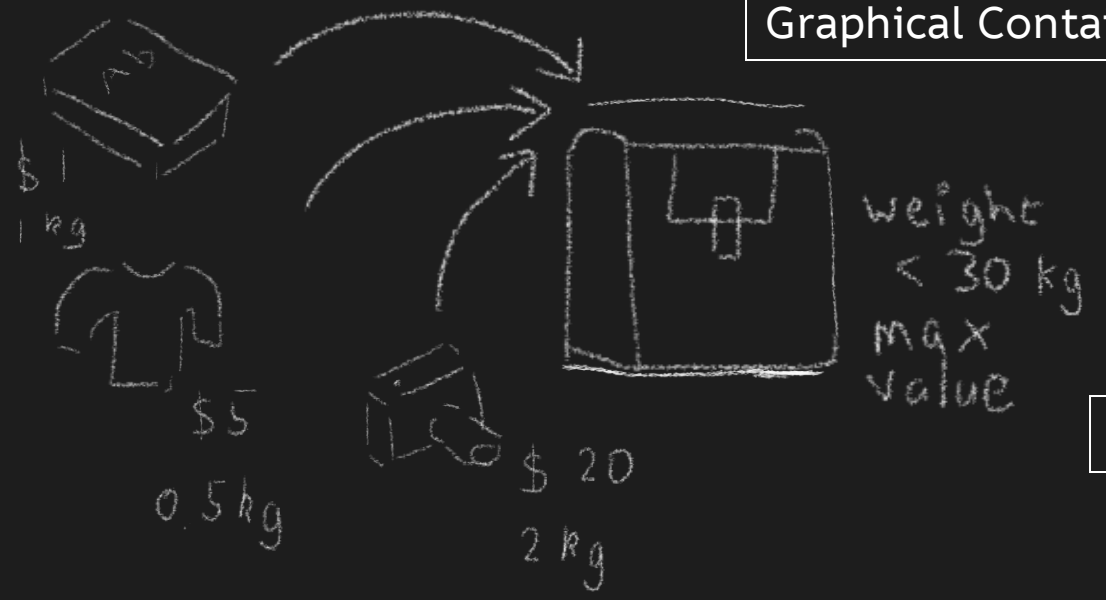
Magic Square



Arrows/Lines

Symbols

Graphical Containers

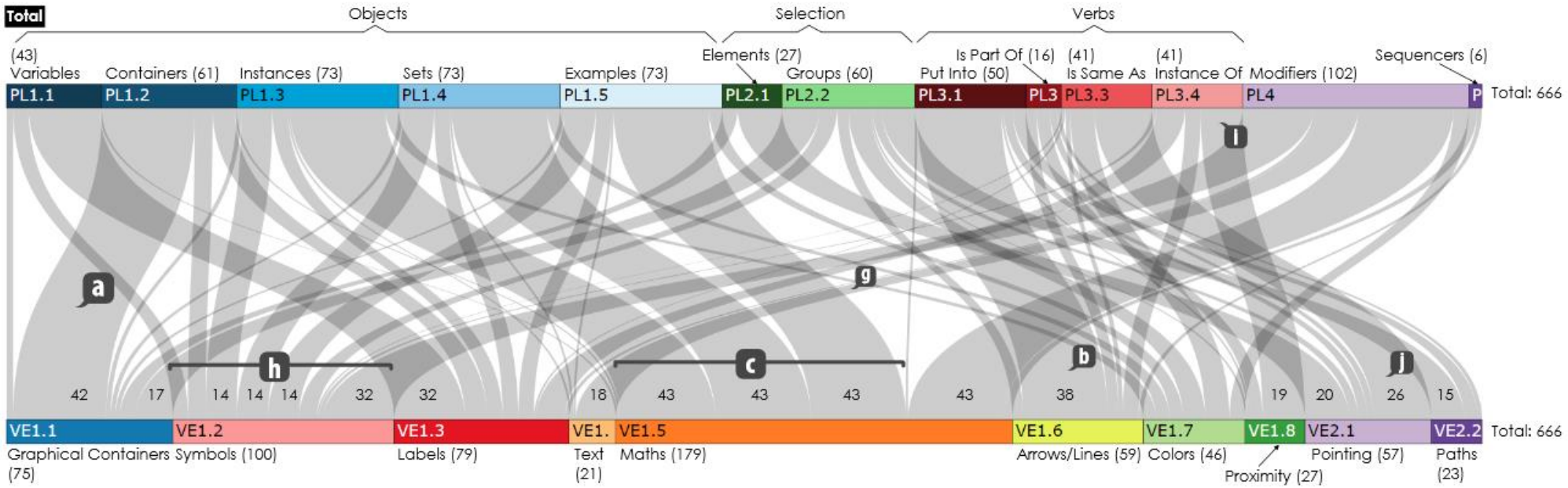


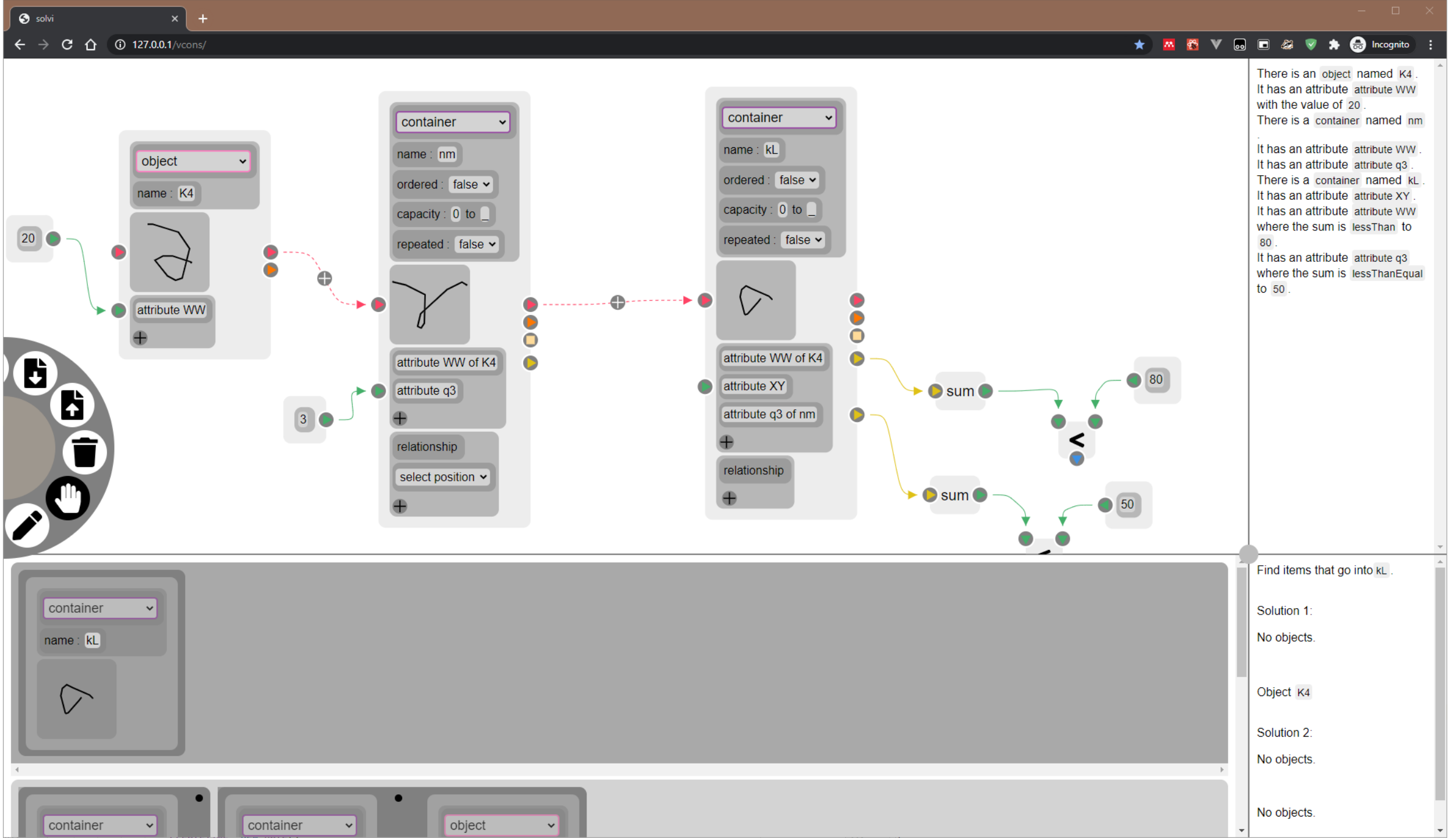
Maths

Text

Understanding How People Graphically Model (Constraint) Problems

- Study of how people graphically represent problems (as opposed to data)
- Semiotic analysis of graphical elements and problem description constructs




solvi
127.0.0.1/vcons/
Incognito
object
name : K4
attribute WW
20
container
name : nm
ordered : false
capacity : 0 to _
repeated : false
attribute WW of K4
attribute q3
3
relationship
select position
container
name : kL
ordered : false
capacity : 0 to _
repeated : false
attribute WW of K4
attribute XY
attribute q3 of nm
relationship
sum
80
sum
50
There is an object named K4 .
It has an attribute attribute WW with the value of 20 .
There is a container named nm .
It has an attribute attribute WW .
It has an attribute attribute q3 .
There is a container named kL .
It has an attribute attribute XY .
It has an attribute attribute WW where the sum is lessThan to 80 .
It has an attribute attribute q3 where the sum is lessThanEqual to 50 .
container
name : kL
Find items that go into kL .
Solution 1:
No objects.
Object K4
Solution 2:
No objects.
No objects.
container
container
object

DEB8

Deb8 HOME You're now connected to Debate_Immigration_After_Brexit. JOHN

and the hard reality is our economy needs migration

from the European Union. I mean,

Scotland alone, EU migrants contribute 7

billion pounds every year. They are more

likely to be in work. They are less

likely to be claiming benefits. They are

more likely to be university educated

than the population as a whole. One of

our biggest challenges in Scotland is

growing our working age population. If we

end EU migration, our working

population over the next 25 years will

fall while our pension at each

population [thank you] going up by 50

percent. One last point. [I need to go to]

Public services are under pressure.

But that's not the fault of

migrants. That is the fault of the

austerity agenda pursued by the Tories

and and banking politicians like that.

Tue, 31 Mar 2020 13:05:08 GMT

Tue, 17 Nov 2020 21:24:49 GMT

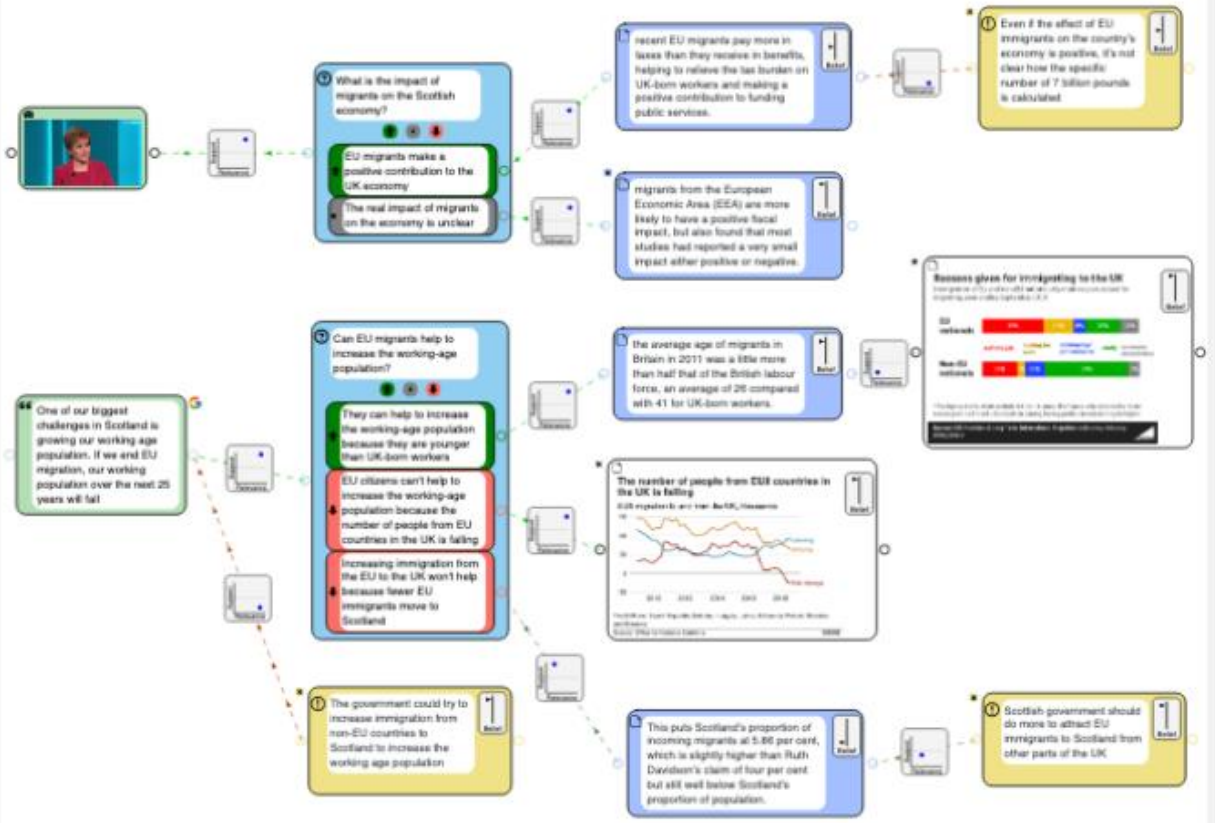
Time

Relevance

Support

Belief

? ! ⋮⋮⋮ ●



https://www.bbc.co.uk/news/

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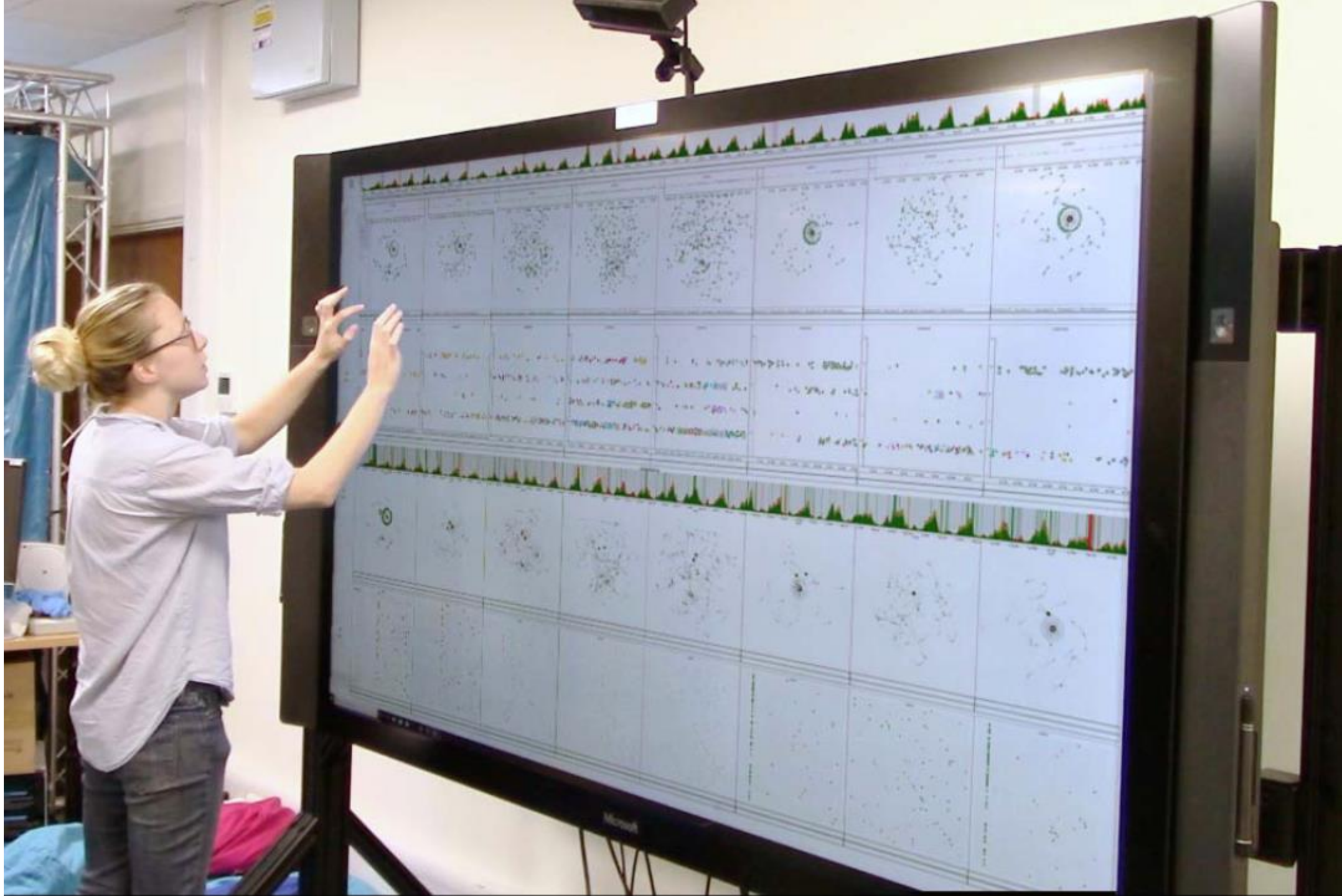
UK migration: Rise in net migration from outside EU

28 February 2019

Net migration to the UK from

Dynamic Network Plaid



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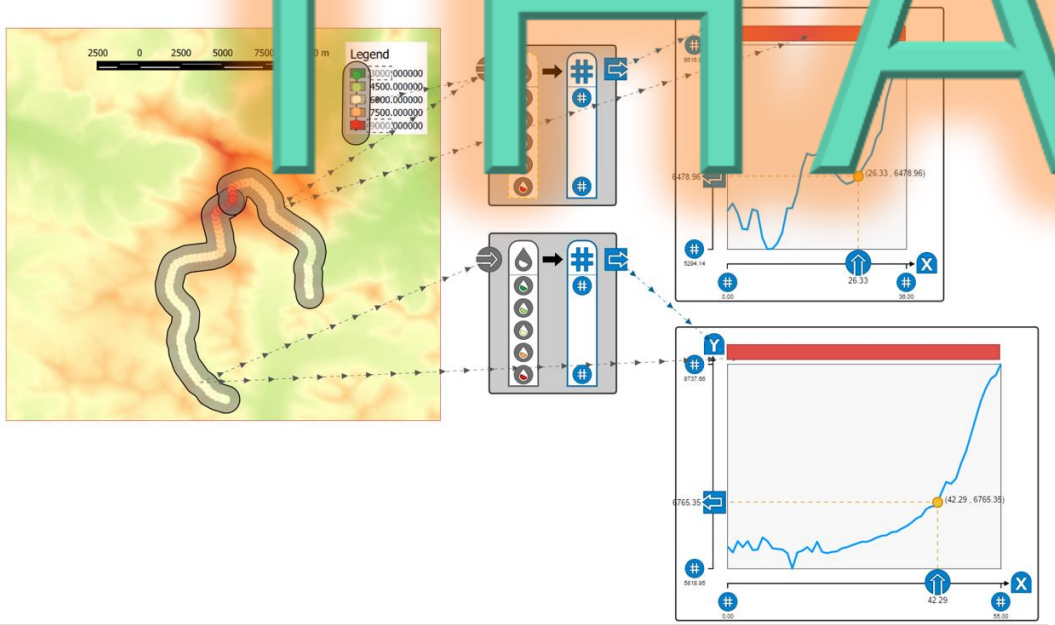
10. Zhu, X., Nacenta, M. A., Akgün, Ö. & Nightingale, P. How People Visually Represent Discrete Constraint Problems. *IEEE Transactions on Visualization and Computer Graphics* **26**, 2603–2619 (2020).

THANKS



nacenta@uvic.ca