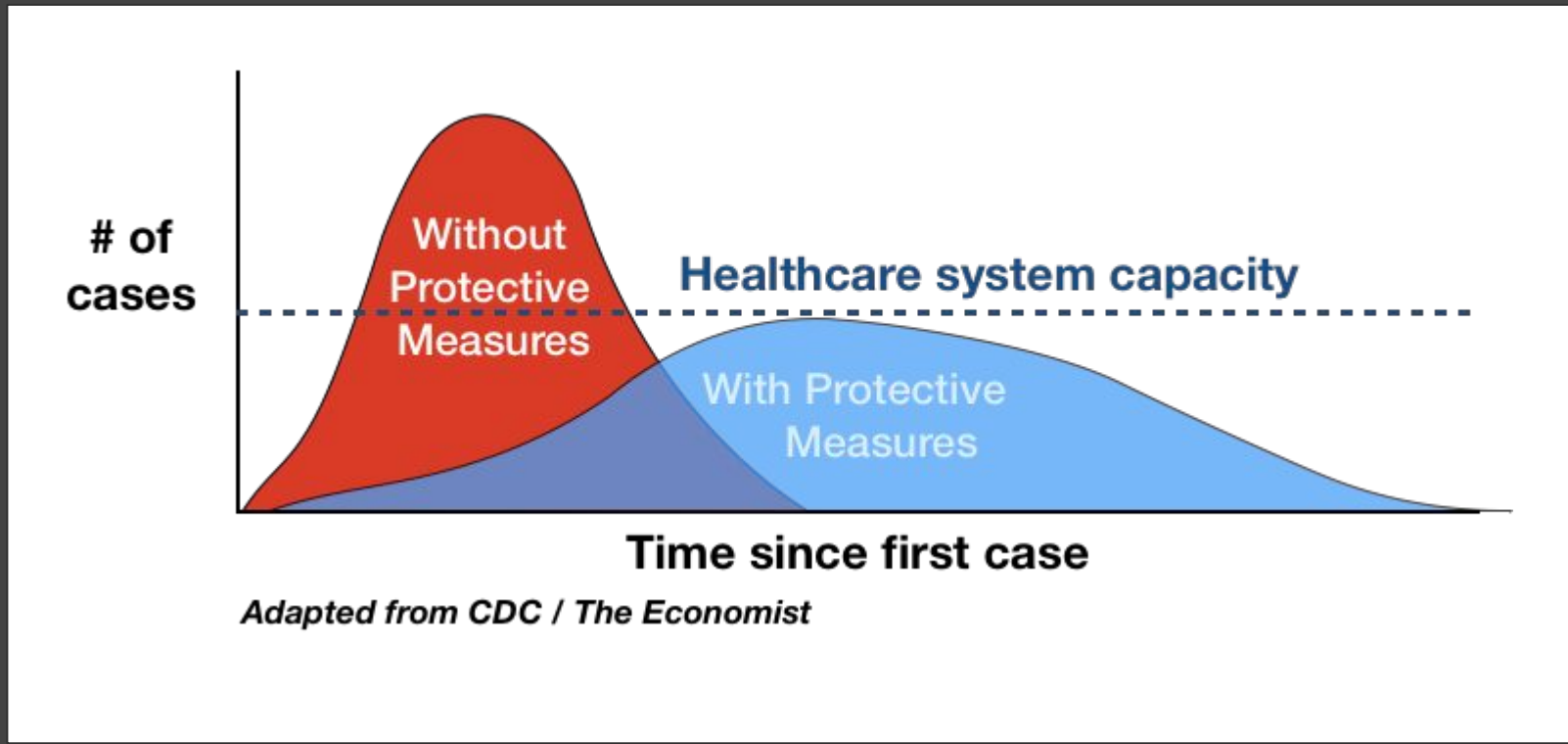
Aalto University
School of Arts, Design
and Architecture

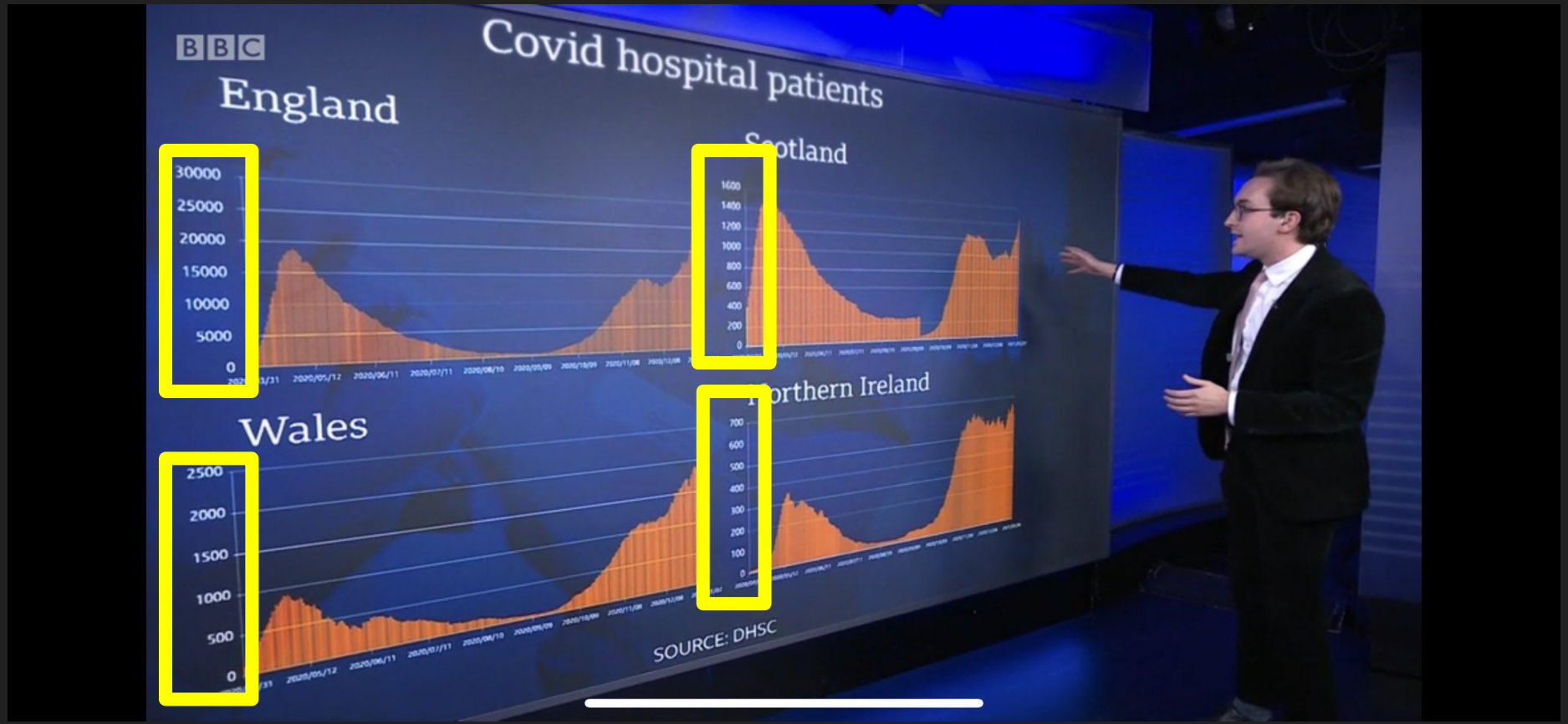
Information Design for Public Sector

Importance of Information Design in public sector
What can we achieve through information design?
Guiding Principles of Information design and tools
Case Discussions
Q & A

Rupesh Vyas,
Associate Professor (Information Design)
Department of Art and Media,
Aalto ARTS



Adapted from CDC / The Economist


BBC
Covid hospital patients
England
30000
25000
20000
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10000
5000
0
Scotland
1600
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1200
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600
400
200
0
Wales
2500
2000
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Northern Ireland
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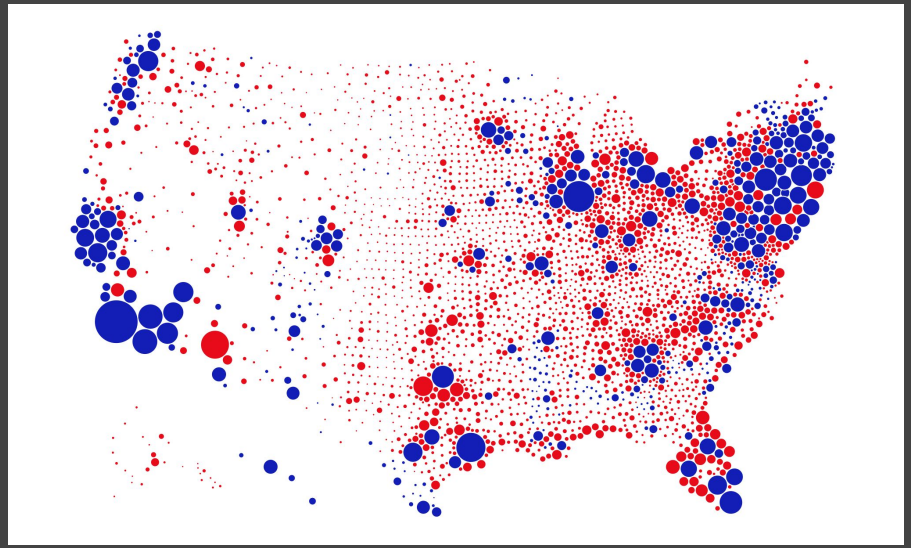
300
200
100
0
SOURCE: DHSC

Try to impeach this
Challenge-accepted by Observable



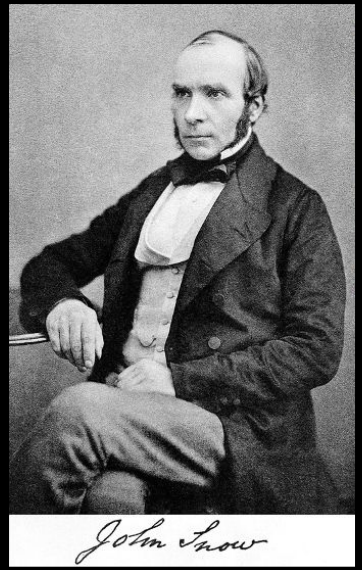
https://observablehq.com/@karimdouieb/try-to-impeach-this-challenge-accepted

How Charts Lie: Getting Smarter about Visual Information by Alberto Cairo * References on Miro Board

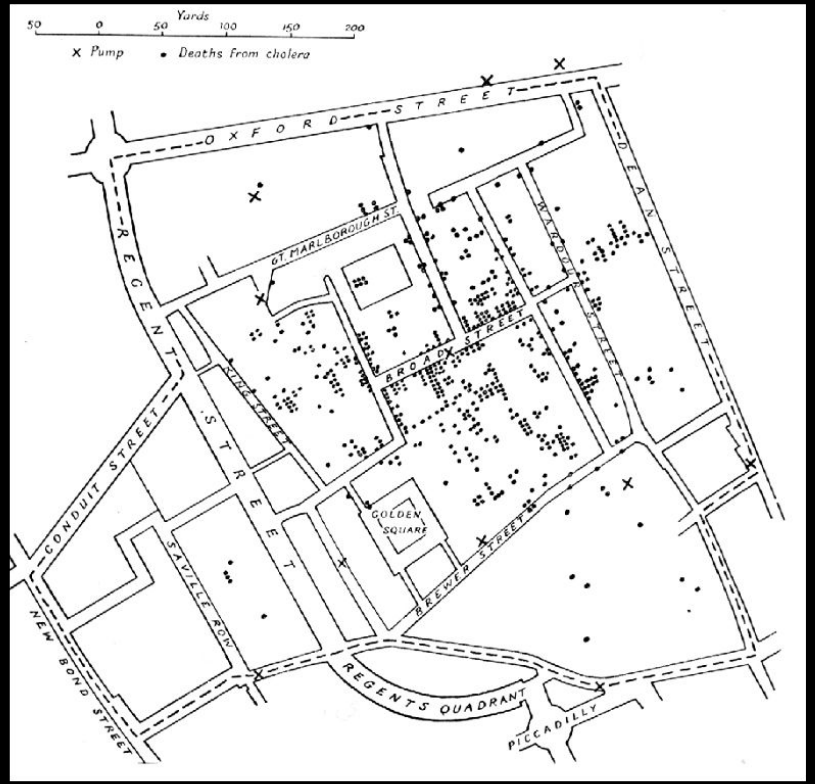
Why Information Design?

-Augment understanding
-Find patterns
-Answer questions
-Discover hidden story
-Expand memory
-Make decisions
-Inspire action

How do we achieve good information design?



Dr. John Snow British physician.
Locating source of a cholera outbreak
(establishing the disease as water-borne)



Information Design
augments perception

Role of information designer
becomes crucial
as **creator, curator and disseminator**.

Information design

Challenges

-Misleading information graphics
-Data Equity/Bias
-Misuse of personal data for growth hacking

Information Design Approach

addressing present and future societal issues.

- Problem solving and Critical Thinking
- Exploratory and Interactive
- Multisensorial and Experiential

Problem solving approach:

HSL, Improving Passenger Information
2016-2017

VCD Student Designers:
Mikko Airikka
Dinh Ngo

Design Workshop:
New Media Students

Producer
Minna Ainoa
Maria Leinvuo

Project Lead/Supervisor
Rupesh Vyas

Challenge:

-Seamless information for bus passengers without using mobile phones*.

- Navigation information for Terminals/Hubs

- In-bus information Dissemination

HSL Passenger Information: Overall Design Process

Learn/Observe

Passenger journey mapping and identifying breakpoints in information expectations

Technology constraints

Case studies
Literature review

Existing material

Contextual Study

Contextual study with producers and distributors of passenger information

Study of constraints of passenger communication system

Build Insight/ Quick Prototyping

Insights
Features
Navigation
Information structure
Interface
Interaction flows

Sketching iterative **design ideas of information touchpoints**

Design and Workshop

Co-design workshop with stakeholders

Building prototypes

Design/Print

Implementation of design considering practical aspects

Implement

Iplement test in real context

Reflect

Document

Future possibilities

Learn/Observe

Passenger journey mapping
and identifying breakpoints in information expectations

4 // Arrival in Holmenkollen Ski Center at 14.30 for an interview

Johan checks the subway schedule from Ruter.com in his hotel room at 13.15. He leaves the hotel at 13.40 to catch the subway that leaves at 13.55 from the closest subway station (National theater) towards Holmenkollen. After not visiting Oslo for a while, Johan first enters the subway station from the wrong entrance where the trains go towards west. Johan checks the subway to make sure he is going in the right direction and then exits the subway stations and enters it from another entrance. Johan finds his way to the platform where the train 1 to Holmenkollen (towards Frognerseteren) goes from. Eventually, Johan arrives in Holmenkollen at 14.20 and walks to the Ski Center to do the first interview.

Travel time: 30 min

13:47 **Your location**

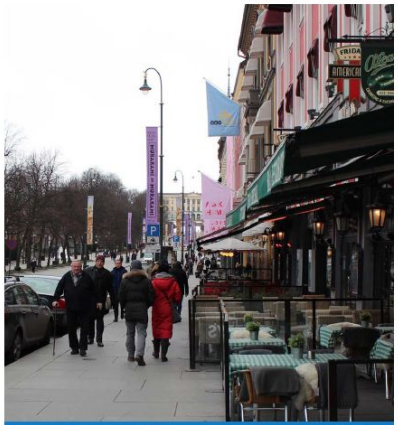
Go 5 min. View in map

13:55 **Nationaltheatret [T-bane]**
Track 2 (Retning vest)
(zone 1)

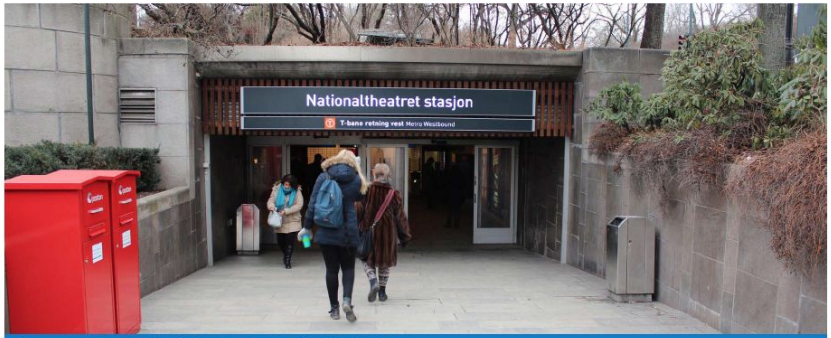
1 Frognerseteren
13 stops

Holmenkollen [T-bane]
Track 2 (Retning Frognerseteren)
(zone 1)

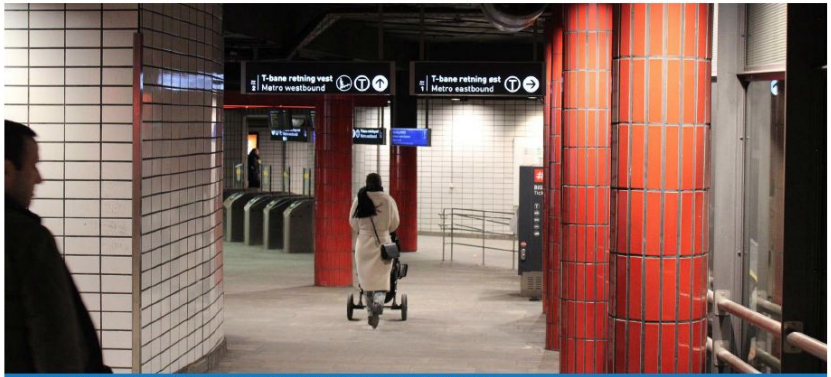
14:18



VIEW TOWARDS THE NATIONALTHEATRET STATION



ENTRANCE OF THE NATIONALTHEATRE METRO STATION



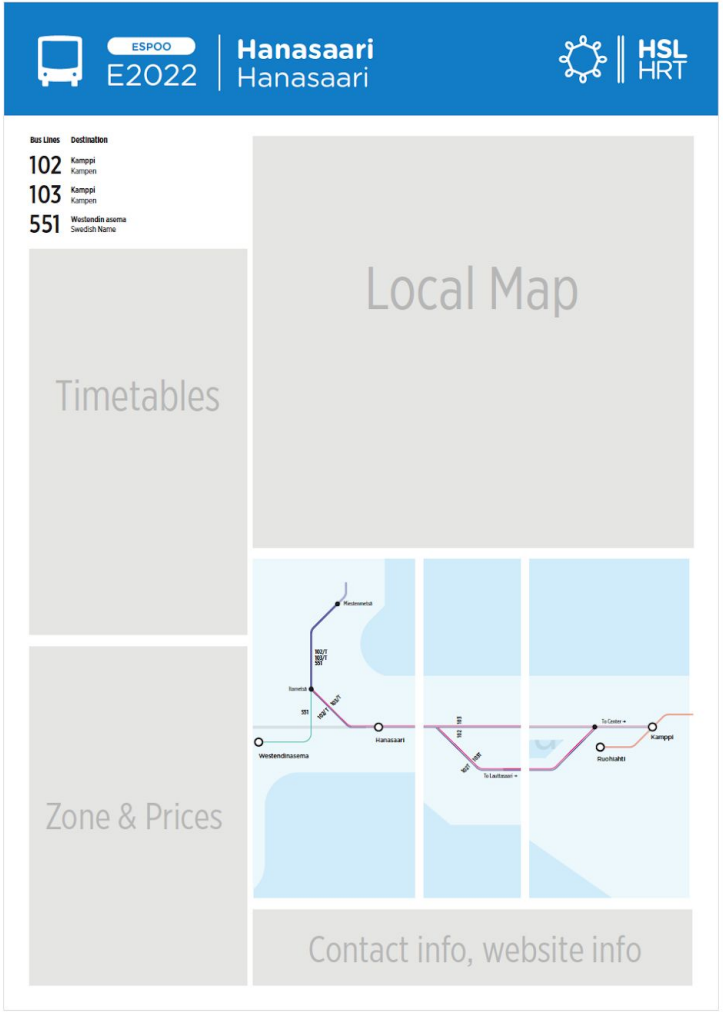
WAYFINDING SIGNS INSIDE THE NATIONALTHEATRE METRO STATION

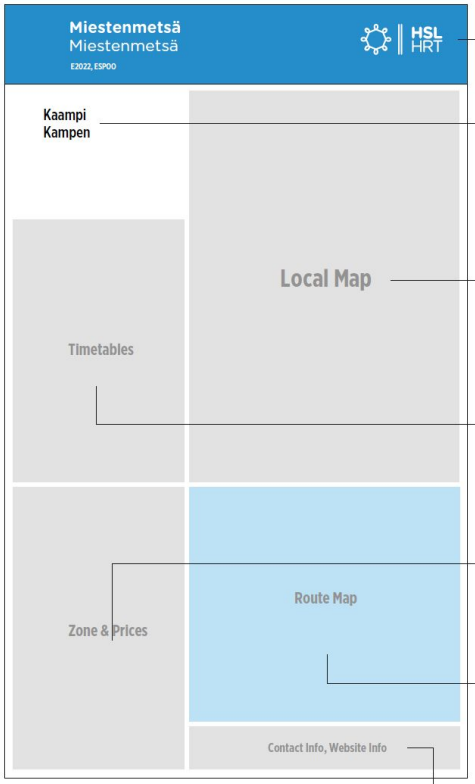
Design and Workshop

Co-design workshop with HSL's implementation teams and Students from Aalto.

Organise information using **L.A.T.C.H** principle by Richard Saul Wurman

Location
Alphabet
Time
Category
Hierarchy





1. Header, showing stop name and number **Needs to show: The transit stop**

2. Route Map, showing current location and ends of lines with major transit hubs. **Needs to show: Routes that service the stop and Areas, points of interest, transit options that are accessible via transit from this stop**

3. Local map, showing nearby stops and points of interest, if applicable. **Needs to show: Nearby surroundings (including points of interest/other transit options)**

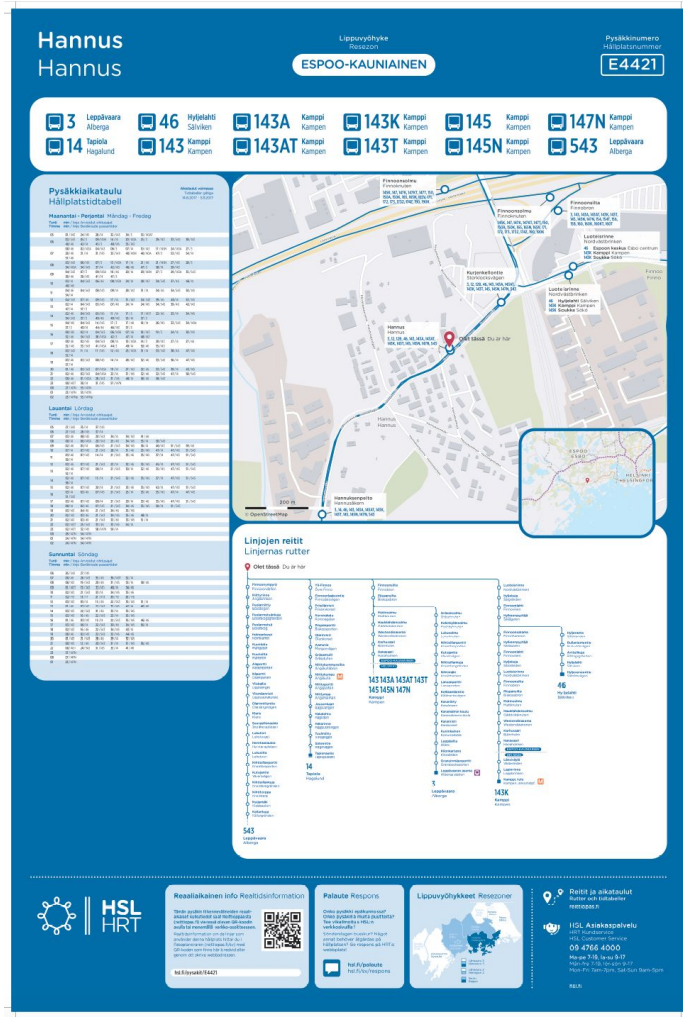
4. Timetables **Needs to show: Routes that service the stop and Areas**

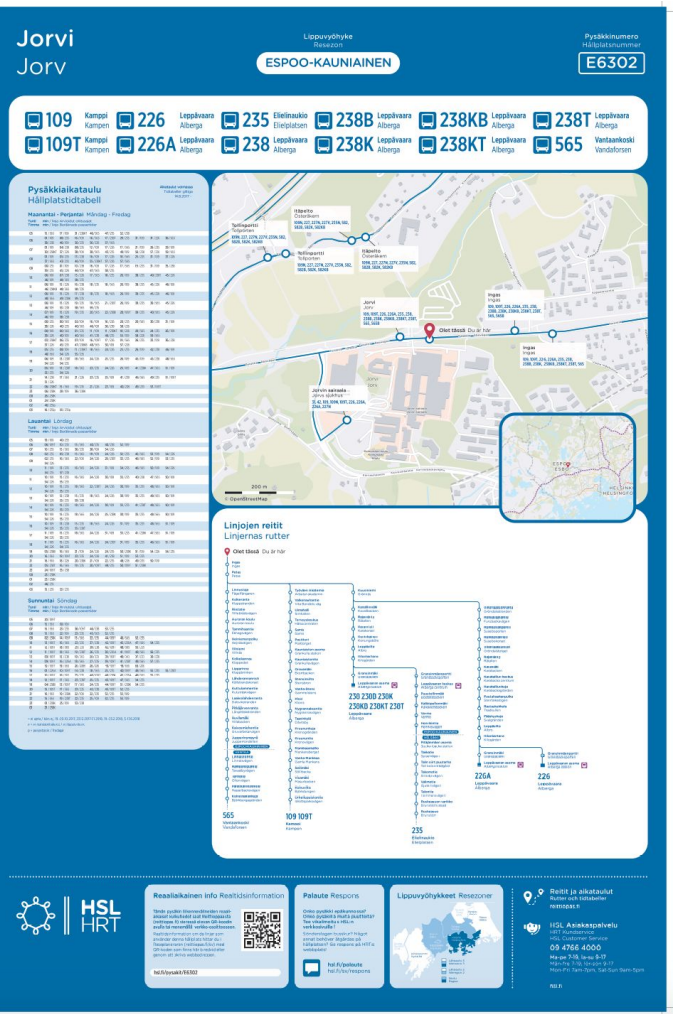
5. Map of zones and related price table. **Needs to show: The transit stop Header, showing stop name and number**

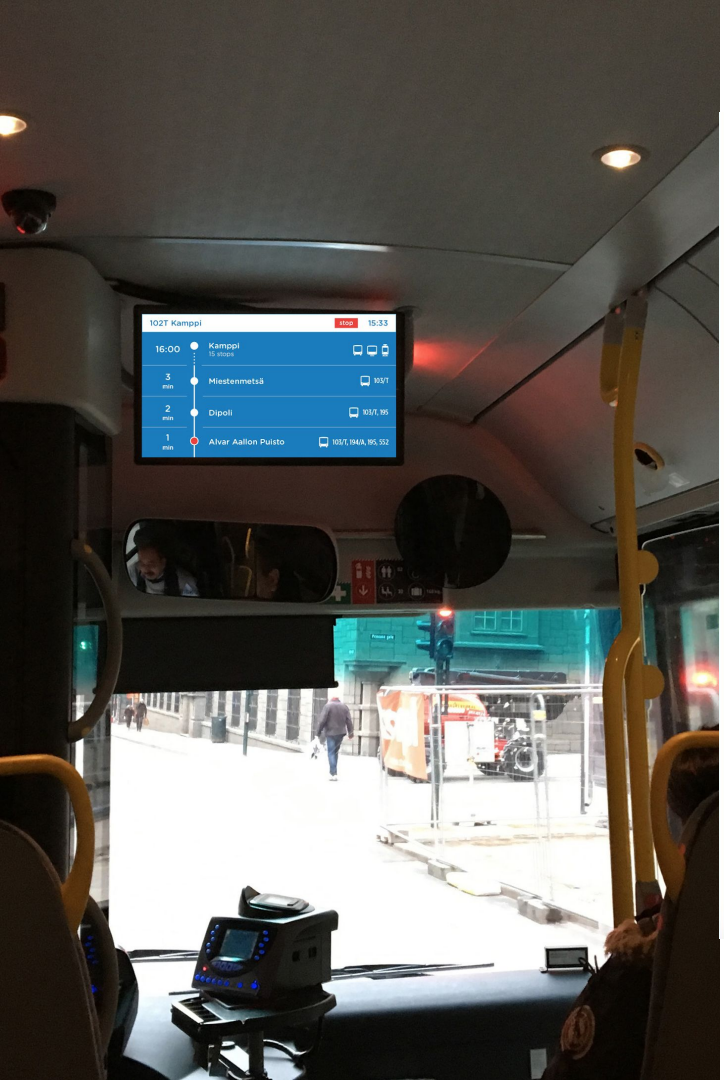
6. Map of zones and related price table. **Needs to show: The transit stop Header, showing stop name and number**

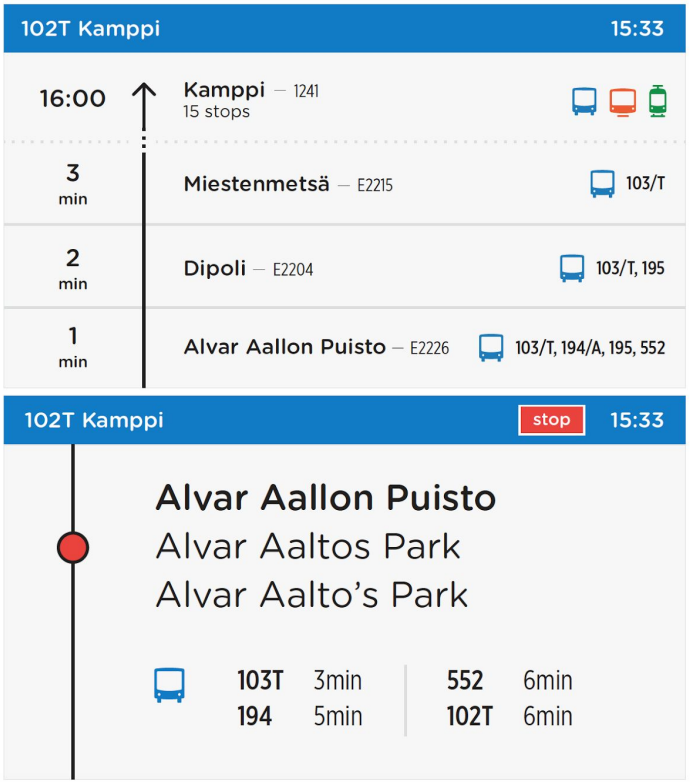
7. Header, showing stop name and number

Design of HSL ‘Bus Information Poster’ was implemented during June-July 2017 across Helsinki Region on each bus stop.









Bus route Information inside bus Display Design suggestions are being processed for implementation by HSL.

Haapaniemi
Aspnäs

65 · 66 · 67/V
68 · 69

65 Kamppi Kampen

VIA HAAMENTIE, KALLIO, VALLILA

Olet täällä Du är här

Maanantai - perjantai Måndag - fredag

05 15 45	**06** 06 20 34 48	**07** 06 20 34 48	**08** 06	
20 34 48 58	**09** 06 20 34 48 58	**10** 06 20 34 48	**11**	
10 20 34 48 58	**12** 06 20 34	**13** 06 20 34	**14** 06	
20 34 48 58	**15** 06 20 34 48	**16** 06 20 34	**17** 06	
10 20 34 48 58	**18** 06 20 34 40 48 56	**18** 06 20 34		
10 20 34	**19** 06 20 34 48	**20** 06 20 34 48	**21** 06	
10 20 34	**22** 06 20 34 48	**23** 06 20 34 48	**00** 06	
26 46	**01** 26 46	**02** 06 36		

Lauantai Lördag

05 15 45	**06** 06 20 34	**07** 06 20 34	**08** 06 20 34	
09 06 20 34	**10** 06 20 34	**11** 06 20 34	**12** 06 20	
34	**13** 06 20 34	**14** 06 20 34	**15** 06 20 34	**16** 06
20 44	**17** 06 20 34	**18** 06 20 34	**19** 06 20 34	**20**
06 20 34	**21** 06 20 34	**22** 06 20 34	**23** 06 20 40	

Sunnuntai Söndag

06 15 45	**07** 06 20	**08** 06 20	**09** 06 20	**10** 06	
15	**11** 06 20	**12** 06 20	**13** 06 20	**13** 06 20	**13**
15 45	**14** 06 20	**15** 06 20	**16** 06 20	**17** 06 20	
18 15 45	**19** 06 20	**20** 06 20	**21** 06 20	**22** 06	

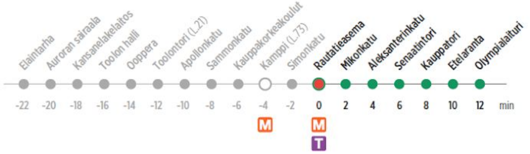
Rautatieasema
Järnvägsstation

2 · 3 · 6/T
7A · 9

2 Olympiaterminaali Olympiaterminalen

VIA KAMPPI, TÖÖLÖ

Olet täällä Du är här



Maanantai - perjantai Måndag - fredag

05 15 45	**06** 06 20 34 48	**07** 06 20 34 48	**08** 06	
20 34 48 58	**09** 06 20 34 48 58	**10** 06 20 34 48	**11**	
10 20 34 48 58	**12** 06 20 34	**13** 06 20 34	**14** 06	
20 34 48 58	**15** 06 20 34 48	**16** 06 20 34	**17** 06	
10 20 34 48 58	**18** 06 20 34 40 48 56	**18** 06 20 34		
10 20 34	**19** 06 20 34 48	**20** 06 20 34 48	**21** 06	
10 20 34	**22** 06 20 34 48	**23** 06 20 34 48	**00** 06	
26 46	**01** 26 46	**02** 06 36		

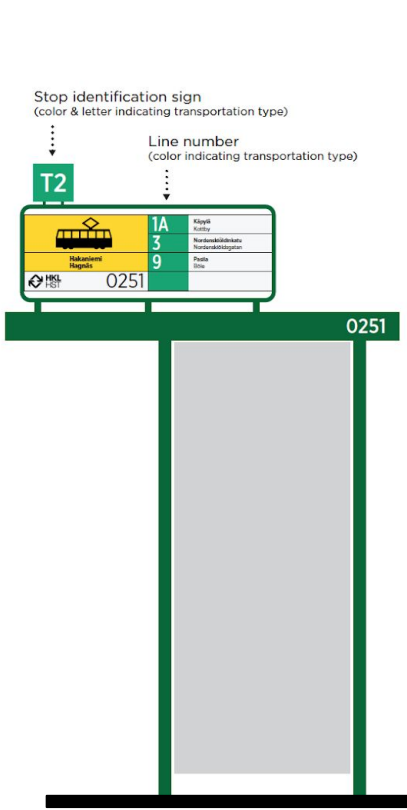
Lauantai Lördag

05 15 45	**06** 06 20 34	**07** 06 20 34	**08** 06 20 34	
09 06 20 34	**10** 06 20 34	**11** 06 20 34	**12** 06 20	
34	**13** 06 20 34	**14** 06 20 34	**15** 06 20 34	**16** 06
20 44	**17** 06 20 34	**18** 06 20 34	**19** 06 20 34	**20**
06 20 34	**21** 06 20 34	**22** 06 20 34	**23** 06 20 40	

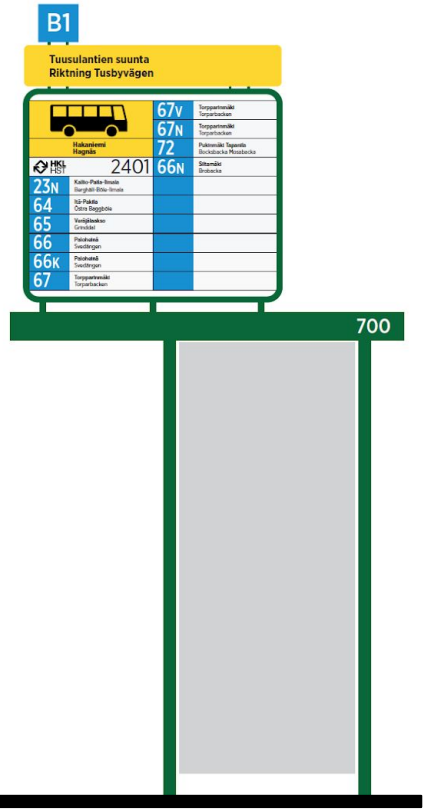
Sunnuntai Söndag

06 15 45	**07** 06 20	**08** 06 20	**09** 06 20	**10** 06	
15	**11** 06 20	**12** 06 20	**13** 06 20	**13** 06 20	**13**
15 45	**14** 06 20	**15** 06 20	**16** 06 20	**17** 06 20	
18 15 45	**19** 06 20	**20** 06 20	**21** 06 20	**22** 06	

TRAM STOPS



BUS STOPS



Learnings:

Learning from passengers, Producers of information and distributors of information can bring interesting insight for clear implementable design ideas.

Visual Principles and in-depth User research can generate meaningful design.

Exploratory Visualisation
FINNGEN Visualisation

Data Analyses by
FIMM, UH

Design Team:
Nicola Cerioli
Darius Pacauskas

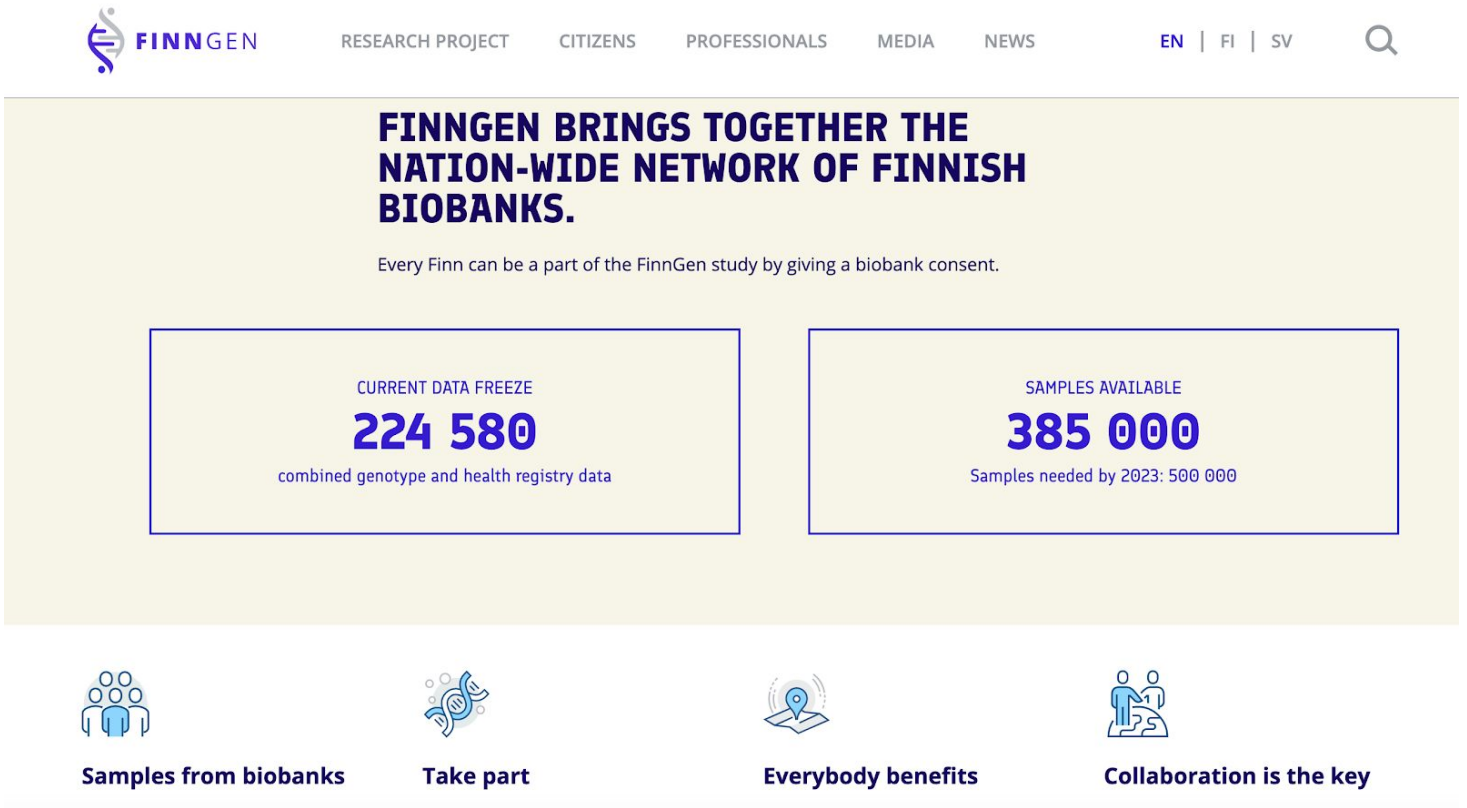
Design research
project Lead:
Rupesh Vyas

Challenge:
Interactive Visual analysis of FINNGEN Data

Explorative, interactive visualization for scientific community as well as general people of the society.

Visualisation for Scientific Discoveries of Genetic correlation with Disease

Information Design and Visual Analyses: **Collaborative Project with FiMM, Helsinki University**



Information Seeking Principles

by Shneiderman (1996)

Progressive disclosure

Overview First
Zoom and Filter
Details on Demand

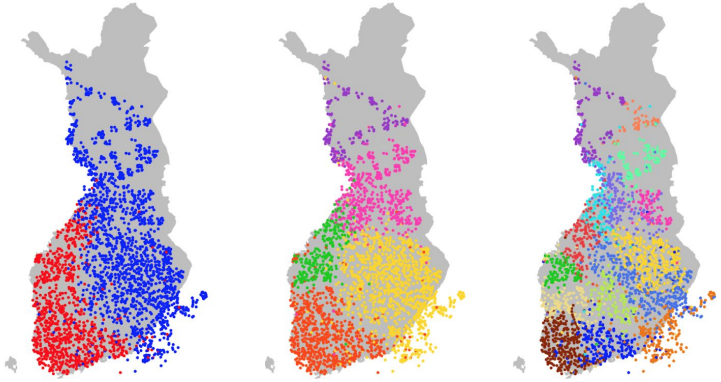
Design Process for Interactive Information Visualization:
Finnish Genetic Structure Data

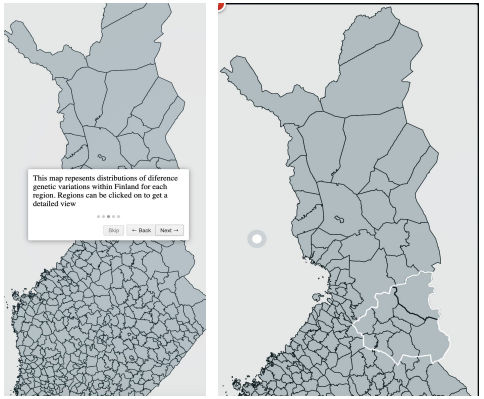
Learn/Observe	**Discovering Data Patterns**	**Quick Prototyping**	**Design and Workshop**	**Implement**
Journey mapping of scientist and researchers in their research **Identifying breakpoints in information expectations** Case studies Literature review **Analysis of existing visualisations**	**Sketching with Data** **Discovering patterns in the data**	**Interactive Visualisation Looking at macro to micro interactions with Data** Building Interactive Visualisation application prototypes	**Co-design workshop with Scientists and researchers** Validating prototypes Implementation of design considering practical aspects	Test in real context Reflect **Publish and Document** **Future Possibilities**

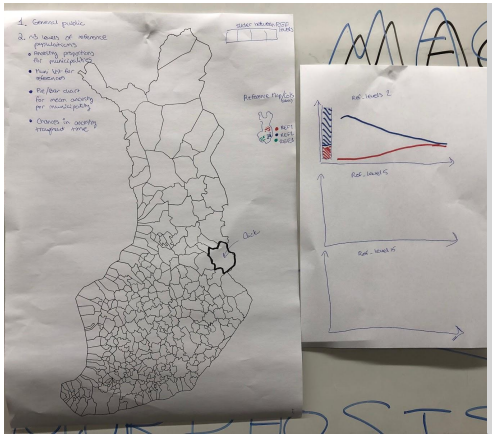
Collaborative Workshop

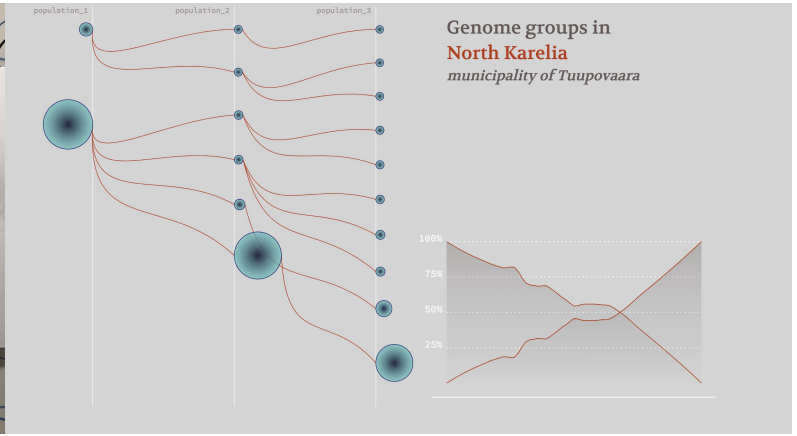
-Defining common discovery expectations

-interactive data sketches



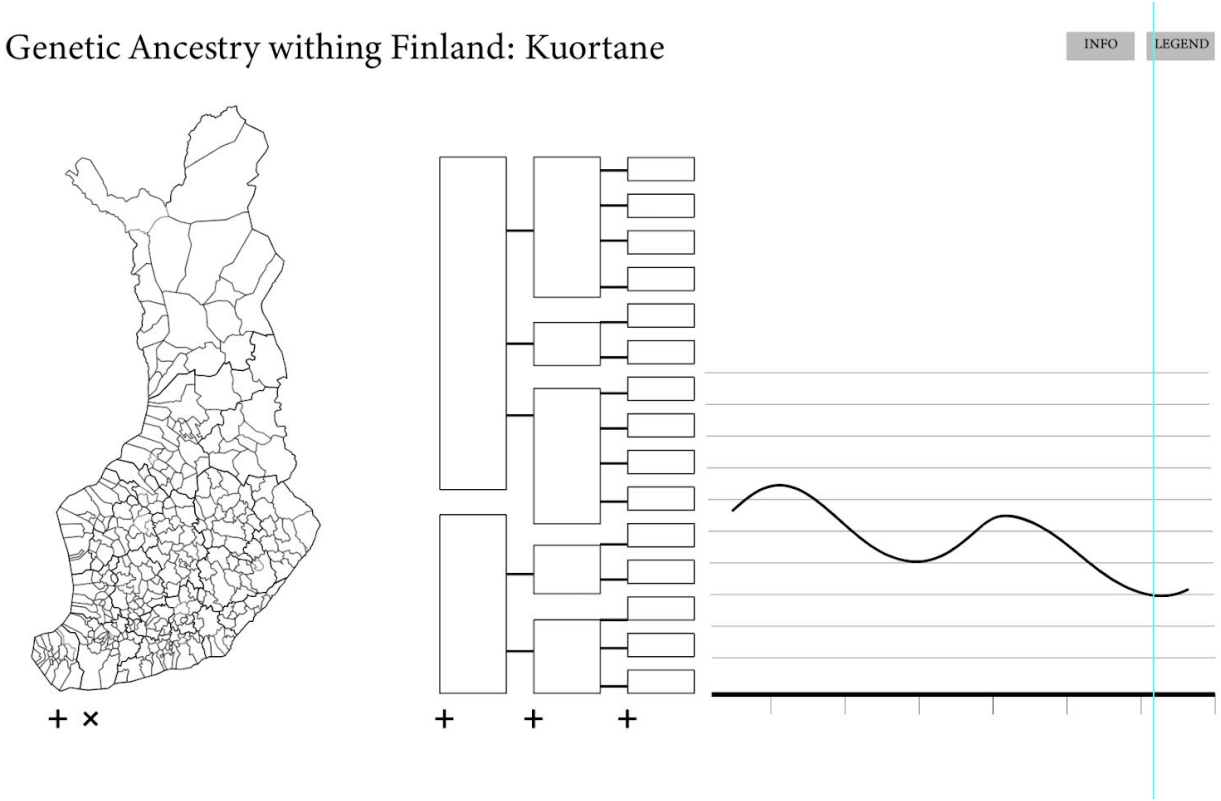






Design Factors:
Data Visualisation

Overview first:
Macro Visualisation
Zoom + Filter
Micro Information
Interaction
Details on Demand
Population Grouping and change over time.



FI EN SE

enter municipality

DETAILS INTRO

Genetic Ancestry within Finland

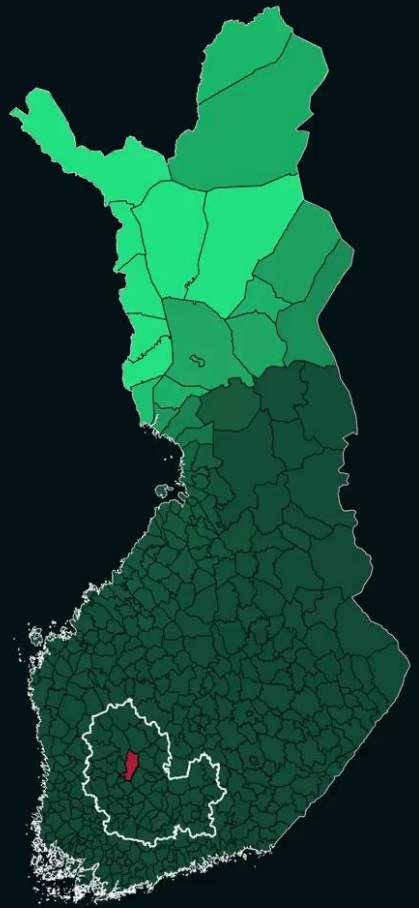
region | municipality

Tavastia | Tampere

Click the large map on left to select a municipality and a region. The chosen municipality is highlighted and the chosen region is outlined in white. If a reference group is selected from the small map on top right, the large map shows the proportion of ancestry from that reference group across Finland.

The small map shows the location of the reference groups. By clicking a reference group, you can see the proportions of ancestry from that reference group across Finland on the large map. You can change the number of reference groups between 2, 6 and 10.

The Ancestry in Municipality tab shows the average genetic ancestry of the selected municipality with respect to the selected level of the reference groups (2, 6 or 10). The three-level tree structure shows the relationships between the three levels of the reference groups. Hover mouse over the bars to see the percentages.



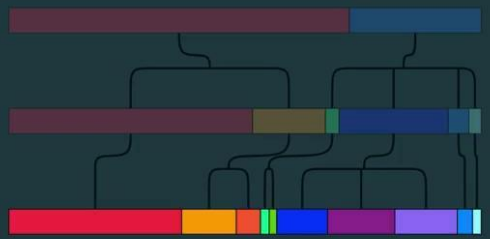
2 Populations

6 Populations

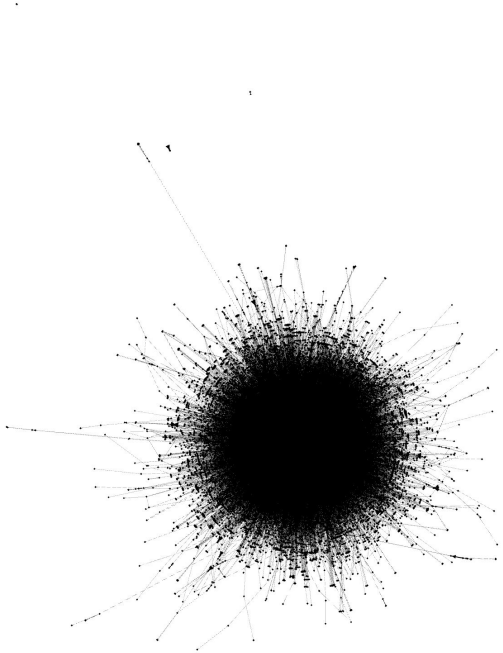
10 Populations

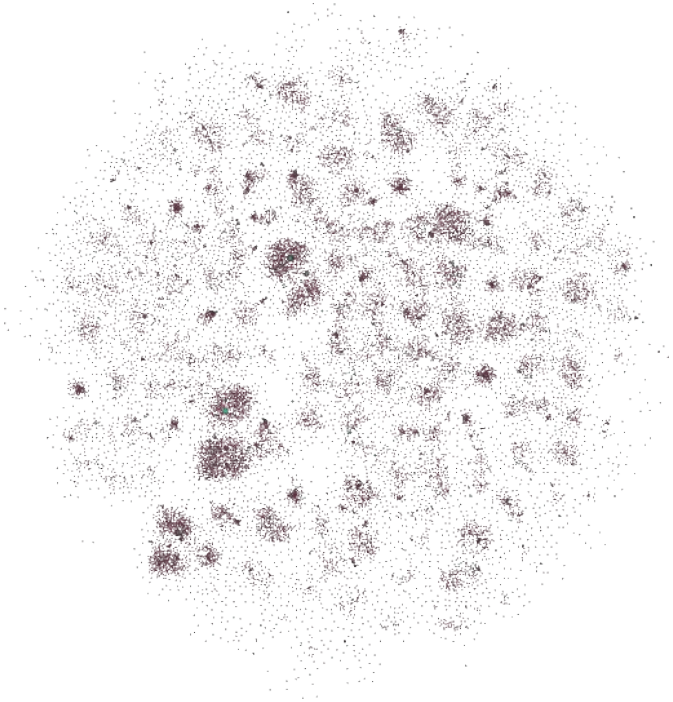
Ancestry in Municipality | Regional Changes

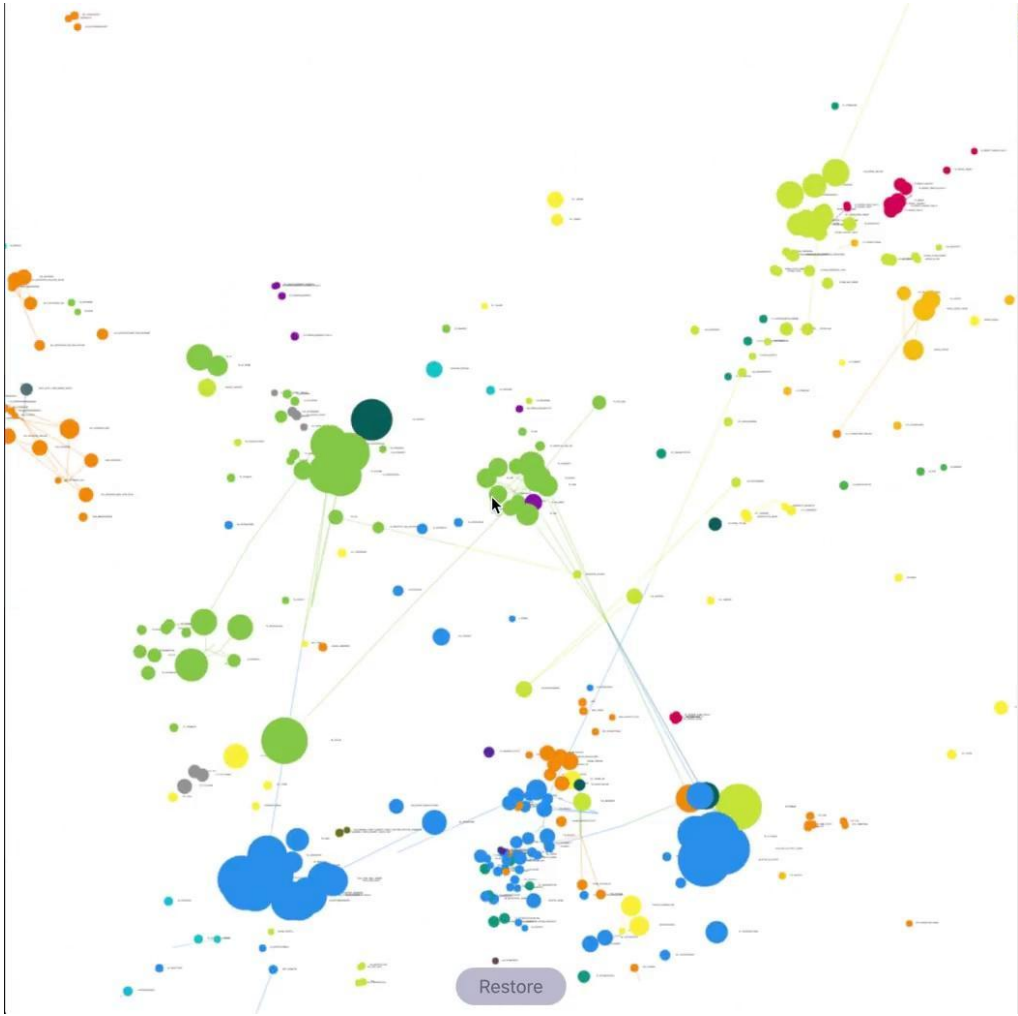
Municipality: Tampere



https://geneviz.aalto.fi/genetic_ancestry_finland/



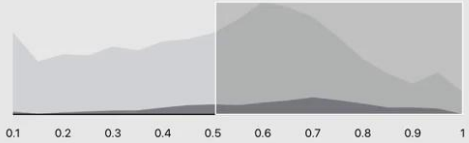




Heart_Left_Ventricle Heart_Atrial_Appendage

heart

from: 0.5055403900146485 to: 1



Experiential Approach:

Pulse of Tripla

Project with City of Helsinki (Megasense)

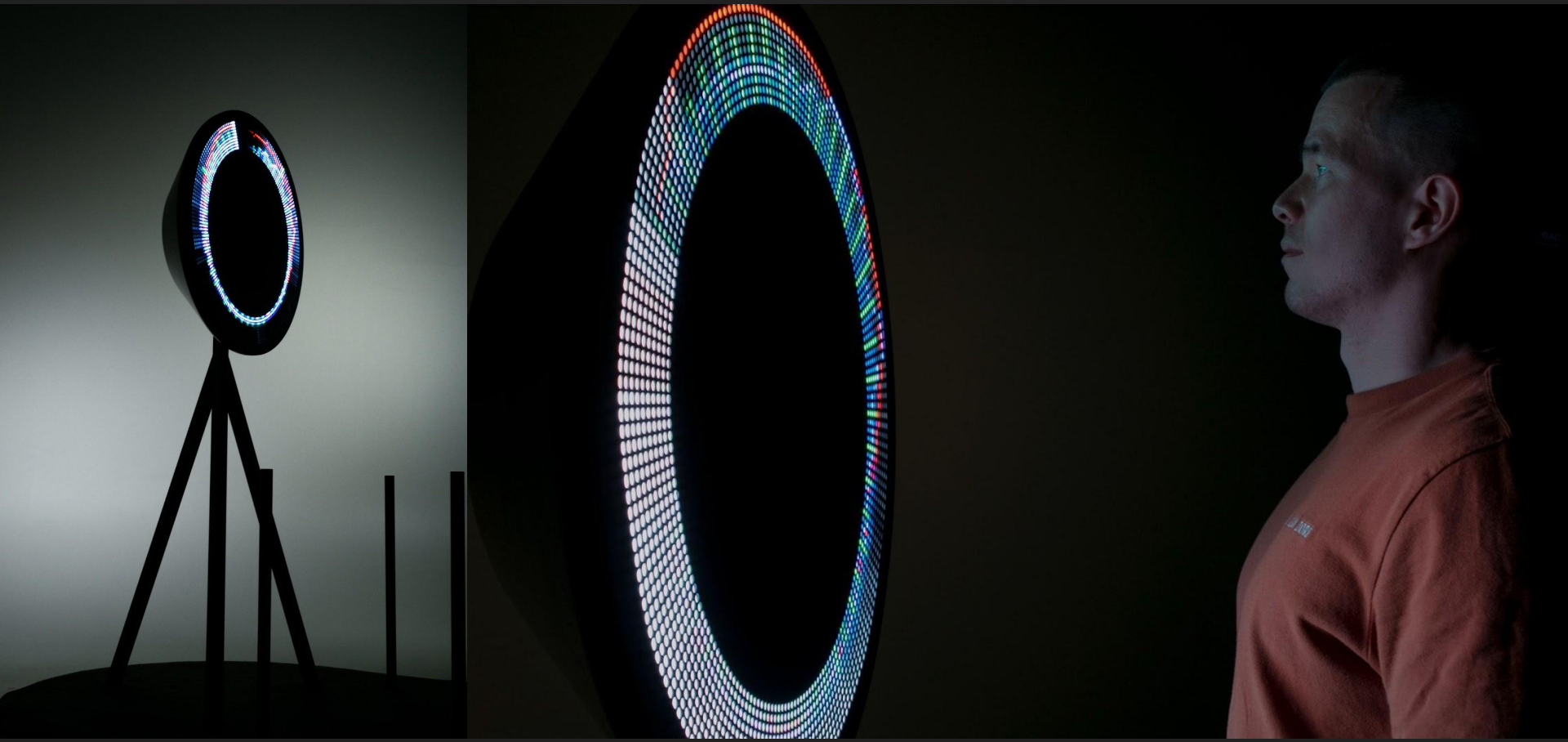
Design Team

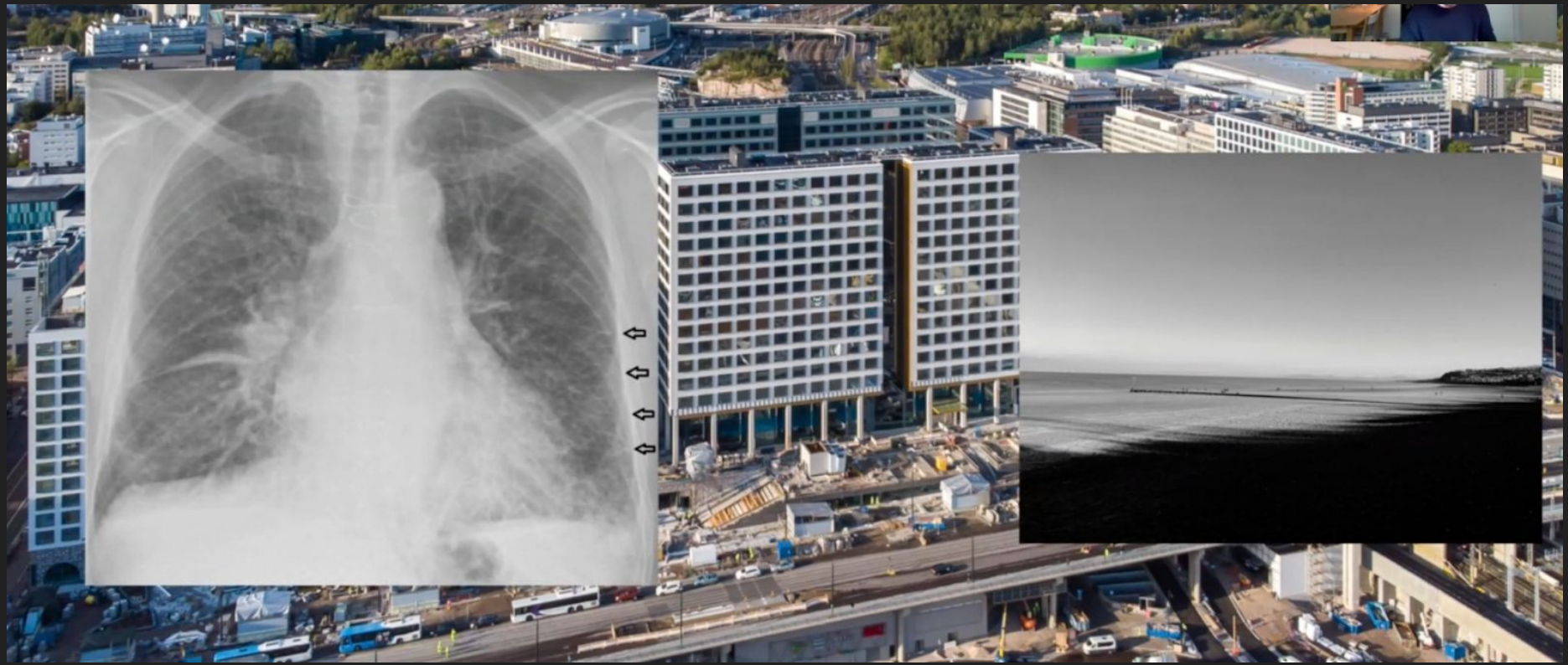
Oilli Ketonen
Kalle Järvenpää
Nicola Cerioli

Koray Tahiroglu
Rupesh Vyas

Challenge:
Turning Air quality Data into Multi-sensory Data Art/Visualisation Sculpture to augment perception

Datasets:
Volatile organic compounds (VOC)
Airborne particulate matter (PM2.5 & PM10)
Carbon dioxide (C02)
Sound pressure





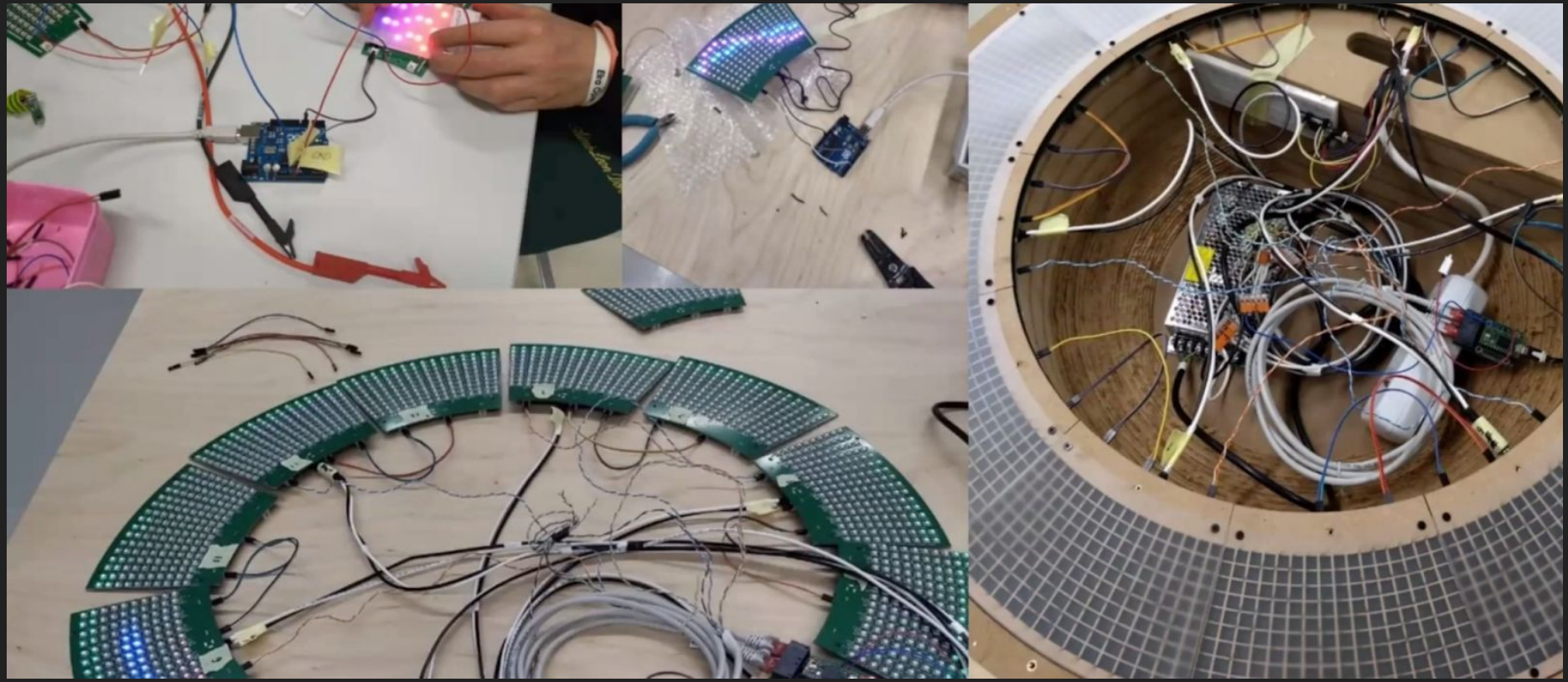
Available Datasets

The available datasets are described here.

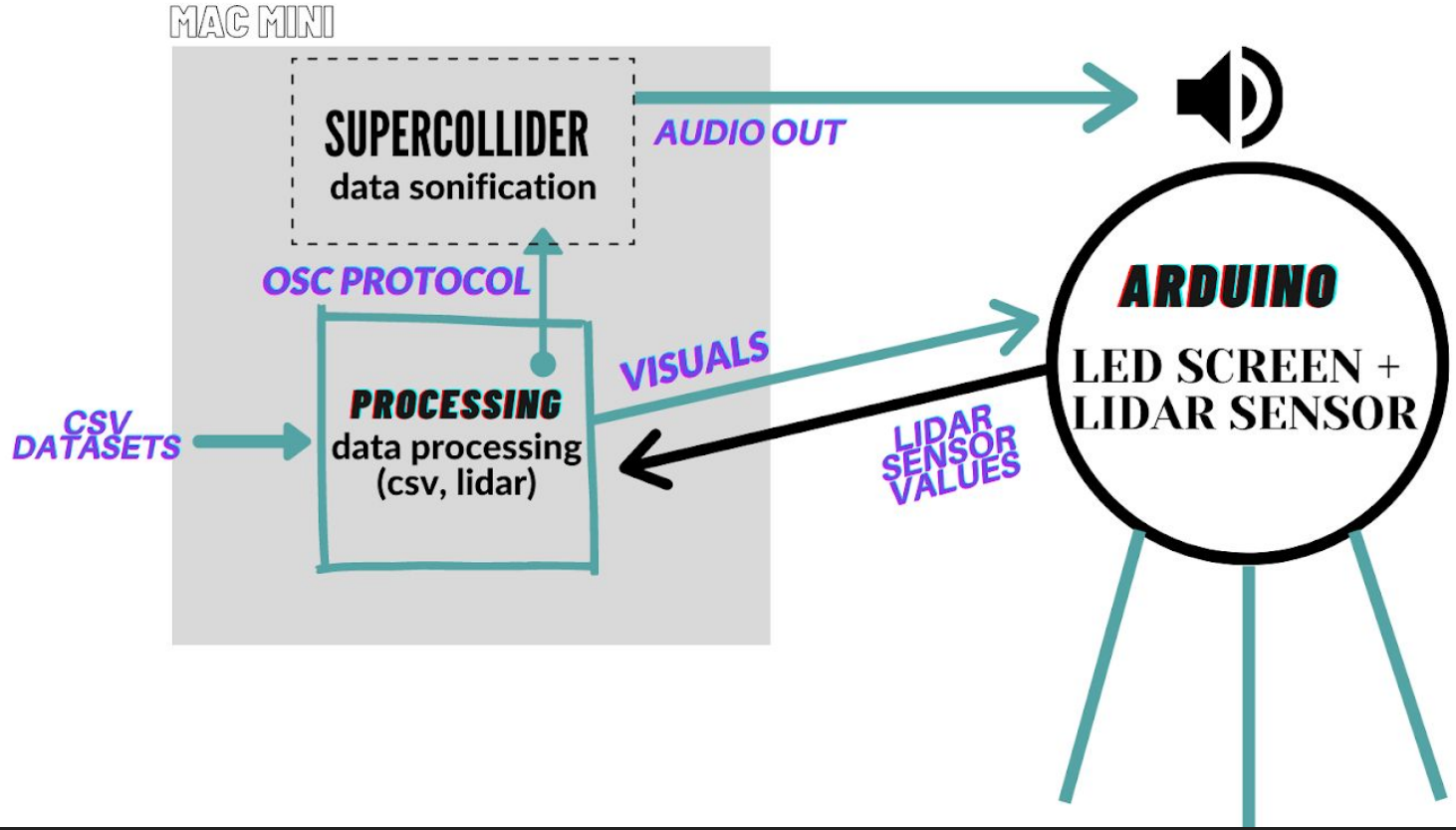
UrbanSense Air Quality Dataset

The Urbansense Air Quality dataset consists of air pollution sensing data reported by low cost sensor devices designed by the University of Helsinki. The devices are stationary and located in and around the Kumpula campus area. The map below shows the locations of currently deployed sensors. All the devices are measuring outdoor air.

Data dimension	Style	Instrument/Sound	Utilized Audio Dimensions	Synthesis technique
co2	musical	cello	pitch, timbre, rhythm	multi-layer sampling
pm2	musical	piano	pitch, timbre, rhythm	multi-layer sampling
TVOC	musical	cello (low)	timbre, amplitude	sample-based granular synthesis
Noise (dB)	abstract	radio static	grain density, granural index	sample-based granular synthesis
Humidity	abstract	water	amplitude, size of water source	multi-layer sampling



Pulse of tripla: data flow




The Pulse of Tripla
Miltä tieto kuulostaa? Astu sisään ja aisti Triplan Pulssi. Vuorovaikutteinen dataveistos tulkitsee ilmanlaadun vaihteluita Mall of Triplassa äänen ja valon avulla.
What is the sound of data? Step in and sense the Pulse of Tripla. The interactive data sculpture uses sound and light to express changes in air quality in the Mall of Tripla.

KOKOUSKESKUS


The Pulse
of Tripla

Learnings:

Collaborate with other knowledge domains as Interdisciplinary synthesis are valuable for future development of Public Sector.

Tools Used:
Javascript, D3, HTML, CSS, Gephi, Python, Node.js

Types of data

Quantitative data(numerical)

Continuous
Discrete

Qualitative data(categorical)

Nominal
Ordinal

Qualitative data

Ordinal data
"Difference and order are implied BUT,
intervals are no longer equivalent.
Example :- ranking system

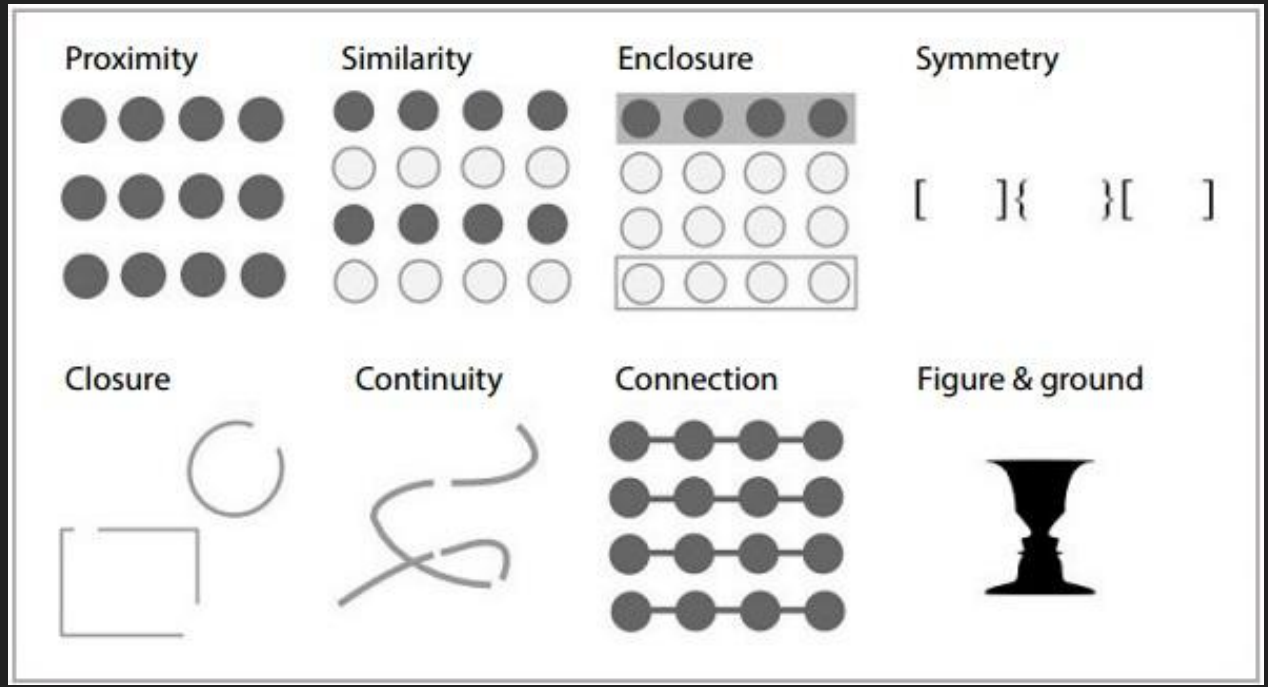
Nominal data
"Only difference is implied.
"Observations are classified into mutually exclusive categories.
"Examples: Gender, ID numbers, pass/fail response

Quantitative data

- **Discrete:** Reflects a number obtained by counting **no decimal**.
- **Continuous:** Reflects a measurement; the number of decimal places depends on the precision of the measuring device.
- **Ratio scale:** Order and distance implied. Differences can be compared; has a true zero. Ratios can be compared.
  Examples: Height, weight, blood pressure
- **Interval scale:** Order and distance implied. Differences can be compared; no true zero. Ratios cannot be compared.
  Example: Temperature in Celsius.

Innate disposition to perceive patterns

Gestalt Visual Perception Principles

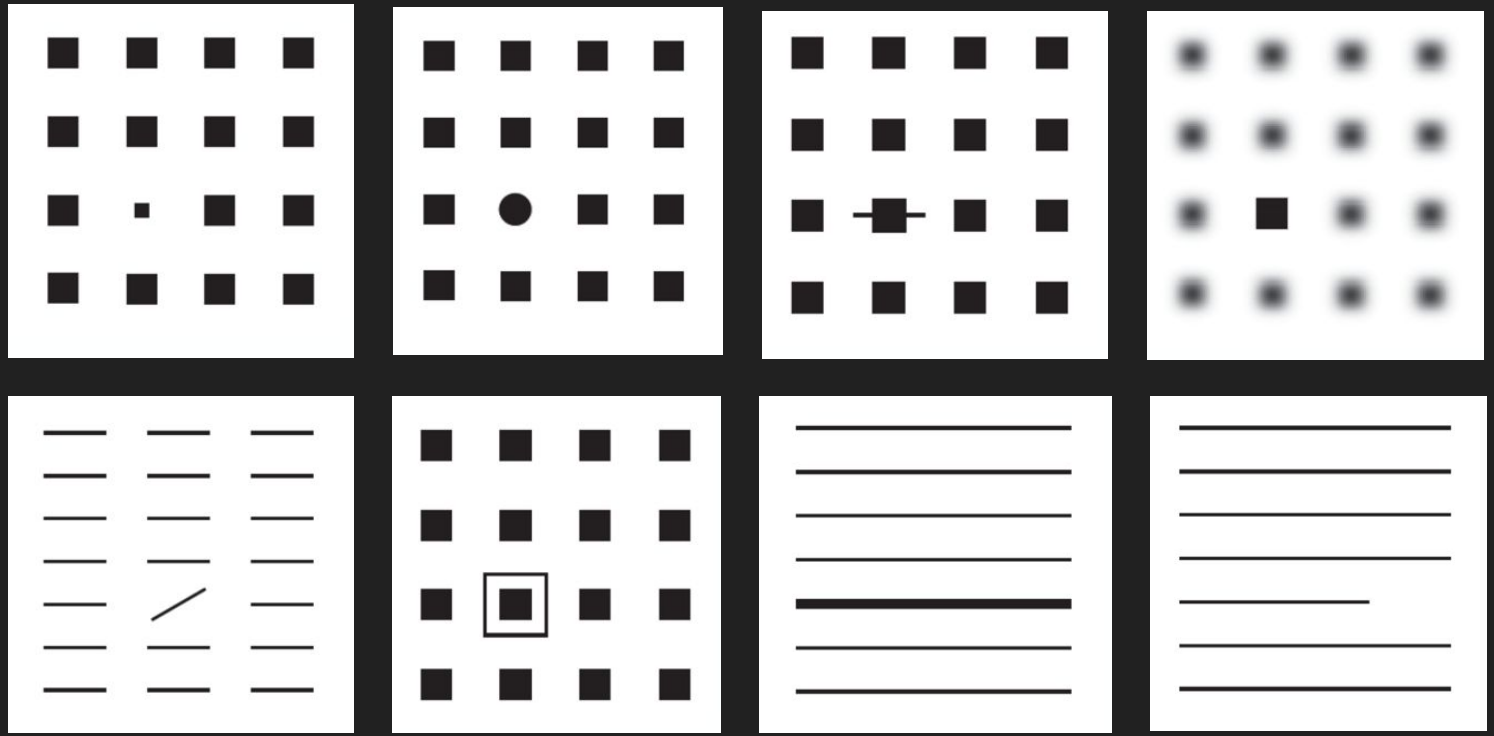


Visual Perception offers handles to free up memory.

MTHIVLWYAGHKILKMTWYN
ARDCAIREQGFPSTWYARN
GFPSWCEILQSNDRCEQDIF
SGHLMFHKMEQTWRN

Visual Perception offers handles to free up memory.

MTHIVL**W**YAGHKILKMT**W**YN
ARDCAIREQGFPST**W**YARN
GFPS**W**CEILQSNDRCEQDIF
SGHLMFHKMEQT**W**RN



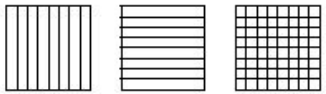
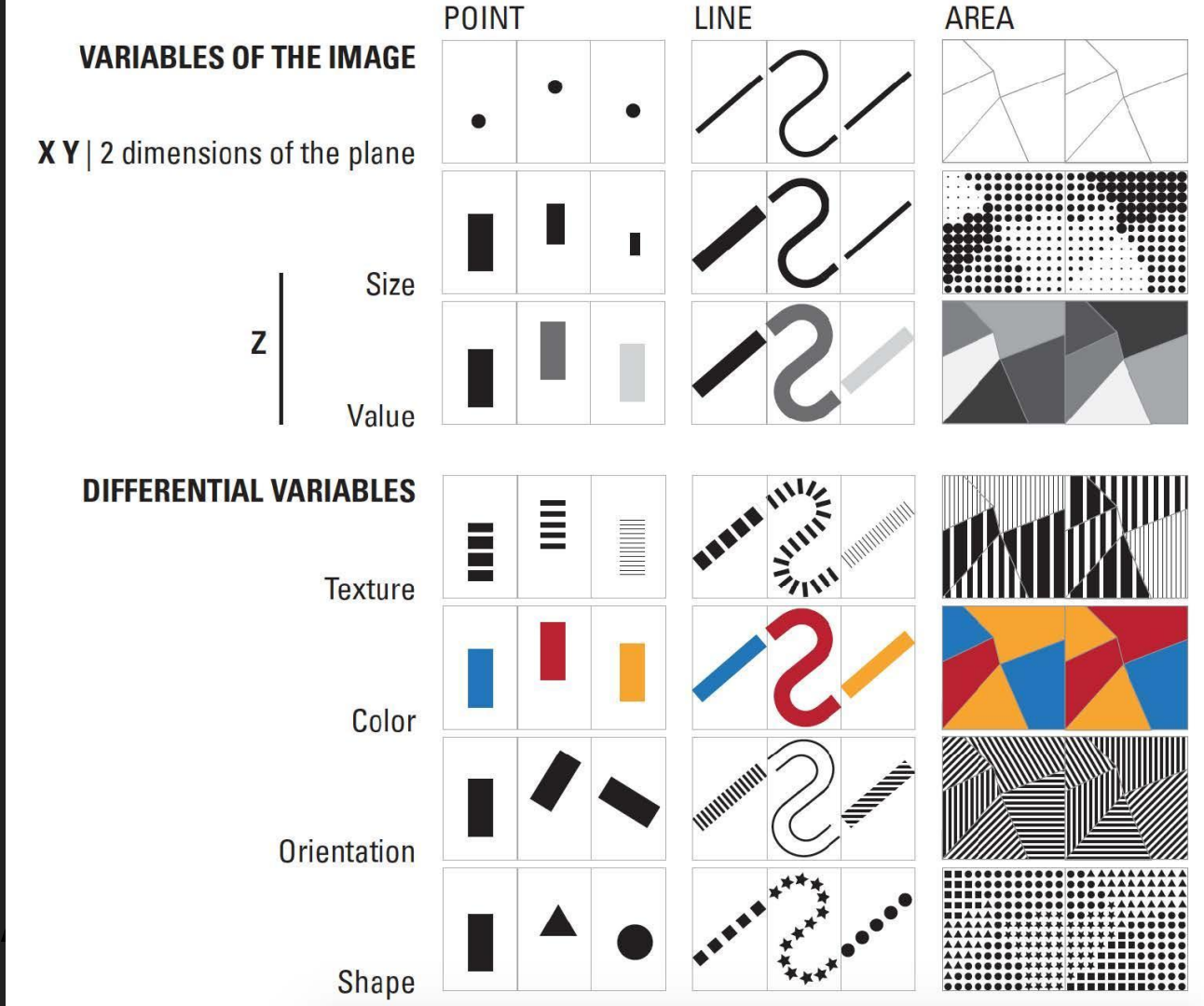
Position changes in x, y, and z location	
Size changes in length, area or volume	
Shape infinite number of shape	
Value changes from light to dark	
Color changes in hue	
Orientation changes in alignment	
Texture variation in 'grain' and texture	

Fig. 2.2 Original visual variable (redrawn from Bertin et al.[22])


POINT
LINE
AREA
VARIABLES OF THE IMAGE
X Y | 2 dimensions of the plane
Z
Size
Value
DIFFERENTIAL VARIABLES
Texture
Color
Orientation
Shape

Mackinlay[23] expanded Bertin's variables and proposes effectiveness of encodings by data type.

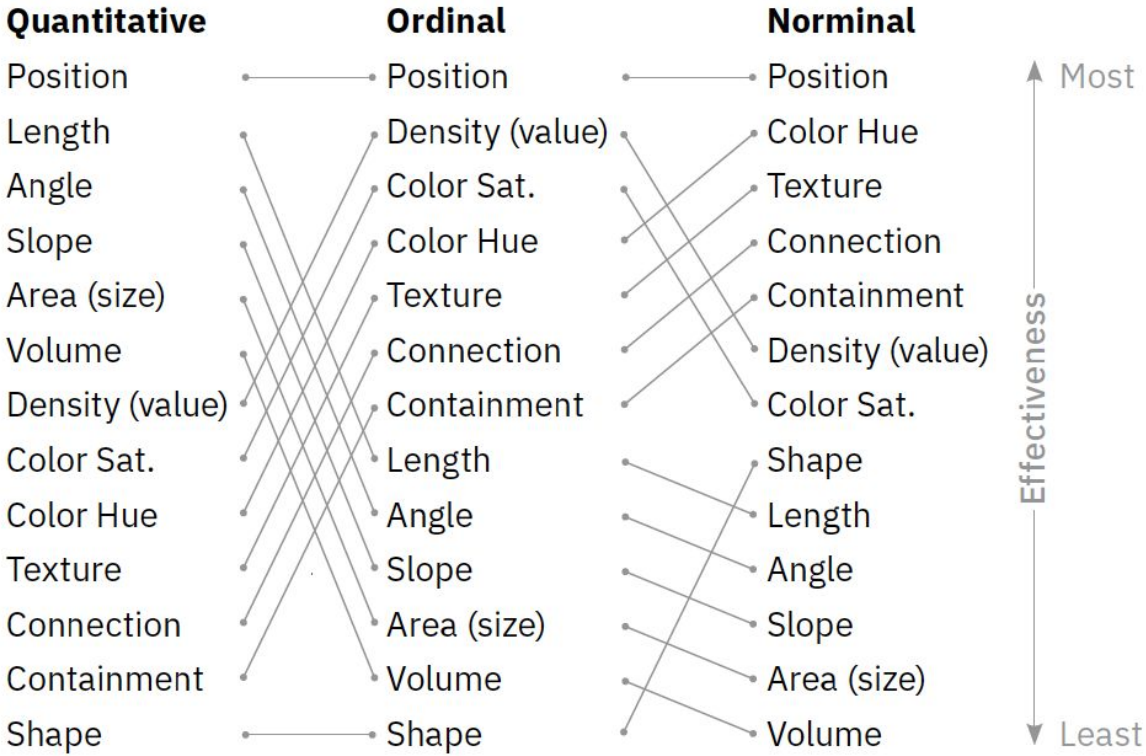
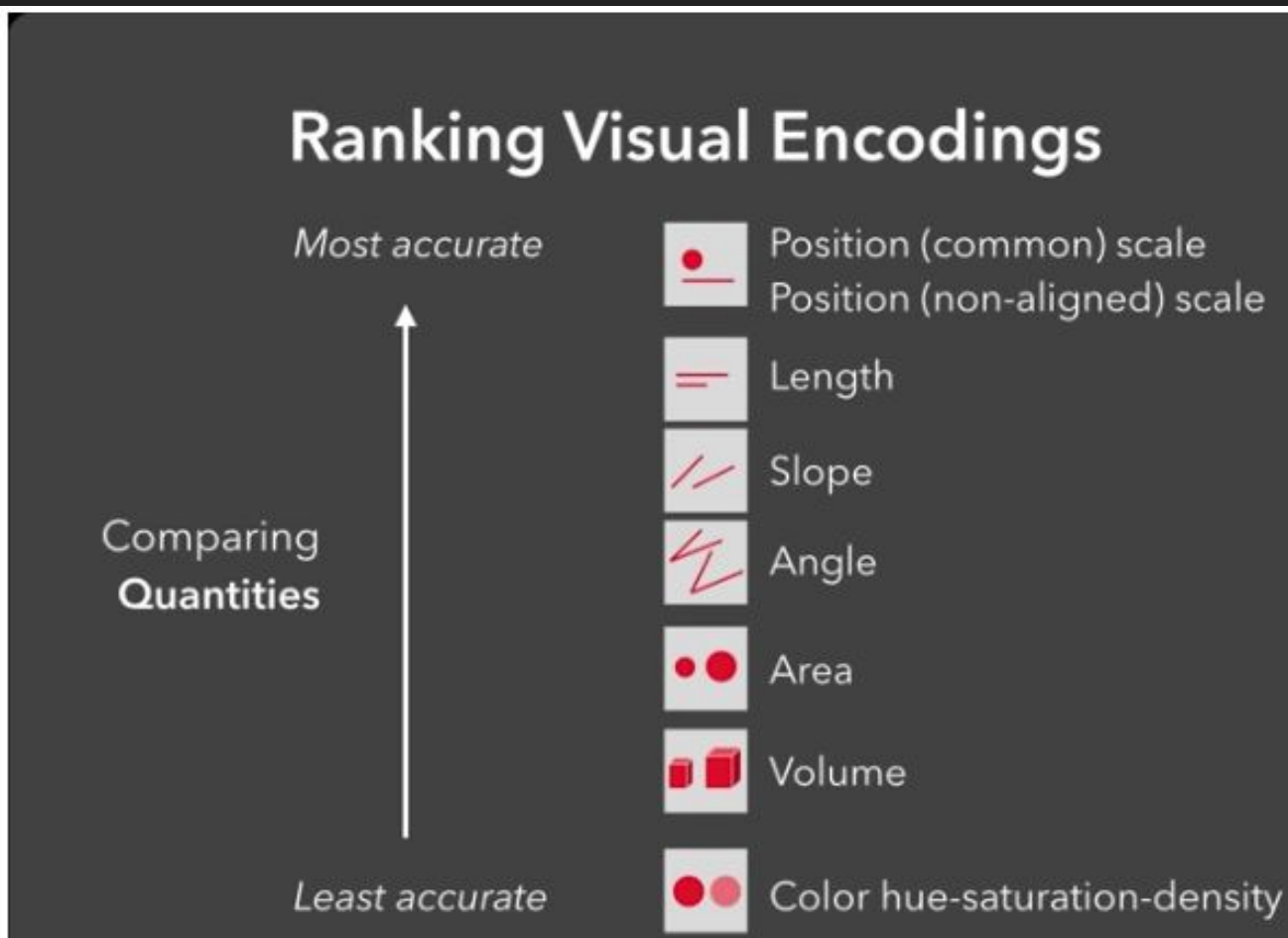


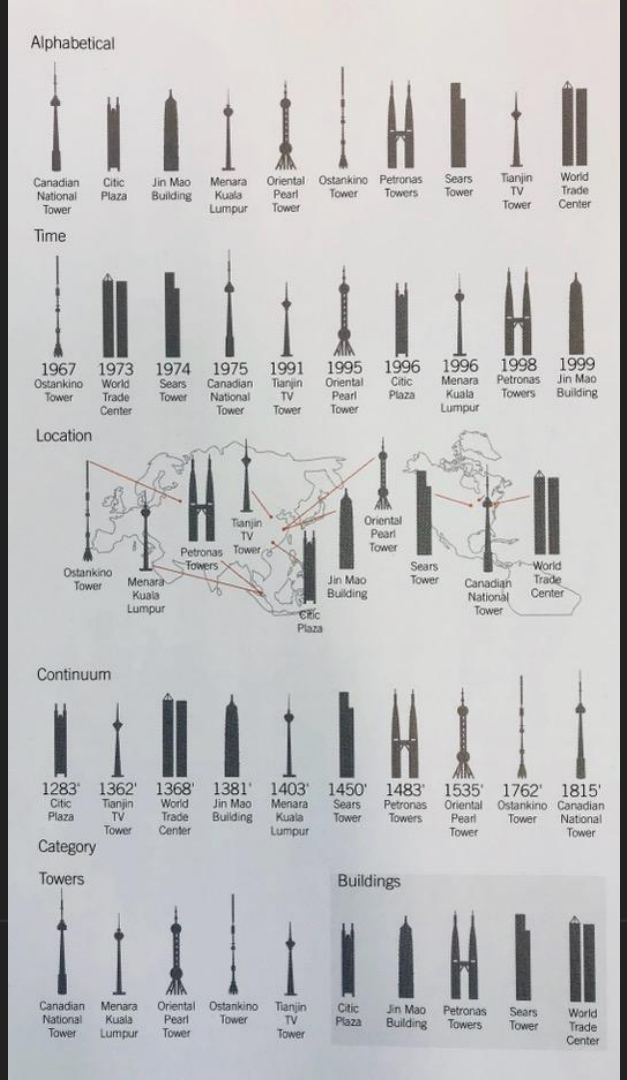
Fig. 2.3 Effective ranking of visual variable (redrawn from Mackinlay[23])

Ranking Visual Encodings



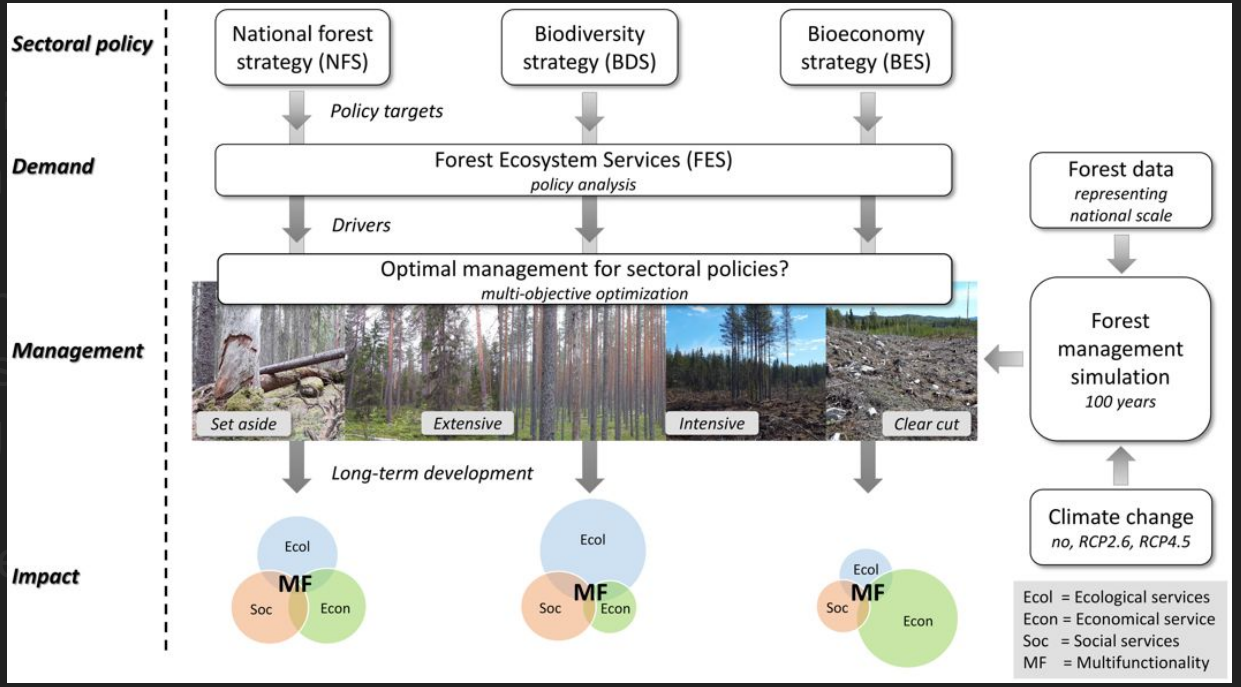
Wurman's LATCH Theory

Location,
Alphabet,
Time,
Category,
Hierarchy

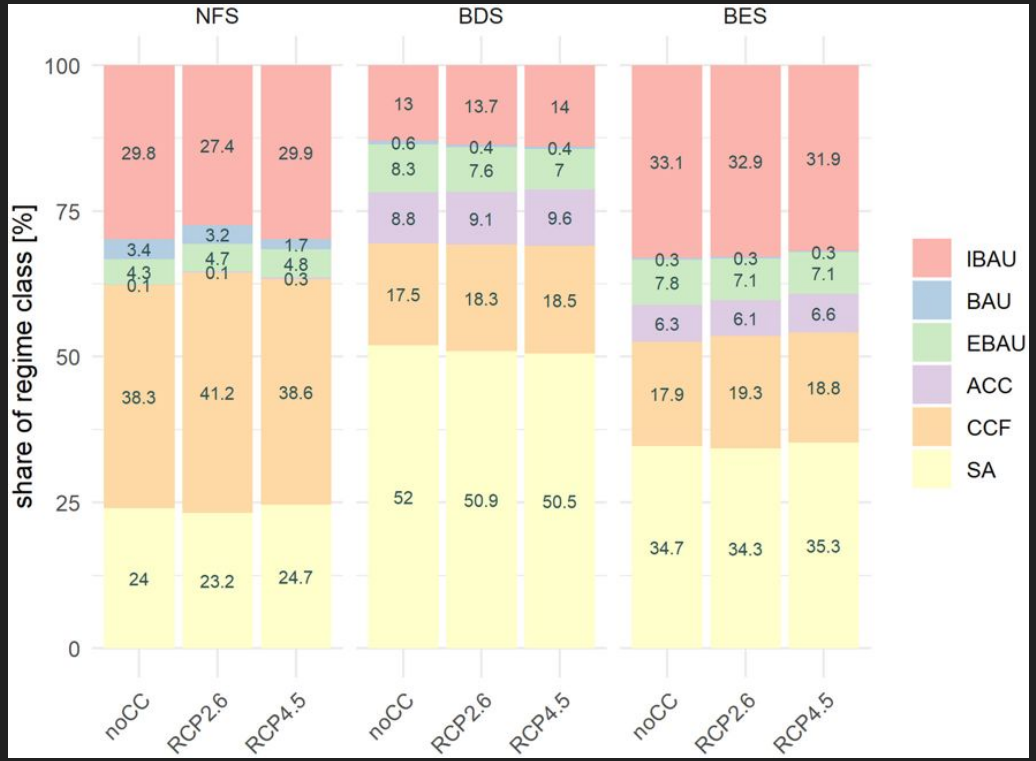


https://demo.with-modality.com/en/studies/touristic-sites/

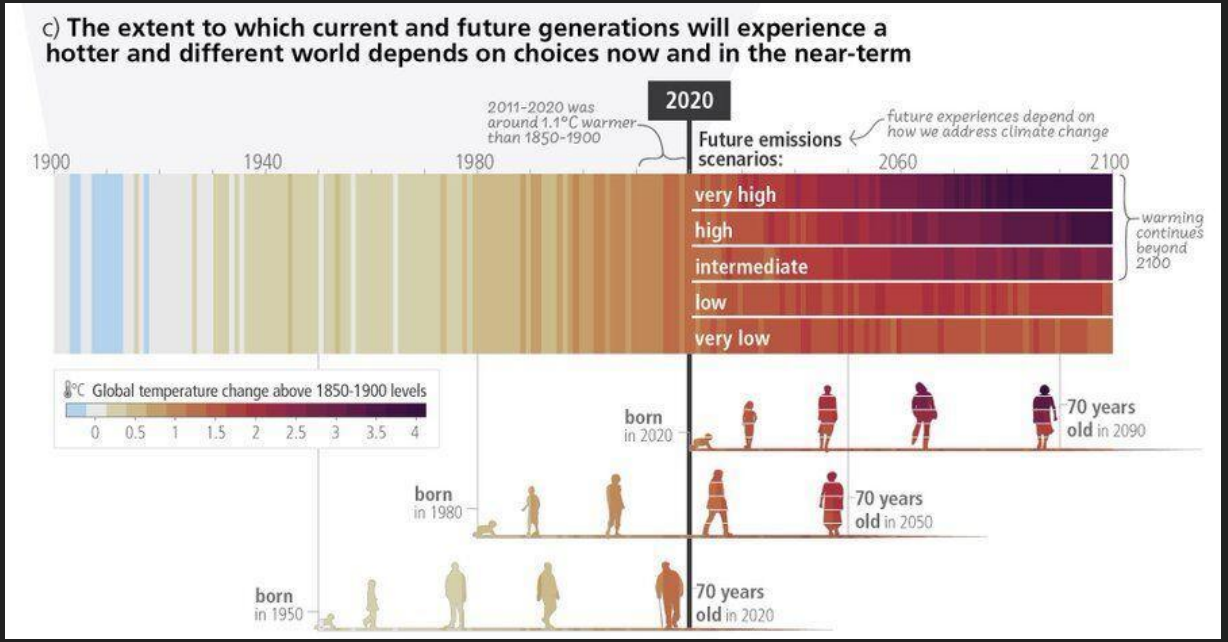
Sectoral policies cause incoherence in forest management and ecosystem service provisioning

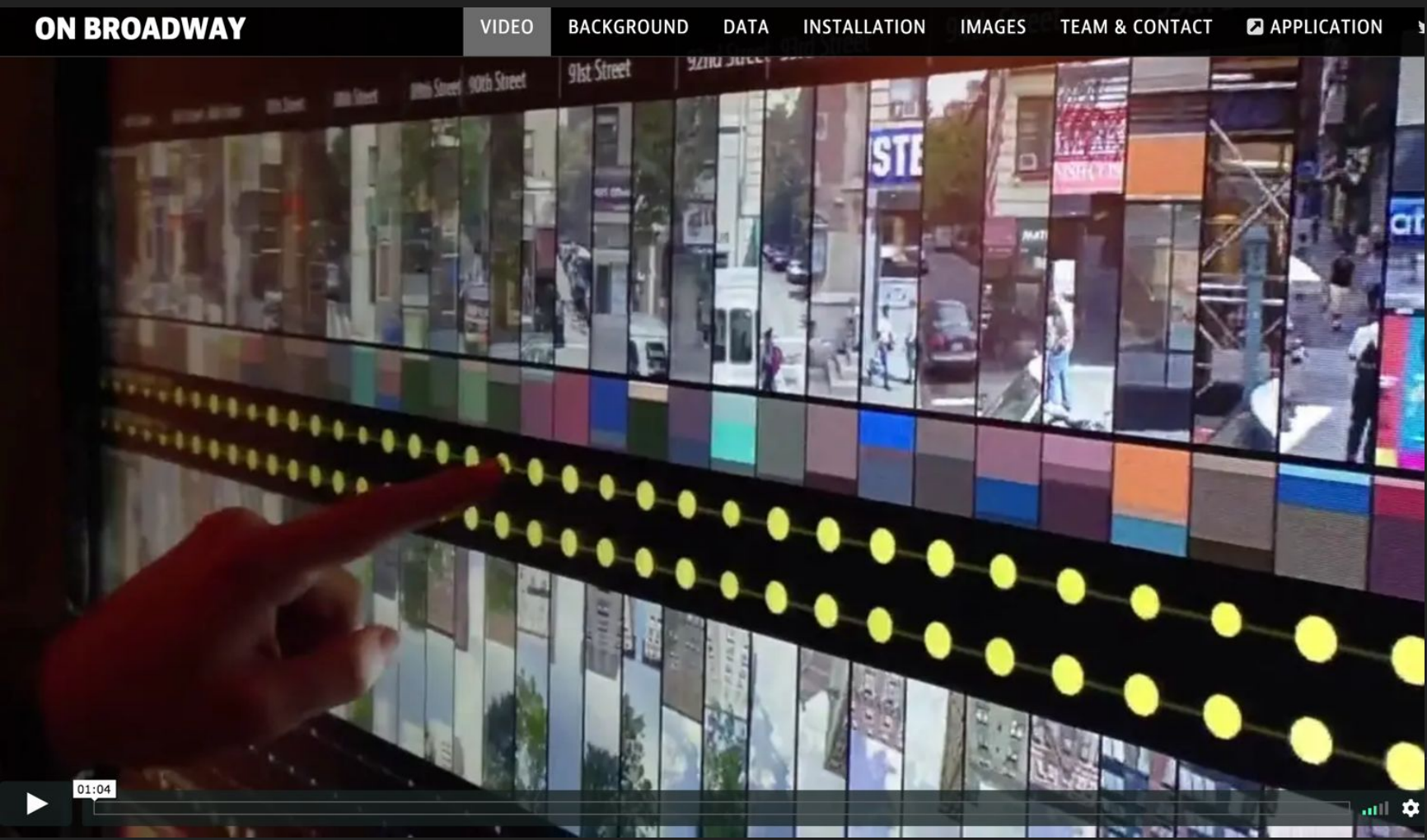


https://www.sciencedirect.com/science/article/pii/S1389934122000016?via%3Dihub#f0020


NFS
BDS
BES
share of regime class [%]
100
75
50
25
0
29.8
27.4
29.9
3.4
3.2
1.7
4.3
4.7
4.8
0.1
0.1
0.3
38.3
41.2
38.6
24
23.2
24.7
13
13.7
14
0.6
0.4
0.4
8.3
7.6
7
8.8
9.1
9.6
17.5
18.3
18.5
52
50.9
50.5
33.1
32.9
31.9
0.3
0.3
0.3
7.8
7.1
7.1
6.3
6.1
6.6
17.9
19.3
18.8
34.7
34.3
35.3
noCC
RCP2.6
RCP4.5
noCC
RCP2.6
RCP4.5
noCC
RCP2.6
RCP4.5
IBAU
BAU
EBAU
ACC
CCF
SA

IPCC report


c) The extent to which current and future generations will experience a hotter and different world depends on choices now and in the near-term
2020
2011-2020 was around 1.1°C warmer than 1850-1900
future experiences depend on how we address climate change
1900
1940
1980
Future emissions scenarios:
2060
2100
very high
high
intermediate
low
very low
warming continues beyond 2100
°C Global temperature change above 1850-1900 levels
0 0.5 1 1.5 2 2.5 3 3.5 4
born in 2020
70 years old in 2090
born in 1980
70 years old in 2050
born in 1950
70 years old in 2020



http://on-broadway.nyc/

Width of the Region Km²

People Leaving in the Region

Region

from Northernmost to Southernmost

Physicians in the Region

Physician's Vacant Positions

(low - medium - high)

Queuing Factor:

Quantity of People Waiting for treatment

People in the region

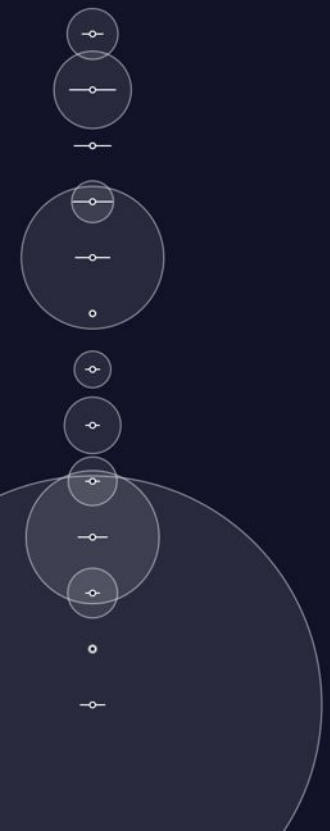
Voronoy Tesselation of Hospitals in Finland

The larger the area, the further the hospital

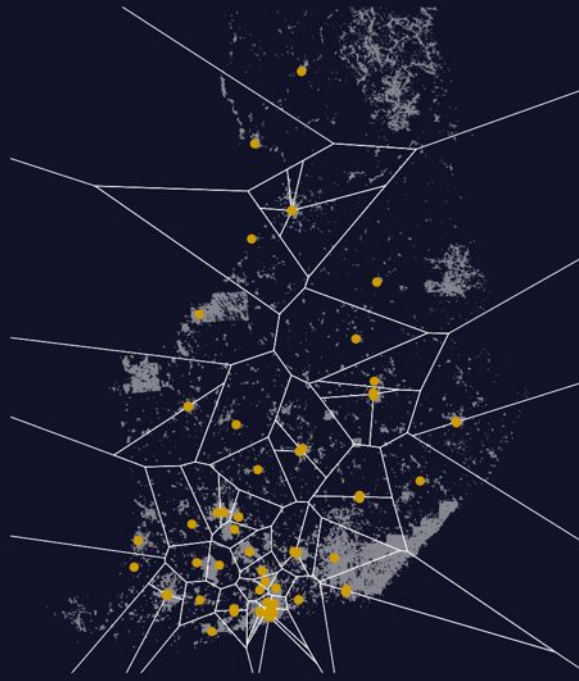
For each building in areas generated by white lines the the yellow dot in the same area represents the closer hospital

Hospital

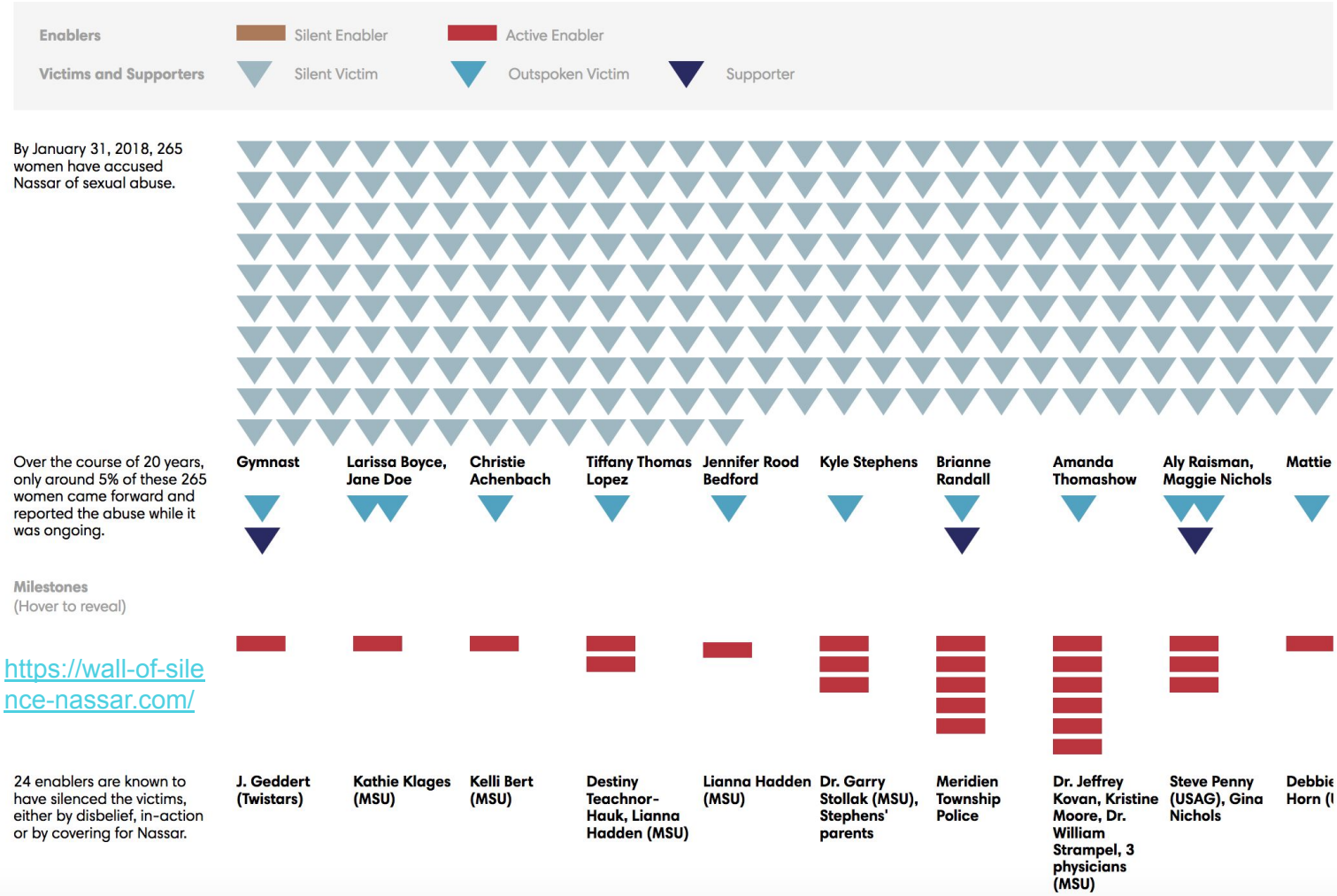
Buildings



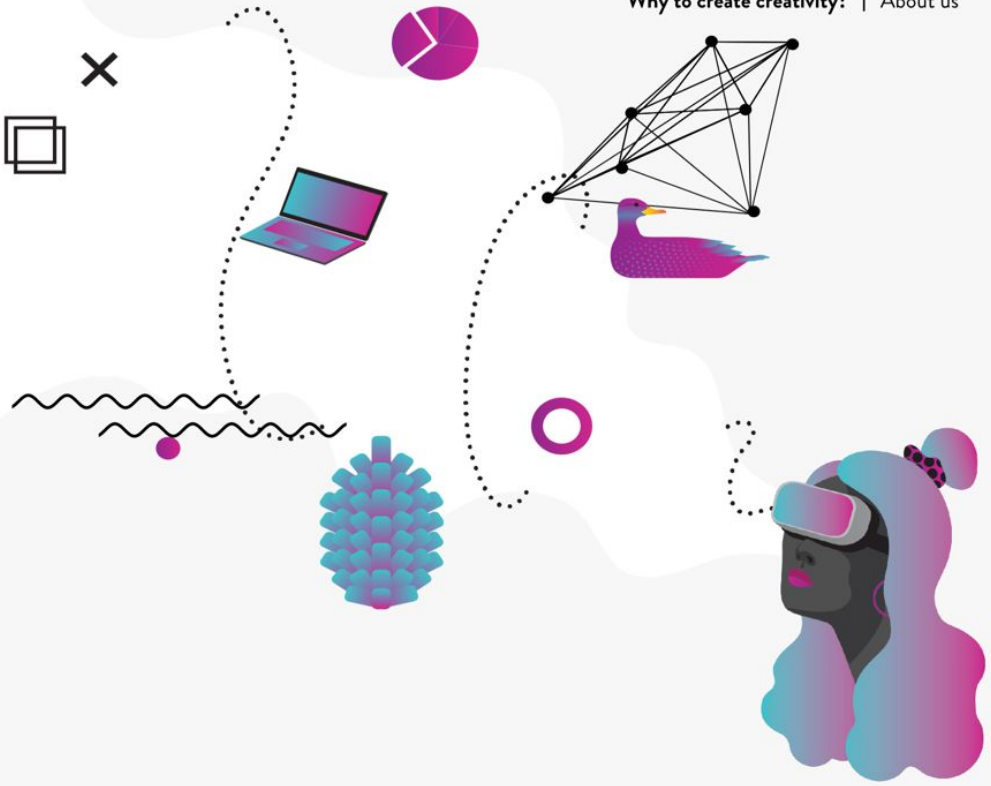
Region	Physicians in the Region	Physician's Vacant Positions	Queuing Factor
Ostrobothnia	●	○ ○	
Central Finland	●	○	
S. Ostrobothnia	●	○	
S. Savonia	●	○ ○	
Pirkanmaa	●	● ●	
Satakunta	●	○	
S. Karelia	●	○	
Päijänne Tavastia	●		
Tavastia Proper	●		
Southwest Finland	●	● ●	
Kymenlaakso	●	○	
Åland Islands	●		
Uusimaa	●	● ●	



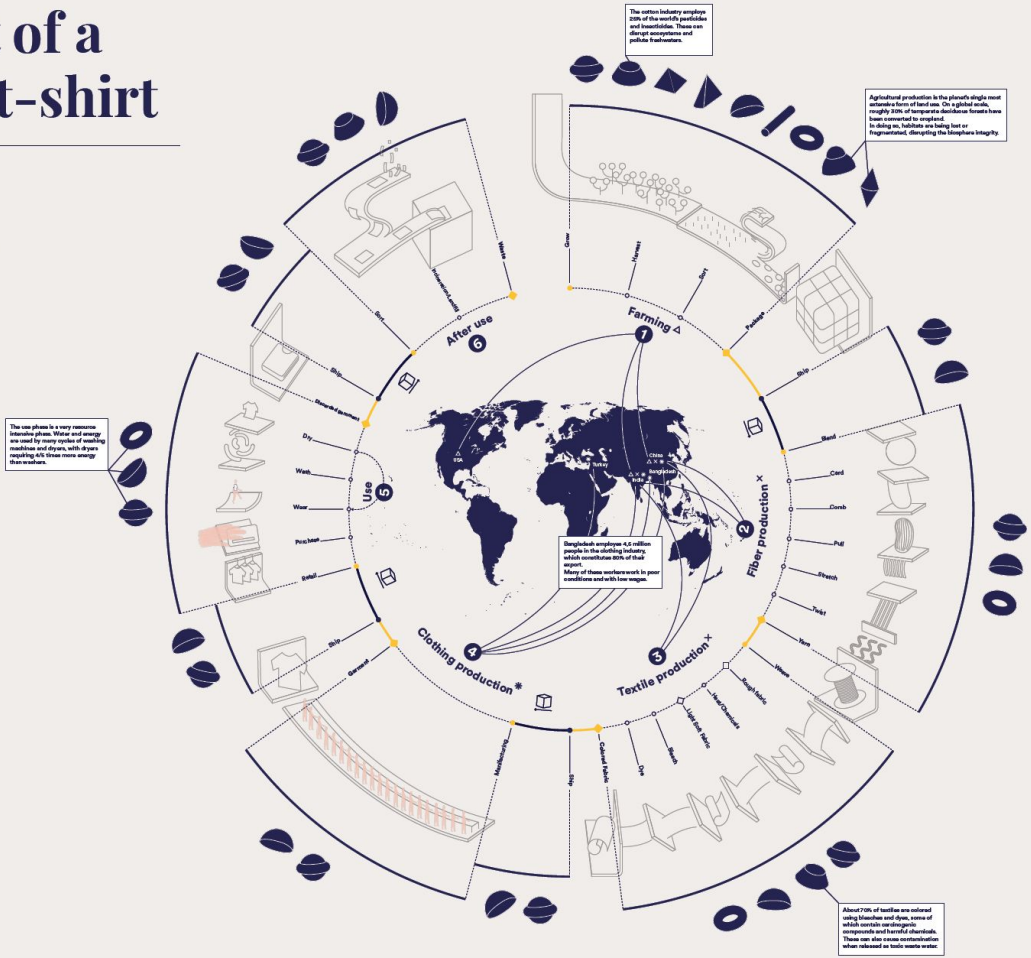
Nassar's Enablers



Why to create creativity



Impact of a cotton t-shirt



Climate change

Recent evidence suggests that the Earth, now passing 390 ppmv CO_2 in the atmosphere, has already transgressed the planetary boundary and is approaching several Earth system thresholds. We have reached a point at which the loss of summer polar sea-ice is almost certainly irreversible. This is one example of a well-defined threshold above which rapid physical feedback mechanisms can drive the Earth system into a much warmer state with sea levels metres higher than present. The weakening or reversal of terrestrial carbon sinks, for example through the on-going destruction of the world's rainforests, is another potential tipping point, where climate-carbon cycle feedbacks exacerbate Earth's warming and intensify the climate impacts. A major question is how long we can remain near this boundary before large, irreversible changes become unavoidable.

Novel entities and chemical pollution

Emissions of toxic and long-lived substances such as synthetic organic pollutants, heavy metal compounds and radioactive materials represent some of the key human-driven changes to the planetary environment. These compounds can have potentially irreversible effects on living organisms and on the physical environment (by affecting atmospheric processes and climate). Even when the uptake and bioaccumulation of chemical pollution is at sub-lethal levels for organisms, the effects of reduced fertility and the potential of permanent genetic damage can have severe effects on ecosystems far removed from the source of the pollution. For example, persistent organic compounds have caused dramatic reductions in bird populations and impaired reproduction and development in marine mammals. There are many examples of additive and synergic effects from these compounds, but these are still poorly understood scientifically. At present, we are unable to quantify a single chemical pollution boundary, although the risk of crossing Earth system thresholds is considered sufficiently well-defined for it to be included in the list as a priority for preanctionary action and for further research.

Stratospheric ozone depletion

The stratospheric ozone layer in the atmosphere filters out ultraviolet (UV) radiation from the sun. If this layer decreases, increasing amounts of UV radiation will reach ground level.
This can cause a higher incidence of skin cancer in humans as well as damage to terrestrial and marine biological systems. The appearance of the Antarctic ozone hole was proof that increased concentrations of anthropogenic ozone-depleting chemical substances, interacting with polar stratospheric clouds, had passed a threshold and moved the Antarctic stratosphere into a new regime. Fortunately, because of the actions taken as a result of the Montreal Protocol, we appear to be on the path that will allow us to stay within this boundary.

Atmospheric aerosol loading

An atmospheric aerosol planetary boundary was proposed primarily because of the influence of aerosols on Earth's climate system. Through their interaction with water vapour, aerosols play a critically important role in the hydrological cycle affecting cloud formation and global-scale and regional patterns of atmospheric circulation, such as the monsoon systems in tropical regions. They also have a direct effect on climate, by changing how much solar radiation is reflected or absorbed in the atmosphere. Humans change the aerosol loading by emitting atmospheric pollution (many pollutant gases condense into droplets and particles), and also through land-use change that increases the release of dust and smoke into the air. Shifts in climate regimes and monsoon systems have already been seen in highly polluted environments, giving a quantifiable regional measure for an aerosol boundary. A further reason for an aerosol boundary is that aerosols have adverse effects on many living organisms. Inhaling highly polluted air causes roughly 800,000 people to die prematurely each year. The toxicological and ecological effects of aerosols may thus relate to other Earth system thresholds. However, the behaviour of aerosols in the atmosphere is extremely complex, depending on their chemical composition and their geographical location and height in the atmosphere. While many relationships between aerosols, climate and ecosystems are well established, many causal links are yet to be determined.

Ocean acidification

Around a quarter of the CO_2 that humanity emits into the atmosphere is ultimately dissolved in the oceans. Here it forms carbonic acid, altering ocean chemistry and decreasing the pH of the surface water. This increased acidity reduces the amount of available carbonate ions, an essential 'building block' used by many marine species for shell and skeleton formation. Beyond a threshold concentration, this rising acidity makes it hard for organisms such as corals and some shellfish and plankton species to grow and survive. Losses of these species would change the structure and dynamics of ocean ecosystems and could potentially lead to drastic reductions in fish stocks. Compared to pre-industrial times, surface ocean acidity has already increased by 30 percent. Unlike most other human impacts on the marine environment, which are often local in scale, the ocean acidification boundary has ramifications for the whole planet. It is also an example of how tightly interconnected the boundaries are, since atmospheric CO_2 concentration is the underlying controlling variable for both the climate and the ocean acidification boundaries, although they are defined in terms of different Earth system thresholds.

Biogeochemical flows

The biogeochemical cycles of nitrogen and phosphorus have been radically changed by humans as a result of many industrial and agricultural processes. Nitrogen and phosphorus are both essential elements for plant growth, so fertilizer production and application is the main concern. Human activities now convert more atmospheric nitrogen into reactive forms than all of the Earth's terrestrial processes combined. Much of this new reactive nitrogen is emitted to the atmosphere in various forms rather than taken up by crops. When it is released, it pollutes waterways and coastal areas or accumulates in the terrestrial biosphere. Similarly, a relatively small proportion of phosphorus fertilizers applied to food production systems is taken up by plants; much of the phosphorus mobilized by humans also ends up in aquatic systems. These can become oxygen-starved as bacteria consume the blooms of algae that grow in response to the high nutrient supply. A significant fraction of the applied nitrogen and phosphorus makes its way to the sea, and can push marine and aquatic systems across ecological thresholds of their own. One regional-scale example of this effect is the decline in the shrimp catch in the Gulf of Mexico's 'dead zone' caused by fertilizer transported in rivers from the US Midwest.

Freshwater use

The freshwater cycle is strongly affected by climate change and its boundary is closely linked to the climate boundary, yet human pressure is now the dominant driving force determining the functioning and distribution of global freshwater systems. The consequences of human modification of water bodies include both global-scale river flow changes and shifts in vapour flows arising from land use change. These shifts in the hydrological system can be abrupt and irreversible. Water is becoming increasingly scarce - by 2050 about half a billion people are likely to be subject to water-stress, increasing the pressure to intervene in water systems. A water boundary related to consumptive freshwater use and environmental flow requirements has been proposed to maintain the overall resilience of the Earth system and to avoid the risk of 'cascading' local and regional thresholds.

Land-system change

Land is converted to human use all over the planet. Forests, grasslands, wetlands and other vegetation types have primarily been converted to agricultural land. This land-use change is one driving force behind the serious reductions in biodiversity, and it has impacts on water flows and on the biogeochemical cycling of carbon, nitrogen and phosphorus and other important elements. While each incident of land cover change occurs on a local scale, the aggregated impacts can have consequences for Earth system processes on a global scale. A boundary for human changes to land systems needs to reflect not just the absolute quantity of land, but also its function, quality and spatial distribution. Forests play a particularly important role in controlling the local dynamics of land use and climate, and is the focus of the boundary for land system change.

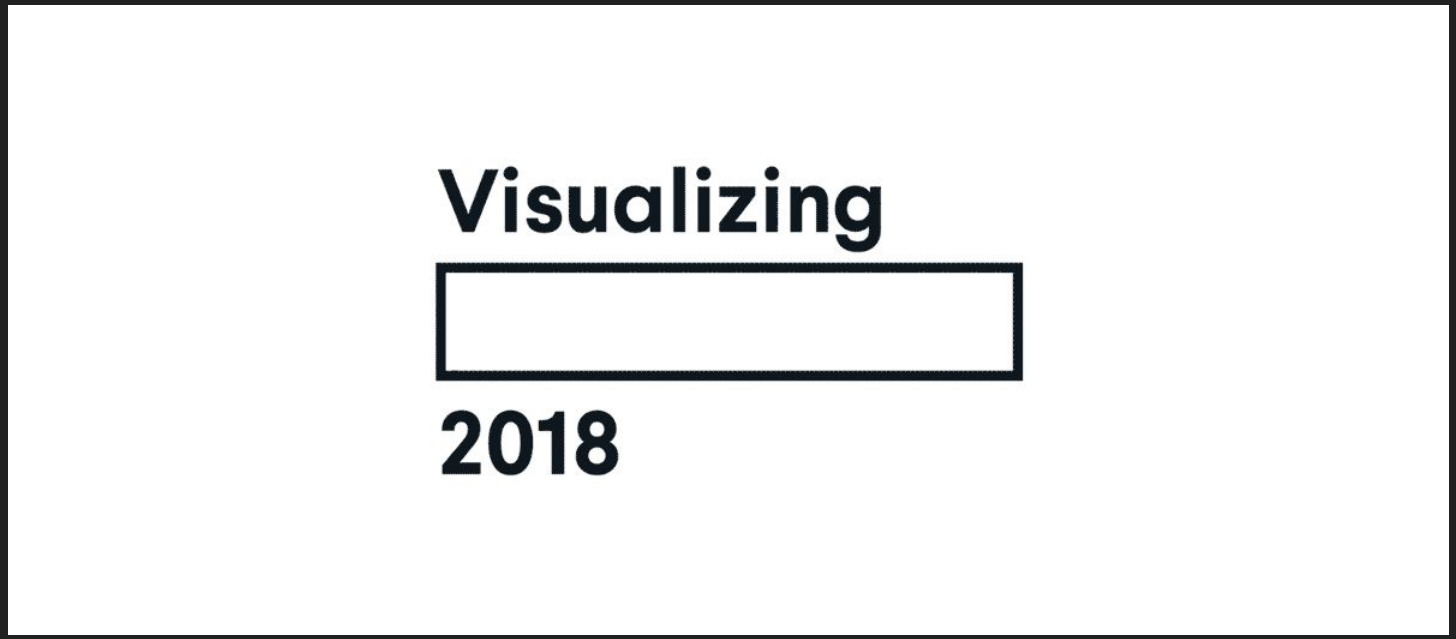
Biosphere integrity

The Millennium Ecosystem Assessment of 2005 concluded that changes to ecosystems due to human activities were more rapid in the past 50 years than at any time in human history, increasing the risks of abrupt and irreversible changes. The main drivers of change are the demand for food, water, and natural resources, causing severe biodiversity loss and leading to changes in ecosystem services. These drivers are either steady, showing no evidence of declining over time, or are increasing in intensity. The current high rates of ecosystem damage and extinction can be slowed by efforts to protect the integrity of living systems (the biosphere), enhancing habitat, and improving connectivity between ecosystems while maintaining the high agricultural productivity that humanity needs. Further research is underway to improve the availability of reliable data for use as the 'control variable' for this boundary.

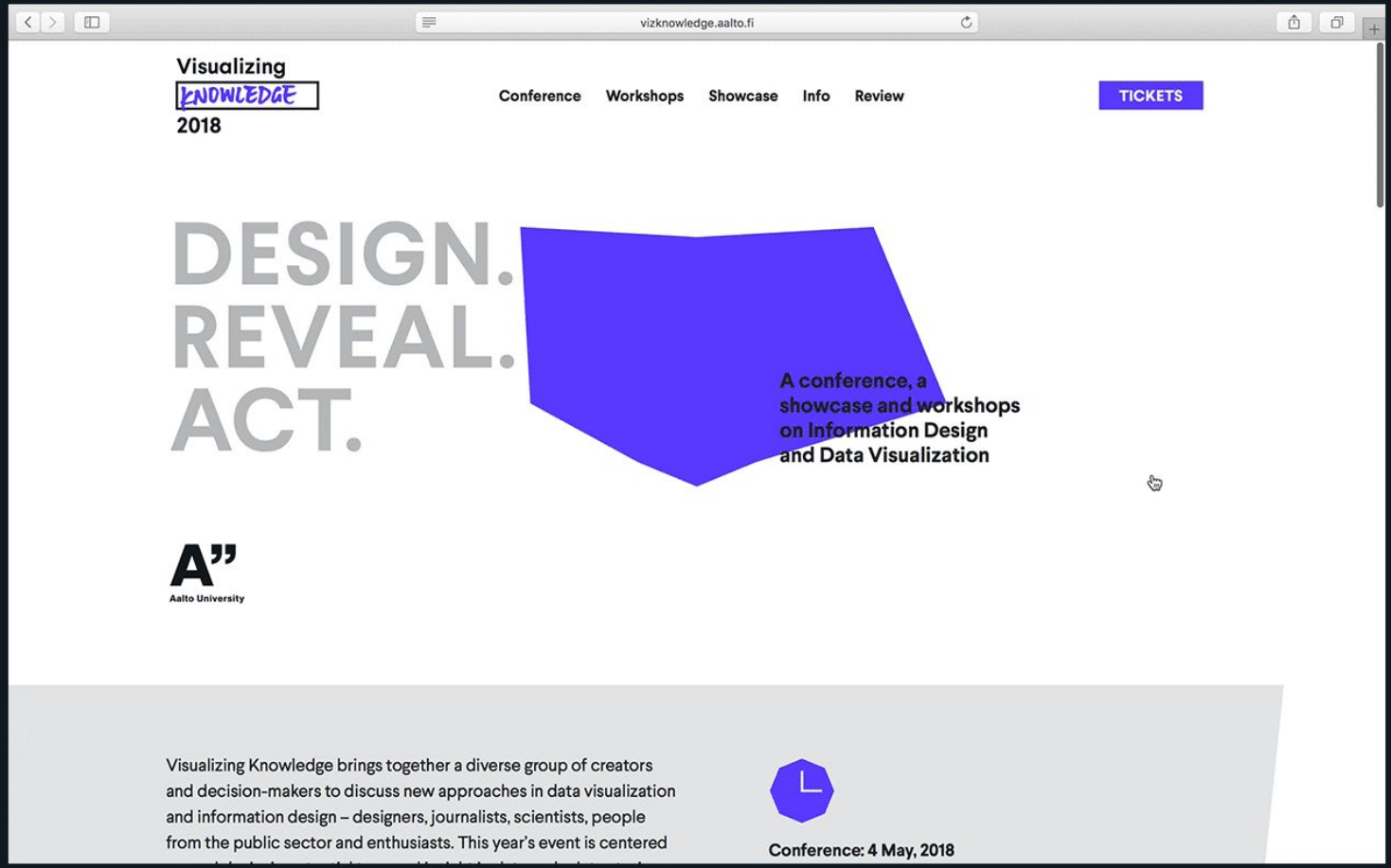
Text: Stockholm Resilience Centre

Information design studio: ada.peiretti

21.3.2023



https://vizknowledge.aalto.fi/


vizknowledge.aalto.fi
Visualizing
KNOWLEDGE
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ACT.
A conference, a showcase and workshops on Information Design and Data Visualization
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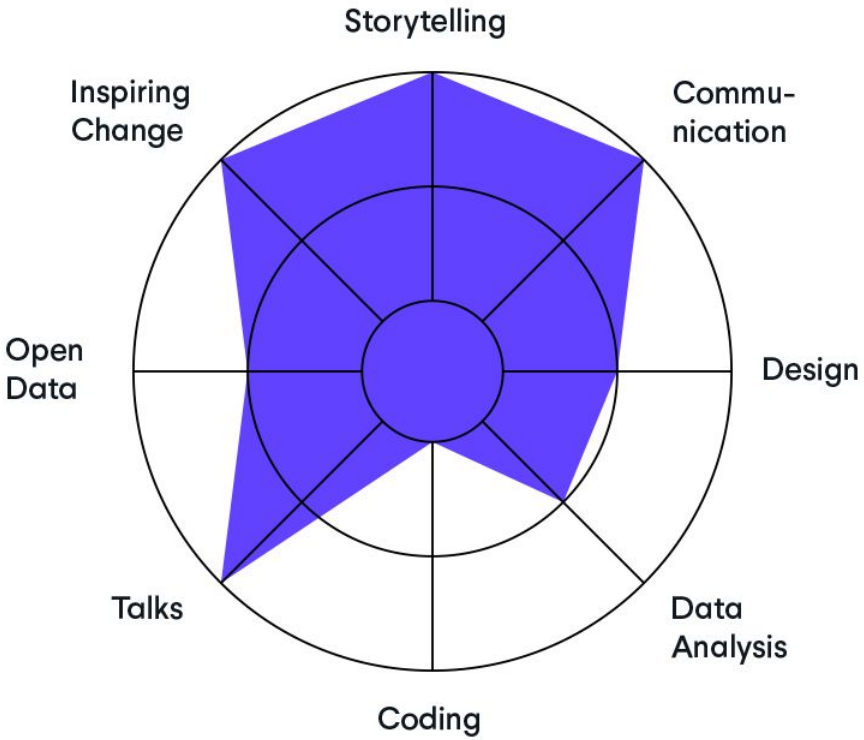
Visualizing Knowledge brings together a diverse group of creators and decision-makers to discuss new approaches in data visualization and information design – designers, journalists, scientists, people from the public sector and enthusiasts. This year's event is centered
Conference: 4 May, 2018



https://vimeo.com/vizknowledge

21.3.2023

Tools: non-coding >> coding

http://selection.datavisualization.ch/
https://datavizproject.com/
https://datavizcatalogue.com/
https://rawgraphs.io/
https://openrefine.org/ (Data cleaning/organising)
https://vega.github.io/vega/
https://d3js.org/

Colour for Data visualisation
http://colorbrewer2.org

The DNA of Visualization

A universal grammar for specifying visualization types

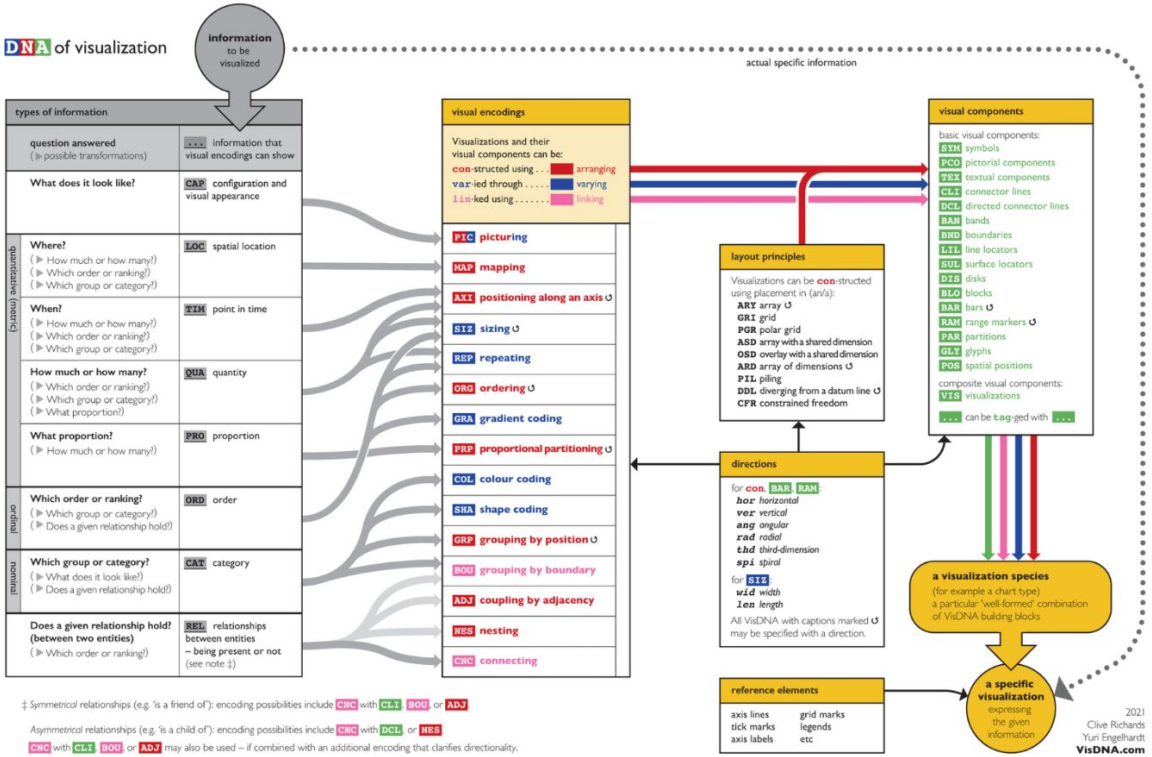
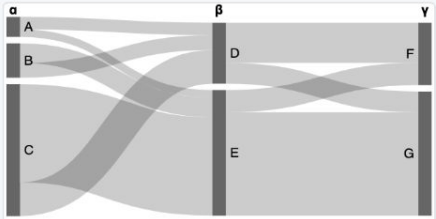


Figure 1. The 'DNA' building blocks and their possible relationships for visualizing information

Tools for information design

RAWGraphs 2.0 beta

About Learning GitHub Report issue



Alluvial Diagram

It shows correlations between categorical dimensions representing them as flows, visually linking categories with shared items. Each rectangle represents a unique value in the selected dimension, its height is proportional to its value. Correlations are represented with curved lines whose width is proportional to their value.

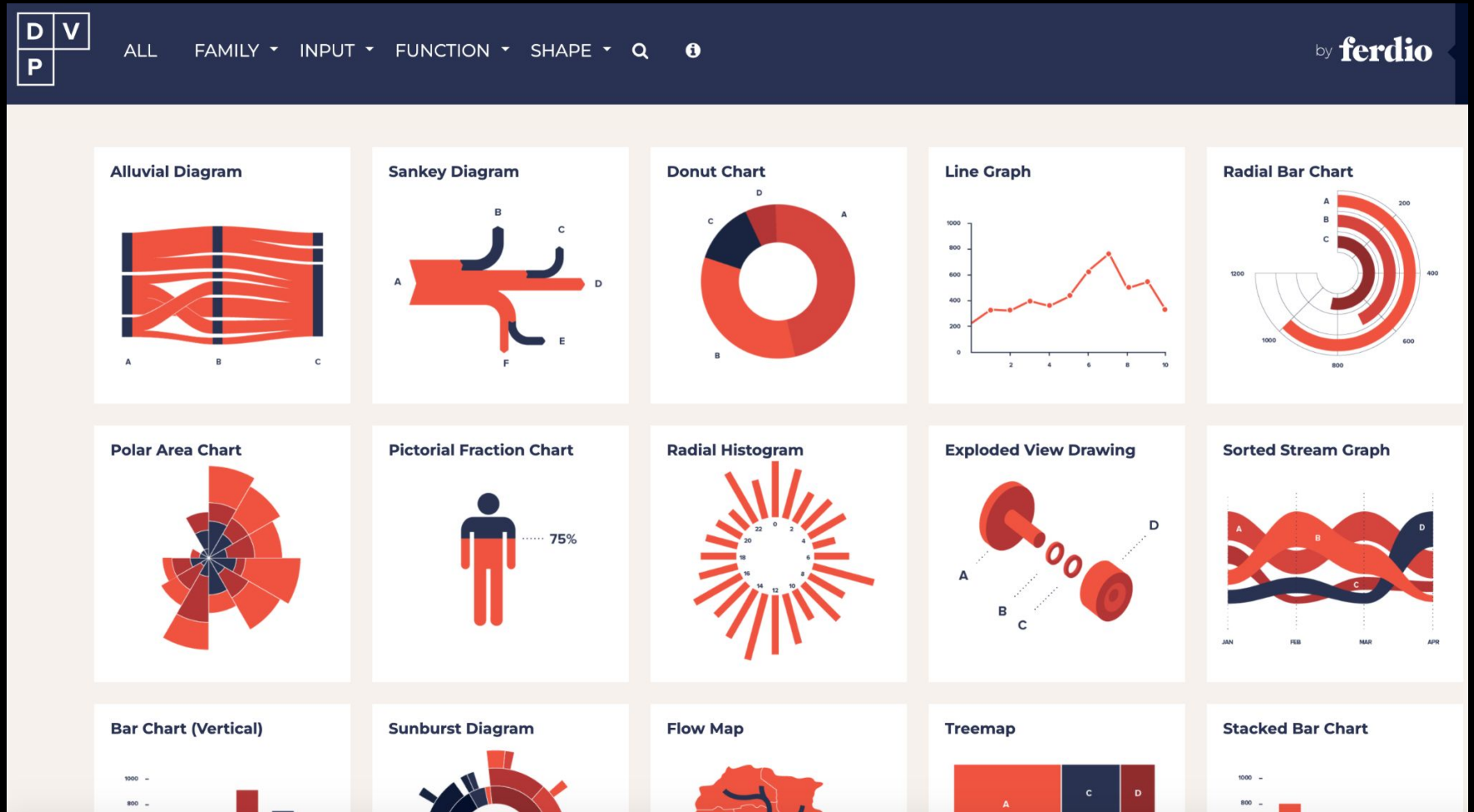
Code Tutorial

https://www.rawgraphs.io/

- **Alluvial Diagram** — Correlations, proportions
- **Arc Diagram** — Networks
- **Bar chart** — Correlations
- **Multi-set bar chart** — Correlations, proportions
- **Stacked bar chart** — Correlations, proportions
- **Beeswarm plot** — Distributions, time series, proportions
- **Box plot** — Distributions
- **Bubble chart** — Correlations, proportions
- **Bumpchart** — Time series, correlations, proportions
- **Circle Packing** — Hierarchies, proportions
- **Circular dendrogram** — Hierarchies, proportions
- **Contour plot** — Correlations, distributions
- **Convex hull** — Correlations, proportions
- **Linear dendrogram** — Hierarchies, proportions
- **Gantt chart** — Time series, correlations
- **Hexagonal binning** — Correlations, distributions
- **Horizon graph** — Time series, correlations
- **Line chart** — Time series, correlations
- **Matrix Plot** — Correlations, time series, proportions
- **Parallel coordinates** — Correlations, distributions
- **Pie chart** — Proportions

Tools for information design

https://datavizproject.com/



OpenRefine

A free, open source, powerful tool for working with messy data

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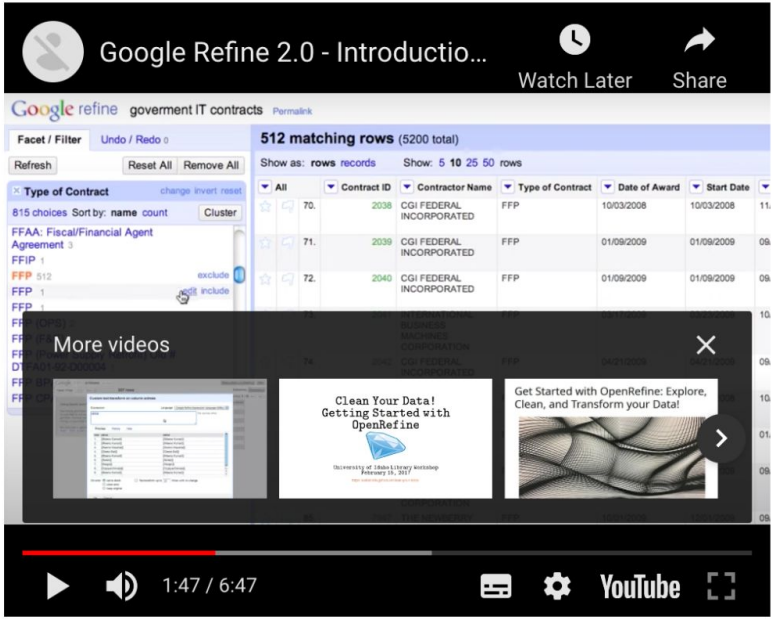
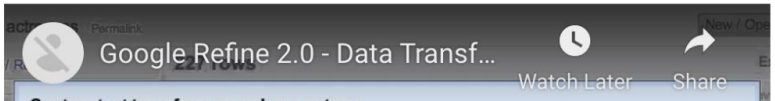
1. Explore Data

OpenRefine can help you explore large data sets with ease. You can find out more about this functionality by watching the video below.

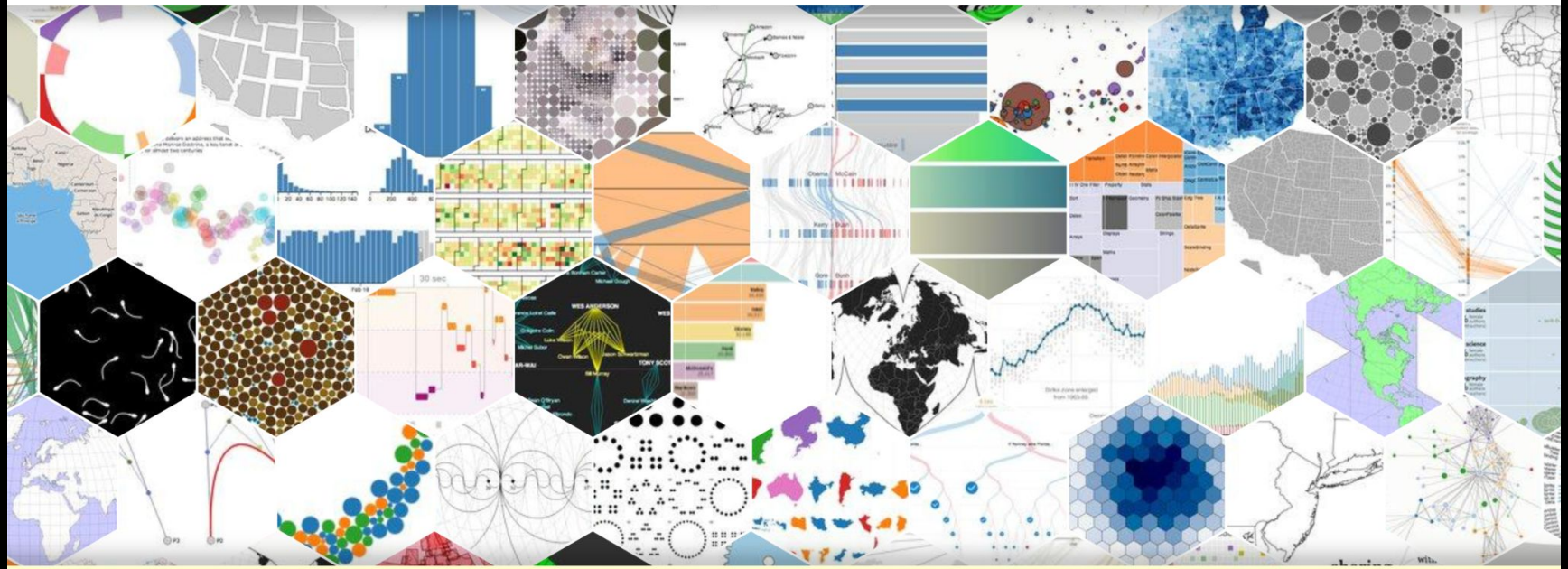


2. Clean and Transform Data



Overview Examples Documentation API Source

Data-Driven Documents



Like visualization and creative coding? Try interactive JavaScript notebooks in **Observable!**

Book References:

> Visualization Analysis & Design by Tamara Munzner
> Visual Explanations by Edward Tufte
> The Visual Display of Quantitative Information by Edwards Tufte
> Now you see it by Stephen Few
> Graphesis, Visual Forms of Knowledge Production by Johanna Drucker
> *How charts Lie by Alberto Cairo*

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