Design perspectives on Information Visualization

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@OPTICHIASM
DENSITY DESIGN LAB

DensityDesign is a research lab in the Design Department of the Politecnico di Milano. It focuses on the visual representation of complex social, organizational and urban phenomena.

Activities

EMAPS
The EMAPS project was an Europea Project funded in the FP7 “science in society” programme (Find. N° 88964). The aim of the project is to...

A Field Guide For Fake News
"A Field Guide to Fake News" is a collaborative project aimed at collecting digital techniques to trace the circulation of fake news. The project is...

Climate Change | Controversy Report
As for the previous year, we asked the students to identify a controversy related to each of their topics. Through digital methods, a specific kind of...

See Research section

See Teaching section

News

FaST – Fashion Sensing Technology
FaST – Fashion Sensing Technology is a project meant to design, experiment...

“From Mind to Reality” Workshop
The week of May 2nd we experimented a new workshop format, engaging students...

San Marino Design Workshop
Within the rich San Marino Design workshop 2015 agenda organized by the...
The standardisation of the Design contribution
Issue stories Issue maps

Absolute and relative visibility of countries in the UNFCCC negotiations, 1995-2011

Absolute and relative visibility of issues in UNFCCC negotiations, 1995-2011

Amounts of funding for projects in specific vulnerability areas in Germany

Bilateral adaptation funding and vulnerability indices

Concentration and fragmentation of OECD member countries bilateral adaptation aid

Concentration and fragmentation of adaptation resources in Bangladesh

Countries issue contingency matrix, 1995-2013

Different indices, different issues

Distribution of adaptation funds by risk and adaptation strategy in Bangladesh

Distribution of funds and projects across administrative units of Bangladesh

Do adaptation projects take place in the most vulnerable areas of Germany?

Evolution over time of international funding for adaptation in Bangladesh

climaps.eu
The standardisation of the Design contribution
The standardisation of the Design contribution
People have always tried to visually organize phenomena that weren’t readily explicable
trying to give a meaning to the **data** available
thanks to the tools they developed
conceiving and re-conceiving visual models
conceiving and re-conceiving visual models
All kinds of visualization have a shared goal: to make sense of reality.
the Quipu system

3000 BCE
Nicole Oresme
≈1370
Tractatus de configuratione qualitatum et motuum
Joseph Priestley
1765
A Chart of Biography
A New Chart of History
William Henry Playfair
1786
The Commercial and Political Atlas and Statistical Breviary
Henry Tanner
Heights Of The Principal Mountains In The World
1836
John Snow
1855
On the Mode of Communication of Cholera
Florence Nightingale
1858
Charles J. Minard
Carte figurative des pertes successives en hommes de l’Armée Française dans la campagne de Russie 1812-1813
1869
Otto Neurath and Gerd Arntz

1934
Vienna Method of Pictorial Statistics
Jacques Bertin
1967
Sémiologie Graphique.
Les diagrammes, les réseaux, les cartes
Exploratory Data Analysis VS. Confirmatory Data Analysis

(the full story - datavis.ca/milestones)
Martin Wattenberg

among the others
visual explorations of culturally significant data
Visualization is part of our culture

Its purpose is insight, not pictures

It is a tool but also a medium

**TOOL FOR UNDERSTANDING - PRODUCING KNOWLEDGE**

It make available some perceptually unavailable space.

**MEDIUM FOR COMMUNICATION - DIFFUSE KNOWLEDGE**

It make available normally invisible relations between perceptually available points.
Visualizations as a process / transformation

<table>
<thead>
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</table>
Visualizations as a process / transformation
### Visualizations as a process / transformation

<table>
<thead>
<tr>
<th>Country</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy</td>
<td>144,084,36</td>
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<tr>
<td>Austria</td>
<td>106,583,40</td>
</tr>
<tr>
<td>Holland</td>
<td>86,125,56</td>
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<tr>
<td>Germany</td>
<td>84,108</td>
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<td>Irland</td>
<td>82,065,96</td>
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<tr>
<td>Great Britain</td>
<td>81,600</td>
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<td>Belgium</td>
<td>72,017,52</td>
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<tr>
<td>Denmark</td>
<td>69,264</td>
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<tr>
<td>Greece</td>
<td>68,575</td>
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<tr>
<td>Luxemburg</td>
<td>66,432,60</td>
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<td>France</td>
<td>62,779,44</td>
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<td>Finland</td>
<td>59,640</td>
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<td>Sweden</td>
<td>57,000</td>
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<td>Slovenia</td>
<td>50,400</td>
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<td>Cyprus</td>
<td>48,960</td>
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<td>Portugal</td>
<td>41,387,64</td>
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<td>Spain</td>
<td>35,051,90</td>
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<td>25,920</td>
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<td>Czech Republic</td>
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<td>Estonia</td>
<td>23,064</td>
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<td>Malta</td>
<td>15,768</td>
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<td>Lithuania</td>
<td>14,196</td>
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<tr>
<td>Latvia</td>
<td>12,900</td>
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<tr>
<td>Ungary</td>
<td>9,132</td>
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<td>Poland</td>
<td>7,369,70</td>
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</table>
Few or simple data

data → visualization

<table>
<thead>
<tr>
<th>Country</th>
<th>CO2 emissions (thousands tons)</th>
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<tbody>
<tr>
<td>Brazil</td>
<td>2854</td>
</tr>
<tr>
<td>Canada</td>
<td>810</td>
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<tr>
<td>China</td>
<td>7225</td>
</tr>
<tr>
<td>Germany</td>
<td>1005</td>
</tr>
<tr>
<td>India</td>
<td>1875</td>
</tr>
<tr>
<td>Indonesia</td>
<td>2038</td>
</tr>
<tr>
<td>Japan</td>
<td>1390</td>
</tr>
<tr>
<td>Russian Fed</td>
<td>2012</td>
</tr>
<tr>
<td>UK</td>
<td>684</td>
</tr>
<tr>
<td>USA</td>
<td>6933</td>
</tr>
</tbody>
</table>
data $\rightarrow$ visualization

Few or simple data
data / visualization

Complex data
Bootstrapping (sketching with data)
To perform an operation enabling
the development of successively more complex ones

Material exploration
What's available | significant | interesting | feasible
Total Unemployment Since Dec. 2007

Source: Bureau of Labor Statistics
VISUALIZATION AS A SIGN SYSTEM
Semiology – the study of symbol systems

Sender and receiver use a language with signs
Establish codes and conventions
Sender encodes information in signs
Receiver decodes information from signs
ESTABLISHING CODES AND CONVENTIONS

data items → visual marks

• POINTS
• LINES
• AREAS
• VOLUMES
• GLYPHS
ESTABLISHING CODES AND CONVENTIONS

data items → visual marks

data attributes → visual properties of marks

• **POSITION** - changes in the x, y, (z) location
• **SIZE** - change in length, area or repetition
• **SHAPE** - infinite number of shapes
• **VALUE** - changes from light to dark
• **ORIENTATION** - changes in alignment
• **COLOUR** - changes in hue at a given value
• **TEXTURE** - variation in pattern
• **MOTION**
A SIMPLE MODEL

Stage 1
“Pre-attentive” processing
Early, rapid detection of color, texture, shape, spatial attributes

Stage 2
Serial processing of object identification (using memory) and spatial layout, action
The most environmental dual system is the Danube and its tributaries, which are used by more than 30 million people in 10 European countries. Wintering and summering birds use the Black Sea, which is the continent's second-largest coastal area, after Russia's Bering.
GESTALT PROPERTIES

Symmetry

Objects as being symmetrical and forming around a center point.

It is perceptually pleasing to divide objects into an even number of symmetrical parts.
TEXT IS NOT PRE-ATTENTIVE
COLOR ISSUES

Complexity of color space

3D / Computer vs. Print display / variety of models and standards

Color not critical for many visual tasks

Color is essential for aesthetics / culture

Call attention to specific data

Increase appeal, memorability
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• **MOTION**
GLYPH

Graphical entities that convey one or more data values via attributes such as shape, size, color, and position.
CHERNOFF FACES
Coding of 15 attributes
Area of the face
Shape of the face
Length of the nose
Location of the mouth
Curve of the smile
Width of the mouth
...

Diagram of Charnoff faces with various measurements and coordinates.
Bill Gates once derided open source advocates with the worst epithet a capitalist can muster. These folks, he said, were a “new modern day sort of communists,” a malevolent force bent on destroying the monopolistic incentive that keeps corporate America afloat. Gates was wrong. Open source is a powerful force for good. It can scale and collective to take on the most challenging problems. It’s a new form of socialism that can reach the masses.
HI!
Data

- Structured
  - Tabular
    - Categorical
      - Nationality
        - Sex
    - Ordinal
      - Income Level
        - Education Level
    - Quantitative
      - Temperature
        - Length
  - Relational (Networks)
  - Spatial (Maps)
- Unstructured
ACCURACY & LEVELS OF ORGANIZATION

+ accurate

POSITION LENGTH ORIENTATION
large gap

SIZE SHAPE

VALUE COLOUR
huge gap

- accurate

<table>
<thead>
<tr>
<th>POSITION</th>
<th>CAT</th>
<th>ORD</th>
<th>QUA</th>
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<tbody>
<tr>
<td>SIZE</td>
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<td>ORD</td>
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<tr>
<td>SHAPE</td>
<td>CAT</td>
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</table>
Usain Bolt vs. 116 years of Olympic sprinters

Based on the athletes’ average speeds, if every Olympic medalist raced each other, Usain Bolt (the London version) would win, with a wide distraction of Olympians behind him. Below, where each sprinter would be when Bolt finishes his race.

Meditations on Years

<table>
<thead>
<tr>
<th>Medalists</th>
<th>Year</th>
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<tbody>
<tr>
<td>United States</td>
<td>1912</td>
</tr>
<tr>
<td>Britain</td>
<td>1908</td>
</tr>
<tr>
<td>Japan</td>
<td>1964</td>
</tr>
<tr>
<td>Canada</td>
<td>1952</td>
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<tr>
<td>Brazil</td>
<td>1948</td>
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<tr>
<td>Australia</td>
<td>1960</td>
</tr>
<tr>
<td>Germany</td>
<td>1904</td>
</tr>
<tr>
<td>South Africa</td>
<td>1910</td>
</tr>
<tr>
<td>Italy</td>
<td>1932</td>
</tr>
<tr>
<td>United States</td>
<td>1924</td>
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</table>

This chart includes medals for the United States and Australia in the “Intermagazine” Games of 1904, which this C.C. does not formally recognize.
Where the Heat and the Thunder Hit Their Shots

The shooting patterns for the players on the Miami Heat and the Oklahoma City Thunder reveal where they are most dangerous on the court. Below, compare each player’s strengths using court maps and analysis by Kirk Goldsberry, a geography professor at Michigan State.

The Heat rely on player positioning to create isolation plays for LeBron James and Dwyane Wade, often on the left side. The Heat take many fewer 3-point shots than the Thunder.

The Thunder are effective from almost any area on the court and shoot many more 3-point shots than the league average. Kevin Durant and James Harden are potent from the top of the arc.
WHERE WE DONATE VS. DISEASES THAT KILL US

Money Raised (in millions)

- Breast Cancer
- Prostate Cancer
- Motor Neuron Disease (including ALS)
- HIV/AIDS
- Diabetes
- Chronic Obstructive Pulmonary Disease
- Suicide
- Heart Disease

Total Deaths (US)

100k, 200k, 300k, 400k, 500k, 600k

DOs

01 - Pick the fittest

manyeyes.com/software/analytics/manyeyes/page/Visualization_Options.html
homes.cs.washington.edu/~jheer/files/zoo/
niceone.org/infodesignpatterns/index.php5#/patterns.php5
datavizcatalogue.com/
DOs

01 - Pick the fittest
02 - Be precise

Full and labeled axis
**DOS**

01 - Pick the fittest

02 - Be precise

03 - Reduce the clutter

Remove useless information
DOS

01 - Pick the fittest
02 - Be precise
03 - Reduce the clutter

Remove useless information
Direct labelling
**DOS**

01 - Pick the fittest

02 - Be precise

03 - Reduce the clutter

04 - Emphasize key message
**DOS**

01 - Pick the fittest

02 - Be precise

03 - Reduce the clutter

04 - Emphasize key message
**DOS**

01 - Pick the fittest

02 - Be precise

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04 - Emphasize key message
**DOS**

01 - Pick the fittest
02 - Be precise
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**DOs**

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01 - Pick the fittest
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04 - Emphasize key message
**DOs**

01 - Pick the fittest
02 - Be precise
03 - Reduce the clutter
04 - Emphasize key message
**DOS**

01 - Pick the fittest

02 - Be precise

03 - Reduce the clutter

04 - Emphasize key message

05 - Test test test

Sketch
**DOS**

01 - Pick the fittest  
02 - Be precise  
03 - Reduce the clutter  
04 - Emphasize key message  
05 - Test test test  

Sketch  
Ask
DOs

01 - Pick the fittest
02 - Be precise
03 - Reduce the clutter
04 - Emphasize key message
05 - Test test test

Sketch
Ask

Check the list (ann kemery.com/portfolio/dataviz-checklist/)
DON'TS

05 - Use 3D

06 - Use more than 6 colors