HCI Lecture 9

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Visualization

- "Visualization" is an umbrella term referring to any kind of visual representation of information designed to enable
 - communication
 - analysis
 - discovery
 - exploration
 - other activities connected to data and information

Kinds of visualization

- Charts
- Maps
- Infographics
- Data visualizations
- News applications

Chart

- A chart is a display in which data are encoded with symbols that have different shapes, colors, or proportions.
- It also known as «diagram» or «plot».
- In many cases, these symbols are placed within a Cartesian coordinate system.
- A type of chart that does not have a Carstesian system is the pie chart.



From "The Truthful Art" by A. Cairo

Maps and data maps

- A map is a depiction of a geographical area or a representation of data that pertains to that area.
- We use the term "data map" to refer to this second kind of map.
- A data map typically includes a map of the area it is showing data of.



From "The Truthful Art" by A. Cairo

Infographic

- An infographic is a multi-section visual representation of information intended to communicate one or more specific messages.
- Infographics are made of a mix of charts, maps, illustrations, and text (or sound) that provides explanation and context.
- They can be static or dynamic.
- What defines an infographic is that its designer doesn't show all information she gathered, but just the portion that is relevant for the point (or points) that she's trying to make.
- Infographics can be lush, colorful, and fun if their designers don't forget that their fundamental goal is to make the public better informed.
- Clarity and depth are paramount in infographics. The embellishments are secondary and optional.



Infographic by Adolfo Arranz for the South China Morning Post.

Data visualization

- A data visualization is a display of data designed to enable analysis, exploration, and discovery.
- Data visualizations aren't intended mainly to convey messages that are predefined by their designers.
- Instead, they are often conceived as tools that let people extract their own conclusions from the data.



Data visualization by Periscopic. http://terror.periscopic.com/

News application

- The term "news application" was invented by the nonprofit investigative journalism organization ProPublica.
- A news application is a special kind of visualization that lets people relate the data being presented to their own lives.
- Its main goal is to be useful by being customizable according to each person's needs.
- A news application can be a simulator, a calculator, or an interactive visual database.



News application by ProPublica http://projects.propublica.org/treatment/

Hybrid visualizations

- Given the complex and rich nature of visualizations, this taxonomy is not rigorously drawn for all visualizations.
- There are visualizations that have characteristics from more than one type of visualization

Example: infographics + data visualization

Visualization by The South China Morning Post



What really matters...

- Any visualization presents information and allows at least a limited amount of exploration or even customization, so it may be hard to tell for sure if a graphic is really an infographic, a data visualization, or a news application.
- What really matters is that if a visualization is illuminating.
- For that, the designers need to keep certain important features and principles in mind.



The five qualities of great visualizations

The hockey stick

- It is believed that one particular visualization, made public in a 2001 report by the IPCC (Intergovernmental Panel on Climate Change), embodies the five qualities of successful visualizations.
- It is a chart showing the difference between the average temperature of each year and the average temperature of the 1961–1990 period, created by Mann and Bradley (University of Massachusetts) and Hughes (University of Arizona).
- It is called the "hockey stick chart" because of its shape.





Chart by Mann, Bradley and Hughes

The hockey stick

- Temperature values have been measured with thermometers daily only since the 17th century.
- To obtain data on temperatures from earlier periods, scientists have measured "proxy" variables (which are related to the variables of interest through known relationships and functions).
- Statistical estimates of the past are never completely accurate, and the uncertainty is visually represented by the gray band, within which scientists are 100% certain the real value falls.
- The closer we get to the present, the smaller the uncertainty becomes thanks to increasingly precise measurements and more widely available data, and therefore the gray band narrows.

The five qualities

- The hockey stick graph did not go unnoticed—on the contrary, it is still considered one of the most iconic and compelling visualizations, thanks to its qualities.
- 1. It is **truthful**, because it is based on honest and thorough research.
- 2. It is **functional**, because it provides an accurate representation of the data and allows the viewer to perform meaningful operations (e.g., seeing changes over time).
- 3. It is **beautiful**, in the sense of being intriguing and aesthetically pleasing.
- 4. It is **insightful**, because it reveals evidence that would otherwise be difficult to see.
- 5. It is **enlightening**, because if we accept the evidence it depicts, it will change the way we think.

Truthful visualizations

A case from USA telecommunications

- The NCTA (National Cable & Telecommunications Association) is a trade organization that handles PR and lobbying on behalf of U.S. cable communication companies.
- In 1992, cable transmissions in the U.S. became subject to regulation with the Cable Television Consumer Protection and Competition Act.
- In 1996, the regulation was relaxed with the Telecommunications Act.
- On the NCTA's homepage, the following graph was published to show that deregulation is beneficial, as it leads to increased investment in the sector.



From "The Truthful Art" by A. Cairo



Investigating more in depth on the NCTA website...



From "The Truthful Art" by A. Cairo

Investigating more in depth on the NCTA website...



Investigating more in depth on the NCTA website...



The facts

- After the introduction of regulation, investments continued to rise.
- After the relaxation of regulation, however, investments saw a sharp decline, which was later offset by another significant increase.

Analysis of the facts

- What caused the decline in investments after deregulation?
 - Was it due to deregulation itself?
 - Or to the economic crisis of 1997–98?
- What caused the growth after that decline?
 - Was it due to deregulation?
 - Or to the dot-com and new economy boom?
- We don't have a definite answer, but we are certain that the message of the first chart is not supported by evidence.

- The findings revealed through the second chart deserve a more in-depth analysis.
- This analysis may not necessarily lead to results that completely disprove the first chart.
- However, as a result, trust in NCTA's communication is certainly damaged.
- Displaying misleading data is not only morally unacceptable, but it also undermines credibility.
- Two recommendations:
 - be honest with the public
 - avoid self-deception, don't jump to conclusions.

Another example



"The costs of the two products are strongly correlated."



What happens if we put the costs of the two products on the same scale?



The correlation disappears or at least becomes much weaker.

Functional visualizations

Functionality

- The main factor in choosing the form of a visualization is not personal taste, but rational thinking.
- The kind of thinking that guides the design of any object meant to be usable and useful.
- One thinks about the purpose for which the object is being created and shapes the raw material to allow people (the users of the object) to achieve that purpose.

Example: pie charts

From "The Truthful Art" by A. Cairo



A negative example

I can see that hard rock has grown, because the slice starts at "noon" in both pies, and you can tell it ends "later" in 2014. But samba? Its slice has shifted, and I can't tell if it stayed the same, slightly grew, or slightly shrank.

Without the percentage figures for 2014, I'm lost.

Question: if I need to read the numbers, what's the point of the visualization? This is a visualization that is not functional at all.



A functional alternative

How Music Preferences Have Changed in Two Decades

Music styles preferred by University of Miami students. Survey based on interviews with 1,000 students. **SOURCE: WishfulThinkingData Inc.**



This is a "slope chart" in English. "Slope" means incline or gradient. It's precisely these slopes that help us instantly see the trends in musical genres and the differences between 1994 and 2014. The percentages are almost irrelevant, because the trends are already clearly visualized without needing to refer to the numbers.

The purpose of the visualization should guide the decision on how to shape the data.

From "The Truthful Art" by A. Cairo

Beautiful visualizations

Which chart is more beautiful?



From "The Truthful Art" by A. Cairo

Which chart do you like more?



The usual trivialities

- It is not what is beautiful that is beautiful, but what pleases.
- Beauty is subjective.
- Beauty is in the eyes of the beholder.

They may be worn-out proverbs and sayings, but they all have in common the fact that they emphasize not the qualities of the object being observed, but the experience of the observer.



Focus on the observers

- From this point of view, the discussion of beauty is connected to the discussion of functionality.
- One thinks about the purpose for which the object is created and shapes the raw material to allow people (the users of the object) to achieve that purpose.
- The purpose, in this case, is to provide users with a meaningful aesthetic experience. At the expense of the readability of the visualization? It depends, indeed, on the purpose.

Visualization by Accurat.it

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Joseph Heller

7 - New York

Ernest Hemingway John O'Hara

Iris Murdoch

os - Dublin

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James Baldwin

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Max Beerbohm

so - London

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Theodore Dreiser

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33. 16 - Terre Haute

Ralph Ellison

19 -Oklahoma City

Richard Hughes

Paul Bowles

97 -New York

80

.29

James P. Donleavy

.20

99 -New York

James M. Cain

98 -Annapolis

87.

James Jones

62 - Robinson

William Golding

-43

Evelyn Waugh

Robert Graves

96 -Newport News

1

41 -Newquay

• 30

Richard Wright

• 32

Walker Percy

-45

Erskine Caldwell

Salman Rushdie

1

Philip Roth

1

Willa Cather

Henry James

26, 27, 32

73

66

So¥.

84

60 -Birmingham

20 - Roxie

Norman Mailer

James Joyce

Carson McCullers

Jerome D. Salinger

64 -New York

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From first published to masterpieces

english novels of 1900 according to the Modern Library ranking. Authors are represented through circles showing their life span where their debut published novel selected from the Modern Debut novel and first masterpiece correspond Sources biography.com britannica.com modernlibrary.com

How to read it?



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- first masterpiece coincide with debut



The visualization has been designed and produced by Accurat (www.accurat.it), and was originally published in Italian on La Lettura the sanday cultural supplement of Corriere della Sera.

Visualization by A.Cairo



Aesthetics vs clarity

- The visualizations show at what age famous writers wrote works that are considered masterpieces.
- The original version is by Accurat.it.
- Cairo created a visualization based on the first one to demonstrate that:
 - his visualization presents the data in a way that the user can understand more quickly,
 - the visualization by Accurat.it has greater aesthetic value, in other words, it is more beautiful.

From first published to masterpieces	Carson McCullers	Norman Mailer 51 - Long Brunch	Ernest Heming 45.74-Ook Park	Vay John O'Hara 22 - Princeton 65	Theodore Dreiser 33.16 - Terre Haute	James Baldwin 39 - New York	Richard Hughes 71 - Weybridge 76 - 29	James P. Donleavy 99 - New York 87	James Jones 62 - Robbason 90	Richard Wright 20 -Roxie	How to read Where the author was born Masterpiece according to the Modern Library Death Asia Europe
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- Forgetting about the subjectivity of beauty and assuming Cairo's evaluation is correct, since his visualization is clearer, is it also the best?
- Cairo himself says no: if the goal is to fascinate the observers with an aesthetic experience, then, although it requires more effort to read and understand, the visualization by Accurat.it achieves its goal.

Insightful visualizations

Insightfulness

- The word "insightful" in this context refers to the ability of visualizations to allow the observer to make discoveries that would not be possible if the data were presented differently.
- "The purpose of visualization is insight, not pictures." (from *Readings in Information Visualization* by Kard, Mackinlay and Schneiderman)

Insights

- The basic idea is that discovery arises from an insight that is stimulated in the observer by the visualization.
- Defining the concept of insight is not easy, but one could distinguish between two types of insight:
 - spontaneous insight
 - knowledge-building insight

Spontaneous insight



"Did you see that spike? What's happening??"

Knowledge-building insight

- It's a less immediate process, without "eureka" or "wow" moments, but it leads to the construction of knowledge.
- Knowledge-building insight is more common in interactive visualizations, where the user can examine different aspects of a complex problem.

How Nations Fare in PhDs by Sex [Interactive]



How women and men fare in doctoral studies around the world

Sep 16, 2014 | Véalo en español

In the U.S., women are going to college and majoring in science and engineering fields in increasing numbers, yet here and around the world they remain underrepresented in the workforce. Comparative figures are hard to come by, but a disparity shows up in the number of Ph.D.s awarded to women and men. The chart here, assembled from data collected by the National Science Foundation, traces the gender gap at the doctoral level for 56 nations. The situation in individual countries varies widely, but as the numbers make clear, there are interesting exceptions to the global trend.



An example of an interactive visualization is this chart by Periscopic for Scientific American magazine on the gender of PhD students across various disciplines. www.scientificamerican.com/article/how-nations-fare-in-phds-by-sex-interactive/

Enlightening visualizations

Enlightened people

- The term "enlightenment" in a context about intuition and the acquisition of knowledge can be ambiguous.
- We are not talking about users being "enlightened" because they made a discovery (that's the insightfulness of visualizations).
- We are talking about the result of a good visualization: enlightened people, meaning those who have changed their way of thinking about an issue and have become better people.

Buffy vs Katrina

- Buffy is a fictional character, the protagonist of a fantasy TV series that aired from 1997 to 2003.
- Katrina is the name of the hurricane that struck the Louisiana coast and New Orleans in August 2005, causing over 1,800 deaths.
- There are very truthful, functional, beautiful, and insightful visualizations on both topics.

visualizingbuffy.com

1x05 - Never Kill a Boy on the First Date

Synopsis:

Buffy sets her sights on the mysterious and brooding Owen, opting to go on a date rather than help Giles prevent a prophecy about an unstoppable vampire rising to help the Master.

Character appearances



svs.gsfc.nasa.gov/Gallery/Katrina2015. html



Relativism vs Enlightenment

- Between Buffy and Katrina, which is the more important topic?
- "It depends on the target audience" is a correct answer from the perspective of functionality, but morally relativistic.
- Enlightenment, in this context, aims to make people better.
- From this point of view, some topics are more important than others because they are more critical to the well-being of others.
- "Do good with data" is the motto of Periscopic visualization studio.

Speaking of well-being...





The chart of weekly unemployment benefit claims in the United States from the 1990s to the present.

Bureau of Labor Statistics, 21 March 2020

Some US stocks tumbled after Trump tariffs Share price index for Apple, Nike, and Lululemon



"Trump tariffs trigger steepest US stocks drop since 2020 as China, EU vow to hit back" BBC, 4 April 2025