

User Interaction 2

CS 4460 - Information Visualization
Spring, 2019
Alex Endert

today

- last category of interaction from last time (connect)
- Visualization by Demonstration

Recall from last time:

7 categories of User Interaction from Yi et al.

Select

Explore

Reconfigure

Encode

Abstract/Elaborate

Filter

Connect - we didn't talk about this one last time

1. Select

“Mark something as interesting”

- Mark items of interest to keep track
- Seems to often work as a preceding action to subsequent operations.

e.g.,

- Selecting a placemark in Google Map
- The Focus feature in TableLens

2. Explore

“Show me something different”

- Enable users to examine a different subset of data
- Overcome the limitation of display size

e.g.,

- Panning in Google Earth
- Direct Walking in Visual Thesaurus

3. Reconfigure

“Show me a different arrangement”

- Provide different perspectives by changing the spatial arrangement of representation

e.g.,

- Sorting and rearranging columns in TableLens
- Changing the attributes in a scatter plot
- The baseline adjustment feature in Stacked Histogram
- The “Spread Dust” feature in Dust & Magnet

4. Encode

“Show me a different representation”

- Change visual appearances

e.g.,

- Changing color encoding
- Changing size
- Changing orientation
- Changing font
- Changing shape

5. Abstract/Elaborate

“Show me more or less detail”

- Adjust the level of abstraction (overview and details)

e.g.,

- Unfolding sub-categories in an interactive pie chart
- Drill-down in Treemap
- Details-on-demand in Sunburst
- The tool-tip operation in SeelT
- Zooming (geometric zooming)

6. Filter

“Show me something conditionally”

- Change the set of data items being presented based on some specific conditions.

e.g.,

- Dynamic query
- Attribute Explorer
- Keystoke based filtering in NameVoyager
- QuerySketch

let's talk about the last one, 7. Connect

7. Connect

“Show me related items”

- Highlight associations and relationships
- Show hidden data items that are relevant to a specified item

e.g.,

- **Highlighting directly connected nodes in a graph vis**
 - we will cover this implementation of “connect” when we talk about graphs.
 - For today, let’s focus on the non-graph examples

Highlighting Connections

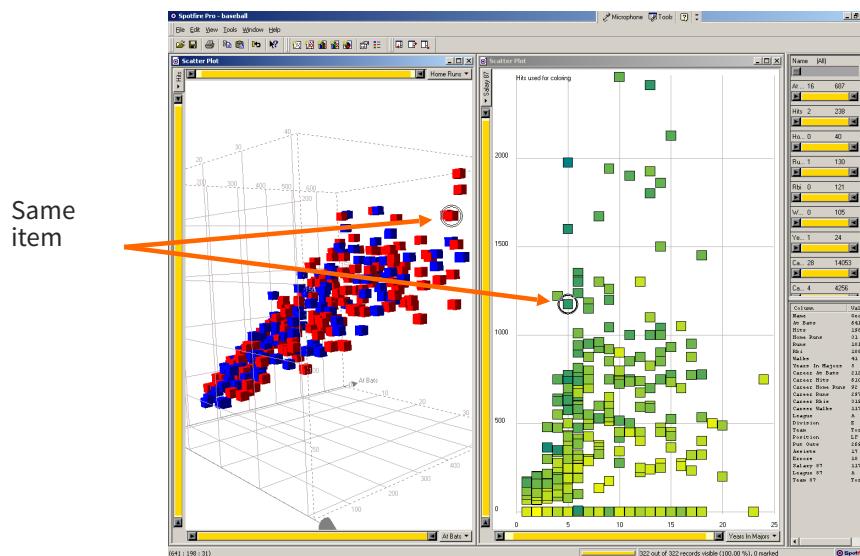
- Viewer may wish to examine different attributes of a data items simultaneously
- Alternatively, viewer may wish to view data case under different perspectives or representations
- But need to keep straight where the data case is

For example, brushing & linking

- Applies when you have multiple views of the same data
- Selecting or highlighting a case in one view generates highlighting the case in the other views
- Very common technique in InfoVis, as mentioned previously

Brushing and linking

highlight the same item in different visualizations
the cartesian spaces of the two visualization are different because
you have different attributes mapping to the axes.



P4 uses brushing

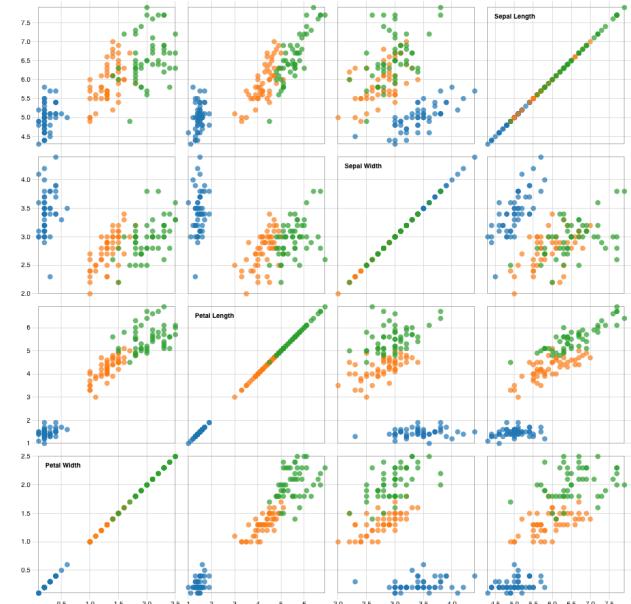
- Let's take a look:
 - <http://va.gatech.edu/courses/cs4460/homework-assignments/>

Example



Another example of brushing and linking

- Scatterplot Matrix
 - <https://bl.ocks.org/mbostock/raw/4063663/>



Interaction Characteristics

new question -> new exploration so on and so forth until an insight is obtained
you want to promote that flow as most as possible.

- So far, we've talked about intents
- **Fluidity** a key to understanding cognition for interactive vis
 - Promotes “flow”
 - Balanced challenge
 - Concentration
 - Loss of self-consciousness
 - Transformation of time
 - Prompt feedback
 - Sense of control
 - Intrinsically rewarding
 - Minimizes the gulfs of action

Elmqvist et al
Information Visualization '11

Info Vis

Research Paper

Fluid interaction for information visualization

Niklas Elmqvist¹, Andrew Vande Moere², Hans-Christian Jetter³, SAGE
Daniel Cernea⁴, Harald Reiterer³ and TJ Jankun-Kelly⁵

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Abstract
Despite typically receiving little emphasis in visualization research, interaction in visualization is the catalyst for the user's dialogue with the data, and, ultimately, the user's actual understanding and insight into these data. There are many possible reasons for this skewed balance between the visual and interactive aspects of a visualization. One reason is that interaction is an intangible concept that is difficult to design, quantify, and evaluate. Unlike for visual design, there are few examples that show visualization practitioners and researchers how to design the interaction for a new visualization in the best manner. In this article, we attempt to address this issue by collecting examples of visualizations with “best-in-class” interaction and using them to extract practical design guidelines for future designers and researchers. We call this concept *fluid interaction*, and we propose an operational definition in terms of the direct manipulation and embodied interaction paradigms, the psychological concept of ‘flow’, and Norman’s gulfs of execution and evaluation.

Keywords
fluidity, flow, embodiment, design, information visualization, human-computer interaction

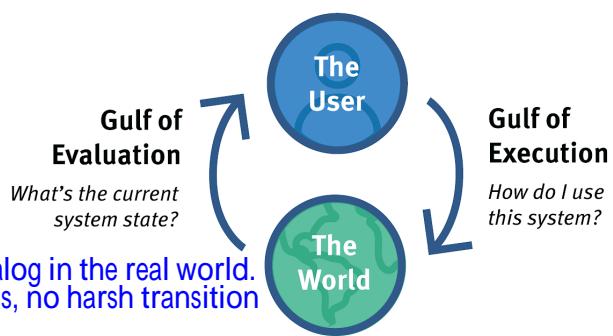
Fluidity Design Guidelines

- Use smooth animated transitions between states
- Provide immediate visual feedback on interaction
- Minimize indirection in the interface
- Integrate user interface components in the visual representation
- Reward interaction
- Ensure that interaction never ‘ends’
- Reinforce a clear conceptual model
- Avoid explicit mode changes

mental model about data that has cultural analog in the real world.
fluid ability to make transition between modes, no harsh transition

congruity: filter, no harsh transition.

want to promote the idea that the operations make sense in terms of where they are placed.



nngroup.com NN/g

Animation for Transitions

- Principles
 - Animation can help “soften the blow” when a view changes
 - Preserve context, allow the viewer to track where things went
- Project overview
 - Developed variety of different transitions and applications
 - Performed experiments to see how these are perceived
- Example:
 - <http://mbostock.github.io/d3/talk/20111018/partition.html>

Heer & Robertson
TVCG (InfoVis) '07

Design Principles

- Congruence (mental matching)
 - Maintain valid data graphics during transitions
 - Use consistent syntactic-semantic mappings
 - Respect semantic correspondence
 - Avoid ambiguity
- Apprehension (easily perceivable)
 - Group similar transitions
 - Minimize occlusion
 - Use simple transitions
 - Use staging for complex transitions
 - Make transitions as long as needed, but no longer

OK

- Let's take a step back and think about representation & interaction again

Supporting Representation

- Interaction in many cases is **vital to representation**

— Provides useful perspective

Many, many examples:

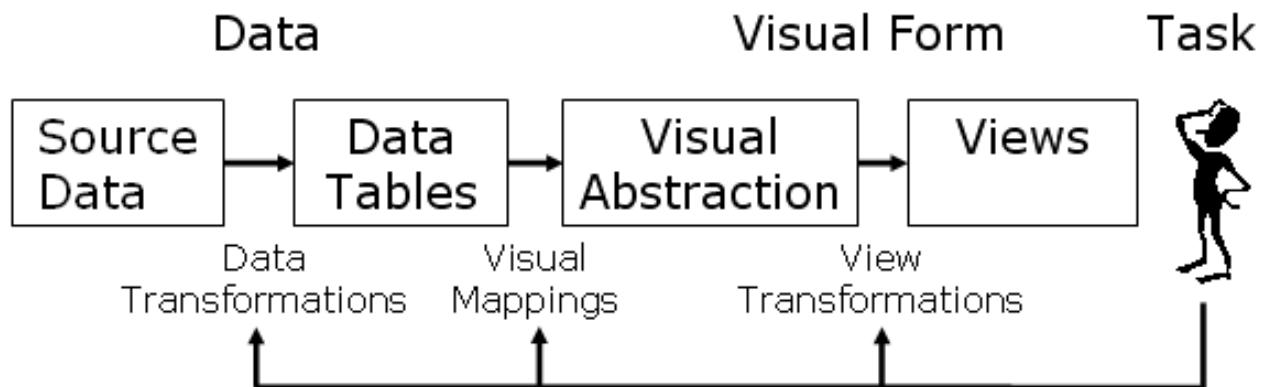
Parallel coords, InfoZoom, anything 3D

— Necessary for clarifying representation

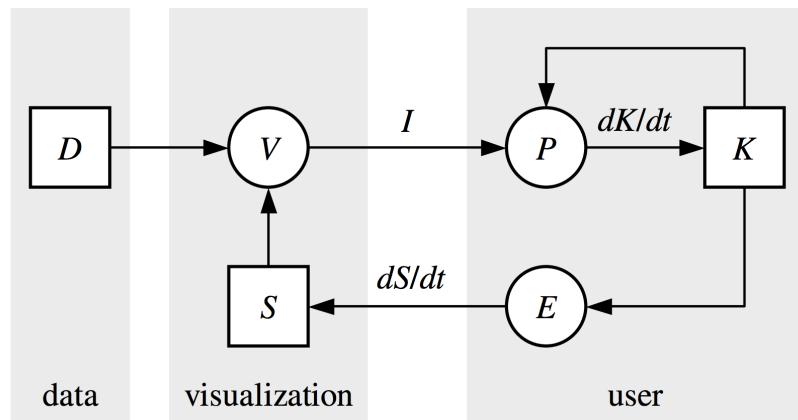
Dust & Magnet

Some representations simply don't work without interaction!

Think back: InfoVis Pipeline



Interaction Moves Visualizations between States



van Wijk, 2005

e.g., OnSet

- Allowing for visual comparison of blood samples for whale sharks
- <http://www.cc.gatech.edu/gvu/ii/setvis/>

Let's discuss

- Get into small groups, and discuss these questions:
 - Why create a visualization the only works if you **have to interact?**
 - What tradeoffs does this design decision entail?
- Discuss for 3-5 minutes. Then, let's share what you all talked about.

Beyond control panels?

- So far, we have talked about interaction taxonomies, categorized by user intent
- Many of the examples are based on control panels that let people directly manipulate sliders
- However, what about other methods to think about interaction?

Visualization by Demonstration

James J. Gibson



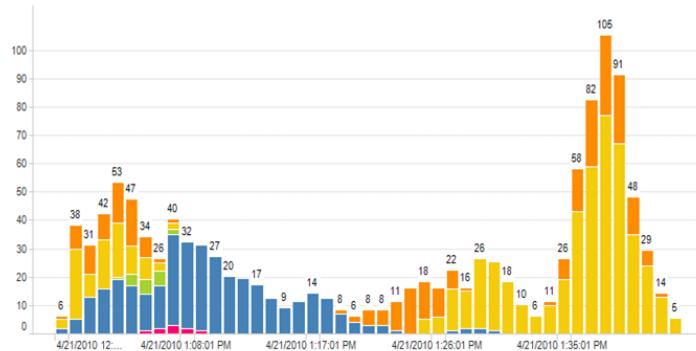
- Affordances
 - objects in our physical environment afford **opportunities for action**
 - based on prior knowledge, context and situation, perception/vision, and situated actions and goals

"The Theory of Affordances", 1977

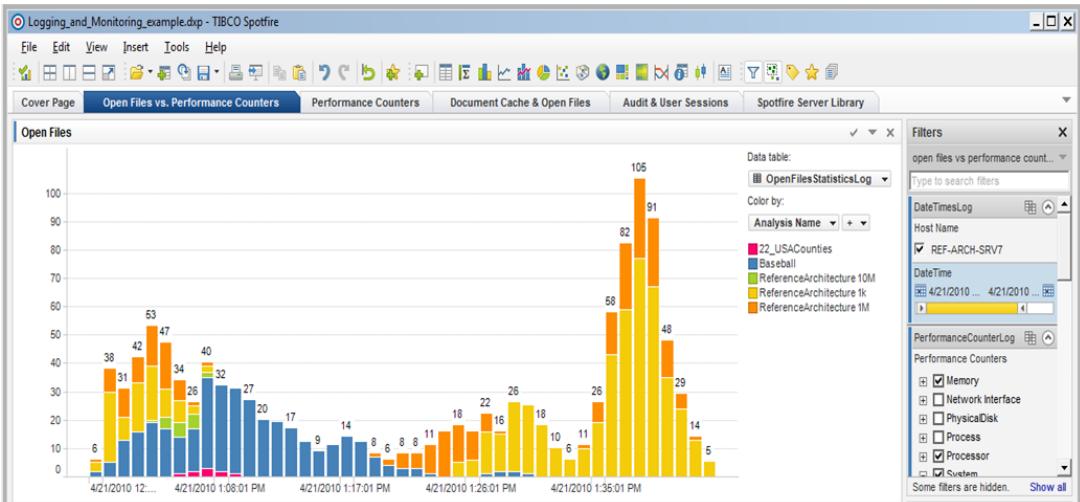


Information Visualization

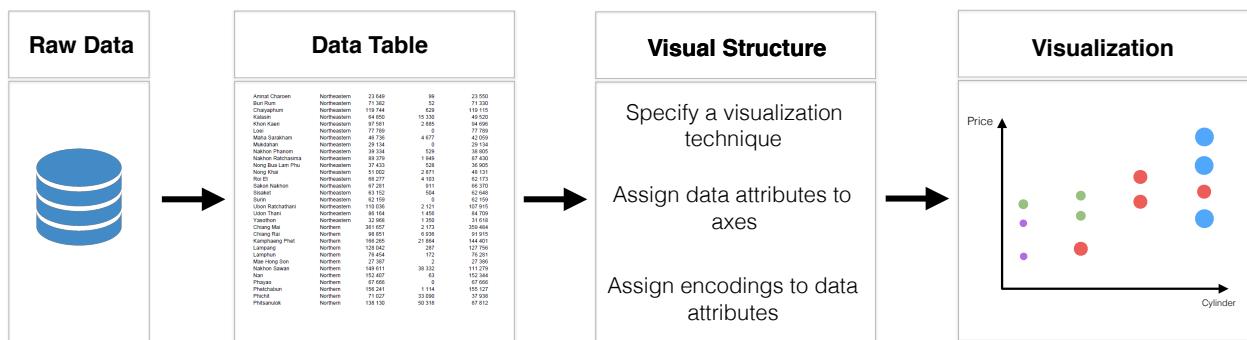
- **Binding data values to graphical encodings** to produce **interactive** visual representations of data
- foster **analytic discourse** with the data through user interaction
 - discovery
 - sensemaking
 - enable specific tasks

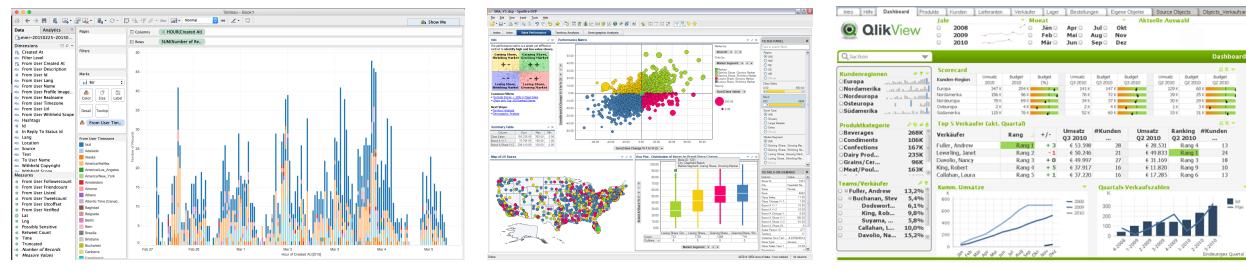
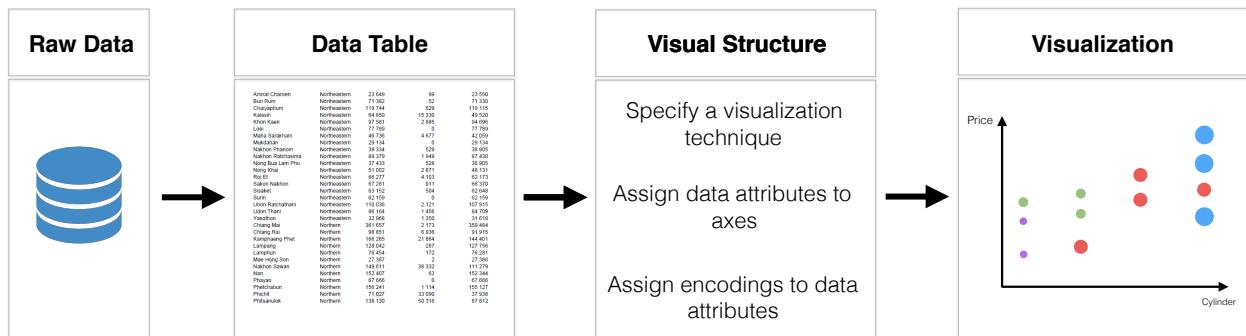


information visualization



interactive information visualization





35

Recommendng Potential Transformations

Visualization Representation Transformations

Data Mapping Transformations

Axes Transformations

View Specification Transformations

1

Visual Representation Transformation

36

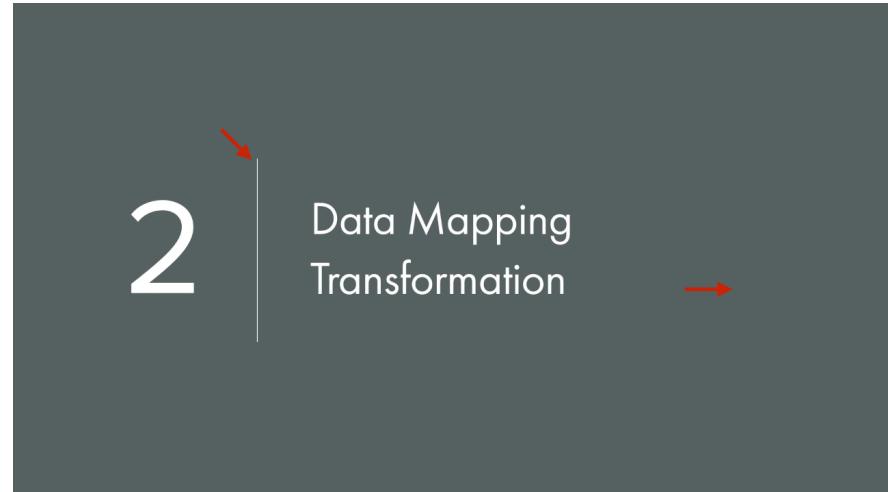
Recommending Potential Transformations

Visualization Representation
Transformations

Data Mapping Transformations

Axes Transformations

View Specification
Transformations



37

Recommending Potential Transformations

Visualization Representation
Transformations

Data Mapping
Transformations

Axes Transformations

View Specification
Transformations



38

Recommending Potential Transformations

Visualization Representation
Transformations

Data Mapping
Transformations

Axes Transformations

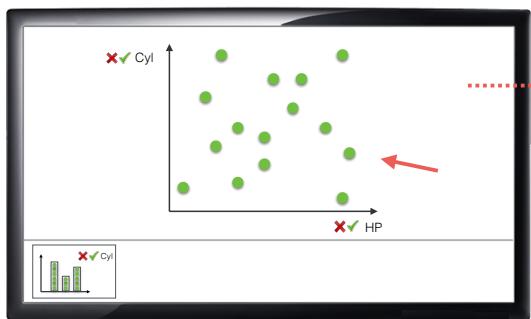
**View Specification
Transformations**

4

**View Specification
Transformation**

39

User Interface



Recommendation Engine

Intent Functions

if scatterplot

- Recommend data attributes for x Axis
- Recommend data attributes for y Axis
- Recommend possible bar charts

if bar chart

- Recommend possible scatterplots
- Recommend sorting the bar chart

Recommendation Table

Name	Relevance	Transformation Type
xAxis_HP	0.6	Axes
yAxis_Cyl	0.5	Axes
Bar_Cyl	0.4	Visual Representation
yAxis_SUV	0.2	Axes

40

recall from last time

- We said controls take up space
- Visualization by Demonstration is an example of one of the two ways to make a better use of the space
- Which one? place controls into visualization

recall from last time

- We said controls take up space
- Visualization by Demonstration is an example of one of the two ways to make a better use of the space
- Which one? — Place controls into the visualization

Key Points

- Interaction facilitates a dialog between the user and the visualization system
- Multiple views amplify importance of interaction connect multiple views using brushing and linking.
- Interaction often helps when you just can't show everything you want

Lots of open research in this area!

- Understanding how to enhance interactive data exploration is an open area
- lots of interest! People want to explore their data!
 - ask questions
 - test hypotheses
 - see “views” of their data
 - construct knowledge
- More on this later, in the Visual Analytics talks

reminder

- please take a few minutes to fill out the mid-semester survey.
-

Pop Quiz

- a little different this time. **The quiz is on Canvas.**
- Using your computer, or your smartphone, log in to canvas and take Quiz 4.
- Access code is: **interaction**
- If you didn't bring a smart device, please raise your hand and I'll give you a hard copy. Fill it out, and hand it back to me.