Topic Notes

Animation

CS 7450 - Information Visualization
April 26, 2011
John Stasko

Agenda

- Animation in InfoVis
  - How to do it
  - Where could it be used?

Animation

- What is it?

Definition

- Animation
  - Rapid successive display of many display frames where objects change position/appearance gradually so as to create the illusion of continuous movement

Application

- Where in InfoVis might animation be handy?

Use

- Possibilities
  - Use time as an option for space, so can show more data (over time)
  - To draw attention to something
  - As a visual encoding of particular variable values
  - To help transition between views

Where?

- Have we seen animation used in some of the systems/papers we've studied so far?

What We Know

- Perception
  - Animation is a very strong visual attention mechanism
    - It's difficult to focus on other items when animation is nearby

Studies about Perception

- How do people perceive animations or animated objects?

User Study

- Moticons – Icons with motion
- How well do people detect and identify them?
- Are they distracting?

Bartram, Ware & Calvert
IJHCS'03

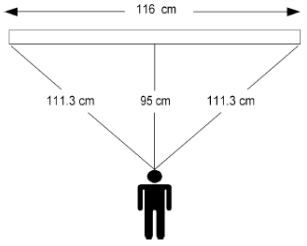
Problem

- Motivation
  - Empirical investigation of the effects of moticons as notification mechanism in a peripheral environment
- Three experiments
  - Experiment 1: Detection
  - Experiment 2: Identification
  - Experiment 3: Distraction

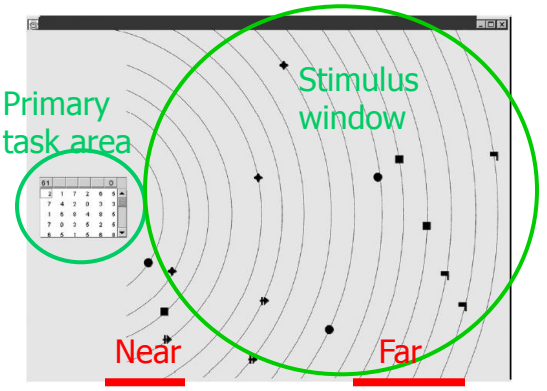
Experiment 1: Detection (1/3)

- Goal
  - Color vs Motion
  - Detection error rates and detection time
- Signal cues
  - Color change: Green, Red
  - Two motion types: High Amplitude, Low Amplitude
- Task
  - Detect any cue changes while performing a given primary task

Experiment 1: Detection (2/3)

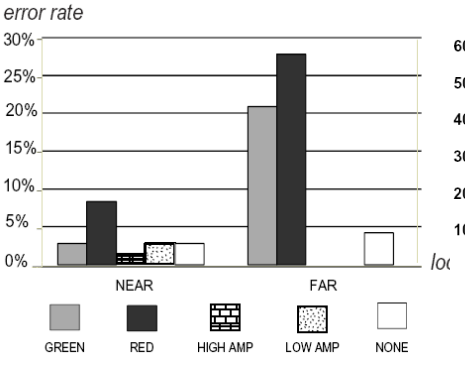


Participant position and screen width

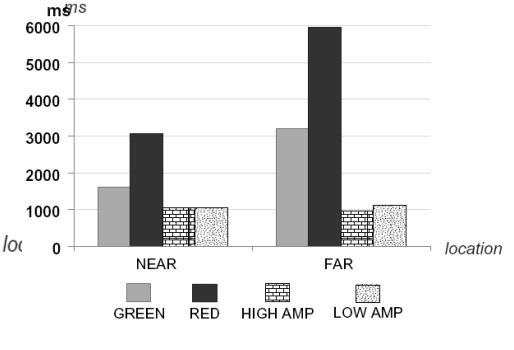


Screen layout

Experiment 1: Detection (3/3)



Detection error rates

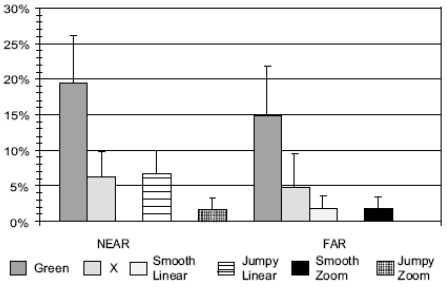


Mean detection time

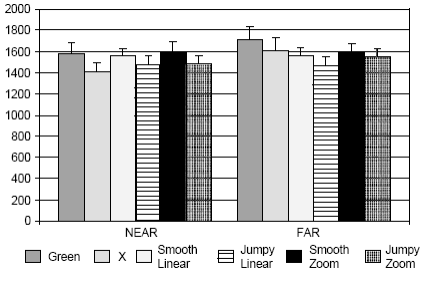
Experiment 2: Identification (1/2)

- Goal
  - In the real world, displays are crowded with multiple colors and shapes
  - Identify which visual element on the screen changed and thus which event the signal represents
- Signal cues
  - Color change
  - Shape change
  - Four motion types: Smooth linear, Jumpy linear, Smooth zoom, Jumpy zoom

Experiment 2: Identification (2/2)



Identification error rates

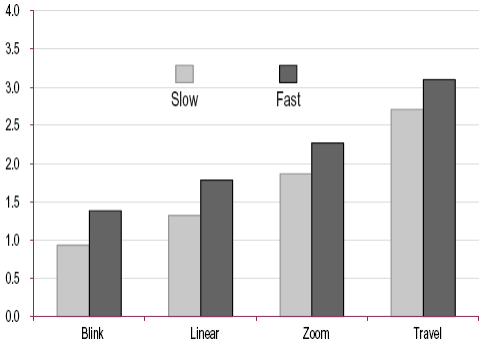


Identification time

Experiment 3: Distraction (1/2)

- Goal
  - Evaluate the distraction and irritation properties of moticons in desktop environment under different task conditions
- Tasks
  - Browsing and studying on-line text
  - Playing FreeCell
  - Playing Tetris
- Motion cues
  - Linear
  - Zoom
  - Blink
  - Travel

Experiment 3: Distraction (2/2)



Distraction rating by type and frequency

Conclusions

- Motion is a strong peripheral cue
- Useful for searching and identifying things
- But it can be distracting

Animation for Transitions

- Can animation help "soften the blow" when a view changes?
- Preserve context, allow the viewer to track where things went

Suite of Transitions

- Developed variety of different transitions and applications
- Performed experiments to see how these are perceived

Heer & Robertson
TVCG '07

Focus

- What types of animation did they use?
- How did they use animation?

Transition Types

- View transformation
- Substrate transformation
- Filtering
- Ordering
- Timestep
- Visualization change
- Data schema change

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

Key Component

- Staging
  - Animation proceeds in stages, not all at once
  - Varies by animation type and view

DynaVis

- Implemented in C# and Direct3D graphics
- Let's see it!

Video

Experiments

- 1 – Track object across transitions
  - Animation beats no-animation, staged animation better than no staging
- 2 – Estimate changing values
  - Animation generally better
- Subjective
  - Staged animation preferred over basic animation preferred over static

Telling the Story

- Can animation help explain the data?
- One traditional use:
  - Temporal data – Use animation to show changes in time

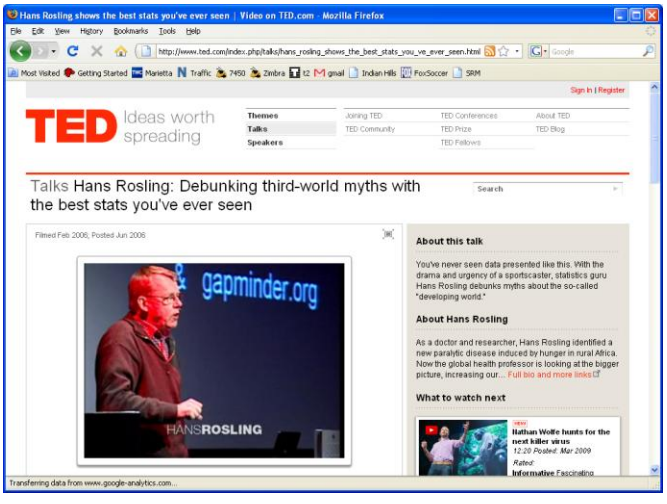
GapMinder

Discussed earlier

- Company started by Hans Rosling, purchased by Google: Trendalyzer
- Focus on world data (by country), much about economics and health
- Spotfire-like scatterplot display augmented with animation (animated bubble chart)
- Tells a very compelling story with visualizations

TED Talks

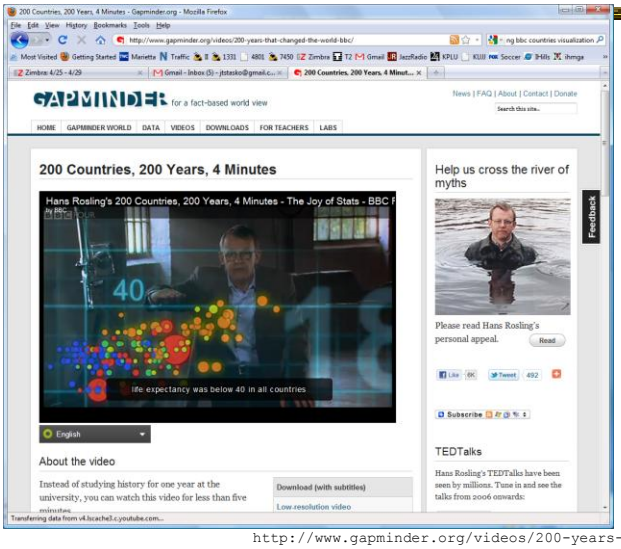
Watched earlier



2006
2007

A Newer One

Video



Same idea

Glitzier special effects

http://www.gapminder.org/videos/200-years-that-changed-the-world-bbc/

Why so Compelling?

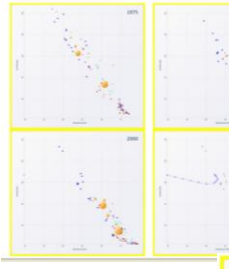
- Did the animation really add value to the visualizations?
- Was it Rosling's speaking that makes it compelling?

Empirical Study

- Examine whether animated bubble charts are beneficial for analysis and presentation
- Run an experiment to evaluate the effects of animation

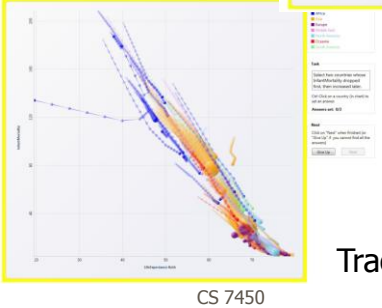
Robertson et al
TVCG (InfoVis) '08

Visualizations Studied



Animation

Small multiples



Traces

Experiment Design

- 3 (animation types) x 2 (data size: small & large) x 2 (presentation vs. analysis)
  - Presentation vs analysis – between subjects
  - Others – within subjects
- Animation has 10-second default time, but user could control time slider

Experiment Design

- Data
  - UN data about countries
- Tasks
  - 24 tasks, 1-3 requires answers per
    - Select 3 countries whose rate of energy consumption was faster than their rate of GDP per capita growth
    - Select 2 countries with significant decreases in energy consumption
    - Which continent had the least changes in GDP per capita

Conditions

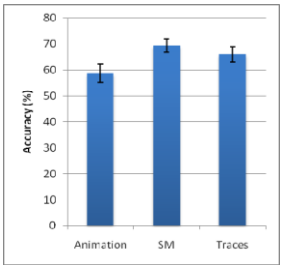
- Analysis – straightforward, interactive
- Presentation
  - 6 participants at a time
  - Presenter described a trend relevant to task, but different
  - No interaction with system

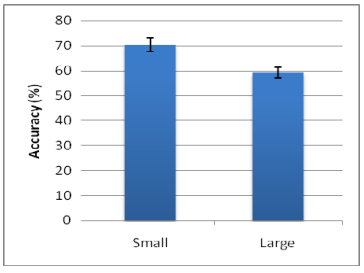
    In animation condition, participants saw last frame of animation (no interaction)

Results

- Accuracy

  Measured as percentage correct
  65% overall (pretty tough)





Significant:
SM better than animation
Small data size more accurate than large

Results

- Speed
  - Presentation
    - Animation faster than small multiples & traces
    - 15.8 secs vs. 25.3 secs vs. 27.8 secs.
  - Analysis
    - Animation slower than small multiples & traces
    - 83.1 secs. vs. 45.69 secs. vs. 55.0 secs.

Results

Table 3. Average ratings for seven questions for each visualization.
* indicates significant differences (p<.05).

	Animation	SM	Traces
Q1. The visualization was helpful to me in answering the questions.	4.6 *Traces	4.2	4.1
Q2. For the smaller dataset, I found the tasks easy using this visualization.	4.6 *SM	4.2	4.5
Q3. For the larger dataset, I found the tasks easy using this visualization.	2.6	3.4 *Traces	2.3
Q4. I enjoyed using this visualization.	4.3 *SM *Traces	3.7	3.5
Q5. I found this visualization exciting.	4.3 *SM *Traces	3.1	3.0
Q6. For the smaller dataset, I found the screen too cluttered.	1.8	1.5	2.0
Q7. For the larger dataset, I found the screen too cluttered.	4.4	2.8 *Animation *Traces	4.7

Table 4. Average ratings for a few general questions.

	Presentation	Analysis	Overall
G1. I found the Traces view enjoyable.	3.8	2.9	3.4
G3. I found the Small Multiples view enjoyable.	4.1	3.4	3.7
G5. I found the Animation view enjoyable.	4.6	5.0	4.8
G7. The animation went too fast for me.	3.2	2.8	3.0
G8. The animation went too slow for me.	1.6	1.3	1.4
G9. I lost track of some data points as they moved.	4.9	4.6	4.8

Subjective

Likert: 0-strongly diagree, 6-strongly agree

Results

G13: Which visualization did you PREFER for the small dataset?
G14: For the large?

Presentation, small: Animation (9) > SM (6) > Traces (3)
Presentation, large: Traces (8) > SM (6) > Animation (4)
Analysis, small: Animation (7) > SM (6) > Traces (5)
Analysis, large: Animation (8) > SM (6) > Traces (4)

Discussion

- People rated animation more fun, but small multiples was more effective
- As data grows, accuracy becomes an issue
  - Traces & animation get cluttered
  - Small multiple gets tiny
- Animation:
  - "fun", "exciting", "emotionally touching"
  - Confusing, "the dots flew everywhere"

Reflections

- Should animation be used more in information visualization?
- Where?

Upcoming

- Review & recap
  - Reading
    - Ward chapter 15
    - Few chapter 13
    - Heer et al
- Next Monday
  - Project demos
  - Bring 2 copies of your paper with you

References

- '06 slides from J. Yang
- All referenced papers