

Animation



CS 7450 - Information Visualization
November 21, 2012
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?

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User Study



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

Bartram, Ware & Calvert
IJHCS'03

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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

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Experiment 1: Detection (1/3)



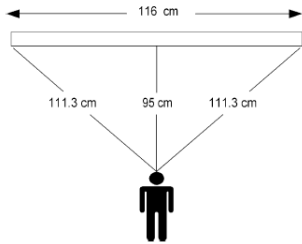
- Goal
 - Color vs Motion
 - Detection error rates and detection time
- Signal cues
 - Color change: Green, Red
 - Two motion types: High Amplitude, Low Amplitude
- Task
 - Detect any cue changes while performing a given primary task

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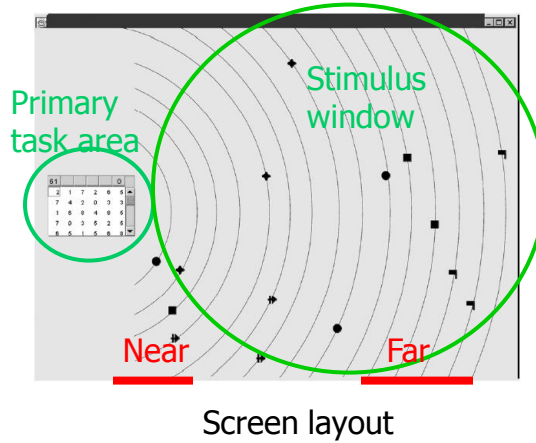
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Experiment 1: Detection (2/3)



Participant position and screen width



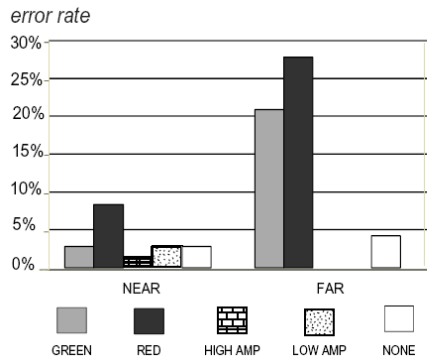
Screen layout

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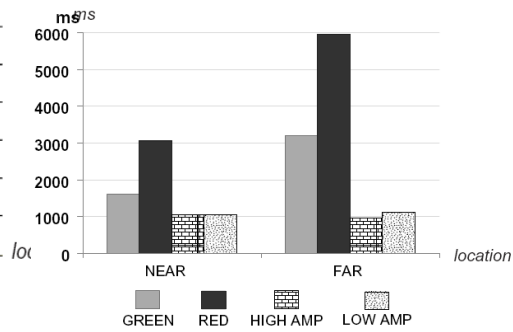
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Experiment 1: Detection (3/3)



Detection error rates



Mean detection time

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Experiment 2: Identification (1/2)



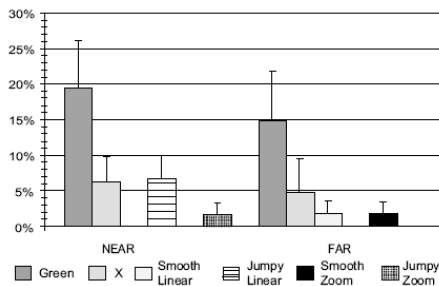
- Goal
 - In the real world, displays are crowded with multiple colors and shapes
 - Identify which visual element on the screen changed and thus which event the signal represents
- Signal cues
 - Color change
 - Shape change
 - Four motion types: Smooth linear, Jumpy linear, Smooth zoom, Jumpy zoom

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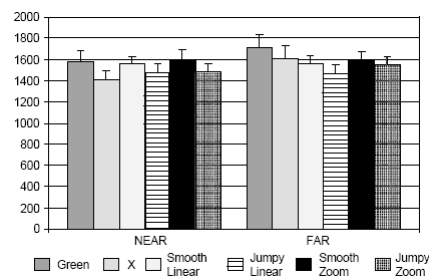
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Experiment 2: Identification (2/2)



Identification error rates



Identification time

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Experiment 3: Distraction (1/2)



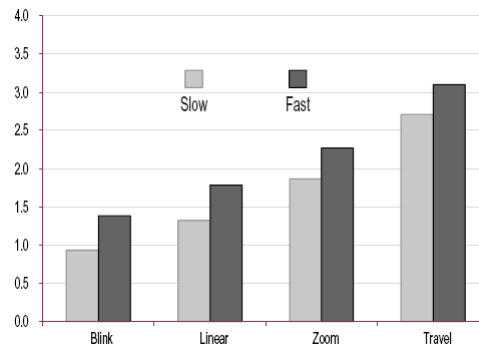
- Goal
 - Evaluate the distraction and irritation properties of motions in desktop environment under different task conditions
- Tasks
 - Browsing and studying on-line text
 - Playing FreeCell
 - Playing Tetris
- Motion cues
 - Linear
 - Zoom
 - Blink
 - Travel

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Experiment 3: Distraction (2/2)



Distraction rating by type and frequency

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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

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Heer & Robertson
TVCG (InfoVis) '07

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Focus



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

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Transition Types



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

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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

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Key Component



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

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DynaVis



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

Video

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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

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Telling the Story



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

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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

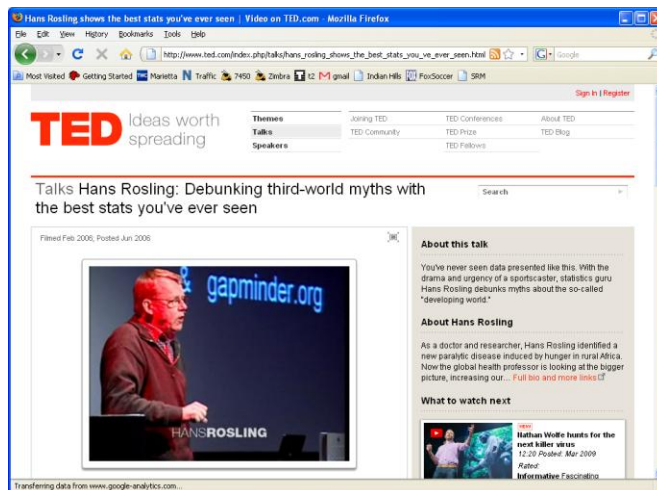
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TED Talks

Watched earlier



2006
2007

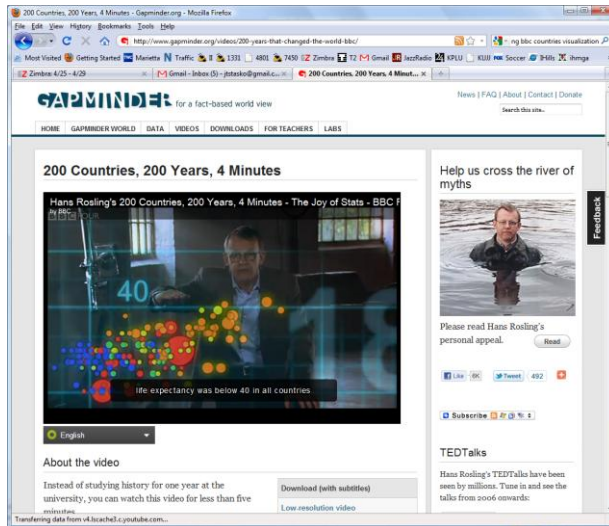
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A Newer One

Video



Same idea

Glitzier special effects

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

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Why so Compelling?

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

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Empirical Study



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

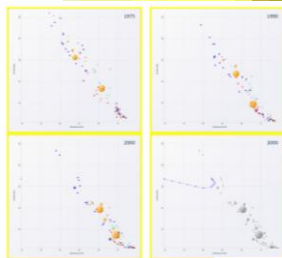
Robertson et al
TVCG (InfoVis) '08

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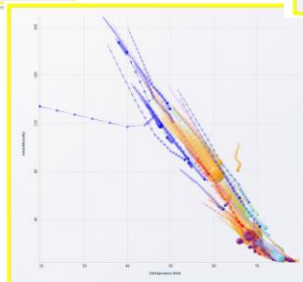
Visualizations Studied



Animation



Small multiples



Traces

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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

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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

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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)

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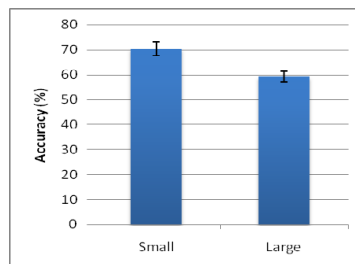
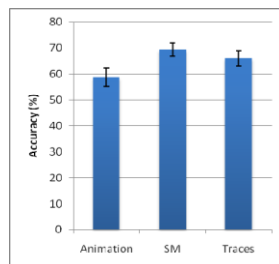
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Results



- Accuracy Measured as percentage correct
65% overall (pretty tough)



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

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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.

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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 disagree, 6-strongly agree

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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?

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HW 8



- Investigative analysis with Jigsaw
- Due next Weds
- Questions?

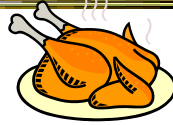
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Upcoming

- Thanksgiving



- Visual Analytics 1
 - Paper
Keim et al '08
- Visual Analytics 2
 - Papers
Stasko et al '08

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References

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

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