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Faculty Summit 2010

Use of Animation in Information Visualization

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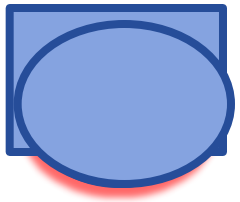
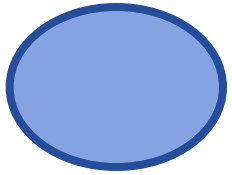
Animation

	Helps?	Hurts?
Attention	direct attention	Distraction
Object Constancy	change tracking	false relations
Causality	narrative	false agency
Engagement	increase interest	"chart junk"
Calibration		too slow: boring too fast: errors





Principles for Animation

Character Animation (Lasseter 1987, based on Thomas and Johnson 1981)

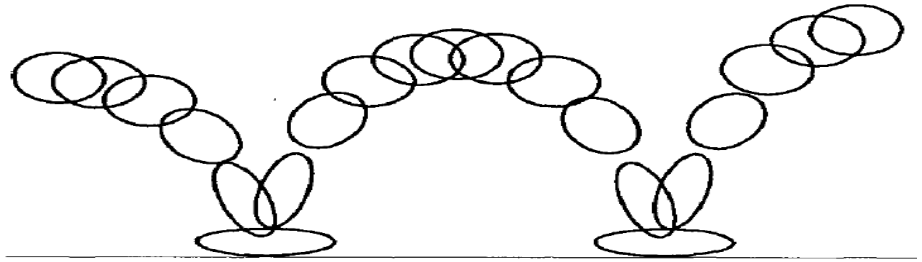
Squash and stretch

Exaggeration

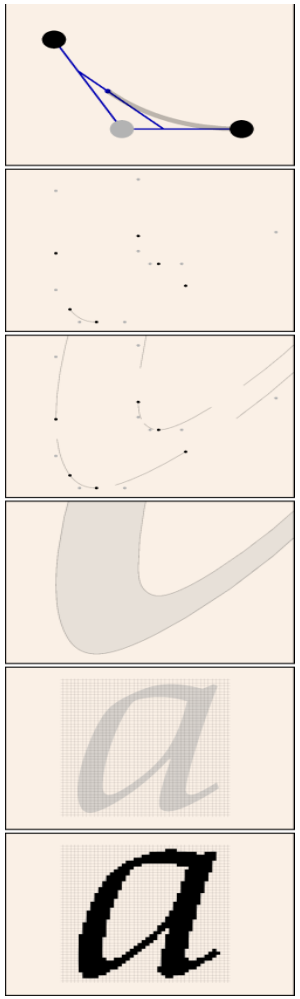
Anticipation

Staging

Slow-in / Slow-out



Principles for Animation



Animated Presentations (Zongker, Salesin 2003)

Make movement meaningful

- Avoid unintended perceptions of agency
- Avoid squash-and-stretch, exaggeration

Direct attention, aid comprehension

- Use anticipation and staging

Do one thing at a time

Reinforce animation with narration

Distinguish dynamics from transitions

Principles for Animation (Tversky et al, 2002)

Congruence Principle

- The structure and content of the external representation should correspond to the desired structure and content of the internal representation

Apprehension Principle

- The structure and content of the external representation should be readily and accurately perceived and comprehended

Principles for Animation

Congruence
Maintain valid data graphics during transitions
Use consistent syntactic/semantic mappings
Respect semantic correspondence
Avoid ambiguity

Apprehension
Group similar transitions
Minimize occlusion
Maximize predictability
Use simple transitions
Use staging for complex transitions
Make transitions as long as needed, but no longer

Uses of Animation in Information Visualization

Transition Animation

- Short animation keeps user in context during view/data transitions

Trend Animation

- Show data changes over time

Static Depictions of Motion (Baudisch, 2006)

- Semi-transparent trails to show change over time

Kinetic Visualization (Ware, 1994)

- Objects in a set shown moving together at the same speed

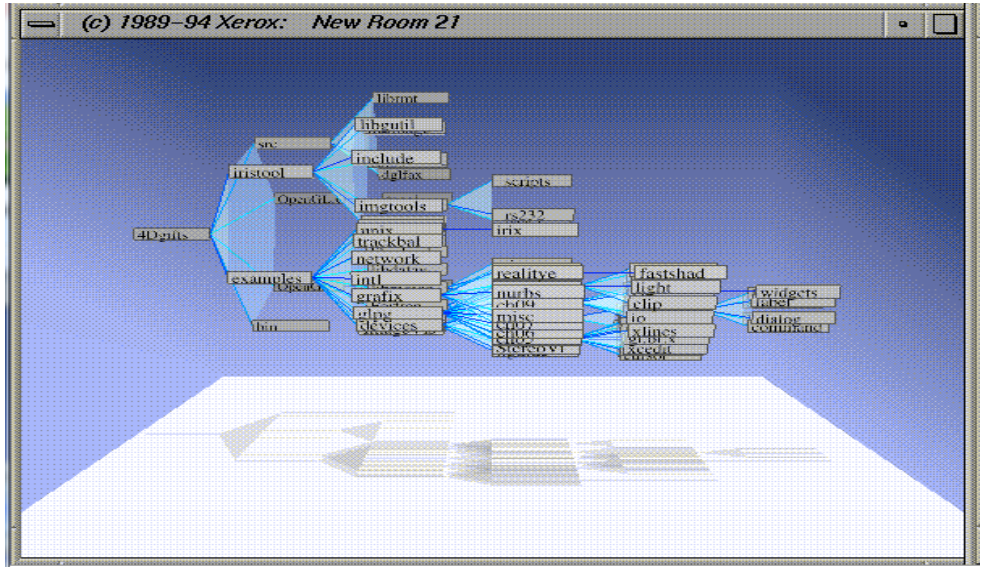
Animation to Illustrate a Process

- Algorithm animation was early example

Cone Tree (CHI 1991)

Hierarchy visualization

- Use of transition animations to retain user context
- Constant time:
  ~ 1 second (from Newell's theory)
- Use of 3D made it possible to see much more of structure

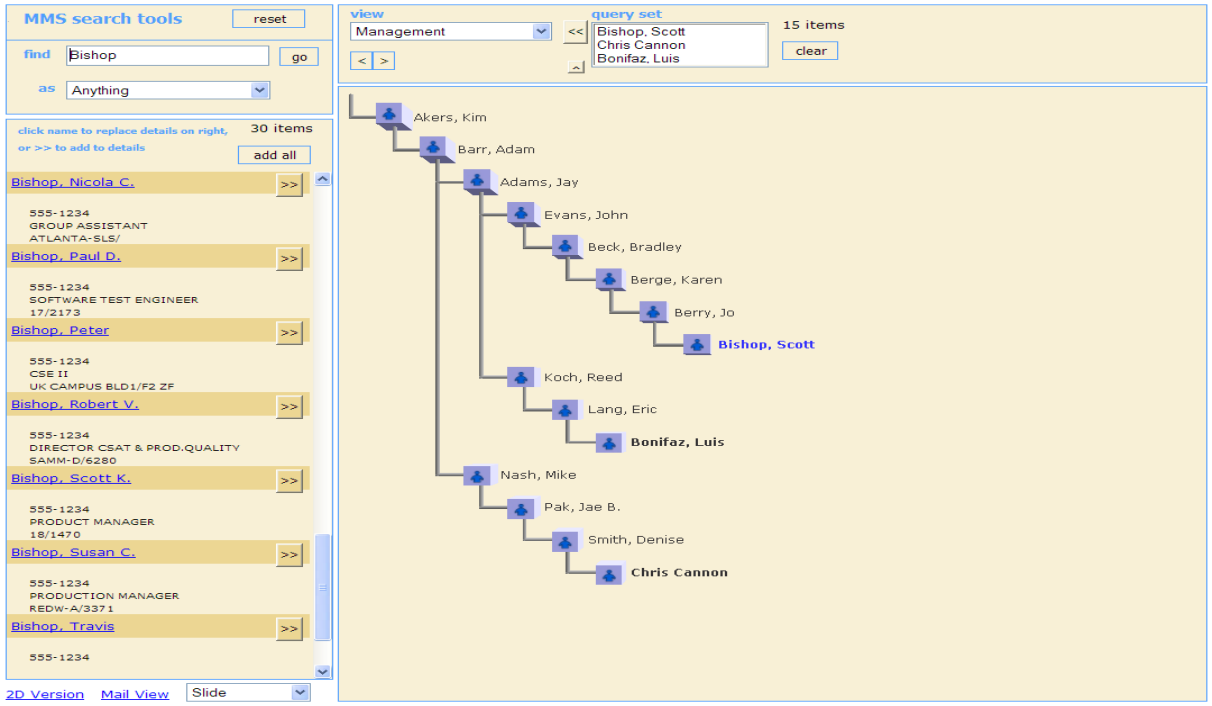


Video

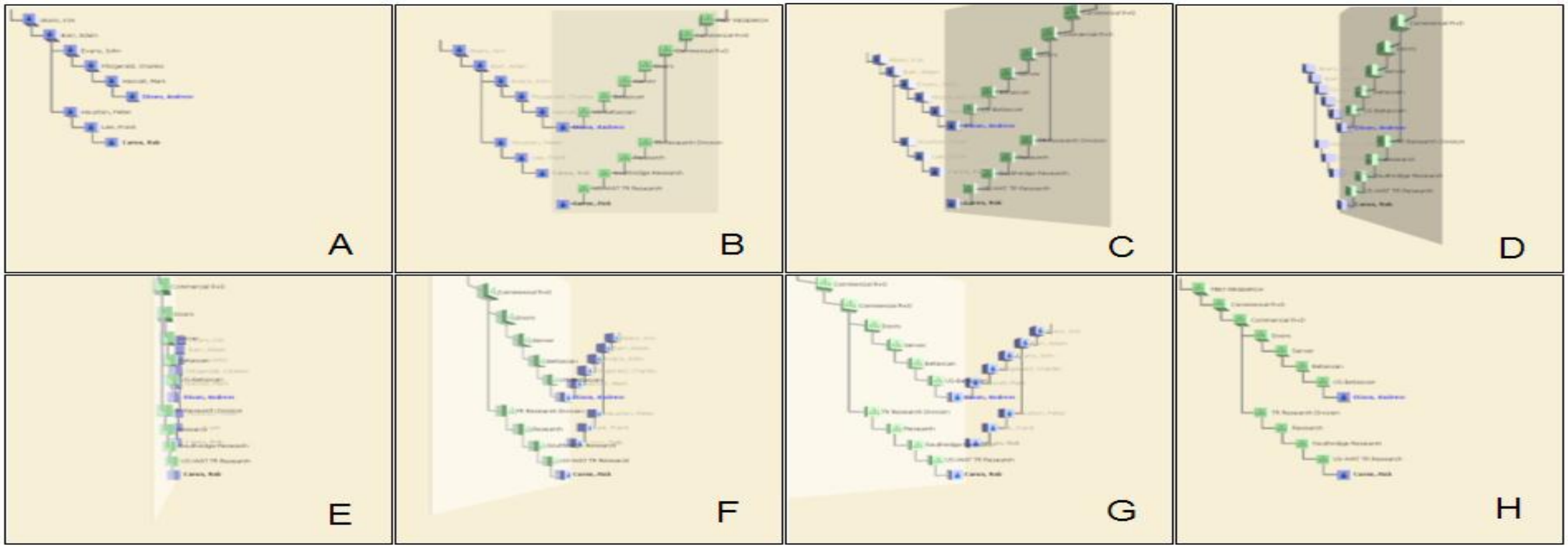
Polyarchy Visualization (CHI 2002)

Multiple Intersecting Hierarchies

- Show multiple hierarchies
- Search results in context
- Show minimal info needed
- Animated transitions key
  - Keeps user in context
- Six user studies demonstrated value of transition animation



Visual Pivot Animation



Proffitt and Kaiser (1993)

- Rotation and translation motions have different perceptual significance
  - Rotations define 3D form
  - Translations define observer-relative displacements
- Suggests Visual Pivot sliding animation may be perceived as observer-relative while rotating animations may be perceived as defining 3D form
  - User task determines which is more useful

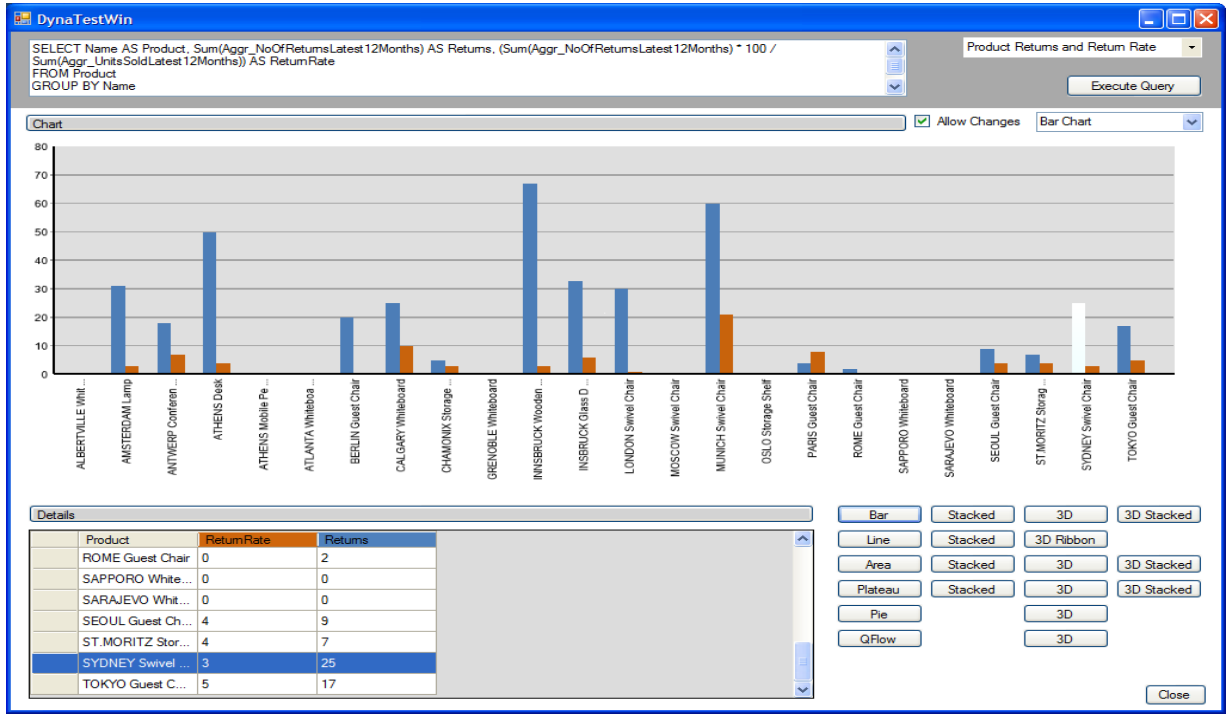
DynaVis (InfoVis 2007): Dynamic Visualization Framework

Animated transitions

- Between chart types
- For new data
- For changed data
- For sorted data

Use of staggered/staged animations was effective

User studies show significant benefits



Demo

Trend Visualization (InfoVis 2008)

Gapminder Trendalyzer appears successful in presentations

- Works because presenter draws attention to relevant changes
- Study shows it is most enjoyable & exciting, but not always preferred

Does it work for analysis?

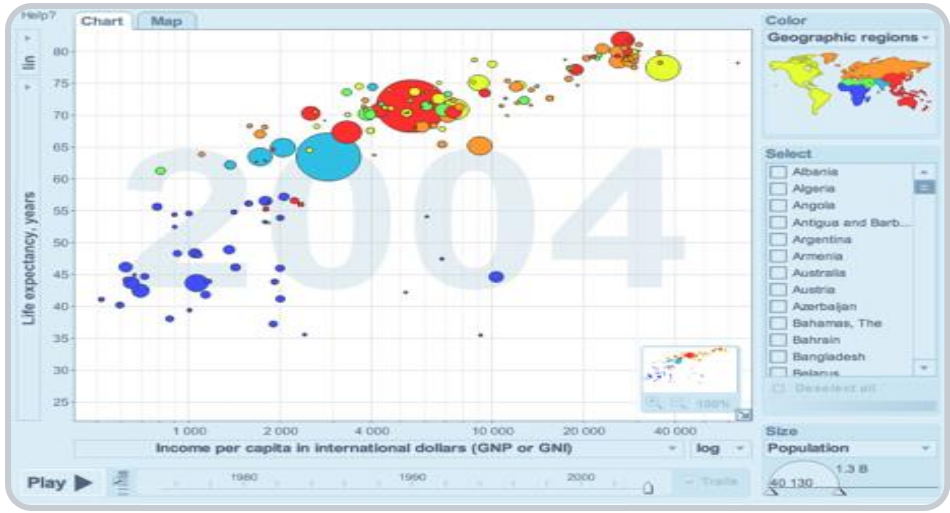
- No: multiple replays make it slowest technique, and not very accurate

Does it scale?

- No: works for up to about 200 data points

Are there alternatives that work better under some conditions?

- Yes: static depictions of trends are faster for analysis
- Yes: small multiples is more accurate

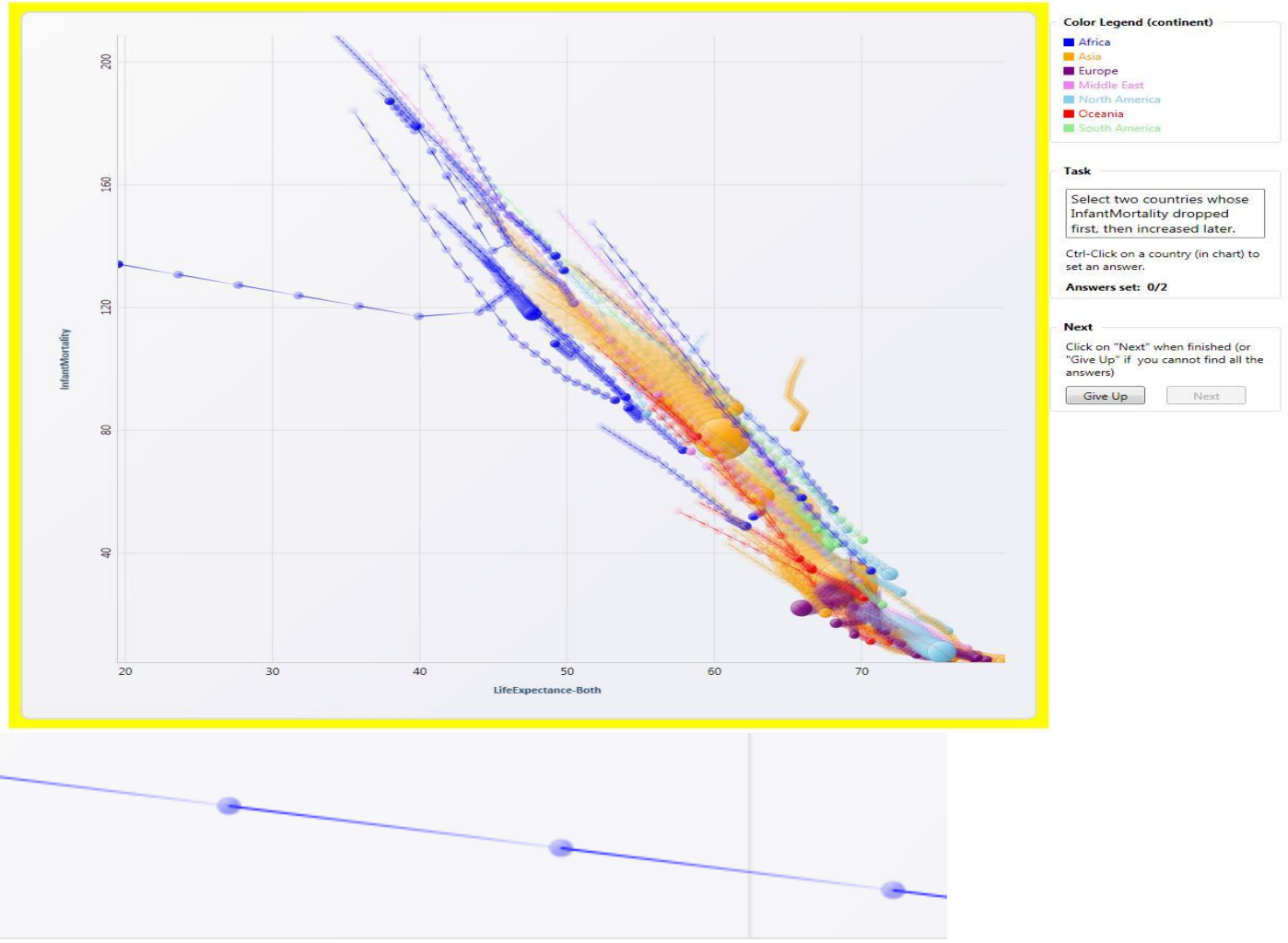


Video

Alternative Trend Visualizations

Traces

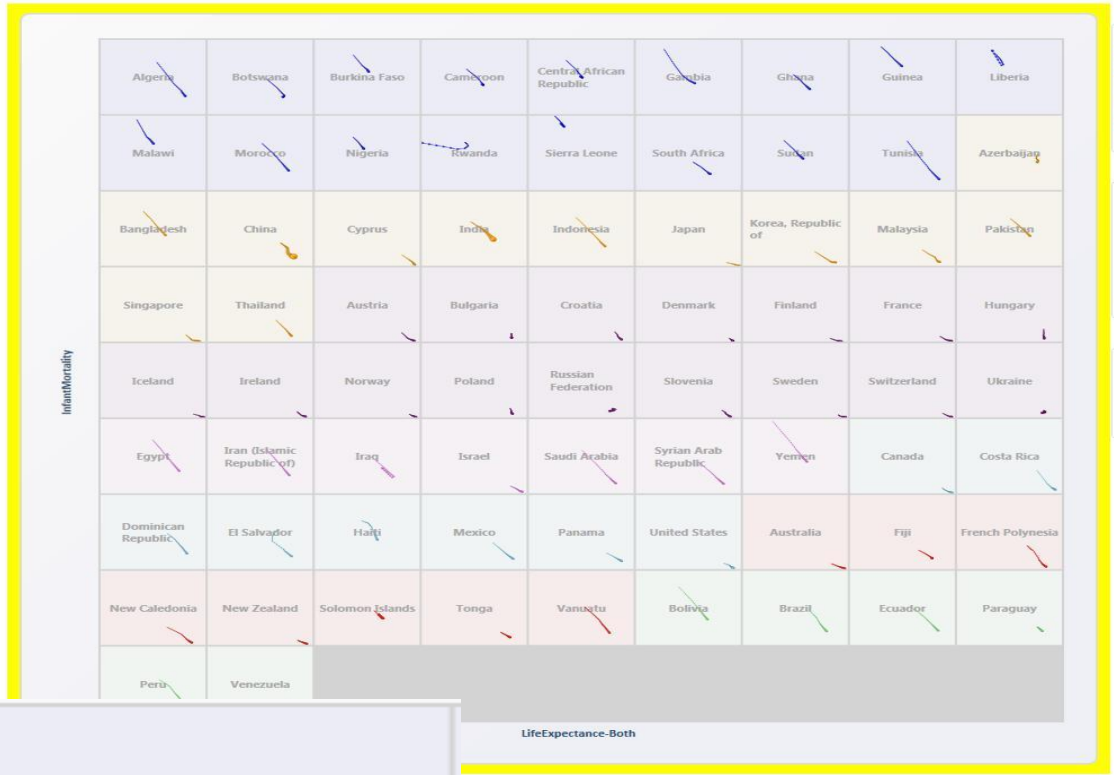
- Show all trends simultaneously
- Fade-in bubbles/links to show direction of flow
- Counter-trends pop-out (without replay)
- Clutter may pose problem in some cases
- Could be addressed by automatic anomaly highlighting



Alternative Trend Visualizations

Small Multiples

- Show each trend separately
- Use bubble size to show direction of flow
- Counter-trends pop-out
- No clutter, but user must scan for answer
- Larger dataset size → smaller multiples



Trend Visualization - Study Conclusions

Trend visualization techniques must include all three alternatives

- Each has distinct advantages for particular situations
- Trend animation works best for presentation
- Traces works best for analysis when the result is not in the clutter
- Small Multiples works best for analysis when there is key information in the clutter

Conclusion: Most Effective Uses of Animation in Visualization

Transition Animation

- Studies show that fixed time (1/2 to 1 sec) transition animation
  - Improves user task performance time
  - Decreases errors
  - Improves user satisfaction
- Studies show additional improvements for carefully used multi-stage and/or staggered animation sequences

Trend Animation

- Gapminder Trendalyzer appears successful in presentations
- Does not work well for analysis!
- Static animation alternatives work better under some conditions

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