CDS 6324
DATA VISUALIZATION

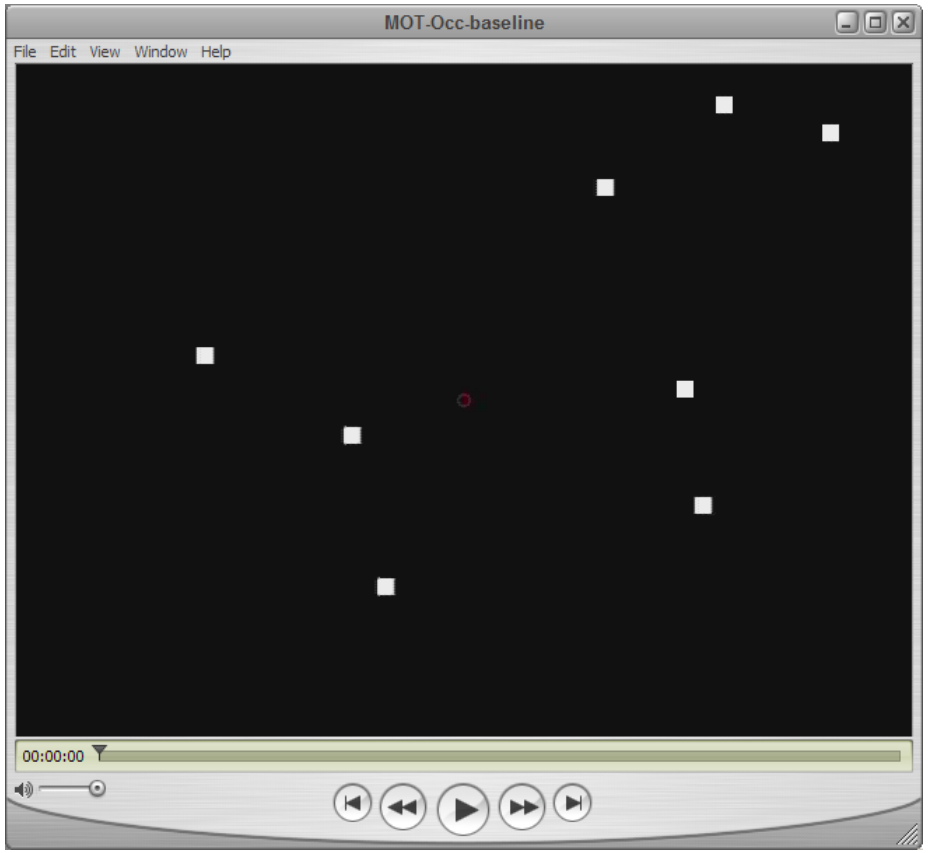
Lecture 8: Interactive Visualization

Why Use Motion / Animation?

- Visual variable to encode data
- Direct attention
- Understand system dynamics
- Understand state transition
- Increase engagement

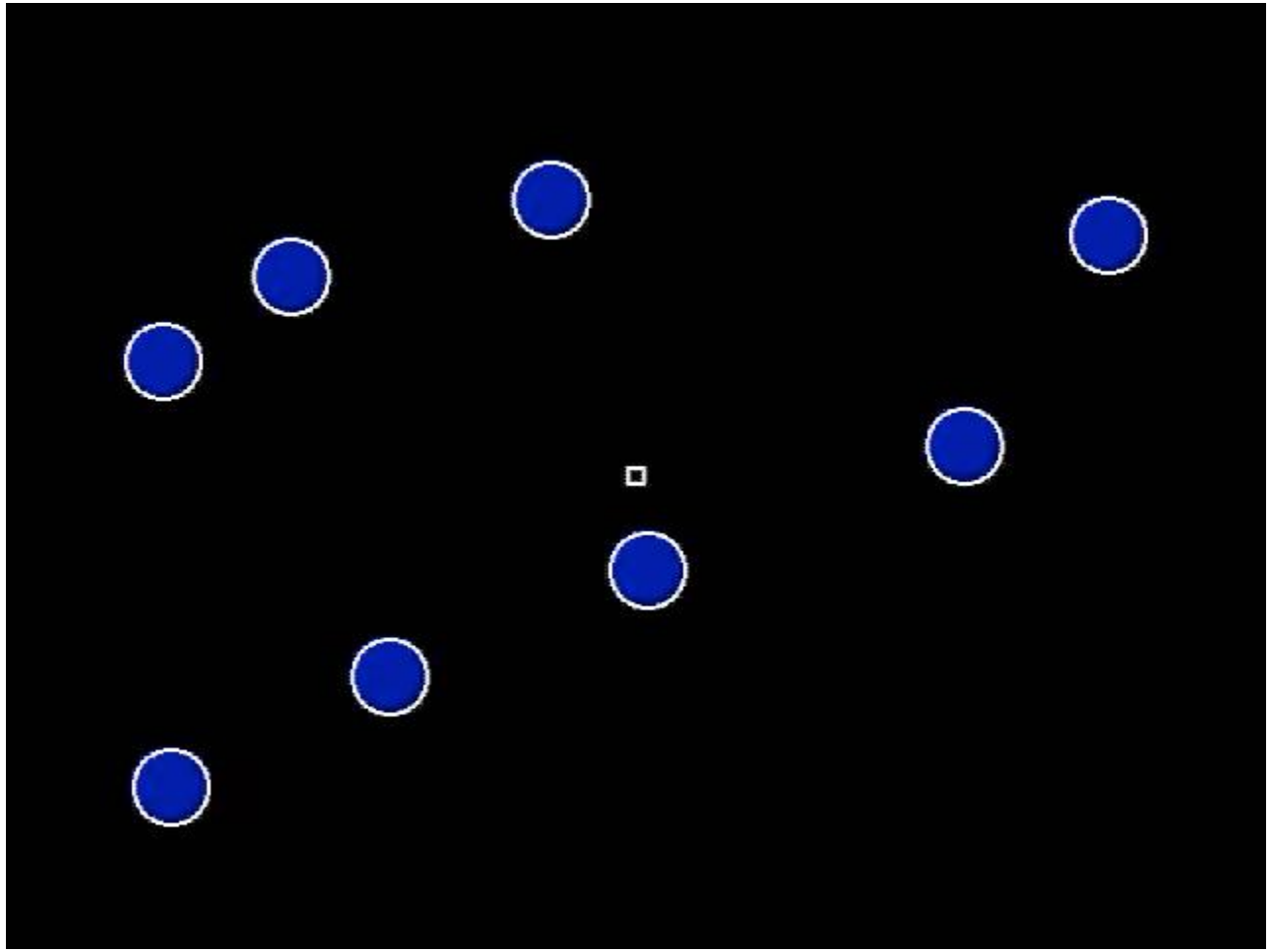
Motion Perception

Tracking Multiple Targets

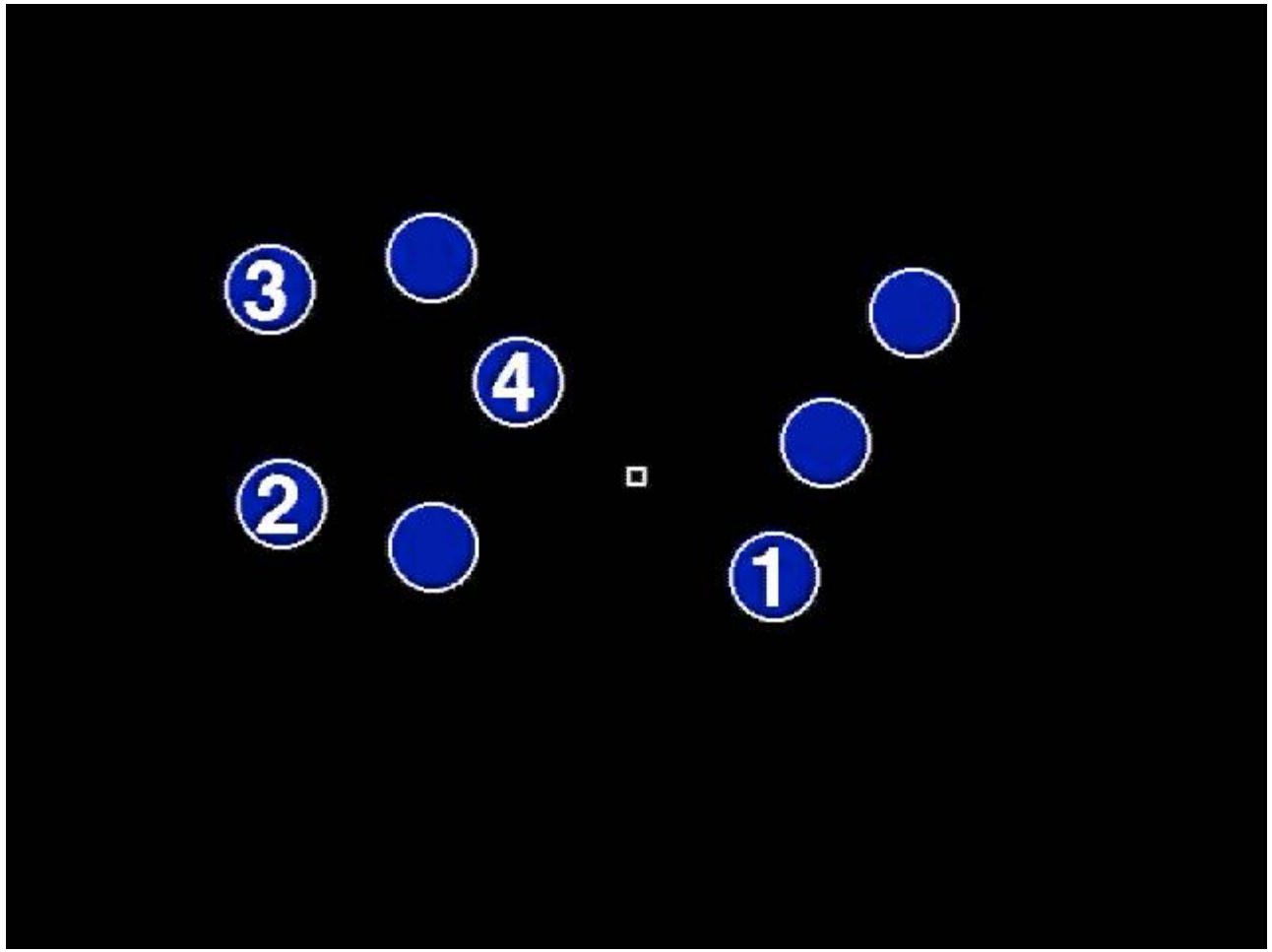


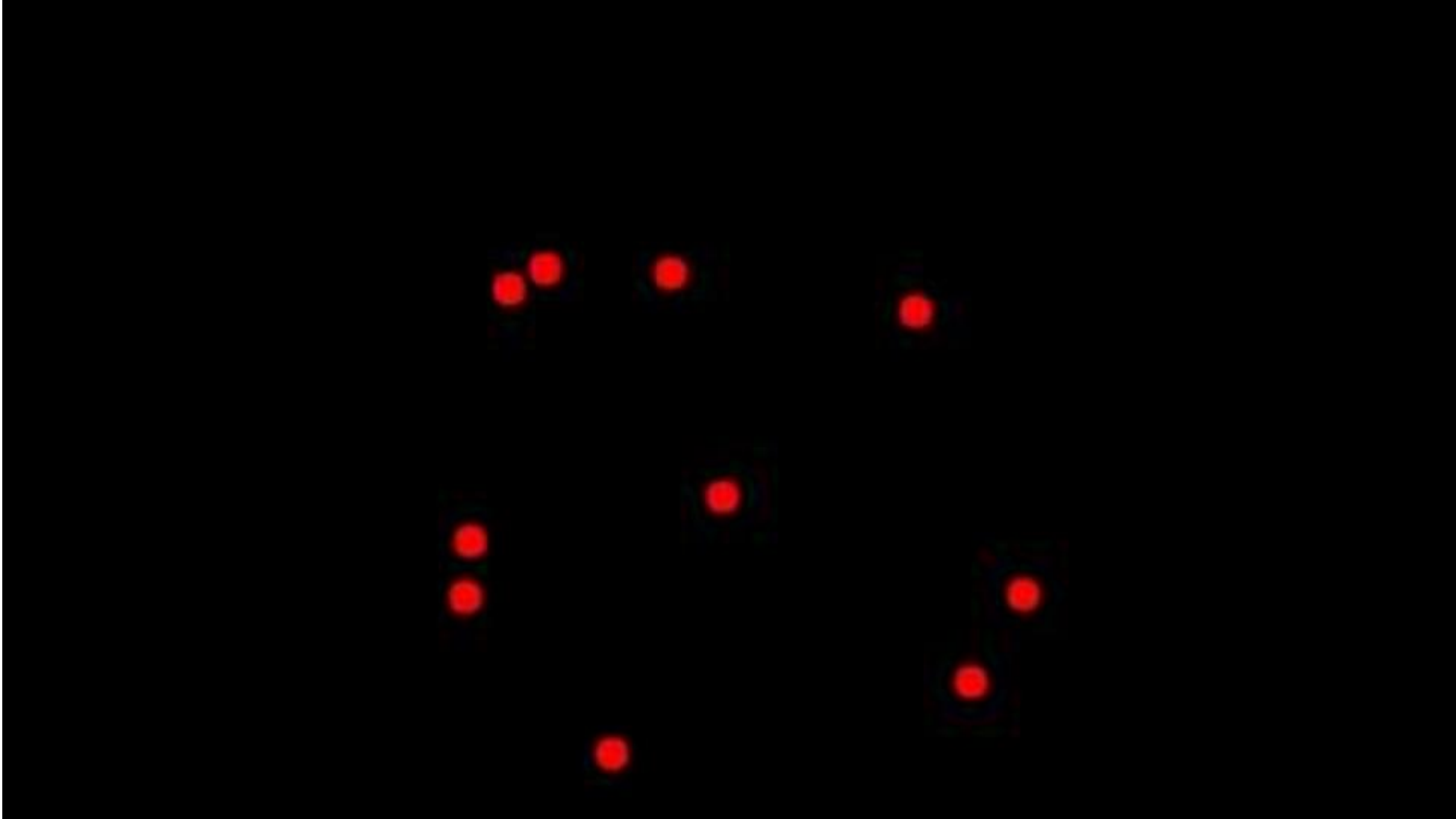
- How many dots can we simultaneously track?
- ~4-6. Difficulty increases sig. at 6. [Yantis 92, Pylyshn 88, Cavanagh 05]

Tracking Multiple Targets



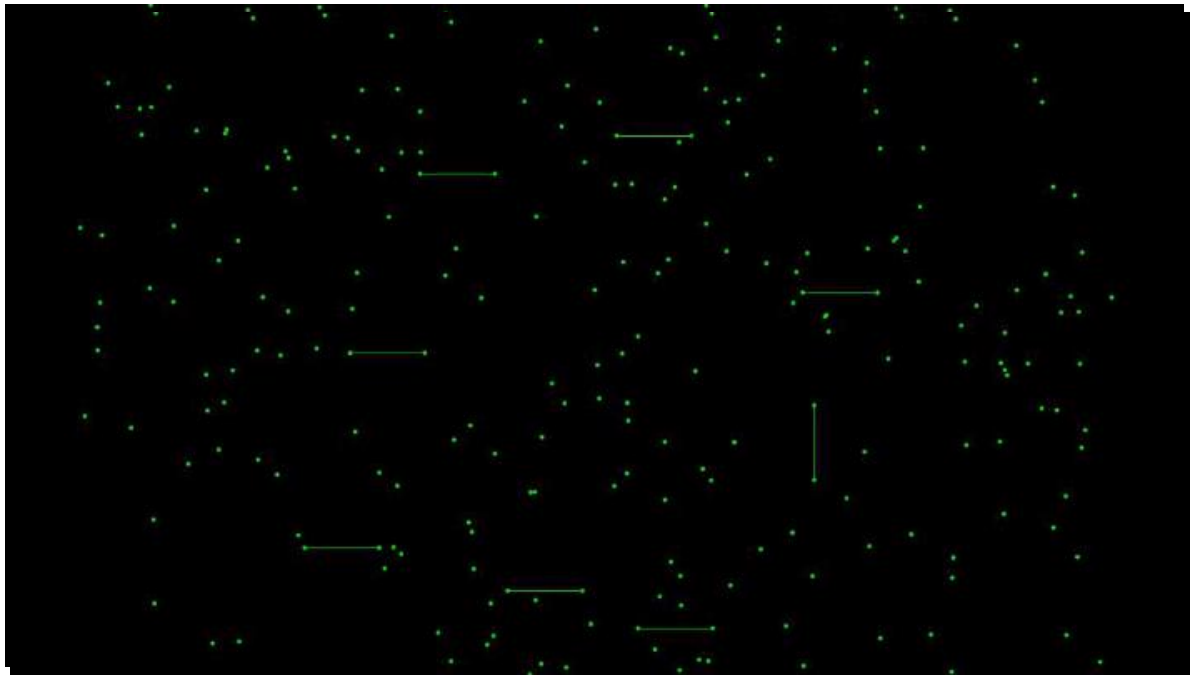
Tracking Multiple Targets





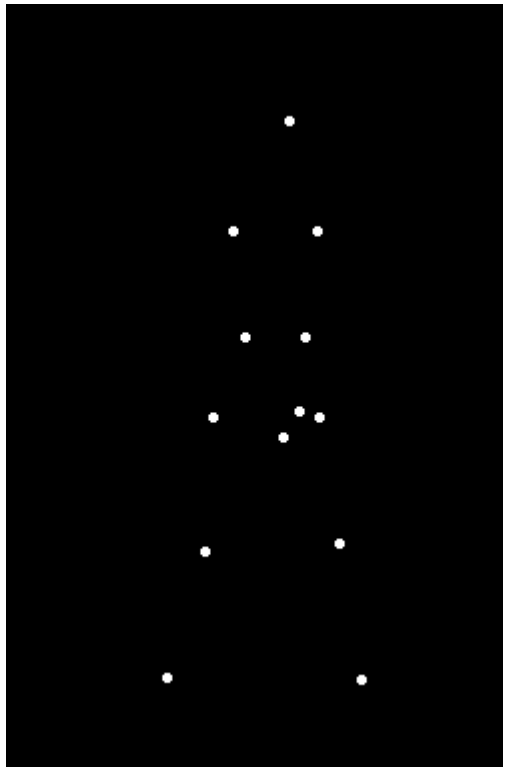
Segment by Common Fate

- The human visual system breaks an incoming image into separate elements, but also reassembles these elements into groups.
- Principle of *common fate* → objects appear grouped when they display the same pattern of motion.
- Eg. Dots moving together are grouped!

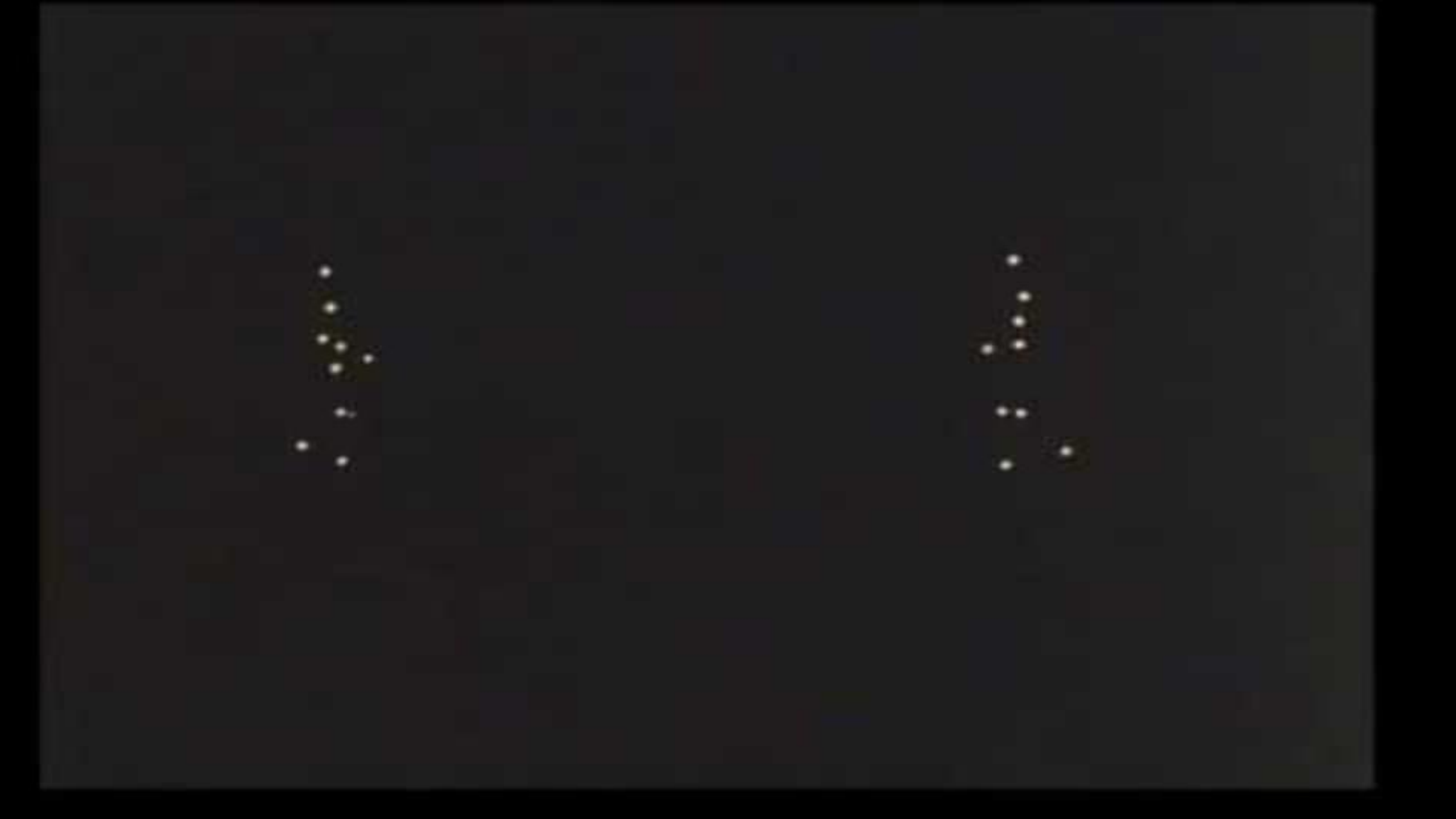


Grouping of Biological Motion

- Johansson (1973) attached small points of light at the joints of human actors, and filmed them moving about in the dark. Observers viewing the film reported vivid impressions of human figures, even though the images contained just a few isolated bright points.



https://www.youtube.com/watch?v=1F5ICP9SYLU



Motions Show Transitions

- See change from one state to next

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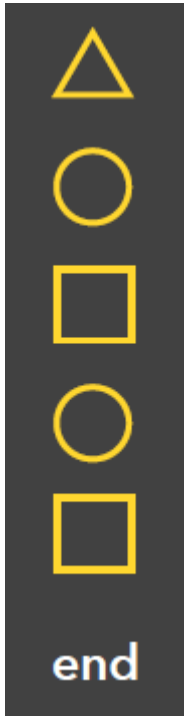

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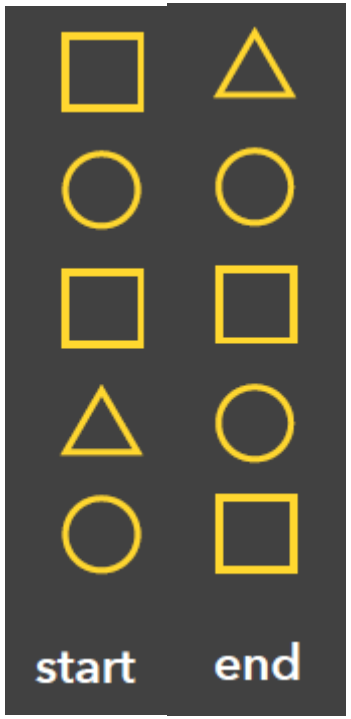
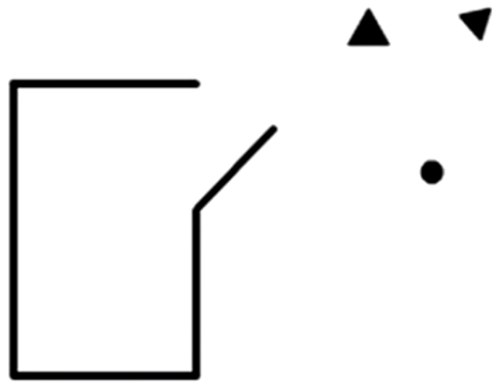
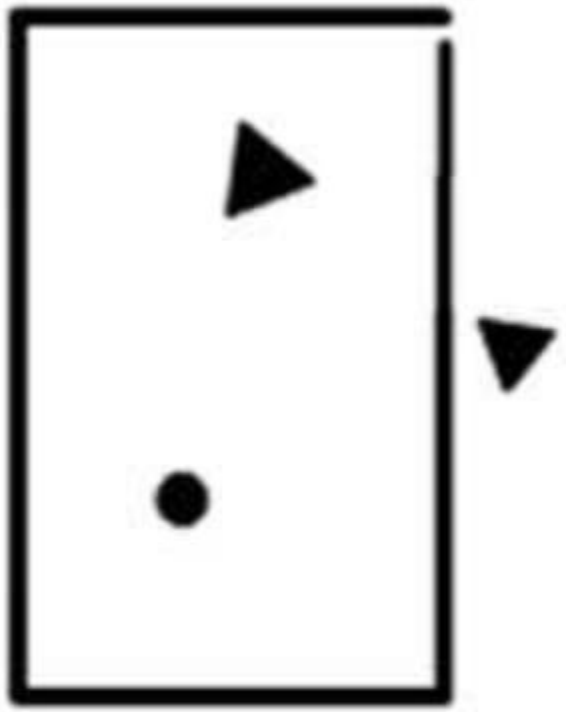


Constructing Narratives

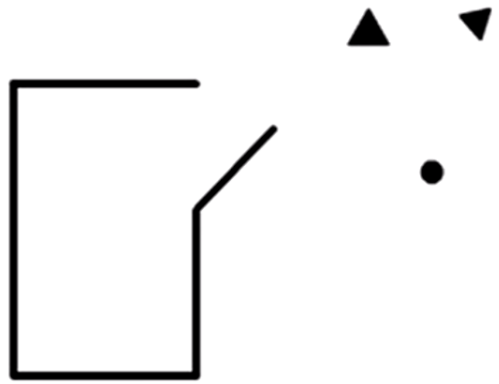
- In the 1944 Heider-Simmel demonstration, members of a study were shown an animation where shapes moved around the screen. What do you see?





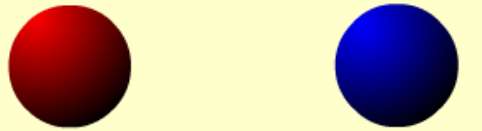
Constructing Narratives

- In the 1944 Heider-Simmel demonstration, members of a study were shown an animation where shapes moved around the screen. What do you see?
- What was discovered was that only three people out of 100 saw shapes moving around. The rest all saw love stories and attributed agency and intent to the shapes.



The Perception of Causality

Michotte demonstration 1. What do you see? Most observers report that "the red ball **hit** the blue ball." The blue ball moved "**because** the red ball hit it." Thus, the red ball is perceived to **"cause"** the blue ball to move, even though the balls are nothing more than color disks on your screen that move according to a programme.



- By means of suitable patterns on a partly concealed rotating disc Michotte was able to give the impression of objects in movement; and where certain conditions of speed, position, and time-interval were satisfied, his subjects received the impression of a causal interaction between two objects for example, the impression that one object has bumped into another (the Launching Effect) or is carrying it along (the Entraining Effect).

Motion Perception Videos

- Johansson's Motion Perception:
  - 2D Motion Perception: https://www.youtube.com/watch?v=1F5ICP9SYLU
  - 3D Motion Perception: https://www.youtube.com/watch?v=KT89CQ2nRpo
- MIT OpenCourseware: Motion perception and pursuit eye movements
  - https://www.youtube.com/watch?v=oPb9AWMN2fY

What is Animation?

The act of
bringing to life

Characteristics of Animation

Animation draws
attention

Animation
gives object
constancy

Animation
suggests **causation**
and **intentionality**

Animation

Is emotionally

engaging

Principles of Animations

Principles of Animations

Congruence

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

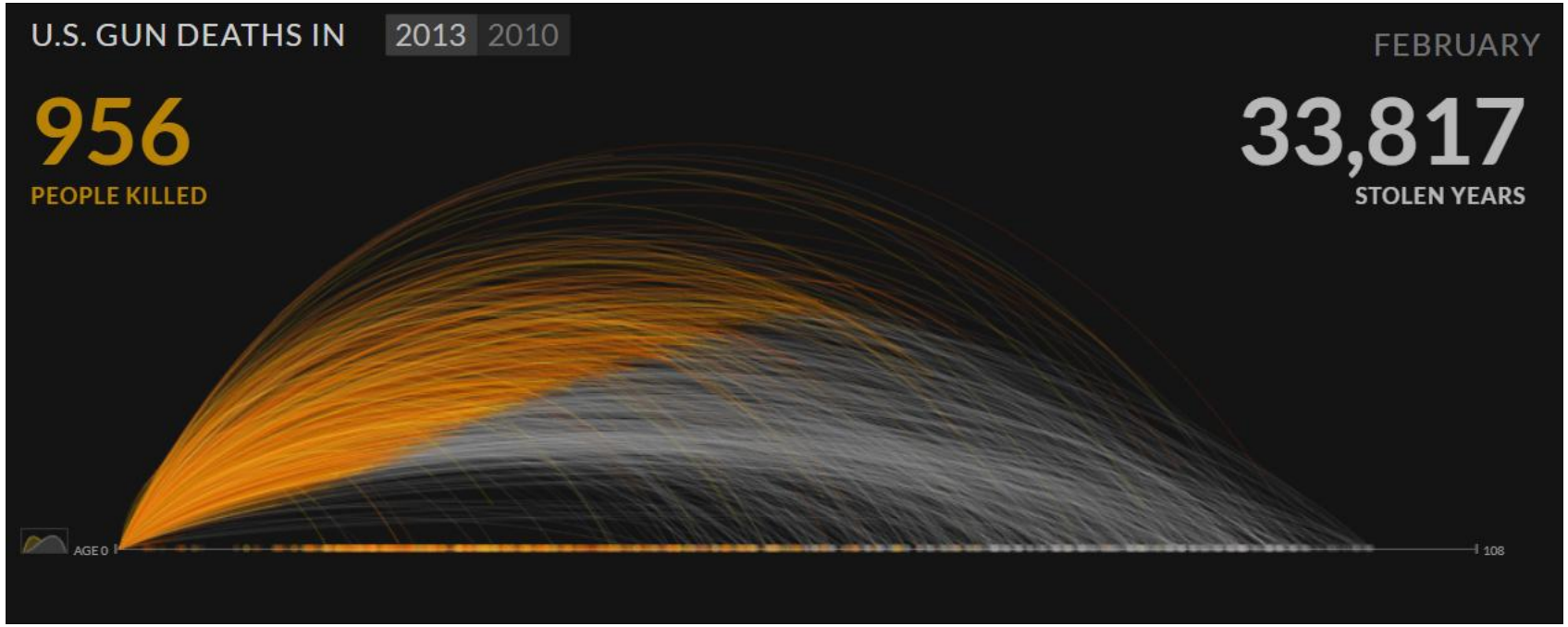
Apprehension

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

Three Uses of Animation

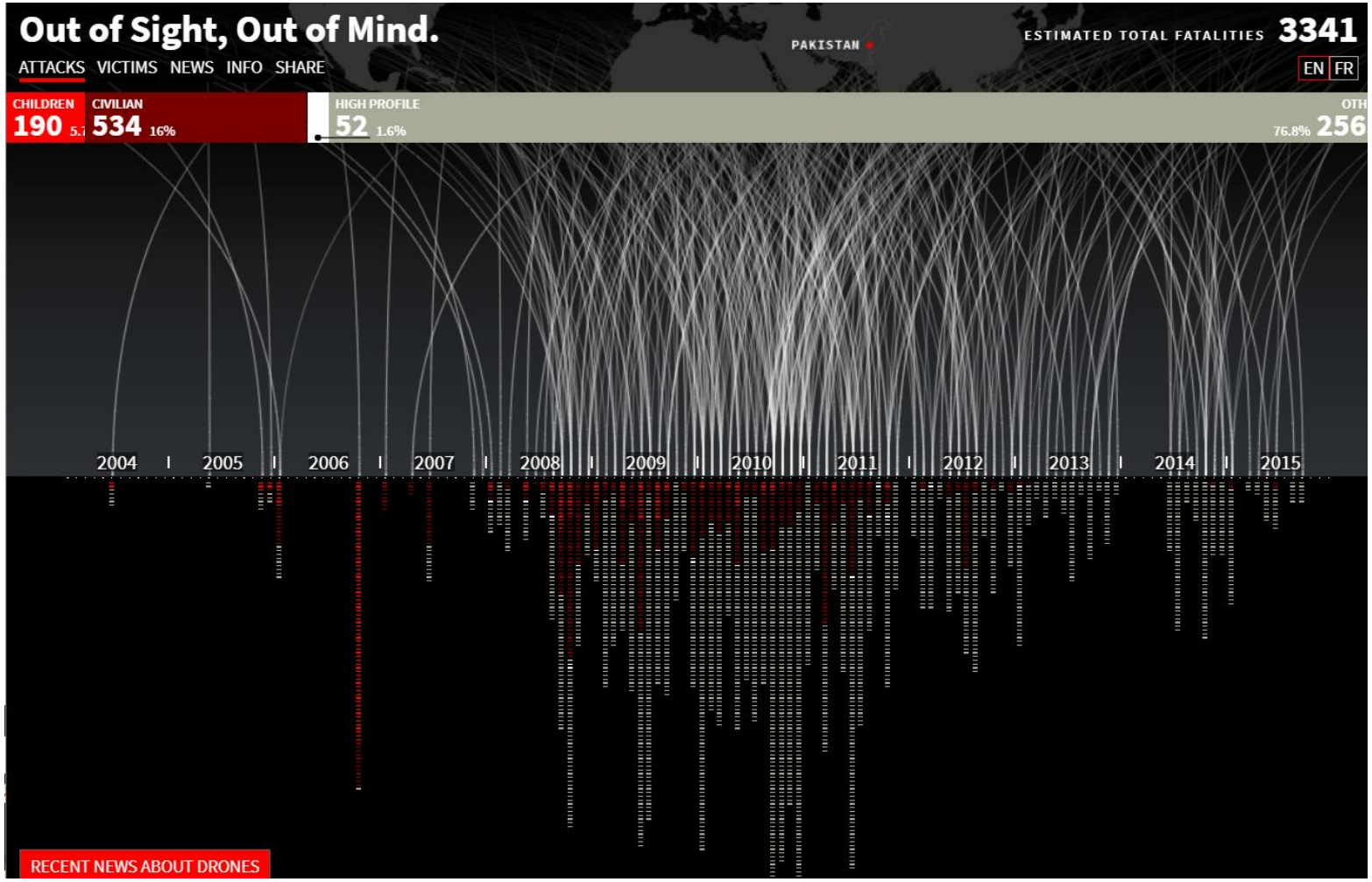
Animation as **narration**

U.S. Gun Deaths [Periscopic]



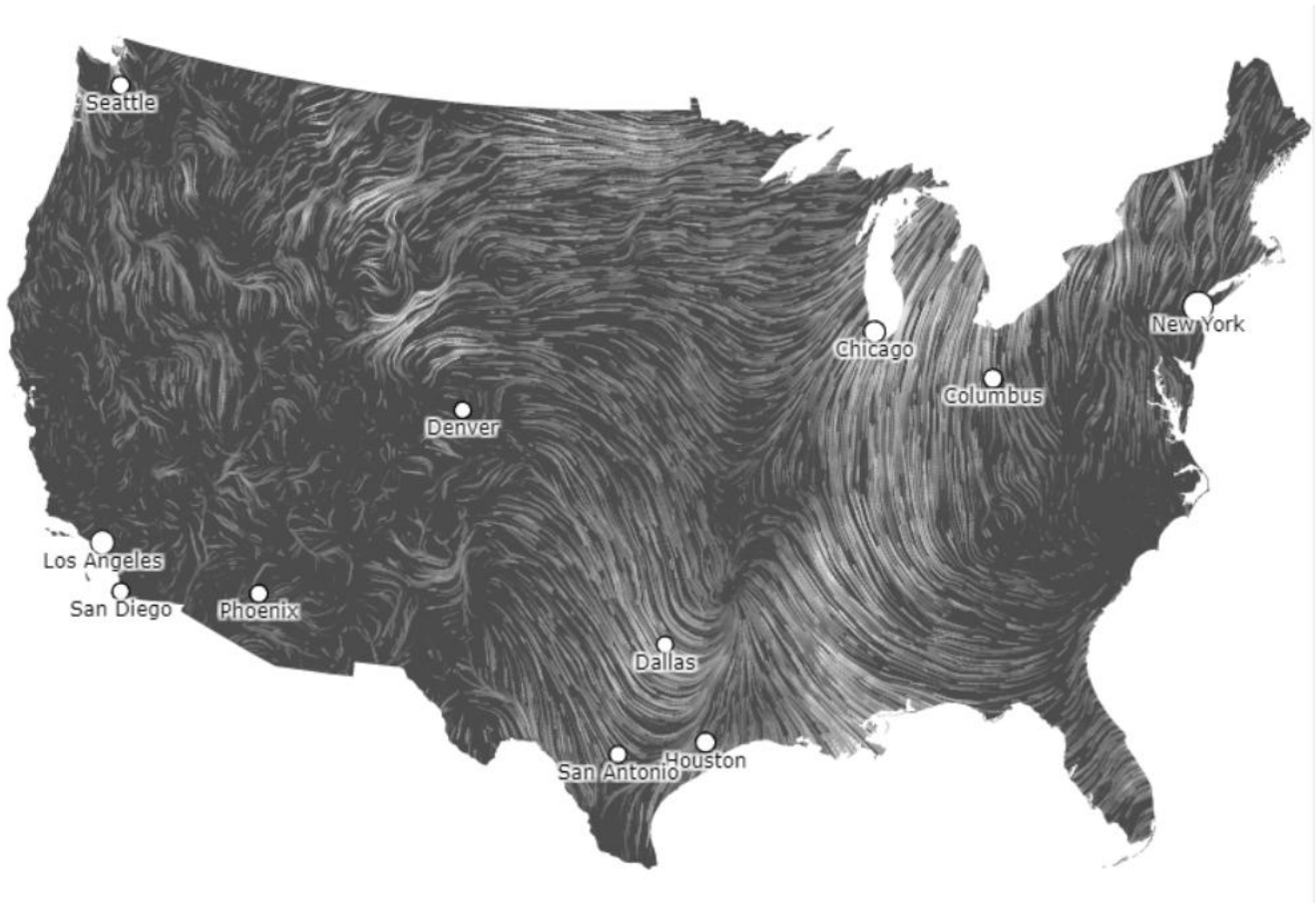
http://guns.periscopic.com/

Out of Sight, Out of Mind [Pitch Interactive]

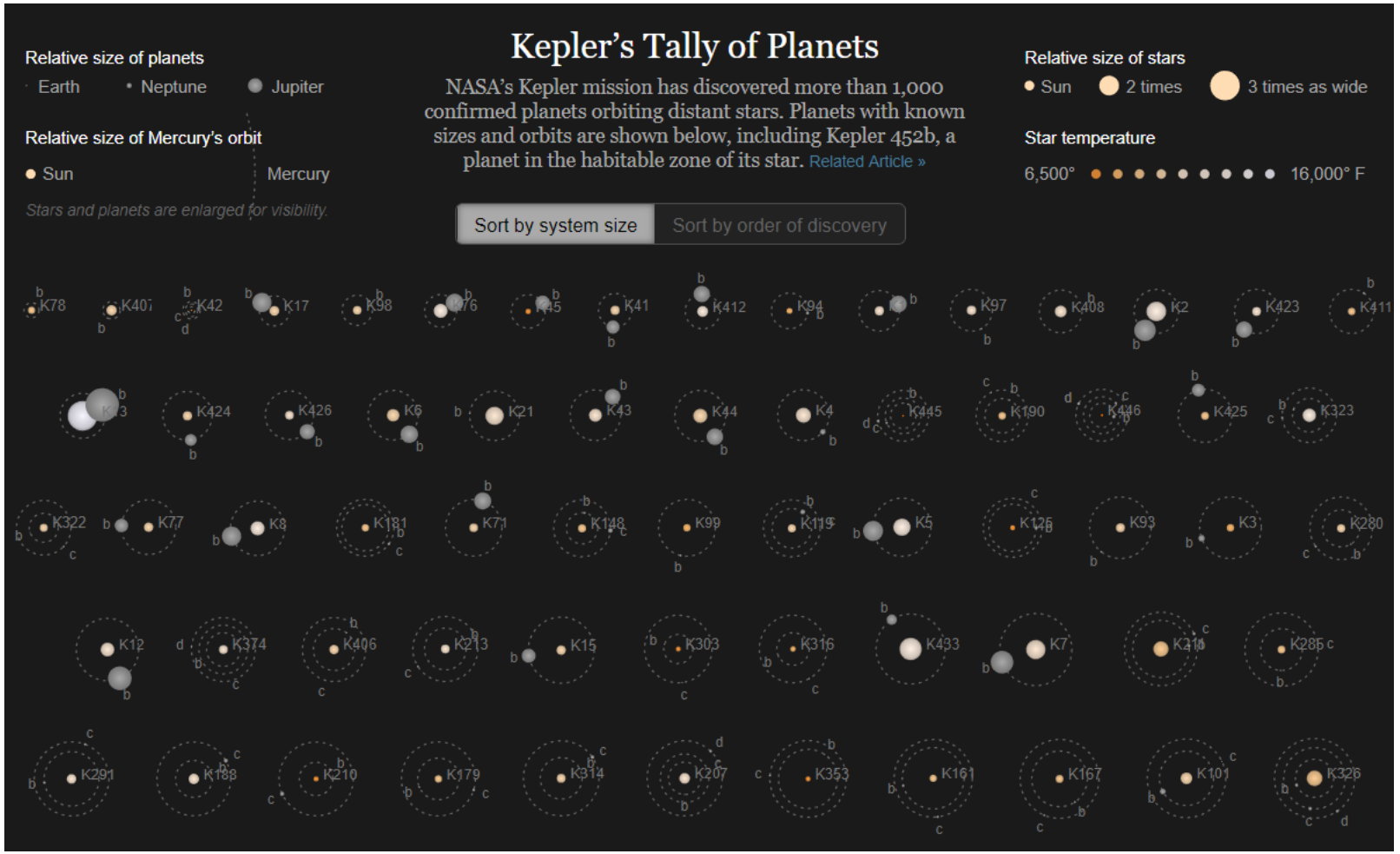


Animation as **encoding**

Wind Map [Fernanda Viegas, Martin Wattenberg]



Kepler's Tally of Planers [New York Times]



Animation as

transition

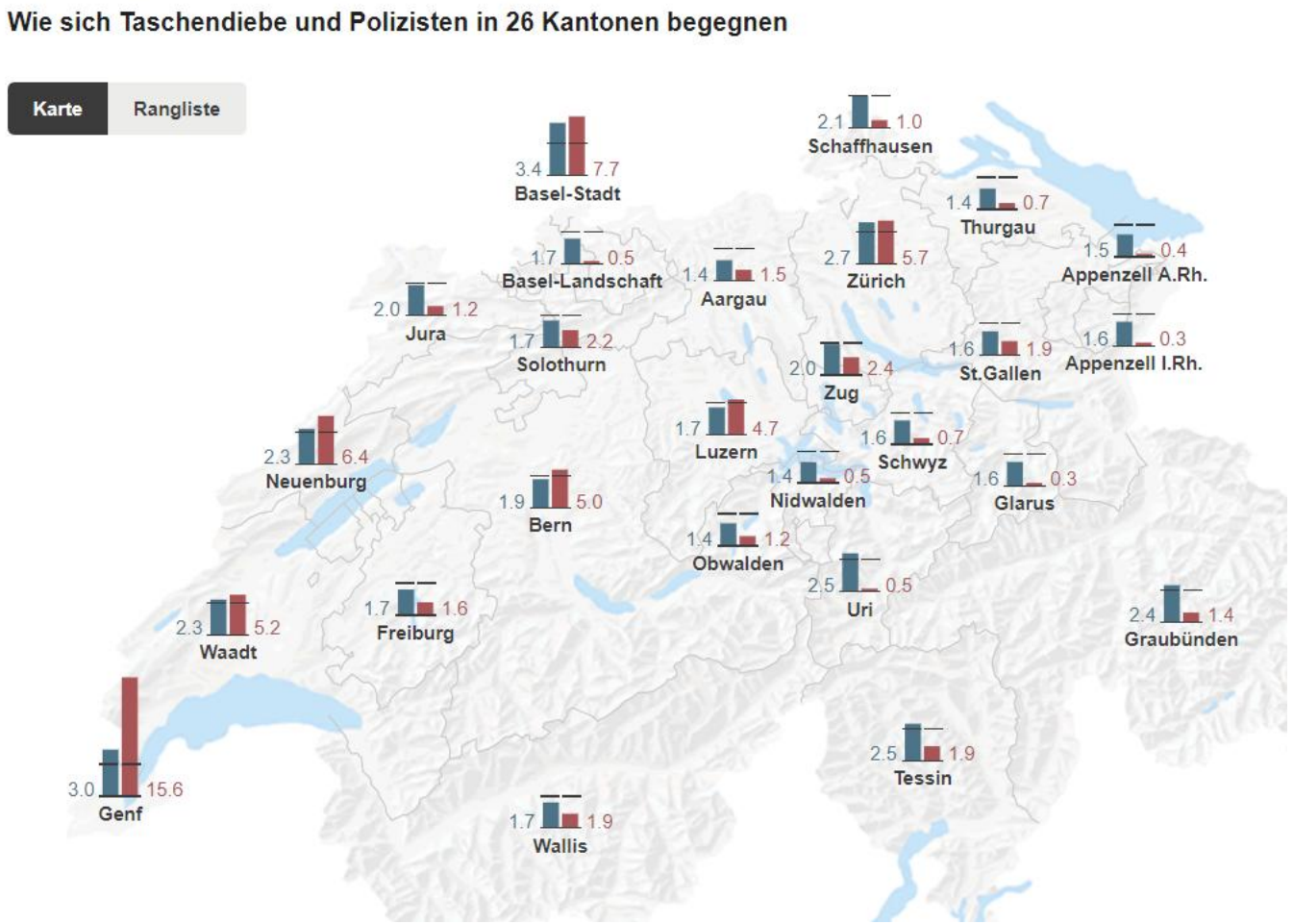
Transformation of view

Weltenbrand [NZZ, Interactive Things]

Weltenbrand – NZZ, Interactive Things

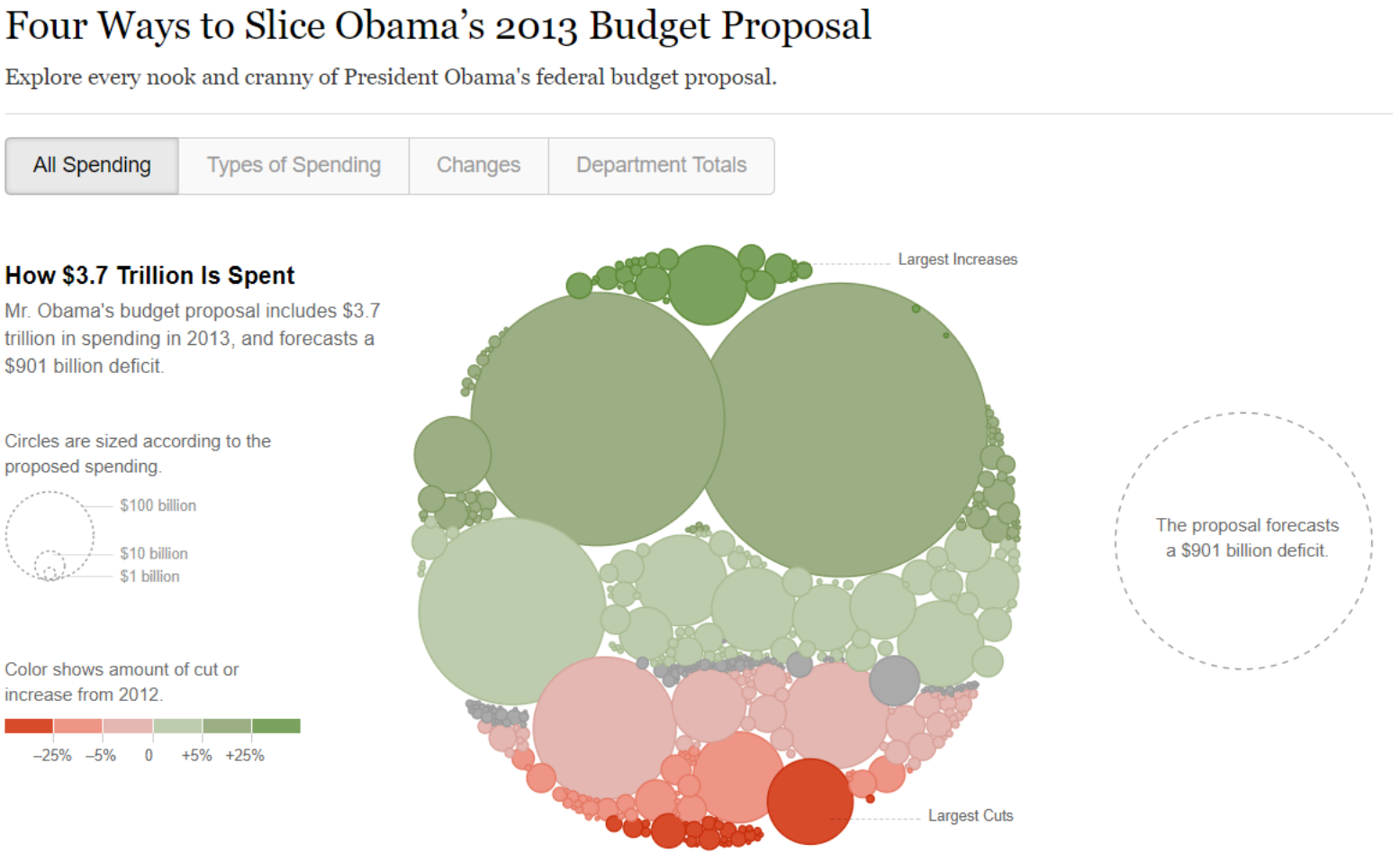
Change of representation

Robbers in Geneva, cops in Basel



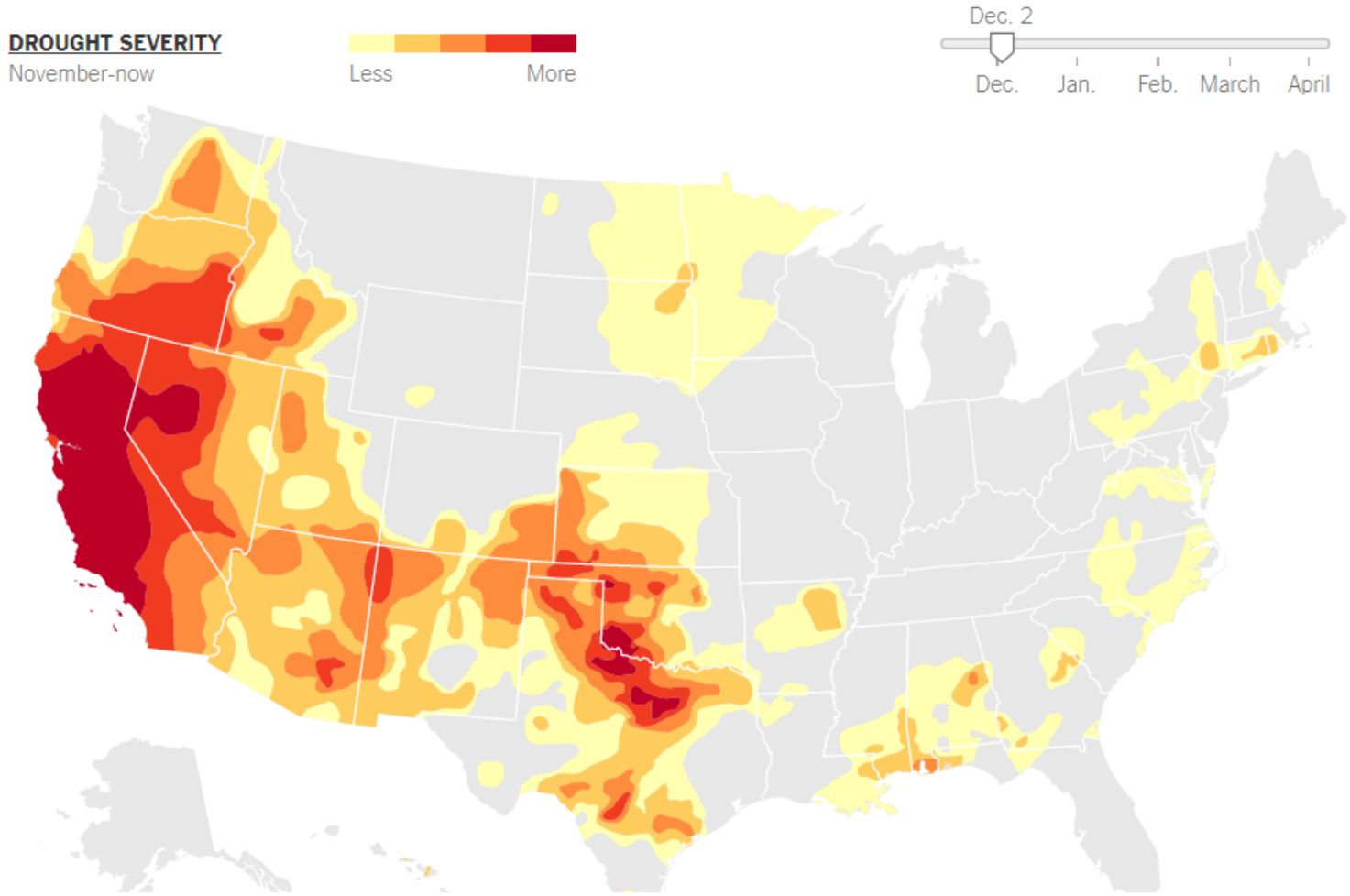
Transformation of the surface

Four Ways to Slice Obama's 2013 Budget Proposal [New York Times]



Timestep

Time Step [Fernanda Viegas, Martin Wattenberg]



Change of
data structure

Zürcher Gemeinderatswahlen [NZZ, Interactive Things]

Reordering

Public Value Atlas [Interactive Things]

Filtering

Public Value Atlas [Interactive Things]

10 Principles of Transitions

Congruence Principles

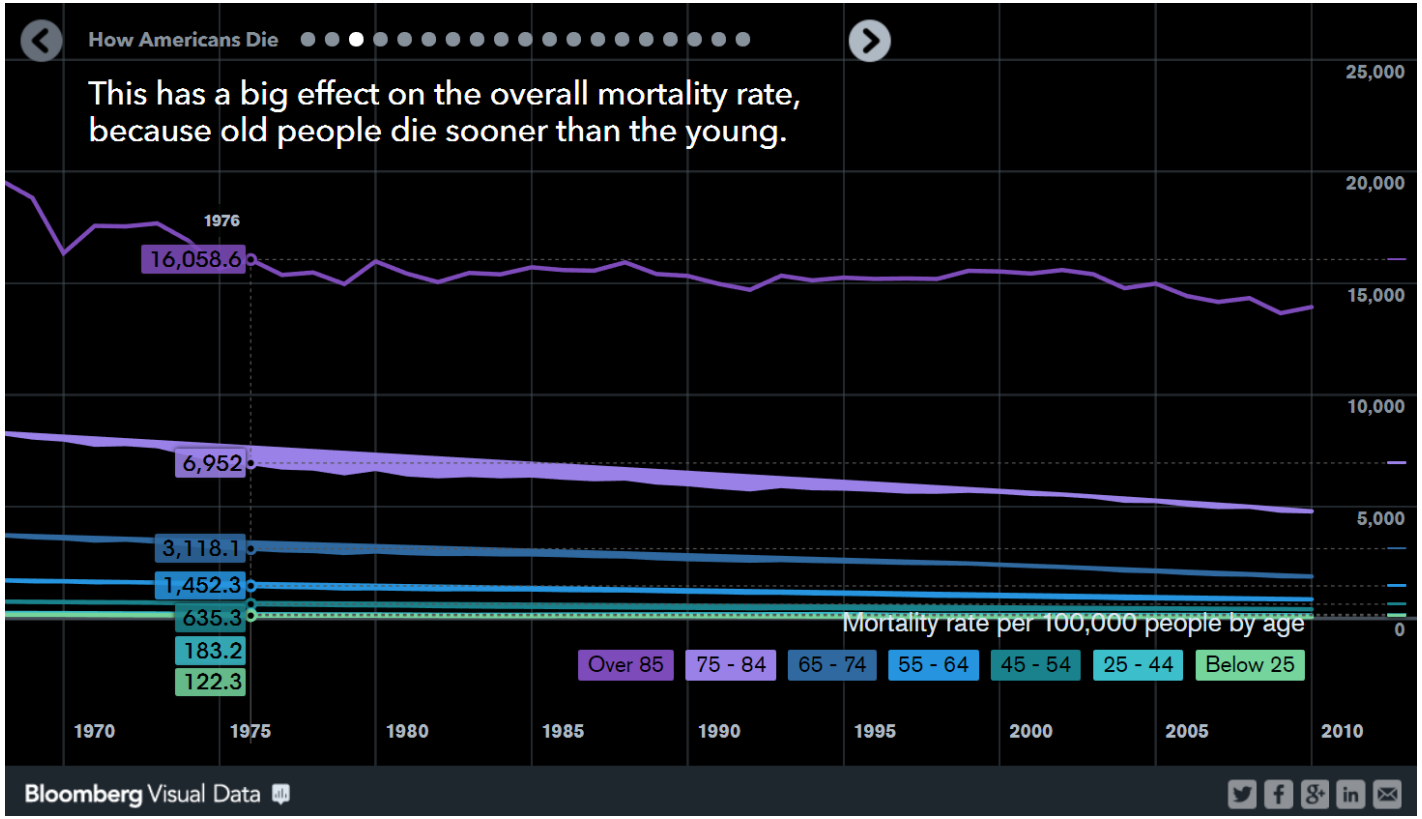
1. Respect Semantics Correspondence
2. Avoid ambiguity
3. Maintain valid graphics throughout a transition
4. Maintain valid mappings across graphics

10 Principles of Transitions

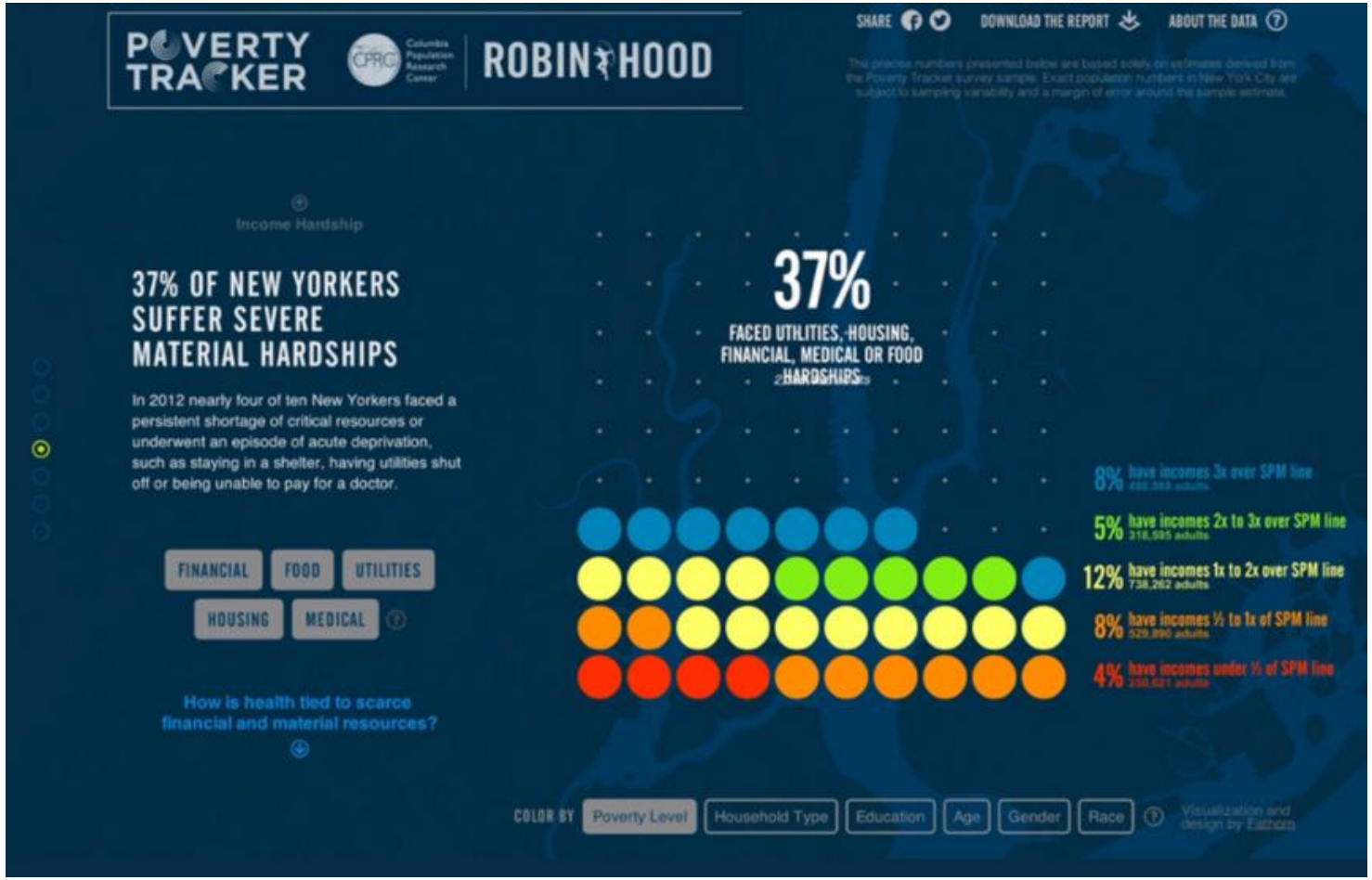
Apprehension Principles

5. Group similar transitions
6. Minimize occlusion
7. Maximize predictability
8. Use simple transitions
9. Stage complex transitions
10. Make transitions as long as needed but not longer

How Americans Die? [Bloomberg Visual Data]



Poverty Tracker [Fathom]

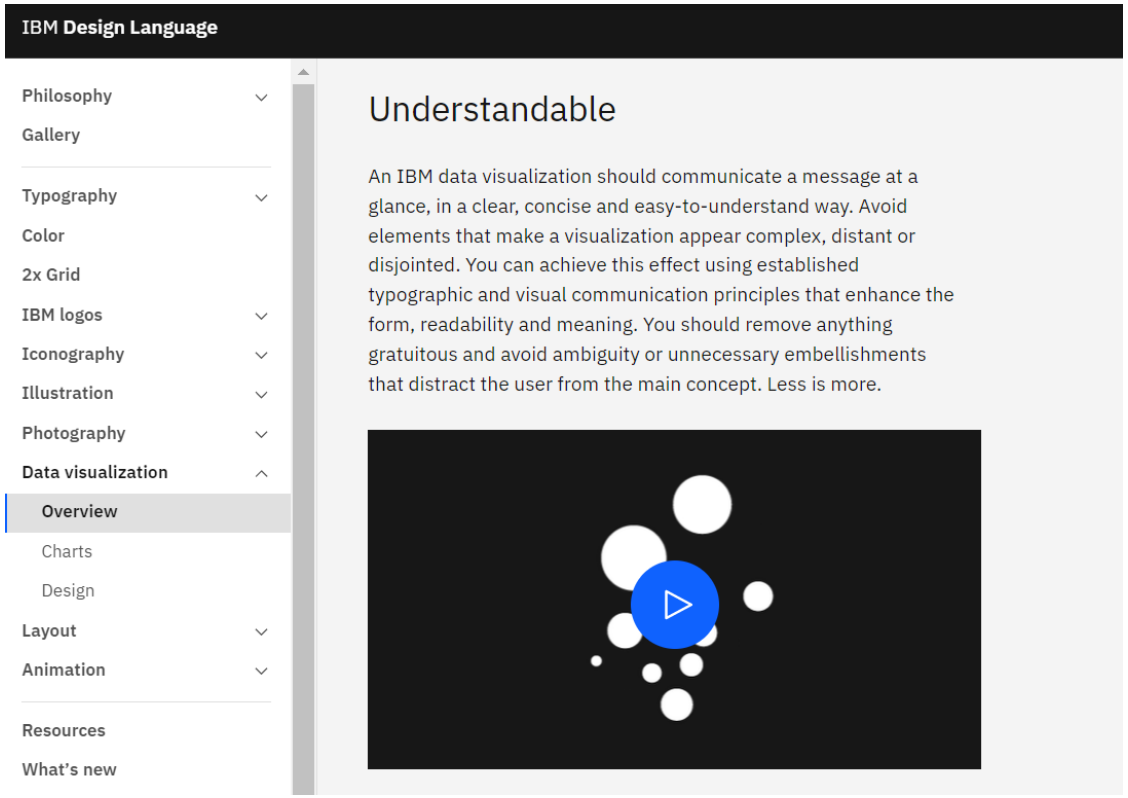


Animation in Statistical Charts

Animation in Statistical Charts

- IBM Design: Animation for Data Visualization

  https://www.ibm.com/design/language/data-visualization/overview



Summary

Principles of Animations

Congruence

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

Apprehension

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3 Uses of Animations

- Animation as **narrative**
- Animation as **encoding**
- Animation as **transition**

Taxonomy of Transitions

- Transformation of the view
- Change of representation
- Transformation of the surface
- Timestep
- Change of Data Structure
- Reordering Filtering

10 Principles of Transitions

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10 Principles of Transitions

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Does Animation Helps?

Animation	Helps?	Hurts?
Attention	direct attention	distraction
Constancy	change tracking	false relations
Causality	cause and effect	false agency
Engagement	increase interest	“chart junk”
Calibration		too slow: boring
		too fast: errors