

CDS 6324

DATA VISUALIZATION

Lecture 8: Interactive Visualization



Why Use Motion / Animation?

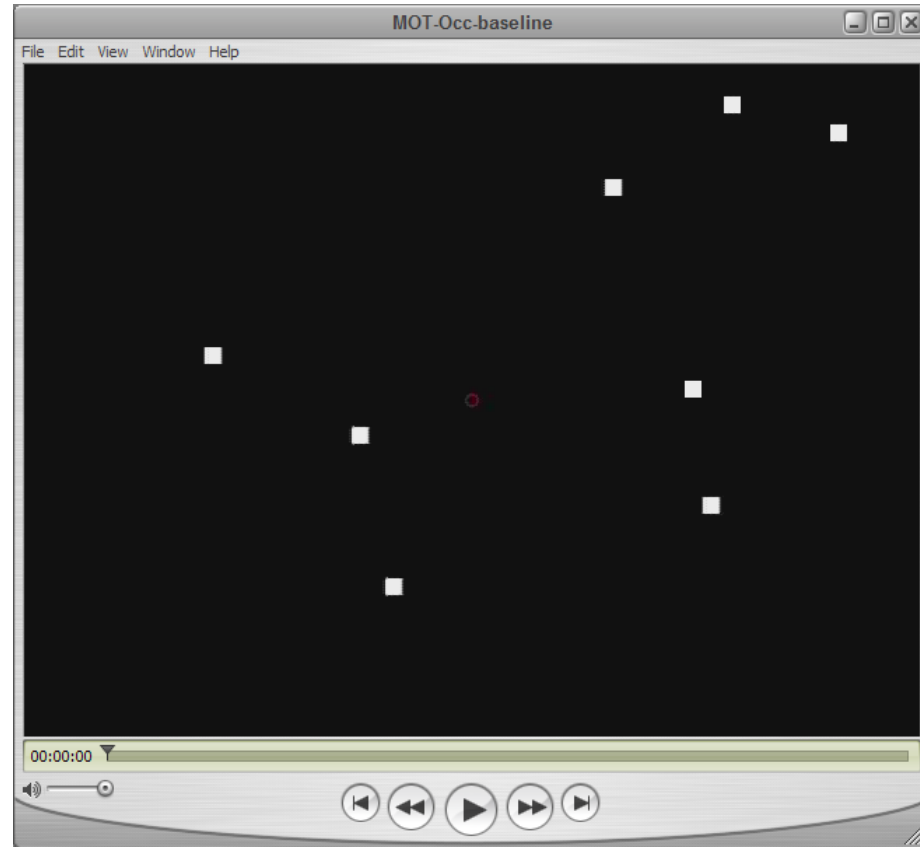
- ▶ Visual variable to encode data
- ▶ Direct attention
- ▶ Understand system dynamics
- ▶ Understand state transition
- ▶ Increase engagement



Motion Perception



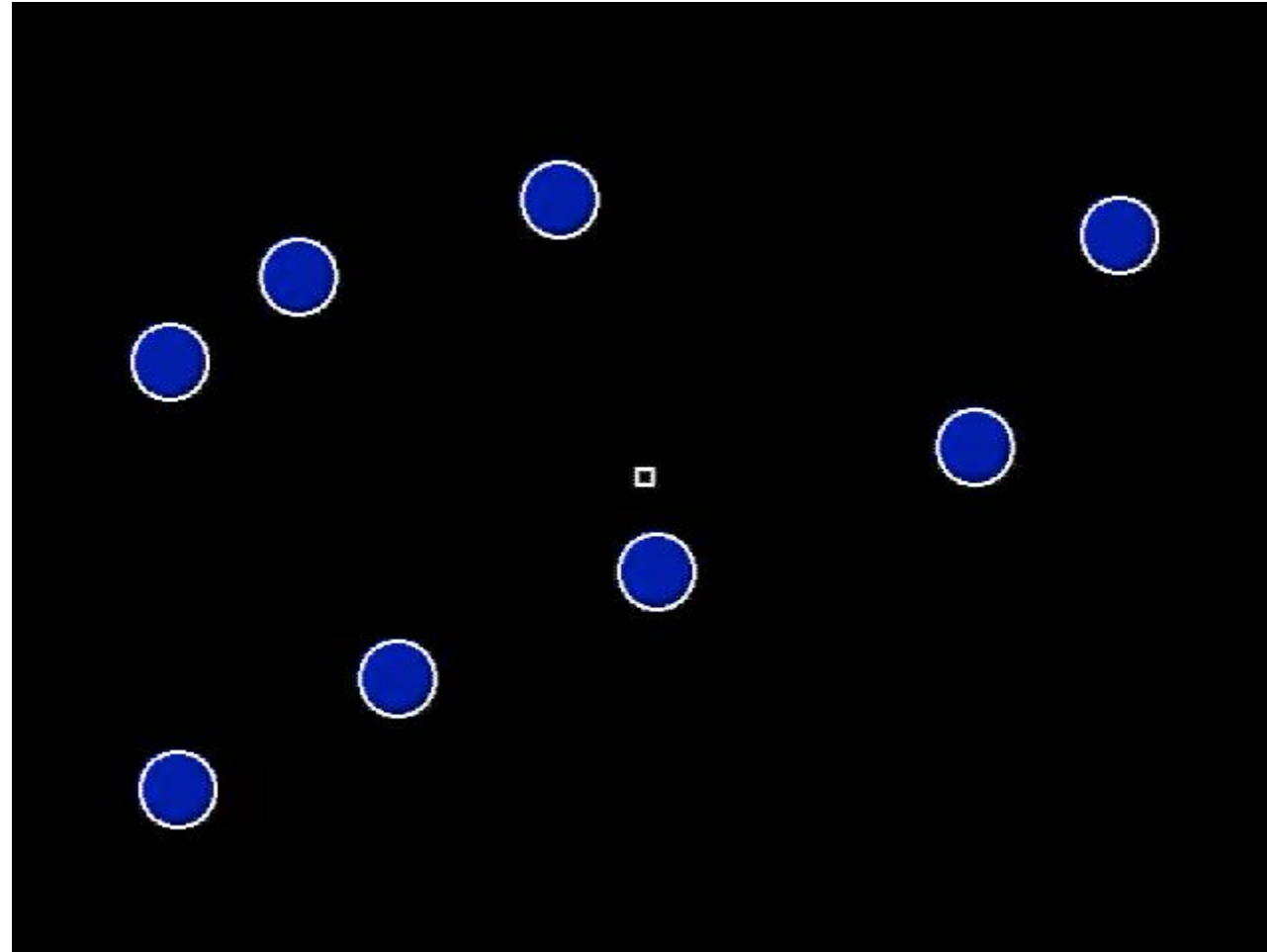
Tracking Multiple Targets



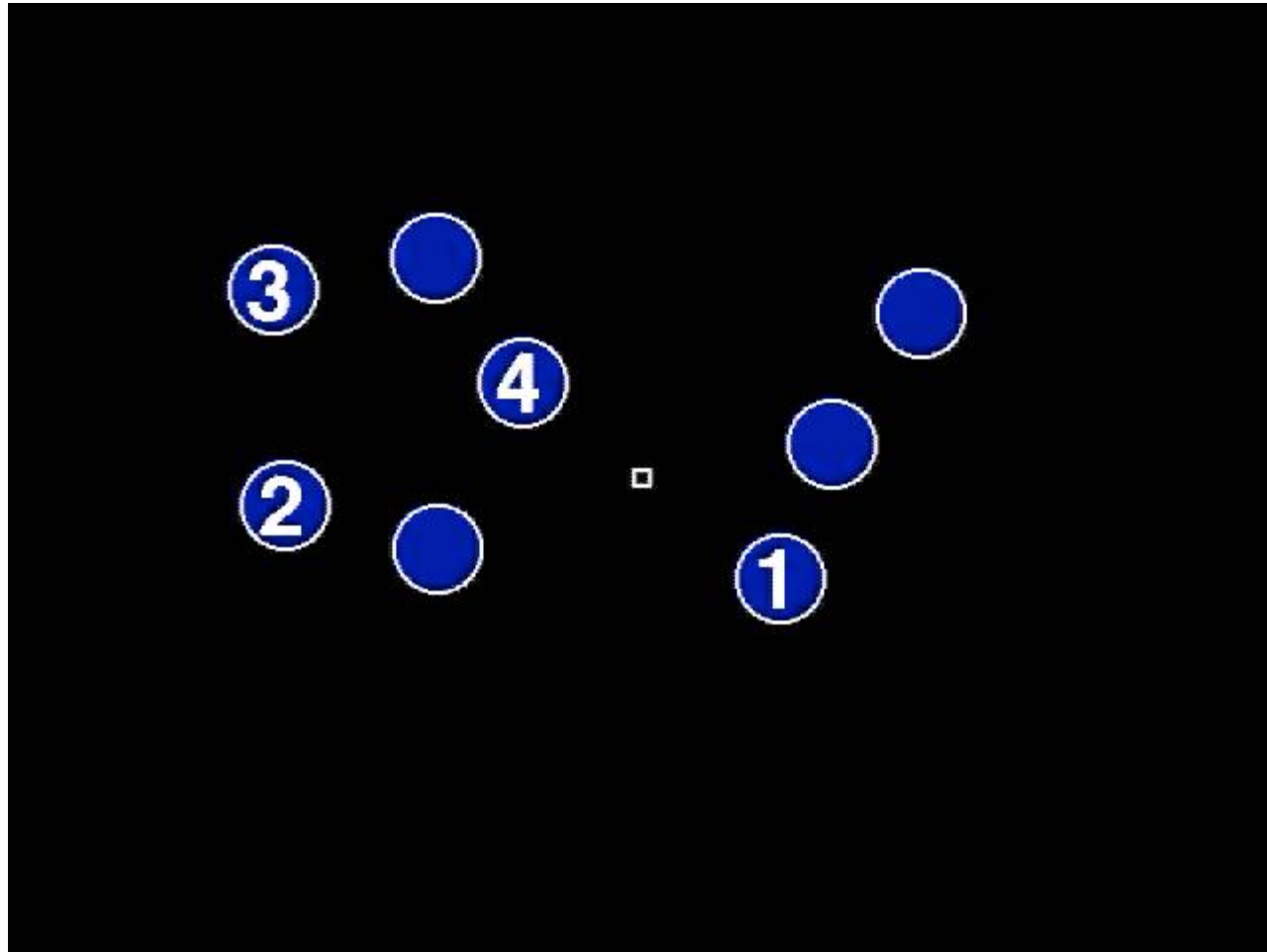
- ▶ How many dots can we simultaneously track?
 - ▶ ~4-6. Difficulty increases sig. at 6. [Yantis 92, Pylyshn 88, Cavanagh 05]
-

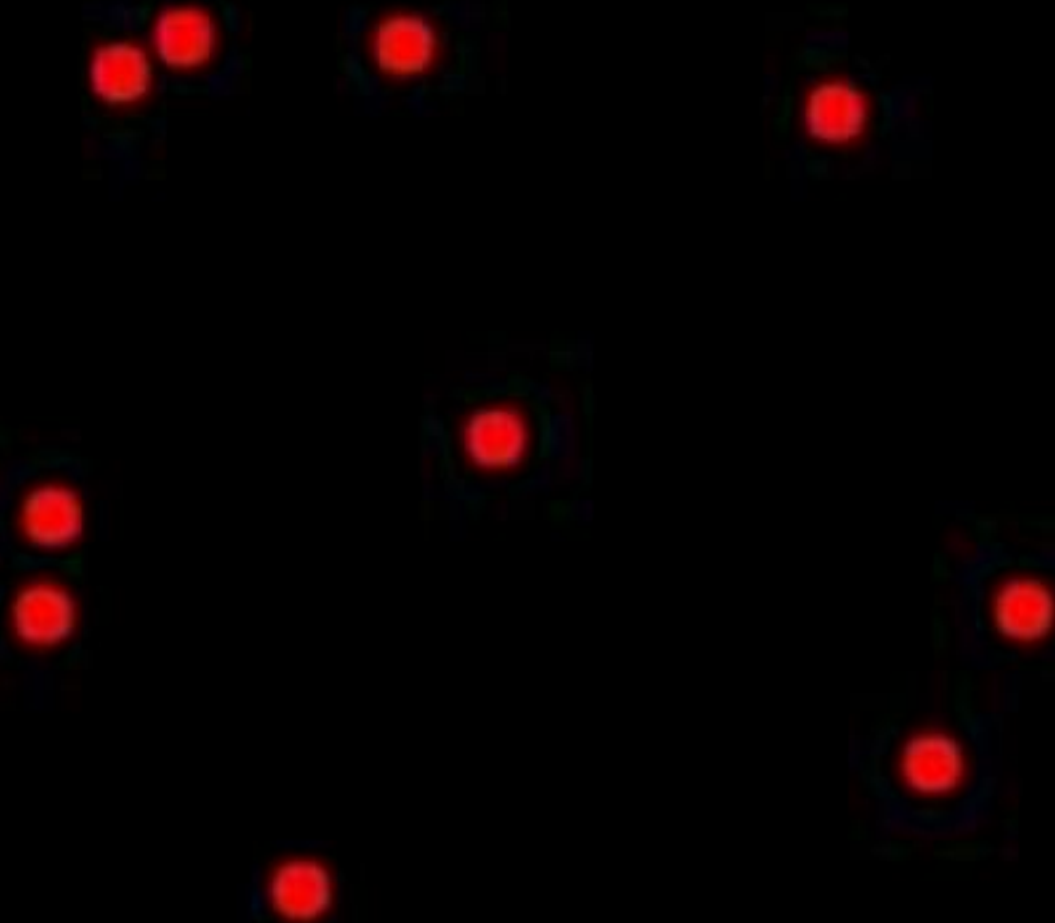


Tracking Multiple Targets



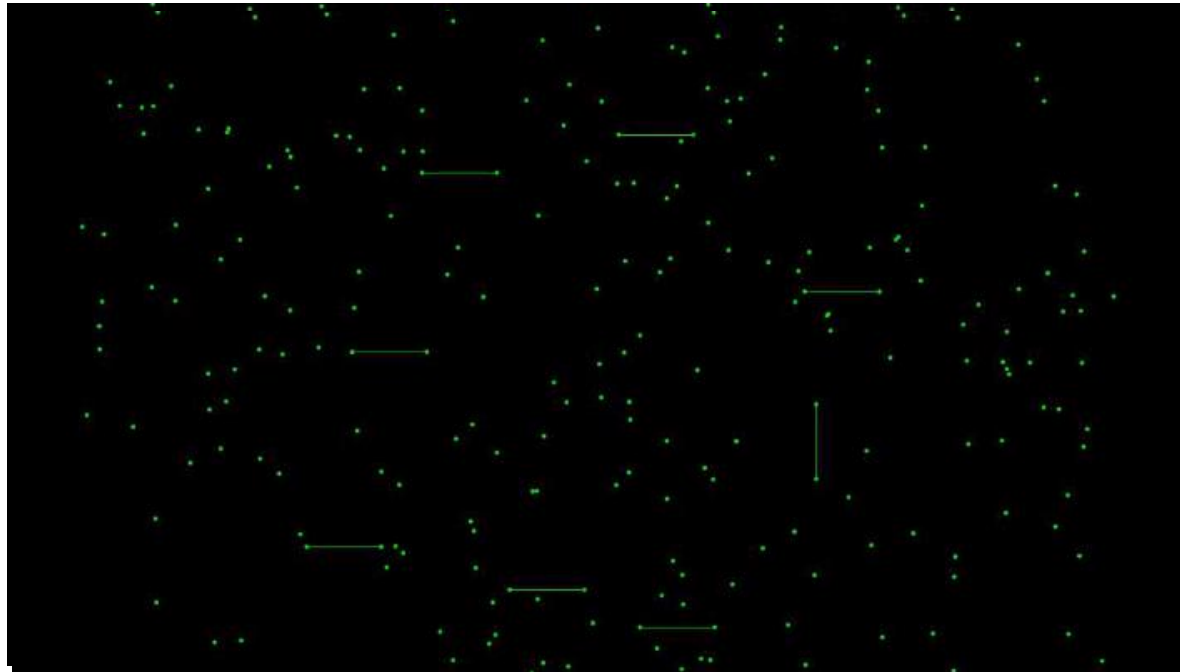
Tracking Multiple Targets





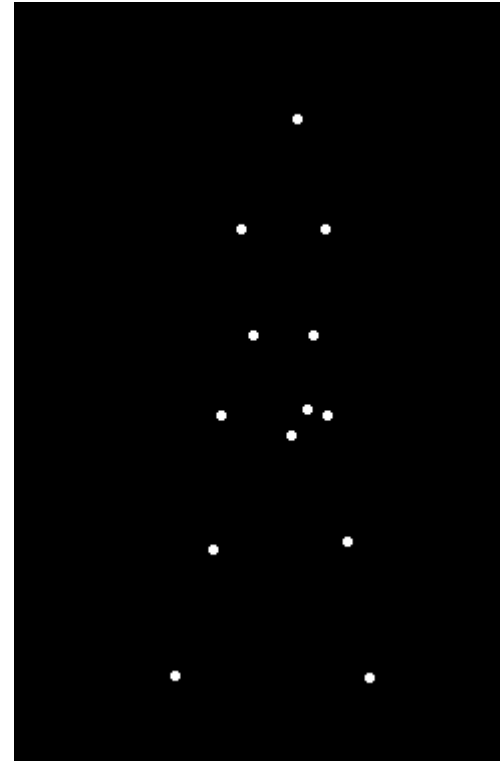
Segment by Common Fate

- ▶ 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=IF5ICP9SYLU>



Motions Show Transitions

- ▶ See change from one state to next



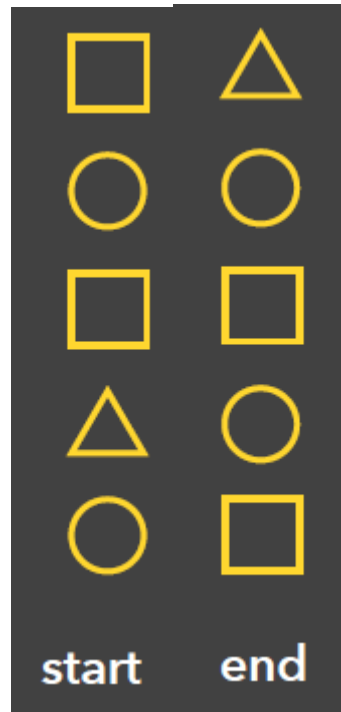
Motions Show Transitions

- ▶ See change from one state to next



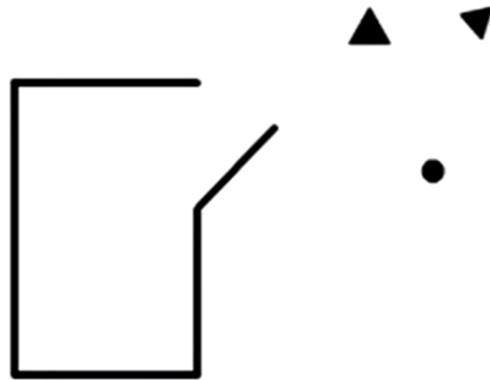
Motions Show Transitions

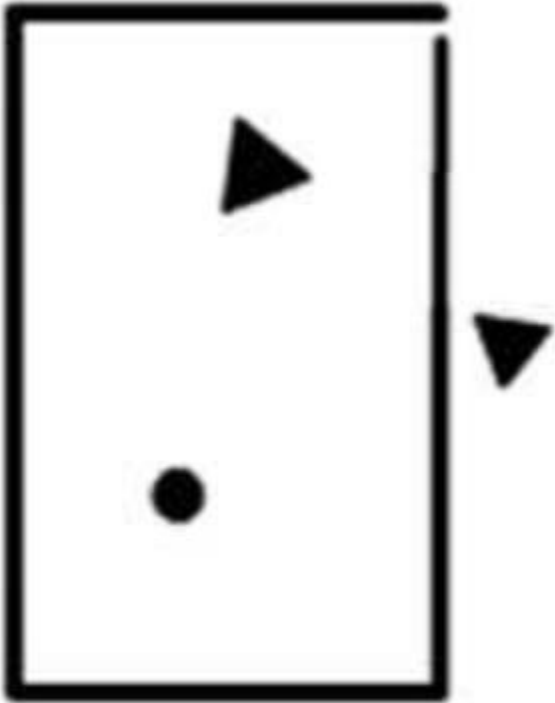
- ▶ See change from one state to next



Constructing Narratives

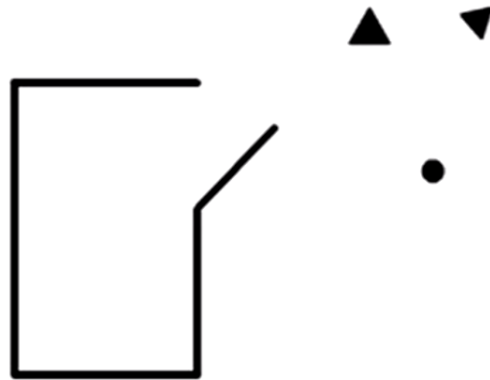
- ▶ In the 1944 Heider-Simmel demonstration, members of a study were shown an animation where shapes moved around the screen. What do you see?





Constructing Narratives

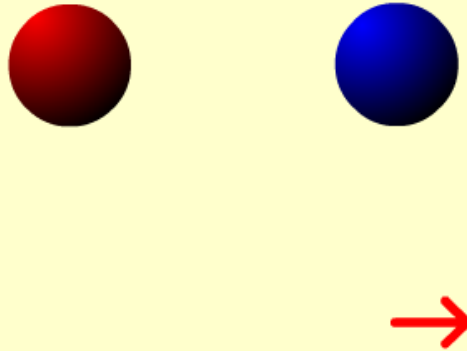
- ▶ In the 1944 Heider-Simmel demonstration, members of a study were shown an animation where shapes moved around the screen. What do you see?
- ▶ What was discovered was that only three people out of 100 saw shapes moving around. The rest all saw love stories and attributed agency and intent to the 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=IF5ICP9SYLU>
 - ▶ 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.**



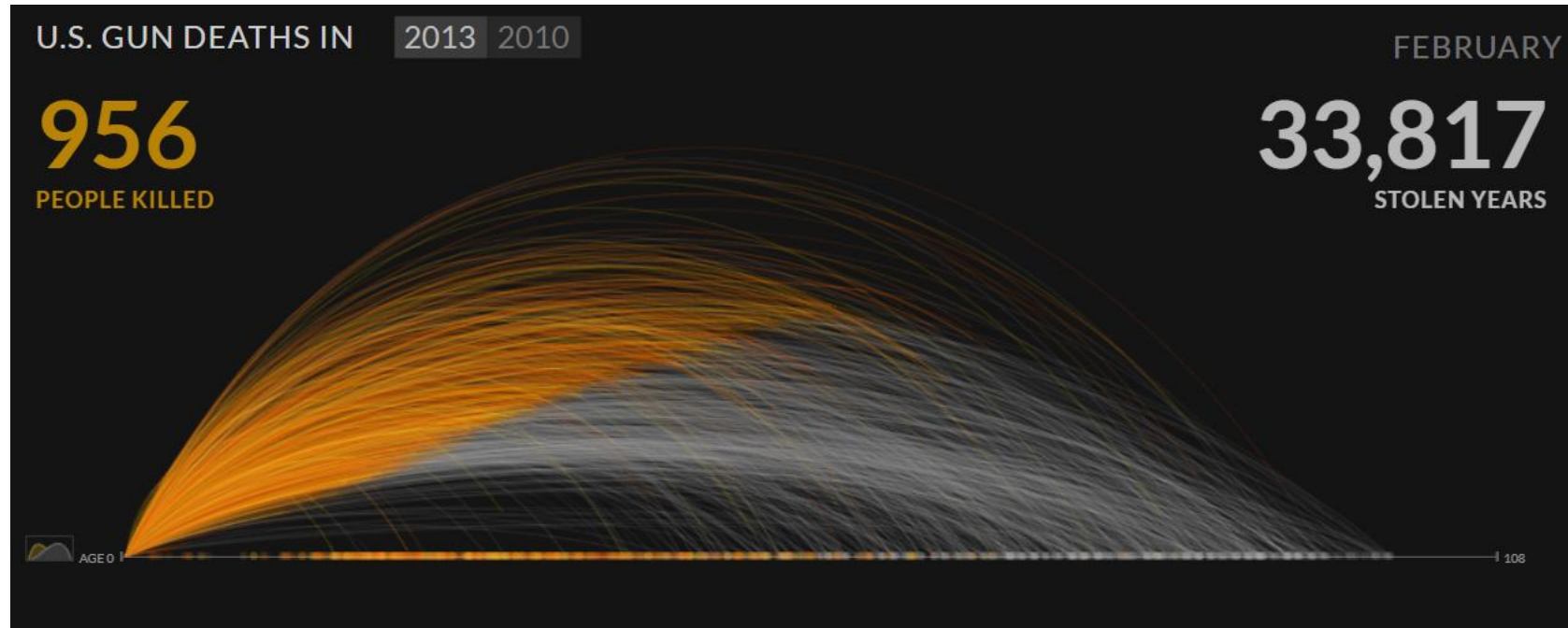
Three Uses of Animation



Animation as **narration**



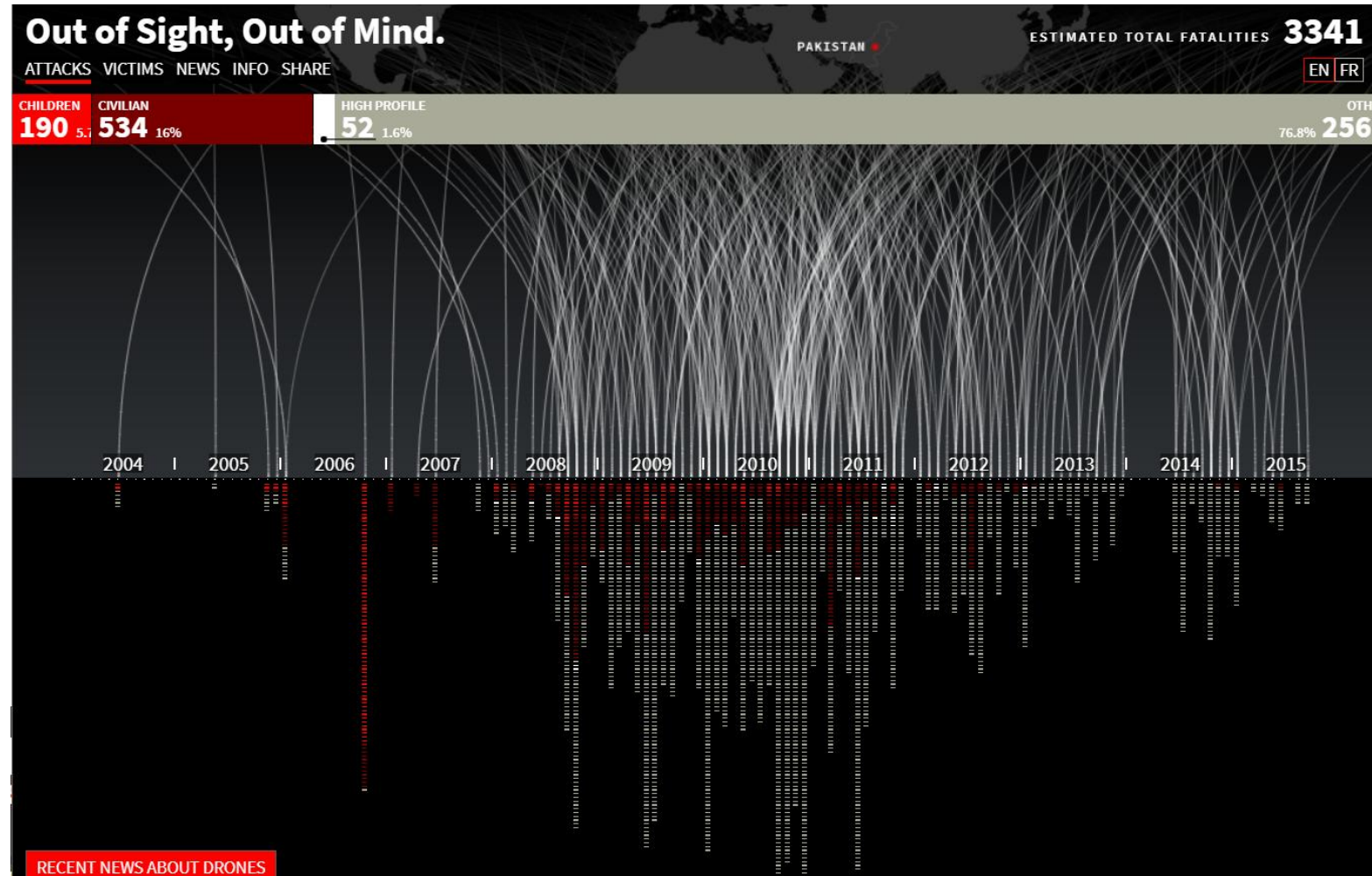
U.S. Gun Deaths [Periscopic]



<http://guns.periscopic.com/>



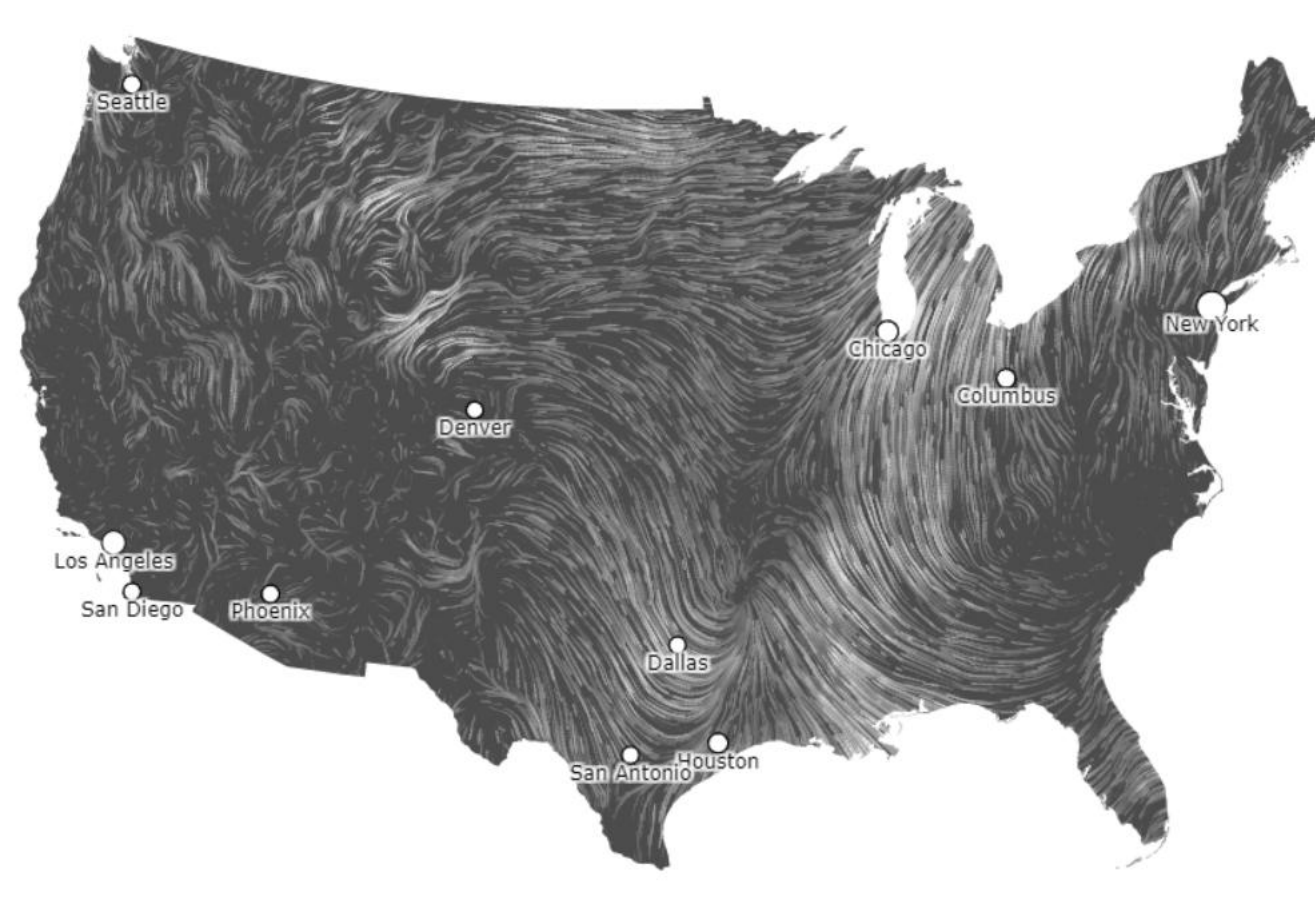
Out of Sight, Out of Mind [Pitch Interactive]



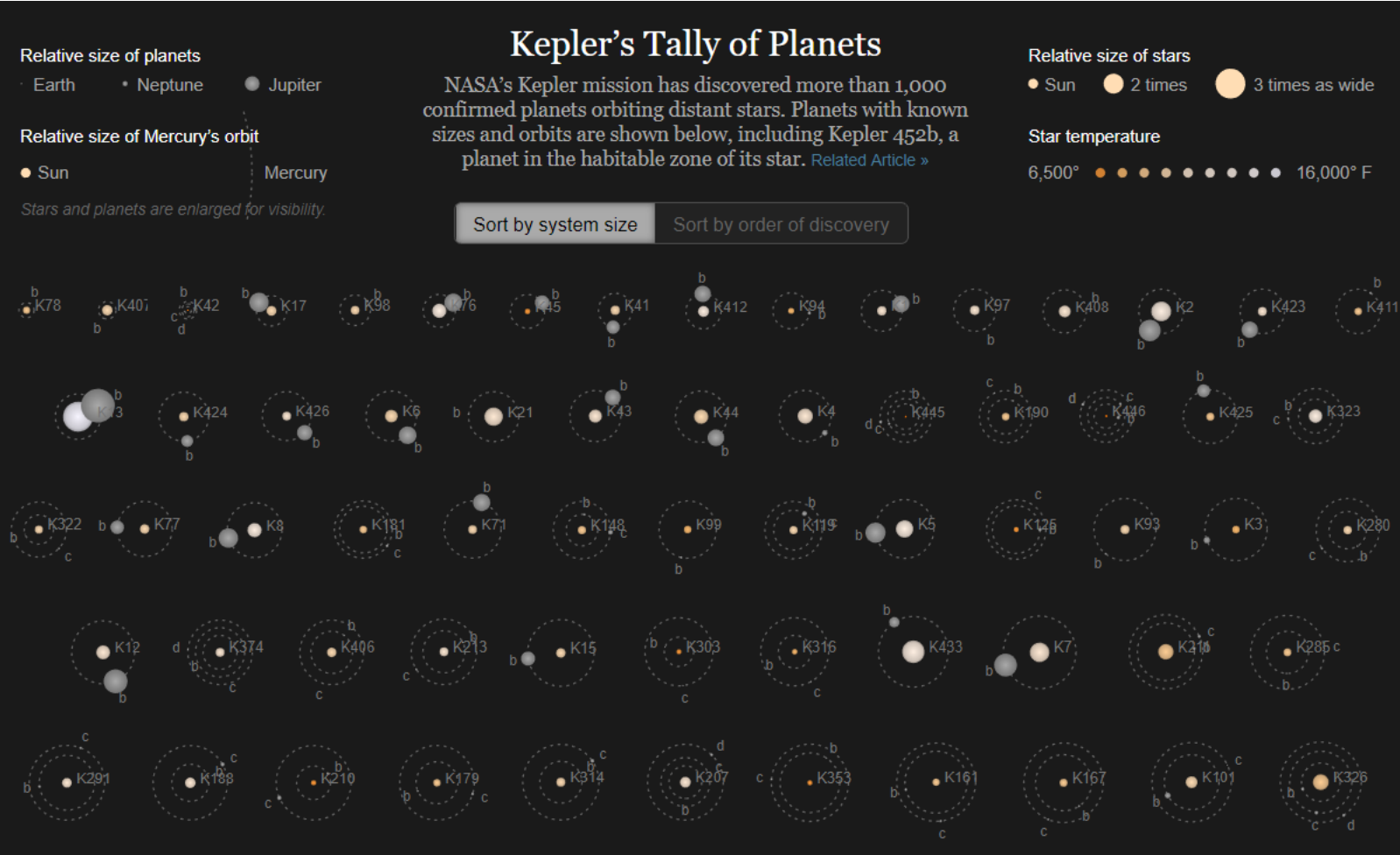
Animation as **encoding**



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

Der Erste Weltkrieg im Überblick

Karte Zeitliste

Tagetücher & Briefe Neuerungen Statistiken Aus dem NZZ-Archiv

Ereignisse und Frontverläufe

- Mittelmächte
- Entente-Mächte
- Frontverläufe
- Verbündete
- Verbündete

1914

1. Februar
Deutschland erklärt den uneingeschränkten U-Boot-Krieg

1915

8. März
Februarevolution in Russland

6. April
Kriegseintritt der USA und Griechenlands

1916

1. August
Friedensnote des Papstes Benedikts XV.

14. August
Kriegserklärung Chinas an Deutschland und Österreich-Ungarn

1917

7. November
Oktoberrevolution in Russland

Soldaten besetzen wichtige Gebäude in St. Petersburg und stürmen das Winterpalais, den Ort, an dem sich die Regierung und letzte Verbündete aufhalten. In Russland beginnt damit die Oktoberrevolution. Die Bolschewiki übernehmen die Macht und bauen eine Räterepublik auf. Sie treten mit den Mittelmächten in Verhandlungen für einen Waffenstillstand.

1918


1919

1920

In Petersburg regieren die Bolschewiken

Ministerpräsident Lenin

Valetta, Malta



Mit Maschinengewehren wird gegen die Teilnehmer der Oktoberrevolution in Petrograd vorgegangen. United Archives / Image

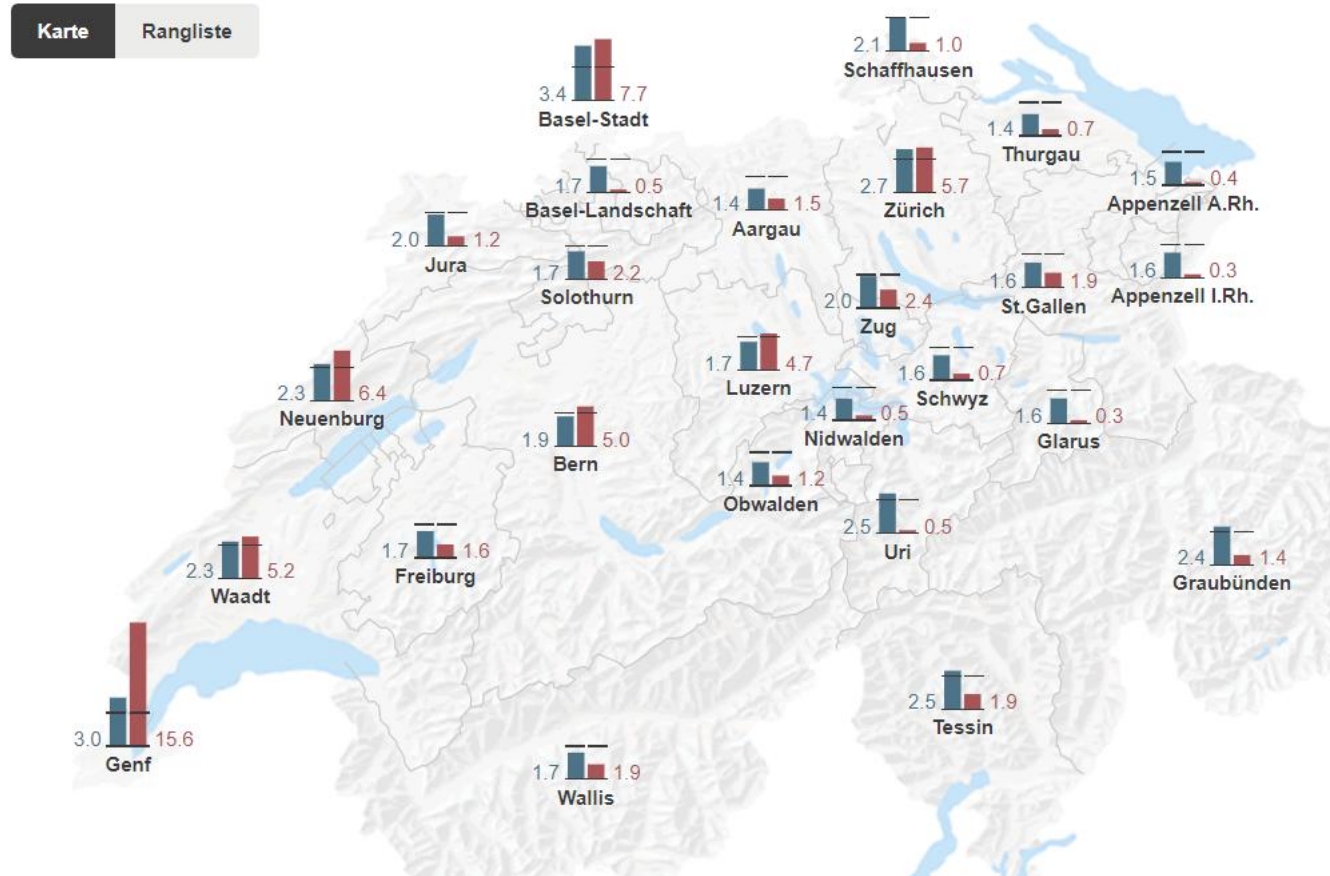
Impressum

Change of representation



Robbers in Geneva, cops in Basel

Wie sich Taschendiebe und Polizisten in 26 Kantonen begegnen



Transformation of the surface



Four Ways to Slice Obama's 2013 Budget Proposal

[New York Times]

Four Ways to Slice Obama's 2013 Budget Proposal

Explore every nook and cranny of President Obama's federal budget proposal.

- All Spending
- Types of Spending
- Changes
- Department Totals

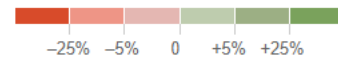
How \$3.7 Trillion Is Spent

Mr. Obama's budget proposal includes \$3.7 trillion in spending in 2013, and forecasts a \$901 billion deficit.

Circles are sized according to the proposed spending.



Color shows amount of cut or increase from 2012.



The proposal forecasts a \$901 billion deficit.

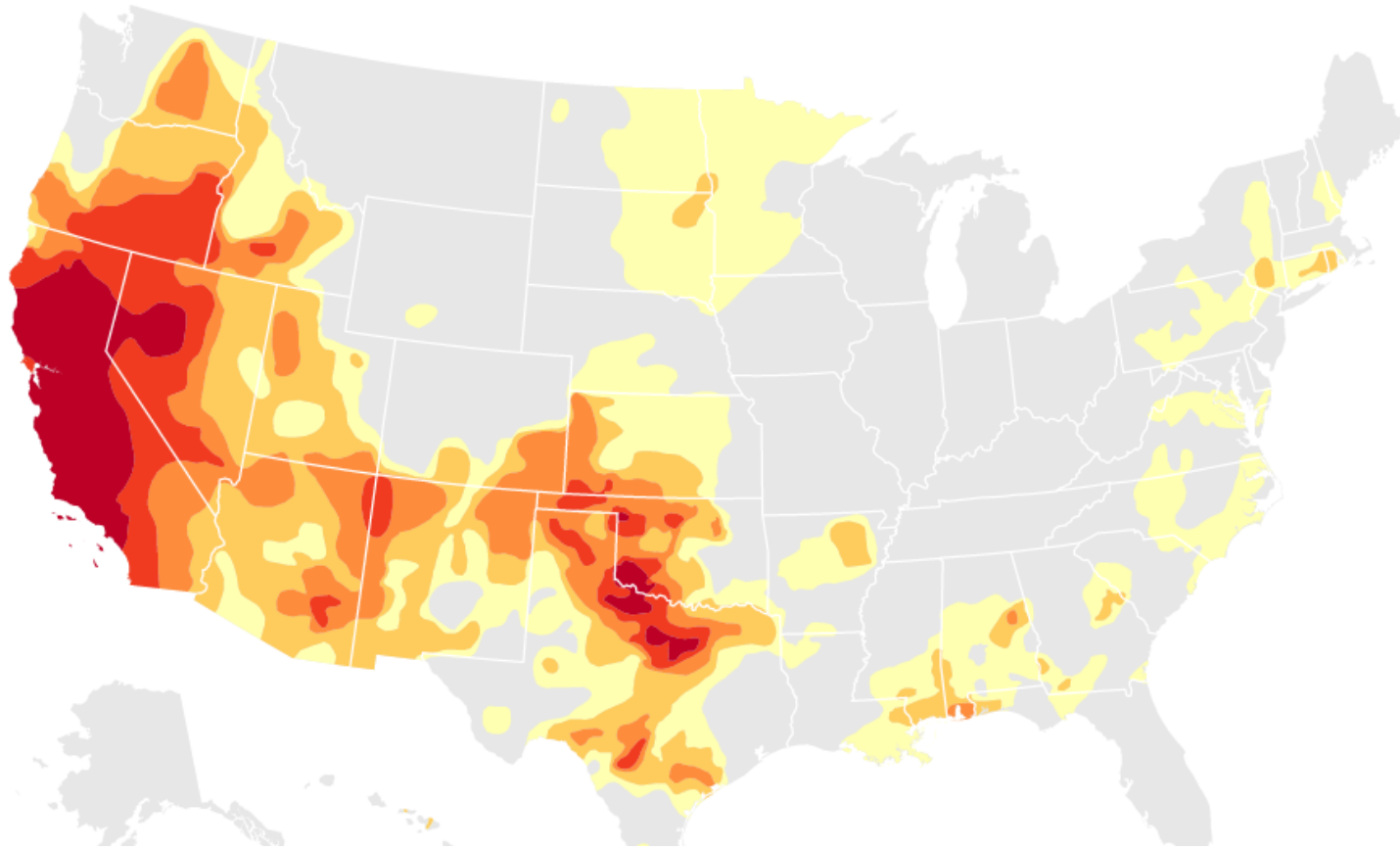
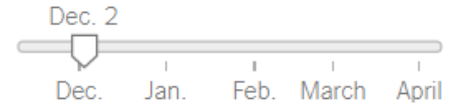


Timestep




Time Step [Fernanda Viegas, Martin Wattenberg]

DROUGHT SEVERITY
November-now



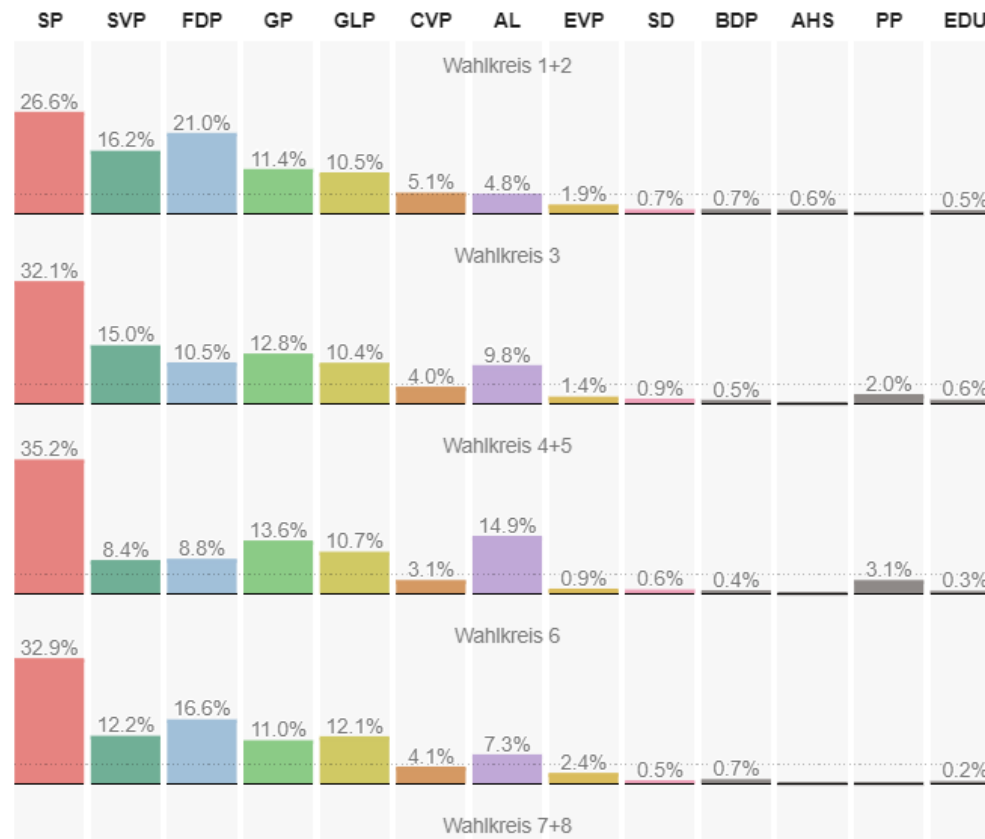
Change of data structure



Zürcher Gemeinderatswahlen [NZZ, Interactive Things]

Wahlkreise
Karte
Liste
2014
2010 – 2014
%
Sitze

Alle Wahlkreise sind ausgezählt. Wähleranteil in %.

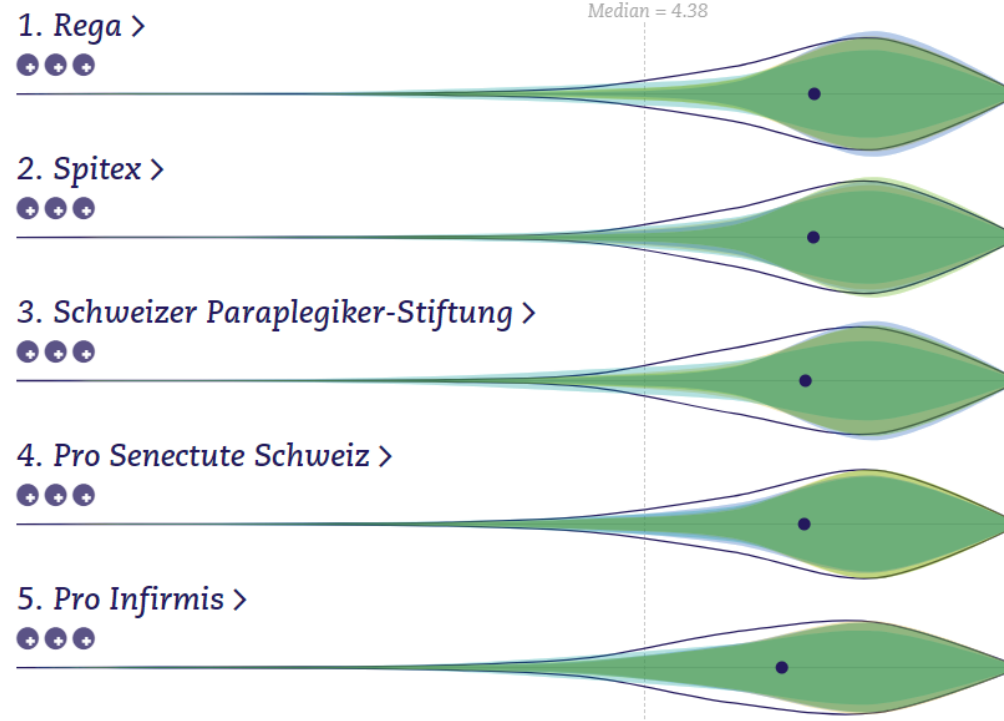


Reordering



Public Value Atlas [Interactive Things]

Beitrag zum Gemeinwohl 2017



	Gemeinwohl	Aufgabenerfüllung	Zusammenhalt	Lebensqualität	Moral
2017	5.56	5.77	5.24	5.59	5.66
2015	5.35				
	5.56	5.62	5.38	5.70	5.54
	5.41				
	5.50	5.70	5.15	5.57	5.58
	-				
	5.49	5.47	5.37	5.55	5.58
	-				
	5.34	5.40	5.15	5.36	5.44
	-				







Filtering



Public Value Atlas [Interactive Things]

Dimensionen Sektoren & Branchen **Hauptsitz** Regionen Jahre

Ansicht:    Teilen  Suchen

Deutschland England **Frankreich** Japan Korea **Niederlande** Schweiz USA

Moralisches Verhalten von Organisationen
aus 2 Ländern 2017

1. AXA >



	Gemeinwohl	Aufgabenerfüllung	Zusammenhalt	Lebensqualität	Moral
2017	4.26	4.76	3.56	4.15	4.59
2015					4.30



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



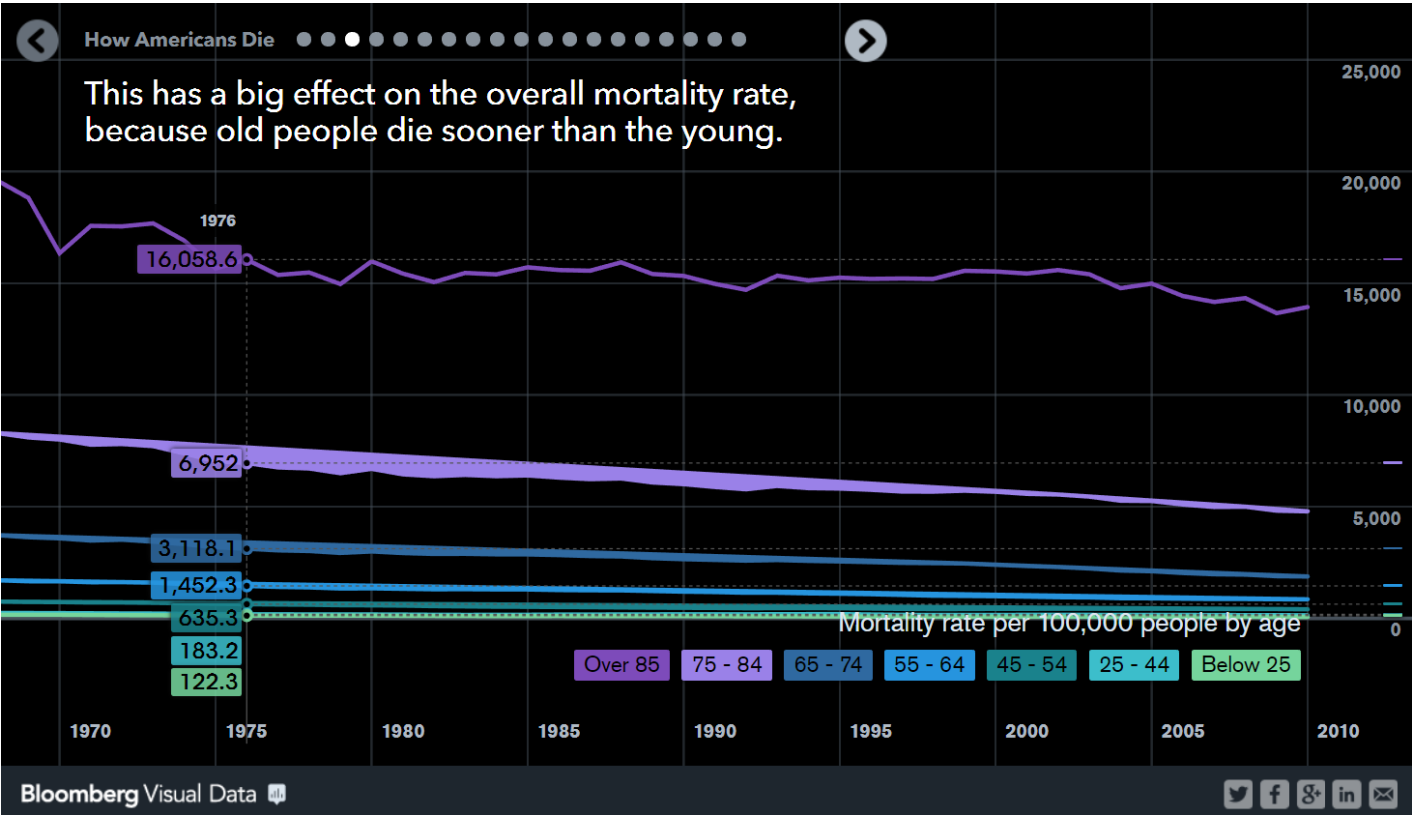
10 Principles of Transitions

Apprehension Principles

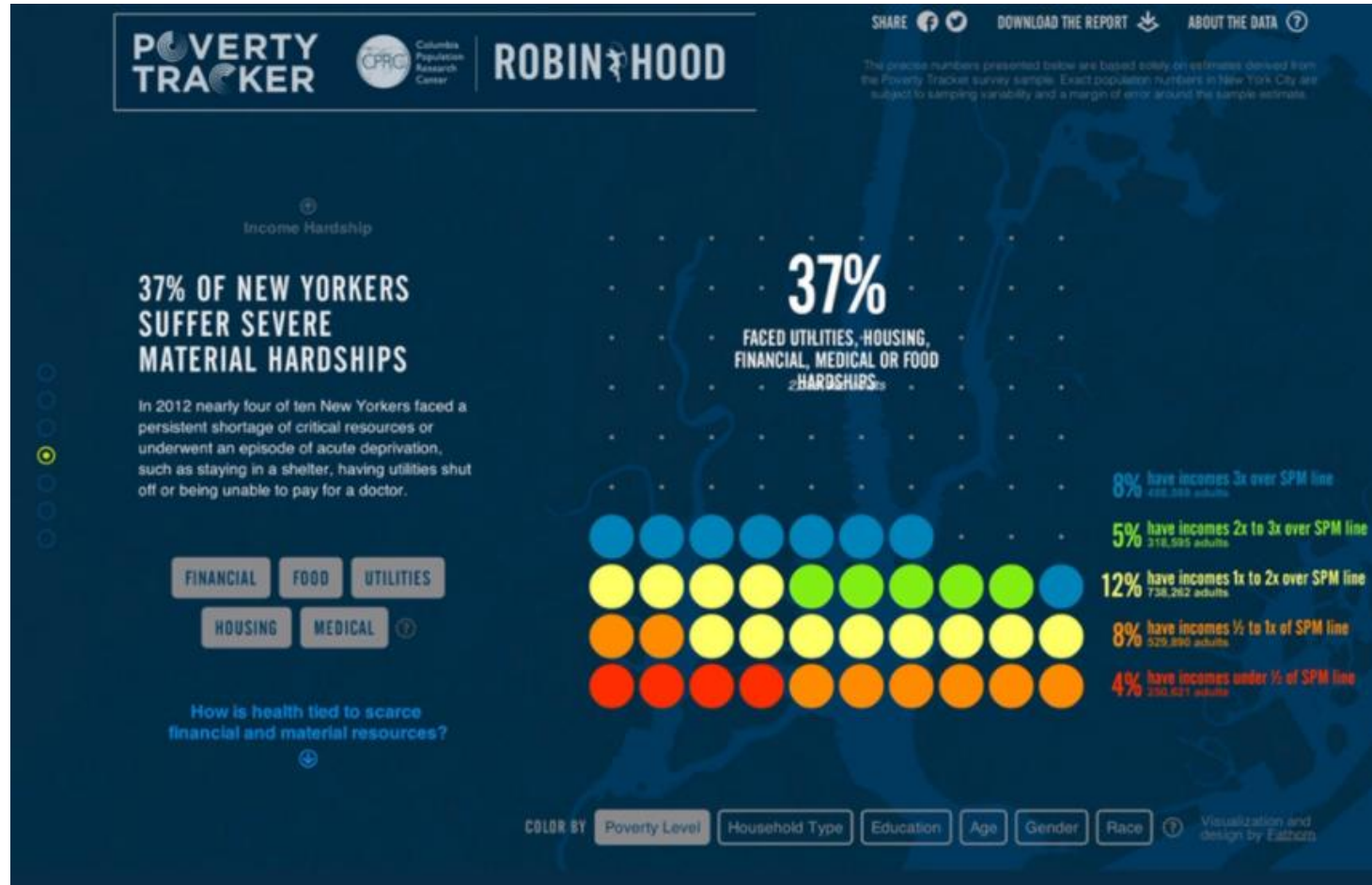
5. Group similar transitions
6. Minimize occlusion
7. Maximize predictability
8. Use simple transitions
9. Stage complex transitions
10. Make transitions as long as needed but not longer



How Americans Die? [Bloomberg Visual Data]



Poverty Tracker [Fathom]



Animation in Statistical Charts

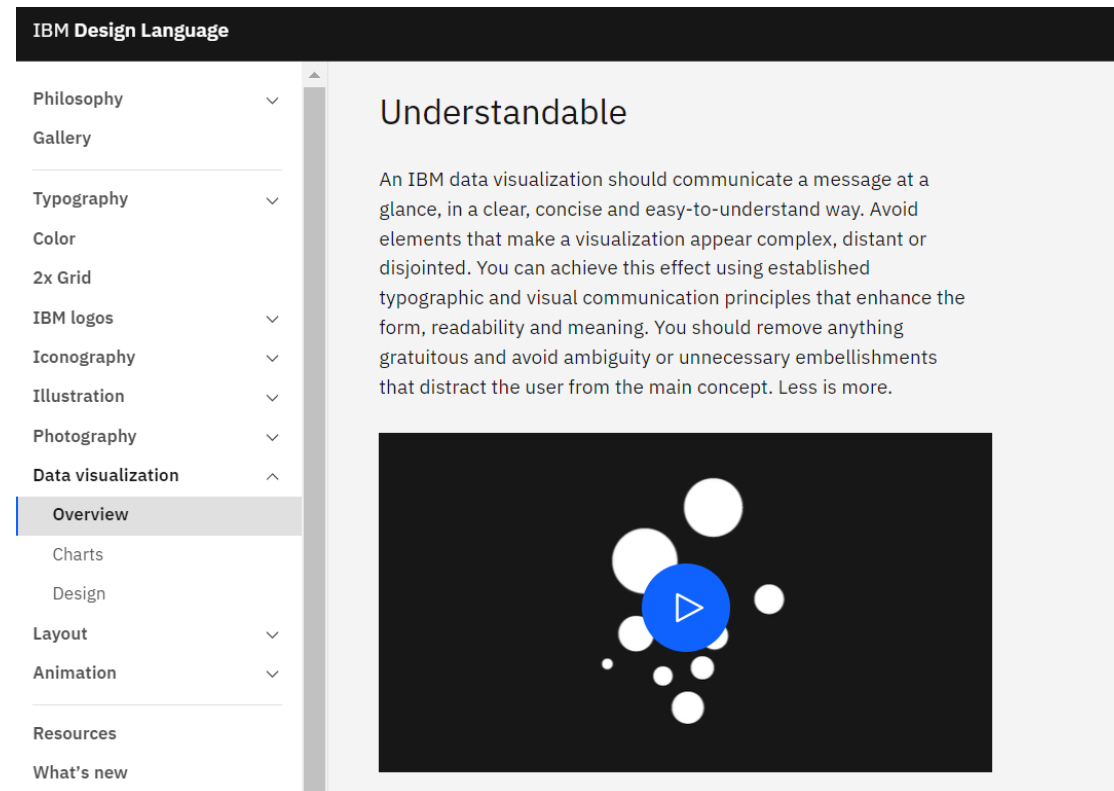


Animation in Statistical Charts

▶ IBM Design: Animation for Data Visualization

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

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-
-
-
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The screenshot displays the IBM Design Language website. On the left is a navigation menu with the following items: Philosophy, Gallery, Typography, Color, 2x Grid, IBM logos, Iconography, Illustration, Photography, Data visualization (highlighted), Overview (sub-item under Data visualization), Charts, Design, Layout, Animation, Resources, and What's new. The main content area is titled 'Understandable' and contains the following text: 'An IBM data visualization should communicate a message at a glance, in a clear, concise and easy-to-understand way. Avoid elements that make a visualization appear complex, distant or disjointed. You can achieve this effect using established typographic and visual communication principles that enhance the form, readability and meaning. You should remove anything gratuitous and avoid ambiguity or unnecessary embellishments that distract the user from the main concept. Less is more.' Below the text is a video player with a play button icon.



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**

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



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

Congruence Principles

1. Respect Semantics Correspondence
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10 Principles of Transitions

Apprehension Principles

5. Group similar transitions
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Does Animation Helps?

Animation

Attention

Constancy

Causality

Engagement

Calibration

Helps?

direct attention

change tracking

cause and effect

increase interest

Hurts?

distraction

false relations

false agency

“chart junk”

too slow: boring

too fast: errors

