

Animation: Understanding Motion

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Goals for animation use

Help visualization convey information

How does *animation* help convey information?

- Explain a process**
- Smooth a transition between states**

NameVoyager [Wattenberg 04]

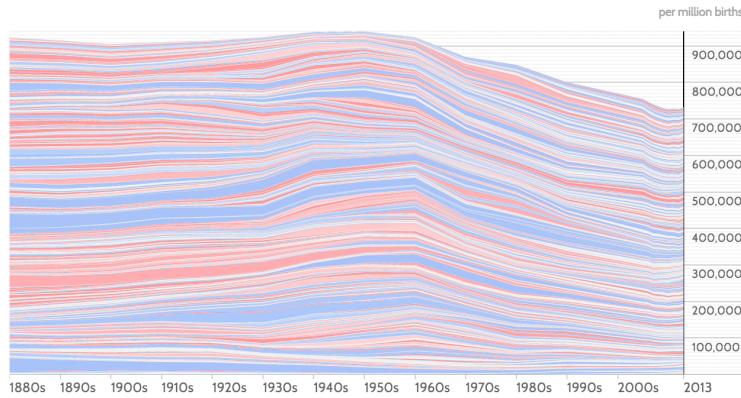
NameVoyager: Explore baby names and name trends letter by letter

Looking for the perfect baby name? [Sign up for free](#) to receive access to our expert tools!

Baby Name:

Both Boys Girls

Current rank: boys 1,000 500 100 25 1
girls 1,000 500 100 25 1



Click a name graph to view that name. Double-click to read more about it.

[enlarge](#)

v0105.h1

Motions directly show transitions

Can see change from one state to next

- States are spatial layouts
- Changes are simple transitions (translation, rotation, scale)

Shows transition better, but

- Still may be too fast, or too slow
- Too many objects may move at once



start end

Problems [Tversky 02]

Difficulties in understanding animation

- Difficult to estimate paths and trajectories
- Motion is fleeting and transient
- Cannot simultaneously attend to multiple motions
- Trying to parse motion into events, actions and behaviors
- Misunderstanding and wrongly inferring causality
- Anthropomorphizing physical motion may cause confusion or lead to incorrect conclusions

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
Introduce interactivity to help user avoid difficulties

Understanding Motion

Motion as a visual cue

Pre-attentive

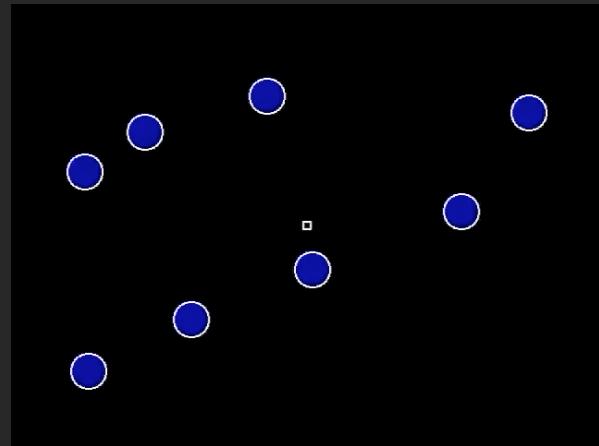
- Stronger than color, shape, ...

More sensitive to motion at periphery

Triggers an orientation response

Motion parallax provide 3D cue (like stereopsis)

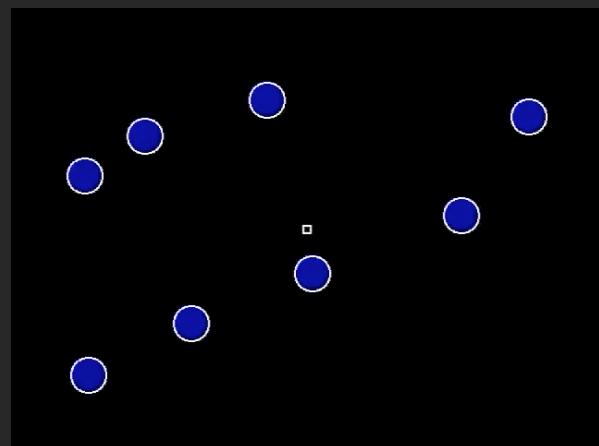
Tracking multiple targets



How many dots can we simultaneously track?

[Yantis 92, Pylyshn 88, Cavanagh 05]

Tracking multiple targets



How many dots can we simultaneously track?

- **4 to 6 - difficulty increases significantly at 6**

[Yantis 92, Pylyshn 88, Cavanagh 05]

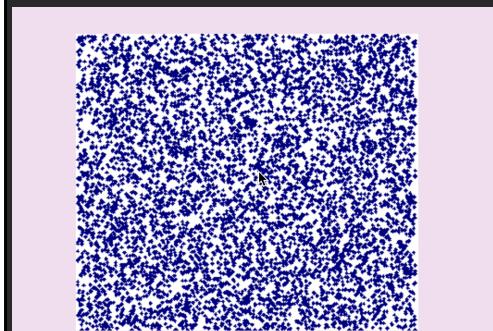
Grouped dots count as 1 object



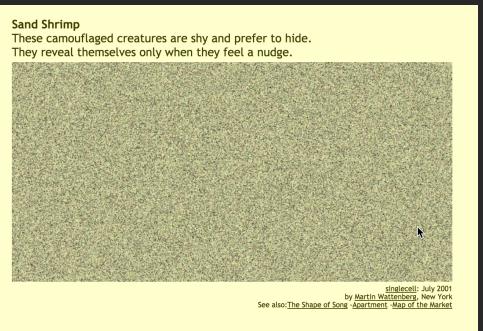
Dots moving together are grouped

<http://coe.sdsu.edu/eet/articles/visualperc1/start.htm>

Segment by common motion (fate)

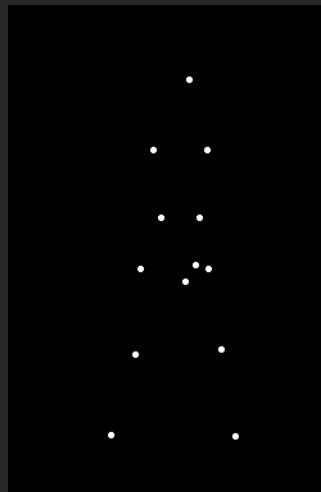


<http://dragon.uml.edu/psych/commfate.html>



<http://www.singlecell.org/july/index.html>

Grouping based on biological motion



[Johansson 73]

http://www.lifesci.sussex.ac.uk/home/George_Mather/Motion/

Constructing narratives

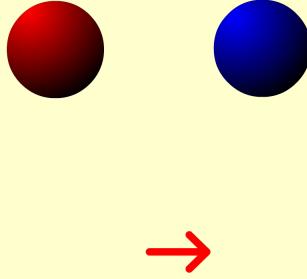
Animation from:
Heider, F. & Simmel, M. (1944).
An experimental study of apparent behavior.
American Journal of Psychology, 57, 243-259.

Courtesy of:
Department of Psychology,
University of Kansas, Lawrence.

http://anthropomorphism.org/img/Heider_Flash.swf

Attribution of causality [Michotte 46]

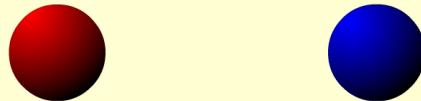
Michotte demonstration 1. What do you see? Most observers report that "the red ball hit the blue ball." The blue ball moved "because the red ball hit it." Thus, the red ball is perceived to "cause" the blue ball to move, even though the balls are nothing more than color disks on your screen that move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



http://cogweb.ucla.edu/Discourse/Narrative/Heider_45.html

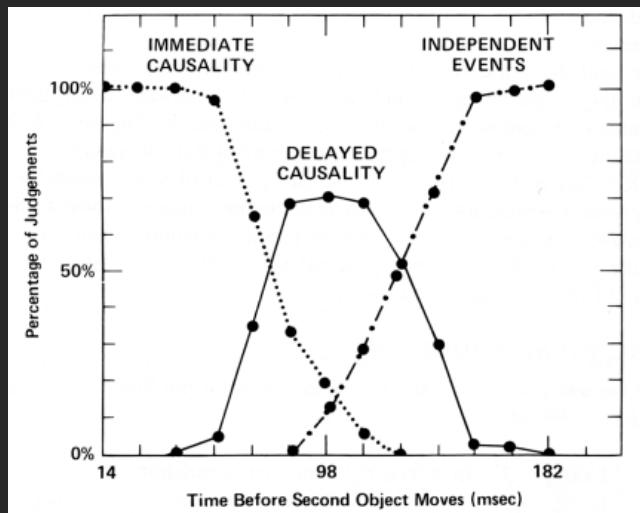
Attribution of causality [Michotte 46]

Michotte demonstration 2. What do you see? Most observers report that "The red ball moved up to blue ball, and stopped. Then the blue ball moved." No cause and effect is implied; the one-second delay between the two movements has reduced the perception of causality.



http://cogweb.ucla.edu/Discourse/Narrative/Heider_45.html

Attribution of causality [Michotte 46]



[Reprint from Ware 04]