ARE YOU BLIND TO CHANGE?

Evaluating the Influence of Change Blindness on Animated Choropleth Maps

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Change Detection and Map Reading

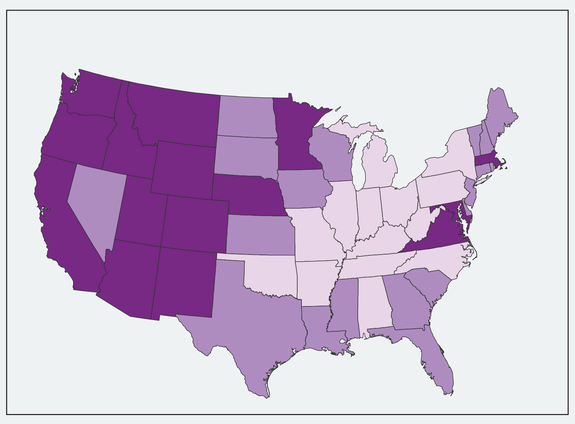
What is Change Blindness?

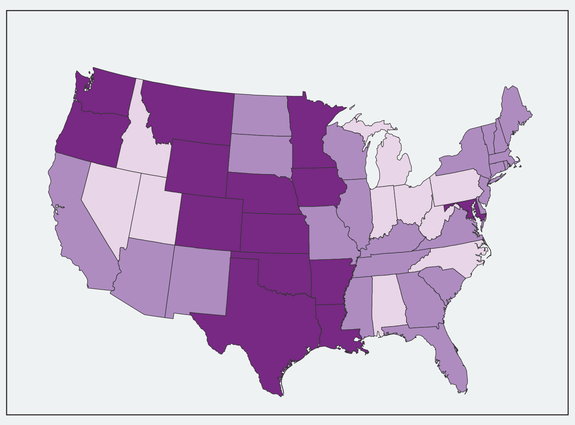
The primary utility of **animated maps** is their ability to depict change over time[1]. However, research demonstrates that observers have "surprising difficulty… noticing large changes to visual scenes", called change blindness[2]. Because observers often fail to notice or perceive changes in both the real world or on a display screen, the primary utility of animated maps is potentially lost.

Change Blindness & Maps

Change Blindness is especially important in animated-map-reading; many important changes can occur across a single map display simultaneously. Readers are required to not only notice changes within the display but to understand their symbolic meaning. In animated choropleth maps this means the reader must **1)** notice a change, **2)** attend to a change, **3)** remember the **initial state**, **4)** and comprehend the difference between the initial and destination states.

Can YOU Detect Change?





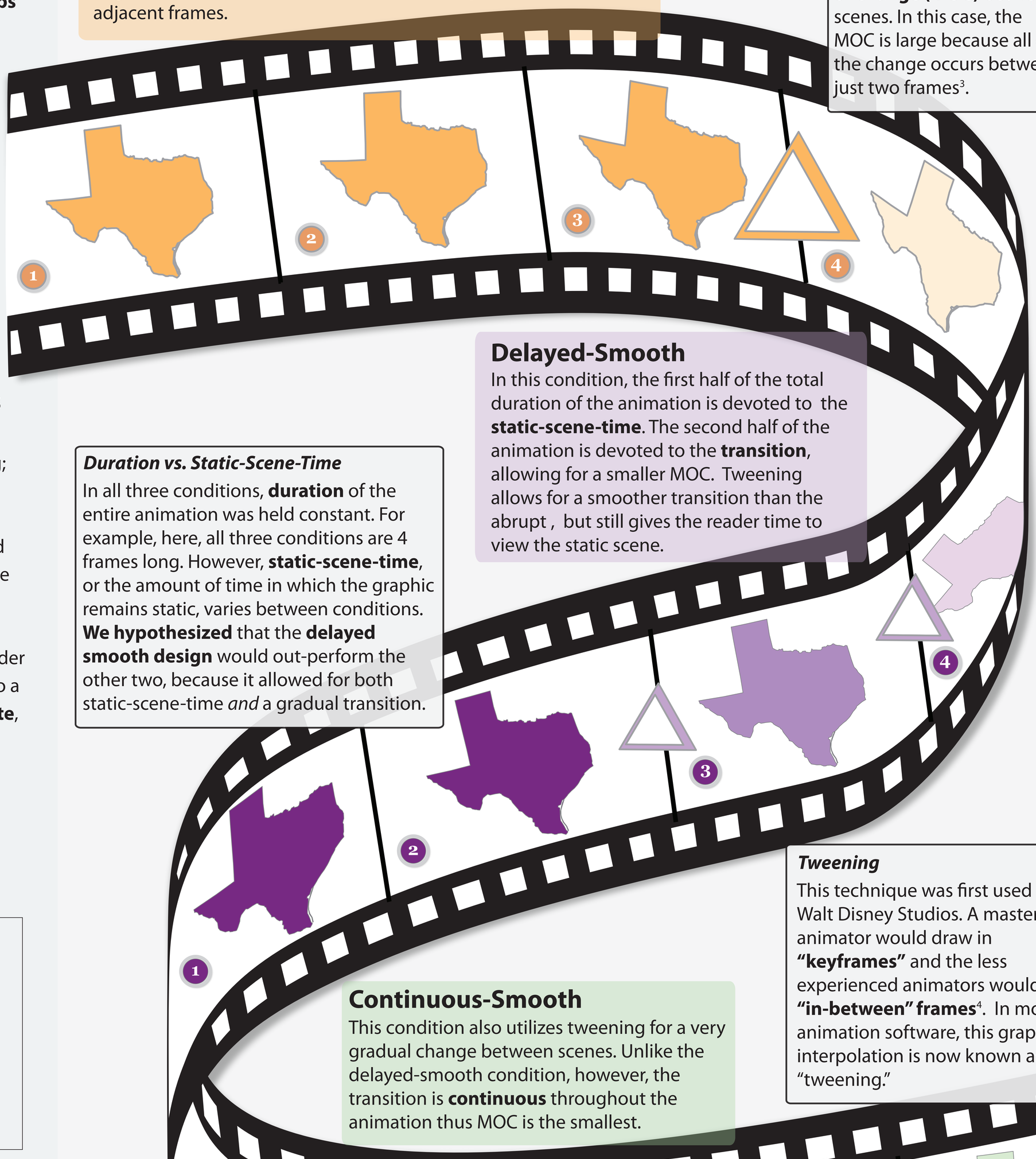
Three Transition Conditions

Abrupt

In this condition, each unit remains static, called static-scene-time, and then **changes abruptly** to the next scene. This transitions has a large MOC because the entire transition takes place between two adjacent frames.

The Delta

In these film strips, the size of the △ (the delta) represents the **magnitude of change (MOC)** between scenes. In this case, the MOC is large because all of the change occurs between just two frames[3].



Duration vs. Static-Scene-Time

In all three conditions, **duration** of the entire animation was held constant. For example, here, all three conditions are 4 frames long. However, **static-scene-time**, or the amount of time in which the graphic remains static, varies between conditions. **We hypothesized** that the **delayed smooth design** would out-perform the other two, because it allowed for both static-scene-time *and* a gradual transition.

Delayed-Smooth

In this condition, the first half of the total duration of the animation is devoted to the **static-scene-time**. The second half of the animation is devoted to the **transition**, allowing for a smaller MOC. Tweening allows for a smoother transition than the abrupt , but still gives the reader time to view the static scene.

Tweening

This technique was first used by Walt Disney Studios. A master animator would draw in **"keyframes"** and the less experienced animators would fill in **"in-between" frames**[4]. In modern animation software, this graphic interpolation is now known as "tweening."

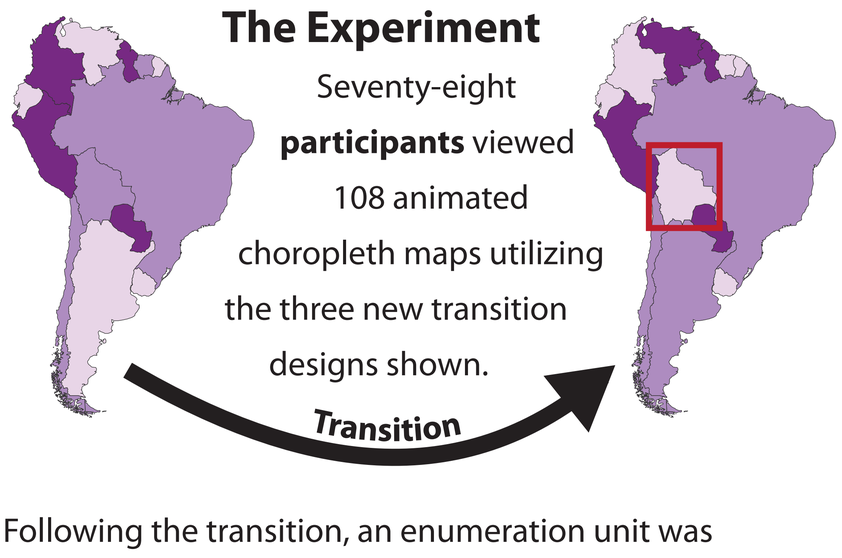
Continuous-Smooth

This condition also utilizes tweening for a very gradual change between scenes. Unlike the delayed-smooth condition, however, the transition is **continuous** throughout the animation thus MOC is the smallest.

Evaluating Human Change Detection

The Experiment

Seventy-eight **participants** viewed 108 animated choropleth maps utilizing the three new transition designs shown.



Following the transition, an enumeration unit was **highlighted**. The participant was then asked one of two question types designed to evaluate their abilities of perception and understanding.

References

[1] Harrower, M. (2007). "Unclassed Animated Choropleth Maps." The Cartographic Journal 44(4): 313-320.
[2] Simons, D. J. and R. A. Rensink (2005). "Change blindness: Past, present, and future." Trends in Cognitive Sciences 9(1): 16-20.
[3] Goldsberry, K. and S. Battersby (2009). "Why are Animated Choropleth Maps Difficult to Read?" Cartographica 44(3): 201-215.
[4] O'Rourke, M. (2003). Principles of three-dimensional computer animation: modeling, rendering, and animating with 3D computer graphics, WW Norton & Company.

THE RESULTS

How Well Do We *Notice* Change?

Question Type #1

Did the highlighted unit change between scenes?

Participants were instructed to indicate either yes, if they thought the unit had changed in color, or no if they did not think the unit changed in color.

Participants Averaged:

64%

Correct on Question Type #1

Median: 66.7%
Minimum Score: 33.3%
Maximum Score: 94.4%

No statistical significance between conditions

How Well Do We *Understand* Change?

Question Type #2

What was the color of the highlighted unit before the scene change?

Participants indicated the color they thought the unit was before the change, and could indicate "no change" by selecting the current color of the unit.

Participants Averaged:

40%

Correct on Question Type #2

Median: 39%
Minimum Score: 16.7%
Maximum Score: 72.2%

Statistical significance between conditions