Beyond Speed and Accuracy, Let's Focus on Engagement and Memorability: A New Framework for Evaluating Cartographic Animations

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Why use animation in cartography?

Maps are powerful communication tools that represent complex ideas in a simplified, yet information rich, graphical design. Modern multimedia techniques take maps to a more sophisticated level by supplementing them with pictures, video, sound, and animation (Dransch 2000). To communicate ideas to our audience, whether fellow researchers or the general public, animation offers a captivating and informative avenue for representing dynamic data in cartography.

- For exploratory purposes
- For communicative purposes

} Animation is particularly useful to convey concepts that are difficult or impossible to convey in static form.

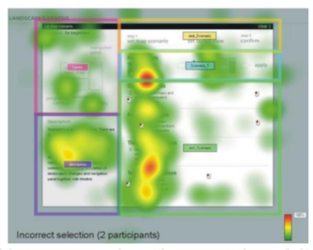
How are visualizations commonly evaluated?

Majority of cartographic evaluations

Bottom-up assessments

These evaluate the smallest interactions that a user has with the visualization and add them together to determine the effectiveness of the visualization as a whole. These methods are based on the belief that effective visualizations should rely on subconscious cues, which can be recognized quickly and without effort.

- **Speed and accuracy assessments**
  how quickly and correctly users can complete specific, usually low-level, tasks
- **Eye-tracking**
  heatmaps and gaze paths showing where on the map the users look



Eye-tracking heatmap. (Opach and Nossum 2011)

Top-down assessments

These evaluate outcomes associated with visualization use.

- Memorability evaluation assessments
- Learning facilitation assessments
- Task outcome assessments

Evaluating cartographic animation using traditional evaluations

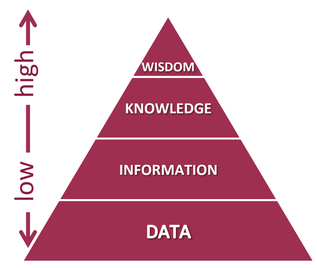
Findings

✓ Positives	Neutral	× Negatives
- quick identification of high contrast colors - quick identification of blinking symbols - users better follow data transitions	- time spent is correlated to performance as task difficulty increases	- specific locational/temporal information is difficult identify - users miss differences due to "change blindness" effect - short term memory has fixed capacity and can be overloaded

> **One must be careful not to fall into a conceptual trap by adopting accuracy as a criterion**. We are not saying that the primary purpose of a graph is to convey numbers with as many decimal places as possible. … If this were the only goal, tables would be better. The power of a graph is its ability to enable one to … see patterns and structure not readily revealed by other means.
>
> - Cleveland and McGill (1984)

Limitations

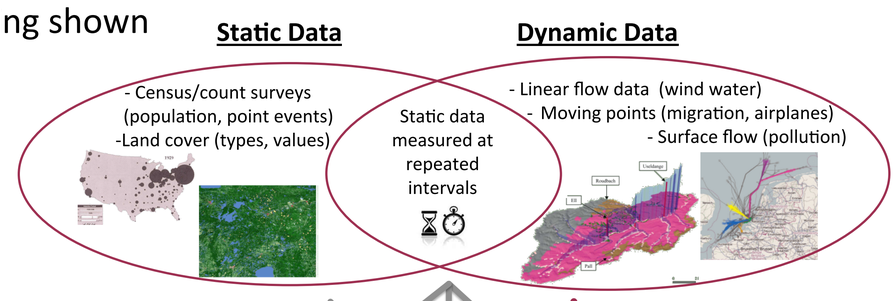
These traditional evaluations focus on the speed of low-level, data-retrieval tasks. Thus, time spent exploring the visualization is seen as a negative. However, cartographic animations are purported be a captivating and informative venue for higher-level knowledge transfer of spatial-temporal patterns. Only evaluating cognitive task time, which only takes milliseconds, disregards rational thought time, which may take minutes to hours (Thomas & Cook 2005). If the main purpose of cartographic animation is to convey higher-level information; than in these traditional assessments, cartographic animations are set-up for failure.



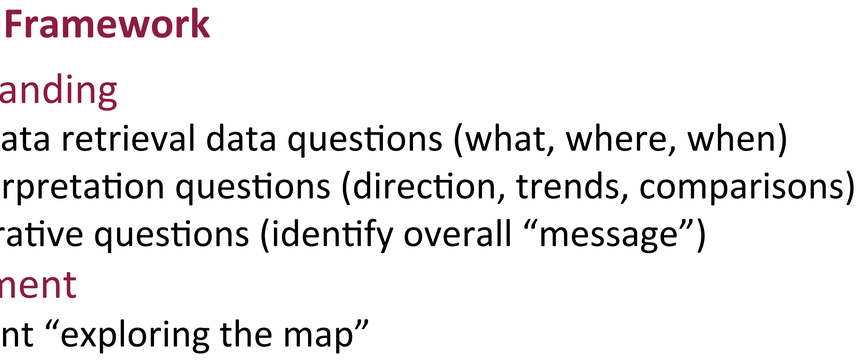
Information Hierarchy (Rowley 2010)

Dynamic and animated. What's the difference?

What is being shown



How is it shown



Proposed visualization evaluation framework

The understanding, engagement, & recall method

This method is based on the assumption that 1) the quality of the users' interaction with a visualization is related to higher-level knowledge transfer, which is as important as their ability to quickly complete low-level information retrieval tasks, and 2) the power of animated cartography is to represent dynamic data by revealing spatial-temporal patterns and structures that are not readily revealed in static displays.

Evaluation Framework

Understanding
Precise data retrieval data questions (what, where, when)
Map interpretation questions (direction, trends, comparisons)
Map narrative questions (identify overall "message")

Engagement
Time spent "exploring the map"
User experience questions (select adjectives describing the interaction)

Recall
One week later…
Re-ask data retrieval questions (can you remember…)
Re-ask map interpretation and user experience questions
Open ended recall (describe the content, look, and anything else that sticks out in your mind of the map you saw last time)

Expected outcomes

It is expected that this evaluation framework will demonstrate the effectiveness of animated cartography at higher-level knowledge transfer of dynamic data.

The users of the animated maps are expected to…

1) have reduced speed and accuracy of responses to specific map data questions.

However,

2) report a more positive and thought provoking experience

3) remember more higher-level information with more accuracy, and remember a more positive experience

References

Cleveland, W. S., & McGill, R. (1984). Graphical Perception: Theory, Experimentation, and Application to the Development of Graphical Methods. *Journal of the American Statistical Association*, *79*(387), 531–554.

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Opach, T., & Nossum, A. (2011). Evaluating the usability of cartographic animations with eye-movement analysis. In *25th International Cartographic Conference*. Paris.

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