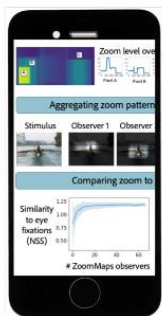
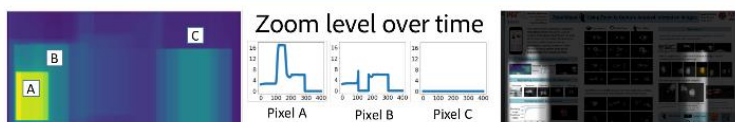


ZoomMaps Using Zoom to Capture Areas of Interest on Images



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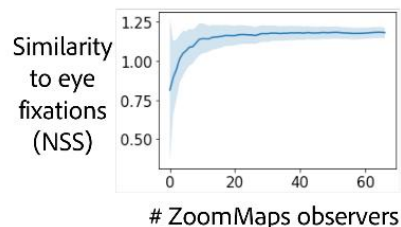
Converting zoom into attention heatmaps



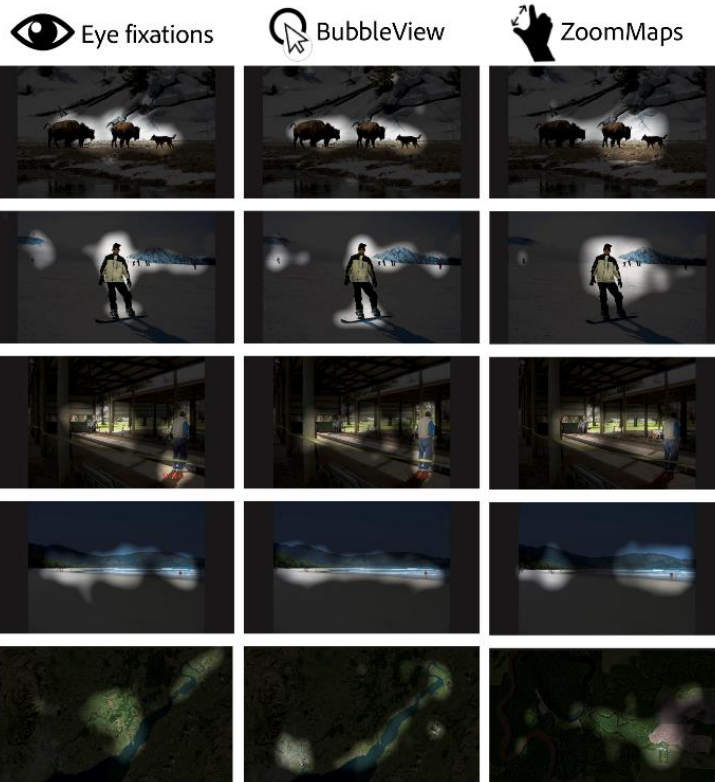
Aggregating zoom patterns across observers



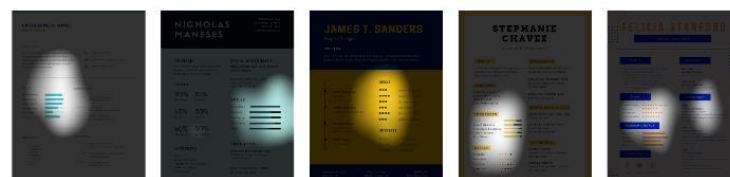
Comparing zoom to eye fixations



ZoomMaps with fixations overlaid for computing NSS



How do people read a document or browse a design?
What is interesting and attention-capturing?

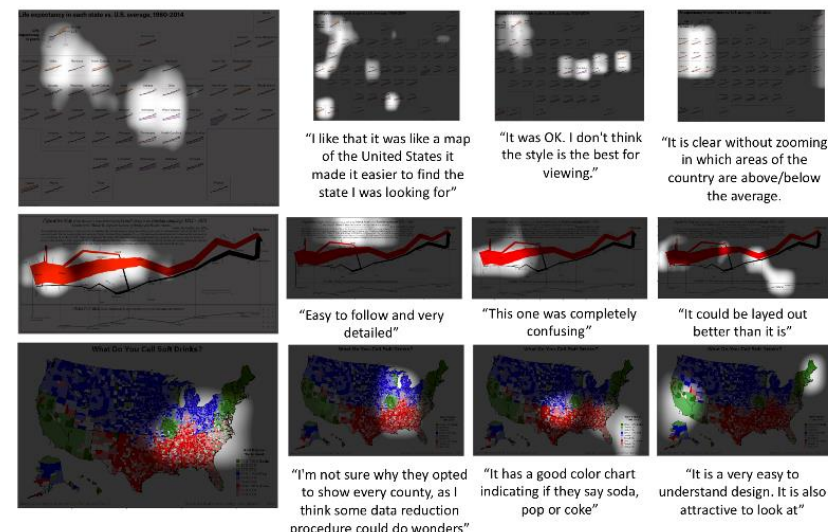


Case Study 1: ZoomMaps for academic posters

Individuals' zoom patterns can be used to generate customized thumbnails for better information recall.



Case Study 2: ZoomMaps for data visualizations



ZoomMaps

F37

CodeCharts



ImportAnnots

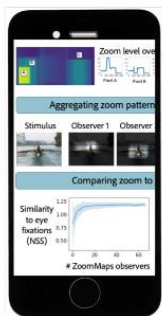


BubbleView



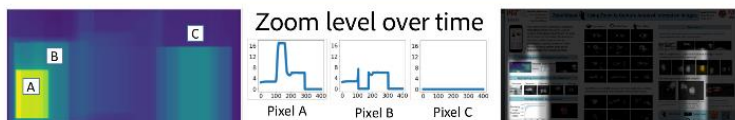
TurkEyes.mit.edu

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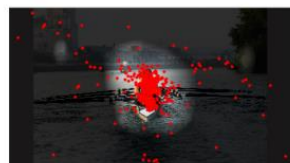
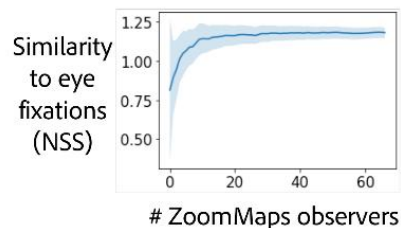
Converting zoom into attention heatmaps



Aggregating zoom patterns across observers

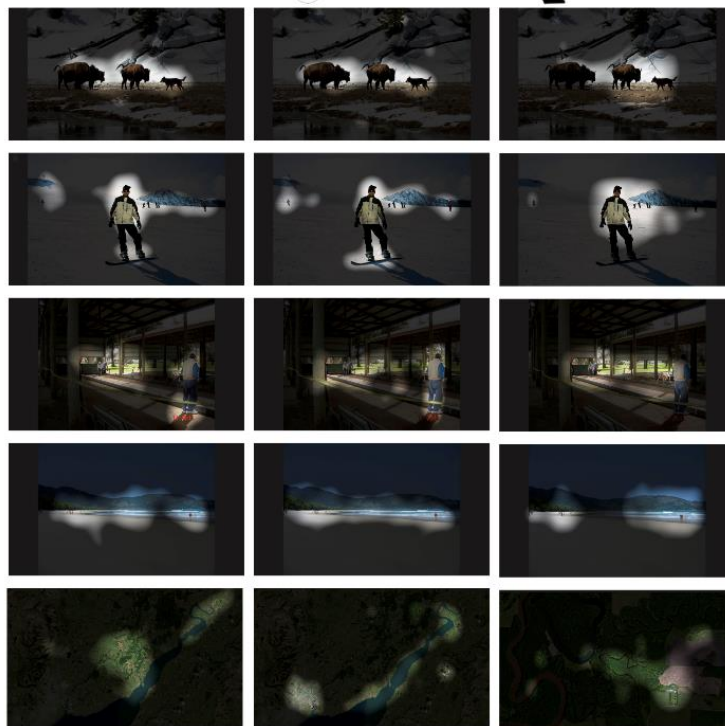


Comparing zoom to eye fixations

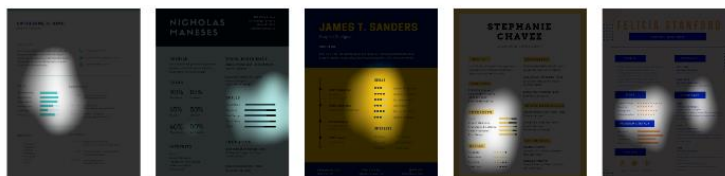


ZoomMaps with fixations overlaid for computing NSS

Eye fixations BubbleView ZoomMaps

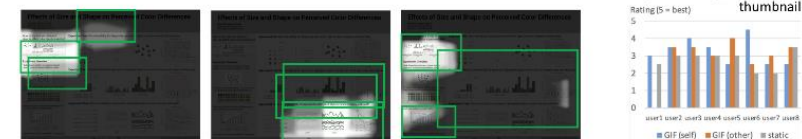


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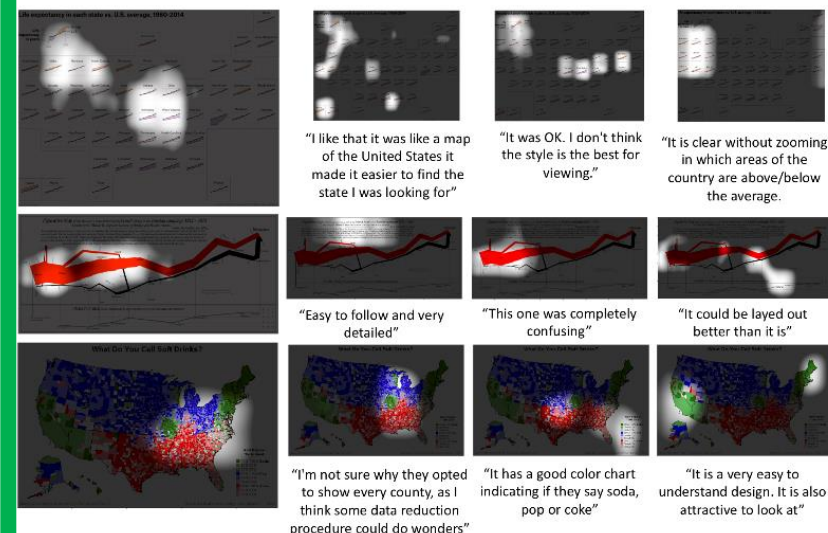


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Case Study 2: ZoomMaps for data visualizations



ZoomMaps

F37

CodeCharts



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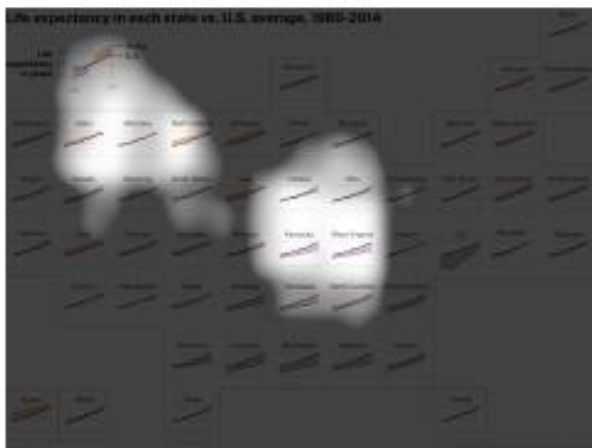


BubbleView

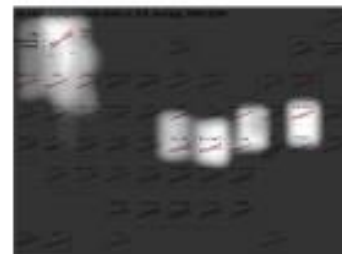


TurkEyes.mit.edu

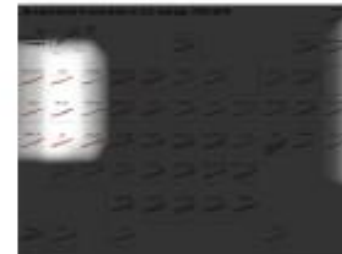
Case Study 2: ZoomMaps for data visualizations



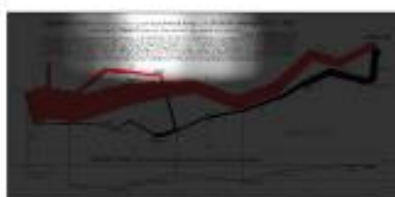
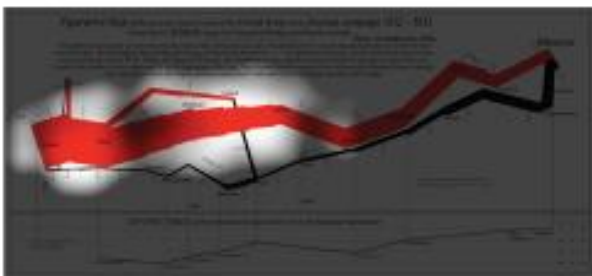
"I like that it was like a map of the United States it made it easier to find the state I was looking for"



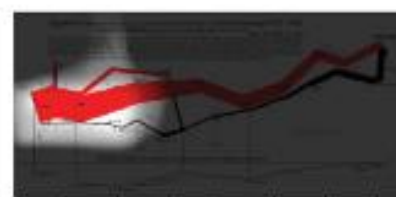
"It was OK. I don't think the style is the best for viewing."



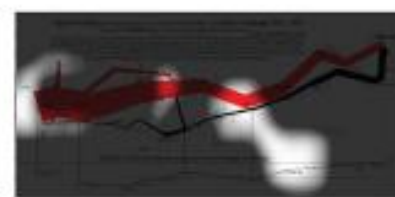
"It is clear without zooming in which areas of the country are above/below the average."



"Easy to follow and very detailed"



"This one was completely confusing"



"It could be layed out better than it is"



"I'm not sure why they opted to show every county, as I think some data reduction procedure could do wonders"



"It has a good color chart indicating if they say soda, pop or coke"



"It is a very easy to understand design. It is also attractive to look at"



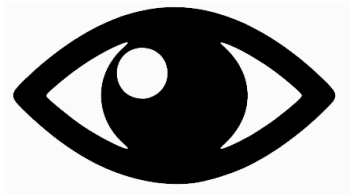
“It is a very easy to understand design. It is also attractive to look at”

How do we capture attention on multi-scale visualizations?

Capturing attention data

Accurate

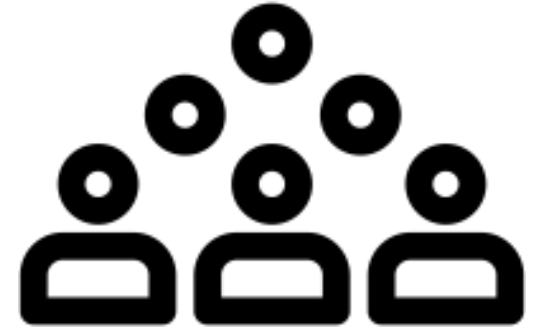
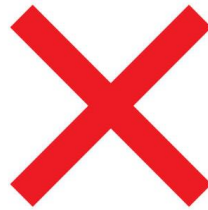
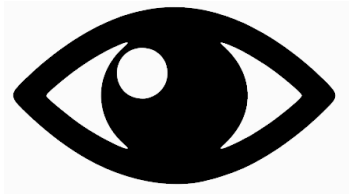
Scalable



Capturing attention data

Accurate

Scalable



Capturing attention data: BubbleView



0 clicks

0 characters

Describe the image in as much detail as possible...

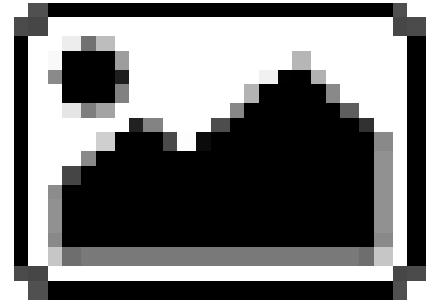
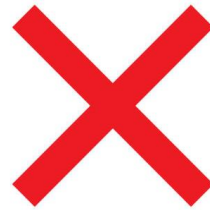
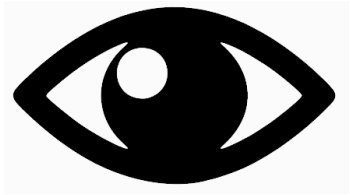
NEXT

Capturing attention data

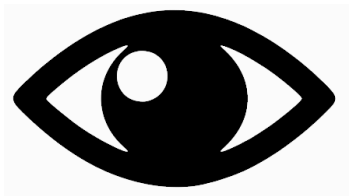


Accurate

Scalable

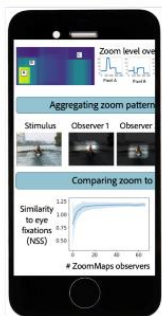
Natural



Capturing attention data

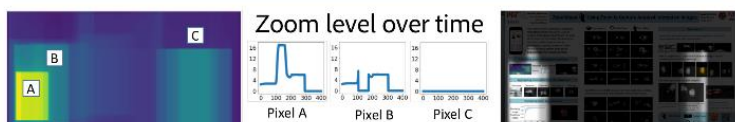
	Accurate	Scalable	Natural	Multi-Scale
	✓	✗	✓	✗
	✗	✓	✓	✗
	✓	✓	✗	✗

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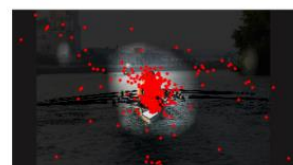
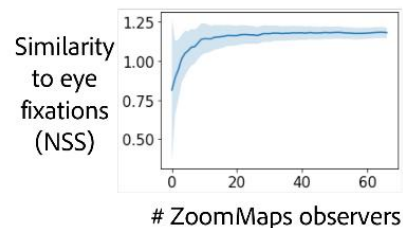
Converting zoom into attention heatmaps



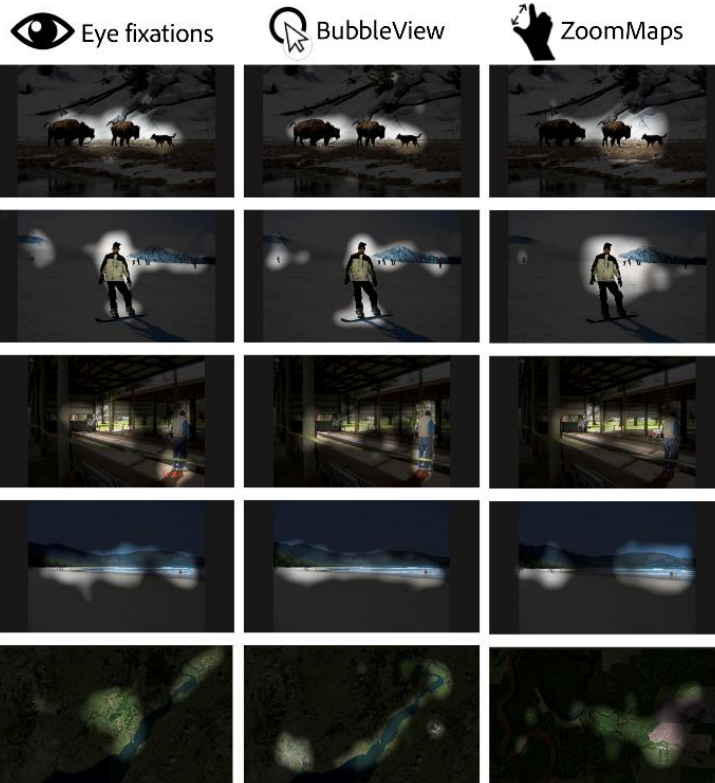
Aggregating zoom patterns across observers



Comparing zoom to eye fixations



ZoomMaps with fixations overlaid for computing NSS



How do people read a document or browse a design?
What is interesting and attention-capturing?

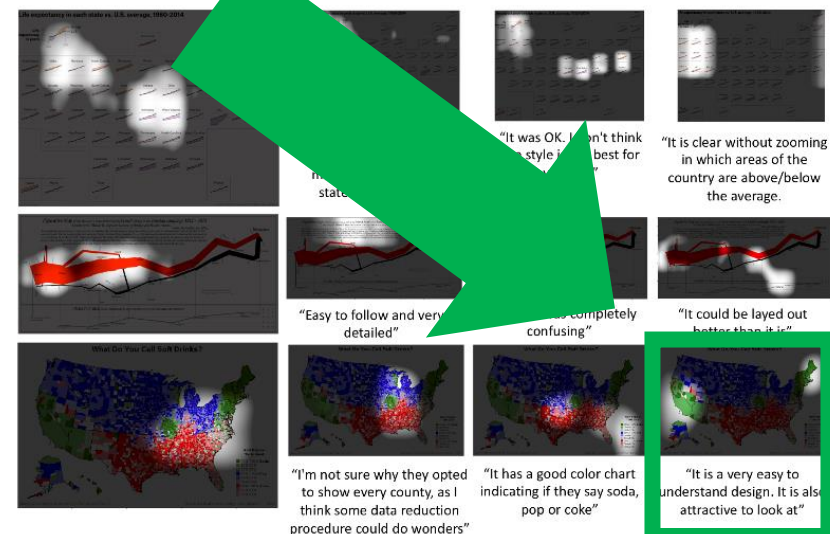


Case Study 1: ZoomMaps for academic posters

Individuals' zoom patterns can be used to generate customized thumbnails for better information recall.



Case Study 2: ZoomMaps for data visualizations



ZoomMaps

F37

CodeCharts



ImportAnnots



BubbleView



TurkEyes.mit.edu

A natural restricted window that operates
at **multiple scales...**



A **natural** restricted window that operates
at **multiple scales**...



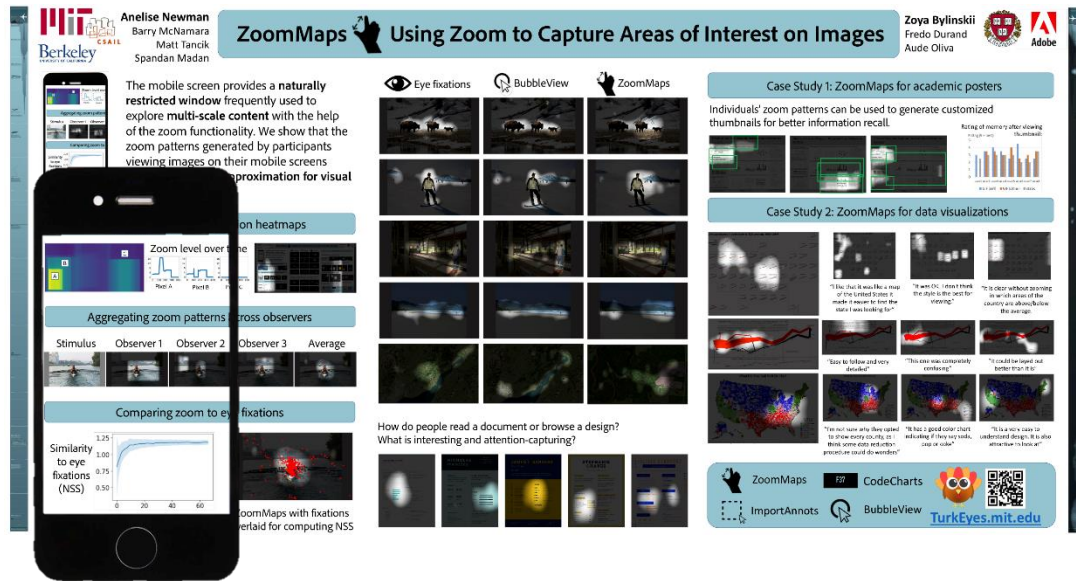


ZoomMaps

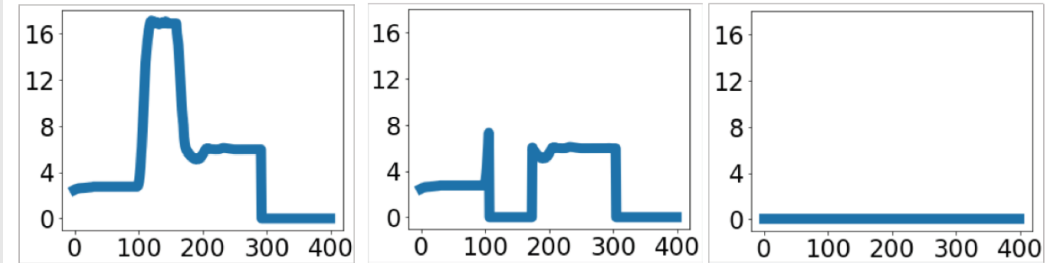
A Zoomable Crowdsourced Interface for Exploring Attention on Large-scale Visualizations

Anelise Newman, Barry McNamara, Aude Oliva, Zoya Bylinskii

From zoom to maps



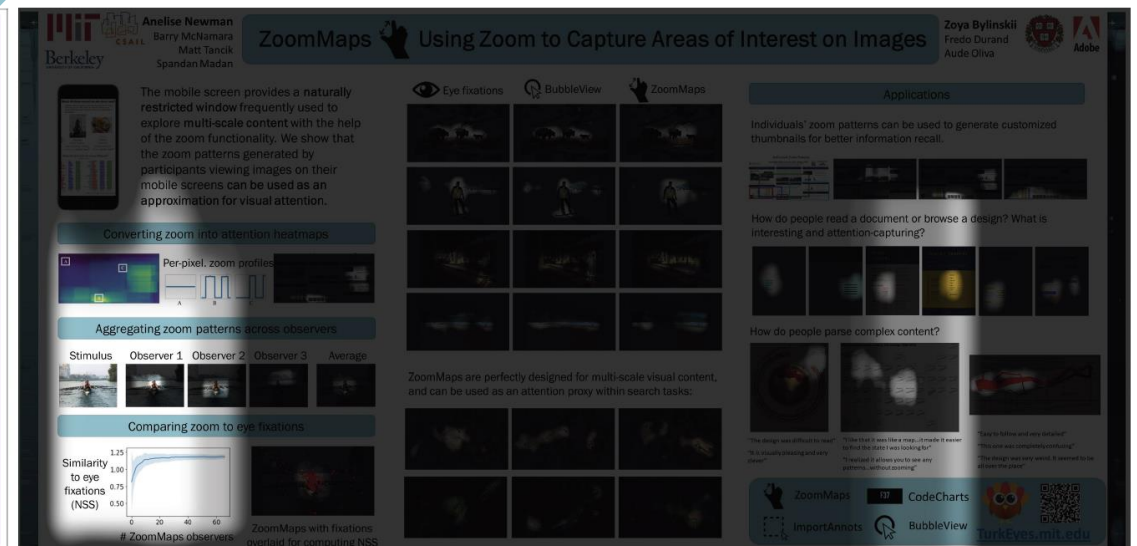
Zoom level over time



Pixel A

Pixel B

Pixel C





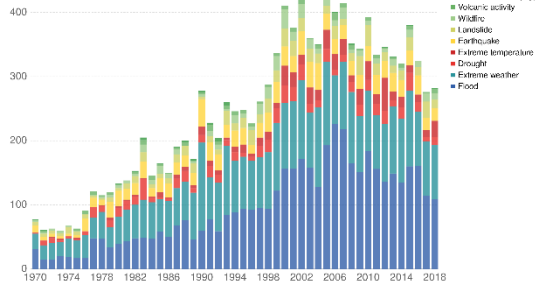
Eye movements



ZoomMaps



NSS = 1.37
(1.58 for BubbleView)



Source: EMDAT (2017): OFDA-CRED International Disaster Database, Université catholique de Louvain – Brussels – Belgium
OurWorldInData.org/natural-disasters - CC BY



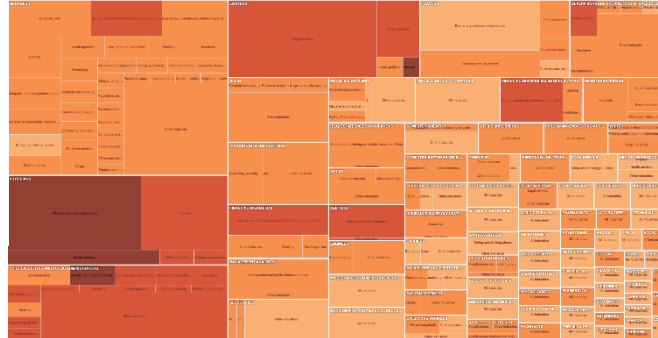
Survey data courtesy of Alan McConchie - popssoda.com

Based on 120,464 Respondents through March 1, 2000

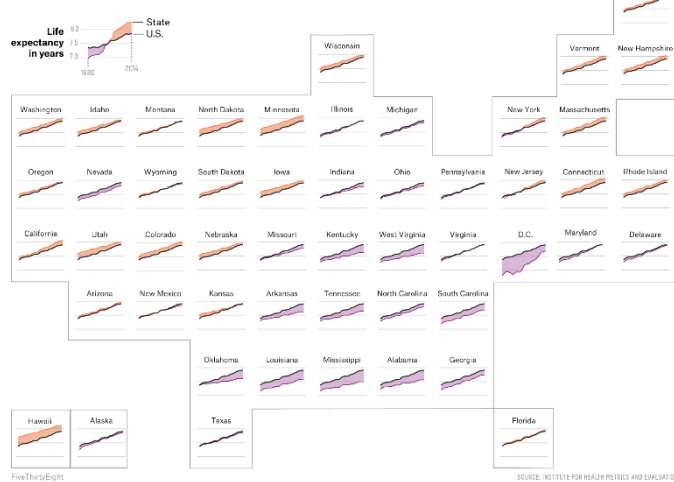
BOSTON SUBWAY MAP



The Top 1 Percent: What Jobs Do They Have?



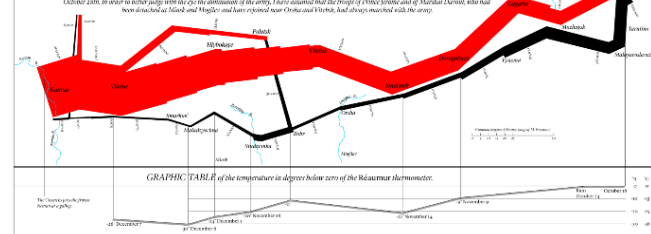
Life expectancy in each state vs. U.S. average, 1980-2014



SOURCE: INSTITUTE FOR HEALTH METRICS AND EVALUATION

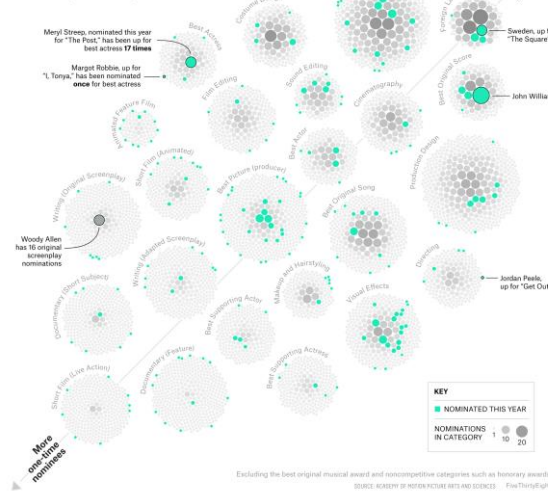
Figurative Map of the successive losses in men of the French Army in the Russian campaign 1812 ~ 1813
Drawn by M. Minard, Inspector General of Bridges and Roads (retired). Paris, November 20, 1869

The numbers of men present are represented by the widths of the colored zones at a rate of one millimeter for every ten thousand men; they are further written across the zones. The red designates the men who enter Russia, the black those who leave it. — The information which has served to draw up the map has been extracted from the words of M. M. Thiery, de Séguir, de Fermeze, de Chambray and the unpublished diary of Jacob, the pharmacist of the Army since 1812.



Which Oscar category is the least open to newcomers?

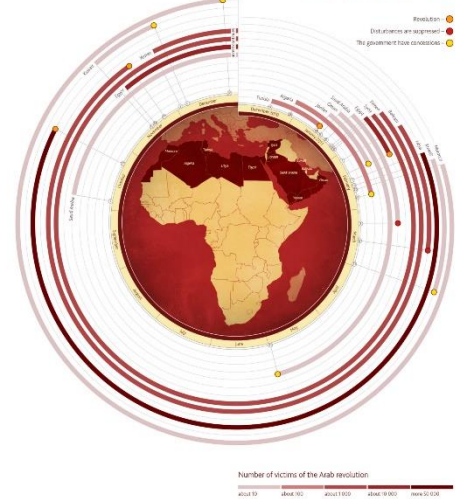
Looking at the 9,942 Academy Award nominations awarded to 5,385 nominees, 1958-2017



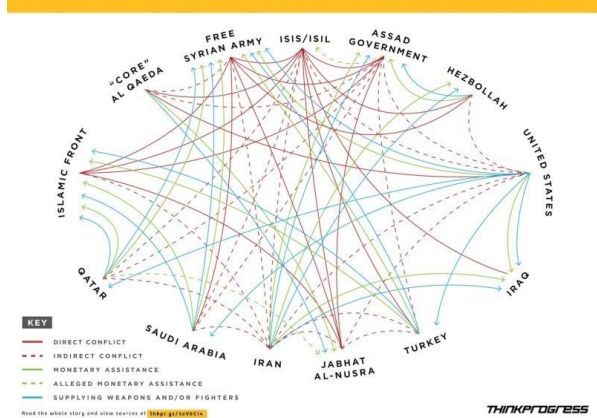
Excluding the best original musical award and noncompetitive categories such as honorary award

SOURCE: ACADEMY OF MOTION PICTURE ARTS AND SCIENCES. *FiveThirtyEight*

ARAB SPRING

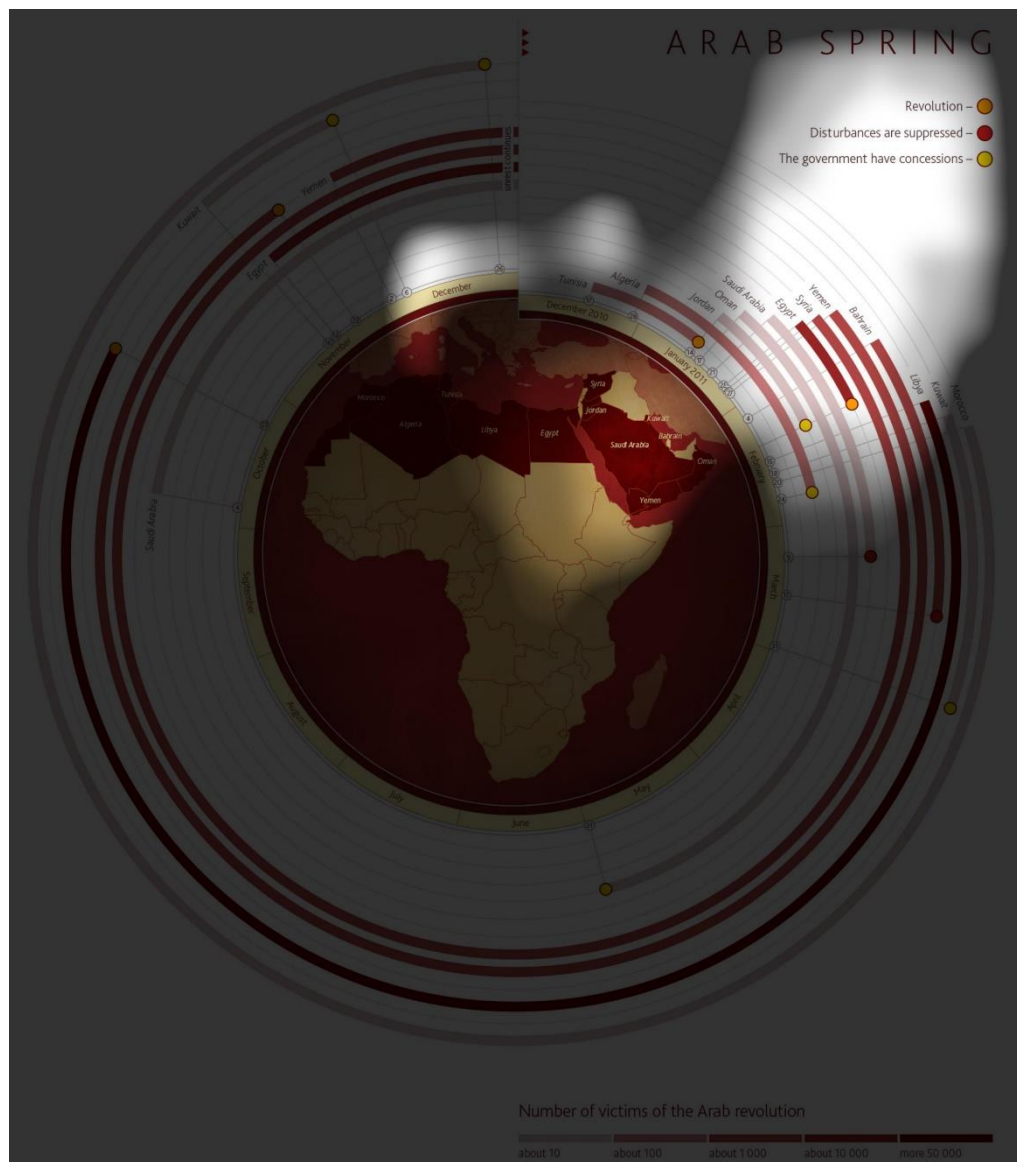


THE TANGLED WEB IN THE FIGHT FOR SYRIA'S FUTURE



THINKPROGRESS

Average Attention Patterns



"It was **hard to read** the information at times because it was in a circle."

"I like the way the dates wrap around the continent of Africa and the Middle East. It does a good job of showing **where each took place.**"

"It was very confusing. I **didn't understand** the curved lines on the side."

All commercial transport aircraft are fitted with underwater locator beacons to assist in the relocation of black box flight data recorders and cockpit voice recorders. These beacons are free-running pingers that transmit signals at an acoustic frequency of 37.5 kilohertz and have an expected battery life of 30 days. The scale of the challenge in locating the black boxes is immense.

200 feet – the width
of a Boeing 777-200.



22 feet – the draft of the Australian

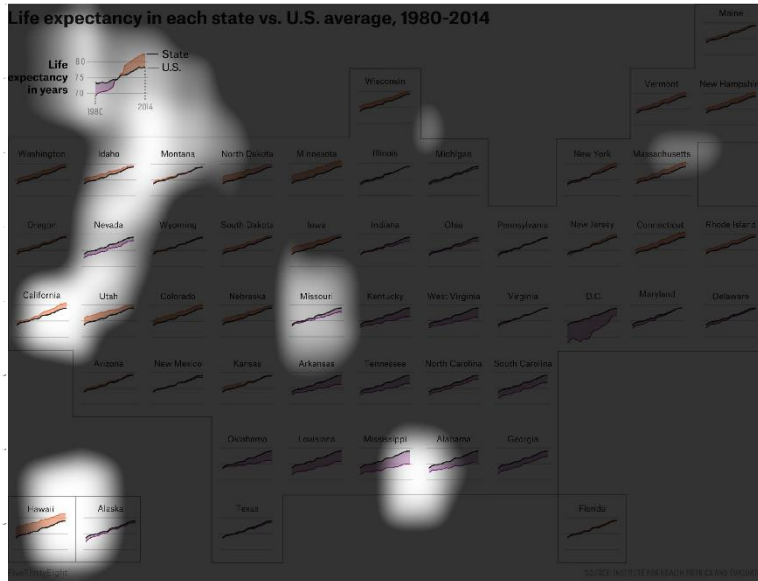
"I think this design is awesome. It really shows how difficult this search is. Also, continuously having to scroll down is a great way of **getting the message across**."

"I like the design. I really like the sea creatures on the design. It makes it fun to **imagine how deep** the beacons can go and be recovered. I like that design can be swiped up and down."

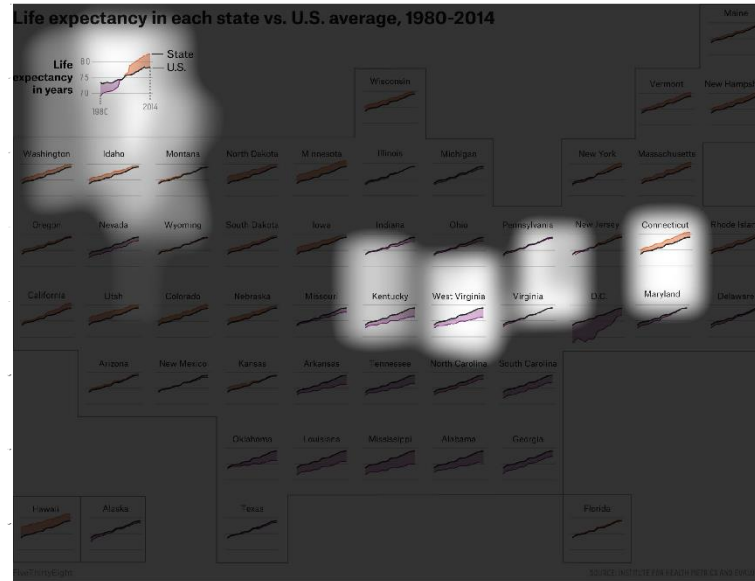
"It is **too vertically long** and the colors are drab."

Individual Differences

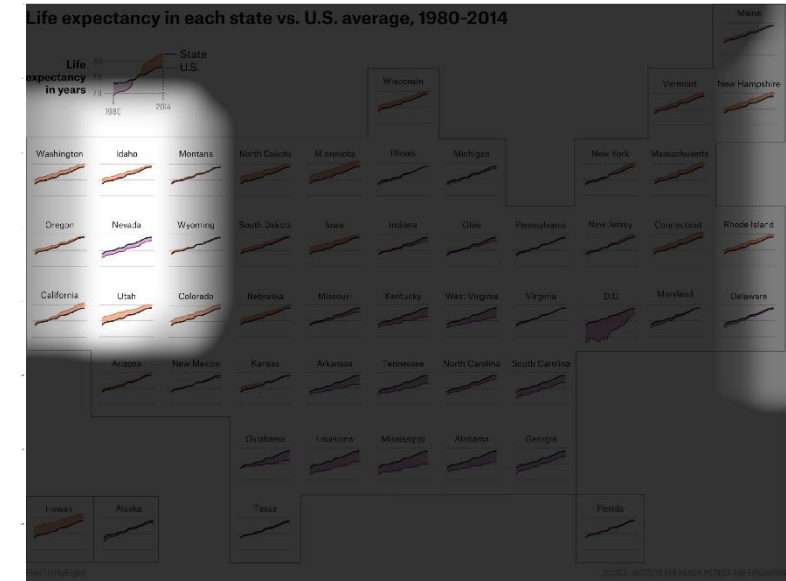
What do you think of the **design** of the visualization?



“I like that it was like a map of the United States it made it easier to **find the state I was looking for**”



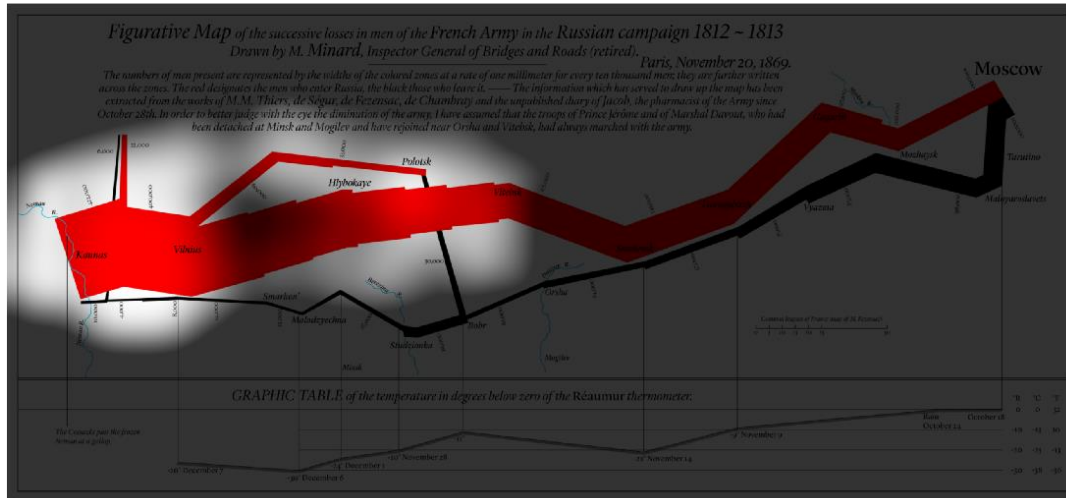
“It was OK. I don't think the style is the best for viewing.”



“it allows you to **see any patterns** that are visible. It is clear **without zooming in** which areas of the country are above/below

Was the visualization well-designed?

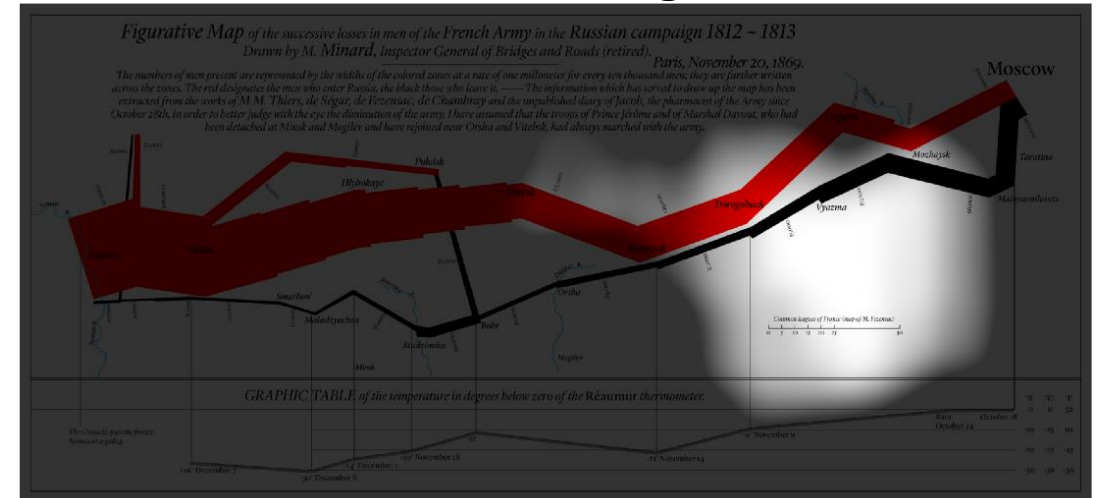
Higher ratings



"It was Ok, the only problem is it was a little hard to judge the width of **the red line**."

"I like the correlation between the two graphs. After you take the time to read through the explanation, the visualization does a good job of visually **taking you on the journey**."

Lower ratings



"The design was very weird. It seemed to be **all over the place**"

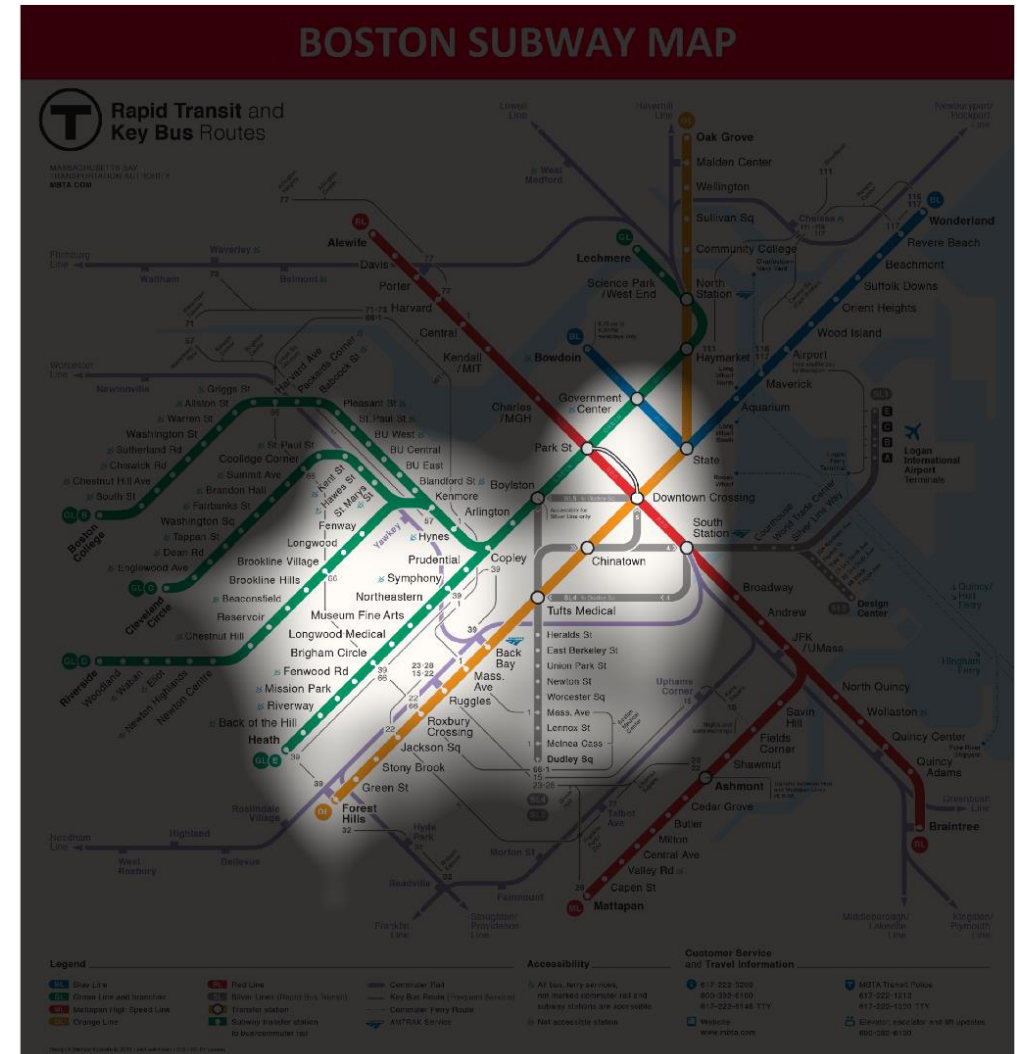
"This was a **jumbled mess**...the thick red line and the black lines it was hard to follow what each line meant."

Was the content interesting?

Higher ratings



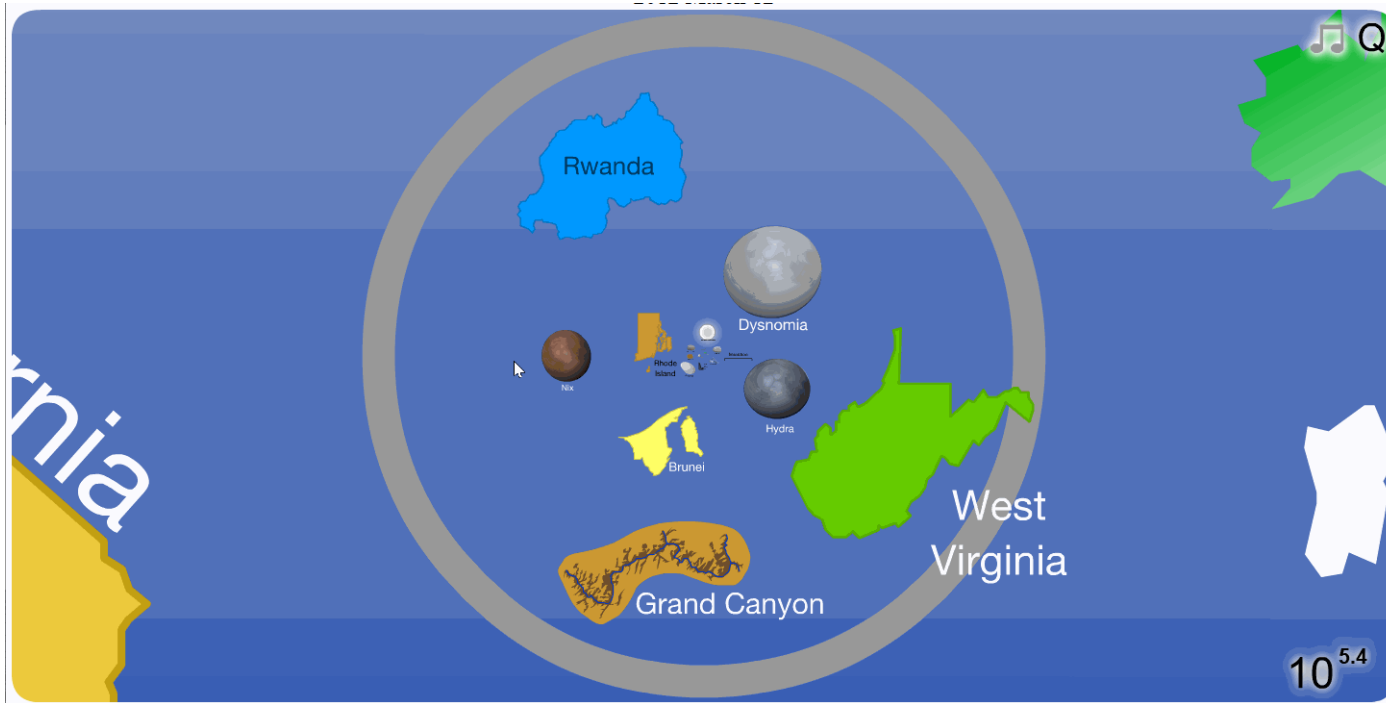
Lower ratings



Takeaways

- Approximates attention on natural images
- Suitable for multi-scale content
- Drill down into individual differences
 - Customized applications

Future Work

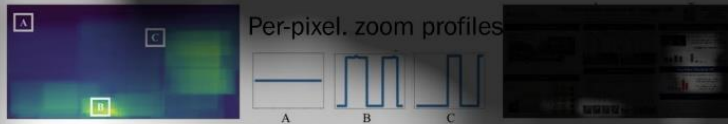


- Interactive visualizations
- Directed tasks
- Applications
 - Modeling
 - Personalized thumbnails

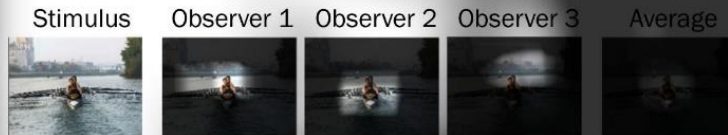


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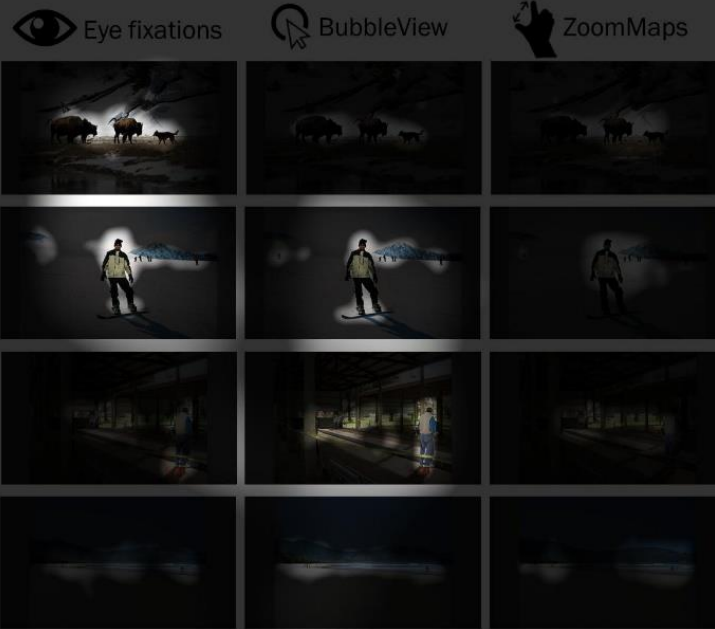
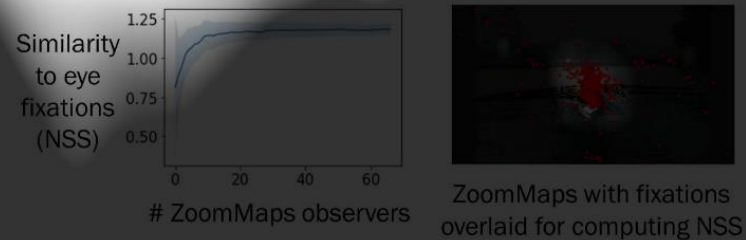
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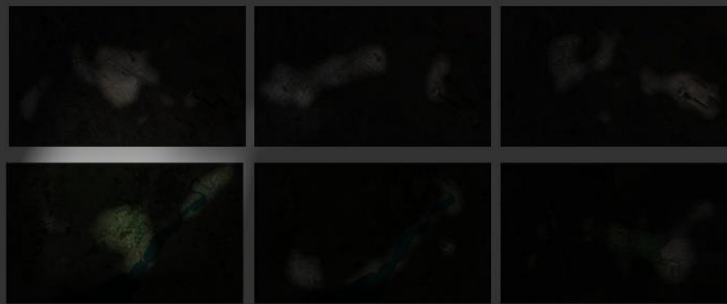
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Comparing zoom to eye fixations

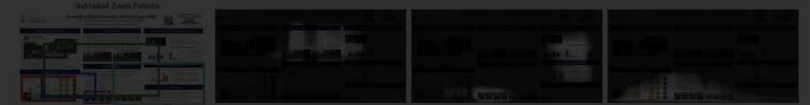


ZoomMaps are perfectly designed for multi-scale visual content, and can be used as an attention proxy within search tasks:

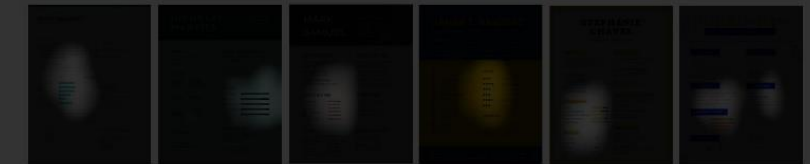


Applications

Individuals' zoom patterns can be used to generate customized thumbnails for better information recall.



How do people read a document or browse a design? What is interesting and attention-capturing?



How do people parse complex content?



"The design was difficult to read"
"It is visually pleasing and very clever"

"I like that it was like a map...it made it easier to find the state I was looking for"
"I realized it allows you to see any patterns...without zooming"

"Easy to follow and very detailed"
"This one was completely confusing"
"The design was very weird. It seemed to be all over the place"



TurkEyes.mit.edu: Scalable Interfaces for Crowdsourcing Attention