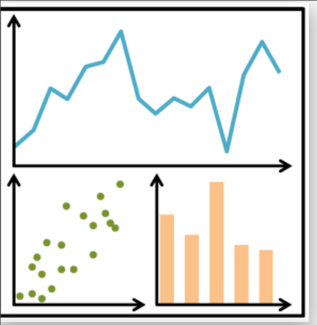
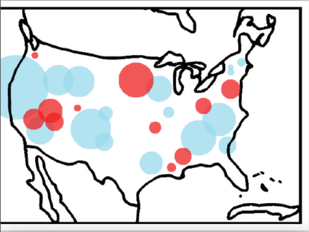
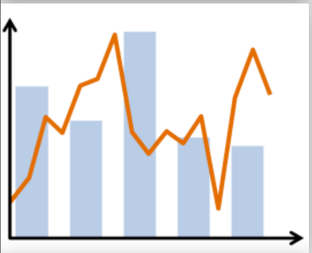
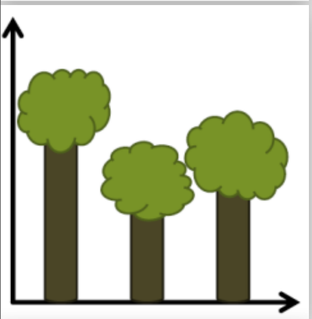
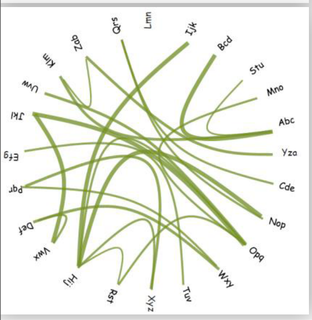






Beyond Memorability: Visualization Recognition and Recall

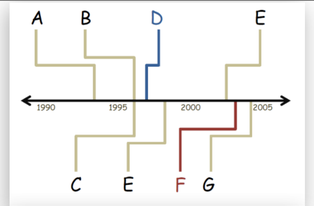
Michelle A. Borkin, Zoya Bylinskii,
Nam Wook Kim, Constance Bainbridge, Chelsea Yeh, Daniel Borkin,
Hanspeter Pfister and Aude Oliva

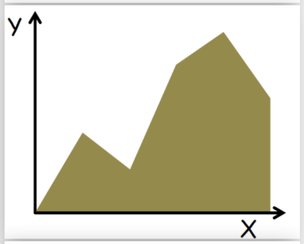
Presented at IEEE InfoVis - October 29, 2015

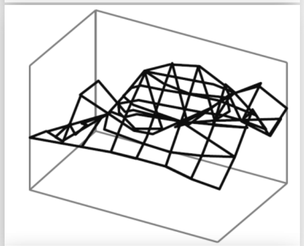
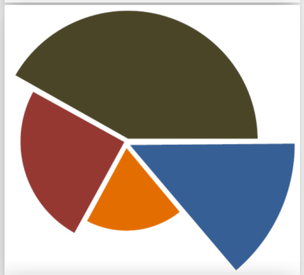
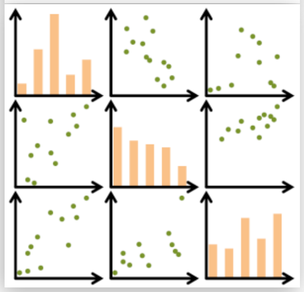
Harvard School of Engineering and Applied Sciences

MIT

CSAIL



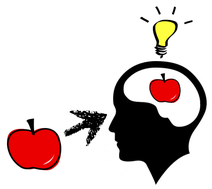


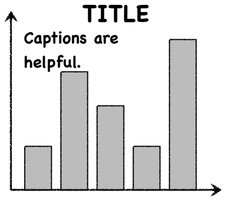
GOAL

What makes a visualization effective?

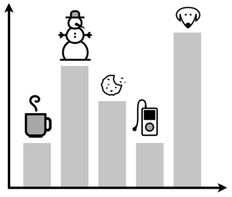
What makes a visualization effective?



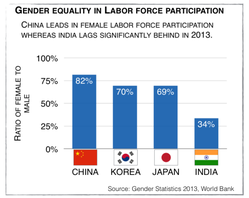
"At-a-glance" **memorable** visualizations have memorable content



Titles and text are key elements

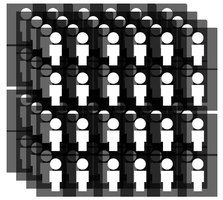


Human recognizable objects (e.g., pictograms) can add to effectiveness

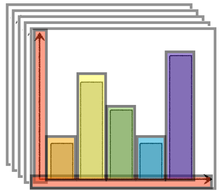


Redundancy helps with visualization understanding

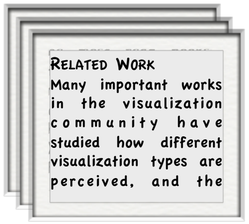
Empirical evidence in support of many conventional qualitative visualization design guidelines



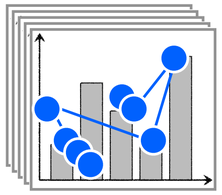
The Experiment



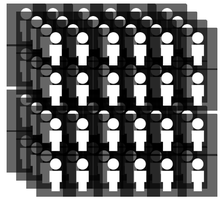
The Data



Related Work



Results



The Experiment

The Data

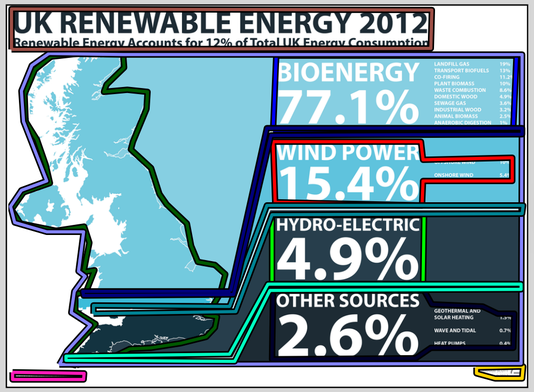
Related Work

Results

The Experiment

Experiment Design

Labeled Visualization Database

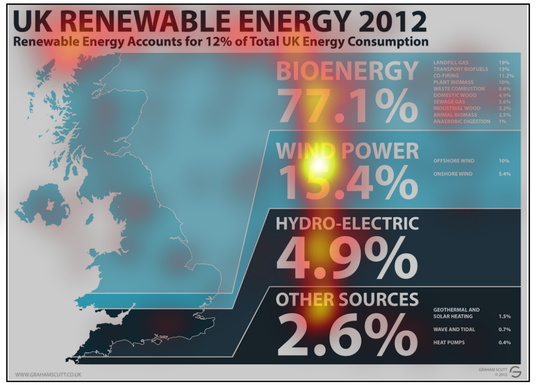


393 visualizations

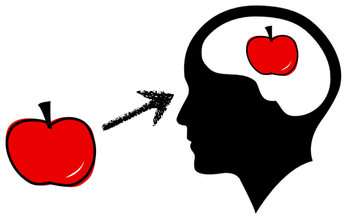
33 participants

"Encoding"

10 seconds / image

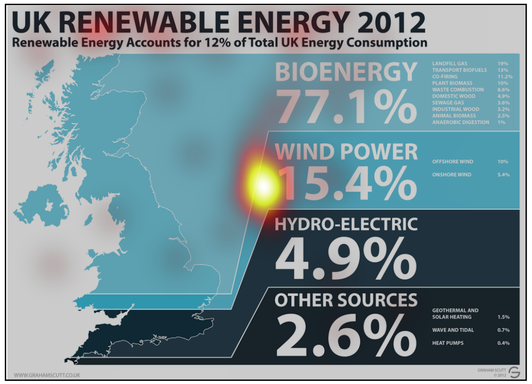


Eye-Tracking Data

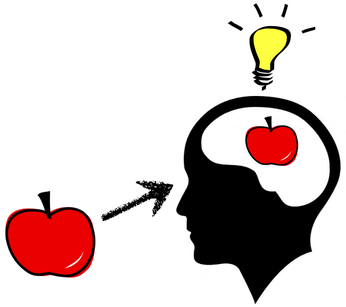


"Recognition"

2 seconds / image



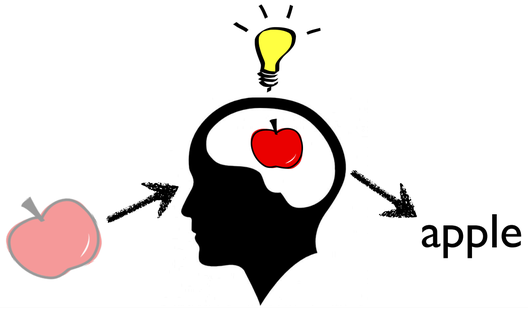
Eye-Tracking Data



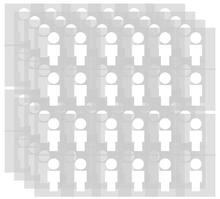
"Recall"

20 minutes

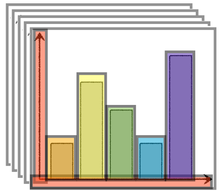
Text Descriptions



~60 minutes



THE EXPERIMENT

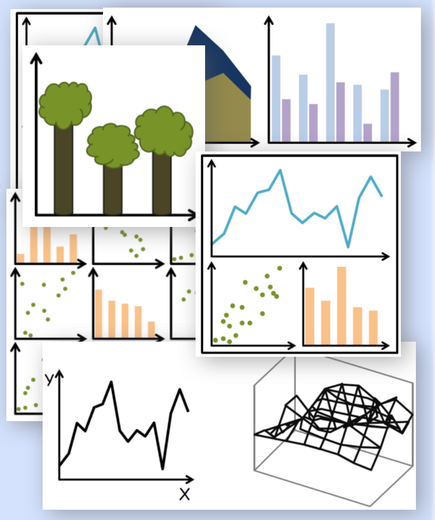


THE DATA

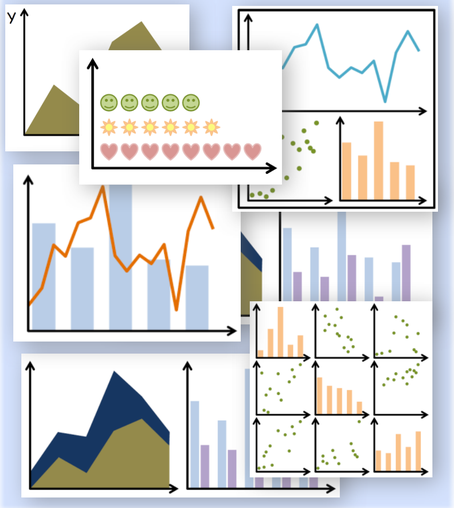
RELATED WORK

RESULTS

Data available at massvis.mit.edu

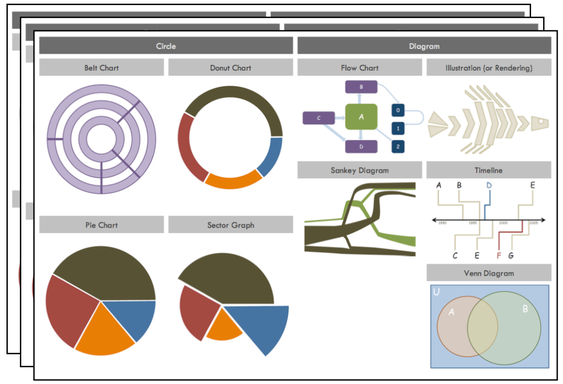


Visualization Database (5,814 images)

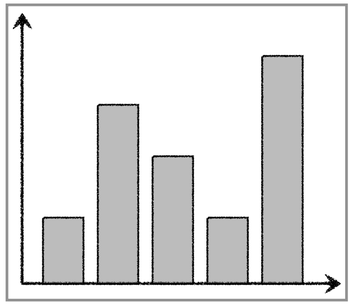


Borkin et al. (2013)

Taxonomy



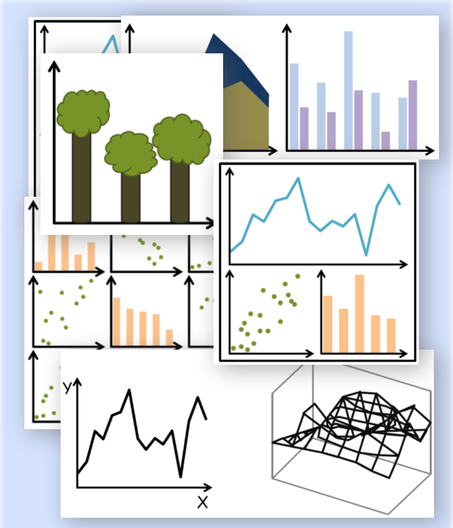
"Single" visualizations (2,068 images)



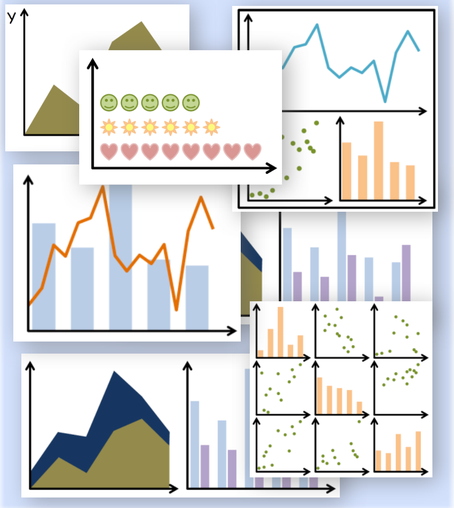
"single"

"Targets" (393)

Data available at massvis.mit.edu

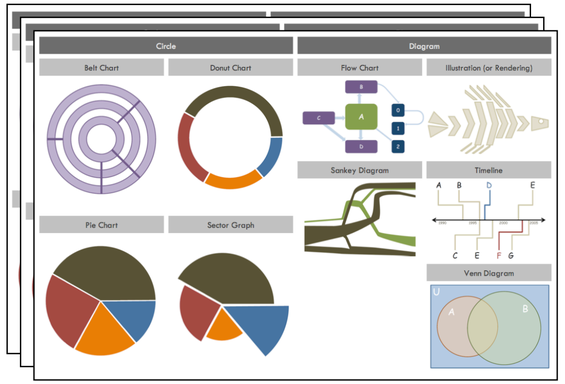


Visualization Database (5,814 images)

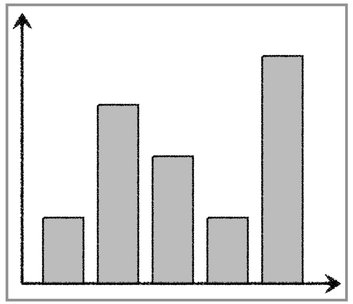


Borkin et al. (2013)

Taxonomy



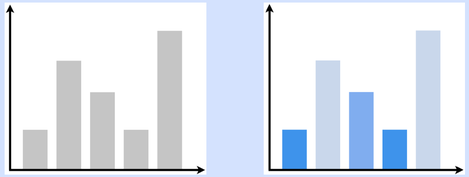
"Single" visualizations (2,068 images)



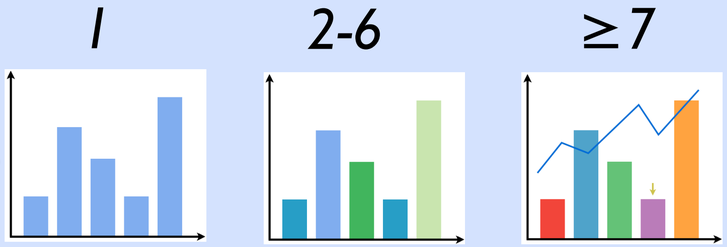
"single"

"Targets" (393)

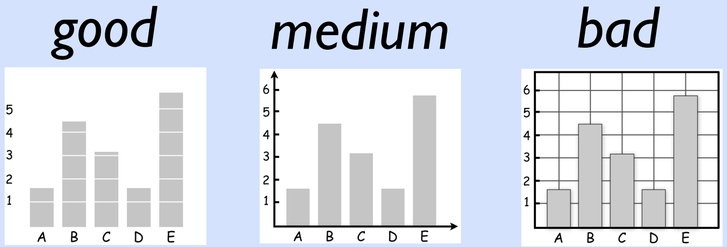
Black & White



Number of Distinct Colors

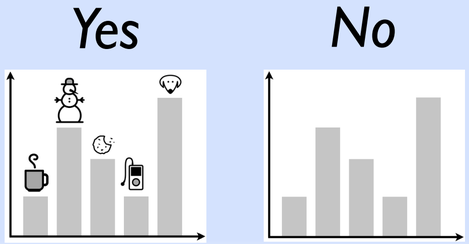


Data-Ink Ratio



Visual Density

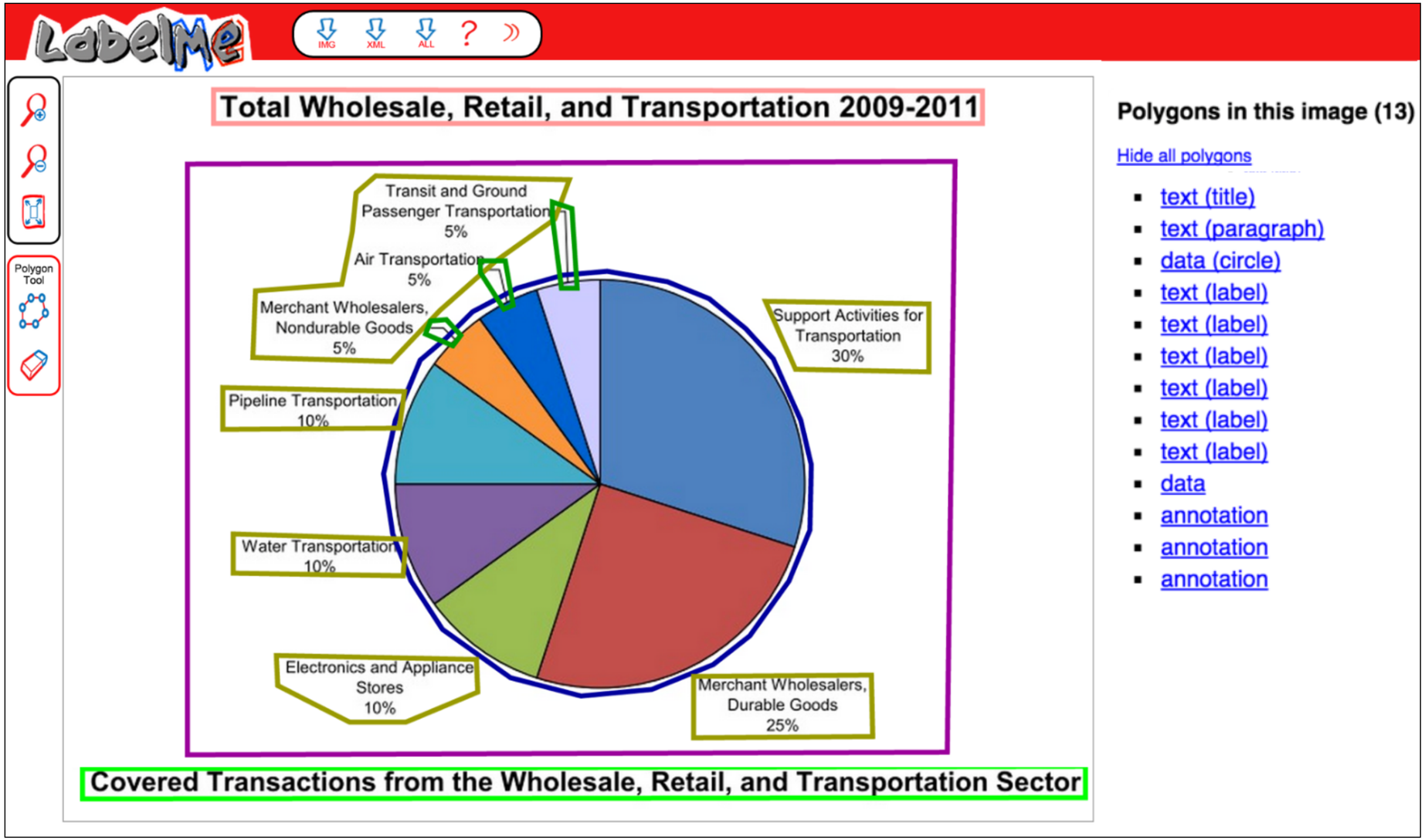
Human Recognizable Objects



"Targets" (393)

FOR EACH VISUALIZATION:

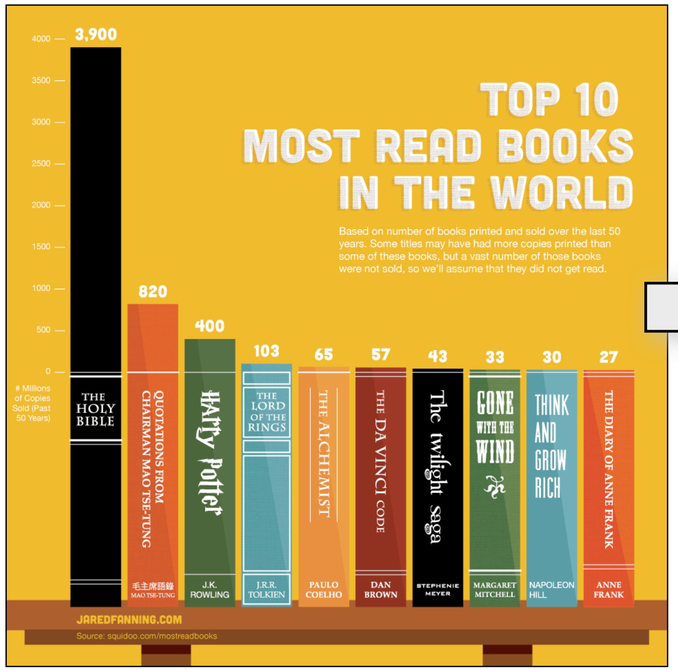
- Labels



“Targets” (393)

FOR EACH VISUALIZATION:

- Labels
- Title transcription

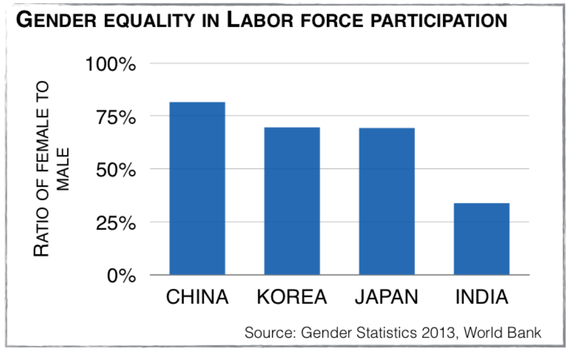


“TOP 10 MOST READ BOOKS IN THE WORLD”

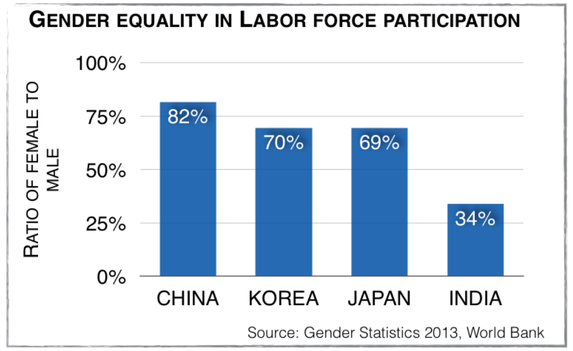
“Targets” (393)

For each visualization:

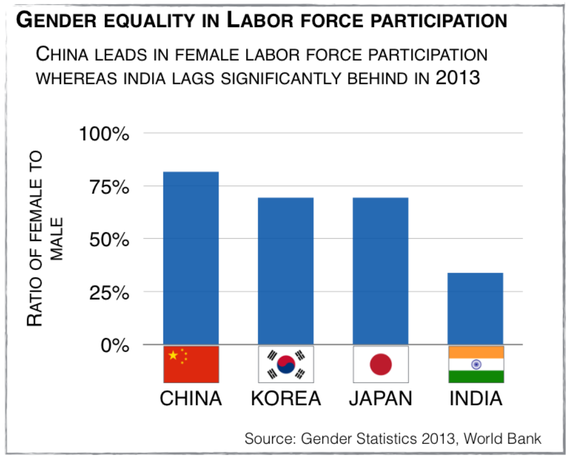
- Labels
- Title transcription
- Data and message redundancy



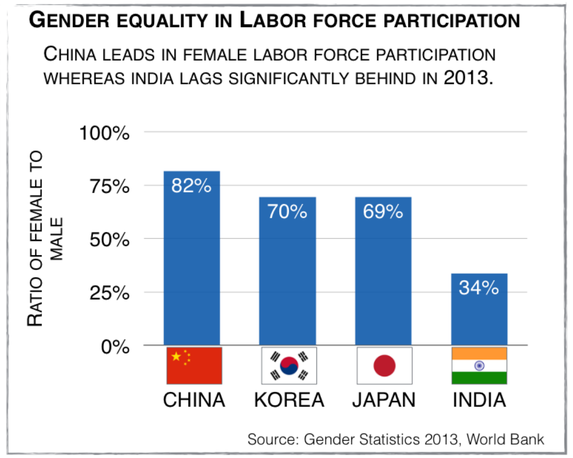
Original



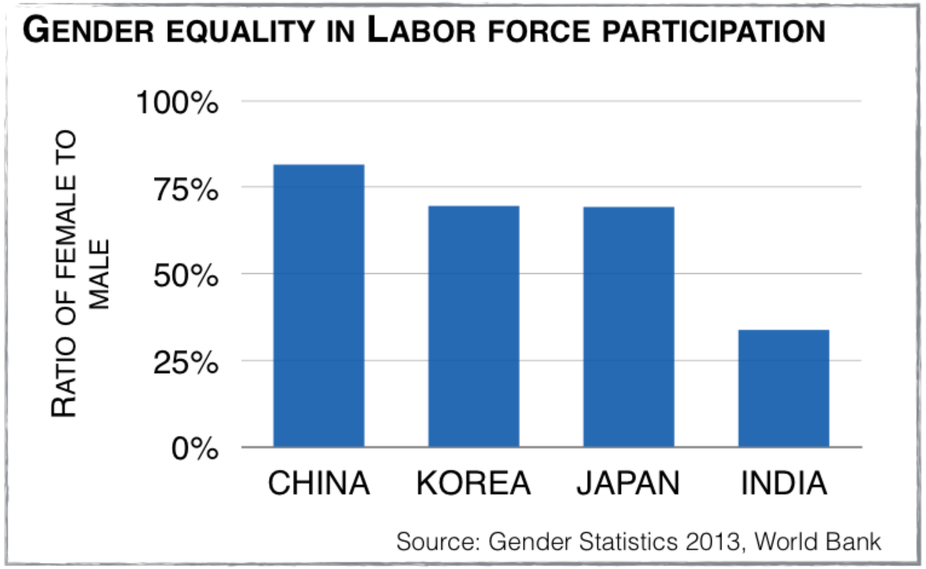
Data Redundancy



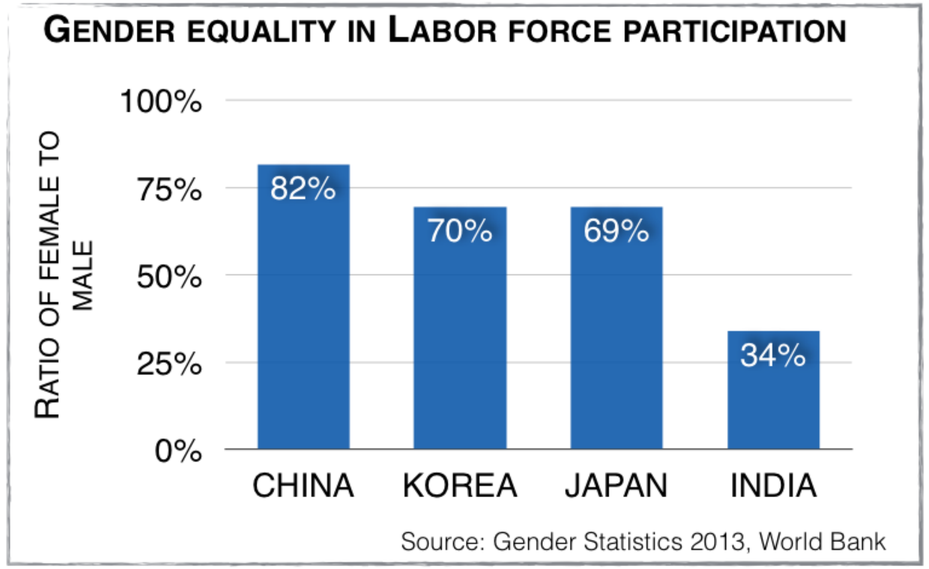
Message Redundancy



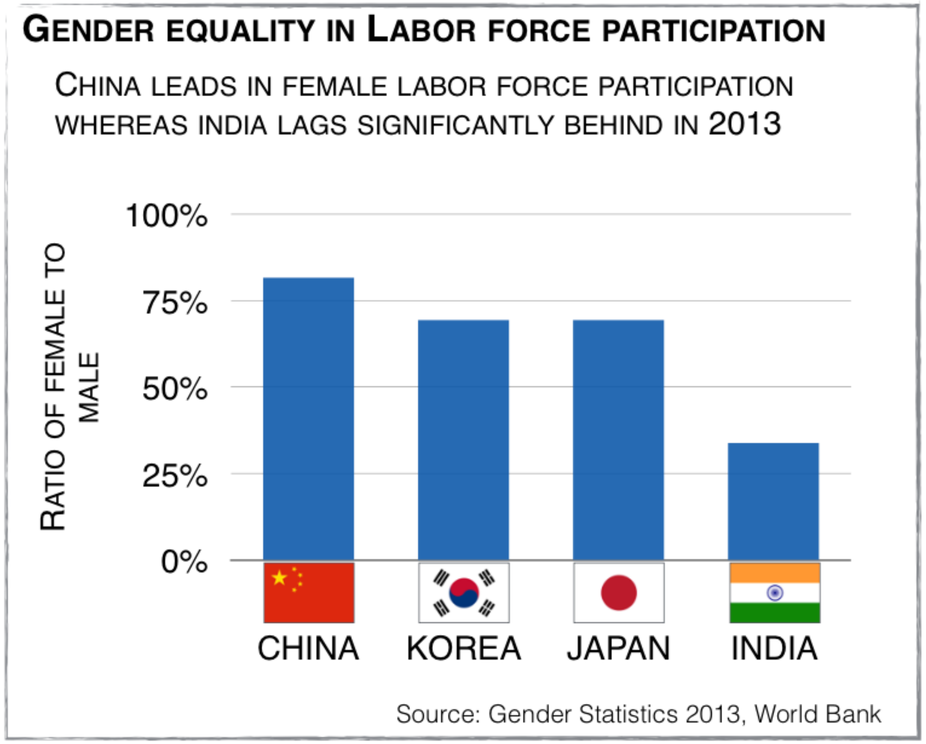
Data & Message Redundancy



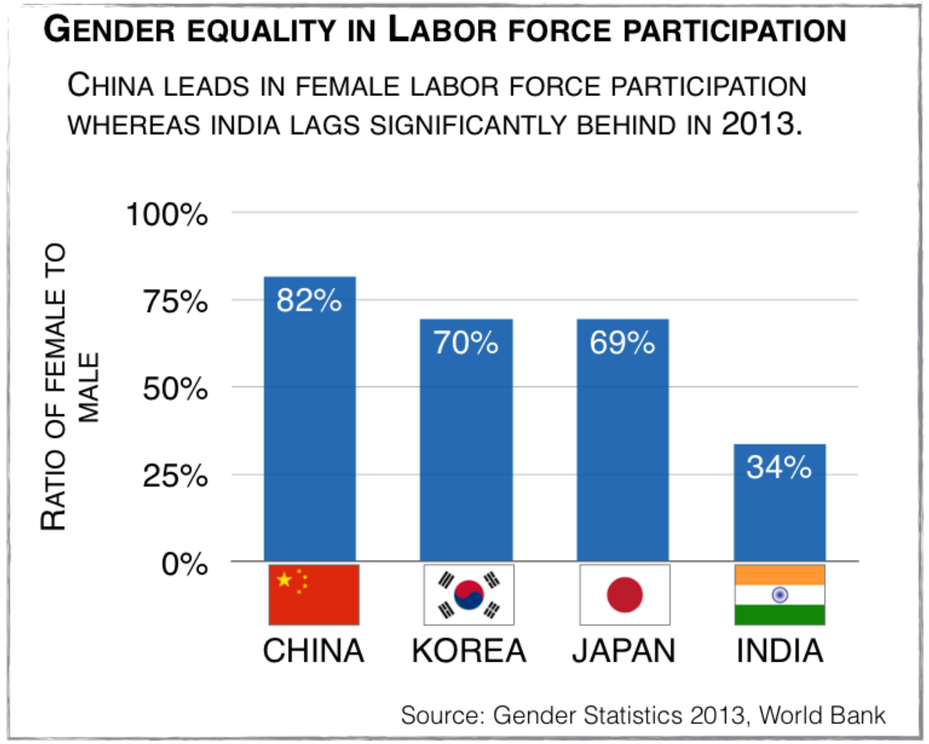
ORIGINAL



DATA REDUNDANCY



MESSAGE REDUNDANCY

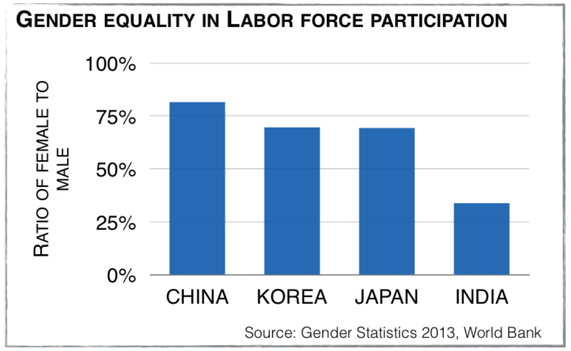


DATA & MESSAGE REDUNDANCY

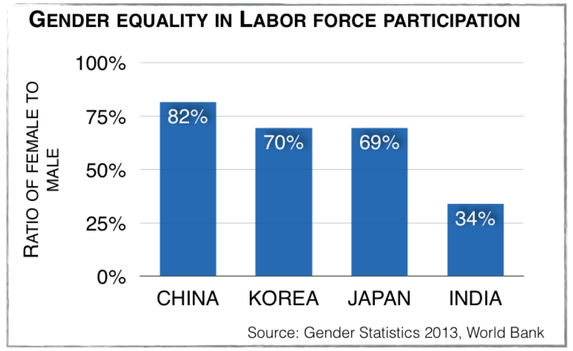
“Targets” (393)

For each visualization:

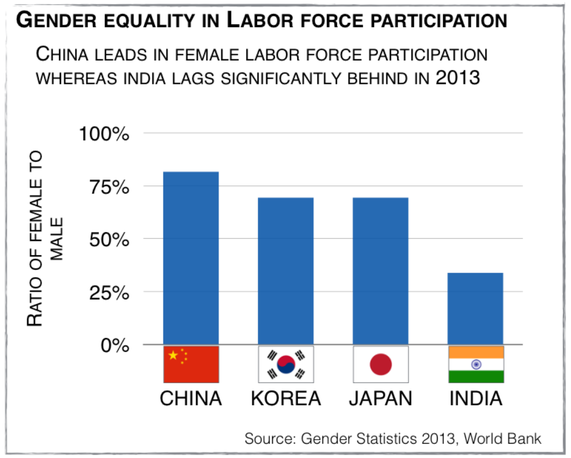
- Labels
- Title transcription
- Data and message redundancy



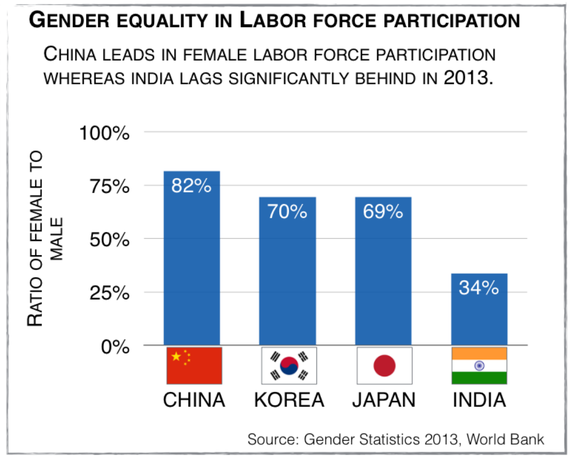
Original



Data Redundancy

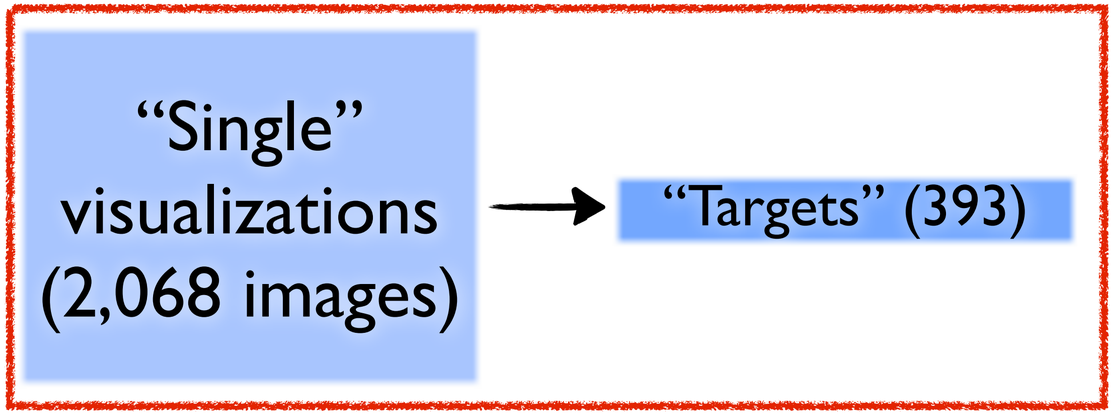


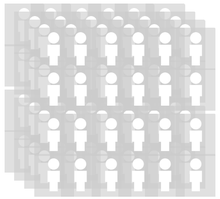
Message Redundancy



Data & Message Redundancy

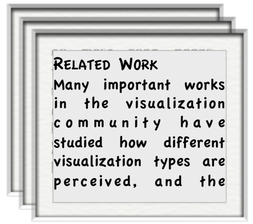
EXPERIMENT





THE EXPERIMENT

THE DATA

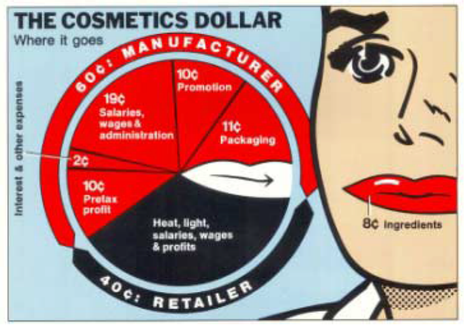


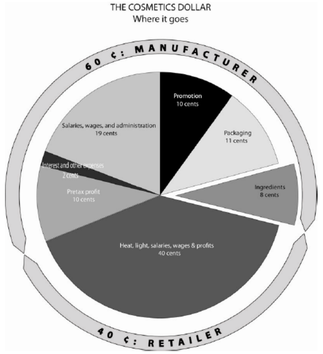
RELATED WORK

RESULTS

Related Work

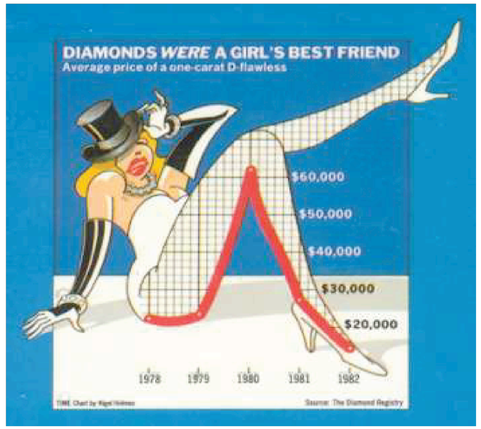
Useful Junk? The Effects of Visual Embellishment on Comprehension and Memorability of Charts





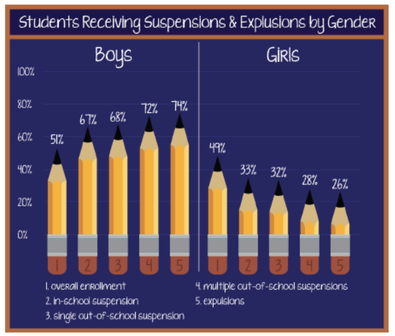
Bateman, et al. (2010)

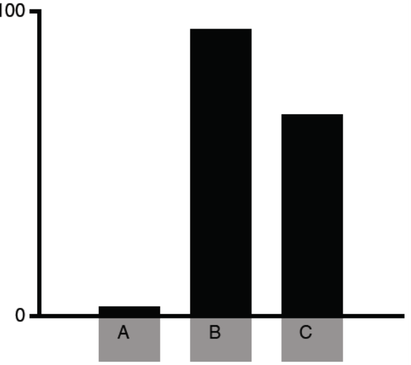
Benefitting InfoVis with Visual Difficulties



Hullman, et al. (2011)

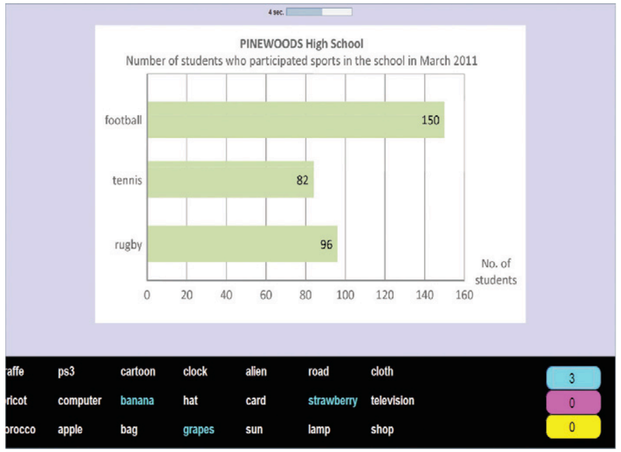
An Evaluation of the Impact of Visual Embellishments in Bar Charts





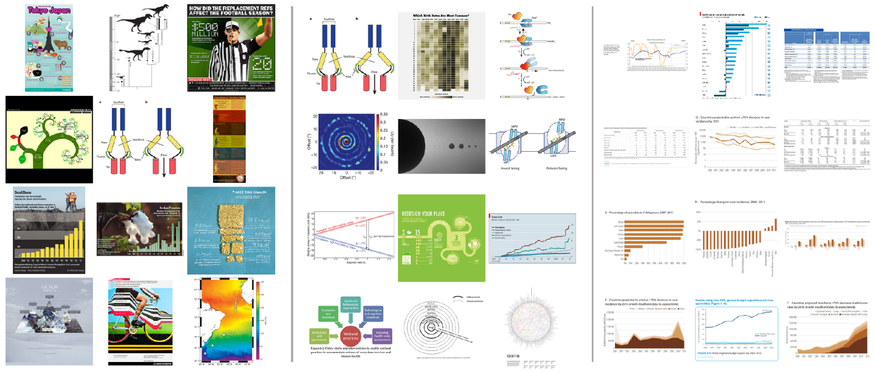
Skau, et al. (2015)

An Empirical Study on Using Visual Embellishments in Visualization



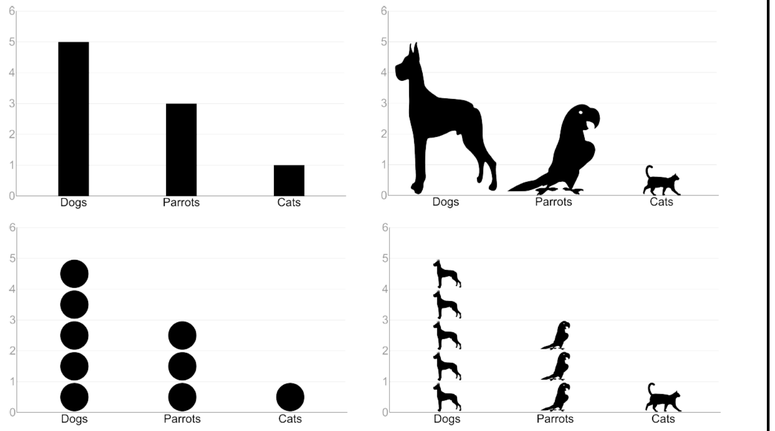
Borgo, et al. (2012)

What makes a visualization memorable?

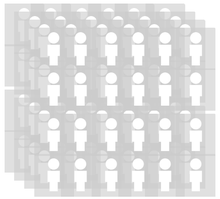


Borkin, et al. (2013)

ISOTYPE Visualization – Working Memory, Performance, and Engagement with Pictographs



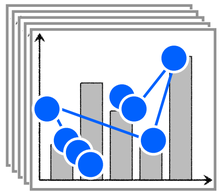
Haroz, et al. (2015)



The Experiment

The Data

Related Work

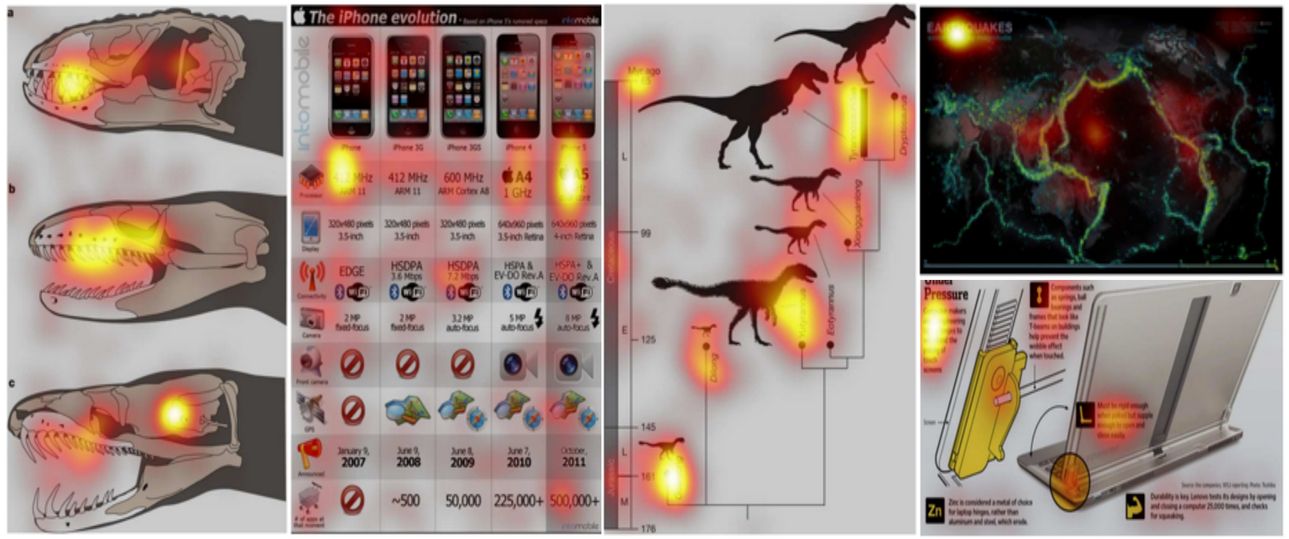


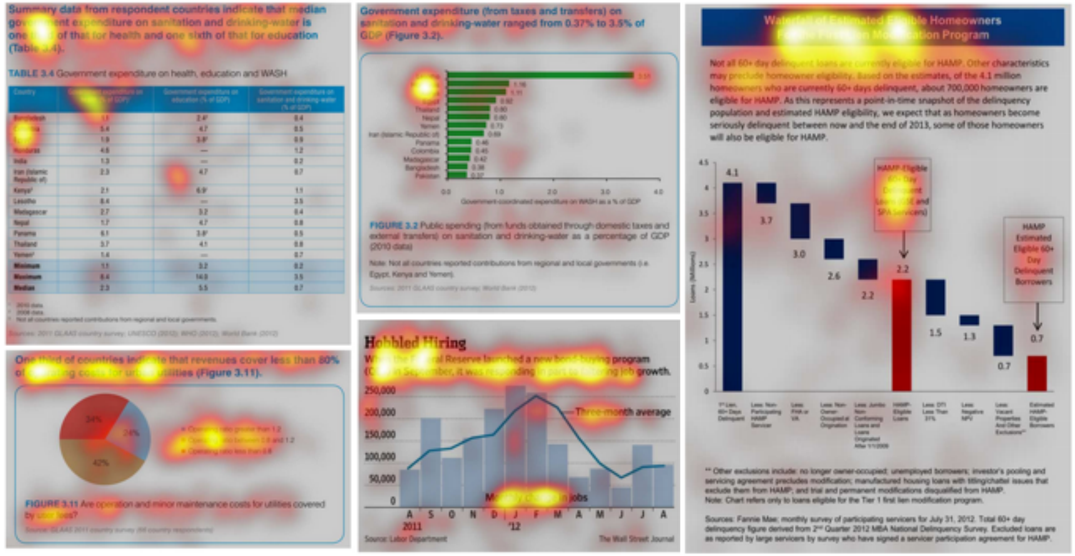
Results

Most Memorable

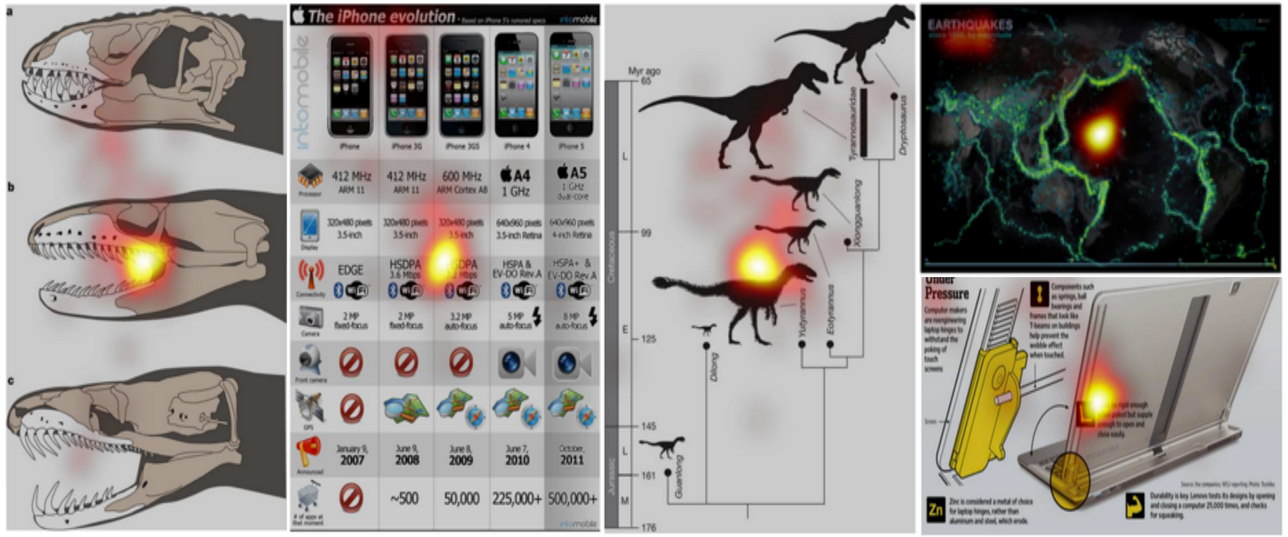
Least Memorable

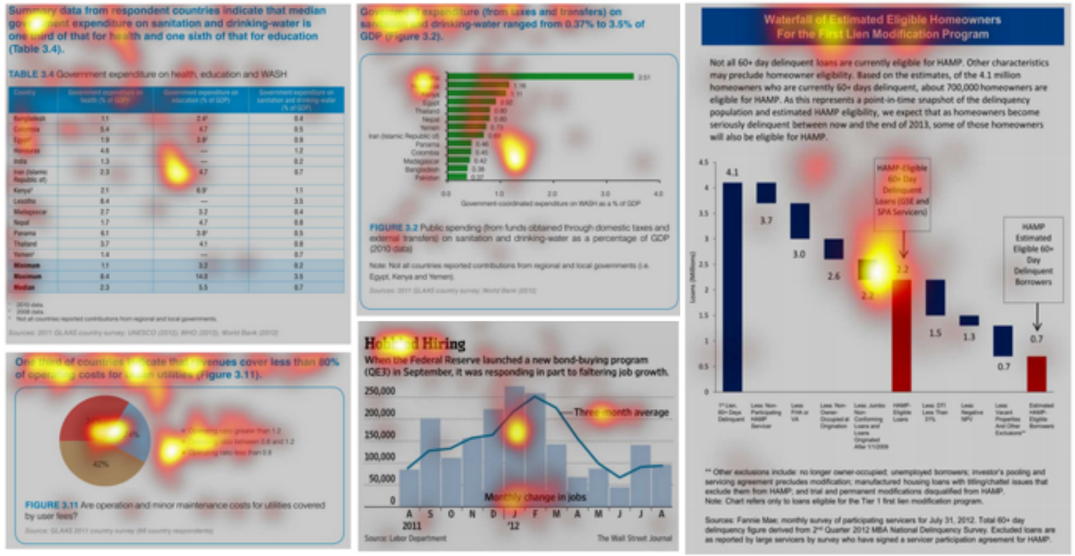
Encoding (10 sec)





Recognition

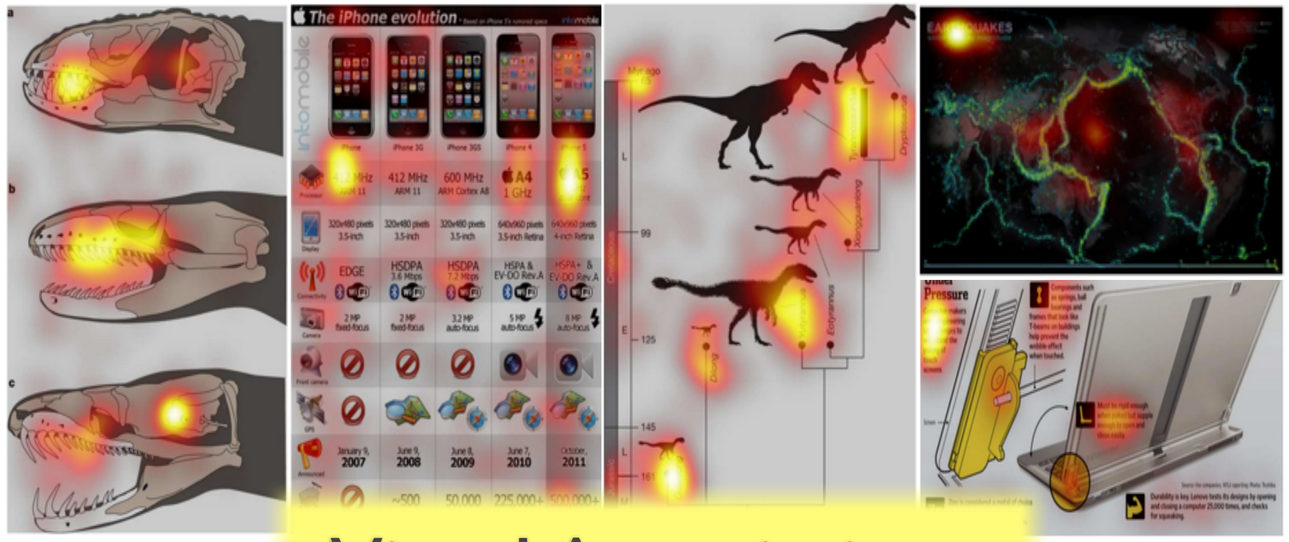


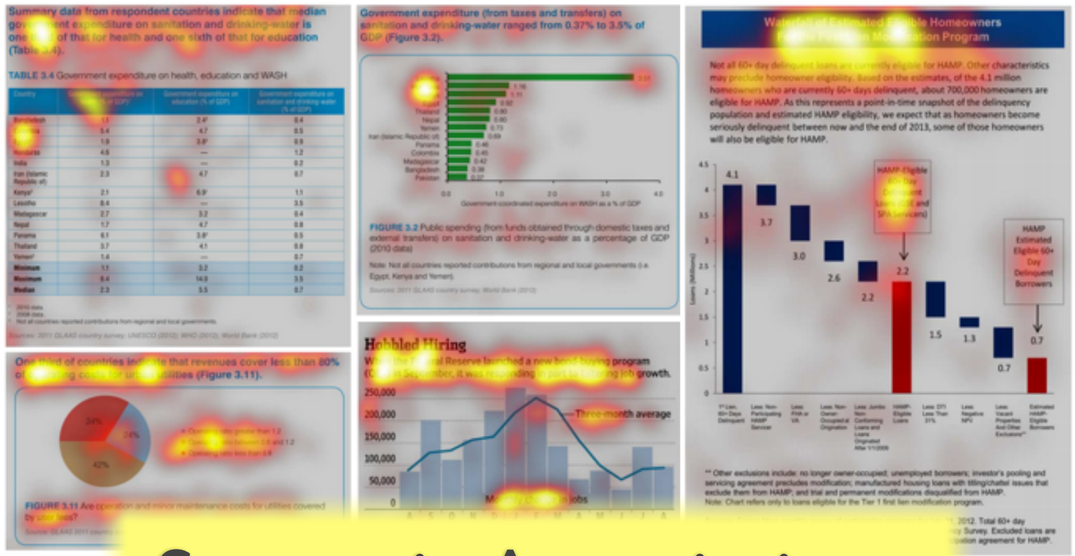


Most Memorable

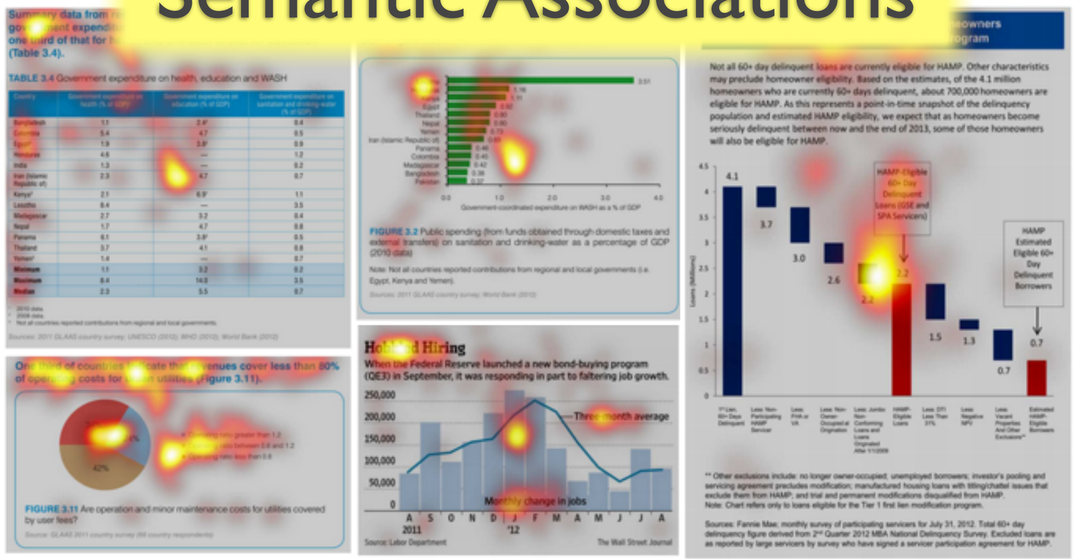
Least Memorable

Encoding (10 sec)





Recognition

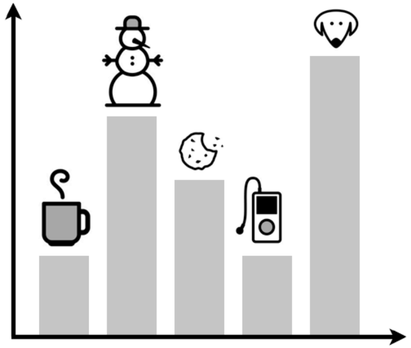


Visual Associations

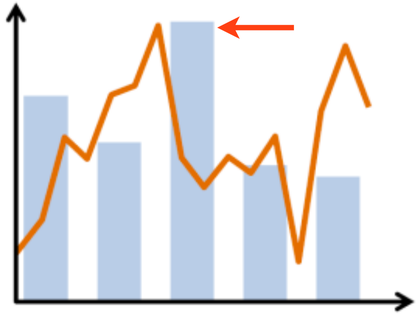
Semantic Associations

Visual Associations

FOR EXAMPLE...



Human Recognizable Objects

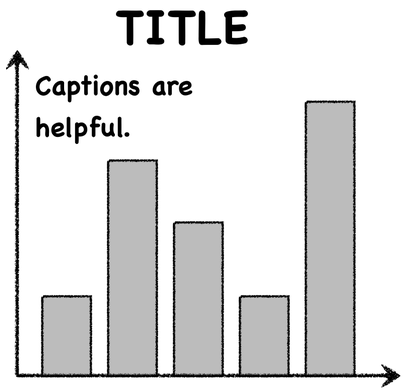


Visual annotations

Visualization/plot

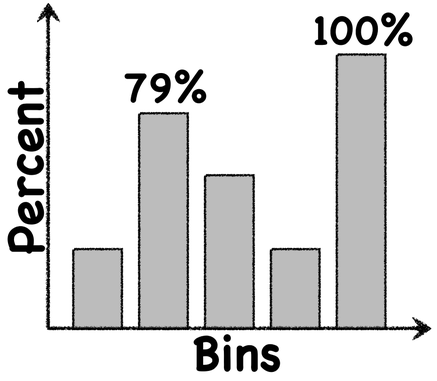
Semantic Associations

FOR EXAMPLE...



Titles

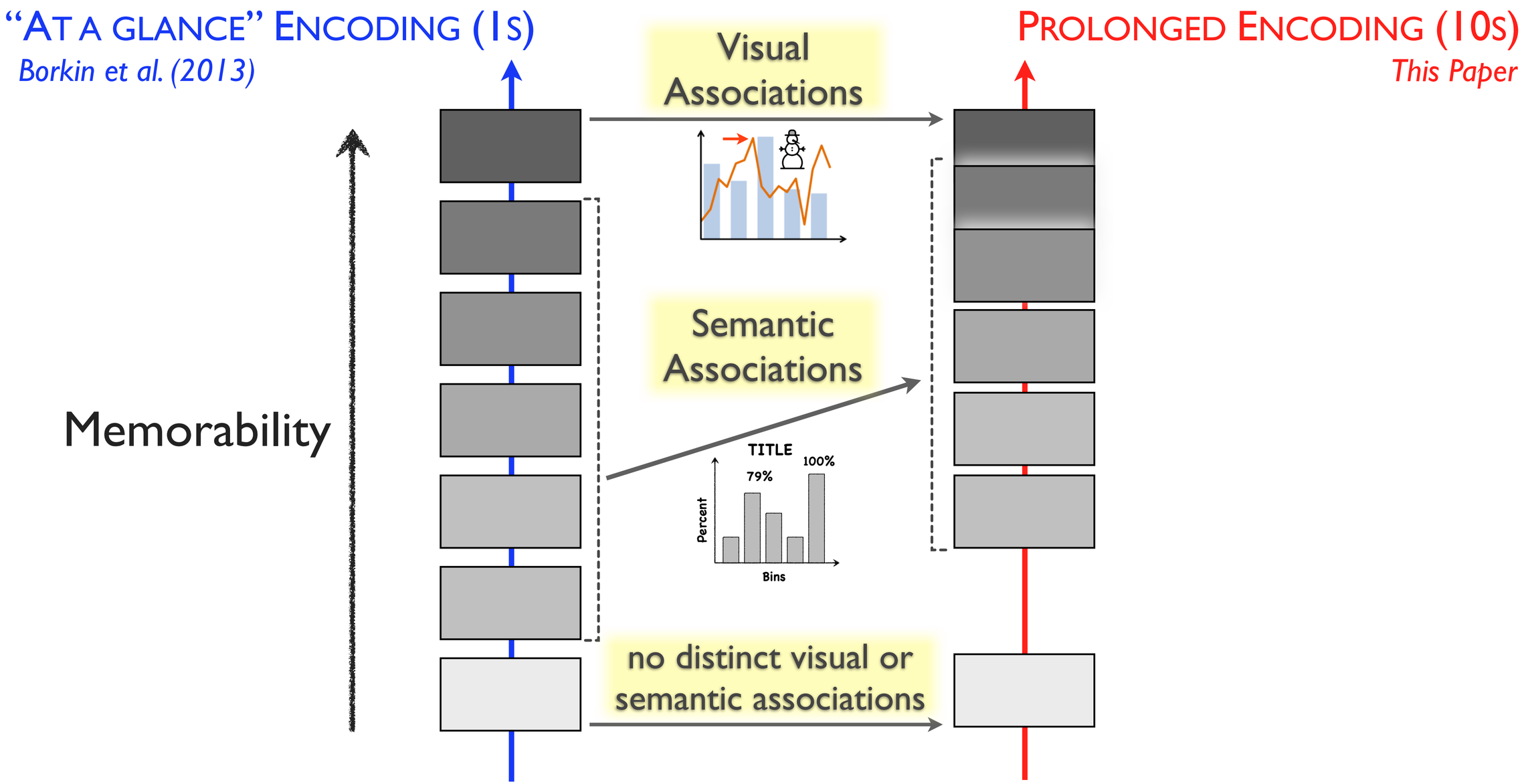
Textual descriptions



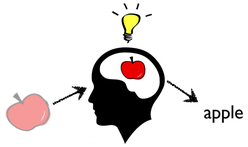
Labels

Axis labels

Recognition



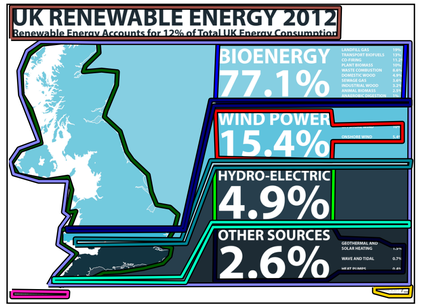
Visualizations ranked by memorability score.



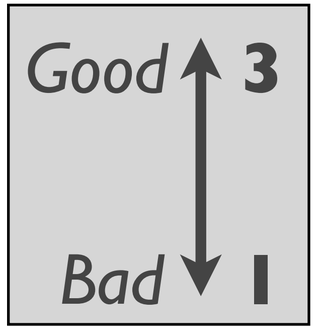
RECALL

"Describe the visualization in as much detail as possible."

FOR ALL 2,773 TEXT DESCRIPTIONS:

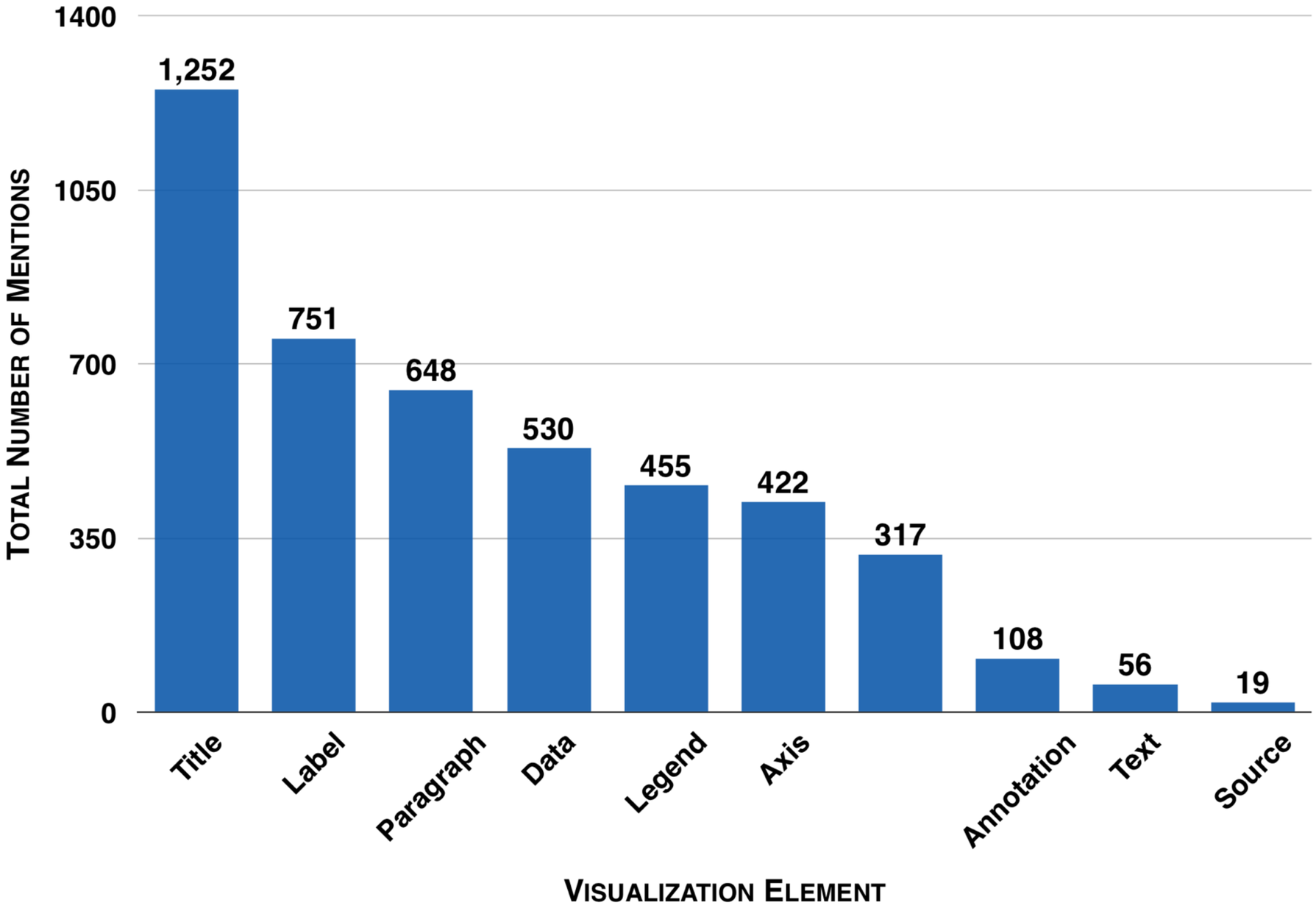


Labels mentioned

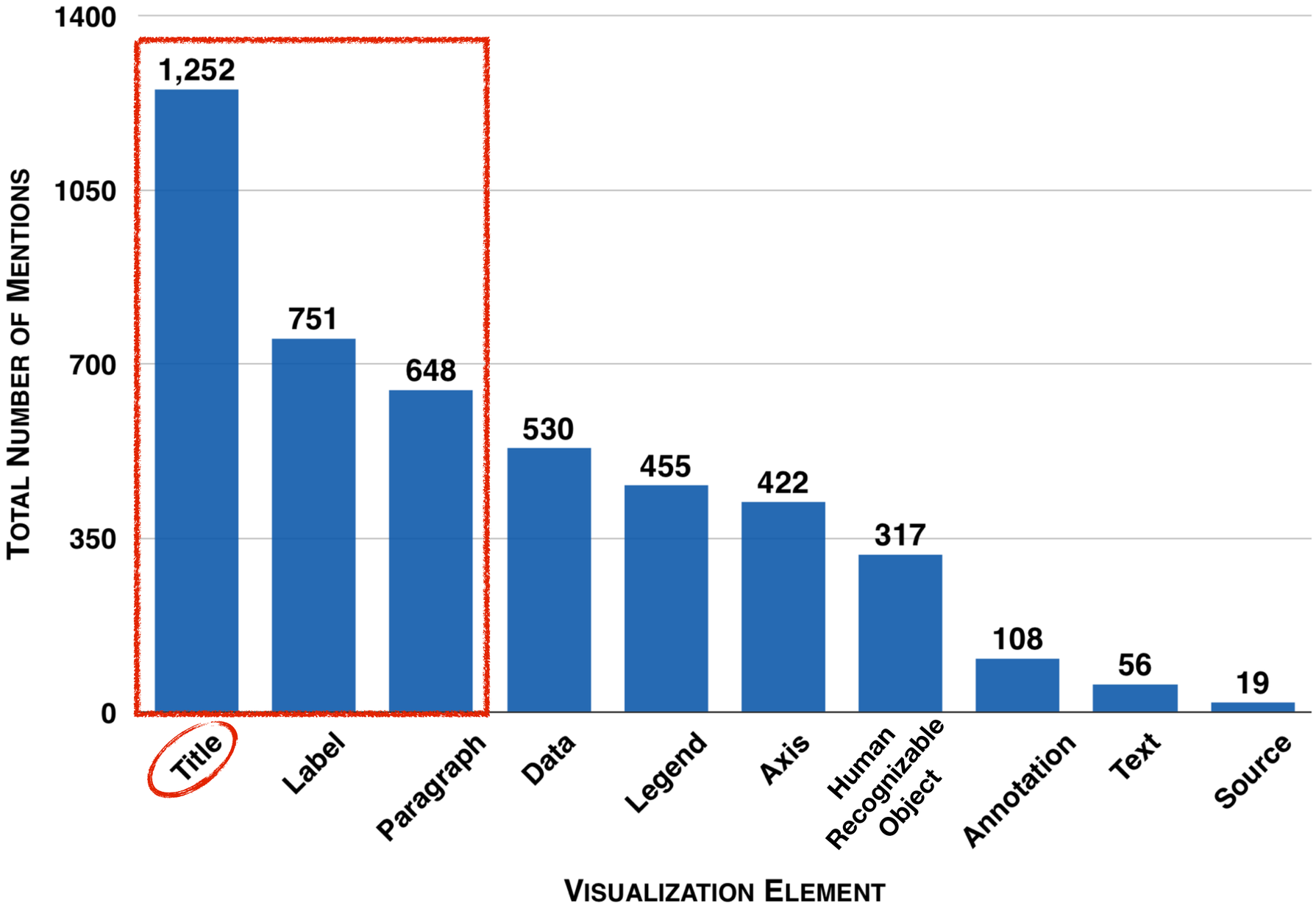


Description quality

Recall


1400
1050
700
350
0
Total Number of Mentions
1,252
751
648
530
455
422
317
108
56
19
Title
Label
Paragraph
Data
Legend
Axis
Annotation
Text
Source
Visualization Element

Recall


1400
1050
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Total Number of Mentions
1,252
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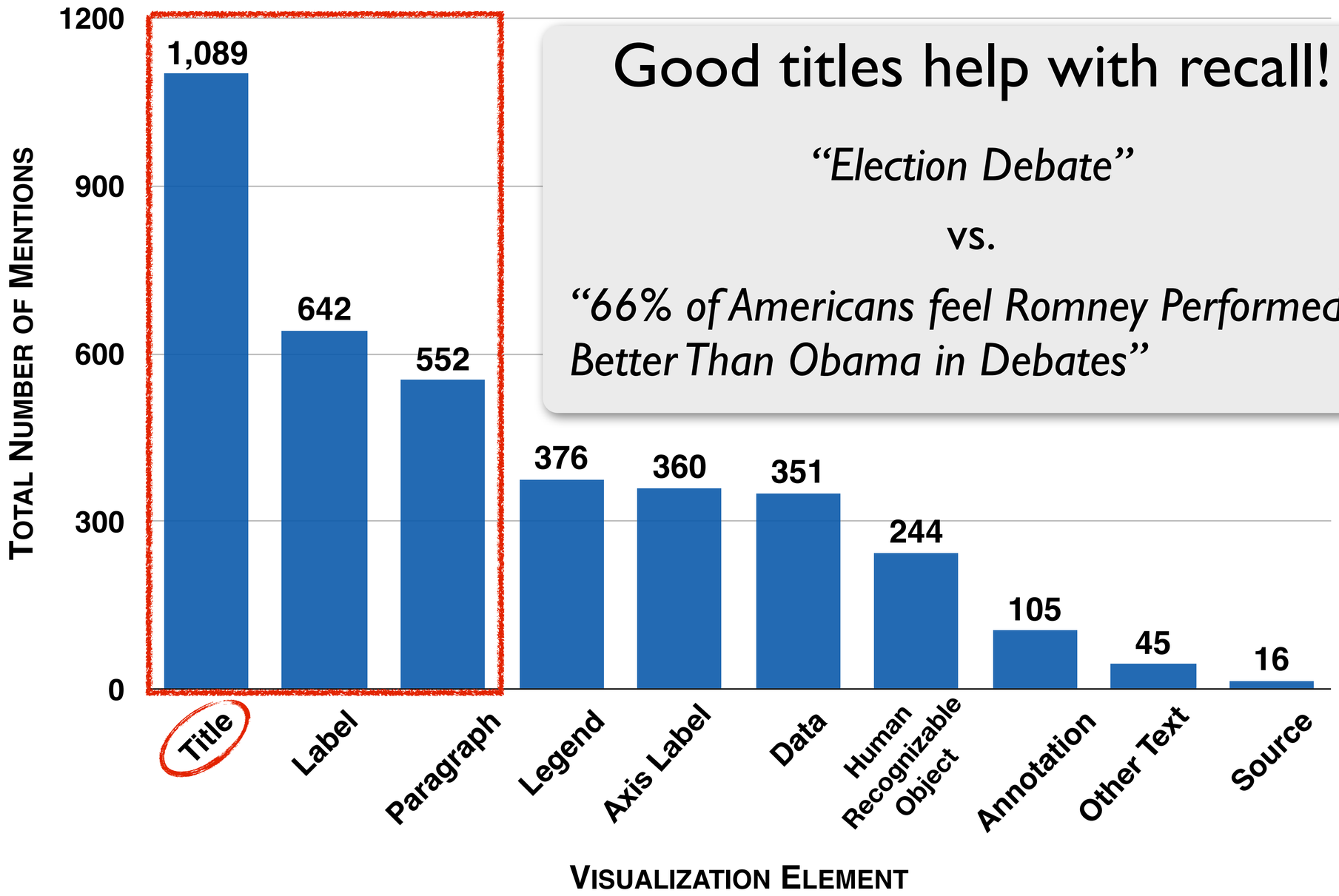
Axis
Human Recognizable Object
Annotation
Text
Source
Visualization Element

RECALL



Good titles help with recall!

"Election Debate"

vs.

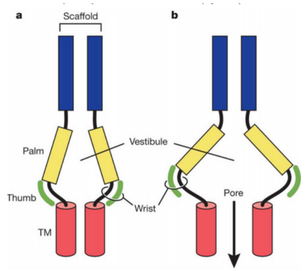
"66% of Americans feel Romney Performed Better Than Obama in Debates"

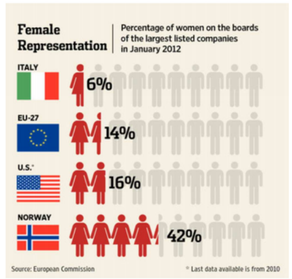
MEMORABLE

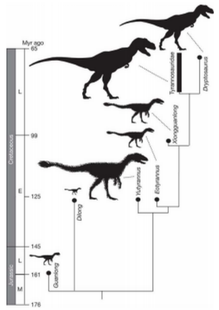
LOW QUALITY DESCRIPTION

HIGH QUALITY DESCRIPTION

FORGETTABLE







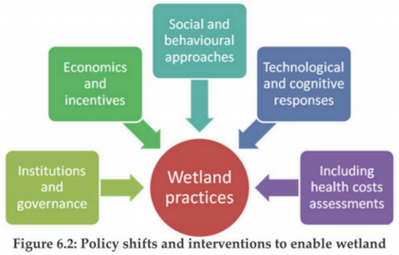
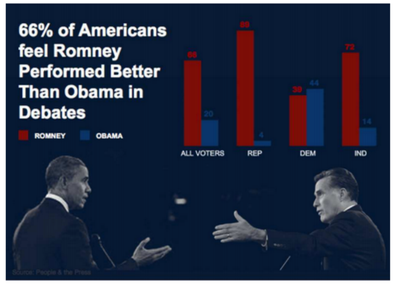
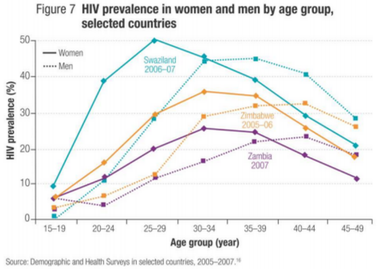
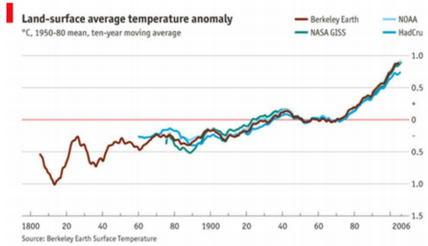
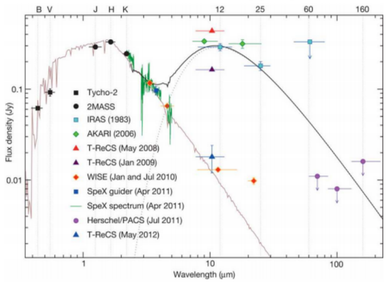


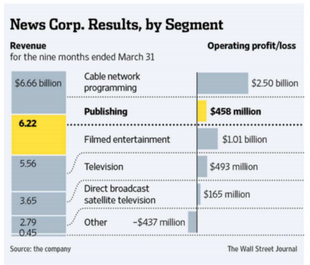
Figure 6.2: Policy shifts and interventions to enable wetland practices to accommodate notions of ecosystem services and human health

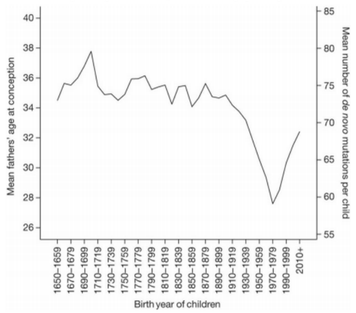


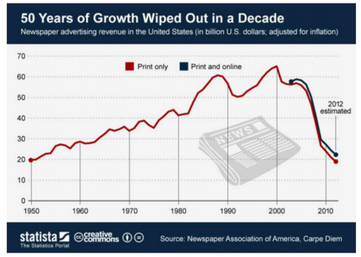


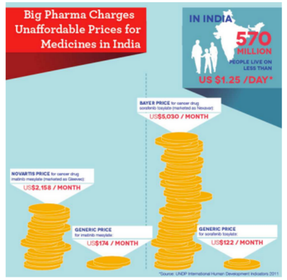


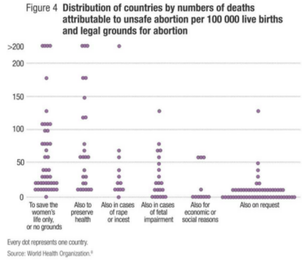








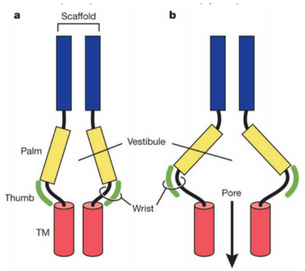


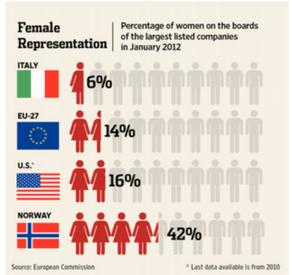


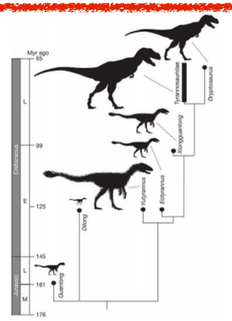
MEMORABLE

LOW QUALITY DESCRIPTION

HIGH QUALITY DESCRIPTION







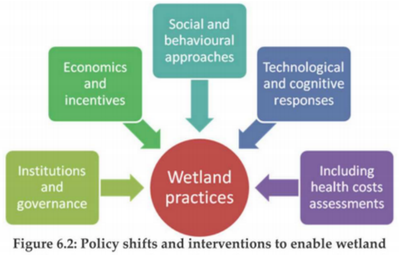
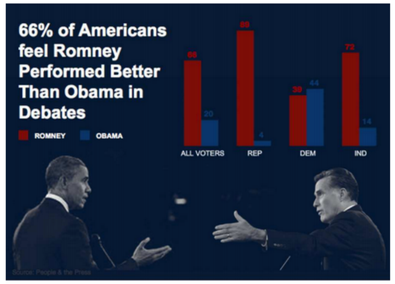
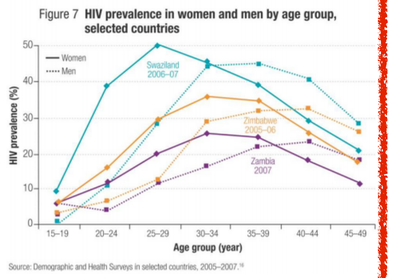
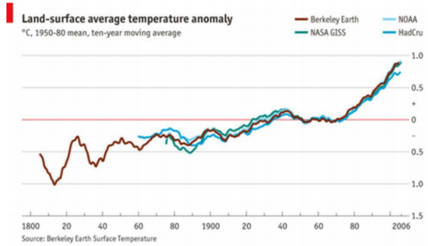
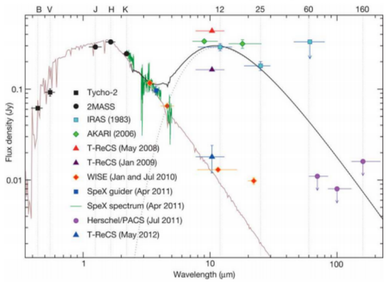


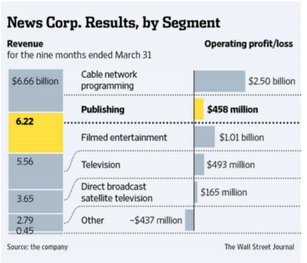
Figure 6.2: Policy shifts and interventions to enable wetland practices to accommodate notions of ecosystem services and human health

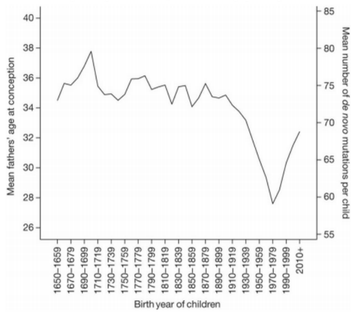


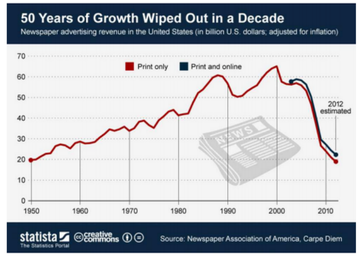


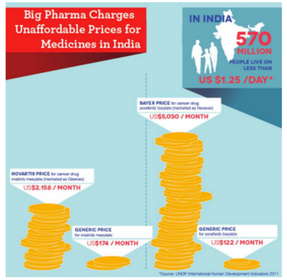


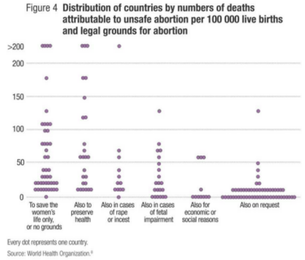












FORGETTABLE

MEMORABLE

"Effective"

Visual Associations

Semantic Associations

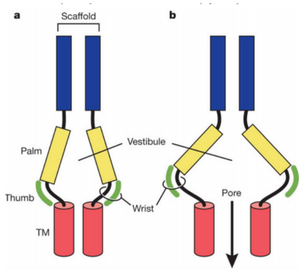
Message redundancy

Data redundancy

Titles/annotations

LOW QUALITY DESCRIPTION

HIGH QUALITY DESCRIPTION



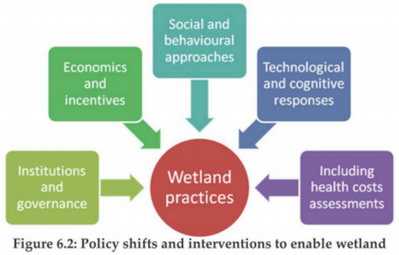
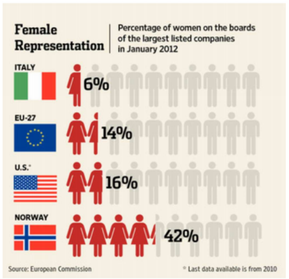
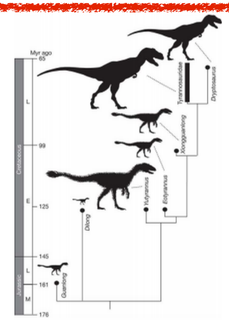
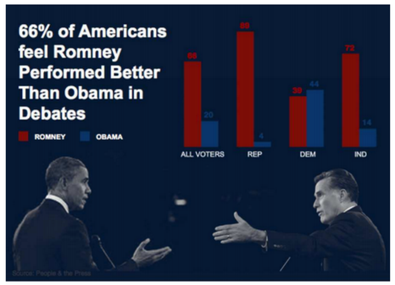
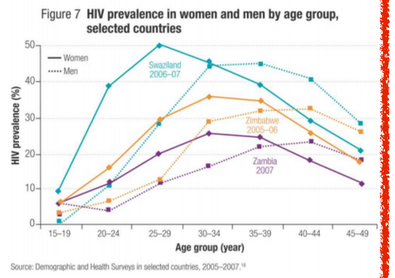


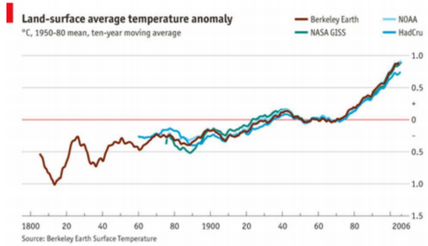
Figure 6.2: Policy shifts and interventions to enable wetland practices to accommodate notions of ecosystem services and human health

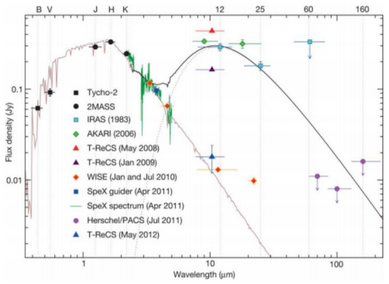


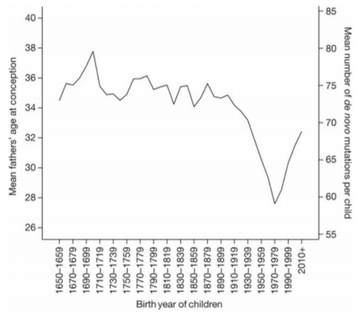


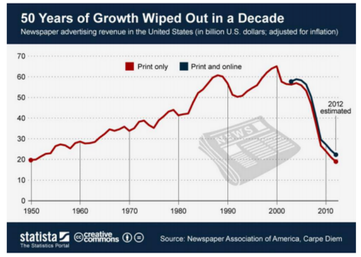


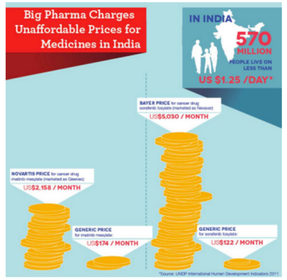


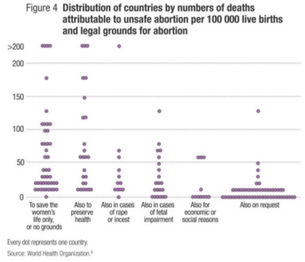








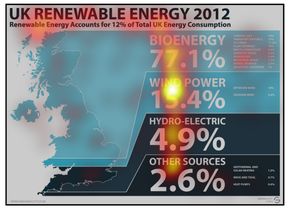




FORGETTABLE

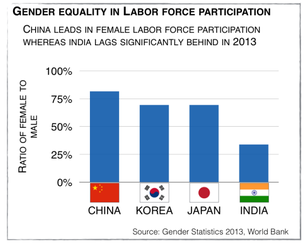
Human Recognizable Objects (HRO)

HROs did not hinder visualization recall



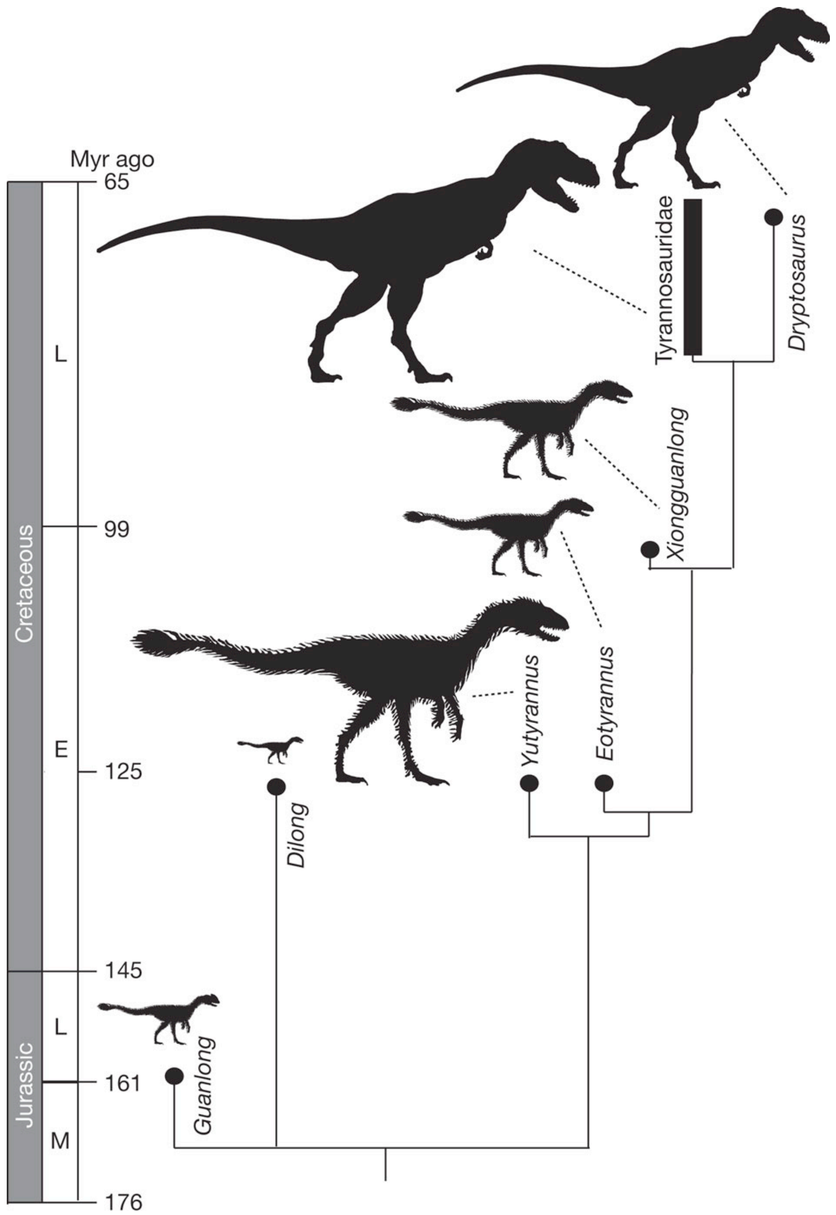
Fixation time least of all visual elements

Recall description quality higher



Message Redundancy

HROs can help with message redundancy



"Evolution from jurassic period to cretaceous T-Rex is towards the top"

"Dinosaur types Tyrannosarae feathered bird-like species development in relation to time"

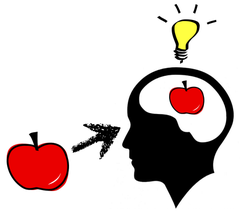
"A clade chart showing evolutionary divergence and relationships between various dinosaurs. Prehistoric time is presented on the left axis."

NOTE: Pictograms can *hurt* visualization understanding

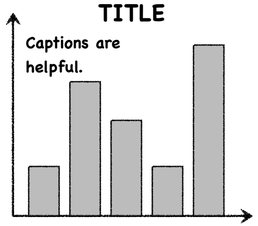
"Had a dinosaur on the top, starbucks"

"Codes started in Japan which also is home to Godzilla."

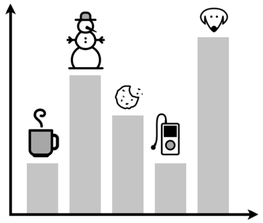
Key Findings



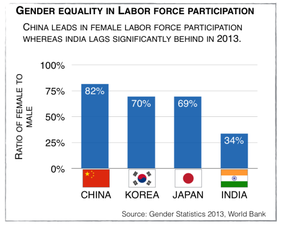
Visualizations that are memorable "at-a-glance" have memorable content.



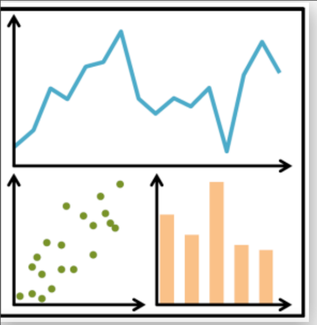
Titles and text are key elements in a visualization and help recall the message.

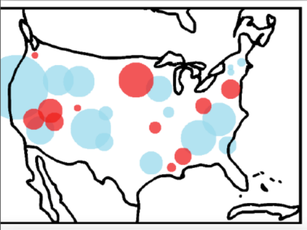


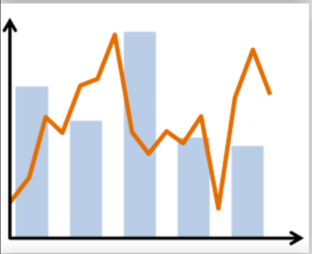
Human recognizable objects (e.g., pictograms) can help with the recognition or recall of a visualization.

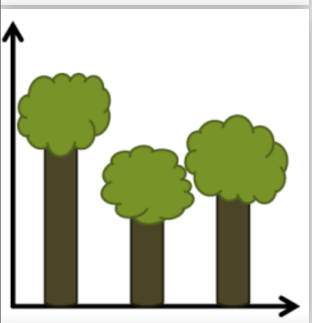


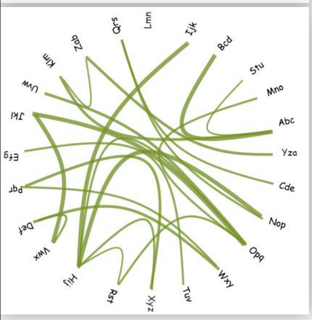
Redundancy helps with visualization recall and understanding.











For more information... and ALL of our data:

MASSVIS DATASET

Massachusetts (Massive) Visualization Dataset

massvis.mit.edu

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