

Please rate the	techniques	according to	o your overall	preference.	
Techniques can have th	e same ratings				
v	ery useless to				Very useful me
Flip Book	0	0	0	0	0
Video Animation	0	0	0	0	0
Staged Animation	0	0	0	0	0

# **Evaluating visualizations**

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RUSTIC: Readable Understandable Supportive Truthful Insightful Communicative

# How do we know if a visualization is successful?

## **Guidance on Evaluation**

- Evaluation means to assure that your design will be successful.
- Do not evaluate for the sake of it. Evaluation is not the end. It should help you "improving" your design, not just "validating".
- Thus, take the critique, and move on.
- It is not a critique of your personal work— it's to assure you're doing the right thing at the right means.

## **Guidance on Evaluation**

- Yes, you can 'over-evaluate':
- i.e., trying to fit your visualization to any specific need
  - This can make your visualization **boring**.
  - Keep some of the energy and creativity and optimize what you want to optimize for – no visualization is ever perfect.

# Why is evaluation hard?

- Visualizations are different
- Humans are different
- Tasks vary
- Pre-knowledge varies
- Visualizations are hardly quantifiable
- When is a visualization successful?

### **Evaluation techniques**



1. Heuristics & Guidelines

## **Guidelines & Heuristics**

- Heuristic: 'self-discovery'
- Guidelines: "general rule, principle, or piece of advice"
  - "Don't use the rainbow colormap"
  - "Optimize data-ink ratio"
  - "Overview first, zoom and filter, details on demand"
- Guidelines are limited.
- Apply on case-to-case basis.

# **Heuristics for visualization**

- **Perception:** Avoid the rainbow color map, Do not use more than 7 colors, Data-ink ratio, ...
- Cognition: Provide organization of material, facilitate overview, use legends, do not decieve, use familiar visualizations, ...
- Usability: maximize effectiveness (i.e., task support), positive satisfaction, ...
- Interaction: Orientation & help, navigation & querying...

The **RUSTIC** principle

# An efficient figure / visualization is ...

- Readable: does it allow for correct perception of information and provides access to all information I need to understand the data?
- Understandable: does it allow reasoning about the phenomena?
- **Supportive:** does it allow solving tasks?
- **Truthful:** is it showing data correctly?
- Insightful: does it provide meaningful insights for the viewer to solve their problem?
- **Communicative:** does it support clear communication?

## Readability

### Resolution





Size

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Pellentesque sollicitudin ipsum elit, et vestibulum nisl dictum et. Sed lobortis molestie felis. Praesent et ligula commodo magna fringilla egestas. Nam nec risus in magna facilisis sollicitudin nec et metus. Sed tincidunt dapibus lacus in viverra. Donec gravida finibus metus eget semper. In nec mauris

### Readability

### **Overlapping labels**

### Small labels





### Readability: Colorblindness

www.color-blindness.com



### Readability: Redundant encoding



### Understandability

### **Missing legends**

### Unknown visualizations



### Supportive: is it supporting my tasks?



**Figure 6.3** On which of these maps is it easier to identify the number of factories of each kind?

### Supportive: is it supporting my task?

### Appropriate for data



### Truthful

### Deceptitive

### Deceptive



#### **Effectiveness of Allergy Medicines**



### Truthful



# Insightful

- Does it support new information?
- Does it surprise?
- Does it help making decisions?
- Is it showing the right things?



Plaisant, Catherine, et al. "LifeLines: using visualization to enhance navigation and analysis of patient records." *The craft of information visualization*. Morgan Kaufmann, 2003. 308-312.

## Communicative

- Is the visualization ready for "first contact"?
- Are visualizations and visual encodings explained?
- Are key messages highlighted?
- Is the visualization "attractive", e.g., does it invite to observation?
- Is the visualization clearly structured?
- Is context and take-home message clear?

### **Communicative:** Titles & Explanations



### Communicative: Data ink ratio





# Communicative: Highlight

### Top 10 design concerns

Engine power is less than expectedTires make excessive noise while drivingEngine makes abnormal/excessive noiseSeat material concernsSeat material concernsExcessive wind noiseHesitation or delay when shiftingBluetooth system has poor sound qualitySteering system/wheel has too much playBluetooth system is difficult to useFront seat audio/entertainment/navigation controls

FIGURE 4.9 Create a visual hierarchy of information

concerns per 1,000 12.9 12.3 11.6 11.6 11.0 10.3 10.0 8.8

Comments indicate that **noisy tire issues** are most apparent **in the rain**.

Complaints about **engine noise** commonly cited **after the car had not been driven for a while**.

Excessive **wind noise** is noted primarily in **freeway driving at high speeds**.

### **Communicative:** Text + Picture

physical social political and economic structures. of a region can place residents at varying risks for vulnerability. Areas susceptible to violence or natural disaster pose clear threats to individuals. An individual's environment also affects his or her development and behavioral choices. Resources available in the physical and social environments create the contexts within which decisions are made about health, education, and employment. Political and social environments also dictate whether resources are accessible to all adolescents. An examination of the residential distribution of adolescents provides a baseline for comparing geographical patterns of vulnerability. Within Uganda, by type of residence, the majority of adolescents (87 percent) live in rural versus urban areas. Figure 6 shows the distribution of adolescents aged 10 to 19 living in Uganda. Regional distributions show Karamoja contains only four percent of the adolescent population. Kampala with a much denser population contains 4.6 percent of the population. The Eastern and Western regions contain the largest proportions of the adolescent population.



#### Household factors influencing vulnerability

Household-level factors have direct impacts on the well-being of adolescents. Households are the primary setting where adolescents live and engage in activities. For this reason, the household environment and the people who live there have significant impacts on the lives of adolescents. Physical conditions of the home influence the health of residents. Family structures and demographic characteristics of household members affect the knowledge, decisions, behaviors and interactions in the environment of the adolescent.

#### Access to improved water sources and sanitation

Unsafe water, inadequate sanitation, and poor hygiene are among the five leading risk factors responsible for one quarter of all deaths in the world (WHO 2009). Unsafe water supplies and inadequate sanitation in homes increase exposure to water-borne diseases and can cause diarrhea. Ensuring access to clean water sources and sanitation is key to maintaining hygiene and health. Improved water sources are those that either naturally protect water from contamination or are constructed to do so. These include piped water, public taps. standpipes, boreholes, tube wells, protected wells and springs and rainwater collection. Improved sanitation includes constructs and systems that prevent fecal contamination. These include flush or pour toilets, ventilated pit latrines, pit latrines with slabs, and composting toilets (UNICEF 2013b).

Housing conditions across East and Southern Africa are largely in need of improvement, and lack of improved sanitation varies by country. In nearly all of East and Southern Africa, over half of adolescents either do not have improved sanitation or share facilities with other households. Conditions are worst in Madagascar and Mozambigue where fewer than four percent of adolescents live in households with improved sanitation that is not shared (Figure 7). Rwanda has the lowest proportion of adolescents affected-35 percent-which is still unacceptably high. Lack of access to improved water sources affects lower proportions but is still a problem in the region. In five countries, fewer than half of adolescents have access to improved water sources (Figure 8). Water conditions are best in Namibia, where only 15 percent of adolescents have no access to improved water.

In Uganda, overall access to improved water and sanitation increased by a small but significant percentage between 2006 and 2011 (Figure 9). In 2006, 33 percent of adolescents had no access to improved water; in 2011, it is 30 percent. The proportion of adolescents without access to improved

#### FIGURE 7

PERCENT OF ADOLESCENTS AGED 10-19 LIVING IN HOUSEHOLDS WITH NO IMPROVED OR WITH SHARED SANITATION, EAST AND SOUTHERN AFRICA



#### FIGURE 8

PERCENT OF ADOLESCENTS AGED 10-19 LIVING IN HOUSEHOLDS WITH NO IMPROVED WATER SOURCE, EAST AND SOUTHERN AFRICA



#### FIGURE 9

PERCENT OF ADOLESCENTS AGED 10-19 LIVING IN HOUSEHOLDS WITHOUT ACCESS TO IMPROVED WATER AND WITHOUT ACCESS TO IMPROVED OR WITH SHARED SANITATION, IN UGANDA, BY REGION, 2006 AND 2011





40 60 80 100

Source: DHS 2006 and 2011

Note: Changes to the geographic boundaries were made to the North region in the 2011 DHS. The 2006 DHS North region is now divided into the North and Karamoja. For this reason, rates for 2006 are not shown for the North since it is not comparable and Karamoja was not identified in the previous survey.

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# 2. Case Studies

### **Case studies**

- Can my visualization solve a given **problem**?
- Define **tasks** that an analyst/audience wants to solve
- Find a good data **example**
- Show how to solve these tasks:
  - screenshots + explanations
- **Convince** yourself, your reader, and your skeptics



# 3. Subjective User feedback

### **Observations**

- Provide users with precise **tasks**
- **Explain** your study
- **Explain** your visualization
- Let your participants **solve** the tasks
- **Record** responses
  - Think aloud (+video)
  - Notes
  - Questionnaires
- Collect:
  - Demographics
  - Rankings / ratings
  - Specific feedback to questions
  - Open feedback

### Questionnaires: Google forms

- Demographics
- Preferences
- Rankings

Please rate the techniques according to your overall preference.							
Techniques can have	ve the same ratings						
	Very useless to				Very useful me		
Flip Book	0	0	0	0	0		
Video Animation	$\bigcirc$	0	$\bigcirc$	0	$\bigcirc$		
Staged Animation	0	0	$\bigcirc$	$\bigcirc$	0		

RESPONSES 6

### <u>Questionaire</u> - Experiment on Dynamic Graph Transitions

Thank you for participating in our experiment. Please answer this questionaire in order to give us valuable feedback. You have the opportunity to add comments at the end of the questionaire. We are happy to cite your comments, which happens anonymously. Feel free to give us any feed back you like.

#### Please enter the ID you got at the experiment. \*

Short-answer text

#### Personal questions

Description (optional)

#### Your age

Short-answer text

#### Gender

Female

O Male

N

#### Do you or have you worked with graphs visualizations before?

	1	2	3	4	5	
lot at all	0	0	0	0	0	Almost Daily

### Questionnaires: Google forms

- Ask for **background** and **expertise**
- **Demographics** if necessary
- Pose very **specific questions**:
  - "how hard was it to understand X."
  - How confident were you doing X?
  - Did X help solving Y?
- Likert scales 1-5 points
- Ask for positive and negative feedback
- Leave space for **open comments**

# 4. Objective Measurements



### **Controlled user studies:**

- Collect quantitative data about **performance**
- Define **hypotheses**
- Define **conditions** under which to test
- Define precise **tasks**
- Control for data, context, task, ...
- **Record**, e.g.,
  - Time users take
  - Errors they make
- Analyze results: Means, medians, pair-wise comparison..



### **Controlled user studies:**



Immersive AR

Desktop

Tablet AR

### **Controlled user studies:**



### **Evaluation techniques**



### **Open Issues in Evaluation**

- Measuring task difficulty & task **taxonomies**
- Train participants
- Defining when a visualization is 'successful'
- Find examples of true insights
- Measure visualizations **in-the-wild**.
- Measuring user **experience**

### **Further readings**

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