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CHANGE THE WORLD FROM HERE

Reflecting on Visualization for Cyber Security

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INTRODUCTION

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Introduction

- Short position paper
- Result of brainstorming session
  - Identify future research directions
  - Suggest approaches for future research
- Designed to encourage discussion

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Brainstorming

- Why has visualization not been more successful in cyber security?
- How can visualization be used effectively for cyber security?
- How do you evaluate visualization for cyber security?

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Motivation

- Success is important
  - Extensive resources required to develop, evaluate, and iterate visualizations
- Success is evasive
  - Avoid common pitfalls
  - Choose a suitable visualization goal
- Success is fuzzy
  - Accuracy and efficiency hard to evaluate

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COMMON PITFALLS

What Should We Avoid?

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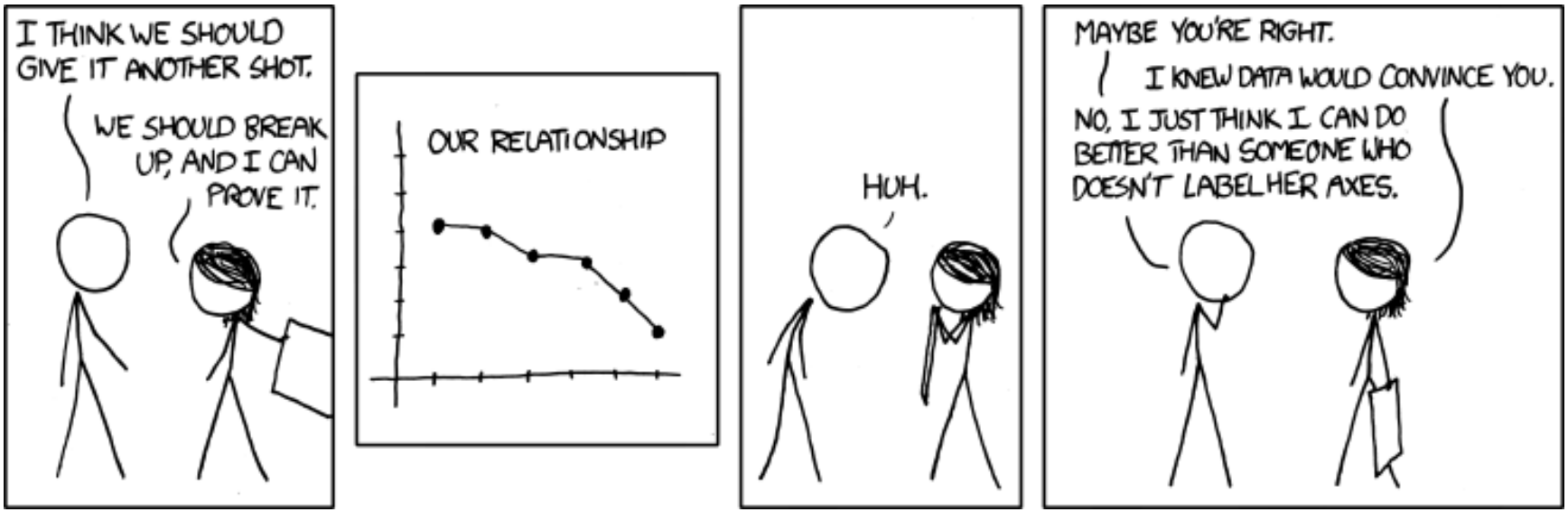
XKCD: Convincing



http://xkcd.com/833/

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Using visualization for the wrong reasons.

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Using visualization for the sake of visualization.

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Visualization Goals

- Statistical Graphics
  – Accuracy, Informative
- Informative Art/Visualization Art
  – Aesthetics
- Infographics
  – Aesthetics, Informative
- Information Visualization
  – Accuracy, Informative, Aesthetics

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Pretty Pictures ≠ InfoVis

- Avoid by specifying a question or goal first
- Do NOT get distracted by fancy encodings
- Do NOT get distracted by novel techniques
- Start with existing and well-tested techniques
- Try state-of-the-art or novel approaches when other techniques fail to perform well

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Visualization is not a magic bullet.

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Goldilocks Principle

http://w8r.com/the-colorful-story-book/the-three-bears

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Goldilocks Principle

- Too Simple Problems
  - Do not need visualization
- Too Complex Problems
  - Rename "too undefined"
  - Part of the solution, but not THE solution
- Problem must be "just right"
  - Need good data *and* good problems

http://w8r.com/the-colorful-story-book/the-three-bears

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USE CASES

What Could We Try?

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Use Cases

- Visualization for a Specific Goal
- Visualization for Exploration
- Visualization as a Stepping Stone
- Visualization for Evaluation
- Visualization as Evidence

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Visualization for a Specific Goal

- Must be accurate and informative
- Must support data analysis
  - Anomaly detection flags event as anomalous, but unknown whether is malicious
  - Use visualization to help resolve this grey area on case-by-case basis
- All other cases are subcases of this one

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Visualization for Exploration

- Sometimes not having a well-formed question is the problem!
- Use visualization to explore data, provide context, and help form questions
- More difficult to evaluate, may lose usefulness after question is formed

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Visualization as a Stepping Stone

- Use visualization as a stepping stone in analysis
  - Guide root cause analysis in a complex environment
- Neither the starting point or ending point
  - Does not provide the question
  - Does not provide the answer
- Provides context, more exploratory in nature

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Visualization for Evaluation

- Aid evaluation of security mechanisms
  - Mechanisms must support complex policies
  - Multiple mechanisms protecting resources
  - Difficult to configure and maintain
- Does not replace mechanisms, only improves usage of those mechanisms

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Visualization as Evidence

- Justification for response to cyber threat
  - A security analyst may need to justify changes to infrastructure to decision makers
- Illustrate evidence of an attack
  - Presenting forensic evidence to a jury
- More focused on story-telling than analysis

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EVALUATION

How Do We Know What Works?

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Evaluation

- Evaluation focused on visualization
  - Focus in visualization community (85%)
  - Focus on pushing boundaries of visualization
- Evaluation focused on data analysis process
  - Focus on application of visualization
  - Less research on this type of evaluation
  - Important for cyber security visualization

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User Performance Evaluation

- Large study
  - Cannot require expert knowledge
  - Simple and measurable tasks
  - Possible for realistic cyber security tasks?
- Small study
  - Require domain experts
  - More complex but still measurable tasks
  - Applicability of results to other environments?

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User Experience Evaluation

- Recruitment still an issue
  - Release visualization for anyone to use
  - Track adoption rate
  - Solicit feedback from users
- Usually requires expert users
  - Must use tool in environment for specific task
  - Usage often needs to be measured over time

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Process Evaluation

- Focused less on techniques, more on tools
  - Techniques broadly applicable
  - Tools must be evaluated within context used
- Focus on understanding environment
  - Independent of any visualization tools
- Focus on visual data analysis process
  - Dependent of visualization tools in use

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Environment Evaluation

- Perform evaluation as a precursor to building visualization tool
  – Help identify problem and visualization goal
- Evaluate how existing tools are used
  – Identify how to improve or supplement tools
- Data collected via field or lab observation, surveys, or interviews

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Analysis Process Evaluation

- How well tool supports data exploration and knowledge discovery
- How well tool allows analyst to generate hypotheses and make decisions
- Often conducted via case studies
  - Target set of actual users
  - Realistic needs
  - Realistic evaluation

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CONCLUSION

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XKCD: The Important Field

http://xkcd.com/970/

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Conclusion

- Short, position paper reflecting on cyber security visualization
- Brainstorming on what to avoid, what to try, and how to evaluate future research
- Highlights importance of the cyber security problem and visualization goal
- Designed to be part of a discussion

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THE END

Questions, Comments, or Discussion?

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