Visualization Challenges, Past & Future

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http://www.cs.ubc.ca/~tmm/talks.html#gi21

@tamaramunzner

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http://www.cs.ubc.ca/~tmm/talks.html#gi21

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Visualization Challenges, Past & Future

Past research: Four themes

technique-driven work ↔ problem-driven work

theoretical foundations
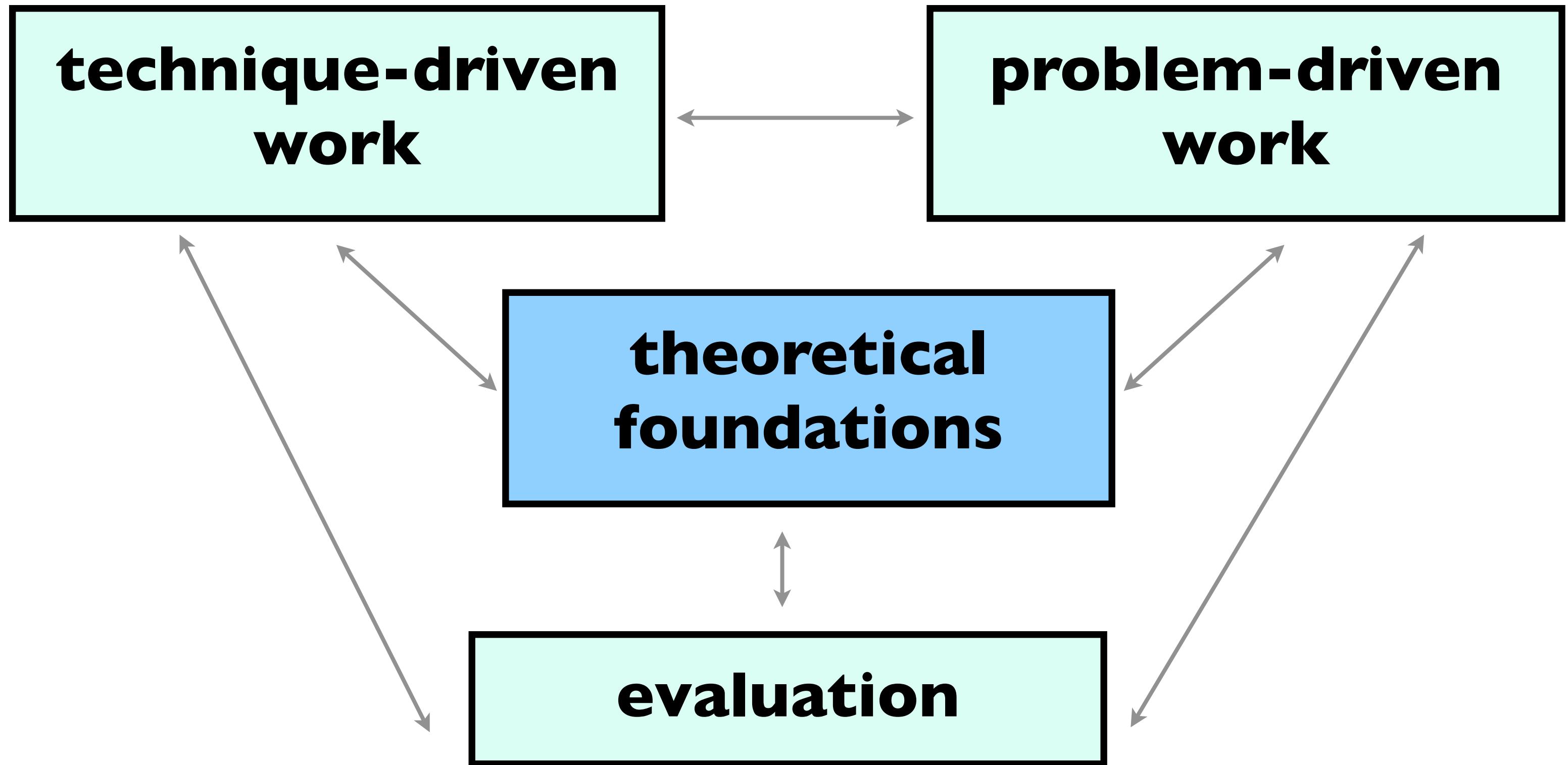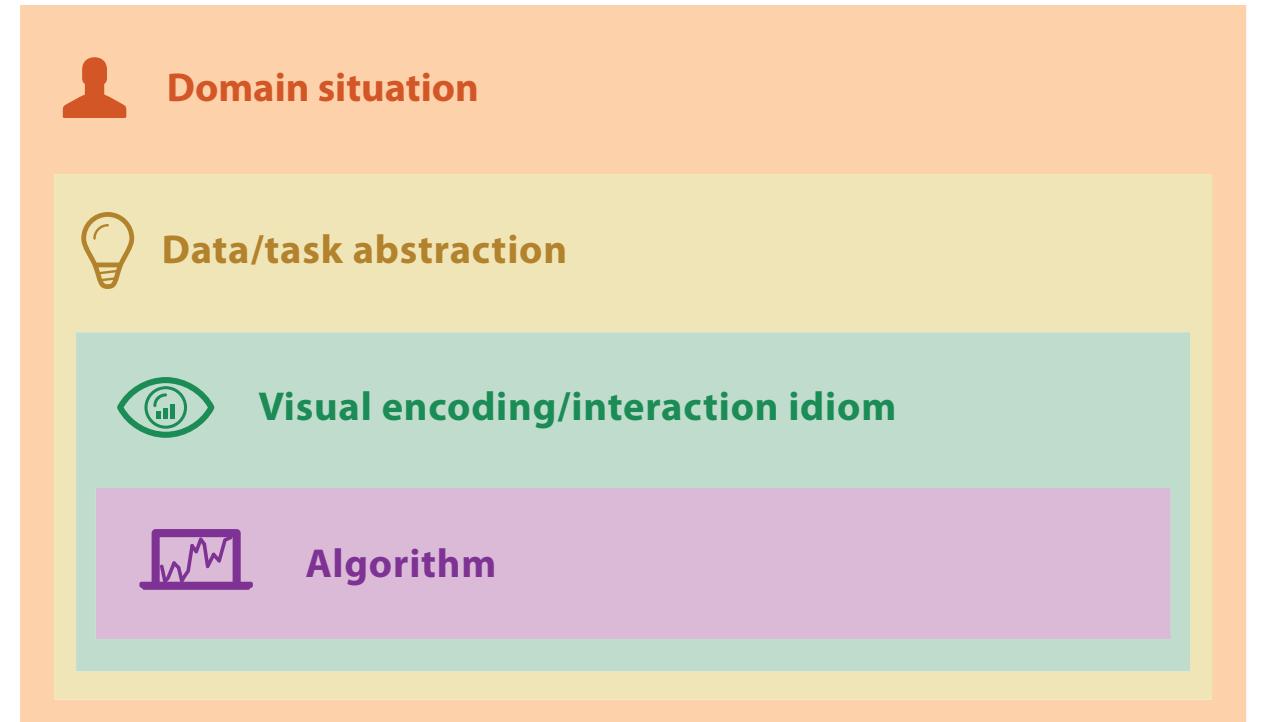
evaluation

A Nested Model

for Visualization Design and Validation

http://www.cs.ubc.ca/labs/imager/tr/2009/NestedModel

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Challenge: Thinking systematically about evaluation

- how to do it myself?
- how to teach other people about doing it?
- so very very many methods!
  - when to pick which one??

Analysis framework: Four levels, three questions

- *domain* situation

  – who are the target users?

- *abstraction*

  – translate from specifics of domain to vocabulary of vis

  - **what** is shown? **data abstraction**

  - **why** is the user looking at it? **task abstraction**

- *idiom*

  - **how** is it shown?

    - **visual encoding idiom**: how to draw

    - **interaction idiom**: how to manipulate

- *algorithm*

  – efficient computation
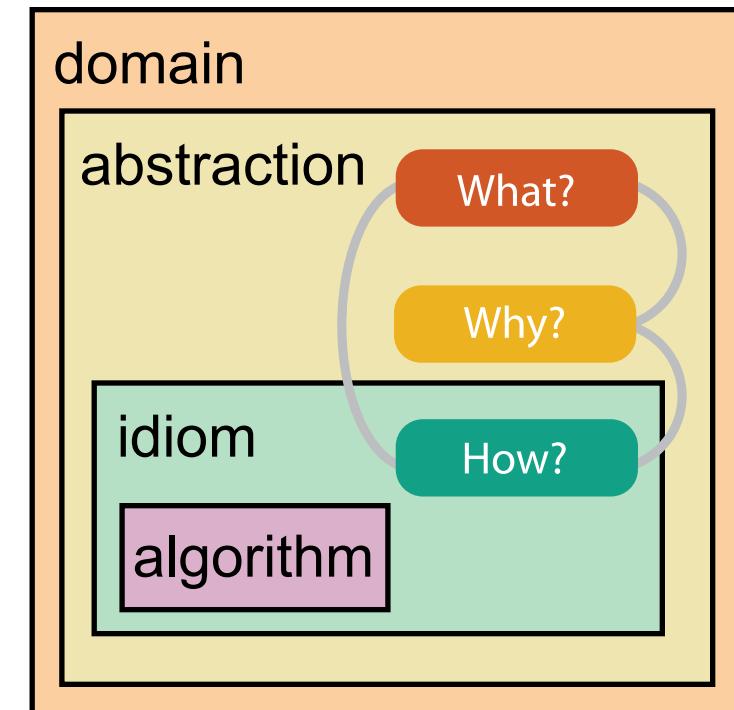
Different threats to validity at each level

Different threats to validity at each level

👤 Domain situation
You misunderstood their needs

Different threats to validity at each level

Domain situation
You misunderstood their needs

Data/task abstraction
You're showing them the wrong thing

Different threats to validity at each level

Domain situation
You misunderstood their needs

Data/task abstraction
You're showing them the wrong thing

Visual encoding/interaction idiom
The way you show it doesn't work

Different threats to validity at each level

Domain situation
You misunderstood their needs

Data/task abstraction
You're showing them the wrong thing

Visual encoding/interaction idiom
The way you show it doesn't work

Algorithm
Your code is too slow

Evaluation: use methods from different fields at each level

- avoid mismatches

anthropology/
ethnography

design

computer
science

cognitive
psychology

anthropology/
ethnography

Domain situation
Observe target users using existing tools

Data/task abstraction

Visual encoding/interaction idiom
Justify design with respect to alternatives

Algorithm
Measure system time/memory
Analyze computational complexity

Analyze results qualitatively
Measure human time with lab experiment (*lab study*)

Observe target users after deployment (*field study*)

Measure adoption

problem-driven
work

technique-driven
work

Michael Sedlmair

Miriah Meyer

Design Study Methodology

*Reflections from the Trenches and from the Stacks*

Tamara Munzner

**http://www.cs.ubc.ca/labs/imager/tr/2012/dsm/**

Design Study Methodology: Reflections from the Trenches and from the Stacks.
*Sedlmair, Meyer, Munzner. IEEE Trans. Visualization and Computer Graphics 18(12): 2431-2440, 2012 (Proc. InfoVis 2012).*

Challenge: Guidelines for problem-driven work

- lessons learned from the trenches: 20 between us

Cerebral
genomics
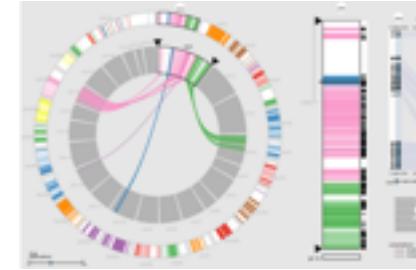
MizBee
genomics
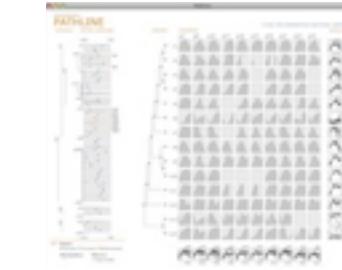
Pathline
genomics
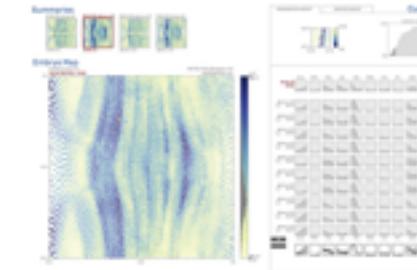
MulteeSum
genomics
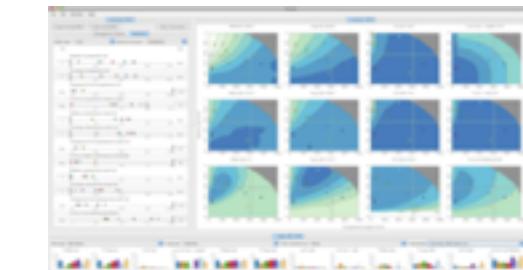
Vismon
fisheries management
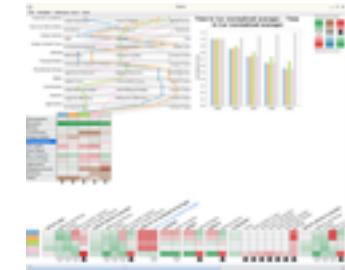
QuestVis
sustainability

WiKeVis
in-car networks
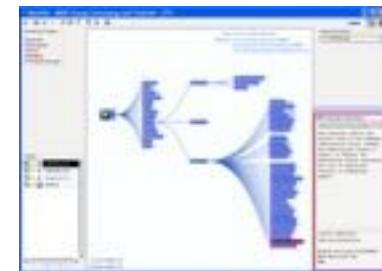
MostVis
in-car networks
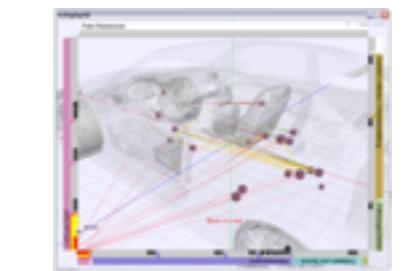
Car-X-Ray
in-car networks

ProgSpy2010
in-car networks

RelEx
in-car networks
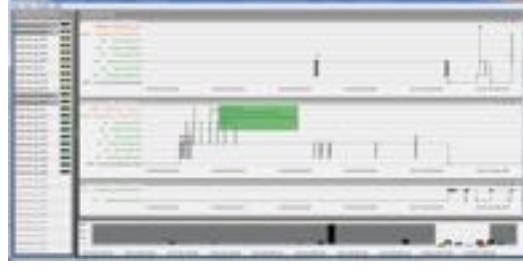
Cardiogram
in-car networks
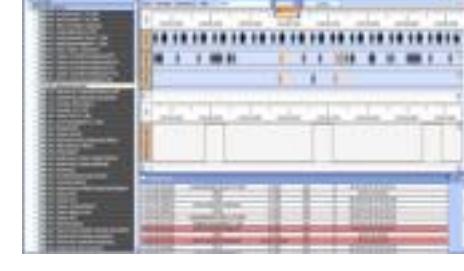
AutobahnVis
in-car networks
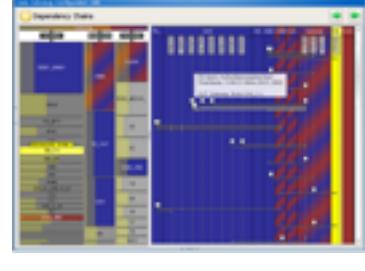
VisTra
in-car networks

SessionViewer
web log analysis
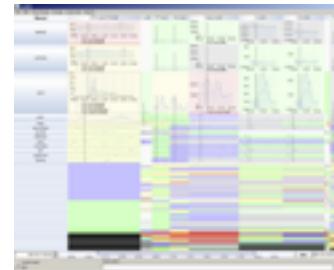
LiveRAC
server hosting
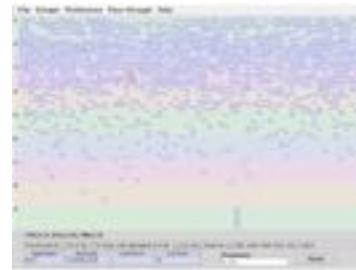
PowerSetViewer
data mining
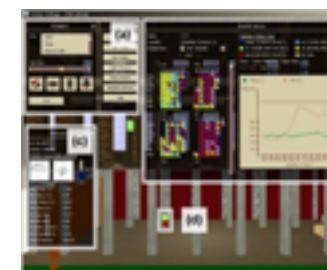
LibVis
cultural heritage
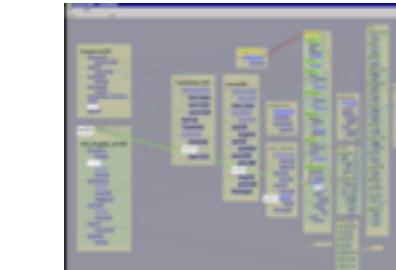
Constellation
linguistics

Caidants
multicast

http://www.cs.ubc.ca/~tmm/talks.html#gi21
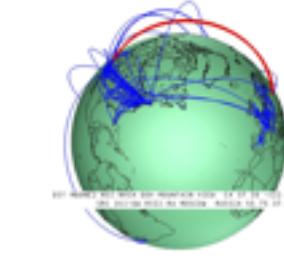
Methodology for problem-driven work

- definitions

- 9-stage framework

- 32 pitfalls & how to avoid them

- comparison to related methodologies

| PF-1 | premature advance: jumping forward over stages | general |
PF-2	premature start: insufficient knowledge of vis literature	learn
PF-3	premature commitment: collaboration with wrong people	winnow
PF-4	no real data available (yet)	winnow
PF-5	insufficient time available from potential collaborators	winnow
PF-6	no need for visualization: problem can be automated	winnow
PF-7	researcher expertise does not match domain problem	winnow
PF-8	no need for research: engineering vs. research project	winnow
PF-9	no need for change: existing tools are good enough	winnow

Design study methodology: 32 pitfalls

PF-21	mistaking technique-driven for problem-driven work	design
PF-22	nonrapid prototyping	implement
PF-23	usability: too little / too much	implement
PF-24	premature end: insufficient deploy time built into schedule	deploy
PF-25	usage study not case study: non-real task/data/user	deploy
PF-26	*liking* necessary but not sufficient for validation	deploy
PF-27	failing to improve guidelines: confirm, refine, reject, propose	reflect
PF-28	insufficient writing time built into schedule	write
PF-29	no technique contribution $\neq$ good design study	write
PF-30	too much domain background in paper	write
PF-31	story told chronologically vs. focus on final results	write
PF-32	premature end: win race vs. practice music for debut	write

Pitfall: Premature publication

- metaphor: horse race vs. music debut

technique-driven

problem-driven

A K Peters *Visualization Series*
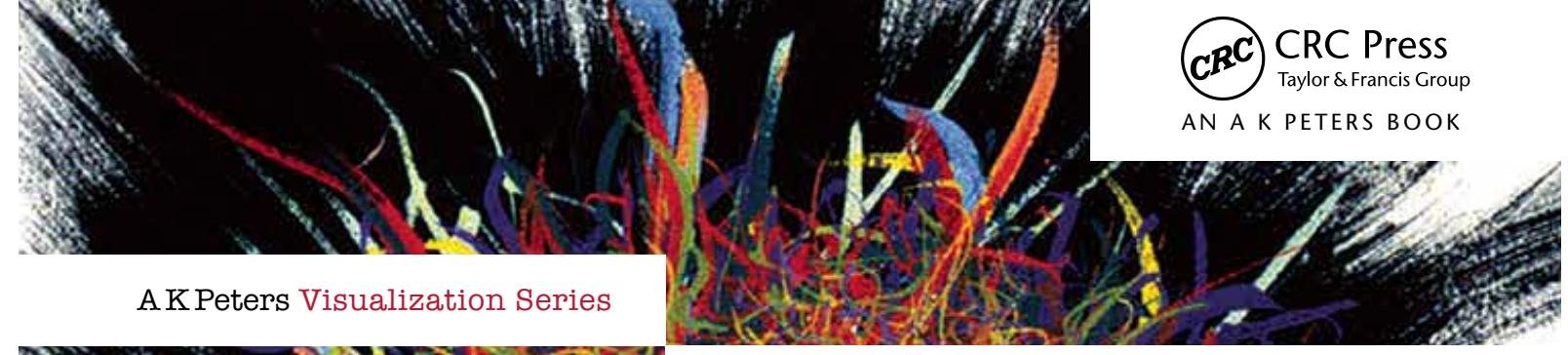
Visualization Analysis & Design

Tamara Munzner

WITH VITALSOURCE® EBOOK

Illustrations by Eamonn Maguire

Visualization Challenges, Past & Future

Past victories

- grand victories: explosive growth of visualization

Past victories & future challenges

- grand victories: explosive growth of visualization

- grand challenges: moonshots?
  - past: Manhattan project, eliminate polio, feature-length CG film...
  - future: cure cancer, reverse climate change...
- visualization? not sufficient -- but very helpful!
  - moonshots as cities
  - enabling technologies as roads
  - visualization as road-building:
    facilitates journeys to any destination

Visualization Challenges:

Visualization Challenges: Better

- validation
  - better controlled experiments
    - replication crisis / credibility revolution

domain
abstraction
idiom
algorithm
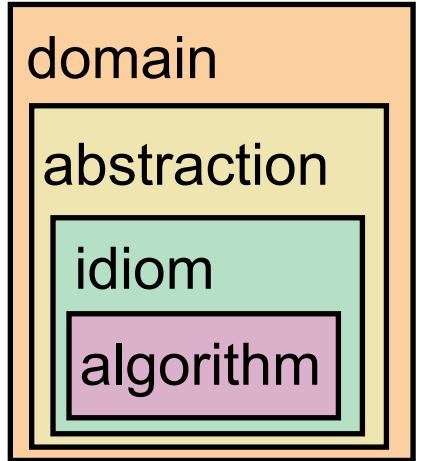
Putting the Self in Self-Correction:
Findings from the Loss-of-Confidence Project.

Rohrer et al
Perspectives on Psychological Science. March 2021.
https://psyarxiv.com/exmb2

Visualization Challenges: Better, Faster

- validation
  - better controlled experiments
    - replication crisis / credibility revolution

- from domain to abstractions
  - faster closing the loop
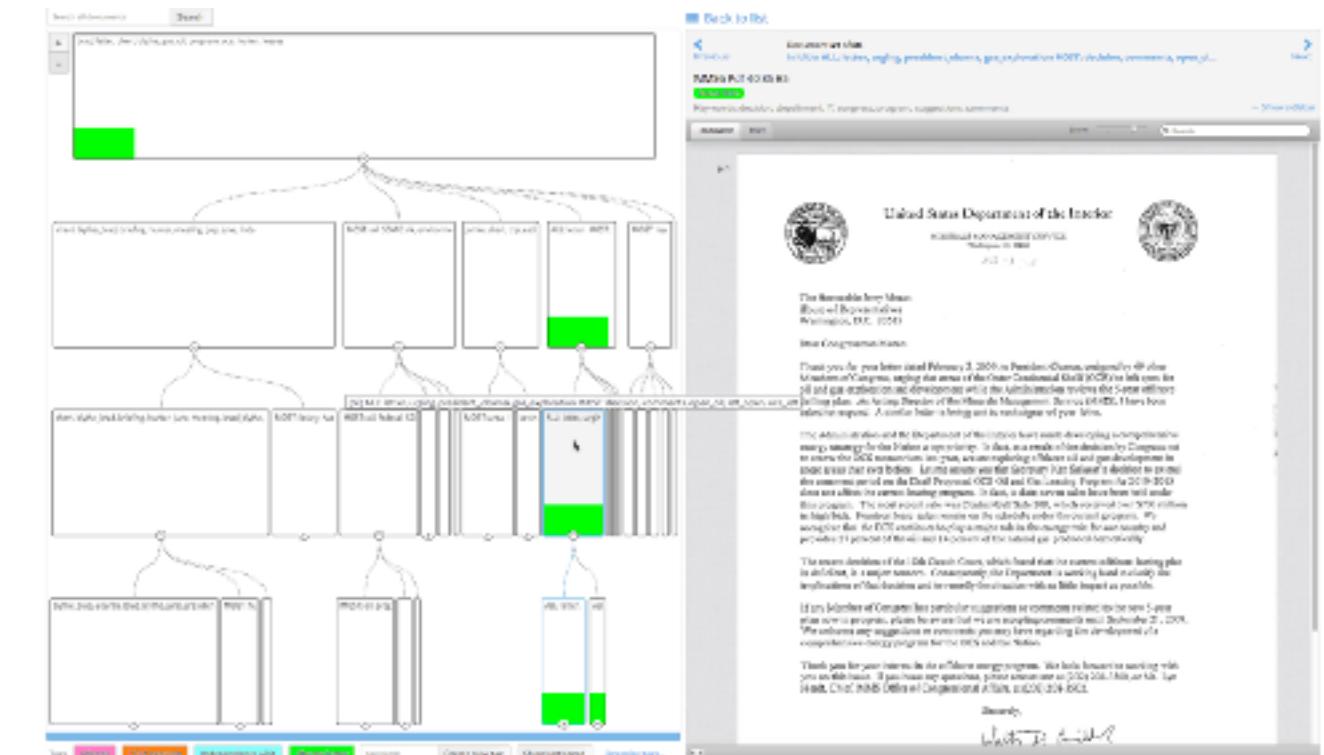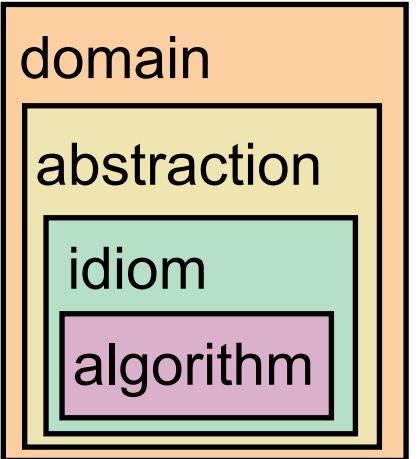
Overview: The Design, Adoption, and Analysis of a Visual Document Mining Tool For Investigative Journalists.

Brehmer, Ingram, Stray, & Munzner.
TVCG (Proc. InfoVis 2014)

Visualization Challenges: Better, Faster

- # validation
  - – better controlled experiments
    - • replication crisis / credibility revolution

- # from domain to abstractions
  - – faster closing the loop

- # idioms
  - – faster rapid prototyping
    beyond single-view visual encoding
    - • complex multi-view workflows
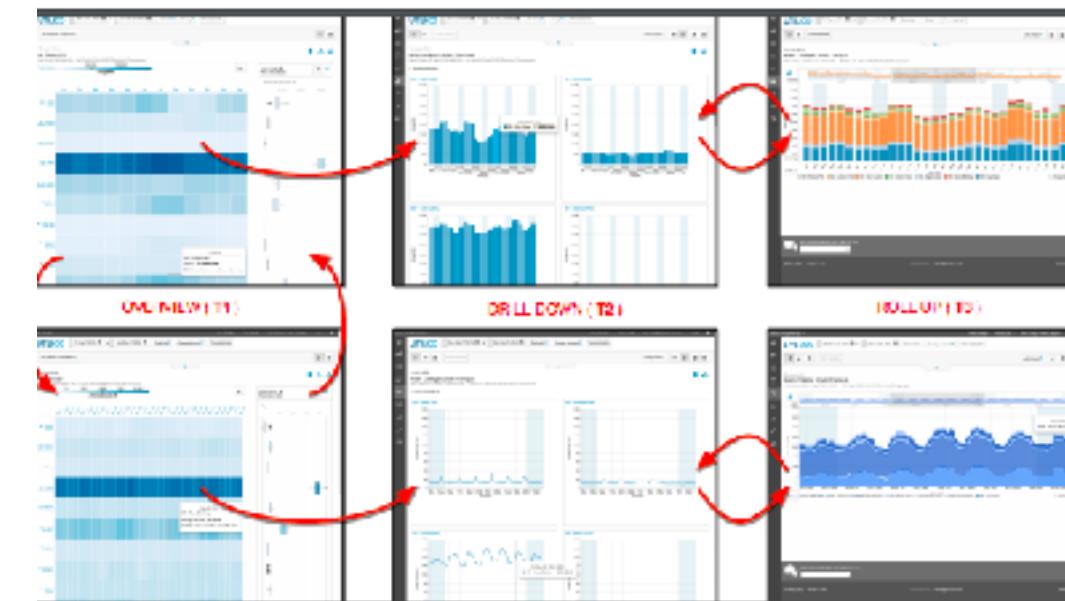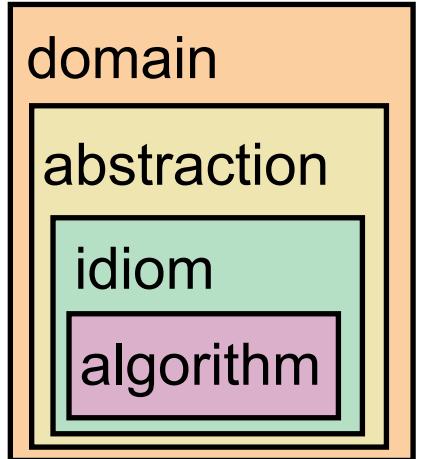
**Matches, Mismatches, and Methods:
Multiple-View Workflows for Energy Portfolio Analysis.**
Brehmer, Ng, Tate, & Munzner.
TVCG (Proc. InfoVis 2015)

Visualization Challenges: Better, Faster, Bigger

- validation
  - better controlled experiments
    - replication crisis / credibility revolution

- from domain to abstractions
  - faster closing the loop

- idioms
  - faster rapid prototyping
    beyond single-view visual encoding
   - complex multi-view workflows

- algorithms
  - bigger data
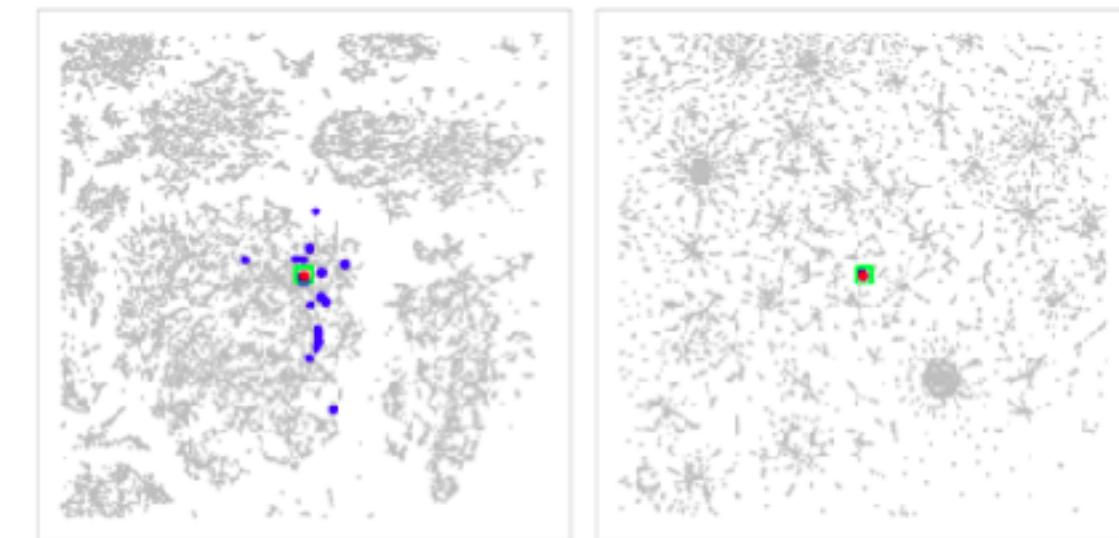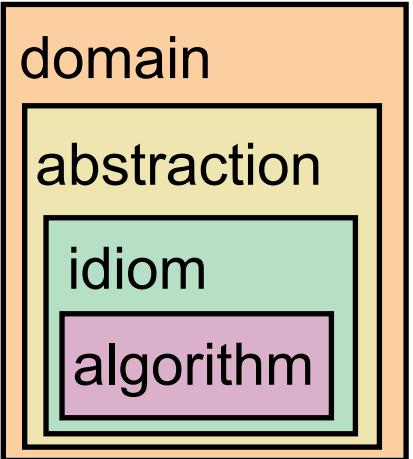
QSNE: Dimensionality Reduction for Documents with Nearest Neighbor Queries.

Ingram & Munzner.
Neurocomputing 2015

More Information

- this talk
  http://www.cs.ubc.ca/~tmm/talks.html#gi21

- book page (including lecture slides & videos)
  http://www.cs.ubc.ca/~tmm/vadbook

- papers, videos, software, talks, courses
  http://www.cs.ubc.ca/group/infovis
  http://www.cs.ubc.ca/~tmm
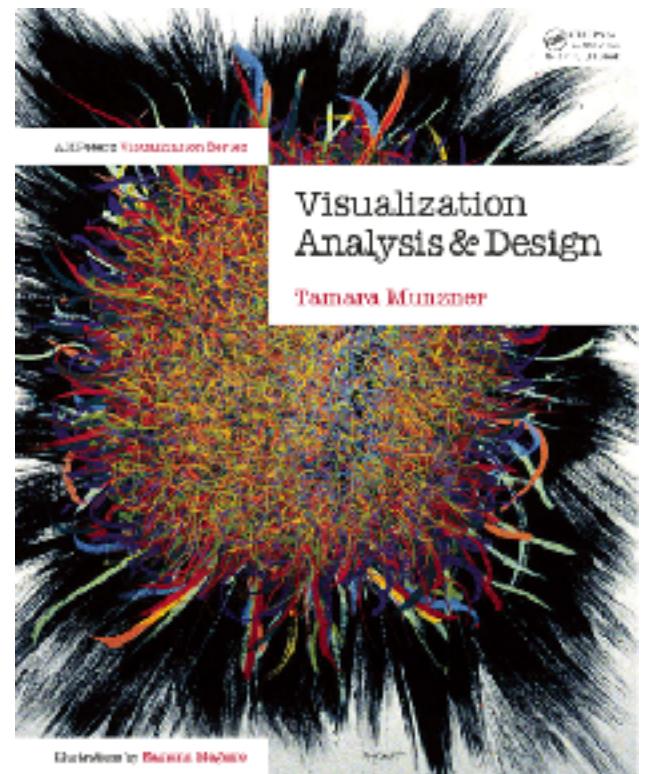
🐦 **@tamaramunzner**

Visualization Analysis and Design.
Munzner. A K Peters Visualization Series, CRC Press, 2014.