

Visualization Challenges, Past & Future

Tamara Munzner
Department of Computer Science
University of British Columbia



Graphics Interface 2021, CHCCS/SCDHM Achievement Award
May 28 2021, virtual

<http://www.cs.ubc.ca/~tmm/talks.html#g121>

Thanks!!



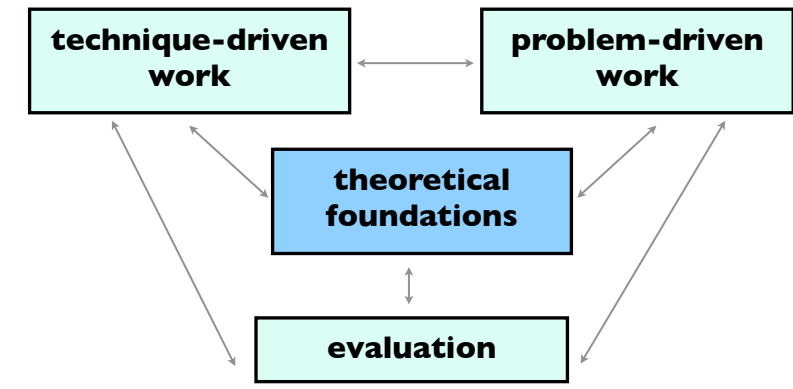
<http://www.cs.ubc.ca/~tmm/talks.html#g21>

2

Visualization Challenges, Past & Future

<http://www.cs.ubc.ca/~tmm/talks.html#g21>

Past research: Four themes

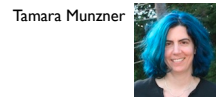
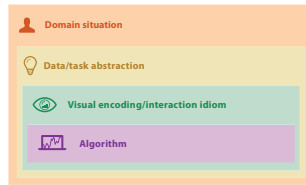


<http://www.cs.ubc.ca/~tmm/talks.html#g21>

4

A Nested Model

for Visualization Design and Validation



A Nested Model for Visualization Design and Validation.

Munzner. IEEE Trans. Visualization and Computer Graphics (Proc. InfoVis 09), 15(6):921-928, 2009.

<http://www.cs.ubc.ca/~tmm/talks.html#g21>

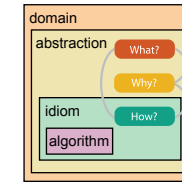
Challenge: Thinking systematically about evaluation

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

<http://www.cs.ubc.ca/~tmm/talks.html#g21>

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



<http://www.cs.ubc.ca/~tmm/talks.html#g21>

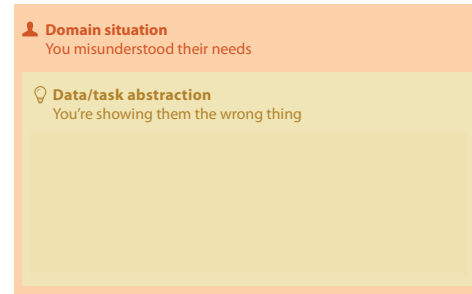
Different threats to validity at each level

Different threats to validity at each level



<http://www.cs.ubc.ca/~tmm/talks.html#g21>

Different threats to validity at each level



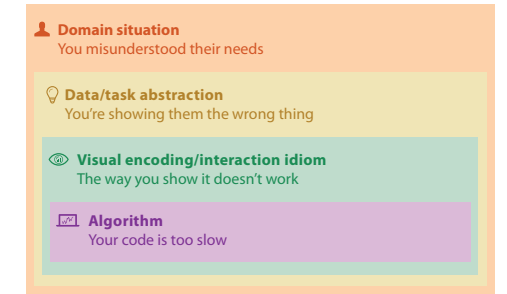
<http://www.cs.ubc.ca/~tmm/talks.html#g21>

Different threats to validity at each level



<http://www.cs.ubc.ca/~tmm/talks.html#g21>

Different threats to validity at each level



<http://www.cs.ubc.ca/~tmm/talks.html#g21>

Evaluation: use methods from different fields at each level

- avoid mismatches

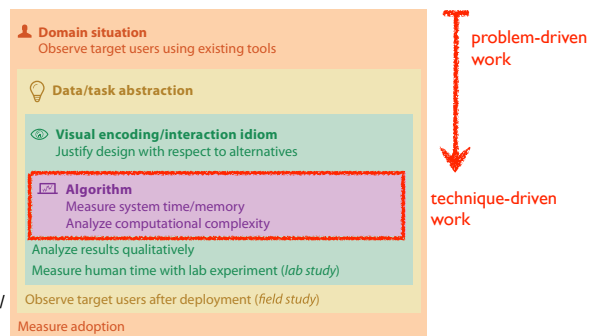
anthropology/
ethnography

design

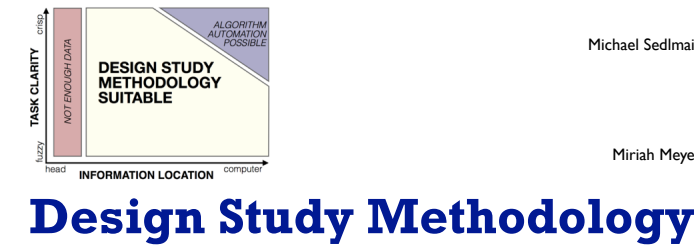
computer
science

cognitive
psychology

anthropology/
ethnography



<http://www.cs.ubc.ca/~tmm/talks.html#g21>



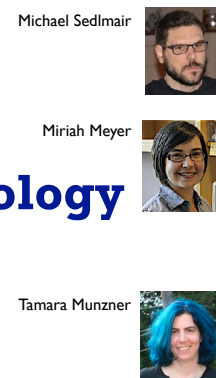
Design Study Methodology

Reflections from the Trenches and from the Stacks

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

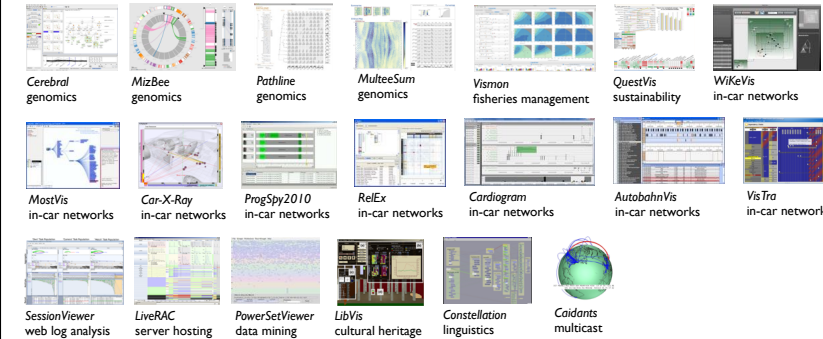
Design Study Methodology: Reflections from the Trenches and from the Stacks.
Sedlmair, Meyer, Munzner. IEEE Trans. Visualization and Computer Graphics 18(12): 2431-2440, 2012. (Proc. InfoVis 2012).

<http://www.cs.ubc.ca/~tmm/talks.html#g21>



Challenge: Guidelines for problem-driven work

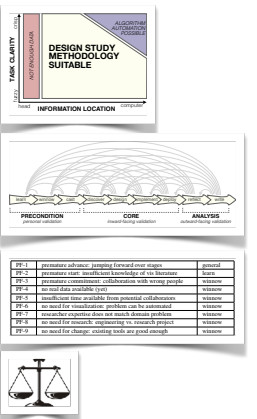
- lessons learned from the trenches: 20 between us



<http://www.cs.ubc.ca/~tmm/talks.html#g21>

Methodology for problem-driven work

- definitions
- 9-stage framework
- 32 pitfalls & how to avoid them
- comparison to related methodologies



<http://www.cs.ubc.ca/~tmm/talks.html#g21>

16

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

<http://www.cs.ubc.ca/~tmm/talks.html#g21>

Pitfall: Premature publication

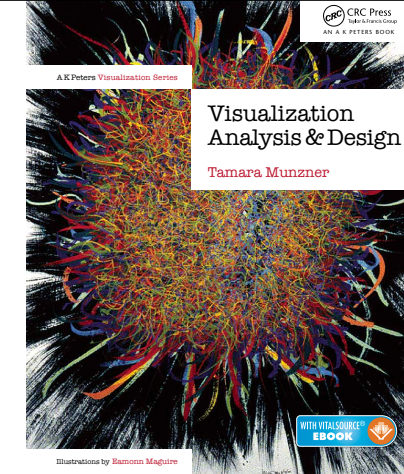
- metaphor: horse race vs. music debut



<http://www.cs.ubc.ca/~tmm/talks.html#g21>

Challenge: Synthesis

- unifying & enduring principles



<http://www.cs.ubc.ca/~tmm/talks.html#g21>

Visualization Challenges, Past & Future

<http://www.cs.ubc.ca/~tmm/talks.html#g21>

Past victories

- grand victories: explosive growth of visualization

<http://www.cs.ubc.ca/~tmm/talks.html#g21>

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



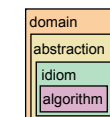
<http://www.cs.ubc.ca/~tmm/talks.html#g21>

Visualization Challenges:

<http://www.cs.ubc.ca/~tmm/talks.html#g21>

Visualization Challenges: Better

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

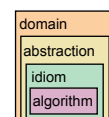


Putting the Self in Self-Correction: Findings from the Loss-of-Confidence Project.
Rohrer et al
Perspectives on Psychological Science, March 2021.
<https://psyarxiv.com/exmb2>

<http://www.cs.ubc.ca/~tmm/talks.html#g21>

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)

<http://www.cs.ubc.ca/~tmm/talks.html#g21>

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

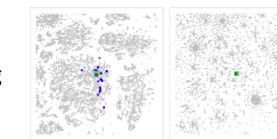


Matches, Mismatches, and Methods: Multiple-View Workflows for Energy Portfolio Analysis.
Brehmer, Ng, Tate, & Munzner.
TVCG (Proc. InfoVis 2018)

<http://www.cs.ubc.ca/~tmm/talks.html#g21>

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



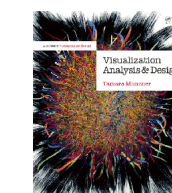
QSNE: Dimensionality Reduction for Documents with Nearest Neighbor Queries.
Ingram & Munzner.
Neurocomputing 2015

<http://www.cs.ubc.ca/~tmm/talks.html#g21>

More Information

- this talk
 - <http://www.cs.ubc.ca/~tmm/talks.html#g21>
- 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](https://twitter.com/tamaramunzner)



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

<http://www.cs.ubc.ca/~tmm/talks.html#g21>