Research Papers and Process

Tamara Munzner
Department of Computer Science
University of British Columbia

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Research Process & Pitfalls

writing infovis papers: pitfalls to avoid

Today
• papers & research pitfalls & process
  – writing infovis research papers
  – review reading, review writing, conference talks
• course endgame expectations
  – final presentations
  – final report
• text course paper vs research paper differences
  – [evaluations]
  – open science
  – making research available, reproducible, replicable

Pitfalls
• writing infovis papers: pitfalls to avoid

Idiom pitfalls
• Unjustified Visual Encoding
  – should justify why visual encoding design choices appropriate for problem
  – prerequisite: clear statement of problem and encoding!
• Hammer In Search of Nail
  – should characterize capabilities of new technique if proposed in paper
• Color Cacophony
  – avoid blatant disregard for basic color perception issues
  – hue of highly saturated color
  – categorical color coding for 15+ category levels
  – green without luminance issues
  – encoding 3 separate attributes with RGB
• Rainbows Just Like In The Sky
  – avoid hue for ordered attribs, perceptual nonlinearity along rainbow gradient

Later pitfalls: Tactics
• Stealth Contributions
  – don’t leave them implicit, it’s your job to tell reader explicitly!
  – consider carefully, often different from original project goals
• I Am Utterly Perfect
  – no you’re not; discussion of limitations makes paper stronger!

Idiom pitfalls
• Unjustified Tasks
  – don’t leave unsaid should be obvious after close reading of previous work
• I Just Know Person X Wrote This Review
  – sometimes true, sometimes false
  – diverged from original goals, in retrospect
• Dense As Plutonium
  – make research available, reproducible, replicable
• Least Publishable Unit
  – don’t hope reviewer or reader will fill them in for you

Other pitfalls
• What I Did Over My Summer Vacation
  – don’t focus on effort rather than contribution
  – don’t be too low level, it’s not a manual
• Bad Slice and Dice
  – two papers split up wrong
  – neither is standalone, yet both repeat

Later pitfalls: Strategy
• Stealth Contributions
  – don’t leave them implicit, it’s your job to tell reader explicitly!
  – consider carefully, often different from original project goals
• I Am So Unique
  – don’t focus on effort rather than contribution
  – don’t leave unsaid should be obvious after close reading of previous work
  – sometimes false: weak work common! reinvent the wheel worse than previous one

Later pitfalls: Results
• Unfettered By Time
  – choose level of detail for performance numbers
  – detailed graphs for technique papers, high-level for design & eval papers
• Star Comparison
  – compare appropriately against state-of-the-art algorithms
  – head-to-head hardware is best (re-run benchmarks yourself, all on same machine)
• Tiny Toy Datasets
  – compare against state-of-the-art dataset sizes for technique (small ok for eval)
• But My Friends Liked It
  – asking lamabtes not convincing if target audience is domain experts
• Unjustified Tasks
  – use ecologically valid user study tasks: convincing abstraction of real-world use

Final pitfalls: Style
• Deadly Detail Dump
  – explain how only after what and why; provide high-level framing before low-level detail
• Story-Free Captions
  – optimize for flip-through-pictures skimming
  – avoid cutting through images with discussion
• Grammar Is Optional
  – good-low level flow is necessary (but not sufficient), native speaker check good if ESL
• Mistakes Were Made
  – don’t use passive voice, leaves ambiguity about actor
  – your research contribution or done by others?

Final pitfalls: Style 2
• Jargon Attack
  – avoid where you can, define on first use
  – all acronyms should be defined
• Nonspecific Use Of Large

Contributions in research papers
• what are your research contributions?
  – what can we do that wasn’t possible before?
  – how can we do something better than before?
  – what do we know that was unknown or unclear before?
• determines everything
  – from high-level message to which details worth including
• often not obvious
  – diverged from original goals, in retrospect
  – state them explicitly and clearly in the introduction
  – don’t hope reviewer or reader will fill them in for you
  – don’t leave unsaid should be obvious after close reading of previous work
  – goal is clarity, not overrelying (limitations typically later, in discussion section)

Final pitfalls: Submission
• Slimy Simultaneous Submission
  – often detected when same reviewer for both
  – instant dual rejection, often multi-conference blacklist
• Resubmit Unchanged
  – respond to previous reviews; often get reviewer overlap, irritated if ignored

Generality
• encoding: visualization specific
  – strategy: all research
  – tactics: all research
• results: visualization specific
• style: all research, except
  – Story-Free Captions, My Picture Speaks For Itself

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Review writing pitfalls
• Uncalibrated Dislay
  -- remember you've only read the best of the best!
  -- most new reviewers are overly harsh
• It’s Been Done, Full Stop
  -- you must say who did it in which paper, full citation is best
• You Didn’t Cite Me
  -- stop and think whether it’s appropriate
• You Didn’t Channel Me
  -- don’t compare against paper you would have written
  -- review the paper they submitted

Paper writing process suggestions
• pre-paper talk
  -- write and give talk first, as if presenting at conference
  -- interact on talk to get to structure, ordering arguments
  -- then create paper outline from final draft of slides
• encourage cross-lecture discussions of critical ideas, creation of key diagrams
• foster understanding of the big picture and rhetorical
• ease out to slide topics you probed over
• pre-paper/practice talk feedback session: at least 2-3x talk length
• global comments, then slide by slide detailed discussion
• nurture culture of internal critique (build your own critique group if necessary)
• have non-authors read paper before submitting
  -- internal review can catch many problems
  -- ideally group feedback session as above

Conference talk pitfalls
• Results As Dessert
  -- don’t save until the end as a reward for the stalwart!
  -- showcase early to motivate
• A Ton of Words, No Pictures
  -- aggressively replace words with illustrations
  -- most slides should have a picture
• Full Coverage Or Bust
  -- can’t fit all details from paper
  -- communicate big picture
  -- talk as advertising: convince them it’s worth their time to read paper!

Course Endgame

Final presentations: Wed Dec 14 2:5-15 pm
• length (14 projects)
  -- presentation live (or pre-recorded) 10 min for groups, 8 min for solo
  -- Q&A live 2 min per project
• session structure
  -- order reverse alphabetical by name, from bottom up on project page
  -- 2 breaks, between each set of 6 presentations
  -- CS dept (fac / grads) & infovis group invited, friends/others very welcome!
  -- refreshments served

Final presentsation content
• presentation structure
  -- motivate: framing, project, results, critique/limitation
  -- condition: don’t assume audience has read proposal or updates (or remember your pitch)
  -- slides (or slide numbers) mandatory for main part
  -- demo strongly encouraged, either live or pre-rendered
  -- format is up to you live presentation or pre-recorded video or a mix
  -- slides/video upload
  -- upload to Canvas: Assignments: Final Slides (mandatory), Final Video (optional)
  -- by noon Wed Dec 14
  -- note: code freeze after presentations!
  -- no additional work on project allowed after presentation deadline
  -- additional two days to get it all written down coherently for final report

Marking: Course overall
• 36% Aspnic Discussion
  -- 9 weeks, 4% per week (mostly)
  -- 75% own comments, 25% responses
  -- (get past 5 codes)
• 14% Sync: In-Class Participation
  -- 12 sessions, 1% per session
  -- 2% final presentations
  -- (most got full credit)

Final Presentations

Course requirements vs research paper standards
• research novelty not required
  -- your choice to use Lever/Xing/what/whenever
  -- no length cap: illustrate freely with screenshots!
• mid-level discussion of implementation is required
• low-level detail that review process, update writeups
• encourage writing about your correctness and style guidelines

Logistics
• Assignments: Final Presentations on Canvas
  -- uploaded due Wed Dec 14 noon (2 hrs before session)
  -- required & pre-slides: Project Final Presentation Slides, PDF
  -- optional & pre-video: Project Final Presentation Video, npt
• Assignment: Final Report on Canvas
  -- due Fri Dec 16 8pm (PST)
  -- required & pre-report: Project Final Report, PDF
  -- required & pre-screenshot: Project Screenshot Image, JPEG
  -- required but not posted code in README (Project Source Code and Other Materials, zip)
  -- encouraged & pre-test: URLs (include in code README)
  -- encouraged & pre-video: (video zip "any" if different from final video project)

Course Endgame

Final reports
• PDF use Infdev templates
• no long caps: illustrate freely with screenshots!
• design study / technique aim for at least 6-8 pages
• analysis / survey aim for at least 15-20 pages
• strongly encouraged to re-use text from proposal & update writeups

Sample outlines: Design study
• https://www.cs.ubc.ca/~tmm/courses/547-22/projdes/index.html
  -- Abstract
  -- concisely summarize your project
  -- do not include citations
  -- Introduction
  -- give big picture, establish scope, some background material might be appropriate
  -- Related work
  -- include both work aimed at similar problems & similar solutions

Report structure: General
• how low-level necessary but not sufficient
  -- concisely summarize your project
• how low-level necessary but not sufficient
  -- concisely summarize your project
• full presentation
• abstract
• motivation
• related work
• background
• methodology
• results
• discussion
• limitations
• conclusion
Open Science: Available, Reproducible, & Replicable Research

Data and Task Abstractions
- analyze your domain problem according to book framework (what/why)
- include both language-domain descriptions and abstract versions
- could split into data vs task, domain vs abstr - or vice versa!
- typically data first then task, so that can refer to data after within task abstr - must have tight connections between data & task abstr
Solution
- describe your solution idea (visual encoding and interaction)
- analyze it according to book framework (how)
  - only for custom encodings, no need to repeat book material for standard chart types
- justify your design choices as solutions to problem set up w/ data/task abstractions
- provide rationale. Design choices with respect to abstractions
  - if significant algorithm work, discuss algorithm and data structures
  - must have tight connections between data & task abstr

Sample outlines: Study design (II)

Abstract
- related study & explainer
Implementation
- medium-level implementation description
- how to compile and run
Data and task abstractions
- medium-level implementation description
- how to compile and run
- which parts are your code vs libraries
Results
- include visualizations, extensionally illustrated with multiple screenshots of your software
- must have live demo URL (provide in README.txt file)
- submit live demo URL (provide in README.txt file)
Discussion / Future Work
- walk reader through exactly how your interface succeeds (or falls short) of solving intended problem
- include scenarios of use, extensively illustrated with multiple screenshots of your software
- provide rationale, discuss choices with respect to alternatives
- if significant algorithm work, discuss algorithm and data structures
- must have tight connections between data & task abstr
- must have tight connections between data & task abstr

Sample outlines: Study design (III)

Abstract
- same as above
Introduction
- discuss the scope of what you're covering, why it's interesting/important/innovative compared to visualization as a field
Related Work
- related studies/previous work (include citations)
Results
- present results systematically, in a way that demonstrates the progression of your work
- include images from papers
Discussion / Future Work
- reflect on your approach, strengths, weaknesses, limitations
- lessons learned: what do you know now that you didn't when you started?
- future work: what would you do if you had more time?

Sample outlines: Study design (IV)

Conclusions
- summarize what you've done
  - different than abstract since reader has seen all the details
Biography
- note format is numerical & alphabetical
  - use citation manager / bibtex!
  - make sure to use references for work that's been published academically
  - don't just URL
- check arXiv papers, some have link to final publication, also search on twitter!
- check carefully to ensure consistency & nothing mangled or missing
- most online sources require cleanup
  - see guidance at https://www.cs.ubc.ca/~tmm/writing.html#refs
Marking
- design study & technique & explanation
  - 12.5% each for
    - intro
    - related work
    - abstractions
  - implementation/milestones
  - discussion
  - 10% style, 2.5% bibliography

Sample outlines: Implementation (diiffs)

Abstract (same as above)
Introduction
- discuss the scope of what you're covering, why it's interesting/important/innovative compared to visualization as a field
Related Work
- related studies/previous work (include citations)
Results
- present results systematically, in a way that demonstrates the progression of your work
Discussion / Future Work
- reflect on your approach, strengths, weaknesses, limitations
- lessons learned: what do you know now that you didn't when you started?
- future work: what would you do if you had more time?

Sample outlines: Survey (diiffs)

Abstract (same as above)
Introduction
- discuss the scope of what you're covering, why it's interesting/important/innovative compared to visualization as a field
Related Work
- related studies/previous work (include citations)
Results
- present results systematically, in a way that demonstrates the progression of your work
Discussion / Future Work
- reflect on your approach, strengths, weaknesses, limitations
- lessons learned: what do you know now that you didn't when you started?
- future work: what would you do if you had more time?

Sample outlines: Design study III

Implementation
- medium-level implementation description
- how to compile and run
Results
- include visualizations, extensionally illustrated with multiple screenshots of your software
- must have live demo URL (provide in README.txt file)
Discussion / Future Work
- walk reader through exactly how your interface succeeds (or falls short) of solving intended problem
- include scenarios of use, extensively illustrated with multiple screenshots of your software
- provide rationale, discuss choices with respect to alternatives
- if significant algorithm work, discuss algorithm and data structures
- must have tight connections between data & task abstr
- must have tight connections between data & task abstr

Sample outlines: Design study IV

Abstract
- related study & explainer
Implementation
- medium-level implementation description
- how to compile and run
Data and task abstractions
- medium-level implementation description
- how to compile and run
Results
- include visualizations, extensionally illustrated with multiple screenshots of your software
- must have live demo URL (provide in README.txt file)
Discussion / Future Work
- walk reader through exactly how your interface succeeds (or falls short) of solving intended problem
- include scenarios of use, extensively illustrated with multiple screenshots of your software
- provide rationale, discuss choices with respect to alternatives
- if significant algorithm work, discuss algorithm and data structures
- must have tight connections between data & task abstr
- must have tight connections between data & task abstr

Sample outlines: Implementation (diiffs)

Abstract (same as above)
Introduction
- discuss the scope of what you're covering, why it's interesting/important/innovative compared to visualization as a field
Related Work
- related studies/previous work (include citations)
Results
- present results systematically, in a way that demonstrates the progression of your work
Discussion / Future Work
- reflect on your approach, strengths, weaknesses, limitations
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- future work: what would you do if you had more time?

Sample outlines: Technique (diiffs)

Abstract (same as above)
Introduction
- big focus on similar solutions, some discussion of similar problems (same task/data combo)
Data and Task Abstractions
- much shorter than the corresponding one for design studies, framing context not core
Solution
- design choices proposed/can essentially not justify use for particular domain problem
- as above, analyze in terms of design choices, justify why appropriate vs alternatives
Implementation/Milestones (same as above)
Results
- less emphasis on scenarios with particular target users
- more emphasis on characterizing the breadth of possible uses
- still definitely include screenshots of the system in action
Discussion / Future Work, Conclusions, Bibliography (same as above)

Open Science: Available, Reproducible, & Replicable Research

Making your research available & reproducible: why bother?
- moral high ground
- for science
- enlightened self-interest
- make your own life easier
- you'll be cited more often by academics
- your work more likely to be used by industry

Making the world care about your research!
- Increasing the Impact of Visualization Research panel, VIS 2017
  - Krao Wangsuphaswat, Data Visualization Scientists, Twitter

Disseminating research
- paper page for each paper
  - everything! PDF, supplemental materials, videos, software/demos, talk slides, figures, ...
  - examples:
    - Table Script: https://www.cs.ubc.ca/group/infovis/pubs/2020/table-scraps/
    - TMM: http://www.cs.ubc.ca/~tmm/writing.html#refs
- write blog post to accompany each paper
  - very high-impact bang for the time buck
    - Multiple Views: Visualization Research Explained umbrella blog
    - https://medium.com/multiple-views-visualization-research-explained
    - UW IDL individual lab blog
    - https://washington-idl.github.io/2020/08/Dissemination-Surprise-Pages/

Code / Video
- required: submit your code
  - so I can see what you've done, but I will not post
  - include README.txt file at root with brief roadmap/overview of organization
  - which parts are your code vs libraries
  - how to compile and run
  - lic or no need to submit data if it's huge
- encouraged but not required
  - submit live demo URL (provide in README.txt file)
  - open-source your code (if so, feel free to just send me that URL)
  - submit supporting video (if different from final presentation)
  - walk through without voiceover
  - voiceover is very nice to have later, software bitrot makes demos not last forever!

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**Supplemental materials: provide as much as possible**

- demo videos show interactive look & feel
- data for computational benchmarks & case studies
- tricky issue in visualization: data might not be yours to release!
- qualitative work: thematic analysis raw & intermediate materials
- quant experimental stimuli: full set of images, not just a few examples
- quant evaluation: data analysis code/scripts
- evaluation: detailed study results
- advance planning ethics approval of satire PR (personally identifiable information)
- technique refinement: previous iterations
- parameters: how exactly to regenerates/produce figures, tables
- additional case studies, screenshots, other exposition
- surveys / design spaces: interactive faceted browser
- examples: treevis.net, dashboarddesignpatterns.github.io

**Dissemination & reproducibility: motivation & howto**

- Open Practices in Vis Research, Steve Haroz
  - https://osf.io/g6gj/download
- Cody Dunne VIS22 panel talk (10 min)
- Simon VanNo's entire Sometimes I'm Wrong blog
  - http://simonvann.oop.org/wrongblog
- Joe Simmons Data Colada blog post What I Won Our Field to Prioritize
- Dara Harvey's brave statement on her previous power pose work
- VI: https://youtu.be/nPdr7xybUbA

**Reproducibility: Levels of effort required**

- 0: cannot be reproduced
- 1: cannot seem to be reproduced
- 2: extreme effort
- 3: considerable effort
- 4: 15 minutes with proprietary tools
- 5: 15 minutes with free tools

**Next week: Research guests & more**

- Steve Kasica (UBC)
  - qualitative research
- Stephen Kobourov (Arizona)
  - techniques & algorithms
- Mara Solen (UBC)
  - survey papers
  - me
  - design spaces for visualization
  - visualizing imperfect models
  - next steps

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**Reference dissemination: what to provide**

- paper
  - put it online at non-paywalled site
- algorithm
  - document well in paper itself
  - document further with code
- code
  - make available as open source (github.com)
  - pick right spot on continuum of effort involved, from minimal to massive
  - just put it up works and all, minimal documentation
  - well documented and tested
  - Build a whole community - (not the common case)
- supplemental materials

**Replication: crisis in psychology, medicine, etc**

- early rumblings left me with (ignorable) qualms
  - papers: Is most of psychology true?
  - many willing to repudiate (their own) earlier styles of working
- open: great for supplemental materials in addition to paper (vs arxiv focus on paper PDF)
  - can create anonymous view-only link for double-blind review
  - examples: osf.io/tr3sb, osf.io/uezfk
- optional, not mandatory
  - advice: post when you submit, update with camera-ready

**Upcoming**

- Reproduction in Signal Processing - What, why, and how

**Remarkable introspection on methods**

- psych: thoughtful willingness to change standards of field
- Simon VanNo’s entire Sometimes I’m Wrong blog
  - http://simonvann.oop.org/wrongblog
- Joe Simmons Data Colada blog post What I Won Our Field to Prioritize
- Dara Harvey’s brave statement on her previous power pose work
- VI:
  - https://youtu.be/nPdr7xybUbA

**When and how will this storm hit visualization?**

- they’re ahead of us (they = psychology)
- they have some paper retractions
- we don’t (yet) have any retractions for methodological considerations
- we agonize about difficulty of getting failure-to-replicate papers accepted
- they hardly ever even try to do such work
- they are a much older field
- we hardly ever even try to do such work
- we are a much older field
- there are a much older field
- they have rich fabric of blogs as major drivers of discussion
- we have few active bloggers

- replication crisis was focus of BELIV 2018 workshop at IEEE VIS
  - evaluation and BEyond - methodological approaches for Visualization