Information Visualization
Marks & Channels, Rules of Thumb
Design Study Methodology
Ex: Decoding

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Week 3, 21 Sep 2022

https://www.cs.ubc.ca/~tmm/courses/547-22
Plan for today

• 15 min: pitches details & project resources
• 45 min: Marks & Channels
  – mini-lecture
  – examples & discussion
  – further Q&A
• 15 min: Rules of Thumb, Design Study Methodology
  – further Q&A
• (break: 10 min)
• 75 min small groups exercise: Decoding
  – 45 min: breakout groups
  – 30 min: reportbacks
Next week

• to read & discuss (async, before next class)
  – VAD book, Ch 7: Arrange Tables
  – paper: LineUp [technique]
  – paper: Revisiting Bertin Matrices [technique]

• sync class: project pitches!
  – 2 min each
  – if already have full or partial team, can combine your times together
  – up to you: prerecord video OR present live, need slides either way
    • due on Canvas by 1pm (Wed Sep 29)
      – if prerecorded, videos and slides. if live: slides
    • video creation tips/resources https://www.cs.ubc.ca/~tmm/courses/547-22/video.html
  – near-realtime Q&A / discussion through dedicated Piazza thread
Pitches

• everybody must do one (solo or team)

• way to find teammates
  – convince them to work on yours, or you decide to work on theirs
  – even if your team is all set, situational awareness of what others doing

• schedule
  – pitches next week in class (Wed Sep 28)
  – must form teams week after that, by Thu Oct 6, 8pm
  – team pre-proposal meetings week after that, in class & OH slot (Wed Oct 12)
    • if no signoff: followup meetings only possible Thu Oct 13 & Fri Oct 14
  – written proposals due Fri Oct 21
    • no class that week, IEEE VIS conference
Project resources: Datasets

• many choices!
  – **Data Is Plural**: weekly newsletter of interesting/quirky datasets by Jeremy Singer-Vine
    • browseable weekly lists
    • single master spreadsheet with everything
    • DVS Challenge: **London Stage dataset**
  – **VAST Challenge**
    • both data and tasks!
    • multiple mini-challenges per year
  – **Kaggle datasets**
    • you'll need to think (hard) about tasks
  – many more on Resources page
    http://www.cs.ubc.ca/group/infovis/resources.shtml#data-repos
Project resources: Tools

• Tools: you're free to pick platform
  – align with current strengths? learn something new?
  – overview of the "big 4": D3, R/tidyverse, Python, Tableau
    https://www.cs.ubc.ca/~tmm/courses/547-22/tools/
  – consider covering your own strengths & goals in your pitch

• Smaller tools: also free to use
  – you pick project scope:
    • build skills by rolling your own?
    • do something bigger by building on existing toolkits/libraries?
  – many, many smaller building blocks
    • https://www.visualisingdata.com/resources/
Mini-Lecture
Marks and channels

- **marks**
  - basic geometric elements

- **channels**
  - control appearance of marks
Channels: Rankings

**Magnitude Channels: Ordered Attributes**
- Position on common scale
- Position on unaligned scale
- Length (1D size)
- Tilt/angle
- Area (2D size)
- Depth (3D position)
- Color luminance
- Color saturation
- Curvature
- Volume (3D size)

**Identity Channels: Categorical Attributes**
- Spatial region
- Color hue
- Motion
- Shape

• **expressiveness**
  - match channel and data characteristics

• **effectiveness**
  - channels differ in accuracy of perception

• **distinguishability**
  - match available levels in channel w/ data
Redundant encoding

• multiple channels
  – sends stronger message
  – but uses up channels

Length, Position, and Value
Marks: Constrained vs encodable

- **Math view:** geometric primitives have dimensions
  - Points: 0D, no constraints on size, can encode more attributes with size & shape
  - Lines: 1D, 1 constraint on size (length), can still size code other way (width)
  - Areas: 2D, 2 constraints on size (length/width), cannot size code or shape code

- **Constraint view:** mark type constrains what else can be encoded
  - Points: 0 constraints on size, can encode more attributes with size & shape
  - Lines: 1 constraint on size (length), can still size code other way (width)
  - Areas: 2 constraints on size (length/width), cannot size code or shape code
    - Interlocking: size, shape, position

- **Quick check:** can you size-code another attribute, or is size/shape in use?
Grouping

• containment
• connection

Marks as Links

→ Containment

→ Connection

Identity Channels: Categorical Attributes

→ Spatial region

→ Color hue

→ Motion

→ Shape
Marks for links

Connection

Containment

Containment can be nested

[Untangling Euler Diagrams, Riche and Dwyer, 2010]
Examples
Quiz: Name those marks & channels

• A: Shooting Media Coverage

https://twitter.com/MonaChalabi/status/1158779046693679106?s=20
Quiz: Name those marks & channels

• B: Tax Rates

Quiz: Name those marks & channels

• C: Sunsqatch

https://flowingdata.com/2017/08/20/sunsquatch-the-only-eclipse-map-you-need/
Quiz: Name those marks & channels

- D: UFC fights

Analyzing marks

• what type of mark?
  – line?
    • no, not length coded
  – point mark with rectangular shape?
    • yes!
  – area?
    • no, area/shape does not convey meaning

Quiz: Name those marks & channels

• E: Alpen Forest Fires

Burned area in hectares on the southern side of the Alps

Source: Swissinc forest fire database

Quiz: Name those channels

• F: Migrations

https://maps.tnc.org/migrations-in-motion/#5/-7.101/-67.939
Quiz: Name that mark

• G: Yet More Alpen Forest Fires

Most forest fires in Switzerland occur on the southern side of the Alps.

Annual number of forest fires between 1980 and 2014

- < 1 Waldbrand
- 1-2
- 2-3
- 3-5
- 5-15
- > 15

Source: Climate & Change Forest, Pfenninger et al. 2016

Quiz: Name those marks & channels

• H: More Alpen Forest Fires

Monthly distribution of forest fires in the Alpine regions caused by,

- den Menschen
- Blitzschläge
- unbekannt

Alpensüdseite

andere Alpengebiete

Average numbers in the period 2000-2018
Source: Swissfire forest fire database

Coxcomb / nightingale rose / polar area chart

• invented by Florence Nightingale:
  Diagram of the Causes of Mortality in the Army in the East
Idioms: **pie chart, coxcomb chart**

- **pie chart**
  - *interlocking area* marks with angle channel: **2D area varies**
    - separated & ordered radially, uniform height
  - accuracy: area less accurate than rectilinear aligned line length
  - *task*: part-to-whole judgements

- **coxcomb chart**
  - line marks with length channel: **1D length varies**
    - separated & ordered radially, uniform width
  - direct analog to radial bar charts

- **data**
  - 1 categ key attrib, 1 quant value attrib

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Coxcomb: perception

- encode: 1D length
- decode/perceive: 2D area

- nonuniform line/sector width as length increases
  - so area variation is nonlinear wrt line mark length!

- bar chart safer: uniform width, so area is linear with line mark length
  - both radial & rectilinear cases
Q&A: Rules of Thumb, DSM
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Q&A/Backup Slides
Marks and Channels
Visual encoding

• how to systematically analyze idiom structure?
Visual encoding

• how to systematically analyze idiom structure?
Visual encoding

• how to systematically analyze idiom structure?

• marks & channels
  – marks: represent items or links
  – channels: change appearance of marks based on attributes
Marks for items

• basic geometric elements

- **Points**
- **Lines**
- **Interlocking Areas**

• 3D mark: volume, rarely used
Marks for links

Containment

Connection

vialab.science.uoit.ca/portfolio/bubblesets

Containment can be nested

[Untangling Euler Diagrams, Riche and Dwyer, 2010]
Channels

• control appearance of marks
  – proportional to or based on attributes

• many names
  – visual channels
  – visual variables
  – retinal channels
  – visual dimensions
  – ...

- Position
  - Horizontal
  - Vertical
  - Both

- Color

- Shape

- Tilt

- Size
  - Length
  - Area
  - Volume
Definitions: Marks and channels

• marks
  – geometric primitives
Definitions: Marks and channels

• marks  
  – geometric primitives

• channels  
  – control appearance of marks
Definitions: Marks and channels

• marks
  – geometric primitives

• channels
  – control appearance of marks

• channel properties differ
  • type & amount of information that can be conveyed to human perceptual system
Visual encoding

• analyze idiom structure as combination of marks and channels
Visual encoding

• analyze idiom structure as combination of marks and channels

1: vertical position

mark: line
Visual encoding

• analyze idiom structure as combination of marks and channels

1: vertical position
mark: line

2: vertical position
horizontal position
mark: point
Visual encoding

• analyze idiom structure as combination of marks and channels

1: vertical position
mark: line

2: vertical position
horizontal position
mark: point

3: vertical position
horizontal position
color hue
mark: point
Visual encoding

• analyze idiom structure as combination of marks and channels

1: vertical position
mark: line

2: vertical position horizontal position
mark: point

3: vertical position horizontal position color hue
mark: point

4: vertical position horizontal position color hue size (area)
mark: point
Redundant encoding

- multiple channels
  - sends stronger message
  - but uses up channels

Length, Position, and Luminance
Marks as constraints

- math view: geometric primitives have dimensions

- Points (0D)
- Lines (1D)
- Interlocking Areas (2D)
Marks as constraints

• math view: geometric primitives have dimensions
  • Points: 0D
  • Lines: 1D
  • Interlocking Areas: 2D

• constraint view: mark type constrains what else can be encoded
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- **quick check**: can you size-code another attribute
  - Or is size/shape in use?
Scope of analysis

• simplifying assumptions: one mark per item, single view

• later on
  – multiple views
  – multiple marks in a region (glyph)
  – some items not represented by marks (aggregation and filtering)
When to use which channel?

**expressiveness**
- match channel type to data type

**effectiveness**
- some channels are better than others
Channels: Rankings

Position on common scale
Position on unaligned scale
Length (1D size)
Tilt/angle
Area (2D size)
Depth (3D position)
Color luminance
Color saturation
Curvature
Volume (3D size)

Spatial region
Color hue
Motion
Shape

Same
Channels: Rankings

**Magnitude Channels:** Ordered Attributes

- Position on common scale
- Position on unaligned scale
- Length (1D size)
- Tilt/angle
- Area (2D size)
- Depth (3D position)
- Color luminance
- Color saturation
- Curvature
- Volume (3D size)

**Identity Channels:** Categorical Attributes

- Spatial region
- Color hue
- Motion
- Shape

- **expressiveness**
  - match channel and data characteristics

• expressiveness

- match channel and data characteristics
Channels: Rankings

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- Volume (3D size)

**Identity Channels: Categorical Attributes**
- Spatial region
- Color hue
- Motion
- Shape

**Attribute Types**
- Categorical
- Ordinal
- Quantitative

• **expressiveness**
  - match channel and data characteristics
  - magnitude for ordered
    - how much? which rank?
  - identity for categorical
    - what?
Channels: Rankings

**Magnitude Channels: Ordered Attributes**

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**Identity Channels: Categorical Attributes**

- Spatial region
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**Expressiveness**
- match channel and data characteristics

**Effectiveness**
- channels differ in accuracy of perception
**Channels: Rankings**

- **Magnitude Channels: Ordered Attributes**
  - Position on common scale
  - Position on unaligned scale
  - Length (1D size)
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  - Color luminance
  - Color saturation
  - Curvature
  - Volume (3D size)

- **Identity Channels: Categorical Attributes**
  - Spatial region
  - Color hue
  - Motion
  - Shape

**Expressiveness Types and Effectiveness Ranks**

- **Expressiveness**
  - match channel and data characteristics

- **Effectiveness**
  - channels differ in accuracy of perception
  - spatial position ranks high for both
Channel effectiveness

• accuracy: how precisely can we tell the difference between encoded items?
• discriminability: how many unique steps can we perceive?
• separability: is our ability to use this channel affected by another one?
• popout: can things jump out using this channel?
**Accuracy: Fundamental theory**

- length is accurate: linear
- others magnified or compressed
  - exponent characterizes

Steven’s Psychophysical Power Law: $S = I^N$

- $S = sensation$
- $I = intensity$
Accuracy: Vis experiments

Cleveland & McGill’s Results

Crowdsourced Results

Positions

Angles

Circular areas

Rectangular areas (aligned or in a treemap)

Discriminability: How many usable steps?

• must be sufficient for number of attribute levels to show
  – linewidth: few bins
Separability vs. Integrality

Position
+ Hue (Color)

- Fully separable
  2 groups each

Size
+ Hue (Color)

- Some interference
  2 groups each

Width
+ Height

- Some/significant interference
  3 groups total: integral area

Red
+ Green

- Major interference
  4 groups total: integral hue
Popout

• find the red dot
  – how long does it take?
Popout

• find the red dot
  – how long does it take?
Popout

- find the red dot
  - how long does it take?
Popout

• find the red dot
  – how long does it take?
Popout

• find the red dot
  – how long does it take?
Popout

- find the red dot
  - how long does it take?
Popout

• find the red dot
  – how long does it take?
Popout

• find the red dot
  – how long does it take?

• parallel processing on many individual channels
  – speed independent of distractor count
  – speed depends on channel and amount of difference from distractors

• serial search for (almost all) combinations
  – speed depends on number of distractors
Popout

• many channels
  – tilt, size, shape, proximity, shadow direction, ...
Popout

• many channels
  – tilt, size, shape, proximity, shadow direction, ...

• but not all!
  – parallel line pairs do not pop out from tilted pairs
Factors affecting accuracy

- alignment
- distractors
- distance
- common scale
Relative vs. absolute judgements

• perceptual system mostly operates with relative judgements, not absolute
Relative vs. absolute judgements

• perceptual system mostly operates with relative judgements, not absolute
  – that’s why accuracy increases with common frame/scale and alignment

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Relative vs. absolute judgements

- perceptual system mostly operates with relative judgements, not absolute
  - that’s why accuracy increases with common frame/scale and alignment
  - Weber’s Law: ratio of increment to background is constant

length

position along unaligned common scale

position along aligned scale

Relative vs. absolute judgements

- perceptual system mostly operates with relative judgements, not absolute
  - that’s why accuracy increases with common frame/scale and alignment
  - Weber’s Law: ratio of increment to background is constant
    - filled rectangles differ in length by 1:9, difficult judgement
    - white rectangles differ in length by 1:2, easy judgement

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Relative luminance judgements

• perception of luminance is contextual based on contrast with surroundings

http://persci.mit.edu/gallery/checkershadow
Relative luminance judgements

- perception of luminance is contextual based on contrast with surroundings

http://persci.mit.edu/gallery/checkershadow
Relative color judgements

• color constancy across broad range of illumination conditions

http://www.purveslab.net/seeforyourself/
Relative color judgements

- color constancy across broad range of illumination conditions

http://www.purveslab.net/seeforyourself/
Grouping

- containment
- connection

Marks as Links

- Containment
- Connection

Identity Channels: Categorical Attributes

- Spatial region
- Color hue
- Motion
- Shape
Rules of Thumb Summary

• No unjustified 3D
• No unjustified 2D
• Eyes beat memory
• Resolution over immersion
• Overview first, zoom and filter, details on demand
• Responsiveness is required
• Function first, form next
Unjustified 3D all too common, in the news and elsewhere

http://viz.wtf/post/137826497077/eye-popping-3d-triangles

http://viz.wtf/post/139002022202/designer-drugs-h2-ducqn
Depth vs power of the plane

• high-ranked spatial position channels: **planar spatial position**
  – not depth!

**Magnitude Channels: Ordered Attributes**

- Position on common scale
- Position on unaligned scale
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- Area (2D size)
- Depth (3D position)

Steven’s Psychophysical Power Law: $S = |N$
No unjustified 3D: Danger of depth

• we don’t really live in 3D: we see in 2.05D
  – acquire more info on image plane quickly from eye movements
  – acquire more info for depth slower, from head/body motion

We can only see the outside shell of the world.
Occlusion hides information

- occlusion
- interaction can resolve, but at cost of time and cognitive load

Perspective distortion loses information

- perspective distortion
  - interferes with all size channel encodings
  - power of the plane is lost!

[Visualizing the Results of Multimedia Web Search Engines. Mukherjea, Hirata, and Hara. InfoVis 96]
3D vs 2D bar charts

• 3D bars very difficult to justify!
  – perspective distortion
  – occlusion

• faceting into 2D almost always better choice
Tilted text isn’t legible

• text legibility
  – far worse when tilted from image plane

• further reading


No unjustified 3D example: Time-series data

- extruded curves: detailed comparisons impossible

[Cluster and Calendar based Visualization of Time Series Data. van Wijk and van Selow, Proc. InfoVis 99.]
No unjustified 3D example: Transform for new data abstraction

• derived data: cluster hierarchy
• juxtapose multiple views: calendar, superimposed 2D curves

[Cluster and Calendar based Visualization of Time Series Data. van Wijk and van Selow, Proc. InfoVis 99.]
Justified 3D: shape perception

• benefits outweigh costs when task is shape perception for 3D spatial data
  – interactive navigation supports synthesis across many viewpoints

Justified 3D: Economic growth curve

- constrained navigation steps through carefully designed viewpoints

No unjustified 3D

- 3D legitimate for true 3D spatial data
- 3D needs very careful justification for abstract data
  - enthusiasm in 1990s, but now skepticism
  - be especially careful with 3D for point clouds or networks

No unjustified 2D

• consider whether network data requires 2D spatial layout
  – especially if reading text is central to task!
  – arranging as network means lower information density and harder label lookup compared to text lists

• benefits outweigh costs when topological structure/context important for task
  – be especially careful for search results, document collections, ontologies
Eyes beat memory

• principle: external cognition vs. internal memory
  – easy to compare by moving eyes between side-by-side views
  – harder to compare visible item to memory of what you saw

• implications for animation
  – great for choreographed storytelling
  – great for transitions between two states
  – poor for many states with changes everywhere
    • consider small multiples instead

literal  abstract
animation  small multiples
show time with time  show time with space
Eyes beat memory example: Cerebral

- small multiples: one graph instance per experimental condition
  - same spatial layout
  - color differently, by condition

Why not animation?

• disparate frames and regions: comparison difficult
  – vs contiguous frames
  – vs small region
  – vs coherent motion of group

• safe special case
  – animated transitions
Animation: Blink comparator

- just two contiguous frames is a special case: animation beats side by side
  – blink comparator used to discover Pluto

[Image of two side-by-side images showing star fields]

https://www.sightsize.com/the-blink-comparator/
Animation: Blink comparator

• just two contiguous frames is a special case: animation is great!
  – blink comparator used to discover Pluto

https://www.sightsize.com/the-blink-comparator/
Change blindness

• if attention is directed elsewhere, even drastic changes not noticeable
  – remember door experiment?

• change blindness demos
  – mask in between images
    https://youtu.be/bh_9XFzbVV8
Resolution beats immersion

• immersion typically not helpful for abstract data
  – do not need sense of presence or stereoscopic 3D
  – desktop also better for workflow integration

• resolution much more important: pixels are the scarcest resource

• virtual reality for abstract data difficult to justify thus far
  • but stay tuned with second wave, AR (augmented reality) has more promise

Overview first, zoom and filter, details on demand

• influential mantra from Shneiderman


• overview = summary
  – microcosm of full vis design problem
Rule of thumb: **Responsiveness is required**

- **visual feedback: three rough categories**
  - **0.1 seconds: perceptual processing**
    - subsecond response for mouseover highlighting - ballistic motion
  - **1 second: immediate response**
    - fast response after mouseclick, button press - Fitts’ Law limits on motor control
  - **10 seconds: brief tasks**
    - bounded response after dialog box - mental model of heavyweight operation (file load)

- **scalability considerations**
  - highlight selection without complete redraw of view (graphics frontbuffer)
  - show hourglass for multi-second operations (check for cancel/undo)
  - show progress bar for long operations (process in background thread)
  - rendering speed when item count is large (guaranteed frame rate)
Function first, form next

• start with focus on functionality
  – possible to improve aesthetics later on, as refinement
  – if no expertise in-house, find good graphic designer to work with
  – aesthetics do matter: another level of function
    – visual hierarchy, alignment, flow
    – Gestalt principles in action
      – (not covered in this class)

• dangerous to start with aesthetics
  – usually impossible to add function retroactively
Form: Basic graphic design ideas

• proximity
  – do group related items together
  – avoid equal whitespace between unrelated

• alignment
  – do find/make strong line, stick to it
  – avoid automatic centering

• repetition
  – do unify by pushing existing consistencies

• contrast
  – if not identical, then very different
  – avoid not quite the same

• buy now and read cover to cover - very practical, worth your time, fast read!
Best practices: Labelling

• make visualizations as self-documenting as possible
  – meaningful & useful title, labels, legends
    • axes and panes/subwindows should have labels
      – and axes should have good mix/max boundary tick marks
    • everything that’s plotted should have a legend
      – and own header/labels if not redundant with main title
  • use reasonable numerical format
    – avoid scientific notation in most cases

[https://xkcd.com/833/]
Rules of Thumb Summary

• No unjustified 3D
  – Power of the plane
  – Disparity of depth
  – Occlusion hides information
  – Perspective distortion dangers
  – Tilted text isn’t legible

• No unjustified 2D
• Eyes beat memory
• Resolution over immersion
• Overview first, zoom and filter, details on demand
• Responsiveness is required
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Design Study Methodology
Design Study Methodology

Reflections from the Trenches and from the Stacks

http://www.cs.ubc.ca/labs/imager/tr/2012/dsm/
Methodology for problem-driven work

• definitions

• 9-stage framework

• 32 pitfalls & how to avoid them

• comparison to related methodologies
Lessons learned from the trenches: 21 between us
Design study methodology: definitions

- **Task Clarity**:
  - Crisp
  - Fuzzy

- **Information Location**:
  - Head
  - Computer

- **Not Enough Data**
  - Design study methodology: suitable

- **Algorithm Automation**: possible
9 stage framework
9-stage framework
9-stage framework

discover

design

implement

deploy
9-stage framework

• guidelines: confirm, refine, reject, propose
9-stage framework

PRECONDITION

CORE

ANALYSIS
Design study methodology: 32 pitfalls

- and how to avoid them

| 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 |
I’m a domain expert! Wanna collaborate?

Of course!!!
considerations

Have data? Have time? Have need?

Interesting problem?

...
roles

Are you a user???

... or maybe a fellow tool builder?
Metaphor

Winnowing
Collaborator winnowing

initial conversation (potential collaborators)
Collaborator winnowing

initial conversation

further meetings
Collaborator winnowing

- initial conversation
- further meetings
- prototyping
Collaborator winnowing

- initial conversation
- further meetings
- prototyping
- full collaboration

collaborator
Collaborator winnowing

Talk with many, stay with few!
EXAMPLE FROM THE TRENCHES

Premature Collaboration!

PowerSet Viewer
2 years / 4 researchers

WikeVis
0.5 years / 2 researchers
EXAMPLE FROM THE TRENCHES

Premature Collaboration!

PowerSet Viewer
2 years / 4 researchers

WikeVis
0.5 years / 2 researchers

- Fellow tool builders
- Data promised
Design study methodology: 32 pitfalls

| PF-10 | no real/important/recurring task | winnow |
| PF-11 | no rapport with collaborators     | winnow |
| PF-12 | not identifying front line analyst and gatekeeper before start | cast |
| PF-13 | assuming every project will have the same role distribution | cast |
| PF-14 | mistaking fellow tool builders for real end users | cast |
| PF-15 | ignoring practices that currently work well | discover |
| PF-16 | expecting *just talking or fly on wall* to work | discover |
| PF-17 | experts focusing on visualization design vs. domain problem | discover |
| PF-18 | learning their problems/language: too little / too much | discover |
| PF-19 | abstraction: too little | design |
| PF-20 | premature design commitment: consideration space too small | design |
Of course they need the cool technique I built last year!
METAPHOR

Design Space

+ good
○ okay
- poor
METAPHOR

Design Space

+ good
○ okay
- poor

your technique...
Metaphor

Design Space

know
METAPHOR
Design Space

know
consider
METAPHOR

Design Space

know
consider
propose
select
Think broad!
<table>
<thead>
<tr>
<th>PF-21</th>
<th>mistaking technique-driven for problem-driven work</th>
<th>design</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF-22</td>
<td>nonrapid prototyping</td>
<td>implement</td>
</tr>
<tr>
<td>PF-23</td>
<td>usability: too little / too much</td>
<td>implement</td>
</tr>
<tr>
<td>PF-24</td>
<td>premature end: insufficient deploy time built into schedule</td>
<td>deploy</td>
</tr>
<tr>
<td>PF-25</td>
<td>usage study not case study: non-real task/data/user</td>
<td>deploy</td>
</tr>
<tr>
<td>PF-26</td>
<td><em>liking</em> necessary but not sufficient for validation</td>
<td>deploy</td>
</tr>
<tr>
<td>PF-27</td>
<td>failing to improve guidelines: confirm, refine, reject, propose</td>
<td>reflect</td>
</tr>
<tr>
<td>PF-28</td>
<td>insufficient writing time built into schedule</td>
<td>write</td>
</tr>
<tr>
<td>PF-29</td>
<td>no technique contribution ≠ good design study</td>
<td>write</td>
</tr>
<tr>
<td>PF-30</td>
<td>too much domain background in paper</td>
<td>write</td>
</tr>
<tr>
<td>PF-31</td>
<td>story told chronologically vs. focus on final results</td>
<td>write</td>
</tr>
<tr>
<td>PF-32</td>
<td>premature end: win race vs. practice music for debut</td>
<td>write</td>
</tr>
</tbody>
</table>
I can write a design study paper in a week!

“writing is research” [Wolcott: Writing up qualitative research, 2009]
METAPHOR

Horse Race vs. Music Debut

Must be first!

Am I ready?

technique-driven

problem-driven
EXAMPLE FROM THE TRENCHES

Don’t step on your own toes!

First design round published

Subsequent work not stand-alone paper

**AutobahnVis 1.0**
[Sedlmair et al., Smart Graphics, 2009]

**AutobahnVis 2.0**
[Sedlmair et al., Information Visualization 10(3), 2011]
Reflections from the stacks: Wholesale adoption inappropriate

- ethnography
  - rapid, goal-directed fieldwork

- grounded theory
  - not empty slate: vis background is key

- action research
  - aligned
    - intervention as goal
    - transferability not reproducibility
    - personal involvement is key
  - opposition
    - translation of participant concepts into visualization language
    - researcher lead not facilitate design
    - orthogonal to vis concerns: participants as writers, adversarial to status quo, postmodernity