DESIGN STUDY METHODOLOGY:
Reflections from the Trenches and the Stacks

Michael Sedlmair, Miriah Meyer, Tamara Munzner

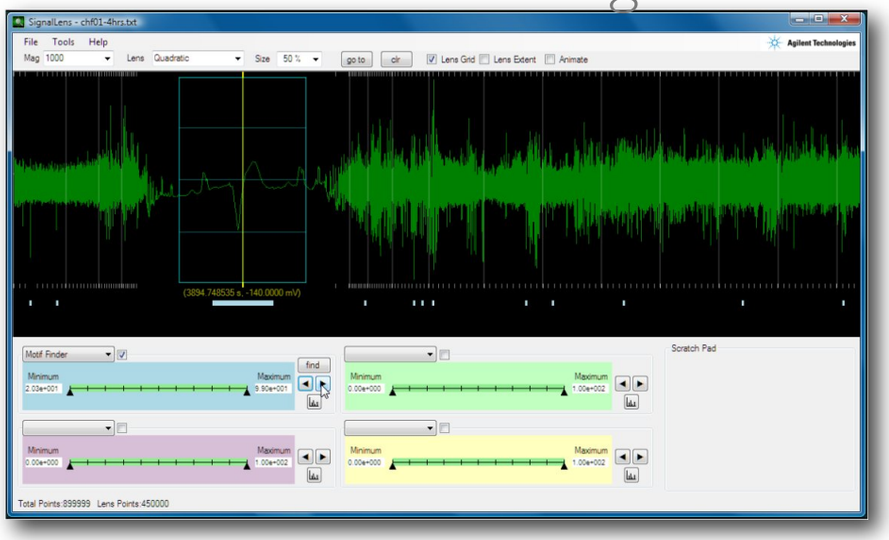
UBC University of British Columbia

University of Utah

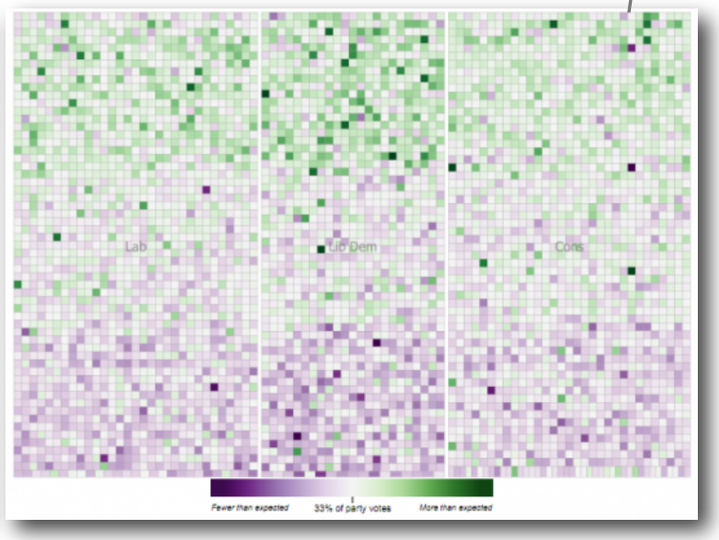
Design Studies

Popular

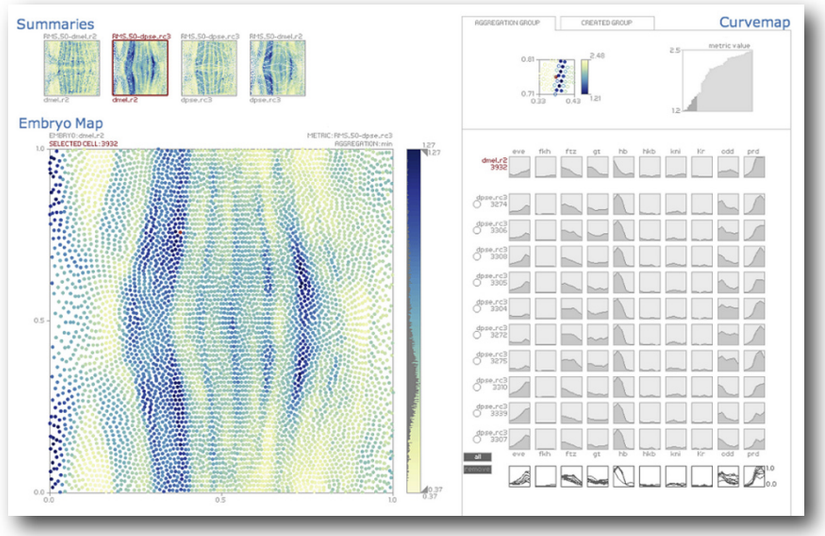
SignalLens



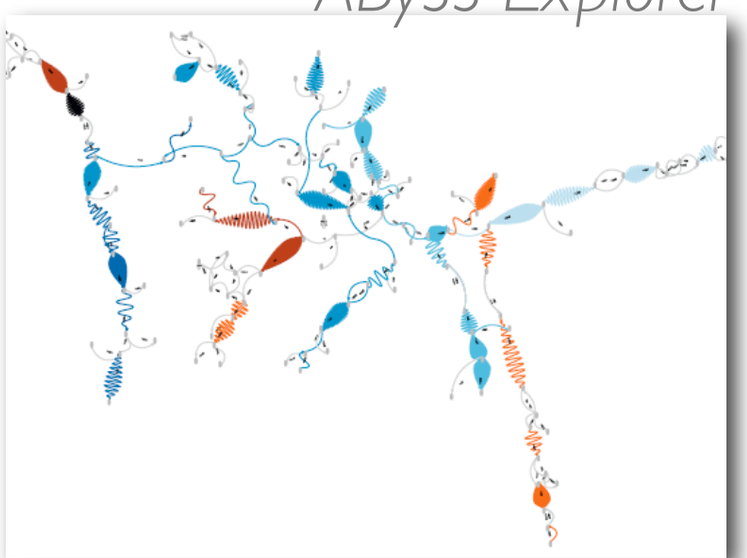
BallotMaps



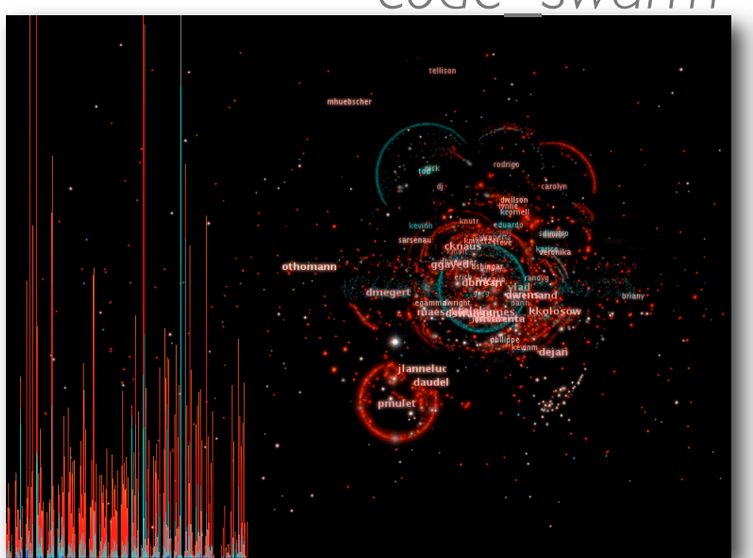
MulteeSum



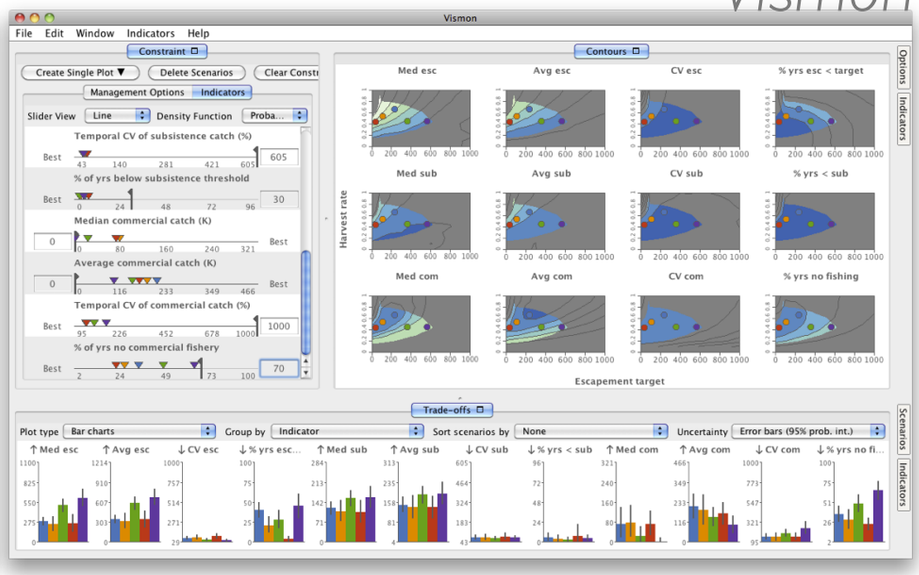
ABySS-Explorer



code_swarm

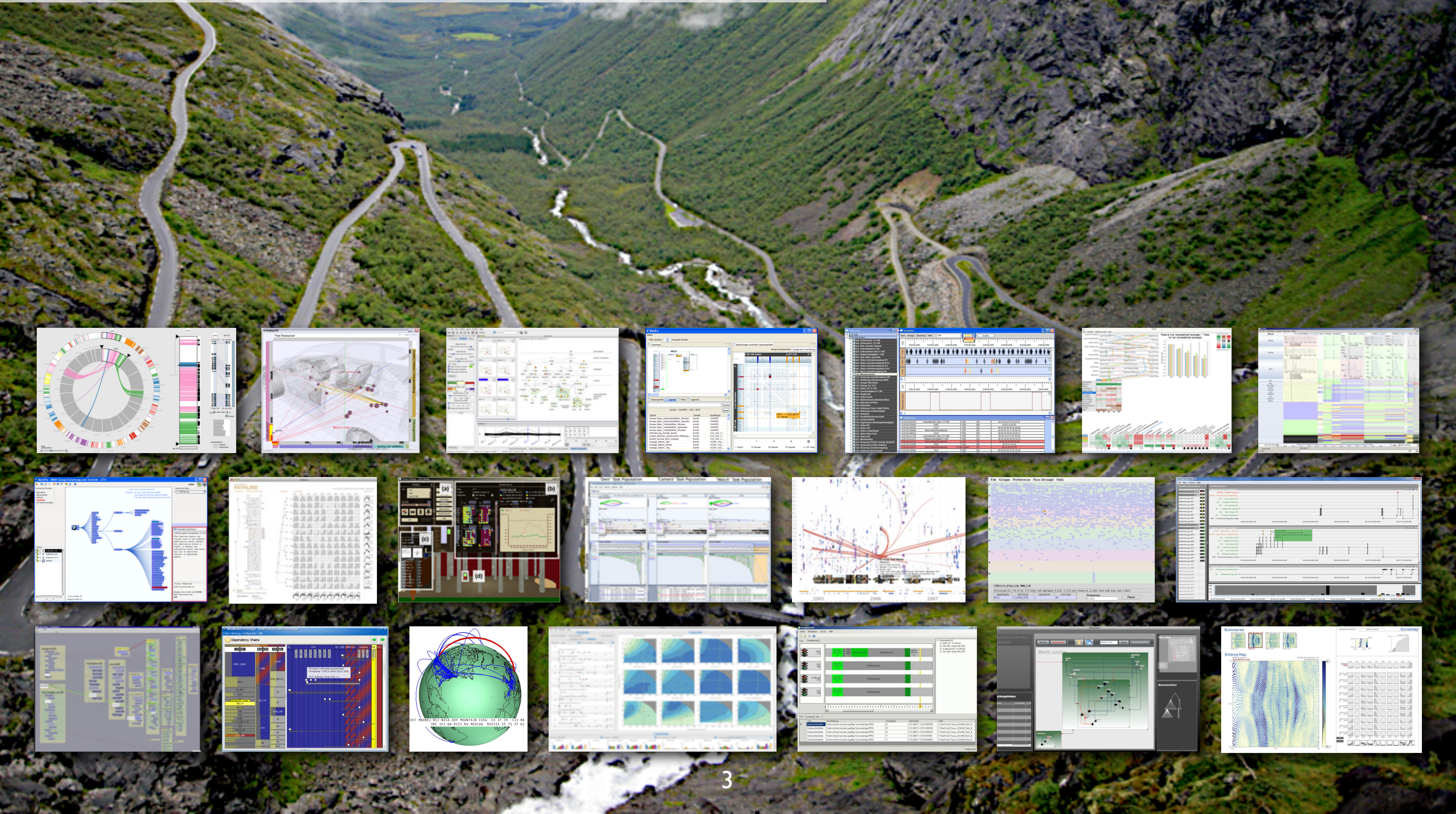


Vismon



Design Studies

Hard!



Design Studies

How to?

Methods

Methodology

http://www.air-n-water.com/blog/quick-summer-meal/
http://manwifeanddog.com/2012/05/05/a-homemade-recipe-for-a-happy-wife/

Design Studies

How to?

Good ingredients

Methods

Methodology

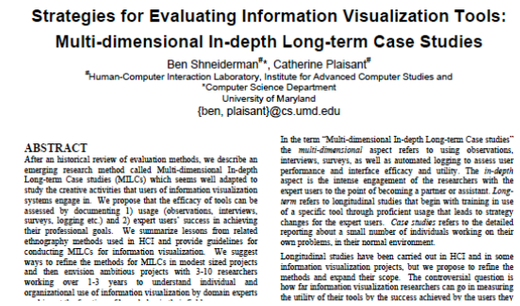
http://www.air-n-water.com/blog/quick-summer-meal/
http://manwifeanddog.com/2012/05/05/a-homemade-recipe-for-a-happy-wife/

Design Studies

How to: Methods

Data Sketches

[Lloyd and Dykes, InfoVis 2011]



Strategies for Evaluating Information Visualization Tools: Multi-dimensional In-depth Long-term Case Studies

Ben Shneiderman#*, Catherine Plaisant#
#Human-Computer Interaction Laboratory, Institute for Advanced Computer Studies and
*Computer Science Department
University of Maryland
{ben, plaisant}@cs.umd.edu

ABSTRACT
After an historical review of evaluation methods, we describe an emerging research method called Multi-dimensional In-depth Long-term Case studies (MILCs) which seems well adapted to study the creative activities that users of information visualization systems engage in. We propose that the efficacy of tools can be assessed by documenting 1) usage (observations, interviews, surveys, logging etc.) and 2) expert users' success in achieving their professional goals. We summarize lessons from related ethnography methods used in HCI and provide guidelines for conducting MILCs for information visualization. We suggest ways to refine the methods for MILCs in modest sized projects and then envision ambitious projects with 3-10 researchers working over 1-3 years to understand individual and organizational use of information visualization by domain experts

In the term "Multi-dimensional In-depth Long-term Case studies" the *multi-dimensional* aspect refers to using observations, interviews, surveys, as well as automated logging to assess user performance and interface efficacy and utility. The *in-depth* aspect is the intense engagement of the researchers with the expert users to the point of becoming a partner or assistant. *Long-term* refers to longitudinal studies that begin with training in use of a specific tool through proficient usage that leads to strategy changes for the expert users. *Case studies* refers to the detailed reporting about a small number of individuals working on their own problems, in their normal environment.

Longitudinal studies have been carried out in HCI and in some information visualization projects, but we propose to refine the methods and expand their scope. The controversial question is how far information visualization researchers can go in measuring the utility of their tools by the success achieved by the users they

MILCs

[Shneiderman and Plaisant, BELIV 2006]

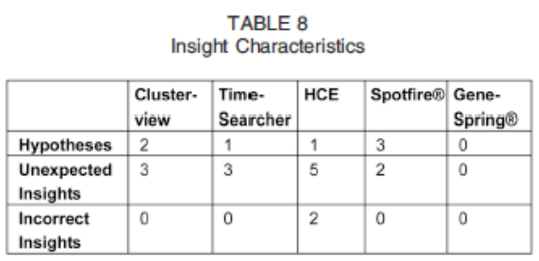


TABLE 8
Insight Characteristics

	Cluster-view	Time-Searcher	HCE	Spotfire®	Gene-Spring®
Hypotheses	2	1	1	3	0
Unexpected Insights	3	3	5	2	0
Incorrect Insights	0	0	2	0	0

Insight-Based

[Sarayia et al., TVCG 2005]

Design Studies

How to: Methodology

Methods

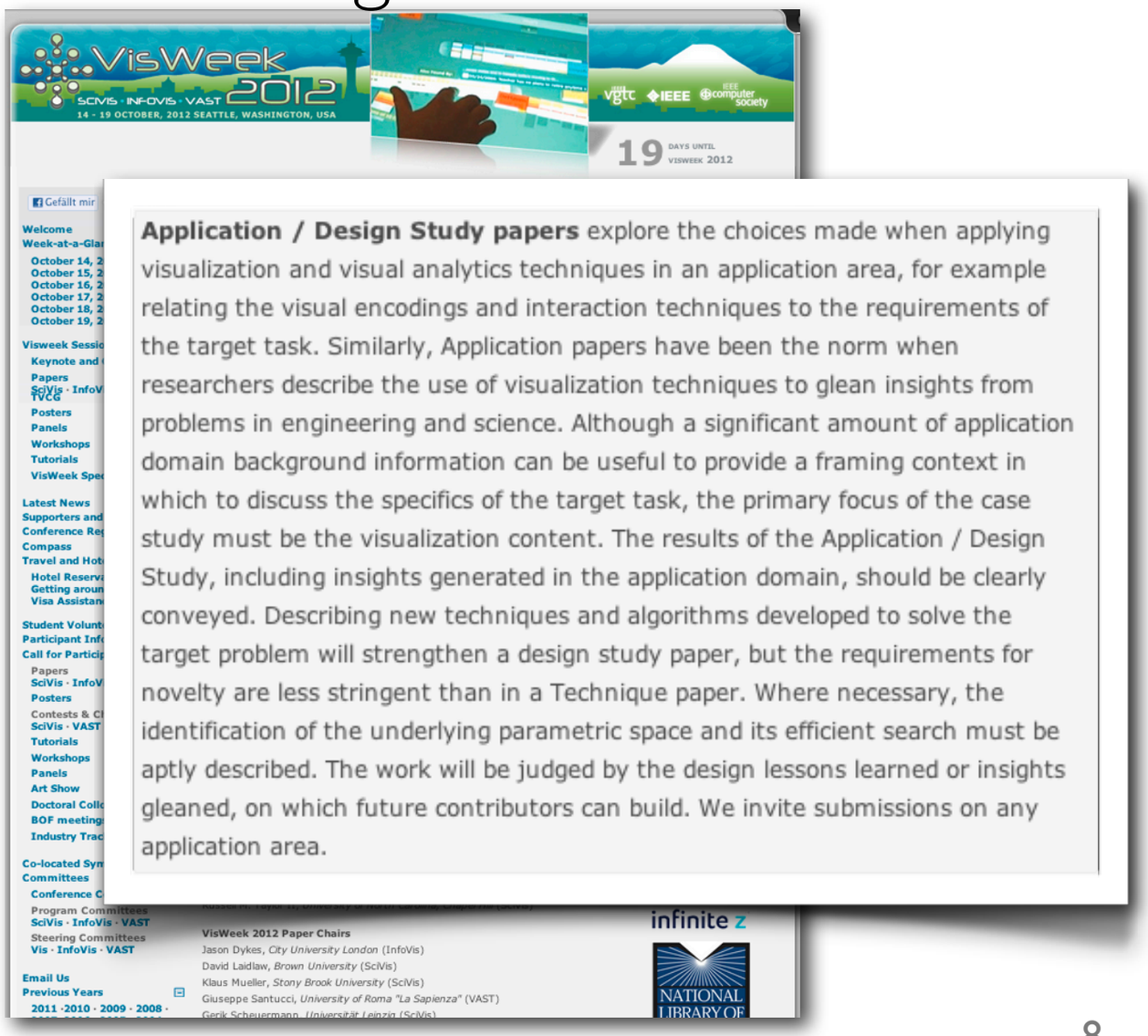
Methodology

http://www.air-n-water.com/blog/quick-summer-meal/
http://manwifeanddog.com/2012/05/05/a-homemade-recipe-for-a-happy-wife/

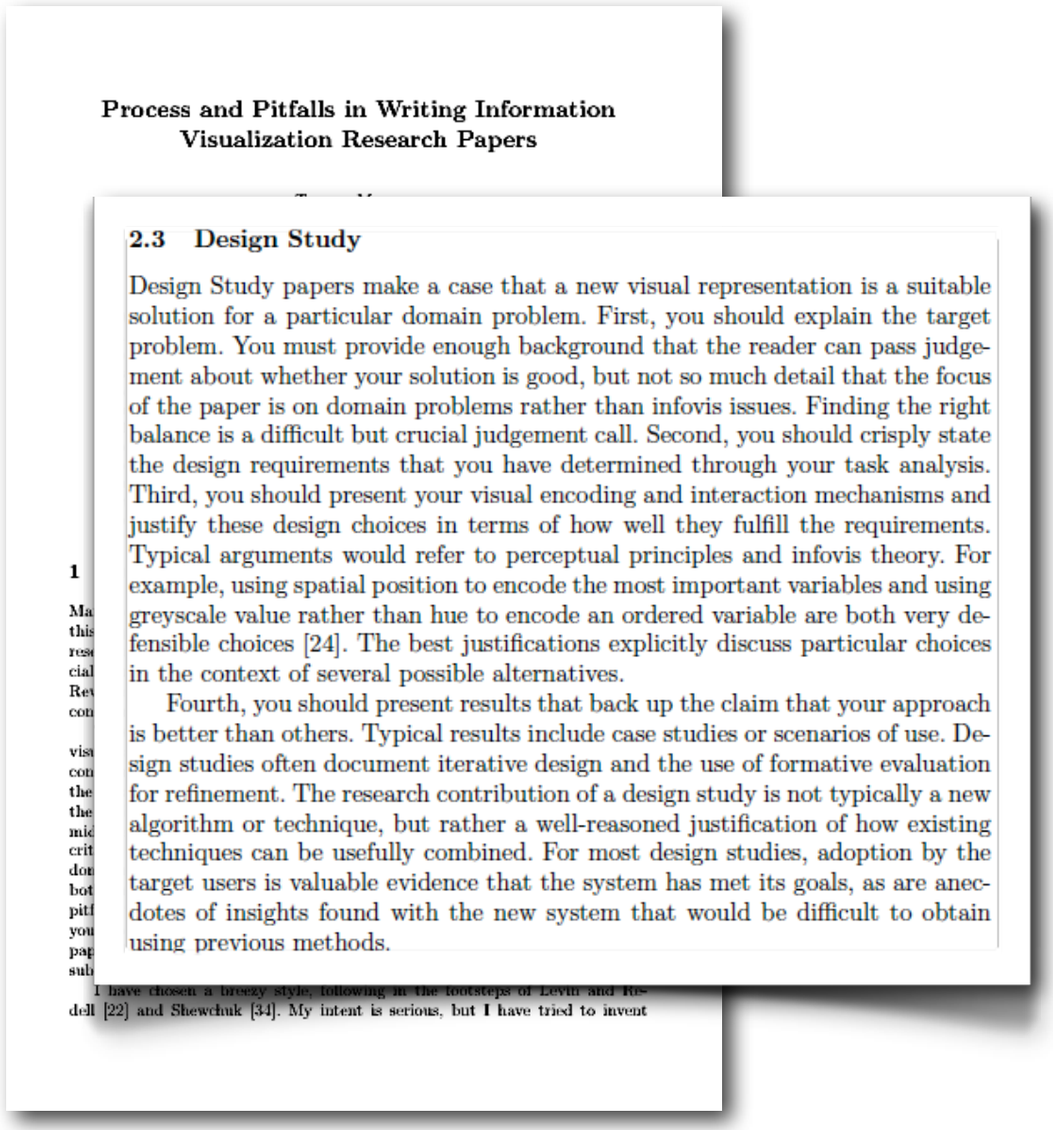
Design Studies

Three paragraphs!

visweek.org



Munzner 2008


Process and Pitfalls in Writing Information Visualization Research Papers

2.3 Design Study

Design Study papers make a case that a new visual representation is a suitable solution for a particular domain problem. First, you should explain the target problem. You must provide enough background that the reader can pass judgement about whether your solution is good, but not so much detail that the focus of the paper is on domain problems rather than infovis issues. Finding the right balance is a difficult but crucial judgement call. Second, you should crisply state the design requirements that you have determined through your task analysis. Third, you should present your visual encoding and interaction mechanisms and justify these design choices in terms of how well they fulfill the requirements. Typical arguments would refer to perceptual principles and infovis theory. For example, using spatial position to encode the most important variables and using greyscale value rather than hue to encode an ordered variable are both very defensible choices [24]. The best justifications explicitly discuss particular choices in the context of several possible alternatives.

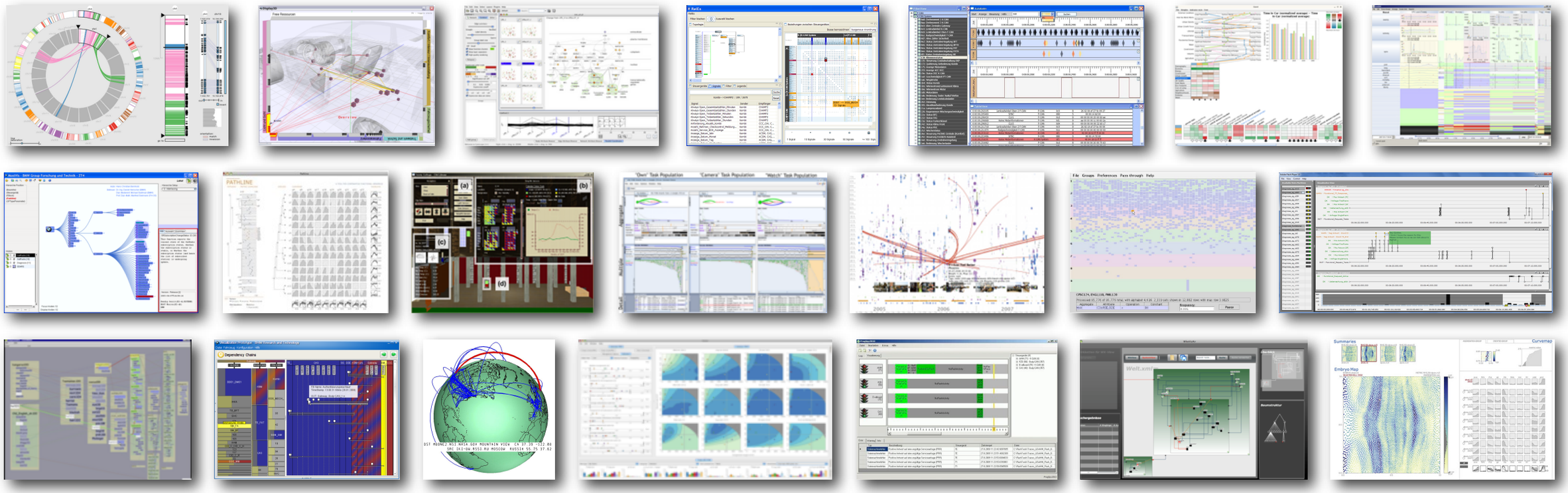
Fourth, you should present results that back up the claim that your approach is better than others. Typical results include case studies or scenarios of use. Design studies often document iterative design and the use of formative evaluation for refinement. The research contribution of a design study is not typically a new algorithm or technique, but rather a well-reasoned justification of how existing techniques can be usefully combined. For most design studies, adoption by the target users is valuable evidence that the system has met its goals, as are anecdotes of insights found with the new system that would be difficult to obtain using previous methods.

Goal

Design Study Methodology

Reflections …

…from the trenches



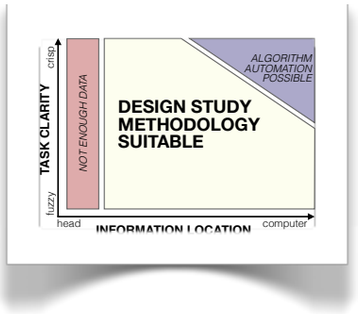
+ reading/reviewing

Reflections ...

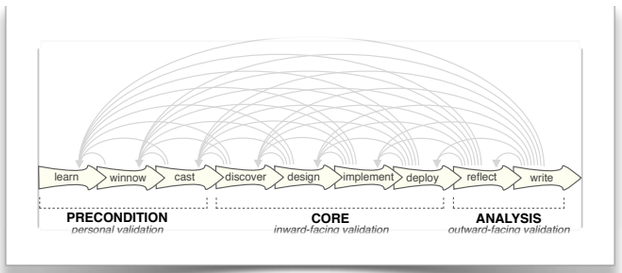
...and the stacks

http://www.freegreatpicture.com/city-impression/trinity-college-dublin-the-old-library-14885

CONTRIBUTIONS



Definitions



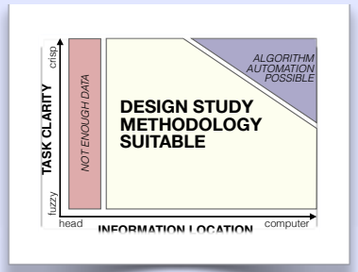
9-stage framework

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

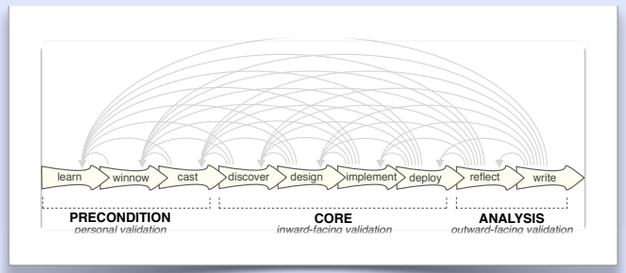
32 pitfalls

Comparison to related methodologies

CONTRIBUTIONS



Definitions



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32 pitfalls

Comparison to related methodologies

Wholesale adoption inappropriate

Definition

What is a Design Study?

Our Definition

Design Study

- a project
- a specific real-world problem
- design a visualization system
- validate the design
- reflect about lessons learned

not a paper

Design Study

- a **project**
- a specific real-world problem
- design a visualization system
- validate the design
- reflect about lessons learned

real users and real data,
collaboration is (often) fundamental

Design Study

- a project
- a specific **real-world** problem
- design a visualization system
- validate the design
- reflect about lessons learned

implications: requirements, multiple ideas

Design Study

- a project
- a specific real-world problem
- **design** a visualization system
- validate the design
- reflect about lessons learned

from problem characterization through final tool

Design Study

- a project
- a specific real-world problem
- design a visualization system
- **validate** the design
- reflect about lessons learned

improve design guidelines

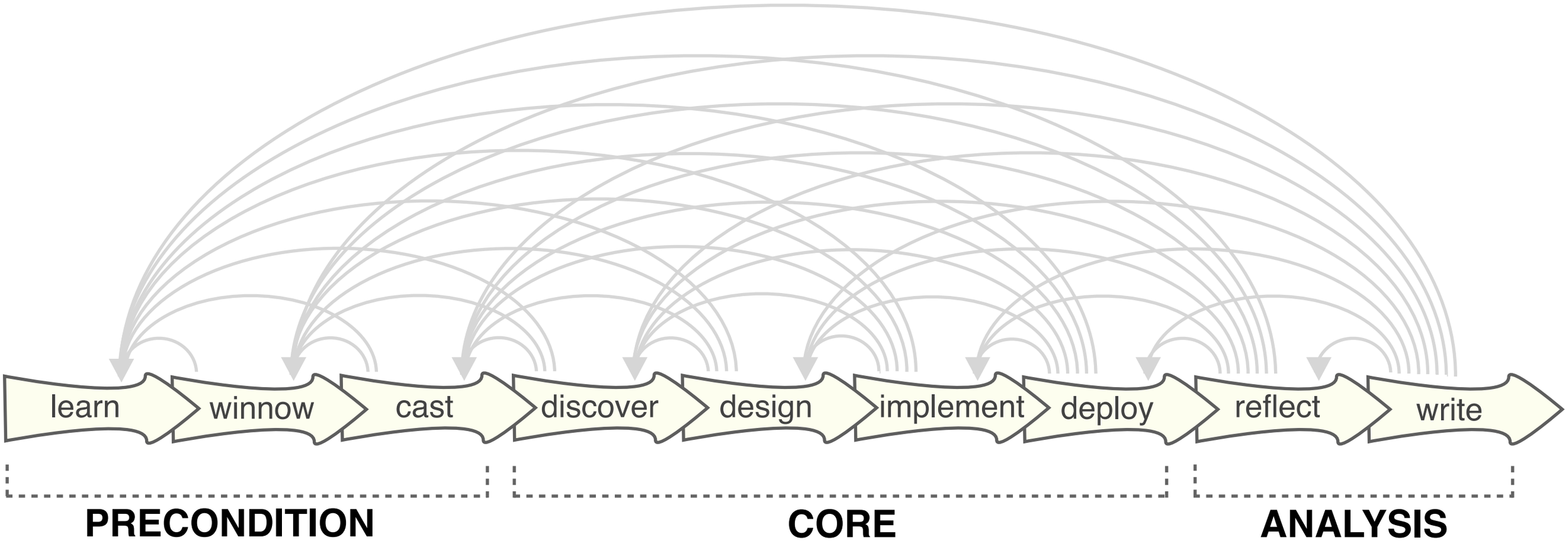
[see also Meyer, Sedlmair, and Munzner, BELIV 2012]

Design Study

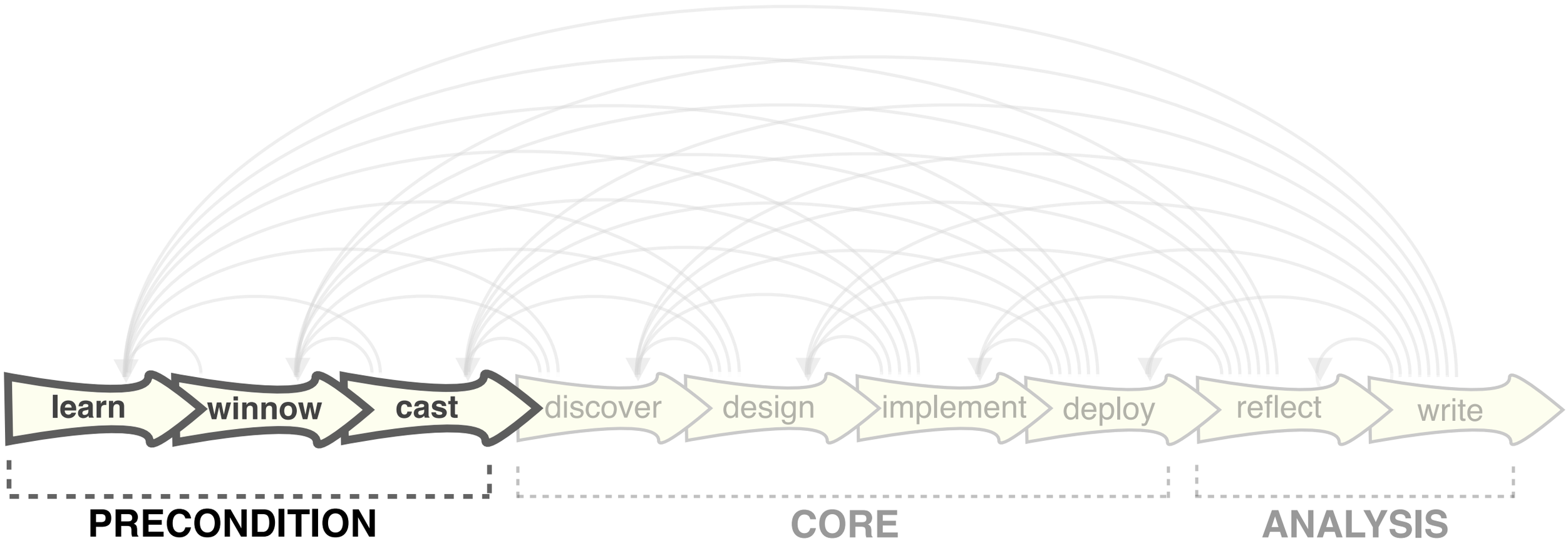
- a project
- a specific real-world problem
- design a visualization system
- validate the design
- **reflect** about lessons learned

The 9-stage Framework

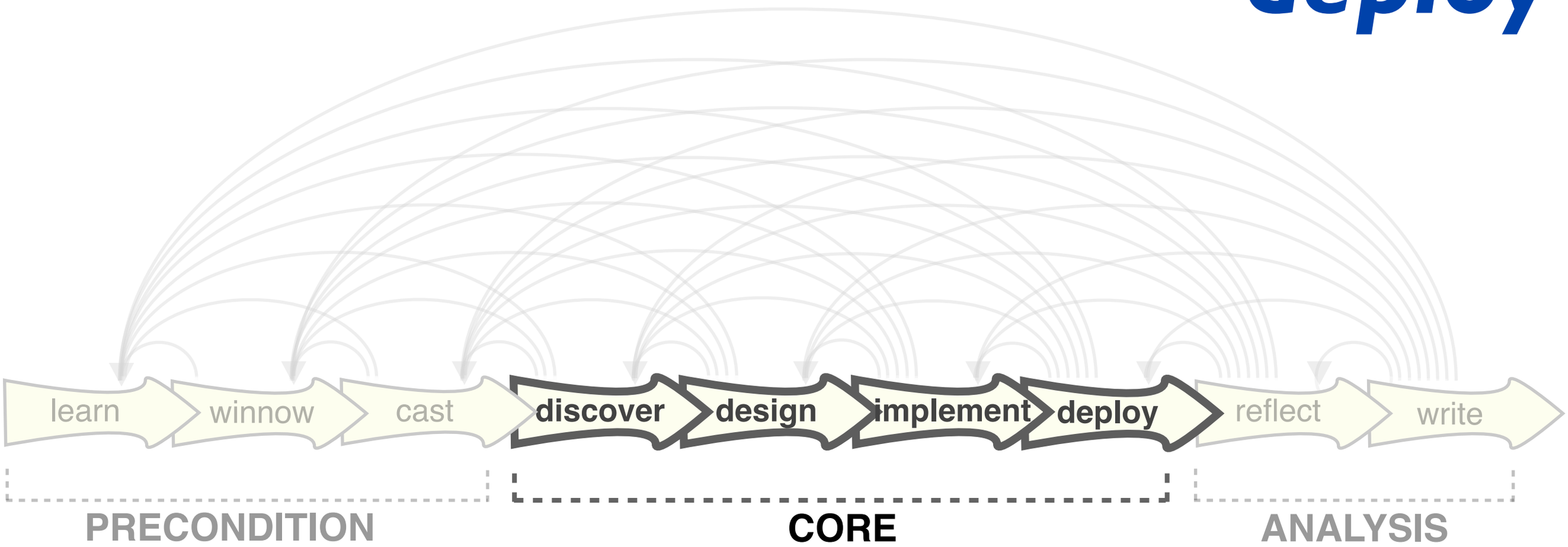
How to do a Design Study?


learn
winnow
cast
discover
design
implement
deploy
reflect
write
PRECONDITION
CORE
ANALYSIS

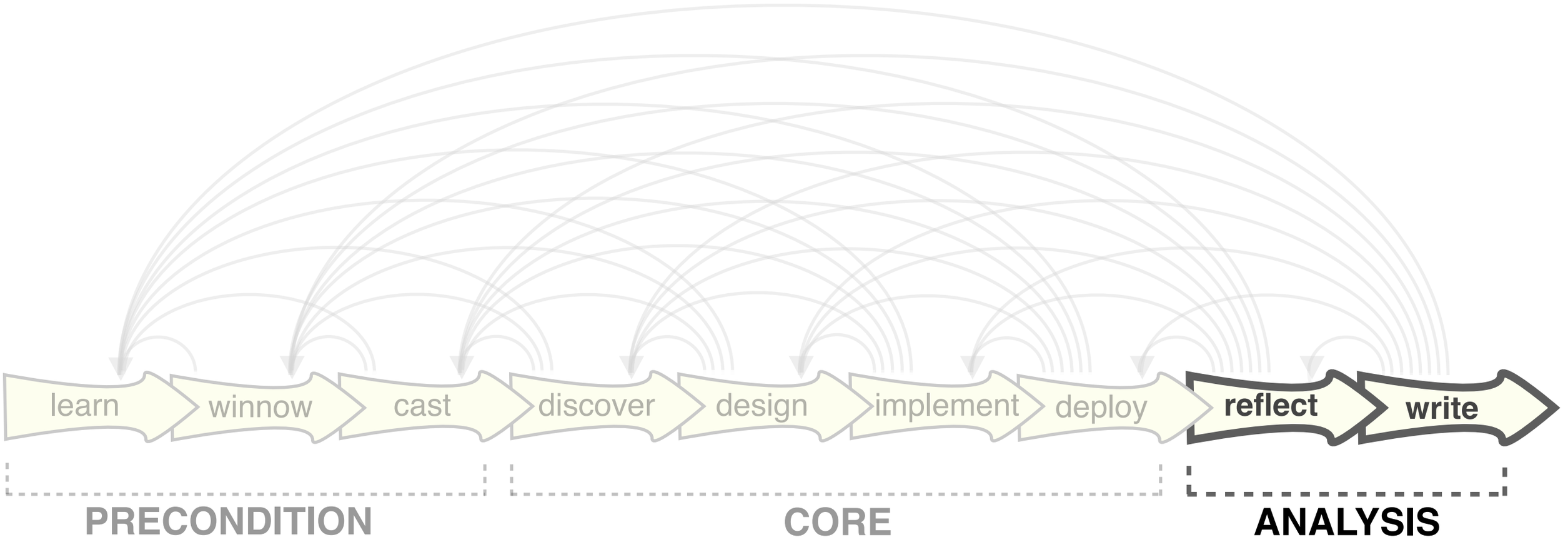
learn
winnow
cast



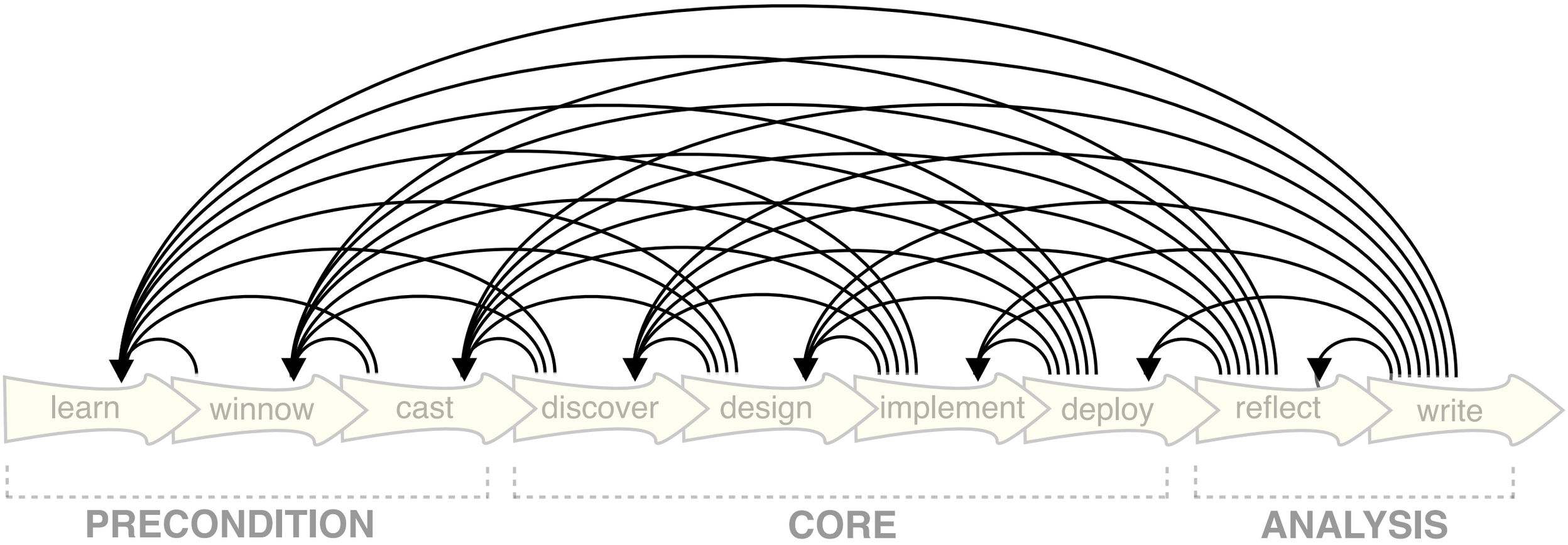
discover
design
implement
deploy



reflect
write



iterative

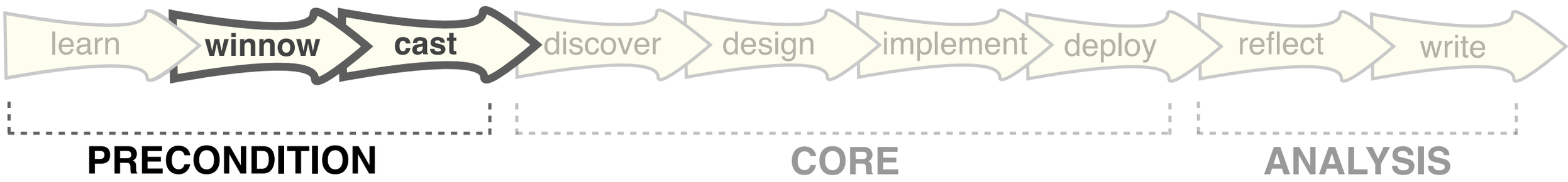

learn
winnow
cast
discover
design
implement
deploy
reflect
write
PRECONDITION
CORE
ANALYSIS

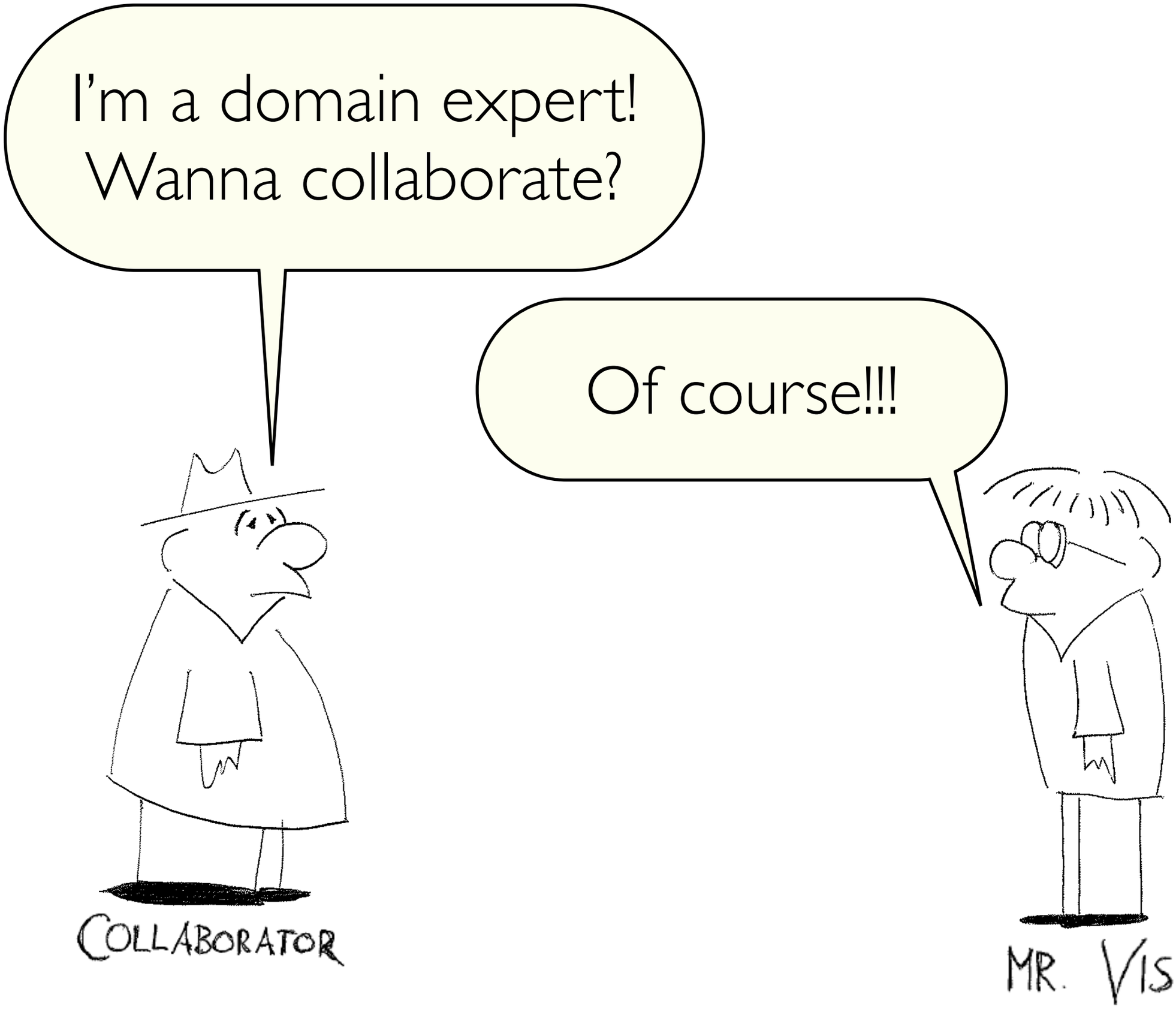
Selected Pitfalls

What to avoid?

Pitfall

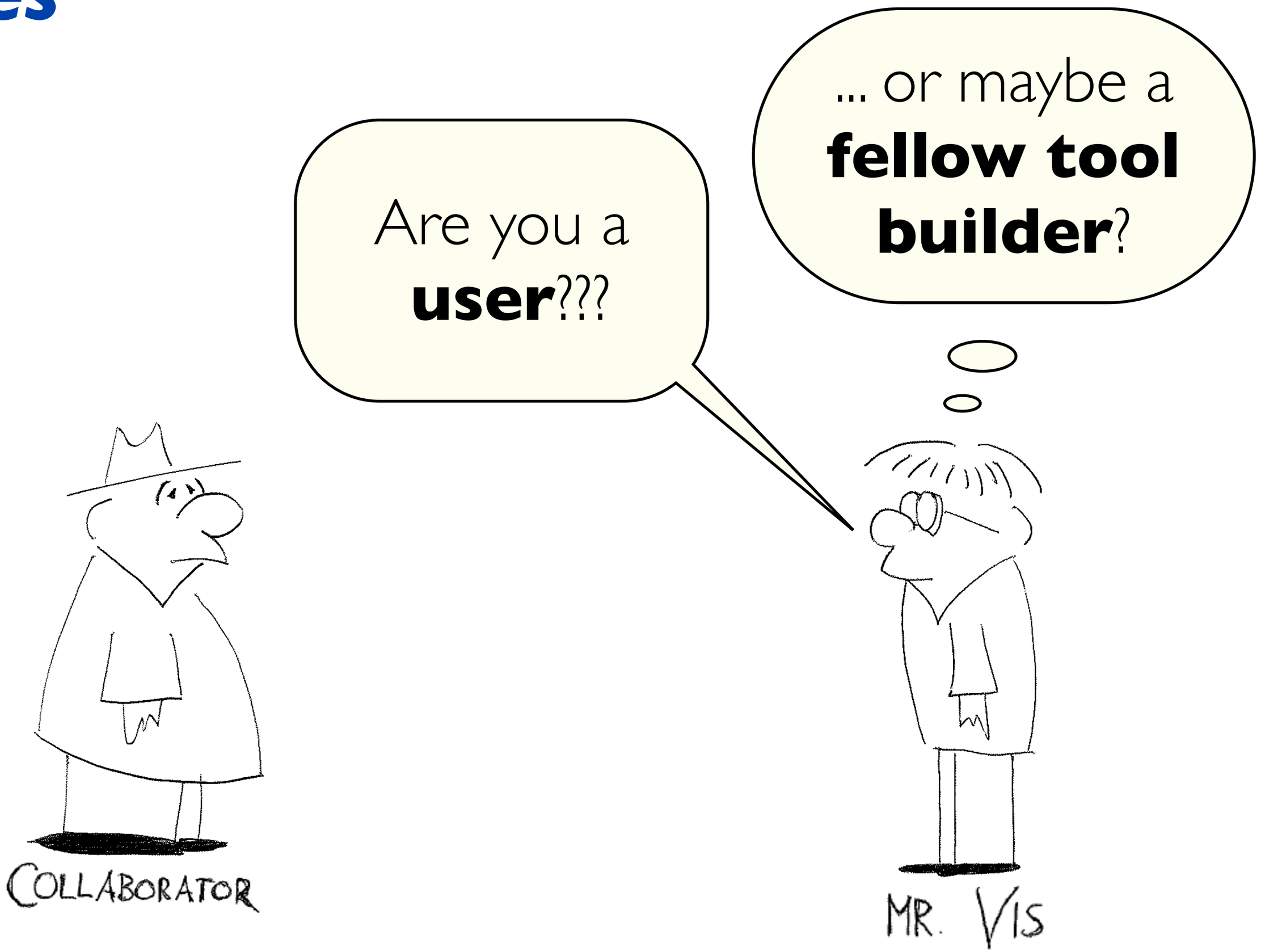
Premature Collaboration




I'm a domain expert!
Wanna collaborate?
Of course!!!
COLLABORATOR
MR. VIS

considerations

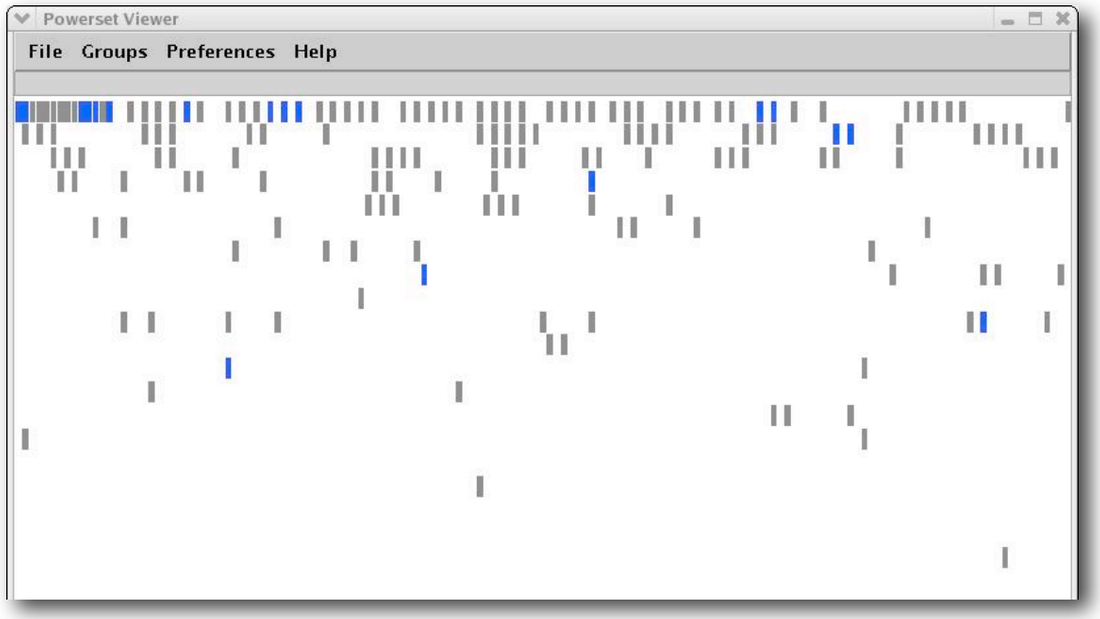
roles


Are you a **user**???
... or maybe a **fellow tool builder**?
COLLABORATOR
MR. VIS

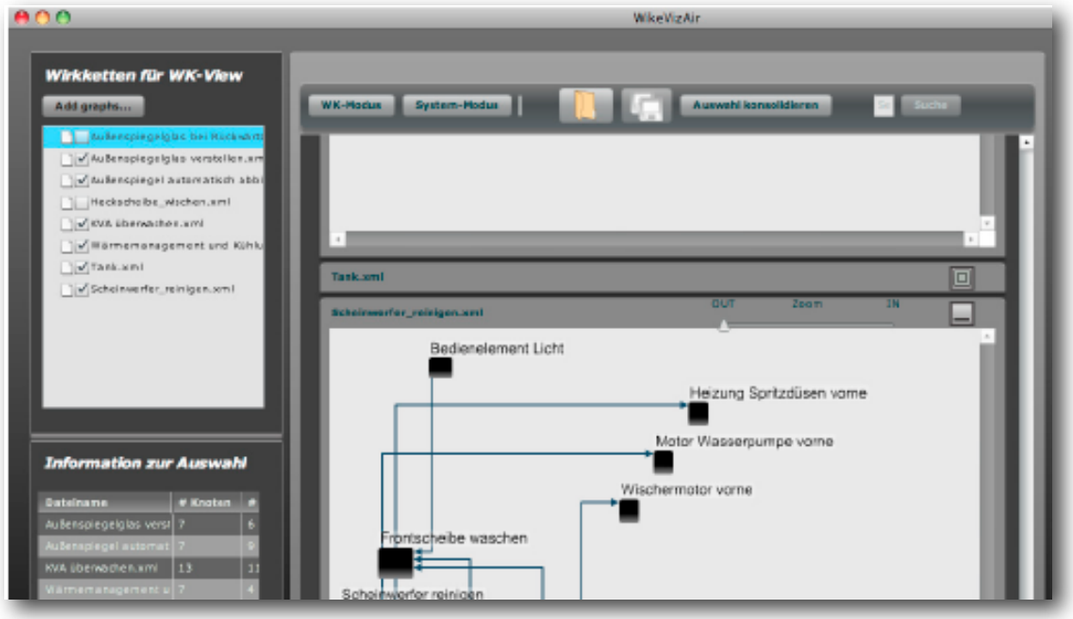
Example From The Trenches

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

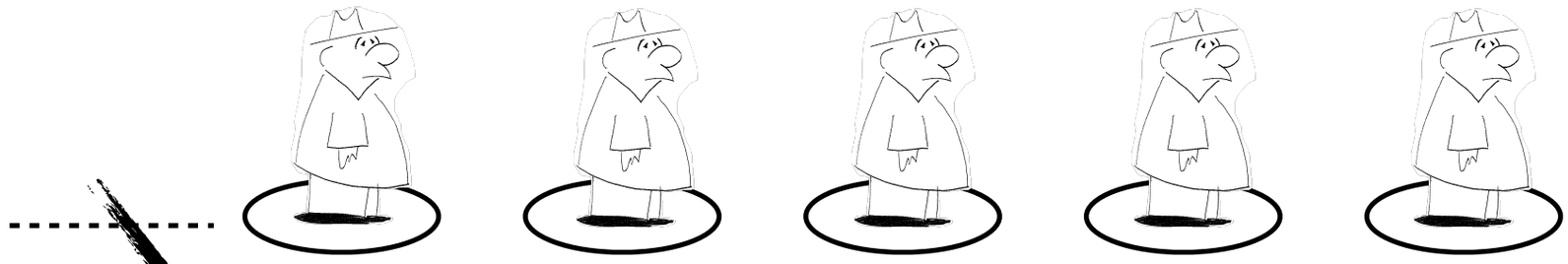
WikeVis
0.5 years / 2 researchers

- Fellow tool builders
- Data promised

Metaphor
Winnowing

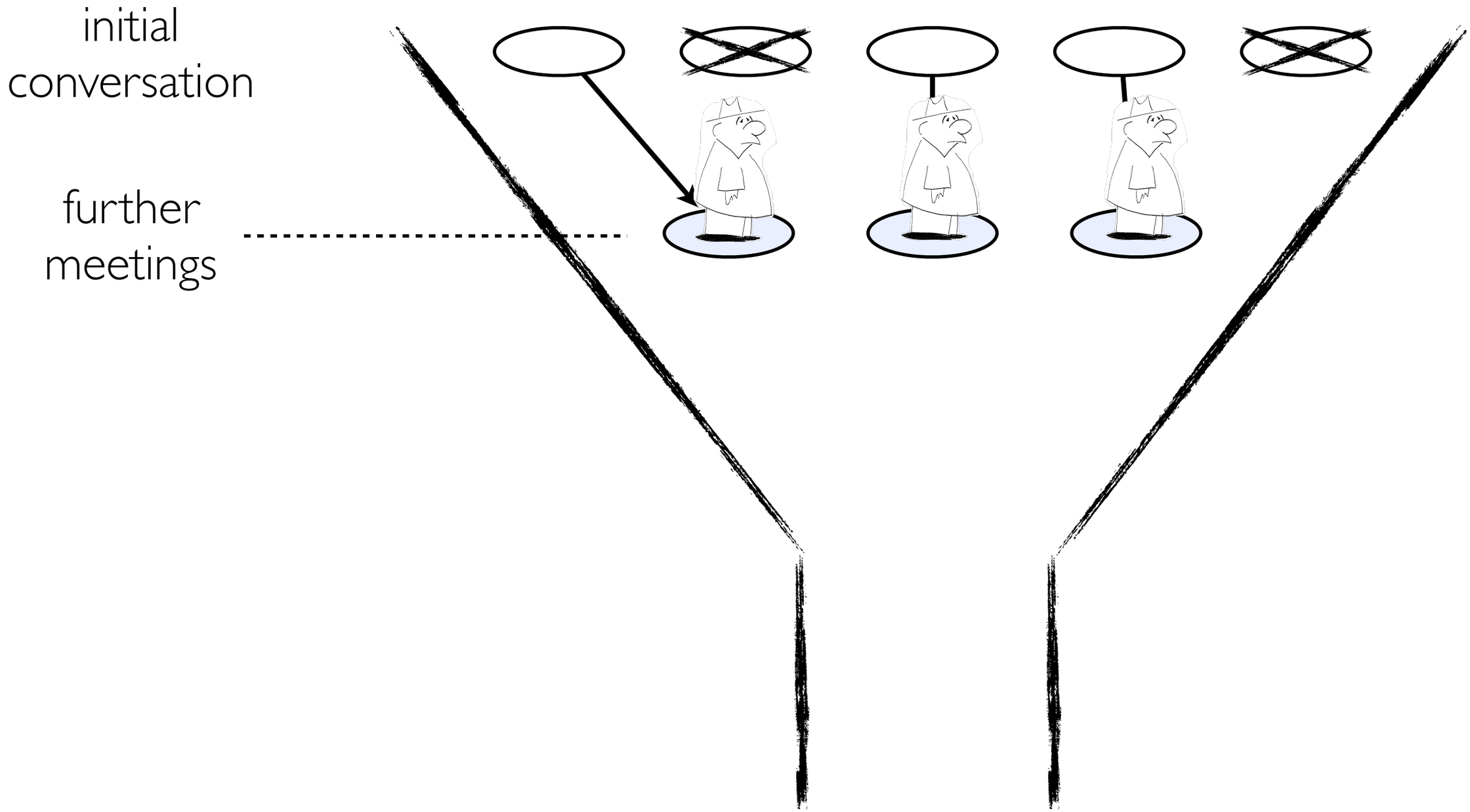
COLLABORATOR WINNOWING

initial conversation



(potential collaborators)

Collaborator Winnowing

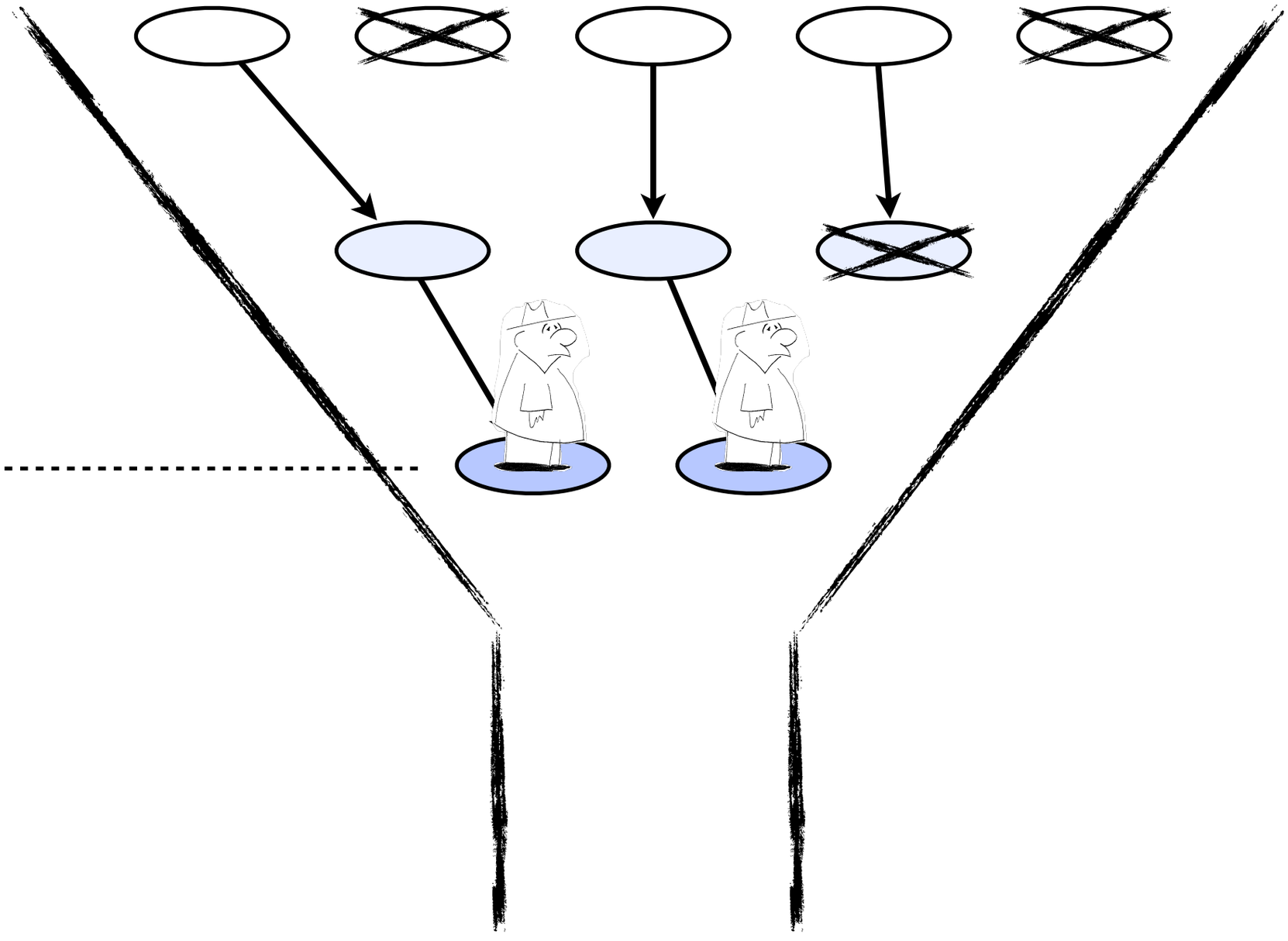


Collaborator Winnowing

initial conversation

further meetings

prototyping



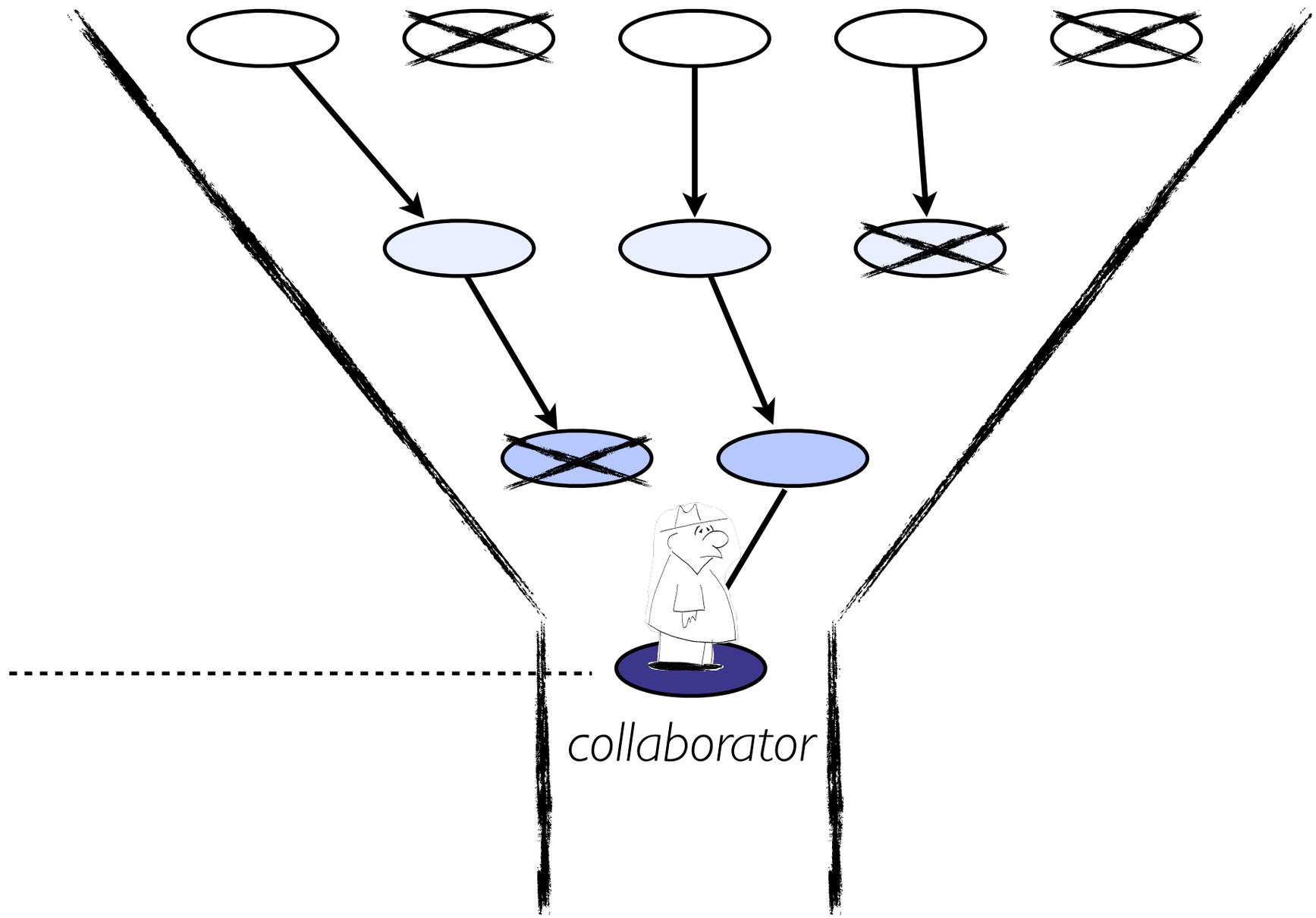
COLLABORATOR WINNOWING

initial conversation

further meetings

prototyping

full collaboration

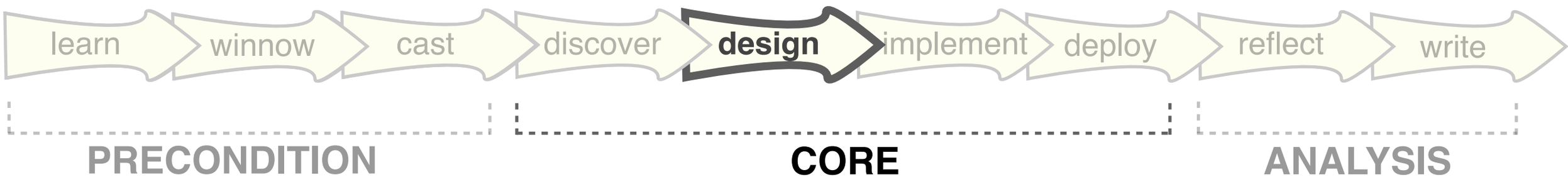


Collaborator Winnowing

Talk with many, stay with few!

Pitfall

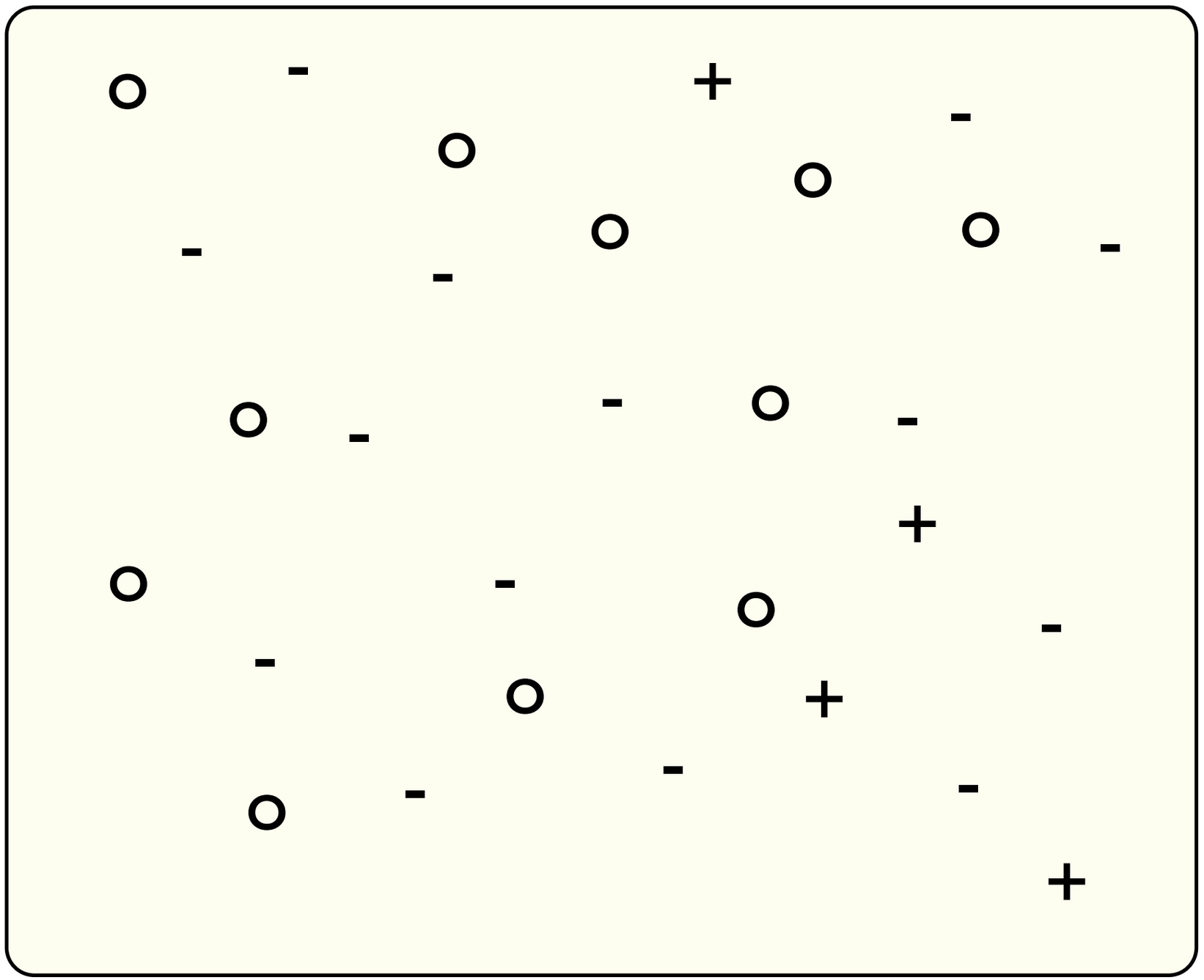
Premature Design Commitment



Of course they need the cool **technique** I built last year!

Metaphor

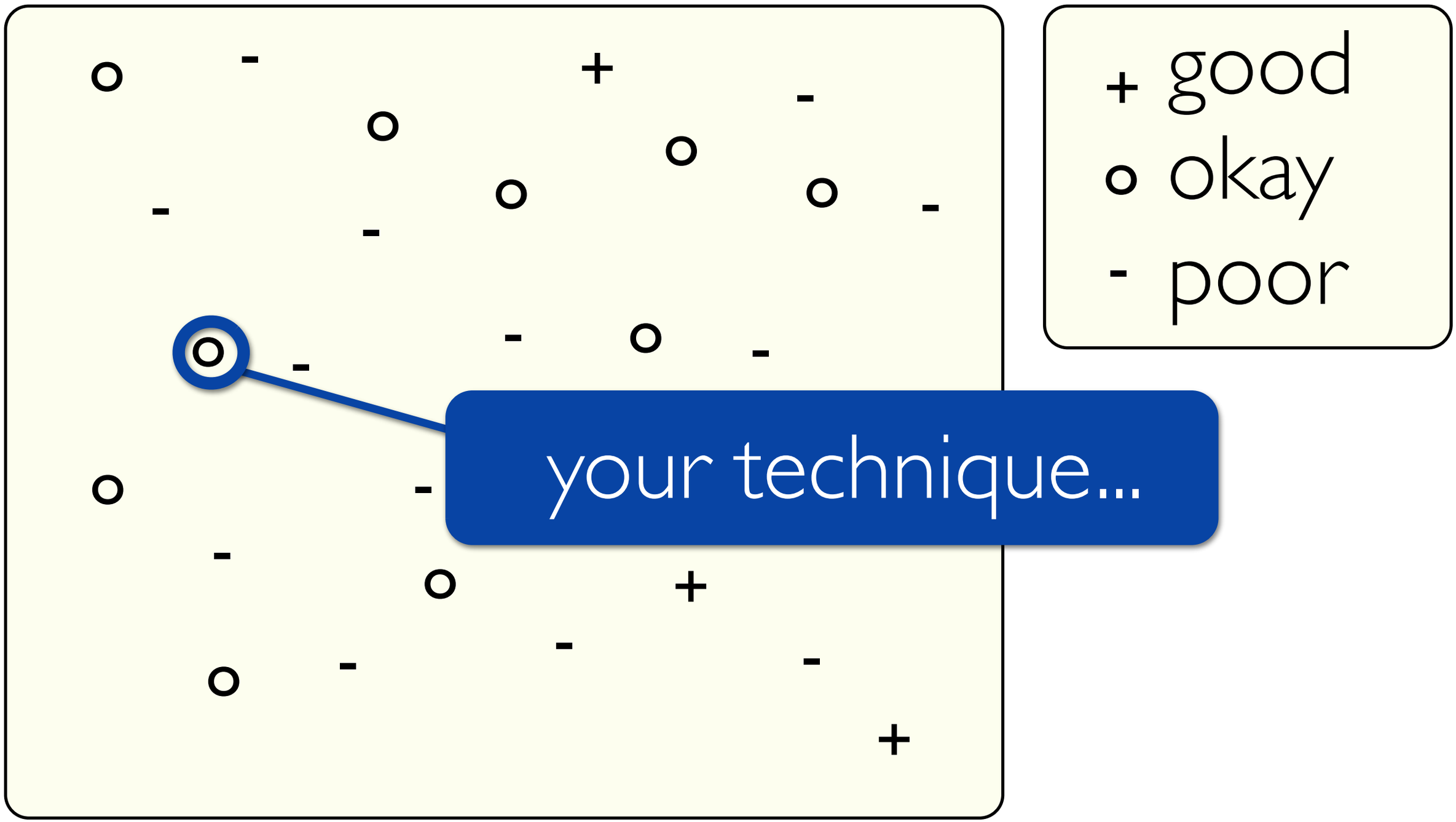
Design Space



+ good
o okay
- poor

Metaphor

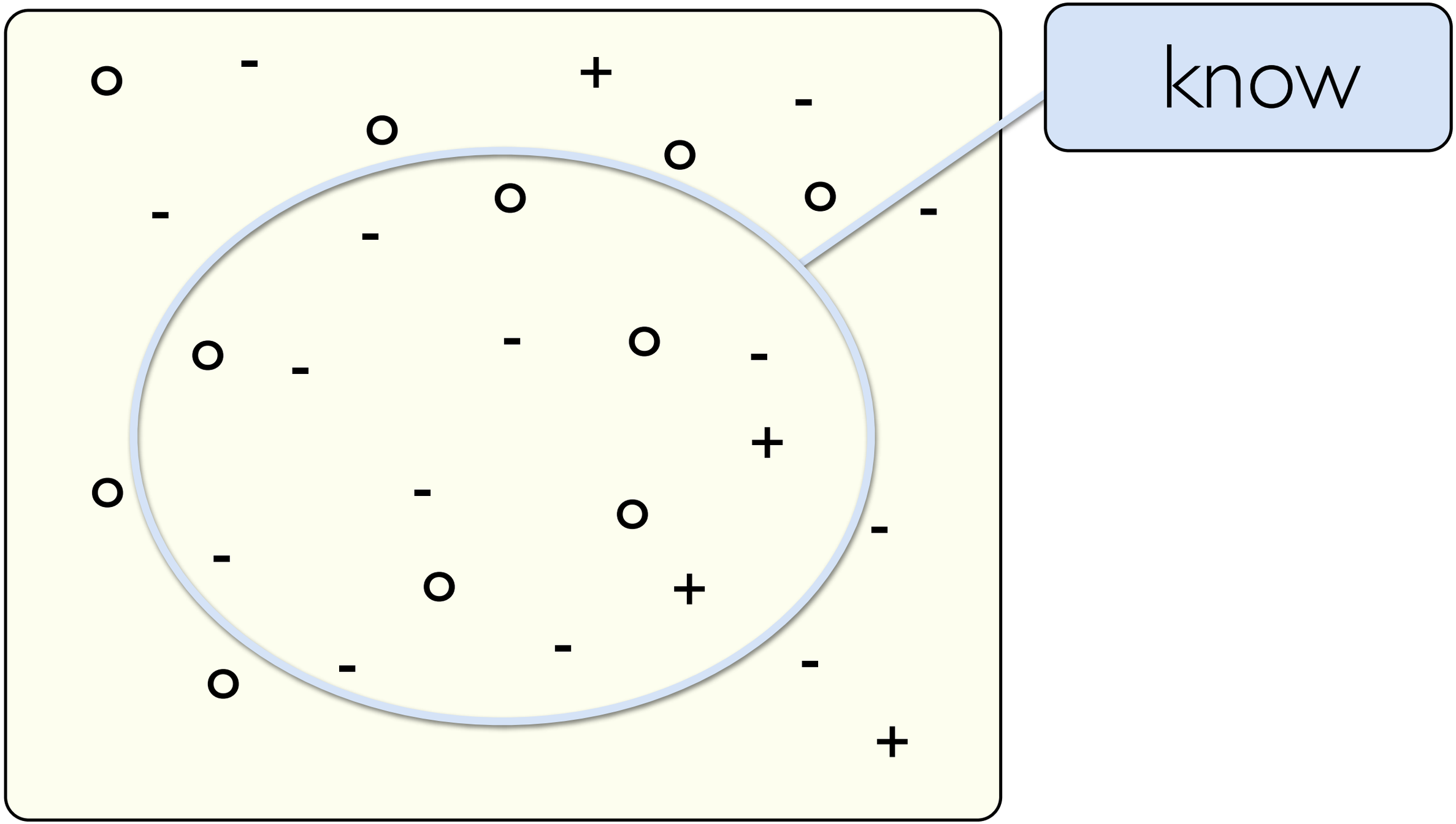
Design Space



+ good
o okay
- poor

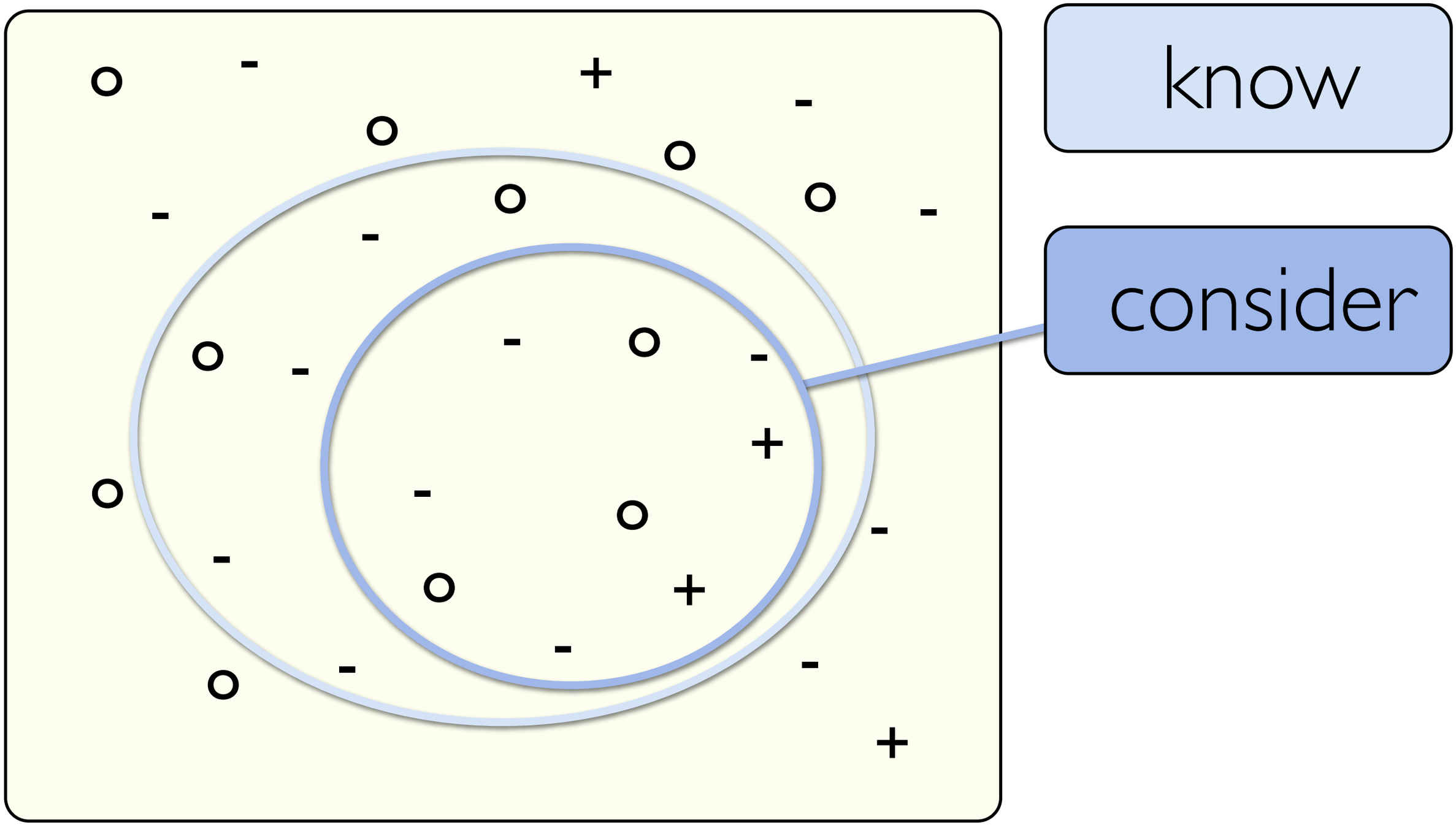
Metaphor

Design Space



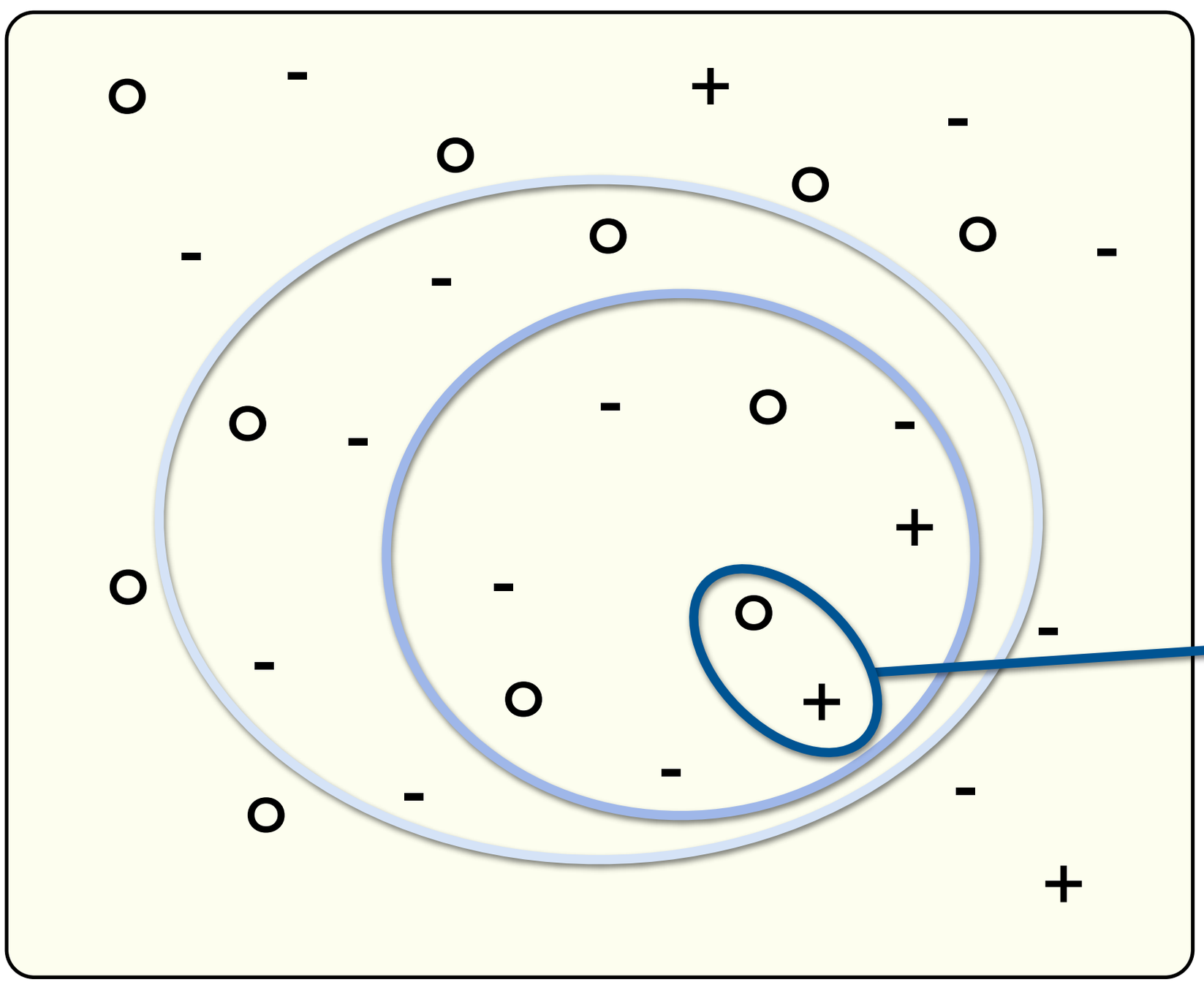
METAPHOR

Design Space



Metaphor

Design Space



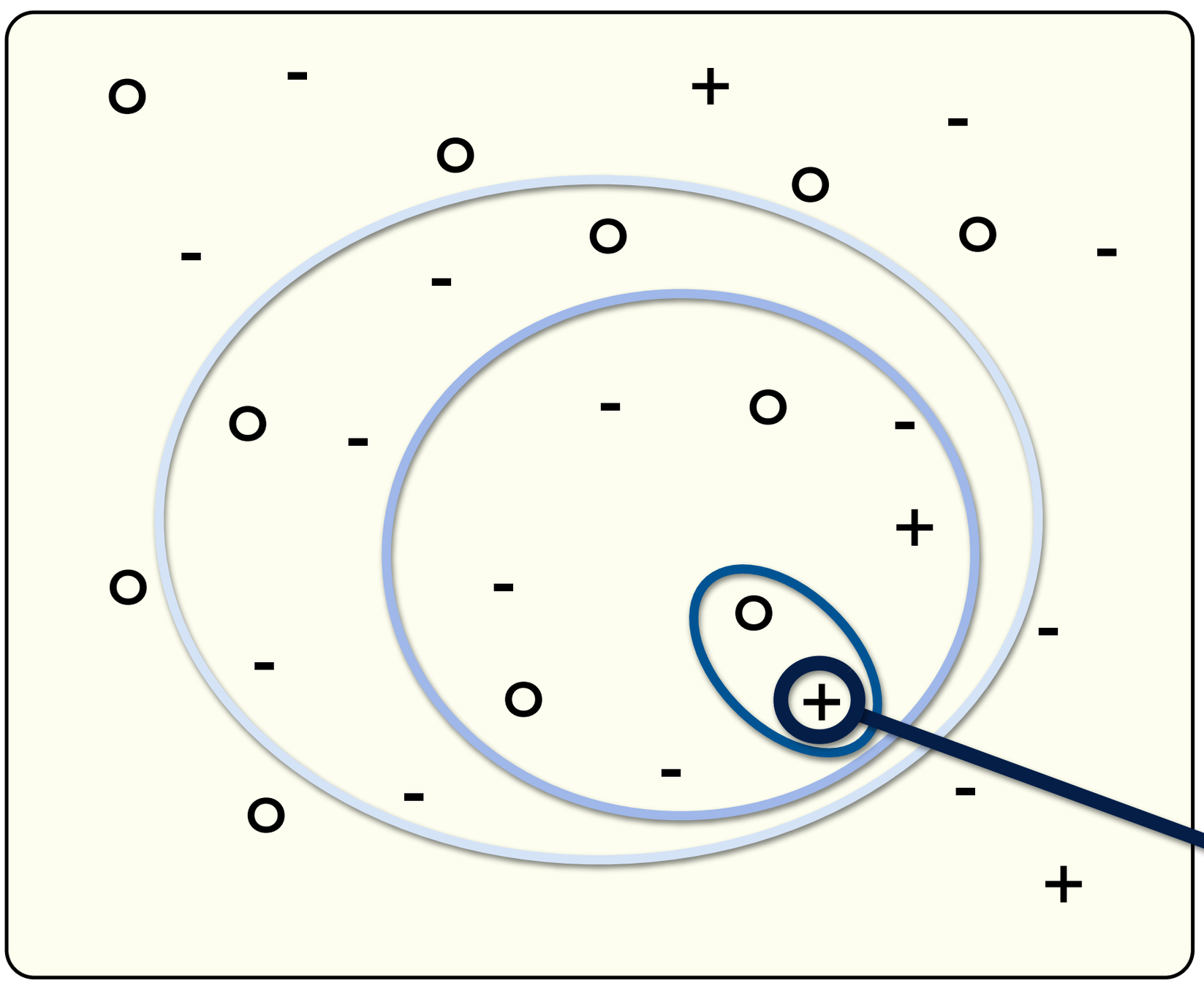
know

consider

propose

Metaphor

Design Space



know

consider

propose

select

Metaphor

Design Space

Think broad!

+ good
o okay
- poor

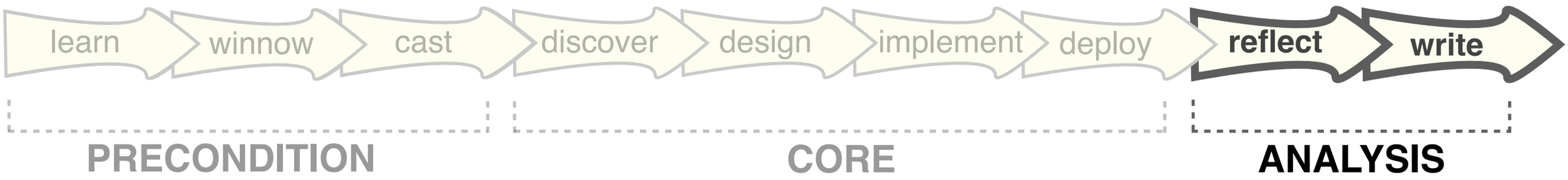
consider

propose

select

Pitfall

Premature Publishing



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!

http://www.alaineknipes.com/interests/violin_concert.jpg

technique-driven

Am I ready?

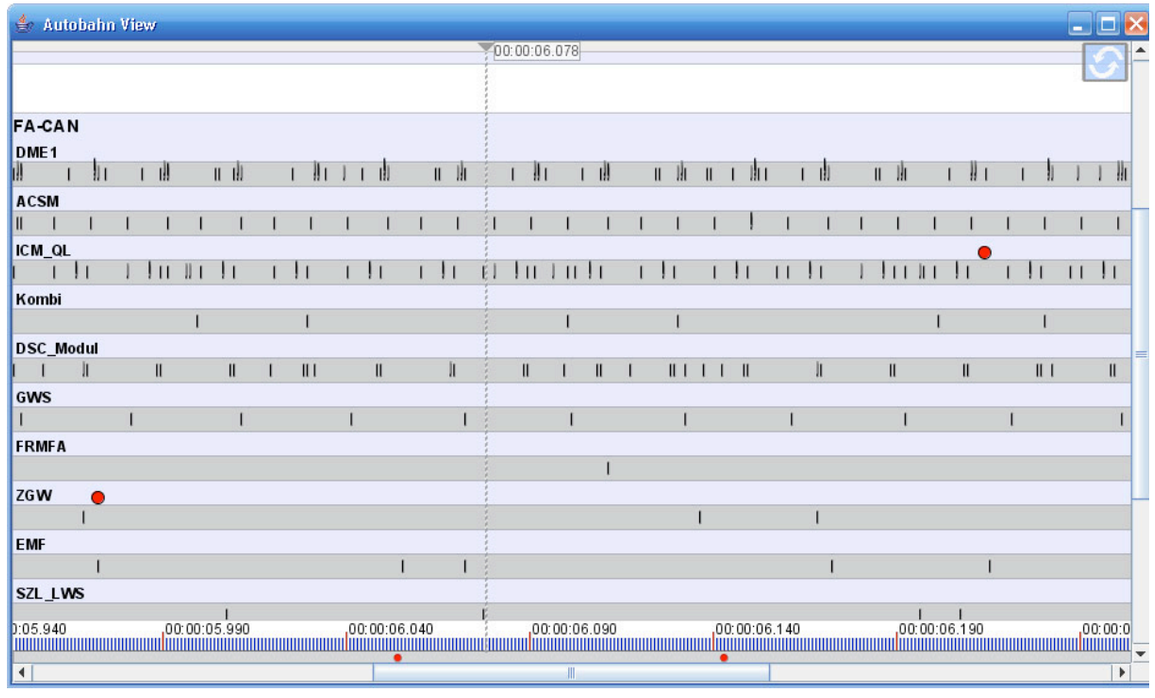
http://www.prlog.org/10480334-wolverhampton-horse-racing-live-streaming-wolverhampton-handicap-8-jan-2010.html

problem-driven

Example From The Trenches

Don’t step on your own toes!

First design round published



AutobahnVis 1.0

[Sedlmair et al., Smart Graphics, 2009]

Subsequent work not stand-alone paper

AutobahnVis 2.0

[Sedlmair et al., Information Visualization 10(3), 2011]

Summary

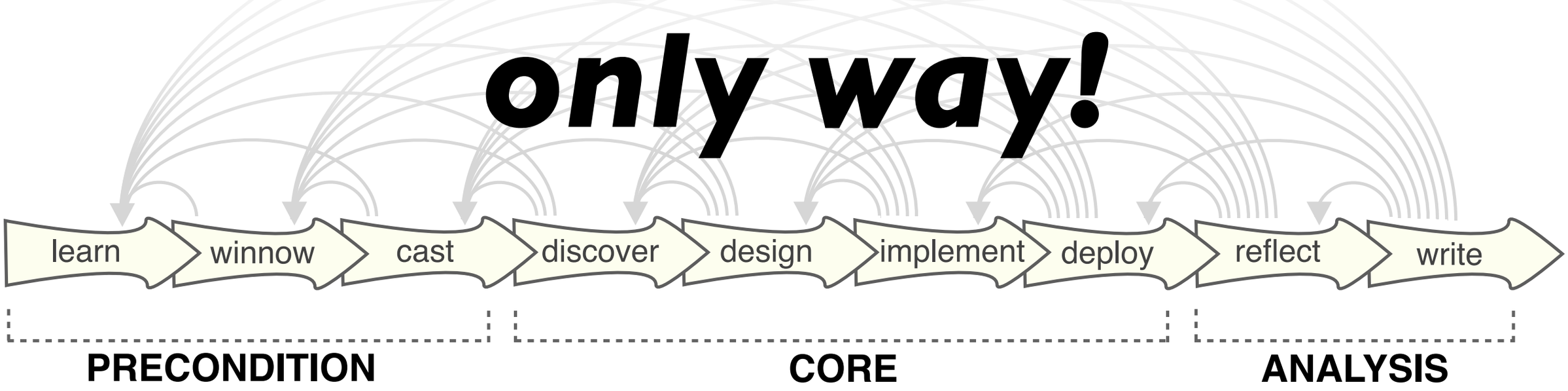
SUMMARY

- why design study methodology
- definition
- 9-stage framework
- selected pitfalls
  - premature collaboration
  - premature design commitment
  - premature publishing

Future Work

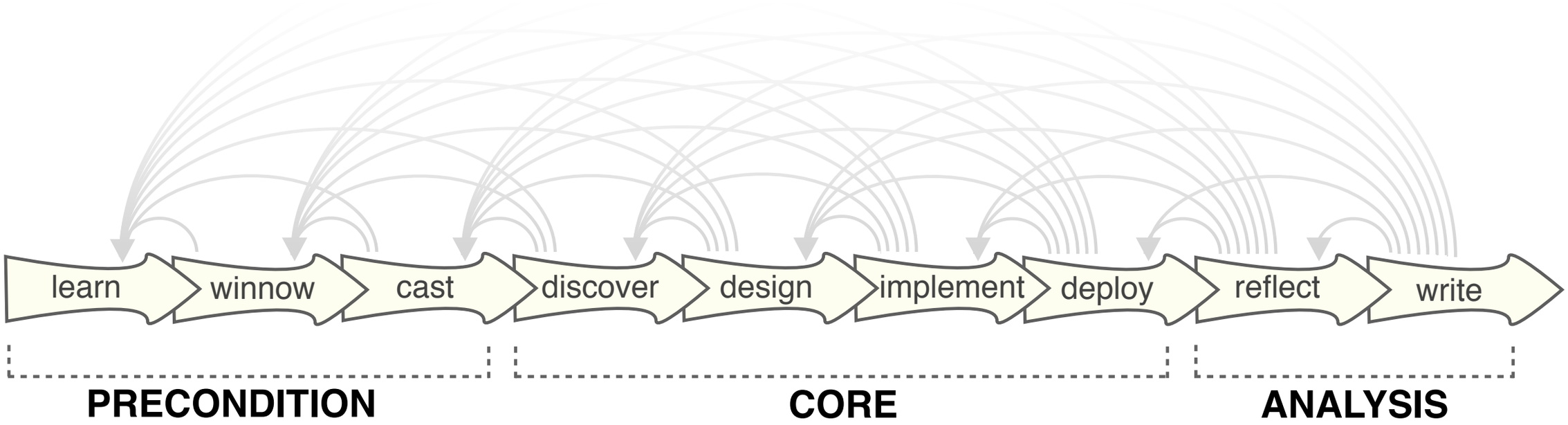
A Start, not an End!

Not the only way!



DESIGN STUDY METHODOLOGY:

Reflections from the Trenches and the Stacks



Thank you!

Michael Sedlmair, Miriah Meyer, Tamara Munzner

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

msedl@cs.ubc.ca