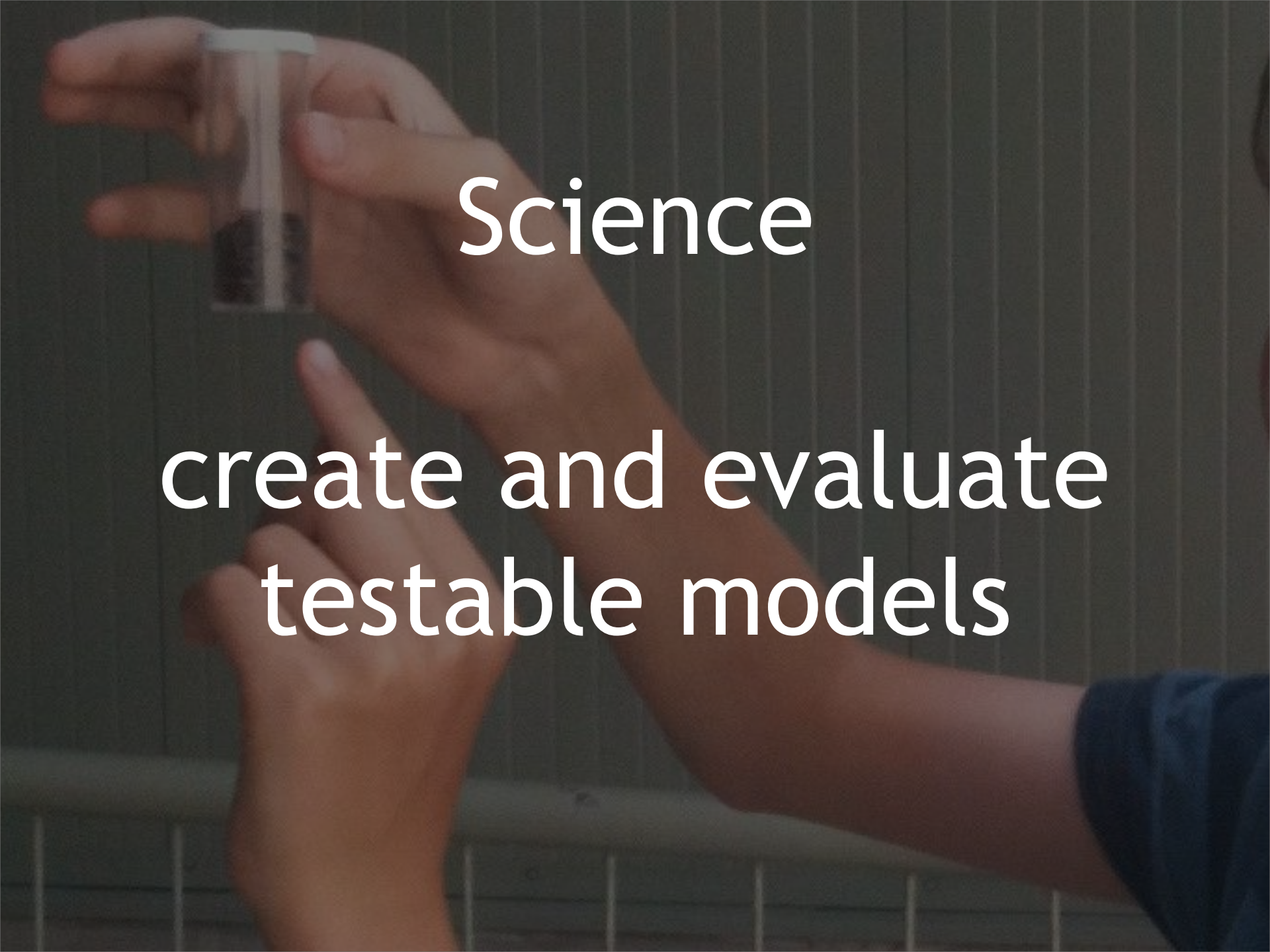


A Science of Programming Language Design?

William Cook, UT Austin

WG 2.16 Austin

(originally at PLATEAU 2012)

A person's hands are shown holding a small, clear vial with a white cap. The background is a dark, textured surface with vertical lines, possibly a wire mesh or a wall. The lighting is soft, highlighting the hands and the vial.


Science

create and evaluate
testable models



Design

create artifact
satisfying need or
desire



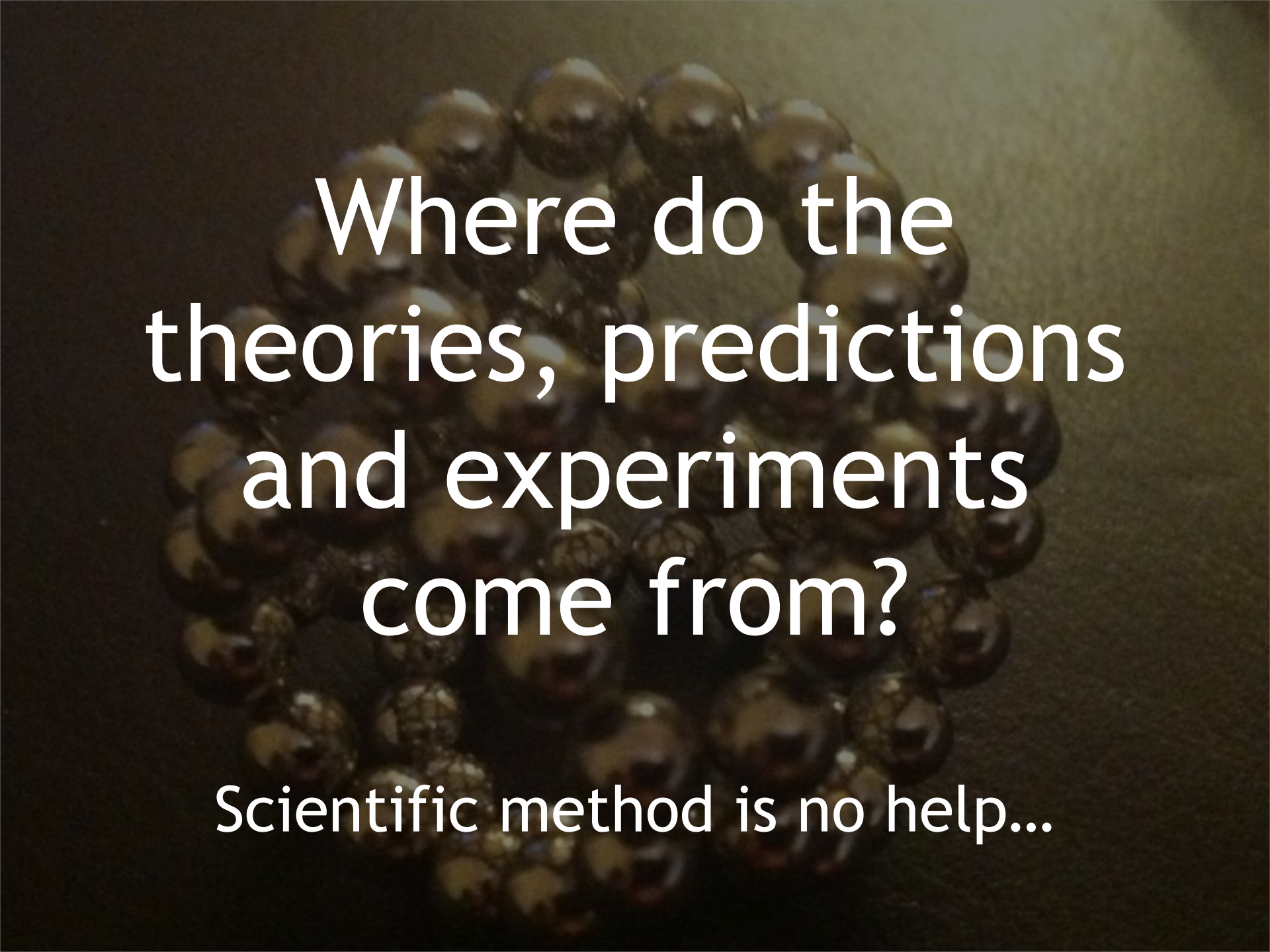
Science
testable model

Design
satisfy desire



Scientific method
is a test plan:

1. predict
2. observe
3. evaluate



Where do the
theories, predictions
and experiments
come from?

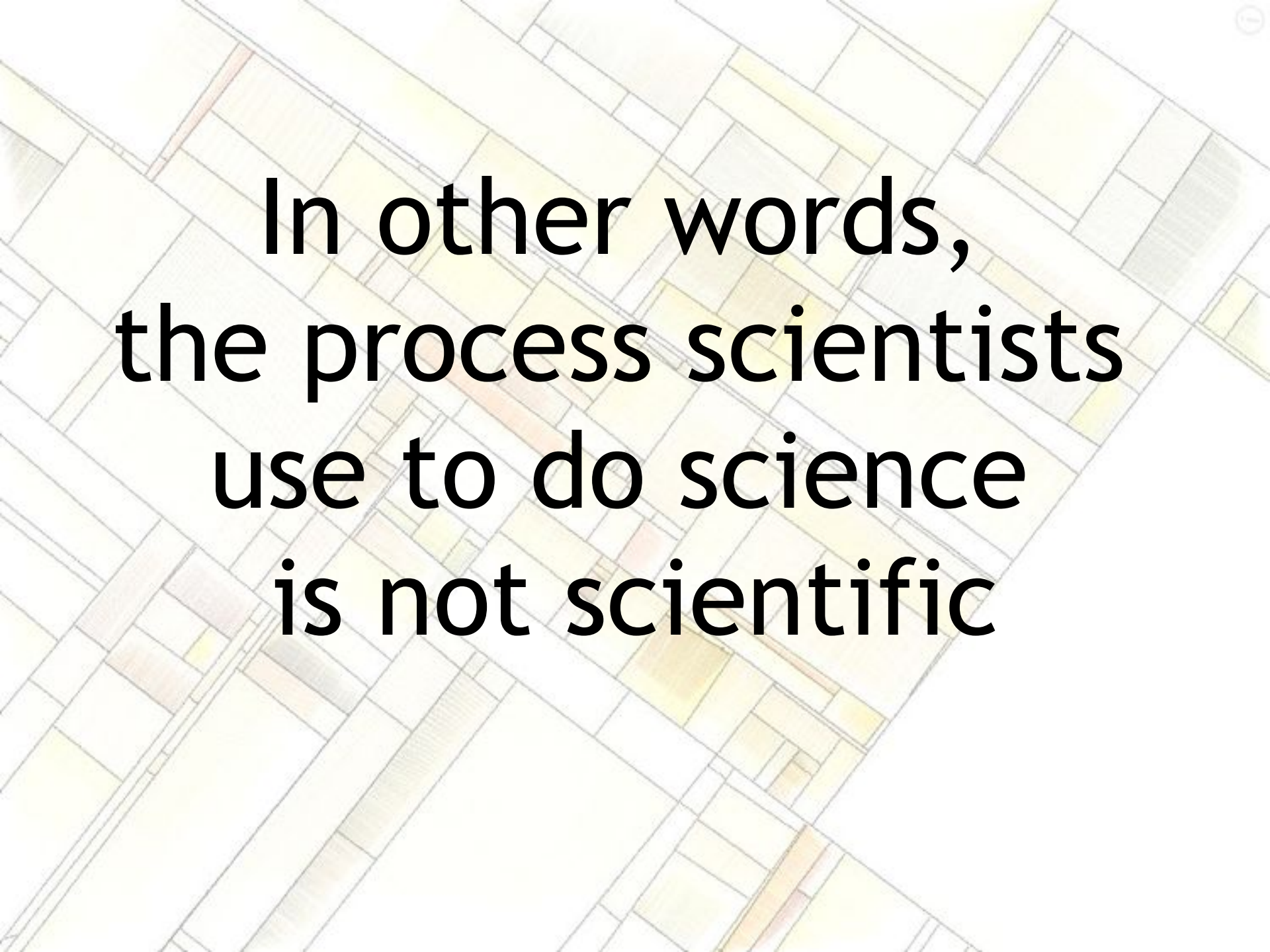
Scientific method is no help...



Scientists
are
designers

A photograph of several clear cylindrical containers filled with macarons of various colors, including pink, yellow, green, brown, orange, and blue. The macarons are stacked vertically in each container. The background is slightly blurred, showing what appears to be a display case or a shop setting.

Scientists
design
theories and
experiments



**In other words,
the process scientists
use to do science
is not scientific**

SCIENCES OF THE ARTIFICIAL

H. Simon, MIT Press 1969



Optimization Satisficing Search

Artifact and Process

Does this apply to PL?
(I don't think so)



Design is not welcome in academia

survives in *professional* schools:
medicine, law, architecture,
fine arts... elsewhere on fringe

graphs: nodes/edges
labelled
ER
Entities, relationships, attributes
two sides cardinality
"roles"
many one
required optional
How many
algorithms courses
are about
designing algorithms?

(versus analyzing them)

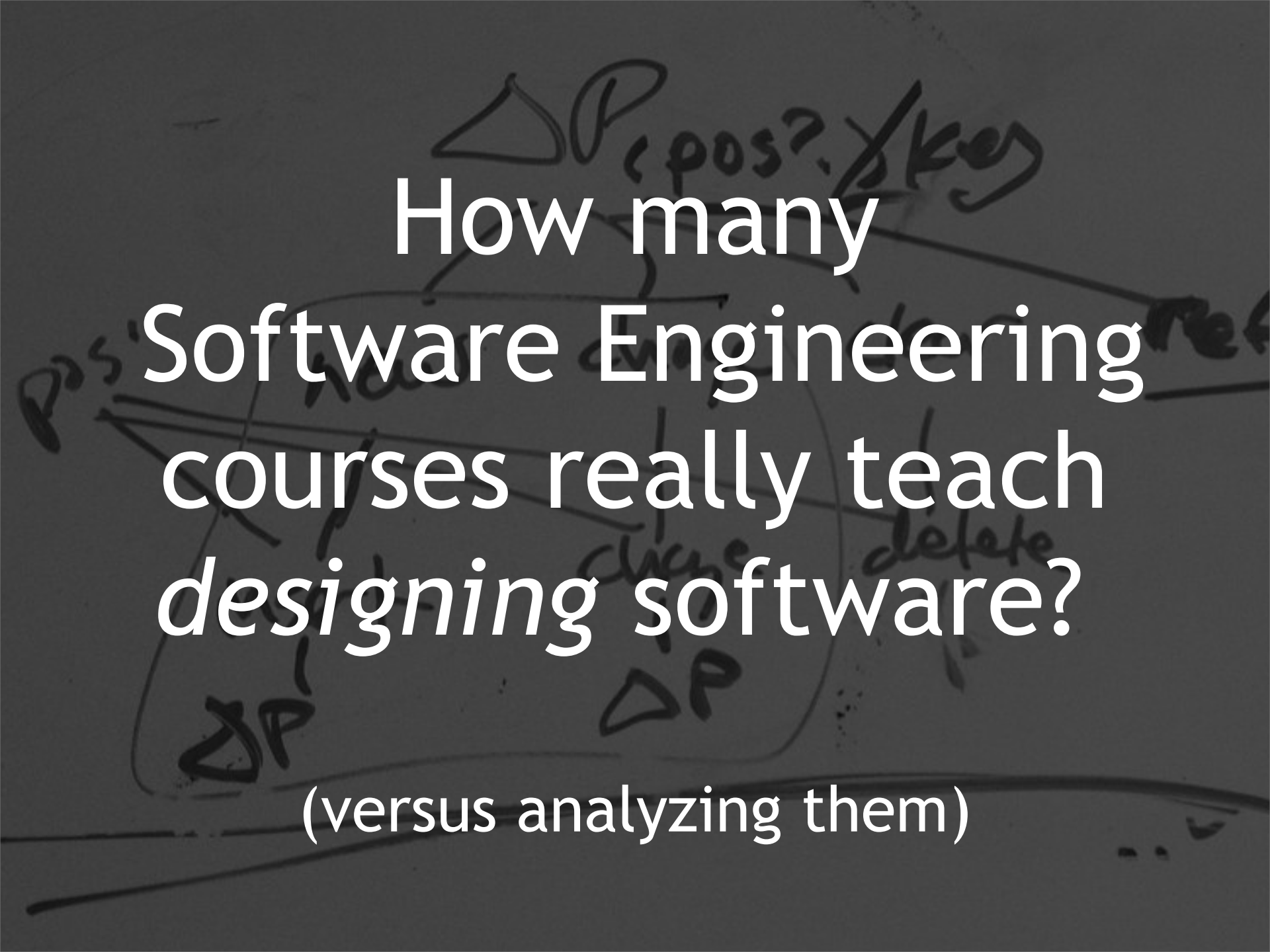
Status Update
text: string
time: Datetime

from	to
1	2
2	3
3	5
6	5
4	3
5	3
5	6

ID	Person name	age	hairColor
1	Sue	45	Blonde
2	Will	20	Brown
3	Bob	23	Red
4	Alice	21	Black
5	Reth	-	-
6	John	-	-

How many
PL courses are about
designing PLs?

(versus analyzing them)



How many
Software Engineering
courses really teach
designing software?

(versus analyzing them)



Not Repeatable

Many design
problems are unique

A man with glasses and a light-colored button-down shirt stands in front of a chalkboard. The chalkboard is covered with faint, hand-drawn diagrams, including circles, squares, and arrows, suggesting a technical or design-related lecture. The text is overlaid on the image in a large, white, sans-serif font.

Not always objective

Design cannot be
defined in a textbook
and taught in a
lecture class



Often
Human Centered
Evaluation
involves humans
(are they satisfied?)



but...

Generalize over values

- Add a new parameter to a function

We do teach design:

```
one x = f x
two x = f (f x)
three x = f (f (f x))
```

PhD supervision!



Apprenticeship

Practice

Critique

Reflect

A photograph of a restaurant interior, dimly lit with warm yellow light. The room features several rectangular tables and dark chairs. A prominent feature is a large glass partition wall with a grid pattern, through which another part of the restaurant is visible. The ceiling has a fan and some pendant lights. The text "How do we know good design?" is overlaid in the center in a white, sans-serif font.

How do we know
good design?



Good Design

Satisfies the human
desire or need

A man with grey hair, wearing a dark jacket over a light-colored shirt, stands in a scenic landscape. He is smiling and has his arms slightly outstretched. The background features a church with a prominent red-tiled steeple, a road with a car, and snow-capped mountains in the distance under a clear sky.

easy to use

high-performance

maintainable

elegant

internally consistent



Objective

high-performance

internally consistent

Intermediate

maintainable

easy to use

Subjective

elegant

Wicked Problems

No test for solutions

Cannot enumerate possible solutions

Every problem is unique, no learning

Defining "wicked problem" is a
wicked problem



My Take

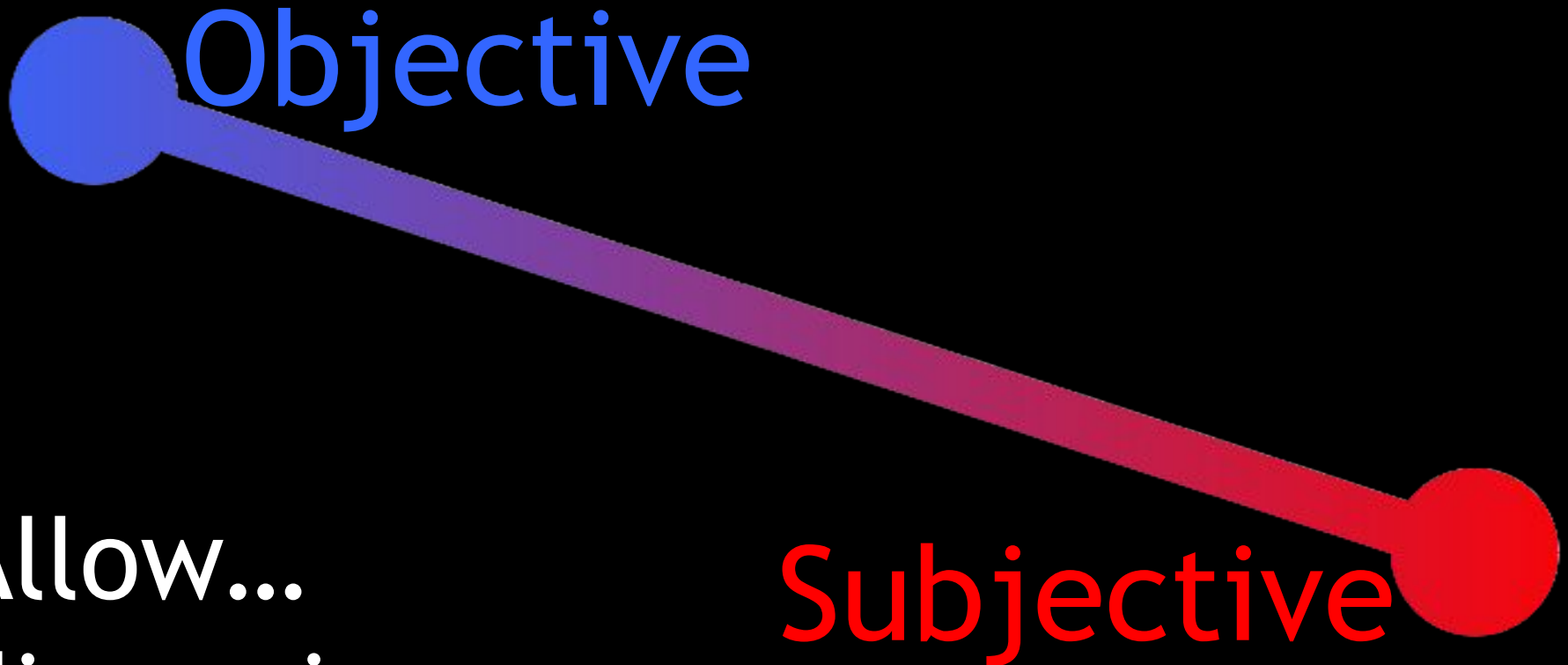
Many things we
really care about...

are not
easy/possible
to measure

Industrial
experimentation
is our current
evaluation
mechanism

Academia should
embrace design

Spectrum of Criteria



Allow...
discussion
of entire spectrum

User Studies
Repository Mining

are great
but not only options

Need to expand the
range of acceptable
"tests" for validity

Acceptable Evidence

- Controlled User Study
- Case study
- Historical data mining
- Reasoned argument
- Benchmark design problem
- Structured critique
- Detailed comparisons

Call to Action:

Formalize
PL design paper
review criteria

Other terms besides
"scientific"

Academically rigorous

Scholarly

IFIP
Working Group 2.16
on
Language Design

approved last year

Embrace Design

Don't fall prey to
"science envy"

academic rigor
not rigor mortis