A Science of Programming Language Design?
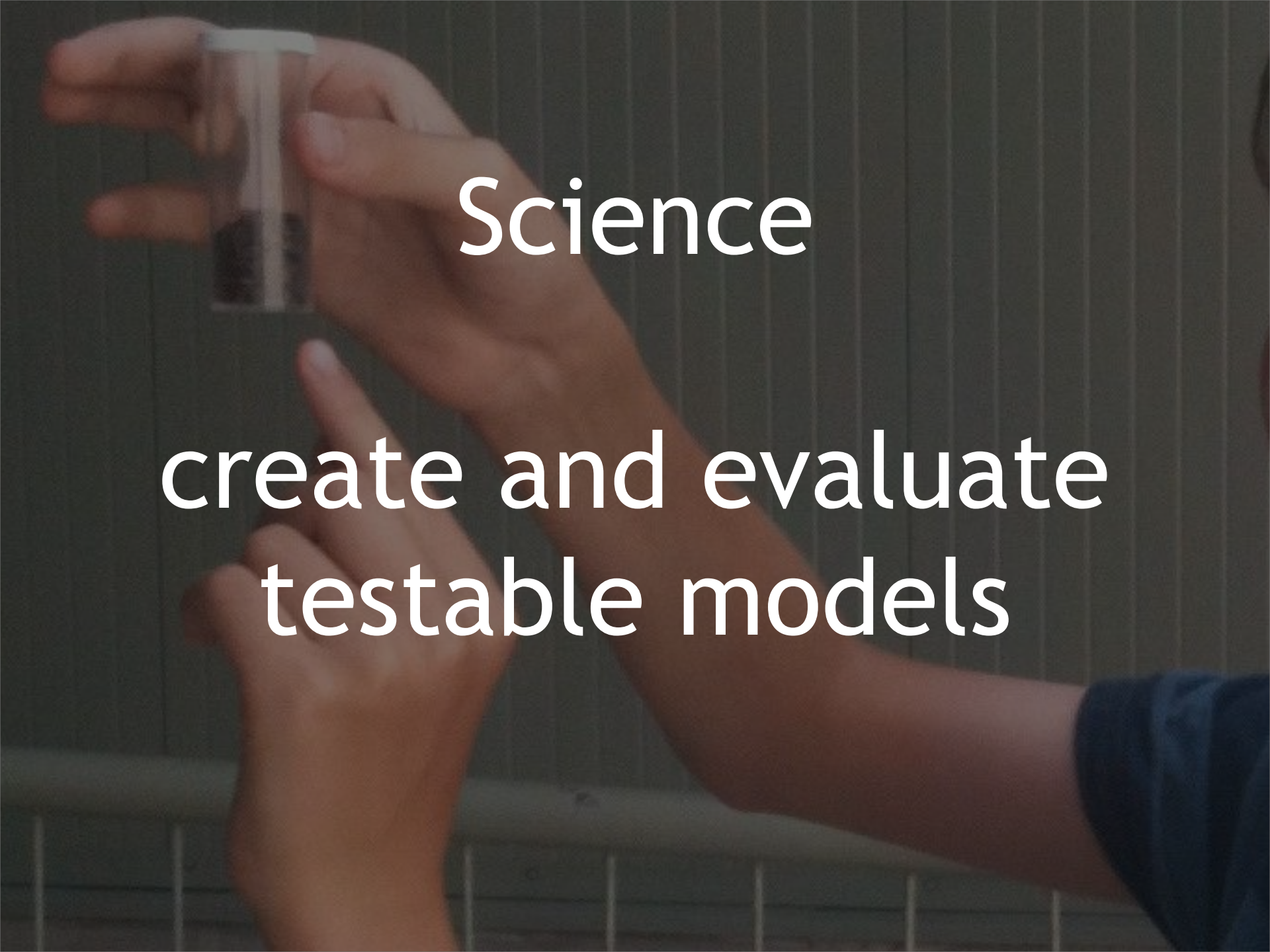
William Cook, UT Austin

WG 2.16 Austin

(originally at PLATEAU 2012)

Science

create and evaluate
testable models

Design

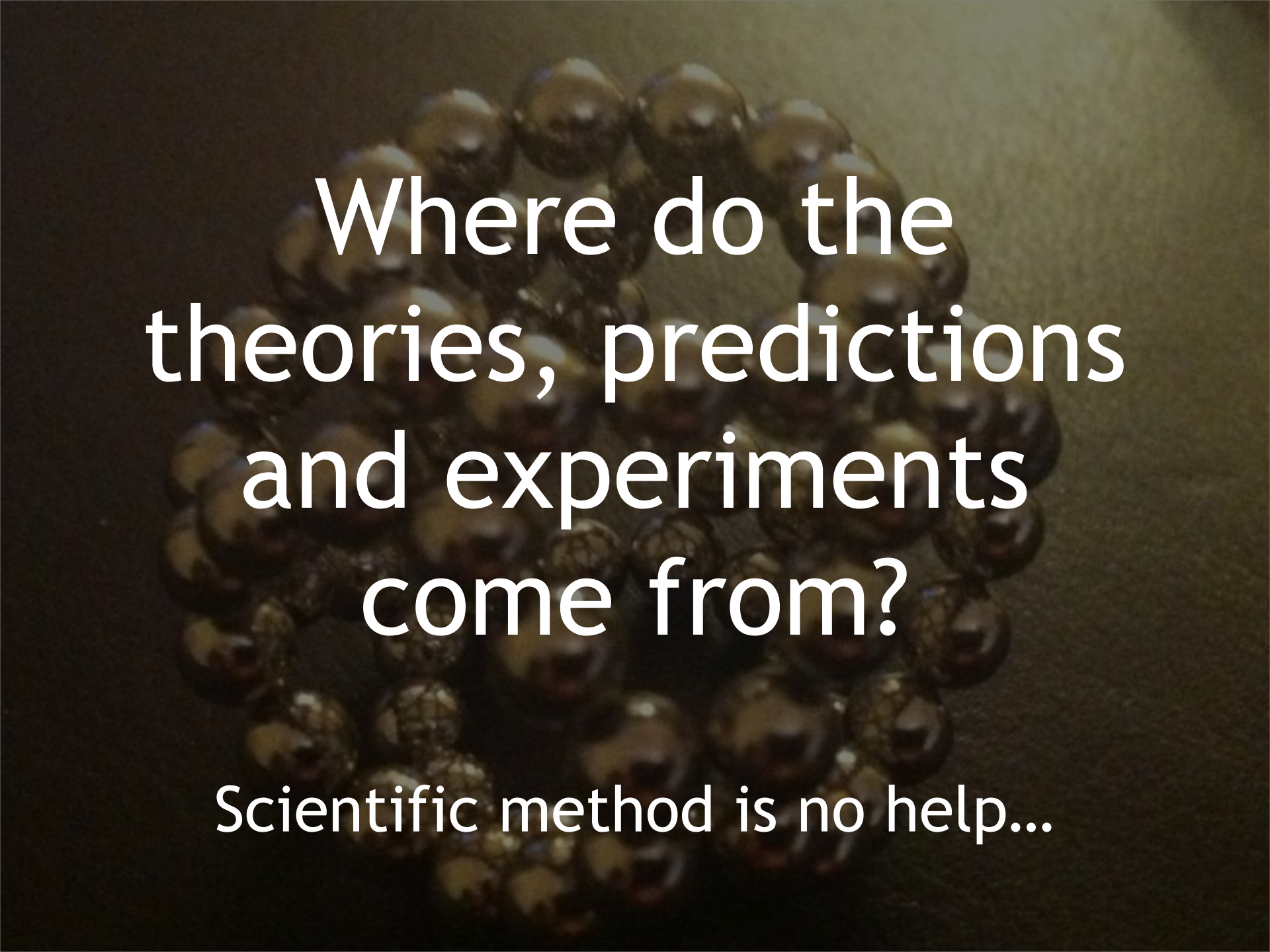## create artifact satisfying need or desire

Science
testable model

Design
satisfy desire

Scientific method is a test plan:

1. predict
2. observe
3. evaluate

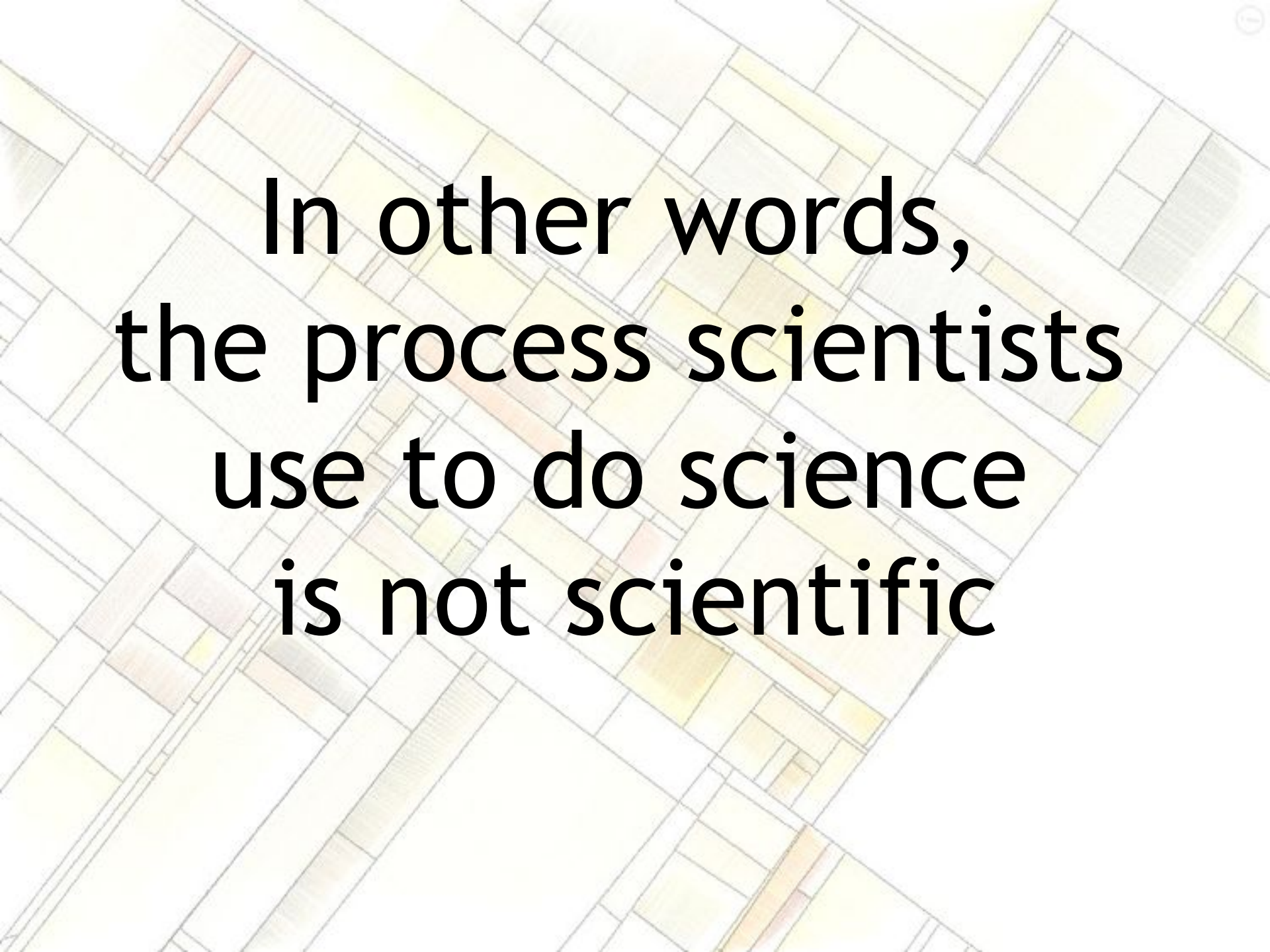# Where do the theories, predictions and experiments come from?

Scientific method is no help...

Scientists
are
designers

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

How many algorithms courses are about designing algorithms?

(versus analyzing them)
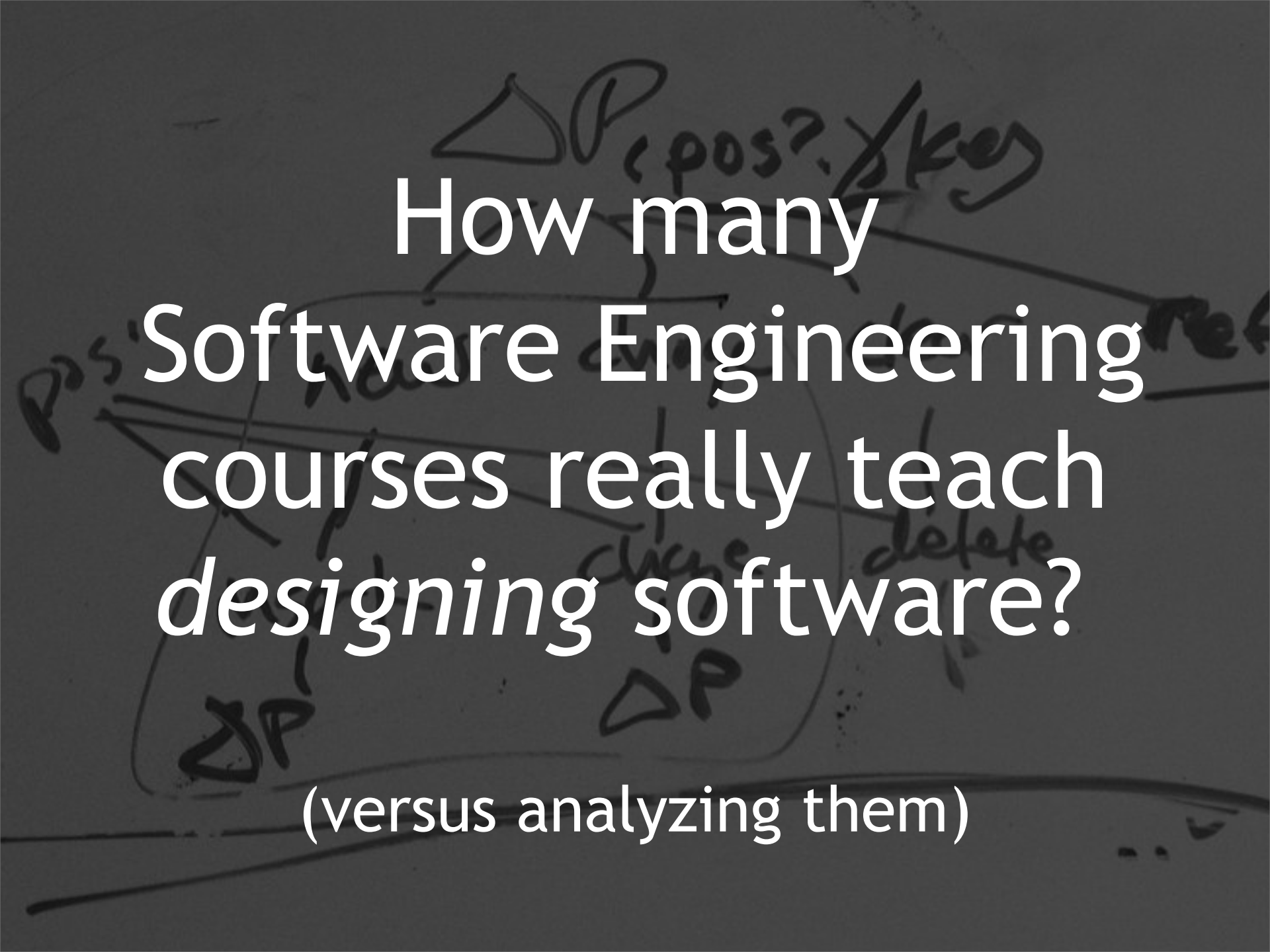
How many
PL courses are about
designing PLs?

(versus analyzing them)

How many Software Engineering courses really teach *designing* software?

(versus analyzing them)

Not Repeatable

Many design problems are unique

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...

We *do* teach design:

PhD supervision!

Apprenticeship

Practice
Critique
Reflect

How do we know good design?

Good Design

Satisfies the human desire or need

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

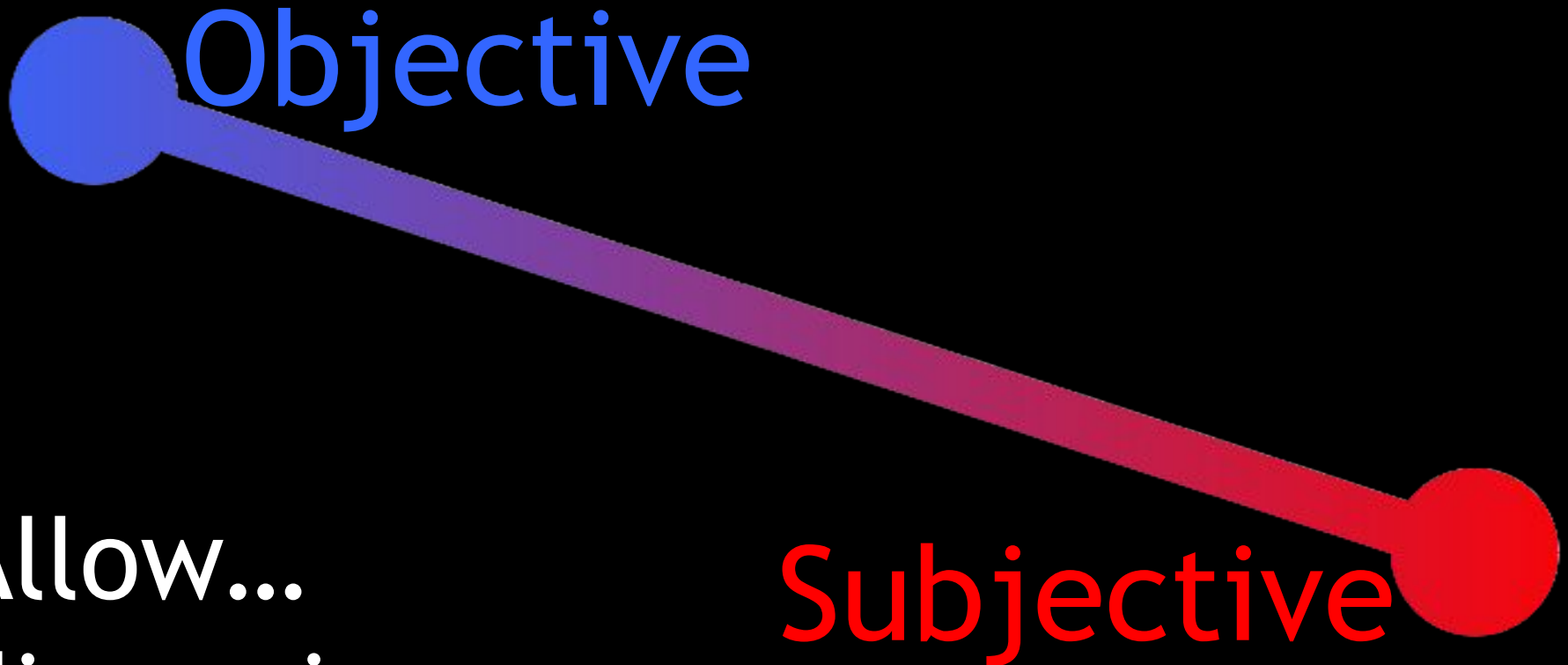# My Take

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

Objective

Subjective

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