



CREATIVITY IN SCIENCE & ENGINEERING: FROM THE HUMAN TO THE ARTIFICIAL

The common wisdom of
a society of agents is
provisional and
sometimes false

Creativity in science
and engineering =
overturning that
provisional knowledge
by individual agents
who see and think
differently

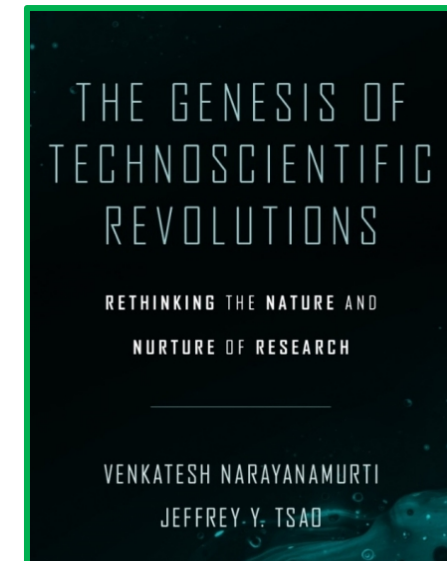
Blue LED

- Nobel Prize 2014
- 3-4% decrease in world energy consumption

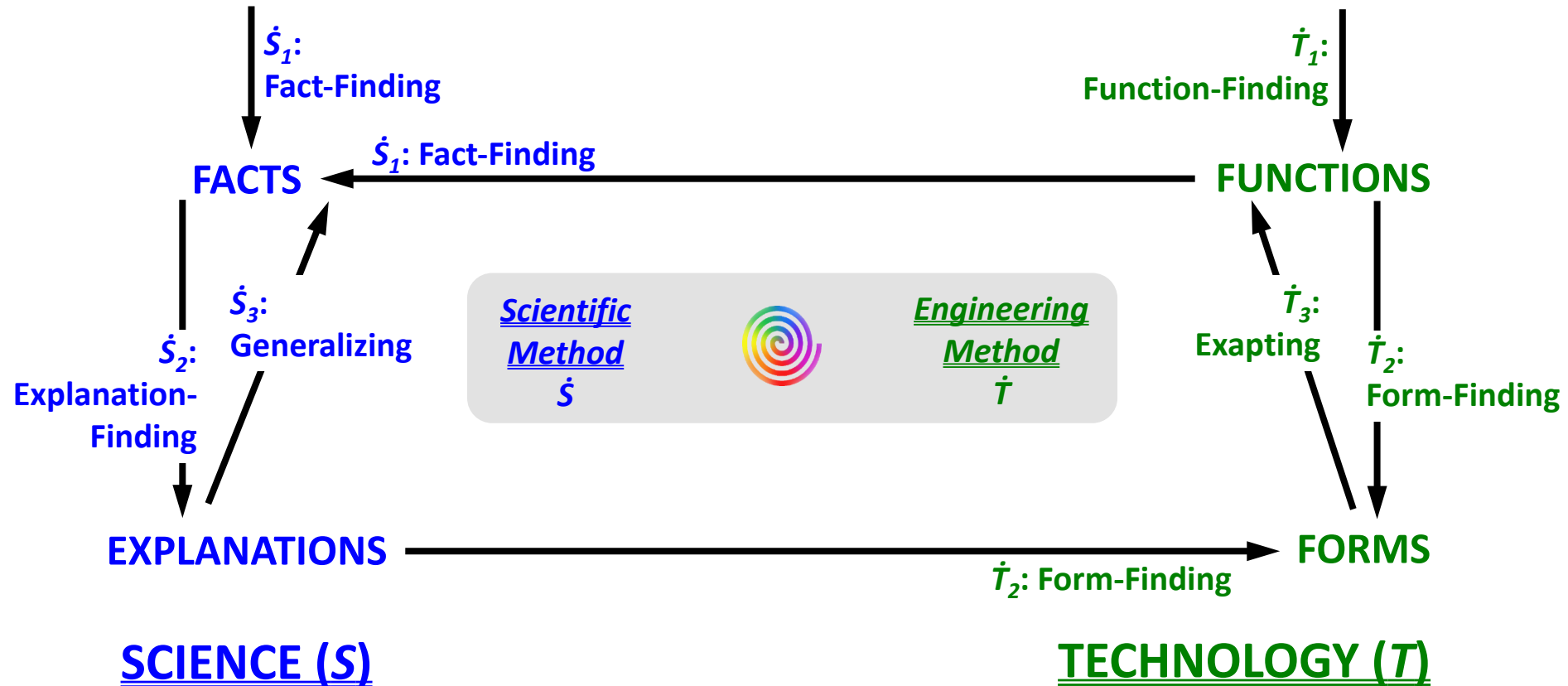


Outline

1. The Technoscientific Method
2. Creative Outcome
3. Surprise and Multi-Agent Coopetition
4. Coopetition and Neurosymbolic Knowledge Representations



1 The Technoscientific Method



The technoscientific method, as practiced by human intelligences, is *complete*: every mechanism is necessary, and there are no additional mechanisms

2 Creative Outcome = Useful Learning \approx Implausible Utility

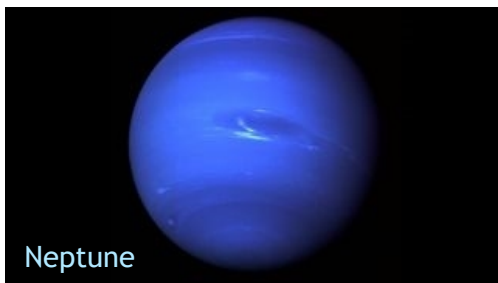


$$u \cdot l = u \cdot D_{KL}(p_{post}, p_{prior}) = u \cdot f(\Delta b, s) \approx u \cdot s^2$$

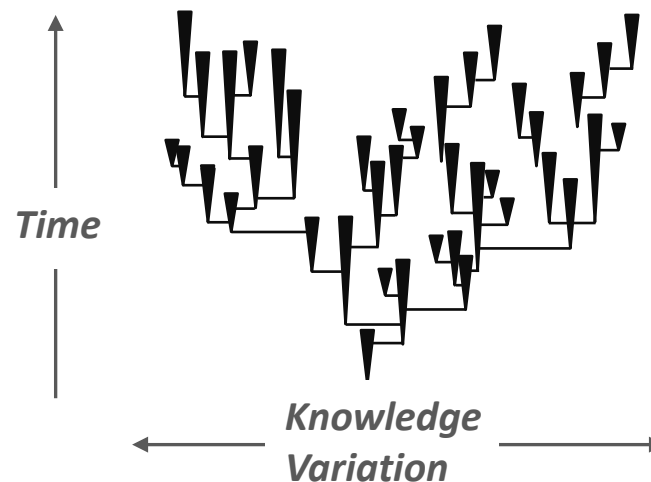
The Simonton ansatz

Kullback-Leibler
divergence

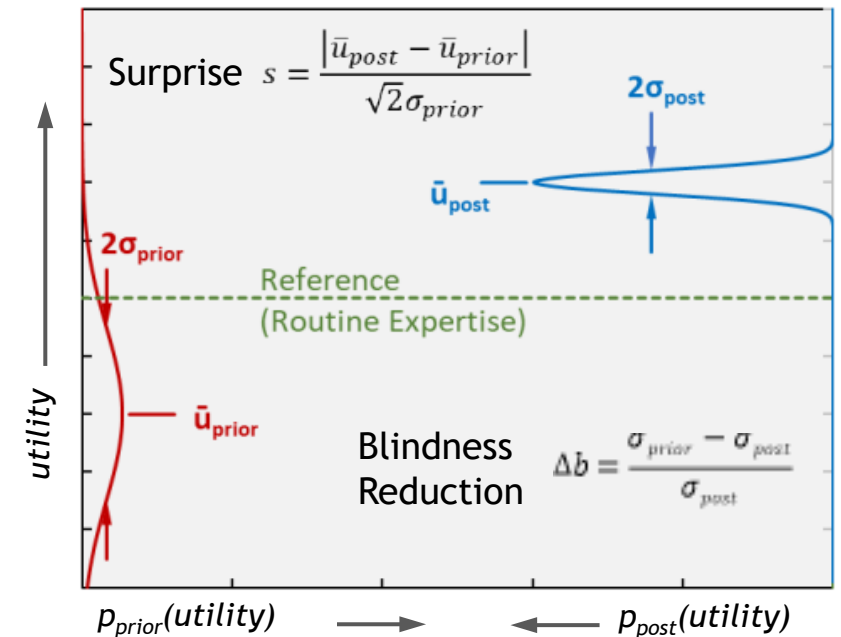
Not *novel* utility:
surprise, not novelty, is
prime



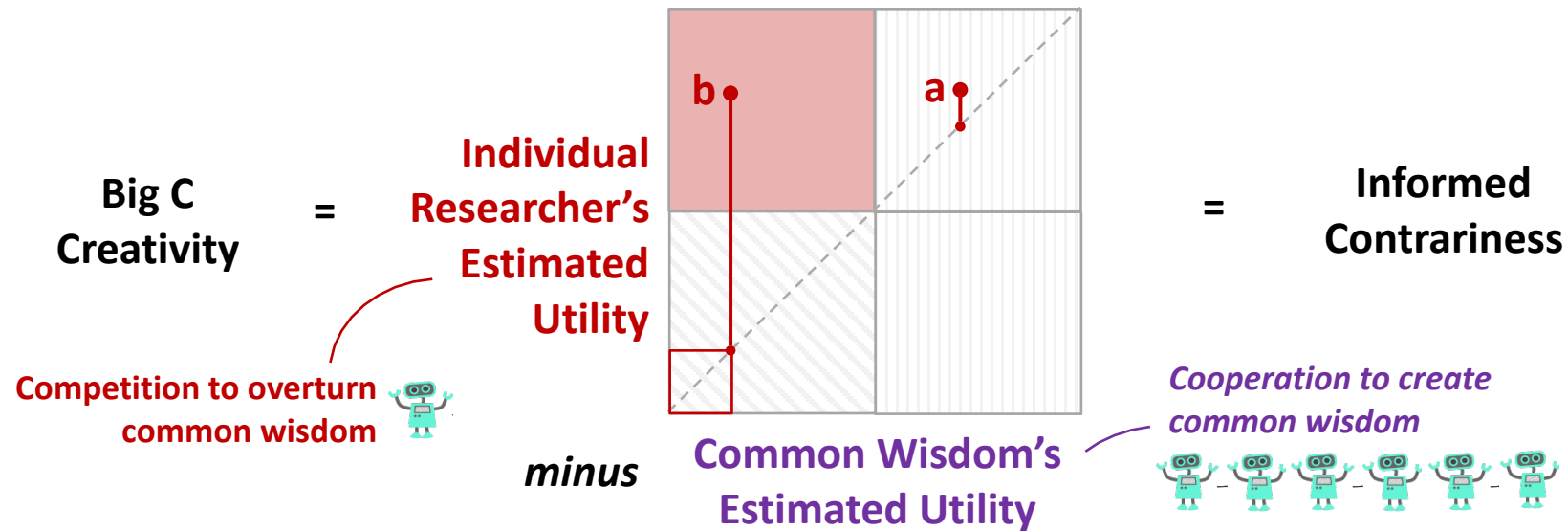
Not *more-certain* utility:
 Δb and s play different roles in
evolution by punctuated equilibria



Guessed utilities of potential nugget
of knowledge before and after test



3 Surprise and Multi-Agent Coopetition

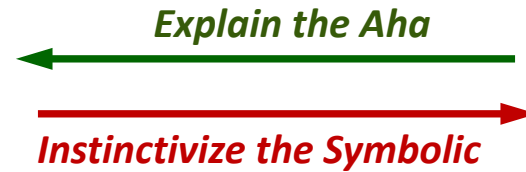


	Informed contrarian	Informed contrarian's implausible utility	Societal common wisdom overturned
Fact	Galilo	Jupiter has moons	Earth exceptionalism
Explanation	Einstein	Special relativity	Time and space are independent
Function	Jobs	iPhone	No one will pay \$500 for a phone
Form	Wright Bros	Airplane	Heavier-than-air flight is impossible

Tell me something that's true that almost nobody agrees with
-- Peter Thiel

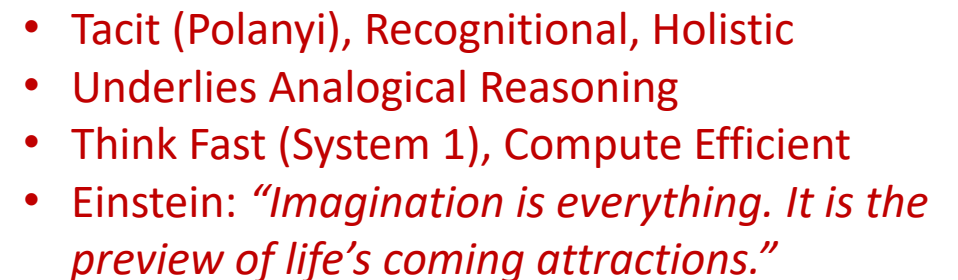


key to accumulation of common wisdom



- ## Neuro (S&T):

key to surprise to common wisdom



Take-Aways



1. The technoscientific method is not mysterious, so how human agents execute it should be translatable to how artificial agents might execute it
2. Creativity in science and engineering is also not mysterious, its essence is surprise and implausible utility.
3. Implausible utility is also not mysterious, it's just a multi-agent coopetition game: agents cooperating to create common wisdom, while competing to surprise that common wisdom
4. Different knowledge representations may be necessary: symbolic for accumulating common wisdom; and connectionist for going beyond common wisdom.