

# Evaluating empirical / theoretical work

— Alan H. Schoenfeld 2008

# Criteria

- Descriptive power
- Explanatory power
- Scope
- Predictive power
- Rigor and specificity
- Falsifiability
- Replicability, generality, and trustworthiness
- Multiple sources of evidence (triangulation)

# Descriptive power

- Denotes the capacity of theories or models to capture **what counts** in ways that seem faithful to the phenomena being described
- Ex: An analytic scheme or representation takes the right factors into account

# Explanatory power

- The degree of explanation provided regarding **how and why things work/happen**
- Analogy to well-established theories
- Explanatory breadth: how it accounts for and predicts all known observations within its scope
- Ex: UML models have low explanatory power as they take into account few parameters

# Scope

- Denotes the range of phenomena covered by the theory
- Ex: A theory of equations is not very impressive if it deals only with linear equations

# Predictive power

- The degree to which a model can **profile future behaviour**
- Ex: Low predictive power
  - When something claim to be impossible and it happens or when the model repeatedly report claims that are not observed

# Rigor and specificity

- The degree to which **objects and their relations** in a model are **well defined** and **represent the real world**

# Falsifiability

- If you can't be proven wrong, you do not have a theory
- **Expose ideas to the public**
- Ex: Not making tautological claims or predictions whose accuracy cannot be tested empirically (**testability**)



# Replicability, generality, and trustworthiness

- If a study is repeated in exact the same context can it output the **same results**?
- Can the results of a study apply to **another sample**?
- Can results be trusted by **other researchers** not involved in the study?

# Multiple sources of evidence (triangulation)

- The more independent sources of confirmation there are the more robust a finding is likely to be

# The three golden rules for research

# Three Golden Rules for Research (Dijkstra, 1982)

- Internal
- External
- Internal / External

# First rule - internal

- It concerns you yourself in isolation

*Raise your quality standards as high as you can live with, avoid wasting your time on routine problems, and always try to work as closely as possible at the boundary of your abilities. Do this, because it is the only way of discovering how that boundary should be moved forward.*

# Reflection

- The **obvious** should be avoided as not instructive as well as the **obviously impossible** as hopeless

# Second rule - internal

- Relation with the scientific world:

*We all like our work to be **socially relevant** and **scientifically sound**. If we can find a topic satisfying both desires, we are lucky; if the two targets are in conflict with each other, let the requirement of **scientific soundness** prevail.*

# Reflection

- A scientifically perfect work not interesting for the society will not harm the society
- An imperfect work that targets the needs of the society can have effect on the society



# Third rule - external/internal

- It deals with the relation between researchers and their scientific colleagues:

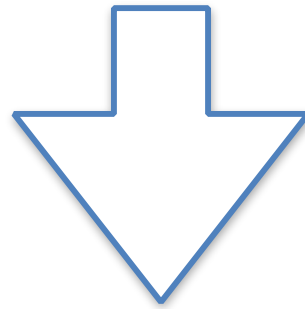
*Never tackle a problem of which you can be pretty sure that (now or in the near future) it will be tackled by other who are, in relation to that problem, at least as competent and well-equipped as you*

# Reflection

- If others will come up with as good a solution as the researcher could obtain, the world doesn't lose anything if the researcher leaves the problem alone
- One should never compete with one's colleagues
- The third rule ensures that the researcher's contributions - if any - will be unique

# Questions

- How do I know my peers c/abilities?
- Lack of trust in peers' capabilities



The prisoner dilemma

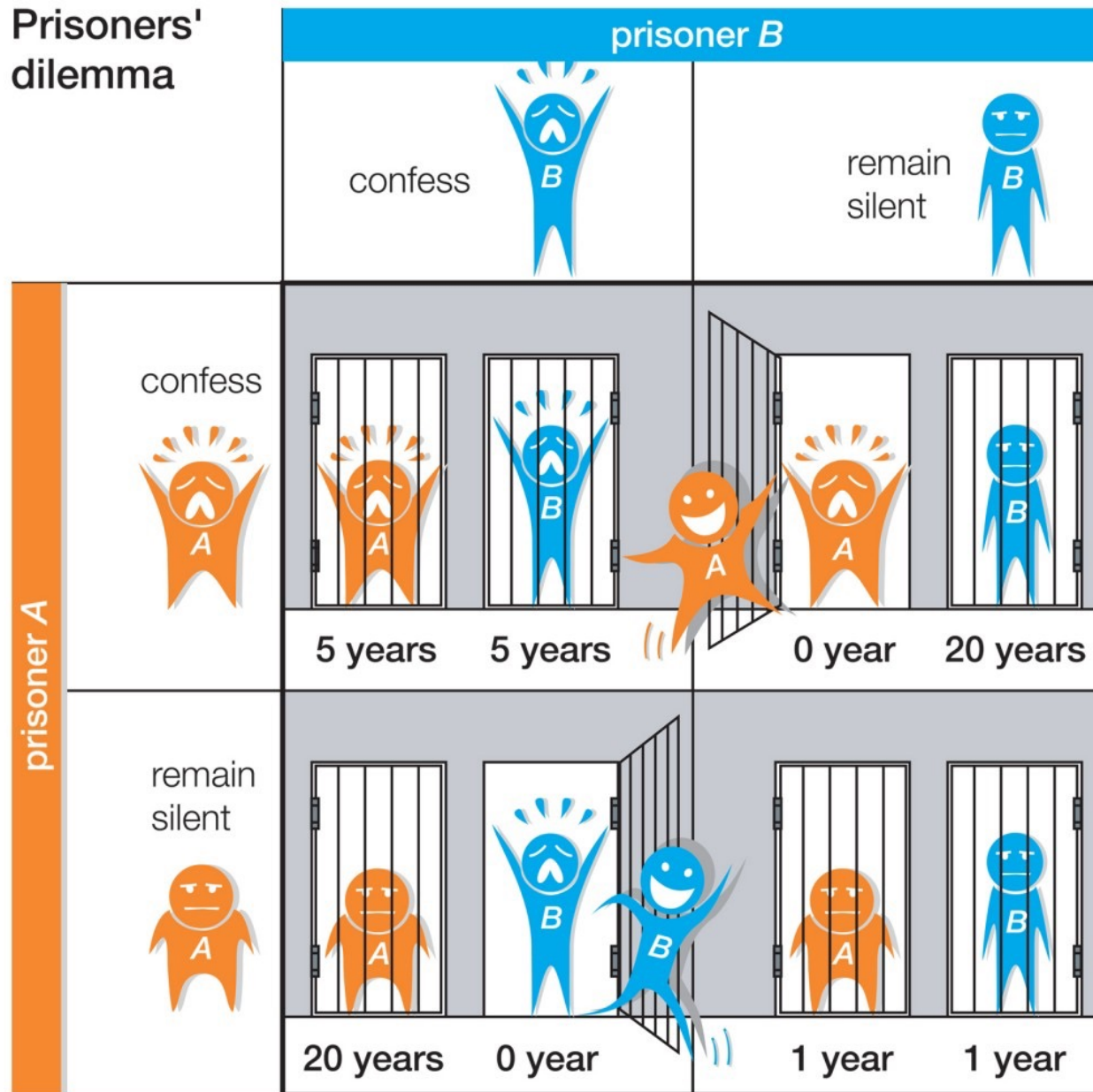
# The prisoner dilemma

*Two completely rational individuals might not cooperate, even if it appears that it is in their best interests to do so*

# Pre-amble

- A prosecutor who does not have enough evidence to put in jail any of the two criminals of a gang offers each prisoner a bargain
- Each prisoner is given the opportunity either
  - to betray the other by testifying that the other committed the crime, or
  - to cooperate with the other by remaining silent

# Prisoners' dilemma



© 2010 Encyclopædia Britannica, Inc.

# Interpretation

- Because **betraying a partner offers a greater reward than cooperating with him**, all purely rational self-interested prisoners would betray the other, and so
- **The only possible outcome** for two purely rational prisoners is for them **to betray each other.**

# Reflecting on the third rule

- Leaving the problem alone = confess
- Tackling the problem = be silent
- It seems following the prisoner's dilemma suggesting for uniqueness!
  
- **Both publish -> good but not unique**
- Both do not publish -> not compete with peers
- **One of them publish -> uniqueness**



# Bias toward collaboration

- Fortunately, humans display a systemic bias towards cooperative behaviour!