Funding risky research

Santa Fe Institute, Oct 31st, 2023

Chiara Franzoni

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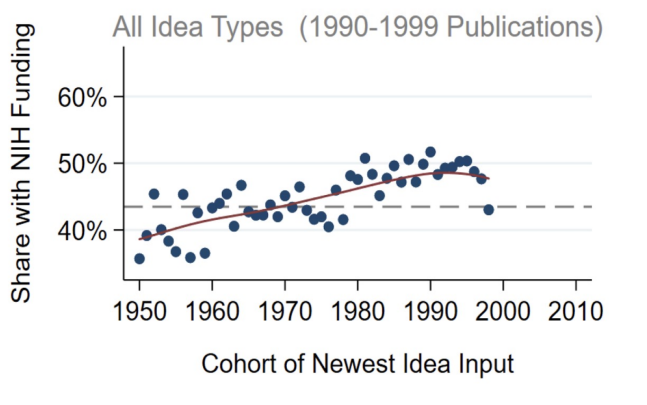
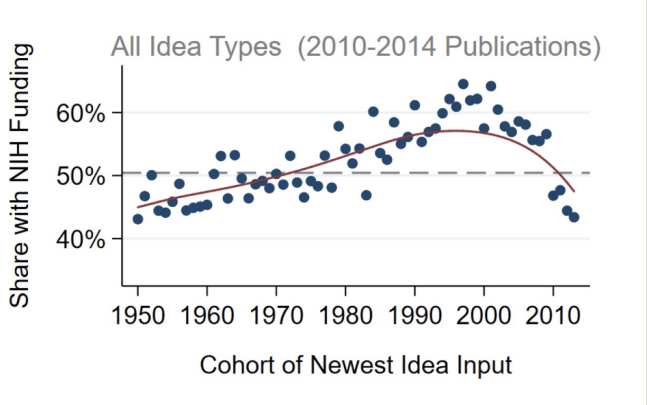
Funding of risky research is on the decline

- Packalen and Bhattacharya investigate "idea vintage" in published research that was supported/not supported by NIH. NIH's funding of projects that build on the most recent ideas declined over the last decades (Packalen and Bhattacharya, 2018).
- NIH awardees less likely to hit and flop than e.g. Howard Huges awardees (Azoulay et al, 2011). Azoulay et al.(2022) risky research less likely to be granted renewals of R01s.

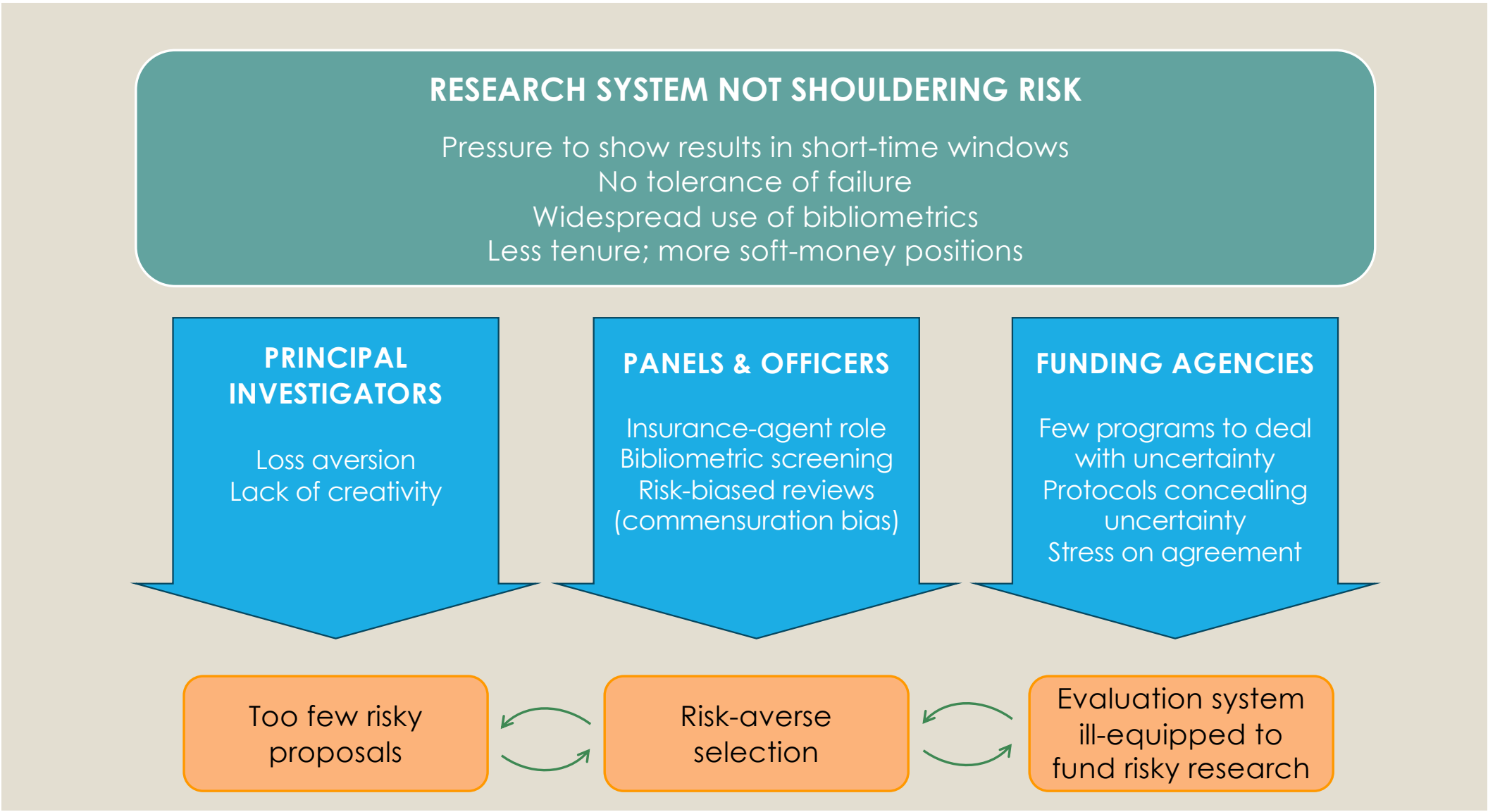




Why?

Franzoni, Veugelers & Stephan, Entr. Innovation Policy & the Economy, 2022.

- While in faculty position at Upenn, Karikò submitted >20 proposals. No funding. Taken-off faculty.
- 2005 Pathbreaking discovery (Pseudo-uridine) paid from Weissman funds
- Funding problem continued. E.g., in 2007 faild R01
  - "Preliminary data should be provided to support that the proposed experiments can be carried out,"
  - "Very preliminary and, there is high likelihood, that these experiments, especially in vivo, will not work."
- 2007 startup funding (STTR grant of NIH)


RESEARCH SYSTEM NOT SHOULDERING RISK
Pressure to show results in short-time windows
No tolerance of failure
Widespread use of bibliometrics
Less tenure; more soft-money positions
PRINCIPAL INVESTIGATORS
Loss aversion
Lack of creativity
PANELS & OFFICERS
Insurance-agent role
Bibliometric screening
Risk-biased reviews
(commensuration bias)
FUNDING AGENCIES
Few programs to deal with uncertainty
Protocols concealing uncertainty
Stress on agreement
Too few risky proposals
Risk-averse selection
Evaluation system ill-equipped to fund risky research

Research system

- Heavy emphasis on accountability
- Competitive replaced block funding (Wang et al. 2018)
- Short-term measurable results:
  - Increase of soft-money, untenured positions (Stephan and Ma 2005)
  - Use of bibliometrics to assess science and scientists (Franzoni, et al., 2011; Stephan et al., 2017)
- No tolerance of failure
  - No publication of "no results"

® Rebecca Horn, Unicorn 1970-71

Peter W. Higgs,
2013 Nobel Prize Winner in Physics

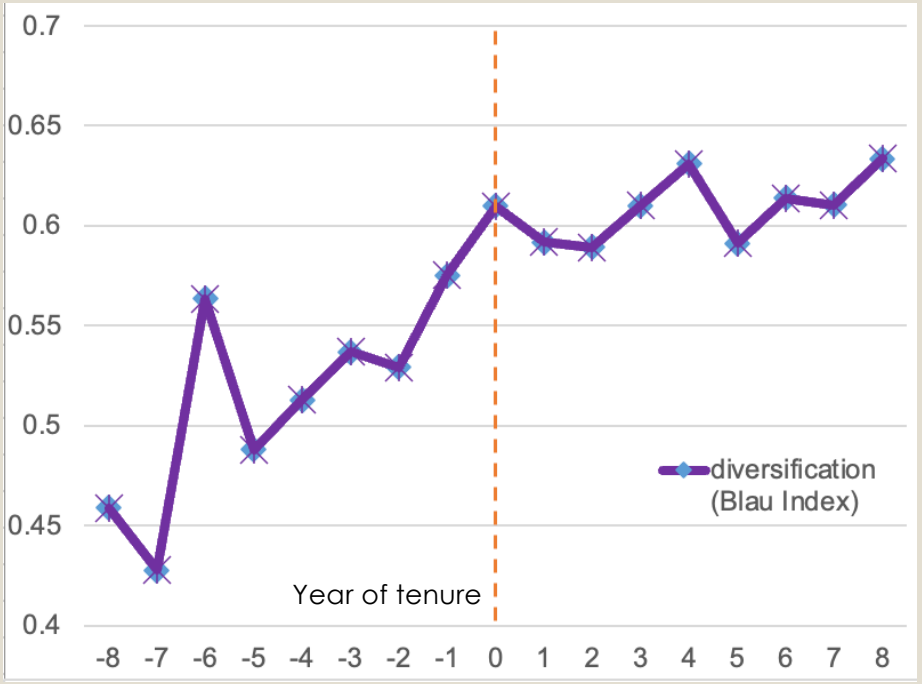
«It's difficult to imagine how I would ever have enough peace and quiet in the present sort of climate to do what I did in 1964.»

Scientists diversity more after tenure
(Franzoni & Rossi-Lamastra, 2017)

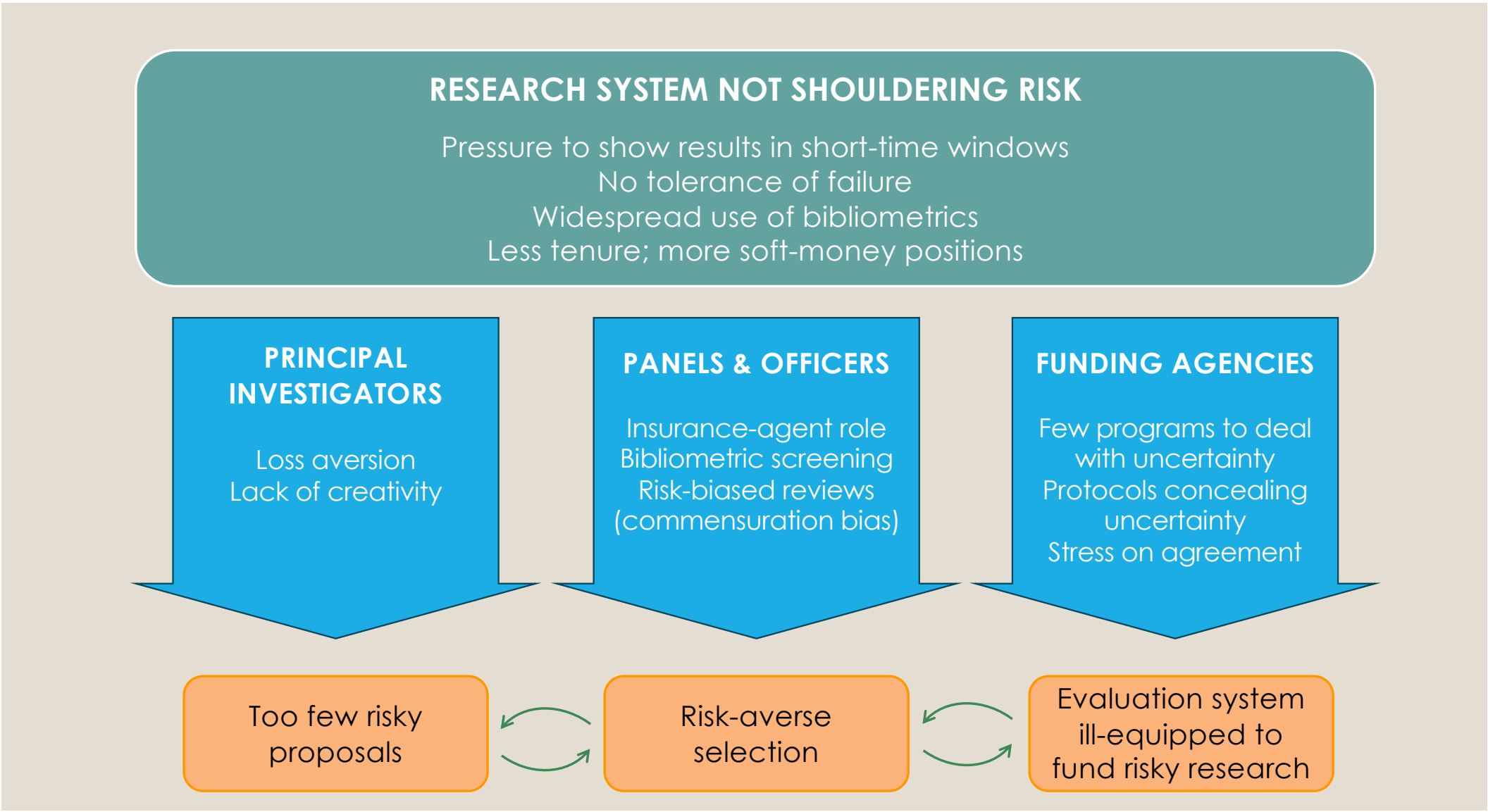
Working on a new research line is costly and time-consuming for scientists. (Myers (2020)

Diversification negatively correlated to publishing in high-impact journals, but more correlated to exceptional achievements.

After tenure (job security), scientists keep a more diversified portfolio of research.



Franzoni & Rossi-Lamastra (2017) Academic tenure, risktaking and the diversification of scientific research, I&I, DOI:10.1080/13662716.2016.1264067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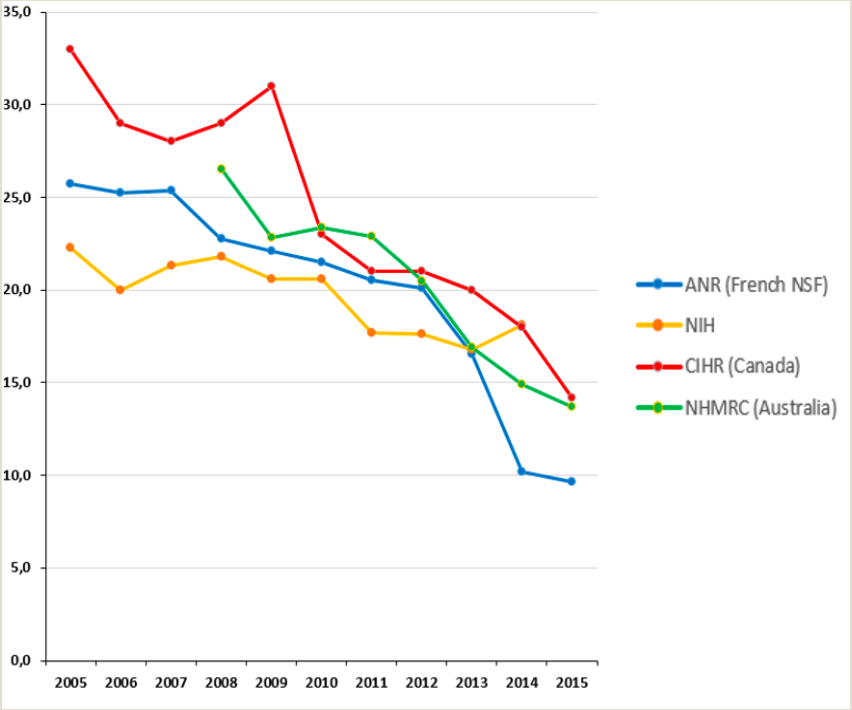
Panels & officers

- Grant Peer Review
  - System of practices and rules rooted in tradition
- Creative proposals disadvantaged: "Novelty penalty"
  - Harvard Medical School (Bourdreau et al., 2014)
  - French National Research Agency (Lanöe, 2019).
  - ERC (applicants) (Wang, Veugelers and Stephan, 2021).



Credit: https://twitter.com/alexis_verger/status/665102533363396609

Panels & officers

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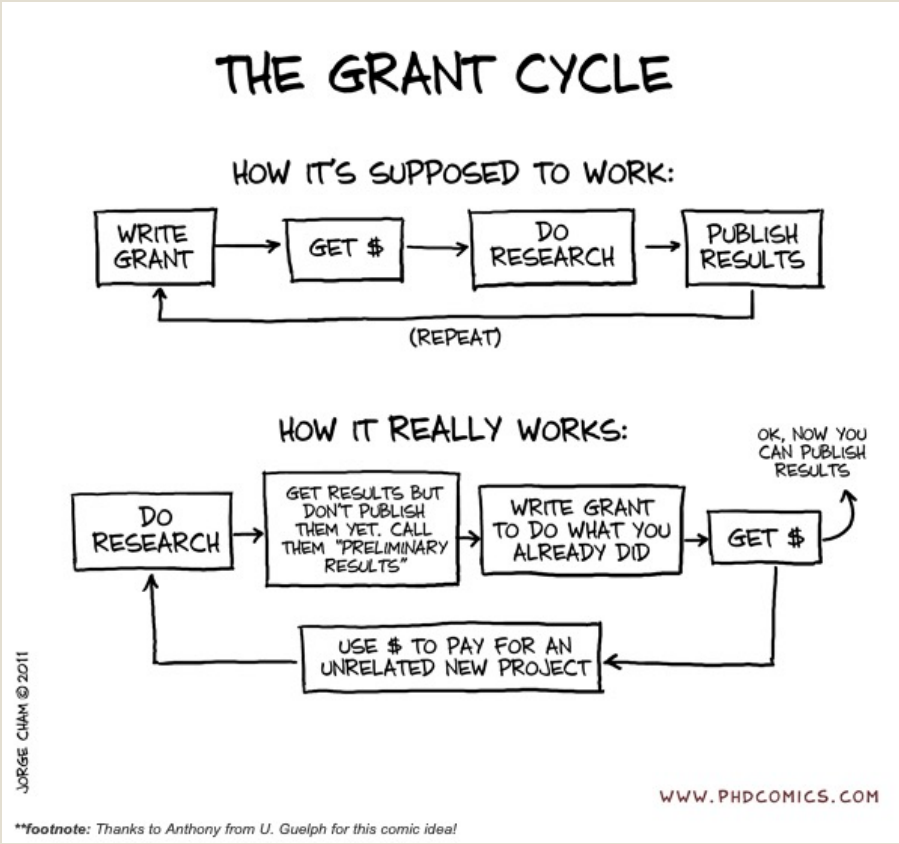
  - ERC (applicants) (Wang, Veugelers and Stephan, 2021).
- «Back burn strategy»
  - Works well, but requires pre-existing funding



Credit: http://phdcomics.com/comics/archive.php?comicid=1431

Scrutinizing
Grant peer review practices

Commensuration bias (Lee, 2015)?

INDIVIDUAL SCORING OF PROPOSALS
BASEDON ON MULTIPLE CRITERIA

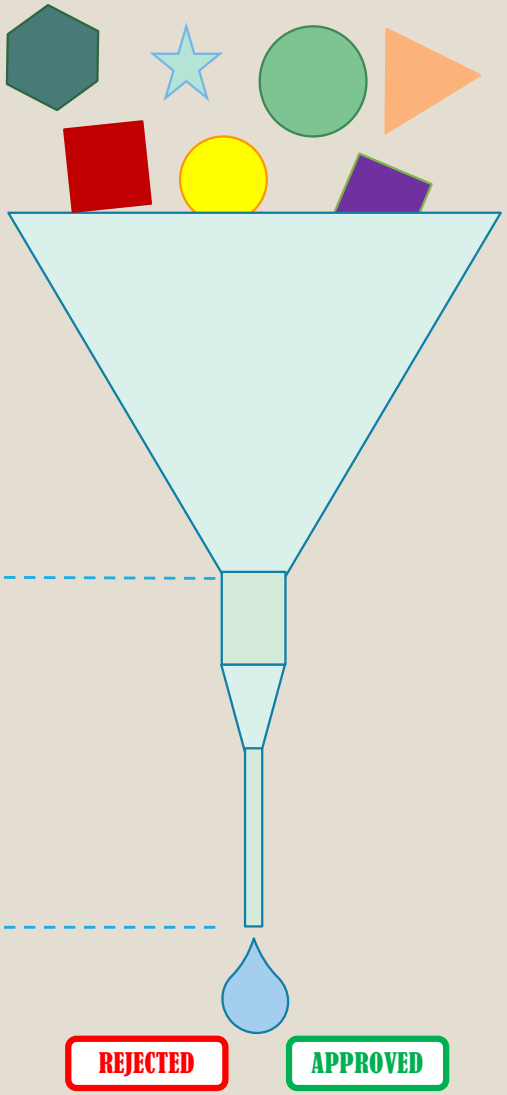
COMMENSURATION
Conversion of multiple criteria into single score

PANEL
AGGREGATION

From multiple opinions to one evaluation

DELIBERATION

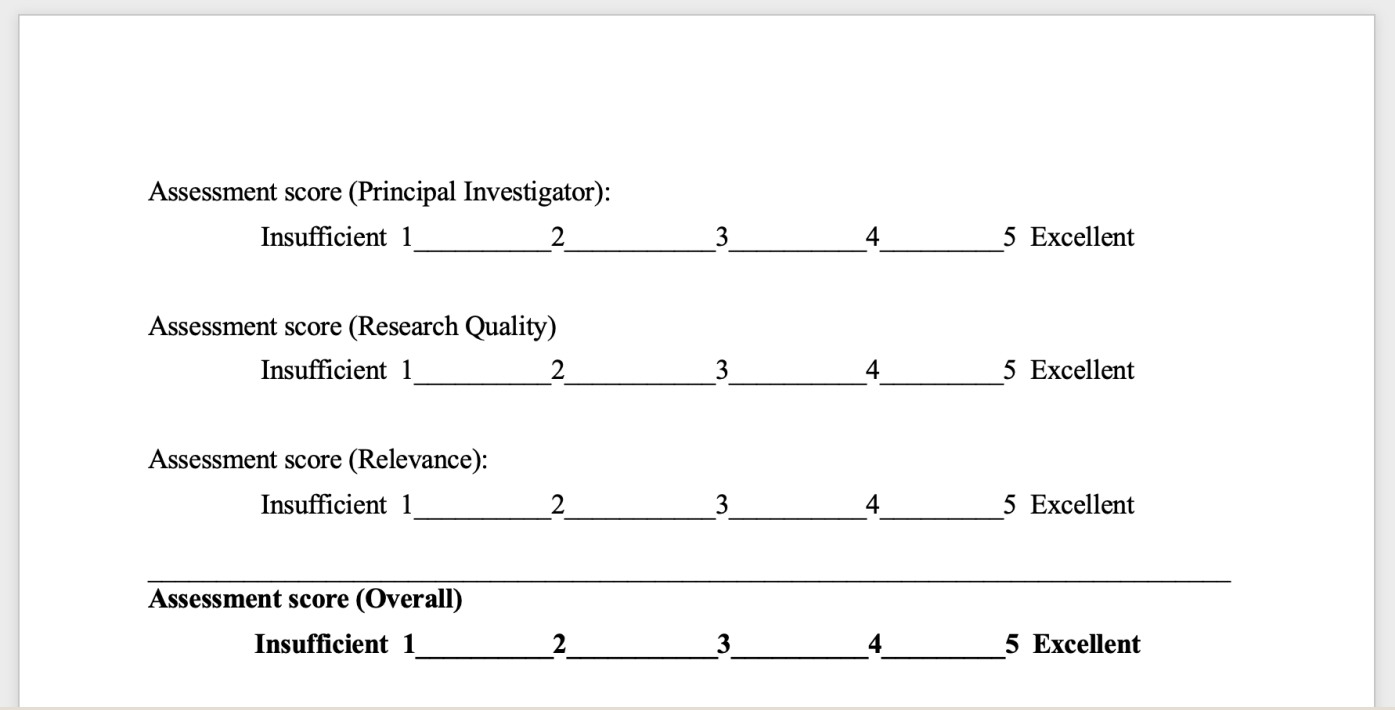
From evaluation to binary choice



Commensuration of 3 criteria into 1 overall score

Franzoni, Brostrom and Stephan, 2023

- SSF (Sweden)
  - 2,105 reports
  - universe 2011 – 2017
  - 586 unique proposals
  - 338 unique reviewers
- 3 criteria scores:
  - PI qualitications
  - Technical quality
  - Relevance for society



Assessment score (Principal Investigator):

Insufficient 1_____2_____3_____4_____5 Excellent

Assessment score (Research Quality)

Insufficient 1_____2_____3_____4_____5 Excellent

Assessment score (Relevance):

Insufficient 1_____2_____3_____4_____5 Excellent

Assessment score (Overall)

Insufficient 1_____2_____3_____4_____5 Excellent

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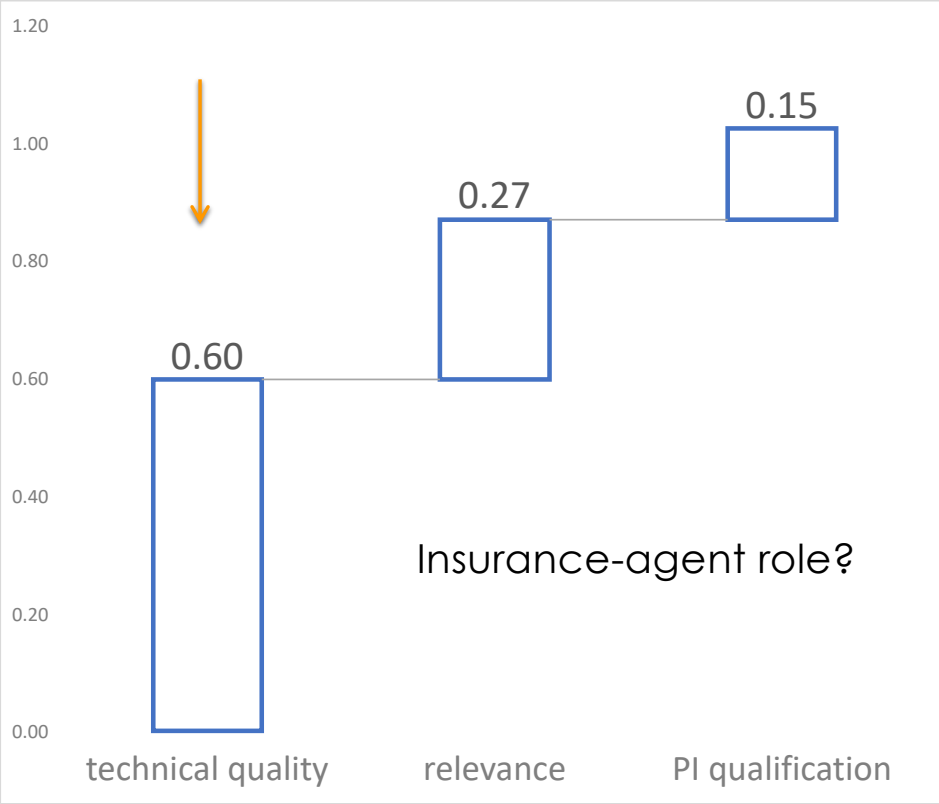

Scoring proposals to gauge risk/reward in science

- But not built on solid understanding of what is «risk» in science
- Often confused
  - *Novelty* (many risky trajectories are not new; risky because had many failures!)
  - *Basic research*.
    - Basic research can be redirected (ambiguous, not risky)
- The result:
  - Evaluation and deliberation methods disadvantaging risky science

Jorge Méndez Blake, Capítulo XXX: Al margen del texto / At the Margin of the Text

Uncertainty and risk-taking in science funding. Meaning, measurement and management in peer review of research proposals

1. "RISK" has many different meanings
   Notion of "risk in science"

1. Risk from Radical uncertainty (Ambiguity)

2. Subjective Expected Utility Approach

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Discussion

Uncertainty and risk-taking in science: Meaning, measurement and management in peer review of research proposals

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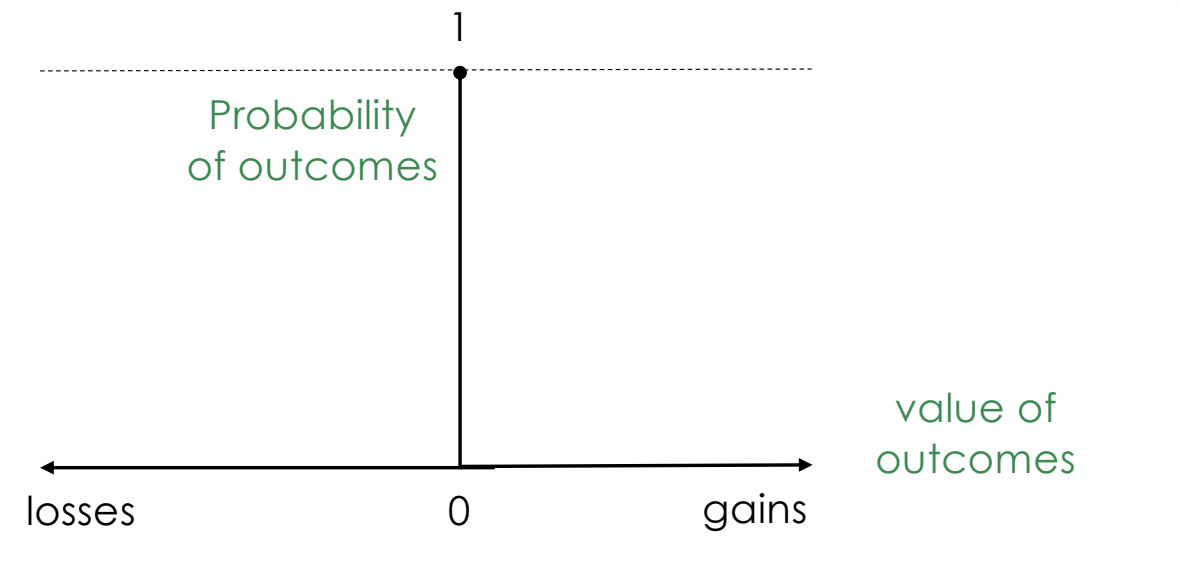
ABSTRACT

Concern that the selection of research projects by peer review disfavors risky science has called attention to ways to incorporate risk into the evaluation of research proposals. This discussion often occurs in the absence of well-defined and developed concepts of what risk and uncertainty mean in science. This paper sets out to address this void with the goal of providing building blocks to further the discussion of the meaning of risk and uncertainty in science. The core contributions of the paper are fourfold. First, we outline the meaning of risk in science, drawing on insights from literatures on risk and uncertainty. Second, based on this outline, we discuss possible ways in which programs can embrace a more comprehensive concept of risk and embed it in peer review of proposals, with the goal of not penalizing risky research proposals with the potential of high return when funding decisions are made. Third, we make an important distinction between research projects involving high-risk and research projects whose evaluation is subjected to ambiguity/radical uncertainty. Fourth, we discuss possible ways of addressing ambiguity/radical uncertainty by funding agencies.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Probability
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outcomes
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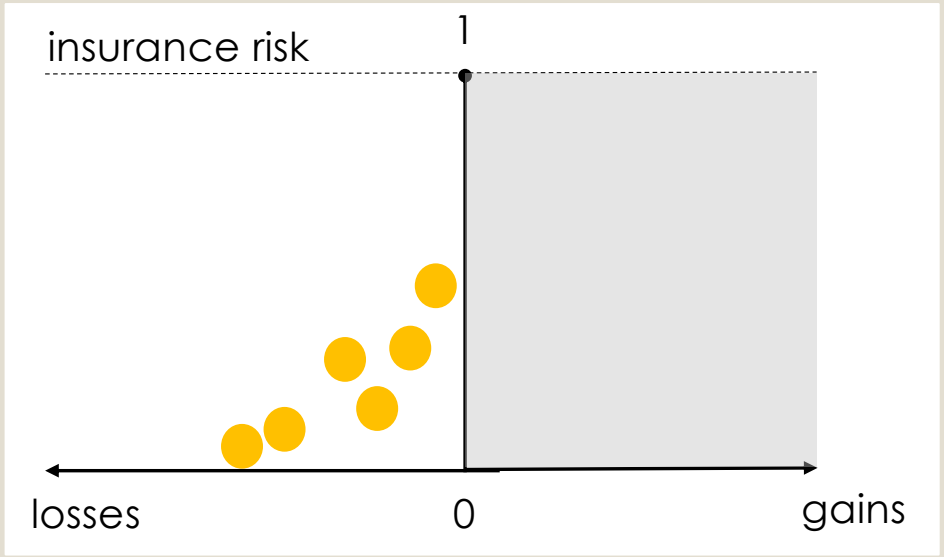
gains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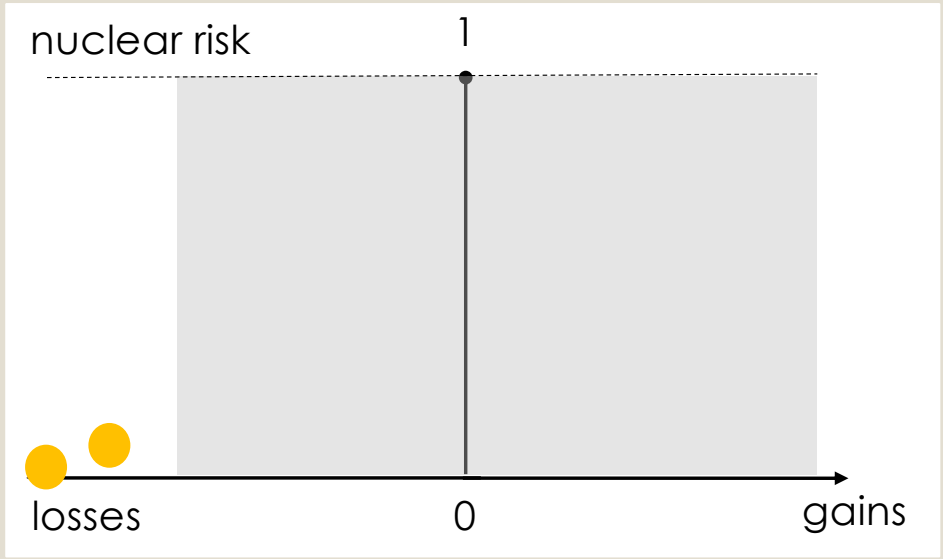
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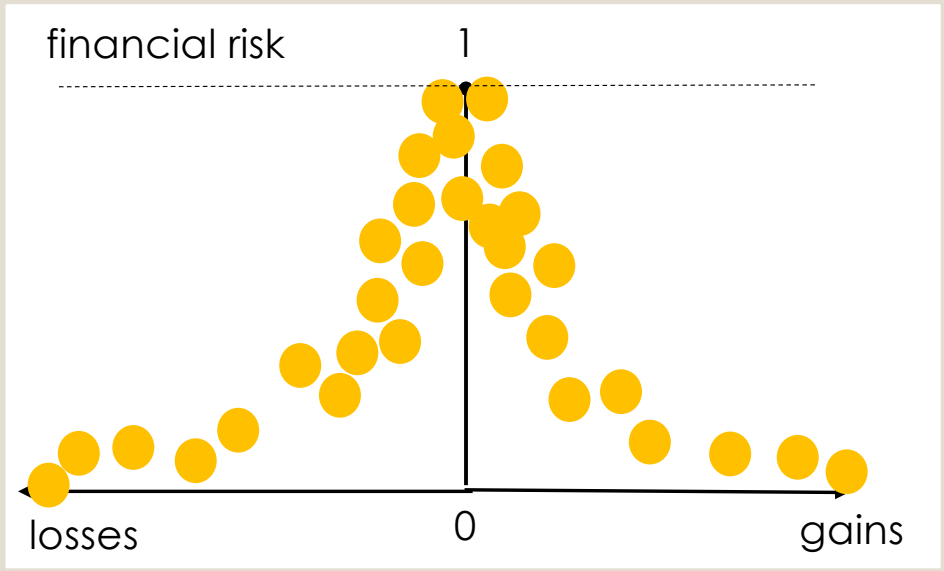
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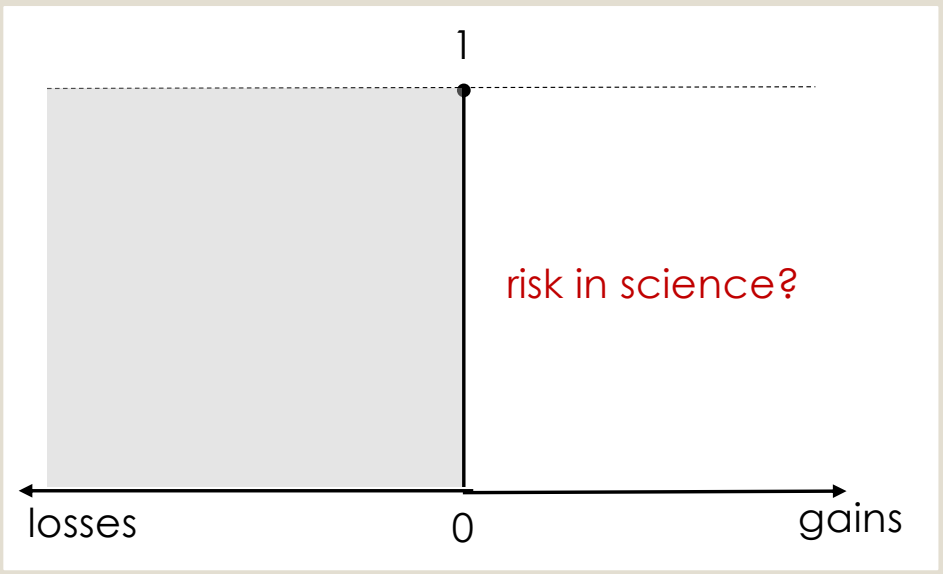
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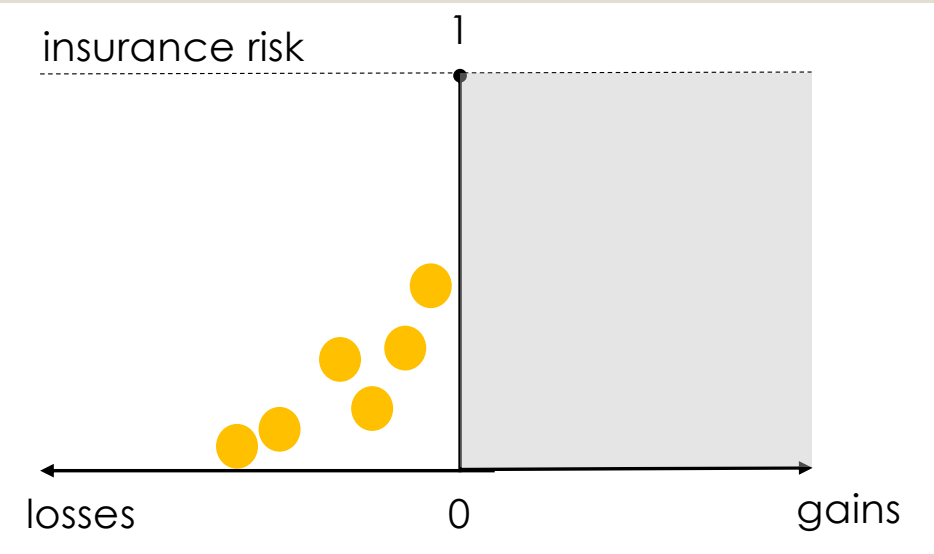
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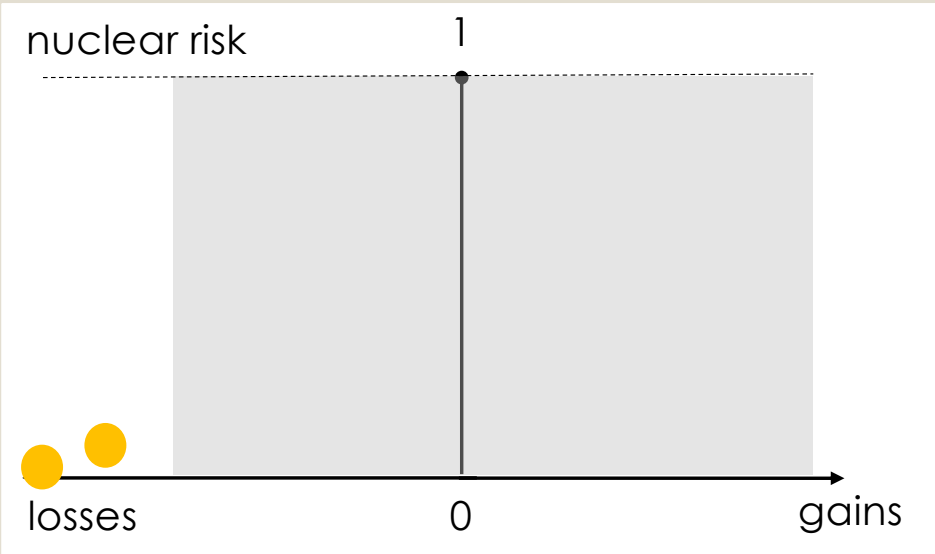
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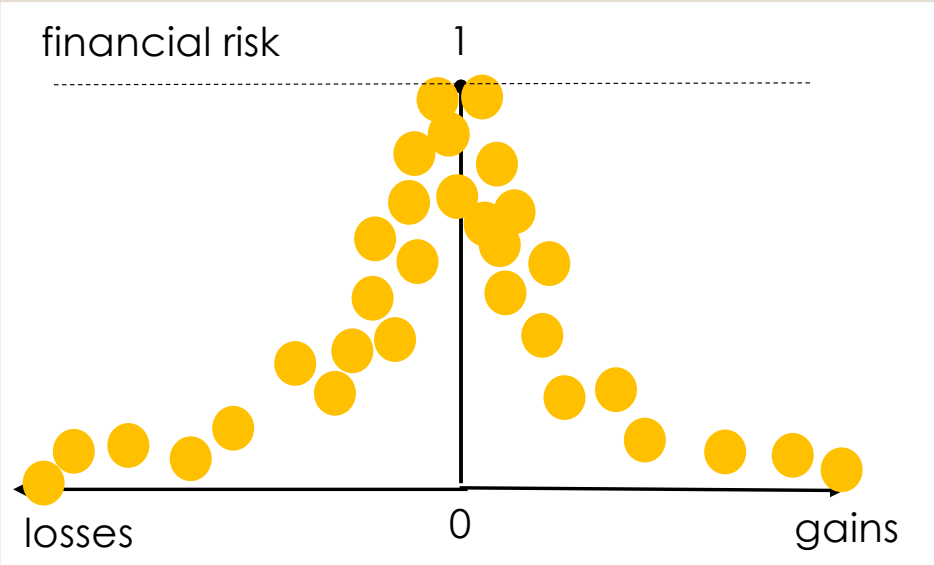
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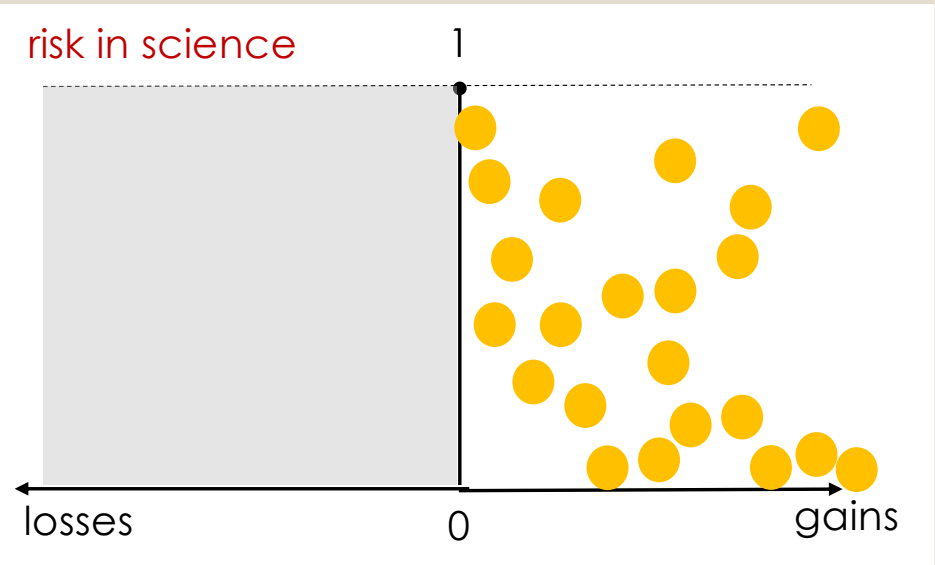
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losses
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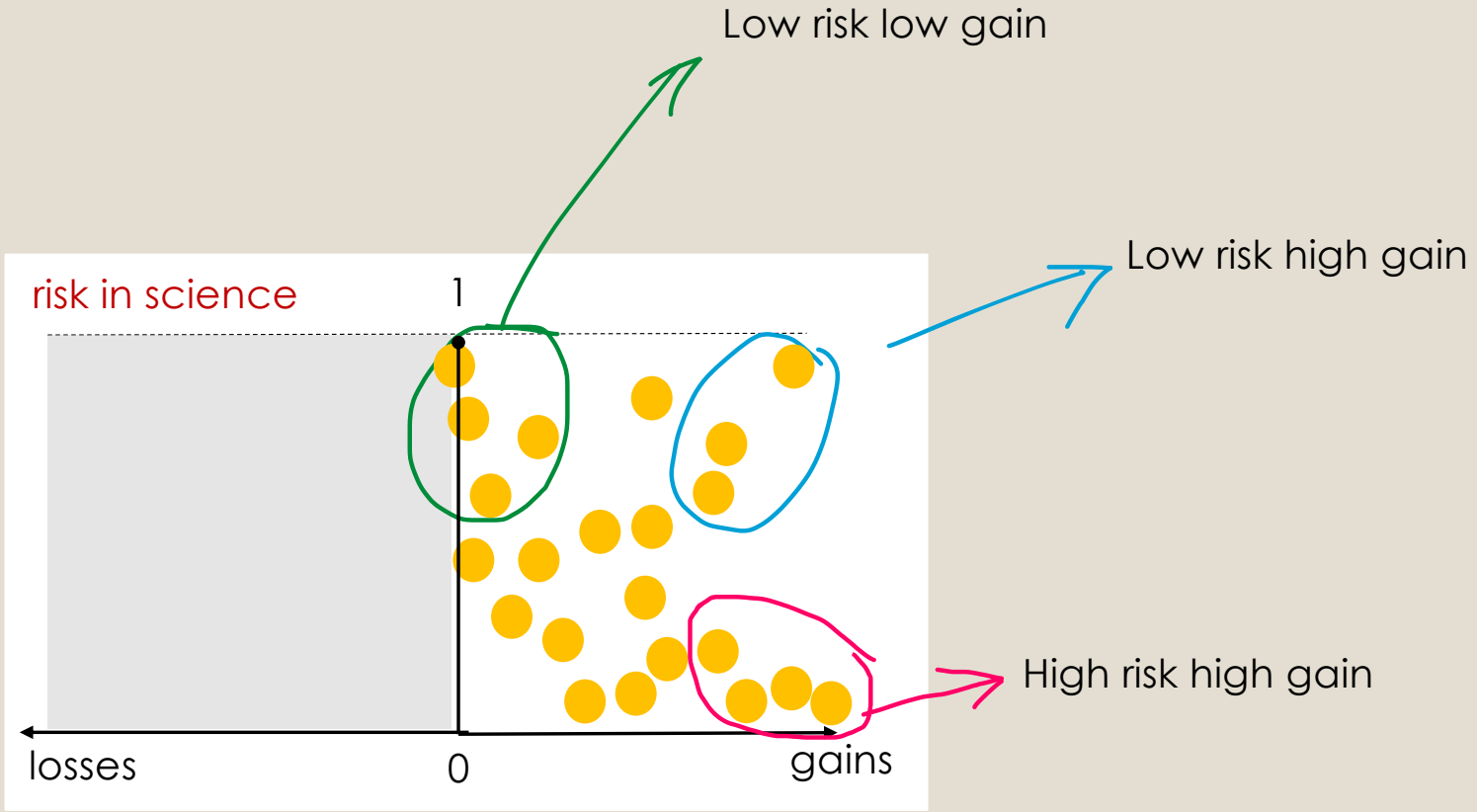
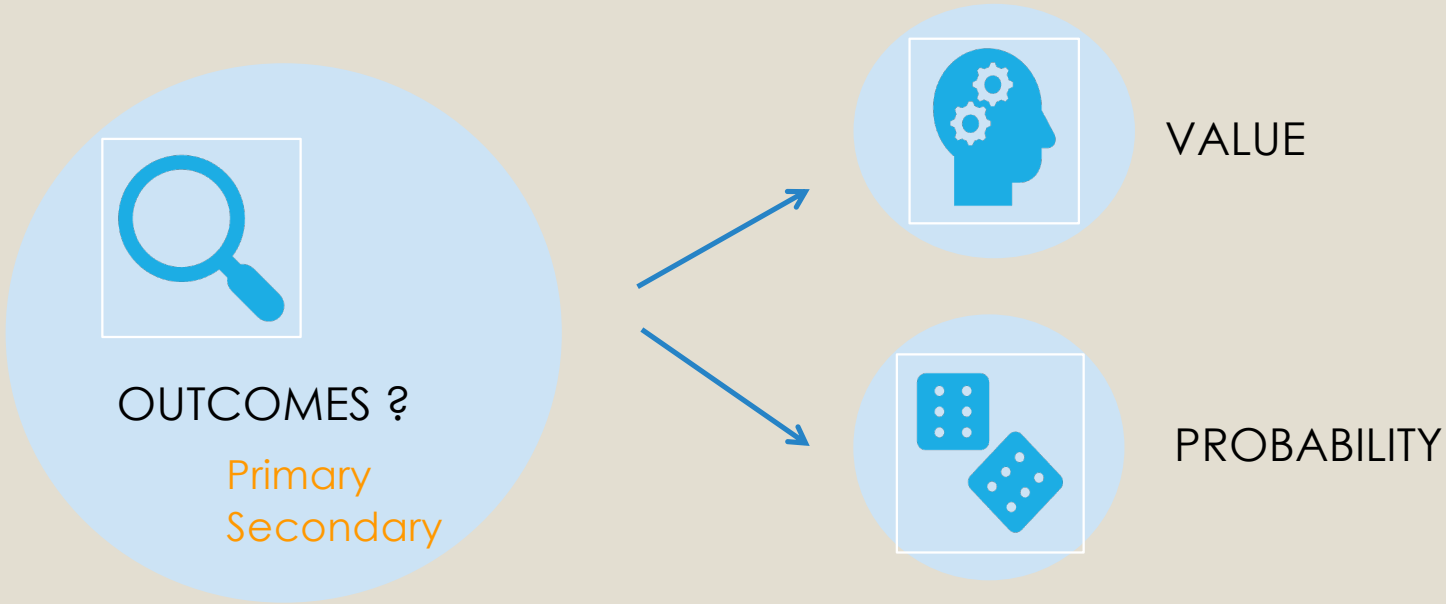

Low risk low gain
Low risk high gain
High risk high gain
risk in science
1
losses
0
gains

Scoring with Subjective Expected Utility (SEU) Approach

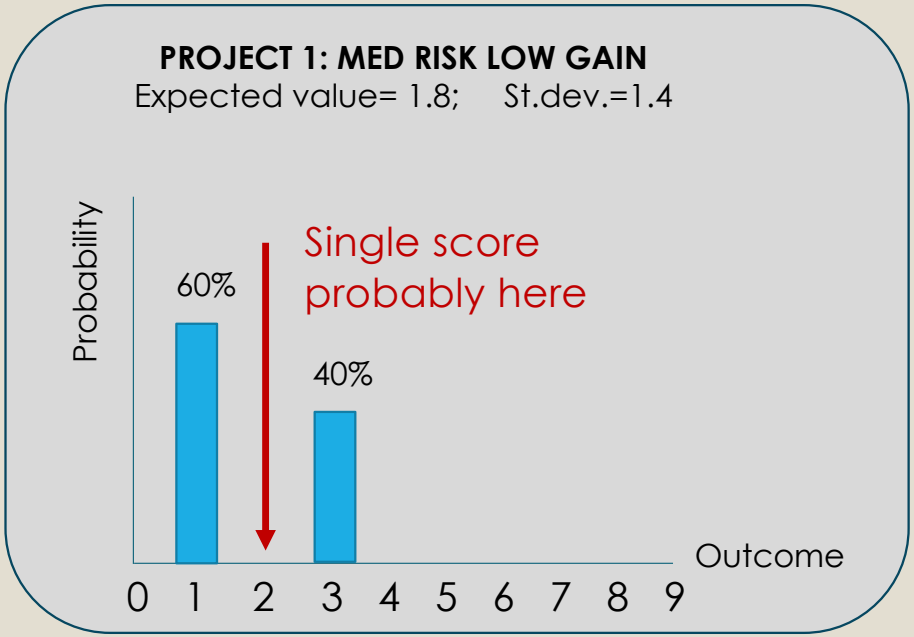


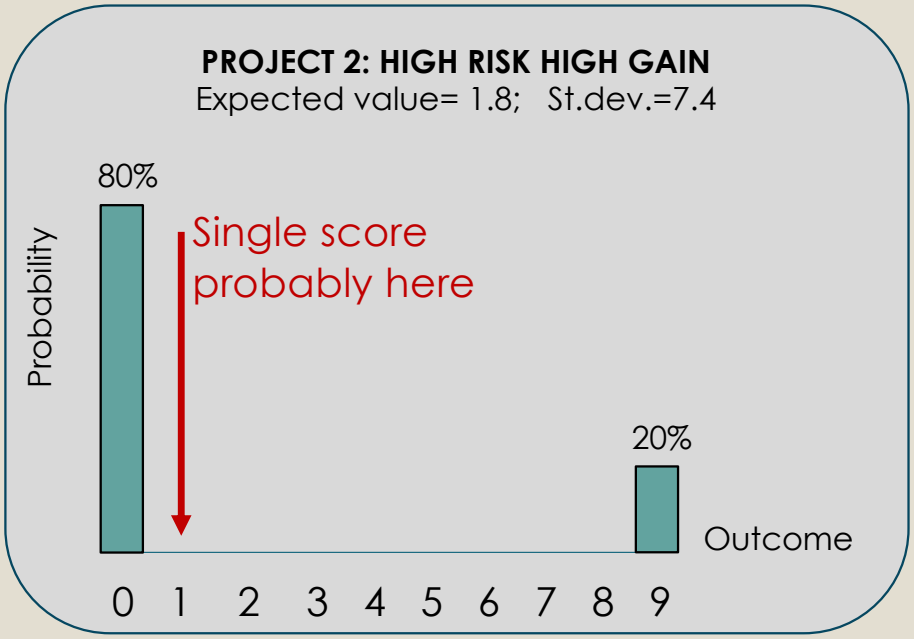
- Identify pairs of value-productivity that involve high-risk high-gain
- If needed, a single Subjective Expected Utility (SEU) of the project *i* (Y_i) can be computed as

$$Y_i = u_{1i} \cdot P_{1i} + u_{2i} \cdot P_{2i} + (u_{1i} + u_{2i}) \cdot P_{2i} \cdot P_{1i}$$

Deliberation for high-risk high-gain projects

- Pairs of value-probability allows discerning between #1 and #2
- Single impact score elicited without thinking at multiple outcomes would likely underestimate #2





- Draw a marble. Win if RED.
- You have the option to choose the urn you draw from

Do you want to draw the marble from Urn#1 or Urn#2?

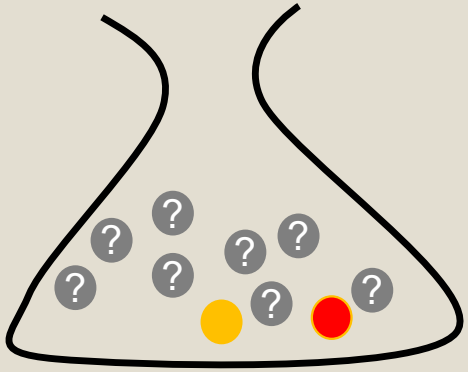
URN #1

50% red
50% yellow

risk

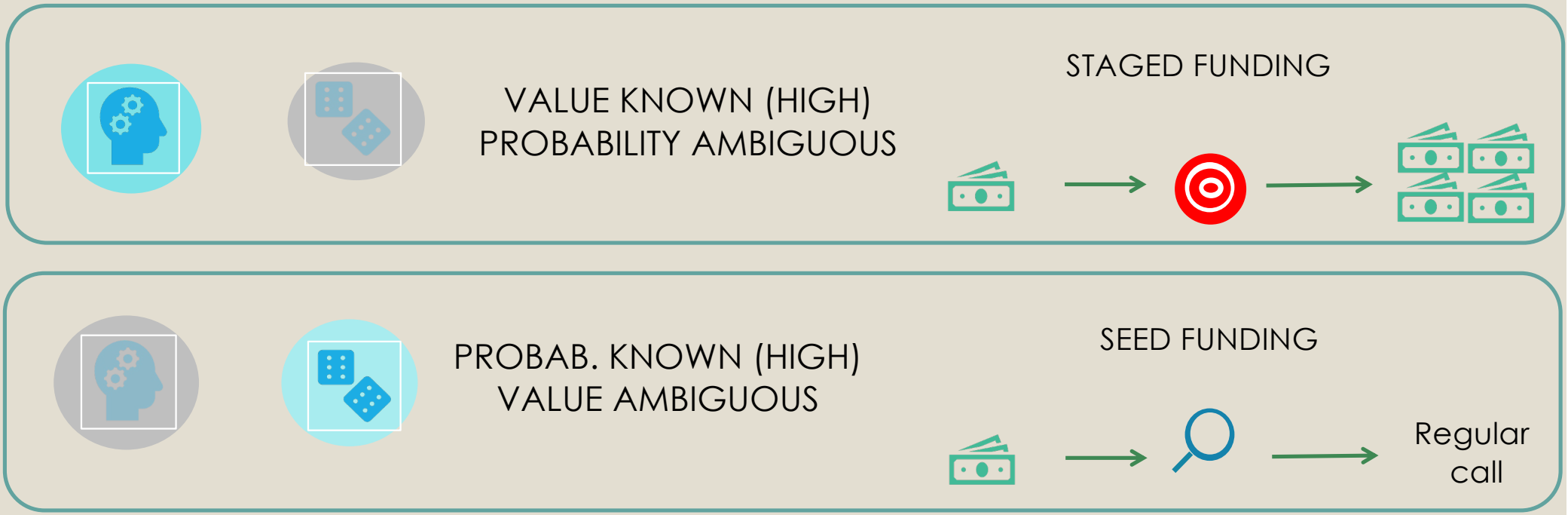
URN #2

there are reds
and yellows



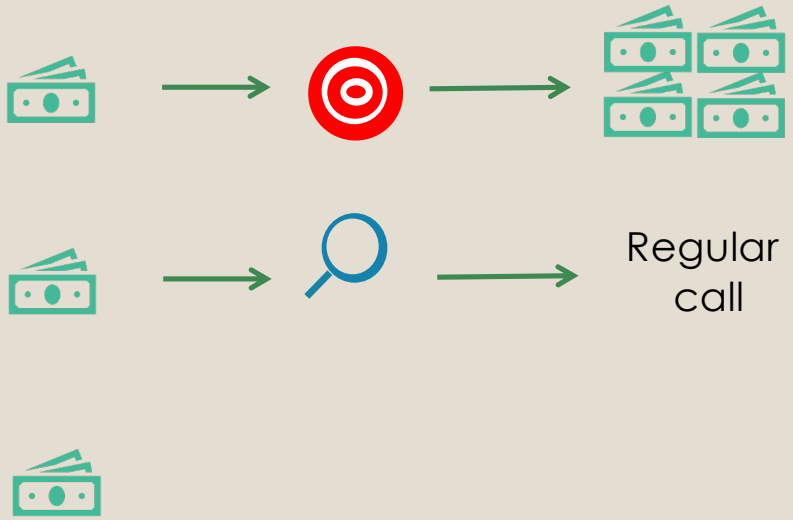
ambiguity

Programs for dealing with ambiguity



Funding models to deal with ambiguity (lack of knowledge)

1. Staged funding (DARPA-H)
   - High potential value
   - Ambiguous probability
2. Seed-funding
   - Known probability
   - Ambiguous potential value
3. Block funding
   - Ambiguous potential value
   - Ambiguous probability



Conclusions & way-forward

® Rebecca Horn, Übungen in neun Stücken: Mit beiden Händen gleichzeitig die Wände berühren, 1974/75

- High-risk-high-gain vital to science
- Several factors coalesce to hinder risk-taking
- Grant peer review
  - New ways to do soring, aggregation, deliberation that allows funding risky science
  - Need of testing!
- Pilot testing (AFS)
- Lab and in-vivo testing
  - Science Policy initiative of J-PAL