What are we measuring when we measure risk attitudes?

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2022-04-21

(nothing new today)

Slovic (1962)

TABLE 1

INTERCORRELATIONS AMONG RISK TAKING MEASURES
($N = 82$)

Variable	1	2	3	4	5	6	7	8
Response sets								
1 Dot Estimation								
2 Word Meanings	−.17							
3 Test Risk	.16	.05						
Questionnaires								
4 Life Experience Inventory	.05	.27**	−.04					
5 Job Preference Inventory[a]	.07	−.14	−.19	−.06				
Gambling preferences								
6 Self-Crediting Test	−.08	.19*	−.24*	.05	.09			
7 Variance preferences	.32**	.03	−.07	.23*	.07	.04		
8 Probability preferences	.16	−.03	−.07	−.03	−.35*	−.20	−.17	
Ratings								
9 Risk rating	.05	.00	−.24*	.34**	.10	−.02	.02	.18[a]

- *"…future research must carefully consider the problem of adequately **defining** and **assessing** risk taking behavior."*

So, how are we doing?

This talk

- **Part 1: a destination**
  - what are risk attitudes?
  - how do we measure them?
- **Part 2: a map**
  - a *detailed map* of elicited risk attitudes
  - an assessment of *convergent* and *predictive* validity*
- **Part 3: finding one's way**
  - task-specific bias
  - risk perception

I. destination: risk attitudes

Measuring risk attitudes

> A **difficult** task with **crucial** relevance

- directly *unobservable*
- *latent* construct (requires a theory)
- should we..
  - *infer* from real world data or from *ad-hoc* choices
  - ask or **t**ask?
  - elicit by *descrption* or by *experience*?

risk noun

\ rɪsk \

Definition of *risk* (Entry 1 of 2)

1 : possibility of loss or injury : PERIL

2 : someone or something that creates or suggests a hazard

3 **a** : the chance of loss or the perils to the subject matter of an insurance contract

also : the degree of probability of such loss

b : a person or thing that is a specified hazard to an insurer

c : an insurance hazard from a specified cause or source

// war risk

4 : the chance that an investment (such as a stock or commodity) will lose value

Risk in psychology

> The act of implementing a goal-directed option qualifies as an instance of risk taking whenever **two things** are true: (a) the behavior in question could lead to **more than one outcome** and (b) some of these outcomes are **undesirable** or even dangerous. In essence, then, risk taking involves the implementation of options that could lead to **negative** consequences.

(*Byrnes et al 1999*)

The state of the art: psychology

> risk loosely defined as **probability of harm**

> focus on **questionnaires** and **intuitive tasks**

- **Quests**:
  - directly ask
  - over different domains
  - tackle risk perception
- **Tasks**
  - putting the subject in a ‘risky’ situation
  - card/gambling tasks

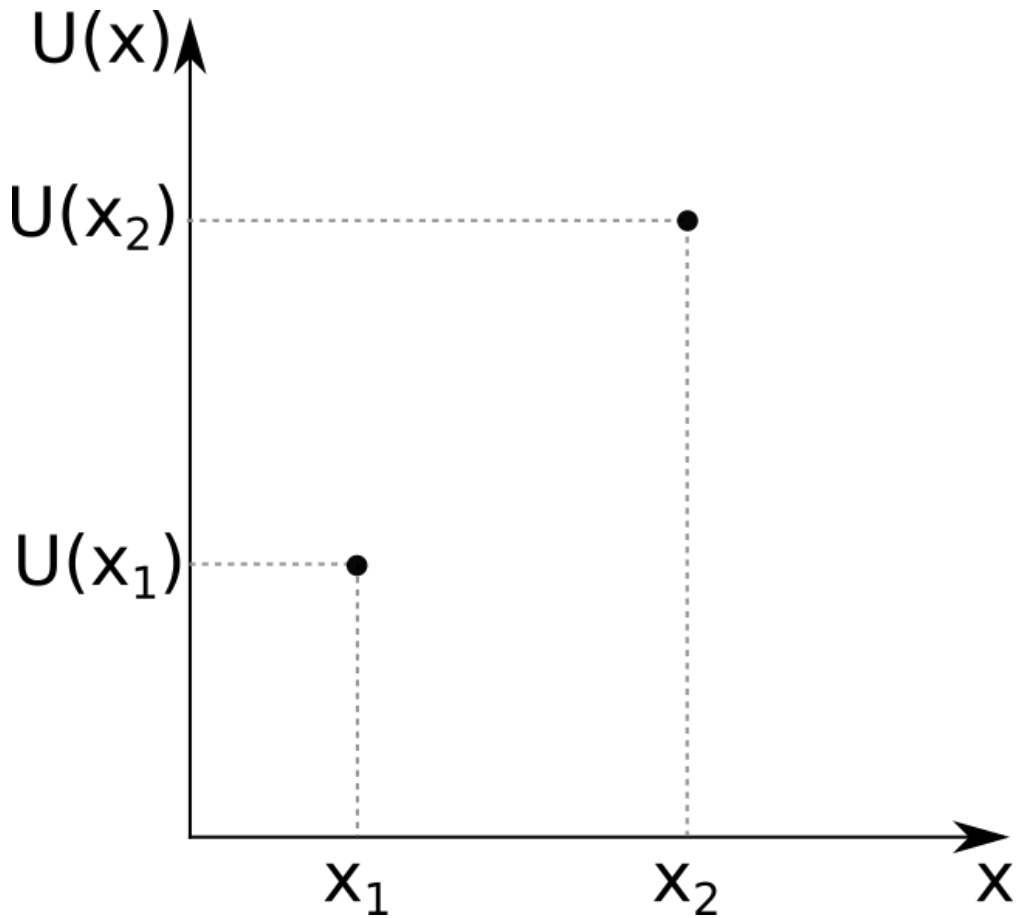
> Metrics of success: **convergent validity** + **predictive validity**

Risk in economics

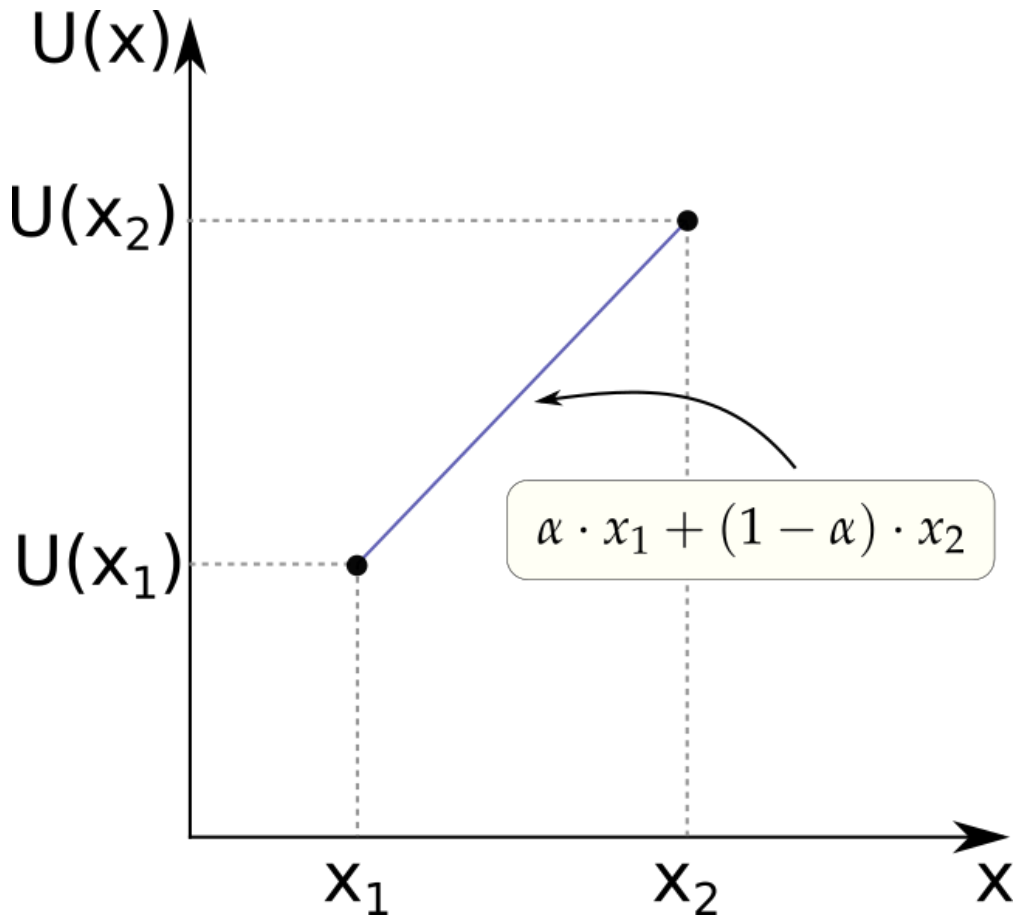
> decisions given a **probability distribution** over **outcomes**

- if probability and outcomes known: **risk**
- if only oucomes known: **ambiguity**
- if both unknown: knightian **uncertainty**

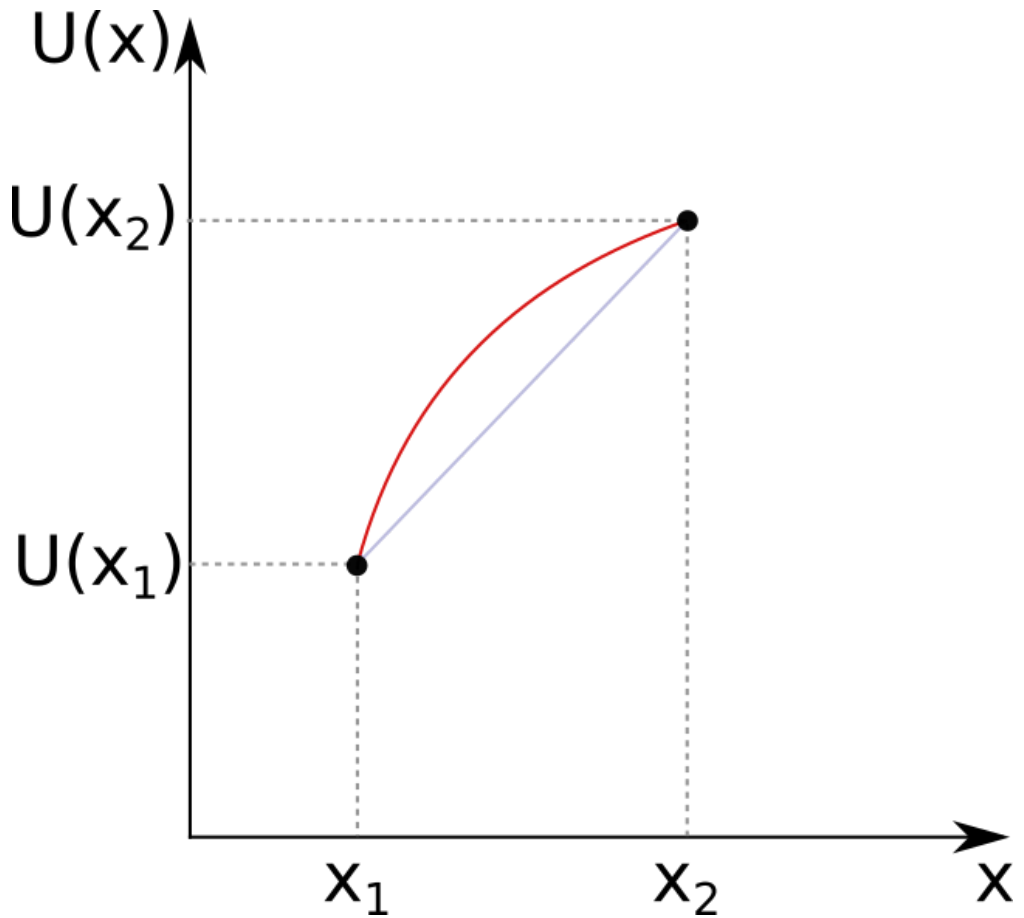
The EUT framework



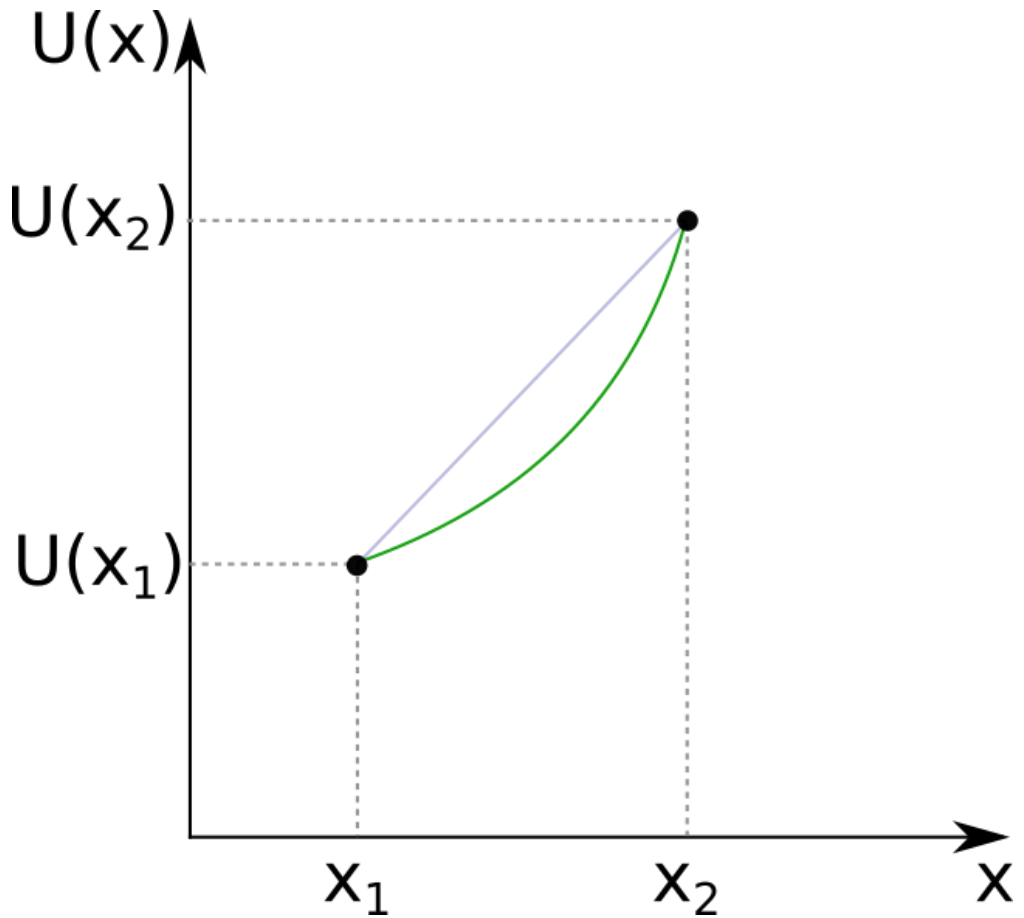
The EUT framework



The EUT framework



The EUT framework



The state of the art: economics

> risk formally defined as **uncertainty over outcomes**

> focus on **decontextualized tasks** (and *questionnaires*)

- **The lottery paradigm**
  - incentives
  - risk task = choice over lotteries
  - different formats, cover stories, contexts
  - strong theoretical underpinning
  - estimation of utility functions ($\Rightarrow$ models)

> Metric of success: **internal validity** (task $\Longleftrightarrow$ theory)

Tools: RETs

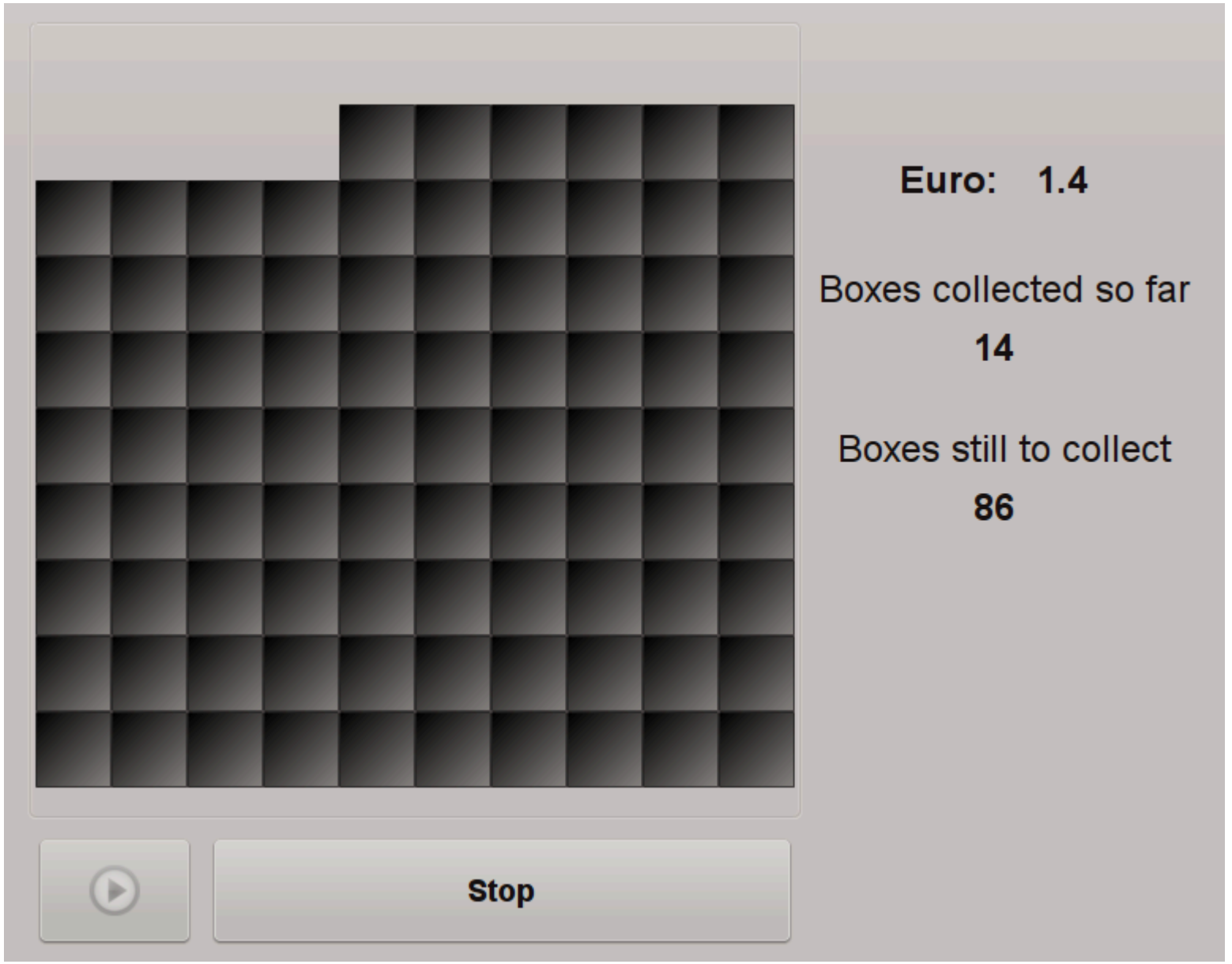
Holt and Laury

	Option A				Option B			
1	1/10	4 €	9/10	3.2 €	1/10	7.7 €	9/10	0.2 €
2	2/10	4 €	8/10	3.2 €	2/10	7.7 €	8/10	0.2 €
3	3/10	4 €	7/10	3.2 €	3/10	7.7 €	7/10	0.2 €
4	4/10	4 €	6/10	3.2 €	4/10	7.7 €	6/10	0.2 €
5	5/10	4 €	5/10	3.2 €	5/10	7.7 €	5/10	0.2 €
6	6/10	4 €	4/10	3.2 €	6/10	7.7 €	4/10	0.2 €
7	7/10	4 €	3/10	3.2 €	7/10	7.7 €	3/10	0.2 €
8	8/10	4 €	2/10	3.2 €	8/10	7.7 €	2/10	0.2 €
9	9/10	4 €	1/10	3.2 €	9/10	7.7 €	1/10	0.2 €
10	10/10	4 €	0/10	3.2 €	10/10	7.7 €	0/10	0.2 €

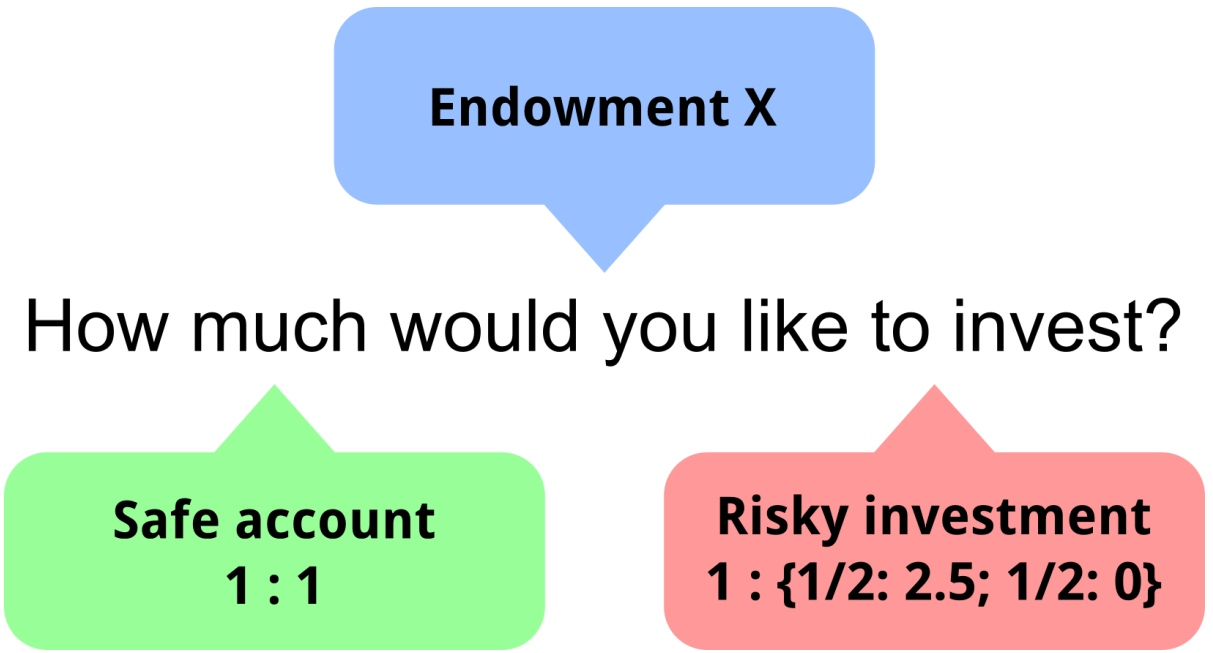
Binswanger / Eckel and Grossmann

	Event	Probability	Outcome
1	A	50%	4 €
	B	50%	4 €
2	A	50%	6 €
	B	50%	3 €
3	A	50%	8 €
	B	50%	2 €
4	A	50%	10 €
	B	50%	1 €
5	A	50%	12 €
	B	50%	0 €

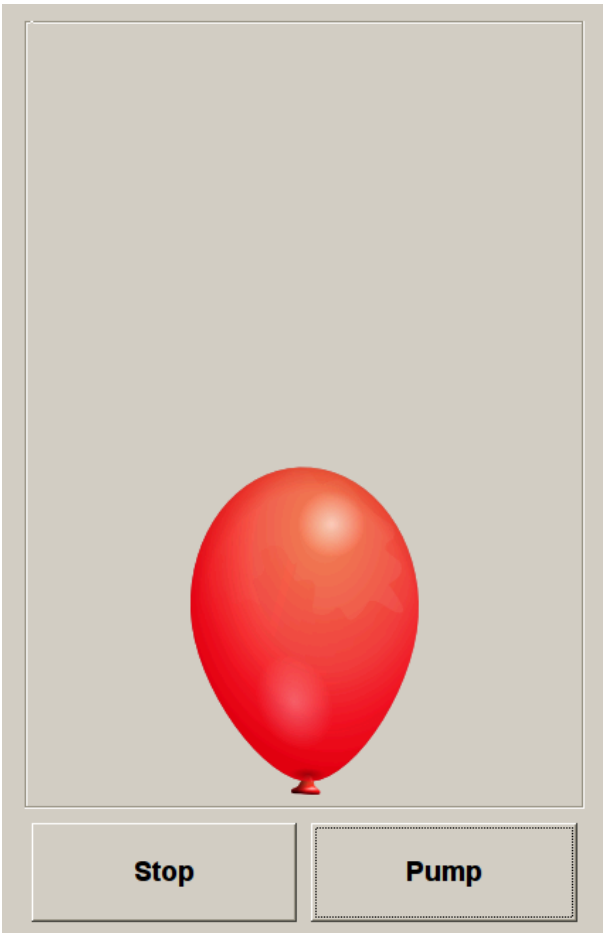
Bomb Risk Elicitation Task



Investment Game (Gneezy and Potters)



Balloon Analog Risk Task (Lejuez et al)



Certainty Equivalent MPL

A	B	
100%	50%	50%
0		
10		
20		
30		
40		
50	100	0
60		
70		
80		
90		
100		

Questionnaire: SOEP

How likely are you to take risks in general, one a scale from 0 (not taking any risks) to 10 (taking many risks)?

Questionnaire: DOSPERT

Domain **Spe**cific **R**isk **T**aking Scale

- 6 domains: investing, gambling, health/safety, recreational, ethical, and social
- 1 to 7 scale: *how risky do you think X is?*
- 1 to 7 scale: *how likely are you to engage in X?*

Examples:

- Riding a motorcycle without a helmet.
- Engaging in unprotected sex.
- Investing 10% of your annual income in a moderate growth diversified fund.

II. a map: METARET

METARET

> **A meta-analysis of Risk elicitation tasks**

- elicited risk atitudes: tasks and questionnaires
- convergent validity: correlation among tasks
- convergent validity: correlation among questionnaires
- predictive validity: correlation task $\iff$ questionnaires

METARET resources

- **your** data (*thanks!*)
- preregistration on OSF
- transparent data collection & analysis on gitHub
- live data exploration on a shiny app

Contributors (so far: 17.321 subjects)

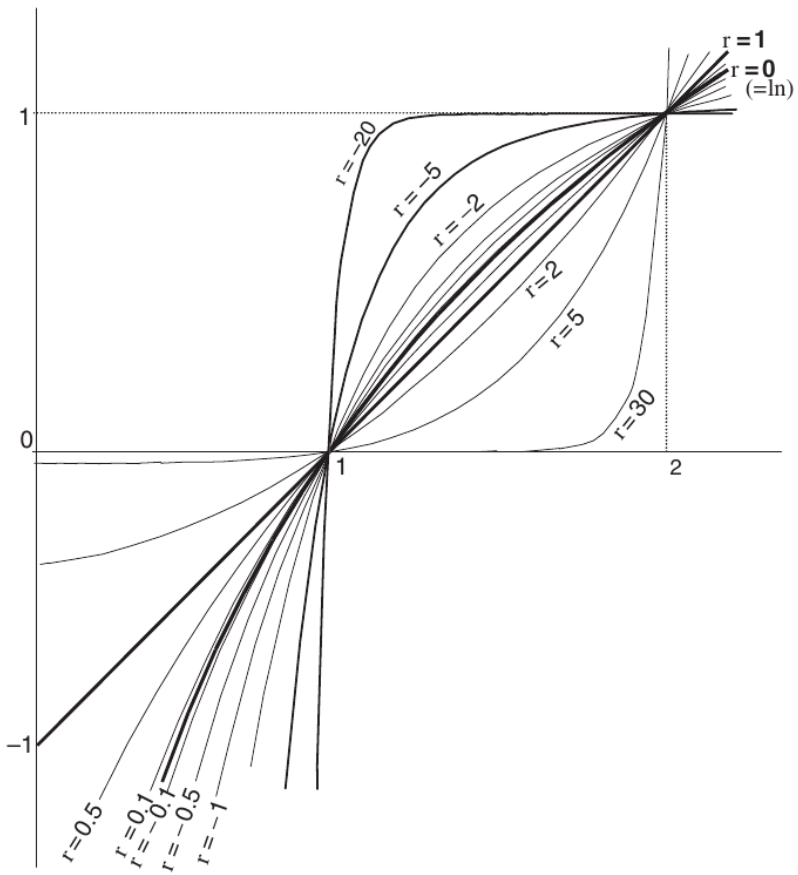
- Gnambs Appel and Oeberst (PONE 2015)
- Crosetto and Filippin (EXEC 2016)
- Filippin and Crosetto (ManSci 2016)
- Pedroni Frey Bruhin Dutilh Hertwig and Rieskamp (NHB 2016)
- Menkhoff and Sakha (JEconPsy 2017)
- Frey Pedroni Mata Rieskamp and Hertwig (ScAdv 2017)
- Nielsen (JEBO 2019)
- Charness Garcia Offerman and Villeval (WP 2019)
- Holzmeister and Stefan (WP 2018)
- Zhou and Hey (ExEc 2018)

Assumptions: CRRA (à la Wakker)

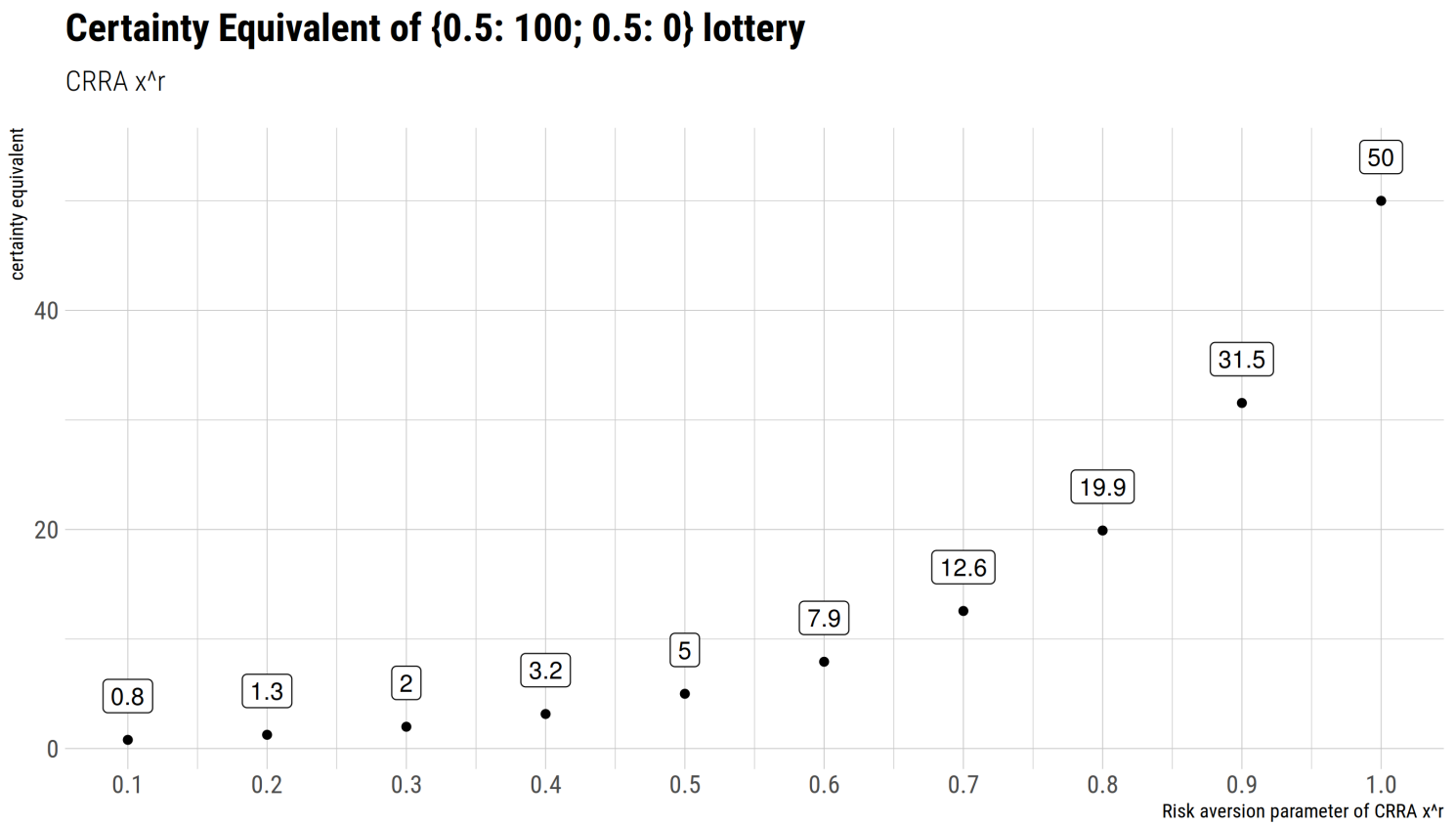
$$u(x) = x^r$$

- simple
- captures risk aversion
- makes different tasks comparable

CRRA



How big are the differences?



1. elicited attitudes

elicited attitudes: summary

- **low** consistency across tasks
- surprisingly, **low** consistency also *within* tasks
- but **heterogeneity** by task is large
- only result that holds: most people are *risk averse*

> possible explanation: between-subjects variation.

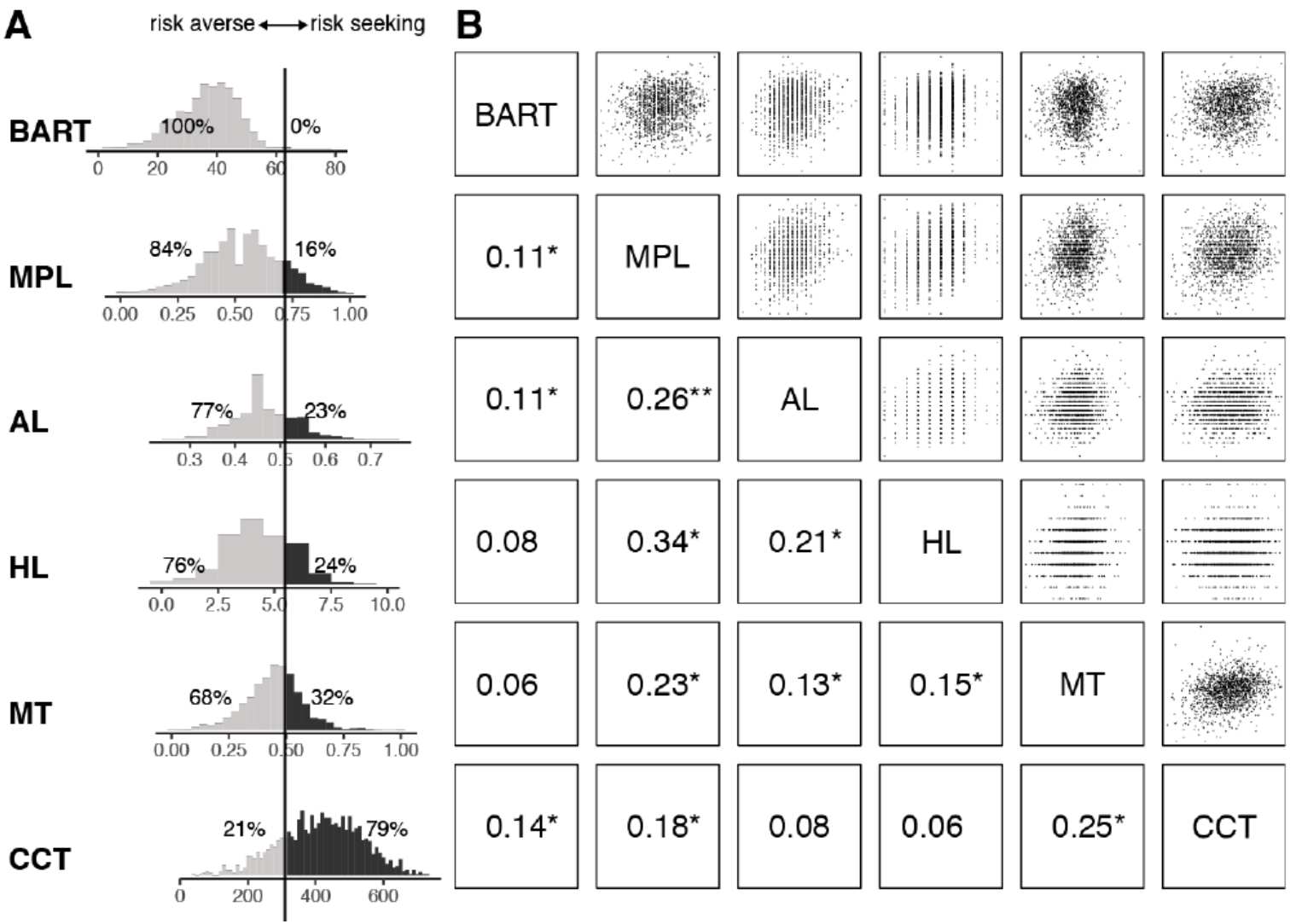
2. Questionnaires

Questionnaires: summary

- **better** consistency across samples
- a tendency to report *'in the middle'*
- we do not really know what those numbers mean

3. Convergent validity

Convergence: more evidence



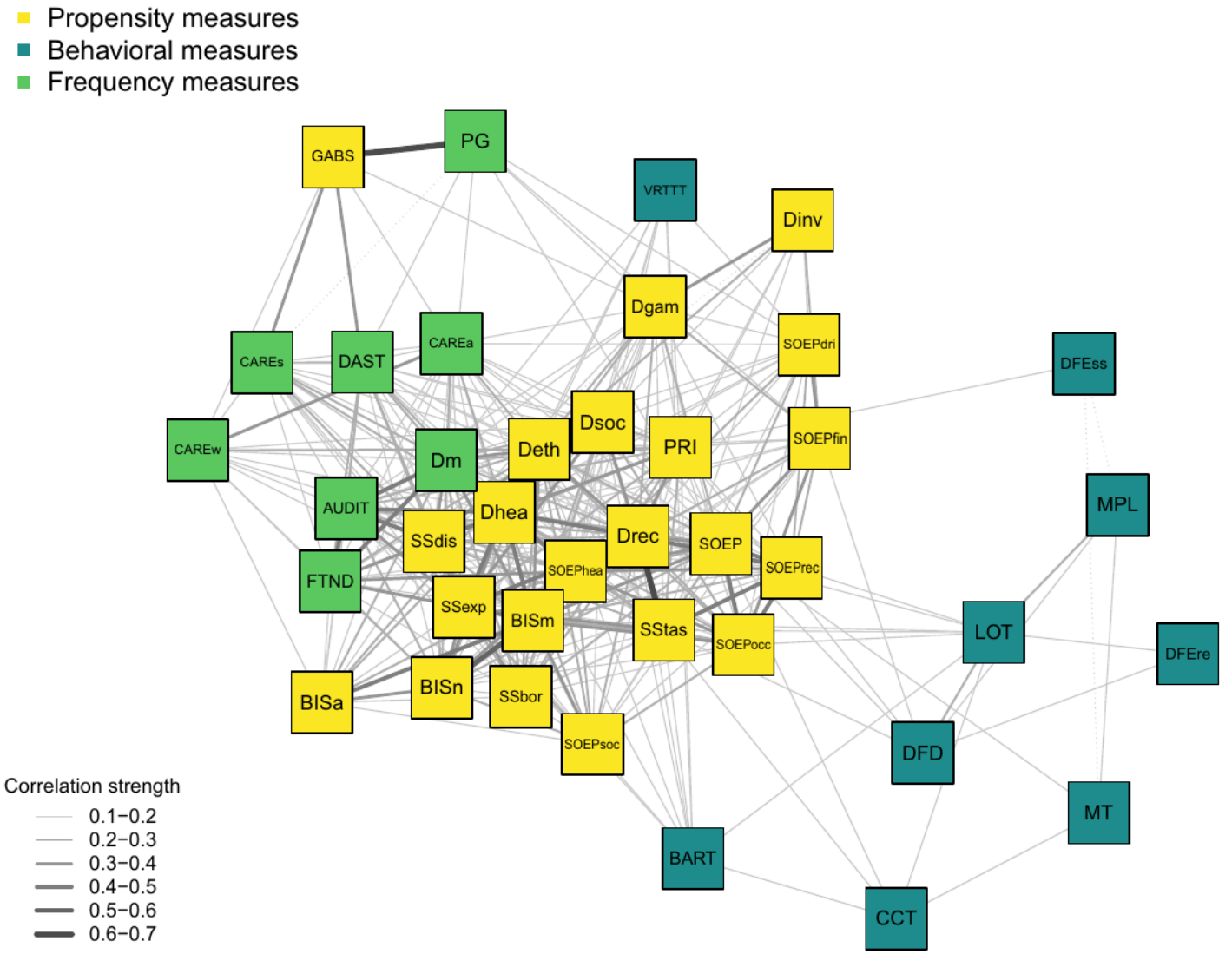
Pedroni et al. Nature Human Behavior 2017

Convergence: summary

- we replicate Slovic 1962 (!!)
- no correlation higher than .35
- when transalitng into r things get *worse*

4. Predictive validity

Predictive validity: more evidence



Frey et al. Science Advances 2017

Predictive validity: summary

- **low** correlations with questionnaires
- across questionnaires and tasks
- Beauchamp et al JRU 2016: questionnaires are rather predictive

We have a problem

III. Finding one’s way

Finding one’s way

- task-specific bias
- noise
- risk perception
- theory

Finding one’s way

- **task-specific bias**
- (noise)
- **risk perception**
- (theory)

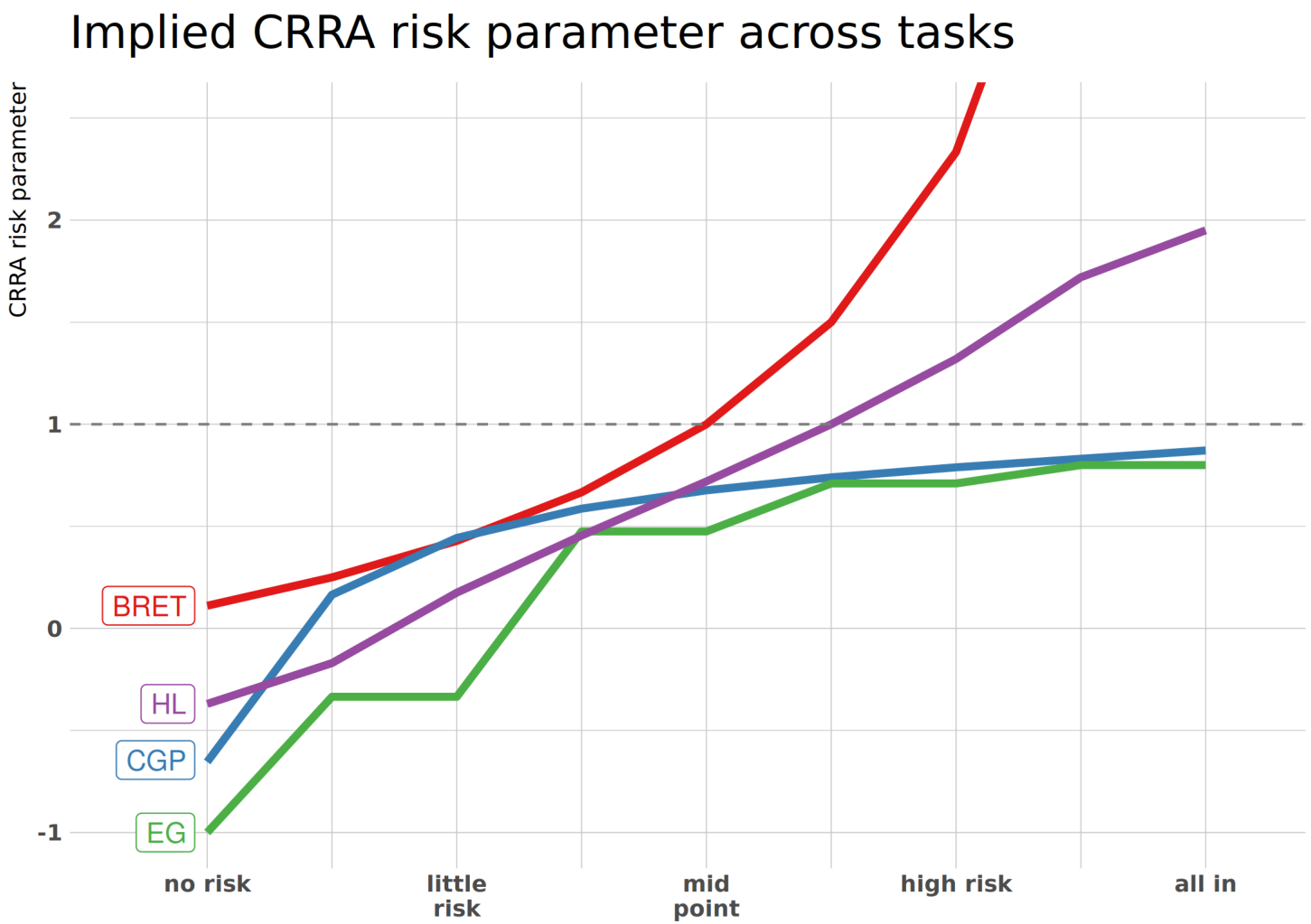
Task-specfic bias

what if tasks distort choices?

> *noisy* preference + one-shot choices $\Rightarrow$ noisy data

- cognitive limits $\Rightarrow$ limited understanding
- *task-specific* bias?

(this work: Crosetto and Filippin, ExEc 2015)


Implied CRRA risk parameter across tasks
CRRA risk parameter
2
1
0
-1
BRET
HL
CGP
EG
no risk
little risk
mid point
high risk
all in

Simulations

How does the mere mechanics of each task affect the outcome?

Simulation exercise:

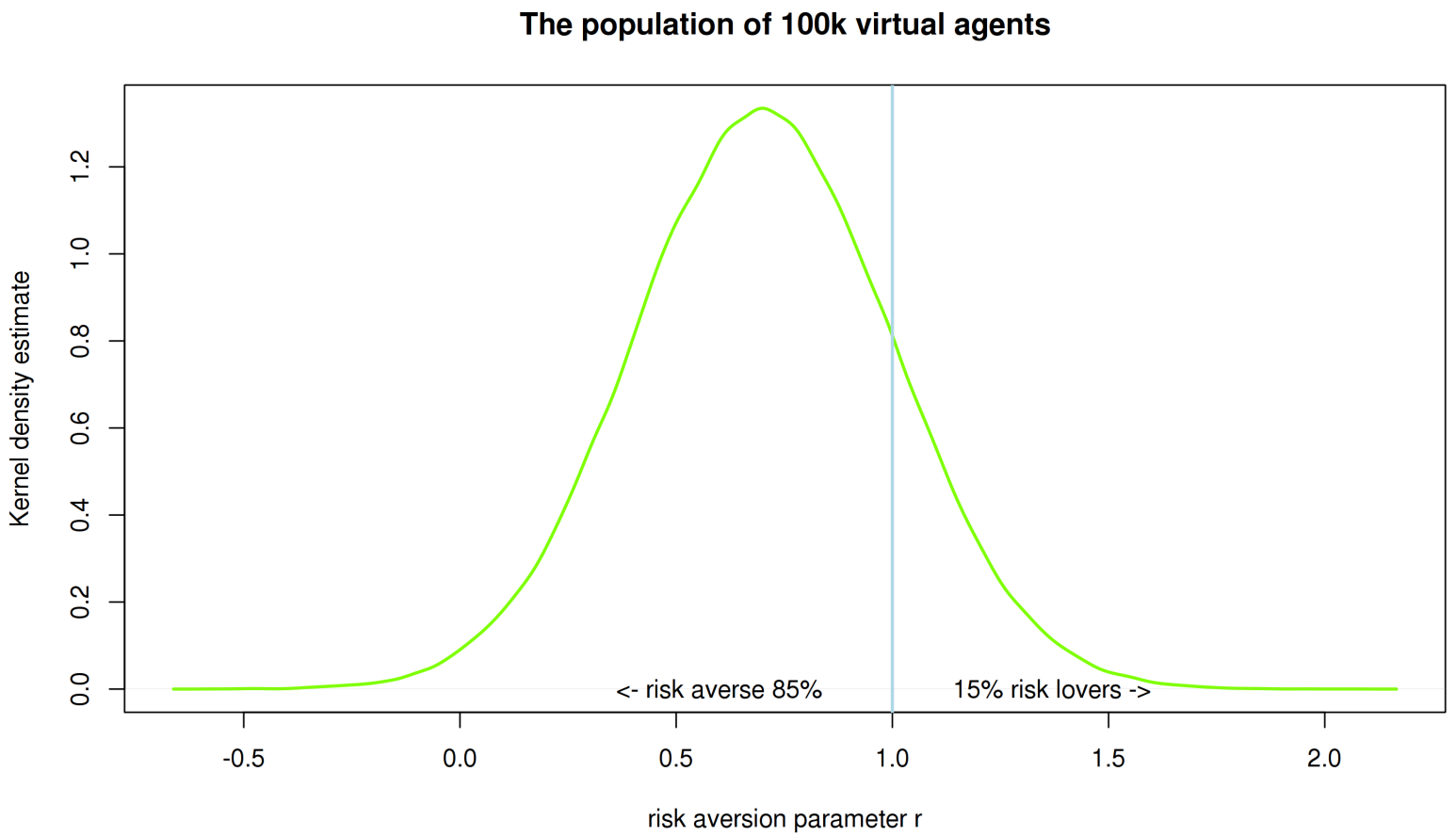
- generate 100k virtual agents
- for each agent, $r \sim N(0.7, 0.3)$
- let the agents play each of the 4 tasks
- collect results, run statistics
- analyze the retrieved $\hat{r}$

Deterministic vs noisy

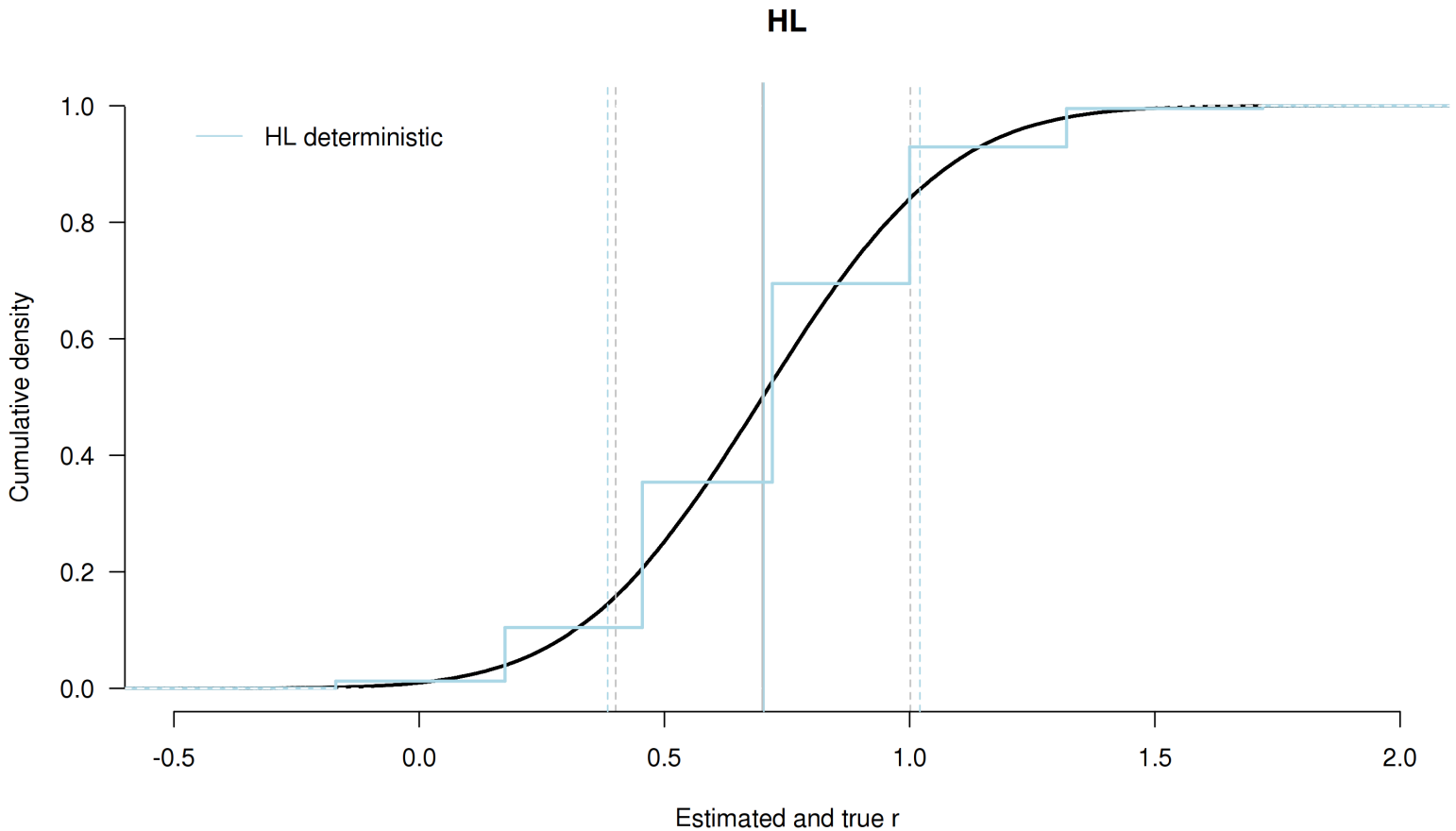
3 types of simulations:

- deterministic
- random parameter model $\Rightarrow$ models fuzzy preferences
  - for each agent, $r = r_0 + \varepsilon,\ \varepsilon \sim \mathrm{N}(0, \mu)$
  - $\mu \in (0.3; 0.6)$
- random agents $\Rightarrow$ models frame effects
  - 10% of subjects act randomly on the space of the task

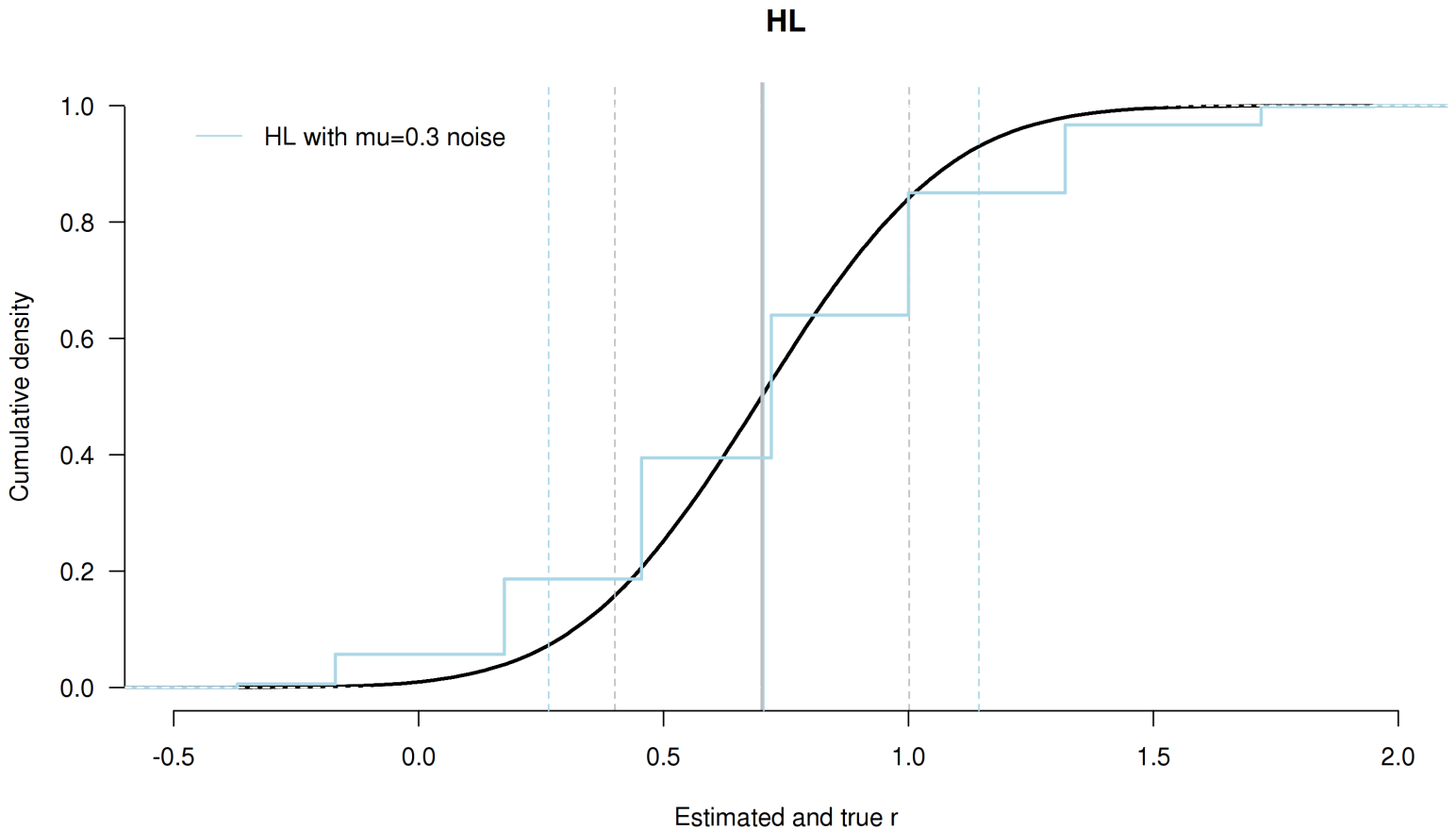
Starting distribution



HL


HL
HL deterministic
Cumulative density
1.0
0.8
0.6
0.4
0.2
0.0
-0.5
0.0
0.5
1.0
1.5
2.0
Estimated and true r

HL


HL
HL with mu=0.3 noise
Cumulative density
1.0
0.8
0.6
0.4
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-0.5
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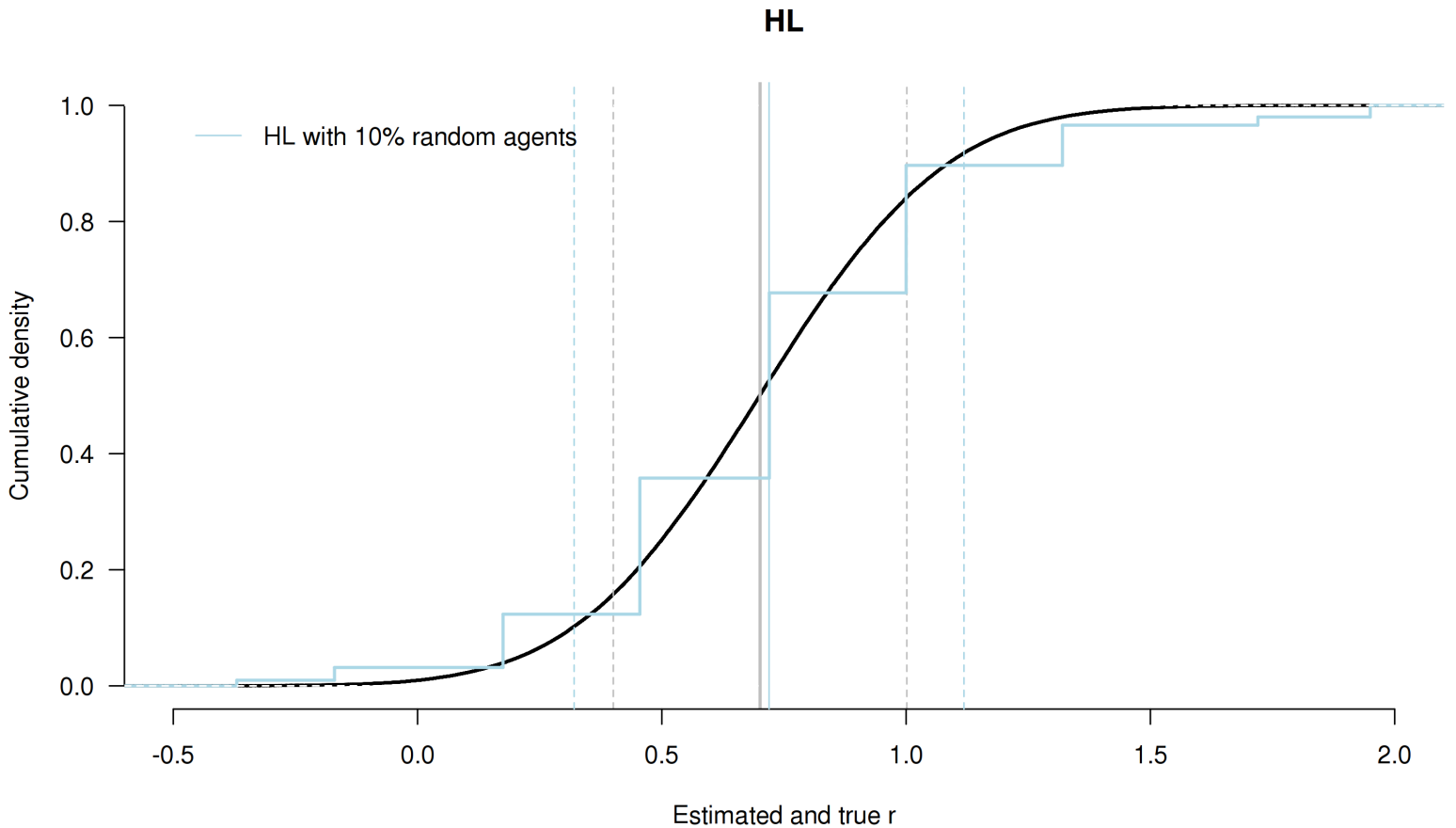
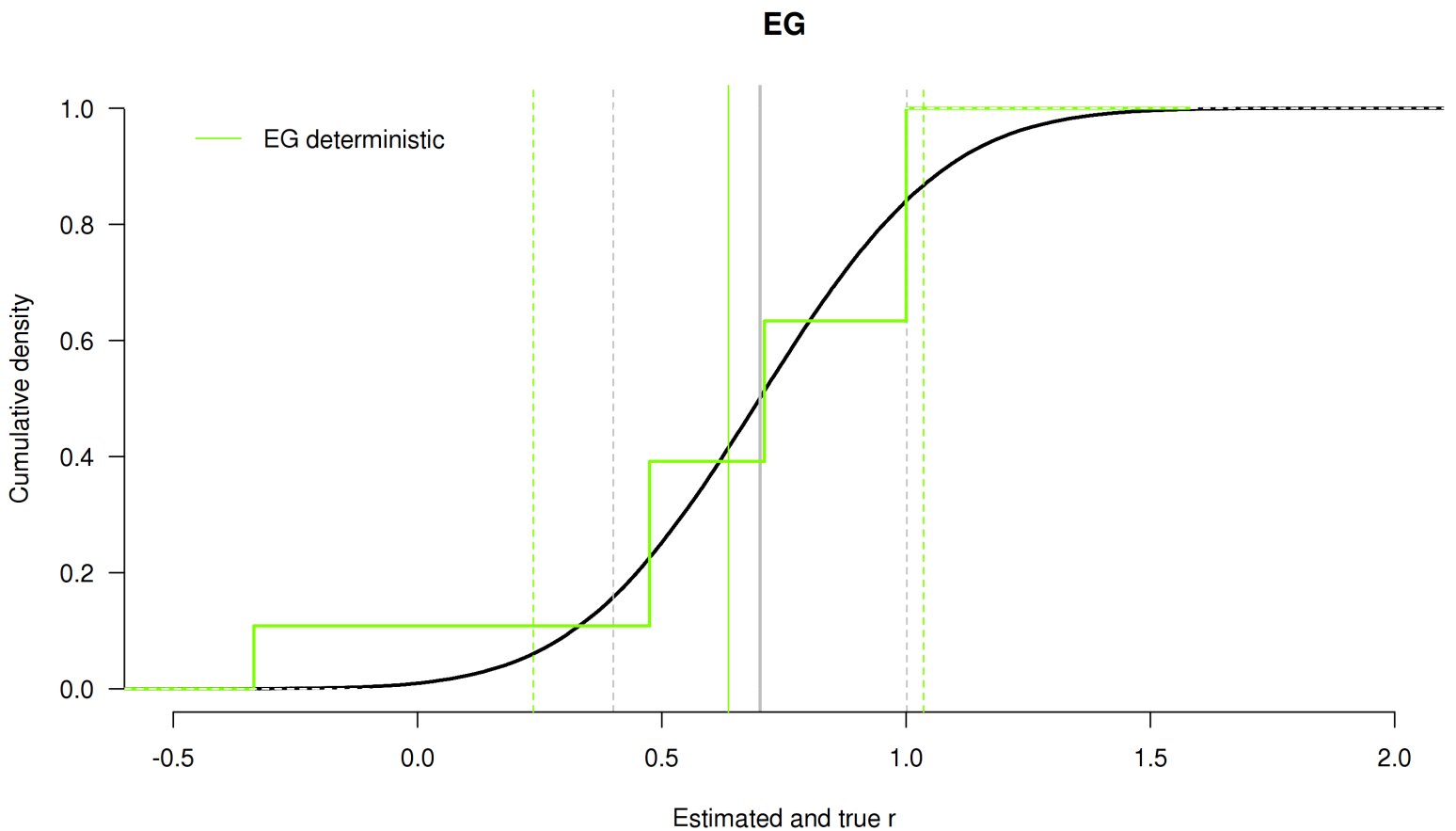
0.5
1.0
1.5
2.0
Estimated and true r

HL


HL
HL with 10% random agents
Cumulative density
1.0
0.8
0.6
0.4
0.2
0.0
-0.5
0.0
0.5
1.0
1.5
2.0
Estimated and true r

EG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Estimated and true r

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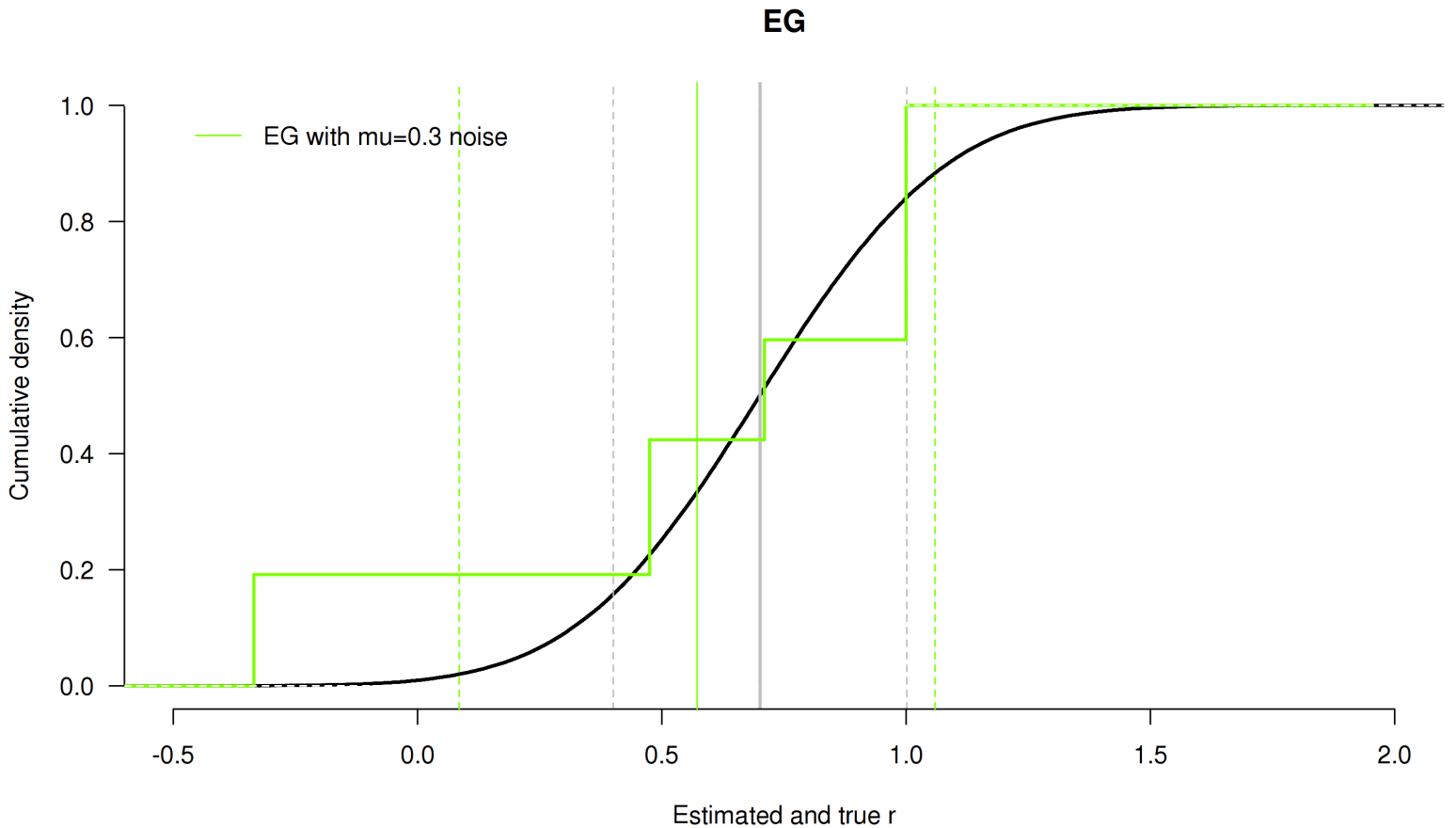
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Estimated and true r

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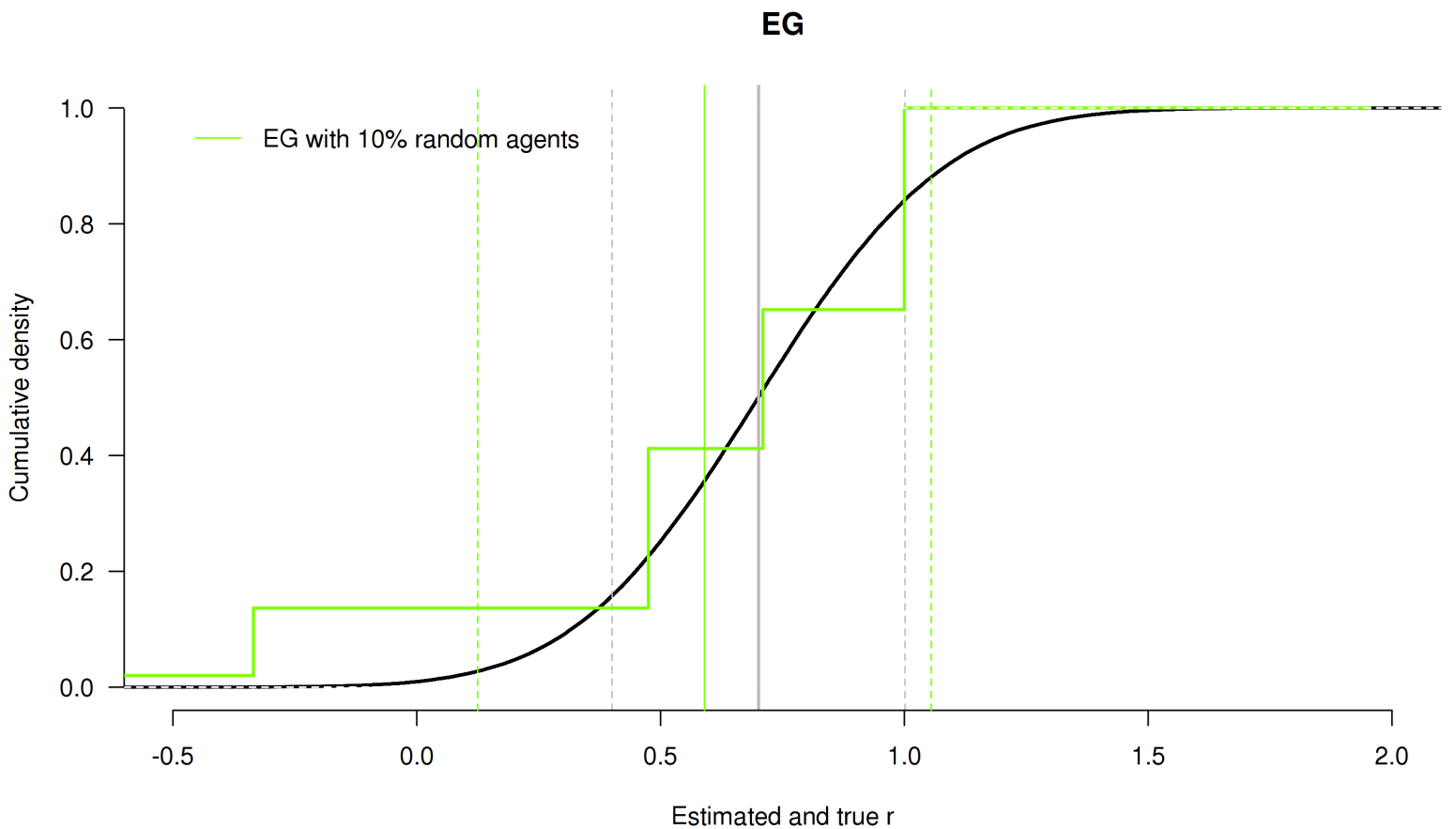
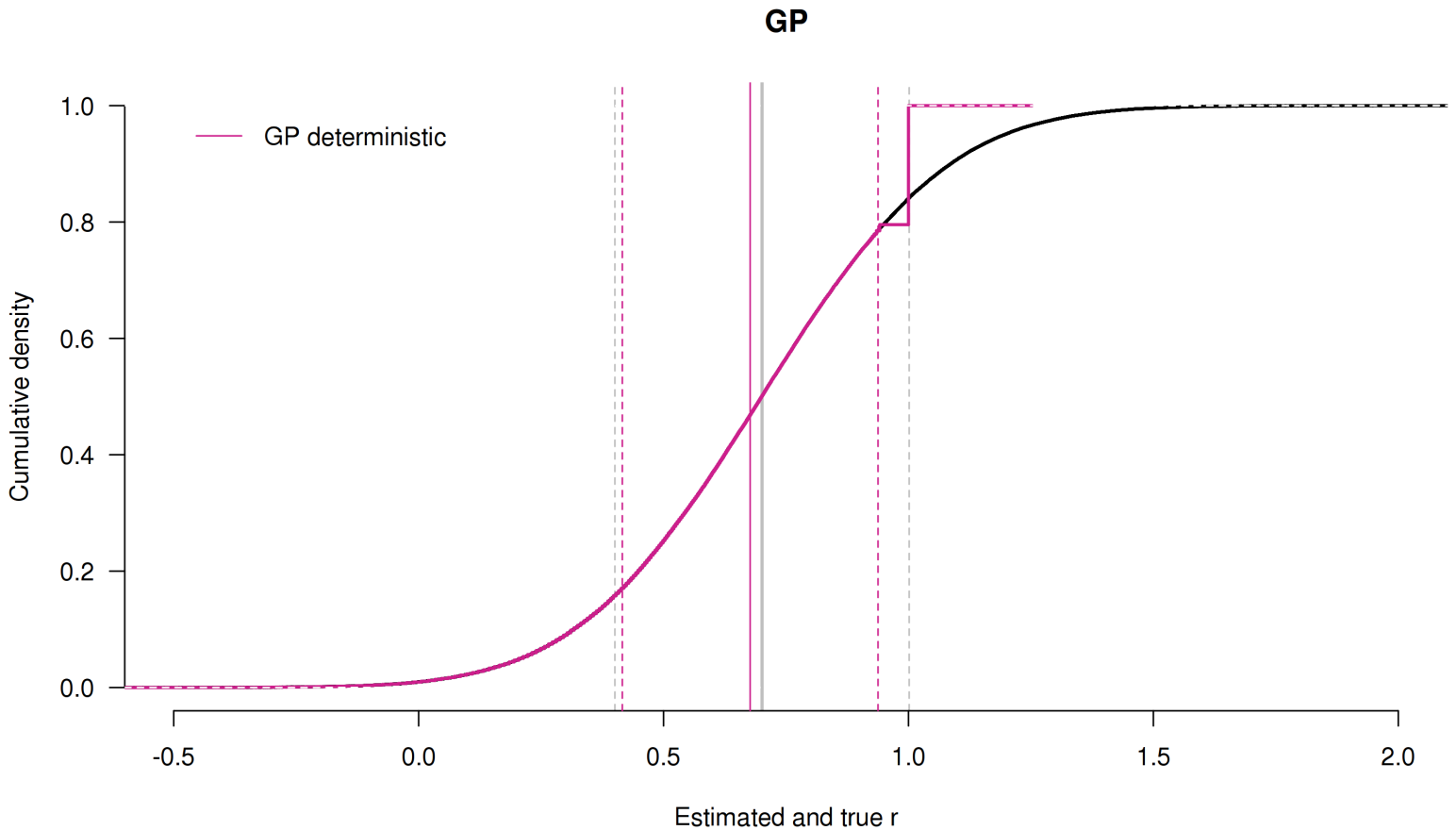

EG
EG with 10% random agents
Cumulative density
1.0
0.8
0.6
0.4
0.2
0.0
-0.5
0.0
0.5
1.0
1.5
2.0
Estimated and true r

GP


GP
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1.0
1.5
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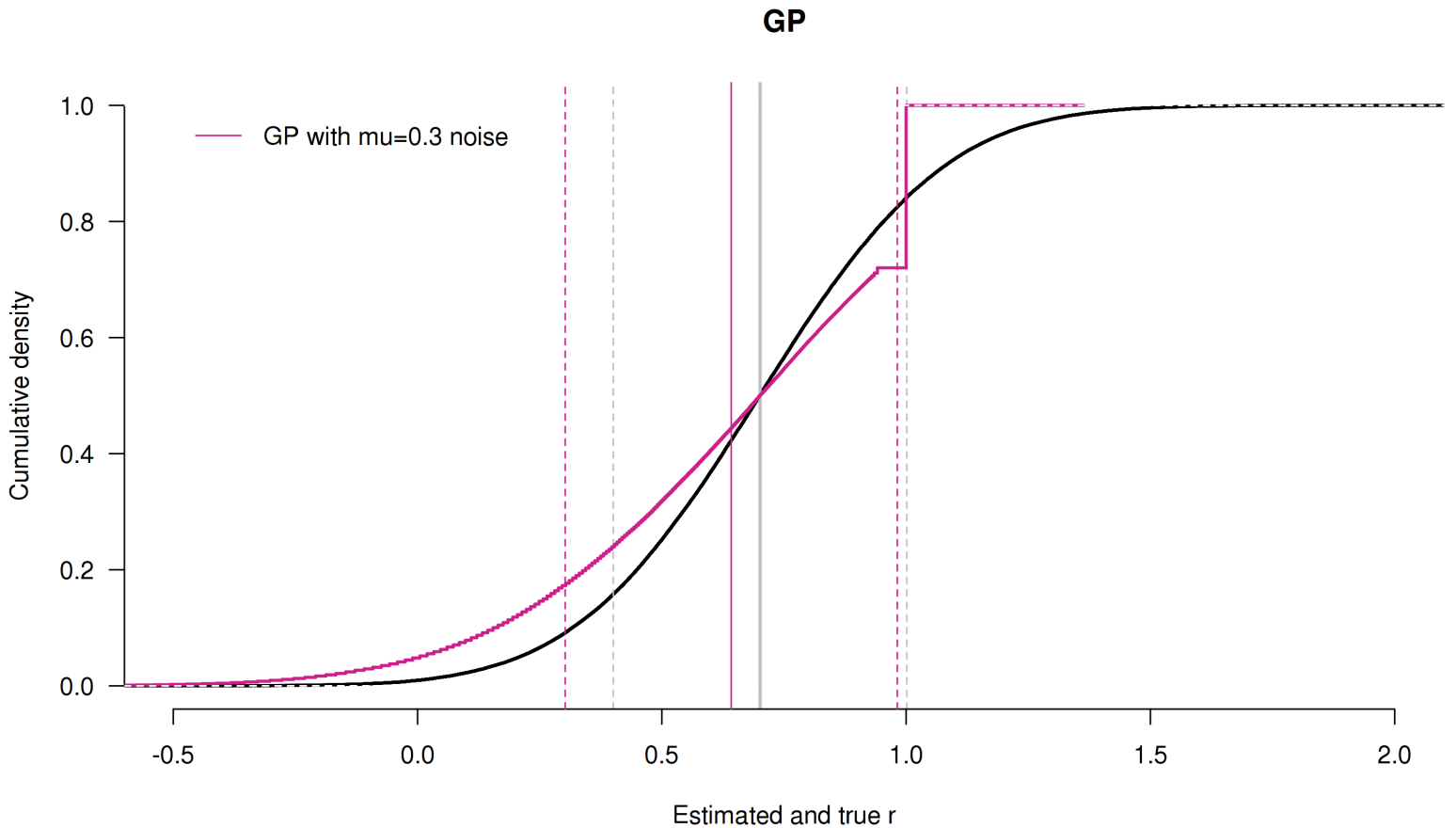
Estimated and true r

GP


GP
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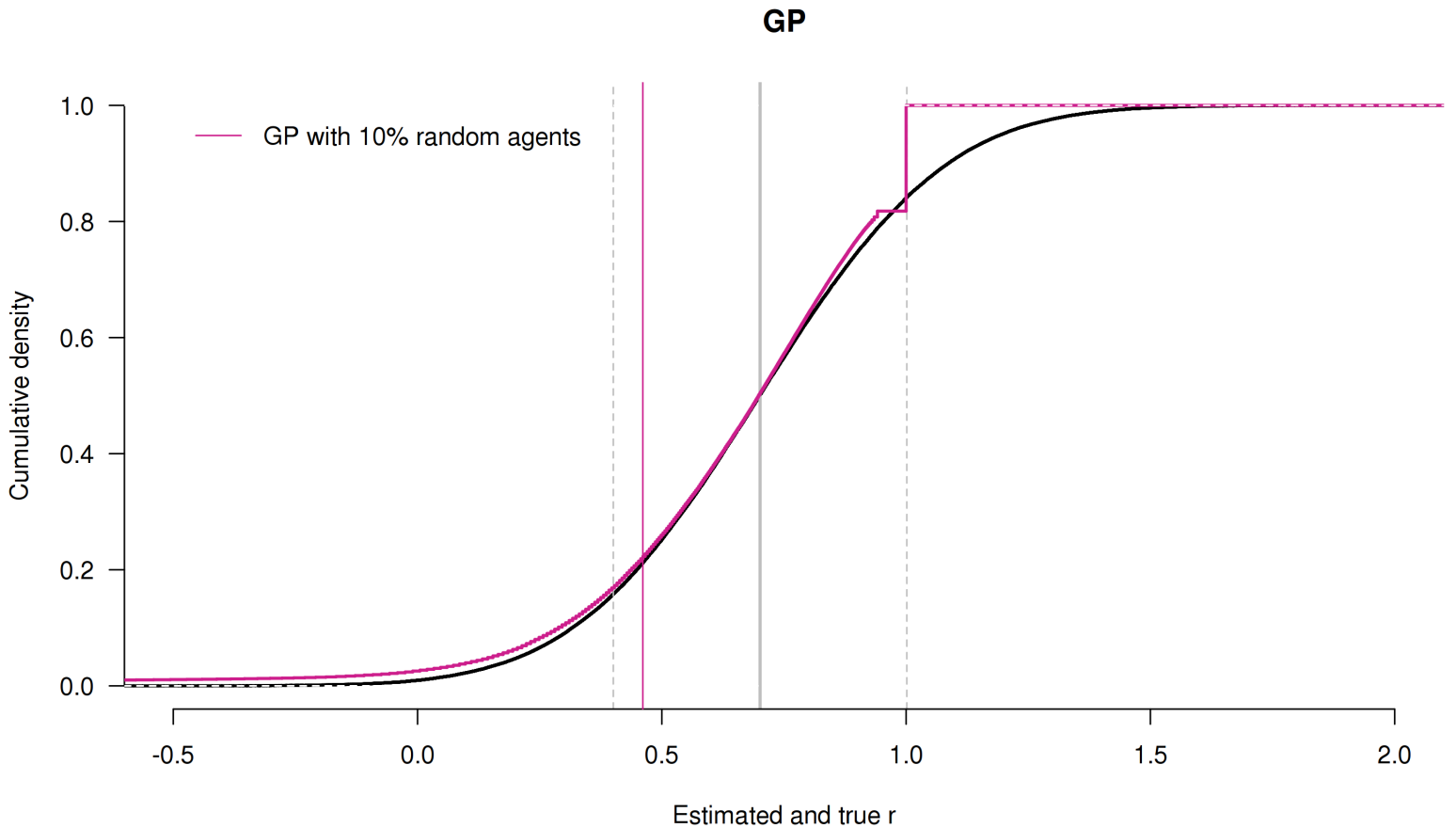
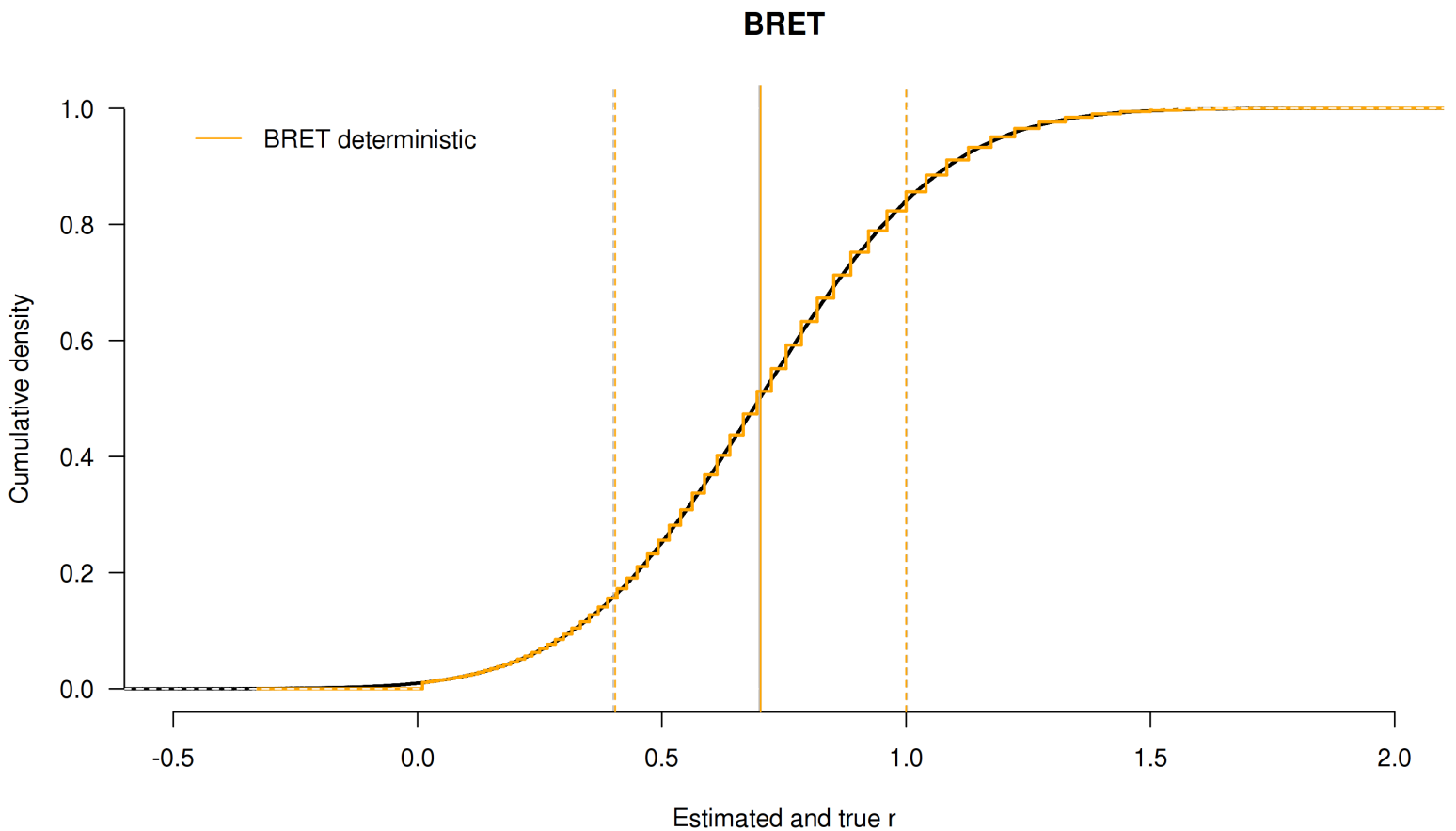
1.0
1.5
2.0
Estimated and true r

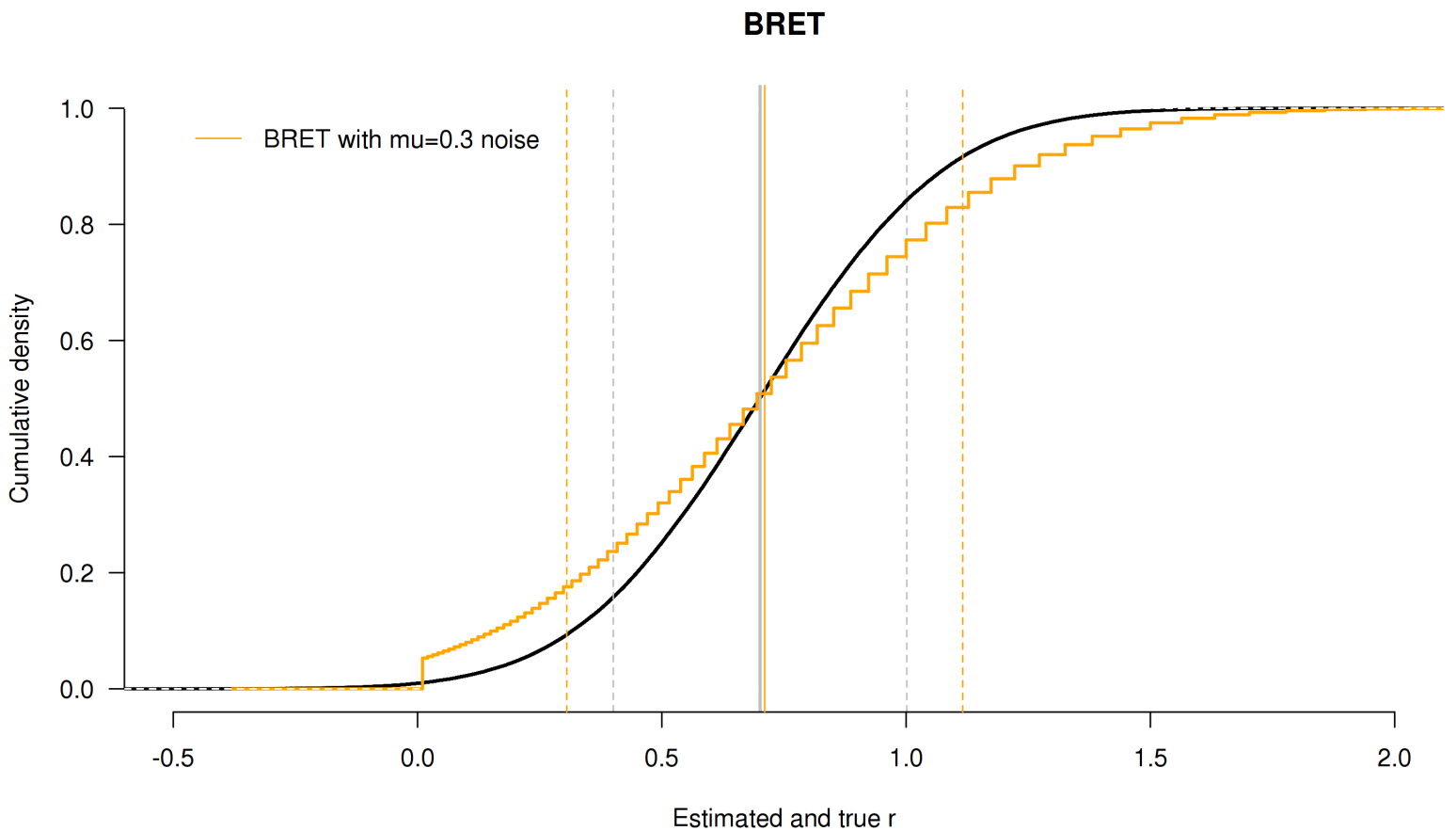
GP


GP
GP with 10% random agents
Cumulative density
1.0
0.8
0.6
0.4
0.2
0.0
-0.5
0.0
0.5
1.0
1.5
2.0
Estimated and true r

BRET


BRET
BRET deterministic
Cumulative density
1.0
0.8
0.6
0.4
0.2
0.0
-0.5
0.0
0.5
1.0
1.5
2.0
Estimated and true r

BRET


BRET
BRET with mu=0.3 noise
Cumulative density
1.0
0.8
0.6
0.4
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0.5
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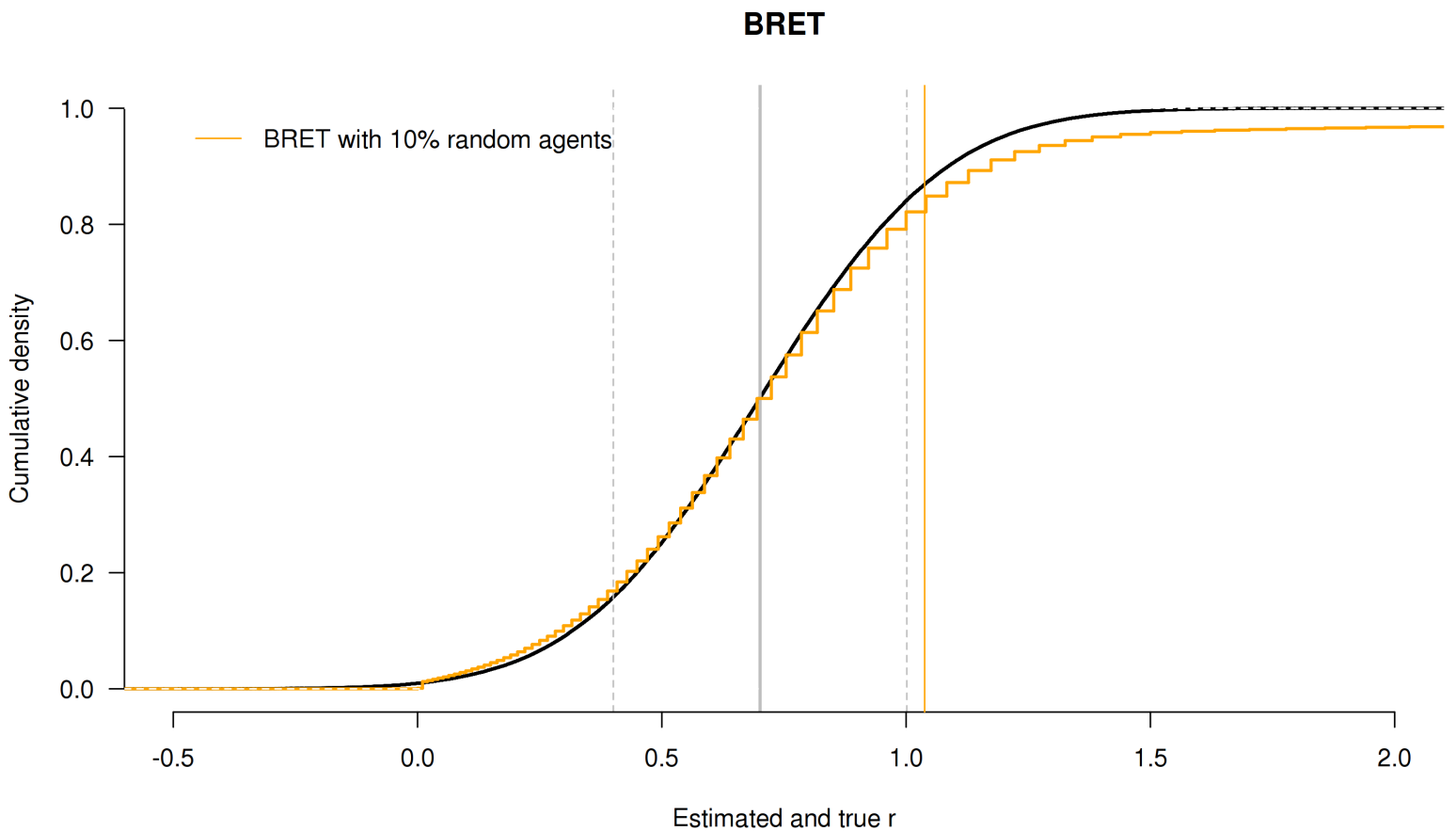
Estimated and true r

BRET


BRET
BRET with 10% random agents
Cumulative density
1.0
0.8
0.6
0.4
0.2
0.0
-0.5
0.0
0.5
1.0
1.5
2.0
Estimated and true r

Task-specific summary

> is there a task-specific bias? **yes**

> does it account for all differences? **no**

> is this the only way to take noise into account? **no**

Risk perception

Risk perception

risk noun

\ ˈrisk \

Definition of *risk* (Entry 1 of 2)

1 : possibility of loss or injury : PERIL

2 : someone or something that creates or suggests a hazard

3 **a** : the chance of loss or the perils to the subject matter of an insurance contract

also : the degree of probability of such loss

b : a person or thing that is a specified hazard to an insurer

c : an insurance hazard from a specified cause or source

// war risk

4 : the chance that an investment (such as a stock or commodity) will lose value

Risk perception: a mismatch

- economists *assume* subjects share the same risk *definition*
- namely:
  - risk as a distribution of **probability** over outcomes
  - EV as the average across all possible states of the world
  - risk aversion as diminishing marginal utility of money
  - subjects care about **variance**
- but subjects think of risk as *probability of a loss*

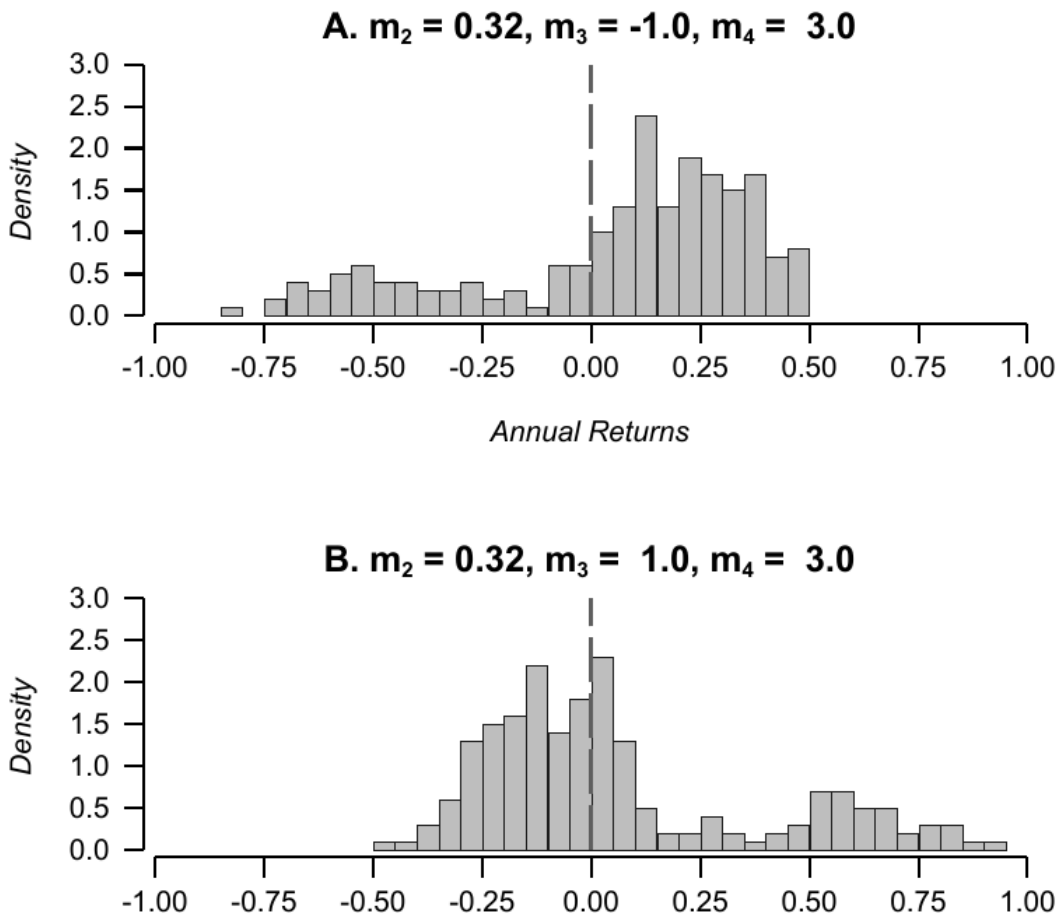
> - *do subjects find our tasks risky?*

- We **do not know** because we **assume** they do

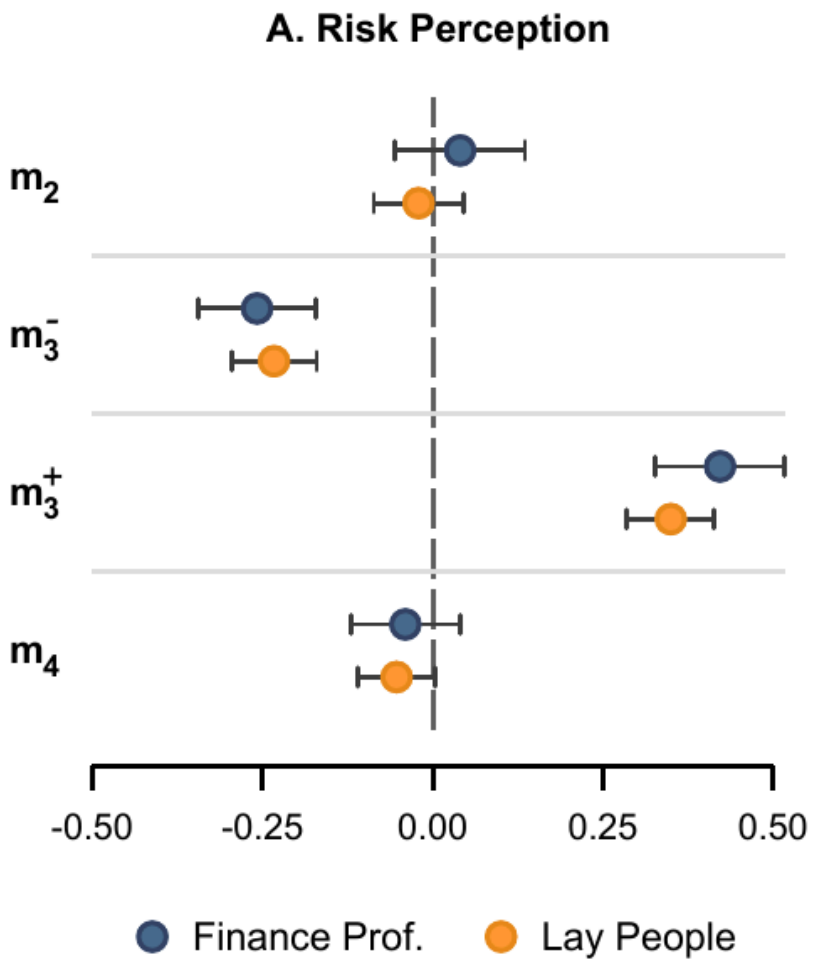
Experimenting on risk perception

- Holzmeister et al Working Paper
- gave description of return from an asset to subjects
- $\sim$ 7000 subjects
- including $\sim$ 2500 **traders**
- asked to rate **perceived risk of each asset**

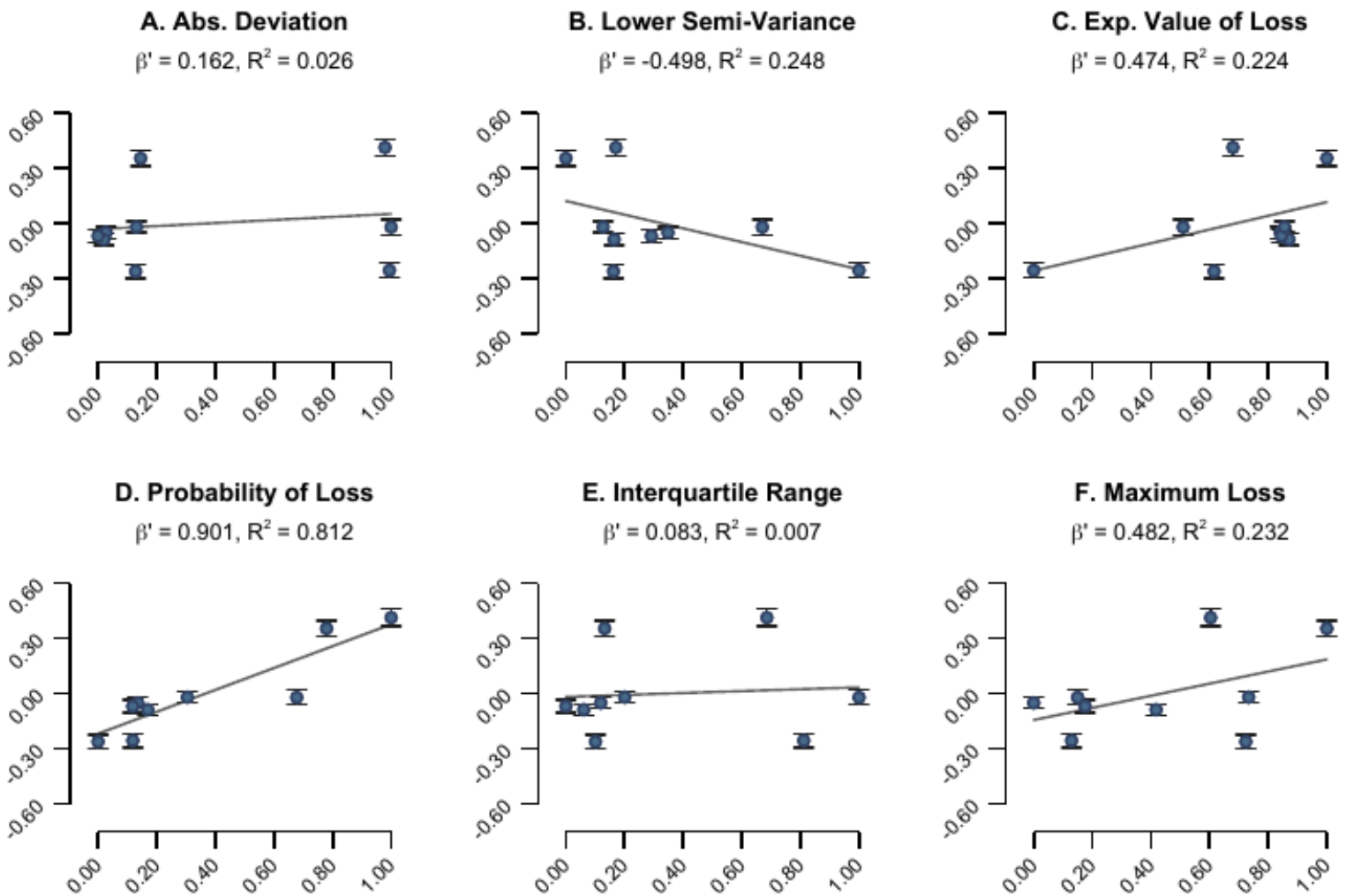
Holzmeister et al: design



results - skewness

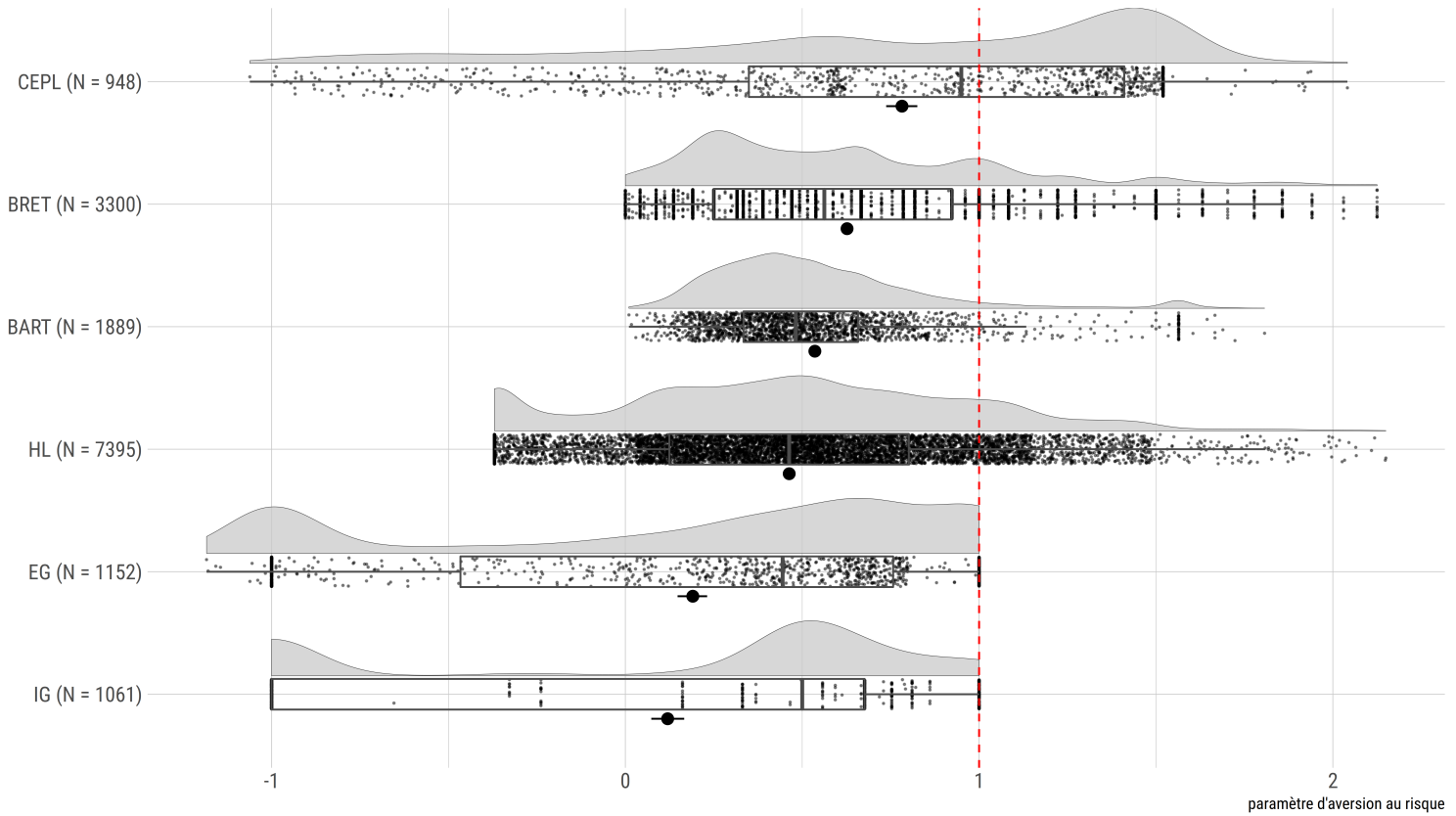


results - aggregate risk measures



Theory

Have we got the right theory?



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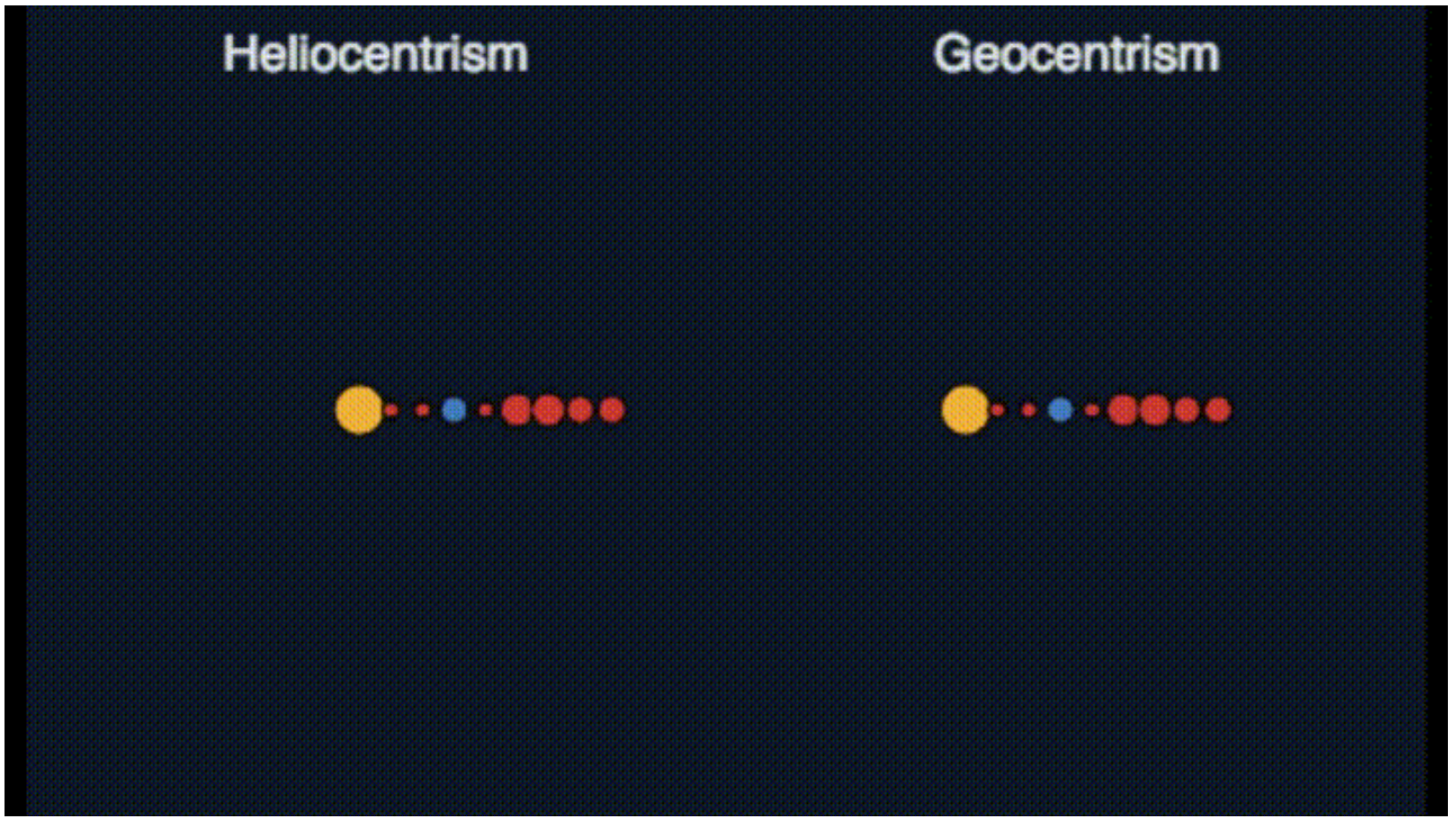

Other theories

- Spiliopoulos & Hertwig: *different* **decision rules** for different contexts
- Schneider and Sutter: **higher moments** matter
- Sunder et al: *curvature of utility* function **not** a valid theory
- **Ergodicity** economics (Peters et al): drop EV, use time-means
- …

Summing up…

> - *"…future research must carefully consider the problem of adequately **defining** and **assessing** risk taking behavior."*
>
> - **exactly as in 1962**

Thanks!

Contribute to the meta-analysis!

if:

- you have **run a RET**
- you have run **more** than one
- you have run a RET and a **questionnaire**
- you have run a RET and another **risk-related measure**

then:

> send your data – paolo.crosetto@inrae.fr

> github: (https://github.com/paolocrosetto/METARET)

shiny app: (https://paolocrosetto.shinyapps.io/METARET/)