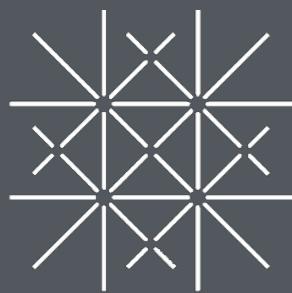


Decisions from Experience

Dirk U. Wulff

Bounded Rationality Winter School @ TAPMI, Manipal, 2020



UNI
BASEL





Drosophila Melanogaster



Monetary lotteries

,,Would you rather have A or B?“

A

4€ with p=.8
otherwise 0

B

3€ with p=1

Allais Paradox (Allais, 1953)

Certainty effect (Kahneman & Tversky, 1979)

Reflection effect (Kahneman & Tversky, 1979)

Loss aversion (Kahneman & Tversky, 1979)

Framing effects (Kahneman & Tversky, 1984)

Risk aversion (Holt & Laury's, 2002)

(Ambiguity aversion) (Ellsberg, 1961)

Experience





Frank H. Knight
1885-1972

Statistical probabilities
'I know something land'



Uncertainty
*'I know
nothing land'*

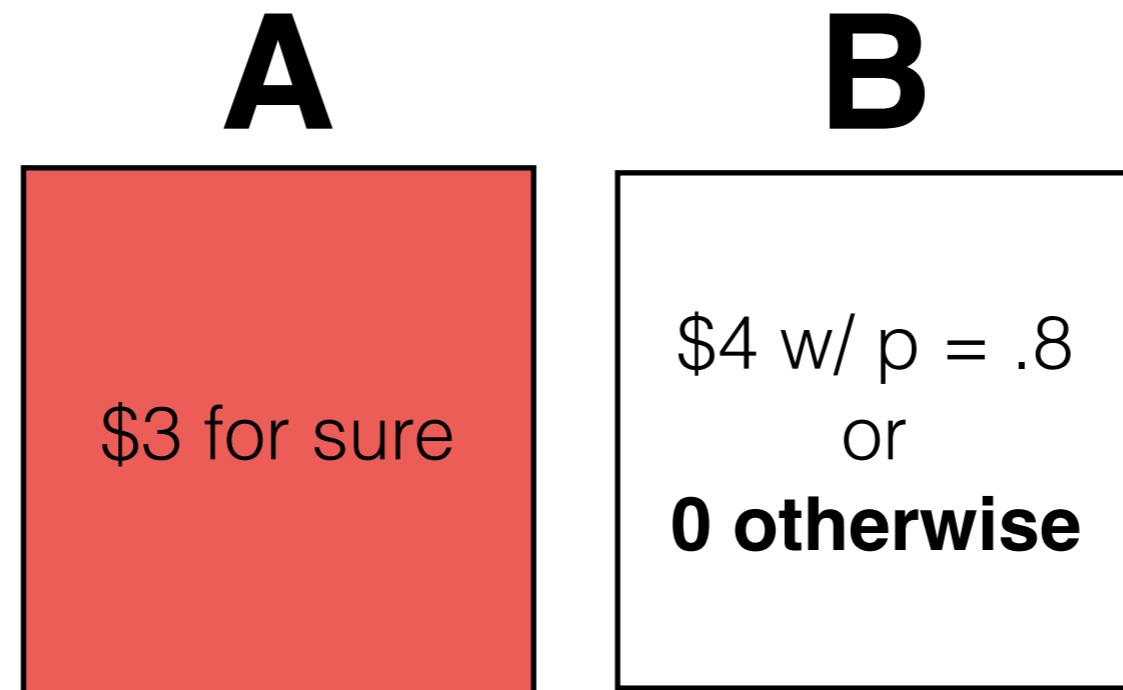


Risk
*'I know
probabilities
land'*

Certainty
*'I know
everything
land'*

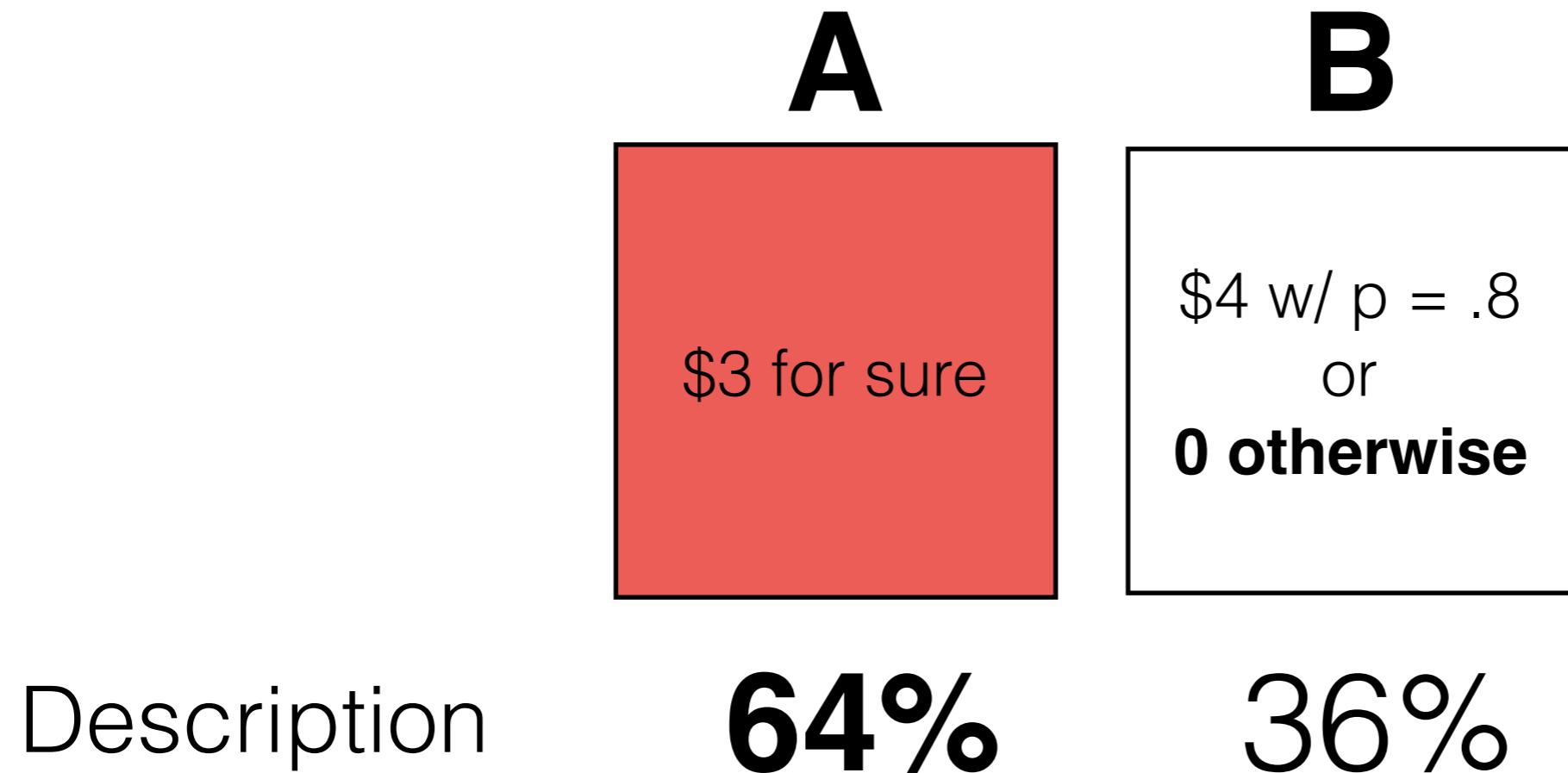
Description-experience gap

and the weighting of small probability events



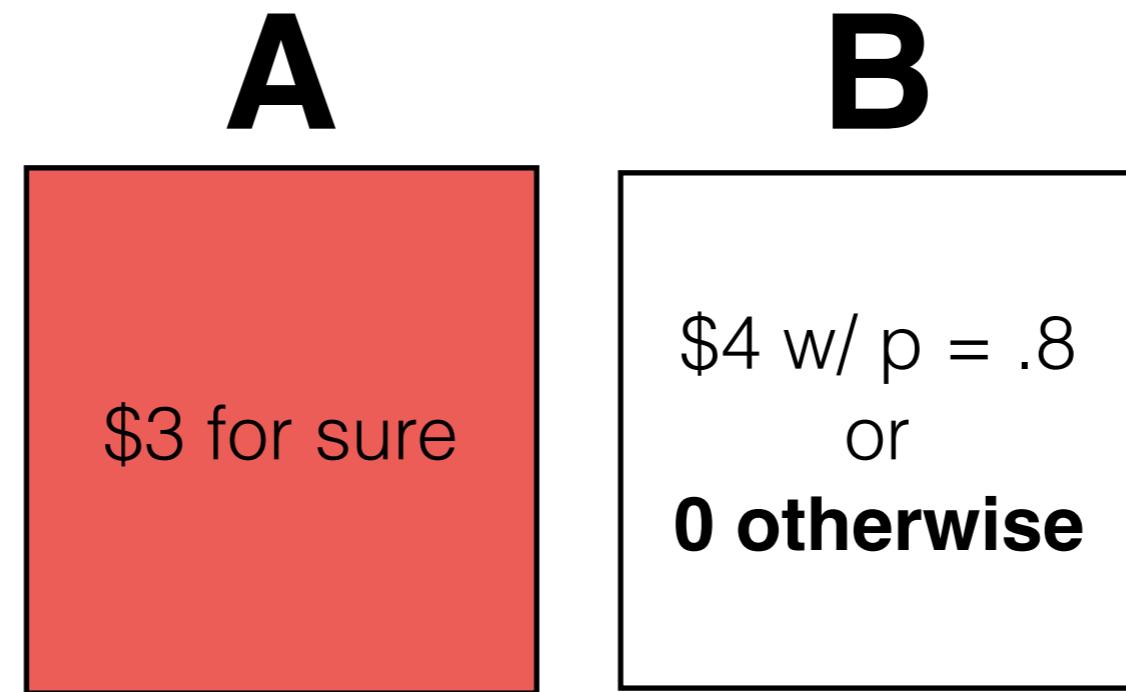
Description-experience gap

and the weighting of small probability events



Description-experience gap

and the weighting of small probability events



Description

64%

36%

Experience

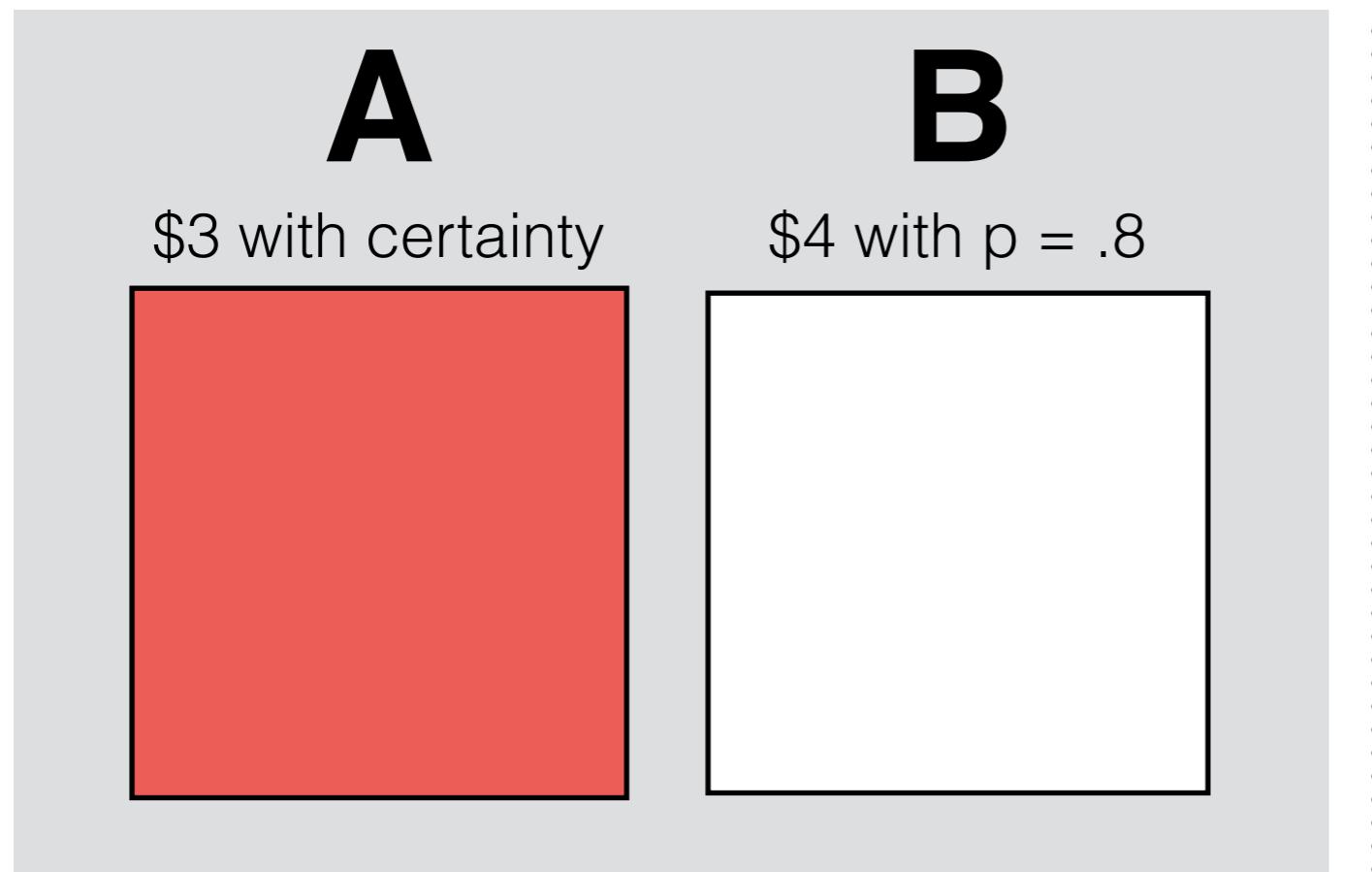
12%

88%

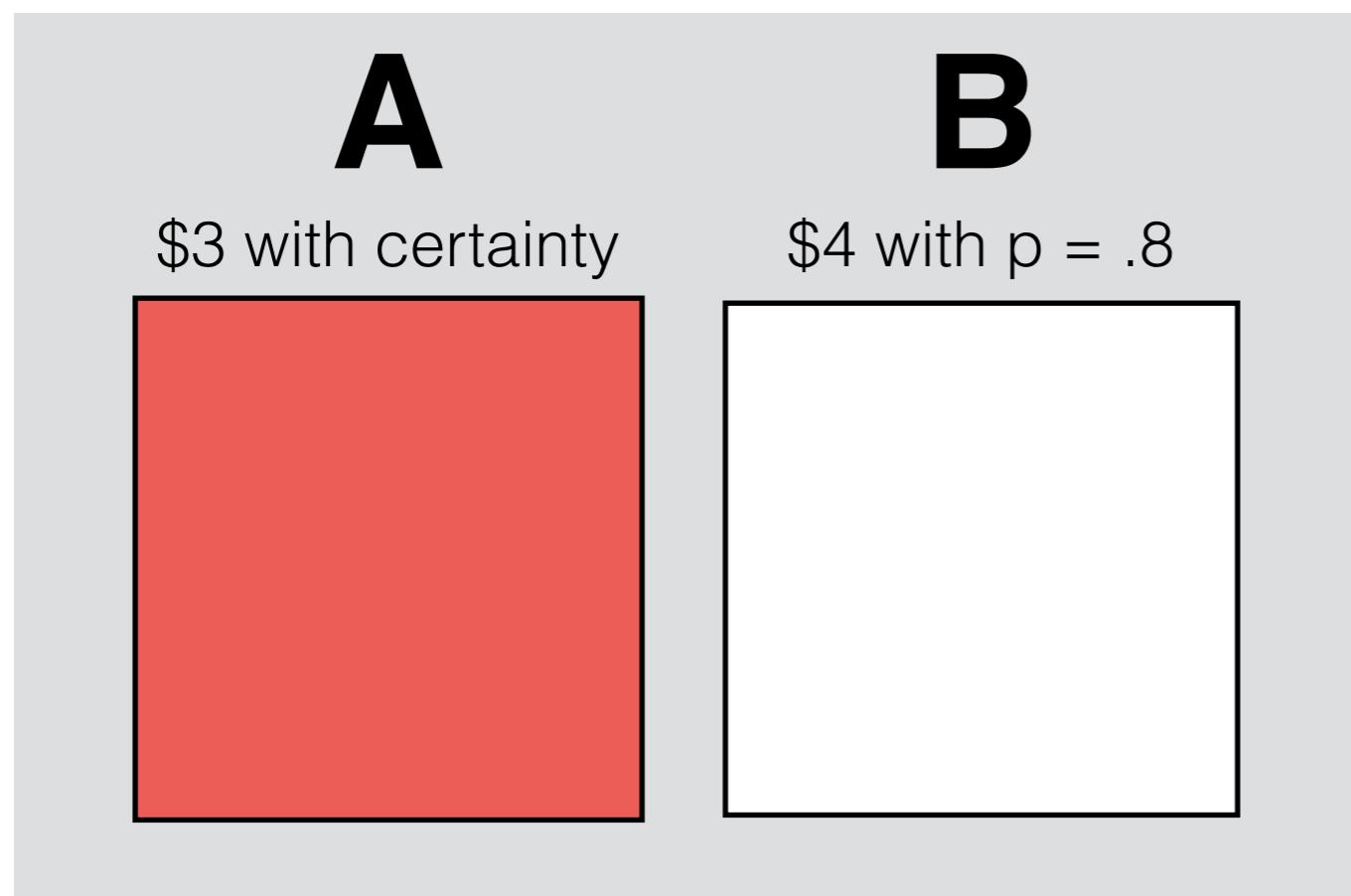
THE GAP

*How robust is it and
why does it occur?*

The sampling paradigm

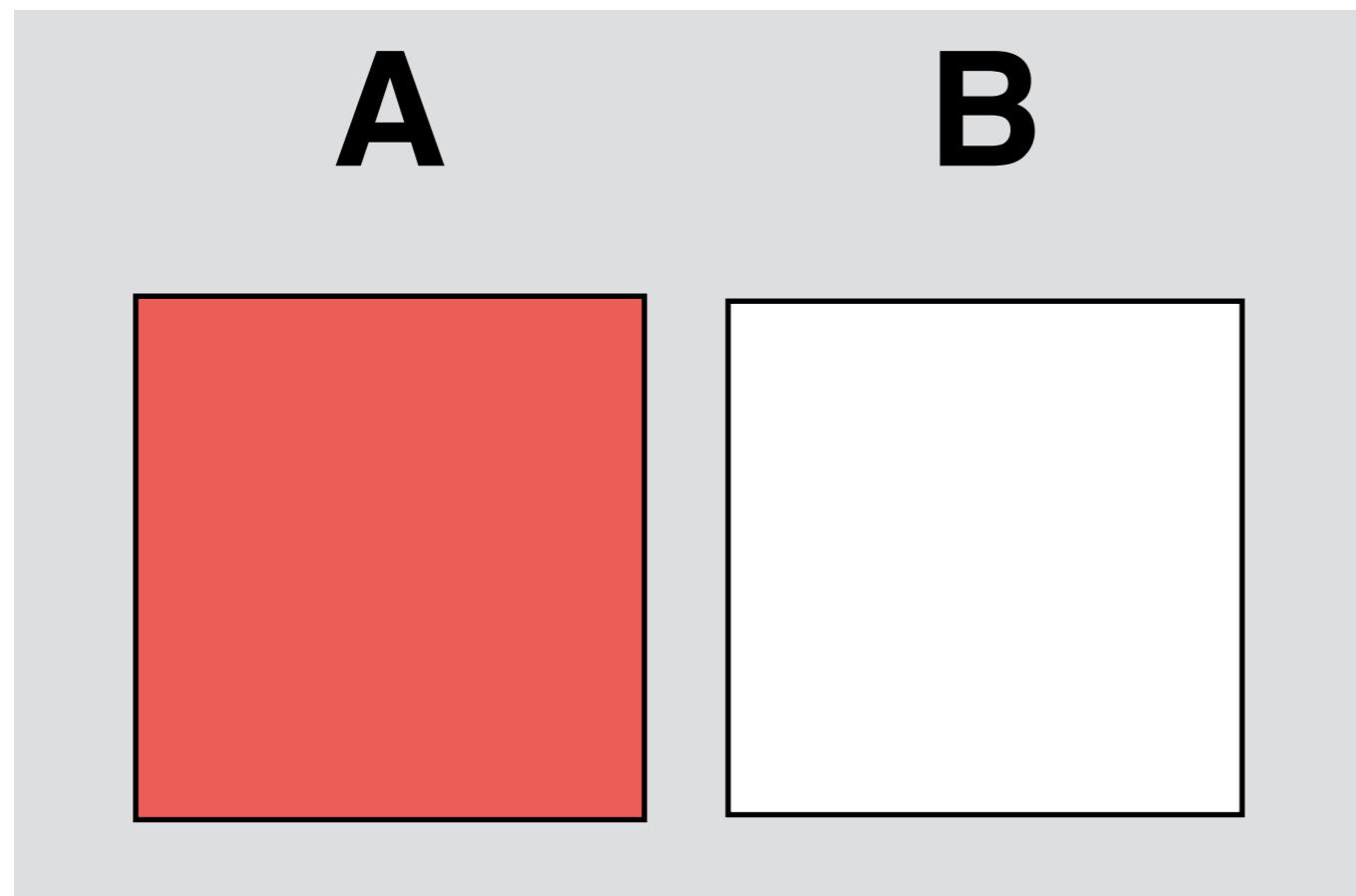


The sampling paradigm



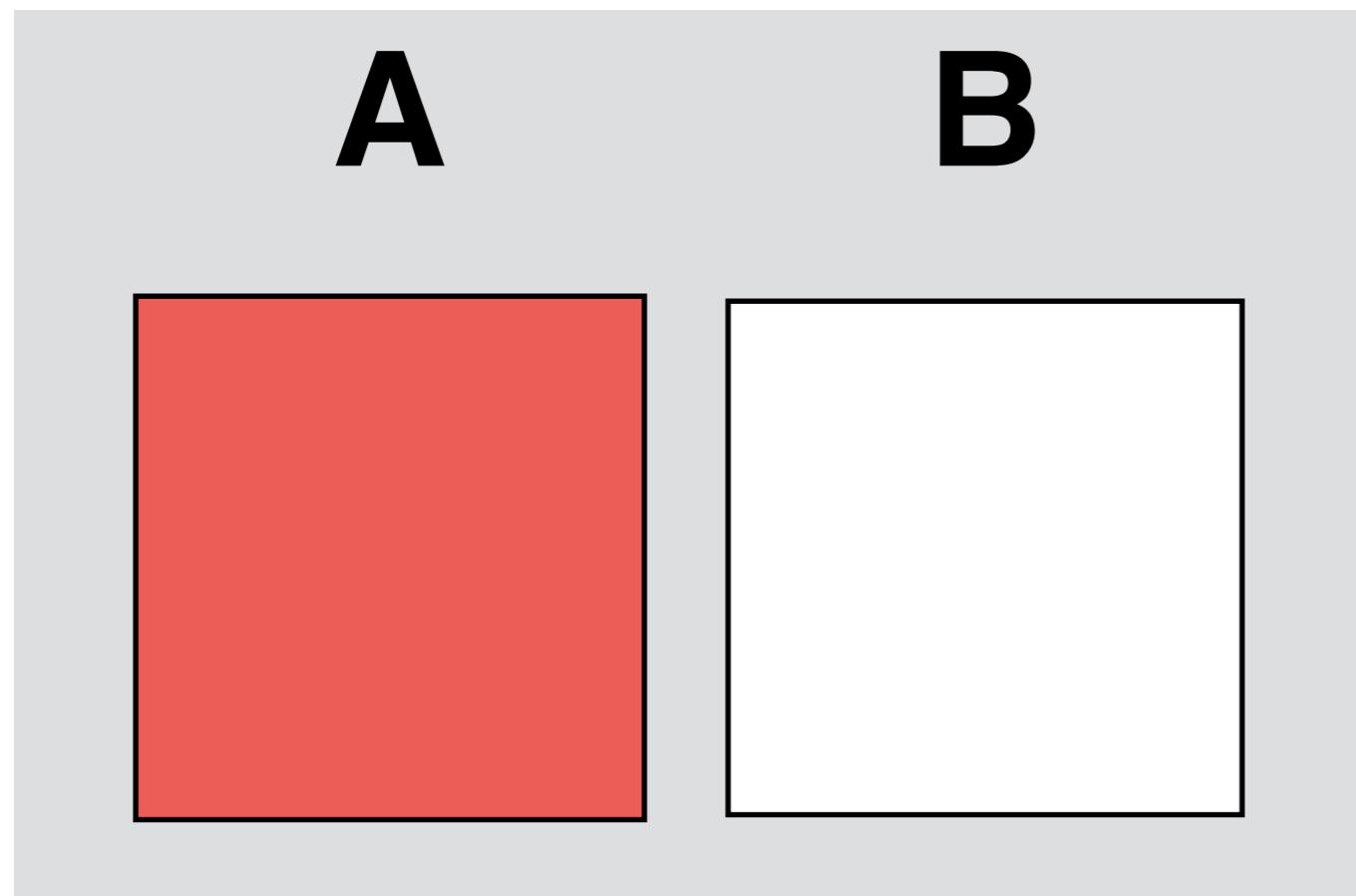
(I) Choice between two
Lotteries

The sampling paradigm

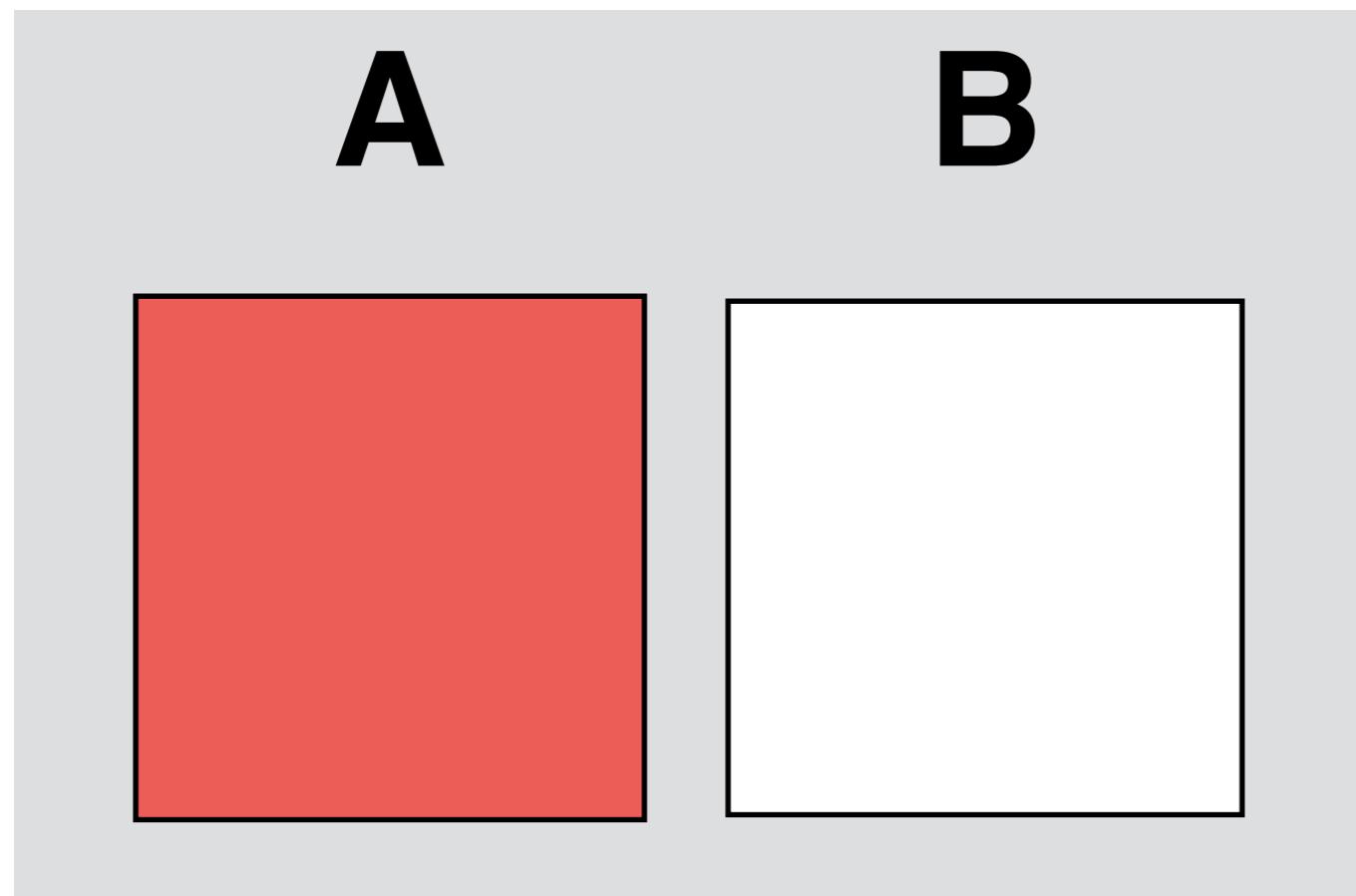


- (1) Choice between two Lotteries
- (2) No prior information

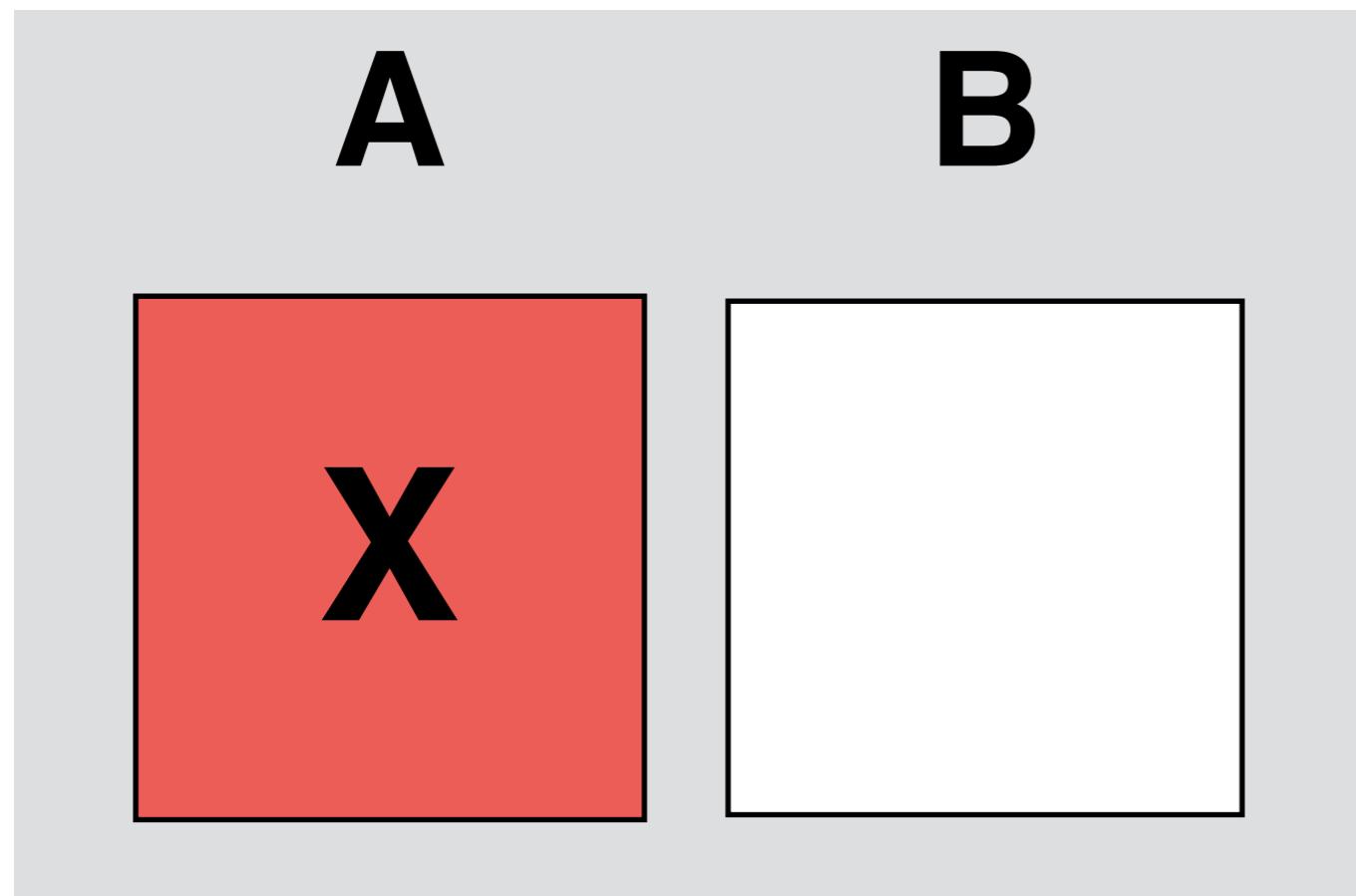
The sampling paradigm



The sampling paradigm



The sampling paradigm



- (1) Choice between two Lotteries
- (2) No prior information
- (3) Search for as long as desired
- (4) When ready, terminate search and make a choice.

Interactive 1

bit.ly/tapmi2020

I The description-experience gap ☰



Interactive 1 - 5min

Go to this [site](#) to try out risky choices based on experience and description. **Don't sample for too long.**

Interactive 2 - 5min

Please enter your intuitions about how people explore using this [survey](#).



References

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II Harnessing simulated experiences ☰

7.34	+5.97%	▲	100.08	120,000
7.89	+2.13%	▲	564.23	900,000
7.45	+6.43%	▲	765.90	600,000

Interactive 1 - 20min

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Interactive 2 - 20min

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THE GAP

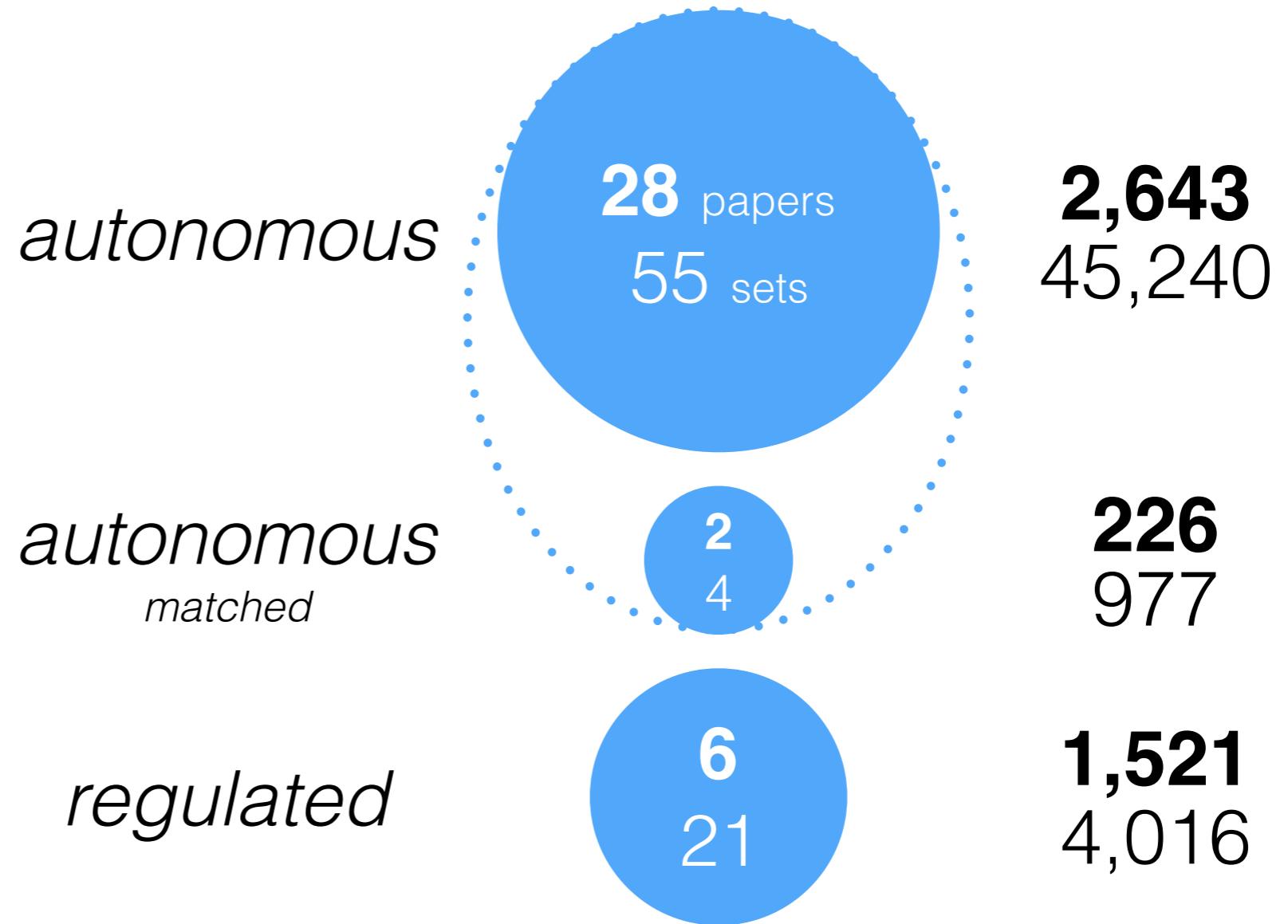
How robust is it?

Data

Sampling paradigm

Experience

4,400 Ppt
45,240 Choices
1,243,444 Samples

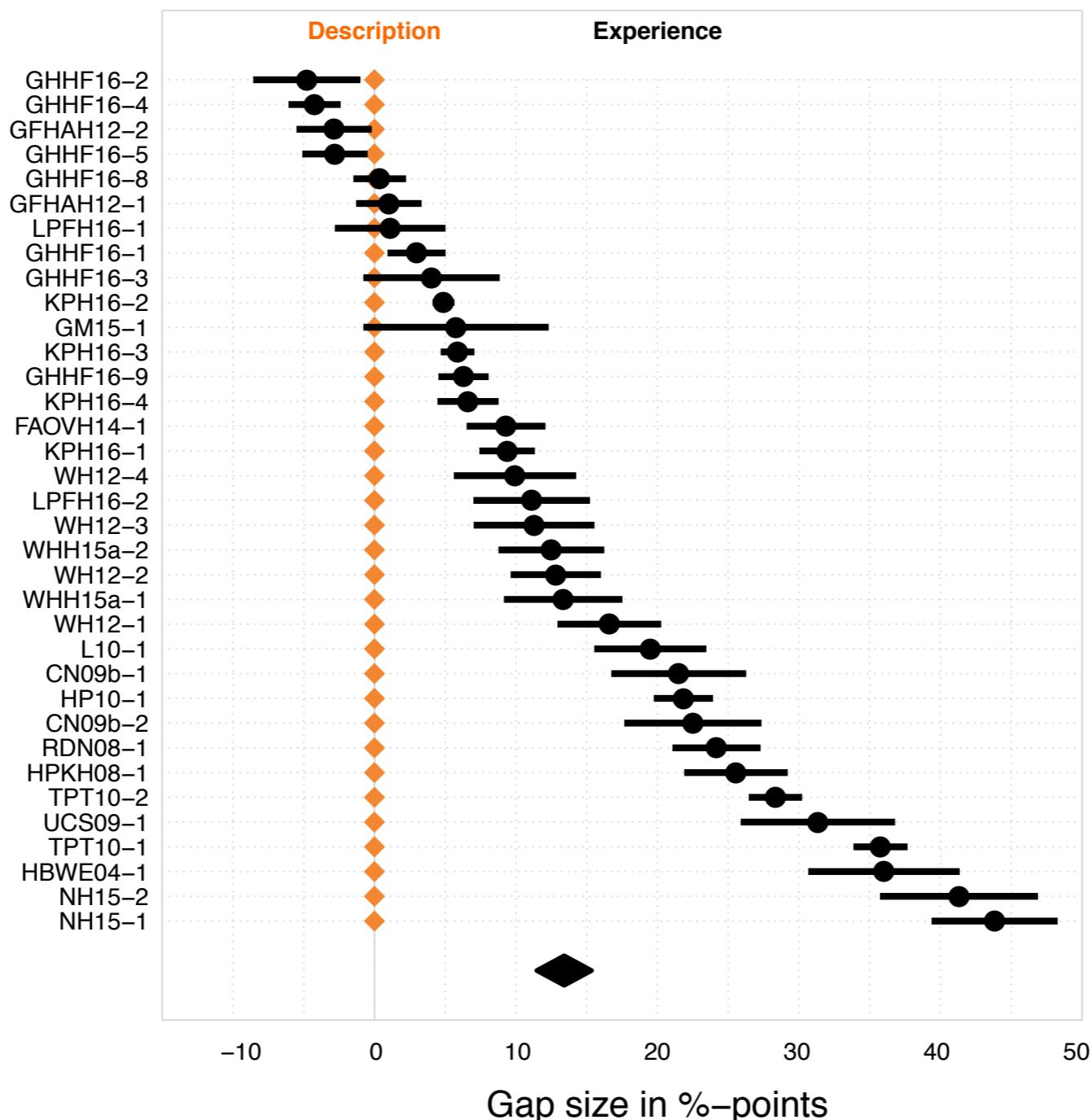


Description

2,208 Ppt
31,353 Choices



A robust Gap

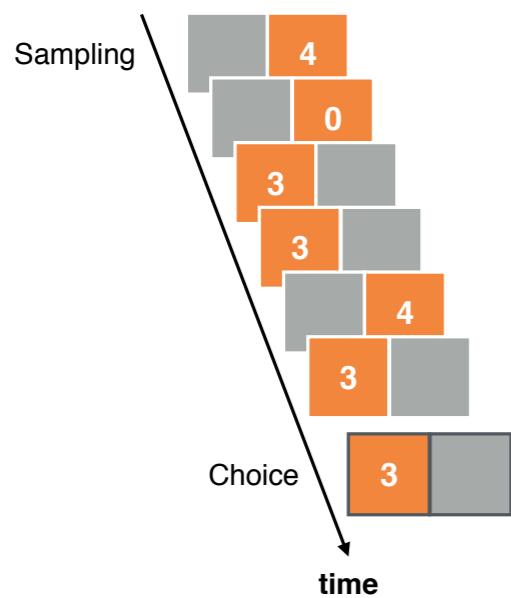


THE GAP

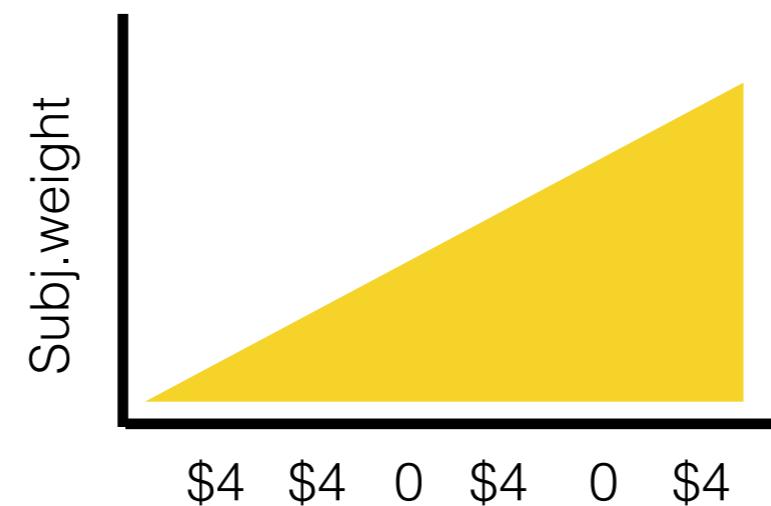
Why does it occur?

Determinants of the gap

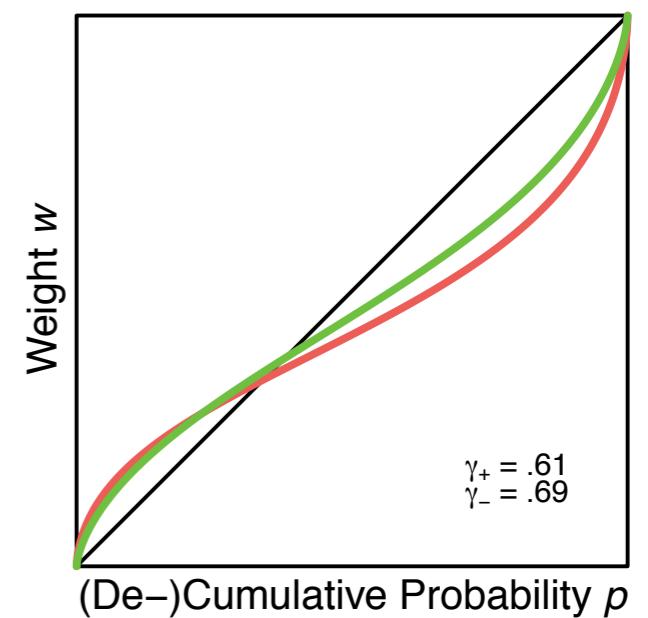
1 Small samples



2 Recency



3 Prob. weighting



Small samples polarise experienced relative frequencies vs. probabilities

Small samples polarise experienced relative frequencies vs. probabilities

10
Draws per
option

Small samples polarise experienced relative frequencies vs. probabilities

10

Draws per
option

36%

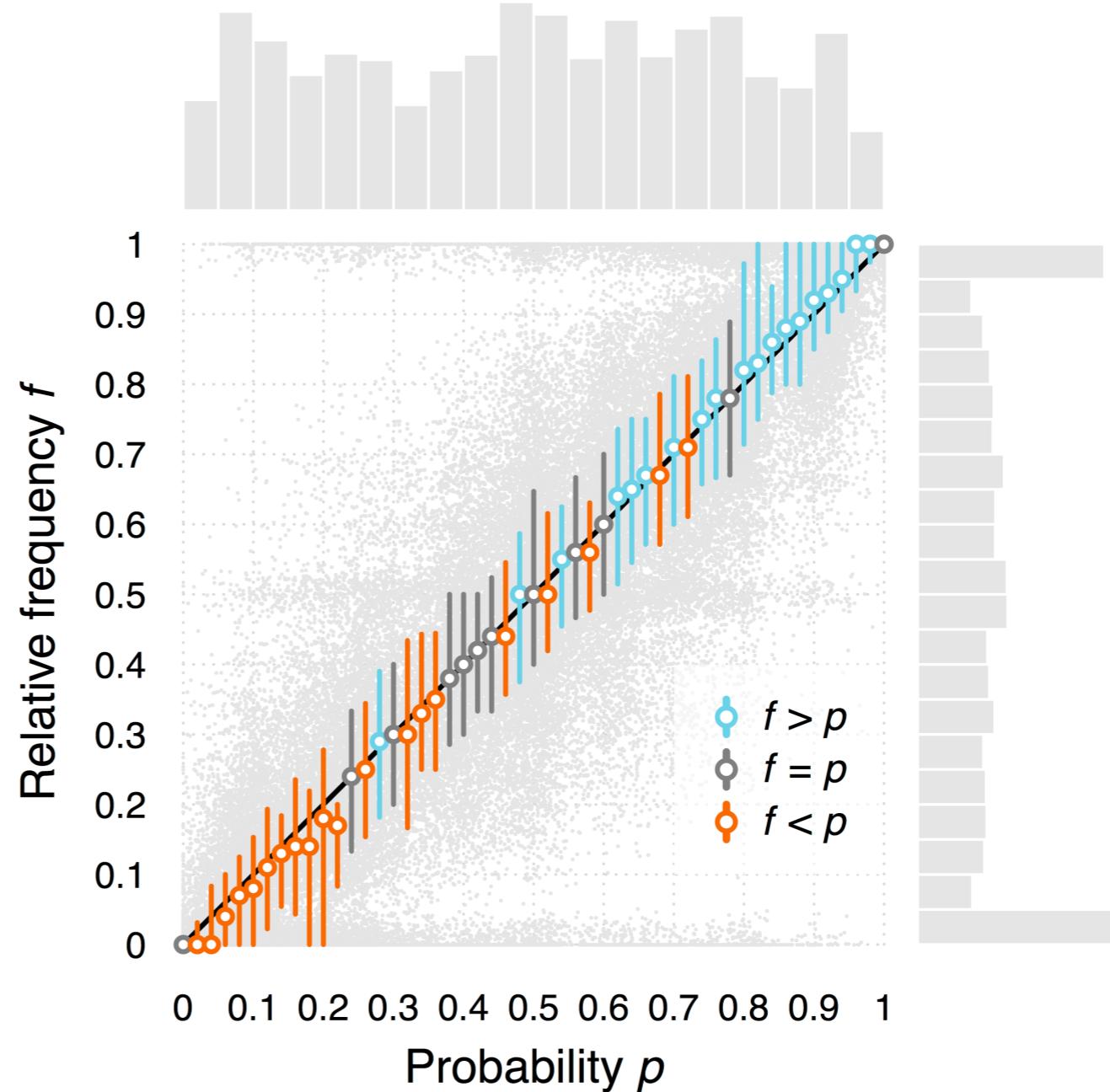
missed
outcomes

Small samples polarise

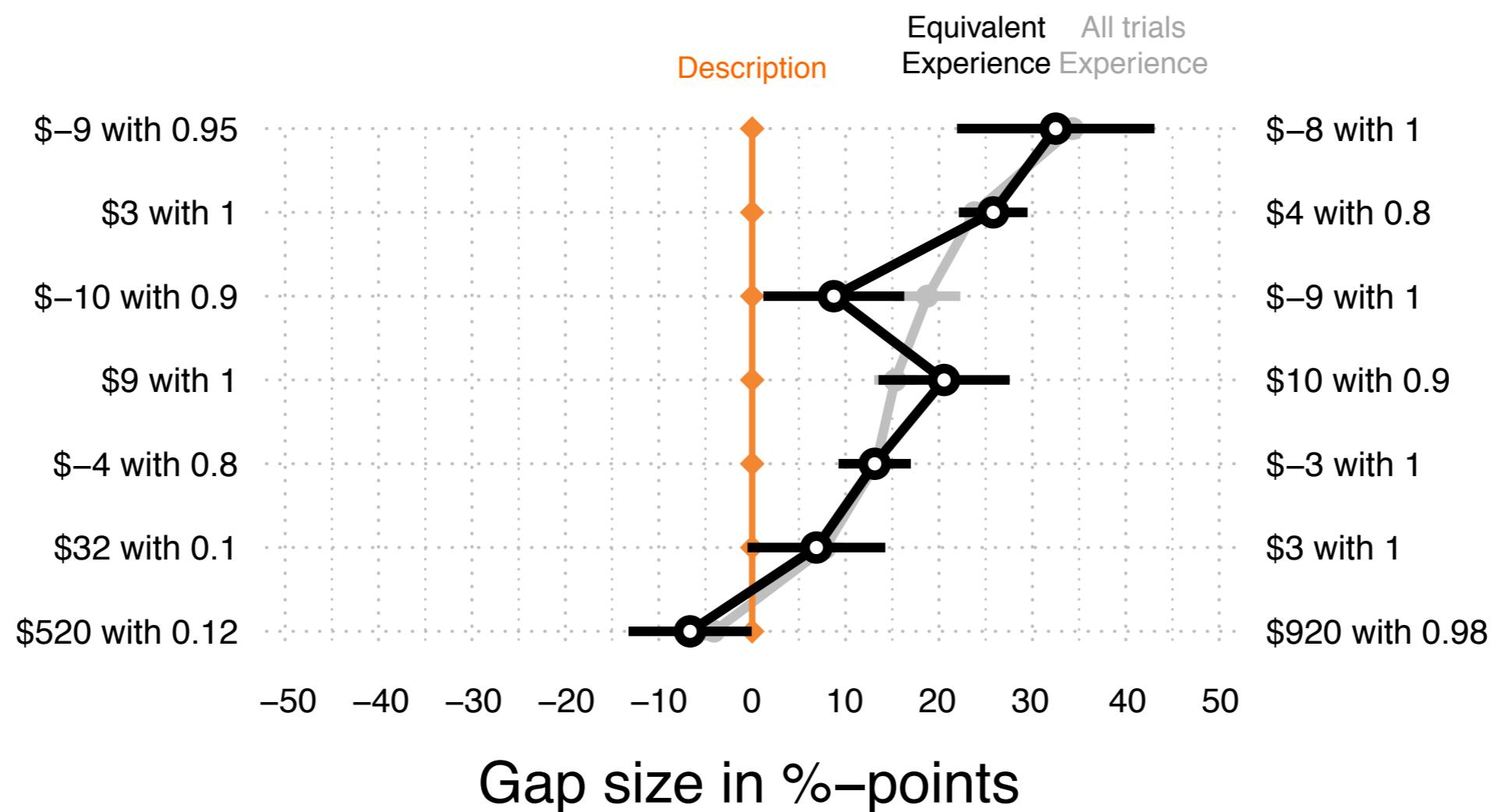
experienced relative frequencies vs. probabilities

10
Draws per
option

36%
missed
outcomes

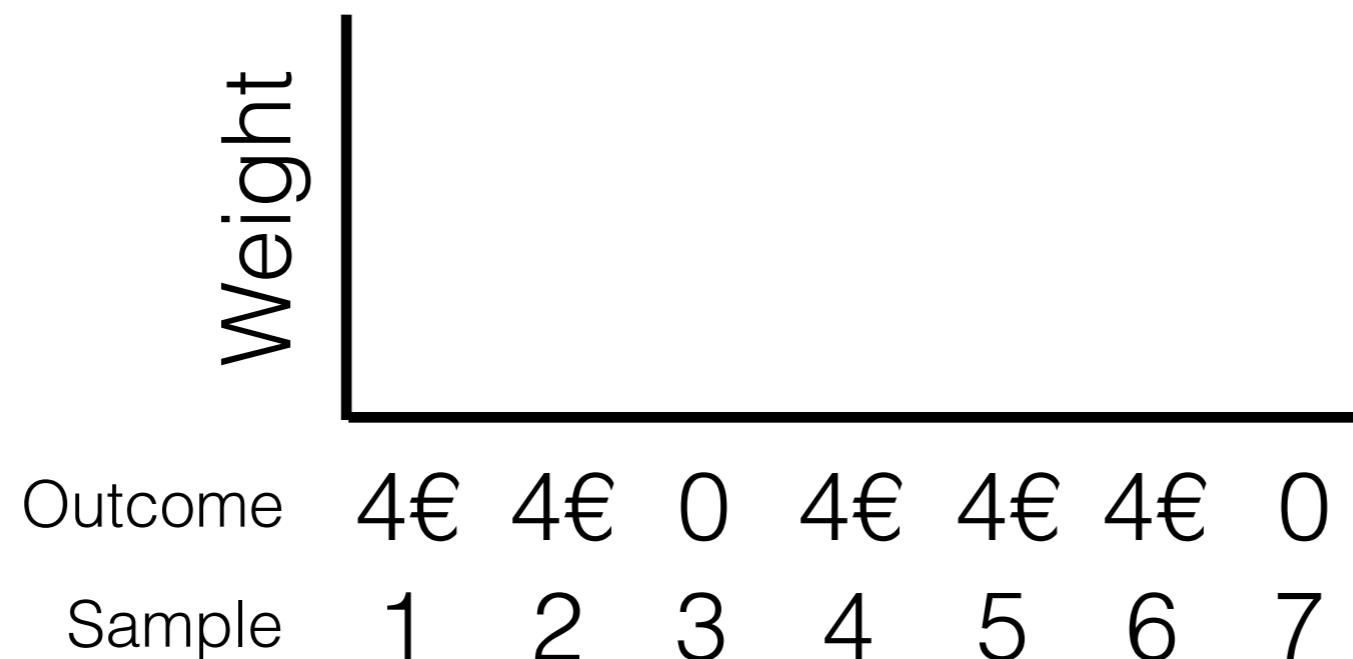


Gap cannot be reduced to sampling error



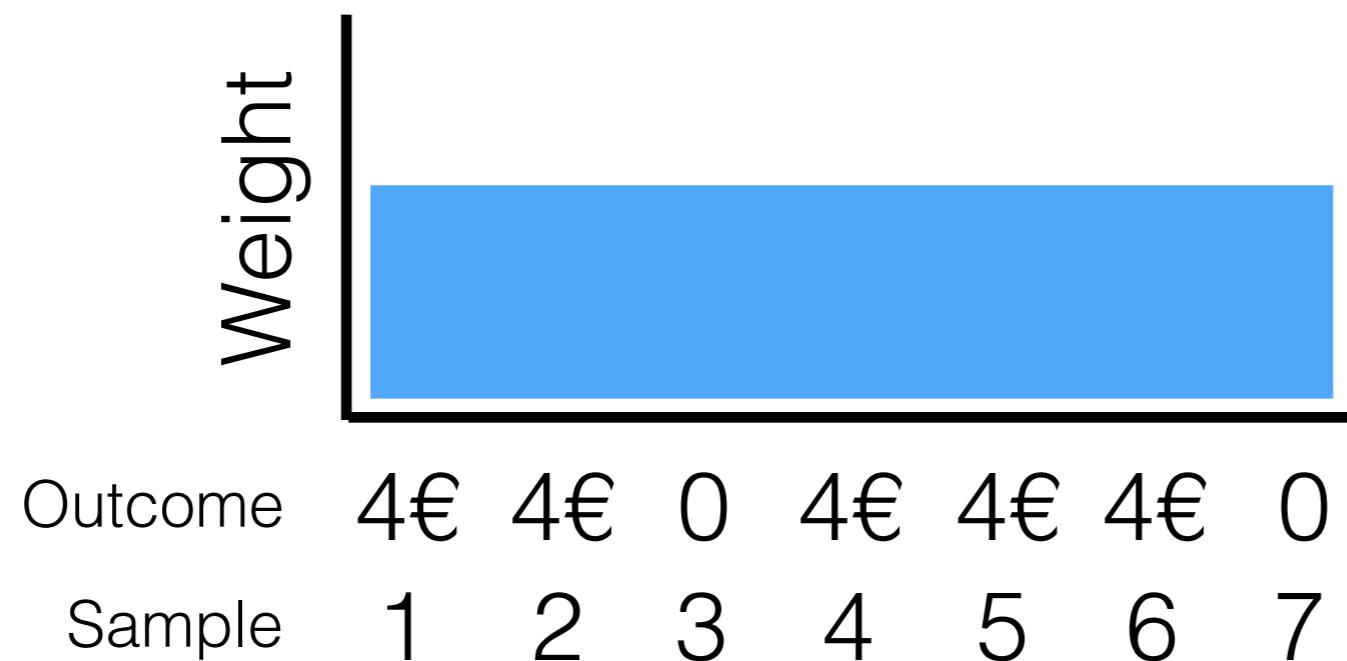
Recency

Position-dependent weighting



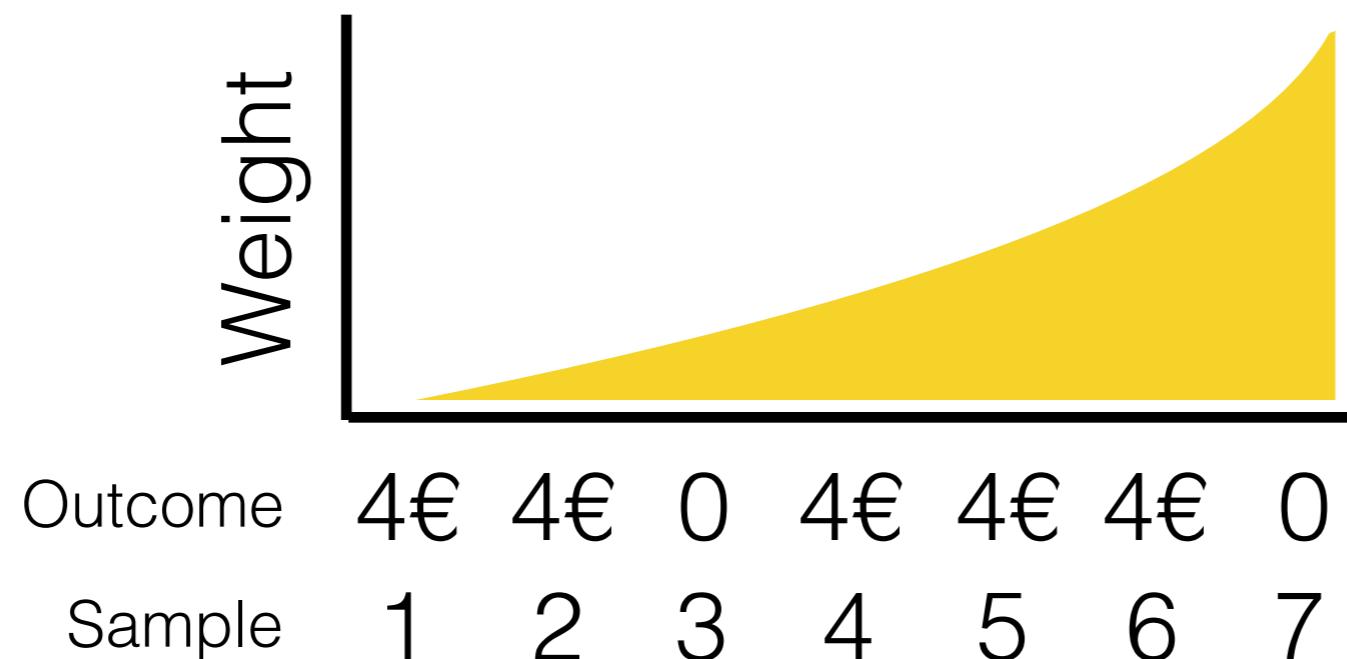
Recency

Position-dependent weighting



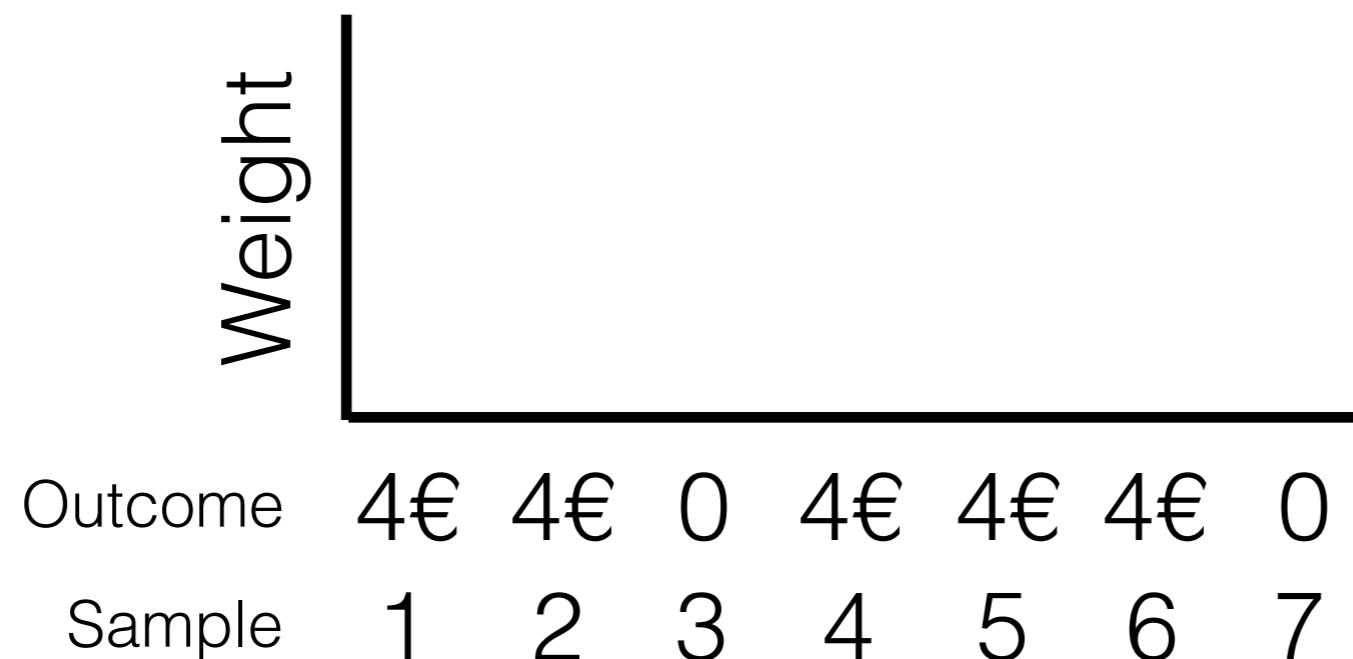
Recency

Position-dependent weighting



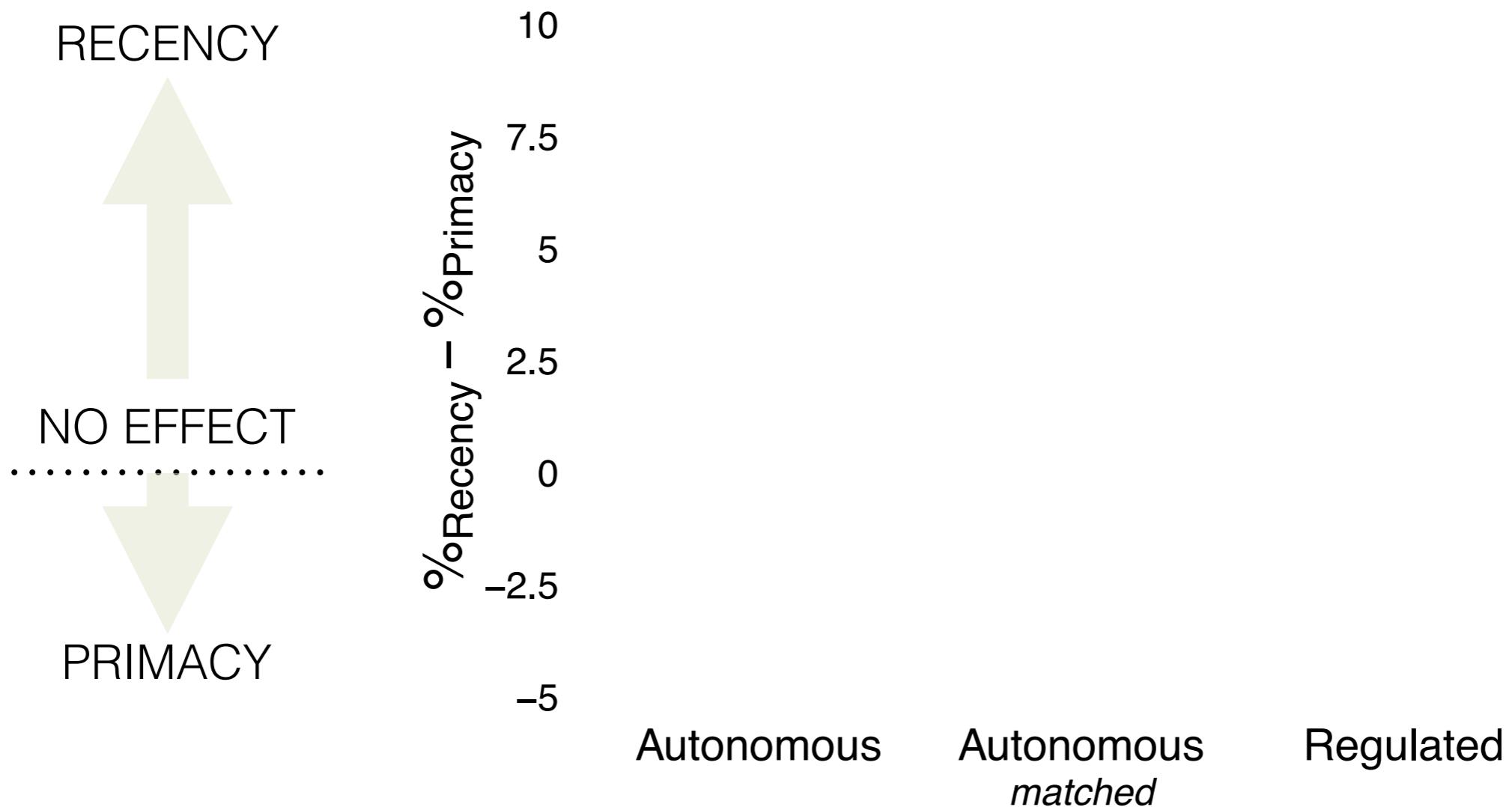
Recency

Position-dependent weighting



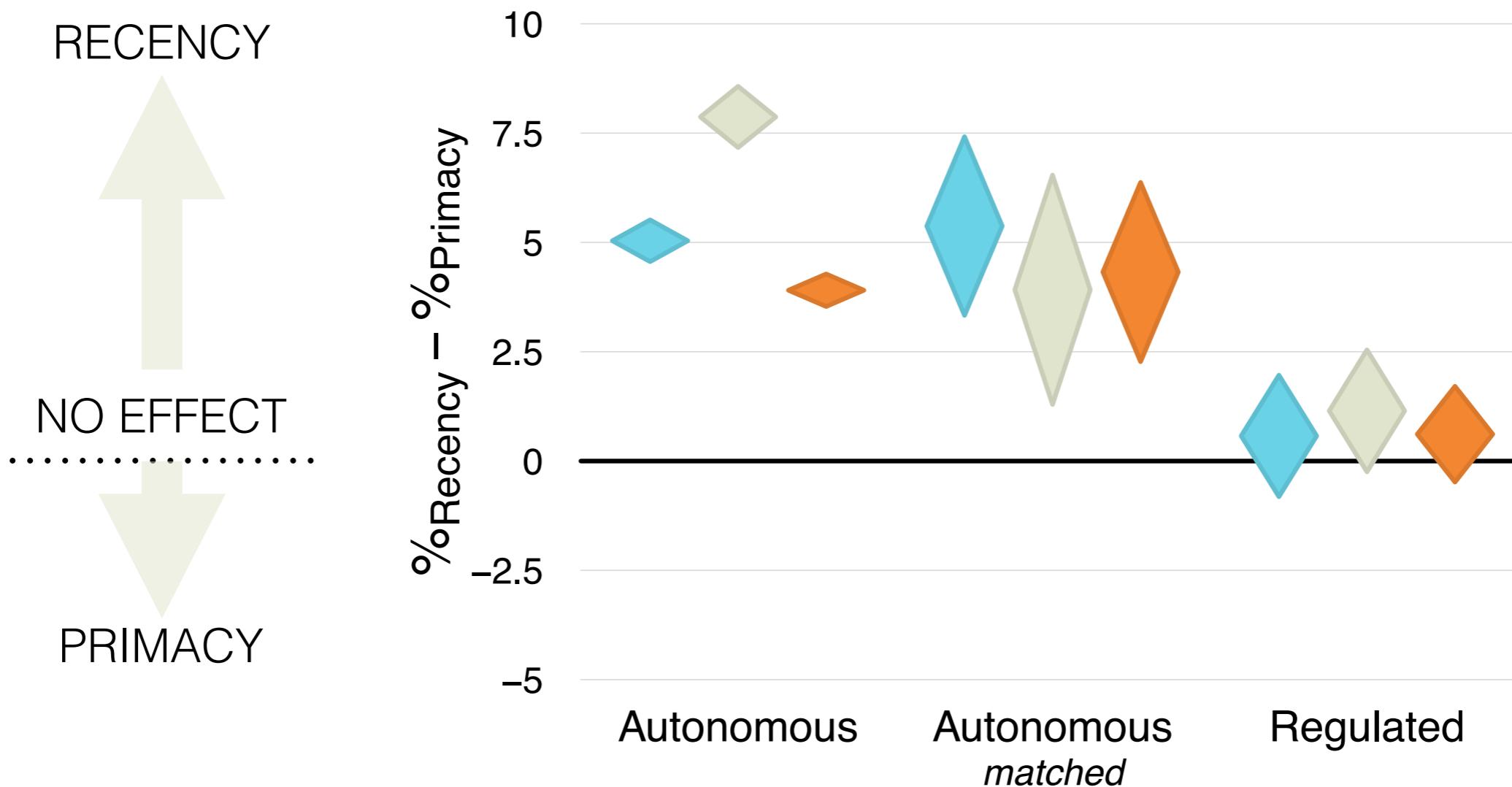
Robust recency effect

for autonomous but not regulated sampling



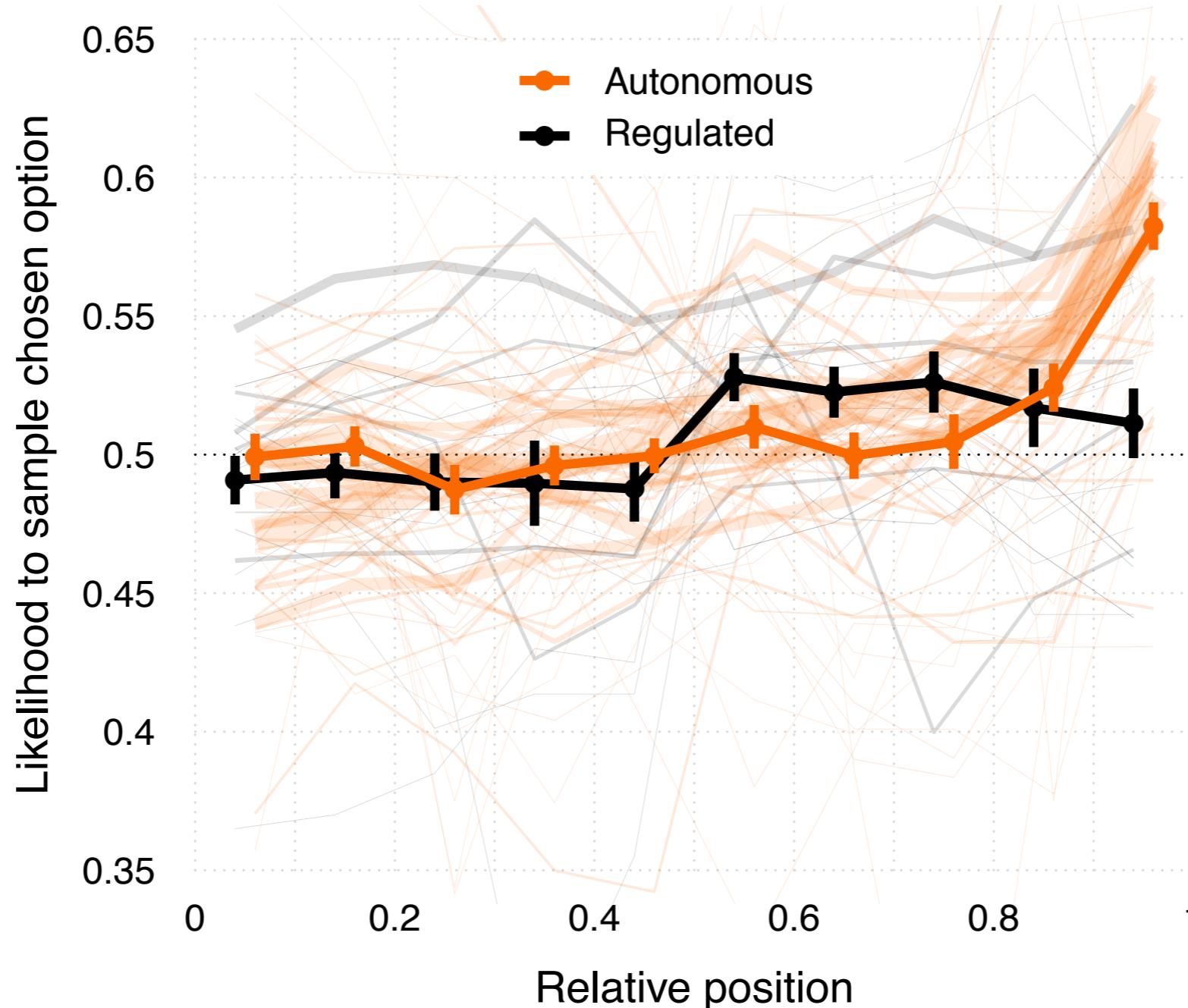
Robust recency effect

for autonomous but not regulated sampling



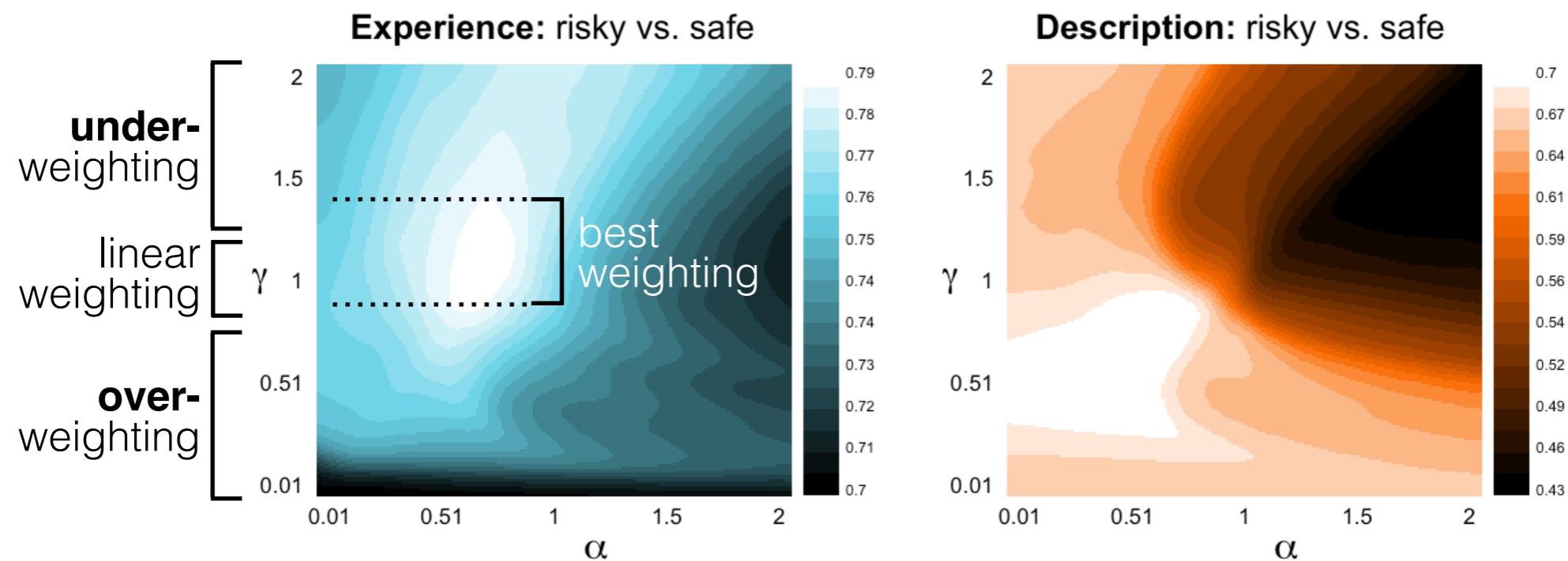
Optional stopping

A gaze-cascade-like effect



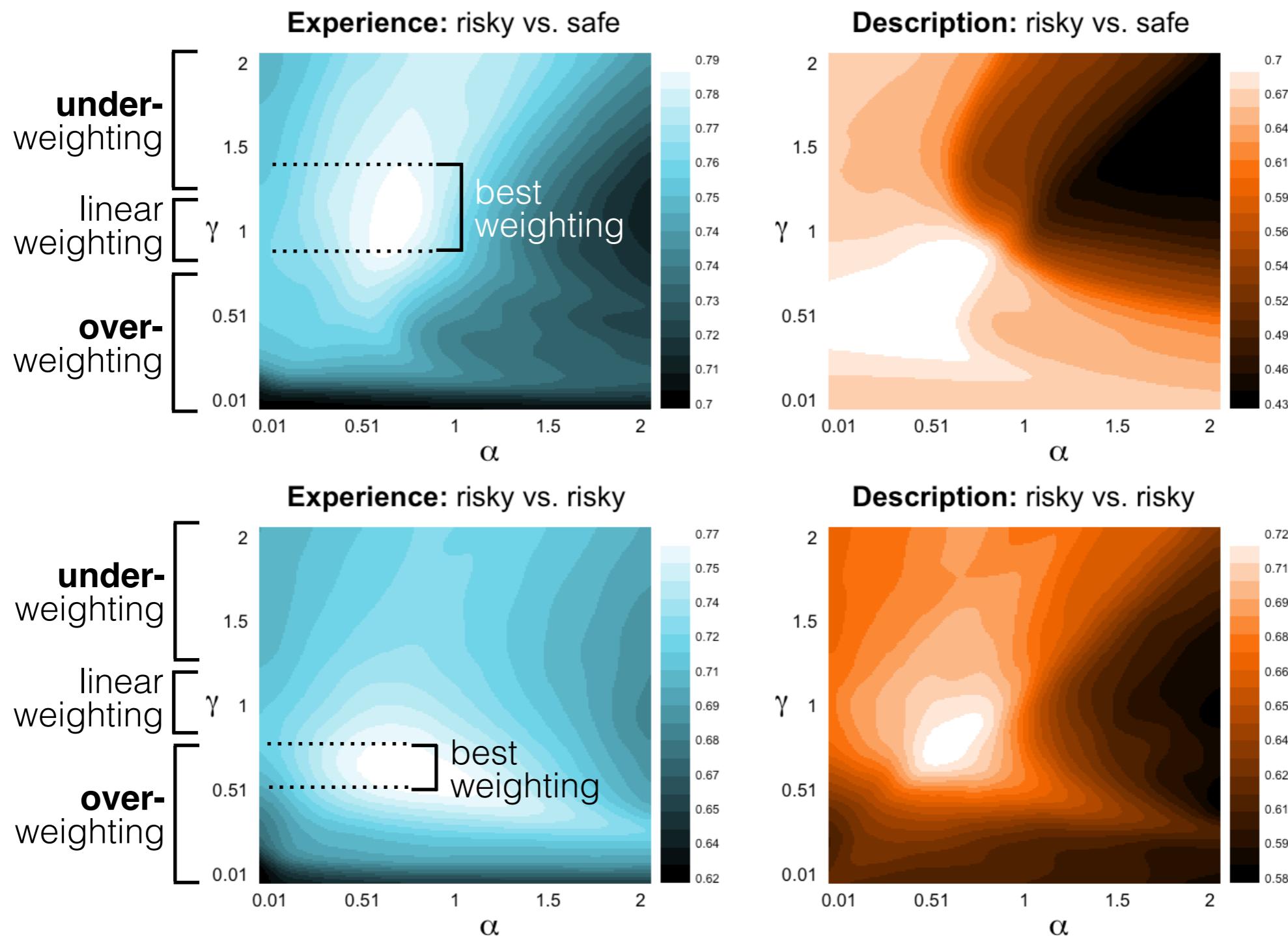
Probability weighting

Substantial item type effects



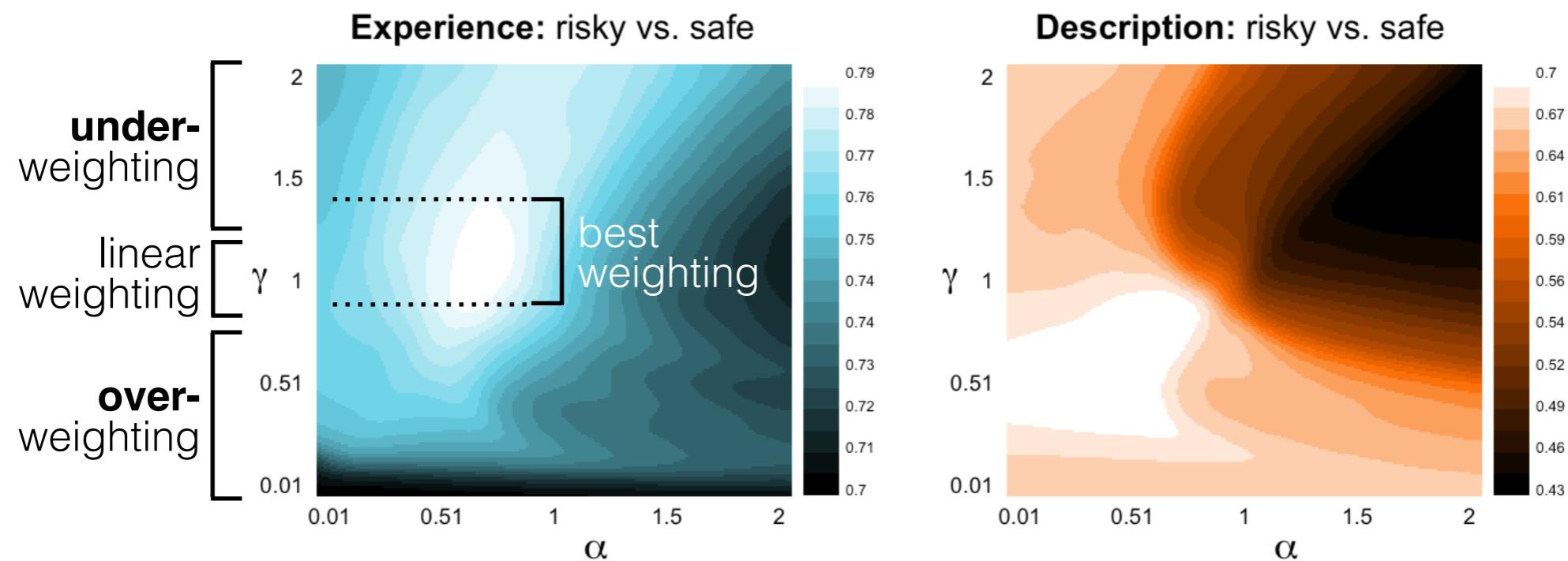
Probability weighting

Substantial item type effects



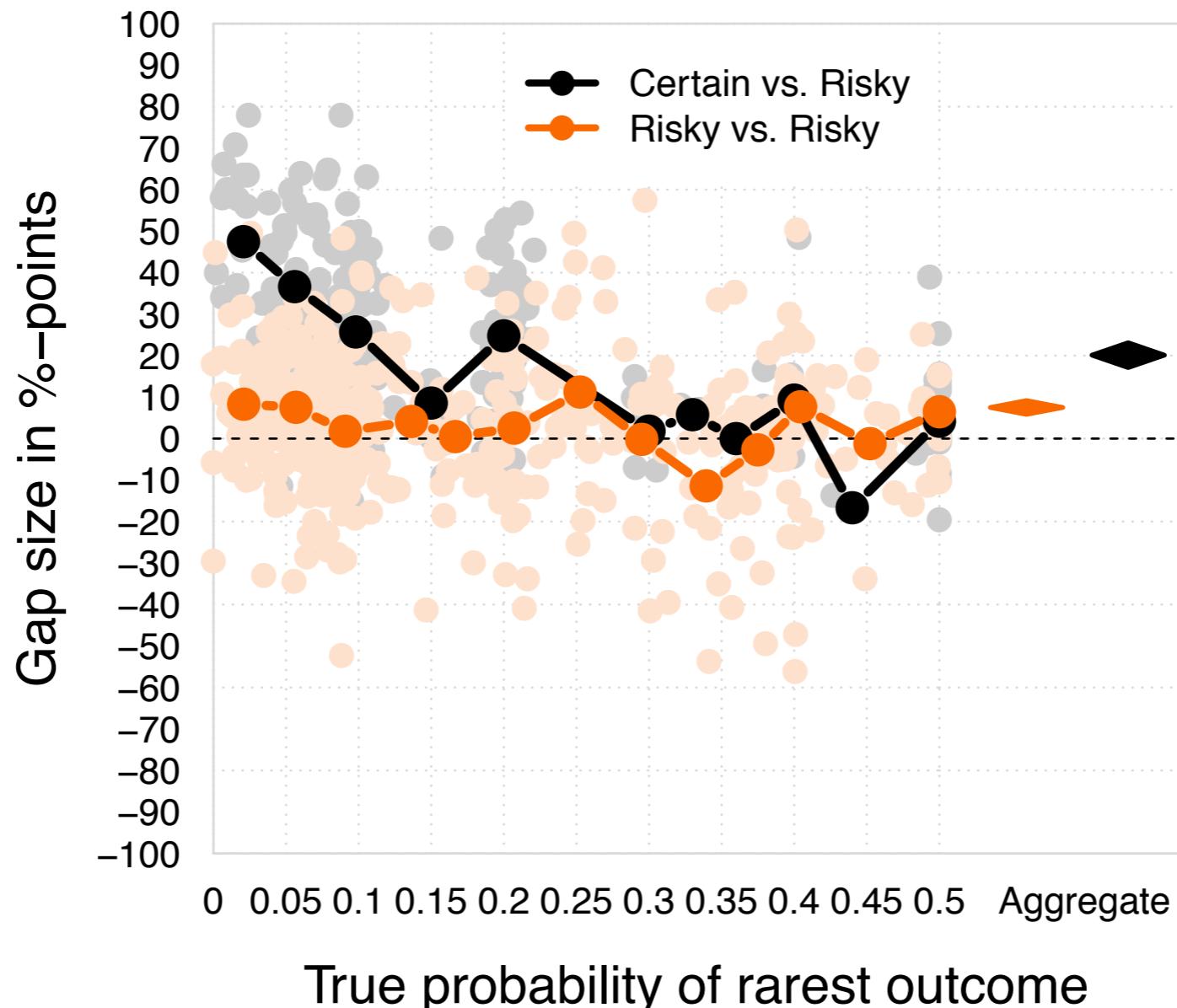
Probability weighting

Substantial item type effects



The gap is moderated by

- (a) the problem structure (risky vs. risky or risky vs. safe)
- (b) the probability of the rare event



Interim conclusions

- 1** The gap is robust.
- 2** The largest driver is sampling error.
- 3** There is a gap beyond sampling error.
- 4** Recency is robust, but it may not contribute to the gap.
- 5** Choices are consistent with different probability weighting across task and item formats, but mechanisms are unclear.



**Max
Mergenthaler**
*MPI for Human
Development*



**Ralph
Hertwig**
*MPI for Human
Development*

SEARCH

*How do people explore and
what does that reveal about
the cognitive process?*

Drivers of search

External

Competition Philips et al. (2014)

Complexity Hills et al. (2013), Noguchi & Hills (2015), Frey et al. (2015)

Domain Lejarraga et al. (2014), Wulff et al. (in rev.)

Incentives Hau et al. (2008), Wulff et al. (in rev.)

Social context Fleischhut (2014)

Variance Lejarraga et al. (2012), Mehlhorn et al. (2014), Wulff et al. (in rev.)

Internal

Affect Frey et al. (2014)

Age Frey et al. (2015)

Aspirations Wulff et al. (2015)

Practice Lejarraga et al. (2012), Wulff et al. (in rev.)

Interactive 2

bit.ly/tapmi2020

I The description-experience gap ☰



Interactive 1 - 5min

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Interactive 2 - 5min

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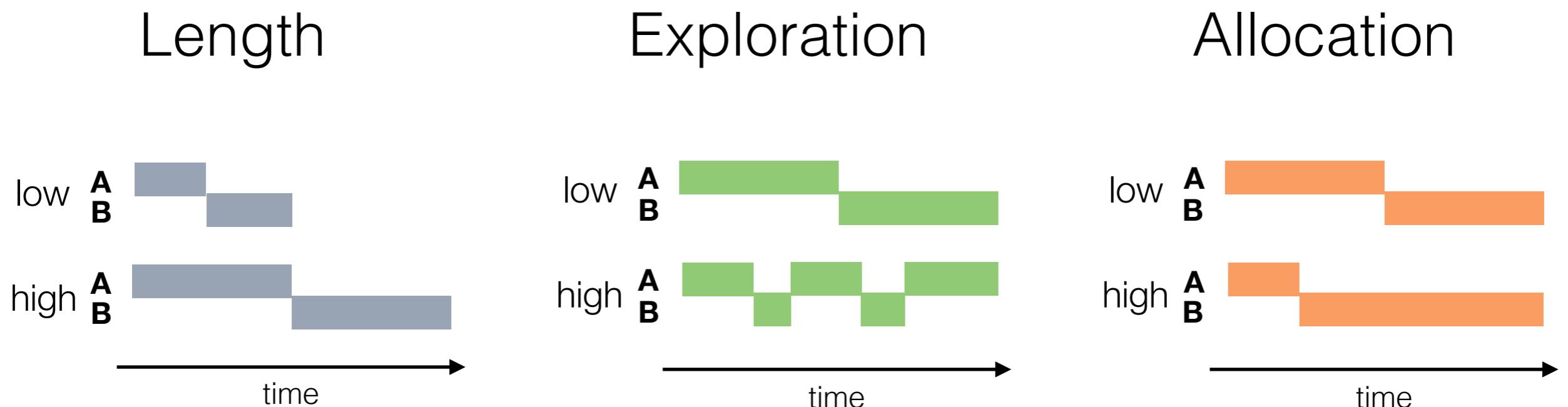
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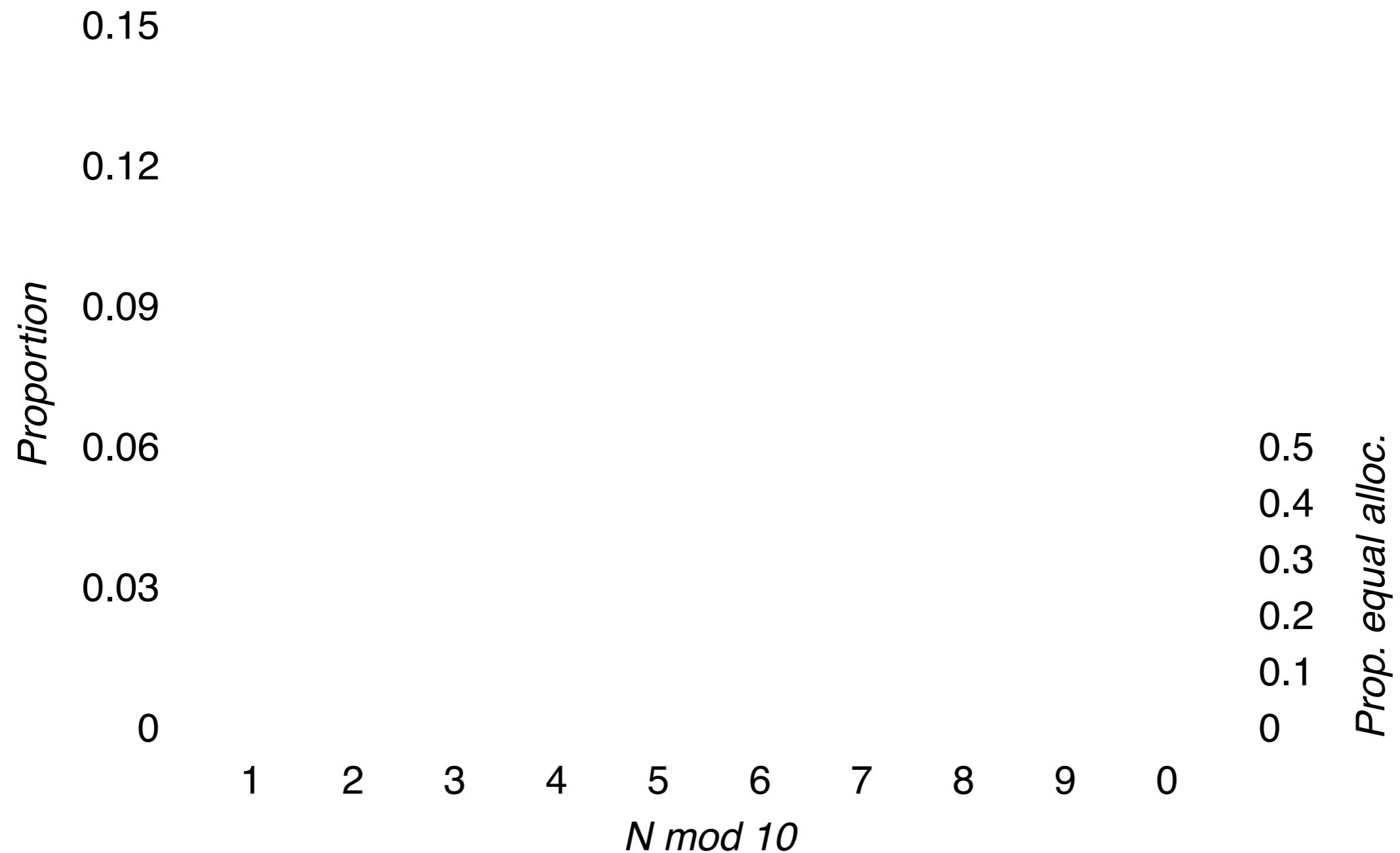
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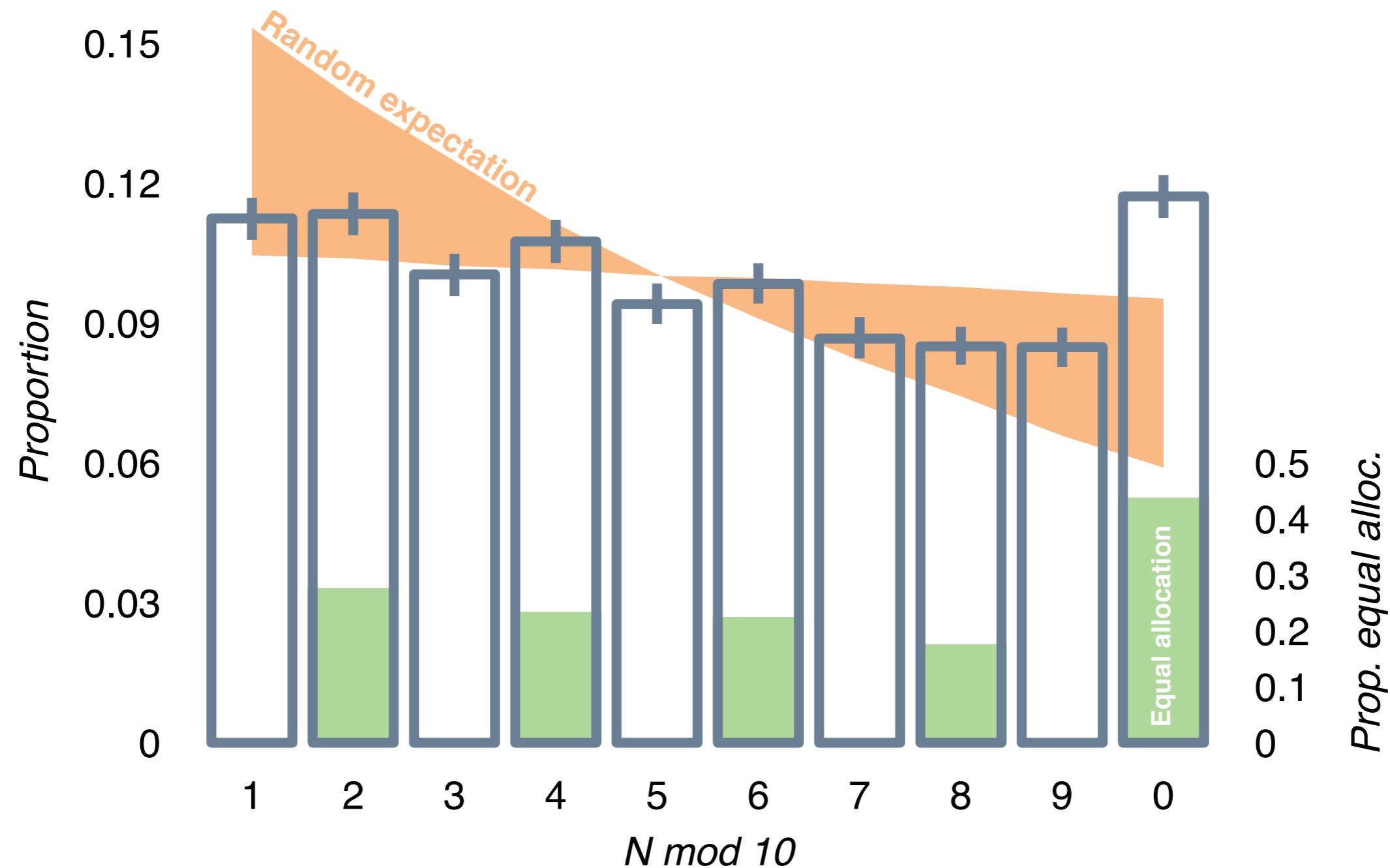
3 behavioral dimensions



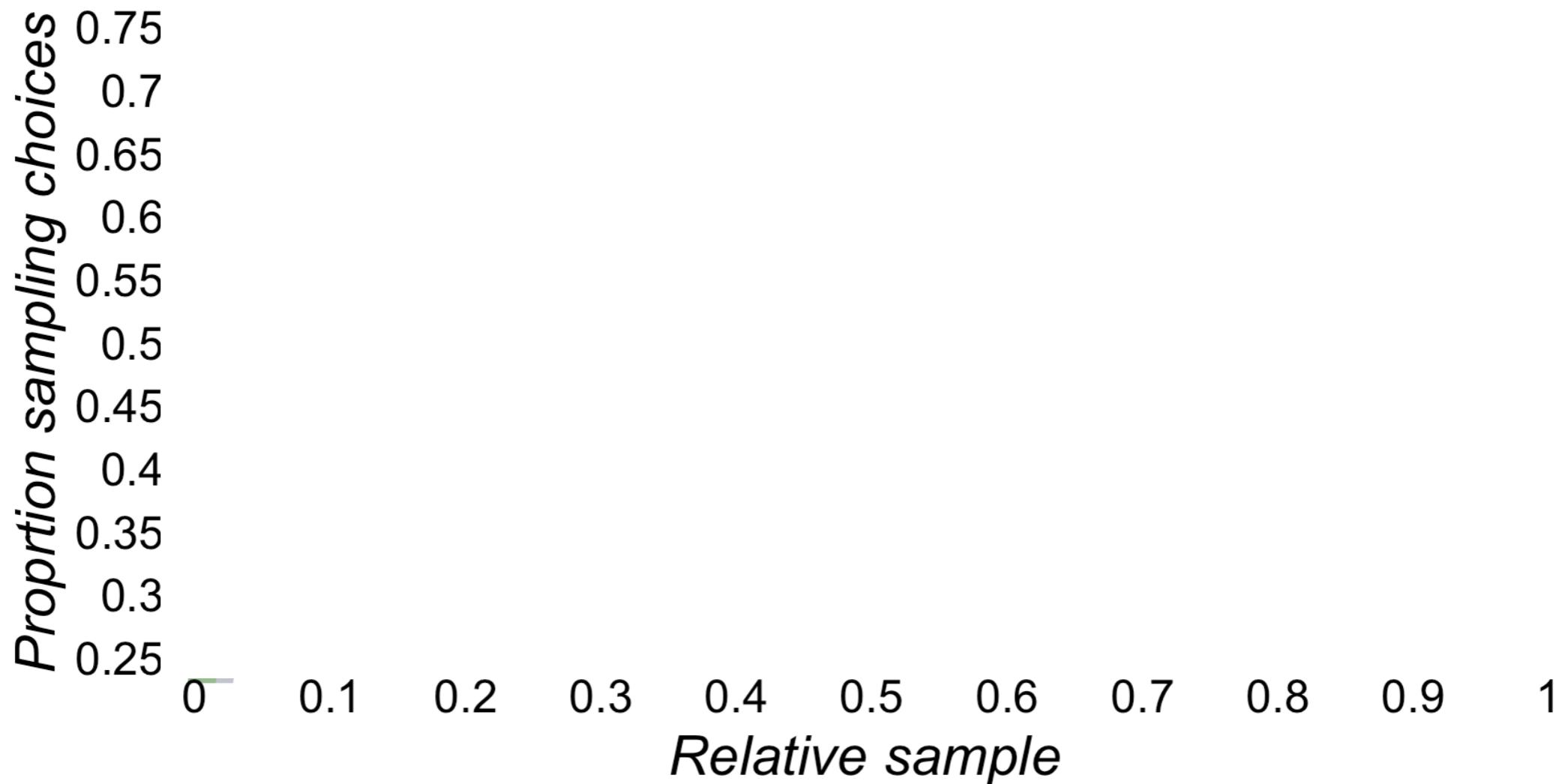
Evidence for **fixed-n** strategy



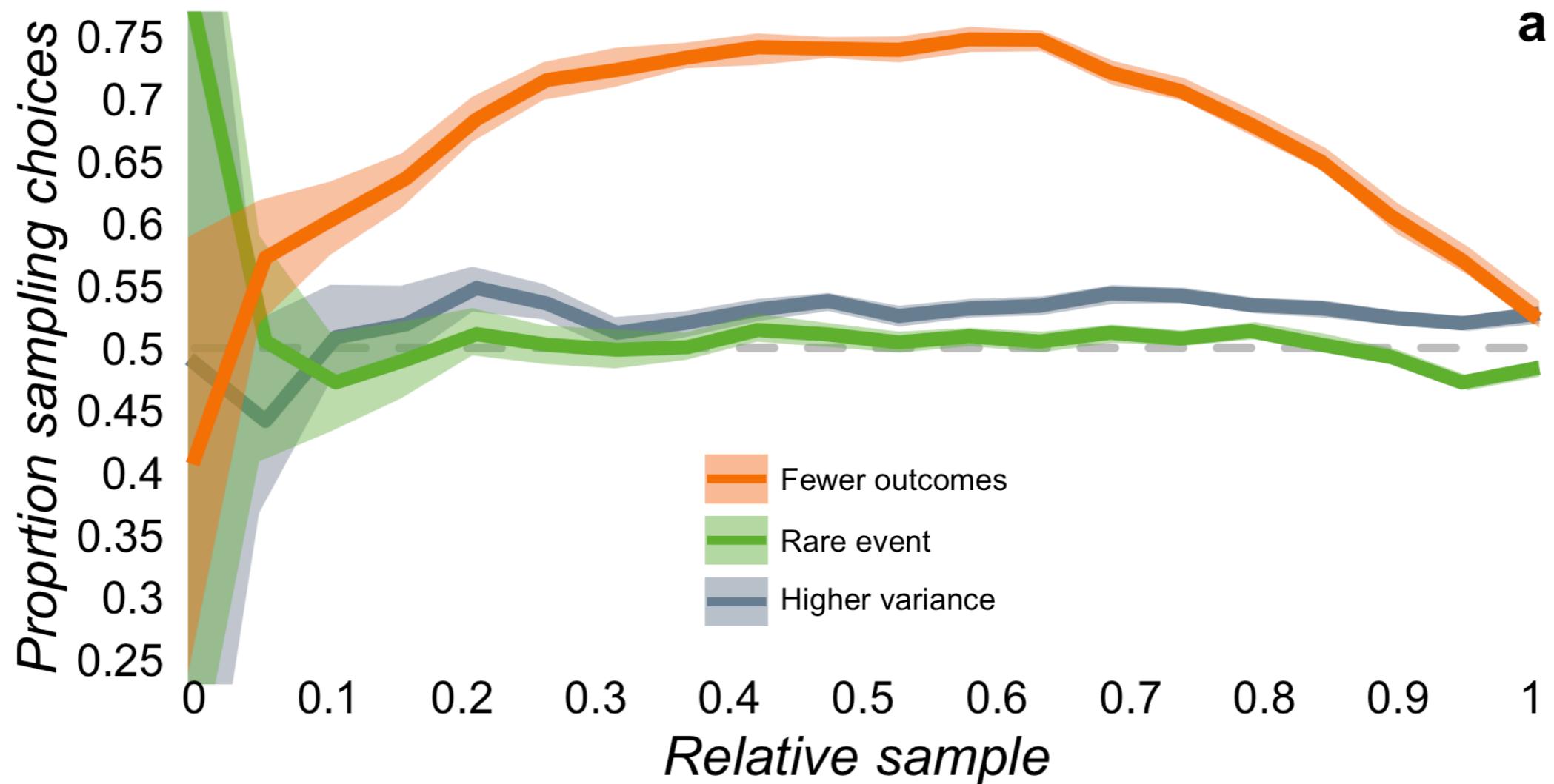
Evidence for **fixed-n** strategy



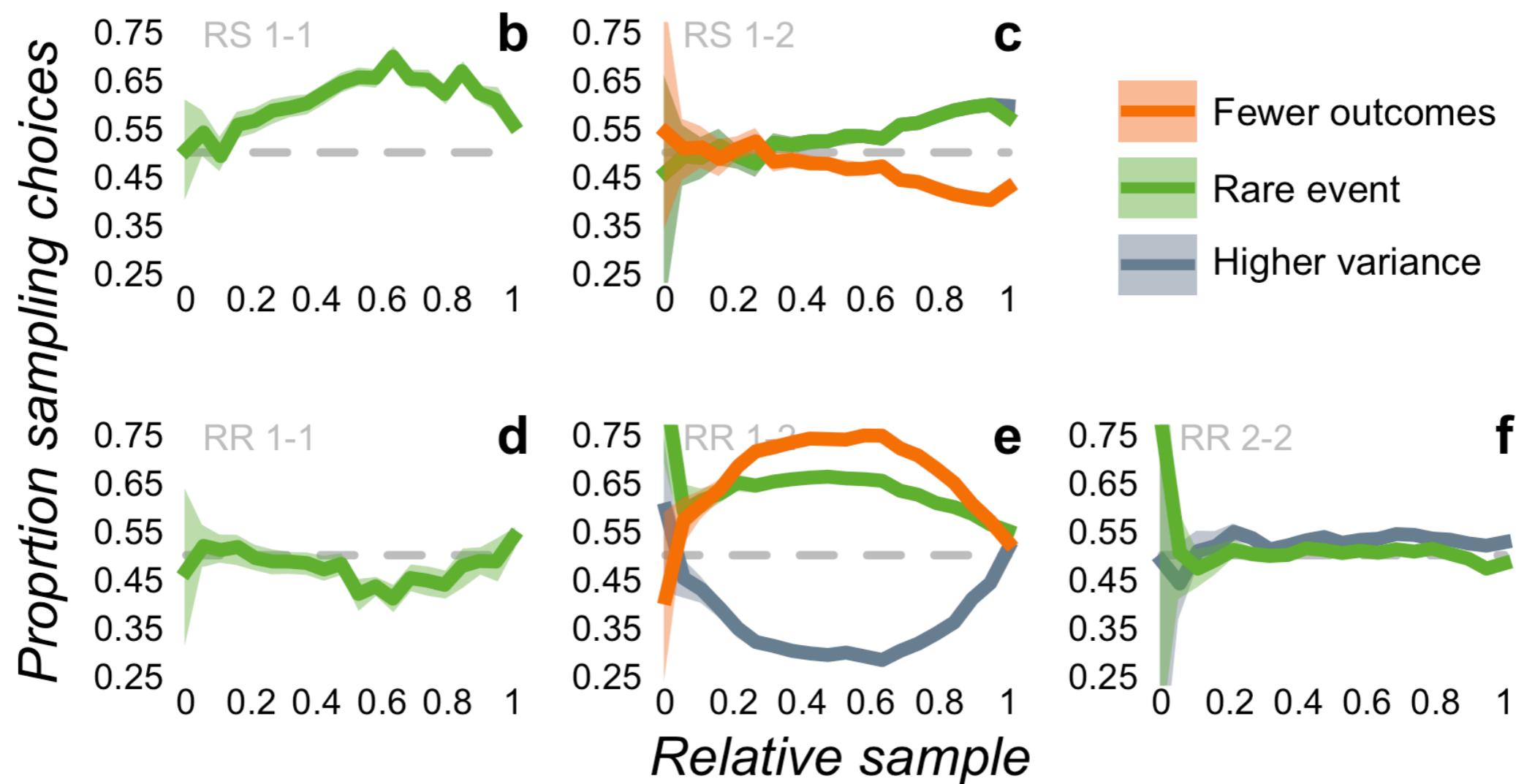
Search driven by **strategic** considerations



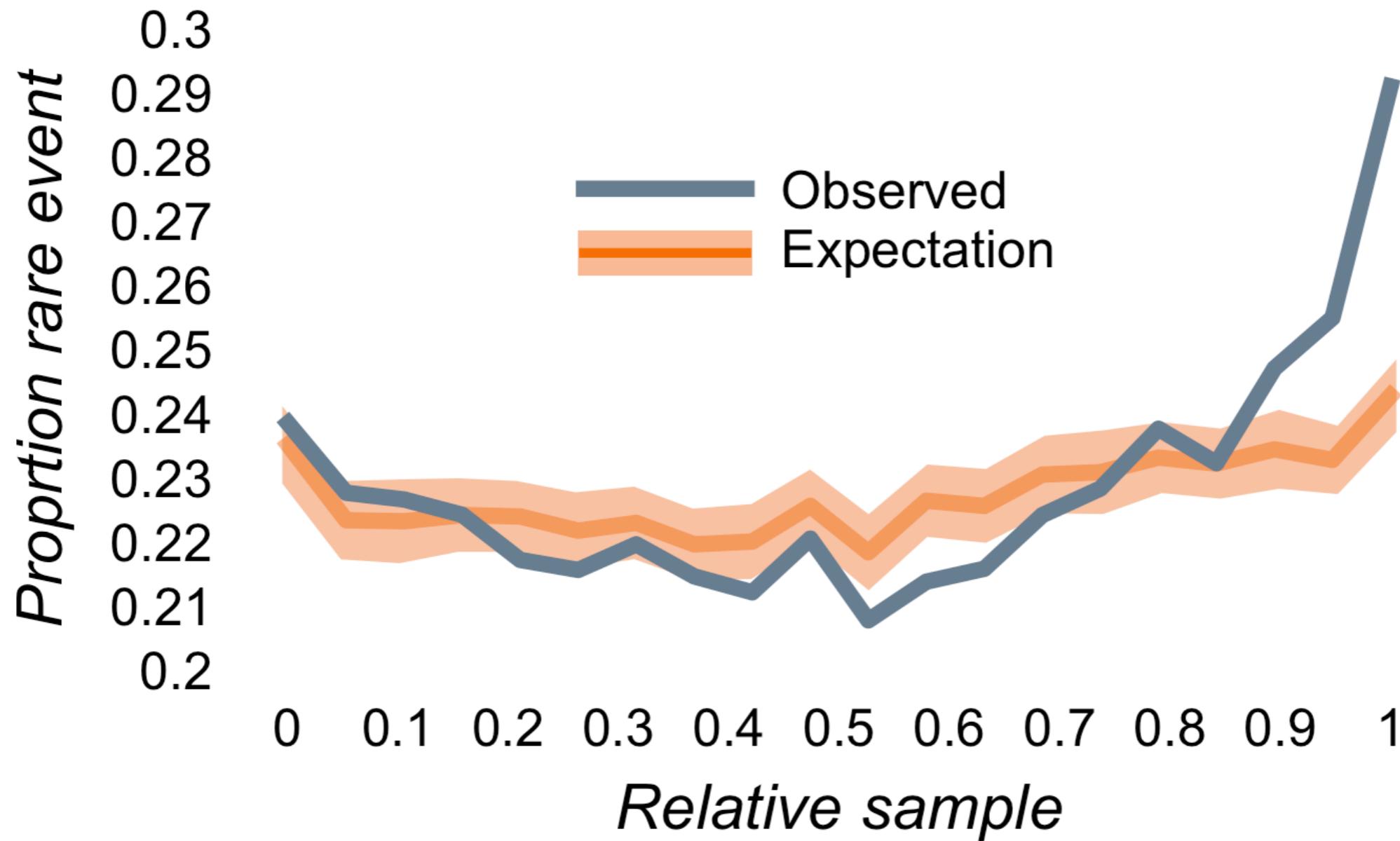
Search driven by **strategic** considerations



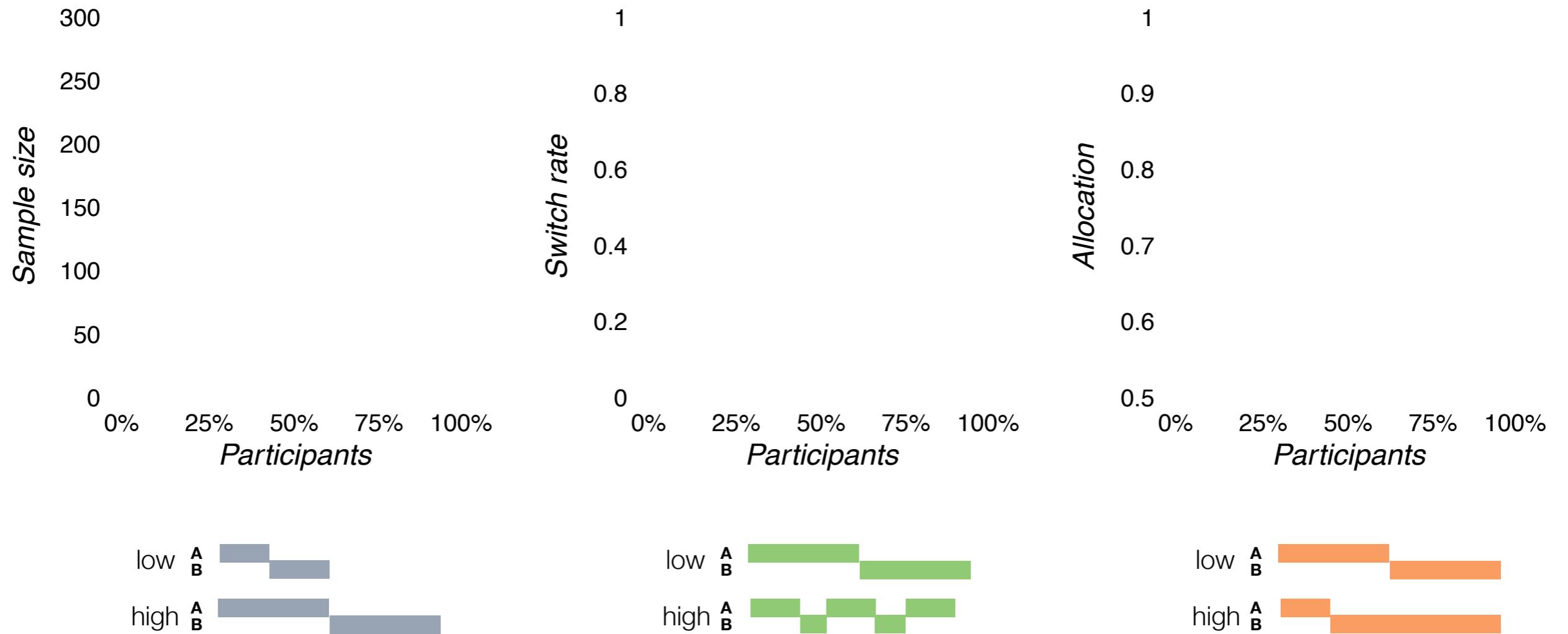
Search driven by strategic considerations



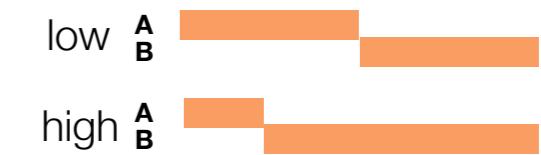
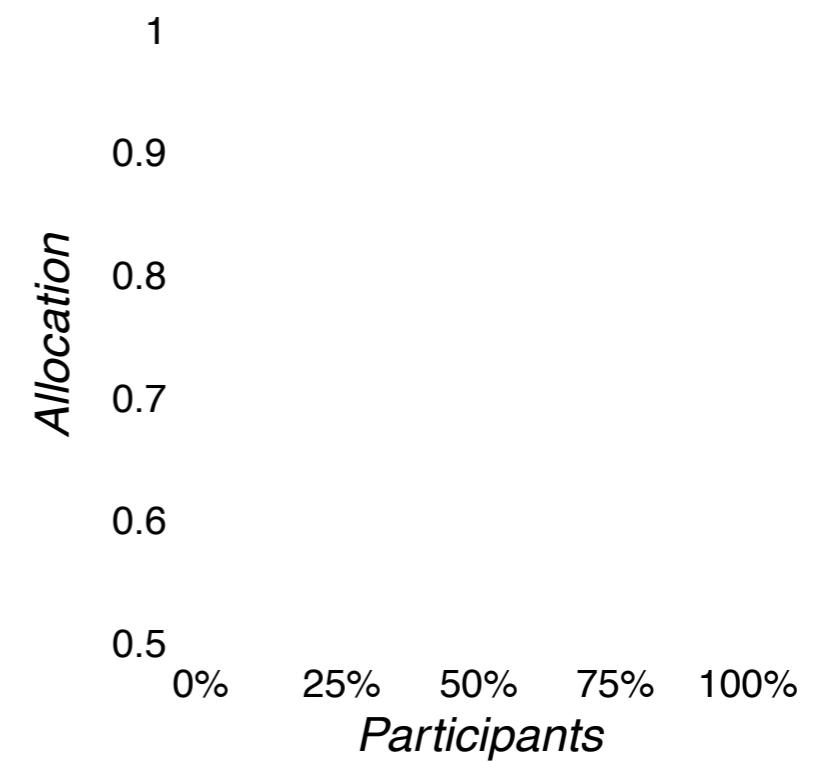
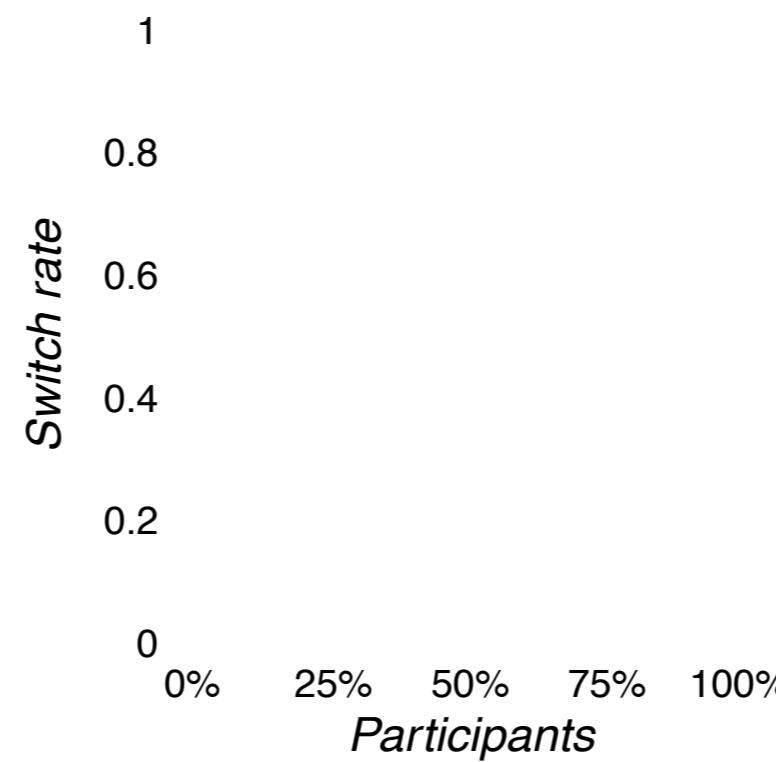
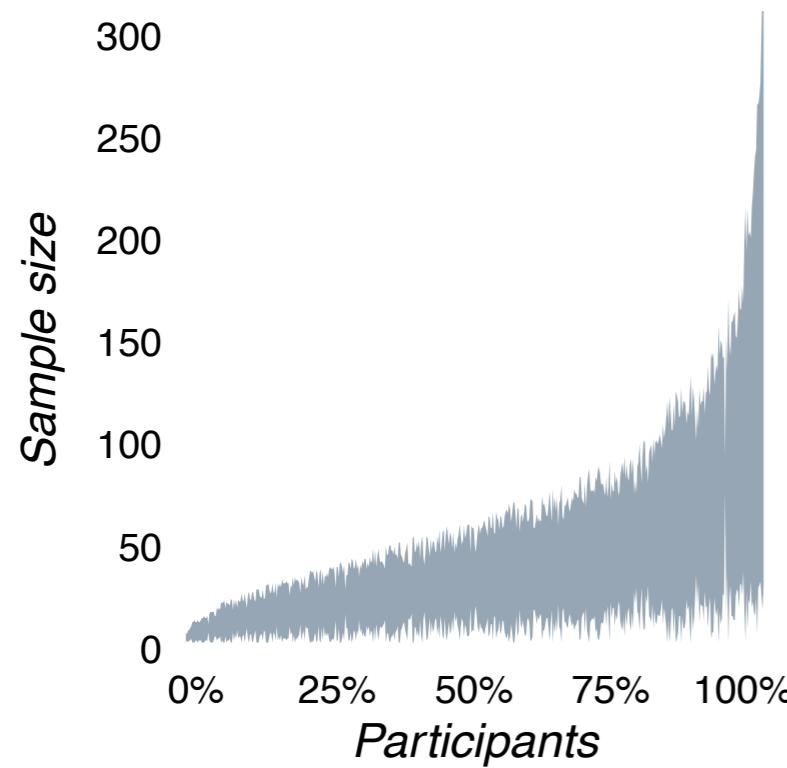
People **hunt** for rare events



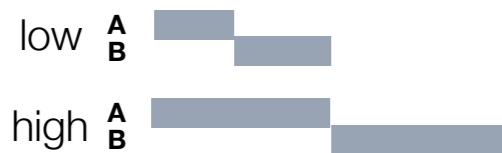
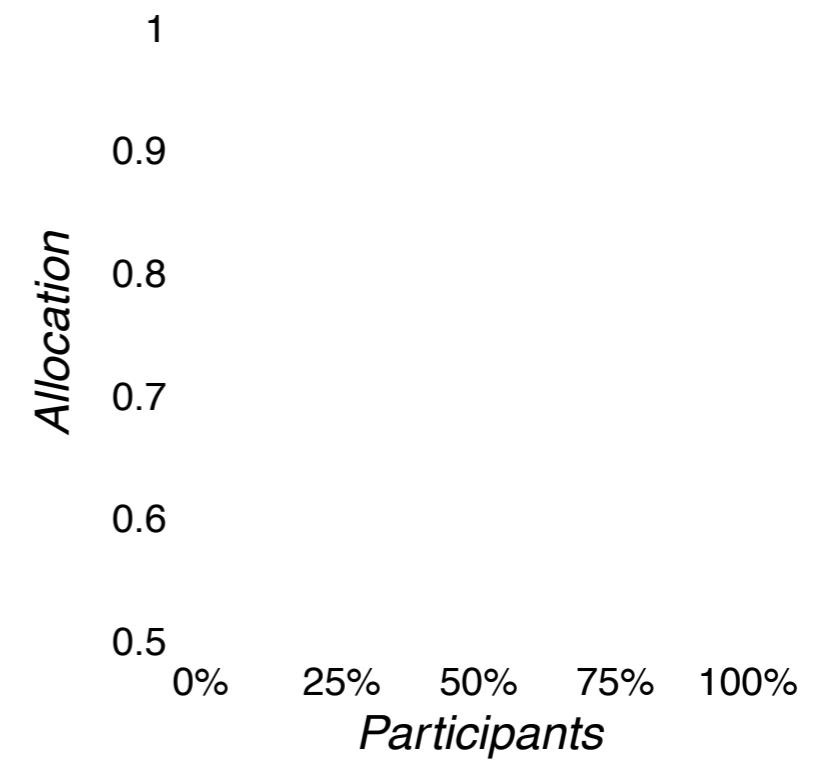
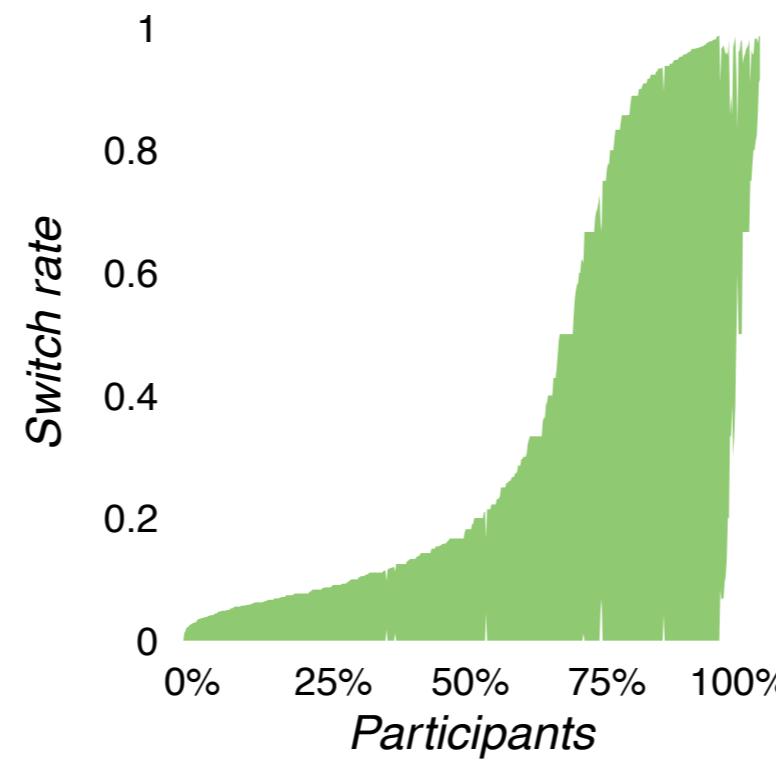
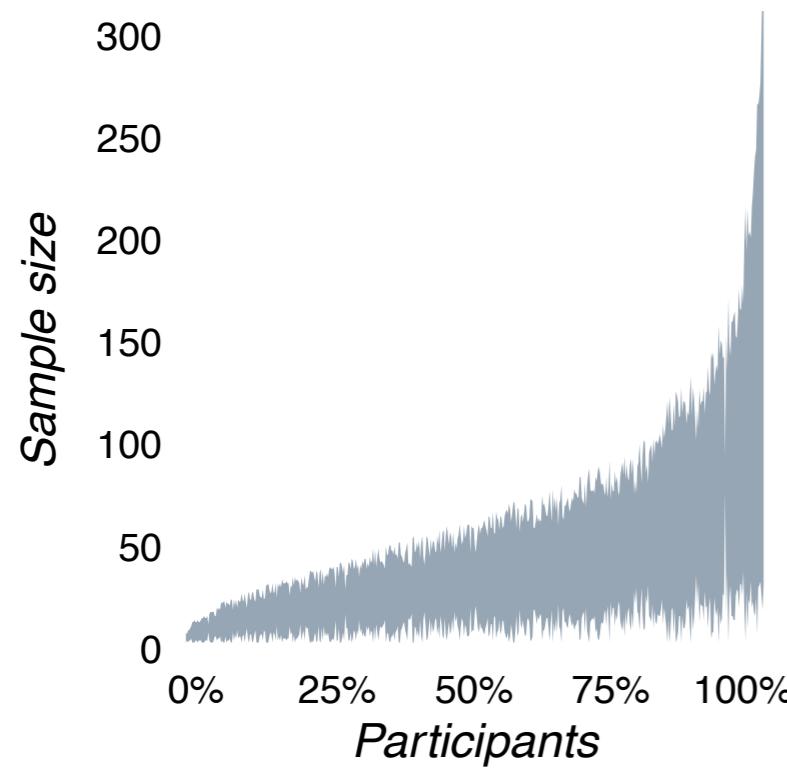
Considerable instability within individuals



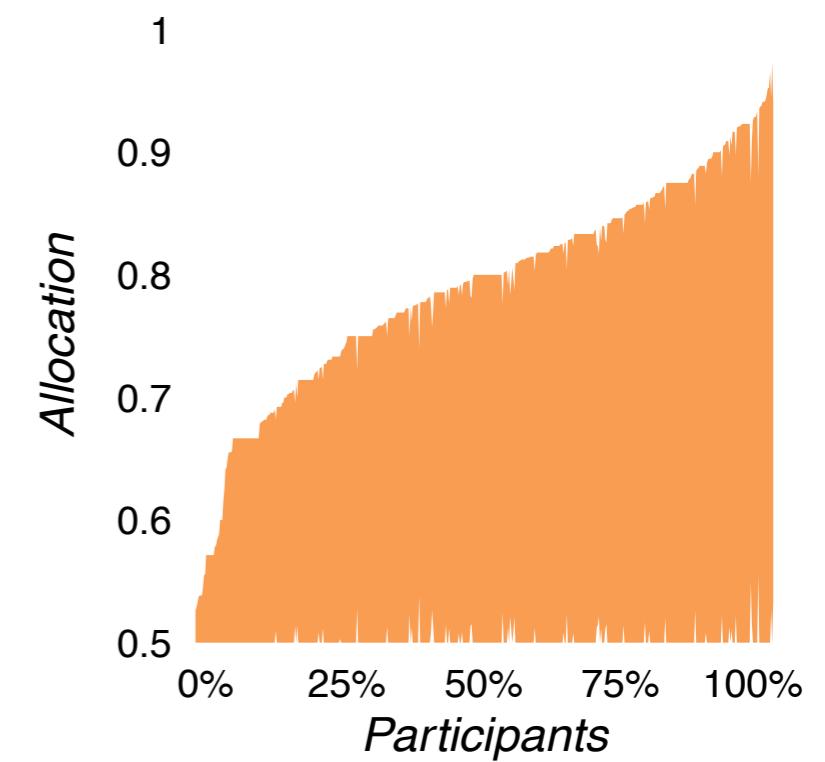
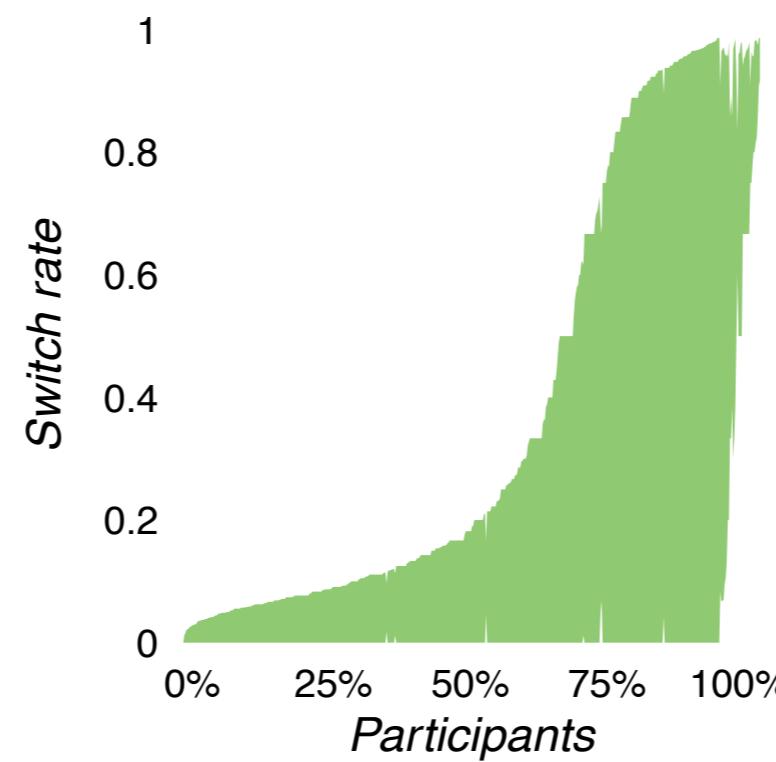
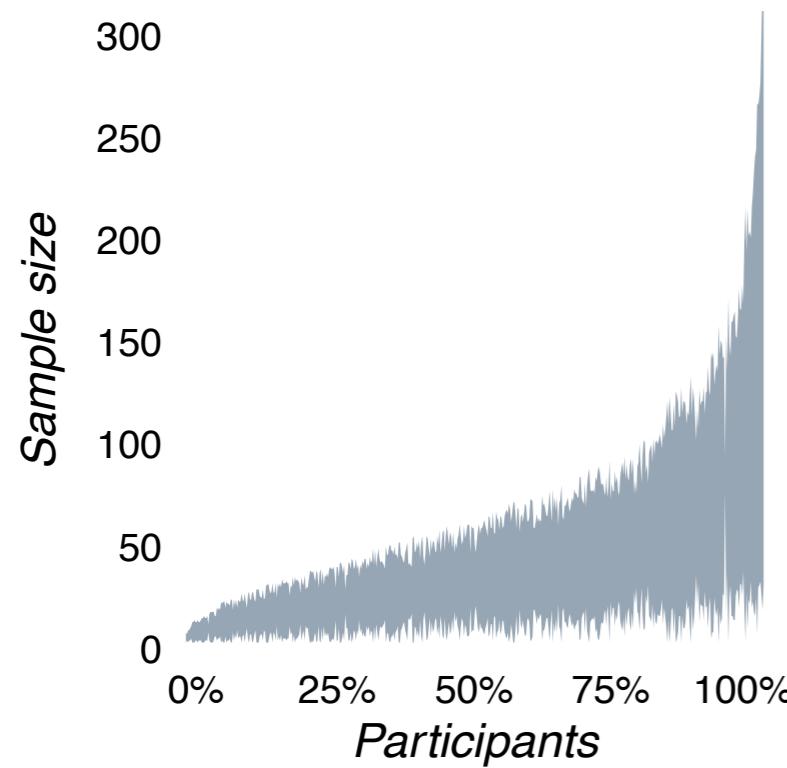
Considerable instability within individuals



Considerable instability within individuals



Considerable instability within individuals



Interim conclusions

1 People's exploration is highly complex

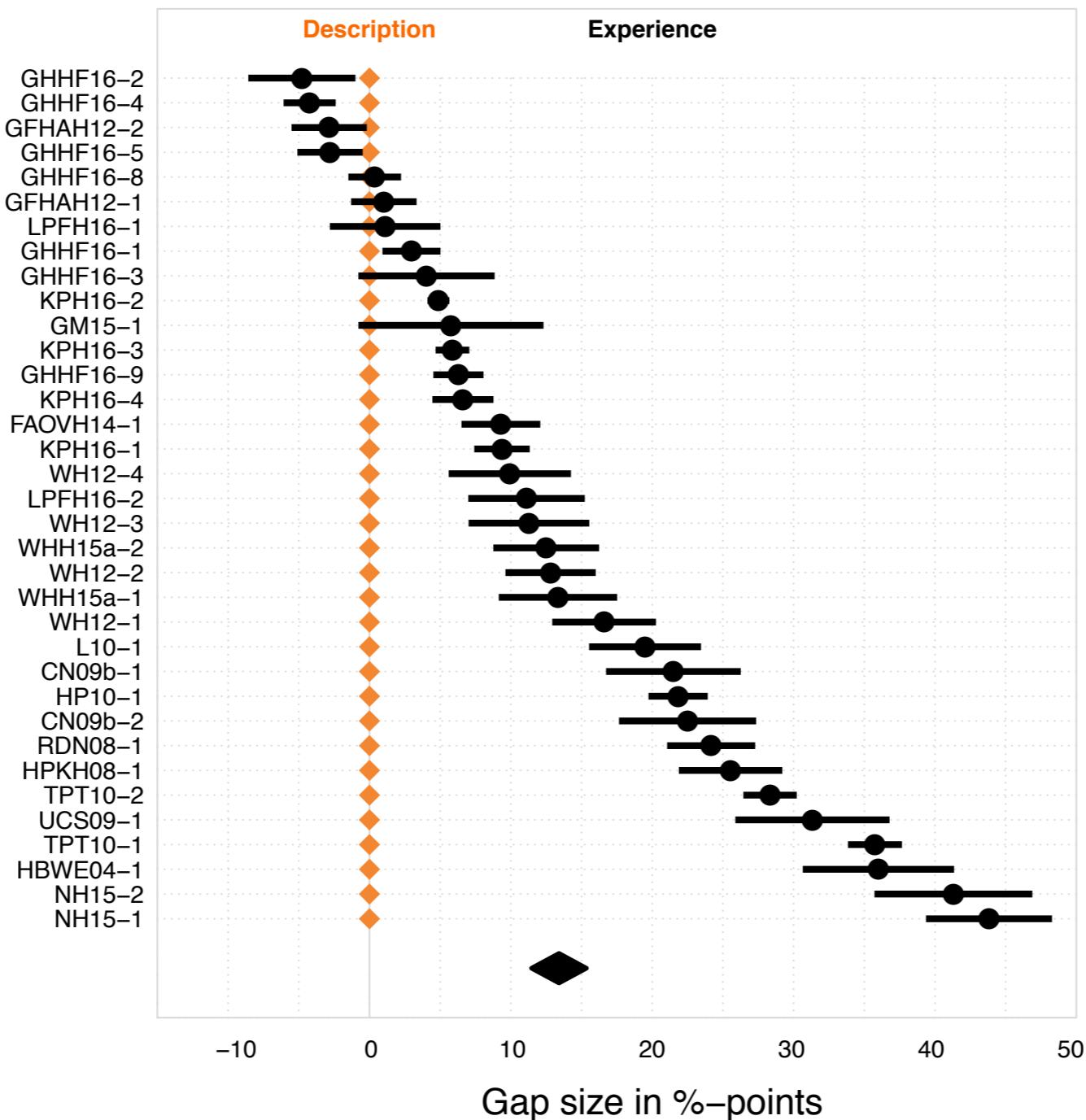
- planning
- diverse strategies
- exploration of strategies

2 (Some) behavior is reflective of higher-order learning about the environment that they are in.

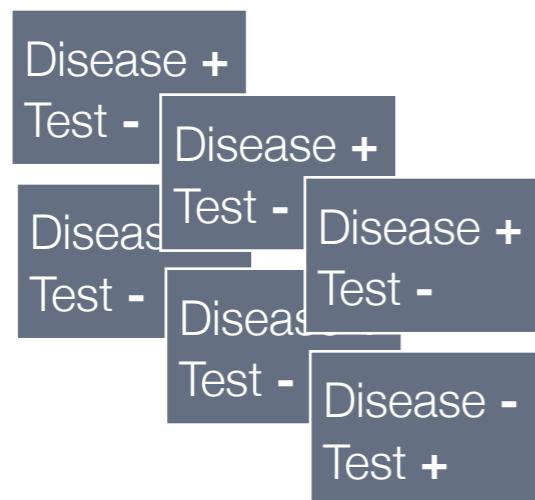


**Mikhail
Spektor**
*Pompeu Fabra
Spain*

A robust Gap. But why exactly?

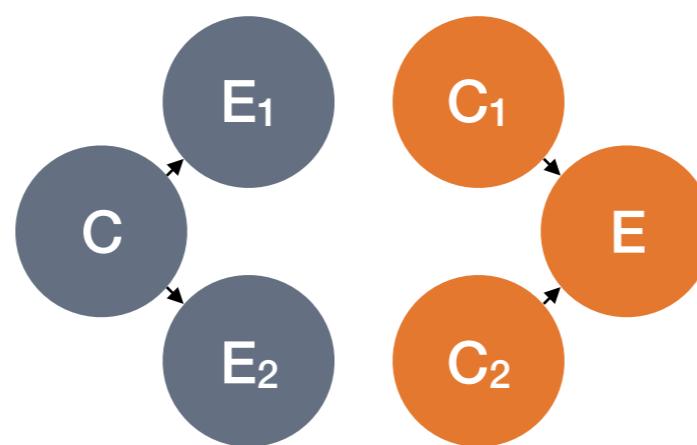


Gaps in other paradigms



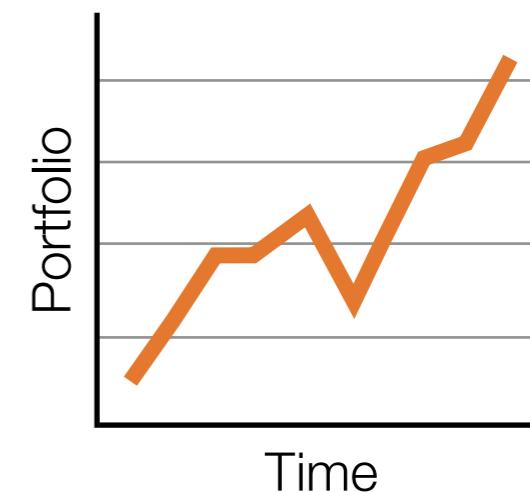
Medical diagnosis

Armstrong & Spaniol (2017)



Causal reasoning

Rehder & Waldmann (2017)



Financial risks

Kaufman, Weber, & Haisley (2013)

Conclusions

- 1** Modes of learning produce substantial gaps in risky choice and other domains.
- 2** We yet have to uncover the precise cognitive mechanisms underlying behavior in decisions from experience (and description).
- 3** Still important implications can be derived for predicting and for changing people's behavior.

Appendix

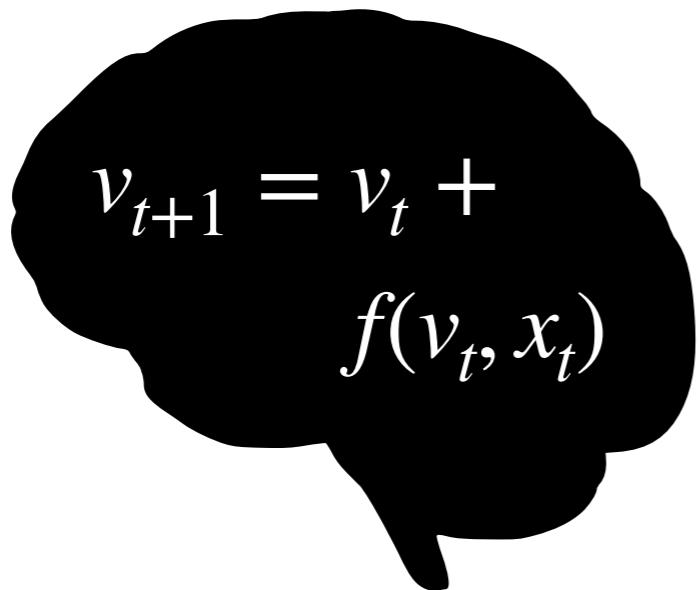
MEMORY REPRESENTATIONS

*How do people process and
represent sampled information?*

Representation in models of decisions from experience

 4 0 4 4 0 4 0 4

Updating



v

Instance-memory



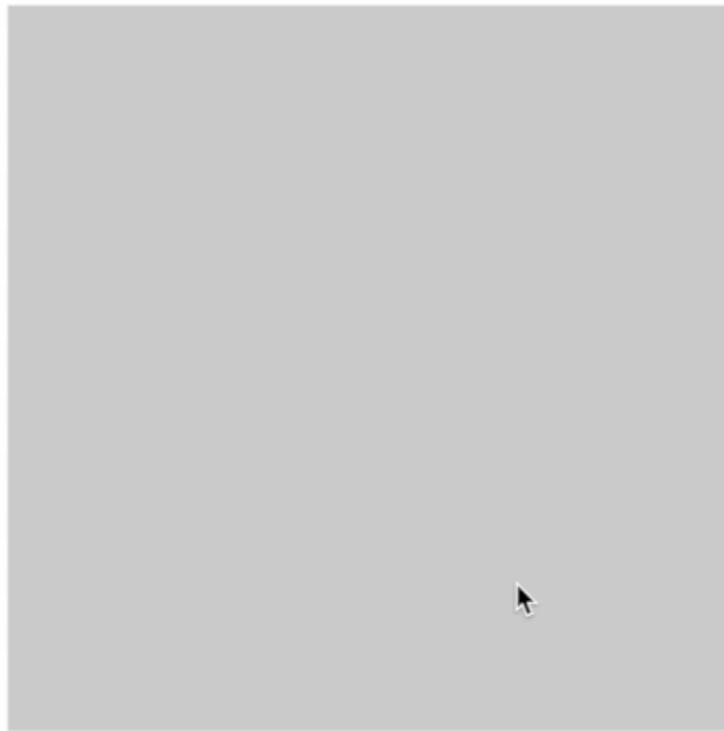
$$v = \sum_i x_i p_i$$

Are samples stored explicitly?

Instruction	Experience	Manipulation	Choose	Probability Ratings
Early “You will choose between the options”	A B 3 0 9 3 9 3	Forget “Ignore all outcomes of value 9 that you saw.”	“Choose A or B”	“How frequent were...?”
Late “Pay attention to the outcomes.”	A B 0 32 9 9 3	Control “”		F A 0 ? (9) ? 32 ? B 3 ? (9) ?

Can learned impressions be revised?

A



B



Can learned impressions be revised?

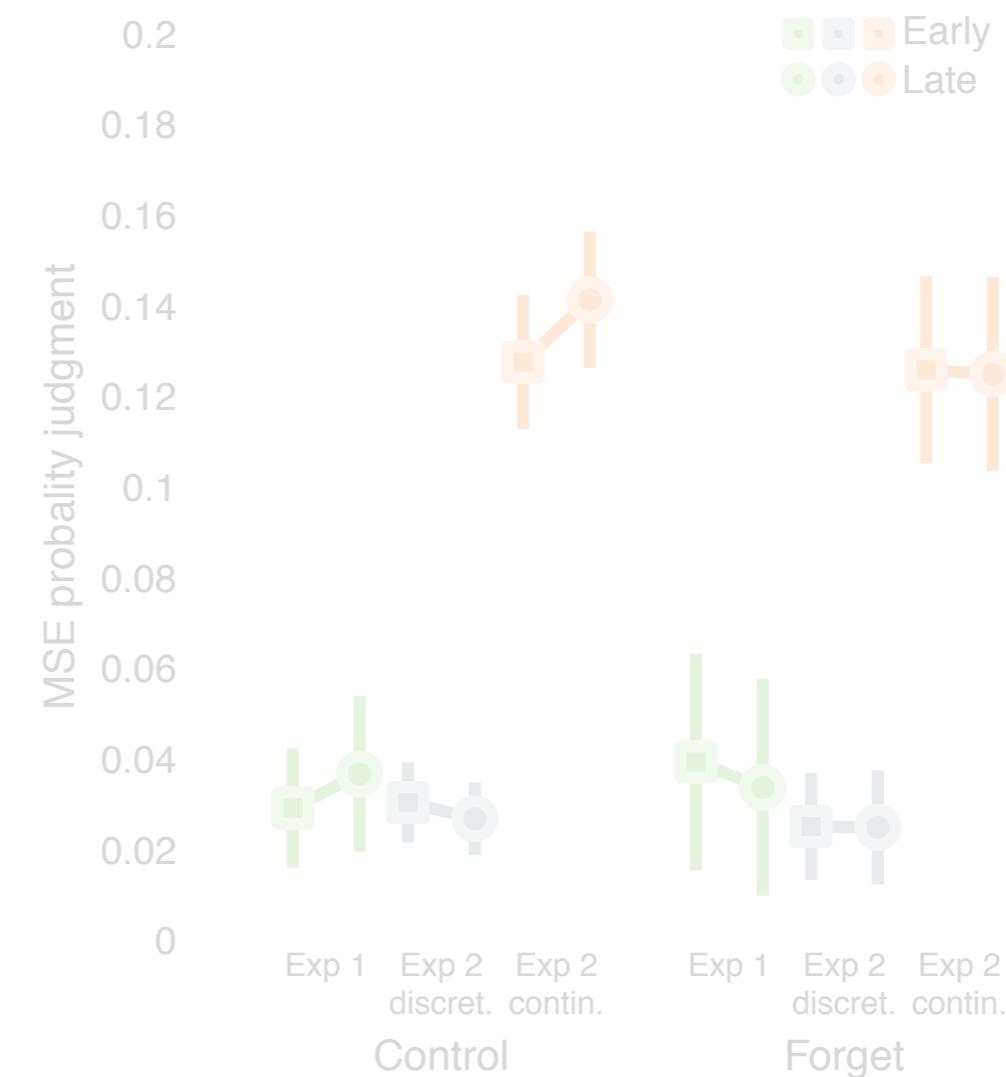
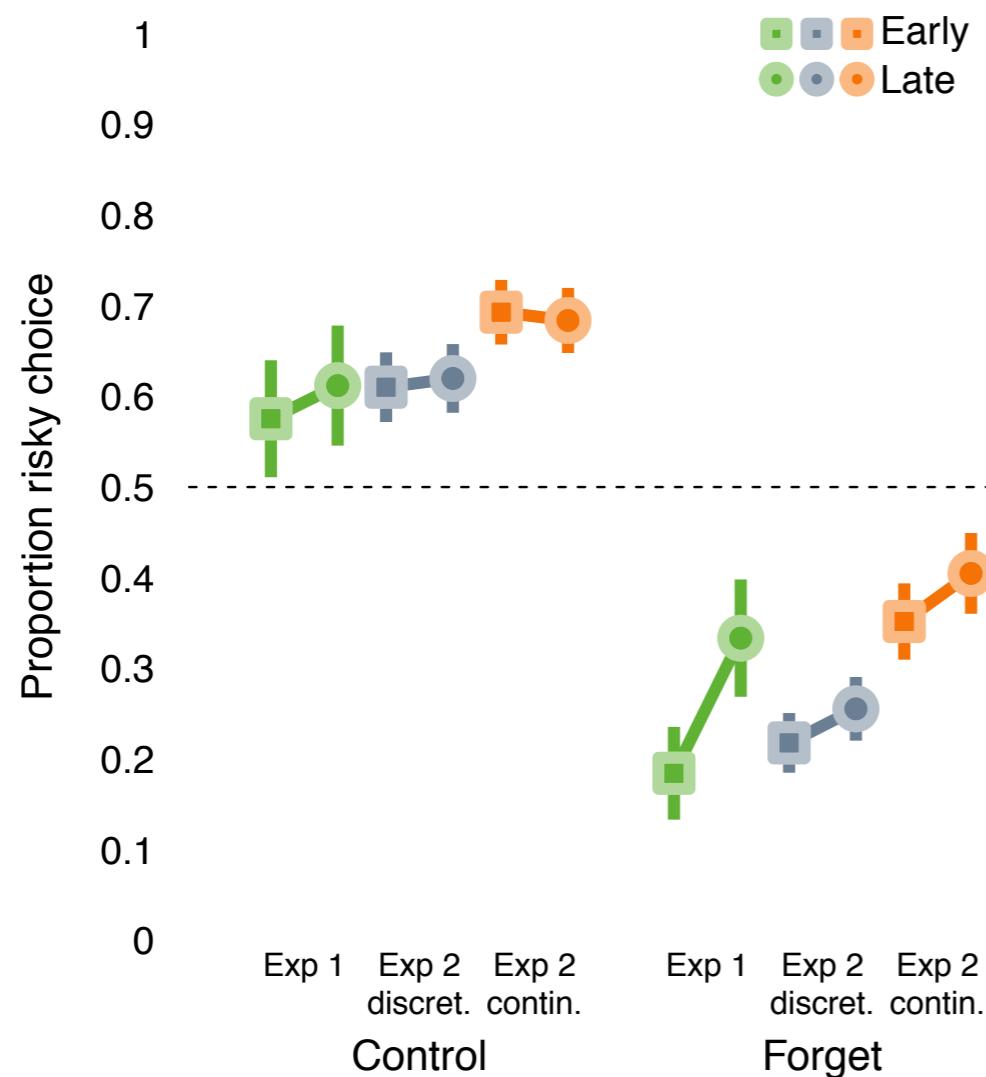
A



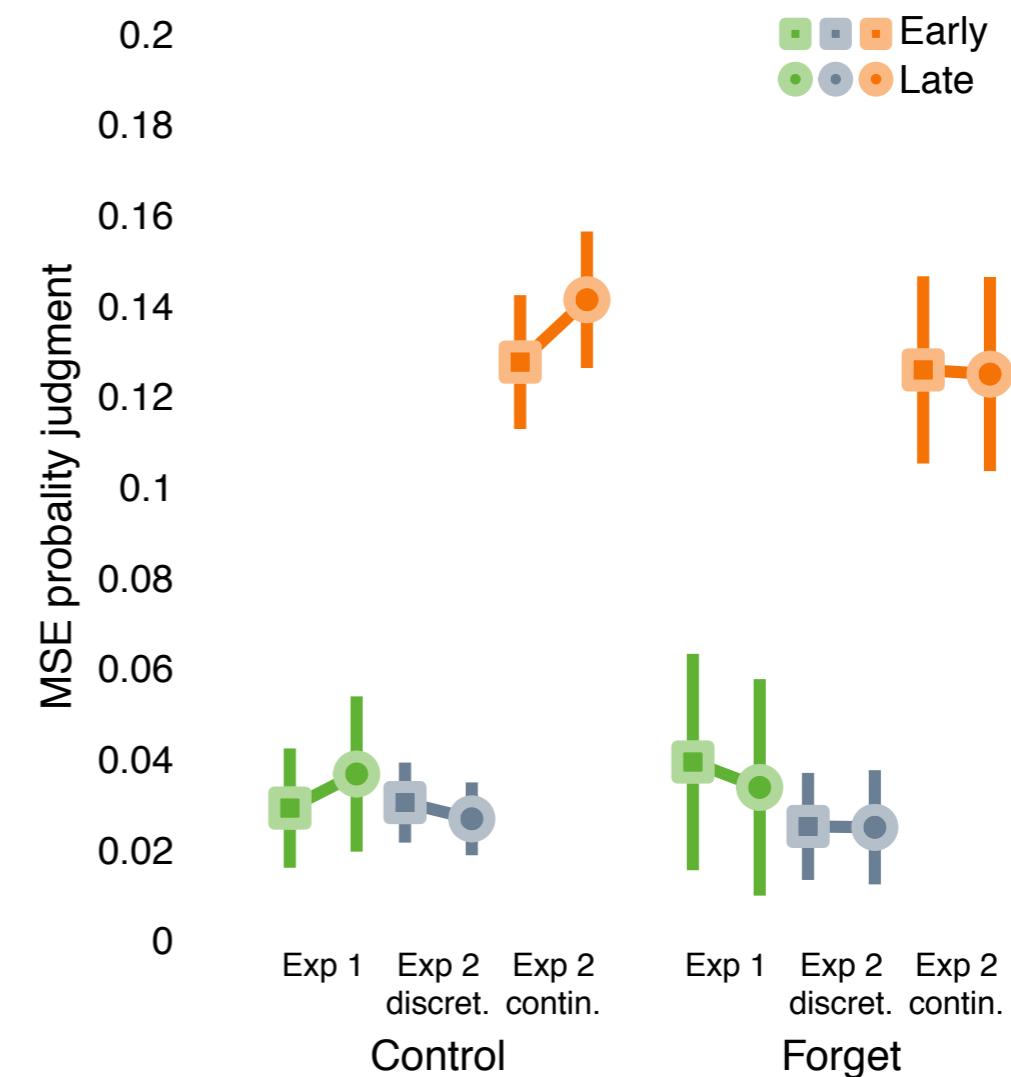
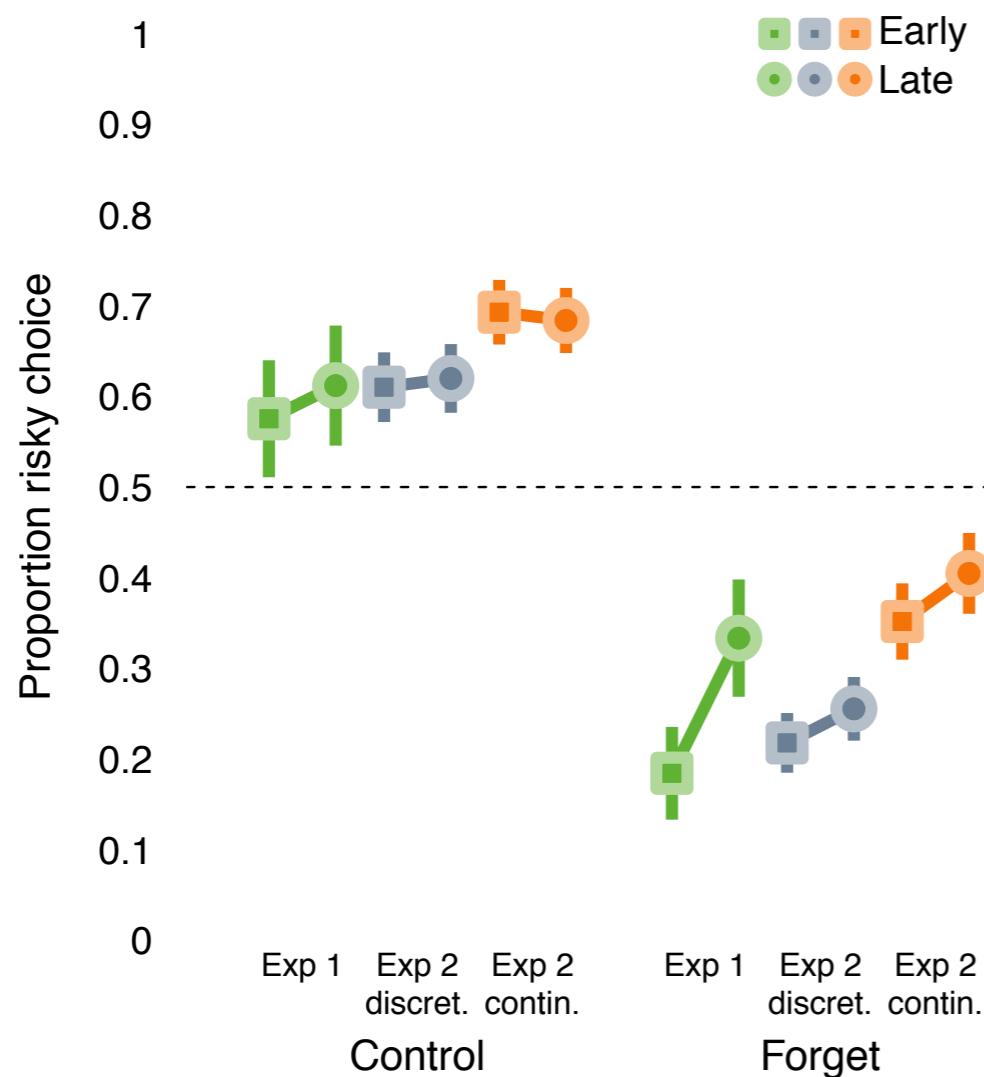
B



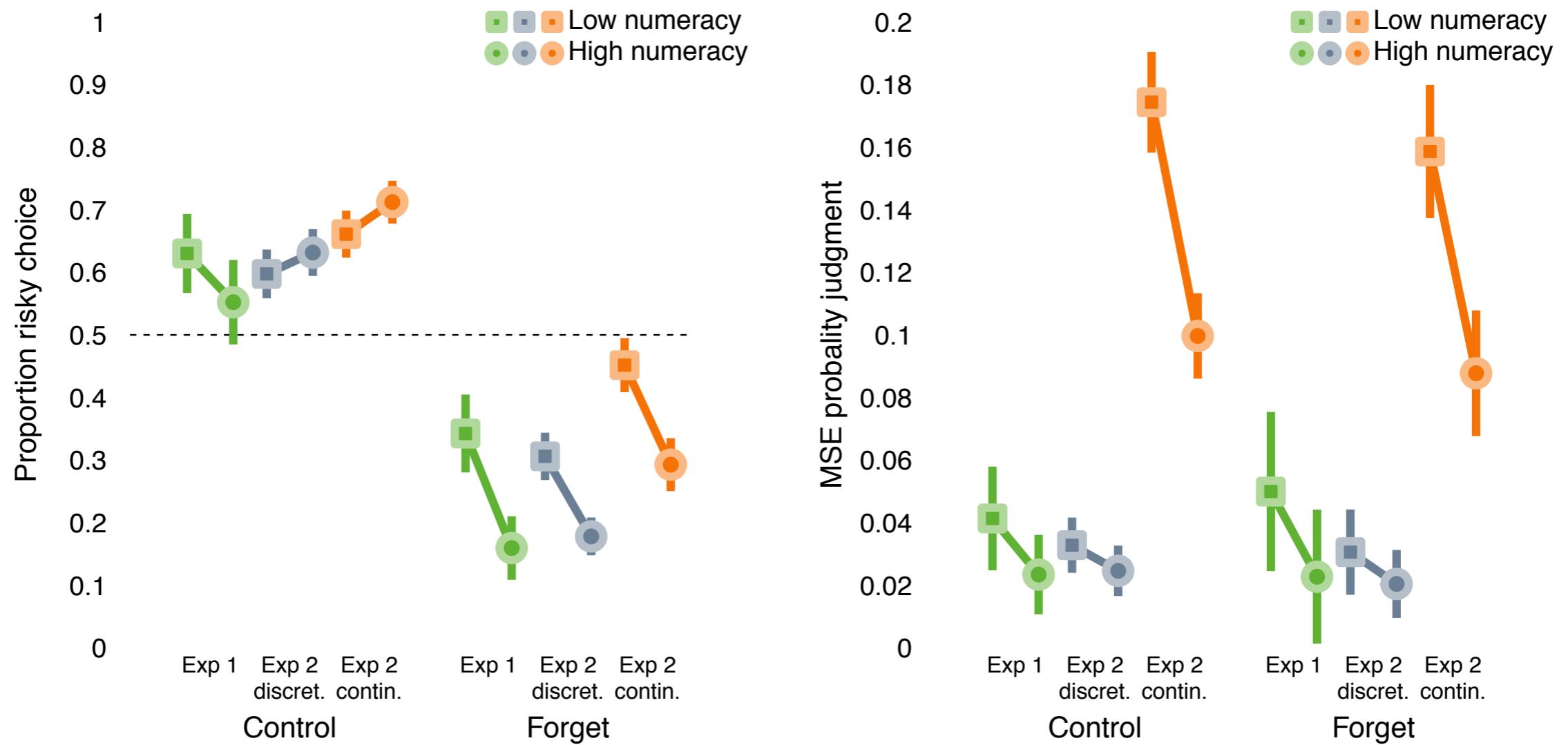
Impressions can be **revised** indicative of explicit representations



Explicit memory representations unaffected by instructions or complexity



Quality of representations depends on numeracy



Conclusions

- 1** People (explicitly) represent information about the relative frequency of individual outcomes.
- 2** Representations are (relatively) robust to variations in instruction and complexity.
- 3** Quality of representations may depend on abilities.



**Marcus
Lindskog**
*Uppsala University
Sweden*

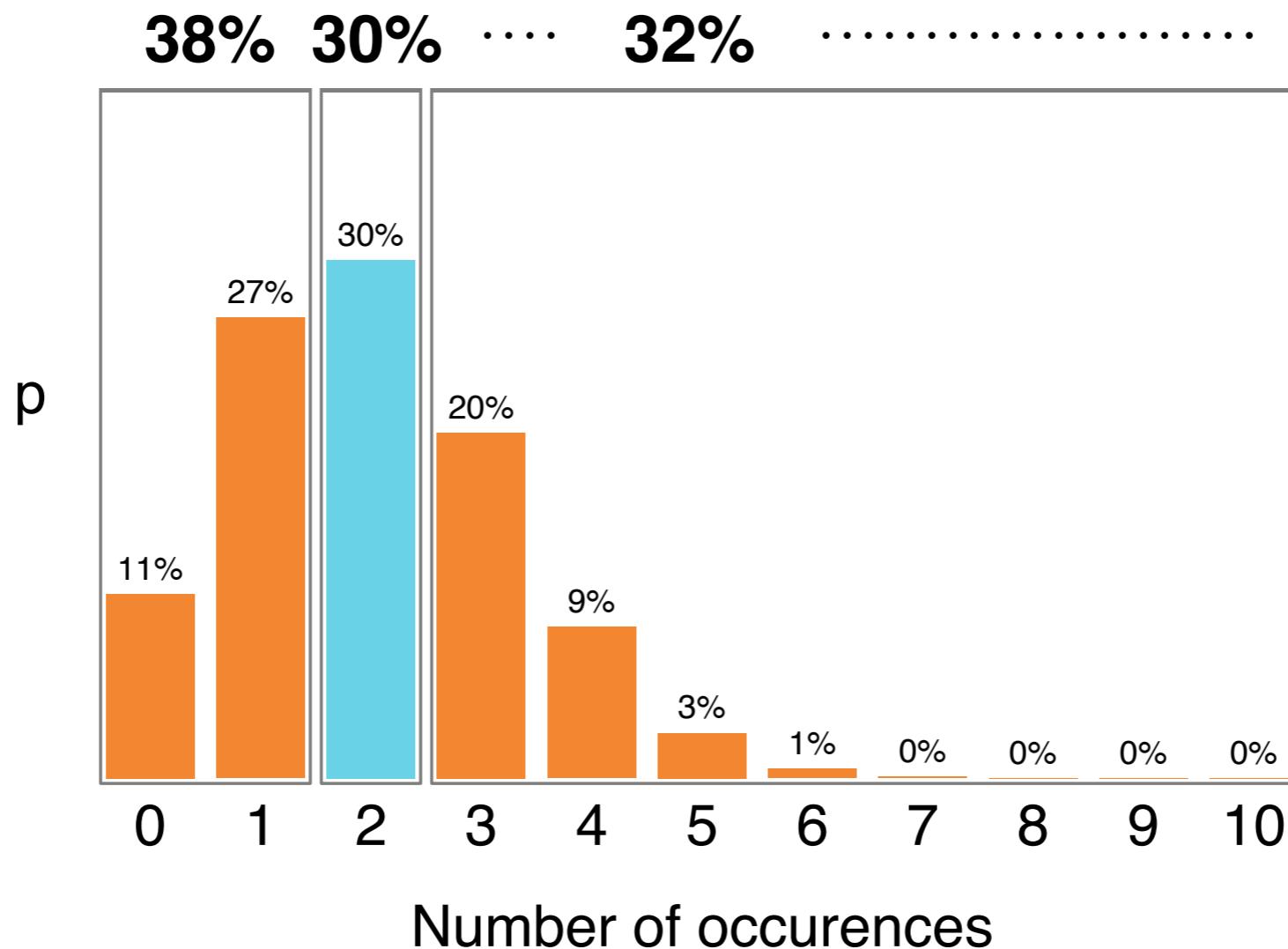


**Ralph
Hertwig**
*MPI for Human
Development*

GAP

Additional information

Small samples suppress rare events



How to measure the gap?

Defintion 1

Discrete underweighting

In favor of the option with the rare event if it is desirable, and against the option with the rare event if it is undesirable. A rare event is the event with the smallest probability between both options.

\$3 for sure

Defintion 2

CPT-based

In favor of the option predicted by cumulative prospect theory (CPT) using the parameter values derived by Tversky and Kahneman (1992).

\$4 w/ $p = .8$
or
0 otherwise