Harnessing **simulated experience**

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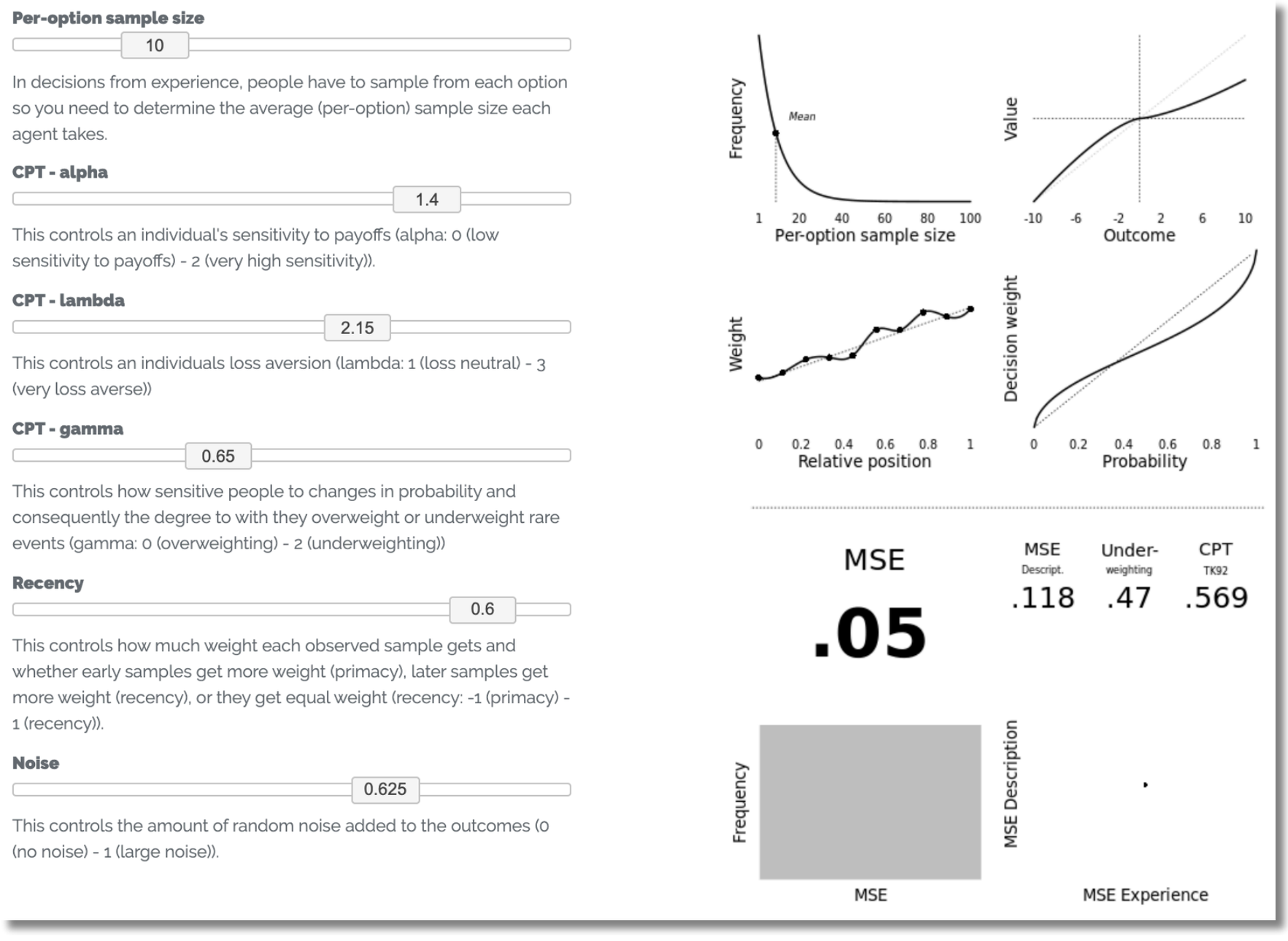
Bounded Rationality Winter School @ TAPMI, Manipal, 2020

UNI BASEL

Simulating decisions from experience



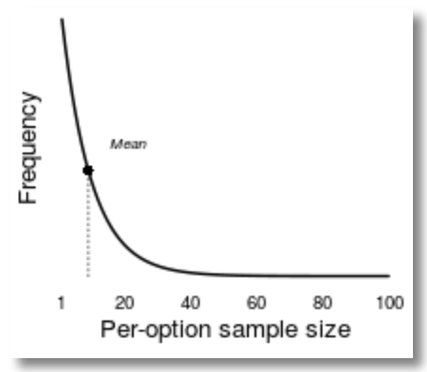
Simulating decisions from experience

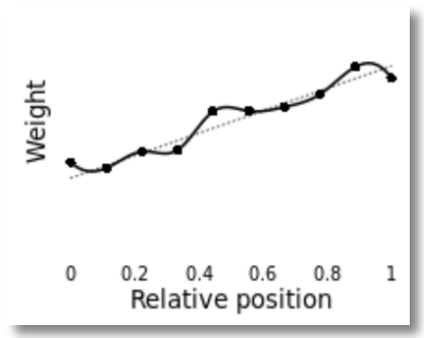
Sampling | Attention (Recency & Noise) | CPT

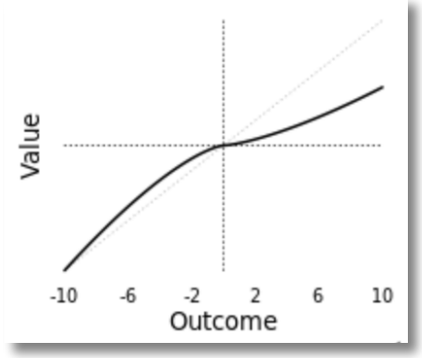
A
4€ with p=.8
otherwise 0

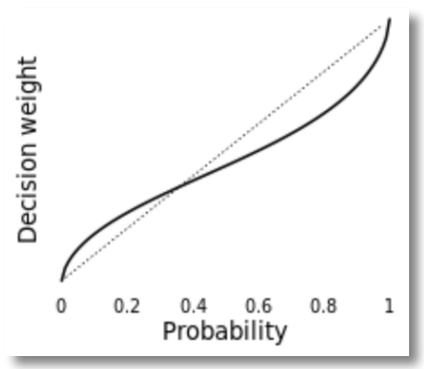
or

B
3€ with p=1







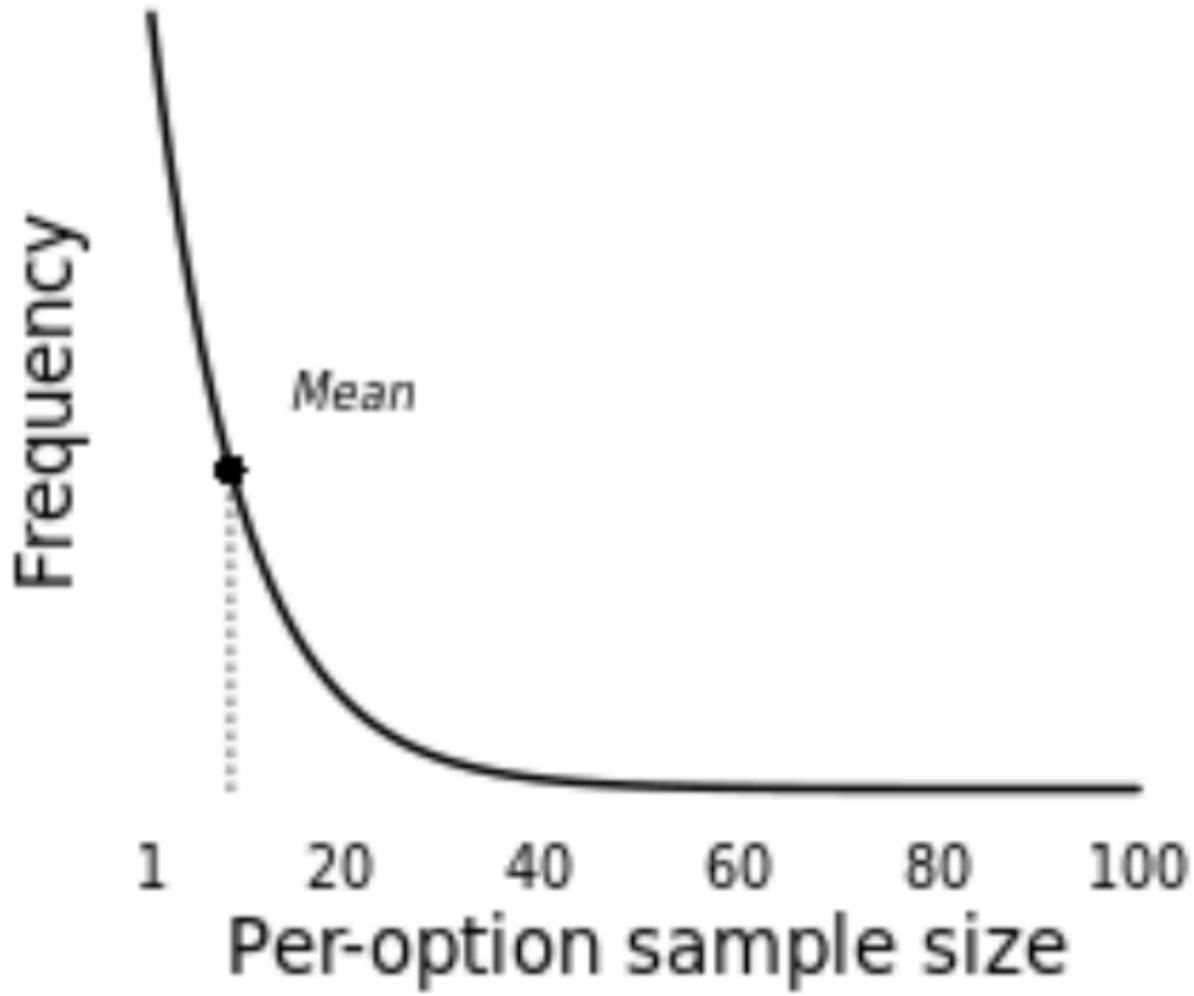


A
72%

B
28%

10,000 agents

Sampling



The 10,000 agents sample according to an exponential distribution.

You control the mean of this distribution, which defines the **average per-option sample size.**

Sampling

A

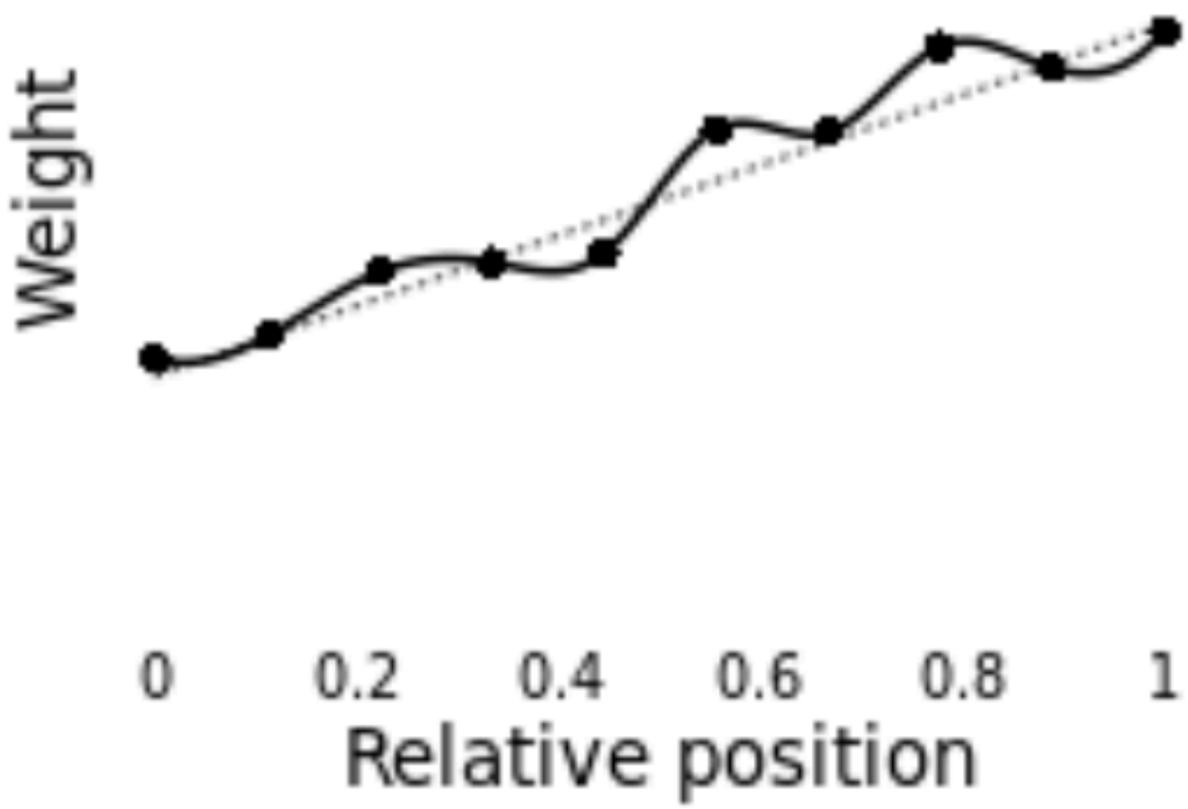
4€ with p=.8
otherwise 0

B

3€ with p=1

"More sampling means less (as-if) underweighting"

Attention



After sampling the agents reweighs the samples to reflect random noise and recency (primacy).

You control the **degree of recency** (or primacy) **and noise.**

Attention

A

4€ with p=.8
otherwise 0

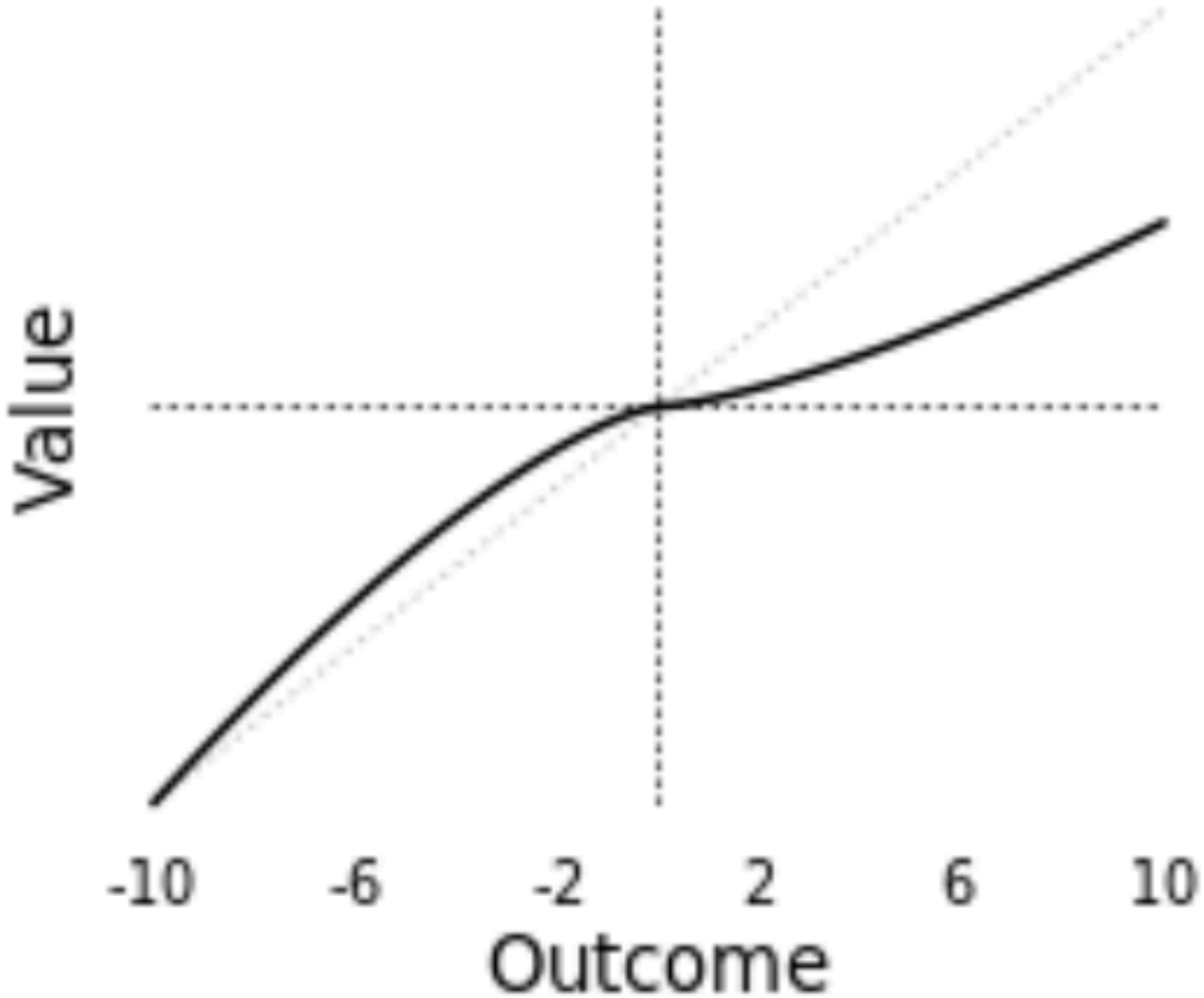
B

3€ with p=1

“More recency (primacy) and noise means more (as-if) underweighting”

CPT

(Cumulative prospect theory)



Finally, decisions are made according to CPTs value and probability weighting function.

In the value function, you control the **degree of risk (alpha) and loss aversions (lambda).**

CPT

(Cumulative prospect theory)

A	B
4€ with p=.8 otherwise 0	3€ with p=1

"More risk aversion (alpha) decreases the weight of extreme outcomes"

CPT

(Cumulative prospect theory)

A

4€ with p=.8
otherwise 0

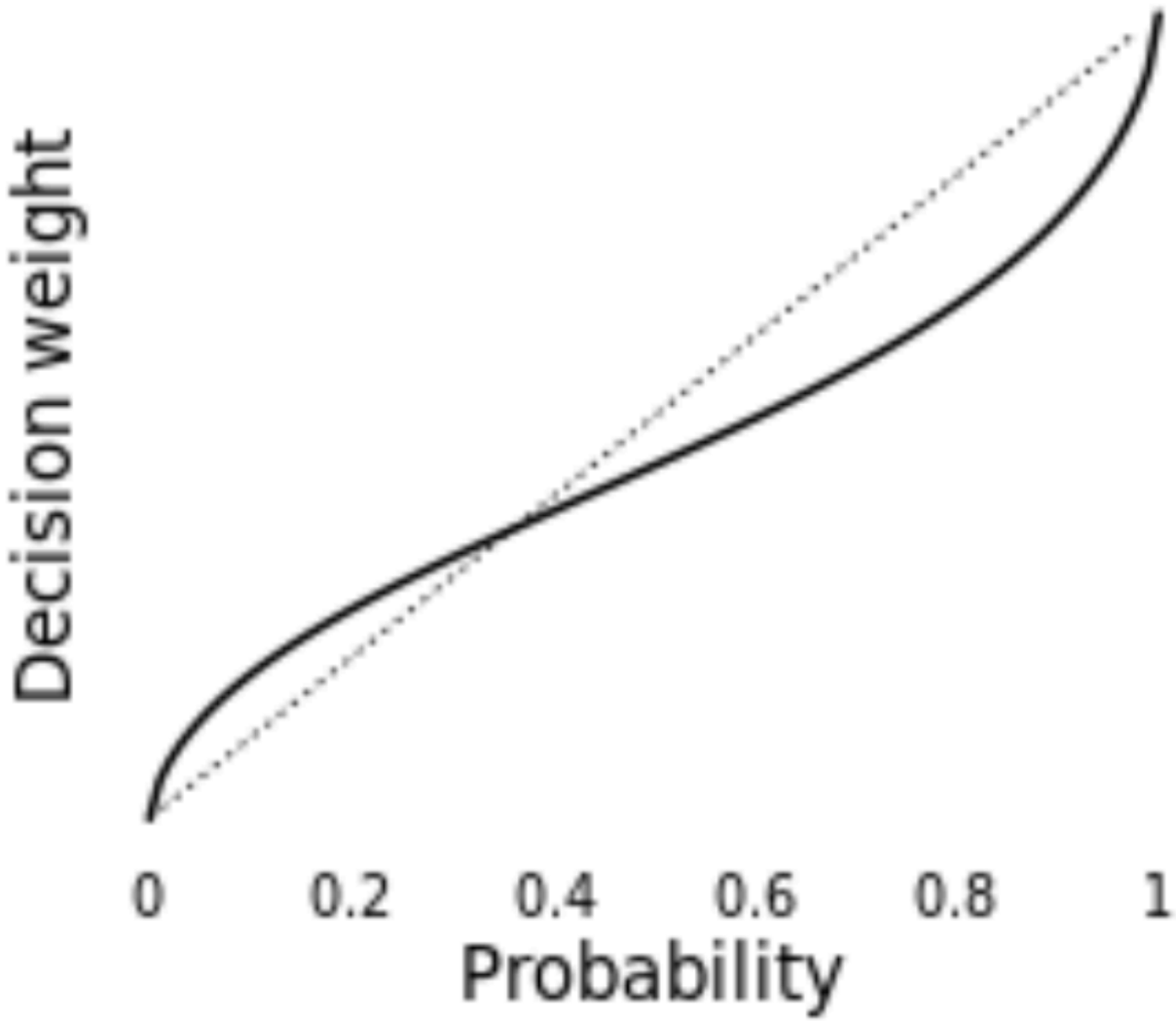
B

3€ with p=1

"More loss aversion (alpha) amplifies the weight of negative outcomes"

CPT

(Cumulative prospect theory)



Finally, decisions are made according to CPTs value and probability weighting function.

In the weighting function, you control the **degree of over- and under-weighting of rare events (gamma).**

CPT

(Cumulative prospect theory)

A

4€ with p=.8
otherwise 0

B

3€ with p=1

“Higher gamma means less underweighting”

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

Interactive 1 - 20min

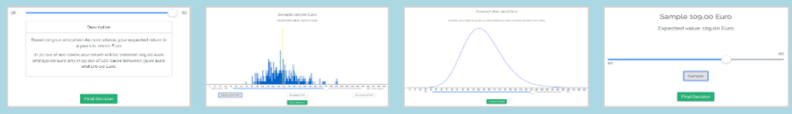
Go to this **site** to explore the cognitive underpinnings of decisions from experience.

When you think you have found the best mix of cognitive components go to this **survey** to enter your predictions.

Interactive 2 - 20min

Try out each of the risk intervention tools below (simply click on them). Only explore the tool. **Don't answer the questions** posed to after you've made the decisions.

Description | Risk tool | Distribution | Experience



When you have explore all risk intervention tools, go to this **survey** to share your impression on each of the tools.

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Censored

Censored

Censored

USING SIMULATED EXPERIENCES

Can experience be used to help people understand risks?

Experience triggers more a**ccurate probability judgments** than description

'How many days do you estimate that it will rain in a ten-day period in each of the four cities?'

		Kent	Talbot	Somerset	Harford
Objective probability		**0.30**	**0.90**	**0.60**	**0.10**
Mean observed probability	Description	0.30	0.90	0.60	0.10
	Experience	0.29	0.91	0.61	0.09
	SD	0.17	0.08	0.14	0.09
Mean frequency judgments	Description	**0.38**	**0.80**	**0.43**	**0.34**
	SD	0.24	0.20	0.25	0.22
	Experience	**0.32**	**0.81**	**0.57**	**0.26**
	SD	0.18	0.16	0.22	0.18
p-value for different means		.205	.733	.005	.059
p-value for different variances		.155	.203	.869	.352

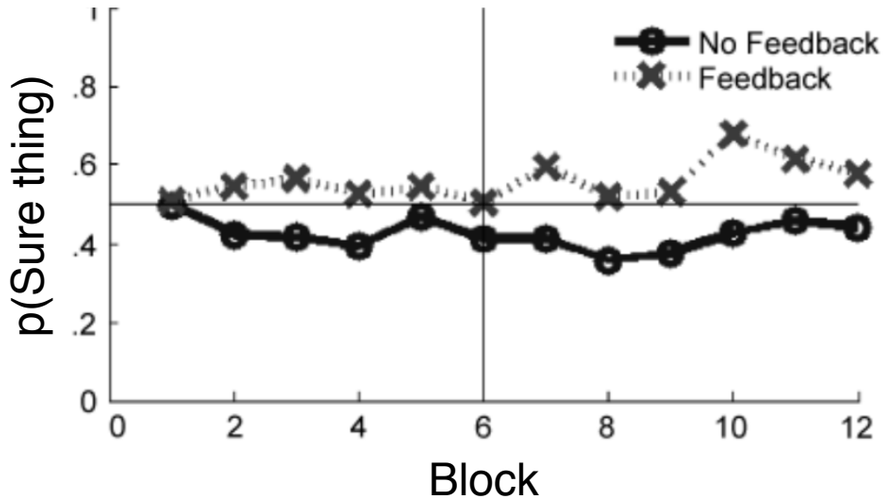
Lejarraga (2010) JBDM; table adapted

Experience ‘debiases’

…description-based choices

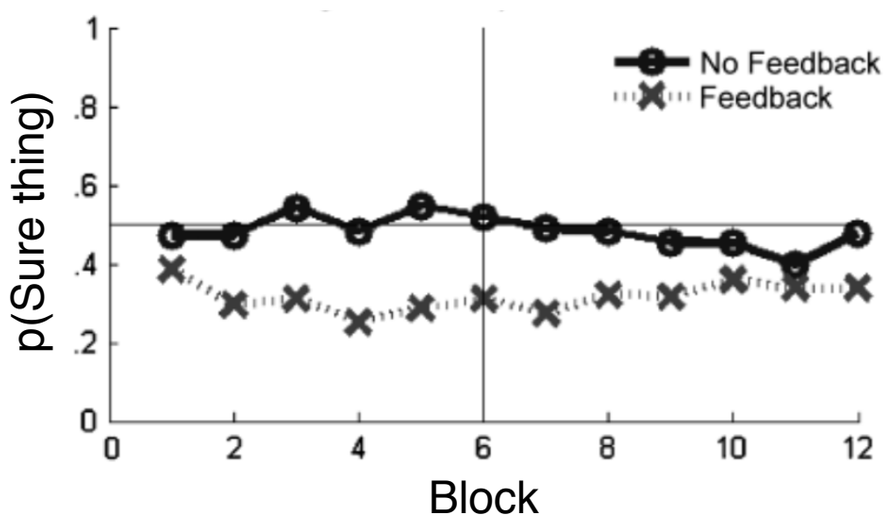
A $3 for sure

B $4 with .8

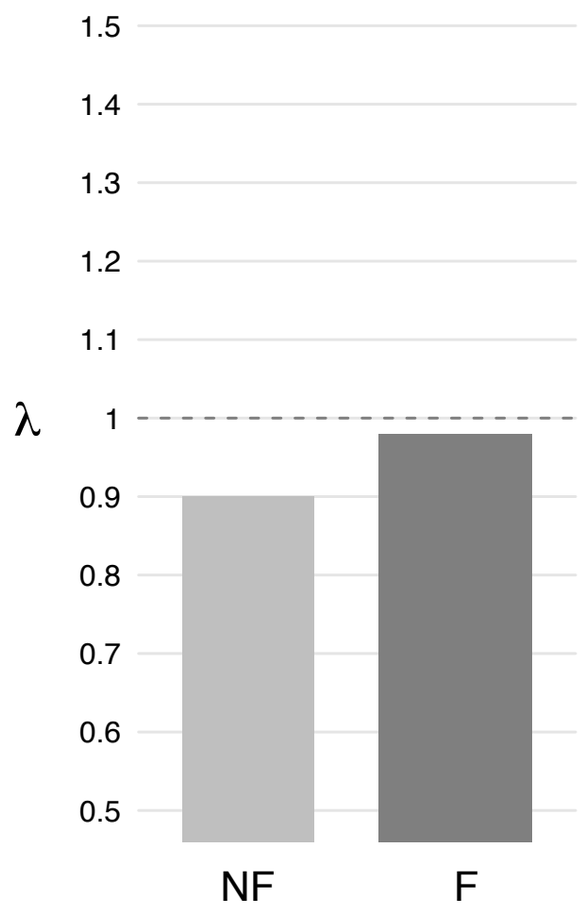


A $3 for sure

B $64 with .05



$$w = e^{-(-log(p))^{\gamma}}$$



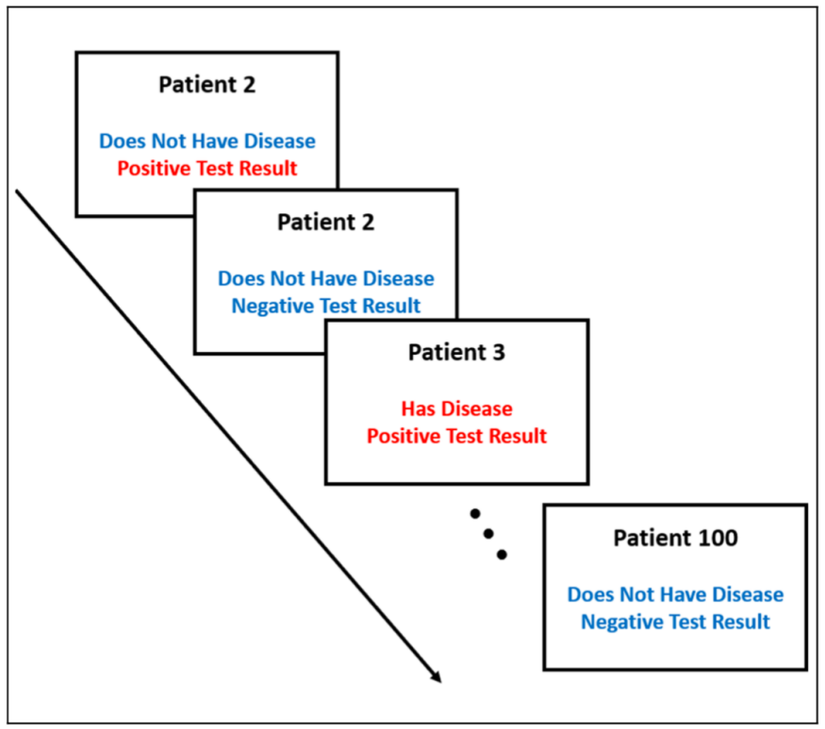
Jessup, Bishara, & Busemeyer (2008) Psychological Science

Format benefits of experience in medical diagnosis

Description

	Polykronisia	Zymbosis
Disease prevalence (%)	2.00	1.00
Test properties (%)		
Sensitivity	100.00	100.00
Specificity	91.84	89
False-alarm rate	8.16	11.11
PPV	20.00	8.33
NPV	100.00	100.00
Frequency (experience format)		
Disease/positive test	2	1
Disease/negative test	0	0
No disease/positive test	8	11
No disease/negative test	90	88

Experience



Armstrong & Spaniol (2017) Medical Decision Making

Format benefits of experience in medical diagnosis

	Description		Experience	
	Younger	**Older**	**Younger**	**Older**
PPV error				
Polykronesia	58.30 (29.01)	51.67 (31.42)	19.15 (26.53)	7.78 (18.07)
Zymbosis	64.53 (37.77)	57.93 (39.51)	10.81 (21.22)	9.29 (19.64)
NPV error				
Polykronesia	26.03 (39.03)	26.03 (39.03)	5.51 (16.15)	8.45 (18.48)
Zymbosis	15.83 (29.18)	27.97 (39.13)	2.84 (4.92)	8.39 (16.70)
Self-assessment				
Confidence	2.75 (1.03)	2.87 (1.20)	3.43 (0.93)	3.28 (1.28)
Difficulty	3.75 (0.87)	3.75 (0.81)	3.05 (1.01)	3.10 (1.11)
Belief in accuracy	3.20 (0.85)	3.20 (0.82)	3.55 (1.06)	3.50 (0.78)
Self v. physician	6.45 (2.72)	6.63 (2.68)	6.38 (2.39)	5.75 (2.44)

Armstrong & Spaniol (2017) Medical Decision Making

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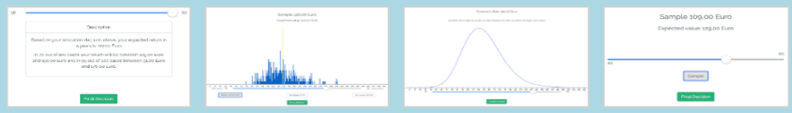

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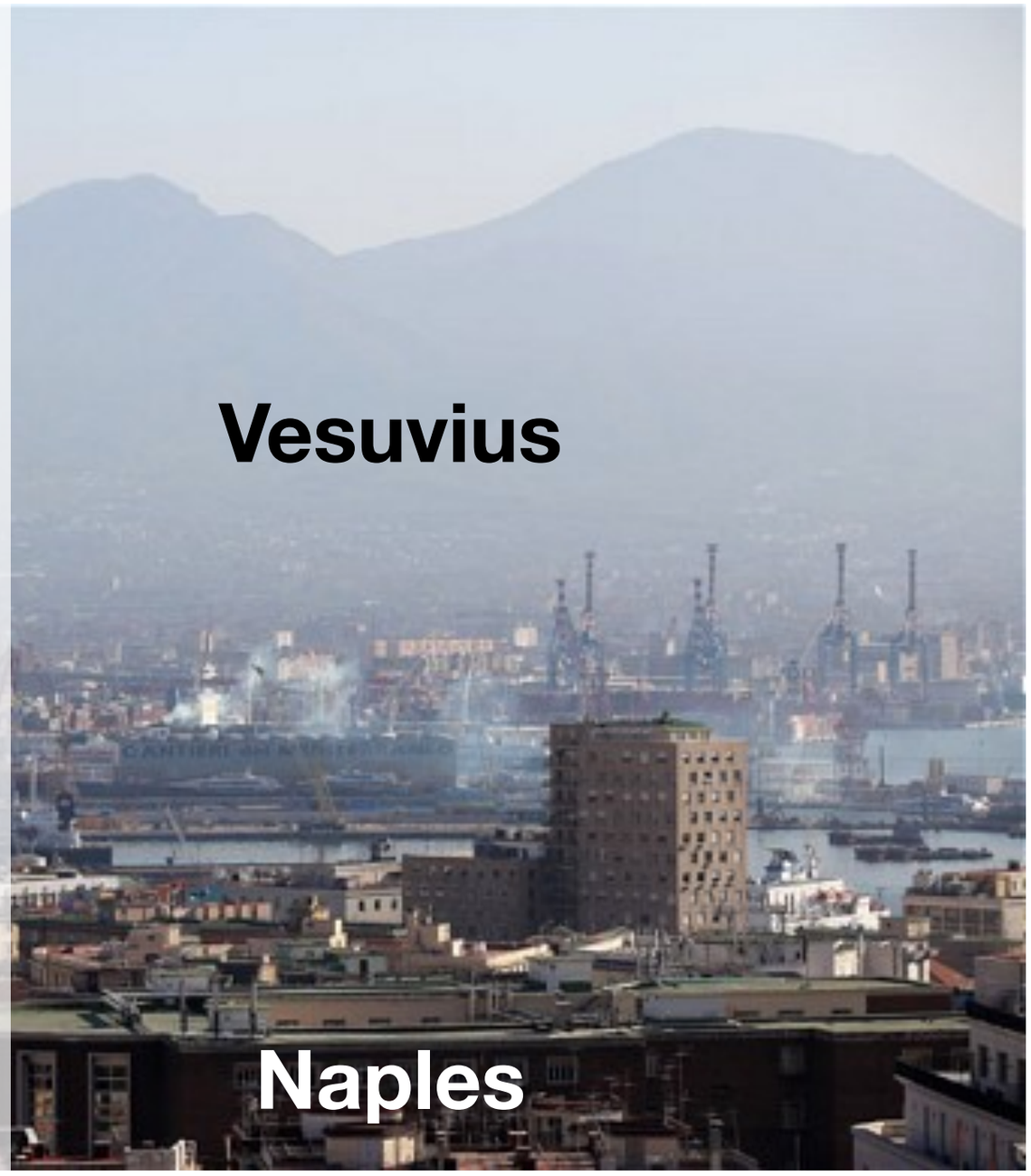
The Weight of Experience

"A crisis could start today. The trouble is that nobody would be able to tell how long it would last, what type of eruption it would be, or how the event would evolve"

"There would be no modern precedent
for an evacuation of this magnitude. This is why the Vesuvius is the most dangerous volcano of the world."

Giuseppe Mastrolorenzo,
Vesuvius Volcano Observatory
(Nature, 2011)



The Weight of Experience

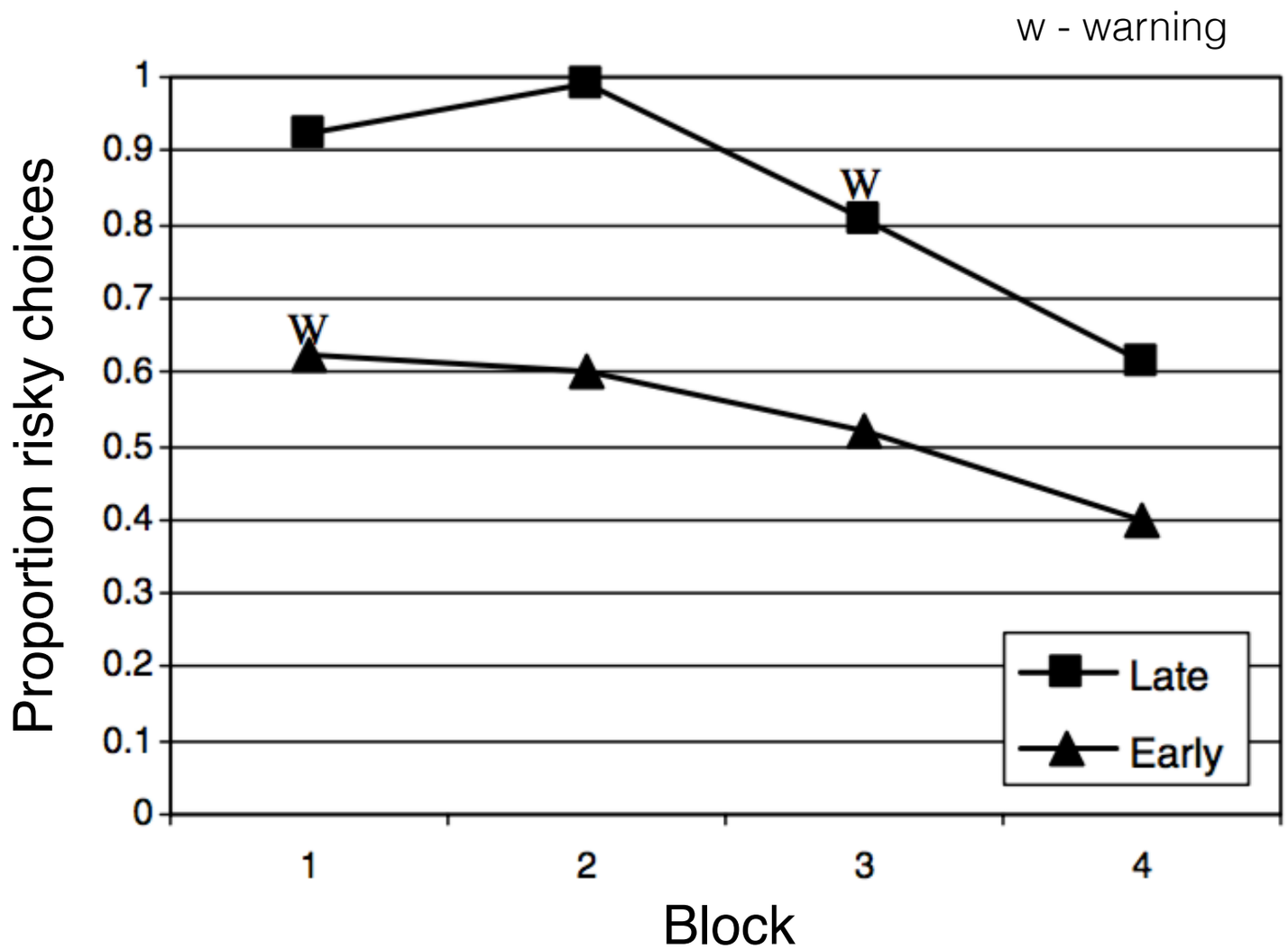
Each time you hit the (Left/Right) button there is a 1 in 1000 chance (.001 probability) that you will lose $15

A	**B**
$0.1 for sure	$0.13 w/ 99.9% or $-15 w/ 0.1%

Early	**Warning**	Repeated Choice
Late	Repeated Choice	**Warning** Repeated Choice

Barron, Leider, & Stack (2008) OBHDP

The Weight of Experience



Barron, Leider, & Stack (2008) OBHDP

4 epistemic states

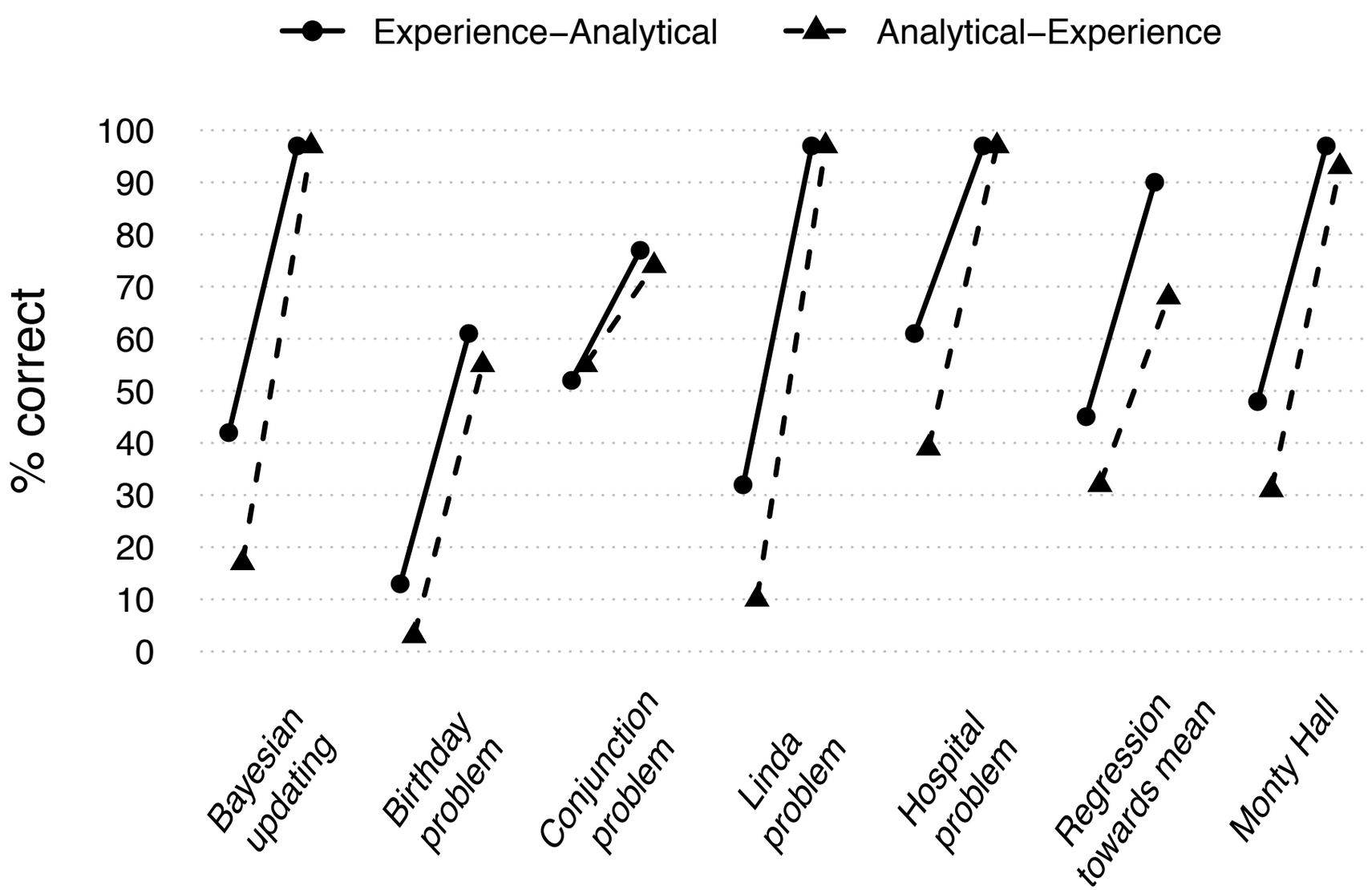
Experience **-** Description **-**

Experience **+** Description **-**

Experience **-** Description **+**

Experience **+** Description **+**

Experience improves probabilistic inference



Hogarth & Soyer (2011) JEP:General; Figure adapted

Conclusions

1 Modes of learning shape risk perception and behavior

2 Experience weighs heavier than description.

3 Experience may foster a better understandings of probabilities

4 Good risk communication probably requires both experience and description.

Ralph Hertwig
MPI for Human Development

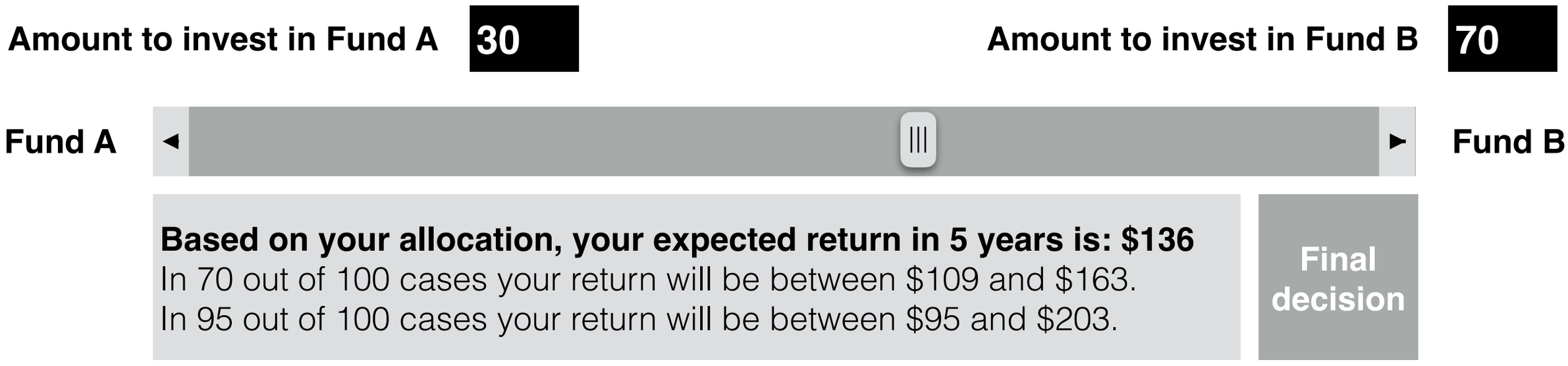
Appendix

Asset allocation

Kaufmann, Weber, & Haisley (2013)

Fund A is a risk-free asset. It has a guaranteed annual return of **3.35% for sure**. If you invest the full $100 in Fund A, you will have a return of $118 in five years, net of fees.

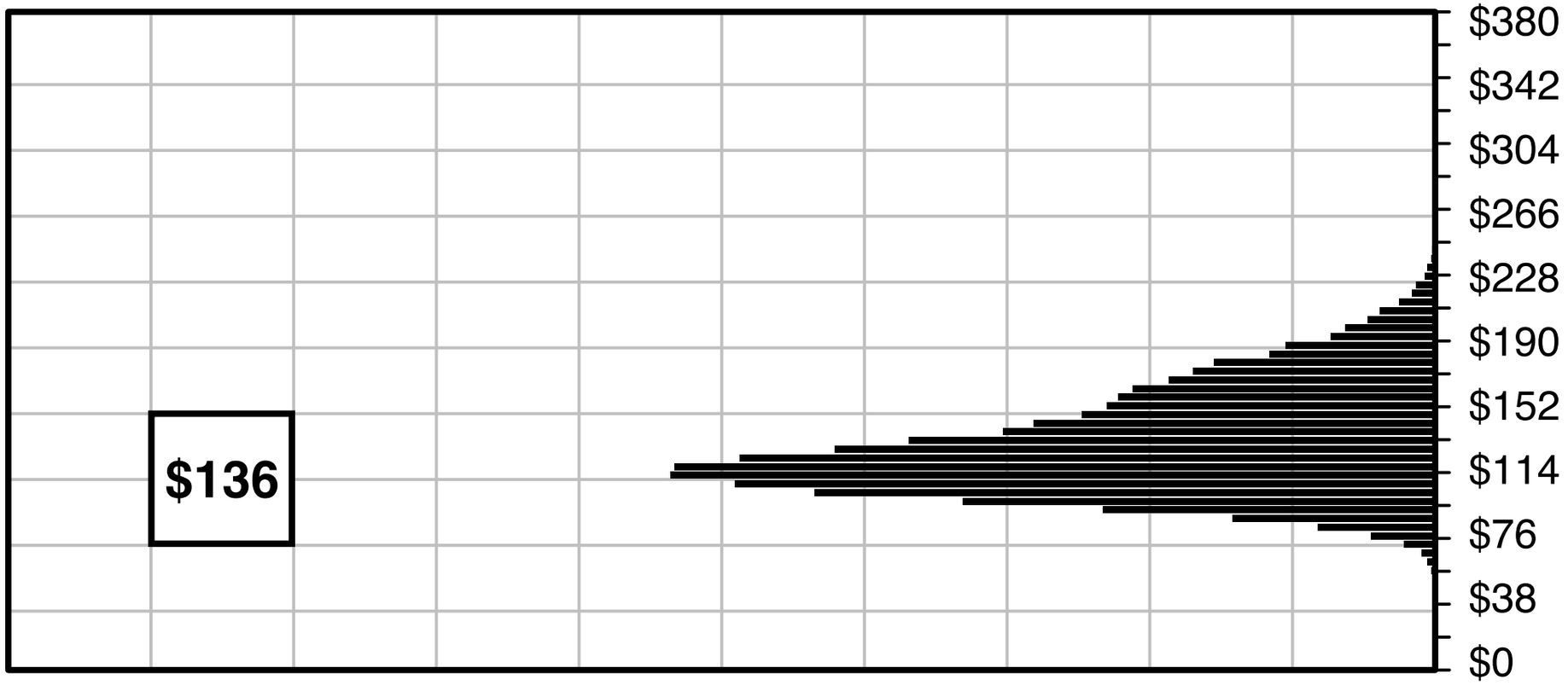
Fund B is a risky asset. It has an expected annual return of **8.92% with an annual standard deviation of 15.89%**. If you invest the full $100 in that asset, you will have an expected final outcome of $153 in five years. However, the actual return is not known. It could be higher or lower. In 70 out of 100 cases your final wealth will be between $100 and $208 and in 95 out of 100 cases between $72 and $289.



Kaufmann, Weber, & Paisley (2013) Management Science; Figure adapted

Asset allocation

Kaufmann, Weber, & Haisley (2013)



Start simulation ☑ Fast mode Show final result

Change allocation

Final decision

Kaufmann, Weber, & Paisley (2013) Management Science; Figure adapted

Inference Problems in Hogarth & Soyer (2011)

1. Bayesian Updating (Gigerenzer et al., 2007, version)

Assume you conduct breast cancer screening using mammography in a certain region. You know the following information about the women in this region:

The probability that a woman has breast cancer is 1% (prevalence).
If a woman has breast cancer, the probability that she tests positive is 90% (sensitivity).
If a woman does not have breast cancer, the probability that she nevertheless tests positive is 9% (false-positive rate).

A woman—chosen at random—gets breast screening, and the test results show that she has cancer. What is the probability that she has cancer?

a) The probability that she has breast cancer is about 81%.
b) Out of 10 women with a positive mammogram, about 9 have breast cancer.
c) Out of 10 women with a positive mammogram, about 1 has breast cancer.
d) The probability that she has breast cancer is about 1%.

2. Birthday Problem

In a group that has 25 people in it, what is the probability that 2 or more people have the same birthday?

3. Conjunction Problem

A project has 7 parts. The success of the project depends on the success of these parts. In order to be successful, all its parts need to be successful.

Assume that each part is independent from the others and each has a 75% success rate.

What is the probability that the project will be successful?

4. Linda Problem (Tversky & Kahneman, 1983)

Jessica is 31 years old, single, candid, and very promising. She graduated in philosophy. As a student, she was anxious about discrimination issues and social justice and also took part in antinuclear demonstrations.

Assign a rank to the following statements from most probable to least probable:

a) Jessica works in a bookstore and takes yoga classes.
b) Jessica is active in the feminist movement.
c) Jessica is a psychiatric social worker.
d) Jessica is a member of the League of Women Voters.
e) Jessica is a bank teller.
f) Jessica is an insurance salesperson.
g) Jessica is a bank teller and is active in the feminist movement.

5. The Hospital Problem (Tversky & Kahneman, 1974)

A certain town is served by two hospitals. In the larger hospital, about 45 babies are born each day. In the smaller hospital, about 15 babies are born each day. As you know, about 50 percent of all babies are girls. However, the exact percentage varies from day to day. Sometimes it may be higher than 50 percent, sometimes lower. For a period of 1 year, each hospital recorded the days on which more than 60 percent of the babies born were girls.

Which hospital do you think recorded more such days?

a) the larger hospital?
b) the smaller hospital?
c) about the same for both hospitals?

6. Regression Toward the Mean

A class of students enters in a TOEFL exam (it is a standardized test of English language). One of the students gets a better result than 90% of the class.

The same class, including the person who had done better than 90% of his class, enters another TOEFL exam. Past data suggest that the correlation between the scores of the different exams is about 0.8.

Which statement is correct?

a) It is more likely that the student in question now gets a better ranking.
b) It is more likely that the student in question now gets a worse ranking.
c) The chances that the student gets a better ranking or a worse one are approximately equal.

7. Monty Hall Problem

There are three doors: A, B, and C. We randomly selected one of them and put a Ferrari behind it. There is nothing behind the remaining two doors.

You will select a door, and we will open it. You will win the game if there is Ferrari behind it.

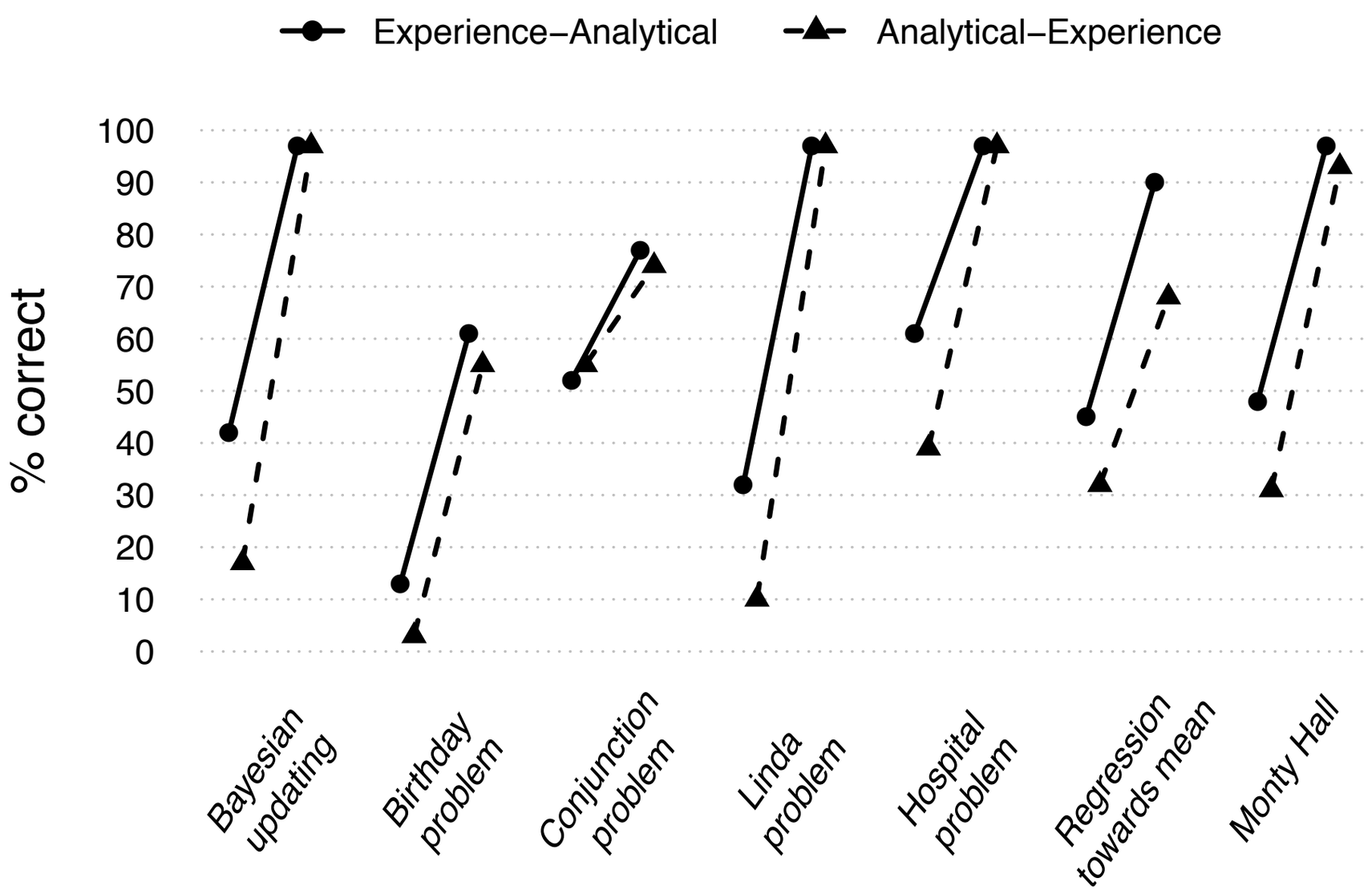
Now select a door. (The participant makes a selection, say A).

Before we open the door you selected, we open B and show you that there is nothing behind it. Now two doors remain: A and C. Behind one of them is a Ferrari. Given this situation, please state if you would like to

a) Stay with your original selection
b) Change to the other door

Hogarth & Soyer (2011)

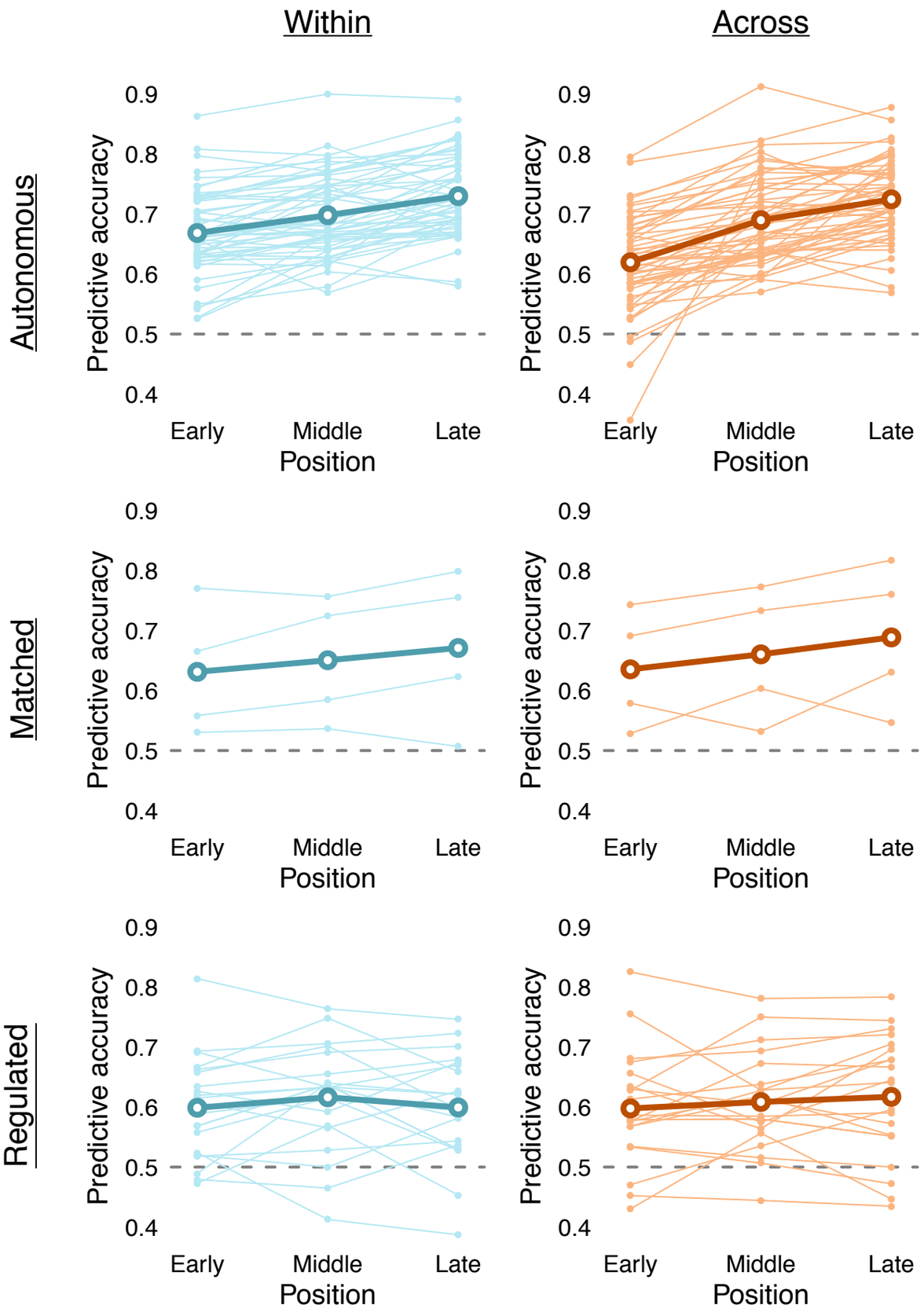
Experience improves probabilistic inference



Hogarth & Soyer (2011) JEP:General; Figure adapted

Linear position weighting

in autonomous sampling and flat in regulated sampling



Wulff et al. (in rev.)