Incentives in Experiments: A Theoretical Analysis

Yaron Azrieli (OSU)
Christopher P. Chambers (UCSD)
P.J. Healy (OSU)

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Current Practice

2011 Publications:

Mechanism:	Only 1 Task	None Paid	One Random	Some Random	All Paid	Rank-Based	Total
	Individual Choice Experiments						
'Top 5' Journals	6	0	3	1	4	0	14
Exp. Econ.	3	0	1	0	2	0	6
	Muti-Person (Game) Experiments						
'Top 5' Journals	8	0	1	0	9	0	18
Exp. Econ.	8	1	3	3	5	1	21

	Mechanism Not in Paper	Discussion of Incentives: None	Brief	Extensive	Total
	Individual Choice Experiments				
'Top 5' Journals	1	7	0	1	8
Exp. Econ.	0	2	0	1	3
	Muti-Person (Game) Experiments				
'Top 5' Journals	6	8	1	1	10
Exp. Econ.	2	7	4	1	12

The Literature

- Invention of pay-one-randomly ('RPS') & I.C. under SEU:
  Wold (1952), Savage (1954), Allais (1953), Wallis.
- RPS not I.C. with non-EU:
  Holt (1986), Karni & Saffra (1987)
- Experiments showing RPS works:
  Camerer (1989), Loomes et al. (1991), Starmer & Sugden (1991), Beatte & Loomes (1997), Cubitt et al. (1998)
- Justification via prospect theory:
  Wakker et al. (1994), Cubitt et al. (1998)
- Experiments showing RPS fails:
  Cox et al. (2014a,b), Harrison & Swarthout (2014)
- Not IC with ambiguity:
  Freeman et al. (2014), Oechssler & Roomets (2014)

What is an Experiment?

Experiment:

1. k Decision Problems $(D_1, D_2, \ldots, D_k)$
2. Payment Mechanism ϕ

The ith Decision Problem: $D_i = \{x, y, z\}$

- Lotteries
- Vectors of dollar payoffs
- Strategies in one-shot games
- Repeated-game strategies
- Consumption goods (focus group)
- Donations to charity (field experiment)

Assumption: Subjects have 'true' preference $\succ$ over choice objects.

Choices

True preference $\Rightarrow$ true favorite in each decision problem.

Subjects may make different choices than true favorites.

- Fairness across decisions (*e.g.*, rotation schemes)
- Wealth effects
- Portfolio effects
- Hedging
- In general, 'complementarities'

Incentive Compatible: Subjects choose their true favorite in each decision problem.

A 'one task' experiment is always IC (if the choice is paid).

Payment Mechanisms

Payment mechanism ϕ maps...

1. choices made
2. a random 'state of nature' (e.g., die roll)

...into a bundle of choice objects (the payment).

Random Problem Selection (RPS): Roll k-sided die.
If r is rolled, pay the subject their choice in rth decision problem.
(RPS=RLIM=POR=$\cdots$)

Pay-All: No die roll. Subject gets the bundle of all choices.

Do *not* assume objective probabilities. Savage framework.

Payment Mechanisms

The RPS mechanism with $k = 3$:

$$D_1 = \{x_1, y_1\},\ D_2 = \{x_2, y_2\},\ D_3 = \{x_3, y_3\}.$$

Suppose $x_i \succ y_i$ in each i.

	Die Roll		
	1	2	3
Truth (x_1, x_2, x_3):	x_1	x_2	x_3
Lie (x_1, y_2, y_3):	x_1	y_2	y_3

Will the subject prefer the Truth or the Lie??

Preferences for Gambles

Preferences $\succ$ over choice objects need to be extended to preferences $\succ^*$ over gambles ('acts').

What should we assume about $\succ^*$?

Consistency: If A pays x in every state, and B pays y in every state, then $A \succ^* B \Leftrightarrow x \succ y$.

Theorem

If only consistency is assumed, then IC $\Leftrightarrow$ one task.

"IC is never free."

Monotonicity: If A **dominates** B (state-by-state), then $A \succ^* B$.

RPS & Monotonicity

Suppose $x_i \succ_i y_i$ in every i.

	Die Roll ('state')					
Strategy	1	2	3	4	$\cdots$	k
Truth:	x_1	x_2	x_3	x_4	$\cdots$	x_k
Lie in D_2 and D_3:	x_1	y_2	y_3	x_4	$\cdots$	x_k

Truth-telling **dominates** (state-by-state) any lie!

Monotonicity $\Rightarrow$ truth-telling is always preferred!

Main Results

Theorem

If $\succ^*$ satisfies monotonicity, then RPS is IC.

Examples where RPS fails must violate monotonicity.

Theorem

If we assume monotonicity and nothing more, then RPS is essentially the only IC mechanism.

Paying in Bundles

$\succ$ only defined over single choice objects. Payments can be bundles. Need to extend $\succ$ to bundles.

No Complementarities at the Top (NCaT): If x_i is the true favorite in each decision problem, then for any $(y_1, \ldots, y_k)$,

$$\{x_1, x_2, \ldots, x_k\} \succ \{y_1, y_2, \ldots, y_k\}.$$

NCaT Violations: fairness, wealth effects, portfolio effects, hedging effects...

Theorem

1. *If $\succ$ satisfies NCaT then the Pay-All mechanism is IC.*
2. *If we assume nothing else (and $\succ$ is strict), it is essentially unique.*

Different versions of NCaT if paying 3 random decisions, *e.g.*

Results Summary

NCaT?	Montonicity? Yes	Montonicity? No
Yes	RPS & Pay All	Pay All
No	RPS	Unknown/None

Framing

Framing is allowed: The decision problems can alter $\succ$.

#	Option A	Option B	Option A	Option B
1	**(.5, $10; .5, $5)**	(.1, $15; .9, $0)		
2	**(.5, $10; .5, $5)**	(.3, $15; .7, $0)		
3	(.5, $10; .5, $5)	**(.5, $15; .5, $0)**	**(.5, $10; .5, $5)**	(.5, $15; .5, $0)
4	(.5, $10; .5, $5)	**(.7, $15; .3, $0)**		
5	(.5, $10; .5, $5)	**(.9, $15; .1, $0)**		

IC mechanism still elicits $\succ$, but $\succ$ is not very 'stable'.

Difference in Row 3 choices could be b/c:

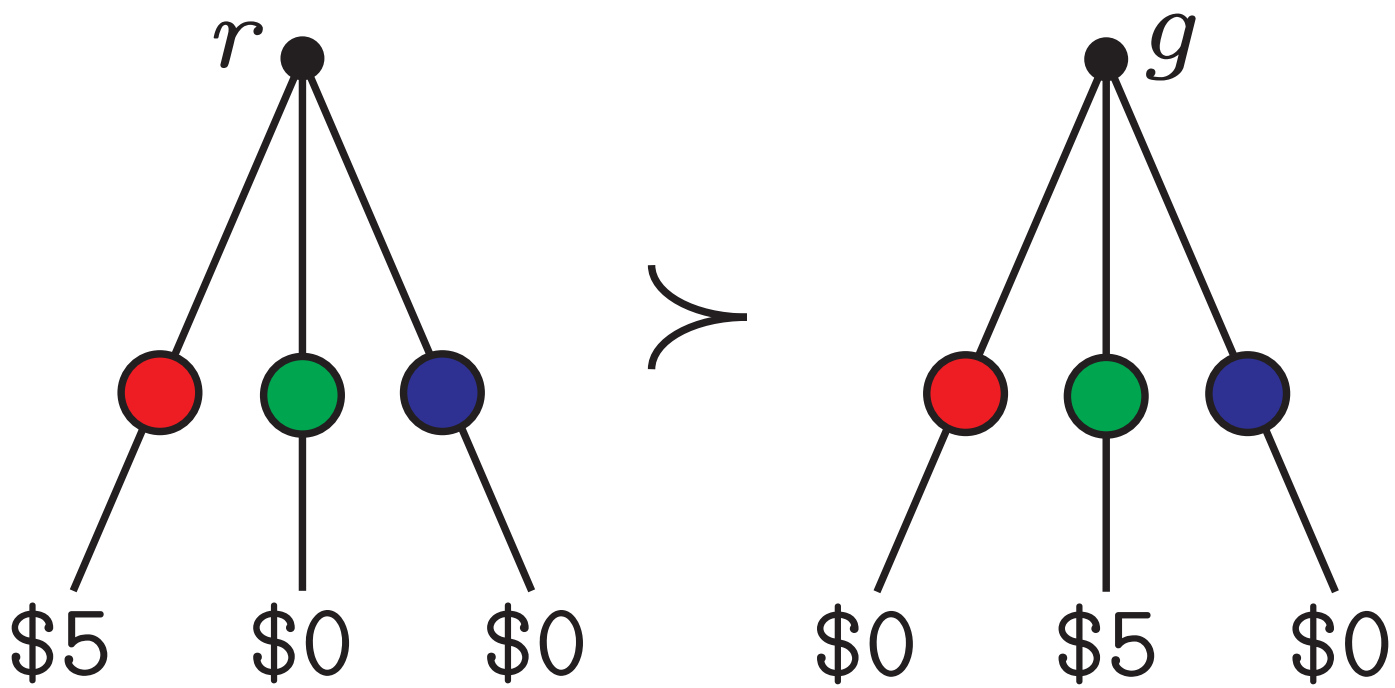
1. $\succ$ same in both, but left experiment isn't IC
2. Both experiments are IC, but $\succ$ differs (framing)

On Monotonicity

Monotonicity is weak on its own...
But becomes strong with other axioms!

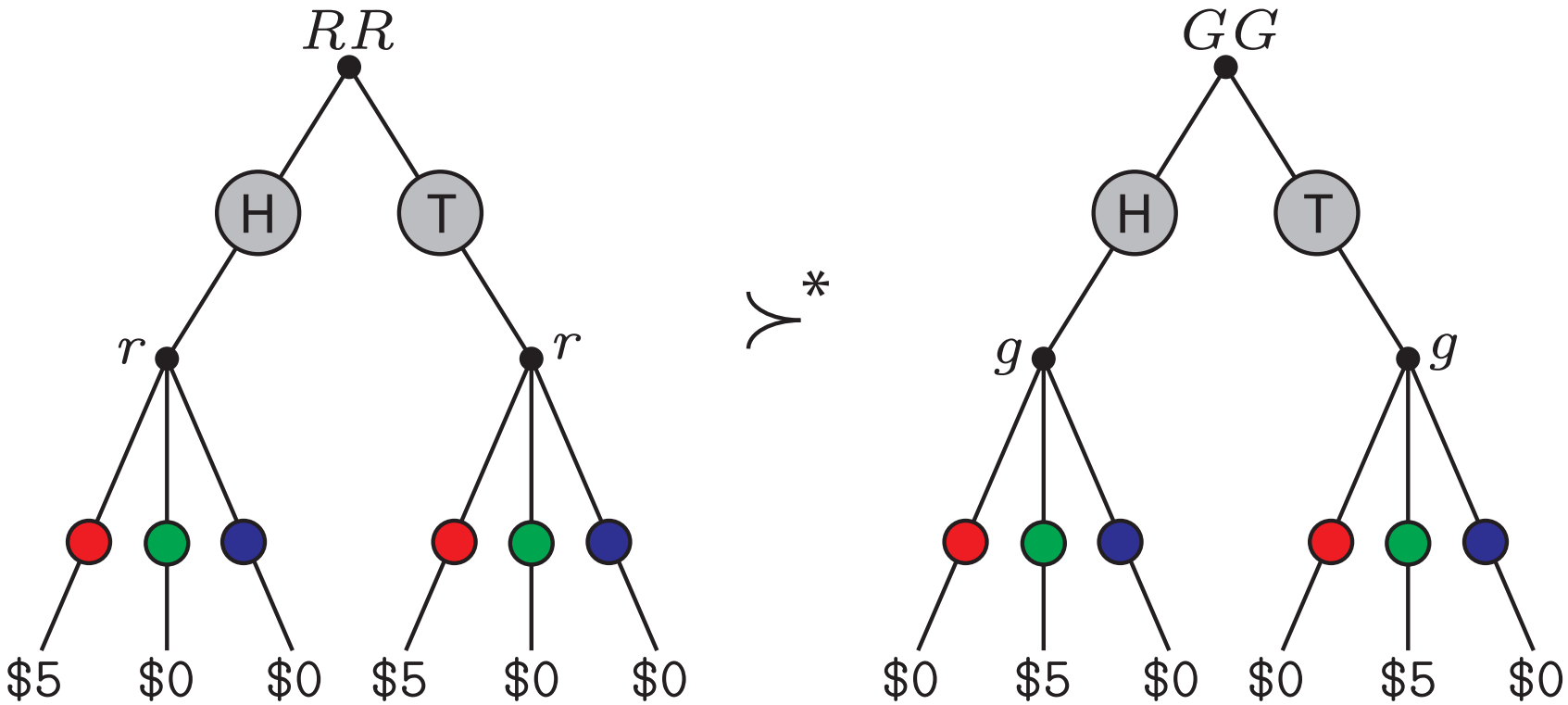
On Monotonicity

Urn contains red, green, blue balls.



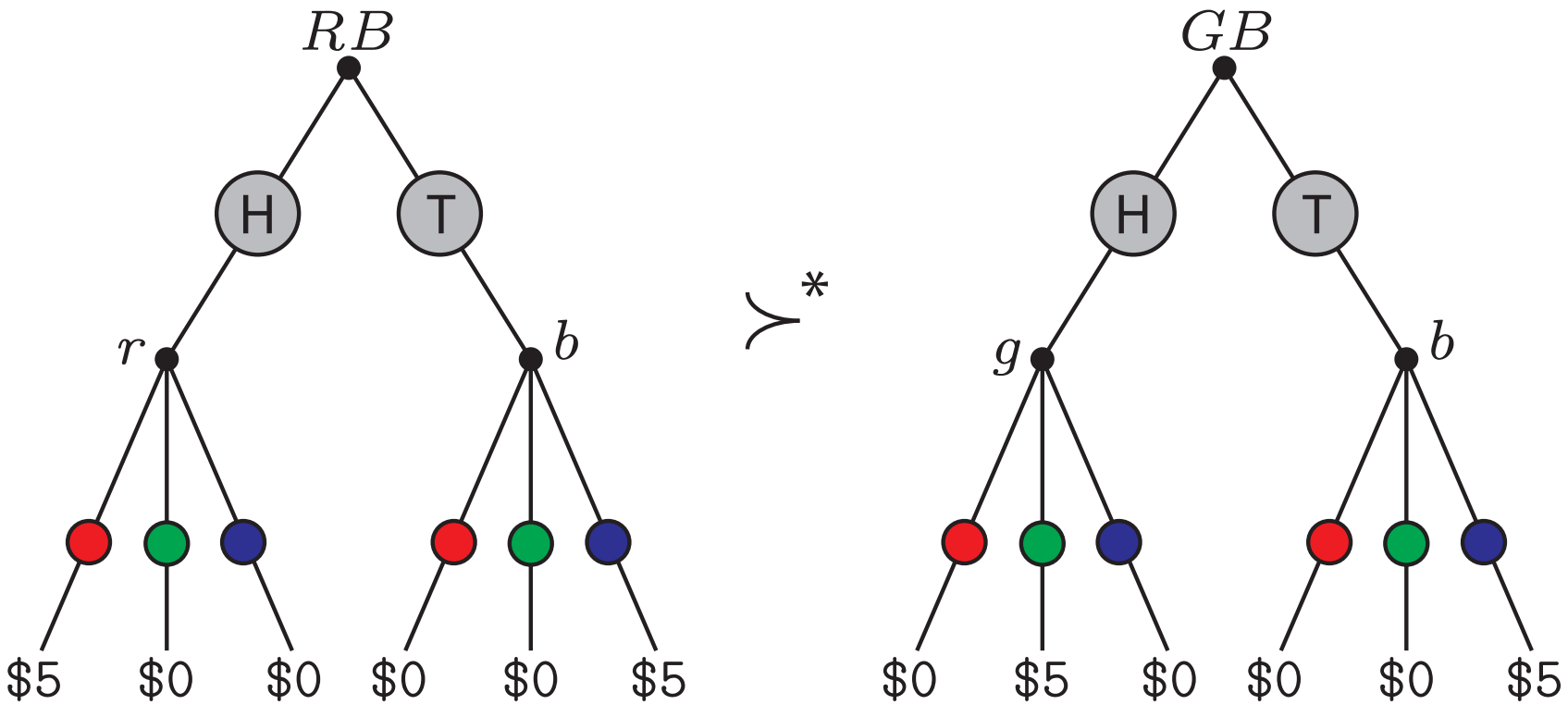
Bed red $\succ$ Bet green

On Monotonicity



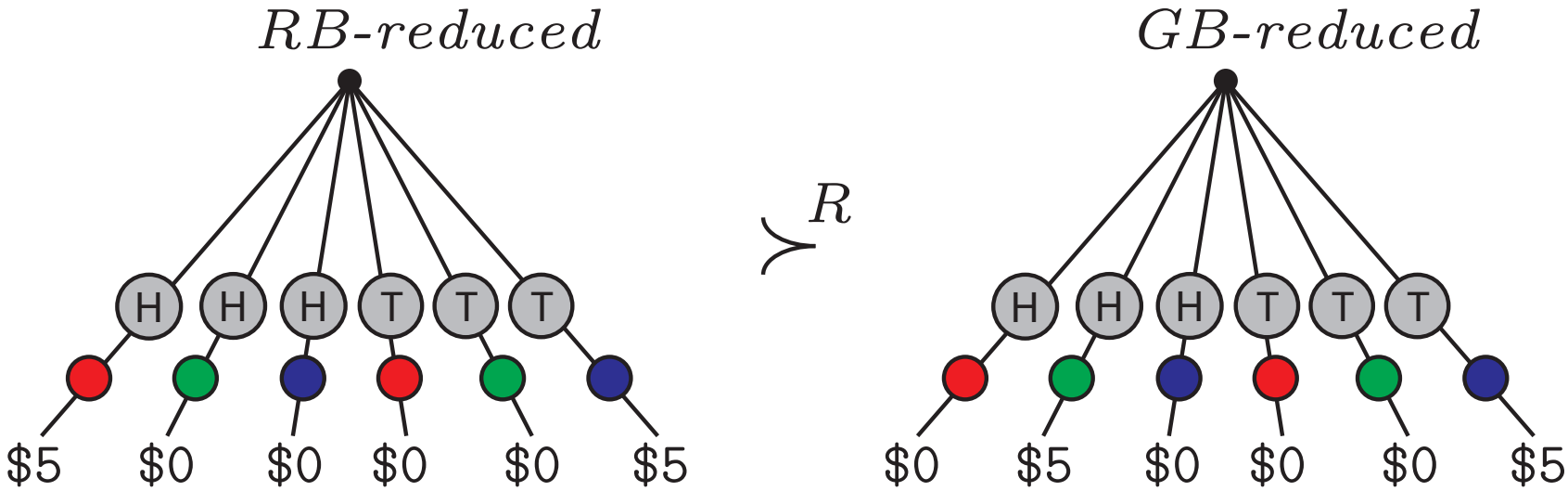
$\succ^*$ is consistent with $\succ$

On Monotonicity



Monotonicity of $\succ^*$ $\iff$ 'compound independence'.

On Monotonicity



$\frac{1}{2}r + \frac{1}{2}b$ $\quad\quad$ $\frac{1}{2}g + \frac{1}{2}b$

Using monotonicity + reduction: $r \succ g \Rightarrow \frac{1}{2}r + \frac{1}{2}b \succ \frac{1}{2}g + \frac{1}{2}b$

Monotonicity + Reduction $\Rightarrow$ Expected Utility

The Bipolar Behaviorist

The Bipolar Behaviorist Claim

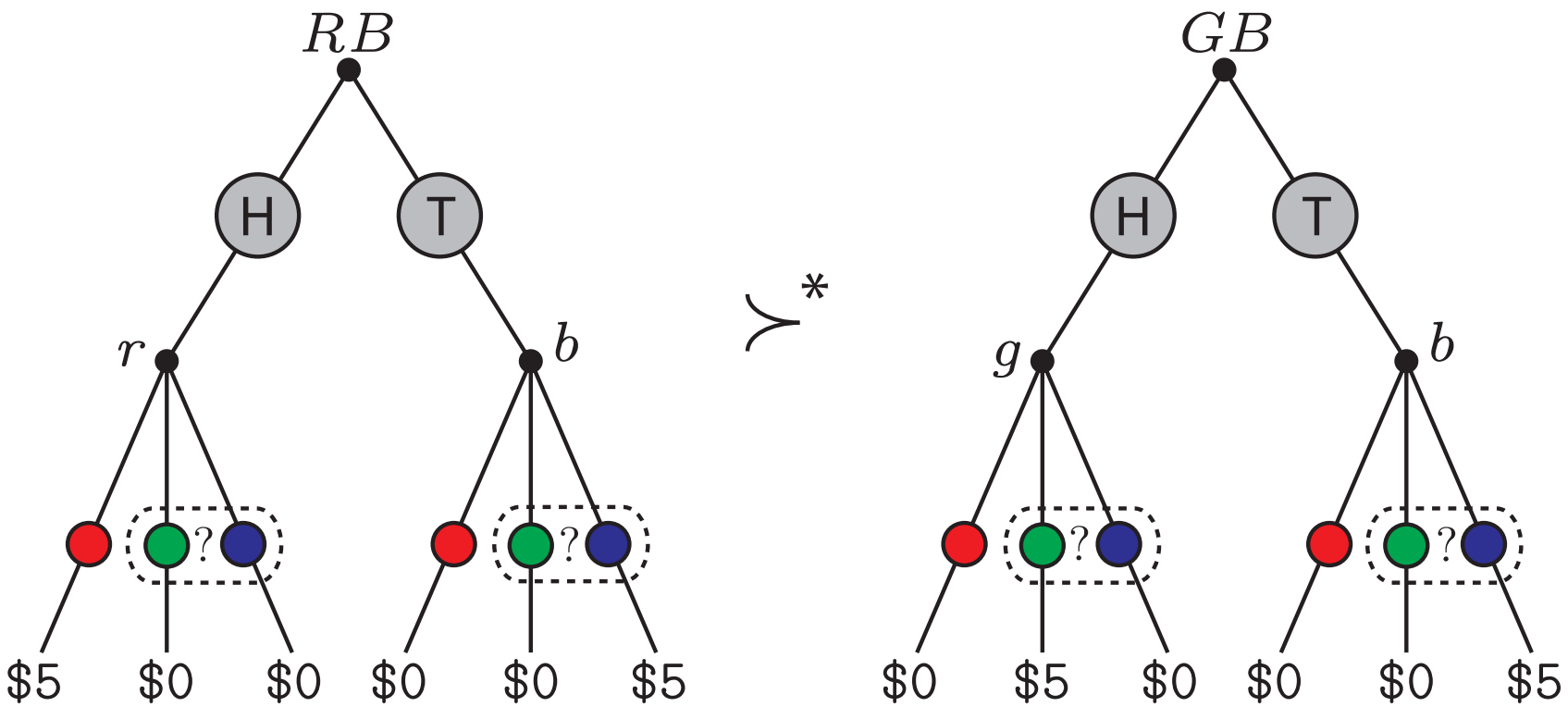
You cannot test non-EU theories using the RPS mechanism.

Our Claim

If you want to test non-EU theories using the RPS mechanism, you need to assume reduction is violated.

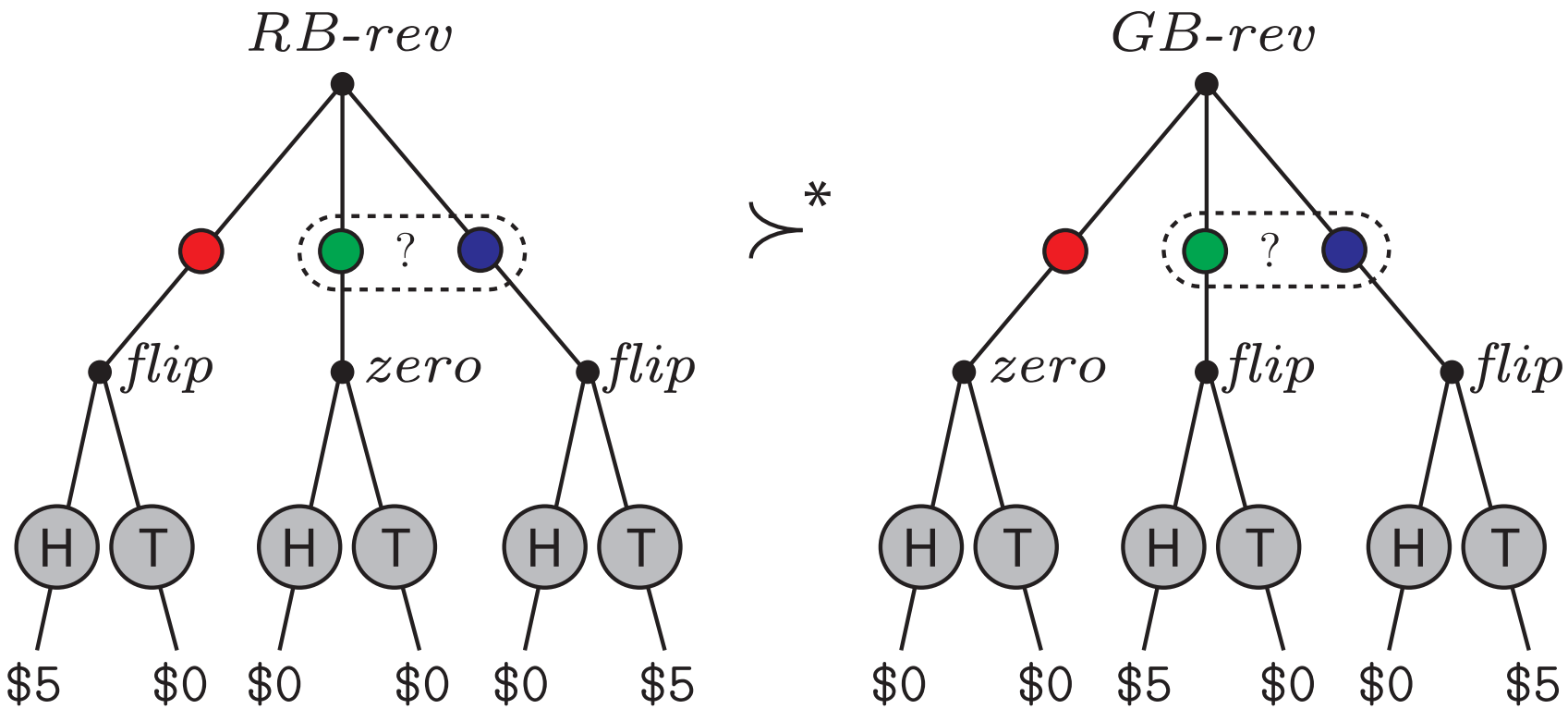
Evidence for reduction: mostly against.

On Monotonicity



Suppose green and blue are ambiguous, and that's why $r \succ g$.

On Monotonicity



Ambiguity averse $\Rightarrow$ *GB-rev* $\succ^*$ *RB-rev*.

Monotonicity + 'Order Reversal' $\Rightarrow$ Ambiguity-Neutral

Summary

- If paying all, need to assume no complementarities.
  - Fairness, portfolio, hedging, wealth, ...
- If RPS, need to assume monotonicity. Weak, unless 2-stage gambles.
  - Reduction & non-expected utility
  - Order Reversal & ambiguity aversion
- Other mechanisms may be IC for certain models.
- **Experimenter needs to decide for themselves!**

My (current) opinion:

- Use RPS
- Separate decisions as much as possible.
- Use separate, physical randomizing devices.

Other Issues

Other Monotonicity Violations:

- Decision Overload w/ Easy/Default Option (NCaT also questionable)
- Ex-Ante Fairness (NCaT also questionable)
- Irrational Diversification (NCaT also violated)

Issues Besides IC:

- Payment Inequality
- Payment Variance
- Confusion
- Irrational Choice

Theory is *not* explicitly dynamic! (But we can discuss.)

The End