

ExpEcon Methods:

Empirical Tests of Incentive Compatibility

ECON 8877

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Testing IC vs. Framing Effects

A test of IC? (Cox Sadiraj & Schmidt 2014)

	D_1	D_2
Treatment 1:	$\{\$4, (\frac{1}{2}, \$10)\}$	
Treatment 2:	$\{\$4, (\frac{1}{2}, \$10)\}$	$\{\$3, (\frac{1}{2}, \$12)\}$

If we observe differences on D_1 , it could be

- the mechanism was not IC, or
- the presence of D_2 altered preferences (e.g., decoy effect).

Other papers that use this method:

- Cubitt Starmer Sugden (1998 Exp.1)
- Beattie & Loomes (1997)
- Cubitt Starmer Sugden (1998 Exp.2)
- Harrison & Swarthout (2014)
- Cox Sadiraj & Schmidt (2015)

Tests Without Framing Confound

Replace Treatment 1 with a “Framed Control” treatment:

	D_1	D_2	Mechanism
Treatment 1:	$\{\$4, (\frac{1}{2}, \$10)\}$	$\{\$3, (\frac{1}{2}, \$12)\}$	Pay only D_1
Treatment 2:	$\{\$4, (\frac{1}{2}, \$10)\}$	$\{\$3, (\frac{1}{2}, \$12)\}$	RPS

LESSON: Proper test of IC must show all subjects same choices.

Test various payment mechanisms in lottery choice setting

1. Pay All (PA)

- PAS: Sequentially (learn outcome each period)
- PAI: Independently at the end

2. Pay One Randomly (POR)

- 2.1 PORpi: with prior info about all choices to be made
- 2.2 PORnp: no info about upcoming choices
- 2.3 PORpas: learn realized payoffs you go, then get 1 at the end

3. Pay All Correlated (PAC) (lotteries must have same state space)

- PAC/N divides payoffs by # of decisions, to match POR

4. One Task (OT)

- 4.1 ImpureOT: Make all choices, but only one is paid
 - Added by a referee (not me!) and reported separately

Design:

- Choice over 5 lottery pairs
- Testing various versions of Allais paradox
- OT: between-subjects. All others: within-subject
 - Therefore OT Allais paradoxes are between-subject via Probit
- Choices on 5 separate slips of paper in an envelope

Analyses:

- Probit on $\text{Pr}(\text{Allais paradox})$ including demographics, EV, etc.
- Choice frequencies
- Probit on choice frequencies

Table 3 Test results for Hypotheses 1–4

Mechanism	CRE	CCE	DCRE	DCCE
OT	No	No	No	Yes ^e
PORnp	No	No	No	No
PORpi	No	Yes ^b	Yes ^c	No
PORpas	Yes ^a	No	No	No
PAS	No	Yes ^b	No	No
PAI	Yes ^a	No	No	No
PAC/N	No	Yes ^b	No	No
PAC	Yes ^a	No	Yes ^d	No

Notes: ^aFan Out; ^bFan In; ^cIRRA; ^dDRRA; ^eIARA

Can't really compare cleanly to OT
But, definite differences across mechanisms
And whether they see the questions in advance or not!

Table 4 Observed frequencies (in %) of choices of less risky options (low and high column figures in bold)

Mechanism	S ₁	S ₂	S ₃	S ₄	S ₅	All Pairs [95 % CI]
OT (231 subjects)	39.47	15.52	27.59	28.95	38.46	28.60 [22.7, 34.4]
PORnp (40 subjects)	37.50	45.00	47.50	32.50	60.00	44.50 [37.6, 51.4]
PORpi (40 subjects)	27.50	50.00	42.50	22.50	50.00	38.50 [31.7, 45.3]
PORpas (40 subjects)	22.50	42.50	20.00	10.00	30.00	25.00 [18.9, 31.1]
PAS (39 subjects)	25.64	23.08	33.33	10.26	17.95	22.10 [16.2, 27.9]
PAC (38 subjects)	36.84	52.63	23.68	21.05	42.11	35.30 [28.4, 42.1]
PAC/N (40 subjects)	37.50	35.00	35.00	22.50	45.00	35.00 [28.3, 41.7]
PAI (38 subjects)	36.84	52.63	36.84	34.21	52.63	42.60 [35.5, 49.7]

All Pairs: % who chose safe in all 5
 Most risk averse: PORnp and PAI
 Least risk averse: PORpas and PAS

What about Impure OT?

- Paper only compares Impure OT to OT
 - More risky choices under Impure OT
 - Framing effect exists!
- But we want Impure OT vs. each mechanism!
- Probit Pr(Safe) results:
 - PORnp, PORpi, and PAI are different from ImpureOT
- But, looking at the actual choice data task-by-task, I don't find significant differences...

Starmer & Sugden (1991)

- 22 binary lottery choice questions. $n = 40$ per treatment
- First 20: hypothetical (piloting for another study)
- Questions 21 and 22: RPS vs. only one paid. Same page.
- Allais paradox questions.

TABLE 1—THE DESIGN OF THE EXPERIMENT

Group	Question 21	Question 22	Incentive
A	P'	P''	P'' is for real
B	P'	P''	Each problem has 0.5 chance of being for real
C	P''	P'	Each problem has 0.5 chance of being for real
D	P''	P'	P' is for real

A vs. B: $p = 0.356$ (my calculation)

C vs. D: $p = 0.043$ (my calculation)

Cubitt Starmer & Sugden (1998)

- Five binary menus of lotteries
- Experiment 1 ($n = 201$)
 - Group 1.1: RPS: $(1/3, D_3; 2/3, D_4)$
 - Group 1.2: RPS: $(1/3, D_3; 2/3, D_5)$
 - (Two other groups to test IND and ROCL)
 - Use D_3 to test IC. No differences.
- Experiment 3 ($n = 202$)
 - 3.1: 20 decisions, 1st is paid
 - 3.2: 20 decisions, 2nd is paid
 - 3.3: 20 decisions, RPS on all 20
 - 3.4: Same as 3.3 but with lower stakes
 - 3.1 D_1 vs 3.3 D_1 : $p = 0.685$
 - 3.2 D_2 vs 3.3 D_2 : $p = 0.120$

Summary of Past Experiments

Table 9

Existing tests of incentive compatibility of the RPS mechanism that have no framing confounds. We describe each of these comparisons in the text below.

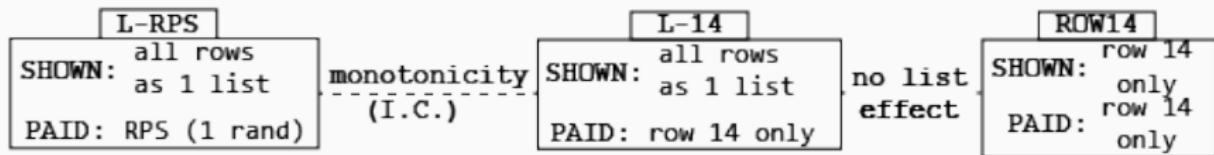
Paper	Names of treatments	p-Value	RPS is I.C.?
Starmer and Sugden (1991)	A vs. B	0.356	✓
Starmer and Sugden (1991)	C vs. D	0.043	✗
Cubitt et al. (1998)	3.1 vs. 3.3	0.685	✓
Cubitt et al. (1998)	3.2 vs. 3.3	0.120	✓
Cox et al. (2014b)	PORpi vs. ImpureOT2	0.122	✓
Cox et al. (2014b)	PORpi vs. ImpureOT3	0.988	✓
Cox et al. (2014b)	PORpi vs. ImpureOT4	0.397	✓

Brown & Healy (2018)

Row #	Option A		or	Option B	
1	Balls 1-10 pay \$10 (50% chance of \$10)	Balls 11-20 pay \$5 (50% chance of \$5)	<input type="checkbox"/>	Ball 1 pays \$15 (5% chance of \$15)	Balls 2-20 pay \$0 (95% chance of \$0)
2	Balls 1-10 pay \$10 (50% chance of \$10)	Balls 11-20 pay \$5 (50% chance of \$5)	<input type="checkbox"/>	Balls 1-2 pay \$15 (10% chance of \$15)	Balls 3-20 pay \$0 (90% chance of \$0)
3	Balls 1-10 pay \$10 (50% chance of \$10)	Balls 11-20 pay \$5 (50% chance of \$5)	<input type="checkbox"/>	Balls 1-3 pay \$15 (15% chance of \$15)	Balls 4-20 pay \$0 (85% chance of \$0)
4	Balls 1-10 pay \$10 (50% chance of \$10)	Balls 11-20 pay \$5 (50% chance of \$5)	<input type="checkbox"/>	Balls 1-4 pay \$15 (20% chance of \$15)	Balls 5-20 pay \$0 (80% chance of \$0)
	Balls 1-10 pay \$10	Balls 11-20 pay \$5	<input type="checkbox"/>	Balls 1-5 pay \$15	Balls 6-20 pay \$0
⋮	⋮	⋮	⋮	⋮	⋮
18	(50% chance of \$10)	(50% chance of \$5)	<input type="checkbox"/>	(90% chance of \$15)	(10% chance of \$0)
19	Balls 1-10 pay \$10 (50% chance of \$10)	Balls 11-20 pay \$5 (50% chance of \$5)	<input type="checkbox"/>	Balls 1-19 pay \$15 (95% chance of \$15)	Ball 20 pays \$0 (5% chance of \$0)
20	Balls 1-10 pay \$10 (50% chance of \$10)	Balls 11-20 pay \$5 (50% chance of \$5)	<input type="checkbox"/>	All Balls pay \$15 (100% chance of \$15)	(0% chance of \$0)

[Click Here When Finished](#)

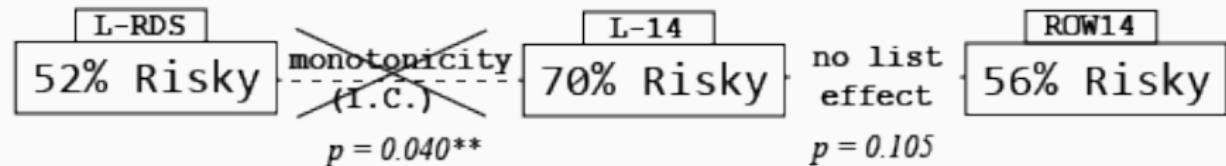
Our Design



- Andreoni-Sprenger formatting
- Standard Ohio State subject pool.
- Between-subjects.
- Computerized.
 - List format: rows must be answered sequentially.
- Physical randomizing devices (die, bingo cage)
- No other tasks in the experiment.
- 60–63 subjects per treatment.
- Question: Do Row 14 choices differ by treatment?

The Results

Row 14:



- Using RPS mechanism makes them switch later.
(More thoughtful? Switching inertia?)
 - Statistically significant.
- Showing whole list makes them switcher earlier
(Closer to the middle.)
 - Not quite significant.
- The two effects nearly offset

Hypothesis

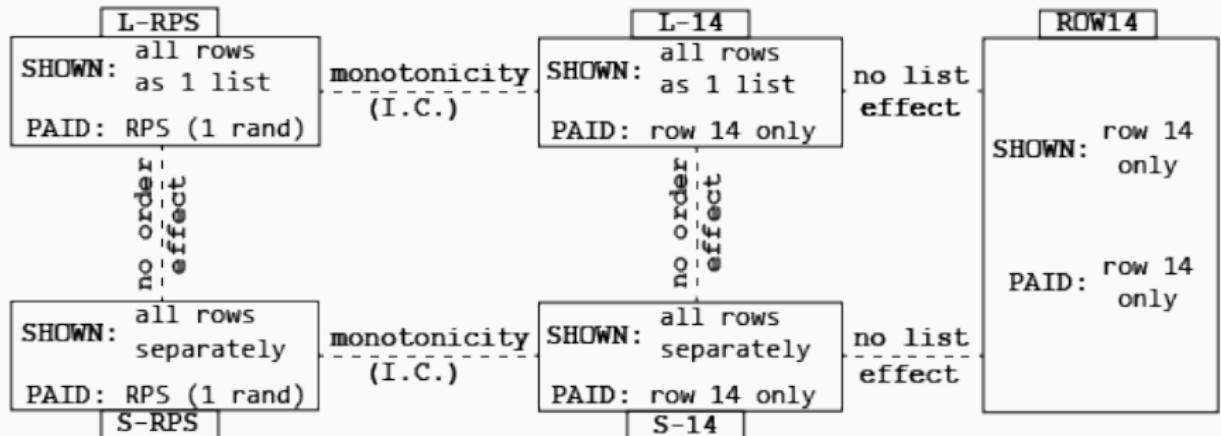
- Subjects are combining the decisions in a reduction-like way.
E.g.: 'When to switch?'
- The 'combining' can be broken by separating the decisions.

New Treatments

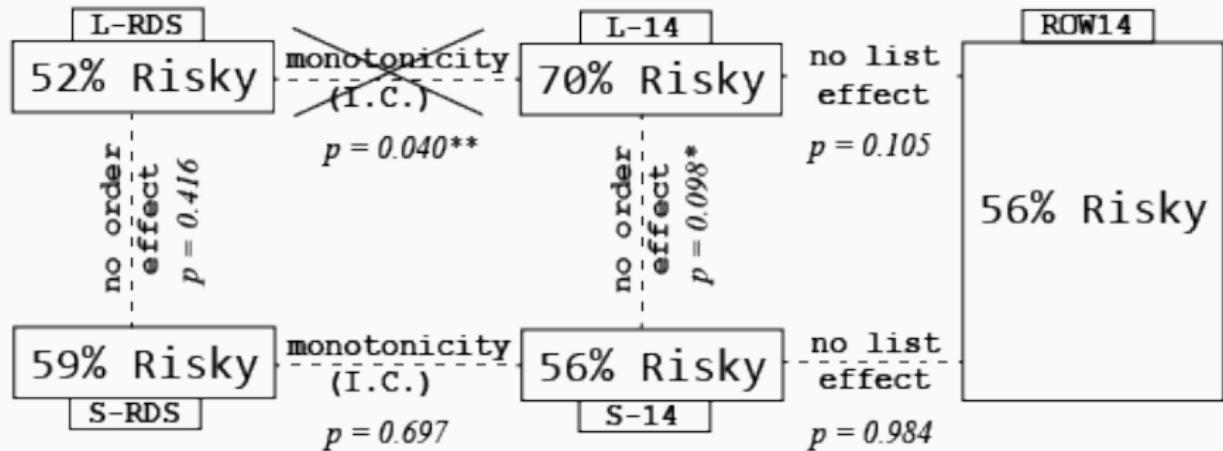
'Separated' treatments.

- Same 20 rows.
- Each shown on separate screen.
- Order of rows randomized for each subject.
- Still comparing RPS to Pay-14-Only.
- Still must answer every row, in order given.
 - First attempt: on paper. They shirked.
 - Second attempt: computerized, forced answers
- Still 60–63 observations per cell, between subjects.

Full Design



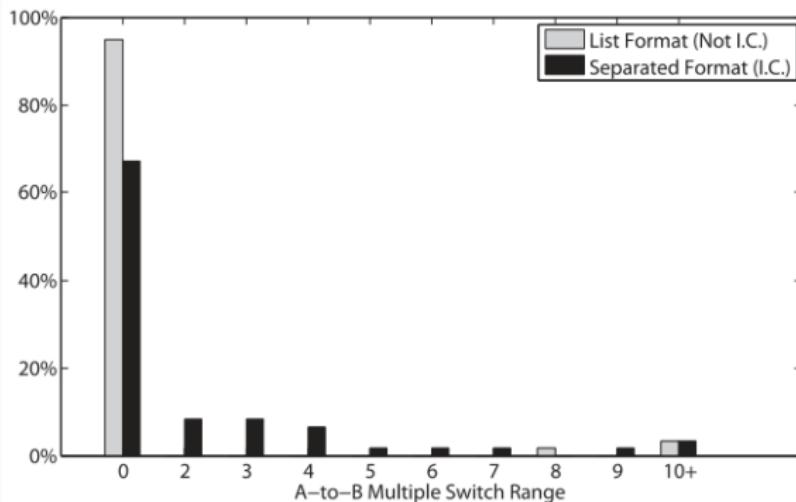
The Results



The Cost of Separation

B-to-A (Risky-to-Safe) switches violate FOSD:

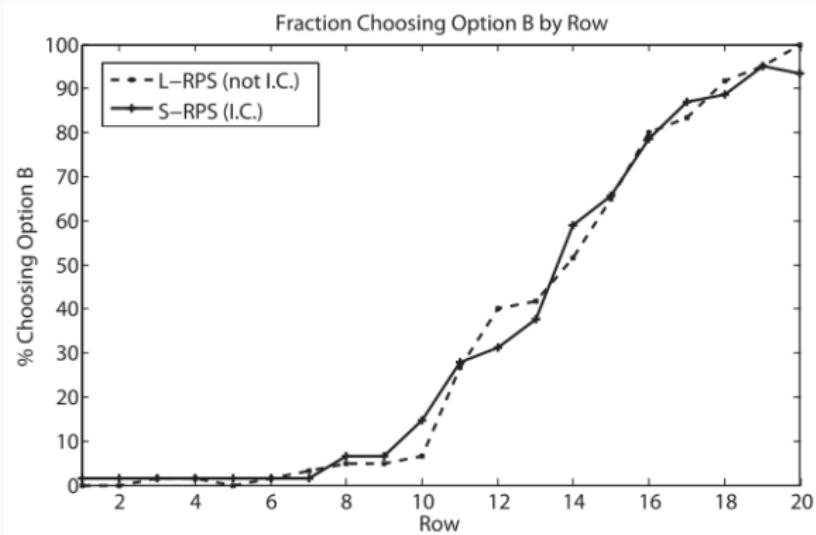
$Risky_{15}$ dominates $Risky_{14}$, but $Risky_{14} \succ Safe \succ Risky_{15}$



LESSON: Separating decisions hurts consistency? NO!

The list format generates *false consistency*!

Biases Cancel Out



L-RPS was fine because “list effect” and “IC failure” canceled out!
I wouldn’t expect that to be true generally...

Past Experiments

Table 9

Existing tests of incentive compatibility of the RPS mechanism that have no framing confounds. We describe each of these comparisons in the text below.

Paper	Names of treatments	Presentation format	p-Value	RPS is I.C.?
Starmer and Sugden (1991)	A vs. B	List	0.356	✓
Starmer and Sugden (1991)	C vs. D	List	0.043	✗
This paper	L-RPS vs. L-14	List	0.041	✗
This paper	S-RPS vs. S-14	Separated	0.697	✓
Cubitt et al. (1998)	3.1 vs. 3.3	Separated	0.685	✓
Cubitt et al. (1998)	3.2 vs. 3.3	Separated	0.120	✓
Cox et al. (2014b)	PORpi vs. ImpureOT2	Separated ^a	0.122	✓
Cox et al. (2014b)	PORpi vs. ImpureOT3	Separated ^a	0.988	✓
Cox et al. (2014b)	PORpi vs. ImpureOT4	Separated ^a	0.397	✓

^a Cox et al. (2014b) give subjects the choices on separate slips of paper, but the subjects could have arranged them into a list-like format if they wanted.

Other Discussion of Separation

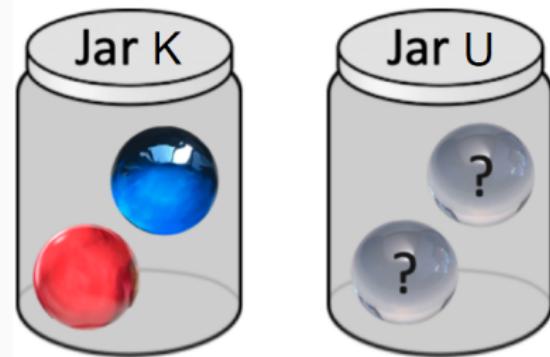
1. Kirby & Marakovic (1996) and Kirby et al. (1999)
 - Use scrambled lists in a field setting, including heroin addicts
2. Eckel et al. (2005)
 - Use scrambled with working poor
 - “we now believe that scrambling is a bad idea because it results in greater inconsistency and variance of responses.”

RPS for Hedging Ambiguity?

Is RPS used to hedge ambiguity?

- Oechssler Rau & Roomets (2019): No
 - Issues with their design
- Baillon Halevy & Li (2022)...

2-Urn Ellsberg Paradox



$D_1:$	$K = \$2.00$ if red from K $U = \$2.10$ if red from U
$D_2:$	$K = \$2.00$ if blue from K $U = \$2.10$ if blue from U

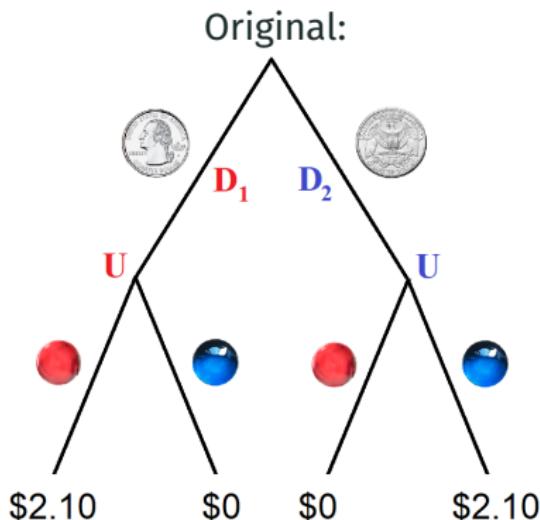
One paid randomly via coin flip

$\Pr(\text{Red in } U) \approx \Pr(\text{Blue in } U)$ & Ambiguity Averse: $K \succ U$ and $K \succ U$.

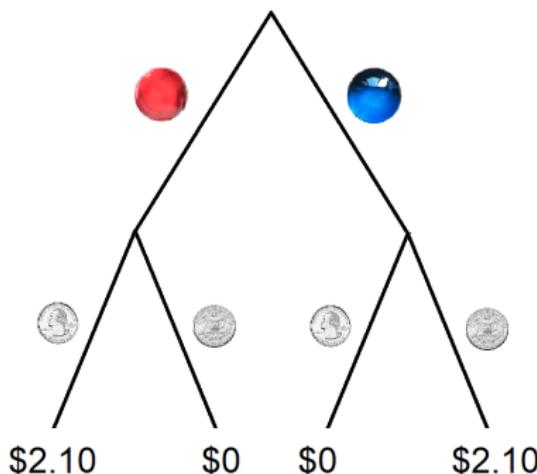
Raiffa (1961): Picking **UU** “hedges away” the ambiguity! $UU \succ KK$

How Hedging Works (Raiffa 1961)

Picking UU :



Order-Reversed:

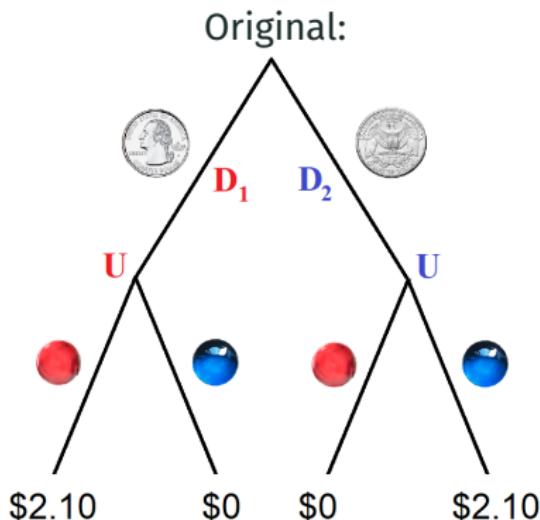


Ambiguity:
 $KK \succ UU$

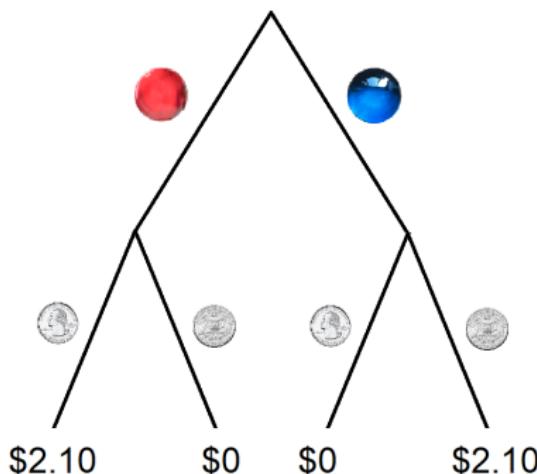
50-50 Lottery For Sure
 $UU \succ KK$

How Hedging Works (Raiffa 1961)

Picking UU :



Order-Reversed:



Ambiguity:
 $KK \succ UU$

50-50 Lottery For Sure
 $UU \succ KK$

Assumption: Order Reversal

Past Experiments

Order reversal has support...

- Coin before \sim Coin after
 - Oechssler, Rau & Roomets (2019; ORR19)
 - Baillon, Halevy & Li (2022)

...yet people don't seem to appreciate hedging:

- Raiffa (1961), Dominiak & Schnedler (2011)
 - Ambiguity averse subjects don't value UU more than U and U
- ORR19 find mixed evidence for hedging
 - Amb. Averse & $Pr(\text{blue}) \approx Pr(\text{red})$ Subjects:
 - 50% consistent with hedging (or randomization)
 - Issues: Indifference & Cross-task contamination

Past Experiments

Baillon, Halevy & Li (2022) (BHL22):

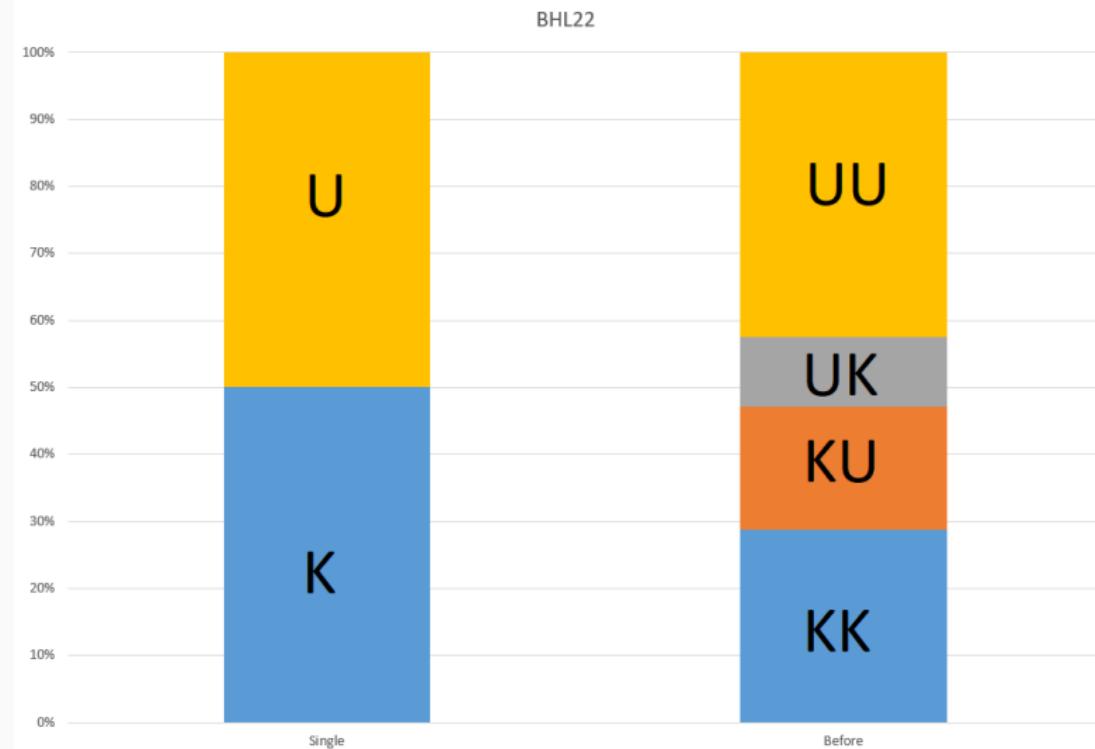
- “Single” Treatment:

- $D_0 = \{\text{K}, \text{K}, \text{U}, \text{U}\}$
- U or $\text{U} \Rightarrow$ Ambiguity neutral/loving or $\Pr(\text{red}) \geq \Pr(\text{blue})$
- K or $\text{K} \Rightarrow$ Strictly ambiguity averse and $\Pr(\text{red}) \approx \Pr(\text{blue})$
- 50% choose K or K
 \Rightarrow 50% are Amb. Averse and $\Pr(\text{red}) \approx \Pr(\text{blue})$
this is a *lower bound* on Amb. Aversion

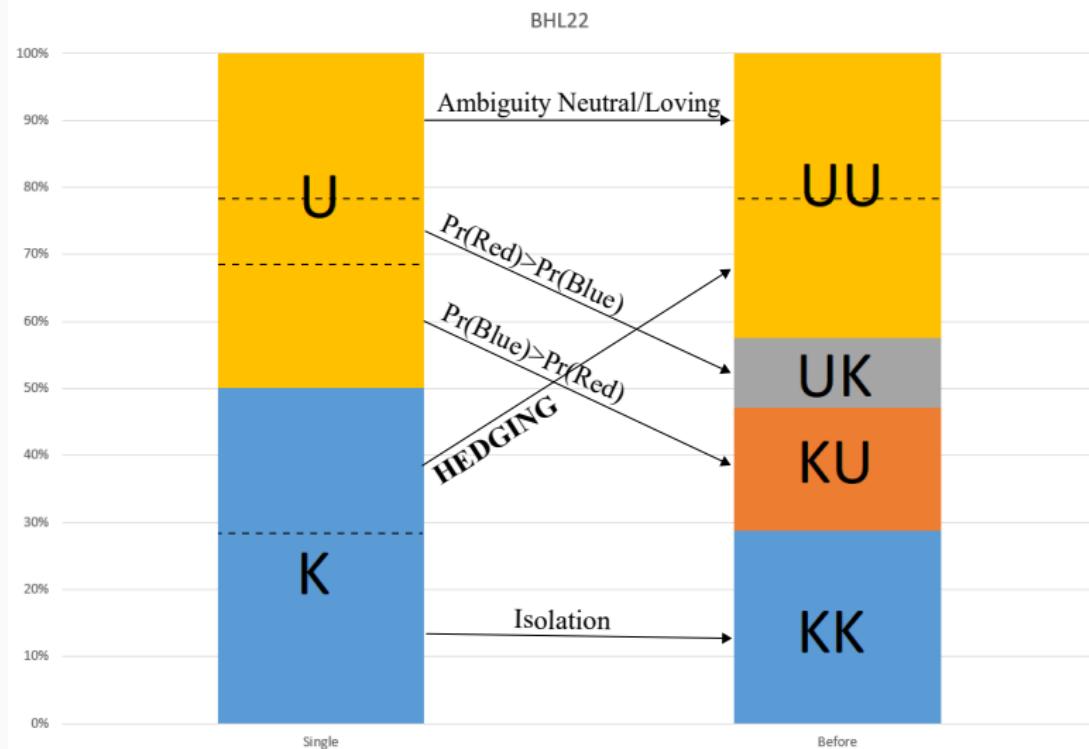
- “Before” Treatment:

- $D_1 = \{\text{K}, \text{U}\}$, $D_2 = \{\text{K}, \text{U}\}$, coin flip **first**
- What will Amb. Averse subjects pick?
 - Order Reversal + Hedging $\Rightarrow \text{UU}$
 - “Isolation” $\Rightarrow \text{KK}$
 - $\Pr(\text{red}) \geq \Pr(\text{blue}) \Rightarrow \text{UK}$ or KU
(uses Azrieli et al. 2018, ignoring stochastic choice)

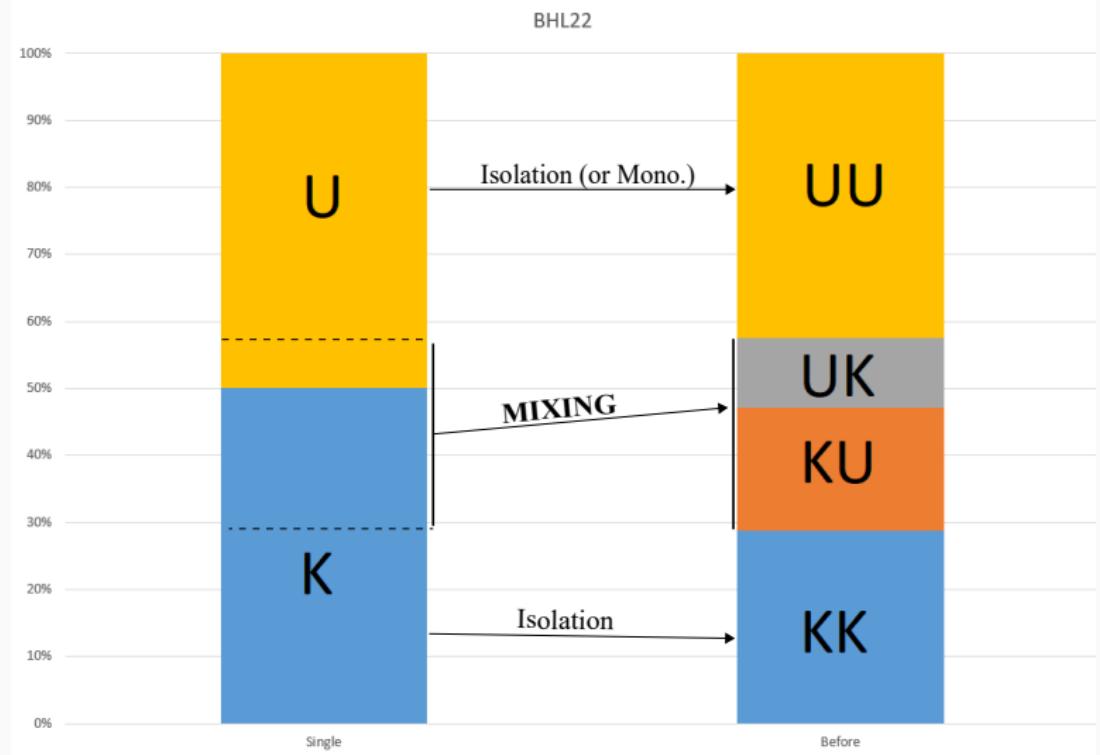
BHL22: Results



BHL22: Story 1



BHL22: Story 2



it necessarily hedging?

Is

Pay All

Susan Laury's paper...

Summary

- Theory: RPS generally fine *unless* subjects “reduce”
(treat the experiment as one large decision)
- List format seems to encourage reduction, IC violations
- Separated format breaks reduction, restores IC
 - Separated *and* random order. Haven’t tested which.
- List format generates *false consistency*
- Ambiguity:
 - RPS is not IC!
 - But is it really hedging??