ExpEcon Methods:
Empirical Tests of Incentive Compatibility

ECON 8877
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Updated 2026-01-28 at 02:18:11

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.

Cox, Sadiraj & Schmidt (2015)

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

Cox, Sadiraj & Schmidt (2015)

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 Pr(Allais paradox) including demographics, EV, etc.
- Choice frequencies
- Probit on choice frequencies

Cox, Sadiraj & Schmidt (2015)

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: [a]Fan Out; [b]Fan In; [c]IRRA; [d]DRRA; [e]IARA

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

Cox, Sadiraj & Schmidt (2015)

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

Cox, Sadiraj & Schmidt (2015)

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

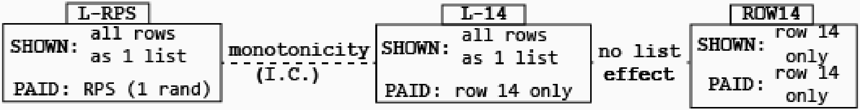
[redacted]

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)	or	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)	or	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)	or	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)	or	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		Balls 1-5 pay $15	Balls 6-20 pay $0
⋮	⋮	⋮		⋮	⋮
18	(50% chance of $10)	(50% chance of $5)	or	(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)	or	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)	or	All Balls pay $15 (100% chance of $15)	(0% chance of $0)

Click Here When Finished

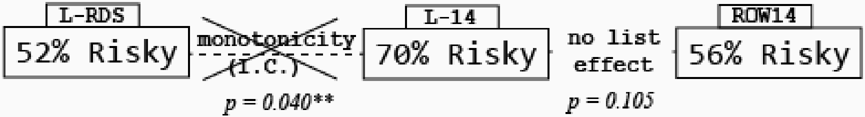
Our Design



- 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

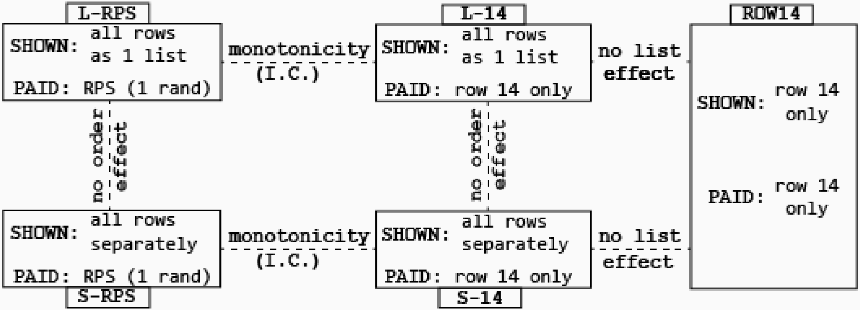
- Subjects are combining the decisions in a reduction-like way.
  E.g.: ‘When to switch?’.
- The ‘combining’ can be broken by separating the decisions.

New Treatments

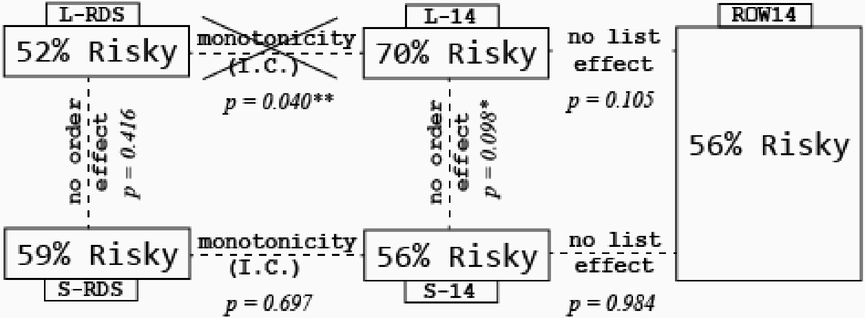
'Separated' treatments.

- 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

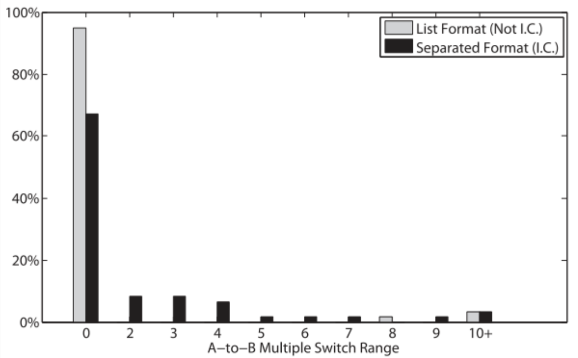

L-RPS
SHOWN: all rows as 1 list
PAID: RPS (1 rand)
monotonicity (I.C.)
L-14
SHOWN: all rows as 1 list
PAID: row 14 only
no list effect
ROW14
SHOWN: row 14 only
PAID: row 14 only
no order effect
no order effect
SHOWN: all rows separately
PAID: RPS (1 rand)
S-RPS
monotonicity (I.C.)
SHOWN: all rows separately
PAID: row 14 only
S-14
no list effect

The Results


L-RDS
52% Risky
monotonicity
(I.C.)
p = 0.040**
L-14
70% Risky
no list
effect
p = 0.105
ROW14
56% Risky
no order
effect
p = 0.416
no order
effect
p = 0.098*
59% Risky
S-RDS
monotonicity
(I.C.)
p = 0.697
56% Risky
S-14
no list
effect
p = 0.984

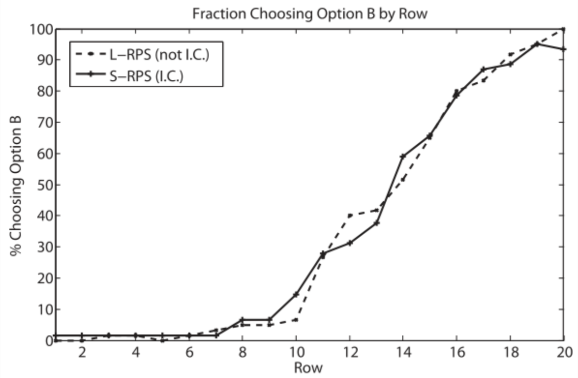
The Cost of Separation

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

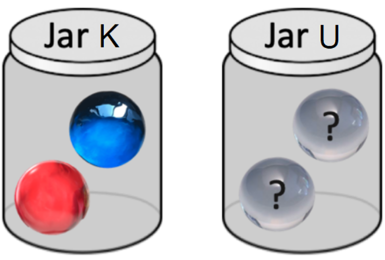
1. Kirby & Marakovic (1996) and Kirby et al. (1999)
    - Use scrambled lists in a field setting, including heroin addicts
2. Eckel et al. (2005)
    - Use scrambled with working poor
    - "we now believe that scrambling is a bad idea because it results in greater inconsistency and variance of responses."

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

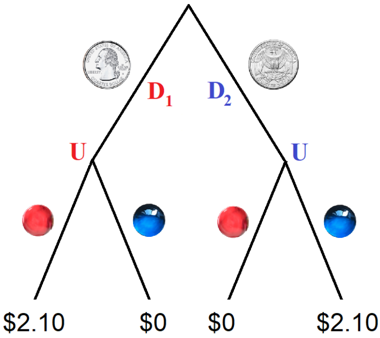
Pr(Red in U)$\approx$Pr(Blue in U) & Ambiguity Averse: K $\succ$ U and K $\succ$ U.

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

How Hedging Works (Raiffa 1961)

Picking UU:

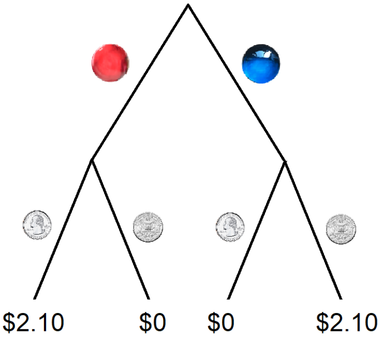
Original:



Ambiguity:

KK $\succ$ UU

Order-Reversed:



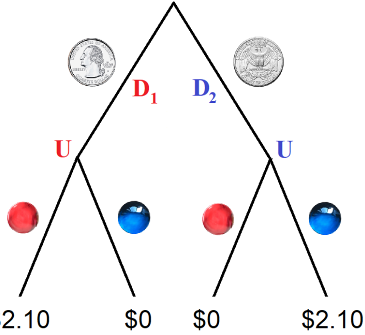
50-50 Lottery For Sure

UU $\succ$ KK

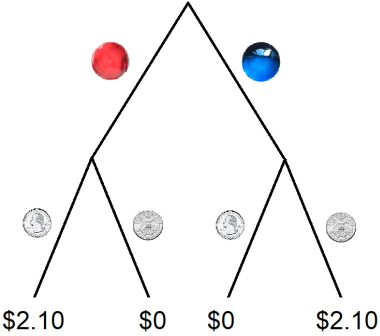
How Hedging Works (Raiffa 1961)

Picking UU:

Original:



Order-Reversed:



Ambiguity:

KK ≻ UU

50-50 Lottery For Sure

UU ≻ 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(blue)$\approx$Pr(red) Subjects:
    - 50% consistent with hedging (or randomization)
    - Issues: Indifference & Cross-task contamination

Past Experiments

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

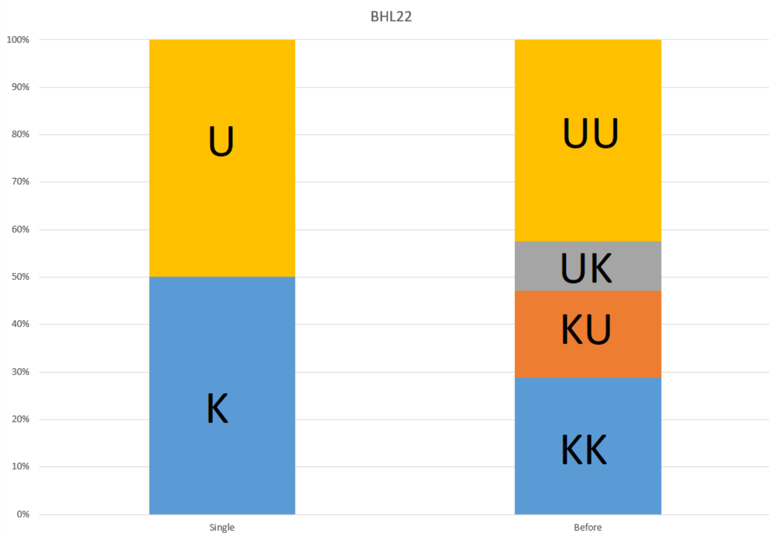
- "Single" Treatment:
  - $D_0 = \{K, K, U, U\}$
  - U or U $\Rightarrow$ Ambiguity neutral/loving *or* Pr(red)$\gtrless$Pr(blue)
  - K or K $\Rightarrow$ Strictly ambiguity averse *and* Pr(red)$\approx$Pr(blue)
  - 50% choose K or K

    $\Rightarrow$ 50% are Amb. Averse *and* Pr(red)$\approx$Pr(blue)

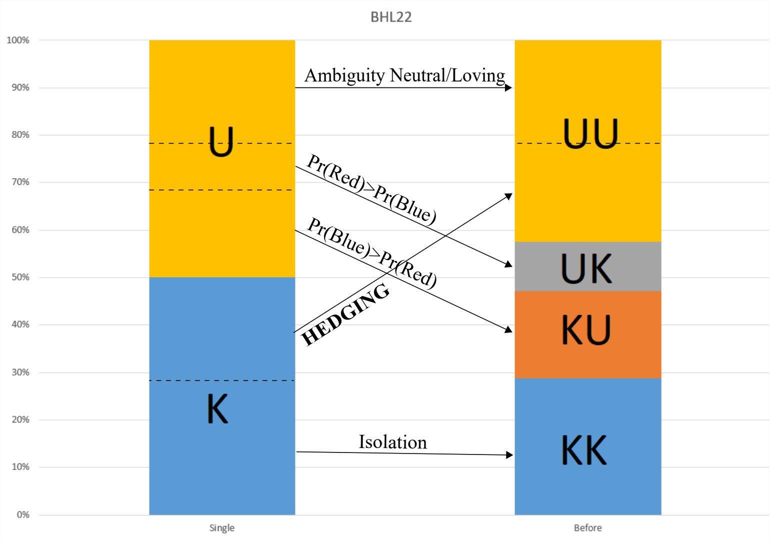
    this is a *lower bound* on Amb. Aversion
- "Before" Treatment:
  - $D_1 = \{K, U\}$, $D_2 = \{K, U\}$, coin flip **first**
  - What will Amb. Averse subjects pick?
    - Order Reversal + Hedging $\Rightarrow$ UU
    - "Isolation" $\Rightarrow$ KK
    - Pr(red)$\gtrless$Pr(blue) $\Rightarrow$ UK or KU

      (uses Azrieli et al. 2018, ignoring stochastic choice)

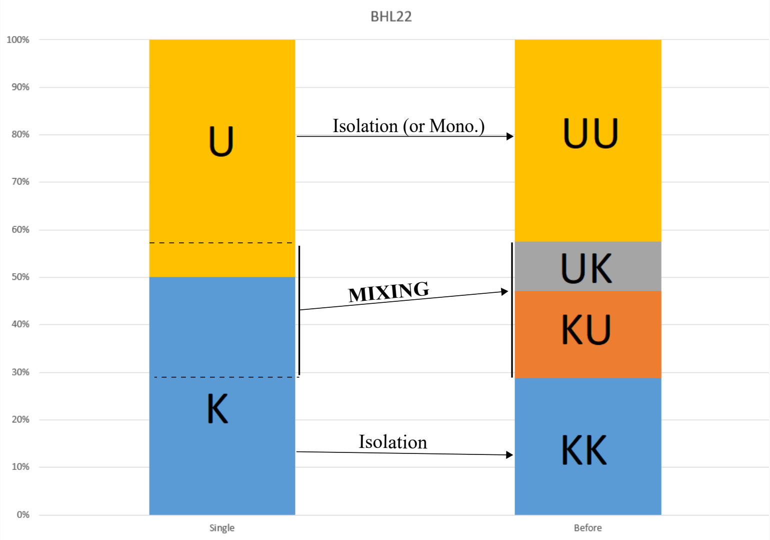
BHL22: Results



BHL22: Story 1



BHL22: Story 2



Is it necessarily hedging?

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??