

Ambiguity Aversion Without Asymmetric Information

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Motivation

Asymmetric Information

- Morris (1997): “It is argued that proponents of subjective expected utility have always understood that a ‘bid–ask spread’ in rational individuals’ willingness to bet is consistent with SEU maximization in the presence of private information.” - Morris (1997) “Risk Uncertainty and Hidden Information”
- SEU: bid-ask spread / ambiguity aversion not normatively appropriate in Ellsberg experiments
- subjects may use heuristics to avoid situations of disadvantageous asymmetric information
- Ellsberg bet is against the experimenter, and the experimenter determines and knows the objective probabilities
- Heuristic: avoid trade in situations of disadvantageous asymmetric information

Motivation

- ① Ellsberg: experimenter determines content of Ellsberg urn
- ② Fox/Tversky: weather in Istanbul
- ③ Here: participants make the urn

A participant-generated Ellsberg urn

A participant-generated Ellsberg urn

① Objective Urn

- ▶ Fair coin falls on Head or Tail.

② Subjective Urn

- ▶ N participants in lab session (N =even in Study 1)
- ▶ every participant selects a ball marked with “Heart” or “Smiley”
- ▶ in your urn there are $N-1$ balls that can have “Heart” or “Smiley”
- ▶ “Heart” “Smiley” is just one symbol pair, we tried numerous
- ▶ order in which the symbols are mentioned is random
- ▶ Study 1: majority symbol decides bet (no ball drawn)
- ▶ Study 2(pilot only): ball drawn from subjective urn

③ Bet

- ▶ You can bet on Head, Tail, “Heart”, “Smiley”
- ▶ Resolution of risk and uncertainty at the same time
- ▶ Order in which bets are displayed is randomized between subjective/objective and symbol pairs are randomized
- ▶ People are explicitly told that symbol appearance is randomized

Instruction Screen (Study 1)

On a single screen people see the instructions, make choice about symbol to send, and bet to choose:

Send a symbol (for you personally irrelevant, order randomized):

Bitte wählen Sie eines der beiden Symbole



How much is each bet worth? You will receive the one you value most.

Option 1	Kopf	Zahl
	EUR 0	EUR 4
	EUR 0	EUR 4

Wie viel ist Ihnen Lotterie 1 wert? (In Cent)

Focal point problem (Study 1)

- Consider the experiment abstracting from bet on objective urn
- Source of ambiguity is strategic uncertainty
- No strategic uncertainty if coordination on a Nash equilibrium is achieved
- Here is the matrix form of the game for $N=2$
- Capital letters = symbol sent; lower case letters = symbol bet on

	(Hh)	(Hs)	(Sh)	(Ss)
(Hh)	(1, 1)	(1, 0)	(0, 1)	(0, 0)
(Hs)	(0, 1)	(0, 0)	(1, 1)	(1, 0)
(Sh)	(1, 0)	(1, 1)	(0, 0)	(0, 1)
(Ss)	(0, 0)	(0, 1)	(1, 0)	(1, 1)

- 4 pure-strategy NE: (Hh, Hh) , (Ss, Ss) , (Hs, Sh) , (Sh, Hs) .

Study 2 (pilot)

N even or odd, your urn has $N - 1$ balls in it
send H or S , bet on h or s

26 Nash equilibria in pure strategies

Prizes 0, 1 (normalized)

$c \sim (\frac{1}{2}; 0, \frac{1}{2}; 1)$

ball is drawn from your subjective urn

a single coin flip for all participants (simultaneous)

		Player 3 (Hh)			
		(Hh)	(Hs)	(Sh)	(Ss)
(Hh)	(1, 1, 1)	(1, 0, 1)	(c, 1, c)	(c, 0, c)	
(Hs)	(0, 1, 1)	(0, 0, 1)	(c, 1, c)	(c, 0, c)	
(Sh)	(1, c, c)	(1, c, c)	(c, c, 0)	(c, c, 0)	
(Ss)	(0, c, c)	(0, c, c)	(c, c, 0)	(c, c, 0)	

		Player 3 (Hh)			
		(Hh)	(Hs)	(Sh)	(Ss)
(Hh)	(1, 1, 0)	(1, 0, 0)	(c, 1, c)	(c, 0, c)	
(Hs)	(0, 1, 0)	(0, 0, 0)	(c, 1, c)	(c, 0, c)	
(Sh)	(1, c, c)	(1, c, c)	(c, c, 1)	(c, c, 1)	
(Ss)	(0, c, c)	(0, c, c)	(c, c, 1)	(c, c, 1)	

		Player 3 (Hh)			
		(Hh)	(Hs)	(Sh)	(Ss)
(Hh)	(c, c, 1)	(c, c, 1)	(0, c, c)	(0, c, c)	
(Hs)	(c, c, 1)	(c, c, 1)	(1, c, c)	(1, c, c)	
(Sh)	(c, 0, c)	(c, 1, c)	(0, 0, 0)	(0, 1, 0)	
(Ss)	(c, 0, c)	(c, 1, c)	(1, 0, 0)	(1, 1, 0)	

		Player 3 (Hh)			
		(Hh)	(Hs)	(Sh)	(Ss)
(Hh)	(c, c, 0)	(c, c, 0)	(0, c, c)	(0, c, c)	
(Hs)	(c, c, 0)	(c, c, 0)	(1, c, c)	(1, c, c)	
(Sh)	(c, 0, c)	(c, 1, c)	(0, 0, 1)	(0, 1, 1)	
(Ss)	(c, 0, c)	(c, 1, c)	(1, 0, 1)	(1, 1, 1)	

Study 2: design (pilot)

Screen 1: Send symbol, bet

A ball of with which symbol would you like to put into the participant-drums of the other participants?

- ↖
- ↗

What would you like to bet on?

- automatic-drum, ↖
- automatic-drum, ↗
- participant-drum, ↖
- participant-drum, ↗

Screen 2: belief (non-incentivized, single prior)

Which balls do you believe did the others participants put into your participant-drum?

- ✓ -----
- 0 chose ↖ and 3 chose ↗
 - 1 chose ↖ and 2 chose ↗
 - 2 chose ↖ and 1 chose ↗
 - 3 chose ↖ and 0 chose ↗

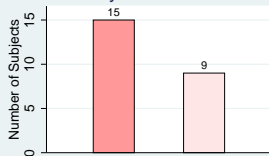
Results - Study 1

Heart - Smiley 1/2

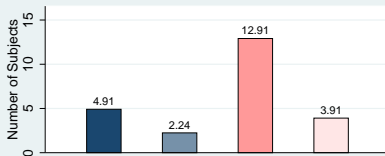


Heart - Smiley (1/2)

Symbol choice



Bet chosen



Rational expectations



Willingness to Pay

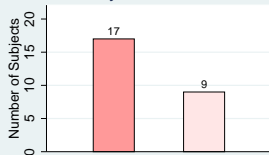


Heart - Smiley 2/2

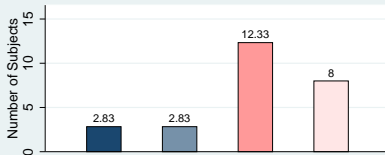


Heart - Smiley (2/2)

Symbol choice



Bet chosen



Rational expectations



Willingness to Pay



Large - Small Circle 1/3

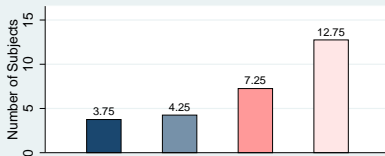


Large Circle - Small Circle (1/3)

Symbol choice



Bet chosen



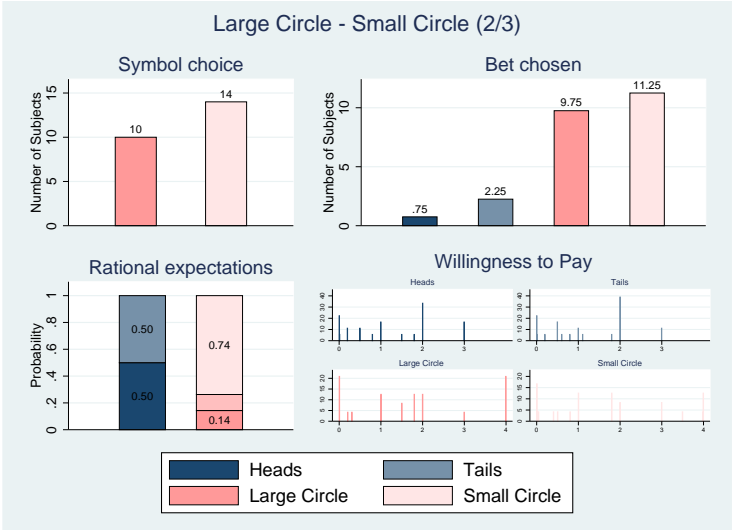
Rational expectations



Willingness to Pay



Large - Small Circle 2/3

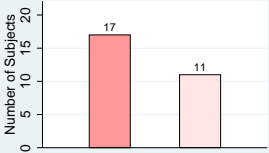


Large - Small Circle 3/3

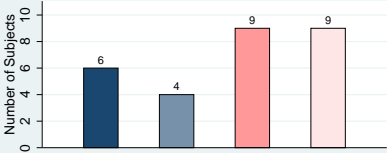


Large Circle - Small Circle (3/3)

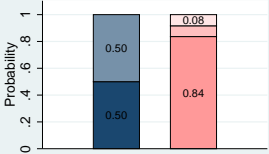
Symbol choice



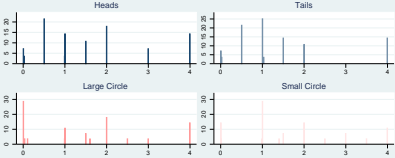
Bet chosen



Rational expectations



Willingness to Pay



Up-Right vs. Up-Left Angle

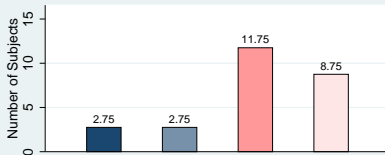


Up-Right Angle - Up-Left Angle

Symbol choice



Bet chosen



Rational expectations



Willingness to Pay

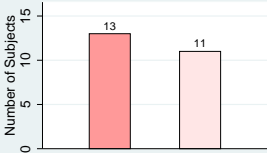


Down-Left Angle - Down-Right Angle (1/2)

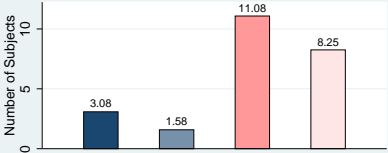


Down-Left Angle - Down-Right Angle (1/2)

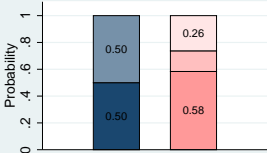
Symbol choice



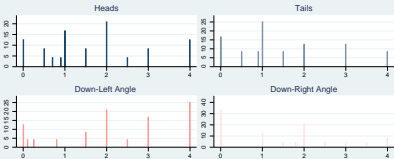
Bet chosen



Rational expectations



Willingness to Pay

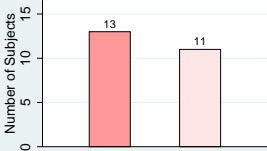


Down-Left Angle - Down-Right Angle (2/2)

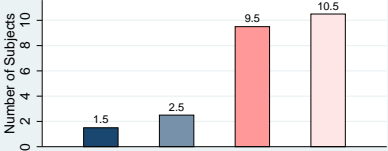


Down-Left Angle - Down-Right Angle (2/2)

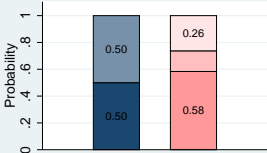
Symbol choice



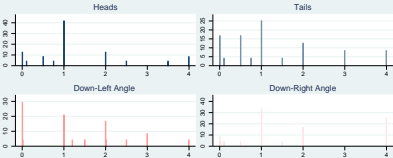
Bet chosen



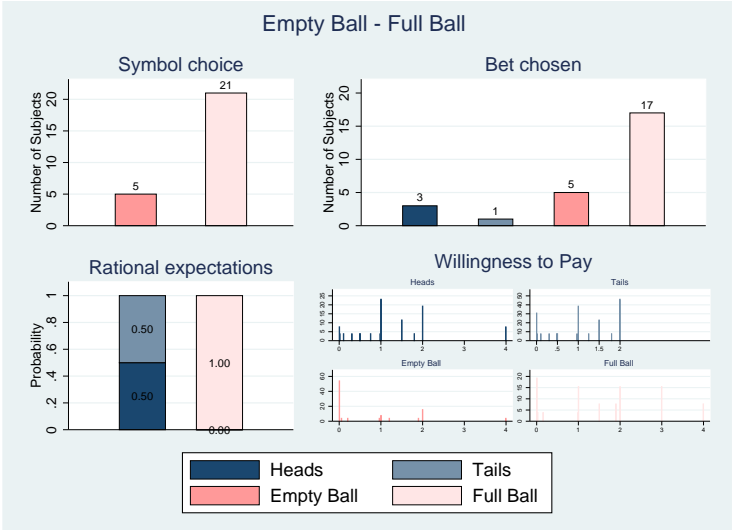
Rational expectations



Willingness to Pay



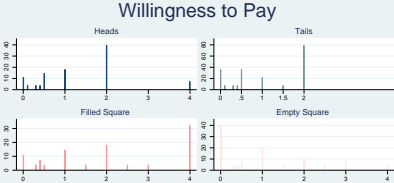
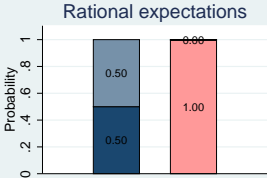
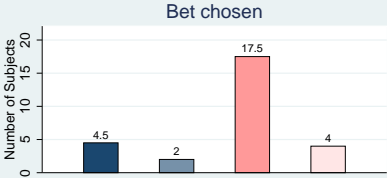
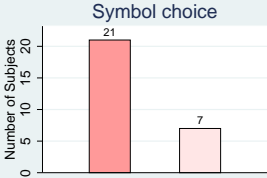
Empty - full ball



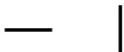
Filled - Empty Square



Filled Square - Empty Square

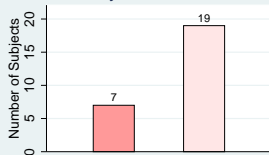


Horizontal - Vertical Bar 1/2

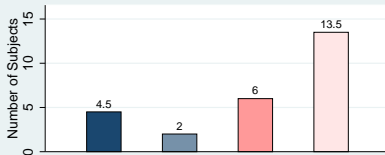


Horizontal Bar - Vertical Bar (1/2)

Symbol choice



Bet chosen



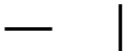
Rational expectations



Willingness to Pay



Horizontal - Vertical Bar 2/2



Horizontal Bar - Vertical Bar (2/2)

Symbol choice



Bet chosen



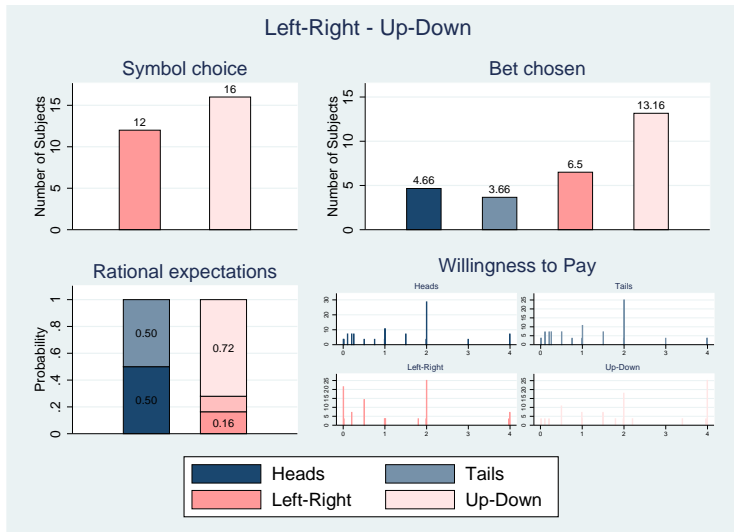
Rational expectations



Willingness to Pay



Leftright - Updown Arrow

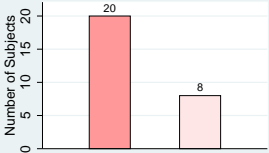


Black-on-White Vs. Inverse

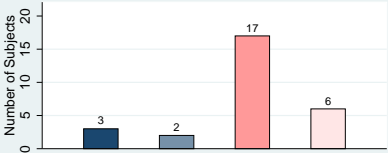


Black Number - White Number

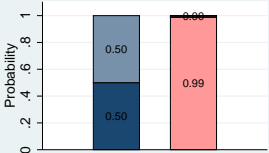
Symbol choice



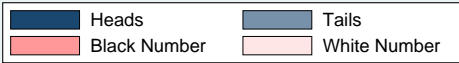
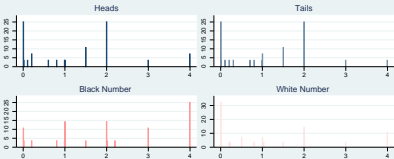
Bet chosen



Rational expectations



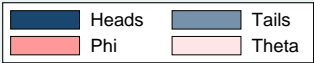
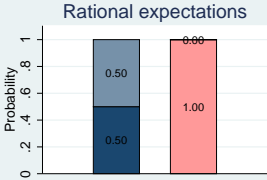
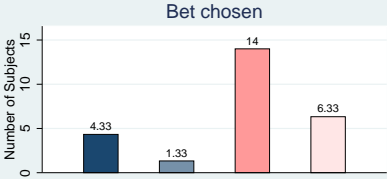
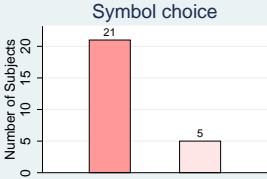
Willingness to Pay



Phi - Theta

ϕ θ

Phi - Theta

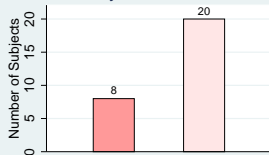


Question Marks

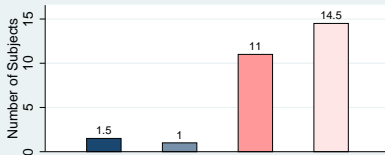
? ?

Question Mark - Inverted Question Mark

Symbol choice



Bet chosen



Rational expectations



Willingness to Pay



Heads

Tails

Question Mark

Inverted Question Mark

Regression analysis

Table 2: With prob_a (binomial)

	Tails	Symbol A	Symbol B
Choosing A (d)	-0.00598 (0.0315)	0.482*** (0.0439)	-0.461*** (0.0447)
Risk aversion	0.00238 (0.00611)	-0.00953 (0.00956)	-0.00452 (0.00955)
P(A wins)	0.258 (0.181)	-0.0324 (0.298)	-0.284 (0.267)
P(A wins) x P(A) > .5	-0.208 (0.145)	0.0996 (0.246)	0.0806 (0.225)
Observations	416	416	416
Xmfx_y	0.125	0.369	0.363

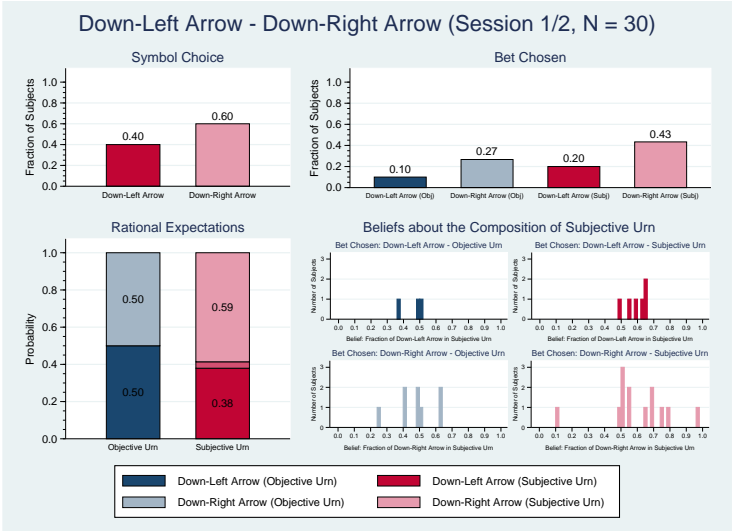
Marginal effects; Standard errors in parentheses

(d) for discrete change of dummy variable from 0 to 1

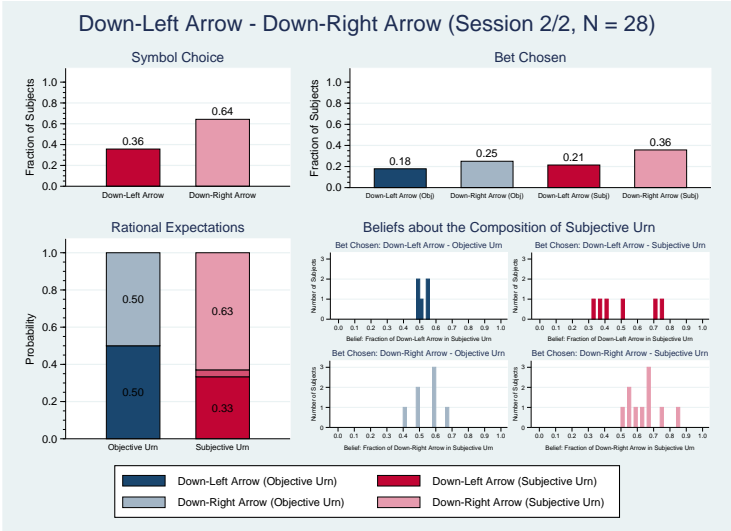
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Results - Study 2 (5 sessions, very preliminary figures)

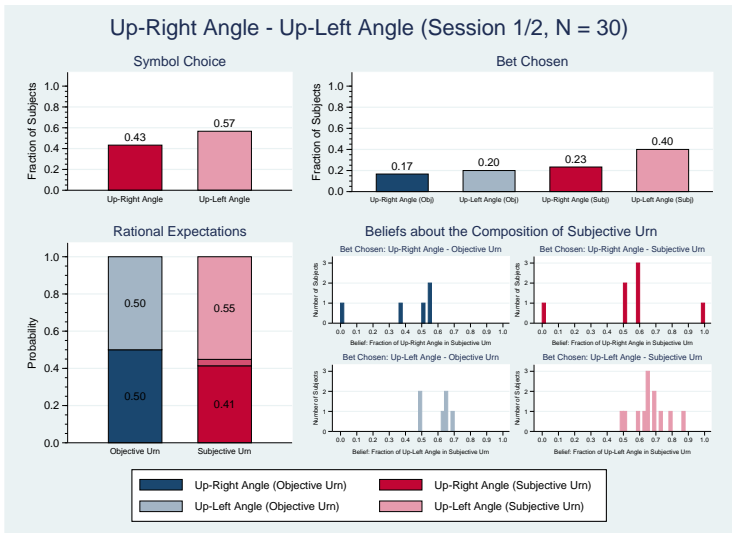
Down-Left Arrow - Down-Right Arrow (Session 1/2)



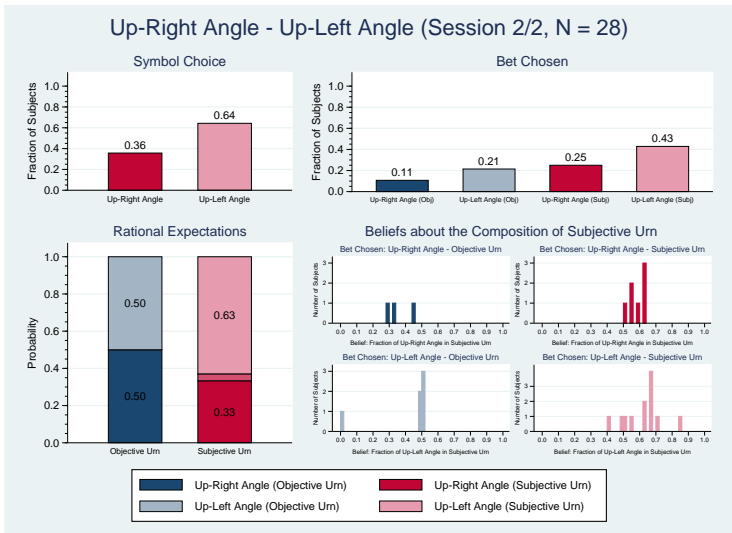
Down-Left Arrow - Down-Right Arrow (Session 2/2)



Up-Right Angle - Up-Left Angle (Session 1/2)

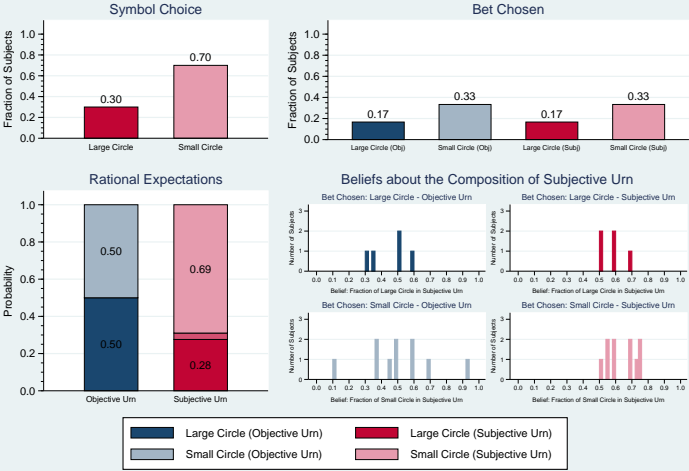


Up-Right Angle - Up-Left Angle (Session 2/2)



Large Circle - Small Circle

Large Circle - Small Circle (Session 1/1, N = 30)



Regression 1

Table: Choosing Objective (0) vs Subjective Urn (1) - probit model

Belief [%]	0.0365*** (0.00827)	0.0356*** (0.00811)	0.0394*** (0.00843)	0.0385*** (0.00828)
Sending A	0.00911 (0.253)	0.0363 (0.249)	0.0460 (0.259)	0.0730 (0.255)
Betting on A	0.225 (0.262)	0.218 (0.259)	0.410 (0.280)	0.409 (0.278)
Objective urn displayed first			0.151 (0.227)	0.130 (0.225)
Choice A displayed first			-0.546* (0.244)	-0.542* (0.243)
Symbol pairs FE	Yes	No	Yes	No

Marginal effects; Standard errors in parentheses

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression 2

Table: Betting on A (1) vs on B (0) - probit model

Belief about % of sent A	0.0226** (0.00722)	0.0221** (0.00715)	0.0248** (0.00756)	0.0244** (0.00750)
Sending A	1.001*** (0.235)	1.002*** (0.234)	0.896*** (0.243)	0.896*** (0.242)
Choosig subjective urn	-0.0917 (0.235)	-0.0811 (0.232)	0.0230 (0.243)	0.0312 (0.242)
Objective urn displayed first			0.0662 (0.241)	0.0627 (0.241)
Choice A displayed first			0.792** (0.243)	0.794** (0.242)
Symbol pairs FE	Yes	No	Yes	No

Marginal effects; Standard errors in parentheses

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression 3

Table: Bet choice - multinomial probit model

	Objective-B	Subjective-A	Subjective-B
Sending A (d)	-0.0542 (0.0866)	0.367*** (0.0815)	-0.335*** (0.0873)
Belief about % of sent A	0.00331 (0.00331)	0.00873*** (0.00231)	-0.0117** (0.00379)
Belief [%]	-0.00433 (0.00321)	-0.00137 (0.00227)	0.0131*** (0.00377)
Objective urn displayed first (d)	-0.0728 (0.0873)	0.0178 (0.0706)	0.0577 (0.0980)
Choice A displayed first (d)	-0.00792 (0.0859)	0.122 (0.0687)	-0.310*** (0.0902)
Observations	146	146	146

Marginal effects; Standard errors in parentheses

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Conclusion

- eliminated asymmetric info: experimenter does not know, no single other subject knows
- evidence now consistent with probabilistic sophistication (Machina/Schmeidler 1992)
- future research: can subjects learn not to use heuristic even when experimenter fills the urn?
- part of larger trend: show where neoclassical econ holds (or is better than thought)
- research agenda: when is ambiguity aversion robust, when does it go away by experience/imitation/feedback

Thank you!

We appreciate comments now or by email.

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