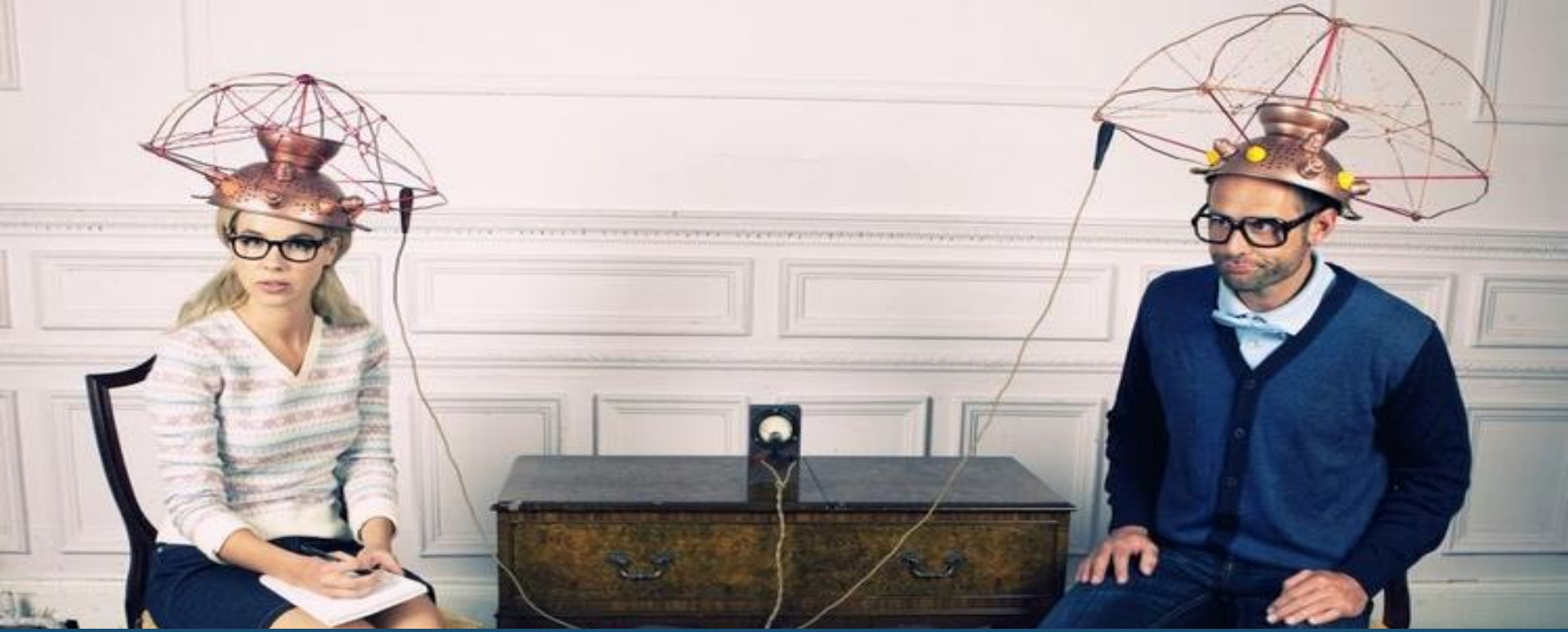

Experimental Economics
Decision-making under risk

Ernesto Reuben

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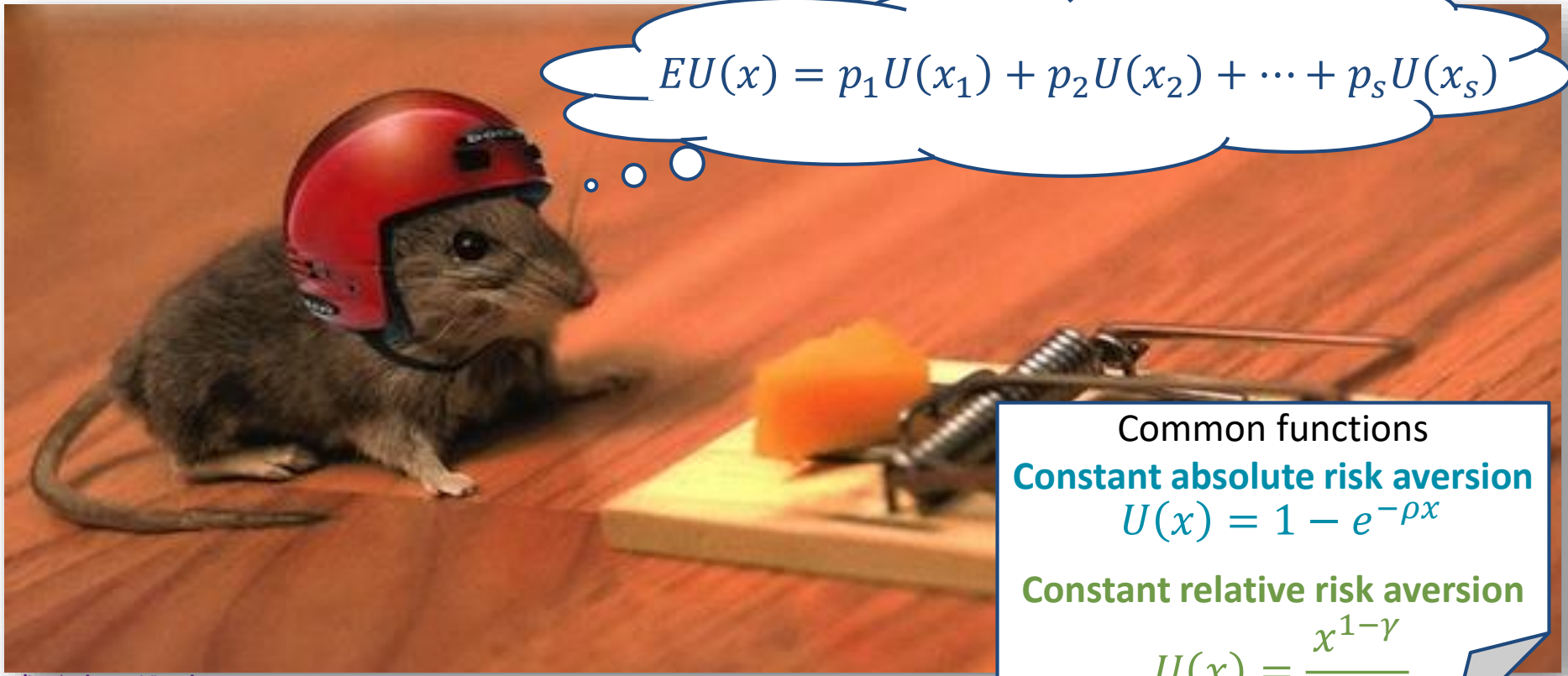
THE ECONOMICS OF RISK AVERSION



Common functions

Constant absolute risk aversion

$$U(x) = 1 - e^{-\rho x}$$

Constant relative risk aversion

$$U(x) = \frac{x^{1-\gamma}}{1-\gamma}$$

How to elicit risk preferences?

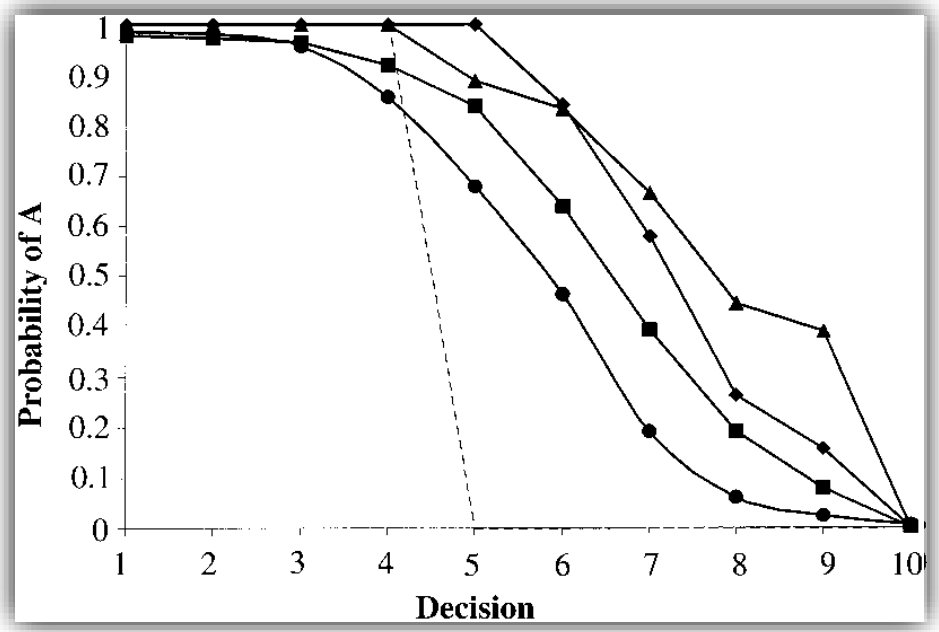
Holt & Laury (2002)

- 212 subjects choose between a series of lotteries
- Treatments: **Low** (≈ $2.50) vs. **High** (from 20x to 90x more) vs. **High hypothetical**

Option A	Option B	Expected difference
1/10 of $180, 9/10 of $144	1/10 of $347, 9/10 of $9	$105
2/10 of $180, 8/10 of $144	2/10 of $347, 8/10 of $9	$75
3/10 of $180, 7/10 of $144	3/10 of $347, 7/10 of $9	$44
4/10 of $180, 6/10 of $144	4/10 of $347, 6/10 of $9	$14
5/10 of $180, 5/10 of $144	5/10 of $347, 5/10 of $9	($16)
6/10 of $180, 4/10 of $144	6/10 of $347, 4/10 of $9	($46)
7/10 of $180, 3/10 of $144	7/10 of $347, 3/10 of $9	($76)
8/10 of $180, 2/10 of $144	8/10 of $347, 2/10 of $9	($107)
9/10 of $180, 1/10 of $144	9/10 of $347, 1/10 of $9	($137)
10/10 of $180, 0/10 of $144	10/10 of $347, 0/10 of $9	($167)

How to elicit risk preferences?

Holt & Laury (2002)



Results

- Almost no risk lovers 8%
- A few risk neutral 26%
- Most are risk-averse 66%
- No difference between **Low** and **High hypothetical**
- Clear difference between **Low** and **High**
  - More risk aversion → 81%

How do they explain increasing relative risk aversion?

- Hybrid of CRRA and CARA with noisy decision making

COMPLEX VS. SIMPLE RISK-PREFERENCE ELICITATION

Dave et al. (2010)

- 881 subjects choose between a series of lotteries
- Treatments: **Simple** (Eckel & Grossman 2002) vs. **complex** (Holt & Laury 2002)

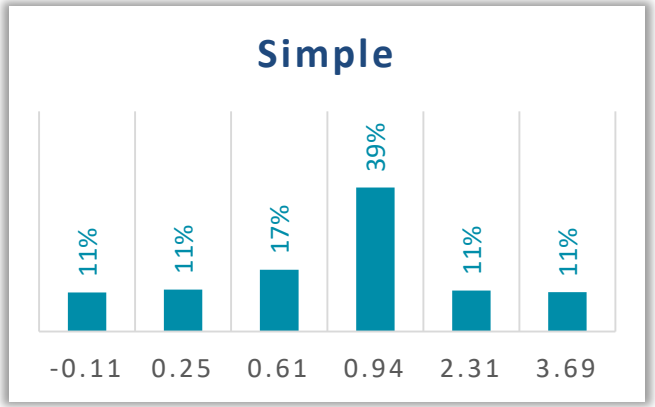
Lottery	Chose A, B, C, D, E, or F
A	1/2 of \$70, 1/2 of \$2
B	**1/2 of \$60, 1/2 of \$12**
C	1/2 of \$52, 1/2 of \$16
D	1/2 of \$44, 1/2 of \$20
E	1/2 of \$36, 1/2 of \$24
F	1/2 of \$28, 1/2 of \$28

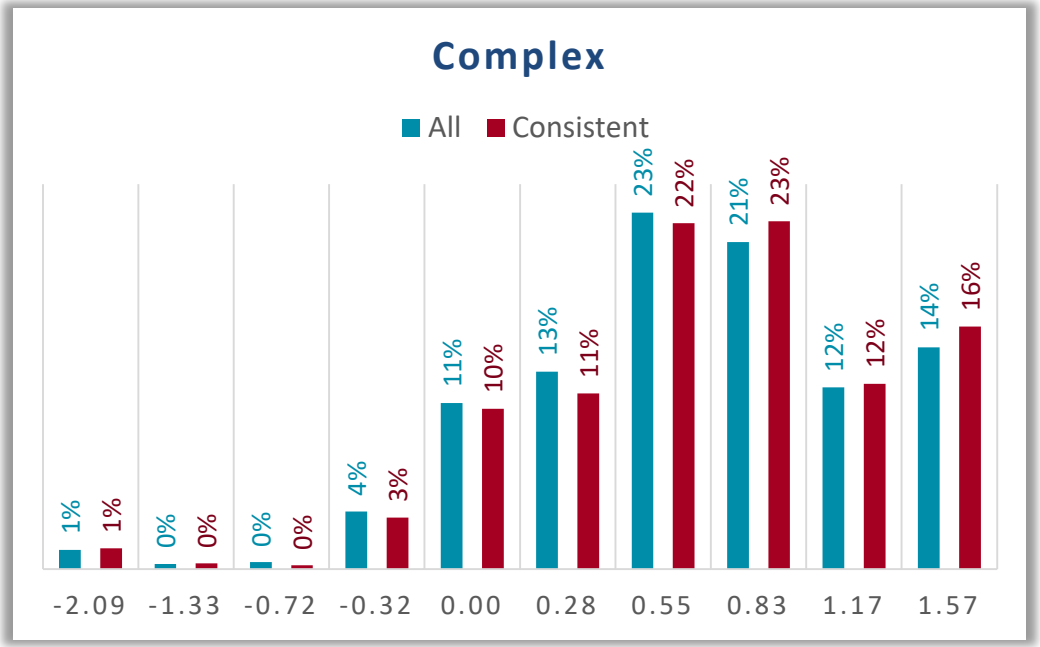
Row	Choose A or B in each row	
	A	B
1	**1/10 of \$40, 9/10 of \$32**	1/10 of \$77, 9/10 of \$2
2	**2/10 of \$40, 8/10 of \$32**	2/10 of \$77, 8/10 of \$2
3	**3/10 of \$40, 7/10 of \$32**	3/10 of \$77, 7/10 of \$2
4	**4/10 of \$40, 6/10 of \$32**	4/10 of \$77, 6/10 of \$2
5	5/10 of \$40, 5/10 of \$32	**5/10 of \$77, 5/10 of \$2**
6	6/10 of \$40, 4/10 of \$32	**6/10 of \$77, 4/10 of \$2**
7	7/10 of \$40, 3/10 of \$32	**7/10 of \$77, 3/10 of \$2**
8	8/10 of \$40, 2/10 of \$32	**8/10 of \$77, 2/10 of \$2**
9	9/10 of \$40, 1/10 of \$32	**9/10 of \$77, 1/10 of \$2**
10	10/10 of \$40, 0/10 of \$32	**10/10 of \$77, 0/10 of \$2**

COMPLEX VS. SIMPLE RISK-PREFERENCE ELICITATION

Dave et al. (2010)

- Again, mostly risk-averse 66% but different estimates depending on the technique: **Complex** detects more risk aversion

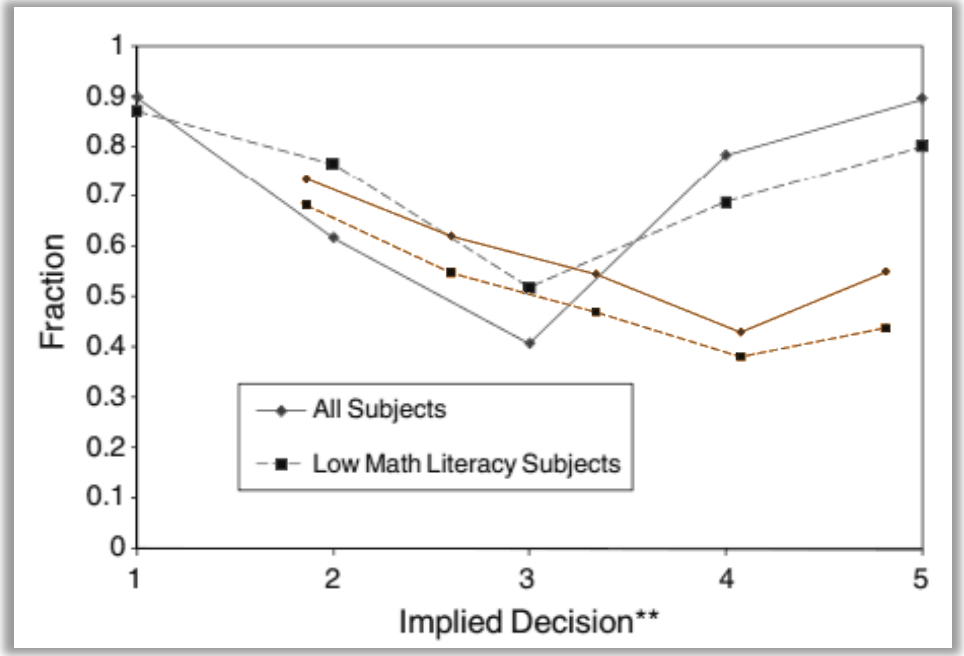




Complex vs. simple risk-preference elicitation

Dave et al. (2010)

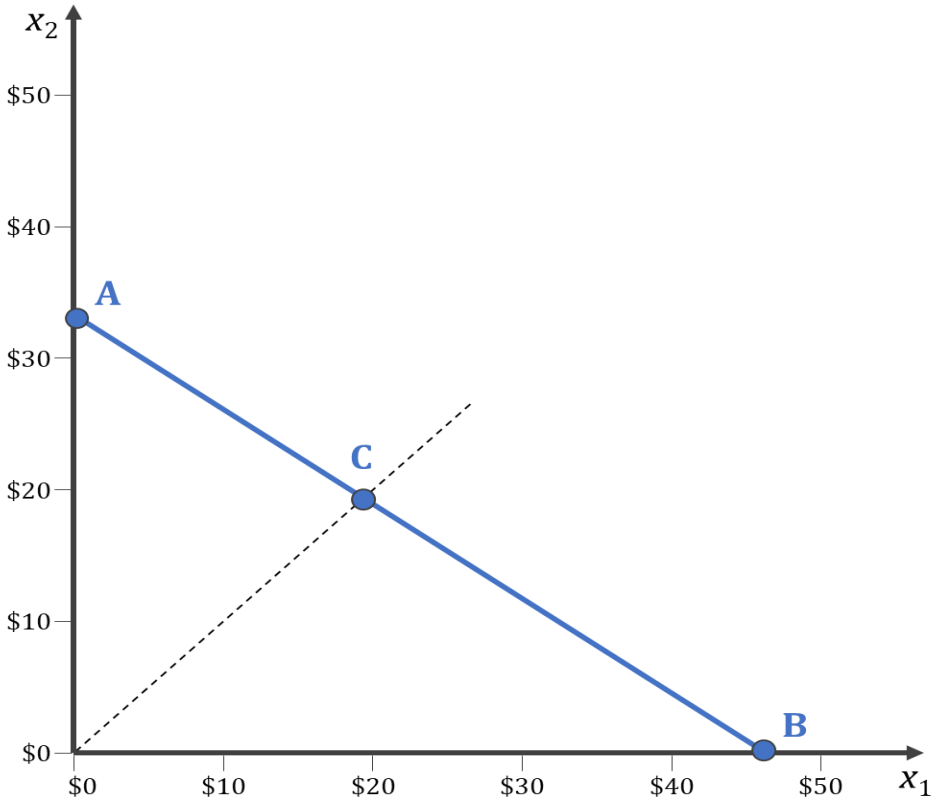
- Predictive accuracy of estimated coefficients by demographics
  - With all subjects, **Complex** has a higher predictive accuracy
  - With low-math literacy subjects, **Simple** has a higher predictive accuracy



Utility maximization and risk-preference elicitation

Choi et al. (2007)

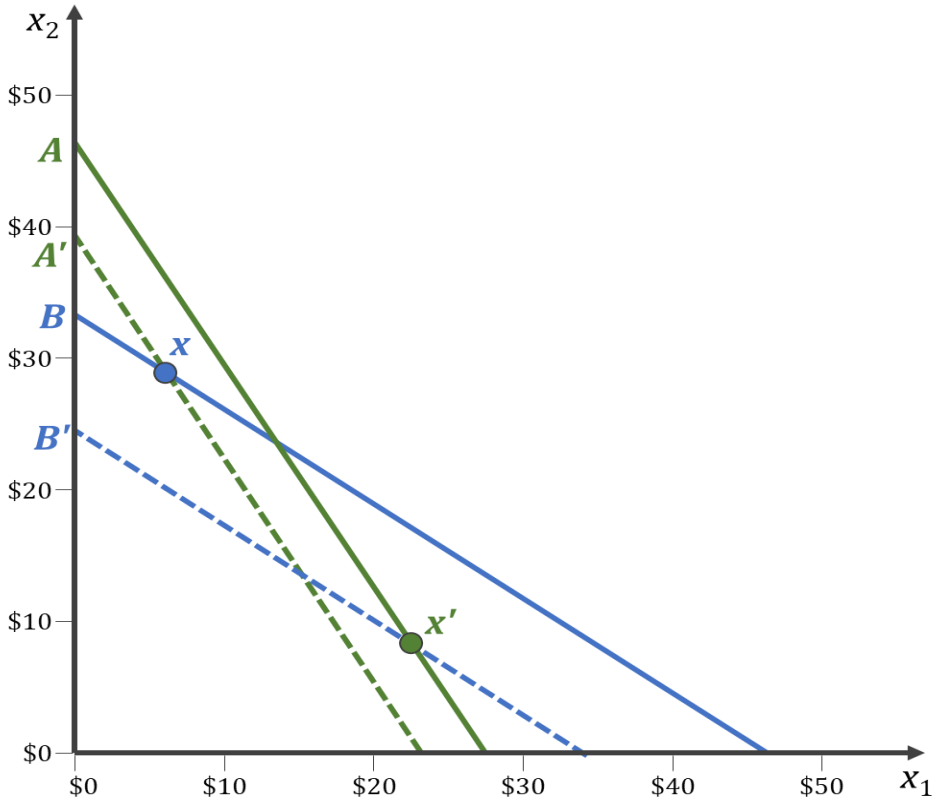
- 93 subjects select 50 portfolios, each corresponding to a point in a budget constraint $p_1x_1 + p_2x_2 = W$, where W is their wealth and x_i is their investment in security i, which pays with probability π_i and is priced at p_i
- Choices made with a graphical interface



Utility maximization and risk-preference elicitation

Choi et al. (2007)

- Measure consistency with utility maximization using the **critical cost efficiency index** (CCEI) of **Afriat (1972)**
  - Minimum amount by which one has to modify budget constraints to eliminate all GARP violations



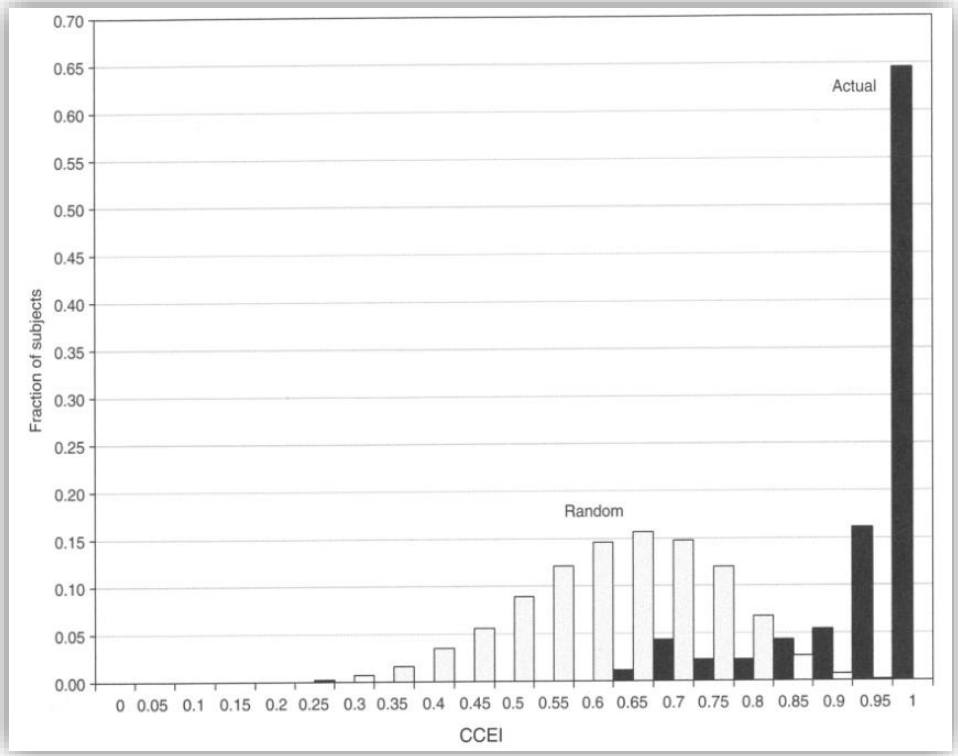
Utility maximization and risk-preference elicitation

Choi et al. (2007)

- High levels of consistency with utility maximization: 80 percent have a CCEI of 0.95 or more
- Similar risk aversion coefficient estimates to other methodologies

Choi et al. (2014)

- No correlation between estimated risk aversion coefficients and CCEI
- CCEI correlates positively with income, household wealth, education, and being male and negatively with age



NON-PARAMETRIC ELICITATION OF UTILITY FUNCTIONS

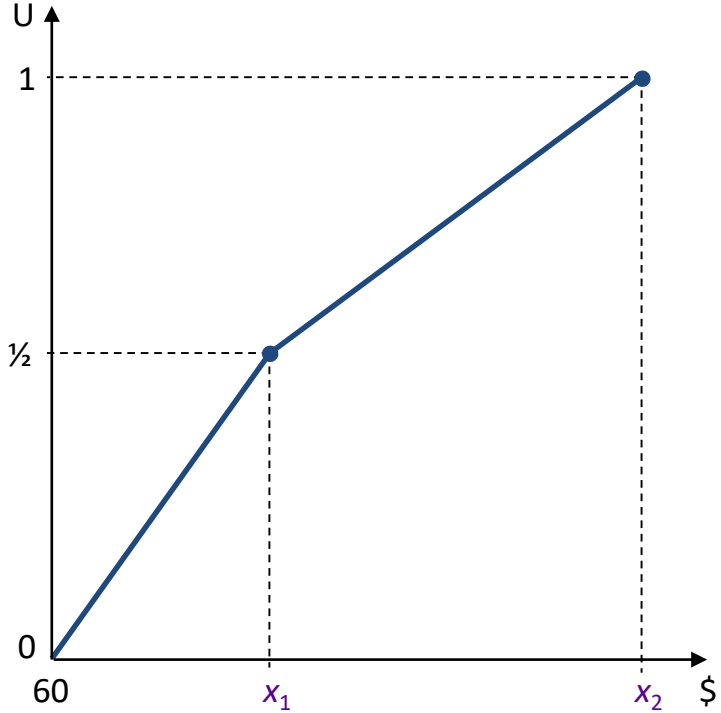
van de Kuilen & Wakker (2011)

- Find the value x_1 that makes you indifferent between **A** and **B**

- Find the value x_2 that makes you indifferent between **C** and **D**

- etc.

Note that
$U(x_2) - U(x_1) = U(x_1) - U(\$60)$



SMALL-STAKE RISK AVERSION

What are we eliciting with small-stake experiments? **(Rabin 2000)**

- Assume your wealth is \$1,000. Do you accept this lottery? Example with $U(x) = x^{(1-\gamma)}/(1-\gamma)$

  $\frac{1}{2} \times \$980^{(1-\gamma)}/(1-\gamma) + \frac{1}{2} \times \$1{,}021^{(1-\gamma)}/(1-\gamma) < \$1{,}000^{(1-\gamma)}/(1-\gamma) \rightarrow \gamma > 2.38091$

- What about the following lotteries?

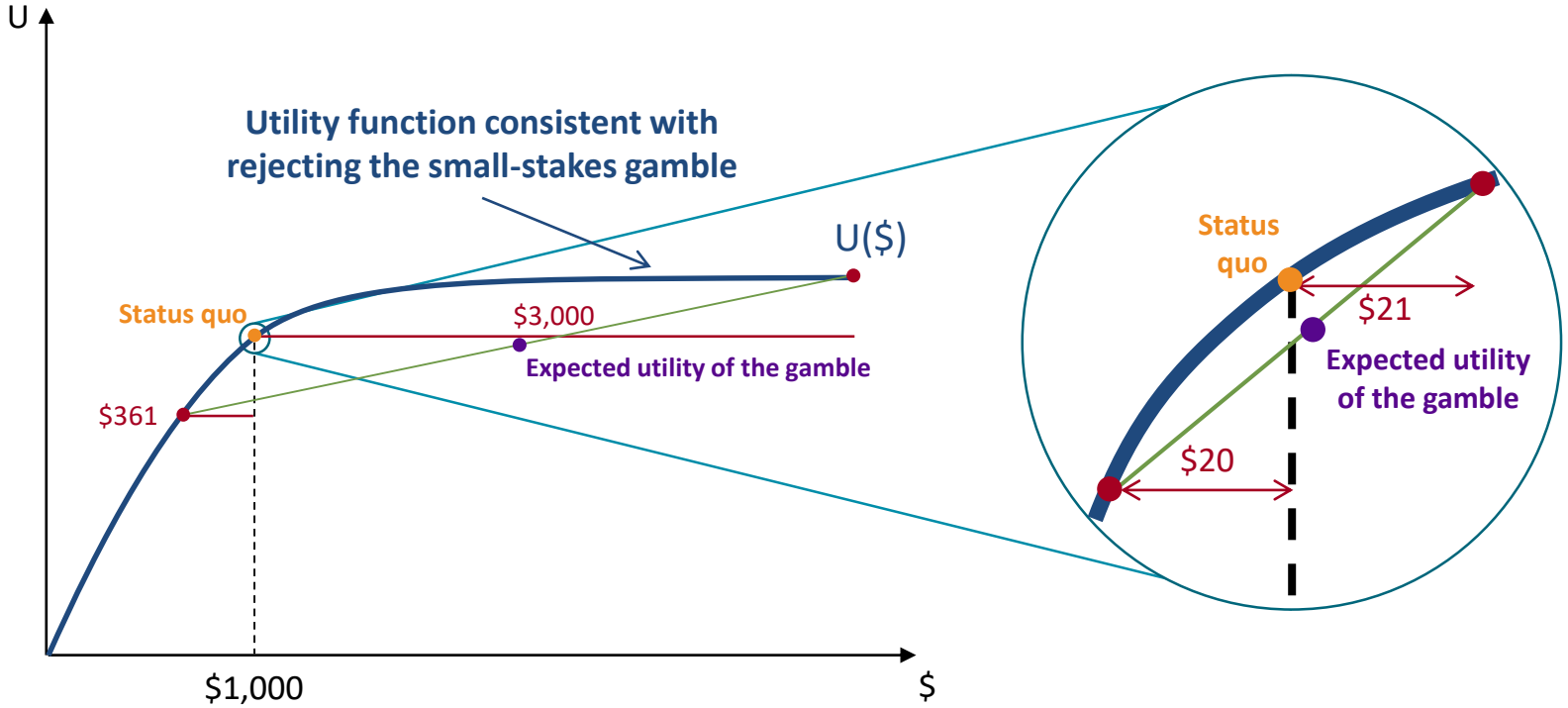
  $\frac{1}{2} \times \$843^{(1-\gamma)} + \frac{1}{2} \times \$1{,}250^{(1-\gamma)} < \$1{,}000^{(1-\gamma)}/(1-\gamma)$

  $\frac{1}{2} \times \$732^{(1-\gamma)} + \frac{1}{2} \times \$1{,}750^{(1-\gamma)} < \$1{,}000^{(1-\gamma)}/(1-\gamma)$

  $\frac{1}{2} \times \$639^{(1-\gamma)} + \frac{1}{2} \times \$4{,}000^{(1-\gamma)} < \$1{,}000^{(1-\gamma)}/(1-\gamma)$

  $\frac{1}{2} \times \$605^{(1-\gamma)} + \frac{1}{2} \times \$301{,}000^{(1-\gamma)} < \$1{,}000^{(1-\gamma)}/(1-\gamma)$

SMALL-STAKES RISK AVERSION?



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- "[Loss aversion] is a departure from expected-utility theory that provides a direct explanation for modest-scale risk aversion" **(Rabin 2000)**

Loss aversion

"The response to losses is consistently much more intense than the response to corresponding gains." **(Kahneman 2003)**

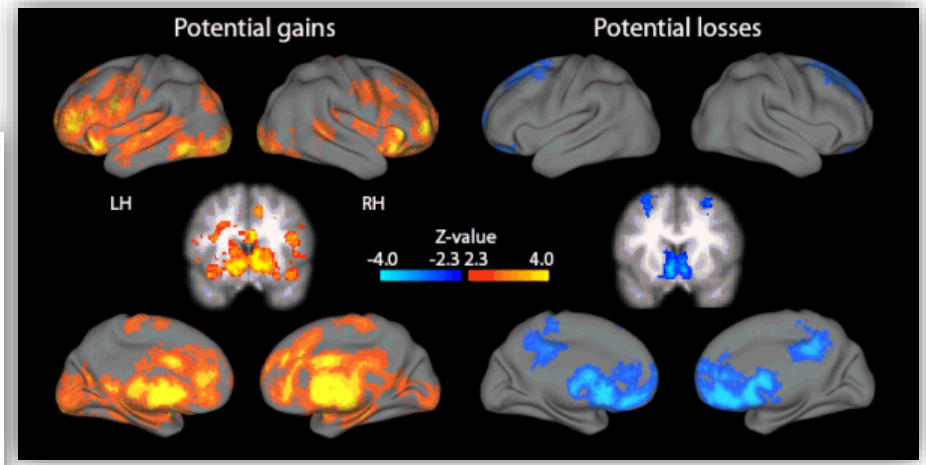
- Two persons get their monthly report from a broker:
  - A is told that her wealth went from $900,000 to $750,000.
  - B is told that her wealth went from $200,000 to $250,000.
  - Who is happier today?

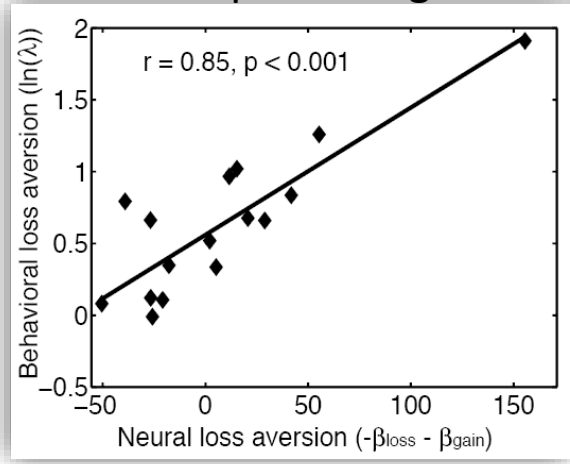
	Lottery (50%)	Lottery (50%)	Safe option
Choice A	$50	$10	$25
Choice B	$30	–$10	$5

LOSS AVERSION INSIDE THE BRAIN

Can we see differences in brain activity for gains and losses? **(Tom et al. 2007)**

- 16 participants who accept/reject gambles while they are scanned using fMRI
- Treatments: increasing **losses** and increasing **gains**
- Activation in *ventral striatum* (associated with assignment of value)
  - Larger decrease in activation due to losses than the increase due to equivalent gains
- Difference in activation is correlated with behavioral loss aversion!





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Loss aversion among our close relatives

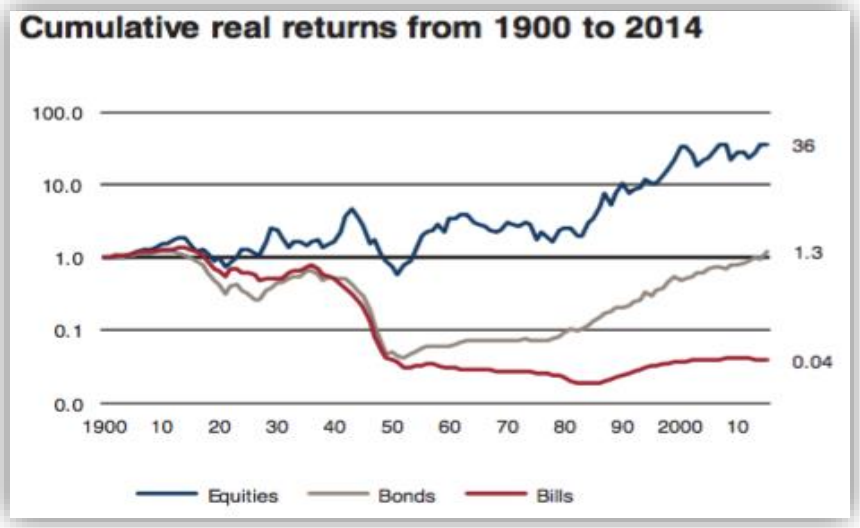
When did loss aversion evolve? Are capuchin monkeys loss averse? **(Chen et al. 2006)**

- First treatment (2 choices)
  - 1 apple **13%**
  - 2 apples – 0.5 × 1 apple **87%**
- Second treatment (2 choices)
  - 2 apples – 0.5 × 1 apple **29%**
  - 1 apple + 0.5 × 1 apple **71%**
- Strong preference for a gamble with gains over an equivalent gamble with a loss

Myopic loss aversion

Can **loss aversion** explain the **equity premium puzzle**?

- Not without additional assumptions



Myopic loss aversion (Benartzi & Thaler 1995)

- Assume **Loss aversion** and **narrow framing**
  - Would you accept this gamble?

    \$50 with $p = 0.333$, –\$20 with $p = 0.667$
  - How about this one?

    \$150 with $p = 0.037$, \$80 with $p = 0.222$, \$10 with $p = 0.444$, –\$60 with $p = 0.297$

Myopic loss aversion

Gneezy & Potters (1997)

- 84 subjects bet 9 times an amount $0 \leq x \leq 200$ cents on a lottery that pays $2.5x$ with probability 33% and $-x$ with probability 67%
- Treatments: Feedback frequency is **high** (after every bet) or **low** (after every three bets)

Investment in lottery (x)	High	Low
Rounds 1-3	52.0	66.7
Rounds 4-6	44.8	63.7
Rounds 7-9	54.7	71.9
Rounds 1-9	**50.5**	**67.4**

ENDOWMENT EFFECT

"… goods that are included in the individual's endowment will be more highly valued than those not held in the endowment, *ceteris paribus*." **(Thaler 1980)**

ENDOWMENT EFFECT

Evidence of the endowment effect (List 2004)

- 124 subjects who could "trade" a candy or a mug after being **randomly-endowed** with:
- **Candy** (could trade for mug), **mug** (could trade for candy), **neither** (must chose candy or mug), or **both** (must give up candy or mug)

Without experience →

Endowed with	Ended with candy
Candy	81%
Mug	23%
Neither	45%
Both	60%

- Does market experience reduce the endowment effect? → repeat the same experiment with 129 similar subjects with market-trading experience (card dealers)

With experience →

Endowed with	Ended with candy
Candy	47%
Mug	44%
Neither	51%
Both	44%

- But experience doesn't always help → card dealers exhibit more myopic loss aversion **(Haigh & List 2005)**

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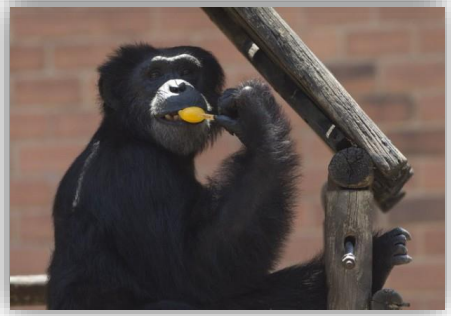
ENDOWMENT EFFECT AMONG OUR CLOSE RELATIVES

When did the endowment effect evolve? Are chimpanzees affected? **(Brosnan et al. 2007)**

- 33 chimpanzees chose between a **juice popsicle** or a tube of **peanut butter** either after they were randomly endowed with one of them or not

Of those not initially endowed
→ **58%** ended with **peanut butter**

Of those **endowed** with **peanut butter**
→ **79%** ended with **peanut butter**



Of those not initially endowed
→ **42%** ended with a **juice popsicle**

Of those **endowed** with **juice popsicle**
→ **58%** ended with a **juice popsicle**

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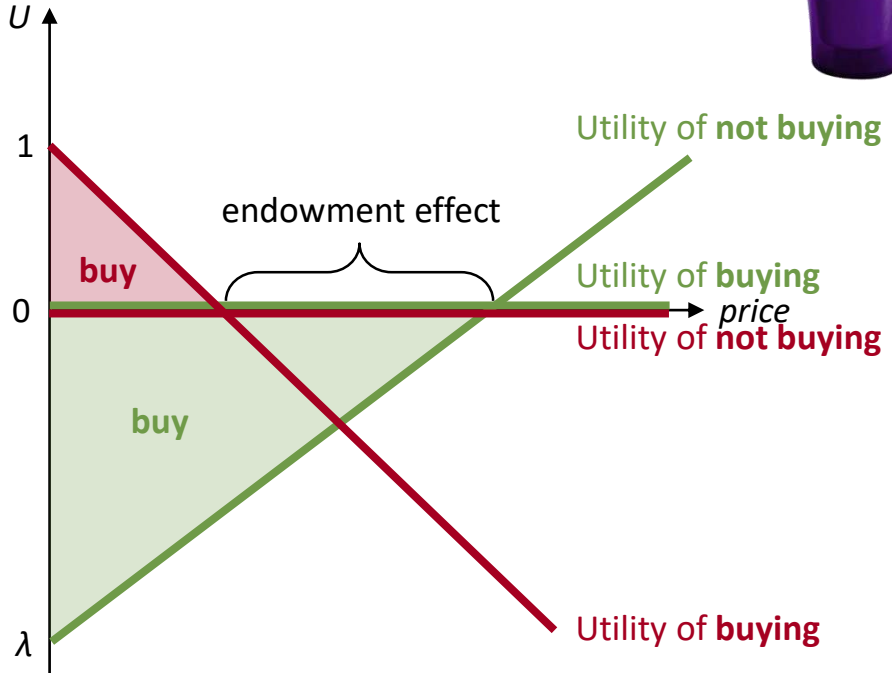
EXPLAINING THE ENDOWMENT EFFECT

- Who just won a silver medal?
- Bronze medalists are happier because they did not expect to win **(Medvec et al. 1995)**
  → Reference-dependent risk attitudes **(Köszegi and Rabin 2007)**

EXPLAINING THE ENDOWMENT EFFECT

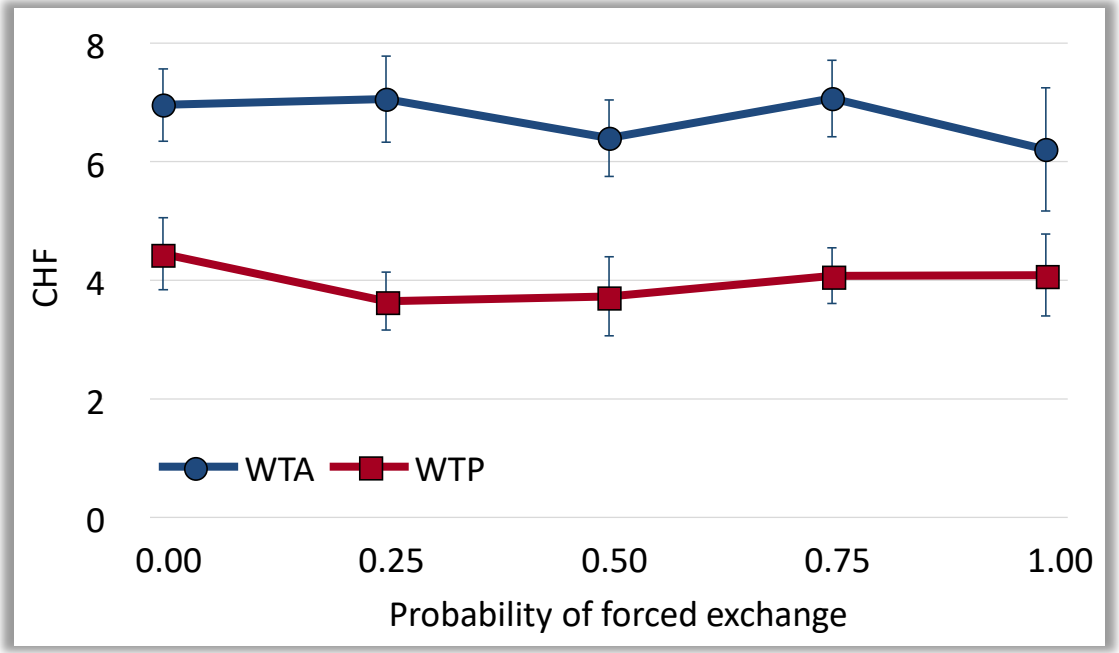
- Consider buying a mug
  - The utility of the mug is 1, the price is p, utility is linear in money, and losses are weighted by λ
- If your expectation is to **not buy**?
  - Utility of not buying: 0 (reference point)
  - Utility of buying: $1 - \lambda p$
- If your expectation is to **buy**?
  - Utility of buying: 0 (reference point)
  - Utility of not buying: $p - \lambda$



Reference-dependent preferences

Reference-dependent preferences and the endowment effect **(Goette et al. 2014)**

- 665 subjects are endowed with either a **mug** or **10 CHF** and submit either their **WTA** or their **WTP** for the mug
- Treatments vary the probability of **forced exchange**: either **0%**, **25%**, **50%**, **75%**, or **99%**



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