Individual Decision Making: Risk, Time and fMRI

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Individual Decision Making

- Regarding Personal Preferences
  - Risk Aversion,
  - Time Discounting,
  - Ambiguity Aversion, etc.
- Measured Characteristics
- Does this correlate with other behavior?

Measuring Risk Preferences

- Consider the following decision:
- You have two choices, A and B:
  - One option gives you NT$1,000,000
  - The other option gives you NT$10,000,000
- Would you pick one of them, or “fold” for a sure NT$5,000,000?
  - (“Who wants to be a millionaire?”)

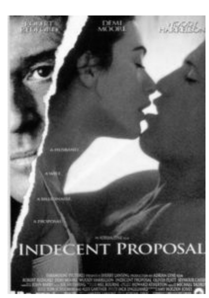
Measuring Risk Preferences

- What if the choices are:
- Option A: 0 or $30,000,000 with (½, ½)
- Option B: $10,000,000 for sure
- What would you choose?
- Why would one take Option B?
- $U(x) = x^{1-r} = x^{0.5}$ (for $r=0.5$)
  - Diminishing Marginal Utility
- Are these too “hypothetical”?

Hypothetical Bias

- **John**: Suppose... I were to offer you one million dollars for one night with your wife.
- **David**: I'd assume you're kidding.
- **John**: Let's pretend I'm not. What would you say?
- **Diana**: He'd tell you to go to hell.
- **John**: I didn't hear him.
- **David**: I'd tell you to go to hell.
- **John**: That's a reflex answer because you view the question as hypothetical. But let's say that there was real money backing it up. I'm not kidding. A million dollars. The night would come and go but the money could last a lifetime. Think of it. A million dollars. A lifetime of security... for one night. Don't answer right away. Just consider it; seriously?

Hypothetical Bias



- **John**: That's a reflex answer because you view the question as hypothetical. But let's say that there was real money backing it up. I'm not kidding. A million dollars. The night would come and go but the money could last a lifetime. Think of it. A million dollars. A lifetime of security... for one night. Don't answer right away. Just consider it; seriously?

Measuring Risk Preferences

- Holt and Laury (AER 2002)
  - (See Handout for the 10 decisions)
- What would you choose?
  - Sorry, I don't have US dollars to pay you…
- Session 1: Real 1x (Baseline)
- Session 2: Hypothetical 20x (or 50x, 90x)
- Session 3: Real 20x (or 50x, 90x)
- Session 4: Real 1x

Real vs. Hypothetical High Stakes

	U(x) = x		$U(x) = x^{0.5}$	
Prob	Safe	Risky	Safe	Risky
0.3	34.40	24.50	5.86	3.62
0.4	35.20	32.00	5.92	4.36
0.5	36.00	39.50	5.99	5.09
0.6	36.80	47.00	6.06	5.83
0.7	37.60	54.50	6.12	6.57
0.8	38.40	62.00	6.19	7.30
0.9	39.20	69.50	6.26	8.04
1.0	40.00	77.00	6.32	8.77

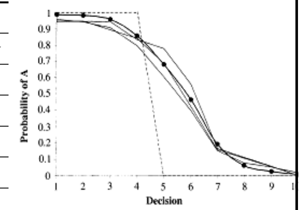


FIGURE 1. PROPORTION OF SAFE CHOICES IN EACH DECISION: DATA AVERAGES AND PREDICTIONS

Note: Data averages for low real payoffs [solid line wit dots], 20x, 50x, and 90x hypothetical payoffs [thin lines] and risk-neutral prediction [dashed line].

Real vs. Real High Stakes (20x,…)

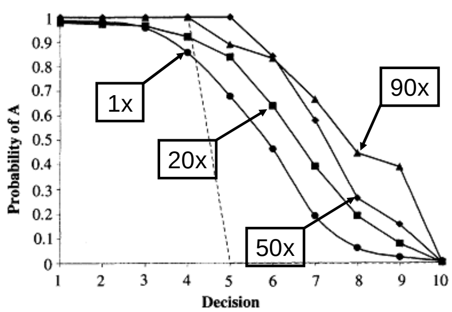


FIGURE 2. PROPORTION OF SAFE CHOICES IN EACH DECISION: DATA AVERAGES AND PREDICTIONS

Risk Aversion at Very High Stakes

Lottery A	Lottery B
\$200 if throw of die is 1-9	\$336.5 if throw of die is 1-9
\$160 if throw of die is 10	\$9 if throw of die is 10
Chosen by 38%	Chosen by 62%

- Even though Lottery B gave \$100 more in expected value, 38% still chose Lottery A!

Average Number of Safe Choice: Order and Incentive Effects

Experiment	Incentives	1x	10x	20x	50x	90x
Holt and Laury (2002) 208 subjects	Real	5.2		6.0	6.8	7.2
	Hypothetical	5.3		4.9	5.1	5.3
Harrison et al. (2005) 178 subjects	Real	5.3	6.4			
			6.0			
Holt and Laury (2005) 168 subjects	Real	5.7		6.7		
	Hypothetical	5.6		5.7		

Between Subject

Order and Incentive Effects

- Participants are risk averse
- Risk aversion increases with "real" higher payoffs
- High hypothetical payoffs are misleading
- Demographics?
  - High income people slightly less risk averse
  - Women are more risk averse ONLY FOR 1x

Follow-up Studies

- – Harrison, Johnson, McInnes, Rutstrom (AER05)
- Harrison, Lau and Rutstrom (SJE 2005)
  - – Representative sample of Denmark (~16x)
  - – Denes are risk averse (r=0.67)
  - – Middle-age and educated are less risk averse
- Dohmen, Falk, Huffman, Sunde, Schupp, Wagner (mimeo 2005)
  - – Large German survey: men, youth, tall, educated are less risk aversion

Prospect Theory Preferences

- Prospect Theory
  - – Risk Aversion, Loss Aversion
  - – Overweighting Low Probabilities
- 1-Parameter Example (Prelec ECMA98):

$$U(x,p;y,q)=\begin{cases} v(y)+\pi(p)(v(x)-v(y)) & \text{if } xy>0 \\ \pi(p)v(x)+\pi(q)v(y) & \text{if } xy<0 \end{cases}$$

$$v(x)=\begin{cases} x^{\alpha} & \text{for } x>0 \\ -\lambda(-x^{\alpha}) & \text{for } x<0 \end{cases} \text{ and } \pi(p)=e^{-(-\ln p)^{\alpha}}$$

Tanaka, Camerer, Nguyen (2007)

- See handout for 3 set of decisions
- Student Presentation:
- Tanaka, Camerer and Nguyen (2007), “Risk and time preferences: Experimental and household data from Vietnam,” revised and resubmitted to the *American Economic Review*.

Time Preferences

- Discounting the Future
  - – Exponential: Dynamic Programming

$$U(c_1,\dots,c_n,\dots)=u(c_0)+\sum_{k=1}^{\infty}\delta^k\cdot u(c_k)$$

- Hyperbolic Discounting

$$U(c_1,\dots,c_n,\dots)=u(c_0)+\beta\sum_{k=1}^{\infty}\delta^k\cdot u(c_k)$$

Preference Reversals

- A: When will you quit smoking?
- B: Tomorrow!
  - – The next day,
- A: When will you quit smoking?
- B: Tomorrow!
- A: But you said that yesterday…
- Tomorrow Never Dies

Hyperbolic Discounting

- Student Presentation
- McClure, Laibson, Loewenstein and Cohen (2004), “Separate Neural Systems Value Immediate and Delayed Monetary Rewards” *Science* 306, October 15 2004

Hyperbolic Discounting Follow-up

- McClure, Ericson, Laibson, Loewenstein, and Cohen (2007) "Time Discounting for Primary Rewards." *Journal of Neuroscience*, 27: 5796–5804.
- Now or 10-30 minutes later
- Immediate "Juice" reward in the scanner
  - How does the results change?
- At what age do children develop into non-hyperbolic discounting?