



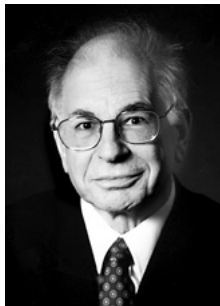
Prospect Theory: Kahneman and Tversky

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Authors



Daniel Kahneman

<http://nobelprize.org/>



Amos Tversky

<http://www.dangoldstein.com/dsn/>

Historical context



- ▶ published 1979
- ▶ 7135 Google Scholar “citations”
- ▶ Tversky left in 1996
- ▶ Nobel 2002: “psychology into economics”

Role of Tversky



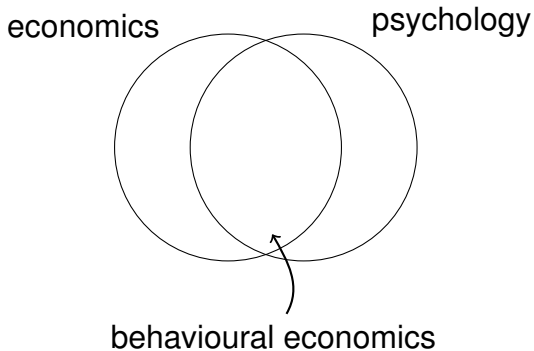
The Nobel Prize was awarded for work that we produced during that period of intense collaboration. (Kahneman, 2002)

Earlier paper

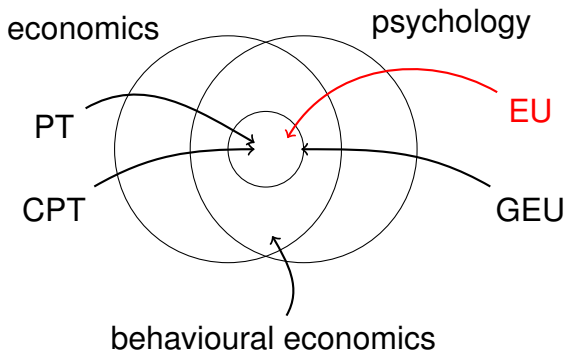


- ▶ Tversky and Kahneman, *Judgment under Uncertainty: Heuristics and Biases*, *Science* 185 (1974), 1124–1131
- ▶ (indirect) attack on rational-agent model
- ▶ but NOT demonstration of irrationality
- ▶ Allais's paradox: non-linear response to risk – how to model?

Utility theory

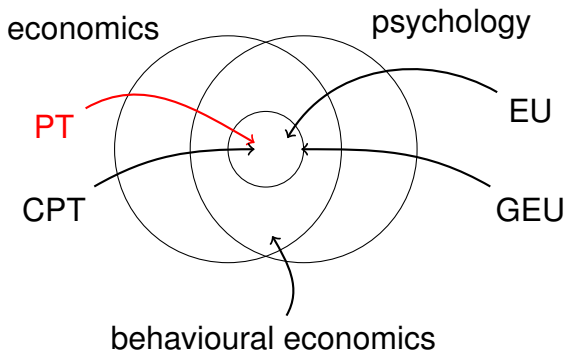


Utility theory



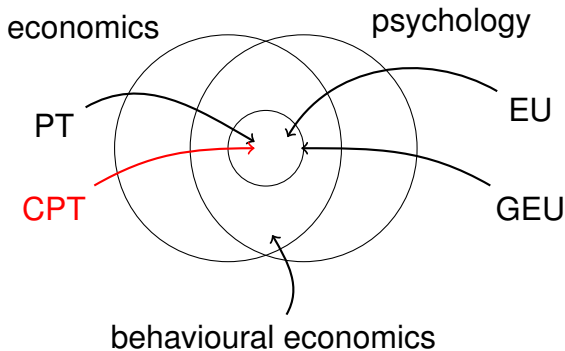
- ▶ **expected utility theory**
(Von Neumann/Morgenstern, 1944)
- ▶ prospect theory (1979)
- ▶ cumulative prospect theory (1992)
- ▶ generalized expected utility theory

Utility theory



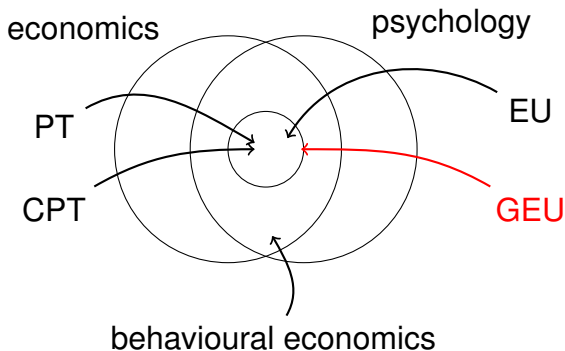
- ▶ expected utility theory (Von Neumann/Morgenstern, 1944)
- ▶ **prospect theory (1979)**
- ▶ cumulative prospect theory (1992)
- ▶ generalized expected utility theory

Utility theory



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- ▶ prospect theory (1979)
- ▶ **cumulative prospect theory (1992)**
- ▶ generalized expected utility theory

Utility theory



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- ▶ **generalized expected utility theory**

Utility theory



- ▶ X state space: mutually exclusive
- ▶ utility function $u: X \rightarrow \mathbb{R}$
- ▶ u captures preferences
- ▶ EU Theorem: u exists iff preference relation
 - ▶ complete
 - ▶ transitive
 - ▶ convex/continuous
 - ▶ independent
- ▶ lexicographic preferences!

Prospect



- ▶ $(x_1, p_1; \dots; x_n, p_n)$: **weighted pd**
- ▶ $p_i = 0 \Rightarrow (x_1, p_1; \dots; x_n, p_n) =$
 $(x_1, p_1; \dots; x_{i-1}, p_{i-1}; x_{i+1}, p_{i+1}; \dots; x_n, p_n)$
- ▶ $(x, p) = (x, p; 0, 1 - p)$
- ▶ $(x) = (x, 1)$: **certain prospect**

Inspiration



... we offered a progress report on our study of judgment under uncertainty, which included much solid evidence. All inferences about human rationality were drawn by the readers themselves. (Kahneman, 2002)

Critique of expected utility



- ▶ expectation: $U(x_1, p_1; \dots; x_n, p_n) = \sum_{i=1}^n p_i u(x_i)$
- ▶ asset integration: $(x_1, p_1; \dots; x_n, p_n)$ acceptable at w
iff $U(w + x_1, p_1; \dots; w + x_n, p_n) > u(w)$
- ▶ risk aversion: u concave

Experiments



1	(2500, .33; 2400, .66)	[2409]	(2400)	[2400]
2	(2500, .33)	[825]	(2400, .34)	[816]
3	(4000, .8)	[3200]	(3000)	[3000]
4	(4000, .2)	[800]	(3000, .25)	[750]
5	(3 week, .5)		(1 week)	
6	(3 week, .05)		(1 week, .1)	
7	(6000, .45)	[2700]	(3000, .9)	[2700]
8	(6000, .001)	[60]	(3000, .002)	[60]

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Experiments



9	$(-x, p/2; -y, p/2)$ $U(-y) = U(-x, p)$	$(-x, p)$ NB: framing!
10	$((4000, .8), .25)$	$((3000), .25)$
11	$(1000 + 0, .5; 1000 + 1000, .5)$	$(1000 + 500)$
12	$(2000 - 1000, .5; 2000, .5)$	$(2000 - 500)$
13	$(6000, .25)$	$(4000, .25; 2000, .25)$
13'	$(-6000, .25)$	$(-4000, .25; -2000, .25)$
14	$(5000, .001)$	(5)
14'	$(-5000, .001)$	(-5)

Experiments



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Editing



- ▶ framing (coding): frame of reference
- ▶ combination: $V(200, .25; 200, .25) = V(200, .5)$
- ▶ segregation: $V(300, .8; 200, .2) = V(200) + V(100, .8)$
- ▶ cancellation: $(y, p; P_1)$ vs. $(y, p; P_2) = P_1$ vs. P_2
- ▶ rounding: $V(101, .49) \approx V(100, .5)$
- ▶ discard unlikely: $V(x, \epsilon; P_1) = V(P_1)$
- ▶ dominance detection

Value



- ▶ v value function
- ▶ concave and steeper for gains, convex for losses
- ▶ π weight function
- ▶ usually $\sum_{i=1}^n \pi(p_i) < 1$, $\pi(\epsilon) > \epsilon$
- ▶ V overall value, after editing

$$V(x_1, p_1; \dots; x_n, p_n) = \sum_{i=1}^n \pi(p_i)v(x_i)$$

- ▶ $V(x) = v(x)$
- ▶ “special” circumstances: $V(P_1|w) \neq V(P_1|w')$

Continuous prospects



- ▶ Tversky and Kahneman, *Advances in Prospect Theory: Cumulative Representation of Uncertainty*, *Journal of Risk and Uncertainty* 5 (1992), 297–323.
- ▶ Karmakar, *Subjectively Weighted Utility: A Descriptive Extension of the Expected Utility Model*, *Organizational Behavior and Human Performance* 21 (1978), 61–72.
- ▶ Rieger and Wang, *Prospect theory for continuous distributions*, *Journal of Risk and Uncertainty* 36 (2008), 83–102.

Key ideas



- ▶ previous: utility related to total wealth
- ▶ adopted differences in wealth instead
- ▶ important because of *loss aversion*
- ▶ *asymmetry* explains property market goes quiet when prices drop, market activity goes up when prices rise
- ▶ *reflection*: flip risk seeking & averse behaviours when exchanging losses and gains
- ▶ *framing*: objects of choice are mental models, not states of world

Controversy



paradoxes “can be made to disappear”

Cognitive illusions



Kahneman/Frederick, 2002

- ▶ System 1: rapid judgement (effortless)
- ▶ System 2: application of rules (effortful)
- ▶ System 1 error, System 2 does not correct

cognitive illusions

Cognitive illusions



→ *Blink*, Malcolm Gladwell, 2005

- ▶ System 1: *thin slicing*/rapid cognition
- ▶ System 2: conscious cognition
- ▶ bad rapid cognition

stereotyping