

Prospect Theory and Preference Reversals

PSYC201: Cognitive Psychology

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Week 9

How Do People *Actually* Make Decisions?

Cognitive Psychology

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Reference Dependence

Value Function
Isolation Effect
Losses loom larger than gains
Endowment Effect
Status Quo Bias

The Four-Fold Pattern

Decision Weights
The Certainty Effect

Framing

Asian Disease Problem

Preference Reversals

How Good Is Prospect Theory?

- Dominant account of human choice is **prospect theory** (Kahneman & Tversky, 1979)
- Maintains idea from EUT that choices involve maximising some kind of expectation
- But utilities and probabilities of outcomes undergo systematic cognitive distortions when evaluated
- Prior to this evaluation, the decision maker must construct a mental representation of the decision problem
- Involves framing options relative to some reference point and the editing of gambles to simplify the choice problem

Daniel Kahneman and Amos Tversky

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How Good Is Prospect Theory?



EUT: Diminishing Marginal Utility, Risk Aversion, and Prospect Evaluation

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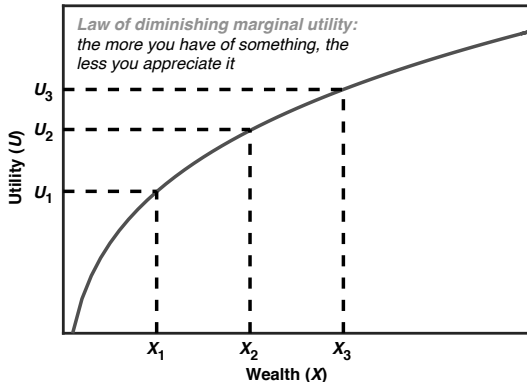
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How Good is Prospect Theory?



- Money has diminishing marginal utility
- People are risk averse: they prefer a sure amount (£500) to a gamble with the same expected value (e.g. 50% chance of winning £1000)
- *Gambles are evaluated in terms of overall states of wealth they lead to*

The Value Function

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How Good Is
Prospect
Theory?

- According to prospect theory, people do not evaluate the outcomes of gambles in terms of *total* wealth
- They interpret them as *changes* in wealth—specifically, gains or losses relative to a neutral reference point
- To capture this, in prospect theory the utility function of EUT is replaced with an S-shaped value function

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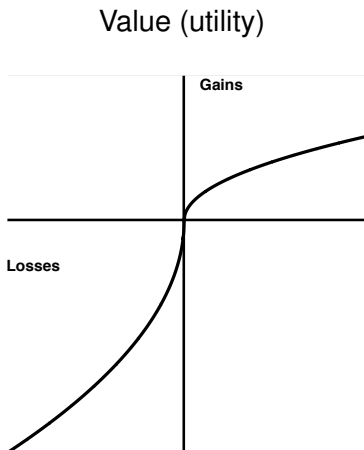
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Preference Reversals

How Good Is Prospect Theory?

- Different functions for gains and losses
- Slope of the function for losses is steeper than for gains → loss aversion
- Value function is concave in domain of gains → risk aversion
- Value function is convex in domain of losses → risk seeking



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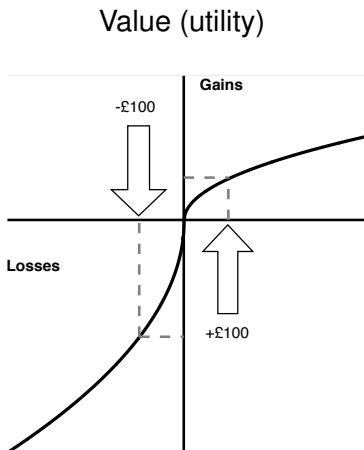
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How Good Is Prospect Theory?

- Different functions for gains and losses
- Slope of the function for losses is steeper than for gains → loss aversion
- Value function is concave in domain of gains → risk aversion
- Value function is convex in domain of losses → risk seeking



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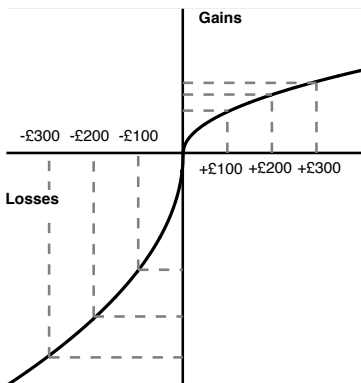
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Preference Reversals

How Good Is Prospect Theory?

- Different functions for gains and losses
- Slope of the function for losses is steeper than for gains → loss aversion
- Value function is concave in domain of gains → risk aversion
- Value function is convex in domain of losses → risk seeking

Value (utility)



Isolation Effect (Kahneman & Tversky, 1979)

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How Good Is
Prospect
Theory?

- Do people interpret outcomes in terms of changes of wealth rather than final states of wealth?
- Supporting evidence from the *isolation effect* (Kahneman & Tversky, 1979)

Isolation Effect (Kahneman & Tversky, 1979)

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How Good Is
Prospect
Theory?

Problem 1

In addition to whatever you own, you have been given £1000. You are now asked to choose between:

A: a 50% chance of £1000

B: £500 for sure

Problem 2

In addition to whatever you own, you have been given £2000. You are now asked to choose between:

C: a 50% chance of losing £1000

D: a sure loss of £500

Isolation Effect (Kahneman & Tversky, 1979)

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Problem 1

In addition to whatever you own, you have been given £1000. You are now asked to choose between:

A: a 50% chance of £1000

B: £500 for sure

Problem 2

In addition to whatever you own, you have been given £2000. You are now asked to choose between:

C: a 50% chance of losing £1000

D: a sure loss of £500

In problem 1, the majority of participants (84%) chose option B demonstrating risk-aversion in the domain of gains

In problem 2, the majority of participants (69%) chose option C demonstrating risk-seeking in the domain of losses

Isolation Effect (Kahneman & Tversky, 1979)

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However, the two choice problems are identical if construed in terms of final states of wealth:

$$\begin{aligned}A &= \text{£}1000 + 50\% \text{ chance of } \text{£}1000 \\ &= \text{£}2000 - 50\% \text{ chance of } \text{£}1000 \\ &= C\end{aligned}$$

$$\begin{aligned}B &= \text{£}1500 \text{ for sure} \\ &= D\end{aligned}$$

These choices conflict with EUT, which requires the same pattern of choices be made in both problems (e.g., either A and C or B and D)

The results fit with the predictions of prospect theory

Losses Loom Larger Than Gains

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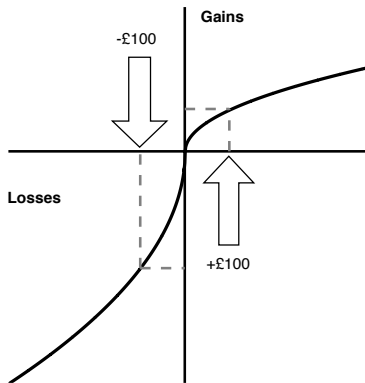
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Preference Reversals

How Good Is Prospect Theory?

- The value function is much steeper in the domain of losses than the domain of gains
- Implies that the displeasure of a loss of £100 is greater than the pleasure of £100
- Hence, people are more averse to losses than equivalent sized gains
- This phenomenon is known as **loss aversion** (Kahneman & Tversky, 1979)



Evidence For Loss Aversion

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How Good Is
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Theory?

- People dislike gambles that offer an equal probability of winning or losing the same amount of money
- They tend to reject gambles that offer a 50% chance of winning £X and a 50% chance of losing £X (especially when X is a large amount)
 - e.g., a 50% chance of gaining £1000 and a 50% chance of losing £1000
- Stronger demonstrations of loss aversion come from the endowment effect and status quo bias

Endowment Effect

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Preference Reversals

How Good Is Prospect Theory?

- Once you acquire something, you are often reluctant to give it up even if offered a price that is more than you paid for it
- This phenomenon is known as the **endowment effect** (Thaler, 1980)

Endowment Effect (Kahneman, Knetsch, & Thaler, 1990)

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How Good Is Prospect Theory?

- Randomly allocated university mugs (worth \approx \$5) to some (but not all) of their students
- Students who had received mugs (the 'sellers') were asked how much they would be willing to sell their mugs for
- The other students (the 'choosers') were asked about their preferences between receiving the mug or various amounts of money
- From a normative standpoint both groups face the same decision problem: mug vs. money
- *But factoring in loss aversion, their situations are different*

Endowment Effect (Kahneman, Knetsch, & Thaler, 1990)

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Preference Reversals

How Good Is Prospect Theory?

- The sellers are contemplating how much money they would accept to *give up* their mug (evaluating a potential loss)
- The choosers are contemplating how much money they would pay to *acquire* the same mug (evaluating a potential gain)

Endowment Effect (Kahneman, Knetsch, & Thaler, 1990)

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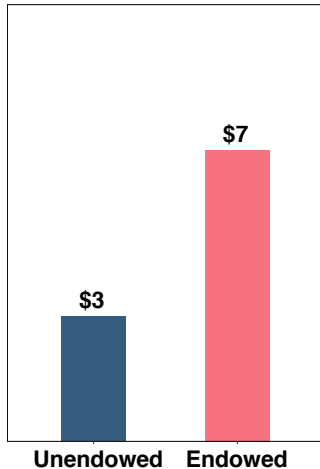
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Preference Reversals

How Good Is Prospect Theory?

- The sellers are contemplating how much money they would accept to *give up* their mug (evaluating a potential loss)
- The choosers are contemplating how much money they would pay to *acquire* the same mug (evaluating a potential gain)
- Simply endowing students with the mugs shifted their evaluations of its worth relative to unendowed students



Endowment Effect and EUT

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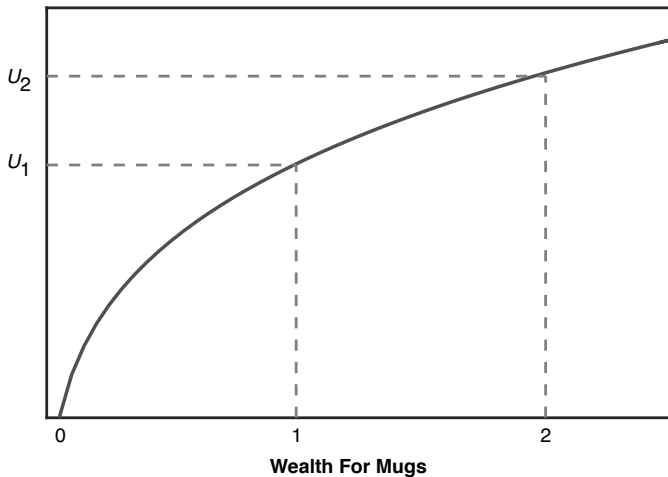
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Preference Reversals

How Good Is Prospect Theory?



Status Quo Bias (Samuelson & Zeckhauser, 1988)

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How Good Is
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- Related to the endowment effect is the **status quo bias** (Samuelson & Zeckhauser, 1988)
- People prefer to remain in the same state (status quo) than take a risk to move to another state
- *Losses of moving away from the status quo loom larger than the potential gains*

Status Quo Bias (Samuelson & Zeckhauser, 1988)

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How Good Is Prospect Theory?

- Two groups of participants:
 - 1 told they had inherited a sum of money
 - 2 told they had inherited a portfolio of investments, most of which were concentrated in one specific option (medium risk)
- Both groups then asked to choose from various investment options (low-risk, moderate-risk, high-risk)
- Participants in group (2) showed a strong status quo bias—they preferred to stick with the previously invested option

The Four-Fold Pattern

- Prospect theory was developed to explain the 'four-fold' pattern shown below

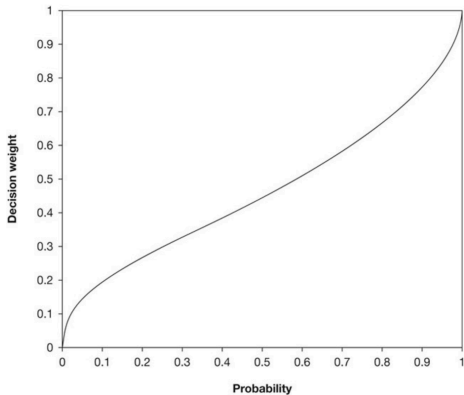
Table: The four-fold pattern of choice behaviour

	Gains	Losses
Small probabilities	Risk-seeking	Risk-aversion
Medium and large probabilities	Risk-aversion	Risk-seeking

- Value function only explains the 'two-fold' pattern of risk-aversion for gains and risk-seeking for losses
- To capture the whole pattern, prospect theory incorporates the notion of **decision weights**

Decision Weights

- Decision makers transform the 'objective' probability of an outcome into a decision weight (a subjective probability)



Decision Weights

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Theory?

- Decision weights can explain risk-seeking with gambles offering small probabilities of gains (e.g., the widespread purchase of lottery tickets) ...
- ... and risk-aversion with gambles that offer small probabilities of losses (e.g., the widespread purchase of insurance)

Decision Weights (Kahneman & Tversky, 1979)

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Preference Reversals

How Good Is Prospect Theory?

Problem 1

Choose between:

A: a 0.001 chance of £5000

B: £5 for sure

Problem 2

Choose between:

C: a 0.001 chance of losing £5000

D: losing £5 for sure

Decision Weights (Kahneman & Tversky, 1979)

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How Good Is Prospect Theory?

Problem 1

Choose between:

A: a 0.001 chance of £5000

B: £5 for sure

Problem 2

Choose between:

C: a 0.001 chance of losing £5000

D: losing £5 for sure

In problem 1, the majority of participants (72%) chose A indicating risk seeking (and replicating the behaviour of lottery players)

In problem 2, the majority of participants (83%) chose D indicating risk-aversion (the behaviour cherished by insurers)

The Certainty Effect

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How Good Is
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- People place a special emphasis on outcomes that are guaranteed to occur or not to occur (cf. Allais paradox)
- Known as the **certainty effect**
- Consider a game of Russian Roulette:
 - how much would you pay to reduce the number of bullets from 4 to 3?
 - what about 1 to 0?
- A shift from uncertainty to certainty (e.g., increasing the chances of survival from 5/6 to 1) is weighted more than an equivalent shift from one uncertain state to another (e.g., an increase from 2/6 to 3/6)

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Preference Reversals

How Good Is Prospect Theory?

- When considering possible gains, people prefer a certain win to a probable win offering a larger gain
- For example, they prefer a certain option of £3000 to an 80% chance of £4000
- When considering possible losses, people prefer a probable large loss to a certain small loss
- For example, they prefer an 80% chance of losing £4000 to a certain loss of £3000

Reflection effect (Kahneman & Tversky, 1979)

- preferences over pairs of gambles in the domain of gains are reversed when the gains are substituted with losses

The Certainty Effect

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- For example, they prefer an 80% chance of losing £4000 to a certain loss of £3000

Reflection effect (Kahneman & Tversky, 1979)

- preferences over pairs of gambles in the domain of gains are reversed when the gains are substituted with losses

The Certainty Effect

Positive prospects			Negative prospects		
1	(4000, .80) 20%	< (3000) 80%	1'	(-4000, .80) 92%	> (-3000) 8%
2	(4000, .20) 65%	> (3000, .25) 35%	2'	(-4000, .20) 42%	< (-3000, .25) 58%
3	(3000, .90) 86%	> (6000, .45) 14%	3'	(-3000, .90) 8%	< (-6000, .45) 92%
4	(3000, .002) 27%	< (6000, .001) 73%	4'	(-3000, .002) 70%	> (-6000, .001) 30%

Note: Adapted from Kahneman, D., & Tversky, A. (1979) Prospect theory: An analysis of decision under risk. *Econometrica*, 47, 263–291.

- For gains, the more certain gamble is preferred to the less certain gamble with large probabilities (1 and 3), whereas with small probabilities (2 & 4) the gamble offering the larger gain is preferred
- The pattern is reversed for the same gambles involving losses

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Preference Reversals

How Good Is Prospect Theory?

- According to prospect theory, the choices people make are determined by their mental representations of the decision problem
- Specifically, whether outcomes are interpreted in terms of gains or losses relative to a specific reference point
- The classic demonstration of this is the Asian disease problem

Loss vs. Gain Framing: Kahneman & Tversky, 1979

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How Good Is
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Problem 1

Imagine that the US is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programmes to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programme are as follows:

If Programme A is adopted, 200 people will be saved.

If Programme B is adopted, there is a 1/3 probability that 600 people will be saved and a 2/3 probability that no people will be saved.

Which of the two programmes would you favour?

Loss vs. Gain Framing: Kahneman & Tversky, 1979

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If Programme A is adopted, 200 people will be saved.

If Programme B is adopted, there is a 1/3 probability that 600 people will be saved and a 2/3 probability that no people will be saved.

Which of the two programmes would you favour?

When participants are presented with Problem 1, the majority (72%) prefer option A. This reflects risk-aversion—people prefer the sure gain of 200 lives to the 1/3 chance of saving 600 lives.

Loss vs. Gain Framing: Kahneman & Tversky, 1979

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Problem 2

Same background scenario.

If Programme C is adopted, 200 people will die.

If Programme D is adopted, there is a 1/3 probability that nobody will die and a 2/3 probability that 600 people will die.

Which of the two programmes would you favour?

Loss vs. Gain Framing: Kahneman & Tversky, 1979

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Problem 2

Same background scenario.

If Programme C is adopted, 200 people will die.

If Programme D is adopted, there is a 1/3 probability that nobody will die and a 2/3 probability that 600 people will die.

Which of the two programmes would you favour?

When presented with Problem 2, the majority of people (78%) select option D (even if they have already answered Problem 1). This reflects risk-seeking—they prefer the gamble over the sure loss.

Loss vs. Gain Framing: Kahneman & Tversky, 1979

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How Good Is Prospect Theory?

- Problem 1 → outcomes framed as possible gains relative to a reference point of 600 people dying
- Problem 2 → outcomes framed as possible losses relative to a reference point of no one dying
- As predicted by prospect theory, respondents shift their choices according to the reference frame that they adopt:
 - When the reference state is 600 deaths, they evaluate the outcomes as gains, and are risk-averse
 - When it is zero deaths, they evaluate the outcomes as losses, and are risk-seeking
- This is a violation of the invariance axiom of EUT

Preference Reversals

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How Good Is
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- The method of eliciting people's preferences can influence their choice between two gambles
- We often see **preference reversals** → people prefer option A to B with one method, but prefer option B to A with another method (e.g., the Allais and Ellsberg paradoxes)
- If you prefer a burger to pasta at a given moment, why should the manner in which I elicit your preference influence your choice between the two?
- Such preference reversals challenge the notion that choice is based on rational principles and stable preferences, as assumed by EUT

Preference Reversals (Lichtenstein & Slovic (1971))

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How Good Is Prospect Theory?

Consider the following pair of gambles:

A: Win £2.50 with probability 0.95, lose £0.75 with probability 0.05

B: Win £8.50 with probability 0.40, lose £1.50 with probability 0.60

Preference Reversals (Lichtenstein & Slovic (1971))

Cognitive Psychology

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Reference Dependence

Value Function
Isolation Effect
Losses loom larger than gains
Endowment Effect
Status Quo Bias

The Four-Fold Pattern

Decision Weights
The Certainty Effect

Framing

Asian Disease Problem

Preference Reversals

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A: Win £2.50 with probability 0.95, lose £0.75 with probability 0.05

B: Win £8.50 with probability 0.40, lose £1.50 with probability 0.60

Gamble A gives a high probability (0.95) of winning a small amount (£2.50) and a very small probability (0.05) of losing an even smaller amount (£0.75), while gamble B gives a medium probability of winning a large amount and a slightly larger probability of losing a modest amount

The expected value of gamble A is £2.34 and that of gamble B is £2.50, so a risk-neutral person (someone who neither seeks nor avoids risk per se) would choose B.

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- Participants were asked to:
 - pick the gamble they would prefer to play, or
 - put a price on each gamble (what amount they would accept to sell the gamble)
- People prefer gamble A over gamble B
- But, they place a higher price on gamble B than gamble A
- This is a clear violation of rational behaviour → suggests people don't have stable preferences, contrary to EUT
- Lichtenstein and Slovic (1973) find that gamblers in a Las Vegas casino were prone to the same tendency

How Good A *Descriptive Model* Is Prospect Theory?

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How Good Is Prospect Theory?

- The data reviewed are largely consistent with prospect theory
- Not too surprising as the model was created to accommodate these anomalies of choice
- But it has generated novel predictions that have subsequently received empirical support
- It provides a better account of how people *actually* make decisions than EUT
- However, it does not give deep psychological explanations for the processes it proposes (e.g., the shape of the value function)

Additional Reading

Cognitive
Psychology

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How Good Is
Prospect
Theory?

Wilkinson, N., & Klaes, M. (2012, Chapter 5). *An Introduction to Behavioural Economics*. Macmillan International Higher Education, 2017.

A copy of the book chapter is located in the same folder as these lecture slides. It's heavy reading, and I don't expect you to understand everything, but it will flesh out some of the ideas discussed here.