Individual Decision Making: Heuristics and Biases

(Kahneman and Tversky 1977, Kahneman 2011)

Heuristics are used to reduce mental effort in decision making, but they may lead to systematic **biases** or errors in judgment.

1. Representativeness heuristic

2. Availability heuristic

3. Anchoring and adjustment

4. Decision framing

5. Prospect theory

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Medical Test Example

Probability of a disease in the population is 1%

10,000 tests are done each year. Test is 98% accurate.

You tested positive. What is your chance of actually having the disease?

2

Medical Test Example

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You tested positive. What is your chance of actually having the disease?

Among 10,000 tested, 100 (1%) would have disease. Almost all (98%) would test positive:

100   x 98% =   98 true positive results

Among 10,000 tested, 9900 (99%) would not have disease. However a small fraction (2%) would test positive:

9900   x   2% = 198 false positive results

Probability of your actually having disease is the probability of true positive results relative to all (true + false) positive test results:

98/ (98+ 198) = 98/296 = 33%

Representativeness heuristic: ignore prior probability in population

Availability heuristic: concentrate on vivid, salient data (true-positive cases)

Anchoring heuristic: heavily influenced by initial test accuracy value of 98%

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Bayes' Theorem

The medical test example is an illustration of Bayes' Theorem:
A method to update our initial knowledge or belief
in the light of new evidence or information.   [20]

Theorem named after Rev. Thomas Bayes (1701-1761, English Presbyterian minister).

Applications of Bayes' Theorem important in data analytics;
predictive modeling; machine learning.

Business applications include spam filtering, credit card fraud
detection, financial forecasting, market research, etc.

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Decision Framing:
How a problem is framed affects our decision making

A rare disease has broken out, which is expected to kill 600 people. There are two possible programs (A, B) to combat it, but they cannot both be used. The consequences of each are known:

A. 200 saved with certainty

B. 1/3 probability that 600 are saved
   2/3 probability that no one is saved

Which would you choose? Why?

A rare disease has broken out, which is expected to kill 600 people. There are two possible programs (C, D) to combat it, but they cannot both be used. The consequences of each are known:

C. 400 die for certain

D. 2/3 probability that 600 die
   1/3 probability that no one dies

Which would you choose? Why?

(Tversky & Kahneman 1981) 5
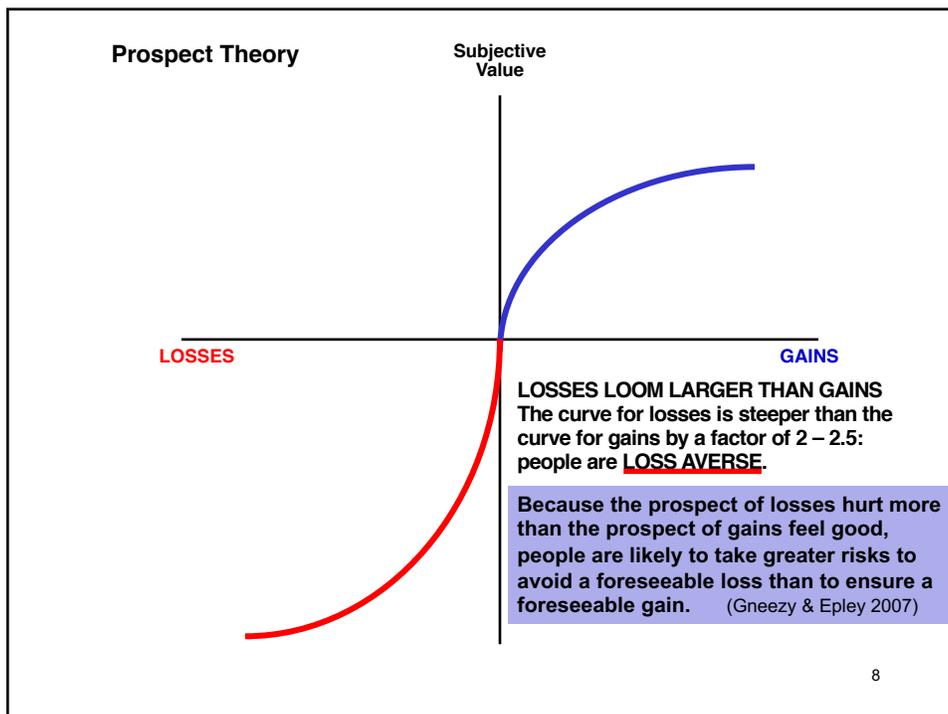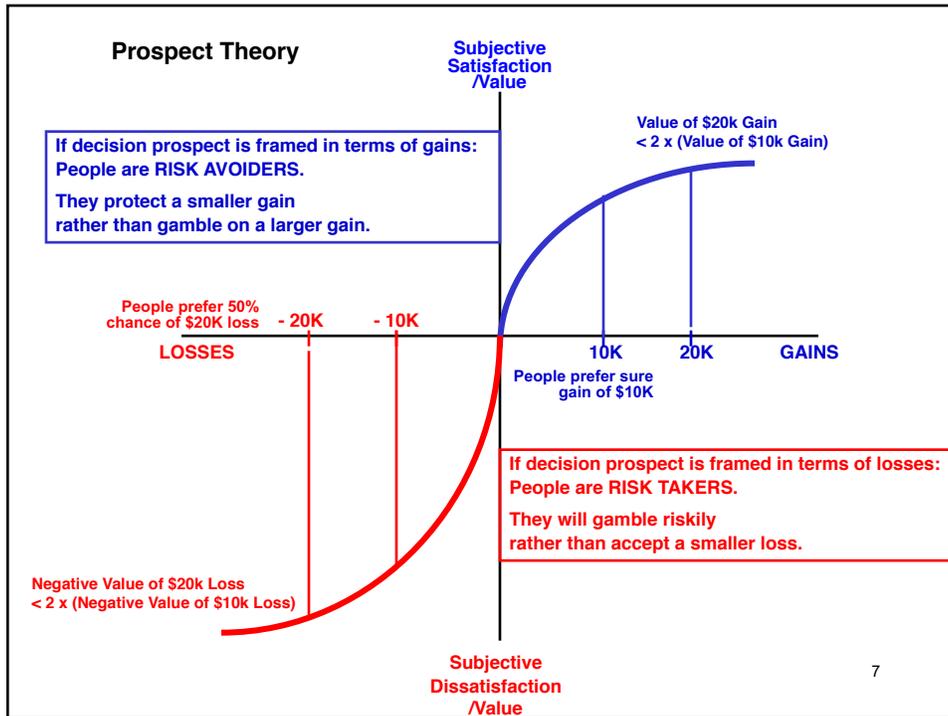

Decision Framing Example (2)

Which would you choose:

A. Sure gain of $10,000

B. 50% chance of getting $20,000

Which would you choose:

C. Sure loss of $10,000

D. 50% chance of losing $20,000

(Tversky & Kahneman 1979) 6

Prospect Theory

Subjective
Satisfaction
/Value

If decision prospect is framed in terms of gains:
People are RISK AVOIDERS.

They protect a smaller gain
rather than gamble on a larger gain.

Value of $20k Gain
< 2 x (Value of $10k Gain)

People prefer 50%
chance of $20K loss

- 20K   - 10K

LOSSES

People prefer sure
gain of $10K

10K   20K   GAINS

If decision prospect is framed in terms of losses:
People are RISK TAKERS.

They will gamble riskily
rather than accept a smaller loss.

Negative Value of $20k Loss
< 2 x (Negative Value of $10k Loss)

Subjective
Dissatisfaction
/Value

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Prospect Theory

Subjective
Value

LOSSES   GAINS

LOSSES LOOM LARGER THAN GAINS
The curve for losses is steeper than the
curve for gains by a factor of 2 – 2.5:
people are LOSS AVERSE.

Because the prospect of losses hurt more
than the prospect of gains feel good,
people are likely to take greater risks to
avoid a foreseeable loss than to ensure a
foreseeable gain.   (Gneezy & Epley 2007)

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Prospect Theory/Loss Aversion in Negotiations

Renegotiation of an existing agreement or contract

Any proposed change in pre-existing terms is seen by one side as a concession to the other

Since losses are felt more keenly than gains:
Side that stands to lose on any new measure will fight harder against it than the other side fights for it

Negotiations over a shrinking pie are especially difficult →
they require an allocation of losses

When people are bargaining over an expanding pie →
they tend to be more easygoing

(Innocenti 2013)

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Custody Case (1)

Imagine that you are serving on the jury of an only-child custody case following a messy divorce. The facts of the case are complicated by ambiguous economic, social, and emotional considerations, and you choose to base your decision entirely on the following observations.
To which parent would you AWARD custody of the child?

Parent A	Parent B
Average income	**Above average income**
Average health	**Minor health problems**
Average working hours	**Lots of work-related travel**
Stable social life	**Very active social life**
Reasonable rapport with child	**Very close relationship with child**

Shafir (1993)   10

Custody Case (2)

Imagine that you are serving on the jury of an only-child custody case following a messy divorce. The facts of the case are complicated by ambiguous economic, social, and emotional considerations, and you choose to base your decision entirely on the following observations.
To which parent would you DENY custody of the child?

Parent A	Parent B
Average income	Above average income
Average health	Minor health problems
Average working hours	Lots of work-related travel
Stable social life	Very active social life
Reasonable rapport with child	Very close relationship with child

Shafir (1993) 11

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Three Mile Island

After the accident at Three Mile Island (1979), 42 scientists who had publicly advocated or opposed nuclear energy development before the accident were asked if they would now change their position on nuclear power.
None of the scientists indicated a change.

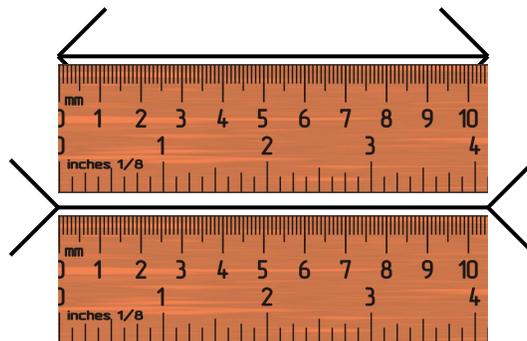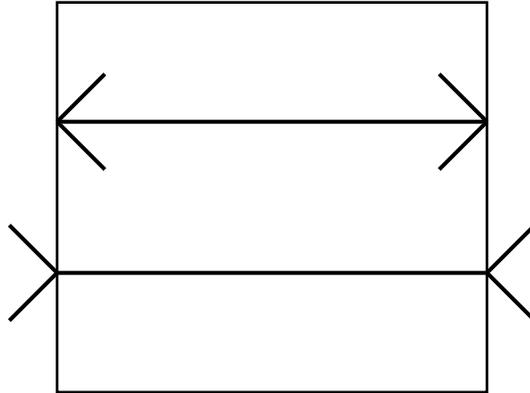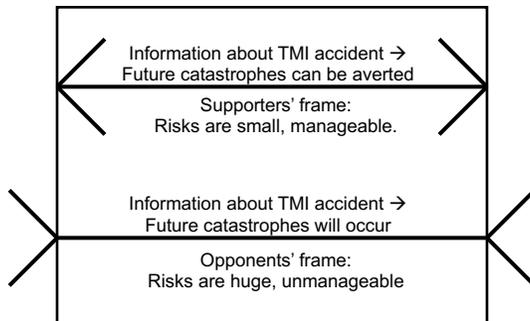| Opponents of nuclear energy	Proponents of nuclear energy
Tended to see the accident as a near catastrophe, symptomatic of the inability of corporations and regulators to manage reactors in a safe manner.	Emphasized that no one was killed; that the radiation release was relatively small; and that therefore the safety system worked.

(Mazur 1981)

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Müller-Lyer illusion

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Müller-Lyer illusion

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Different Groups, Different Frames

Information about TMI accident → Future catastrophes can be averted

Supporters' frame:
Risks are small, manageable.

Information about TMI accident → Future catastrophes will occur

Opponents' frame:
Risks are huge, unmanageable

Common frame
- **Our knowledge of nuclear plant safety is incomplete**
  - **What factors led to TMI accident?**
- **What worked in preventing disaster, what did not?**

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GUARDING AGAINST BIASES

- **Be mindful of cognitive biases**

- **Recognize bias-prone decision situations**

Questions to ask ourselves:

o   Is this a situation where there are stereotypes available?

o   Are we being influenced by examples from popular media, limited experience?

o   Are we starting from an initial impression or value that may be unreliable?

o   Are we framing the decision problem or decision outcomes in ways that could affect how we weigh options and make choices?

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GUARDING AGAINST BIASES

- **Be mindful of cognitive biases**

- **Recognize bias-prone decision situations**

- **Act as a Devil's Advocate**
  Question assumptions, challenge reasoning

- **Use probability and statistics**

  Remind ourselves
  o   **not to over-generalize from small samples** of observations or data points
  o   to consider the possibility of **false positive and false negative cases**
  o   to take into account **prior probabilities, population sizes**

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