

Decision Making and the Brain

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Availability Heuristic Comparing between options in which we have more information on one option in comparison to others. This occurs because our brains often rely on mental shortcuts, using the information that comes most readily to mind. Advertising usually uses this to its advantage as repetitive posting makes users convinced that it is a good product.

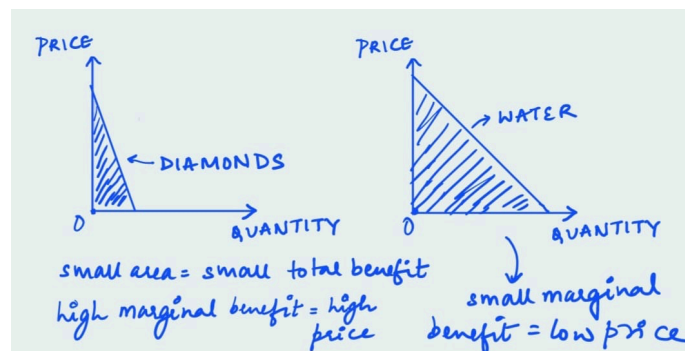
Decision Bias : Good vs Bad Decisions (Retrospective Bias) We feel that the quality of good decisions is better than bad decisions. People on average think more about good decisions unless the bad decision was very terrible.

Expected Value theory

Expected value = $\sum \text{probability} * \text{value}$

This helps us make decisions if we get a high return at a reasonable probability we will mostly choose to do it.

Diamond water paradox The paradox highlights that diamonds, despite their high price, have less practical value than water. While this might seem tied to labor costs, a flawless diamond found on a hike would still fetch the same price as one mined and processed, showing buyers value the product, not the effort. Prices reflect marginal utility the value of an additional unit of a good. Water's abundance gives it low marginal utility and price, while diamonds' scarcity makes their marginal utility and price much higher. Additionally, the value of consuming more of a good decreases as needs are satisfied.



St. Petersburg paradox It shows how expected value fails to capture people's actual choices. In a coin toss game where payouts double with each toss, the expected value is infinite. Yet, people are unwilling to pay large amounts to play, revealing a disconnect between theory and behavior. This led to modifying theory from expected value to expected utility.

1) Utility of money declines with increasing gains

2) Utility is dependent on the amount of money a person already has.

Expected Utility When something is **valuable but influenced by other factors**, like enjoying a barbecue more on a sunny day than a rainy one, we consider these factors in decision-making. By factoring in the probability of weather, we calculate the expected utility to make a more informed choice.

Decision Making Models

- ❖ **Normative model** tells us how people ought to make decisions
A person should decide whether to buy coffee by calculating its utility
- ❖ **Descriptive model** how people actually make decisions
Observing that most people buy coffee from a café
- ❖ **As-if model** we do not if it is truly happening the calculations of normative model
person makes the decision as if they calculated the utility and cost rationally
- ❖ **Process model** how agent is carrying out these computations
how the person actually decides, step by step: noticing they're tired, recalling their favorite café, weighing their options briefly, and choosing to buy coffee

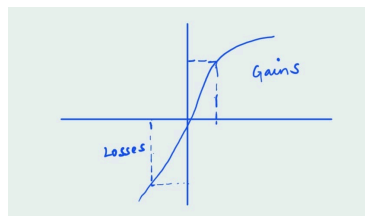
Axioms of expected utility theory

- ❖ **Sure thing** decision made doesn't depend on outcome of event you associate with it
- ❖ **Transitivity** $A > B > C$ then $A > C$
- ❖ **Dominance** A better than B(1 feature), $A \approx B$ (other features) then $A > B$
- ❖ **Invariance** order in which options are presented or context should not influence choice

Allais Paradox Two lotteries one risky and one safe in which risky lottery has higher payoff. A rational choice is to choose an option with highest expected utility but in face of uncertainty **people tend to choose an option with little uncertainty**.

Prospect Theory: How do we actually make decisions?

It is a descriptive model. Through the experiments we saw that in the **gain domain** one is usually **risk averse**, whereas in the **loss domain** people prefer **gambling**(and are greedy), **gains matter more than losses**, we measure gains and losses from a **reference point**(people with different financial conditions make similar choices).



Non linearity in probability weights People tend to choose options with low probabilities and high returns, believing they might win. Decision weights don't align linearly with probabilities: **low probabilities are often overweight**, while medium and large probabilities are underweighted.

Endowment Effect People tend to value items they own more highly than they would if they didn't own them. Sales tactics often exploit this bias to sell products. An experiment tested this idea on **monkeys**, offering them two treats: fruit discs and cereal cubes. If a monkey chose a fruit disc, it could be traded for cereal, but **very few monkeys opted to make the trade**. A variation of the experiment offered an extra oat along with the cereal, yet most monkeys still didn't want to trade.

Status-quo bias preference for the current state and resistance to change. For example, organ donation is often set as the default on driver's licenses, and many people don't alter it. This bias also fosters brand loyalty. People may avoid making changes due to the **stress of making decisions** or because **deviating from the current state feels risky**.

Framing Effect how our decisions are influenced by how options are presented. For example, people are more likely to choose an item labeled "80% fat-free" over one labeled "20% fat," even though both mean the same thing, because the term "fat-free" anchors their decision. To make decision-making more efficient, our minds often use shortcuts or heuristics, **relying on easily accessible information**. This was demonstrated by the fact that the **framing effect is more common in older individuals**, possibly due to **limited cognitive resources**. Another example is the Asian flu problem, where the words "save" and "die" serve as **anchors**.

Ambiguity Aversion/ Ellsberg Paradox We tend to **avoid options that are considered to be ambiguous**. We might prefer to take a course which has reviews over a course which is being taken for the first time.

Risk aversion occurs when the probability of outcomes is known but the outcome is uncertain, while ambiguity aversion arises when both the probability and outcome are unknown.

Shortcomings of prospect theory It is an **as-if model rather than a process model**, meaning it doesn't explain how decisions are actually made. It also doesn't account for ambiguity, where probabilities are unknown. Additionally, it doesn't fully address counterfactual outcomes situations where you observe an outcome but don't directly experience it.

Loss aversion from gaze allocation and pupil dilation

Why do people tend to avoid losses?

Participants asked to make decisions about gambles, where they could either win or lose money.

- **Valuation bias** - people give more weight to losses than to gains
Proved by participants spent more time looking at the loss side of the gamble
- **Response bias** - people avoid situations with potential losses
participants chose to accept a gamble (especially one that involved a potential loss), their pupils dilated more. This is a sign of increased mental effort and tension.