Heuristics and Biases

Summary of Tversky, A., & Kahneman, D. (1974). Judgment under Uncertainty: Heuristics and Biases. *Science, 185*(4157), 1124–1131.

Note

Fiedler, K., & von Sydow, M. (2015). Heuristics and biases: Beyond Tversky and Kahneman's (1974) judgment under uncertainty. In M. W. Eysenck & D. Groome (Eds.,) *Cognitive Psychology: Revisiting the classical studies* (2nd ed., pp. 146-161). London, UK: SAGE.

- Tversky and Kahneman's paper describing their work on heuristics was influential in psychology not because of the scientific value
  - They are not proposing a theory with a specific mechanism that can be tested and replicated
  - There is anecdotal evidence for those specific heuristics, but few experimental demonstrations with clear empirical evidence
- Instead, it propelled research because it was a provocative demonstration of fallacies and irrationality in the real world
  - It challenged the predominant view of rational decision-making
  - It gave rise to a new wave of behavioral research
  - It increased the public awareness on fallibility of human decision-making

What are heuristics?

- Common decision routines – mental “shortcuts” – that work well most of the time, but occasionally lead to undesirable outcomes.

- Direct quote from the article: “People rely on a limited number of heuristic principles which reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations. In general, these heuristics are quite useful, but sometimes they lead to severe and systematic errors.”

Three key heuristics

- **Representativeness**: people estimate the probability or likelihood of an event by how much it resembles their existing stereotypes or typical cases (and not based on actual statistical probabilities).

- **Availability**: people estimate the likelihood of an event based on how easily examples or instances of that event come to mind.

- **Anchoring and adjustment**: people rely on an initial reference point (the "anchor") and then make adjustments to reach their final decision or estimate.

Representativeness

- Judgment rule in which an estimate of the probability of an event is determined by one of two features:
  - Similarity: How similar is the event to the population of events it came from (parent population)?
    - Insensitivity to prior outcomes: people disregard or underweight the base rate (the actual frequency or probability) of an event, but instead rely more heavily on specific, vivid information or recent experiences.
  - Randomness: Does the event seem similar to the process that produced it?
    - Insensitivity to sample size: people assume that the characteristics of a small sample reflect the characteristics of a larger population.

Representativeness: similarity

Example:

Steve is very shy and withdrawn, invariably helpful, but with little interest in people, or in the world of reality. A meek and tidy soul, he has a need for order and structure, and a passion for detail.

What is the probability that Steve works as: a farmer, a salesman, an airline pilot, a librarian, or a physician?

Representativeness: similarity

- In the representativeness heuristic, we use Steve's similarity (or: the degree to which he is representative of) to a stereotype of a librarian or other profession to judge his profession.
  - Librarians are quiet and tidy, salesmen are loud and extroverted… etc.
- When we judge probability of the outcome, we need to know the prior probability (or base-rate frequency) of outcomes.
  - There are many more farmers in the population than librarians → therefore Steve is more likely to be a farmer than a librarian
  - But base-rate frequency does not affect the similarity of Steve to stereotypes of librarians and farmers → so prior probabilities have no effect on representativeness heuristic

Insensitivity to prior probability of outcomes

Example:

There is a group of 100 people, and from that group we randomly select some people.

- One group: 70 engineers and 30 lawyers (70% chance of engineer, 30% lawyer)
- Another group: 30 engineers and 70 lawyers (30% chance of engineer, 70% lawyer)

What is the probability is that those people are lawyers or engineers?

Insensitivity to prior probability of outcomes

- When we do not give participants any description, they correctly predict the probability that a person is an engineer or a lawyer: based on group proportions (70/30 or 30/70).
- But if we *also* gave participants a description of those randomly selected people, then participants started judging this probability based on descriptions, not proportions. Even when the description was irrelevant:
  - Dick is a 30-year-old man. He is married with no children. A man of high ability and high motivation, he promises to be quite successful in his field. He is well liked by his colleagues. → people judged this as 50% chance of Dick being an engineer or a lawyer

Representativeness: randomness

Example:

We toss a coin six times; which outcome is more probable: H-H-H-T-T-T or H-H-T-H-T-T?

- We think it's H-H-T-H-T-T because it *appears* more random than H-H-H-T-T-T

What about H-H-H-H-T-T or H-H-H-T-T-T?

- We think it's H-H-H-T-T-T because it has an even distribution of H and T, which is a more probable outcome in the long run

Insensitivity to sample size

Example:

A certain town is served by two hospitals. In the larger hospital about 45 babies are born each day, and in the smaller hospital about 15 babies are born each day. As you know, about 50% of all babies are boys. However, the exact percentage varies from day to day. Sometimes it may be higher than 50%, sometimes lower.

For a period of 1 year, each hospital recorded the days on which more than 60% of the babies born were boys. *Which hospital do you think recorded more such days?*

- The larger hospital, the smaller hospital, or about the same?

Insensitivity to sample size

- Many people judge that the small hospital and the large hospital report roughly the same number of days where 60% of the babies born are boys.
- This is incorrect: sampling theory explains that the large hospital (which has a larger number of born babies) is less likely to stray from the 50% distribution.
  - Larger samples are more likely to reflect the population distribution
  - Variations are more likely in smaller samples
- When evaluating the likelihood of a specific outcome in a sample from a given population, people generally assume that the sample size does not affect the resemblance between a sample statistic and a population parameter.

Availability

- Judgment rule in which frequency or probability of an event is based on how easily examples can be recalled or remembered.
  - Retrievability of instances: how easily examples come to mind.
  - Effectiveness of search set: how well the search process retrieves relevant information.

Retrievability of instances

- If one group has more instances that are more familiar/salient than another group, the first group will seem to be bigger (even if the two groups are the same size).
  - **Example:** if you are at a new restaurant and you are offered a menu of 20 dishes, where 10 dishes are well-known to you (such as pizza), whereas the other 10 are completely new to you (such as pierogi) – you will judge the menu as having more familiar dishes than unfamiliar dishes.
- Recency effect: recent occurrences are likely to be relatively more available than earlier occurrences.
  - **Example:** if you ordered delivery from a pizza place four days in a row, and the pizza was not very tasty on day one, but delicious on day four, you will be more likely to think on day five that it is a very good idea to order from that delicious pizza place.

Effectiveness of search set

Example:

If a random word is taken from an English text, is it more likely that the word starts with K, or that K is the third letter?

Effectiveness of search set

- When the size of a class (and therefore probability of an event) is judged by the availability of its instances, a class whose instances are easily retrieved will appear more numerous than a class of equal frequency, whose instances are less retrievable.
- Simply put: if I can remember examples from one class more easily than examples from another class, then I will automatically judge the first class as larger.
  - It is easier to remember words that start with K, than words where K is the third letter → therefore I think that the probability is higher for a word to start with K.

Anchoring and adjustment

Example:

You have 5 seconds to calculate the product of numbers 1 through 8:

- 1 x 2 x 3 x 4 x 5 x 6 x 7 x 8 → median estimate: 512
- 8 x 7 x 6 x 5 x 4 x 3 x 2 x 1 → median estimate: 2250

→ Correct answer is 40,320

Anchoring and adjustment

- In many situations, people make estimates by starting from an initial value that is adjusted to yield the final answer. The initial value (the anchor), or starting point, may be suggested by the formulation of the problem, or it may be the result of a partial computation.
- Different starting points yield different estimates, which are biased toward the initial values.

Discussion

- Errors in judgment occur regardless of our motivation
- Both layman and experts are equally prone to same biases when they think intuitively
- People usually do not detect biases in their own judgments of probability

Critique

Fiedler, K., & von Sydow, M. (2015). Heuristics and biases: Beyond Tversky and Kahneman's (1974) judgment under uncertainty. In M. W. Eysenck & D. Groome (Eds.,) *Cognitive Psychology: Revisiting the classical studies* (2nd ed., pp. 146-161). London, UK: SAGE.

- Kahneman and Tversky describe heuristics as allegedly irrational judgments and decisions, but they can often be re-interpreted in terms of reasonable assumptions about the task and the problem setting
- Lack of evidence about a specific underlying cognitive mechanism
- Such normative and content-blind models are often inappropriate and unjustified as benchmarks of rationality

Most scathing critique: Gerd Gigerenzer

Gigerenzer, G. (1996). On narrow norms and vague heuristics: A reply to Kahneman and Tversky. *Psychological Review, 103*(3), 592–596.

- The heuristics in the heuristics-and-biases program are too vague to have explanatory power
  - The vague definition allows researchers to bend the heuristic to the observed phenomena, therefore falling into the confirmation bias trap
- They are interpretative labels which lack testable constraints on the cognitive decision process
- They lack precise and falsifiable process models, which means they cannot be tested and proved/disproved
- They are vague about the antecedent conditions that elicit various heuristics
  - It is unclear exactly what situations or conditions will elicit a heuristic
  - Evidence is anecdotal at best
- There is little work done on investigating the relationship between heuristics