Thinking, problem solving and intelligence

Supported GRE teaching and original transfer practice

Thinking, problem solving and intelligence

- Describe concepts, prototypes and schemas.
- Tell an **algorithm** 算法 from a **heuristic** 启发式, and name common heuristics and biases.
- Recognise obstacles to problem solving.
- Compare theories of intelligence and interpret test scores carefully.

Concepts and schemas

- Natural concepts have fuzzy edges and are built around a **prototype** 原型, the most typical member. People confirm "a robin is a bird" faster than "a penguin is a bird".
- A **schema** 图式 is organised knowledge about a topic; a script is a **schema** for a sequence of events, such as ordering in a restaurant.
- Schemas speed up understanding, but they also bend memory toward what was expected.

Heuristics and biases

- **Availability heuristic 可得性启发式**: judging frequency by how easily examples come to mind. After news coverage of a plane crash, people overestimate the risk of flying.
- **Representativeness heuristic 代表性启发式**: judging probability by similarity to a type, while ignoring base rates. The Linda problem is an example.
- Anchoring: estimates stay close to a starting number, even an irrelevant one.

Heuristics and biases (2)

- Framing: "90% survive" and "10% die" lead to different choices, though they mean the same.
- Confirmation bias: looking only for evidence that supports a belief.

Problem solving

- Functional fixedness: seeing an object only in its usual role. In Duncker's candle problem, people fail to use the box of tacks as a shelf.
- Mental set: using a method that worked before when a simpler one is available.
- Useful strategies: means–end analysis (reduce the gap to the goal step by step), working backward from the goal, and setting the problem aside, which sometimes leads to sudden insight.

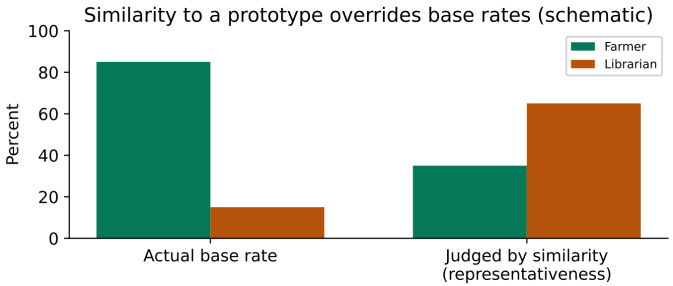
Intelligence

- Spearman (1904) found that scores on different tests correlate, and proposed a general factor, g.
- Cattell separated fluid intelligence (solving new problems, which declines in later adulthood) from crystallised intelligence (knowledge and vocabulary, which stays or rises).
- Gardner proposed multiple intelligences; Sternberg proposed analytical, creative and practical abilities.
- IQ tests are scaled to a mean of 100 and a standard deviation of 15. A score describes performance on that test under its conditions, with known reliability and validity; it is not a fixed measure of a person's worth.

Worked example: base rates

- The description fits the librarian stereotype: this is representativeness.
- In the United States, farmers outnumber male librarians by more than 20 to 1.
- Even if the description is four times as common among librarians, farmers remain more likely. Similarity cannot replace the base rate.

Figure: Worked example: base rates



- The **representativeness heuristic** lets similarity to a stereotype override the base rate
- Read the axes and units first.

Worked example: naming the process

- Thinking shark attacks are common after a summer of shark news: availability.
- Offering €200 for a used bike because the seller first asked for €300: anchoring.
- Trying to unblock a sink only with a plunger, because that worked last time, when the trap simply needs unscrewing: mental set.

Common errors

- Calling a heuristic an error in itself; heuristics are efficient, and their failures are predictable.
- Confusing availability (ease of recall) with representativeness (similarity).
- Thinking a combination of events can be more likely than one of them.

Common errors (2)

- Saying fluid and crystallised intelligence decline together.
- Treating an IQ score as fixed and complete.

Key terms

- **prototype**: The most typical member of a category.
- **schema**: An organised body of knowledge that guides understanding and memory.
- **algorithm**: A step-by-step procedure that guarantees a solution when followed correctly.
- **heuristic**: A mental shortcut that is fast but can lead to errors.

Check yourself

- A student cannot see that a coin could be used as a screwdriver. What is this called?
- Which kind of intelligence usually keeps rising into later adulthood?
- Why must "teller and feminist" be less likely than "teller"?