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COGNITION

Chapter 10: Decision Making

Fundamentals of Cognitive Psychology *(Kellogg)*

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Algorithm: precise set of rules guaranteed to produce the correct answer

Heuristic: rule of thumb, and informal strategy or approach that works under some circumstances (not all)

- **Induction** – the process of reasoning from the particular to the general
- **Deduction** – the process of drawing, by reasoning, particular conclusion from more general principles assumed to be true
- Francis Bacon proposed logical induction as the logic of scientific discovery and deduction as the logic of argumentation.
 - In fact, both processes are used synergistically in the behavioral sciences: by observation of particular events (induction) and from already known principles (deduction).

- three statement logical form

Major Premise

Minor Premise

Conclusion

- The **logical validity of the conclusion** is determined entirely after 'accepting' the premises as true (it is a *logical deductive conclusion* – that is a conclusion that necessarily follows from the premises)

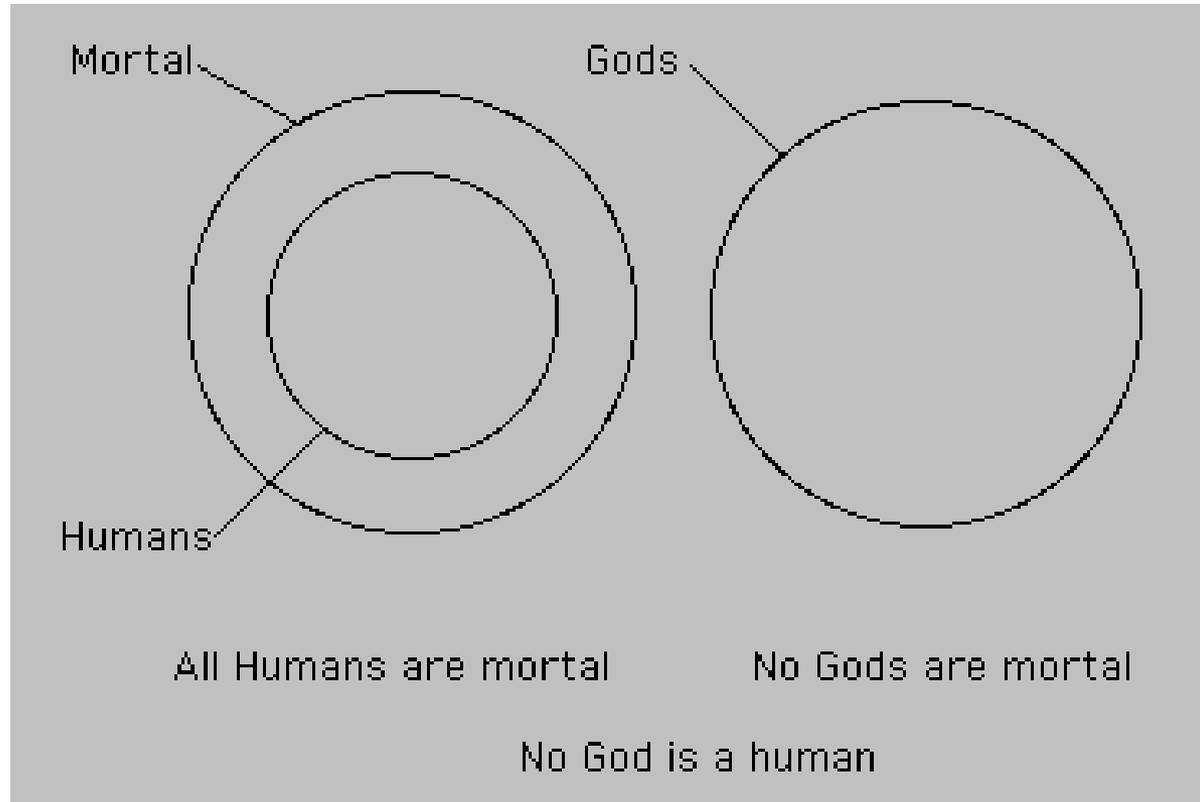
All bears are animals

Some animals are white

Thus, some bears are white (**Invalid conclusion**)

- Syllogistic reasoning is highly subject to the confirmation bias; you can guard against this
 - (1) through the use of Euler Circles (*Venn diagrams*) while
 - (2) trying to falsify the conclusion.

Euler Circles



Major and Minor Premises

- “All”
- “Some”
- “None”

People do poorly with syllogisms, even when the content is “meaningless” letters.

Cognitive Constraints (Syllogistic Reasoning)

- Atmosphere Hypothesis
 - “*All, Some*” → incorrectly assume syllogism is valid
 - “*no, none*” → if “conclusion” is negative is more likely to be accepted (even though not valid)
- Illicit Conversion (all A are B does NOT mean all B are A, but people tend to perform this “illicit conversion”)
- Belief Bias: meaningful information can lead to accepting logically invalid conclusions

two major parts:

conditional clause (if-then)

evidence

- Determine whether the evidence supports, refutes or is irrelevant to the stated relationship.
 - The "if" clause of the conditional is the antecedent
 - The "then" clause of the condition is the consequent
- The question is whether you can draw a logical conclusion from the evidence

The four possible conditional reasoning situations:

If P then Q

P

Thus, Q

valid inference **AFFIRM THE ANTECEDENT** (modus ponens)

If P then Q

Not P

Thus, NOT Q

invalid inference **DENY THE ANTECEDENT**

If P then Q

Q

Thus, P

invalid inference **AFFIRM THE CONSEQUENT**

If P then Q

Not Q

Thus, NOT P

valid inference **DENY THE CONSEQUENT** (modus tollens)**

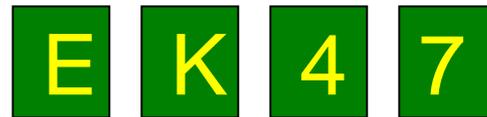
** people miss DENY the CONSEQUENT frequently

Conditional Reasoning

- People are generally good about Affirming the Antecedent, but have difficulty denying the consequent. People also have a tendency to engage in the two invalid forms. In addition, people have a tendency to perform an "**ILLCIT CONVERSION**" and switch the condition from if P, then Q to If Q then P.

Conditional Reasoning (Wason card problem)

Which card or cards do you need to turn over to test "*if VOWEL on one side then EVEN on other side*".



Typically subjects will show a **confirmation bias** – avoid seeking evidence in opposition to our beliefs

Martini Coke 31 17

- Meaningful material seems to help people.
- People are not good at abstract logic.

Wason (1968) Inductive Reasoning Test

- “8, 10, 12, ...”
- Participants are to propose additional elements/sequences to identify the rule
- The evidence supported the confirmation bias

Decisions Under Uncertainty are like Decisions Under Risk

(but use subjective odds vs. given odds)

The concept of “*utility*” (value or gain associated with each possible outcome)

One view of human decision making is to maximize utility... BUT:

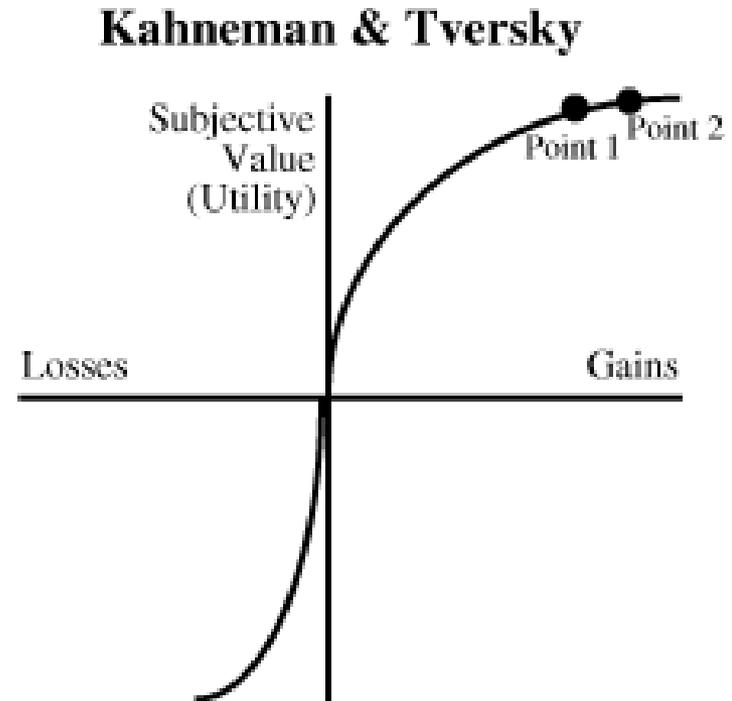
- bet with $1/3$ chance of winning \$8

OR

- bet with $5/6$ chance of winning \$3

Subjective Utility

- The “joy” of winning or “pain” of losing levels off with greater amounts
- Losses steeper than gains – people are risk averse
- The shape of the function yields **Framing Effects** -- the way a question is worded has an important effect on people's decisions.
 - This effect is both robust & pervasive. (Asian Disease, theatre ticket, calculator).

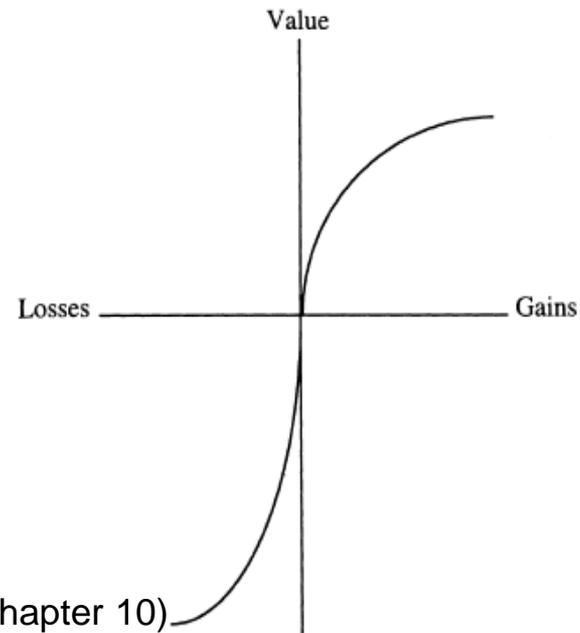
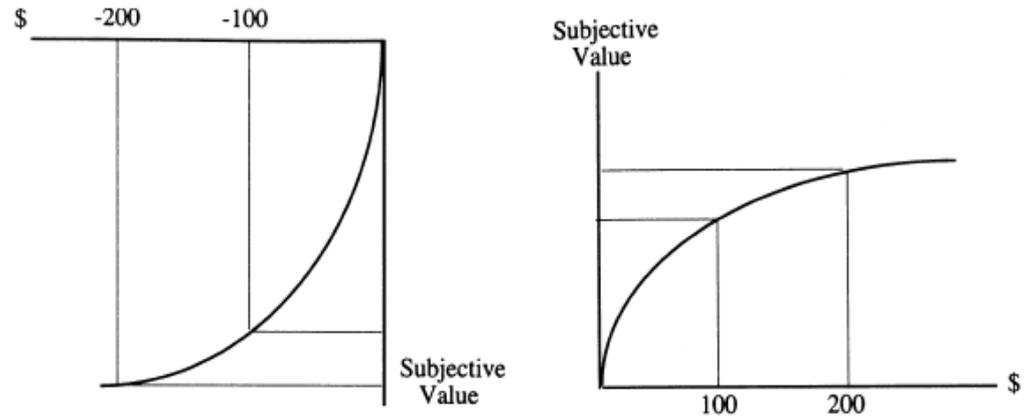


Framing Effects

- Making a different decision depending on where people see themselves to be in relation to the curvilinear subjective utility function.
- e.g.,
 - shopping for \$15 calculator... drive 5 min to save \$5?
 - Shopping for \$150 jacket... drive 5 min to save \$5?

Once you have lost money it is ok to keep losing more (relatively little added subjective cost) – this appears in stock trades for professional brokerage houses!

The subjective utility curve has a zero point (reference for gains and losses) – after purchase lowered expectations lead to early sell when the stock does well and being late to “cut bait”



Emotion and Thinking

- When people are in a good mood they try to maintain “the good vibe” and thus actually become increasingly risk averse
 - Risk averse in the domain of gains

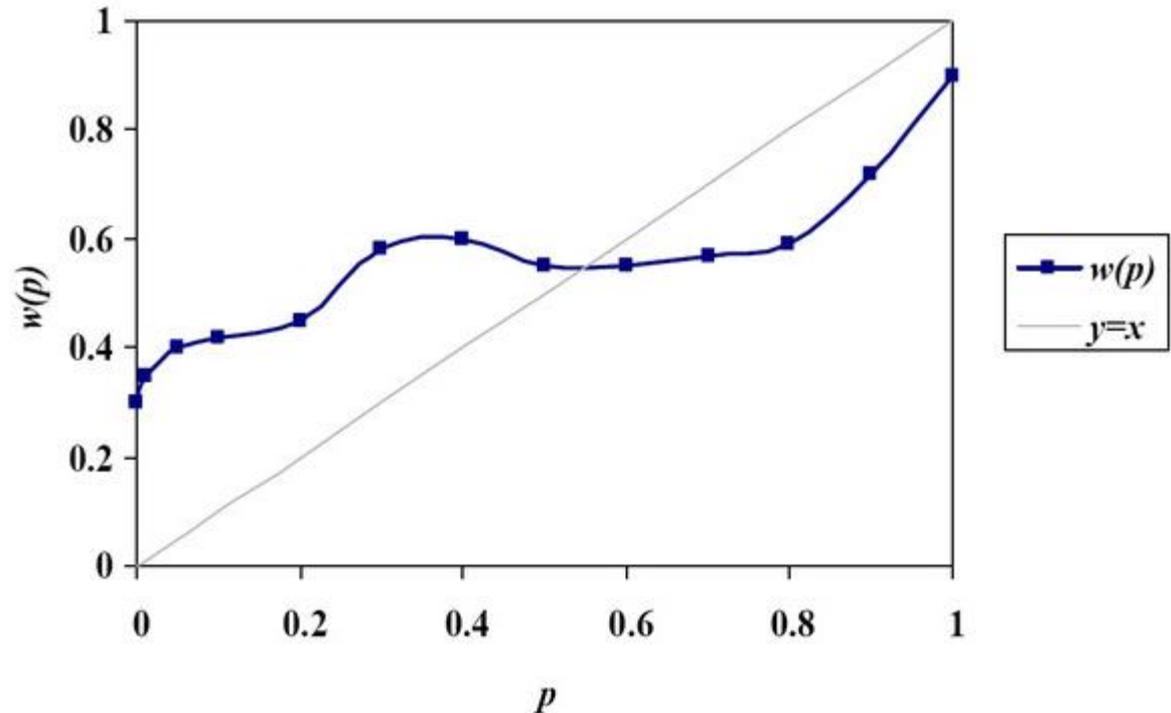
Subjective Probability

Highly probable events are underestimated

Low probability events are overestimated

(Kahneman & Tversky, 1982)

Sample Probability Weighting Function



Kahneman & Tversky

In making predictions and judgments under uncertainty, people do not appear to follow the calculus of chance or the statistical theory of prediction. Instead, they rely on a limited number of heuristics which sometimes yield reasonable judgments and sometimes lead to severe and systematic errors (p.237, 1982)

Heuristics and Biases

Representativeness Heuristic

Judgment strategy based on estimates of how similar an event seems to be to its population: whether the event seems similar to the process that produced it, or, how similar is event to the population of events it came from. A sample looks representative if it is similar in important characteristics to the population from which it was selected. For example, a random process should produce a random looking result.

- Which sequence of coin tosses is more likely?
HHHHHH
HHHTTT THHTHT
- **The gambler's fallacy: Ignoring the effect of sample size**
 - **Law of large numbers:** the **TRUTH** is that large samples are very likely to be representative of the population from which they are selected (Central Limit Theorem, etc.); small samples may not be.
 - **"Law" of small numbers:** **Mistaken** belief that small samples will be representative of the population from which they are selected. (this is a **mistake** that people make... it is not a real law)
- stereotypes can lead to **Base-Rate neglect** (failure to obey Bayes Theorem) via a **"conjunctive fallacy"** (bank teller)

Heuristics and Biases: Availability Heuristic

making a decision based on ease of retrieval from memory. You estimate the frequency or probability of an event by how easy or fast it is to think of examples of the event. This is often accurate, but can lead to errors when availability is not correlated with true, objective frequency.

- Frequency
- Familiarity
- Salience
- Vividness
 - Examples:
 - Words with K 1st vs. 3rd (Tversky & Kahneman, 1973)
 - How many words with K first vs. K third?
 - (people say first-k but really more third-k [harder to think of them])

Heuristics and Biases: Simulation Heuristic

- **Simulation Heuristic** – constructing a mental model of an event and then “running the model” to make a prediction of some future event, or imagine a different outcome of some event or action.
- **The undoing heuristic** - changing events (more likely *downhill* changes than *horizontal* or *uphill* changes [p.375])
- **Hindsight Bias** - because the scenario happened, we feel that the outcome should have been predictable since it is now very easy to picture how the event could have happened.
- **Anticipating Outcomes** (using simulation) both positive and negative and then deciding what to do based on these anticipated outcomes tends to produce more realistic (rather than biased) evaluations.

A central issue in the use of heuristics is the matter of representation: do we process the **PROBABILITY** or the **RELATIVE FREQUENCY**?

There are two opinion polls, in one set, 6 include candidate “A” and “A” wins 5 of the 6. In another set, 18 include candidate “B” and “B” wins 9 of the 18. Who do you expect to win?

Bizarrely, people **OFTEN** claim that “B” is more likely to win... this shows a reliance on raw scores rather than probabilities.

More Heuristics and Biases

Halo Effect -- Opinion/Evaluation generalized from a high score on one trait to a high score on all traits (also "negative halo effect")

Anchoring and Adjustment - People usually begin by guessing a first approximation -- an anchor -- and then make adjustments to that number on the basis of additional information. Often leads to a reasonable answer, but can lead to errors in some cases.

- **It the average price of an undergraduate textbook more than, or less than, \$10.00?**
- **What is the average price of an undergraduate textbook?**
- **typical finding: those with the \$10 anchor produce lower estimated prices than those students given a \$100 anchor. Part of this is due to the availability heuristic. It also works to bias estimates of frequency or number (e.g., the number of countries in Africa .. anchor at 5 versus anchor at 80...).**

Terminology

- Syllogistic reasoning
- Conditional reasoning
- Deductive
- Inductive
- Illicit conversion
- Belief bias
- Affirm the antecedent
- Deny the consequent
- Affirm the consequent
- Deny the antecedent
- Subjective Probability
- Subjective utility
- Decisions under risk
- Decisions under uncertainty
- Representativeness
- Availability
- Halo effect
- Gambler's fallacy // "law" of small numbers
- Simulation heuristic

Assignment #10

Biases in Reasoning and Decision Making

Assignment #10 (Biases in Reasoning and Decision Making):

GOAL: To have you demonstrate your grasp three different cognitive biases in decision-making. One of these must be the "*Anchoring and Adjustment*" heuristic; another must relate to the work of Kahneman. The remaining one is any cognitive biases in decision-making not already included in your write-up that was discussed in class or which is mentioned in the text (group think, framing, etc.).

REQUIREMENT: Write a report discussing the heuristics that have influenced three separate decisions that you have personally made. Provide a brief description of each of three scenarios in which you had to make a decision (or were involved in the decision making) and the cognitive biases that may have been involved (possibly in retrospect). Each of the three sections of this assignment will include a clear definition of the heuristic(s), the description of the situation, and statements that indicate why each heuristic applies to the situation as you have described it. It is possible (but not required) that multiple heuristics may have influenced each decision; you may note this, but you must describe three separate decision-making episodes. One of the episodes must use the "anchoring and adjustment" heuristic, another as discussed by Kahneman. The other heuristic is up to you.

Due Date: start of class.

GOAL: To have you demonstrate your grasp of the scope and relevance of cognitive psychology. Goal #5 (see syllabus page 3) of the psychology degree objectives focus on the role of the individual within society.

REQUIREMENT: Your task is to elucidate (discuss) how the content covered in this course is relevant to GOAL #5 (syllabus page 3). You **MUST** use different examples and specific discussion questions than addressed in previous written assignments. I expect two to three pages, not more, not less. I do not want you to throw in technical terms where they are not appropriate; I do want you to describe how an increased knowledge of cognitive psychology content impacts your ethics, appreciation for diversity, and development of skepticism.



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