



Cognitive Psychology

M5X00908 Brain, Behaviour, and Cognition (BBC)

Judgement and Decision Making

Dr Kate Williams

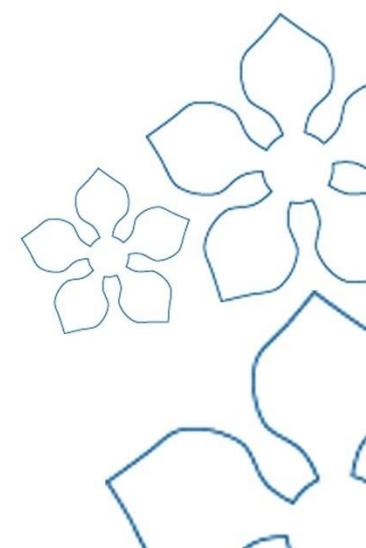


PRIFYSGOL CYMRU

Y Drindod Dewi Sant

UNIVERSITY OF WALES

Trinity Saint David



Essential Reading!!!!

- Eysenck, M. W., & Keane, M. T. (2015). *Cognitive psychology: Chapters 13 & 14.*
- **Chapter 13 & 14 of the website companion.**



PRIFYSGOL CYMRU
Y Drindod Dewi Sant
UNIVERSITY OF WALES
Trinity Saint David

Introduction

- Judgement: deciding or making an assessment on the likelihood of various events based on incomplete information.
- Decision making: Selection between options
 - Often ultimately actions
 - Applied cognition
- Judgement forms important initial part of decision making
- However, with decision making, if full information is not available then a judgement is required.
- With judgement what matters is accuracy, with decision making what matters is importance of the decision.

Introduction

- Typically assess quality of decisions in terms of the consequence – good or bad.
- However, other factors influence decisions....
 - What we know about aspect under consideration
 - What can we gain or loose if we acted on our choice,
 - What risks are involved,
 - Biases and heuristics in our reasoning process.
- Heuristic = a mental shortcut that allows us to solve problems and make judgments quickly and efficiently.
- Today we will discuss these aspects that can affect how we make judgements & decisions, and any reasoning that we do in order to reach a conclusion.

Judgement Research

- We tend to change our mind about things when presented with new information.
- Bayes' theorem uses the relative probabilities of two hypotheses before data are obtained (prior odds), and we calculate the probabilities of obtaining observed data under each hypothesis (posterior odds).
 - Shown in the taxi-cab problem (Kahneman and Tversky 1972).
- Taxi involved in hit and run, 2 companies (Green & Blue) operate in the city.
- 85% of cabs in the city are Green and 15% are Blue.
- Witness identified the cab as Blue, court tested reliability of witness under same conditions that existed on night of the accident & concluded witness correctly identified each of the two colors 80% of the time & failed 20% of the time.

Judgement Research

- Ps asked what is the probability that the cab involved in the accident was Blue rather than Green?
- Most Ps in the study gave probabilities over 50%, and some gave answers over 80%.
- The correct answer, found using Bayes' theorem, is lower than these estimates:
- There is a 12% chance (15% times 80%) of the witness correctly identifying a blue cab.
- There is a 17% chance (85% times 20%) of the witness incorrectly identifying a green cab as blue.
- There is therefore a 29% chance (12% plus 17%) the witness will identify the cab as blue.

Judgement Research

- This results in a 41% chance (12% divided by 29%) that the cab identified as blue is actually blue.
- People often take less account of the prior odds (*base-rate information*) than they should from Bayes' theorem. Base-rate information: "the relative frequency with which an event occurs or an attribute is present in the population". Koehler (1996)

Are we rational decision makers?

- What is rationality? It can depend on what we define as rational, but at one time it was believed that behaving rationally involved selecting the best option.
- This assumption was built in to **Normative** models – focuses on how people should make **optimal** decisions rather than how they actually made them.
 - Normative is basically the ideal.
- Choosing between options involves calculating the one with the highest **expected utility** (value)
 - How probable outcome x utility of outcome (von Neumann & Morgenstern, 1944; 1947).
- Which option would you prefer?
 - **Option 1.** 40% chance to win £2000, (60% chance to win nothing)
 - **Option 2.** £600 for sure

E.g., Coombes, Dawes, & Tversky:
Mathematical Psychology (1970)

Rational to take option 1.

- Expected value of option 1:
 $40\% \times £2000 = £800$
- Expected value of option 2:
 $100\% \times £600 = £600$



PRIFYSGOL CYMRU
Y Drindod Dewi Sant
UNIVERSITY OF WALES
Trinity Saint David

Expected Utility Theory

Issues with this approach

- Utility (value) is often **subjective**
 - If you had no money or £500 debt you would likely be more happy with £600 for certain
 - Therefore your motivations are not necessarily driven by value of monetary outcome (or **objective** utility) but value relating to other circumstances
- Need to appraise the value of all options (especially when more options available)?
 - **Maximising**:
 - To find the absolute 'best' option
 - Takes effort and is exhaustive
 - **Satisficing**:
 - Targeted to most crucial or salient elements not all
 - Minimal requirement met (Simon, 1960)

Certainty and risk

- 100% or 0% chance of an outcome is a 'certainty'.
- 95% or 5% chance of an outcome is 'near' certain.
 - 95% We are aware there is a small chance that the outcome will not occur.
 - 5% We are aware there is a small chance that the outcome could occur.
 - With intermediate probabilities we are less sensitive to this e.g. between 60% and 55%



PRIFYSGOL CYMRU
Y Drindod Dewi Sant
UNIVERSITY OF WALES
Trinity Saint David

Kahneman and Tversky, 1984

Certainty and risk

- An outcome that is a 'near' certainty (e.g. 95%) and positive is considered less attractive than it should be (as aware of 5% may not happen)
- An outcome that is unlikely (e.g. 5%) but positive is considered more attractive than it should be (as aware of 5% chance will happen).
- Sensitivity to small change but from certain to uncertain



PRIFYSGOL CYMRU
Y Drindod Dewi Sant
UNIVERSITY OF WALES
Trinity Saint David

Kahneman and Tversky, 1984

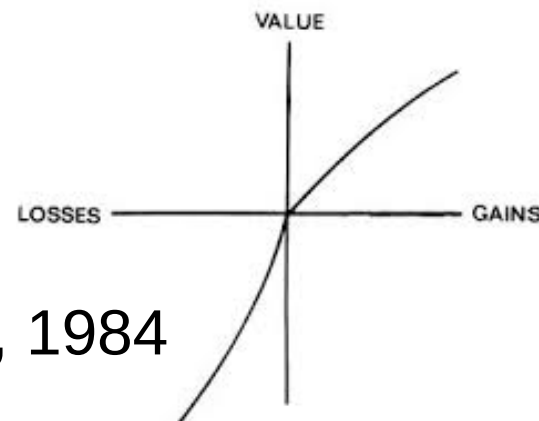
Risk and gain

- Which would you prefer?
 - 50% chance to win £200, (50% chance to win nothing)
 - £100 for sure
- Expected value of both options is identical:
 $.50 \times £200 + .50 \times £0 = 1.0 \times £100$
- But people prefer sure outcome over a risky prospect with same expected value
 - Risk Aversion



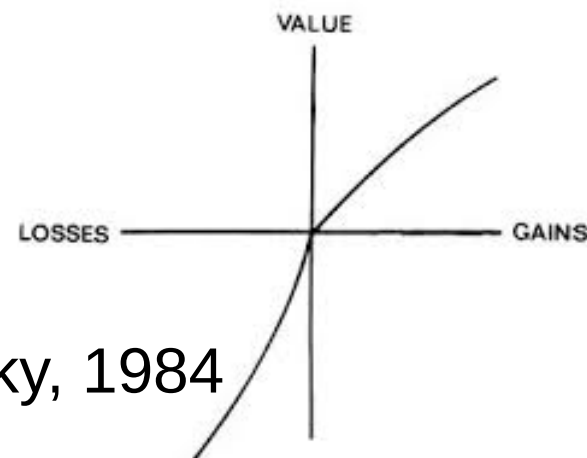
PRIFYSGOL CYMRU
Y Drindod Dewi Sant
UNIVERSITY OF WALES
Trinity Saint David

Kahneman and Tversky, 1984



Risk and loss

- Which would you prefer?
 - 50% chance **to lose** £200, (50% chance to lose nothing)
 - A loss of £100 for sure
- Expected value of both options is identical:
 $.50 \times £200 + .50 \times £0 = 1.0 \times £100$
- But people prefer risky option over a sure loss with same expected value
 - **Risk Seeking**



PRIFYSGOL CYMRU
Y Drindod Dewi Sant
UNIVERSITY OF WALES
Trinity Saint David

Kahneman and Tversky, 1984



Prospect theory:

Kahneman & Tversky (1979; 1984)

1. Individuals identify a reference point representing their current state.
 2. Individuals are more sensitive to potential losses than to potential gains; this is loss aversion.
- Whether decision about 'gain' or 'loss' can effect decision, regardless of objective expected value
 - We are risk averse when seeking gains
 - We are risk seeking when minimising losses
 - Against the 'normative' view of process
 - What we should do in each case
 - Optimal decision making

Framing/Context

- The manner/way in which information is provided to us can influence our decisions.
- It often involves our decisions being influenced by irrelevant aspects of a situation
- “10% off if you buy before Friday!”
 - Discount vs. surcharge?
 - (10% more if you buy later?)
- Presenting information in different ways can effect the choices people make
 - Can frame in terms of certainty or uncertainty
 - Can frame in terms of losses or gains
 - Other ways to frame context of a choice?

Framing effects

A strange disease is threatening to kill 600 people in the UK.

You are a NHS policy maker and have to decide which of two alternative programs to combat the disease to implement:

(Tversky & Kahneman, 1987)



PRIFYSGOL CYMRU
Y Drindod Dewi Sant
UNIVERSITY OF WALES
Trinity Saint David

Framing effects

If *program A* is adopted,
200 people will be saved

If *program B* is adopted,
there is a $1/3$ probability that
600 people will be saved,
and a $2/3$ probability that no
people will be saved.

If *program A* is adopted,
400 people will die

If *program B* is adopted,
there is a $1/3$ probability that
nobody will die,
and a $2/3$ probability that 600
people will die.

Gain-frame cond. 72% favour A
(Even though both would on
average lead to the same).

Loss-frame cond. 78% favour B
(Even though both would on
average lead to the same).

Comparing A with A in both: Saved 200 = 400 die
Difference is the framing: Either 'positive' or 'negative'
Positive: Risk averse
Negative: Risk seeking

Framing effects

- These findings provide less support for the prospect theory than initially appears.
- Mandel and Vartanian (2011) found that when all programmes were completely described the framing effect disappeared.
- Wang (1996) has argued that social and moral factors not considered by prospect theory can influence performance on this type of task
 - Ps choose between definite survival of 2/3 of patients, which is known as the deterministic option, and a 1/3 probability of all patients surviving and a 2/3 probability of none surviving, which is known as the probabilistic option.

Framing effects

- The deterministic option leads on average to the survival of twice as many patients but the probabilistic option seems fairer because all patients share the same fate.
- Ps prefer deterministic option when problem is related to 6 unknown patients but they prefer the probabilistic option when its related to 6 close relatives because they are more concerned about fairness of that condition.
- Almashat and colleagues (2008) looked at eliminating the framing effect by presenting medical scenarios involving cancer treatments. The effect disappeared when Ps were asked to list the advantages and disadvantages of each option and justify their decision.

Are we rational decision makers?

- Utility theory: should calculate and maximise personal value: 'Rational' choices
- However, context/framing effects decisions e.g.
 - Certainty/uncertainty
 - Gains/losses
 - Positive and negative framing of context
- Also arguable that we do not maximise we satisfice
- One 'short-cut' in decision making may be 'heuristics'



PRIFYSGOL CYMRU
Y Drindod Dewi Sant
UNIVERSITY OF WALES
Trinity Saint David

Heuristics

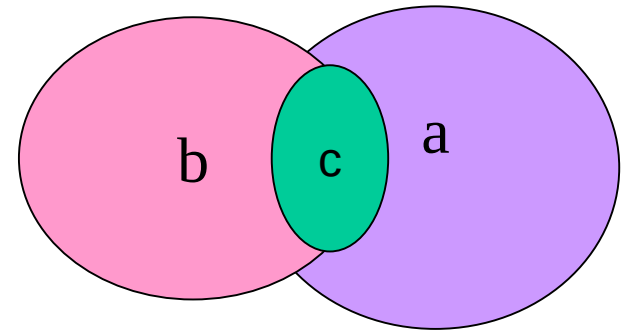
(Kahneman & Tversky, 1973, 1974, 1982)

- ‘Rules of thumb’ that simplify and speed decision making processes.
- “Strategies that ignore part of the information with the goal of making decisions more quickly, frugally, &/or accurately than more complex methods”. Gigerenzer & Gaissmaier, 2011, P.454.
 - Do not guarantee maximal decision
 - E.g. Old looking pubs will sell better beer inside
- Heuristics and influences in reasoning researched:
 - Representativeness
 - Availability
 - Anchoring and adjustment
 - Could also be referred to as ‘biases’ in decisions

Representativeness

- Representative heuristic = deciding an object/person belongs to a category because it/they appear typical of it.
- Tverky & Kahnman: evidence of this through the conjunction fallacy: the mistaken belief that combination of 2 events (A & B) more likely than one event on its own.

c is necessarily a subset of a and b ,
thus c can never be more likely than a



- They used the following description: Linda is 31 years old, single, outspoken & very bright. Studied philosophy and, as a student, was very concerned with issues of discrimination and social justice, and was a member of the Campaign for Nuclear Disarmament.

Representativeness

- Which of the following categories is Linda more likely to belong to (rank as more likely):
 - a) Linda is a bank clerk
 - b) Linda is a feminist
 - c) Linda is a feminist bank clerk (most rank highest)
- Representativeness is a form of stereotyping and can lead to misjudgements
 - E.g. a man wearing a suit in a university must be someone senior?
 - Personal appearance can sway judgements (may be correct/incorrect)
 - Consider for example a court case and how the defendant appears, their hobbies, or their accent
 - Or, older pubs sell better beer: not just people are misjudged

Availability

Availability heuristic refers to the frequencies of events that can be estimated on the basis of how easy or hard it is subjectively to retrieve them from long-term memory.

Which type of four-letter word is more common?

Words that begin with an R?

R _ _ _

Words that have R in the third position?

_ _ R _

- **Results**

- 69% of subjects believed that there are more R _ _ _ words

Correct answer:

_ _ R _ words are more common than R _ _ _ words

How do we explain this bias?

Availability

Availability to memory

It is easier to generate R _ _ _ words than _ _ R _ words from memory

- Estimate likelihood based on memory retrieval
 - the easier it is to retrieve instances of something, the higher its estimated likelihood or frequency
- Linked to ‘recognition bias’ (Goldstein & Gigerenzer, 2002)
 - Place higher **value** on which can be recognised from memory
 - E.g. A person who does not follow football asked who is likely to be better team?
 - Manchester United or Borussia Dortmund
 - More likely recognise **Manchester United**

Availability - Evaluation

- Oppenheimer (2004): we do not always use the availability heuristic.
- Much of the work on heuristics has been limited despite the experimental evidence for error-prone heuristic use.
- Tversky & Kahneman's (1974) one-word definitions are vague & fail to make testable predictions.
- There has been limited theorising in this field (Fiedler & von Sydow, 2015).
- Error-prone judgements may be based on availability of information rather than incorrect heuristic use.
- Finally, much of the research severely lacks ecological validity.



Judgement Theories

- Support Theory: Tversky and Koehler (1994)
 - based in part on the availability heuristic
 - Assumes any given event will appear more or less likely depending on how it is described.
 - More explicit description of an event typically regarded as having a greater subjective probability because it:
 - draws attention to less obvious aspects;
 - overcomes memory limitations.
 - But, explicit description can *reduce* subjective probability if it & lead us to focus on low-probability causes (Sloman et al., 2004).
 - Providing an explicit description can reduce subjective probability by making it more *effortful* to comprehend an event (Frederick, 2011)
- 

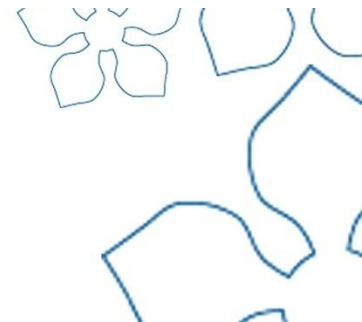


Judgement Theories

- Dual-Process Models: Kahneman (2003) & De Neys (2012).
 - Judgements depend on processing within 2 systems:
 - System 1: intuitive, automatic and immediate (e.g., heuristics).
 - System 2: an analytical, controlled and rule-governed system.
- System 1 rapidly generates intuitive answers that are monitored or evaluated by System 2.
- Since System 2 is more cognitively demanding, processing in this route takes more time.



PRIFYSGOL CYMRU
Y Drindod Dewi Sant
UNIVERSITY OF WALES
Trinity Saint David





Judgement Theories

- Dual-process Models – Evidence:
 - Ps who used System 2 to solve the Linda problem took 40% longer than those who used only System 1 (De Neys, 2006).
 - Ps take longer to answer incongruent problems when System 1 and 2 processes would produce different answers (De Neys & Glumicic, 2008).
 - Neither system is used for some problems (Pennycook & Thompson, 2012).
 - Usage of System 1 and System 2 processing depends more on *how* information is presented (Chun & Kruglanski, 2006).
 - The model explains individual differences in judgement.
 - But it is based on the assumption that most people rely almost exclusively on System 1, errors can also occur in System 2, and many of the assumptions have been shown to be incorrect or oversimplified.
- 

Anchoring and adjustment

- Can become fixated on a starting reference point
 - We don't adjust readily in light of new information
 - E.g. Selling a house, you want £125k
 - Offered £100k by buyer X, followed by final offer of £120k
 - Offered £130k by buyer Y, followed by final offer of £120k
 - Decision to 'sell' will not just be based on final offer
- Endowment/over commitment
 - Once we make a decision we anchor to it and justify it at all costs
 - More likely to allocate more money or resources to poor investment decisions which you have made yourself.



Summary

- We can propose a normative way in which decision-making would be optimal
 - Mathematically correct, expected-utility based
 - Often termed ‘rational’
- Decisions can be personally biased or rational
 - Subjective and objective utility
- Framing and context can bias choices in examples
 - Certainty, risk and valence (positive/negative)
- Heuristics can be used to make decisions
 - Speeding and reducing process (aiding satisficing)
 - Such constraints can bias decisions (and cause errors)
- Can also anchor to a judgement starting point
 - Even in cases where this is detrimental



Key References....

- Kahneman, D., & Tversky, A. (1984). Choices, values, and frames. *American psychologist*, 39, 341-350.
 - Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica: Journal of the Econometric Society*, 47, 263-291.
 - Kahneman, D., & Tversky, A. (1972). Subjective probability: A judgment of representativeness. *Cognitive psychology*, 3, 430-454.
 - Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, 185, 1124-1131.
 - Kühberger, A. (1998). The influence of Framing on Risky Decisions: A Meta-analysis. *Organizational Behavior and Human Decision Processes*, 75, 23-55.
- 



Key References....

- Anchoring
 - Jacowitz, K. E., & Kahneman, D. (1995). Measures of Anchoring in Estimation Tasks. *Personality and Social Psychology Bulletin*, 21, 1161-1166.
 - LeBoeuf, R. A., & Shafir, E. (2006). The long and short of it: physical anchoring effects. *Journal of Behavioral Decision Making*, 19, 393–406.
 - Wansink, B., Kent, R. J., & Hoch, S. (1998). An anchoring and adjustment model of purchase quantity decisions. *Journal of Marketing Research*, 1998, 71-81.
- Availability Heuristics
 - Schwarz, N., Bless, H., Strack, F., Klumpp, G., Rittenauer-Schatka, H., & Simons, A. (1991). Ease of retrieval as information: Another look at the availability heuristic. *Journal of Personality and Social psychology*, 61(2), 195.
 - Stepper, S., & Strack, F. (1993). Proprioceptive determinants of emotional and nonemotional feelings. *Journal of Personality and Social Psychology*, 64(2), 211.
- Loss Aversion
 - Tversky, A., & Kahneman, D. (1991). Loss Aversion in Riskless Choice: A Reference-Dependent Model. *The Quarterly Journal of Economics*, 106(4), 1039–1061.
 - Novemsky, N., & Kahneman, D. (2005). The Boundaries of Loss Aversion. *Journal of Marketing Research*, 42, 119-128.