Cognitive Psychology

PSYC230

Lecture # 14

Decision making

Normative (Rational) Models

Expected Value Theory
Subjective Utility Theory

Descriptive Decision Models

Framing & Sunk Cost Effects

Recognition-Primed Decision Making (RPD)

The SRK Model

Heuristics & Biases

Reasoning & Logic

Inductive & Deductive Reasoning

Descriptive Decision Models

People frequently make irrational decisions
(violate the normative assumptions)

Satisficing

(bounded rationality)
Simon

People don't make the absolutely best decisions
they make decisions that are *good enough*

You want to buy a used car,
you decide on the features you want,
you decide what you are willing to pay

Without considering every car available

People take shortcuts in making decisions
based on their past experiences

Heuristics & Biases

Elimination by Aspects

Simplifying the decision by focussing on
one aspect at a time

Use price of the car as 1st aspect, eliminate all
cars over $3,000

Move on to next aspect, colour
all non-red cars are eliminated

Etc., until only one vehicle meets criterion
on last aspect

Heuristics & Biases

The Framing effect

Tversky & Kahneman (1986)

Physicians & patients make different decisions
depending on whether the choice was worded in
terms of *lives saved* or *lives lost*

Slight changes in wording the question
(the problem frame) result in different decisions

The Framing effect

A disease is expected to kill 600 people
you must choose between two
possible treatment programmes

Treatment 1: Will save 200 lives — 72% pick
Treatment 2: 33% chance that 600 lives will be saved, 67% chance that no lives will be saved — 28% pick

Treatment 1: 400 people will die — 22% pick
Treatment 2: 33% chance that no one will die, 67% chance that 600 will die — 78% pick

Slight changes in wording the question result
in much different decisions

Heuristics & Biases

The Sunk Cost Effect

Throwing good money after bad

Money and effort you've already spent (futilely) shouldn't affect your decision about what to do next – but it does.

Pay $12 to see a movie
WORST movie you've ever seen
Do you get up and walk out?

Or do you stay and *get your money's worth?*

The Sunk Cost Effect

You're driving from the ski fields back home to Hamilton. It is late at night, and you are having real difficulties staying awake. But you're nearly home now. Do you keep driving?

Sunk costs are irrelevant to current decisions- instead, only incremental costs should influence future decisions.

Sunk costs have already been paid- you can't get that cost back.

People take shortcuts in making decisions based on their past experiences

Heuristics & Biases

Heuristics used in obtaining information

Heuristics used in considering alternatives

Heuristics used in selecting actions

Salience Bias

We are "hardwired" to filter incoming information, based on its salience, in the following order:

loud sounds
bright lights
motion
spatial position

Humans are biased to attend to high-salience information,
even if salient cues contain less information

The "As If" Heuristic

Not all information sources are equally reliable – some sources should be considered more valuable and given more weight

In practice people fail "to consider the source" and behave **as if** all sources had equal value

Decisions are usually based more on the total *number* of cues, without considering their reliability or importance

Heuristics used in considering alternatives

Representativeness – probabilities judged on appearance (*gambler's fallacy*)

Availability – probabilities judged on how many examples can easily be called to mind

Anchoring & adjustment – probabilities judged on early anchors and then adjusted upward or downward slightly

Confirmation bias – ignore information not consistent with what you have decided

Illusory correlations – belief that two events are causally connected

Heuristics used in selecting actions

Restricted range – only consider a few possible courses of action (*elimination by aspects*)

Loss aversion – avoid actions that might cost unpleasantness of a loss is greater than the pleasure of a gain of the same magnitude (*framing effects*)

Cognitive fixation – stick with course of action even though the conditions have changed (*sunk costs*)

Overconfidence – overestimate of one's own skills or knowledge

Overconfidence

People (novices & experts) are much more confident about their decisions than they should be (particularly in situations where information is poor or incomplete).

Danger of stopping the search for answers before all available evidence is collected.

(related to Confirmation Bias)

The human decision maker is:

Impatient -- early evidence is given greater weight

Simple -- we attend to only a few attributes

Trusting -- ignore the reliability of information source

Conservative – try to avoid losses and stick with what we've already decided or started to do

Optimistic -- overestimate our own abilities, positive outcomes & underestimate negative ones

Heuristics used in obtaining information

Cue simplicity -- attention to a limited number of sources

Cue primacy – early information carries the most weight

Later information is ignored (see confirmation bias)

Cue salience – prominent information is given more weight

Cue reliability (As-if Heuristic) the reliability or value of an information source is not considered

Recognition-Primed Decision Making
(Naturalistic Decision Making)
Klein & Calderwood

Like the anaesthesiologist example at the beginning of the lecture, real-world decision making has

incomplete, complex, & dynamic information

conflicting goals, time stress, high risks

large set of outcomes, costs, & benefits

In these cases, results from laboratory experiments do not always generalise well

Recognition-Primed Decision Making (RPD)
Klein & Calderwood

In most instances, experts recognise a pattern and recall a single course of action (*intuition*)

Rapid pattern matching & action without comparing & contrasting possible alternatives

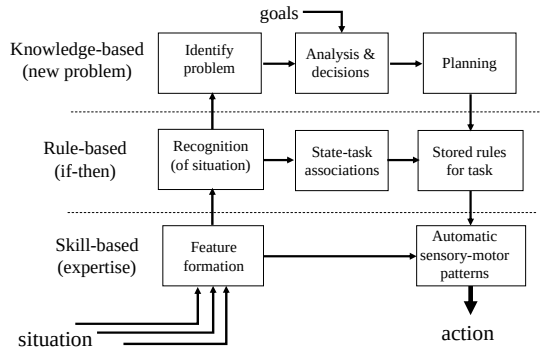
What does this remind you of?
Procedural memory, automatic, implicit, practised

To work well, you must have seen lots of previous examples (*expertise*) and have good *situation awareness*

The SRK Model

Rasmussen

Skill, Rule, & Knowledge based decision making



Reasoning & Logic

Deductive Reasoning

Reasoning from the general to the specific

Inductive Reasoning

Reasoning from the specific to general

Deductive Reasoning

Reasoning from the general to the specific (*top down*)

Syllogisms -- Conditional arguments (if-then arguments)

Starts with *premises (accepted as fact)*

If you're a dairy farmer, then you're rich
You're a dairy farmer

Finishes with an *inference*

Therefore, you're rich

Works with negative cases too

If you're a dairy farmer, then you're rich
You're not rich
Therefore, you're not a dairy farmer

It is possible to be wrong with deductive reasoning

deductive fallacies

Premise

If you're a dairy farmer, then you're rich

You're a dairy farmer Therefore, you're rich	You're not rich Therefore, you're not a dairy farmer
Modus ponens	*Modus tollens*
You're rich Therefore, you're a dairy farmer	You're not a dairy farmer Therefore, you're not rich
Confirming the consequence	*Denying the antecedent*

Deductive Reasoning

Reasoning from the general to the specific

If the red light appears, then the engine is overheating.
The red light appeared.
Therefore the engine is overheating.

Modus ponens

If the red light appears, then the engine is overheating.
The engine is not overheating.
Therefore, the red light must not have appeared

Modus tollens

People have the most trouble with the modus tollens (confirmation bias)

Deductive Reasoning

Reasoning from the general to the specific

If the red light appears, then the engine is overheating
The red light did not appear
Therefore, the engine is not overheating

Denial of the antecedent

If the red light appears, then the engine is overheating
The engine is overheating
Therefore, the red light appeared

Confirmation of the consequence

The most common mistake is confirming the consequence (we read conditional, but think bi-conditional)

Card selection problem
(Wason 1968)

Verify the following premise:

If there is a vowel on one side, there is an even number on the other side.

O	T	4	9

Which cards do you turn over to verify premise?
(Turn over as few cards as you can)

If there is a vowel on one side, there is an even number on the other side.

O	T	4	9
modus ponens	denying the antecedent	confirming the consequence	modus tollens

33% choose O only

47% choose O & 4

Only 4% choose O & 9

Deductive Reasoning
Reasoning from the general to the specific

Performance improves if you are in a familiar situation (experience → heuristics)

Card the patron problem

Four cards, on one side you see each person's drink order. On the other side is the person's age. You must verify that there are no underage drinkers:

If somebody is drinking alcohol they must be at least 18 years old.

Beer (modus ponens)	22	Coke	(modus tollens)

Deductive Reasoning
Reasoning from the general to the specific

Syllogistic arguments can also be made easier through the use of decision aids

Venn Diagrams

All basketball players are tall
Pat is a basketball player
Therefore, Pat is tall

Inductive Reasoning

Reasoning from the specific to general
(*bottom up*)
Unlike deduction, certainty is not possible

Induction yields probabilities, what is likely to be true

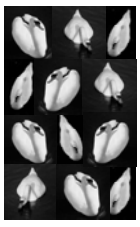
Inductive reasoning can be wrong too…

Representativeness heuristic: probabilities judged on appearance (*gambler's fallacy*)
My number is "overdue" to come up.
(People are poor at aggregating probabilities

Anchoring & adjustment heuristic Availability heuristic

Inferential statistics are a form of inductive reasoning

Inductive Reasoning
Reasoning from the specific to the general



Unlike deduction, certainty is not possible

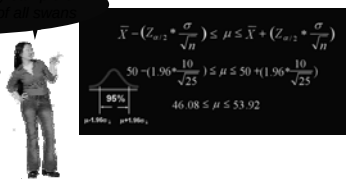
Induction yields probabilities, what is likely to be true

Inductive Reasoning

Reasoning from the specific to the general

Inferential statistics are a form of inductive reasoning

I'm 95% confident that my sample of swans is representative of all swans



Inductive reasoning is difficult *(unless you're Sherlock Holmes*

What evidence do you look for?

How do you interpret it?

A hypothesis is a belief about a population parameter (*mean, proportion, variance*)

Must be stated **before** analysis

Null Hypothesis:

What is tested

Always has equality sign: =, ≤, or ≥

Specified as H_0:

μ = Some Numeric Value

Example, H_0: $\mu = 50$

Alternative Hypothesis:

Opposite of null hypothesis

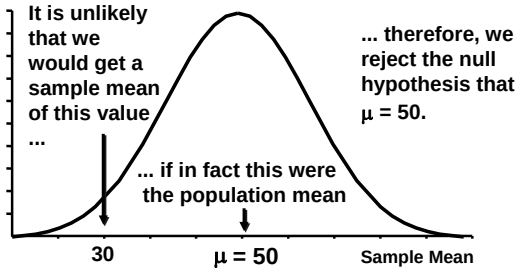
Always has inequality sign: ≠, <, or >

Specified as H_a:

μ < some value

Example, H_a: $\mu < 50$

Confidence intervals & hypothesis testing



Confidence intervals & hypothesis testing

Actual status of research hypothesis:

Researcher's conclusion:	H_{null} is true	H_{null} is false (H_{alt} is true)
H_{null} false	Type I error (p = alpha)	Correct conclusion (p = 1 – beta = power)
H_{null} true	Correct conclusion (p = 1 - alpha)	Type II error (p = beta)

What does this remind you of?

Inductive Reasoning

Categorical inferences

Two factors increasing the likelihood of inducing a conclusion

Similarity between categories in the premises

Similarity between premises' categories and an inclusive category

Sparrows eat fleagles
Tuis eat fleagles
} Chickens eat fleagles

More likely than

Sparrows eat fleagles
Tuis eat fleagles
} Ostriches eat fleagles

Sparrows eat fleagles
Tuis eat fleagles
} Animals eat fleagles

Reasoning by Analogy

Fire is to asbestos as water is to:

vinyl air cotton faucet

Beer is to air as meat is to:

breathe water fire light

The key to solving verbal analogies lies is in how the terms are encoded semantic, phonemic, orthographic, etc.

Inductive solutions here look a lot like the steps involved in problem solving