Cognitive Psychology

PSYC230

Lecture # 13

Last Time

Two different theories concerning the type of information stored in semantic knowledge

Imagery Theory

Images contain *analogue* information & spatial relations: colour, size, sound

Really just a part of:

Dual-code Theory

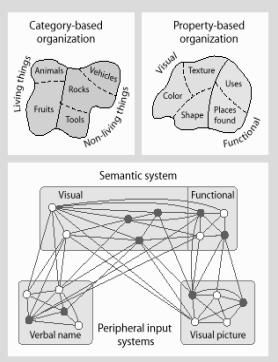
Both *Imaginal* and *Verbal codes* are used

Propositional Theory

Propositions are abstract, non-linguistic, "mentalese" that express a relationship between concepts

e.g., teaches (Sam, psychology)

Two different hypotheses concerning the organization of semantic knowledge & why category deficits occur



Things may be represented in several ways, depending on our experience with them

Our representations of facts encompass multiple dimensions and are distributed (and linked) accordingly

Connectionist/PDP Models

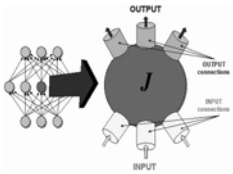
neural networks -- information is distributed across multiple layers & processed in parallel

content addressable memory

graceful degradation

default assignment

generalisation



Production System Models

knowledge represented a set of procedures and if-then rules about the world

Newell & Simon (1972): used production rules IF-THEN relationships

IF a particular condition is met
THEN a specific action will be performed

organised into hierarchical routines & subroutines comprising a production system

Expert systems

MYCIN - diagnosis of bacterial infections using blood & glucose test results

Based on IF-THEN statements (productions)
500 rules can handle 100 different infections
In some cases can suggest treatment

How do we know what someone's mental representation is?

Knowledge extraction

Protocol analysis - overtly describe the steps while performing a task

Protocol analysis allows researchers to identify the procedures and rules used by experts

Ericsson & Simon (1984)

Usually identifies a series of steps (script) – procedures or goals and rules – production system

But the experts may not always be aware of the rules they use, or think they use certain rules when they do not

Some of their expertise (particularly procedural scripts) is *Implicit Knowledge:* surgery example

Strong AI -- tries to build intelligent systems using the same processes and information structures that humans use

Weak AI -- building intelligent systems that produce intelligent outputs (like humans), even though the processes may be quite different

What about semantic knowledge? (facts about the world)

Pathfinder

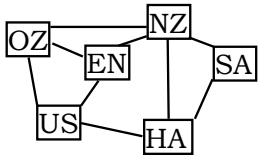
Uses pairwise similarity ratings to form a *proximity matrix*, then a network

How similar are:	1 very similar	6 very different
New Zealand & Australia		
New Zealand & USA		
New Zealand & Hawaii		
New Zealand & England		
New Zealand & Samoa		
Australia & USA		
Australia & Hawaii		
Australia & England		

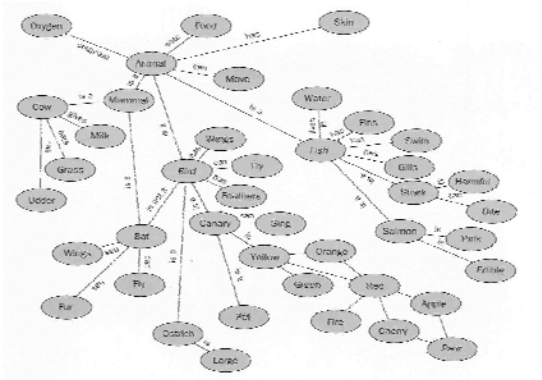
proximity matrix
(hard to visualise)

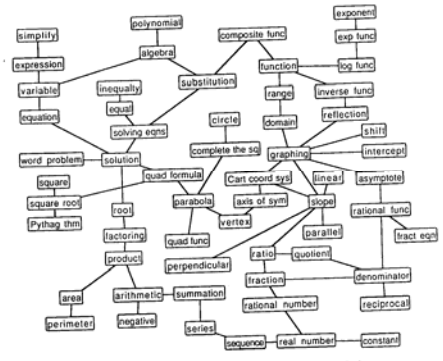
	NZ	OZ	US	HA	EN	SA
NZ	0	3	5	4	2	2
OZ	3	0	3	4	3	6
US	5	3	0	3	5	6
HA	4	4	3	0	5	3
EN	2	3	3	5	0	5
SA	2	6	6	3	5	0

pathfinder network



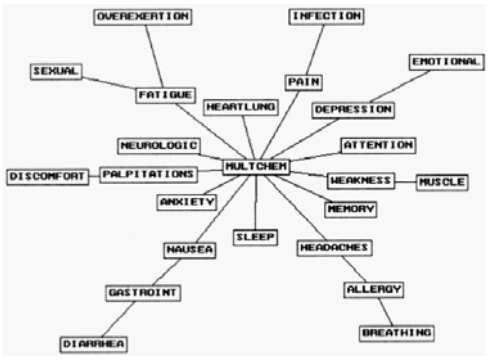
Semantic Network Model
(Collins & Loftus, 1975)



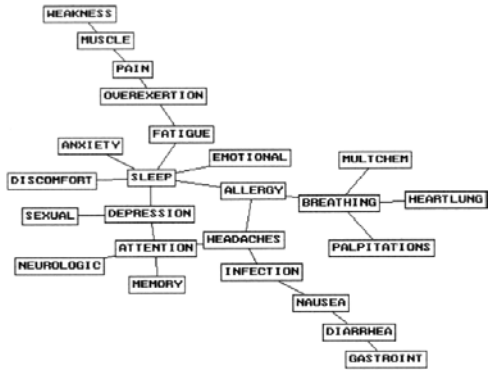


Expert's representation of 60 concepts from algebra
(Expert's & novices' representations are quite different)

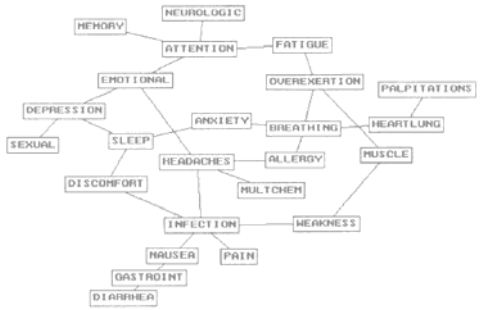
PFNet of symptoms associated with multiple chemical sensitivity (MCS), from MCS patients



PFNet of symptoms associated with multiple chemical sensitivity (MCS), from Psych students

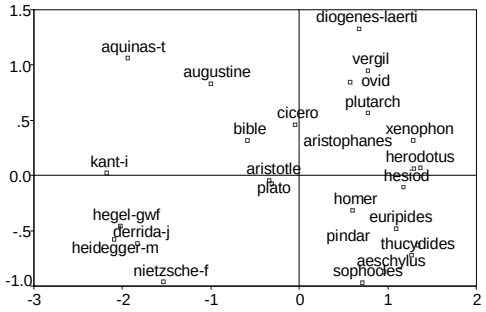


PFNet of symptoms associated with multiple chemical sensitivity (MCS), from asthma patients

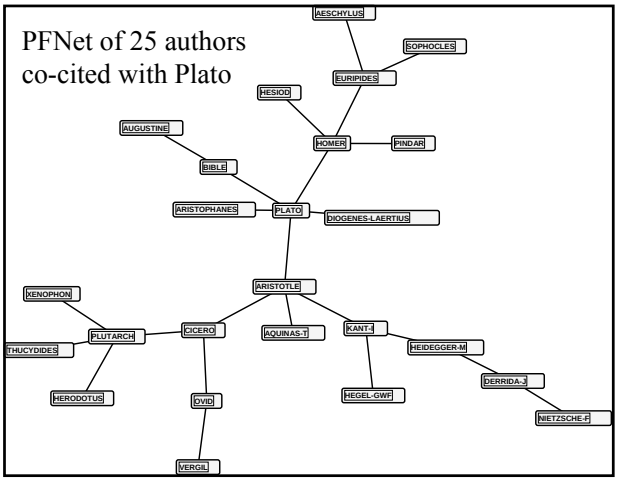


25 Authors Co-cited with Plato

2D Multi-dimensional scaling (MDS) map



PFNet of 25 authors co-cited with Plato

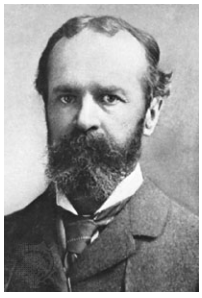


New Topic

Decision making

William James

"There is no more miserable human being than one in whom nothing is habitual but indecision, and for whom the lighting of every cigar, the drinking of every cup, the time of rising and going to bed every day, and the beginning of every bit of work, are subjects of express volitional deliberation" (1890)



Characteristics of decision making

1) Must select one choice from a number of choices

2) There is some information available about the choices

3) Time frame for choosing is long (longer than 1 sec)

4) There is uncertainty as to which is the best choice

Examples of decision making

Fire fighting

Consumer behaviour

Jury deliberations

Medical diagnosis

Aircraft flight judgements (pilots & ATCs)

Electrical & mechanical fault diagnosis

Process control

Allocation of resources

Use of safety equipment

Decision making

Normative (Rational) Models

Expected Value Theory

Subjective Utility Theory

Descriptive Decision Models

Framing Effects

Recognition-Primed Decision Making (RPD)

The SRK Model

Heuristics & Biases

Reasoning & Logic

Inductive & Deductive Reasoning

Classical Decision Theory

Normative (rational) models

Expected value theory

"economic man & woman" base decisions on utility

maximise the expected value (payoff)

$$E(v) = \sum_{i=1}^{n} p(i)\, v(i)$$

the sum of the value of each outcome multiplied by its probability

Your choice:

A 20% chance of winning \$50 $E(v) = .2 * \$50 = \$10$

A 60% chance of winning \$20 $E(v) = .6 * \$20 = \$12$

Basic Steps In Rational Decision Making

1. Identify all possible options (including doing nothing).
2. Quantify the value (or cost) of consequences of each decision.
3. Assess the likelihood of each consequence actually happening.
4. Integrate across all possibilities.

A real-life example

An anesthesiology team in a large hospital consisted of four physicians, three of whom were residents in training. The group was asked to assist with four procedures in one building (in vitro fertilisation, perforated viscus, reconstruction of a leg artery, & appendectomy) and an exploratory laparotomy in another building. All the procedures were urgent and could not be delayed for regular operating-room scheduling. There were several delays in preoperative preparation and several surgeons and nurses were pressuring the team to get the procedures finished. The situation was complicated by the fact that the staff was only able to run two operating rooms simultaneously and the best use of resources was to overlap procedures so that one case was started as another was finishing. The anesthesiologist in charge had to decide how to allocate the four team members to the five needed procedures. Also there was always the possibility that a major emergency case would come into the trauma centre in which case the anesthesiologist in charge was expected to be immediately available. The decision was relatively simple: should she allocate only the other three anesthesiologists to the five procedures or should she help out also, leaving no one available in case of an unexpected major emergency?

Apply the classical approach to the anaesthesiologist problem

Choices/possible outcomes	Probability	Utility -10 to +10	Expected value
Use three anaesthesiologists			
No emergency:	.80	-4	-3.2
Emergency arrives:	.20	10	2.0
			$E(v) = -1.2$
Use four anaesthesiologists			
No emergency:	.80	6	4.8
Emergency arrives:	.20	-10	-2.0
			$E(v) = 2.8$

Do you agree with this choice?

Different outcomes have different values for different people

Is that how people really make decisions?

Quantifying cost and value, and computing costs and benefits for all options is cognitively demanding.

Expected value doesn't take into account less tangible personal things like stylish, popular, or respected "subjective utility".

Expected Value Theory was replaced by
Subjective Utility Theory

Subjective utility = individual judgements of value

Job A = .5 chance of a 20% raise in salary in 1st year, travel required, paid holidays

Job B = .8 chance of a 10% raise in salary in 1st year, dental care, health insurance, vacation time

Subjective probability = individual estimates of the likelihood of outcomes

Still a Normative (rational) approach that assumes people consider all the alternatives

Descriptive Decision Models

People frequently make irrational decisions (violate the normative assumptions)

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
Treatment 2: 33% chance that 600 lives will be saved, 67% chance that no lives will be saved

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

Slight changes in wording the question result in much different decisions

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.

Descriptive Decision Models

People frequently make irrational decisions
(violate the normative assumptions)

Satisficing

(bounded rationality)
Herb 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

I want a sporty car, fun to drive….
and its got to look good – a red one would be great
I want it to have a good sound system,
and I've got that $3,000 coming in next month

and so you start visiting car lots & reading ads

When you find a car that meets your criteria,
you buy it

Without visiting every car lot or considering
every car available

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

Questions ?