



Cognitive Psychology

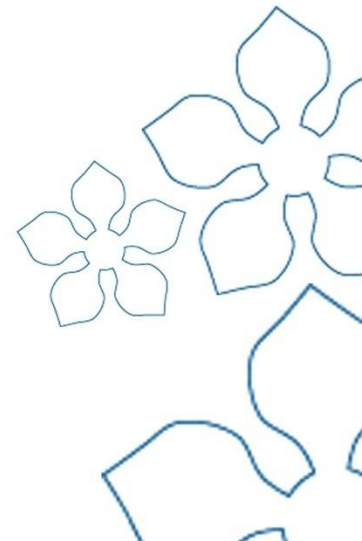
M5X00908 Brain, Behaviour, and Cognition (BBC)

Concepts, Categorisation, and Schema

Dr Kate Williams



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Essential Reading!!!!

- Eysenck, M. W., & Keane, M. T. (2015). *Cognitive psychology: Chapter 7.*



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Organisation of memory

- LTM two key roles:
 - Storage of information (in useful form)
 - Retrieval of information (in accurate way)
- Consider scale of this task in terms of amount/variation of information
- Organisation is key to this ability



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Organisation of semantic memory

- What is the capital of France?
- How did you access the fact 'Paris'?
 - Memory retrieval process of stored fact
 - Meaningful links to information stored
 - Key components: Capital/France?
 - Starting to see *organisation* in process and structure
- How about 'Did Henry VIII have feet'?
 - Memory retrieval of that as a 'fact'?
 - Related semantic information and connections



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Mental representation of knowledge

- Powerful forms of organisation:
 - **Categorisation** of information
 - Grouping of information
 - Connections between information
 - **Schemata** for information
 - Information not stored ad-hoc
 - Structures 'readied' for certain information
 - Relations between information intrinsically stored
- Ways of storing information
- Heavy influence on how information retrieved



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Answer these questions

- Name a fruit **beginning** with the letter **p**
- Name an animal **beginning** with the letter **d**
- Name a metal **beginning** with the letter **i**
- Name a bird **beginning** with the letter **b**



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Answer these questions

- Name a fruit **ending** with the letter **h**
- Name an animal **ending** with the letter **e**
- Name a metal **ending** with the letter **r**
- Name a bird **ending** with the letter **h**



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Organisation of semantic memory

- How do we access the answers?
- E.g. 'Animal beginning with d?'
 - Access category of 'animals'
 - Category of 'beginning with d'
- May interpret as:
 - Previously stored categories of information
 - Created through encoding of previous cases
 - Previously encoded 'dog' as member 'animals'
 - Also stored in category 'd words'



How is knowledge organised in memory?

- Loftus (1992) two conditions:
 - C1: smaller category (e.g. fruit) then initial letter (e.g. p)
 - E.g. Name a fruit beginning with the letter 'p'
 - C2: initial letter then smaller category
 - E.g. Name something beginning with letter 'p' which is a fruit
 - Quicker with fruit category first (Condition 1)
- Memory is activated (primed) by initial instruction
- This initiates memory search
 - Category fruit is a manageable and coherent packet of information
 - Words beginning with 'p' is a potentially huge and diffuse category



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Categories and concepts

- Is this organisation about merely:
 - Grouping/clustering of different objects?
 - Physical objects?
- Concepts and categories can be more abstract:
 - Things you don't like about work
 - Your favourite music
 - Jobs you need to get done this week
 - Things that make you sad
 - Justice



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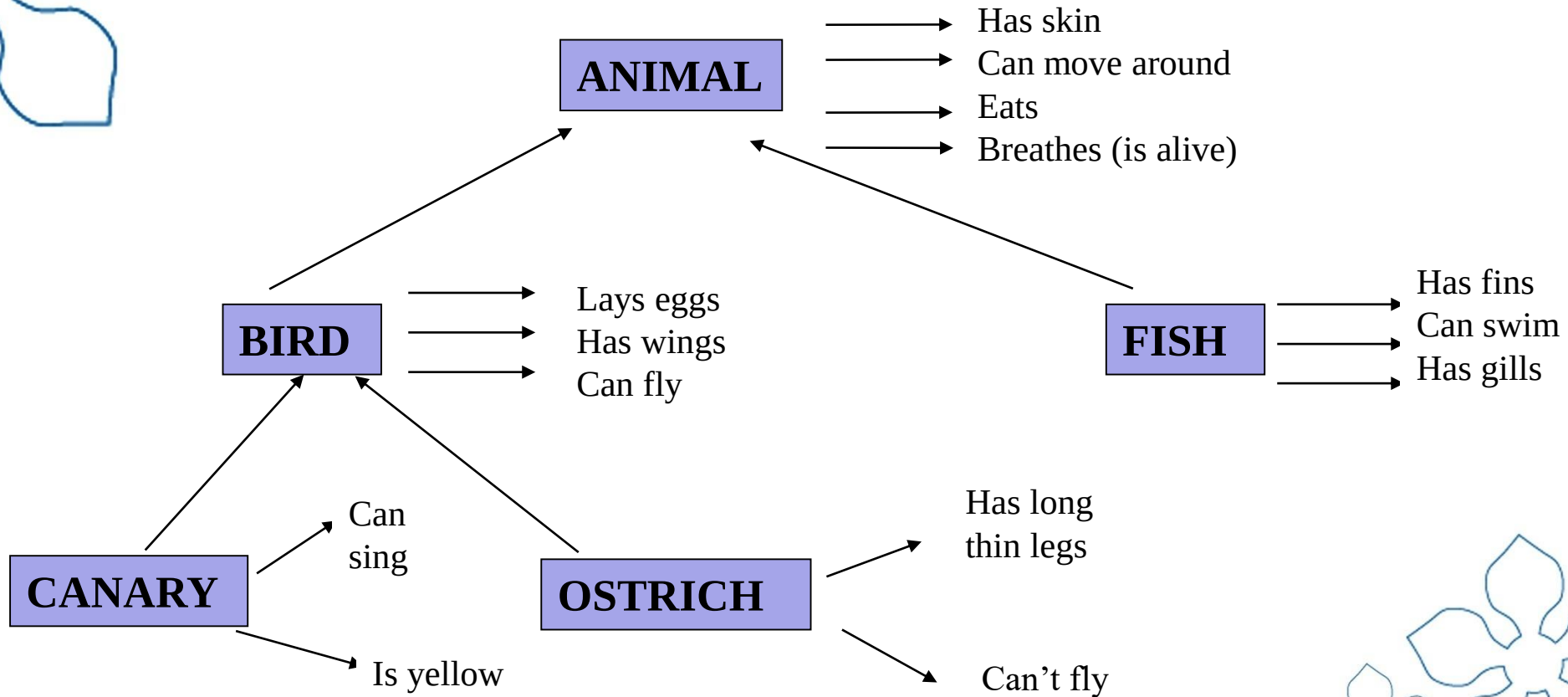
Concepts and categories

- How do we judge whether an item belongs to a concept/category?
 - Is 'dog' a member of 'animals'?
 - Is 'earwig' a member of 'animals'?
 - Process necessary to make the decision
 - Initial organisation in LTM
 - **Criteria** for organisation/categorisation



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Quillian (1969): The Teachable Language Comprehender



Sentence verification tasks

Collins and Quillian (1972)

Reaction time data:

- Concept verification
 - ‘is a canary an animal?’
 - ‘is a canary a bird?’ - faster RT
- Property verification
 - ‘does a canary have skin?’
 - ‘can a canary fly?’ - faster RT
 - Does an ‘earwig’ breathe? – slower RT



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Interpretation of data

- Rosch (1973) - Typicality effects
 - Dominant features
 - A canary is yellow vs a canary can breath
 - Dominant members:
 - Birds eat worms
 - I heard the bird singing
 - I watched a bird fly over the house
 - The bird was perching on the twig
 - Replace 'birds' with:
 - Robins
 - Eagles
 - Ostriches
 - Penguins

Rosch (1973) – prototype view

- Categories are organised around central ‘prototypes’ (typical description)
- Hold in memory this prototype which also has characteristic attributes
- E.g. a prototype ‘chair’ in memory



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Prototypes

- In each of the categories we come across there are potentially infinite instances, so the cognitive system needs to create a summary representation.
- An average representation across all instances of a category.
- The prototype incorporates the most typical aspects of the instances from a category.
- Some category instances will be *more* typical than others depending on the “distance” from the category prototype:
 - E.g., Robin more typical bird (thus closer to the prototype) than a penguin.

Prototypes

- Can make comparisons between **new examples** and category **prototype** to judge membership
- Membership = similarity of an example's attributes to the prototype list of attributes
- Make a judgement on how strongly similar
- Allows for 'fuzzy' membership
 - E.g. Is a spider an insect?
 - Is a tomato a fruit?
- View of categories as having fuzzy boundaries
- Involves reasonable intuitions.



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Prototypes vs Exemplars

- Prototype is idea of ONE stored memory against which new examples are compared
- Alternative is that categories represent all (or many) previously seen examples (exemplars)
- E.g. Category 'chair'
 - Every example you have seen of a 'chair' incorporated
- Incidental form of learning (non-deliberate)
- How make category judgement with this view?
- New example compared with previous examples held in memory
 - (*Medin & Shaffer, 1978; Medin, Goldstone & Gentner, 1993*)



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Exemplars



How similar to **each** 'exemplar' is it?
Is it a member of category 'chair'?

Prototypes vs Exemplars

- Exemplar view emphasises our *learning*
- Highlights we don't 'know' of a category innately
 - Does a newborn know what a 'chair' looks like?
 - No, this is *demonstrated* with examples
 - Over time concept is developed
 - Also indicates that concepts can change
 - Each new example becomes an 'exemplar' can change the representation stored



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Prototypes vs Exemplars

- Weakness with Exemplar theory: not all categories are equally good – e.g., chair is a fairly intuitive category but is that the case for say the Eiffel Tower?
 - Is ‘exemplar theory’ too cumbersome?
 - Compare every single example of category/concept?
 - E.g. All ‘chairs’ seen in forming and judging category?
 - Possible we convert this back to ‘prototype’ representation?
 - Evidence for ‘prototypes’ in recognition testing
 - Prototype **not observed** in examples -> highest recognition score (Hess, 1982; Hess & Slaughter, 1986)
 - Evidence that we still store specific exemplars within a category to form a concept
 - Category exemplars influence concept held in memory (*Hess & Slaughter, 1986*)
- 

Prototypes vs. Exemplars

- Both predict similarity will determine classification:
 - Prototype: similarity to AVERAGE of instances
 - Exemplar: similarity to each individual instance
- In many cases their predictions will be the same
- It requires a clear category structure to identify situations where their predictions will differ.
- But can all categorisation be reduced to similarity?



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Evidence from Category Variability

- Rips (1989): Pizza/Coin experiment:
 - Group 1: asked whether an object 5 inches in diameter was more likely to be a coin or a pizza (Categorisation).
 - Group 2: asked to judge the similarity of the object to either a coin or a pizza (Similarity).
 - The size of the object was roughly $\frac{1}{2}$ way between both.
 - Findings:
 - Ps in the categorisation group judged the object to be a pizza, while Ps in the similarity group judged the object to be a coin.
 - If categorisation is based on similarity, then both groups should have provided the same answer.
 - Conclusion: The fact that they didn't suggests knowledge about the variability of sizes of objects influences decisions
 - Pizzas vary in size whereas coins must be in a constant size by law

Categorisation

- Is cognition categorisation? (E.g. van Gelder, 1993; in Categorisation by Humans and Machines, Nakamura et al. Eds.)
- Categories and concepts add great processing ability
- Represent large amounts of stimuli under one concept
- Apply top-down knowledge to stimuli
 - E.g. concept of 'cow' in recognising distorted image (you now perceive)
 - Perception of objects and recognition
- Skilled problem-solving as a search through exemplars (Kulatunga-Moruzi, Brooks & Norman, 2004)



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Schemas in memory representation

- Idea that memory is 'readied' for certain information
- We don't place information into a 'blank slate' storage system
 - Knowledge aiding **new** knowledge
- This allows us to store more efficiently
 - Greater coherence of information
 - Associations in memory
 - Better performance in using/retrieving



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Schemata

- Bartlett (1932)
 - Abstract group of knowledge about a particular situation
- Familiar events/situations have a schema
 - E.g. 'What to do in a restaurant' schema
 - Stereotype
- Depicting how knowledge may be used and stored for actions and situations
 - *Useful* information
 - Skilled domains of behaviour



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How comprehensible?

“The procedure is actually quite simple.

First you arrange things into different groups depending on their makeup.

Of course, one pile may be sufficient depending on how much there is to do.

If you have to go somewhere else due to lack of facilities, that is the next step; otherwise you are pretty well set.

It is better to do too few things at once than too many.

Remember mistakes can be expensive.

At first the whole procedure will seem quite complicated.

Soon, however, it will become just another fact of life”

(Bransford and Johnson, 1973 / Bransford 1979)

- Without schema difficult to encode or retrieve information
- With schema of ‘ironing’ far easier to store and retrieve

Schema in memory

- Why is information easier to retrieve if stored in schema or concept?
 - Can simply activate a global schema E.g. 'Ironing'
 - Top-down processing from the global concept
 - Activation based/connectionist views (e.g. Collins & Loftus, 1975; McNamara, 1992):
 - Bottom-up processing
 - Activation of one part of schema also activates the other components of the schema
 - E.g. 'Sitting down' in *restaurant* schema also activates 'looking at the menu'
 - Ultimately recall many pieces of information
 - Relates to 'chunking' of information (Miller, 1958)
 - Many pieces of information stored and recalled as one item

Summary

- Organisation of memory is key to our functioning
 - Representation of stored knowledge
 - Retrieval of that knowledge for use
- Semantic information holds large amount of our useful knowledge about world
- Memory systems to cope with that knowledge
- Schema that represent associated information:
 - Efficient storing and retrieving
 - Enhancement of performance using memory
- Categorisation and concepts
 - Prototypes and exemplar based theories
 - Stored representations retrieve large amounts of information





Next Week...

Decision Making

Essential reading:

Eysenck, M. W., & Keane, M. T. *Cognitive psychology*: **Chapters 13 & 14.**

