PSY1002 – Lecture 14

Memory III: Semantic Memory

Claudia von Bastian

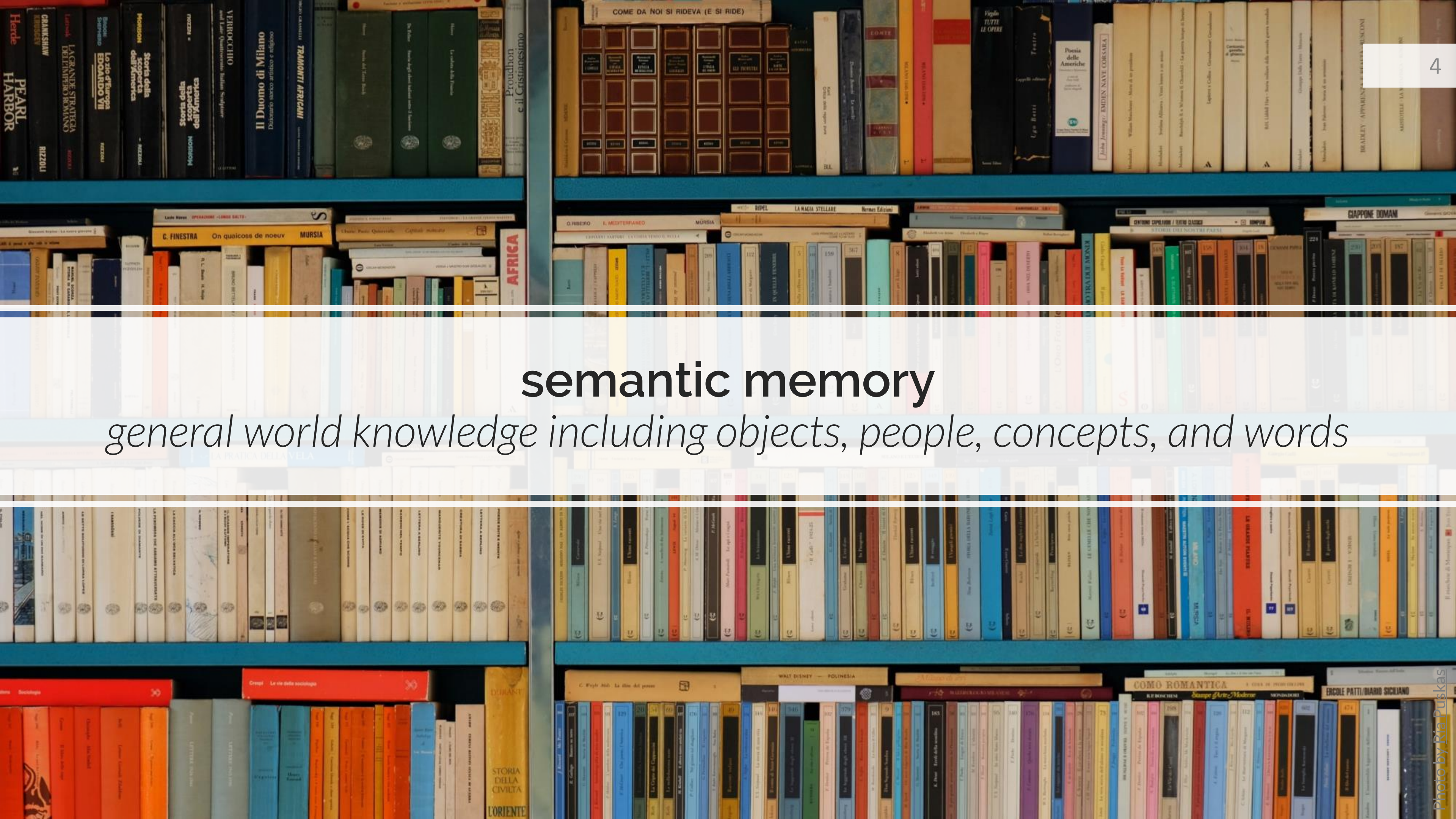
Recap: Last week

- **Mental time travel** allows for reconstructing memories of personal past events and their contexts.
- Memory can be measured with **direct and indirect tests**.
- Memory can be improved by considering **influences on encoding and retrieval**.

Memory Lectures

- Memory I: Processes and Systems
- Memory II: Episodic Memory
- Memory III: Semantic Memory
- Memory IV: Memory Errors
- Memory V: Memory and the Law

Photo by Josh Hild



semantic memory

general world knowledge including objects, people, concepts, and words

Photo by Ria Puskas

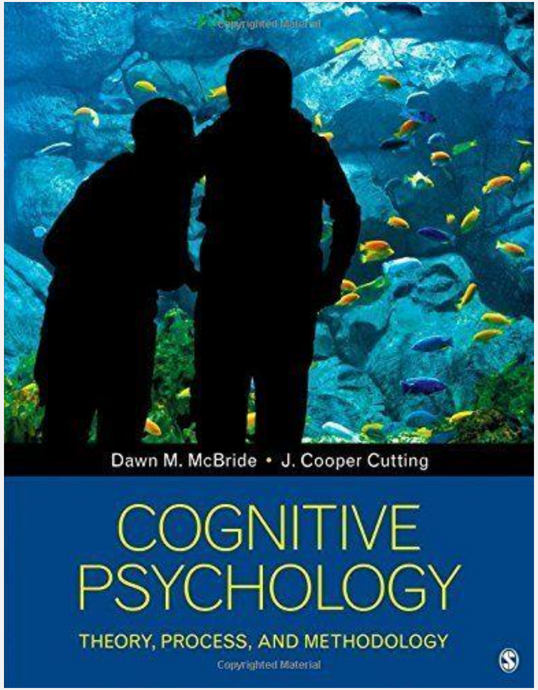
Learning objectives

- Explain how the structure of semantic memory can be described as a **network**.
- Describe theories of **categorisation** and explain their strengths and weaknesses.
- Explain how **categories, schemata and scripts** are used for prediction and reconstruction.
- Describe the **five primary schema processes** and how they can be demonstrated experimentally.

Key concepts

- Semantic memory networks
  Spreading activation, hierarchical network model (Collins & Quillian, 1969); network elements (nodes, paths, and features; basic, subordinate, and superordinate levels); associative network model (Collins & Loftus, 1975); semantic relatedness
- Theories of categorisation
  Classical theory (Aristotle vs. Wittgenstein); measuring categorisation (typicality ratings, exemplar production, membership verification); prototype theory (Rosch, 1975); exemplar theory; explanation-based theory; Barsalou's (1983) experiments
- Categories, schemata and scripts
  Predicting what happens next based on regularities in the world
- Schema processes *(Alba & Hasher, 1983)*
  Selection (Bransford & Johnson, 1972), abstraction (Carmichael et al., 1932), interpretation (Johnson et al., 1973), integration (Bransford et al., 1972), and reconstruction (Bartlett, 1932; Brewer & Treyens, 1981)

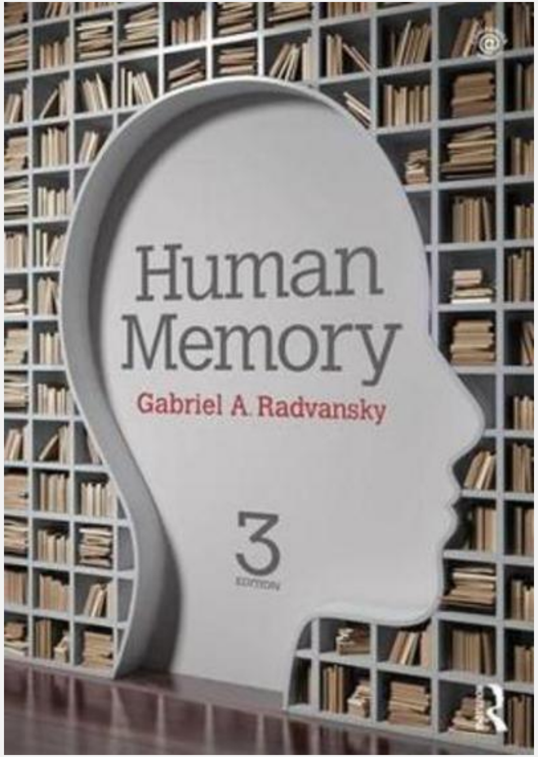
Core reading



Chapter 10: Concepts and Knowledge

Chapter 7: Memory Errors. The Reconstructive Nature of Memory (pp. 157-160)

Optional reading



Chapter 9: Semantic Memory

Important: All exam-relevant materials are covered in core reading and lecture materials. Optional reading is **not exam-relevant and truly optional**.

Semantic Memory

1: Semantic memory structure

Semantic memory structure


Photo by RHUCK

a canary has feathers


Photo by Dan Novac

a robin lays eggs


Photo by Andrew Alexander

Paris is the capital of France

Semantic memory structure

How is semantic information stored in memory?

Photo by Samuel Zeller

Option 1: Separately stored representations of information and their various relations.
Problem: not economical

a canary is a bird;
a canary has feathers;
a canary lays eggs

a robin is a bird;
a robin has feathers;
a robin lays eggs

a sparrow is a bird;
a sparrow has feathers;
a sparrow lays eggs

Semantic memory structure

How is semantic information stored in memory?

Photo by NASA

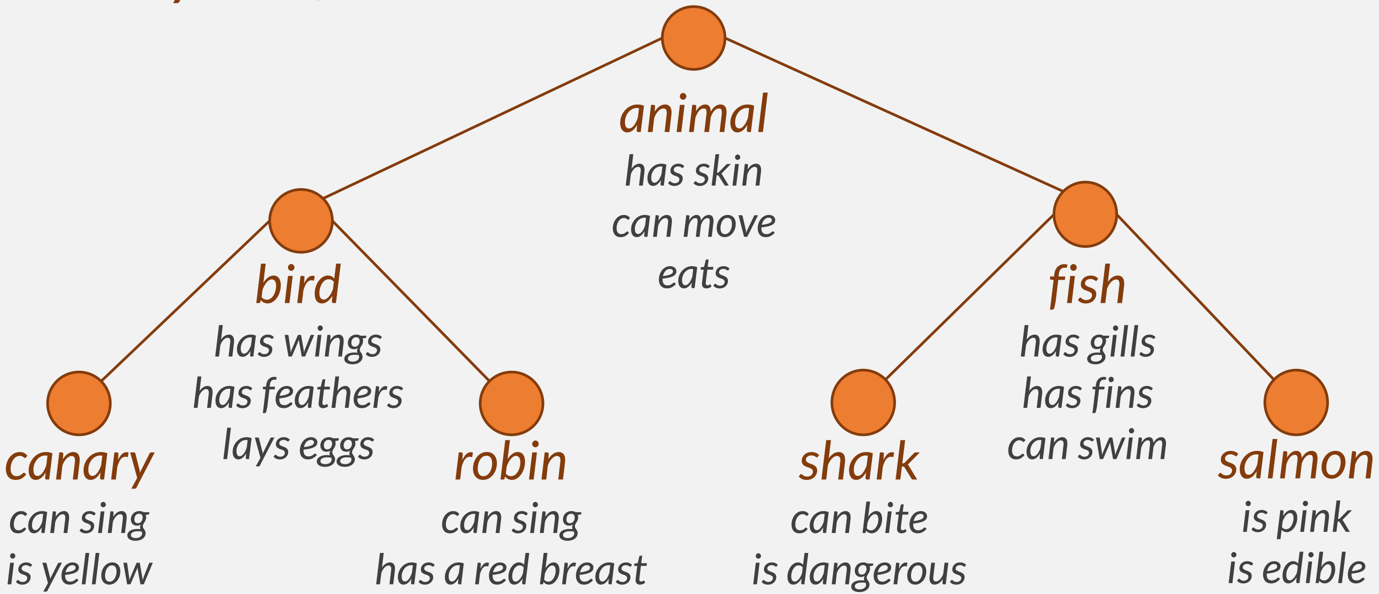
Option 2: Storing representations and their relations in a more economical **network**.

birds have feathers and lay eggs;
canaries are birds;
robins are birds;
sparrows are birds

Semantic memory structure

Collins & Quillian's (1969) hierarchical network model

A canary has feathers.



Allan Collins

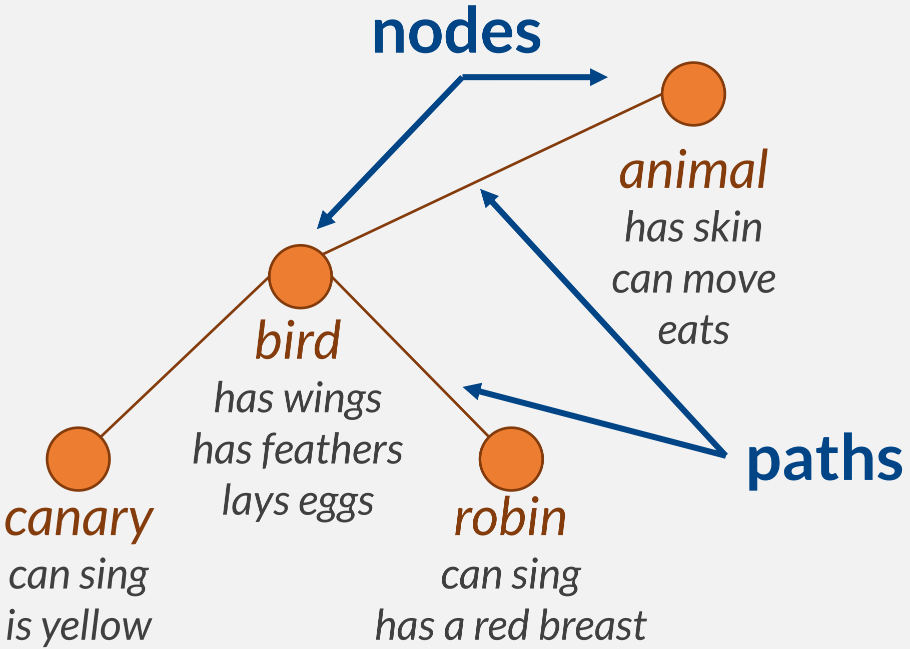
Ross Quillian

Collins, A. M., & Quillian, M. R. (1969). Retrieval time from semantic memory. *Journal of Verbal Learning and Verbal Behavior, 8*, 241-248. doi: 10.1016/S0022-5371(69)80069-1

Semantic memory structure

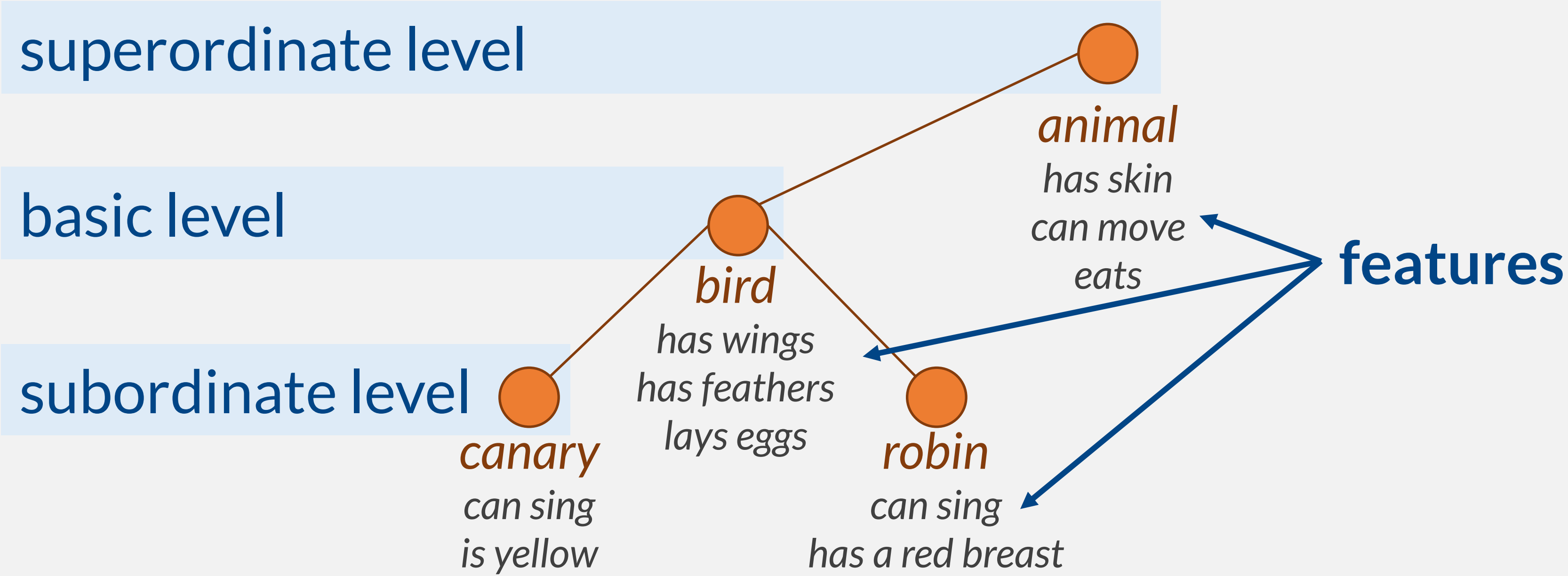
Collins & Quillian's (1969) hierarchical network model

Access of concept representations through **spreading activation** between nodes via their connecting paths.



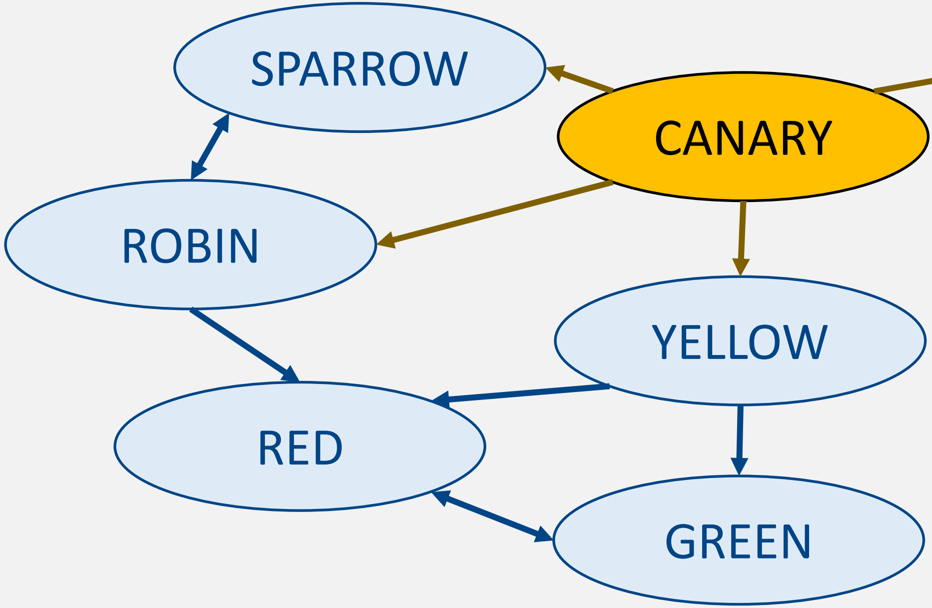
Semantic memory structure

Collins & Quillian’s (1969) hierarchical network model



Semantic memory structure

Collins & Loftus' (1975) associative network model



Allan Collins

Elizabeth Loftus

Hierarchy has later been replaced by **semantic relatedness**.

Collins, A. M., & Loftus, E. F. (1975). A spreading-activation theory of semantic processing. *Psychological Review, 82*, 407-428. doi: 10.1037/0033-295X.82.6.407

A world without meaning

Imagine for a moment what it would be like not to have semantic memory…

… not knowing what a "bird" is,

… not knowing that Paris is the capital of France,

… not knowing how to use a phone when it rings,

… not knowing that snow will eventually melt,

… not knowing the rules and concepts of life.

Photo by Ashim D'Silva

A world without meaning

Semantic dementia

Syndrome of progressive deterioration in semantic memory, leading to the loss of knowledge about objects, people, concepts, and words.

https://youtu.be/fkKrsbwQvrE

Semantic Memory

2: Categorisation

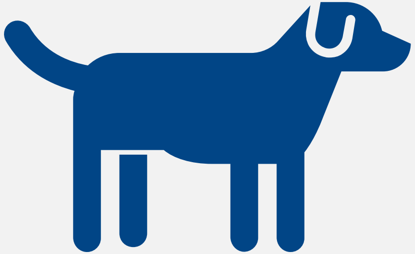
Forming concepts: categories


Photo by Nikolay Tchaouchev


Photo by Christoph Schmid

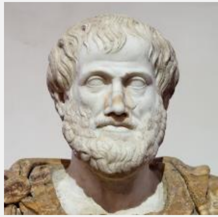

Photo by Berkay Gumustekin


Photo by Braydon Anderson



Semantic memory enables us to form **representations of categories** (e.g. “dog”) based on regularities in the world, thereby allowing us to make predictions about what will happen next.

Classical theory of categorisation



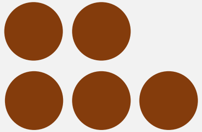
Aristotle
(384-322 BC)

Categories are defined by **necessary and sufficient** features.

Odd numbers cannot be divided evenly into groups of two.

Is 5 an odd number?

5 = 2 + 2, remainder 1 → 5 must be odd



Pause and think

Try to come up with a definition for the concept of “chair”.

Pause and think

Does your definition hold for all of these examples?

Classical theory – criticisms

Ludwig Wittgenstein (1889-1951)

Family resemblance: different members of a category can share different features.

Photo by Kelly Miller

Photo by Paul Hanaoka

Photo by Ruslan Bardash

Wittgenstein, L. (1953). *Philosophical investigations*. New York, NY: Macmillan

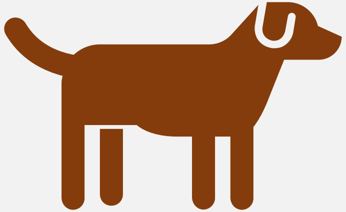
Classical theory – criticisms

Central tendency: categories exhibit an averaged ideal


Photo by Nikolay Tchaouchev


Photo by Christoph Schmid


Photo by Berkay Gumustekin



Classical theory – criticisms

Graded membership: some members are more typical for a category than others


Photo by Jacques LE HENAFF

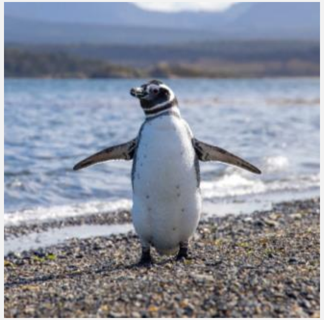


Photo by Sander Crombach


Photo by Shannon Litt

Measuring categorisation

Typicality ratings

Rank the following chairs from being the best example to being the worst example of a chair:

Photo by Kelly Miller

Photo by Paul Hanaoka

Photo by Ruslan Bardash

Photo by Nick Karvounis

Photo by Kari Shea

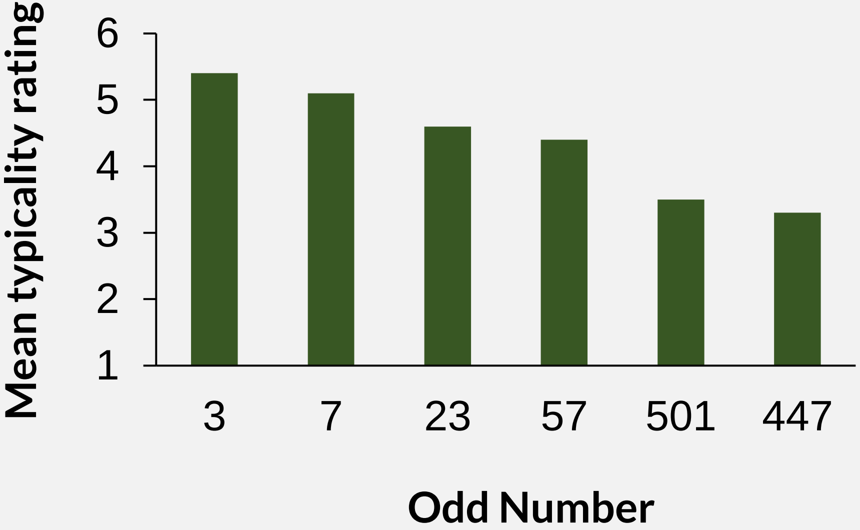
Photo by Jonathan Savoie

DV: average rank or rating

Measuring categorisation

Sharon Lee Armstrong

Armstrong et al.'s (1983) typicality experiments



👉 Graded membership exists even for odd numbers.

Armstrong, S. L., Gleitman, L. R., & Gleitman, H. (1983). What some concepts might not be. *Cognition, 13*, 263-308. doi: 10.1016/0010-0277(83)90012-4

Measuring categorisation

Exemplar production

Recall as many pieces of furniture as you can.

chair, desk, cupboard,
bed, drawer, lamp, …

DVs: frequency of production and/or position in the production

Measuring categorisation

Category membership verification

Is this an exemplar of the category?

furniture: carpet

bird: robin

fish: shark

DVs: accuracy of responses and/or reaction times

Semantic Memory

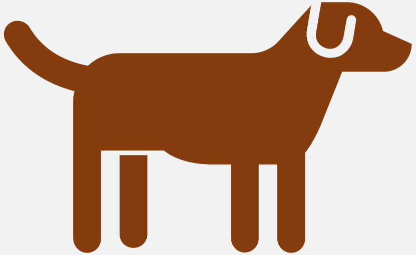
3: Modern theories of categorisation

Prototype theory *(Rosch, 1975)*

Eleanor Rosch

Categories are determined by a mental representation that is a **weighted average** of all category members. This **prototype** may or may not be an actual entity.

Photo by Hannah Lim



Common features:
four legs, furry, tail,...

Distinctive features:
barks, is omnivore,...

Rosch, E. (1975). Cognitive representations of semantic categories. *Journal of Experimental Psychology: General, 104*, 192-233. doi: 10.1037/0096-3445.104.3.192

Prototype theory – criticisms

Prototype theory cannot explain:

How can people tell the **size of categories**?

Photo by Hannah Lim

Many types of dogs

Photo by Matthew Cramblett

Fewer types of elephants

Prototype theory – criticisms

Prototype theory cannot explain:

How can people **add new members** to a category?

Photo by Hannah Lim

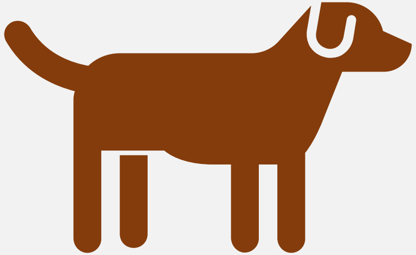


Photo by Puli Club

Exemplar theory

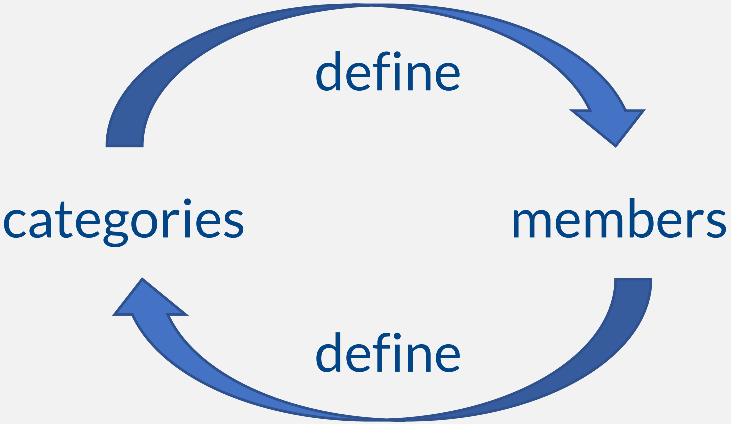
Categories consist of **separate** representations of the physical features of **experienced examples** of the category.

- ✓ People can tell category sizes
- ✓ People can add new members

Exemplar theory – criticisms

Exemplar theory cannot explain:

How can people retrieve all category members to define a category if retrieval is based on category membership (**theoretical circularity**)?



Exemplar theory – criticisms

Exemplar theory cannot explain:

How do people form **abstract categories** of things without physical features?

Types of social groups, ideologies of political parties, types of world events, ways to make friends, …

Explanation-based theory

Categories are based on **common causal characteristics** rather than physical features.

Previous accounts

waterfowl: animals with webbed feet

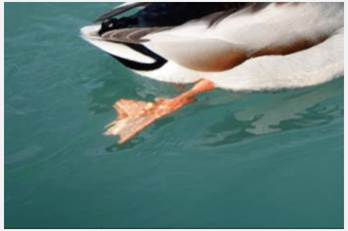


Photo by Elena G

Photo by Hermes Rivera

Explanation-based account

waterfowl: animals that swim

Photo by John Yunker

Photo by Rob Pumphrey

Explanation-based theory

Categories can be created **ad hoc** using **world knowledge and explanations**.

things with a distinctive smell

Photo by Miguel Andrade

Photo by Nathan Dumlao

Photo by Skeeze

Explanation-based theory


Lawrence Barsalou

Barsalou's (1983) experiments:

Do *ad hoc* categories (e.g. *things with a distinctive smell*) have the same features as common categories (e.g. *fruit*)?

- Family resemblance
- Central tendency
- Graded membership

Barsalou, L. W. (1983). Ad hoc categories. *Memory & Cognition, 11*, 211-227. doi: 10.3758/BF03196968

Explanation-based theory

Barsalou's (1983) experiments:

Which of the following are ways to make friends?

a) Join a card playing club

b) Get convicted for murder

c) Don't take regular showers

d) Go to University lectures

Barsalou, L. W. (1983). Ad hoc categories. *Memory & Cognition, 11*, 211-227. doi: 10.3758/BF03196968

Explanation-based theory

Barsalou's (1983) experiments:

*Which of the following is the **most typical** way to make friends?*

a) Join a card playing club

b) Get convicted for murder

c) Don't take regular showers

d) Go to University lectures

Barsalou, L. W. (1983). Ad hoc categories. *Memory & Cognition, 11*, 211-227. doi: 10.3758/BF03196968

Explanation-based theory

Barsalou's (1983) experiments:

👉 High average agreement among participants regarding category membership, typicality of members, and production of exemplars.

Ad hoc categories are **similar to common categories** in that they exhibit family resemblance, central tendency, and graded membership.

Barsalou, L. W. (1983). Ad hoc categories. *Memory & Cognition, 11*, 211-227. doi: 10.3758/BF03196968

Semantic Memory

4: Schemata and scripts

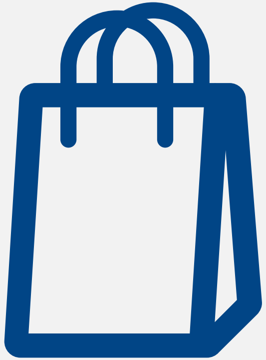
Forming concepts: schemata

Photo by Becca McHaffie

Photo by Clem Onojeghuo

Photo by Artem Bali

Photo by Gary



Semantic memory also enables us to form **schemata** (e.g. “buying things”) that capture commonly encountered aspects of life. They can be thought of as explanation-based **event categories**.

Forming concepts: scripts


Photo by Jay Wennington

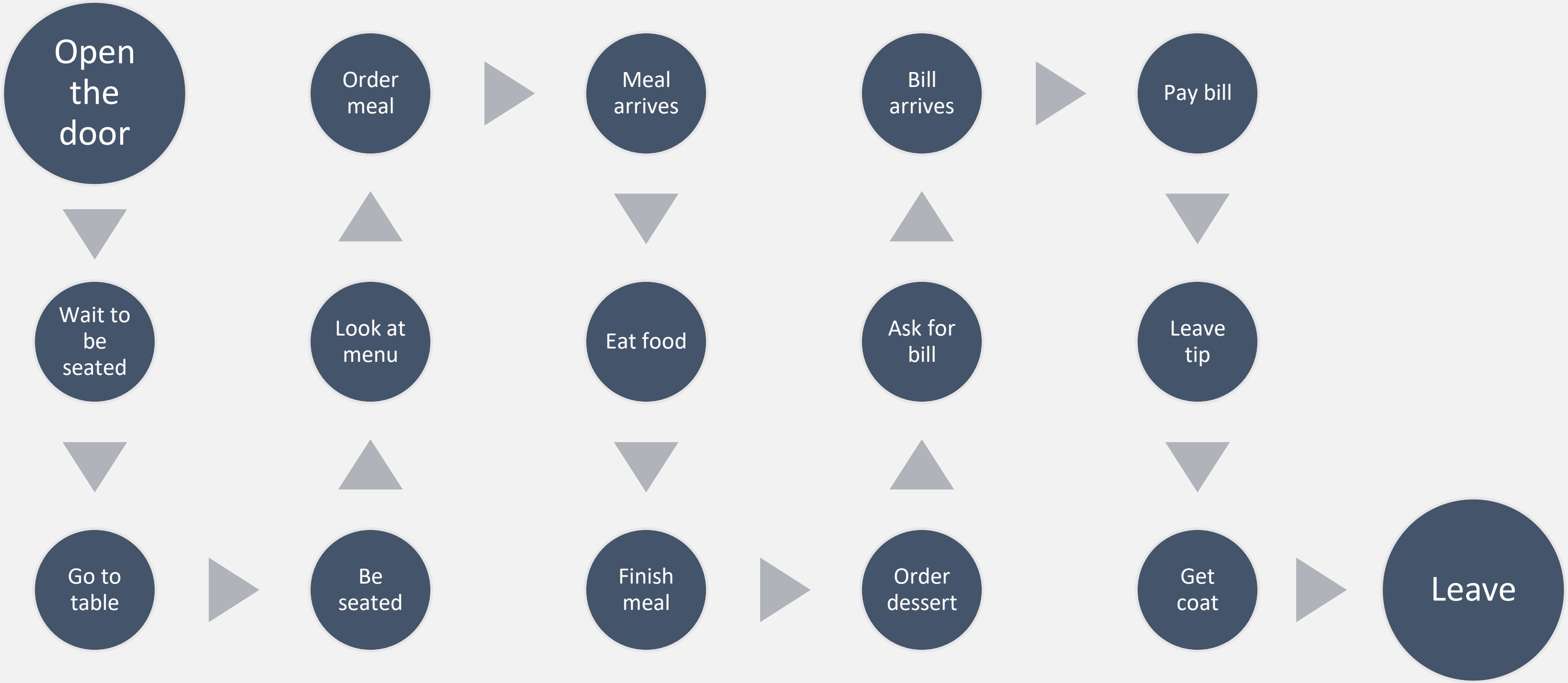

Photo by Kevin Curtis


Photo by Priscilla Du Preez


Photo by Takafumi Yamashita

Semantic memory also enables us to form **scripts** (e.g. “eat in a restaurant”) that capture the order of events for common aspects of life. They can be thought of as **temporally ordered schemata**.

Forming concepts: scripts



Schema processes

Five primary schema processes *(Alba & Hasher, 1983)*

encode

retrieve

1. Selection
2. Abstraction
3. Interpretation
4. Integration

5. Reconstruction

Joseph
Alba

Lynn
Hasher

Alba, J. W., & Hasher, L. (1983). Is memory schematic? *Psychological Bulletin, 93*, 203-231. doi: 10.1037/0033-2909.93.2.203

Schema processes

Five primary schema processes *(Alba & Hasher, 1983)*

encode → retrieve

1. **Selection**
2. Abstraction
3. Interpretation
4. Integration

5. Reconstruction

Alba, J. W., & Hasher, L. (1983). Is memory schematic? *Psychological Bulletin, 93*, 203-231. doi: 10.1037/0033-2909.93.2.203

Schema processes

Selection of information central to a schema


Photo by Becca McHaffie


Photo by Clem Onojeghuo


Photo by Artem Bali

Photo by Gary

matching preferences against supply, quality, and price

Schema processes

Bransford & Johnson's (1972) experiments

study text
without given a topic,
topic given after, *or*
topic given before reading

freely recall text

John
Bransford

Marcia
Johnson

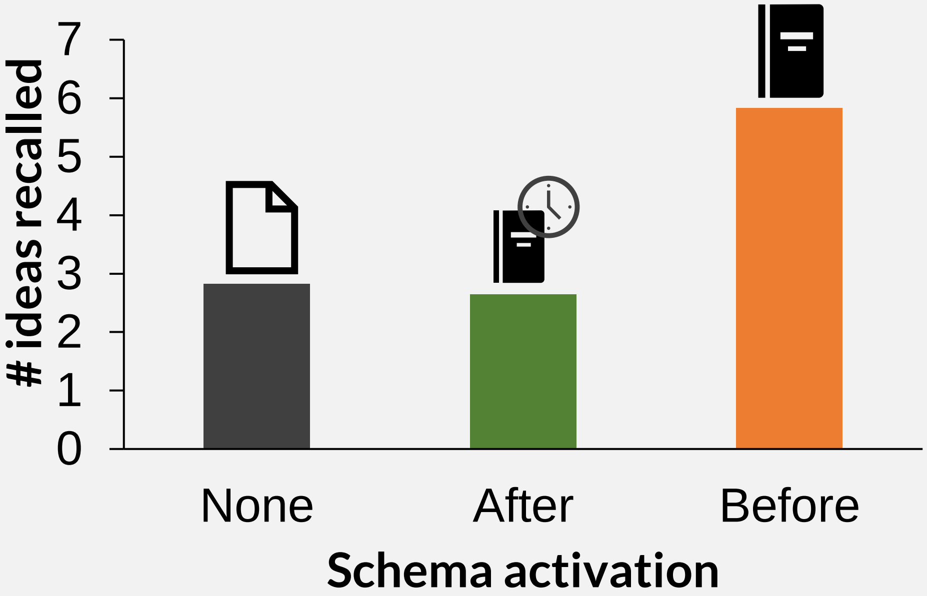
Bransford, J. D., & Johnson, M. K. (1972). Contextual prerequisites for understanding: Some investigations of comprehension and recall. *Journal of Verbal Learning and Behavior, 11*, 717-726. doi: 10.1016/S0022-5371(72)80006-9

Washing clothes

The procedure is actually quite simple. First you arrange things into different groups… 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 important not to overdo any particular endeavor. That is, it is better to do too few things at once than too many. In the short run this may not seem important, but complications from doing too many can easily arise. A mistake can be expensive as well… At first the whole procedure will seem complicated. Soon, however, it will become just another facet of life. It is difficult to foresee any end to the necessity for this task in the immediate future, but then one never can tell. After the procedure is completed one arranges the materials into different groups again. Then they can be put into their appropriate places. Eventually they will be used once more and the whole cycle will have to be repeated. However, that is part of life.

Schema processes

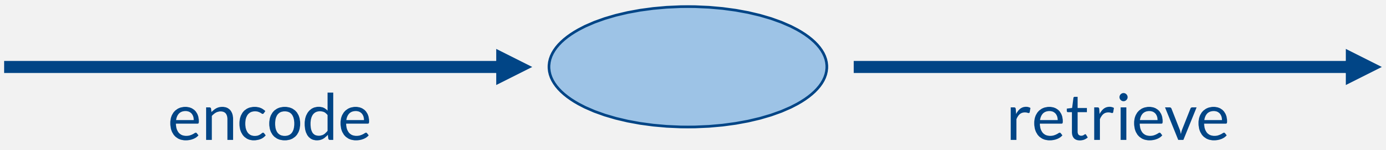
Bransford & Johnson's (1972) experiments



Schema activation benefits encoding of schema-relevant information.

Schema processes

Five primary schema processes *(Alba & Hasher, 1983)*



1. Selection
2. **Abstraction**
3. Interpretation
4. Integration

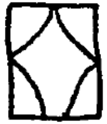
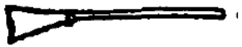
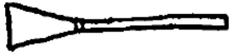
5. Reconstruction

Alba, J. W., & Hasher, L. (1983). Is memory schematic? *Psychological Bulletin, 93*, 203-231. doi: 10.1037/0033-2909.93.2.203

Schema processes

Leonard Carmichael (1898-1973)

Carmichael et al.'s (1932) experiments

Recall	Label 1	Origin	Label 2	Recall
	*Curtains in a window*		*Diamond in a rectangle*	
	*Seven*		*Four*	
	*Gun*		*Broom*	

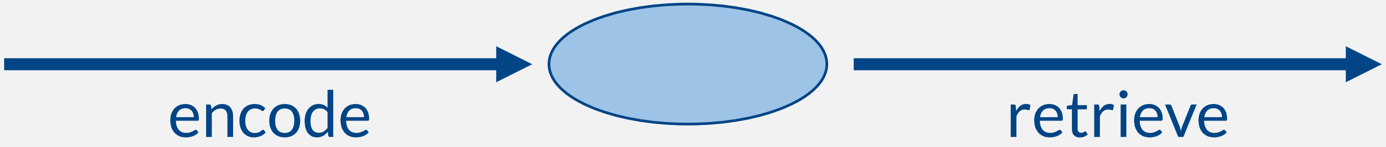
Carmichael, L., Hogan, H. P., Walter, A. A. (1932). An experimental study of the effect of language on the reproductions of visually perceived forms. *Journal of Experimental Psychology, 15*, 73-86. doi: 10.1037/h0072671

Schema processes

The surface form of information (e.g. ambiguities in pictures, verbatim wording) is converted into a more **abstract representation** that captures the meaning but is **schema-consistent**.

Schema processes

Five primary schema processes *(Alba & Hasher, 1983)*



1. Selection
2. Abstraction
3. **Interpretation**
4. Integration

5. Reconstruction

Alba, J. W., & Hasher, L. (1983). Is memory schematic? *Psychological Bulletin, 93*, 203-231. doi: 10.1037/0033-2909.93.2.203

Schema processes

Marcia Johnson

Johnson et al.'s (1973) experiment

When the man entered the kitchen he slipped on a wet spot and ***dropped*** (***just missed***) the delicate glass pitcher on the floor. The pitcher was very expensive, and everyone watched the event with horror.

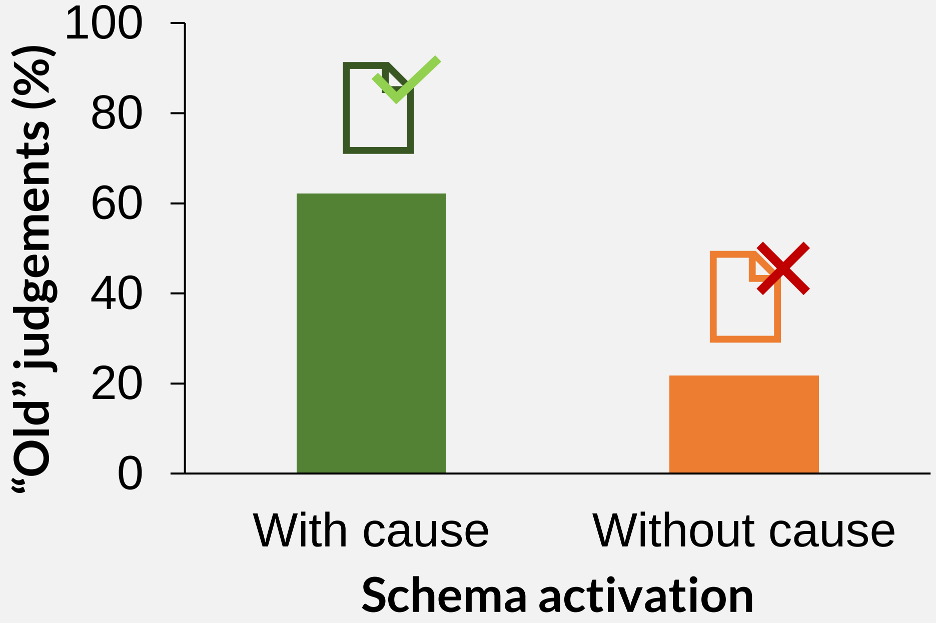
Is this exactly the sentence you heard?

When the man entered the kitchen he slipped on a wet spot and broke the delicate glass pitcher when it fell on the floor.

Johnson, M. K., Bransford, J. D., & Solomon, S. K. (1973). Memory for tacit implications of sentences. *Journal of Experimental Psychology, 98*, 203-205. doi: 10.1037/h0034290

Schema processes

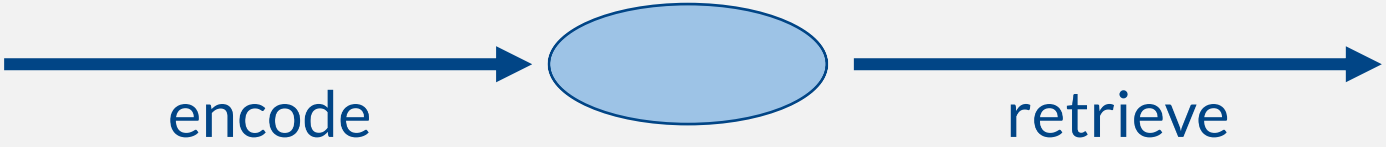
Johnson et al.'s (1973) experiment



Interpretation is used to "fill in the gaps" in a story with schema-consistent information.

Schema processes

Five primary schema processes *(Alba & Hasher, 1983)*



1. Selection
2. Abstraction
3. Interpretation
4. **Integration**

5. Reconstruction

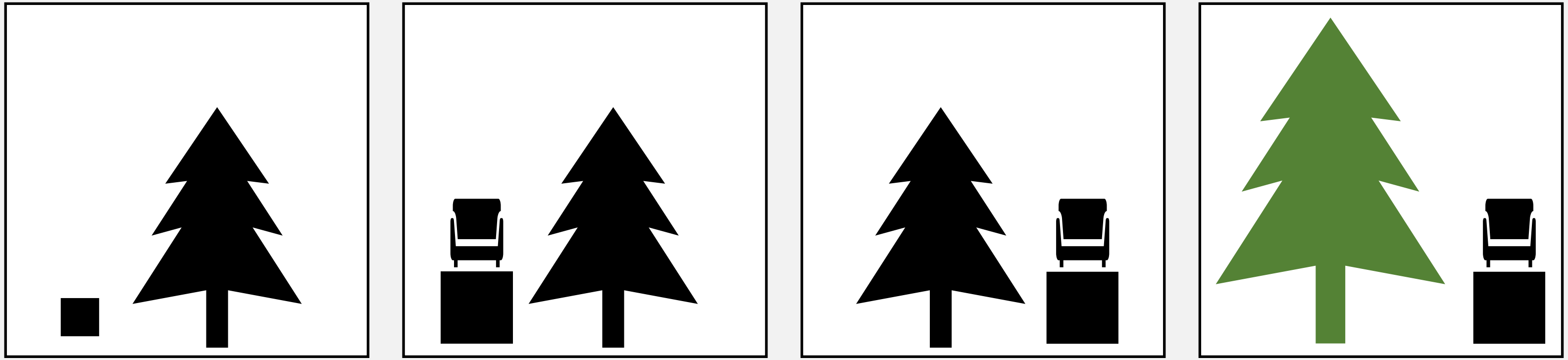
Alba, J. W., & Hasher, L. (1983). Is memory schematic? *Psychological Bulletin, 93*, 203-231. doi: 10.1037/0033-2909.93.2.203

Schema processes

John Bransford

Bransford et al.'s (1972) experiments

There is a tree with a box beside it, and a chair on top of the box. The box is to the right of the tree. The tree is green and extremely tall.



Schema processes

Bransford et al.'s (1972) experiments

Which sentence did you hear?

a) The box is to the right of the tree.
b) The chair is to the right of the tree.
c) The box is to the left of the tree.
d) The chair is to the left of the tree.

Schema processes

Bransford et al.'s (1972) experiments

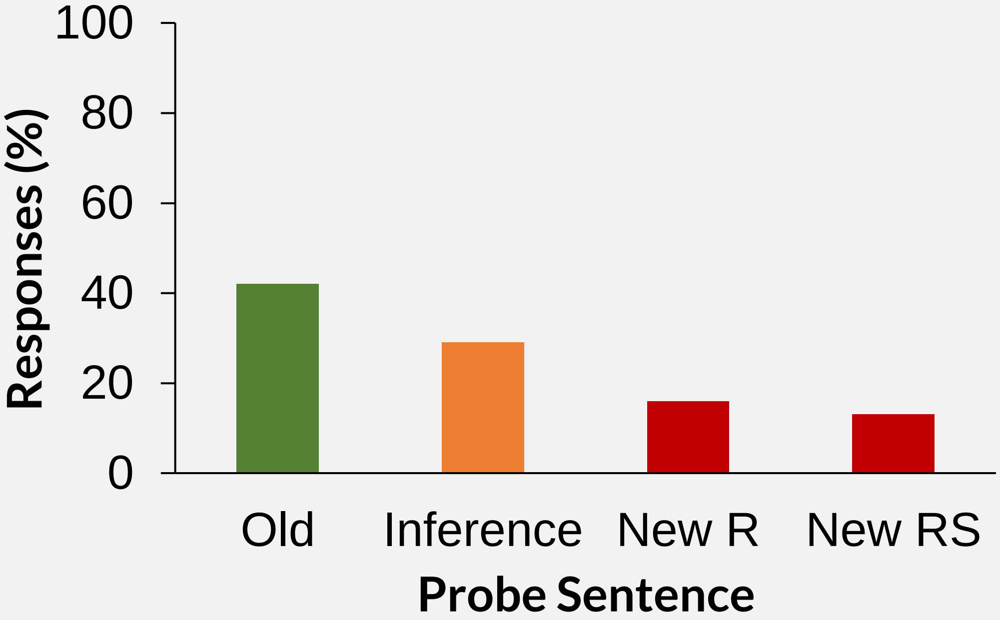
Which sentence did you hear?

a) The box is to the right of the tree.
b) The chair is to the right of the tree.
c) The box is to the left of the tree. *relation change*
d) The chair is to the left of the tree. *relation & subject change*

old *new* *new, but permissible inference*

Schema processes

Bransford et al.'s (1972) experiments



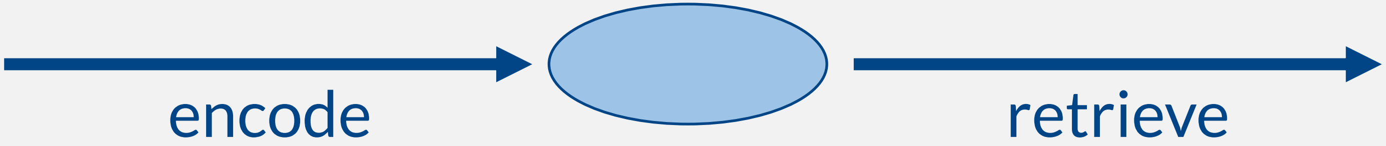
Integration of information is used to form schema-consistent holistic representations.

Semantic Memory

5: Schema processes – retrieval

Schema processes

Five primary schema processes *(Alba & Hasher, 1983)*

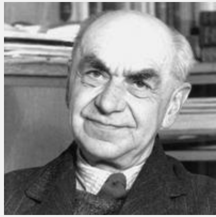


1. Selection
2. Abstraction
3. Interpretation
4. Integration

5. Reconstruction

Alba, J. W., & Hasher, L. (1983). Is memory schematic? *Psychological Bulletin, 93*, 203-231. doi: 10.1037/0033-2909.93.2.203

Schema processes



Frederic Bartlett (1886-1969)

Bartlett's (1932) experiments

British students studied the Native American tale *The War of the Ghosts* and were asked to recall it after days, weeks, months, or years

Bartlett, F. C. (1932). *Remembering: A study in experimental and social psychology*. Cambridge, UK: Cambridge University Press.

The War of the Ghosts (1 of 2)

One night two young men from Egulac went down to the river to hunt seals and while they were there it became foggy and calm. Then they heard war-cries, and they thought: “Maybe this is a war-party”. They escaped to the shore, and hid behind a log. Now canoes came up, and they heard the noise of paddles, and saw one canoe coming up to them. There were five men in the canoe, and they said:

“What do you think? We wish to take you along. We are going up the river to make war on the people.”

One of the young men said, “I have no arrows.”

“Arrows are in the canoe,” they said.

“I will not go along. I might be killed. My relatives do not know where I have gone. But you,” he said, turning to the other, “may go with them.”

So one of the young men went, but the other returned home.

The War of the Ghosts (2 of 2)

And the warriors went on up the river to a town on the other side of Kalama. The people came down to the water and they began to fight, and many were killed. But presently the young man heard one of the warriors say, “Quick, let us go home: that Indian has been hit.” Now he thought: “Oh, they are ghosts.” He did not feel sick, but they said he had been shot.

So the canoes went back to Egulac and the young man went ashore to his house and made a fire. And he told everybody and said: “Behold I accompanied the ghosts, and we went to fight. Many of our fellows were killed, and many of those who attacked us were killed. They said I was hit, and I did not feel sick.”

He told it all, and then he became quiet. When the sun rose he fell down. Something black came out of his mouth. His face became contorted. The people jumped up and cried. He was dead.

Schema processes

Bartlett's (1932) experiments: *recall four months later*

Original

The people came down to the water and they began to fight, and many were killed. But presently the young man heard one of the warriors say, "Quick, let us go home: that Indian has been hit."

Recall

The man was in the midst of the fighting, and was wounded. The natives endeavored to persuade the man to return, but he assured them that he had not been wounded. I have an idea that his fighting won the admiration of the natives.

Schema processes

Bartlett's (1932) experiments

Details were **reconstructed** to be simplified and fit cultural schema

canoes = boats

paddles = rowing

protagonist from "Egulac" = British warrior

Schema processes

William
Brewer

Brewer & Treyens (1981) experiments

Participants were waiting in a graduate student office and later asked to recall everything they could remember about the room.

Brewer, W. F., & Treyens, J. C. (1981). Role of schemata in memory for places. *Cognitive Psychology, 13*, 207-230. doi: 10.1016/0010-0285(81)90008-6

Schema processes

Brewer & Treyens (1981) experiments

Participants recalled:

- ✓ Chair
- ✓ Desk
- ✓ Poster
- ✓ Skull
- ✗ Books
- ✗ Filing cabinet

Schema theory

Five primary schema processes *(Alba & Hasher, 1983)*

1. Selection
2. Abstraction
3. Interpretation
4. Integration
5. Reconstruction

- Schema processes affect encoding and retrieval of information.
- Those effects can change our memories and, thus, their correctness.

more on memory errors next week

Alba, J. W., & Hasher, L. (1983). Is memory schematic? *Psychological Bulletin, 93*, 203-231. doi: 10.1037/0033-2909.93.2.203

Take-home message

- Semantic memory has been described as a hierarchical and later as an **associative network**.
- **Theories of categorisation** moved from a classical view of categories as definitions to explanation-based theories.
- **Categories, schemata and scripts** are used to predict what happens next based on regularities in the world.
- **Five schema processes** describe how schemata can affect encoding and retrieval.

Next week

- Memory I: Processes and Systems
- Memory II: Episodic Memory
- Memory III: Semantic Memory
- Memory IV: Memory Errors
- Memory V: Memory and the Law

Photo by Josh Hild