Representation of Knowledge

weekly_readings #week-6-7 #my-notes-755

Contents

> Taken from John Anderson - Cognitive Psychology and Its Implications (2015, Freeman_Worth) - libgen.li.pdf
> Ch-5

Knowledge and Regions of Brain

Brain regions involved in **abstraction** of knowledge:

1. **Prefrontal Regions:** *extracting meaningful info* from pictures and sentences.
   - Left Prefrontal: processing of verbal info
   - Right Prefrontal: processing of visual material
2. **Posterior Regions (temporal cortex):** *representation of Categorical Info*

Memory for Meaningful Interpretations of Events

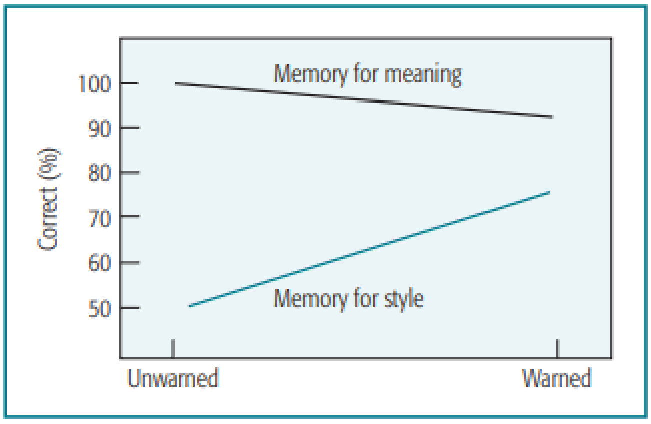
- mem. for verbal info
- mem. for visual info
- importance of meaning to mem.
- implication of good mem. for meaning

Memory for Verbal Information

Desertation Study by Eric Wanner (1968)

- **Setting & Task:**
    - Listen to Tape-recorded informations
    - Participants divided into 2 groups:
        - G1: received a warning that they will be tested on their ability to recall particular sentences
        - G2: received no such warnings
    - After this the instructions were same for both groups
    - One of the 4 (i, ii, iii, iv) possible critical sentences were presented:
        - pair(i, ii) & pair(iii, iv) - *differ in style* but not in meaning
        - pair(i, iii) & pair(ii, iv) - *differ in meaning* but not in style
        - eg:
            - (i) When you score your results, do nothing to **correct your** answers but **mark carefully** those answers which are wrong
            - (ii) When you score your results, do nothing to **correct your** answers but **carefully mark** those answers which are wrong
            - (iii) When you score your results, do nothing to **your correct** answers but **mark carefully** those answers which are wrong
            - (iv) When you score your results, do nothing to **your correct** answers but **carefully mark** those answers which are wrong
    - On Page 2 they were presented 2 sentences:
        - the critical sentence that they had studied
        - another sentence that differed from the prev. sentence either in style or just in meaning

- **Observations and Implications:**

- 

1. Memory / accuracy: changes in words that result in changes in {**meaning > style**}
   - indicates that, people normally extract the meaning from a linguistic message
   - Memory for meaning is equally good for G1 and G2 (slight difference is not statistically significant)
2. G1 (warned group) remembered the *changes in style* almost by 80% accuracy
   - indicates that, people are capable of remembering exact wording if that is their goal

- **Conclusion**
  - Thus, although we do not normally retain much information about exact wording, we can do so when we are cued to pay attention to such information.

Memory for Visual Information

> Our memory for visual information often seems much better than our memory for verbal information

Shepard 1967

- **Objective:** *performed one of the early experiments comparing memory for pictures with memory for verbal material*

- **Task:** two types:
  - **T1 - Picture memory task**
    - participants first studied magazine pictures (one-at-a-time)
    - Then, presented with pairs of pictures (one studied one not studied)
    - Asked to identify which they had studied
  - **T2 - Sentence memory task**
    - participants studied sentences (one-at-a-time)
    - Then, presented with pairs of sentences (one studied one not studied)
    - Asked to identify which they had studied

- **Observations**
    - Only 1.5% error on T1 (visual task)
    - About 11% error on T2 (verbal task)
- **Conclusion**
    - memory for verbal information was quite good, but memory for visual information was virtually perfect

Brady, Konkle, Alvarez, and Oliva (2008)

- **Task:** Had participants study a set of 2500 images, then identify individual pictures, when paired with similar alternatives.
- **Observations:** 87.5% accuracy

Nickerson and Adams (1979)

- **Objective:** people do not always show such good memory for pictures—it depends on the circumstances
- **Task:** Asked Americal students to identify which of the pictures was the "actual US Penny"
- **Observations:** Not able to identify the actual penny (despite having seen it so many times)
- **Conclusions:** It seems that the details of the penny are not something people attend to. In the experiments showing good visual memory, the participants are told to attend to the details.

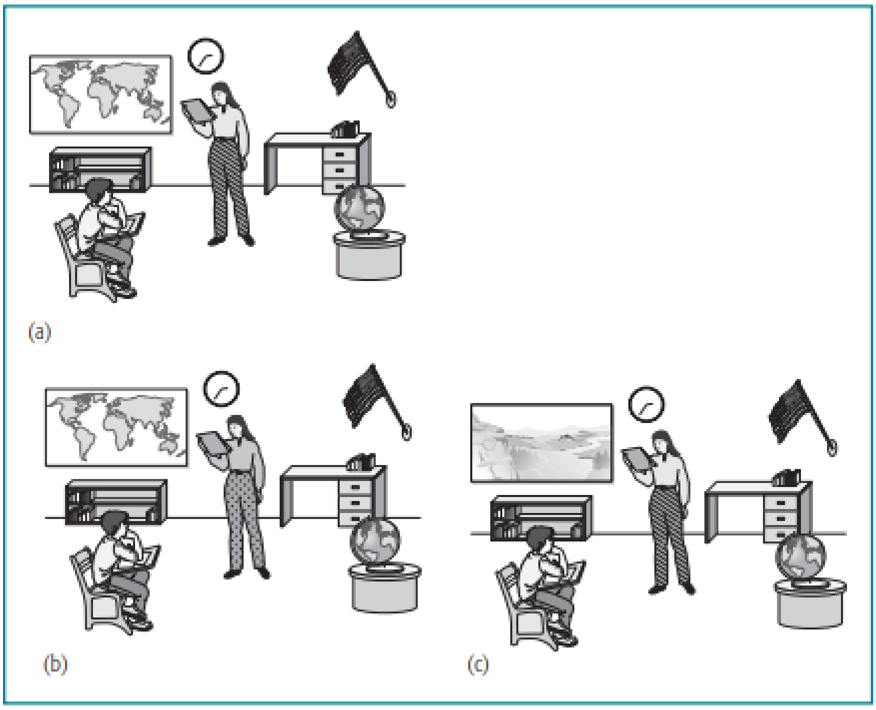
Marmie and Healy (2004)

- **Objective:** Role of attention in memory
- **Task:** Participants examined a novel coin for a minute and then, a week later, were asked to remember the details
- **Observations:** achieved much higher accuracy than in the penny study
- **Conclusions:** Role of attention confirmed

```
How do people actually deploy their attention,
when studying a complex visual scene?
```

Mandler and Ritchey (1977)

- **Objective:** Typically, people attend to, and remember, what they consider to be the meaningful or important aspects of the scene
- **Task:**
    - Participants studied pictures of scenes (*like- Classroom*). 8 such pictures for 10 sec.

- They were then, presented with series of pictures and asked to identify the studied pic.
- The series included - "studied picture", and "distractor picture"
- The distractor was of 2 types:
  - **Token distractor:** differed from the target image in a relatively **unimportant** visual detail (eg- pattern of teacher's cloth)
  - **Type distractor:** differed from the target image in a relatively **important** visual detail (eg- what's there on the board - what is being taught)
- 

- **Observations:**
  - Recognized the *original* pic - 70% of the time
  - Rejected *Token distractors* (unimp. diff.) - only 60% of the time
  - Rejected *Type distractors* (imp. diff.) - 94% of the time
- **Conclusions:**
  - Participants are more sensitive to meaning-significant changes in a picture rather than details details in the picture
  - ***Similar to Wanner** - participant more sensitive to meaning-significant changes in a sentence**

Importance of Meaning to Memory

> What if the material is not meaningful, such as hard-to-follow

Bransford and Johnson (1972) - for verbal memory

- **Task:** Participants were divided into 2 groups and asked to read the following passage:

- > The procedure is actually quite simple. First you arrange items 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 things. 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 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 then have to be repeated. However, that is part of life. (p. 722)
  - G1: not given any context
  - G2: Told before reading that its about *washing cloths*
  - Later tested for recall
- **Observations:** G1 showed poor recall. In fact, recall(G2) = 2 . recall(G1)

Goldstein & Chance (1970) - for visual memory

- **Task:**
  - compared **memory for faces** *versus* **memory for snowflakes**
  - Test for recognition, 48 hours later
- **Observations:**
  - recognize 74% of faces but only 30% faces
  - (*Even though individual snowflakes are more visually different than individual faces*)
- **Interpretation:**
  - Participants don't know what sense to make of the features in a snowflake.
  - But they are capable of doing so in case of faces

Oates & Reder (2010) - visual mem can be poor than verbal mem

- **Title:** "*Sometimes a Picture Is Not Worth a Single Word,"*"
- **Task, Obs, ...**
  - Compared recognition memory for words with recog. mem. for abstract pictures.
  - Found recog. for pictures was quite poor -- about half as that for words.

Bower, Karlin, Dueck (1975) - reason for good mem. for picture

- **Study:** Participants studied drawings with or without an explanation of their meaning
- **Test:** Redraw the pictures
- **Observations:**
  - when explanation was given: 70% correctly reconstructed (better recall)
  - when explanation not given: 51% correctly reconstructed

- **Conclusions:**
    - memory for the drawings depended critically on participants' ability to give them a meaningful interpretation

Implications of Good Memory for Meaning

- When faced with materials to remember, it will they can be given some meaningful interpretation.
- **Applications:**
    - shopping lists, names for faces, telephone numbers, rote facts in a college class, vocabulary items in a foreign language, and so on.
- In all cases, we can improve memory if we associate the items to be remembered with a meaningful interpretation.

Example:

- The association DAX-GIB can be remembered as "Dad" - "Gibberish"
- So I might have created an image of my father speaking some gibberish to me. This would have been a simple **mnemonic (memory-assisting) technique**

Propositional Representations

> We have shown that in many situations people **do not remember exact physical details** of what they have *seen* or *heard* but **rather the "meaning" of what they have encountered**.

- To be more prices about what is meant by "meaning", cognitive psychologists have developed what is called a **propositional representation**
- **Proposition** - smallest unit of knowledge that can stand as a separate assertion (meaningfully judged as T/F)

Consider the following sentences:
We have shown that in many situations people do not remember exact physical details of what they have seen or heard but rather the "meaning" of what they have encountered.

The info in above sentence can be communicated by the following simpler sentences:
A. Lincoln was president of the United States during a war.
B. The war was bitter.
C. Lincoln freed the slaves.

If any of these simple sentences were false, the complex sentence also would be false

Claims of Propositional Representations

- **Does not claim that**, a person remembers simple sentences like these when encoding the meaning of a complex sentence.
- **Rather it claims that**, the material is encoded in a more abstract way
- *eg- the propositional representation poposed by Kintch 1974*

Popositional Representation proposed by Kintch 1974

- Each poposition is rep. as a list containing:
  - **relation**
  - followed by an ordered list of **arguments**
- **Relation:** organize the arguments and typically correspond to
  - verbs (*free*)
  - adjectives (*bitter*)
  - other relational terms (*president of*)
- **Argument:** refer to particular times, places, people, objects, and typically correspond to
  - nouns (*Lincoln, war, slaves*)
- *Example:*
  - A) (president-of: Lincoln, United States, war)
  - B) (bitter: war)
  - C) (free: Lincoln, slaves)

Demostration by Bransford and Franks (1971)

- **Objective:** to demostrate the psychological reality of propositional units
- **Study:** participants studied 12 sentences, including the following:
  - The ants ate the sweet jelly, which was on the table.
    The rock rolled down the mountain and crushed the tiny hut.
    The ants in the kitchen ate the jelly.
    The rock rolled down the mountain and crushed the hut beside the woods.
    The ants in the kitchen ate the jelly, which was on the table.
    The tiny hut was beside the woods.
    The jelly was sweet.
  - The **propositional units** in these sentences come from either of the 2 sets of 4 propositions.
1. (eat: ants, jelly, past)	1. (roll down: rock, mountain, past)
2. (sweet: jelly)	2. (crush: rock, hut, past)
3. (on: jelly, table, past)	3. (beside: hut, woods, past)
4. (in: ants, kitchen, past)	4. (tiny: hut)
- **Test:** recognition memory was tested for following three kinds of sentences:
  1. Old: actually studied
     (*The ants in the kitchen ate the jelly*)
  2. New: Not studied but consisted of the propositions that occured in studied sentences
     (*The ants ate the sweet jelly*)

    3. Noncase: Neither studied nor contains those propositions (*The ants ate the jelly beside the woods*)
- **Observations:**
    - Participants had almost no ability to discriminate between **Old** and **New**, and said they had actually heard either
    - They were however confident that they did not study the **Noncase**.
- **Conslusions:**
    - Although people remember the propositions they encounter, they are quite insensitive to the actual combination of those propositions

Amodal versus Perceptual Symbol Systems

As per Barsalou,

1. **Amodal Symbol System** (eg- propositional representations)
    - Elements within the system are inherently non-perceptual.
    - The original stimulus may be a picture or a sentence, but the representation is abstracted away from the verbal or visual modality
    - Given this abstraction, one would predict that participants would be unable to remember the exact words or exact picture.
2. **Perceptual Symbol System** (a hypothesis by Barsalou)
    - Information is represented in terms specific to a particular perceptual modality (visual, auditory, ...)
    - It is an extension of **Paivio's (1971, 1986) dual code theory** which claimed that:
        - info is rep in combined verbal + visual codes
        - *Paivio suggested when we hear a sentence, we also develop a visual image of what it describes. I we later remember only the visual image and not the sentence, we will remember what the sentence was about but not the exact words*
        - Does not predict that which mem for visual will be better than verbal. Depends on the relative attention.

Holmes, Waters & Rajaram (1998)

- **Objective:** A replication of Bransford and Franks (1971) study
- **Task:** same as before but in addition participants asked to count the number of letters in the last word of each sentence.
- **Observations:** Increased ability to discriminate sentences studied and not studied but with similar meaning.
- **Interpretations:** counting words increased the attention to the wording.

> But how can an **abstract concept** (such as *honesty*) be represented in a **purely perceptual cognitive system**?

Barsalou, Simmons, Barbey, and Wilson (2003)

- *cited evidence that when people understand a sentence, they come up with a perceptual representation of that sentence*. For example: `Stanfield and Zawan (2001)`
- *cited **neuroscience studies** showing that concepts are represented in brain areas similar to those that process perceptions*

Stanfield and Zwaan (2001)

- **Study:** Participants read a sentence a sentence about a nail being pounded into either the wall or floor.
- **Test:** They were shown pictures of a nail being pounded either vertically or horizontally. And asked whether the object in the picture had been mentioned in the sentence heard earlier or not.
- **Observations:** Response was quicker when the orientation in the sentence matched with that in the picture.
- **Conclusions:** Thus, their representation of the sentence seemed to contain this perceptual detail

Embodied Cognition

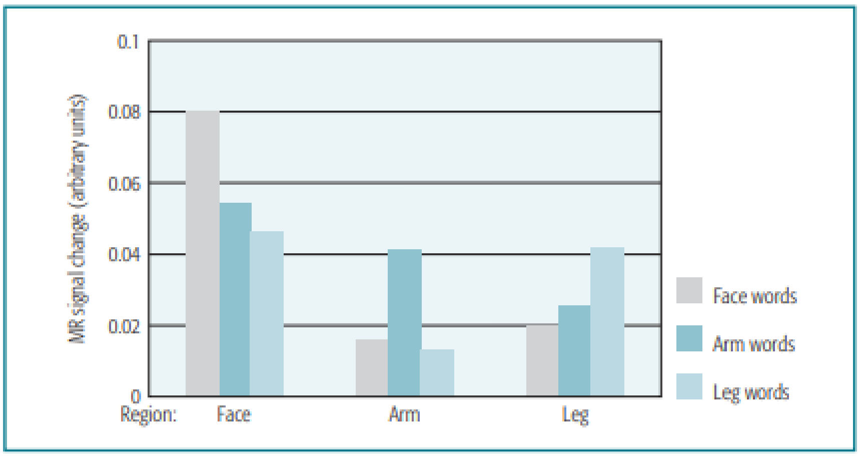
> Barsalou's perceptual symbol hypothesis is an instance of the growing emphasis in psychology on understanding the contribution of the environment and our bodies to shaping our cognition
>
> As Thelen (2000) describes the viewpoint:
>
> To say that cognition is *embodied* means that it arises from bodily interactions with the world and is continually meshed with them. From this point of view, therefore, cognition depends on the kinds of experiences that come from having a body with particular perceptual and motor capabilities that are inseparably linked and that together form the matrix within which reasoning, memory, emotion, language and all other aspects of mental life are embedded. (p. 5)

Embodied Cognition emphasizes the ***contribution of "motor action"*** and how it connects us to the environment

Glenberg (2007)

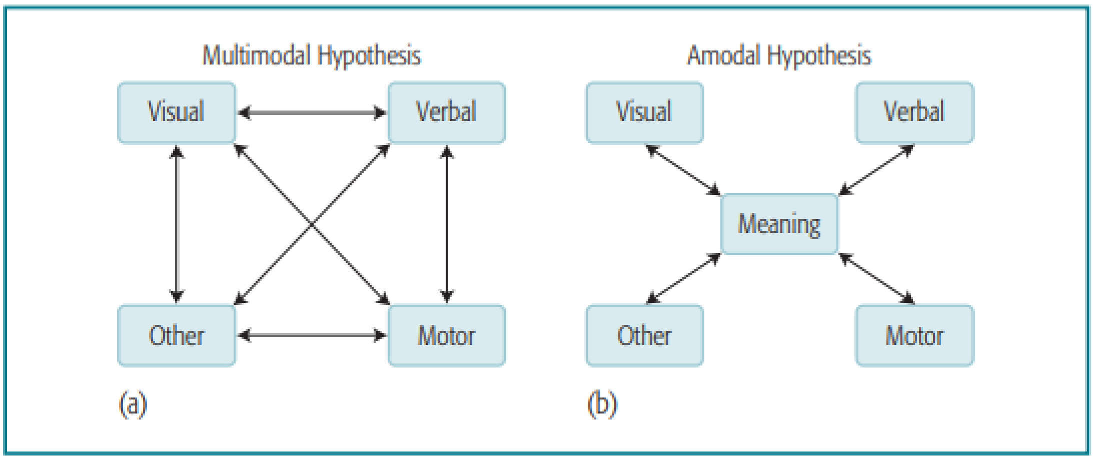
- argues that our understanding of language often depends on convertly acting out what the language describes.
- He points to an *fMRI study*

fMRI Study by - Hauk, Johnsrude & Pulvermuller (2004)

- They recorded brain activation while people listened to verbs *like - lick, pick or kick*
- They looked for activity along mortex cortex of various regions *like - face, arm, pick*
- **Obs:** there was greater activation in the part of the mortor cortex that would produce the action.
- 

> part of our understanding of someone performing an action is our ability to relate to our own motor system so that we can mimic the action.

How info is related between different perceptual and motor modalities



1. **Multimodal Hypothesis:** There are mechanisms for translation between each modality
2. **Amodal Hypothesis:** Each mdality can be translated back and forth to a central meaning representation (which is more abstract).

The amodal hypothesis holds that this information is retained in the central meaning system. The multimodal hypothesis holds that the person has converted the information from the modality of the presentation to some other modality.

Conceptual Knowledge

> When we look at a picture, we do not see it as a collection of specific objects.
> Rather, we see it as a pic. of a teacher instructing a student on Geography
> Here, *teacher, student, instruction, geography* are examples of categories

- People tend to remember **categorical information** rather than specific details.
- By doing so, we gain the ability to predict.
  - **Example**- If I say "I was licked by a dog". The listener can predict the number of legs, it approx. size and so on.
- The effects of such categorical perceptions can be -ve as well (eg- they can lead to **stereotyping**)

Dunning and Sherman (1997)

- **Study:** Participants studied sentences like:
  - Elizabeth was not very surprised upon receiving her math SAT score.
  - Bob was not very surprised upon receiving her math SAT score.
- **Observations:**
  - It is more likely to falsely believe that, they heard "Elizabeth was not very surprised upon receiving her **low** math SAT score."
  - Than it is believe the low score for Bob
- **Interpretation:**
  - The participants stereotype women to be poor in maths.
  - Also, results were similar for both gender participants (though they were not sexist)

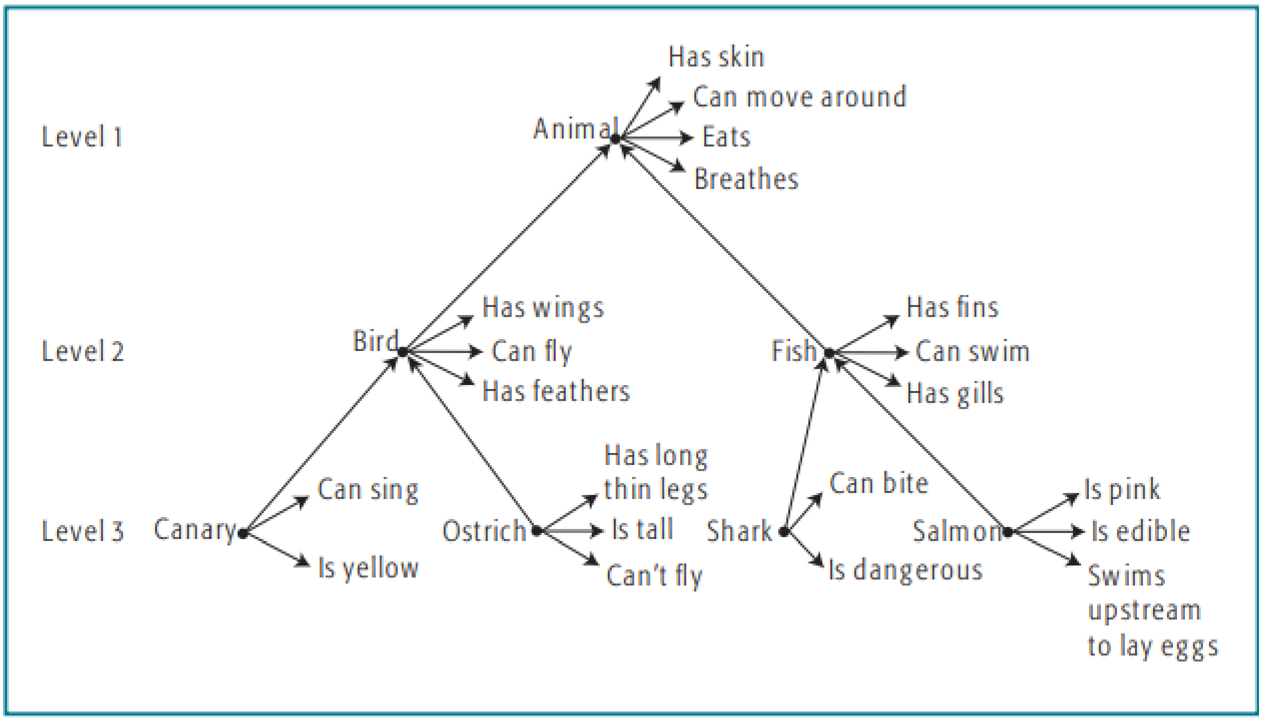
Any research on Categorization has focussed on:

- How we form these categories
- How we use them to interpret experiences
- Notations for representing these categories

(1) Semantic Networks

Quillian (1966) proposed that people store information about various categories in a network structure.

- Nodes of categories are linked by an **is a** link
- Properties that are true of the categories are associated with them
- Properties that are true for a given category, are also true for all low-level category under it.



Collins and Quillian (1969)

- **Objective:** To test the psychological reality of such networks
- **Study:** Participants given some assertions like:
    1. Canaries can sing.
    2. Canaries have feathers.
    3. Canaries have skin
- **Test:**
    - Participants were shown these
    - Along with false assertions, such as "apples have feathers," (to keep them HONEST)
    - and they had to judge which were true and which were false.
- **Prediction and Explanation:**
    - Info needed to confirm:
        - sent-(1) is directly stored with "canary"
        - sent-(2) requires traversing up the chain by one link to reach "bird"
        - sent-(3) requires traversing up the chain by two links to reach "animal"
    - If our categorical knowledge were structured like the above fig., we would expect the verification time to follow the order: (1) < (2) < (3)
- **Observations:**
    - Indeed the predictions were true. Time taken was 1310, 1380, 1470 ms. respectively.
- **Complications:**
    - *Subsequent research on the retrieval of information from memory has somewhat complicated the conclusions drawn from the initial Collins and Quillian experiment.*
    - Retrieval Time for a fact also depends on **how how often the fact is experienced**
        - Example:

        - (1)"Apples are eaten" (2) "Apples have dark seeds"
        - Although info for (1) might be present in an intermediate concept such as "food". Yet, it is faster to verify it (sent-1)
    - Hence, it seems that, if a fact about a concept occurs frequently, then it will be stored with that concept, even if it could also be inferred from a more general concept.
- **Conclusions - about organization of facts in semantic memory and their retrieval times**
    1. If a fact about a concept is encountered frequently, it will be stored with that concept even if it could be inferred from a higher order concept.
    2. The more frequently a fact about a concept is encountered, the more strongly that fact will be associated with the concept. Thereby, more readily they can be verified.
    3. Inferring facts that are not directly stored with a concept takes a relatively long time.

(2) Schemas

> **Problem with Semantic Networks:**
> Semantic networks, which just store properties with concepts, cannot capture the nature of our general knowledge about a house, such as its typical size or shape.
>
> **Rumelhart & Ortony, 1976** proposed a particular way of representing such knowledge that seemed more useful than the semantic network representation. Their rep. structure was called a **"schema"**

Schemas: represent categorical knowledge according to a slot structure, in which slots are the attributes that members category possess. However, the actual values of those attributes can be different for different members, but under some constraints specified by the slot.

Example: (a partial schema of a "House")

```
{
        "Isa": building,
        "Parts": rooms,
        "Materials": [wood, brick, stone]
        "Function": human dwelling
        "Shape": [rectilinear, triangular]
        "Size": 100–10,000 square feet
}
```

- Values present there are called **default values**. They can be overwritten for specific member

- There is a special attribute **"Isa"**. which points to the *superset*. Unless contradicted, a a concept inherits features of its superset. These *Isa-links* create a **Generalization-Hierarchy**
- Schemas have another type of structure called a **Part-Hierarchy**. Parts of houses, such as *walls* and *rooms*, have their own schema definitions. Wall - {"hasWindows": True}. Thus, using part-hierarcy we can infer that a house has windows.

> Hence, Schemas represent concepts in terms of supersets, parts, and other attribute-value pairs.
>
> Lets, now discuss the following topics:
>
> - Psychological Reality of Schemas
> - Degree of Category Membership
> - Event Concepts

(2.1) Psychological Reality of Schemas

People will infer that an object has the default values for its category, unless they explicitly notice otherwise

Brewer and Treyens (1981)

- **Objective:** Effect of schema on memory
- **Task:**
  - 30 Participants were brought individually to a room, and told that it was an office of the exerimenter, and asked to wait there.
  - After 35s, the experimenter returned and took them to a seminar room nearby.
  - There they were asked to write down, what all they saw in the previous room.
- **Observations:**
  - 29/30 recalled - chair, desk, walls (actually present - and default for an office)
  - 8/30 recalled - bulletin board and skull (actually present - but not default for an office)
  - 9/30 recalled - books (not actually present - but default for an office)
- **Conclusion:**
  - person's memory for the properties of a location is strongly influenced by that person's default assumptions about what is typically found in the location.

(2.2) Degree of Category Membership

- One of the important features of schemas is that, they **allow variations** in the objects of the schema.
- Thus, if schemas really encode our knowledge, **we ought to see a shading** from less typical to more typical members of the category.

Rosch (1973)

- **Objective:** variations in category membership
- **Task:** asked participants to rate the typicality of various members of a caegory (1-most, 7-least typical)
- **Observations:** Particpants consistently rated some members as more typical than others.
  - *Example: Birds (Robin > Chicken), Sports (Football > Weight lifting)* ...

Rosh (1975)

- **Task:** Particpants to identify the category to which a given pictured object(s) belong.
- **Observations:** faster to judge a picture as an instance of a category when it presents a typical member of the category.
  - *Example: Robins are seen as birds more rapidly than Chickens*
- **Conclusions:** Typical members of a category have an advantage in recognition

Rosh (1977)

- **Objective:** To demostrate another way in which some members of a category are more typical.
- **Task:**
  - Participants to compose sentence for category names (*such as "bird"*).
  - The category name in those sentences was then replaced with:
    - (1) typical member ("robin"),
    - (2) less typical member ("eagle")
    - (3) peripheral member ("chicken")
  - Then, asked to rate the sensibility of the updated sentences.
- **Observations:**
  - Sensibility Ratings - goodness (1 > 2 > 3)
- **Conclusion:**
  - Results indicate that, when participants wrote the sentences about a given category, they were thinking of typical members of the category

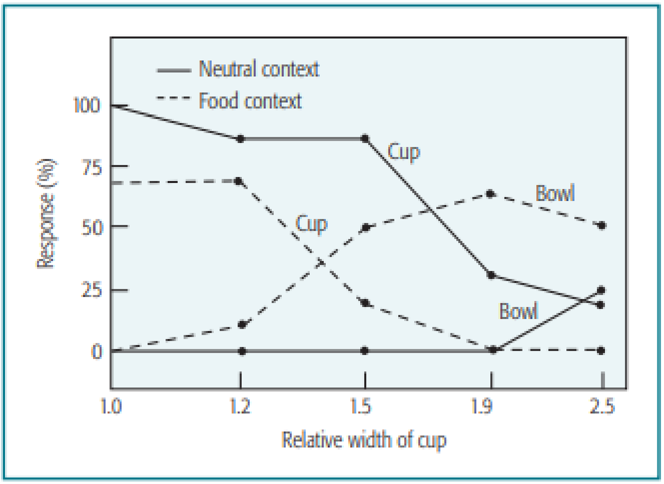
McCloskey and Glucksberg (1978)

- **Objective:** To Look at people’s judgments about what were or were not members of various categories
- **Findings:** Although participants did agree on some items, they disagreed on many.
  - 30 agreed that "cancer" is a **disease** and "happiness" is not. But only 16 agreed that "stroke" was a **disease**
  - 30 agreed that "apple" is a **fruit** and "chicken" is not. But only 16 agreed that "pumpkin" was a **fruit**
- **Tested the same participants again after month**
  - Found that many have changed their minds.

- **Conclusions:**
  - disagreement about category boundaries **does not occur just among participants** — people are very **uncertain even within themselves** exactly where the boundaries of a category should be drawn

Labov (1973)

- *Which items participants would call cups and which they would not*
- **Setting & Task:**
  - 

  - Shown items 1-4 and a 5th item. (increasing width-to-depth ratio)
  - And asked to flag them as Cup or Bowl under 2 conditions:
    - C1 (neutral context): simply presented with pictures of objects
    - C2 (food context): asked to imagine the object being filled with mashed potatoes.
- **Observations:**
  - 

  - **C1:** %cup decreasing with relative width. But no clear boundary. Even at 2.5 rel-width, 25% still said cup
  - **C2:** fewer cup responses and more bowl responses.
- **Conslusion:**
  - It seems that, people's classification behaviour (identifying the boundary of category membership) depends:
    1. Not only on: properties of the object
    2. But also on: the context in which the object is presented / imagined

(2.3) Event Concepts

Similar to objects, events can also have categories:
Example:

```
"Going to a Movie" involves: {
        - going to the theatre
        - buying the tickets
        - buying snacks
        - seeing the movie
        - returning from the theatre
}
```

Schank and Abelson (1977) proposed versions of event schemas that they called **scripts**, based on their observation that many events involve *stereotypic sequences of actions*

Bower, Black, and Turner (1979)

- **Objectives:** To test the psychological reality of the script-notion.
- **Task:** participants were asked to name what they considered the 20 most important events in an episode (such as "going to a resturant").
- **Observations:** with 32 participants, they failed to complete agreement on what these events were. Although considerable consensus were reported.

TABLE 5.2 Agreement About the Actions Stereotypically Involved in Going to a Restaurant

Open door[a]	*Eat salad or soup*
Enter[b]	Meal arrives
Give reservation name	**Eat food**
Wait to be seated	Finish meal
Go to table	*Order dessert*
Sit down[c]	*Eat dessert*
Order drinks	Ask for bill
Put napkins on lap	Bill arrives
Look at menu	**Pay bill**
Discuss menu	*Leave tip*
Order meal	Get coats
Talk	**Leave**
Drink water	

[a]Roman type indicates items listed by at least 25% of the participants.
[b]Italic type indicates items listed by at least 48% of the participants.
[c]Boldface type indicates items listed by at least 73% of the participants.

- Using 73% as a criterion, we find that the stereotypic sequence was sit down, look at menu, order meal, eat food, pay bill, and leave

Bower et al. (1979)

- **Objectives:** To show that such action-scripts have a number of effects on memory for stories
- **Study:** participants to study that included some but not all typical events from a script.
- **Test:** 2 types: *Recall* and *Recognition* (in seperate experiments)

- **Observations:**
  - *Recall Test:* tendency to report events that were part of the script but not actually present in the story
  - *Recognition Test:* participants thought they had studied script items which were actually not present in the story.
  - However, participants showed greater tendency to remember (recall or recognize) actual items from the stories, despite the distortions in the direction of general schema

Bower et al. (in a yet another experiment)

- **Study:** They read to the participants stories comprising of 12 prototypical actions in an episode; but with 8 of them rearranged
- **Test & Observations:** In recall test, participants showed a strong tendency to put the actions back to their normal order. (50% of the statements were put back)
- **Conslusions:** powerful effect of general schemas on memory for stories.

> New events are encoded with respect to general schemas and that subsequent recall is influenced by the schemas
>
> But it is not clear that *misrecalling* is the right characterization of such a phenomena
>
> Scripts server as a valuable basis for filling in missing information and for correcting errors in information
> **Example:** *If storyteller says the paid was check before the meal was ordered, we have some reason to doubt the storyteller*

(3) Abstraction Theories versus Exemplar Theories

Diasdvantage of the previous theories (Semantic network and Schemas)

1. **Semantic Networks** do not capture the graded character of categorical knowledge such that different instances are better or worse members of a category.
2. **Schemas** can do this, but it has never been clear in detail how to relate them to behavior.

Abstraction vs Exemplar Theories

1. **Abstraction Theories** *hold that* we can actually abstract general properties of a category from specific instances we have studied that those we store as abstractions
2. **Exemplar Theories** *hold that*, we can store only specific instances and that we infer general properties form these instances.

> **DEBATE:**
> British philosophers **John Locke** and **George Berkeley**.

> - Locke claimed that he had an abstract idea of a triangle that was neither oblique nor right-angled, neither equilateral, isosceles, nor scalene, but all of these at once,
> - while Berkeley claimed it was simply impossible for himself to have an idea of a triangle that was not the idea of some specific triangle.

ABSTRACTION THEORIES

- **Schema Theory** is an example of abstraction theory
- **Prototype Theories (Reed 1972)** assumes that people store a single prototype of what an instance of a category is like and judge specific instances in terms of similarity to that prototype
- **(Hayes Roth & Hayes-Roth 1977) (J. R. Anderson 1991)** store a representation that also encodes some idea of the allowable variation around the prototype

EXEMPLAR THEORIES

- exemplar theories could not be more different.
- We store specific instances rather than any general concept. Hence at the time of judging, we compare a specific test instance, to the other specific training instances that we have in our store.
- *how typical a specific bird is in the general category of birds, we compare the specific bird to other specific birds and make some sort of judgment of average difference*

SIMILARITIES IN THE PREDICTIONS BY ABSTRACTION AND EXEMPLAR

- Both types predict that it is easier/better to process central members of a category
  1. **Abstraction Theories:** since central members are more close to the abstract representations of a concept.
  2. **Exemplar Theories:** since, central members will be more similar, on average, to other instance of a category.

DIFFERENCES IN THE PREDICTIONS BY ABSTRACTION AND EXEMPLAR

- Unlike Abstract Theories, Exemplar Theories predict that specific instances that some might have encountered should have effects that go beyondany effect of some representation of the central tendency.
  - ***Example:*** Although we may think that dogs in general bark, we may have experienced a peculiar-looking dog that did not, and we would then tend to expect that another similar-looking dog would also not bark.
  - Such effects of specific instances can be found in some experiments (e.g., Medin & Schaffer, 1978; Nosofsky, 1991).
- people may infer tendencies that are not in the specific instances (Elio & Anderson, 1981).
  - ***Example:*** if we have encountered many dogs that chase balls and many dogs that bark at the postman, we might consider a dog that both chases balls and barks at the postman to be particularly typical. However, we may never have observed any specific dog both chasing balls and barking at the postman.

COMBINATION OF ABSTRACTION AND EXEMPLAR

- According to **Ashby & Maddox (2011)**, it seems people may sometimes use abstractions and at other times use instances to represent categories.
- Evidence of this expanded view comes from *Neuroscience studies*
- **Smith, Patalano, and Jonides (1998)**
  - **Task:** They had participants to learn to classify a set of 10 animals. Divided into 2 groups:
    - G1: encouraged to use rules such as "An animal is from Venus if it has ..."
    - G2: encouraged to simply memorize the categories from 10 animals.
  - **Observations:**
    - G1: (who used abstract rules): Regions in prefrontal cortex tended to be activated.
    - G2: (who memorized instances): Regions in the occipital visual areas in cerebellum were activated
- **Smith and Grossman (2008)**
  - review evidence that, using exemplars also activate brain regions supporting memory (such as *"hippocampus"*)
- Although *Smith et al* identified an **abstract system the involves explicit reasoning**,
  - there is also evidence for **abstract systems that involve unconscious pattern recognition**
  - Example: Our ability to distinguish "Cats" from "Dogs" without being able to articulate any features that distinguish them.
  - **Ashby & Maddox (2005)** argued that this system depends on the *"basal-ganglia"* (related to implicit category learning)

(4) Natural Categories and their Brain Representations

Laboratory and Natural Categories

- **Laboratory-defined categories** display the same sort of fuzzy boundaries that natural categories do and share a number of other attributes,
- But, **Natural categories** arise over a much longer time than the time spent on a typical laboratory task.
  - This leads to people developing biases about such categories:
    1. Living Things
    2. Artifacts
  - Most researches documenting this bias has been done with **primary-school children**
  - For instances,
    1. If primary-school children are told that:
       - a human has a spleen, they will conclude that dogs have spleens too (Carey, 1985)

        - a red apple has pectin inside, they will assume that green apples also have pectin (Gelman, 1988)
    2. If children are told that an artifact such as a cup is made of ceramic, they do not believe that all cups are made of ceramic
    3. If told that a cup is used for “imbibing” (a term they do not know), they believe that all cups are used for imbibing.
    4. If told that they can “repast” with a particular red apple, they do not necessarily believe that they can repast with a green apple
  - The previous statements can be grouped as:
    1. (cat: **Natural**, type: **part**)
    2. (cat: **Artifact**, type: **part**)
    3. (cat: **Artifact**, type: **action**)
    4. (cat: **Natural**, type: **action**)
  - In summary, children come to believe that:
    - From (1) all things in a **biological** category have the same **parts** (like pectin in apples)
    - From (3) all things in an **artifact** category have the same **function** (like imbibing for cups)

Cognitive Neuroscience perspective

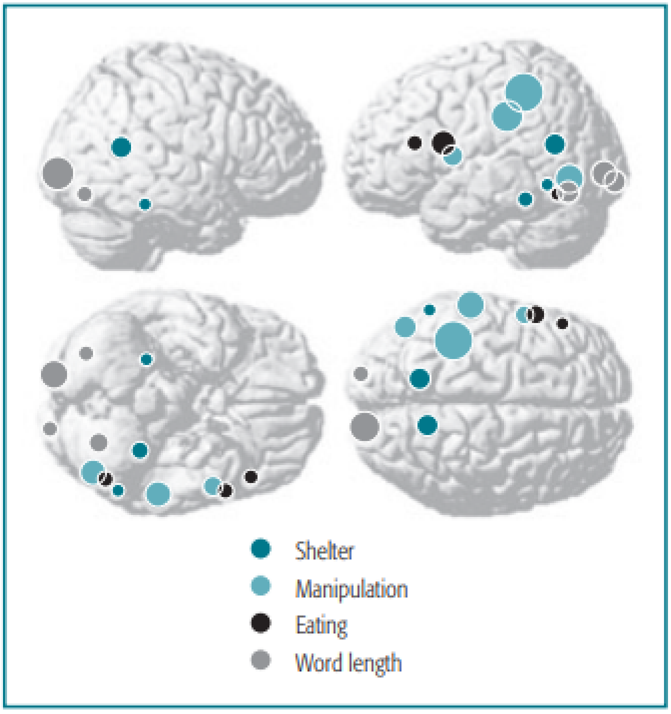
- Cognitive neuroscience data suggest that biological and artifact categories are represented differently in the brain
- Much of the evidence comes from patients with **semantic dementia** (deficit in categorical knowledge)
  1. Damage to **temporal lobes** - defecit in knowledge of **Biological categories**
     - Warrington & Shallice, 1984; Saffran & Schwartz, 1994
     - They were unable to recognize "duck" but could only say that it was an "animal"
     - However, knowledge about artifacts ("tools", "furnitures") were unaffected
  2. Damage to **frontoparietal lesions** - defecit in knowledge of **artifact categories**
     - but unaffected in their processing of biological categories
- **Warrington & Shallice, 1984; Farah & McClelland, 1991**
  - Suggested that, these dissociations occur because:
    1. **Biological** categories are more associated with **perceptual features** such as shape, *whereas*
    2. **artifacts** are more associated with the **actions** that we perform with them
- **Farah & McClelland**
  - developed computer simulation model of this dissociation that learns associations among words, pictures, visual semantic features, and functional semantic features.
  - **TASK and OBSERVATIONS:**
    - By **selectively damaging the visual features** in their computer simulation,
      - They were able to produce a **deficit in knowledge of living things**; *and*
    - By **selectively damaging the functional features**,

        - They were able to produce a **deficit in knowledge of artifacts**.
    - **CONCLUSIONS:**
        - Thus, loss of categorical information in such patients seems related to loss of the feature information that defines these categories.
- **Brain-imaging data also seem consistent with this conclusion (A. Martin, 2001)**
    - Processing of both animals and tools activates regions of the **temporal cortex**,
    - But the tool regions tend to be located above (superior to) the animal regions.
    - There is also activation of **occipital regions** (visual cortex) when processing animals.
    - In general, the evidence seems to point to:
        1. A greater visual involvement in the representation of animals
        2. A greater motor involvement in the representation of artifacts.

Caramazza, 2000 - A DEBATE

- There is some debate in the literature over whether the real distinction is between
    - **natural categories** and **artifacts** *or between*
    - **visual-based** and **motor-based** categories

"Mind Reading"

- 

- Although temporal lobe plays a critical role in representation of natural categories.
- There is evidence that knowledge is distributed in the entire brain.
- **Cherkassky, Aryal, and Mitchell (2010)**
    - An fMRI study of brain representations of common words - *(hammer, tomato, house*).
    - There were regions activated throughout the brain depending on features of the word.

- Served the basis of an impressive *60 Minutes report, "Mind Reading"*, where these researchers were able to predict what words a person was reading.

> ***There are differences in the ways people think about biological categories and artifact categories and differences in the brain regions that support these two types of categories***