Chapter 10 – Comprehension

Comprehension & Memory

Comprehension:
– allows us to make sense of environment

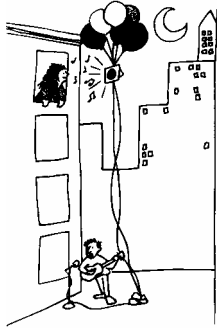2 Influences:
– individual (prior knowledge)
– text material

Comprehension & Memory cont'd

Recall….Bartlett

• had S's remember stories
• Found:
  – preserved theme
  – Errors! - regularization etc
• Reconstruction

Effects of Prior Knowledge

If the balloons popped, the sound wouldn't be able to carry, since everything would be too far away from the correct floor. A closed window would also prevent the sound from carrying, since most buildings tend to be well insulated. Since the whole operation depends on a steady flow of electricity, a break in the middle of the wire would also cause problems. Of course, the fellow could shout, but the human voice is not loud enough to carry that far. An additional problem is that a string could break on the instrument. Then there would be no accompaniment to the message. It is clear that the best situation would involve less distance. Then there would be fewer potential problems. With face to face contact, the least number of things could go wrong.

Bransford & Johnson (1973)

- title or picture provided context to help understand the passage
- title or picture only helped if given before the passage

GROUP	# ideas recalled (14)
no context	3.6
context after	3.6
context before	8.0

Bower, Black & Turner (1979)

- interested in how scripts influence understanding and memory for text
- subjects read 6 stories then performed an intervening task for 10 minutes before trying to recall the stories in writing
- remembered 53% of the interruptions of the script (e.g., waiter spilled soup, needing menu translation)
- remembered 38% of script actions)
- remembered only 32% of irrelevant information (e.g., type of print on menu, color of waitress's hair)

Prior Knowledge & Retrieval

Anderson & Pichert (1978)

- Read story: homebuyer or burglar
- Test 1: report story
- Test 2:
  - 1/2 report from *same* perspective
  - 1/2 from *other* perspective

Anderson & Pichert (1978) cont'd

Results:
- Test 1:
  - reported ideas consistent with perspective

- Test 2:
  - switched group reported 10% more on second test

Summary

Prior Knowledge:
- can make abstract text easier to comprehend
- comprehension -> better recall
- can determine emphasis

Text Organization

2 Levels of Organization:
- Global coherence: main events in story
  - e.g., what happens to major characters
- Local coherence: most recent events
  - e.g., where character is going & why

Comprehension:
- integrate local events into global events

Story Structure

Characteristics:
1. Setting – describes time, location and main characters in narrative
2. Theme – main goals of characters in narrative
3. Plot – sequence of events related to achieving the goals in a narrative
4. Resolution – outcome of events in the plot

- each characteristic builds on others
- allows for integration of components

Thorndyke (1977)

Circle Island is located in the middle of the Atlantic Ocean north of Ronald Island. The main occupations on the island are farming and ranching. Circle Island has good soil but few rivers and hence a shortage of water. The island is run democratically. All issues are decided my majority vote of the islanders. The governing body is a senate whose job is to carry out the will of the majority. Recently, an island scientist discovered a cheap method of converting salt water into fresh water. As a result, the island farmers wanted to build a canal across the island, so that they could use water from the canal to cultivate the island's central region. Therefore, the farmers formed a procanal association and persuaded a few senators to join. The procanal association brought the construction idea to a vote. All the islanders voted. The majority voted in favor of construction. The senate, however, decided that the farmers' proposed canal was ecologically unsound. The senators agreed to build a smaller canal that was 2 feet wide and 1 foot deep. After starting construction on the smaller canal, the islanders discovered that no water would flow into it. Thus the project was abandoned. The farmers were angry because of the failure of the canal project. Civil war appeared inevitable.

setting

theme

plot

resolution

Thorndyke (1977)

3 conditions:
- regular theme placement
- theme at the end of story
- no theme presented

Recall results:
  Regular > End > No theme

Integration of Details

Kieras (1978)
- varied whether ideas in sentences were linked
  – 1/2 S's: each sentence linked to previous
  – 1/2 S's: few linking ideas in sentences

Kieras (1978)

Linked	Non Linked
The ants ate the jelly.	The kitchen was spotless.
The <u>ants</u> were hungry.	The table was wooden.
The <u>ants</u> were in the kitchen.	The ants were hungry.
The <u>kitchen</u> was spotless.	The <u>ants</u> were in the <u>kitchen</u>.
The <u>jelly</u> was grape.	The jelly was grape.
The <u>jelly</u> was on the table.	The <u>jelly</u> was on the <u>table</u>.
The <u>table</u> was wooden.	The <u>ants</u> ate the <u>jelly</u>.

Kieras (1978)

- Result:
  - S's in "linked" group = much higher recall of story & details

- Conclusion:
  - Linking = > easy integration
  - Integration => better comprehension

Lesgold, Roth & Curtis (1979)

A thick cloud of smoke hung over the forest. The forest was on fire.

- easy to relate last sentence to first sentence, as first sentence contains information relevant to last sentence, and this information would still be in working memory

Lesgold, Roth & Curtis (1979)

Now, how easy is it to relate the following first and last sentences?

A thick cloud of smoke hung over the forest. The smoke was thick and black, and began to fill the clear sky. Up ahead Carol could see a ranger directing traffic to slow down. The forest was on fire.

- Easy -- middle sentences maintain connecting information in working memory

Lesgold, Roth & Curtis (1979)

How easy is it to relate the following first and last sentences?

A thick cloud of smoke hung over the forest. Glancing to one side, Carol could see a bee flying around the back seat. Both of the kids were jumping around but made no attempt to free the insect. The forest was on fire.

- Not easy – need to retrieve 1st sentence from LTM

Haviland & Clark (1974)

- presented sentence pairs in a tachistoscope
- got 1st sentence, hit a key to get 2nd sentence
- got 2nd sentence, and the participant pressed a key when they thought that they understood the second sentence
- measured time between key presses
  – Ed was given an alligator for his birthday. The alligator was his favorite present.
  – Ed was given lots of things for his birthday. The alligator was his favorite present.

Haviland & Clark (1974)

- Results:
  - S's slower to read 2nd sentence when relation had to be inferred

- Conclude:
  - Drawing inferences reduces ease of comprehension

Summary

Influence of Text
- Providing theme promotes comprehension
- Linking helps integration
- Drawing inferences slows comprehension

Seidenberg et al. (1982)

- read a sentence
  - "They need a new sink"
- pronounce a probe word that follows
  - right away, "tap" and "swim" are primed
  - a little later, only "tap" is primed
- lexical access of multiple word meanings probably occurs rapidly; selection of appropriate meanings follows shortly thereafter

Carpenter & Daneman (1981)

He turned his back on the rock concert stage and looked across the resort lake. Tomorrow was the annual, one-day fishing contest and fishermen would invade the place. Some of the best bass guitarists in the country would come to this spot. The usual routine of the fishing resort would be disrupted by the festivities.

Carpenter & Daneman (1981)

- Carpenter & Daneman (1981) used "garden path" sentences to show the processing of constituents

- the correct constituent is selected using context, which sometimes requires disambiguation

Reading & Comprehension

- Eye - tracker:
  - monitors eye-movements & stimulus text

Reading & Comprehension

- saccades & fixations
- span of apprehension
  - How much info can we take in with single fixation?
- moving window technique
  - take in ~ 20 characters

Reading & Comprehension

Gaze Duration
- total time spent on part of text
- Regression = reverse saccade
  - Comprehension difficulty
- Fixate on content words
- Fixate on uncommon words

Integration of Constituents

- Carpenter and Just (1983): often much of the time is spent between sentences in reading—by measuring subject pacing on a computer and by monitoring eye movements
- Cirilo and Foss (1980): the most time is spent at the beginning and end of passages, where the heavy constituent construction occurs, and less time on sentences in the middle

Syntactic Effects

Syntactic Expectations:

The women light the candles.

- "light" can be a noun or a verb
- expect verb sense when follows a noun

Syntactic Effects

Syntactic Expectations:

The old man the boats.

- In this case, syntactic expectation is wrong causing one to reinterpret sentence
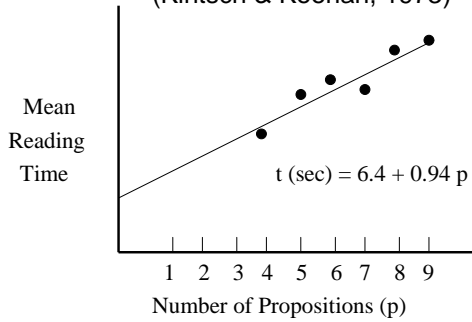
Propositions

- comprehension involves constructing and storing a related set of propositions (idea units) that describe details of text or story
- 3 experiments that provide evidence that propositions are the unit of analysis in comprehension
- note logic of converging operations: these experiments all use different procedures, but all provide evidence for same conclusion

1. Kintsch & Keenan (1973)

- subjects were timed on how long it took to read different sentences
- all sentences were approximately the same length (i.e., had the same number of words)
- sentences differed in terms of the number of propositions they contained

Reading Time
(Kintsch & Keenan, 1973)

Mean
Reading
Time

$t \text{ (sec)} = 6.4 + 0.94\ p$

1 2 3 4 5 6 7 8 9
Number of Propositions (p)

Reading Time
(Kintsch & Keenan, 1973)

- comprehension time depends on number of propositions in the sentence, not the number of words

2. Probe Technique
(Caplan, 1972)

1. *Whenever one telephones at **night** / rates are lower.*

2. *Make your calls after six because / **night** rates are lower.*

• Test: Was "night" in the sentence (night 4th last word in both sentences)?

• Subjects fastest in sentence #2 because night is in last proposition...
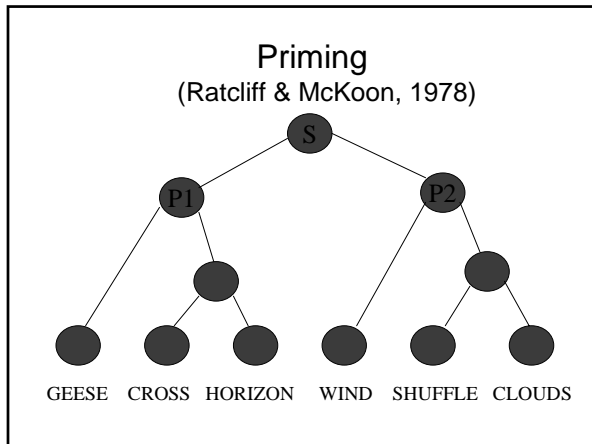
2. Probe Technique
(Caplan, 1972)

• results support Kintsch & Keenan's results - it is propositions, not number of words that is important

• results indicate sentence processed in terms of propositions

• last proposition is in working memory, so information is easiest and fastest to retrieve (i.e., recency effect)

3. Priming
(Ratcliff & McKoon, 1978)

• presented subjects with a series of sentences to learn

• e.g., *Geese crossed the horizon as wind shuffled the clouds.*

• *assumed sentences stored in memory as a series of linked propositions*

Priming
(Ratcliff & McKoon, 1978)

```
                    S
                 /     \
               P1       P2
              /  \      /  \
             /    ●    /    ●
            /   / | \ /    / \
           ●   ●  ● ●  ●  ●
        GEESE CROSS HORIZON WIND SHUFFLE CLOUDS
```

Priming
(Ratcliff & McKoon, 1978)

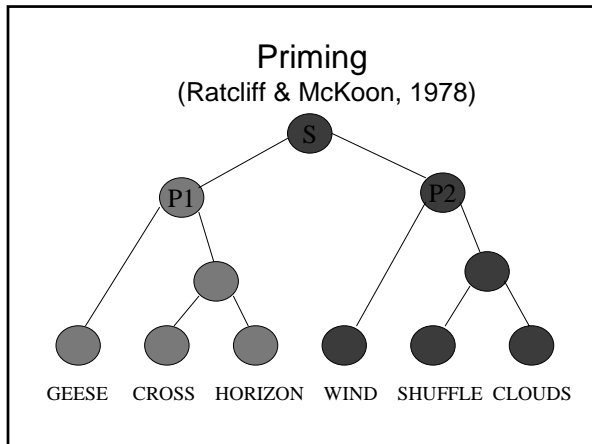- subjects given recognition test - was word in one of the sentences you studied?

First Prediction:

Faster recognition decision for a word when preceding word from same sentence.

- activation of word will spread to activation of sentence

Priming
(Ratcliff & McKoon, 1978)

Second Prediction:

Even faster recognition for a word that follows a word from the same proposition

- activation of word will activate proposition; stronger activation because closer together
- note: same logic as spreading activation account of lexical decision priming (e.g., bread - butter)

Priming
(Ratcliff & McKoon, 1978)

GEESE   CROSS   HORIZON   WIND   SHUFFLE   CLOUDS

Priming
(Ratcliff & McKoon, 1978)

- found word from a sentence primed word following word from same sentence
- found even greater priming for word from same proposition
- note: distance between words in sentence not important, propositional relationships are what is important
- e.g., greater priming for Geese -> Horizon than for Horizon -> Wind

Priming
(Ratcliff & McKoon, 1978)

- results support view that sentences are stored in memory as a series of linked propositions
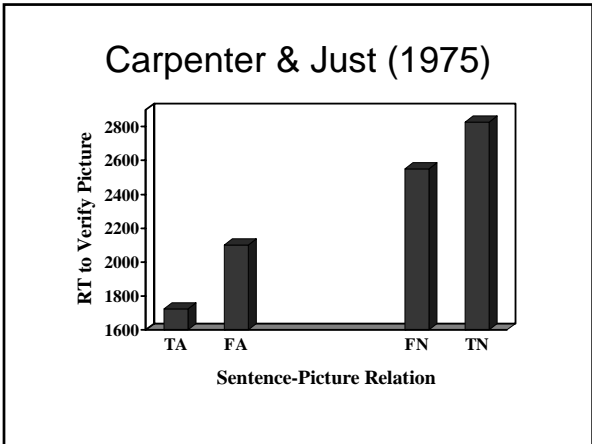- consistent with spreading activation view

15

Summary

- comprehension (encoding) is a constructive process
- propositions are the unit of analysis
- information stored in memory as a series of linked propositions
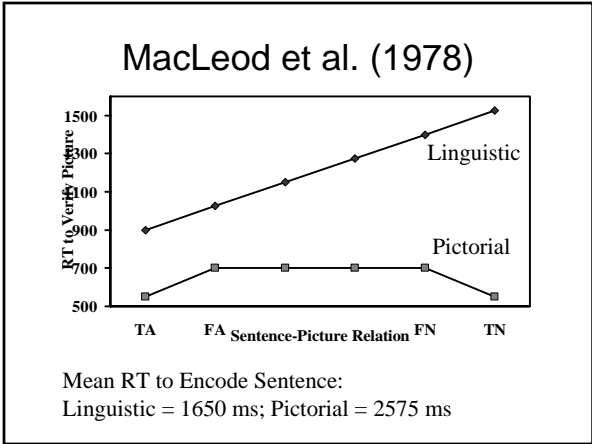
Syntactic Translation

- Chase & Clark (1972)
- the sentence-picture verification task
- construct linguistic propositions from the sentence and the picture, then compare these constituents one at a time
- illustrates syntactic processes in comprehension
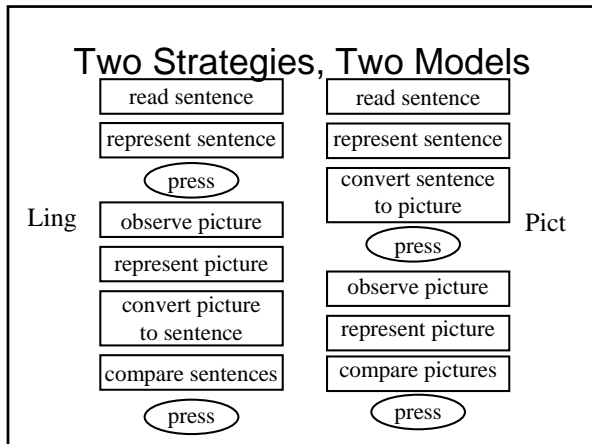
Sentence-Picture Verification

- true affirmative (TA):
  – PLUS ABOVE STAR
- false affirmative (FA):
  – PLUS BELOW STAR $+$
- true negative (TN): $*$
  – PLUS NOT BELOW STAR
- false negative (FN):
  – PLUS NOT ABOVE STAR

Carpenter & Just (1975)

Bar chart. Y-axis: RT to Verify Picture (1600 to 2800). X-axis: Sentence-Picture Relation (TA, FA, FN, TN).

Strategies

- MacLeod, Hunt, & Mathews (1978)
- suggested two strategies:
  - linguistic
  - pictorial
- measured sentence and picture times separately
- strategy choice depends on spatial ability
- Mathews, Hunt, & MacLeod (1980)

MacLeod et al. (1978)

Line graph. Y-axis: RT to Verify Picture (500 to 1500). X-axis: Sentence-Picture Relation (TA, FA, FN, TN). Two lines labeled Linguistic and Pictorial.

Mean RT to Encode Sentence:
Linguistic = 1650 ms; Pictorial = 2575 ms

Two Strategies, Two Models

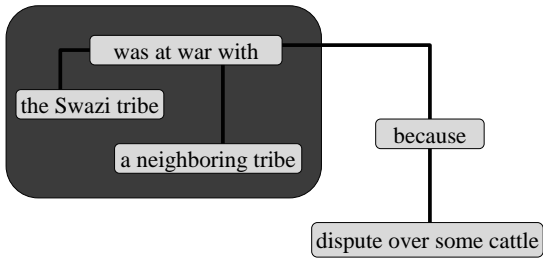| Ling	Pict
read sentence	read sentence
represent sentence	represent sentence
press	convert sentence to picture
observe picture	press
represent picture	observe picture
convert picture to sentence	represent picture
compare sentences	compare pictures
press	press

MacLeod et al. (1978)

- strategies in cognition
- visual vs verbal strategy
- based on ability, but not "hard wired"
- converging sources of evidence for the different strategies

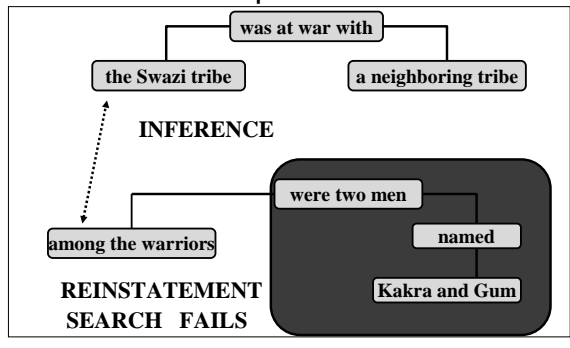## Kintsch's (1979; 1994) Model of Comprehension

Text:

The Swazi tribe was at war with a neighboring tribe because of a dispute over cattle. Among the warriors were two unmarried men, Kakra and his younger brother Gum. Kakra was killed in a battle.

18

Kintsch's (1979; 1994) Model of Comprehension

was at war with

the Swazi tribe

a neighboring tribe

because

dispute over some cattle

Cycle 1: Analysis of first sentence

Kintsch's (1979; 1994) Model of Comprehension

was at war with

the Swazi tribe

a neighboring tribe

INFERENCE

were two men

named

among the warriors

Kakra and Gum

REINSTATEMENT SEARCH FAILS

Kintsch's (1979) Model of Comprehension: Summary

- comprehension easiest if we can relate new information to propositions in working memory
- comprehension slower if must retrieve related concepts from long-term memory (reinstatement search)
- comprehension slower still if reinstatement search fails; must make inference as to how new information relates to previous information

Summary

- comprehension (encoding) is a constructive process
- meaning stored in memory as a series of linked propositions
- related information integrated (i.e., propositions linked or combined in memory)
- remember gist, not literal details, of information
- context aids memory, but only if context can aid comprehension (i.e., comes before, not after)