PSYC 2530: Memory II

Phenomena and principles

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Last compiled 03/25/22

Reminders from last class

Reading is Chapter 9 on Memory II

Roadmap

1 Measuring Memory

2 Memory Phenomena

3 Memory Principles

Measuring Memory

Memory processes and abilities are measured with memory tasks

- Memory tasks are imperfect
- Need to critically evaluate how performance in a task relates to hypothesized memory processes

Recall vs recognition

Recall Task

Encoding phase:

- view a list of items (usually words)

Recall phase:

- generate as many items from the list as possible
- e.g., write down as many words as you can remember

Recognition Task

Encoding phase:

- view a list of items (usually words)

Recognition phase:

- view one item at a time, judge whether the item is OLD (shown before) or NEW (not shown before)

Example Memory Task

Let's do a quick demo

We will do a memory test for words

Before we start make sure you have a way to write down answers

Encoding Phase

I am about to read 15 words, one at a time

Try to remember each word as best as you can

Listen to each word

Recall test

Spend 1 minute and write down as many individual words as you can remember

I will show you the list of words at the end and you can count how many you correctly recalled

Recognition task

In a recognition test participants see a stimulus and judge whether the stimulus is OLD or NEW?

Is this word OLD or NEW?

snooze

Is this word OLD or NEW?

piano

Is this word OLD or NEW?

sleep

Recall task performance

The list of words:

bed rest awake tired dream wake snooze blanket doze slumber snore nap peace yawn drowsy

- How many words did you recall correctly?
- Did you write down any words that were not on the list?
- Does failing to recall an item mean you don't have a memory for it?

Recognition task performance

How did you do on the recognition task?

- Performance can depend on how easy the NEW items are.
- People can get 100% correct on all OLD items, just by saying OLD every time...

Memory Phenomena

In the next section we are going to explore laboratory memory phenomena

These are experimental manipulations that influence memory performance

Example 1: False-memory

Did you recall or recognize this word?

sleep

If you did, then you just had a false-memory.

- sleep was not on the list!
- The words in the list were manipulated to cause this effect
- scroll down for citation

DRM paper

Roediger, H. L., & McDermott, K. B. (1995). Creating false memories: Remembering words not presented in lists. Journal of experimental psychology: Learning, Memory, and Cognition, 21(4), 803.

Roadmap

1 Measuring Memory

2 Memory Phenomena

3 Memory Principles

Many Memory Phenomena

The textbook reviews several memory phenomena

We review them here

Memory Phenomena definition

Really general definition:

> *Anything to do with human and animal memory*

Laboratory definition:

> *Changes in memory measurements resulting from experimental manipulations*

Picture Superiority effect

Is your memory better for pictures than other things?

- Gehring, R. E., Toglia, M. P., & Kimble, G. A. (1976). Recognition memory for words and pictures at short and long retention intervals. Memory & Cognition, 4(3), 256–260. https://doi.org/bmxw8f
- navigate down for next slide

Picture Superiority effect

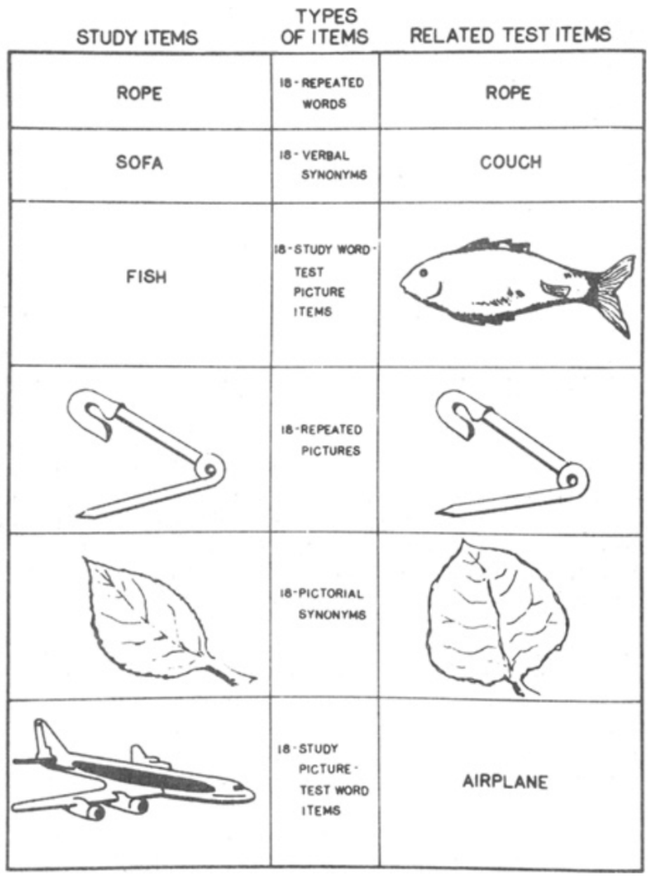

Figure 1. Types of items (16 verbal + 16 pictorial fillers not shown).

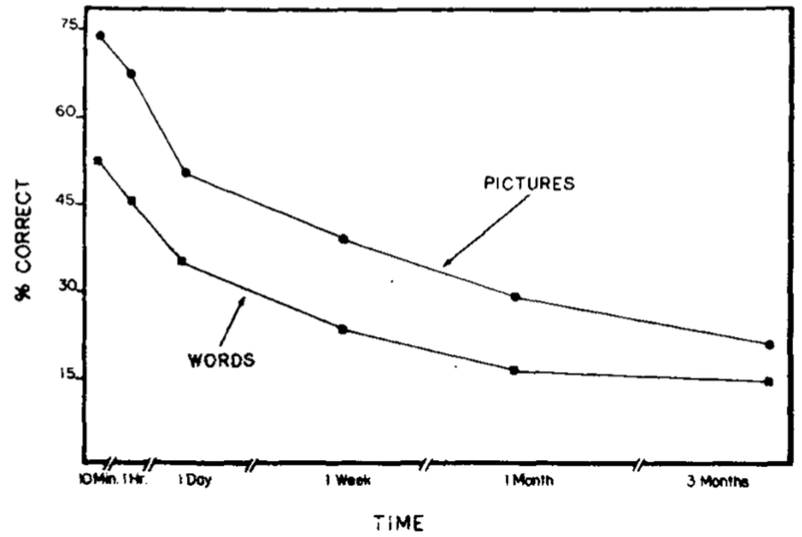

Figure 2. General superiority of pictorial performance over all retention intervals in Experiment I, after correction for guessing. The standard errors of the mean for the collapsed pictorial data over each increasing interval are 2.265, 2.815, 3.119, 2.978, 2.572, and 2.172, respectively; and for the verbal data, 2.466, 2.971, 2.625, 2.694, 1.890, and 1.910, respectively.

Frequency effects

What do you remember better?

- More frequent things?
- Less frequent things?

Journal of Experimental Psychology:
Human Learning and Memory
1980, Vol. 6, No. 5,576-587

Test-Expectancy and Word-Frequency Effects in Recall and Recognition

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University of South Carolina

James H. Neely
Purdue University

To determine if people who expect a recall (RCL) test encode a list of to-be-remembered (TBR) words differently than those who expect a recognition (RGN) test, people were first induced to expect a RCL or a RGN test and then were asked to remember a critical list consisting of both high-frequency (HF) and low-frequency (LF) words. Following presentation of the critical list, different groups received either an expected RCL test, an unexpected RCL test, an expected RGN test, or an unexpected RGN test. There were two main results: (a) People who expected RCL did better in both RCL and RGN than did people who expected RGN, but to a much greater degree for HF than LF words. (b) The standard word-frequency effect was obtained; namely, HF words were better recalled but more poorly recognized than LF words. These data were interpreted within the framework of Anderson and Bower's generate–recognize theory as indicating that, compared to people expecting a RGN test, people expecting a RCL test more variably encode the semantic interpretations of the TBR word. The implications that these data have for Glanzer and Bowles' theory of the word-frequency effect and for classroom examinations were also discussed.

Table 1
Mean Percent Correct RCL and Mean Percent Correct RGN for HF and LF Targets as a Function of Test Expectancy and Balancing of Practice

Type of test and test expectancy	Type of target and balancing of practice: HF BP	HF UP	HF *M*	LF BP	LF UP	LF *M*
RCL						
Expects RCL (39, 32)[a]	27	23	25	18	17	18
Expects RGN (34, 32)	20	16	18	16	14	15
M expectancy difference			7			3
RGN						
Expects RCL (36, 32)	57	53	55	73	69	71
Expects RGN (36, 32)	44	46	45	70	73	71
M expectancy difference			10			0

Note. RCL = free recall; RGN = recognition; HF = high frequency; LF = low frequency; BP = balanced practice; UP = unbalanced practice. Percent correct RGN is based on the high-threshold correction procedure. See text for details.
[a] Numbers in parentheses indicate the number of people tested in the BP and UP groups, respectively.

Presentation Rate and Spacing

How does study time influence word memory?

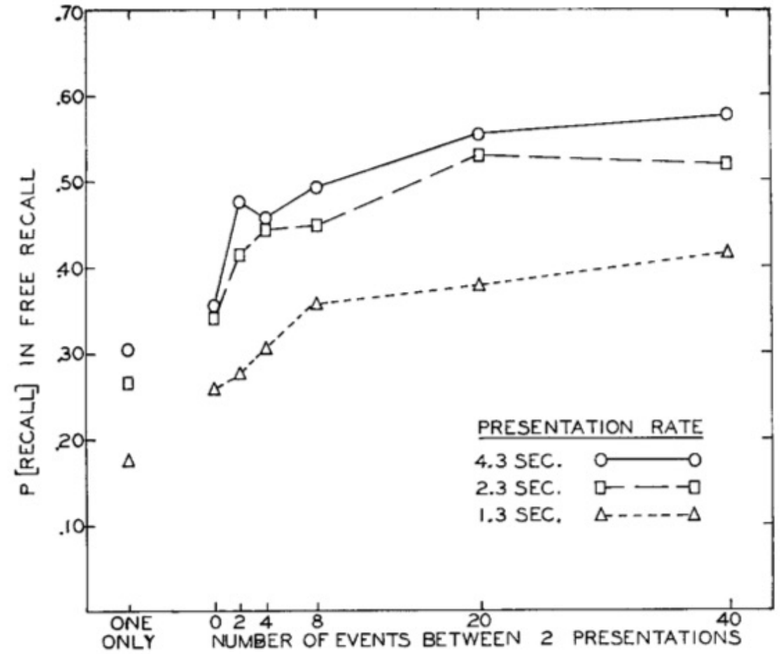
What about spacing out your practice?

- Melton, A. W. (1970). The situation with respect to the spacing of repetitions and memory. Journal of Verbal Learning and Verbal Behavior, 9(5), 596–606. https://doi.org/cpd74k

Presentation Rate and Spacing

Words were presented for 1.3, 2.3, and 4.3 seconds.

Repetitions of the same word were separated, or spaced out, by 0, 2, 4, 8, 20, or 40 intervening words.



Pro-active interference (PI)

Proactive interference happens when prior learning activities interfere with current learning activities.

- The more lists of words you already learned…
- The harder it gets to learn new lists of words

PI example from Underwood

Underwood, B. J. (1957). Interference and forgetting. Psychological Review, 64(1), 49–60. https://doi.org/c3vqj9

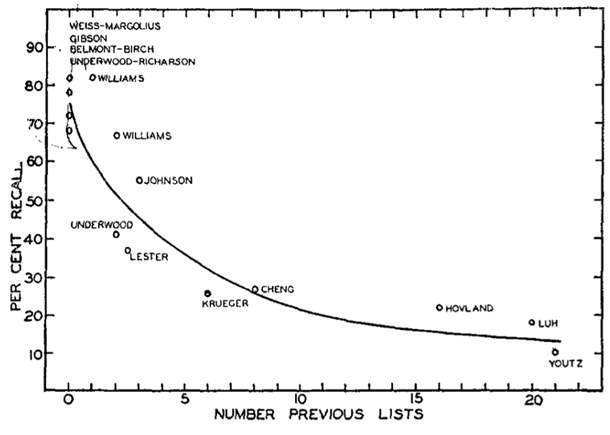


FIG. 3. Recall as a function of number of previous lists learned as determined from a number of studies. From left to right: Weiss and Margolius (35), Gibson (9), Belmont and Birch (3), Underwood and Richardson (33), Williams (36), Underwood (27, 28, 29, 30), Lester (17), Johnson (14), Krueger (16), Cheng (6), Hovland (11), Luh (18), Youtz (37).

Retroactive interference (RI)

Retroactive interference happens when new learning activities interfere memory for past learning activities.

RI example

- Phase 1: learn 24 nonsense syllables and do memory test
- Phase 2, **Exp**: learn 24 new nonsense syllables
- Phase 2, **Control**: read magazine
- phase 3: final memory test for first list

TABLE 1

MEAN NUMBER OF ITEMS CORRECTLY RETAINED ON ORIGINAL TEST AND RETEST

Condition	Experimental Group					Control Group				
	N	Original Test		Retest		*N*	Original Test		Retest	
		Mean	*SD*	Mean	*SD*		Mean	*SD*	Mean	*SD*
Recall	51	8.63	3.11	6.35	3.47	52	8.03	3.55	7.45	3.10

Fan effect

Some words co-occur more or less with other words…

The number of associates a word has is called its fan

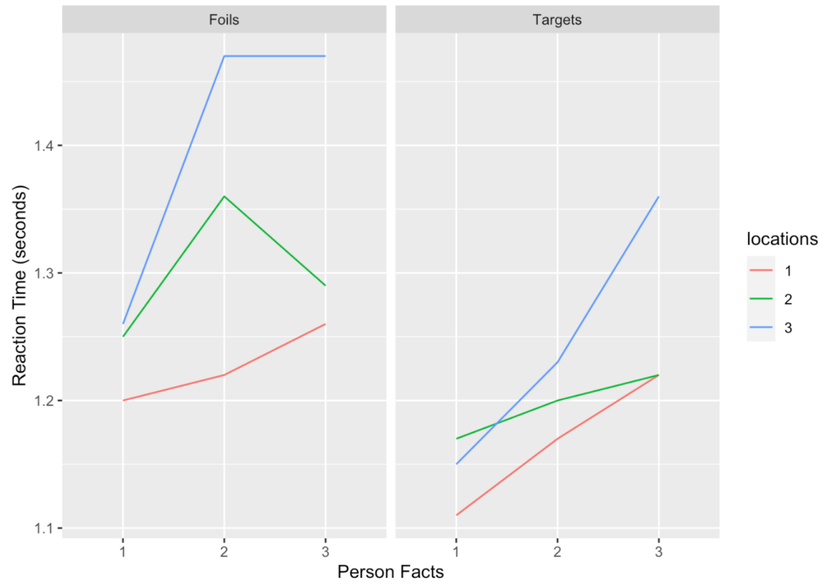
Fan effect: The time to recognize an item increases as its fan, or number of associates, increases

Fan effect example

Table 1
Examples of Experimental Material in the Fan Experiment of J.R. Anderson (1974)

Material studied	Target probes	Foil probes
A hippie is in the park.	3-3. A hippie is in the park.	3-1. A hippie is in the cave.
A hippie is in the church.	1-1. A lawyer is in the cave.	1-3. A lawyer is in the park.
A hippie is in the bank.	1-2. A debutante is in the bank.	1-1. A debutante is in the cave.
A captain is in the park.	—	2-2. A captain is in the bank.
A captain is in the church.	—	—
A debutante is in the bank.	—	—
A fireman is in the park.		—
A lawyer is in the cave.		
—		
—		
—		

Note. Dashes indicate more items.



Meaningfulness

Making information meaningful can make it more memorable

Self-reference effect

The self-reference effect shows that relating information to yourself can help you remember it better.

- Rogers, T. B., Kuiper, N. A., & Kirker, W. S. (1977). Self-reference and the encoding of personal information. Journal of Personality and Social Psychology, 35(9), 677. https://doi.org/cfzwx7

Self-reference effect example

Table 1
Examples of the Rating Tasks

Task	Cue question	Manipulation
Structural	Big letters?	The adjective was either presented in the same size type as the question or twice as large.
Phonemic	Rhymes with XXXX?	XXXX was a word that either rhymed or did not rhyme with the adjective.
Semantic	Means same as YYYY?	YYYY was either a synonym or unrelated word to the presented adjective.
Self-reference	Describes you?	Subjects simply responded *yes* or *no* to indicate the self-reference quality of the presented adjective.

Table 2
Recall, Rating Time, and Adjusted Recall as a Function of Rating Task and Rating for Experiment 1

	Rating task				
Rating	Structural	Phonemic	Semantic	Self-reference	
		Mean recall			Total
yes	.28	.34	.65	1.78	3.05
no	.06	.34	.68	1.06	2.14
Total	.34	.68	1.33	2.84	5.19

Meaningful Context

How well do you think you can understand and remember this paragaph?

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 the instrument. Then there could 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 lest number of things could go wrong.

Bransford and Johnson

Participants read the previous paragraph under different conditions:

Full context

Partial context

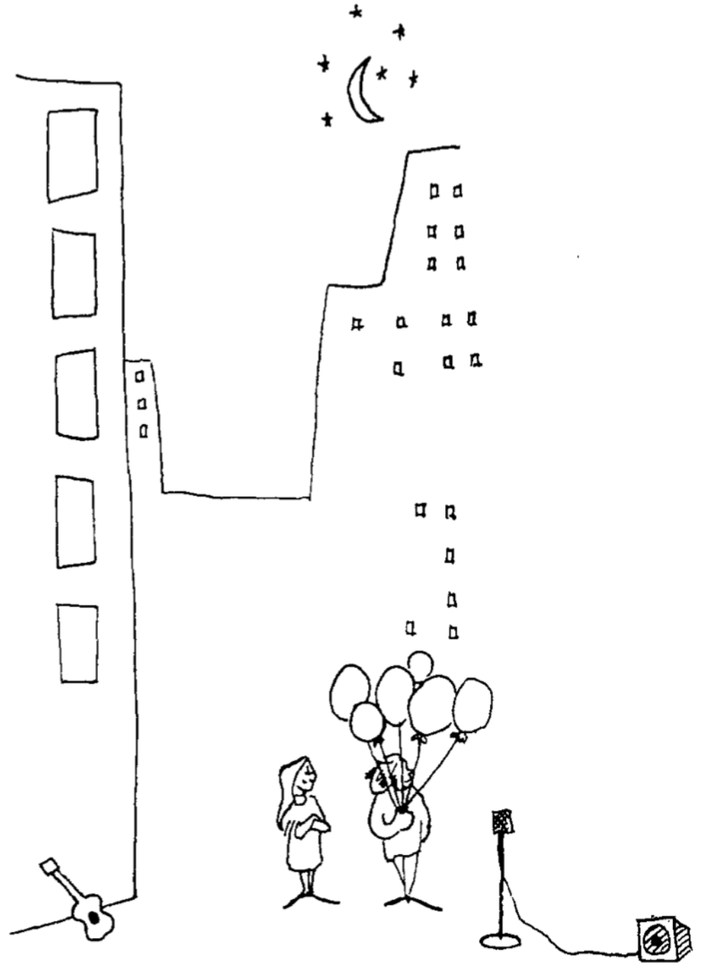


FIG. 2. Partial context picture for Experiment I.

Results

Participants who got the full context picture BEFORE they read the paragraph, showed much higher comprehension and recall

TABLE 1

MEAN COMPREHENSION RATINGS AND MEAN NUMBER OF IDEAS RECALLED, EXPERIMENT I

	No context (1)	No context (2)	Context after	Partial context	Context before	Maximum score
Comprehension	2.30 (.30)[a]	3.60 (.27)	3.30 (.45)	3.70 (.56)	6.10 (.38)	7
Recall	3.60 (.64)	3.80 (.79)	3.60 (.75)	4.00 (.60)	8.00 (.65)	14

[a] Standard error in parentheses.

Environmental Context Effects

How does your environment influence your memory?

- Godden, D. R., & Baddeley, A. D. (1975). Context-dependent memory in two natural environments: On land and underwater. British Journal of Psychology, 66(3), 325–331. https://doi.org/10.1111/j.2044-8295.1975.tb01468.x

Design

Divers encoded words either on land or under water

Then they attempted to recall words in the same or different context from where they encoded the words

Results

Table 1. *Mean number of words recalled in Expt. I as a function of learning and recall environment*

Learning environment	Recall environment: Dry — Mean recall score	Dry — S.D.	Recall environment: Wet — Mean recall score	Wet — S.D.	Total
Dry	13·5	5·8	8·6	(3·0)	22·1
Wet	8·4	3·3	11·4	(5·0)	19·8
Total	21·9	—	20·0	—	—

Testing Effect

Does quizzing yourself help you remember things?

- Roediger III, H. L., & Karpicke, J. D. (2006). Test-enhanced learning: Taking memory tests improves long-term retention. Psychological Science, 17(3), 249–255. https://doi.org/10/cp47ms
- There will be some midterm questions about this paper
- It is available to read on blackboard

What is the testing effect?

Better memory for material that was tested and successfully recalled or recognized, compared to material that was not tested

- E.g., better later memory for a concept if it was on a quiz, compared to concepts that were not quizzed

Prior research

Testing effects have usually been obtained for word lists, picture lists, or multiple-choice questions

Questions

- Does the testing effect generalize to more educationally relevant conditions?
- Can the testing effect be obtained using prose materials and free-recall tests without feedback?
- Will benefits extend beyond restudying the material?

Experiment 1

Question:

- Will the testing effect occur for prose materials and free-recall tests without feedback?

Method

- 120 participants studied two prose passages on “the sun” or “sea otters)
- Passages were 256 and 275 words in length
- Each passage was divided into 30 idea units for later scoring

Design

- 2 x 3 mixed-factorial design
- Learning condition: restudy vs. test
- Delay to memory test: 5 min, 2 days, 1 week

Procedure

Phase 1: Participants studied a passage for the first time

- Then they either restudied the passage OR were given a recall test to remember as much of the material as they could

FINAL TEST: All participants were given a final recall test after a 5 minute, 2 day, or 1 week delay

Results

Experiment 2

What are the effects of repeated restudying vs re-testing on memory for the passages?

Method

“A 3 x 2 between-subjects design was used. Subjects learned one of the two prose passages under one of three conditions (S 5 study, T 5 test): repeated study (SSSS), single test (SSST), or repeated test (STTT). Ninety subjects were given a final recall test following a 5-min retention interval, and 90 took a final test after 1 week. Thirty subjects were assigned to each of the six between-subjects conditions.” (Roediger & Karpicke, 2006)

Results

Roadmap

1 Measuring Memory

2 Memory Phenomena

3 Memory Principles

Memory Principles

The following are general principles about memory performance

These are not strong principles in the sense that they always describe how memory works

But, memory performance often generally follows these principles

Levels of Processing Principle

Principle: The strength, quality, and depth of encoding will determine later memory performance

- Craik, F. I., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 11(6), 671–684. https://doi.org/10/cpcxr6

Shallow versus deep encoding

Shallow encoding

Brief amount of time

“low-level” processing

Less overall processing of stimulus

Result = Weak memory trace

Deep encoding

More time encoding

More meaningful processing

More overall processing

Result = Strong memory trace

Example

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Examples of the Rating Tasks

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Cue-dependent memory

Principle: Context matters for encoding and retrieval

Cues in the environment can trigger memory retrieval for information previously paired/associated with the cue

Encoding Specificity Principle

> *"In its broadest form the [encoding specificity] principle asserts that only that can be retrieved that has been stored, and that how it can be retrieved depends on how it was stored. In its more restricted senses, the principle becomes less truistic and hence theoretically more interesting. For instance, we assume that what is stored about the occurrence of a word in an experimental list is information about the specific encoding of that word in that context in that situation. This information may or may not include the relation that the target word has with some other word...If it does, that other word may be an effective retrieval cue. If it does not, the other word cannot provide access to the stored information because its relation to the target word is not stored."*

Tulving, E., & Thomson, D. M. (1973). Encoding specificity and retrieval processes in episodic memory. Psychological Review, 80(5), 352. https://doi.org/10/cgj2rr

In other words

The encoding specificity principle says the details of how information was encoded in the first place matters for later memory retrieval.

If some target information was encoded in relation to its context, then contextual cues may be useful for retrieval later on.

However, if the operations that occurred during encoding did not focus much on contextual information, then contextual cues may not be very useful as retrieval cues later on.

TIP/TAP

TIP: Transfer inappropriate processing

TAP: Transfer appropriate processing

How a person makes use of prior information encoded by memory depends on how the information was encoded in interaction with the demands of present task.

Qualifying the previous principles

The TIP/TAP principle further qualifies the preceding principles.

- Memory depends on how deeply you encode information (levels of processing), the context around the encoding episode (context-dependent memory), and how the information is encoded (encoding-specificity principle)
- BUT, memory performance will also depend on the nature of the processing required by the retrieval task.

Matching vs mismatching processing

According to TIP/TAP, previous information becomes more available when retrieval processing conditions match well with encoding processing conditions, and becomes less available when the conditions mismatch.

- Encoding and retrieval demands Match = better memory
- Encoding and retrieval demands mismatch = worse memory

Morris, Bransford and Franks

Demonstrated that the tasks performed at encoding and retrieval can influence memory performance.

- Morris, C. D., Bransford, J. D., & Franks, J. J. (1977). Levels of processing versus transfer appropriate processing. Journal of verbal learning and verbal behavior, 16(5), 519-533.

Encoding Phase

Subjects encoded words in two conditions:

- **semantically** (in a sentence) to encourage deep processing, or
- **rhyming** condition to encourage more shallow phonetic processing.

Retrieval Phase

Two kinds of recognition tests: standard vs rhyming

- Purpose was to change the processing demands during retrieval to match or mismatch with encoding task

Standard	Rhyming
Hear a word a judge OLD vs NEW	Hear a cue word (not shown during encoding) Judge whether they heard a rhyming word during encoding

Consider?

What would the levels of processing principle predict for memory performance in this experiment?

The results

Standard: better memory for semantic encoding than rhyming encoding

Rhyming test: better memory for rhyming encoding than semantic encoding

Acquisition mode	Recognition test	
	Standard	Rhyming
Semantic–Yes	.844 (.155)[a]	.333 (.224)
Rhyme–Yes	.633 (.239)	.489 (.252)

What's next

Take the quiz and complete any additional assignments

Next week we begin discussing implicit influences in cognition.