9.00 - MEMORY

Professor John Gabrieli

The *Fragile* Power of Memory

WHY DO WE REMEMBER WHAT WE EXPERIENCE?

WHY DO WE FORGET WHAT WE EXPERIENCE?

IS MEMORY LIKE A CAMERA OR LIKE A PUNCH BOWL ?

BOTTOM-UP & TOP-DOWN INFLUENCES ON MEMORY

- **Bottom-Up**

  perceptual experience

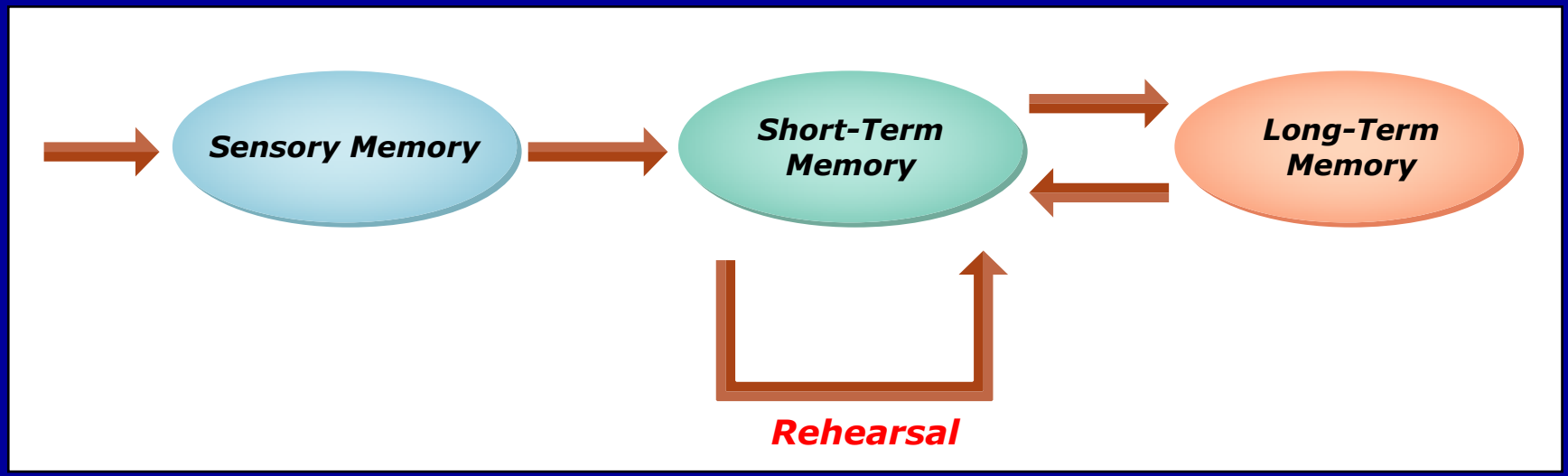
  what we see and hear

- **Top-Down**

  prior knowledge, concepts, expectations, subsequent experience

and which grows over time?

The Three-Stage Model of Memory



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What letters do you see?

A Q Z R

T P W L

B Y S D

A Q Z R

T P W L

B Y S D

(whole-report)

What letters do you see?

H B S T

A H M G

E L W C

middle row??

H B S T

A H M G

E L W C

(partial-report)

ATTENTION & SENSORY STORES

- **12 letter display**

  whole-report condition

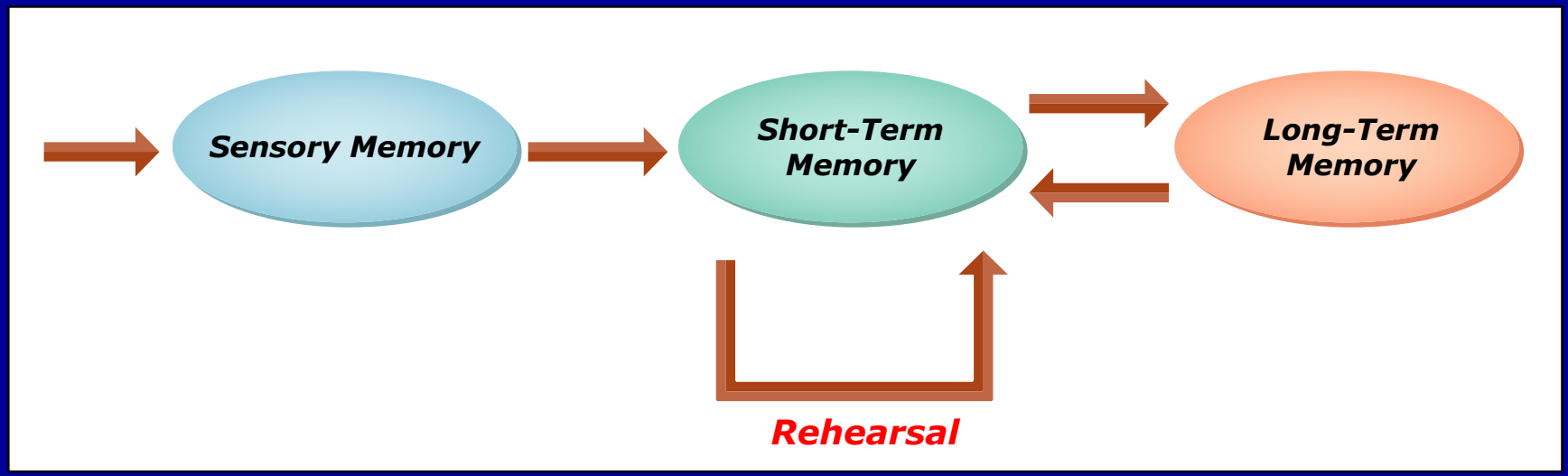
  37% correct (4 letters)
- **12 letter display -**

  tone after display (high, medium, low

  partial-report condition

  76% correct (3 letters)
- **Much is sensed, but attention selects only a little to be remembered**

The Three-Stage Model of Memory



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SHORT-TERM MEMORY

- limited capacity
- 7+/-2 chunks

Test of Digit Span

Span of 4: 6 1 9 4

Span of 5: 3 7 8 5 2

Span of 6: 9 6 5 2 8 3

Span of 7: 4 2 6 9 8 5 1

Span of 8: 8 1 6 3 7 2 4 9

Span of 9: 6 2 5 7 3 4 9 8 1

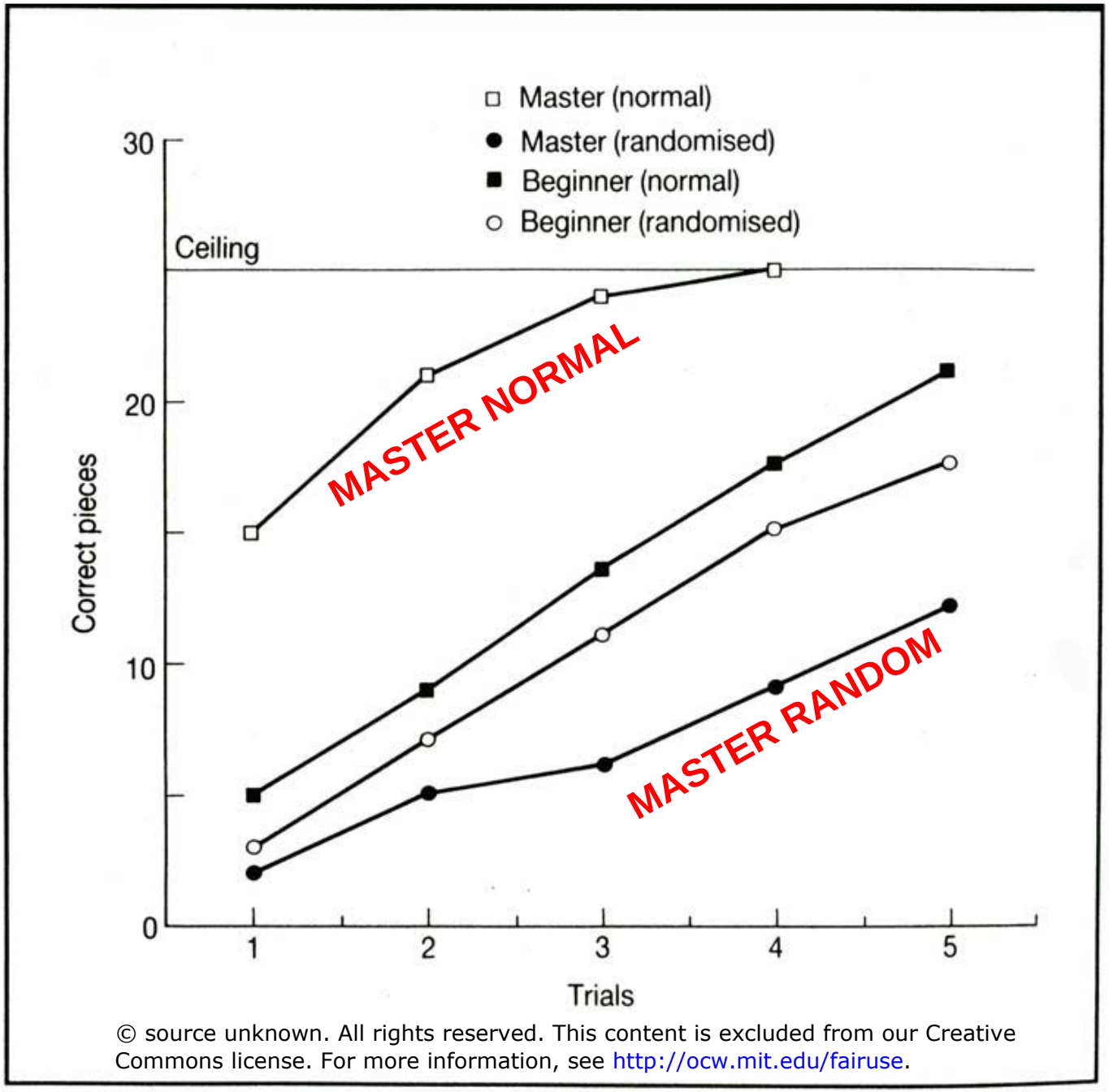
Span of 10: 9 3 8 2 4 7 1 5 3 6

Span of 11: 5 8 1 4 7 9 3 2 6 1 7

SHORT-TERM MEMORY

- limited capacity
- 7+/-2 chunks
- prior knowledge defines chunks, allows for more information to be retained in memory, may also miscode information

WHERE WERE THE CHESS PIECES?



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the value & price of knowledge

What letters do you see?

F
B
I
C
I
A
I
B
M
M
T
V

What letters do you see?

FBI CIA IBM MTV

F
B
I

C
I
A

I
B
M

M
T
V

FBI CIA IBM MTV

What letters do you see?

G D C E I A H B F

What letters do you see?

A B C D E F G H I

What words do you see?

LEAF PAPER SEAT TIRE CAR FISH ROCK WIRE WHEEL BEACH TREE BOY RADIO RULE

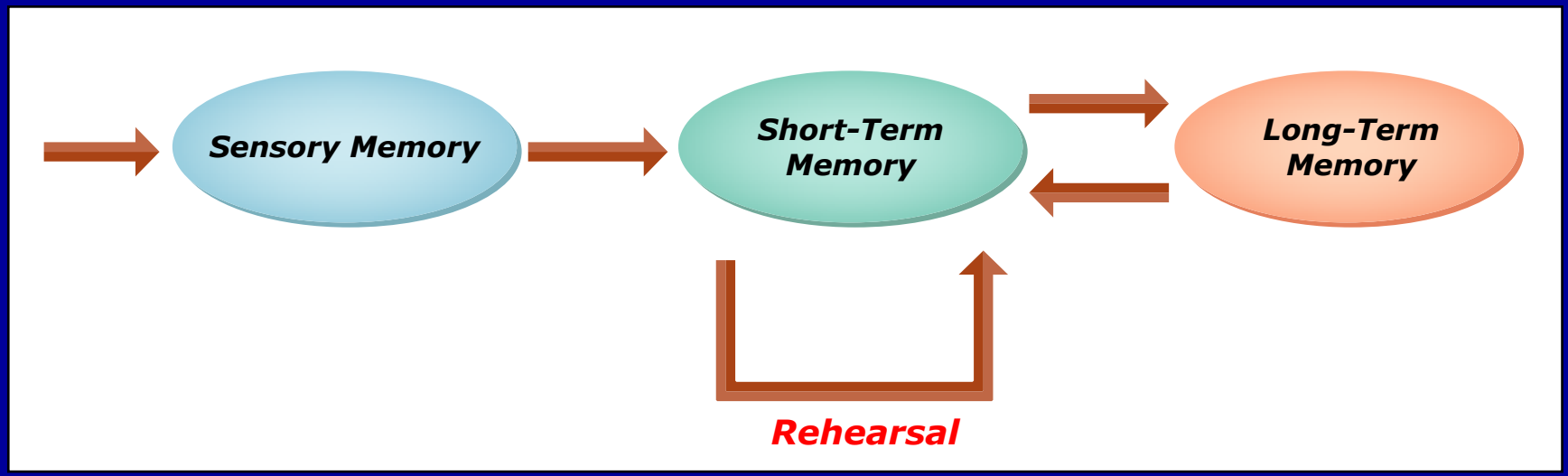
What words do you see?

WHILE I WAS WALKING THROUGH THE WOODS A RABBIT RAN ACROSS MY PATH

LEAF PAPER SEAT TIRE CAR FISH ROCK WIRE WHEEL BEACH TREE BOY RADIO RULE (13)

WHILE I WAS WALKING THROUGH THE WOODS A RABBIT RAN ACROSS MY PATH (13)

The Three-Stage Model of Memory



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LONG-TERM MEMORY or SECONDARY MEMORY

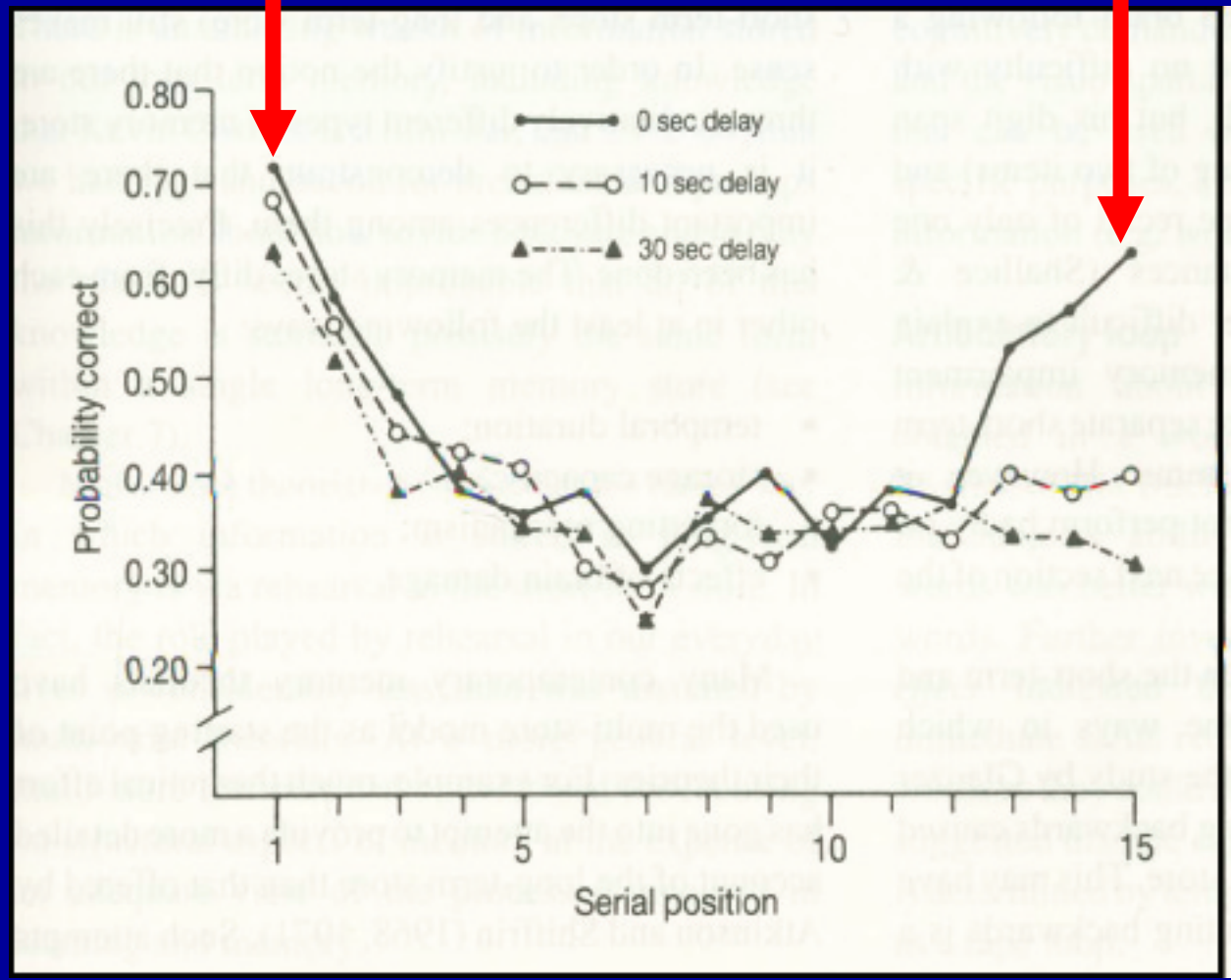
- serial position effect
  - primacy (LTM)
  - recency (STM)

- encoding and depth of processing
- organization
- encoding specificity
- passive forgetting vs. interference
- proactive interference
- retroactive interference
- memory for gist
- flashbulb memories
- false memories

Memory Test

1. Mailbox
2. Sardine
3. Shotgun
4. Peacock
5. Credit
6. Detail
7. Flicker
8. Airline
9. Spinach
10. Clarinet

Primacy Effect = LTM Recency Effect = STM



Free recall as a function of serial position and duration of the interpolated task.

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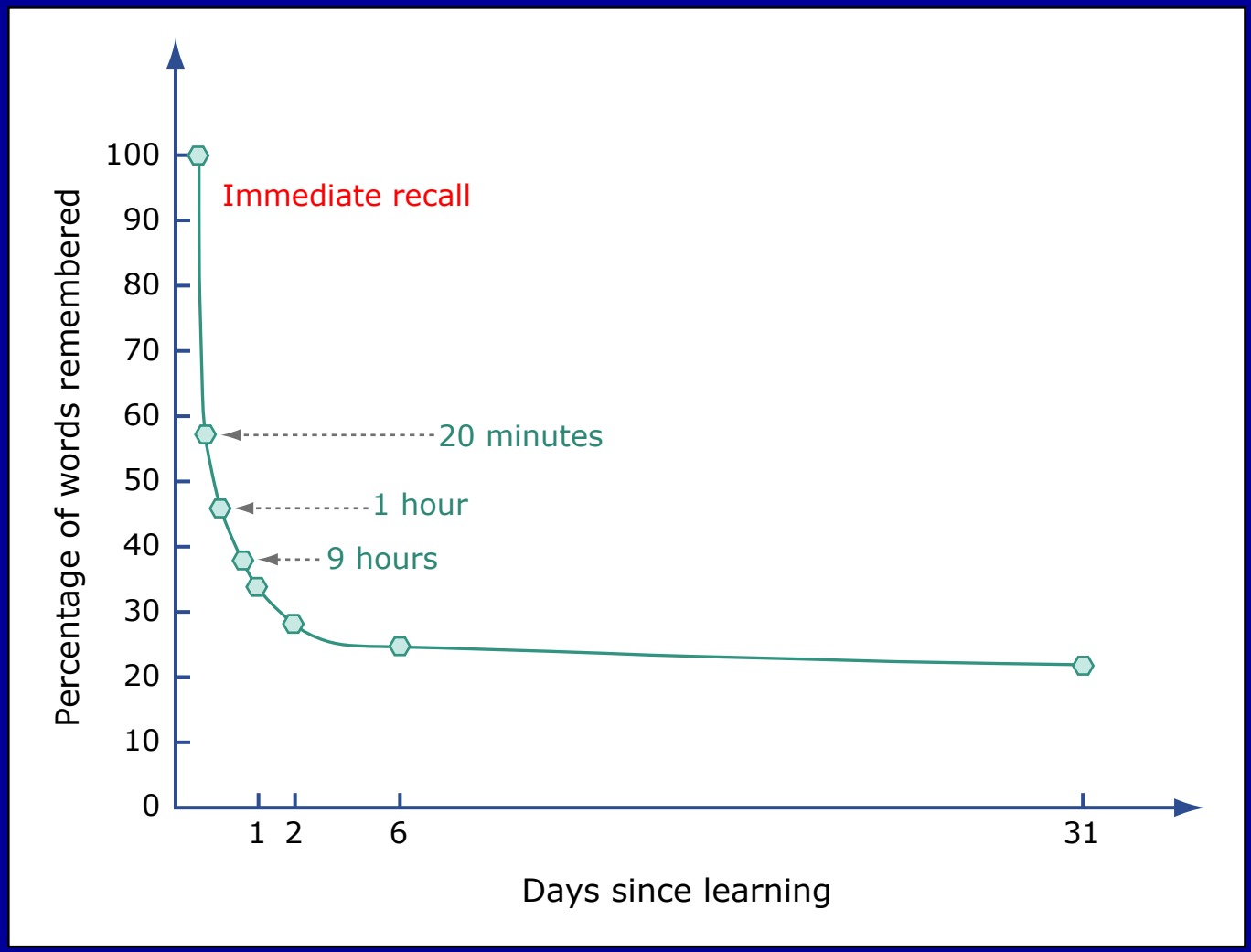
Ebbinghaus' Curve of Forgetting



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If word is in CAPITAL LETTERS,
Tap left hand

If word is in lower case letters,
Tap right hand

zebra
CAR
TABLE
mosquito
MONKEY
train
DESK
termite
BUS
wasp
camel
SOFA

WHAT WERE THE WORDS?

If word names a LIVING thing,
Tap left hand

If word names a non-living thing,
Tap right hand

SPIDER
chair
FOX
TRUCK
lamp
BEE
tiger
boat
RABBIT
tractor
bed
BUTTERFLY

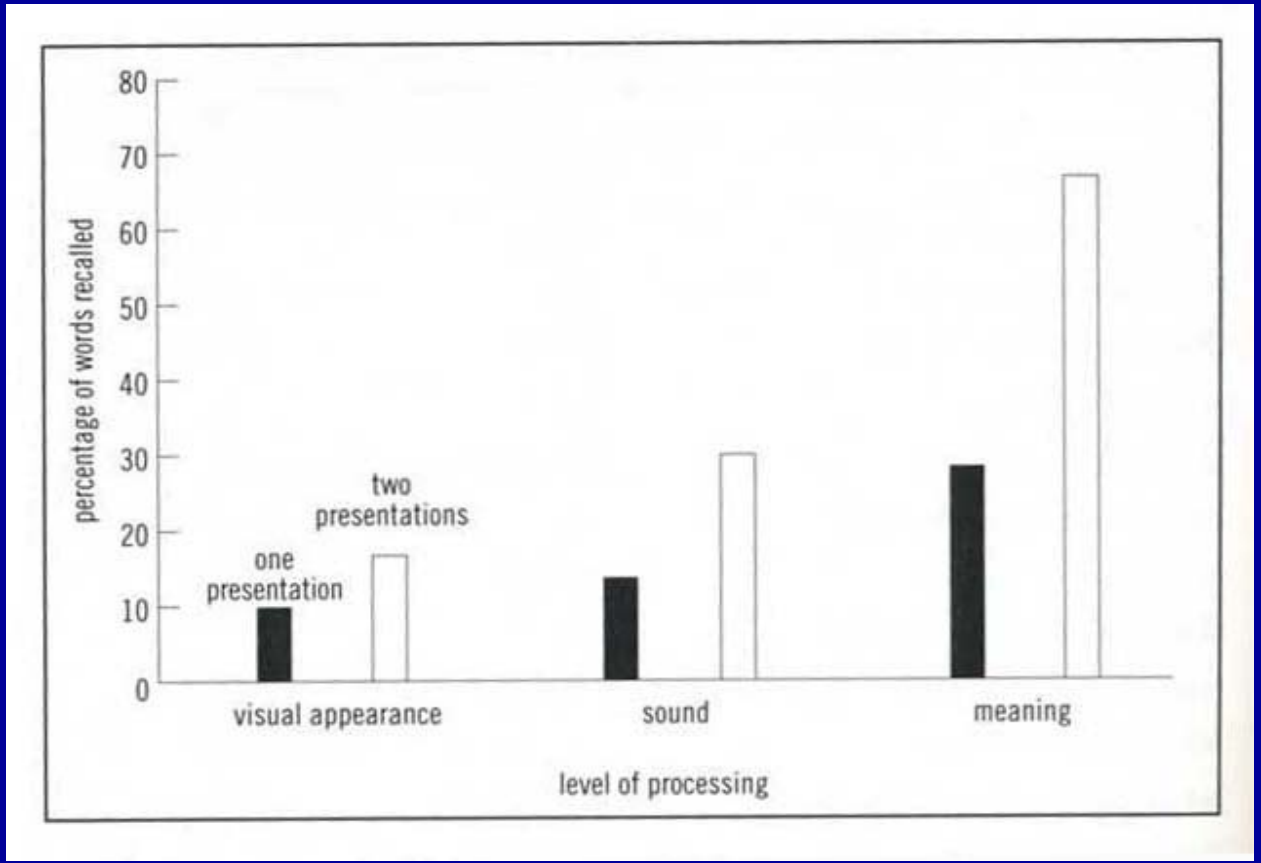
WHAT WERE THE WORDS?

zebra
CAR
TABLE
mosquito
MONKEY
train
DESK
termite
BUS
wasp
camel
SOFA

SPIDER
chair
FOX
TRUCK
lamp
BEE
tiger
boat
RABBIT
tractor
bed
BUTTERFLY

Appearance
Shallow Encoding
Poor Memory

Meaning
Deep Encoding
Good Memory



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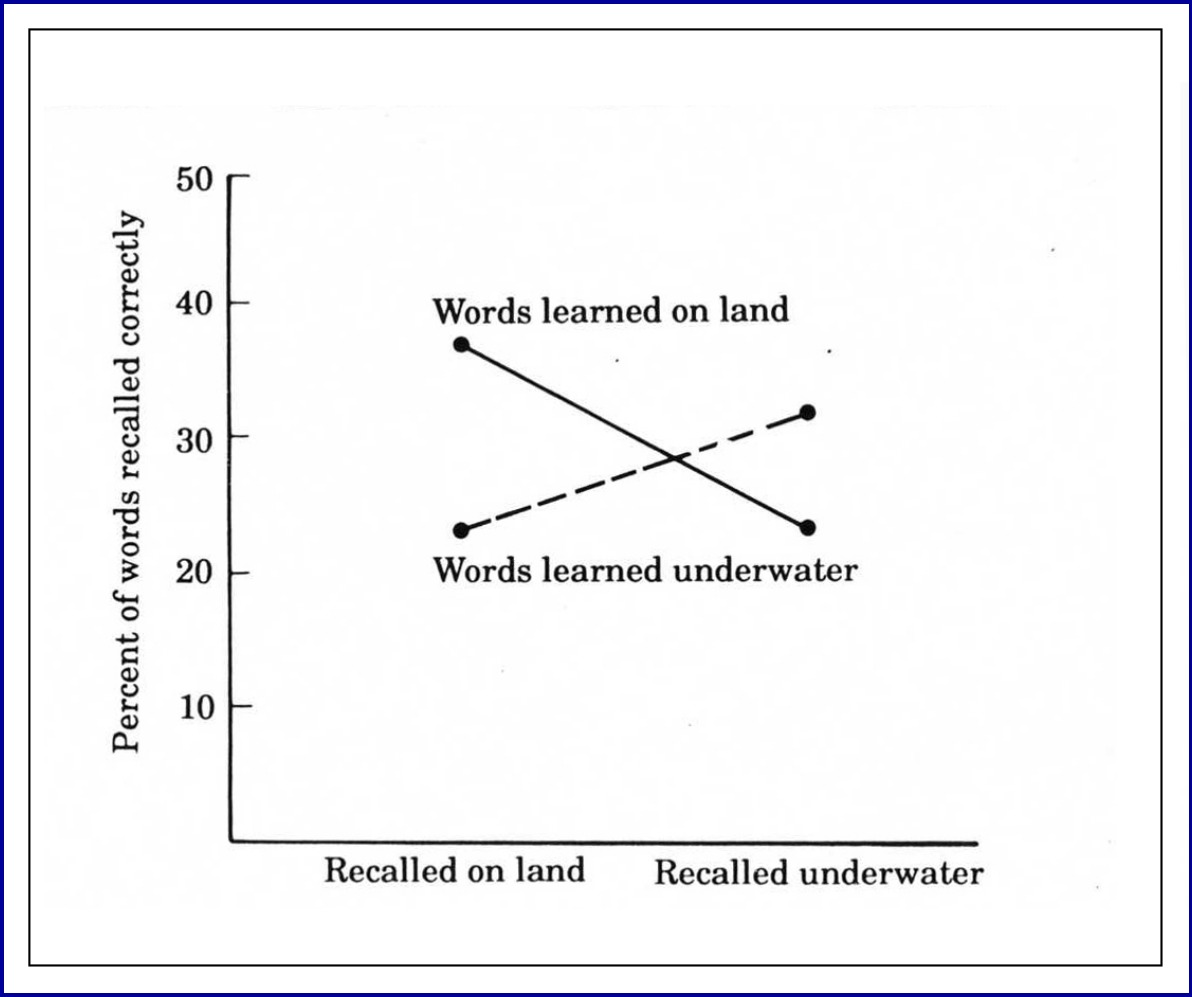

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The effect of context on recall of word lists. Words learned underwater are best recalled underwater, and vice versa. (From Godden and Baddeley, 1975)

SERVE

EDUCATE

LAWYER

CAREER	VACUUM	WRITER	ELECTRICIAN	TEACHER	COOK
DUST	DESIGNED	SCRUB	HOUSEWORK	CARPENTER	ENTERTAIN
PHYSICIAN	HOME	PLUMBER	ARTIST	RESPONSIBILITES	CHILD CARE
SKILLED	PURCHASE	CREATIVE	BATHE	FOOD	PROFESSIONAL

RESPONSIBILITIES

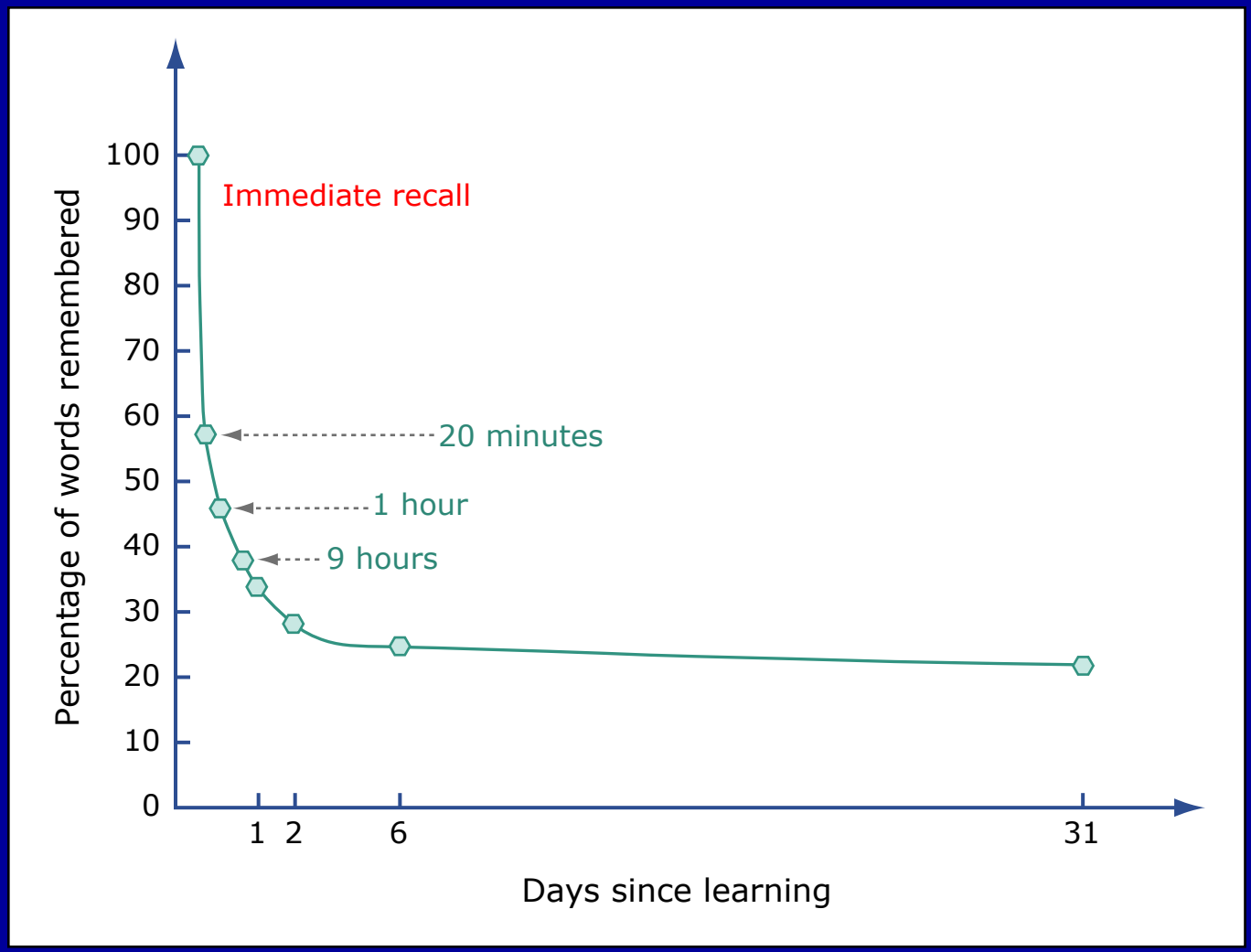
CAREER

HOME

PROFESSIONAL	SKILLED	CREATIVE	HOUSEWORK	CHILD CARE	FOOD
LAWYER	PLUMBER	WRITER	VACUUM	BATHE	PURCHASE
PHYSICIAN	ELECTRICIAN	ARTIST	DUST	EDUCATE	COOK
TEACHER	CARPENTER	DESIGNER	SCRUB	ENTERTAIN	SERVE

Memory better after semantically organized display than after random display

Ebbinghaus' Curve of Forgetting



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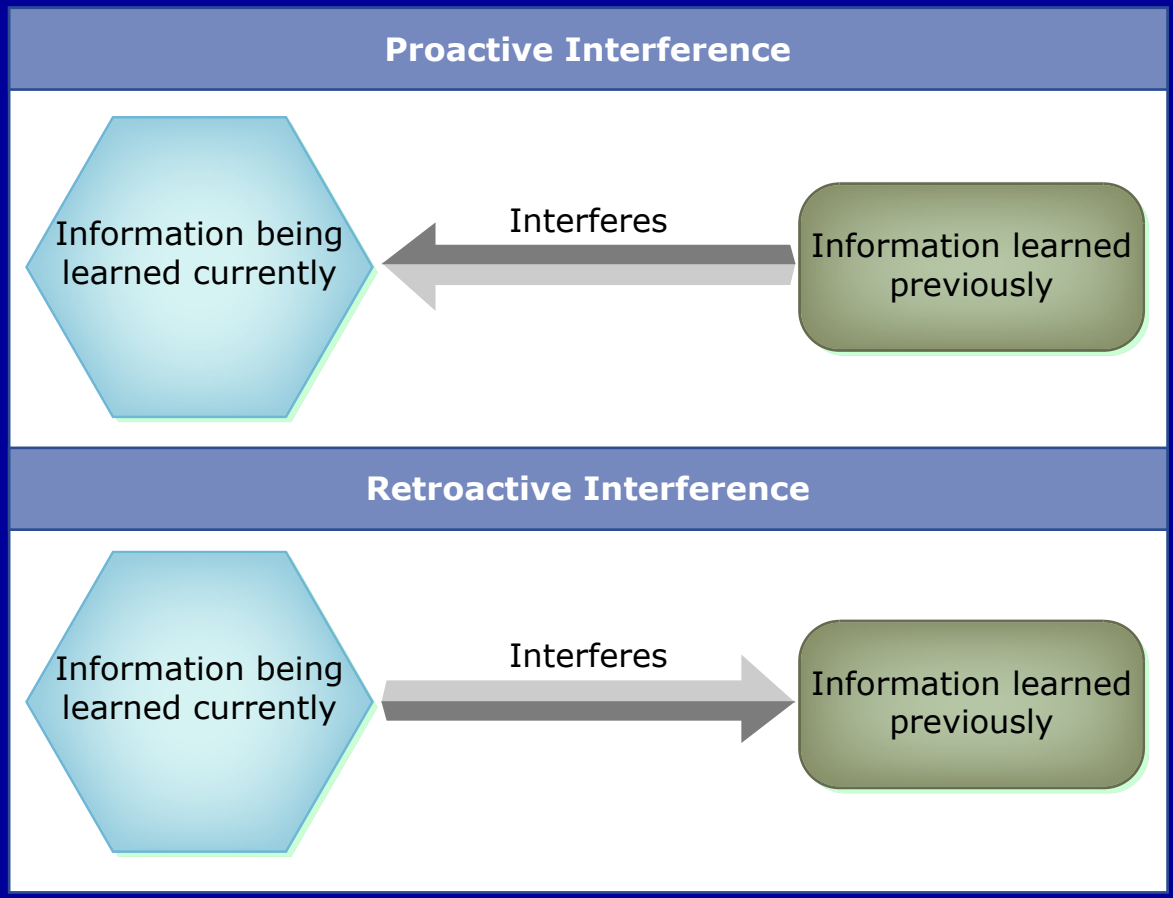
WHY DO WE FORGET?

passive forgetting?

or

interference?

Proactive and Retroactive Interference



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Retroactive Interference

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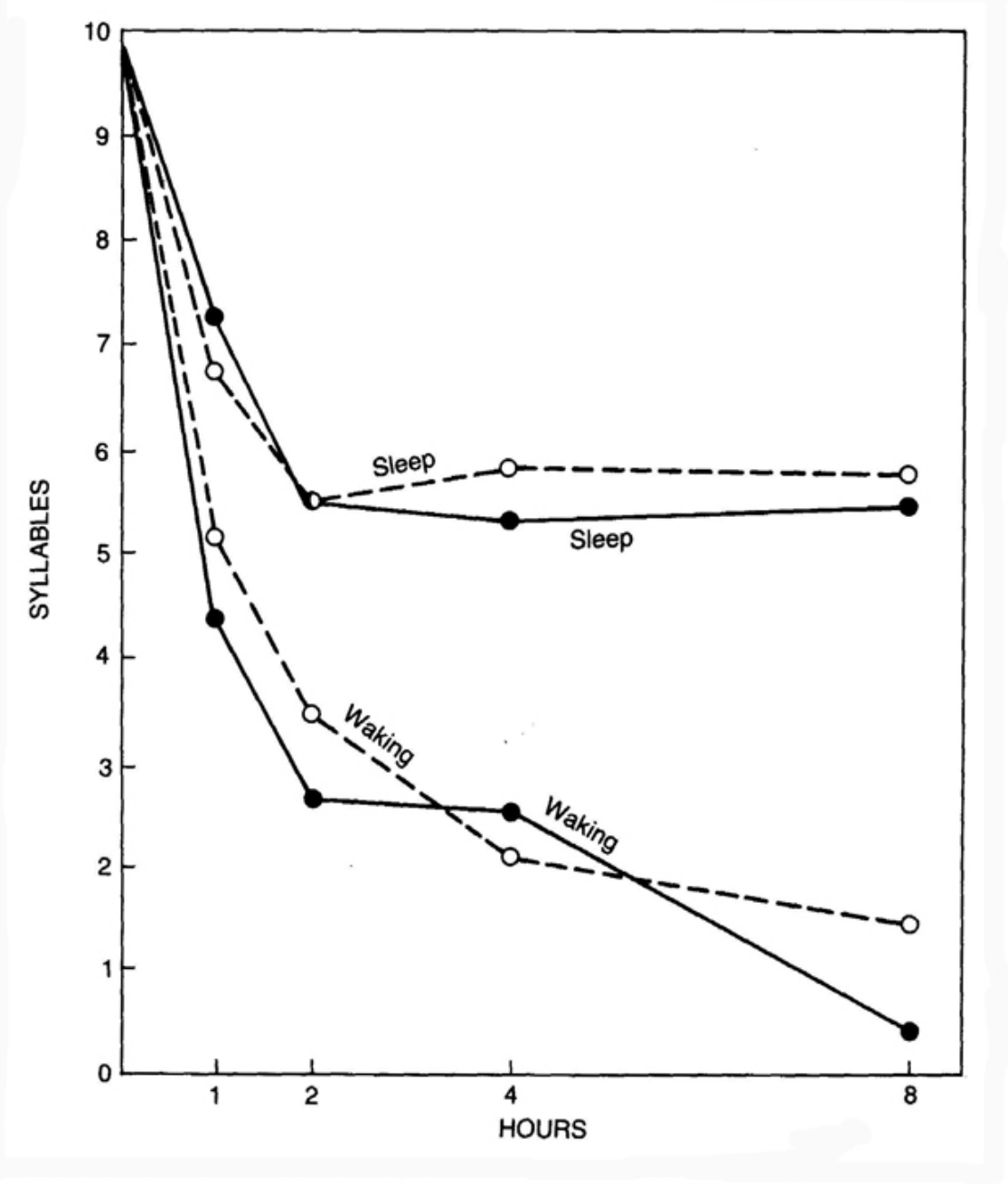
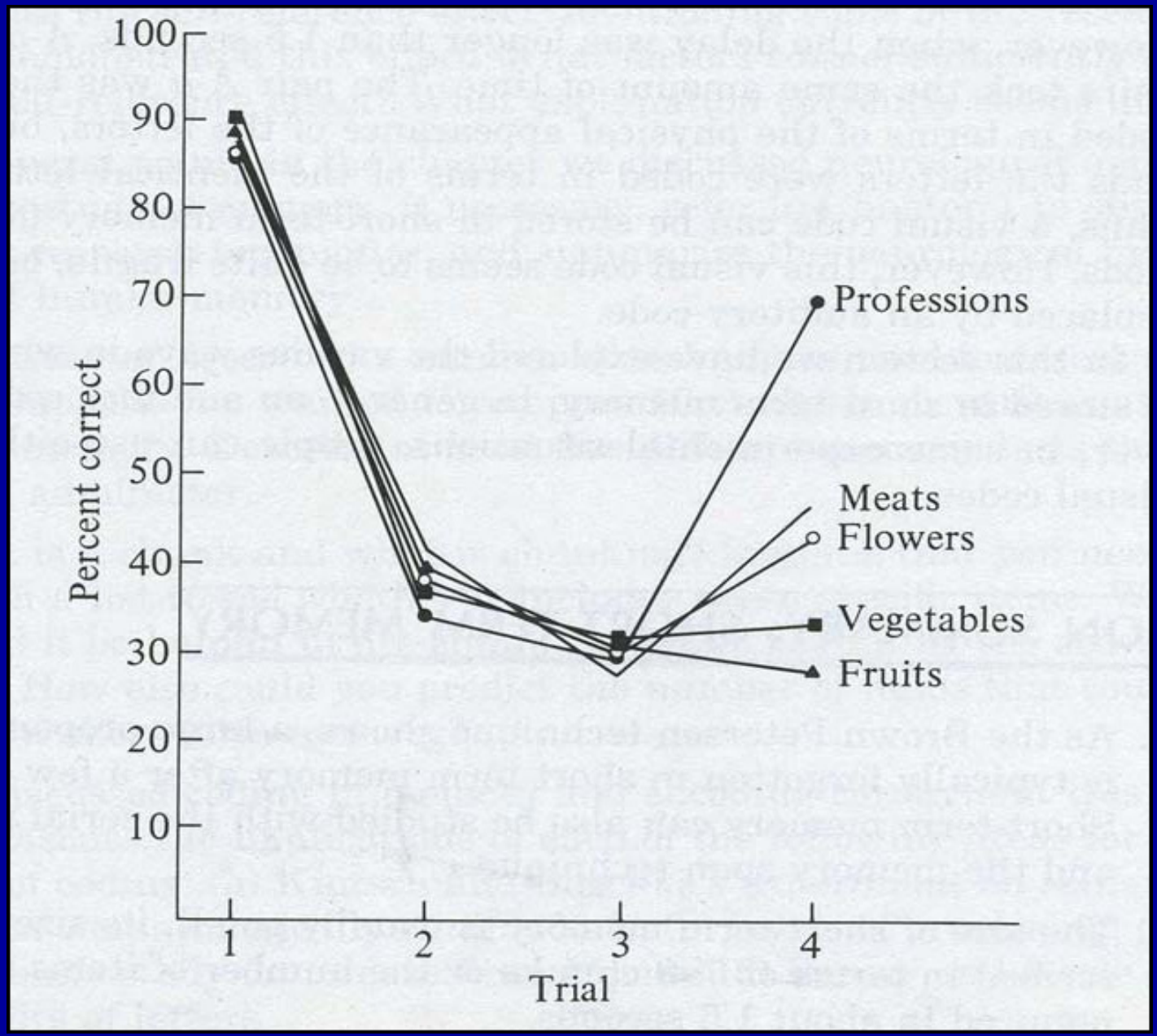


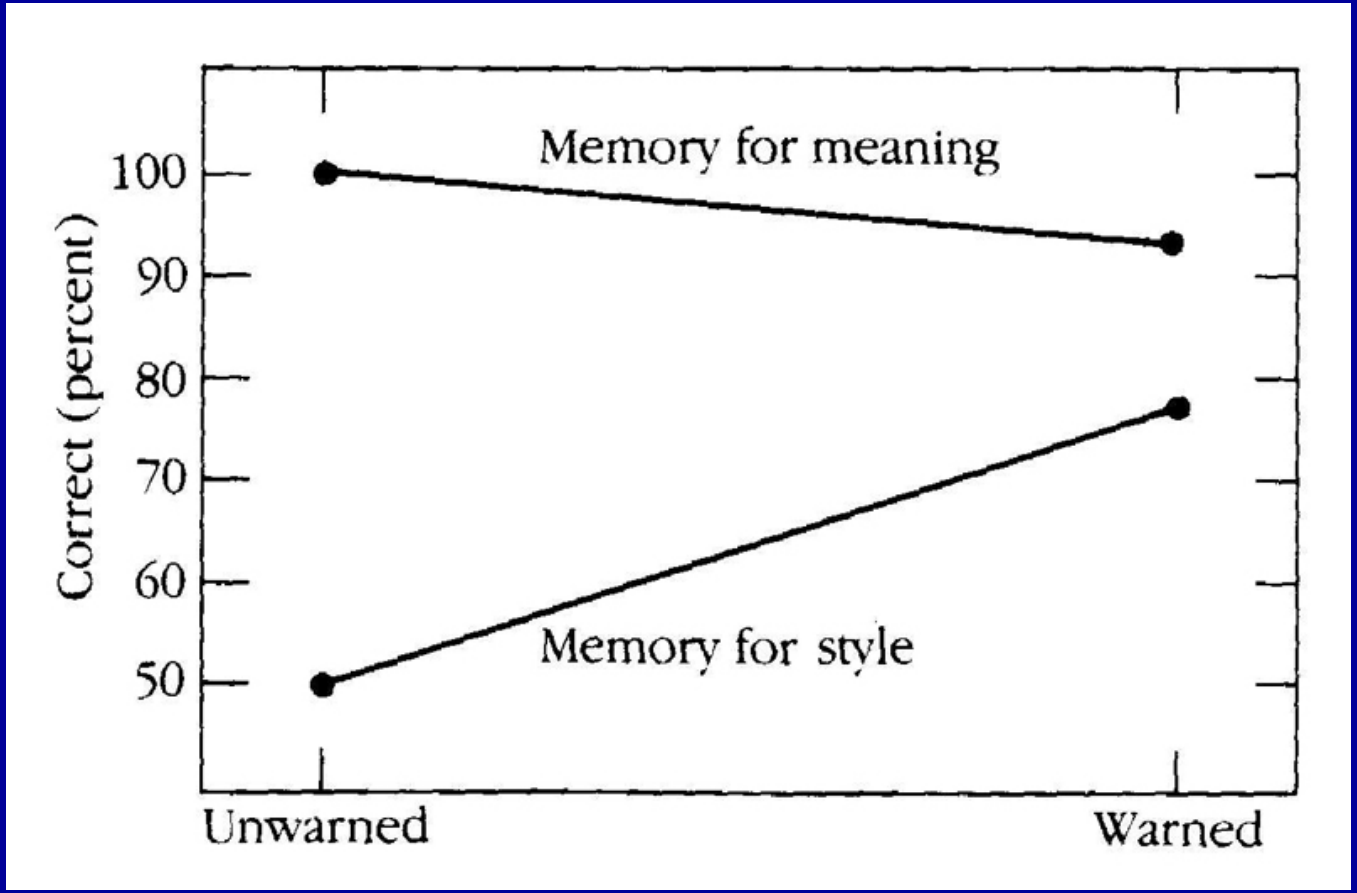
The classic Jenkins & Dallenbach (1924) result, showing higher recall of nonsense syllables for two subjects who slept after acquisition versus remaining awake after acquisition.

PI (18 sec)

banana peach apple	138	
plum apricot lime		245
melon lemon grape		97
orange cherry pineapple	189	
doctor teacher lawyer		177



Source: Wickens, D. D., et al. "Multiple Encoding of Word Attributes in Memory." *Memory & Cognition* 4, no. 3 (1976): 307-10. © Springer Science+Business Media. All rights reserved. This content is excluded from our Creative Commons license. For more information, see http://ocw.mit.edu/fairuse.



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Ability of warned versus unwarned subjects to remember a wording difference that affected meaning versus style. (Adapted from Wanner, 1968)

door

window

glass

pane

shade

ledge

sill

house

open

curtain

frame

view

breeze

sash

screen

shutter

IS MEMORY LIKE A CAMERA OR LIKE A PUNCH BOWL ?

BOTTOM-UP & TOP-DOWN INFLUENCES ON MEMORY

- **Bottom-Up**

  perceptual experience

  what we see and hear

- **Top-Down**

  prior knowledge, concepts, expectations, subsequent experience

and which grows over time?

THE MIND OF A MNEMONIST

(A Little Book About a Vast Memory)

- Mnemonist - S.
- A.R. Luria studied S for 30 years
- at 30, editor noticed that S. took no notes but had verbatim recall - sent S. to Luria

6	6	8	0
4	4	3	2
1	6	8	4
7	9	3	5
4	2	3	7
3	8	9	1
1	0	0	2
3	4	5	1
2	7	6	8
1	9	2	6
2	9	6	7
5	5	2	0
	0	1	

- studied for 3 minutes
- recall numbers in 40 sec
- same rate of recall months later
- faster left than right, down than up
- had to reinstate episode "see" room, "hear" voice
- errors were visual (3/8)
- could recall such lists 15 years later

imagery & synesthesia

- if S. heard noise while imaging he would see "puffs of steam" or "splashes" on the image
- converted auditory to visual experience, tones to colors
- could change resting pulse of 70-72 to 100 or 64, temperature of hand by 2 degrees
- problems in attending to message vs. voice, recognizing faces or voices in varied expression, abstract ideas, metaphors
- how to get rid of memories? write down and burn notes - active imaging of nothing

life & career

- professional mnemonist
- music school teacher
- vaudeville actor
- efficiency expert
- treated people with herbs, wife, son

FLASHBULB MEMORIES

- **Emotion important in determining what we remember - surprise & arousal**

  Kennedy assassination
  Challenger Disaster
  OJ Simpson verdict
  9/11 attack

  place
  ongoing activity
  source of news
  own feelings
  emotions in others
  aftermath

  Studies that test right after and a year later:

  - better remembered, but susceptible to distortion
  - over-confident

Eyewitness Testimony

see slides

sports car/intersection/turns/hits pedestrian

YIELD SIGN or STOP SIGN

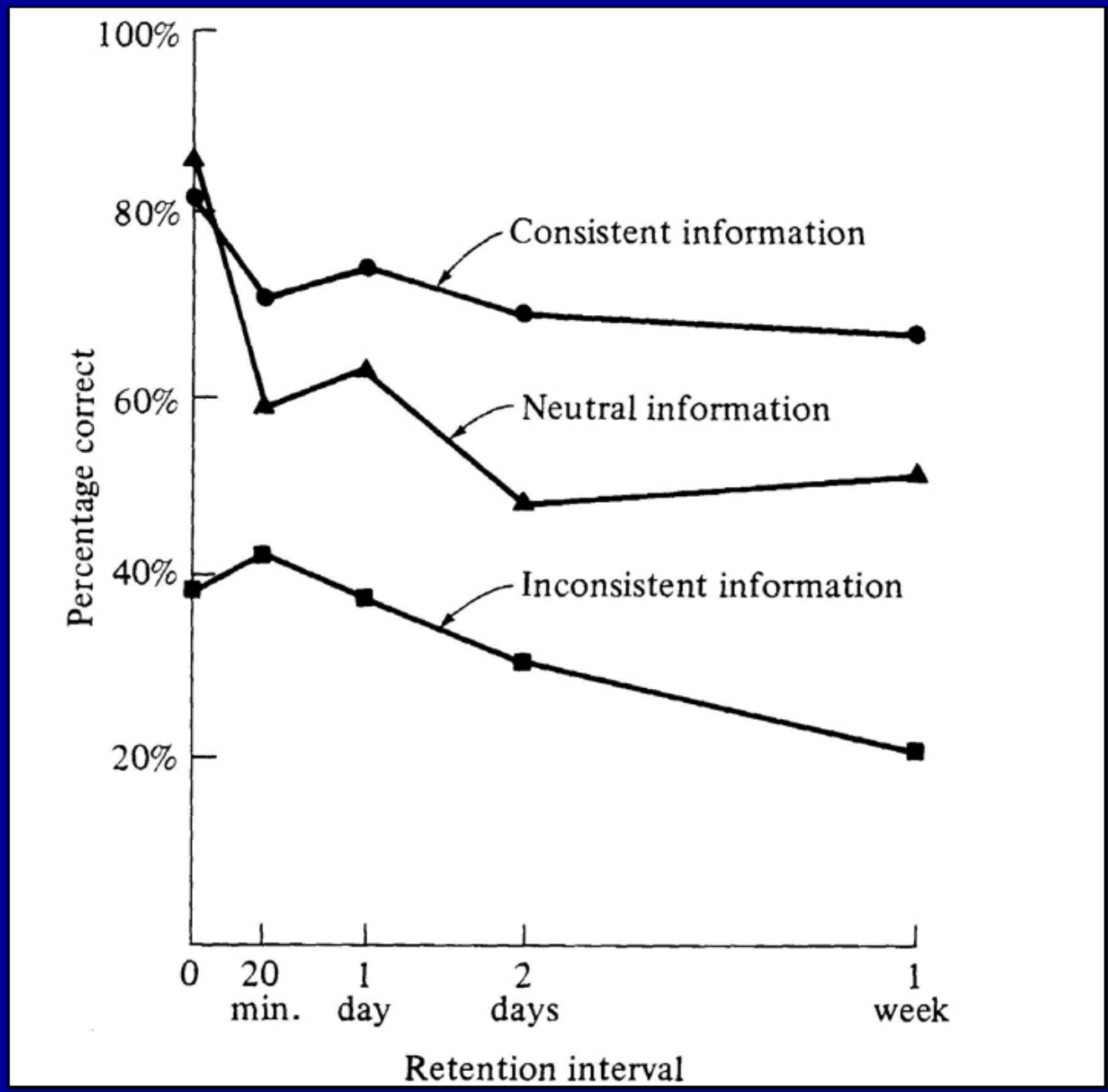
questions

"Did another car pass the red Datsun while it was stopped at the yield sign?" (consistent)

"Did another car pass the red Datsun while it was stopped at the stop sign?" (inconsistent)

"Did another car pass the red Datsun while it was stopped ?" (neutral)

Which slide did you see?



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Loftus study

Planting lost-at-mall memories

Jim, graduate student, “reminds” younger brother Chris of losing Chris in a mall when Chris was five, and an older, tallish man bringing him back.

Two days later, Chris says, “I was with you guys for a second and I think I went over to look at the toy store, the Kay-bee toy, and, uh, we got lost and I was looking around, and I thought, ‘uh-oh. I’m in trouble now.’ You know. And then I…I thought I was never going to see my family again. I was really scared, you know. And then this old man, I think he was wearing a blue flannel, came up to me…he was kind of old. He was kind of bald on top…he had a ring of grey hair…and he had glasses.”

MEETING BUGS BUNNY AT DISNEYLAND

- 120 people see an ad for Bugs Bunny at Disneyland to evaluate ads (all had been there)

  meet? shake hand? - frequent (1/3) recall of Bugs Bunny during visit to Disneyland

- dark October night
- woman hitchhiker picked up on Pacific Highway South 10 miles outside of Seattle
- man turns into isolated dirt road, rapes her, leaves her by the side of the road
- 24 hours later she looks at array of photos, picks Steven Titus - he is convicted
- few months later, another man is arrested for a series of rapes - she sees picture and realizes this is the real rapist
- Titus released - lost all his money, job, fiancee, reputation - 4 years pursuing a lawsuit - dies 11 days prior to trial of a heart attack - 10 months later his estate gets $2.8M
- 80,000 trials/year rely mainly on eyewitness testimony - of 1,000 wrong convictions, about half involved eyewitness errors

Woman at home in Australia.

Raped in her home.

Identifies Donald Thompson, a renowned Australian psychology who studies eyewitness memory biases.

Donald Thompson was on the TV live at the same time as the woman was raped. She had been watching the program.

September 22, 1969

- **Susan Nason - 8 years old - missing and found murdered on October 31, 1969**

November 1989

- **Eileen Franklin remembers that her father murdered Susan Nason**

November 30, 1990

- **George Franklin found guilty**

Courage to Heal - Ellen Bass & Laura Davis

"If you think you were abused and your life shows the symptoms, then you were.“

- Do you feel you have to control your emotions?
- Are you afraid of anger?
- Do you have blocks of your childhood that you can't remember? Do you have a sense that "something happened?"
- Do you have problems with alcohol, drugs, food, migraines, or back pain?

"When someone asks you, "Were you sexually abused as a child?" there are only two answers: One of them is "Yes," and one of them is "I don't know." You can't say "No."

- Roseanne on *"Oprah"*

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