

# Senior Moments 2: Fact, Fiction, and Fixes

Short-term memory, Working memory, Working Memory Training  
Catherine Weir, Summer term 2015

**Pick up handout and pencil -  
we will be doing cognitive exercises**

## F, F, and F

### Fact:

- a) Working memory is one aspect of cognition that tends to decline with age.

### Fiction:

- a) Memory is a single process.

### Fix:

- a) Training on working memory is likely to improve working memory scores.

# Recap from last class

Encode info - Store info - Retrieve info

Memory failures may also indicate memory efficiency.

Attitudes about aging influence memory:

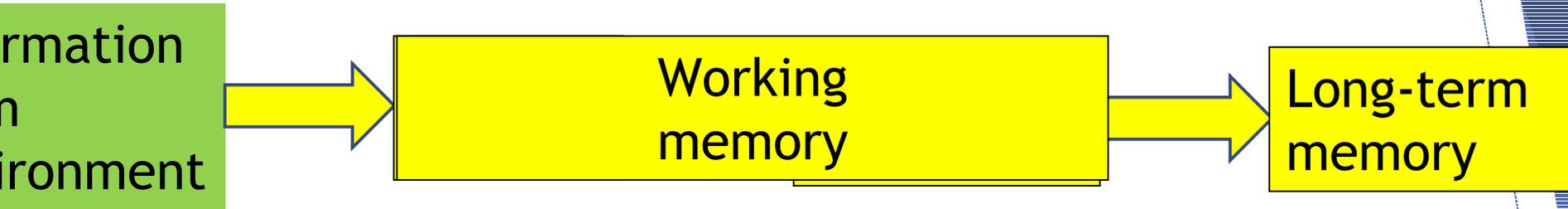
- ▶ Older adults with negative attitudes about senior memory tend to do worse on memory tasks (and report feeling older).

Prospective memory: remembering what you plan to do without prompting -- *turning off coffee maker when going on trip; attending your wedding* Task 2

1. *What were the 3 types of prospective memories?*
2. *What was an effective retrieval strategy?*
3. *How did interruptions affect prospective memory?*

1. Event cue best.
2. Imagine doing task.
3. Interrupted memory worse.

# Ideas about how memory is organized



1960s idea based on information-processing model of Atkinson & Shiffrin, 1968.

- ▶ Short-term memory: short here means *a few seconds*
- ▶ *Examples:* Remembering a phone number, combination lock, or sentence.

Updated version of memory model that takes account of more research findings.

Task 3 Memory Span

# WORKING MEMORY - updated version of STM

Memory not only STORES information, it **PROCESSES** information Baddeley & Hitch, 1974

## ILLUSTRATIONS when we use our WORKING MEMORY

Math:  $(2 \times 3) - 2 = 5$  T / F?

Logic: letter sequence (AB or BA), statement about sequence, you decide True / False

B A A follows B True / False

B A B is followed by A True / False

A B B does not follow A True /

False

Language processing

- a. Where there's a will, I want to be in it.
- b. In a democracy, it's your vote that counts. In feudalism, it's your count that votes.

## Evidence for SEPARATE kinds of memory: Working Memory differs from Long-term Memory

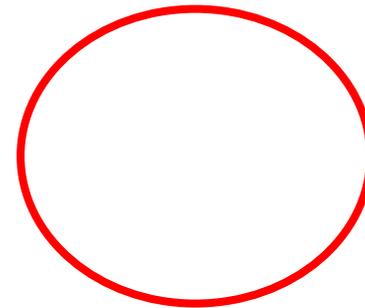
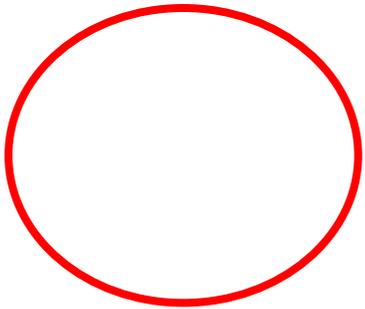
**Cognitive tests:** different factors affect WM & LTM. Rhyming words are hard to remember in the short term; rhyming does not influence long term memory very much.

Different **brain regions** are active for the different modules of memory. Frontal regions are important in Working Memory.

**Brain damage:** Some patients (anoxia, encephalitis) cannot learn words, but working-memory span is same as non-patients. Others (surgery) can remember long-term material but have impaired working-memory span.

# Brain scan data from GMU labs

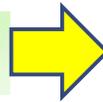
Strenziok, Greenwood, Santa Cruz, Thompson, Parasuraman 2013



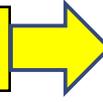
Had to drop the graphics to reduce size of file for DocStore.  
This was a scanned picture of brain scan data for working memory and  
episodic memory (one of the pieces of Long-Term Memory)

# WORKING MEMORY: Important Findings

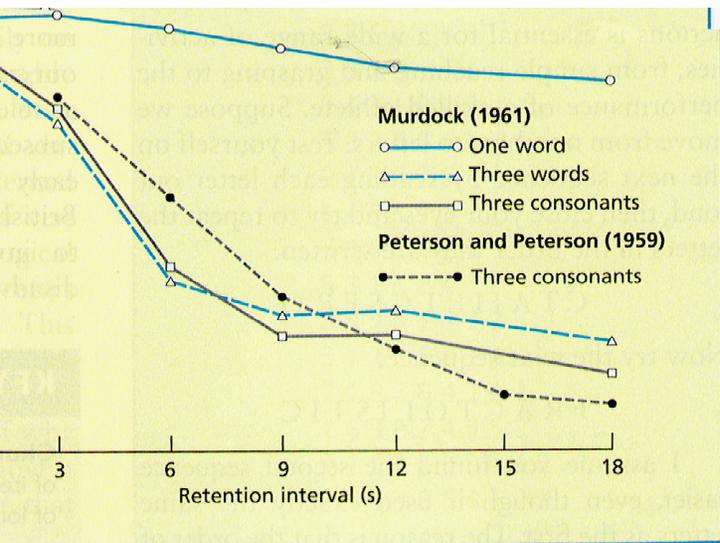
Environment



WM

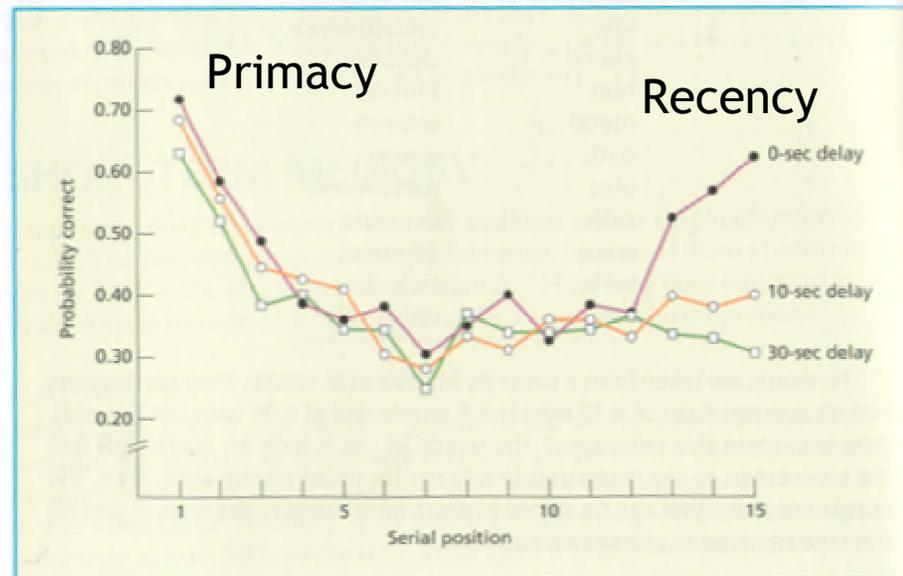


LTM



**1. Rapid forgetting:** e.g. XRQ items

**2. Middle of list of unrelated words forgotten more than ends.** Consistent with interference as a major cause of forgetting  
Glanzer & Cunitz, 1966



# WORKING MEMORY - Important Findings cont'd

## Limited Capacity of Working Memory. MEMORY SPAN

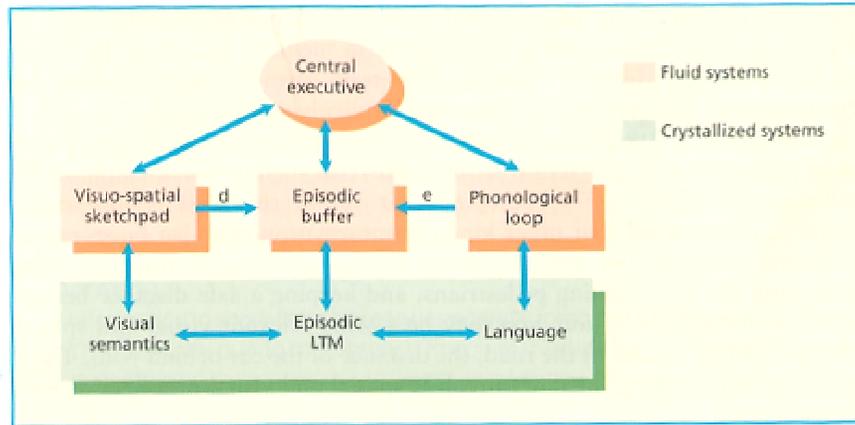
- What type of material - digits 9.3 items, letters 7.3
- Length of words - greater memory span for shorter words.  
**hint, verb** (6.7 words) vs. **advantage, occasion** (5.1 words)

Mueller et al. 2003

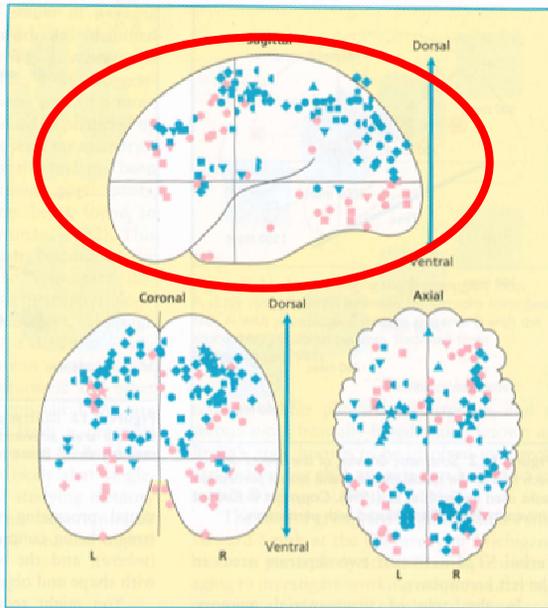
- Chunking the material - **A I C S R I I B F** Miller, 1956

Stretch Break - 2 minutes

# Working memory has many subunits



- **CENTRAL EXECUTIVE** - controls attention (what you select to see, to hear, to touch, ...); doesn't store. *Flashlight in dark*
- **VISUAL-SPATIAL SKETCHPAD** - stores spatial information briefly - *recall map while following friend's conversation*
- **BUFFER (EPISODIC BUFFER)** - stores/combines information briefly from parts of working and long-term memory.  $(2 \times 3) - 2 = 4$
- **PHONOLOGICAL LOOP** - stores speech information briefly - *listening to sentence while remembering/generating own*



## Neural evidence: Different places in brain for different elements of working memory

Smith & Jonides 1999

**Visual-spatial sketch pad**

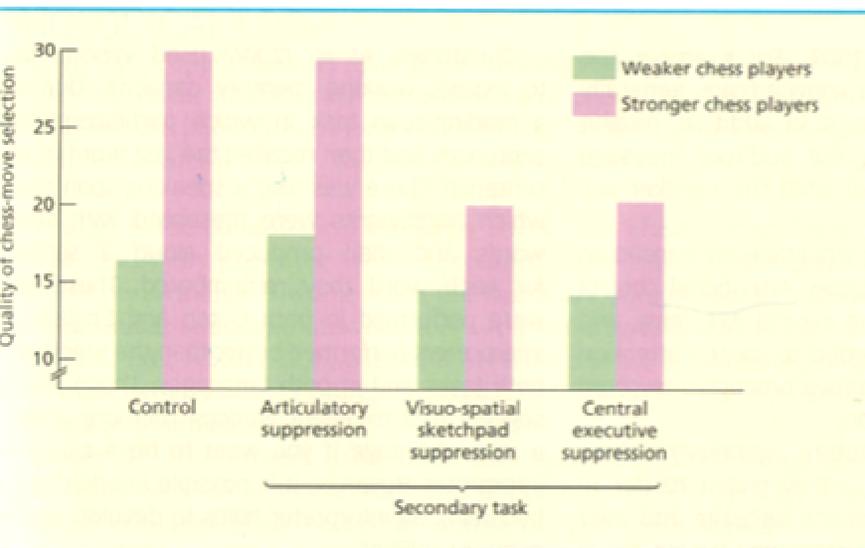
Memory for images of objects (pink)

Memory for location of objects (blue)

## Frequent cognitive method to study Working Memory: Memory when doing 2+ things at once

Dual task studies: Play chess and do something else.

Chess players - novices and masters



Articulatory suppression - say word  
“see-saw” over and over rapidly

Visual-spatial suppression - press  
keys on keypad in a pattern over  
and over rapidly

Central executive suppression -  
produce series of random digits

Robbins et al. 1996

# Central executive



## functions of Central executive

1. Planning - *steps in starting a car*
2. Coordinating mental processes - monitor to see if plan is working - *listen for engine, look at display on dashboard*
3. Inhibiting irrelevant information & sustaining attention to task- *focus on starting car, inhibit thinking of errand*

## evidence comes from

- People with dysexecutive syndrome
- People driving while talking with a passenger or using a cell phone or texting -- Strayer

# trayer studies of distractions while driving

## Relating this to Working Memory

Distraction was involved in almost 25% of accidents in 2012

2012: ~3,500 died; 420,000 injured in distracted driver accidents

67% of drivers report having used cell in car in last month (US, Europe)

Distractions while driving - cognitive attention, vision, manual skills

Texting (sending & receiving): 23 times as likely to have accident

Cell phone conversation: very distracting

Books on tape/ radio / music: little distraction when hazard occurs

Passenger: actually help to direct attention to driving

# Visual-spatial Sketchpad

Two kinds of information in this part of working memory.

Memory for *what* object is (Visual aspect - form, color)

Memory for *where* object is (Spatial aspect - location)



Students could do a spatial task at same time as playing computer game only after much practice with *Space Fortress*. Logie 1988

Capacity of sketchpad is about 4 objects: when deciding if one thing in an array has been changed.

# Visual information stays in system **briefly**

- ▶ How long does an image stay in the visual system?  
Sperling called this iconic memory? Sperling, 1960s

**Icon lasts up to ½ second**

What can you recall from this briefly - presented grid of letters

\*\*

R	W	F	K
T	X	Z	N
C	B	D	Y

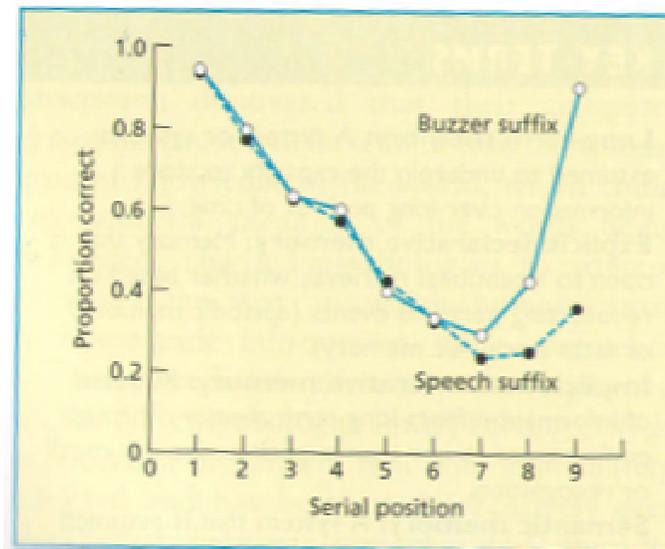
# Processing language in Phonological Loop - “ECHO”

Listen to someone saying telephone number. Then dial it on a phone. We hear the sounds” when dialing. Try it.

Best memory for beginning of information.

Good memory at end of information stream if info is non-speech. Crowder, 1972

**703 455 1154**



# Phonological Loop

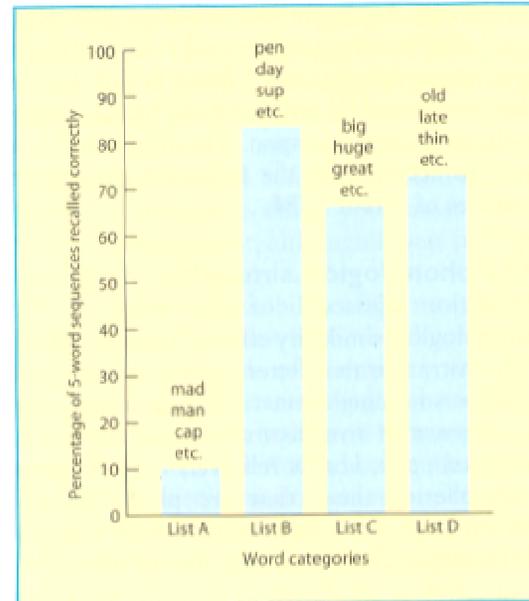


Figure 2.4 The effect of phonological and semantic

Phonological similarity effect - when words share a sound, the working memory scores are lower. Baddeley, 1966

Studies with articulatory suppression while doing memory task: muttering “the-the-the” while learning words. If phonological loop is part of learning, then worse memory with “the-the” than without.

# Episodic buffer

Buffer to combine information from phonological loop, sketchpad, and long-term memory.

$14 + 18 + 22$

Memory study showing long-term memory influences working memory recall. Darling & Havelka, 2010

Task: remember random digits in order.

Different ways of presenting digits

1. Presented in one place visually
2. Arranged along a horizontal line
3. On a keypad similar to that on telephones.

Long-term familiarity with presentation method influences the memory (in Episodic Buffer), then the keypad condition will be best.

Students had better recall memory in the 3<sup>rd</sup> condition.



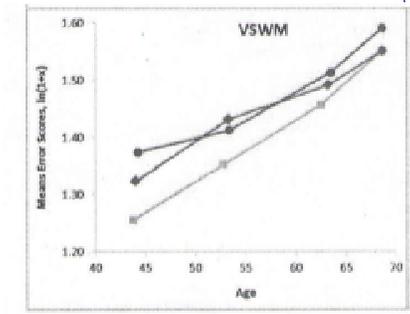
# Training to Improve Working Memory

Karbach & Verhaegen 2014; Hurley 2013 *Smarter* (book)

## “Making Working Memory Work” -

- Declines with age without intervention.
- Inconsistent findings about how to overcome losses

Card matching test  
Ronnberg et al. 2014



## Combined results of ~50 studies

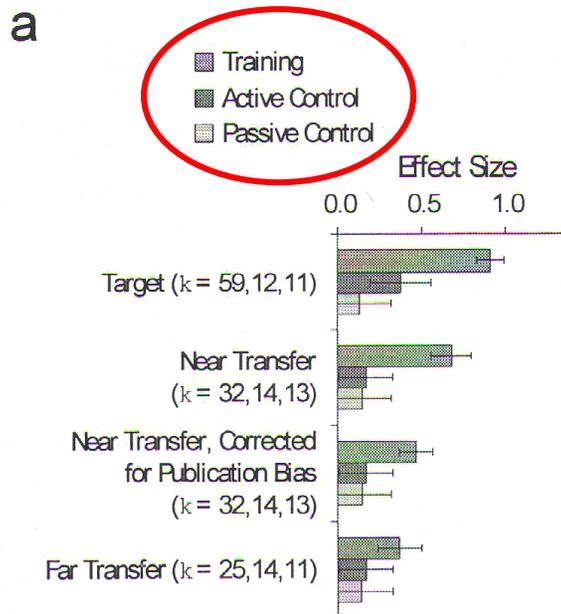
- Studies considered working memory training.
- Older adults were 60+ years when trained
  - Trained group compared to Active or Passive control group.
  - Older adults compared to younger adults in some studies.

# Comparing Training Groups

**Training group** might practice memory strategy like chunking items

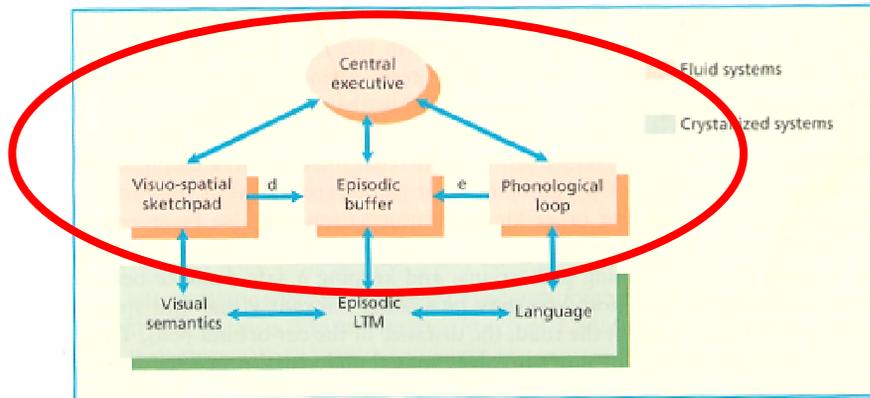
**Active control group** might do crosswords or rate artworks.

**Passive control** might participate in socials.



1. Training groups improved more than either active or passive control group *on the task in the training* (by  $\frac{1}{2}$  SD).
2. No statistical difference between active & passive controls.
3. Group comparisons: Improvement on *non-trained tasks* was greater for trained groups than for control groups.

# Summary of Working Memory Research



## 1. Working Memory Findings

- Rapid forgetting --- make recall immediate
- Better memory for information at start of list - put important stuff first
- Chunk items together -- draw on previous experience

## 2. Working Memory subunits

- Central executive - avoid irrelevant material, focus on task at hand
- Visual spatial sketchpad - practice to extend memory span
- Phonological loop - choose verbal items that do not share a sound
- Episodic buffer - rely on previous experience, practice this

# F, F, and F

## Fact:

- a. Memory has several modules for different aspects of remembering: Working memory (WM), Long-term Memory (LTM).
- b. Working memory involves *processes* for performing tasks as well as places to *store* information. WM predicts IQ scores fairly well.

## Fiction:

- a. All memory declines with age.
- b. If you forget the middle of a phone number when dialing, you might have Alzheimer's Disease.
- c. Memory is a single process.

## Fixes:

- a. Training on working memory tasks improves working memory.
- b. Good memorizers learn strategies like chunking items & *use* the strategy when they need to remember.