Senior Moments 4: Fact, Fiction, and Fixes

Catherine Weir, Summer term 2015

Exercise, Memory at microscopic level, Dementia

F, f, & F

- Fact: 30% improvement in memory for groups doing aerobic exercise -- on average.

- Fiction: Occasionally forgetting where you put the keys (or car) is probably an early sign of Alzheimer's dementia.

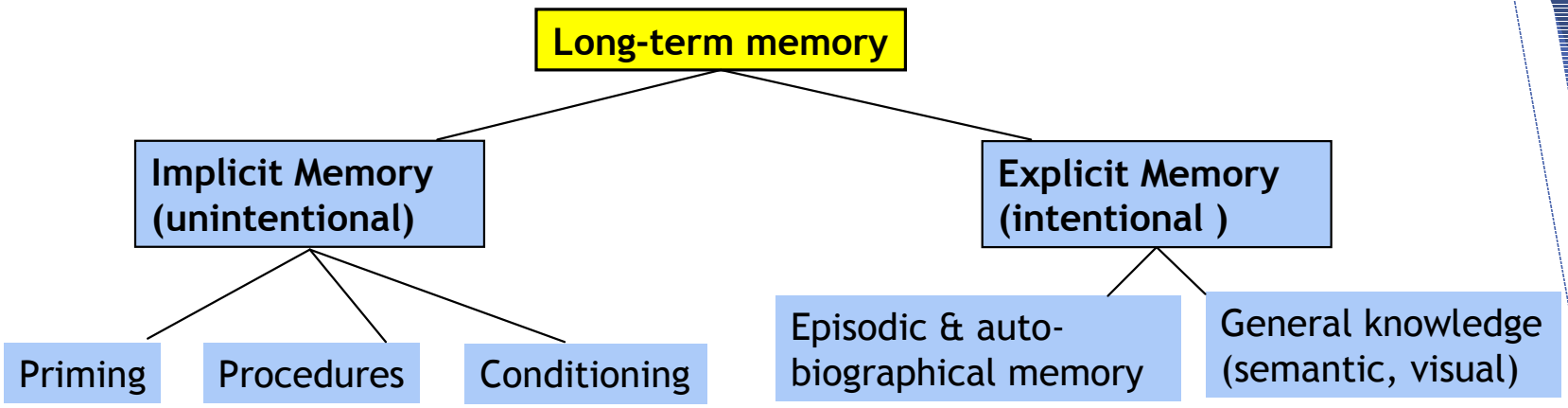
- Fixes: Give up heavy drinking of alcohol; control blood pressure & cholesterol to improve cognitive performance.

(1) I will give you 1 minute to think of a word answering the 6 questions in Set A. Put them in the Task 1 boxes. Record the number under the table.

(2) I will give you 1 minute to think of a word answering the 6 questions in Set B. Use Task 1 boxes.

Set A	Set B
1. Fruit starting with p.	1. Fruit ending with h.
2. Animal starting with d.	2. Animal ending with w.
3. Metal starting with i.	3. Metal ending with r.
4. Bird starting with b.	4. Bird ending with n.
5. Country starting with F.	5. Country ending with y.
6. Boy’s name starting with H.	6. Boy’s name ending with d.

Semantic Memory Quiz (General Knowledge)



1. Are nouns stored by first letter or last letter? Demo suggests
2. Is semantic memory part of Long-term Memory or Working Memory?
3. Is semantic memory part of Unintentional Memory or Intentional Memory?
4. What are the parts of Unintentional Memory in the Baddeley model?

Working memory & Long-term memory Quiz

- Working memory (WM) is 1st step to communicate with LTM.
  1. INPUT information
  2. RETRIEVE information
- Long-term memory (LTM) Many times as large as WM
  1. T/F We cannot learn and remember information without awareness.
  2. T/F Best guesses about forgotten information are generally off-base.
  3. T/F The best way to remember a list is to read the items repeatedly.

Exercise and Memory

Links to memory at a molecular level

Benefit of Physical Exercise on Cognitive Outcomes in Older Adults? Hindin & Zelinski 2012

- 42 studies with ~4,000 healthy older adults (age ~70 yrs). Sometimes physical exercise was beneficial, sometimes not.
- Two kinds of interventions were compared over all 42 studies:
  1. Extended practice on cognitive task (1,000s of trials, 18 sessions on average)
  2. Aerobic exercise (15 to 60 minutes/session; ~50 sessions)
- Trained groups were better than controls (.5 Standard Deviations for cognitive training; .33 SDs for aerobics)
- Individual's improvement: Better memory at end of training by 0.7 SDs for cognitive training; 0.4 SDs for aerobics.

Best Benefits for Memory

Colcombe & Kramer 2003

- How long was best work-out? 31 to 45 minutes

  [shorter session had 1/6 benefit, longer had 2/3rd benefit]

- How long was most beneficial commitment to exercise? 6+ months

  [short duration (1-3 months) 5/6th benefit; medium (4-6 months) ½ benefit]

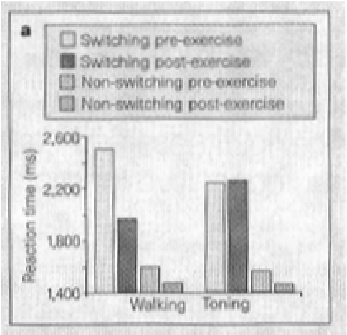
- Which type of training was better - cardio only or cardio/strength? Combined cardio/strength was 1/3rd better

- Which age group showed most benefit? Ages 66 -80 yrs

  [Young-old (55-65 yrs) less than 1/2 benefit]

Typical study of fitness training Kramer et al. 1999

- 124 sedentary adults between 60 and 75 years
  - Aerobic training - walking [no info on how long]
  - Non-aerobic exercise - stretching, toning
- Cognitive pretests and posttests
  - Task switching (extra time needed to switch between tasks)

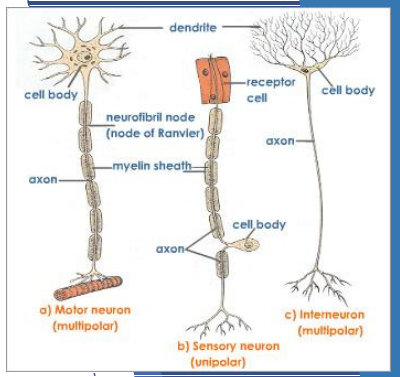


Immediate Benefits of Exercise on Memory

Hogan, Mata, Carstenson 2013

- With only one 22-minute exercise session on a stationary bike, 3 groups of people improved when doing a memory task.
- Study details:
  - Control group judged the quality of images in an online picture gallery for 20 minutes.
  - The task was 2-back memory. Both accuracy and speed were measured. 5 9 6 3 0 9 8 7 8
- Age effect or not?
  - *Pre-test* of memory task: older (65+) group were less accurate and took longer than younger groups (19-39 yrs; 40-64 yrs).
  - *Post-test* of memory: *all ages who did exercise* improved their speed to do 22 trials in an n-back task (1.03 to .95 seconds) compared to all three ages in control condition (.95 to .94 seconds).

How can exercise improve memory?



- **Structure of brain using MRI** Burzynska et al. 2014 University of Illinois
  - **White matter increases in brain tissues after 12-month of aerobic exercise -103 community dwelling seniors 60-79 years.**
    - Exercise reversed the usual age decline in white matter in two regions of the brain (frontal & temporal lobes) and working memory tests.
    - Sedentary behaviors reduced the white matter around the hippocampus (important in memory).
- **Proposed ways these brain changes could happen –**
  - **Physical activity increases neurotransmitters & other "factors" in brain that maintain the white matter.**
  - **Exercise may improve the oxygen supply to temporal lobe tissue.**
  - **Sitting around might increase cholesterol and fatty acids taken up by muscles and fat tissues. This, in turn, may reduce cognition.**

Brain volume increases after aerobic training

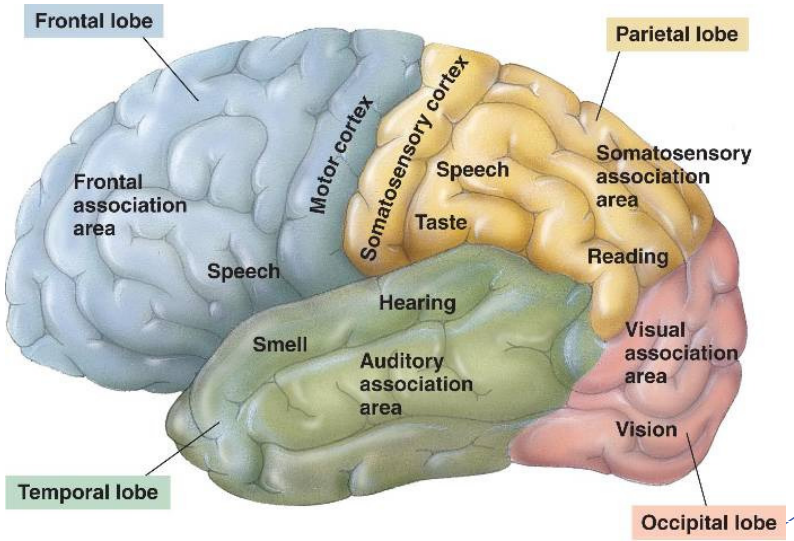
Colcombe et al. 2006

- Older adults who have lifelong fitness training had less loss in brain volume than those with a sedentary lifestyle.
- Randomly assigned 59 sedentary older adults (60-79 yrs) and 20 young adults (18-30) to aerobic exercise or control
  - Aerobic group did exercises to generate 60-70% heart rate reserve.
  - Control group did stretching/toning exercises.
  - Both did 3 x 1-hour/week session over 6 months

Results of study about brain volume increases after aerobic training

Colcombe et al. 2006

- Older adults in aerobic training showed greater volume in frontal & temporal brain regions compared to control group.
- Young adults: brain volumes did not differ for the exercise and control groups.



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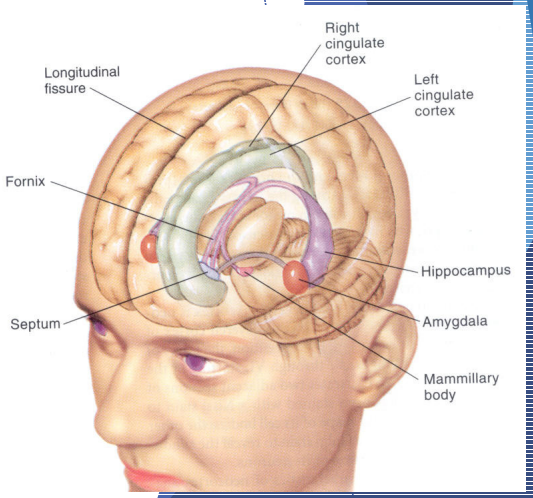
Memory at the Molecular-level

- Nobel prizes have been given for research on how memories are stored by the brain.
  - Most research shows that memories are stored at the synapses (gaps between neurons). Memory is *distributed*, not in one place.
  - Eric Kandel (Nobel 2000) showed that neural changes differ for different kinds of memory (conditioning vs. habituation).
  - John O'Keefe (Nobel 2014) demonstrated that the hippocampus has place cells responding only when animal is at a certain place.

- How does this relate to everyday memory?
  - Memories are able to endure because of *multiple* representation.
  - Hippocampus (& entorhinal cortex) works like an internal GPS. Early Alzheimer's patients are often lost in space and these areas deteriorate.
  - Hippocampus is also the place where working memories are consolidated and move to long-term memory.

Micro-level Memory: Keeping new neurons healthy

- "The Adult Brain Makes New Neurons, and Effortful Learning Keeps Them Alive" Shors, 2014
  - Adult brains can generate 1000s of new neurons each day. One region where these neurons appear is the hippocampus but significant numbers die.
    - Decreases in # of new cells: stress, aging, alcohol
    - Increases in # of new cells: exercise, sex, antidepressants
  - What makes these new neurons survive?
    - Learning new skills: MAP – Mental And Physical training



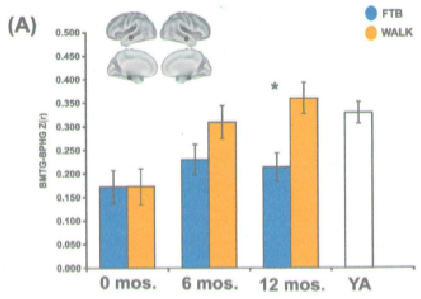
- **Easy learning is NOT enough for new neurons to survive. Shors concludes that EFFORTFUL LEARNING is critical.**
- **Learning a sequence of related tasks increases survival of more neurons.**
- **Caveat: most research is on lab animals.**
- **Human applications of this work**
  - Space out learning sessions; Do self-testing; Vary conditions of training; Interleave different topics in a session. Bjork et al. Ann Rev 2013
  - Choosing challenging training – new language, new instrument, new sport all at once! Ericcson et al. 2009

Way physical activity can change brain function via neurobiological markers

Voss et al. 2013 University of Illinois

Several neurobiological factors may be involved

- BDNF generally has a protective role in maintenance of the brain cells – both grey matter and white matter: Brain-Derived Neurotropic Factor
- Other neurobiological factors: insulin-like growth factor type 1, vascular endothelial growth factor



Voss study about how exercise can change memory

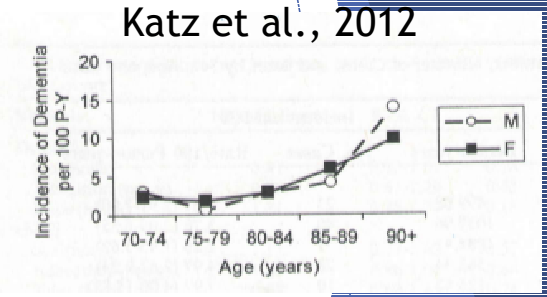
- After walking training (aerobic) for 1 year, 65 subjects (66 yrs) had more of these neural factors and more functional connections between hippocampus & temporal lobe.
- Control group did flexibility-balance training for same amount of time: 3 times/week for 40-minute sessions.

Dementia? What is it?

What is dementia?

- Dementia defined: progressive deterioration of brain functions associated with memory loss, declines in intelligence, poor judgment, difficulty thinking abstractly, and sometimes personality changes.
- Affects about 5% of 65+ population; by 90's, 13% per year
- Kinds of dementia
  - Alzheimer's -70% of dementia cases
  - Vascular dementia (strokes) ~15%
  - Dementia with Lewy bodies – ~10% of dementia patients
  - Others: Huntington's disease, Traumatic brain injuries, Frontal-temporal dementia, Transient global amnesia, Parkinson's, Korsakoff's syndrome
- Differentiate dementia from
  - Delirium – 25% of those admitted to hospitals have delirium. Possible causes of delirium include illness (fever), malnutrition, surgery
  - Depression – this disorder can slow reasoning, increase forgetting

Katz et al., 2012



Alzheimer’s Association – Brain tour

Alzheimer's Disease (AD) versus Aging

Not little losses with AD, the memory problems are profound and much more severe than declines with age.

Controls are matched in age.

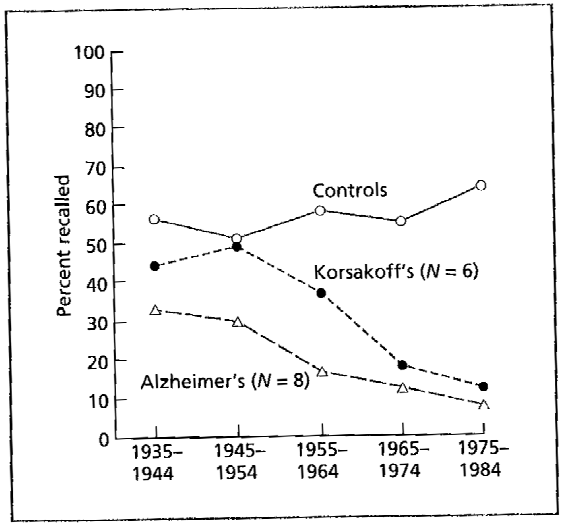


Figure 11.6 Percentage recall of famous news events as a function of when they occurred. Data from Kopelman (1989).

Treatments for dementia

- For dementias associated with environmental factors:
  - Reduce heavy drinking, eating fats, smoking
  - Control high cholesterol, extreme blood pressure, diabetes
  - Take less estrogen replacement
- Risk factors that cannot be changed easily: age, family history, Downs syndrome, sleep apnea
- Medications – change the amount of neurotransmitters. Effective only in early stages of dementia.

Evidence-based ways to enhance memory

Type of memory	Fixes
Prospective	Use event-cue if possible, avoid interruptions, plan & imagine task in detail
Working Memory	Recall immediately, Chunk items, Important items 1st,Can use visual image or echo to prolong working memory briefly
Episodic Memory	Use retrieval strategies deliberately, restructure information, process items deeply, associate info with other memories
In general	Exercise regularly (aerobic), Use exercise ball at desk, Learn new material that is difficult for you, Learn several skills at once (cognitive, physical), Practice retrieving information.

F, f, & F for today's class

- Fact: 30% improvement in memory on average for groups doing aerobic exercise.

- Fiction: 1) Occasionally forgetting where you put the keys

  (or car) is probably an early sign of Alzheimer's dementia.

  2) Alzheimer's or other dementia is inevitable as we age.

  3) Prevagen or other meds can reverse memory losses.

- Fixes for memory declines: 1) Keep learning information difficult for you.
- 2) Look after yourself: Give up heavy alcohol, control blood pressure, cholesterol, diabetes.
- 3) Do aerobic exercise routinely.

Summary of course

Final Quiz: What changes with age, what doesn't?

	No age decline	Declines with age
Prospective memory	In natural situations	
Working memory		Yes, overcome with specific practice
Priming (LTM)	Not much decline	
Procedural (LTM)	Not much decline, esp. with expertise	Yes, overcome with exercise, cogn training
Episodic (LTM)	Not much decline	
Semantic (LTM)		
Brain volume		Yes, healthy ~ about 10% loss by 90 years old; diseases – more loss