Neuropsychological Assessment in Persisting Concussion Symptoms: How Brain Injury Affects Thinking Skills

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CANADIAN CONCUSSION CENTRE
Research | Diagnosis | Solutions

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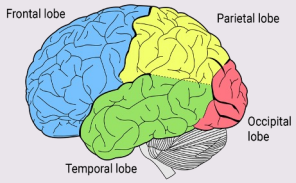
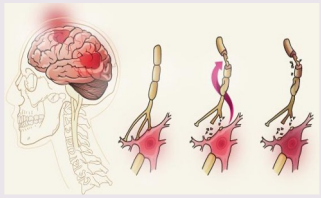
Toronto Western
Princess Margaret
Toronto Rehab
Michener Institute

Learning Objectives

I. How various regions of the brain contribute to thinking skills



II. How brain injury can impact thinking skills

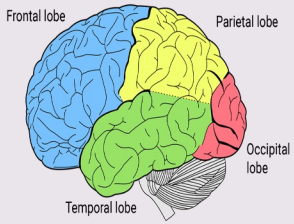


III. How we evaluate thinking skills in neuropsychology

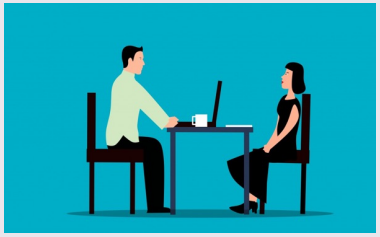
Overview

I. From neurons to cognition

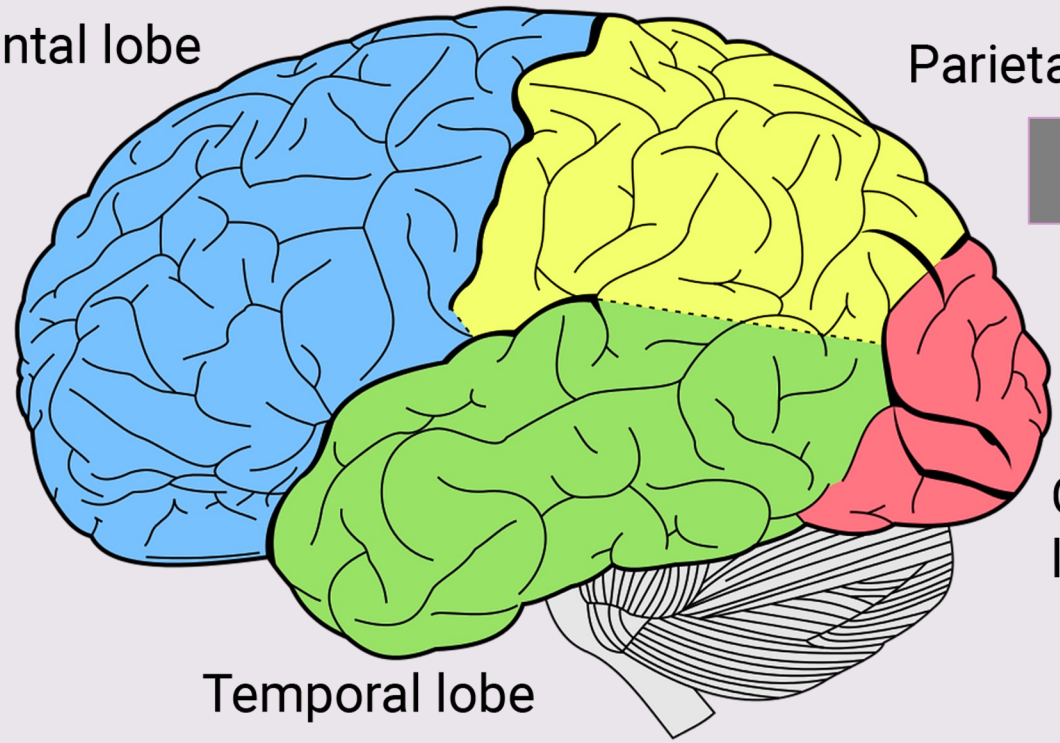
II. Brain injury can impact thinking skills.



III. How we evaluate thinking skills.



What is cognition?



Executive Function

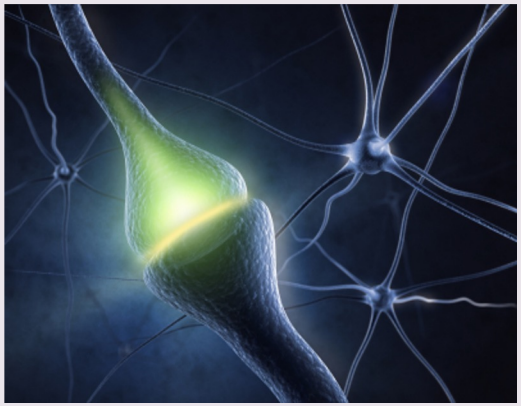
Visuospatial skills

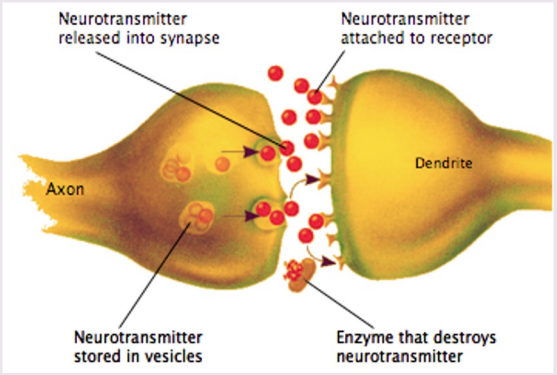
Seeing

Memory & Language

UHN Toronto General Toronto Western Princess Margaret Toronto Rehab Michener Institute

How does our brain produce cognition?





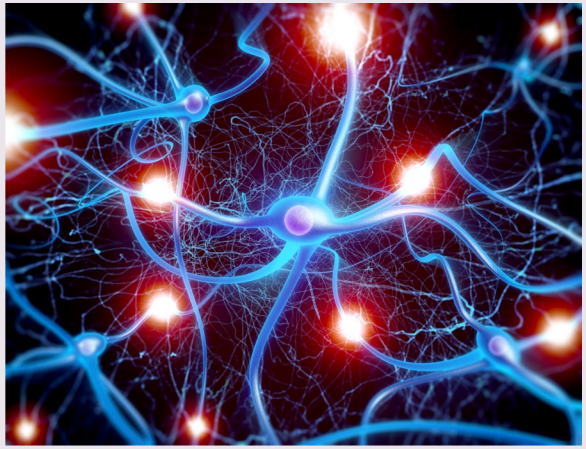
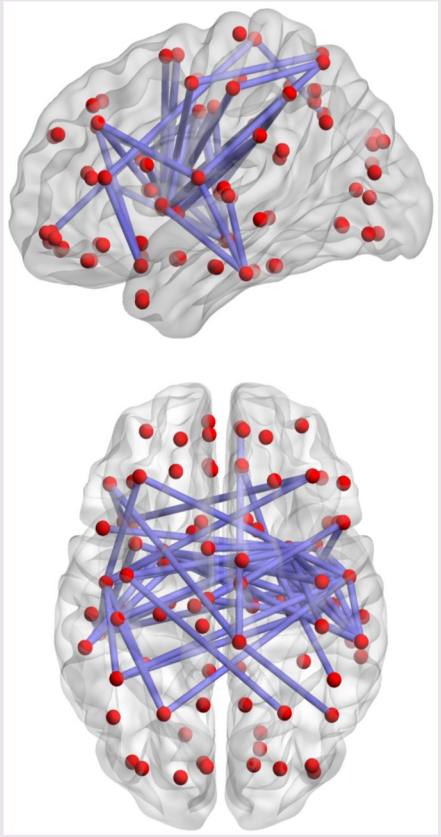


Image Sources: http://schizophreniaenlightened.blogspot.ca/2015/10/whats-going-on-in-that-brain.html; http://www.bbwca.com/neurotransmitters/neurotransmitters-therapy; https://www.lakehouserecoverycenter.com/blog/addiction-help-drugs-alcohol-affect-neurotransmitters-brain

Cognition requires Neuronal Network Activation

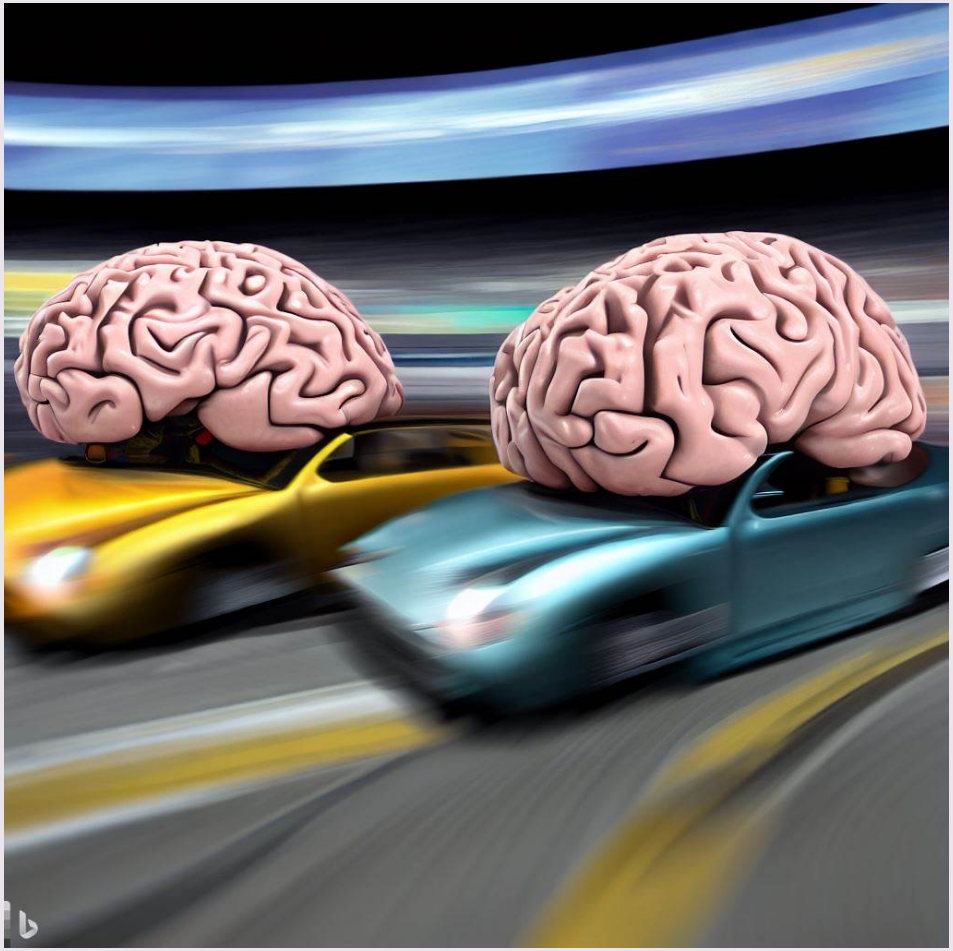
http://www.nutramed.com/brain/neurotransmitters_aminoacids.htm



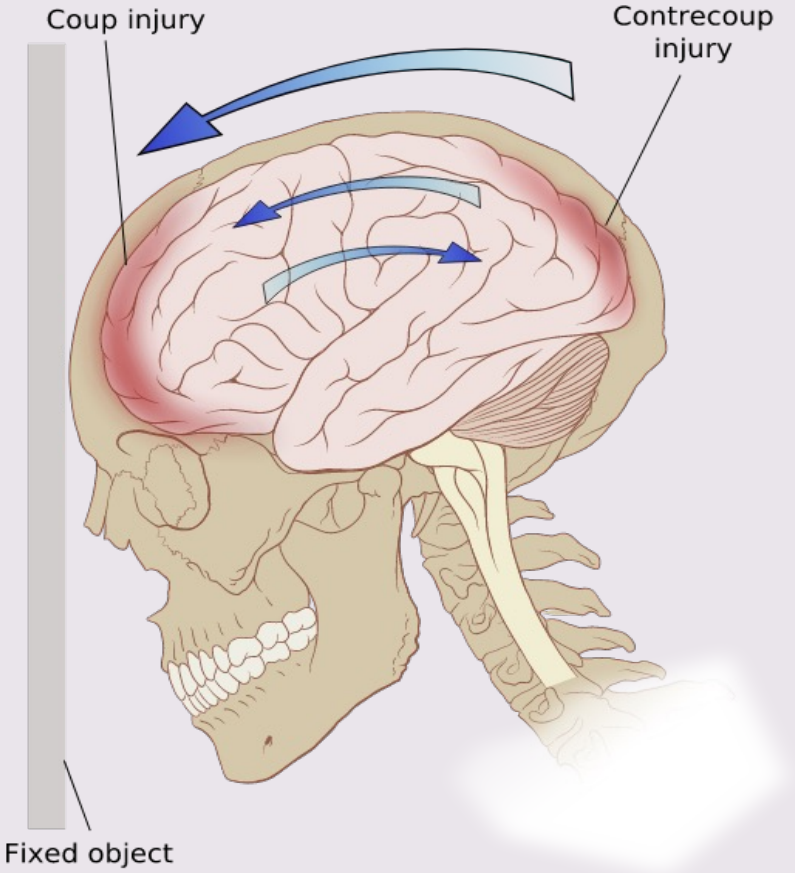
https://en.wikipedia.org/wiki/Biological_neural_network

http://www.clipartkid.com/symphony-orchestra-clipart-images-pictures-becuo-ZcZyct-clipart/

The Brain as a Race Car…



What happens if we disrupt the flow of information in the brain?



Disrupted neuronal communication

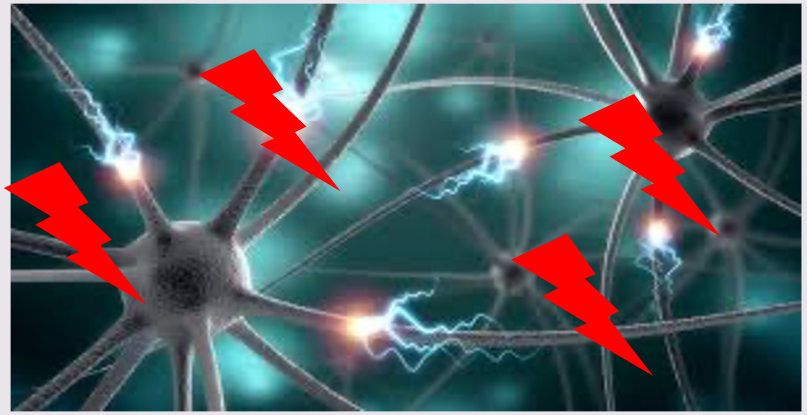
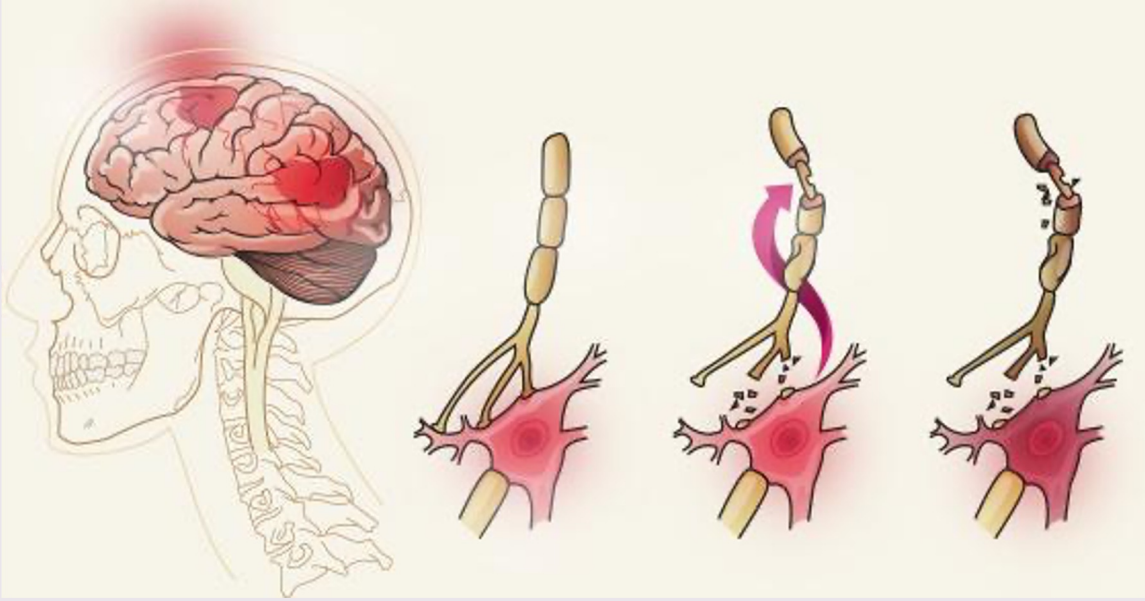


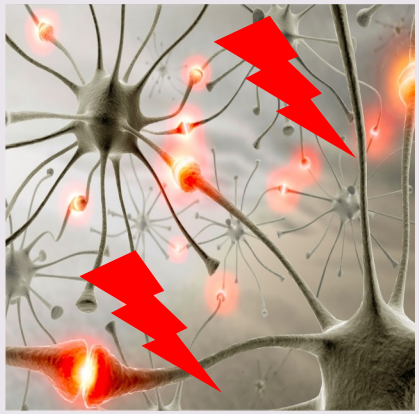
Image Sources: www.livescience.com; https://s-media-cache-ak0.pinimg.com/736x/6f/bd/9c/6fbd9c38d36a9deee6f586d910fd172a.jpg

Concussive injuries can damage neurons

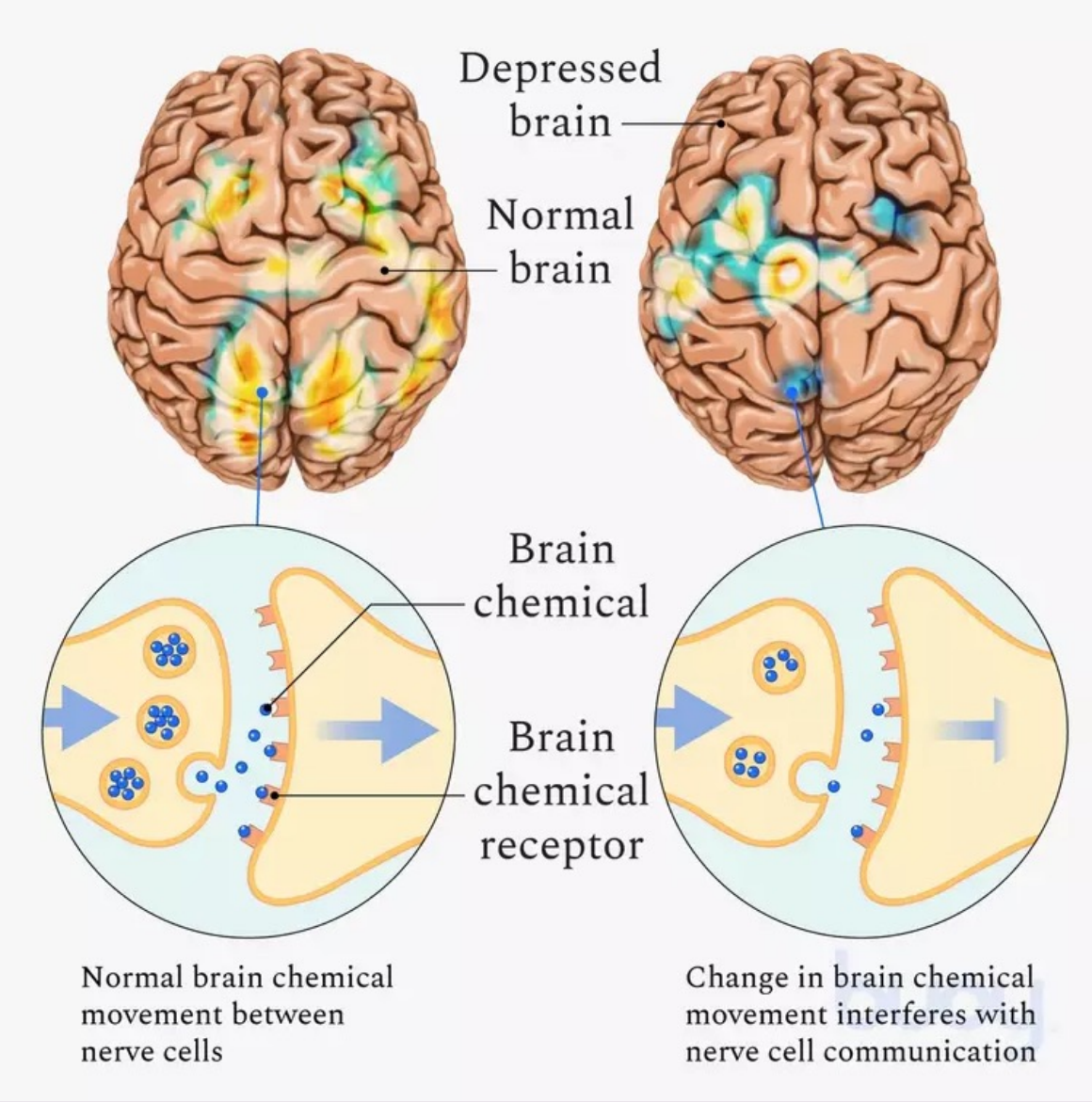
Primary damage to neurons



www.tbibraininjurysurvivor.com

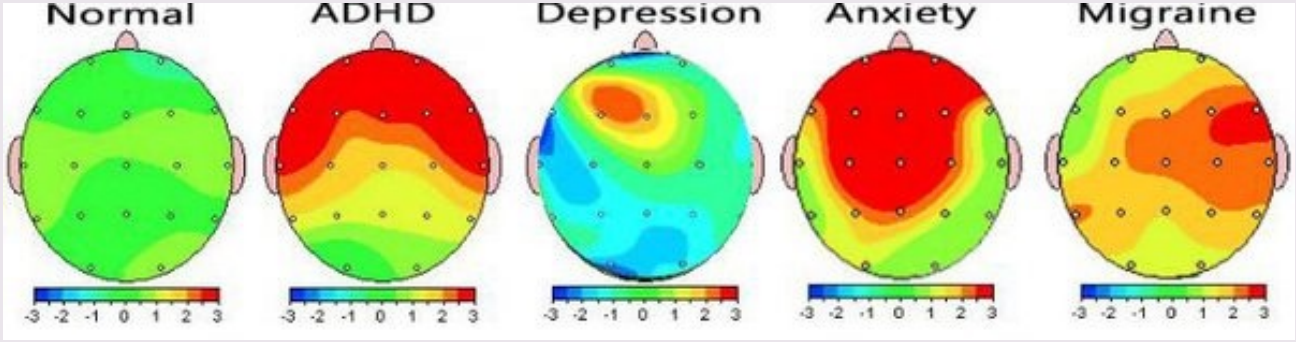


Concussion → Mood → Cognition

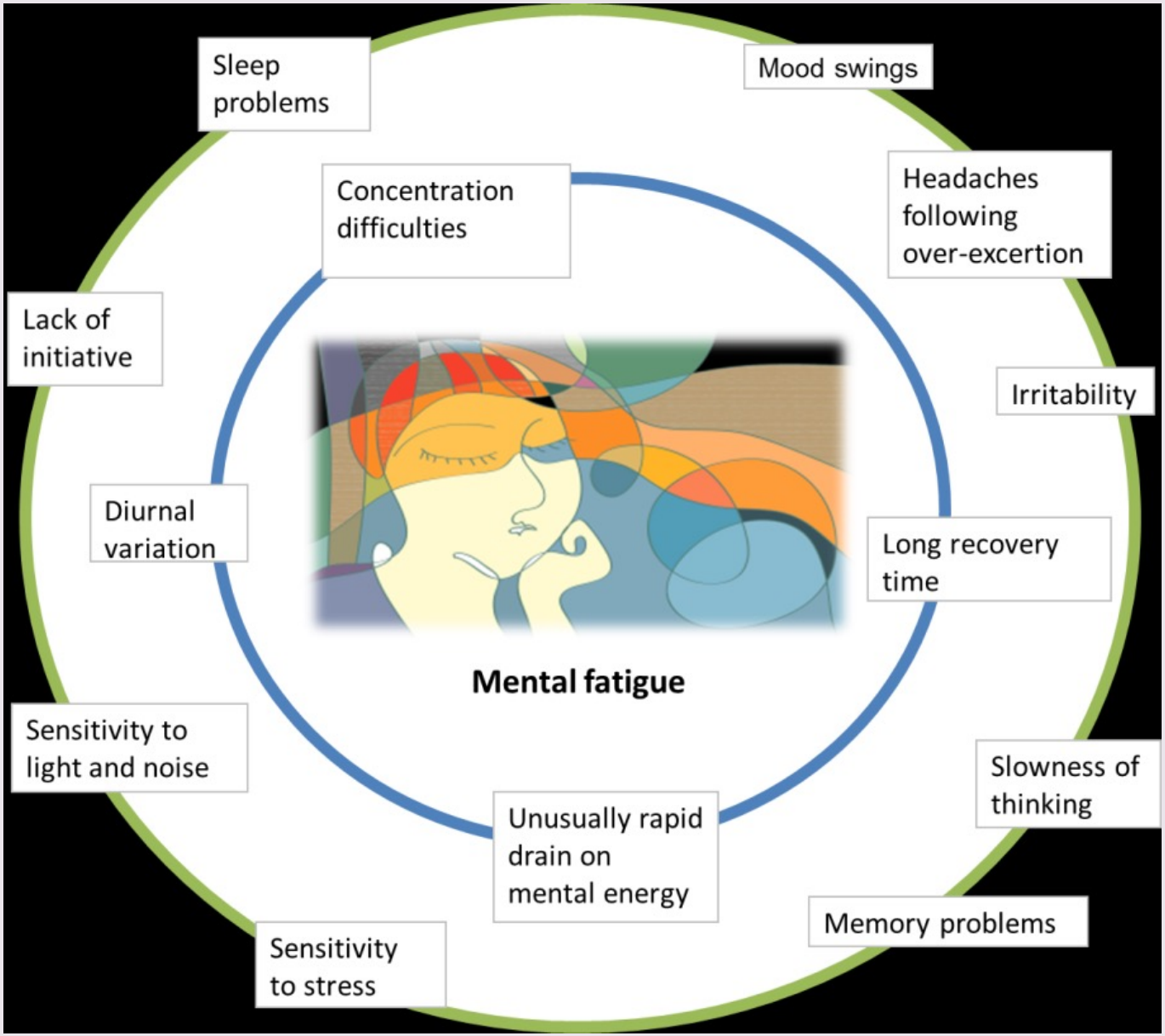


Lemke et al, 2022, Buoy Health

Concussion → Mood → Cognition



Concussions are multi-faceted



https://www.intechopen.com/chapters/46126

What type of thinking skills can be impacted?

Sustaining attention

Slowed thinking speed

Reduced cognitive stamina

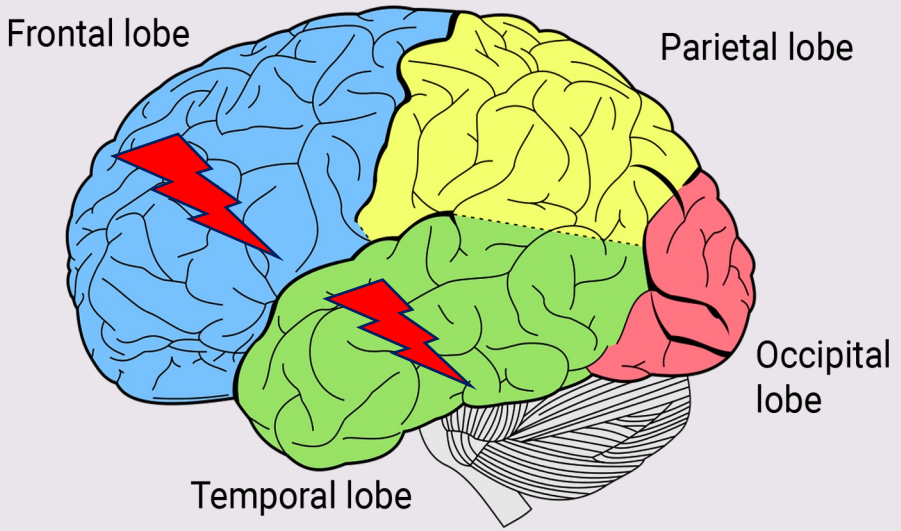
Learning new information

Multi-tasking

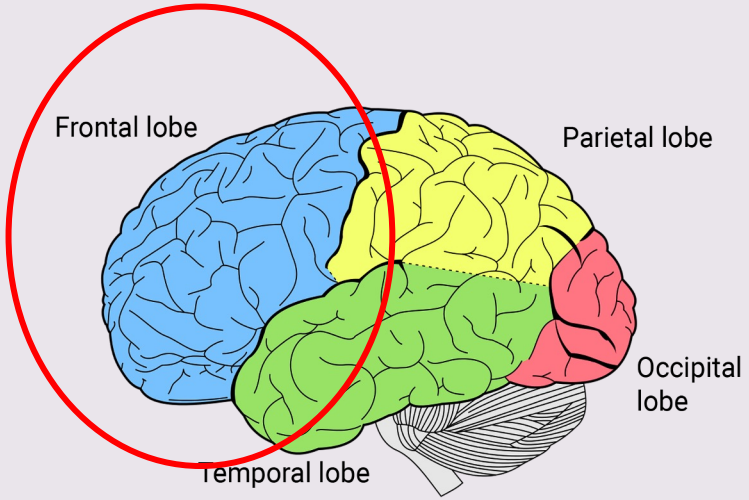
Word finding

Mental flexibility

+ other types of cognition

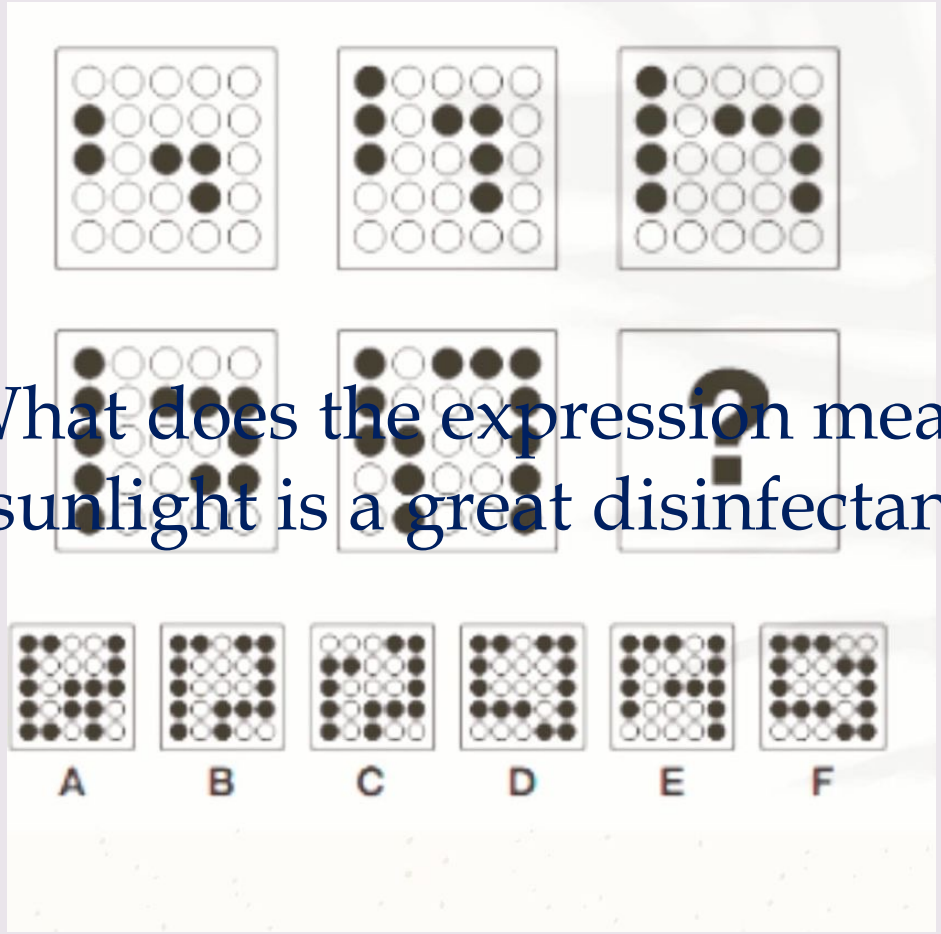


Executive Function



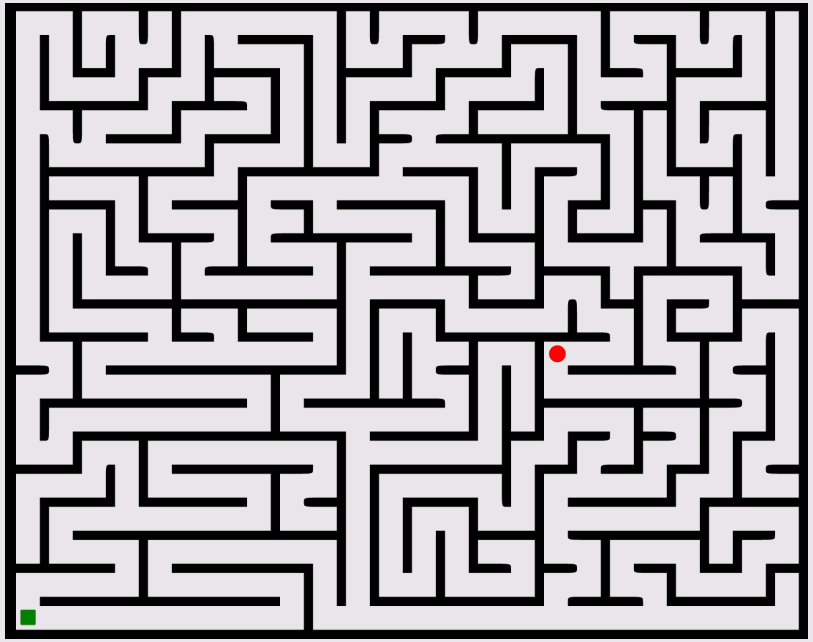
How do we assess thinking skills?

Reasoning and Problem Solving



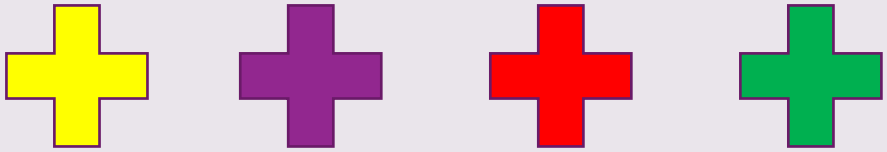
What does the expression mean:
"sunlight is a great disinfectant"?

Reasoning and Problem Solving

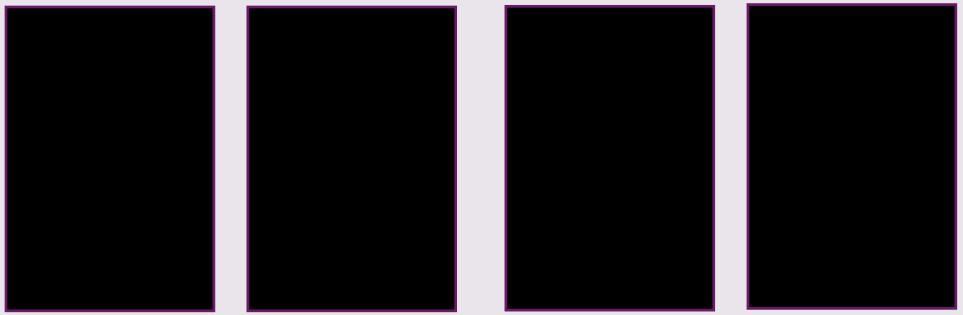


If a train leaves at 7am from Oshawa traveling at 90 km/hr for 110 km to Mississauga, when will it arrive?

Attention span



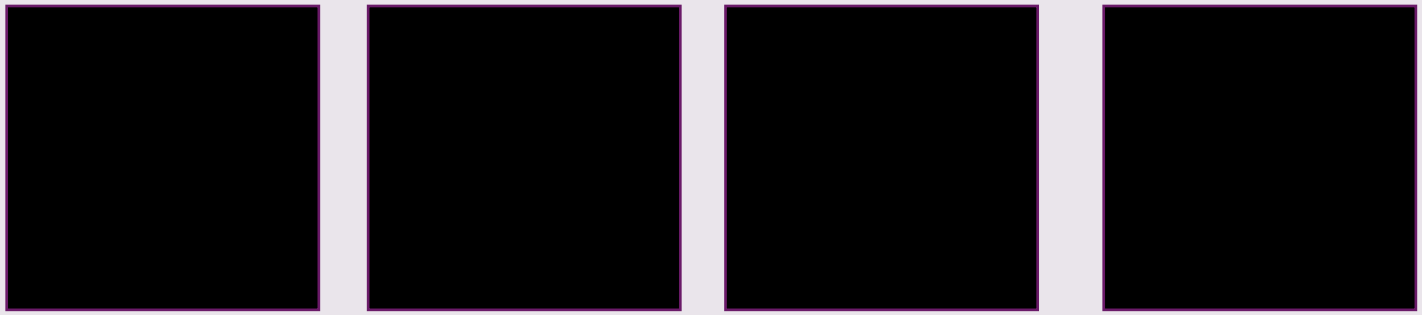
Attention Span



Working memory

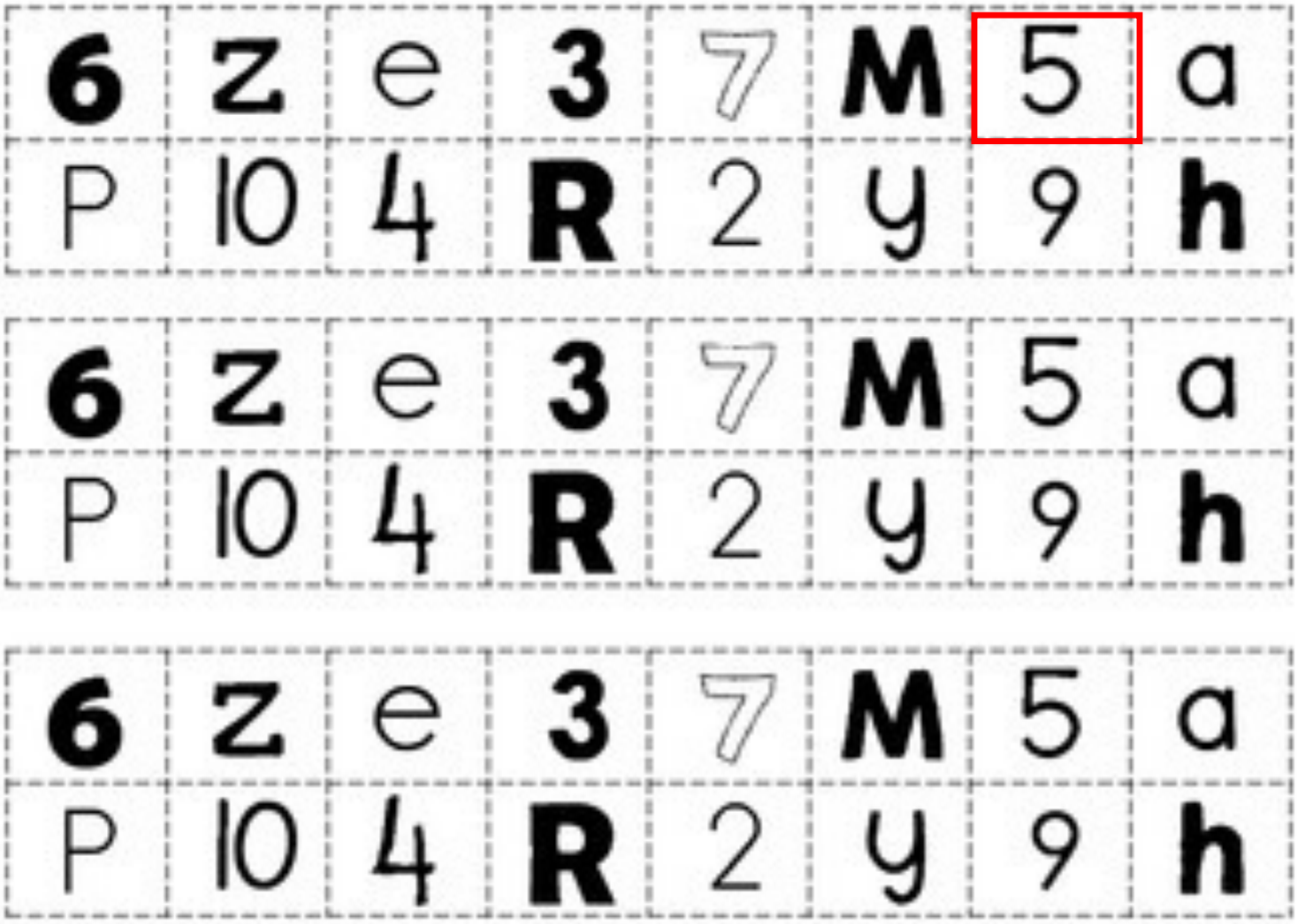
27... 33... 49... 17...

Working memory



Multi-tasking

Complex Attention




6 Z e 3 7 M 5 a
P 10 4 R 2 y 9 h
6 Z e 3 7 M 5 a
P 10 4 R 2 y 9 h
6 Z e 3 7 M 5 a
P 10 4 R 2 y 9 h


6 Z e 3 7 M 5 a
P 10 4 R 2 y 9 h
6 Z e 3 7 M 5 a
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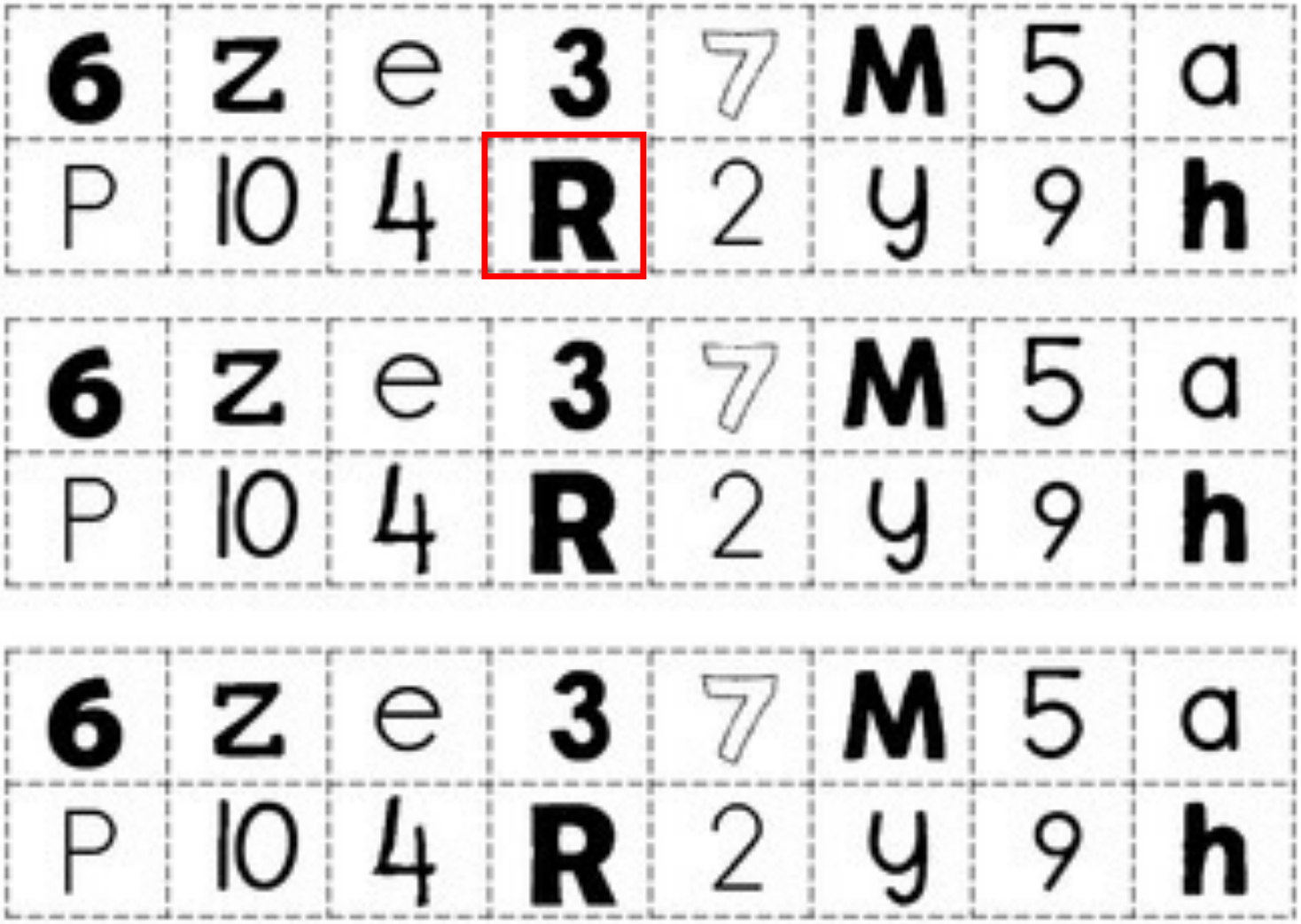

6 z e 3 7 M 5 a
P 10 4 R 2 y 9 h
6 z e 3 7 M 5 a
P 10 4 R 2 y 9 h
6 z e 3 7 M 5 a
P 10 4 R 2 y 9 h

Inhibition

Clapping Test

Processing Speed

Fast Reactions Test

How fast can you react?

Click here for instructions

Instructions:

When you see **GO!**
press the **SPACE BAR**
as quickly as you can.

Use a finger on your writing hand.

Click here to continue

Memory processes

Encoding

Storage

Retrieval

http://news.heart.org/memory-lapses-among-highly-educated-may-signal-higher-stroke-risk/

Learning Test

horn
grass
bass
cement
cleats
boots

piano
loafers
mud
plastic
trombone
sandals

Recall Memory Test

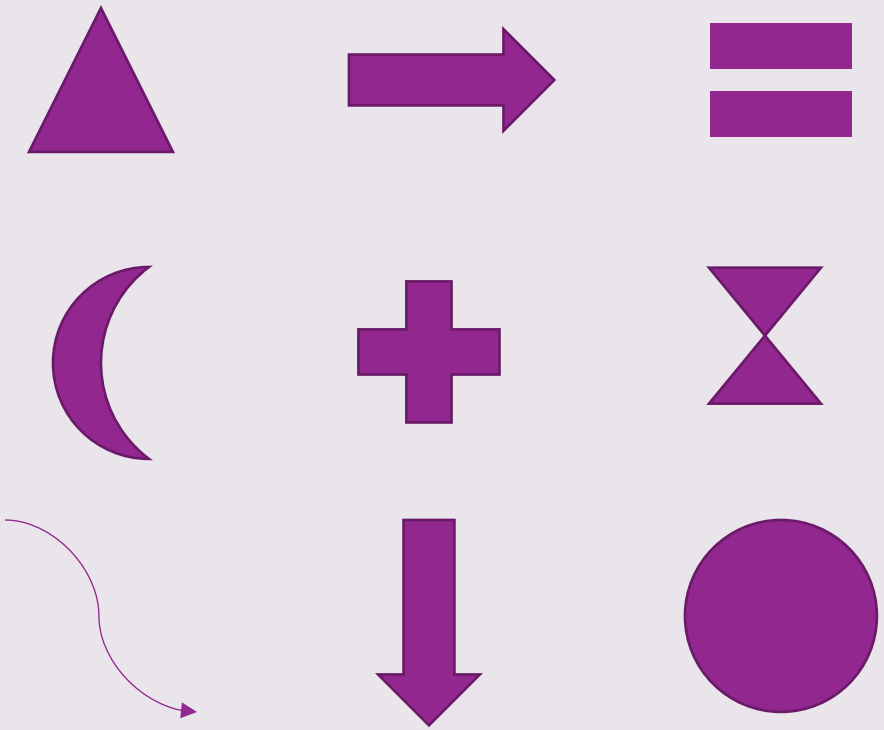
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

Recognition Memory Test

1. Was grass on the list? Yes or no?
2. Was accordion on the list? Yes or no?
3. Was sandals on the list? Yes or no?
4. Was trumpet on the list? Yes or no?

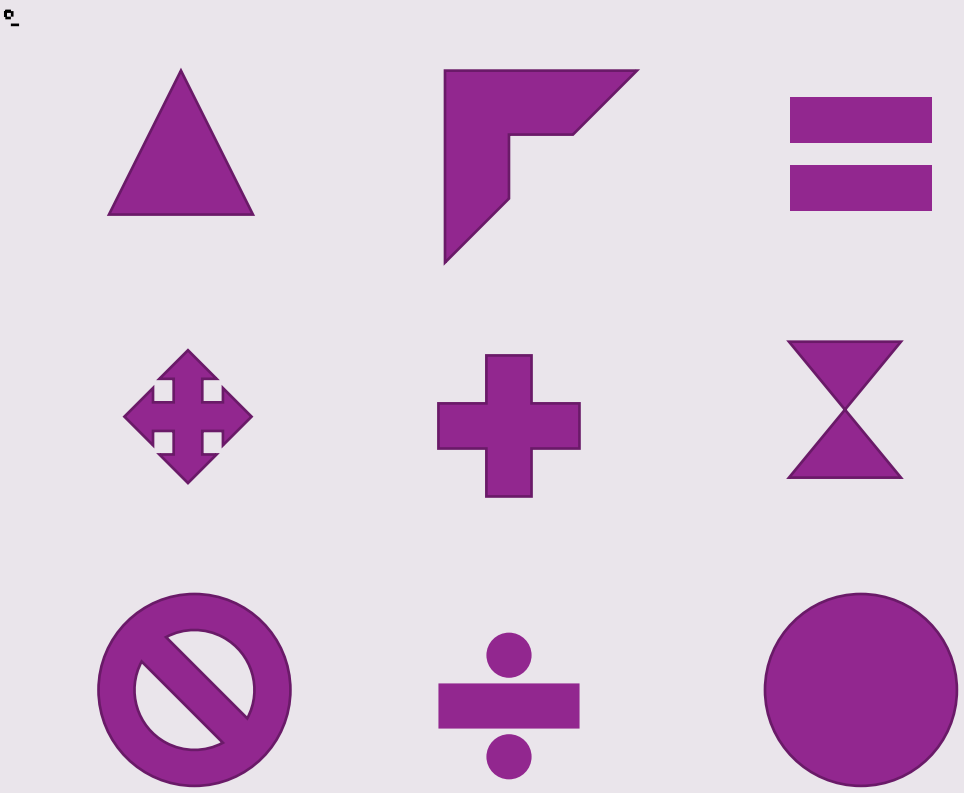
I.

Visuospatial Learning

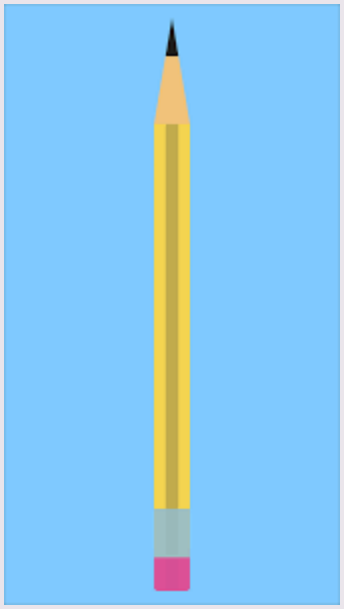


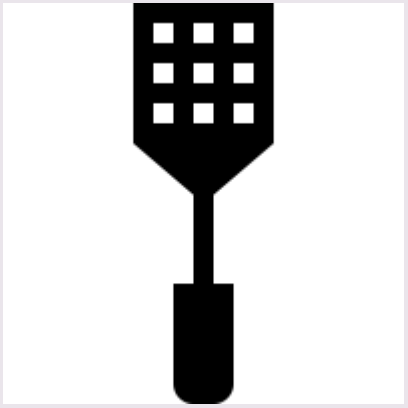
Visuospatial Recall

Visuospatial Recognition



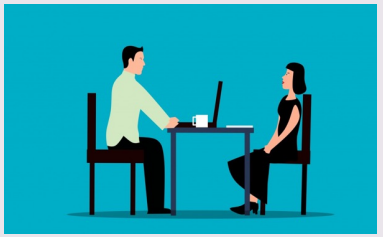
What do you call it?





Nuts and Bolts of a Neuropsychological Assessment

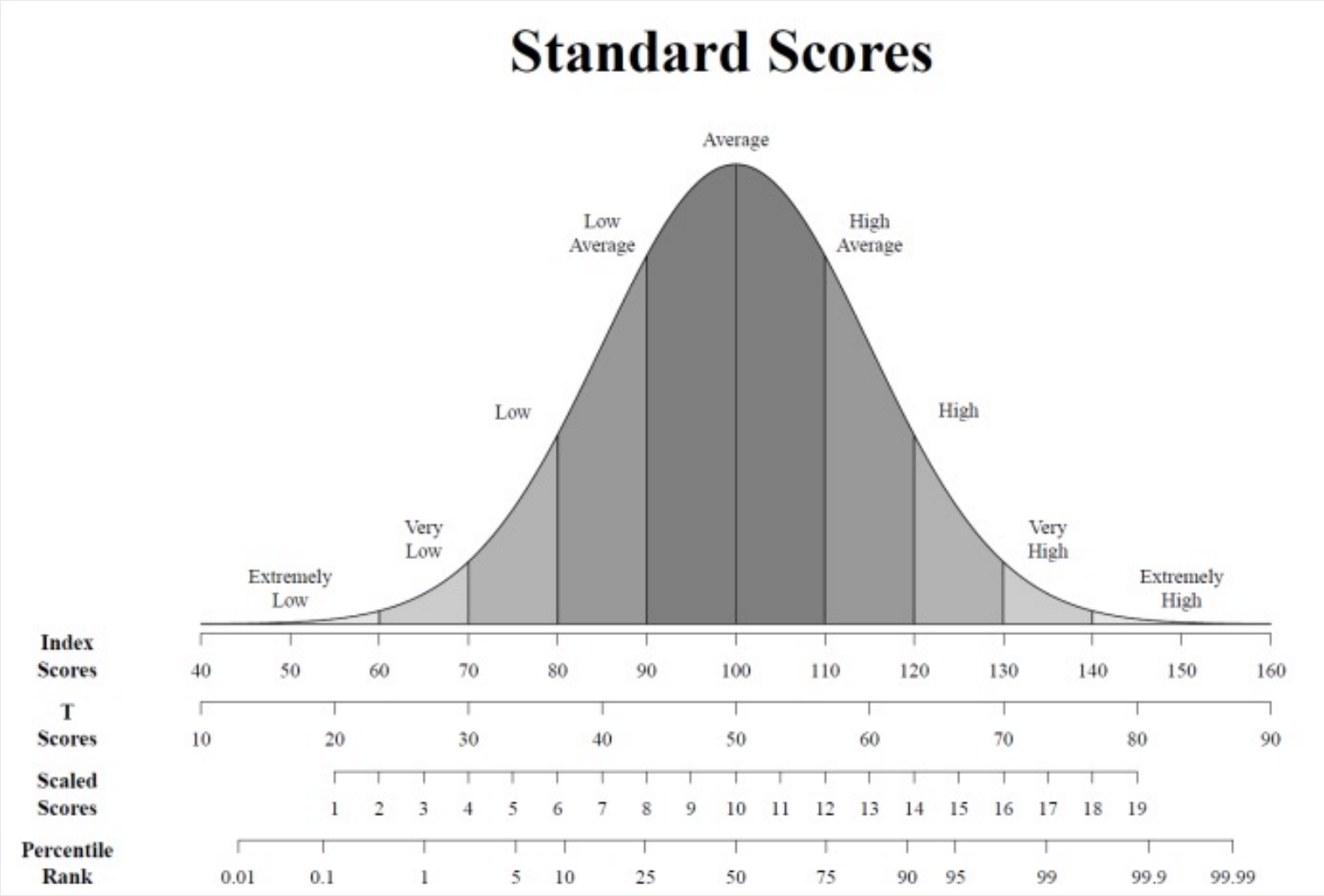
- **Clinical Interview:** understanding your perspective



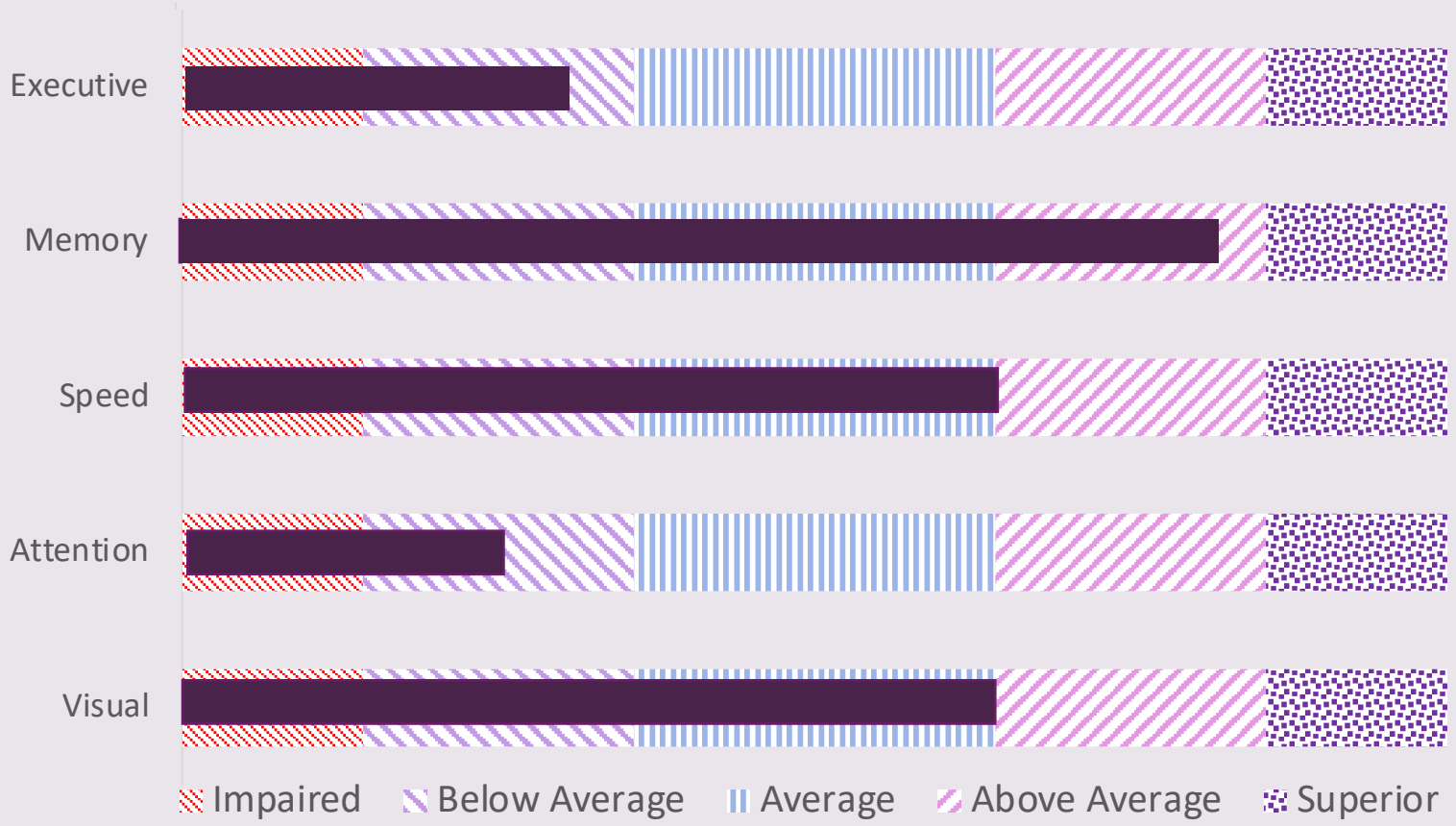
- **Neuropsychological Testing:** across cognitive domains

- **Feedback:** communication of strengths and weakness, implications for referral question, and strategies

Comparing individuals to themselves & the population…

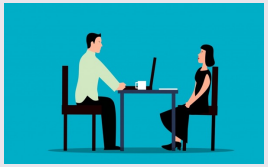


Profile of Cognitive Strengths and Weaknesses

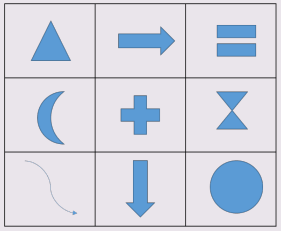


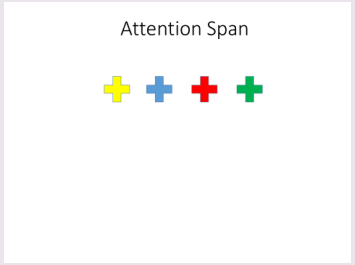
The Neuropsychological Approach

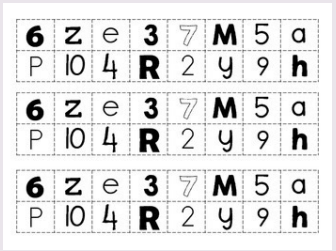
- Comprehensive interview

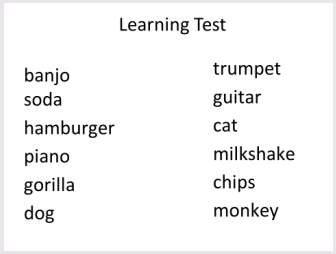


- Hypothesis-driven tests, comprehensively assess domains

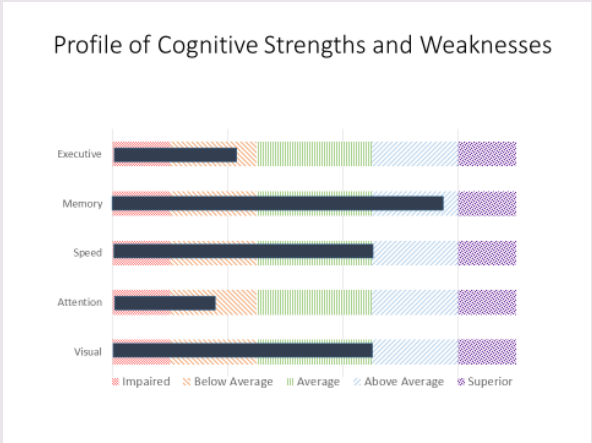








- Cognitive profile integrated with medical investigations to inform diagnosis + prognosis



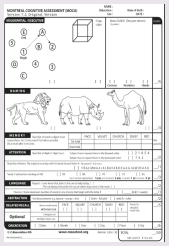
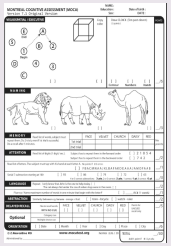
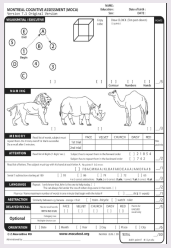
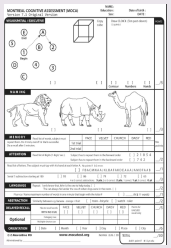
Common challenges

- Culture/Language

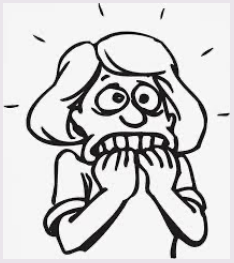
- High Baseline

- The Testing Environment/One Test Challenge

- Serial screening tests

- The Role of Mood in Cognition

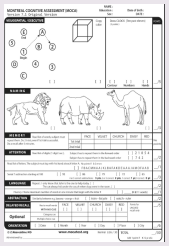


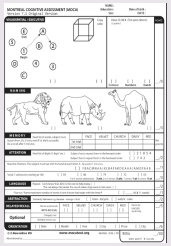
How do we handle the challenges?

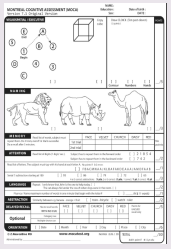
- Culture/Language

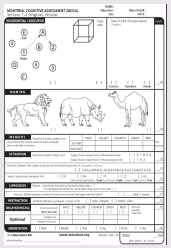
- High Baseline

- The Testing Environment/One Test Challenge
- Serial screening tests









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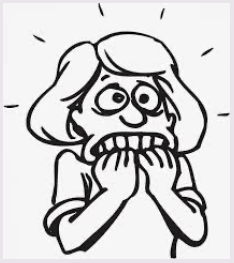
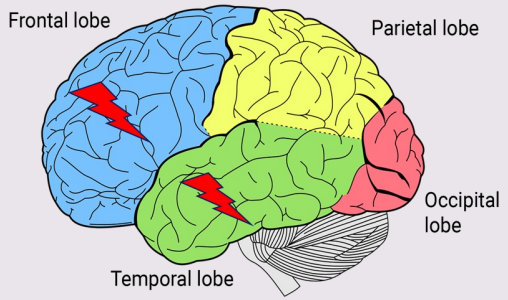


Purpose of neuropsychology assessment in persistent symptoms of post-concussion



- **Diagnosis**
  - Does pattern of cognitive strengths and weaknesses fit with other information (e.g., MRI, EEG, medical history)?
  - Are secondary factors impacting thinking skills?
    - e.g., mood, sleep disruption, fatigue, pain
  - Identifying modifiable targets
- **Prognosis**
  - ability to return to work/activity, track recovery, recommendations for optimization

Questions

UHN Toronto General Toronto Western Princess Margaret Toronto Rehab Michener Institute

EXTRA SLIDES

Memory processes

Encoding

Storage

Retrieval

http://news.heart.org/memory-lapses-among-highly-educated-may-signal-higher-stroke-risk/

Memory Strategies

What do you do when you are trying to remember something?

Memory Strategies

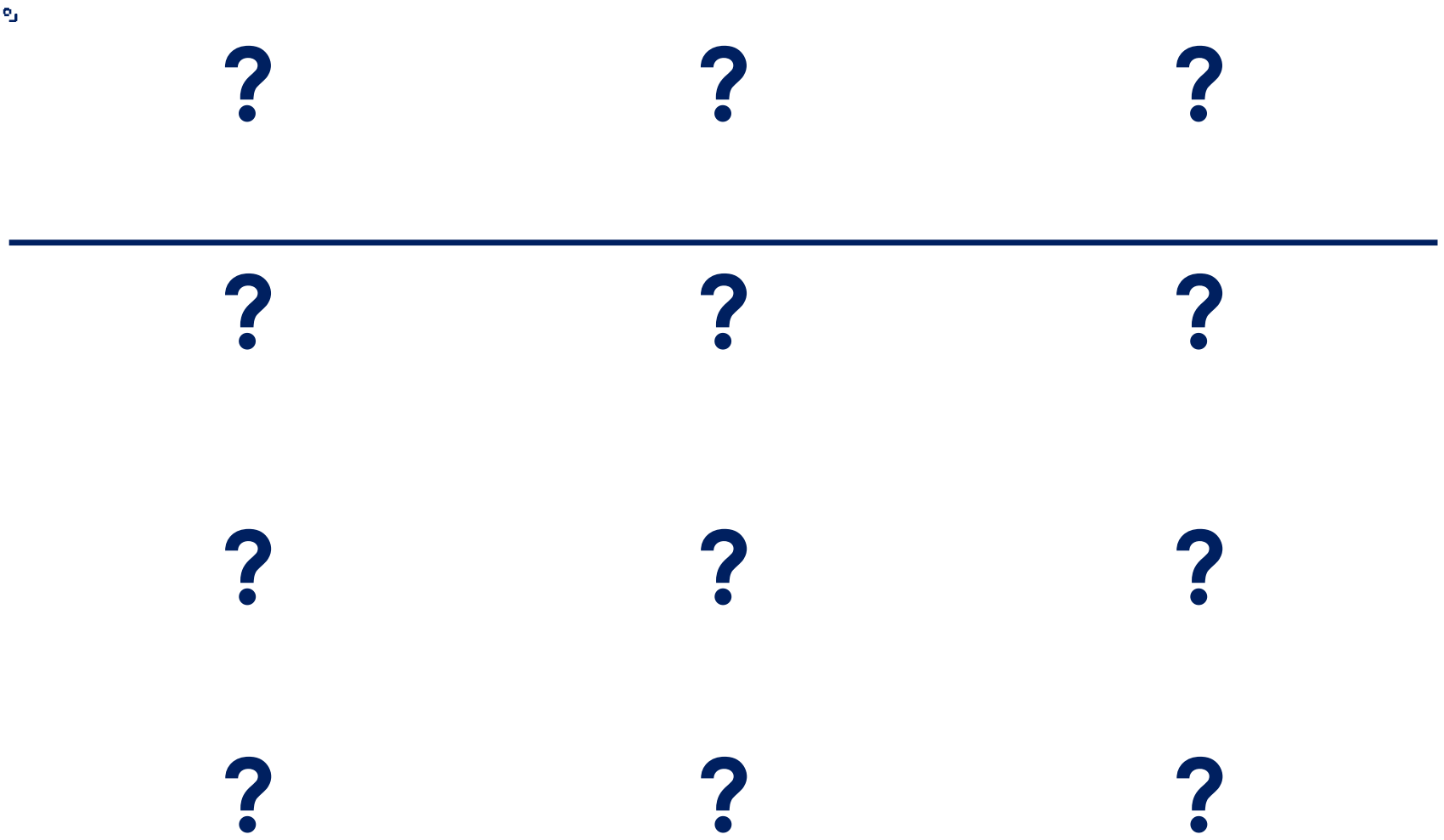
1. Be strategic
2. Be creative
3. Be organized

Lovelace & Twohig (1990). *Bulletin of the Psychonomic Society,* 28:115.

Memory Strategies

Do an experiment with numbers.

9	**1**	**9**
6	3	6
4	1	6
3	1	4



9	1	9
6	3	6
4	1	6
3	1	4

Memory processes

Encoding

Storage

Retrieval

http://news.heart.org/memory-lapses-among-highly-educated-may-signal-higher-stroke-risk/

Memory processes

Encoding

Storage

Retrieval

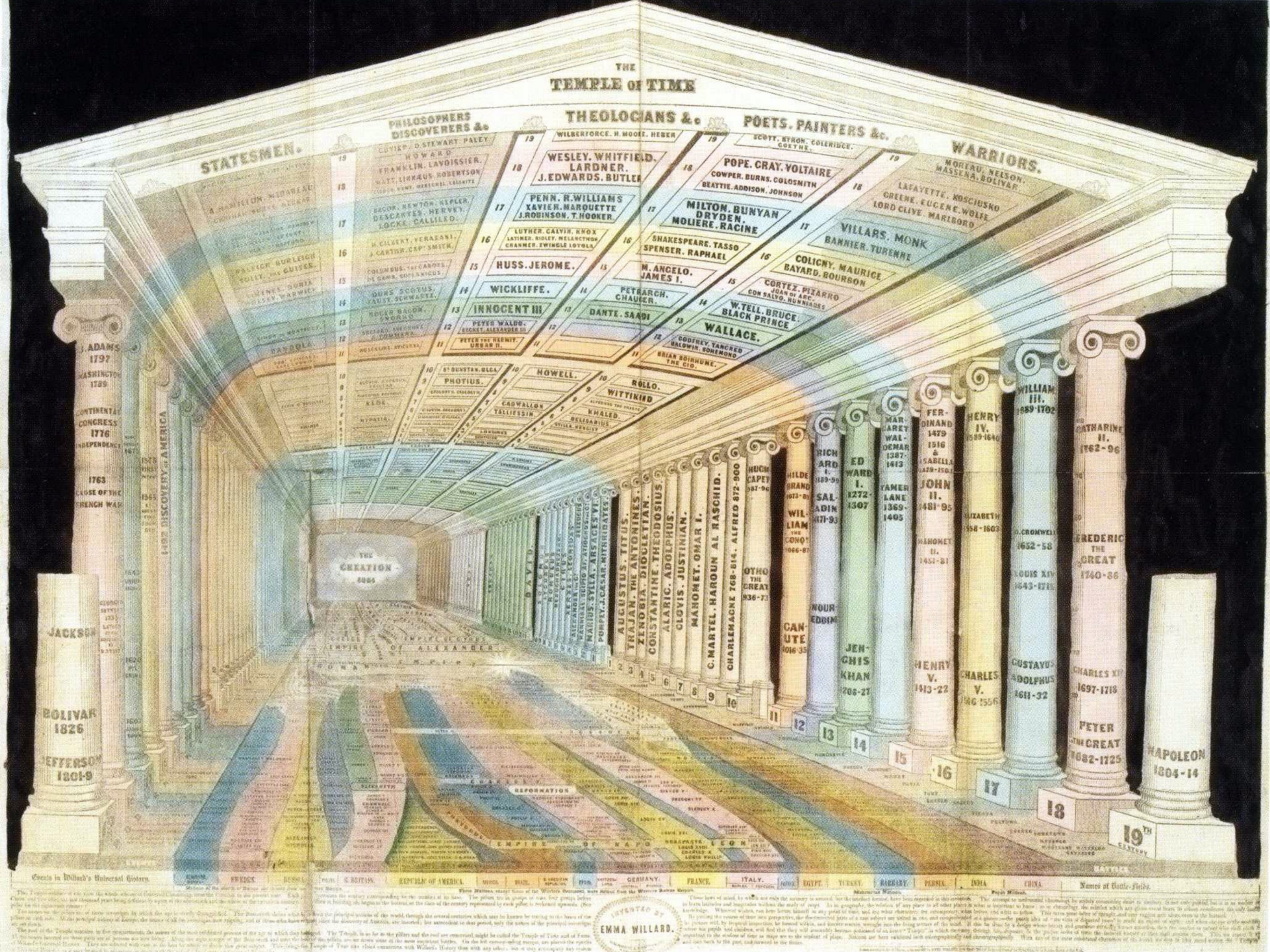
http://news.heart.org/memory-lapses-among-highly-educated-may-signal-higher-stroke-risk/

Memory Strategies

- Make new information meaningful!
  - ➢ elaborate and rich

- Use all of your senses

http://www.rediquest.com/senses/


THE
TEMPLE OF TIME
STATESMEN.
PHILOSOPHERS
DISCOVERERS &c.
THEOLOGIANS &c
POETS. PAINTERS &c.
WARRIORS.
J. ADAMS 1797
WASHINGTON 1789
CONTINENTAL CONGRESS 1776 INDEPENDENCE
1763 CLOSE OF THE FRENCH WAR
1492 DISCOVERY OF AMERICA
JACKSON
BOLIVAR 1826
JEFFERSON 1801-9
THE CREATION 4004
EMPIRE OF ALEXANDER
EMPIRE OF NAPOLEON
REFORMATION
AUGUSTUS. TITUS. TRAJAN. THE ANTONINES. ZENOBIA. DIOCLETIAN. CONSTANTINE. THEODOSIUS. ALARIC. ADOLPHUS. CLOVIS. JUSTINIAN. MAHOMET. OMAR I. C. MARTEL. HAROUN AL RASCHID. CHARLEMAGNE 768-814. ALFRED 872-900
HUGH CAPET 987-96
OTHO THE GREAT 936-73
HILDEBRAND 1073-85
WILLIAM THE CONQ. 1066-87
CANUTE 1016-35
RICHARD I. 1189-99
SALADIN 1171-93
NOUREDDIN
EDWARD I. 1272-1307
JENGHIS KHAN 1206-27
MARGARET WALDEMAR 1387-1413
TAMERLANE 1369-1405
FERDINAND 1479 1516 & ISABELLA 1479-1504
JOHN II. 1481-95
MAHOMET II. 1451-81
HENRY V. 1413-22
HENRY IV. 1589-1640
ELIZABETH 1558-1603
CHARLES V. 1516-1556
WILLIAM III. 1689-1702
O. CROMWELL 1652-58
LOUIS XIV 1643-1715
GUSTAVUS ADOLPHUS 1611-32
CATHARINE II. 1762-96
FREDERIC THE GREAT 1740-86
CHARLES XII 1697-1718
PETER THE GREAT 1682-1725
NAPOLEON 1804-14
19TH CENTURY
WILBERFORCE. H. MOORE. HEBER
WESLEY. WHITFIELD. LARDNER. J. EDWARDS. BUTLER
PENN. R. WILLIAMS XAVIER. MARQUETTE J. ROBINSON. T. HOOKER
LUTHER. CALVIN. KNOX LATIMER. RIDLEY. MELANCTHON CRANMER. TWINGLE LOYOLA
HUSS. JEROME.
WICKLIFFE.
INNOCENT III.
PETER WALDO.
PETER THE HERMIT. URBAN II.
ST DUNSTAN. OLGA
PHOTIUS.
HOWELL.
CADWALLON
TALLIESSIN.
KHALED.
BELISARIUS.
ROLLO.
WITTIKIND
SCOTT. BYRON. COLERIDGE. GOETHE.
POPE. GRAY. VOLTAIRE.
COWPER. BURNS. COLOSMITH
BEATTIE. ADDISON. JOHNSON
MILTON. BUNYAN DRYDEN. MOLIERE. RACINE
SHAKESPEARE. TASSO SPENSER. RAPHAEL
M. ANGELO. JAMES I.
PETRARCH. CHAUCER.
DANTE. SAADI
WALLACE.
GODFREY. YANCRED BALDWIN. BOHEMOND
BRIAN BOIRHUNE. THE CID.
MOREAU. NELSON. MASSENA. BOLIVAR
LAFAYETTE. KOSCIUSKO GREENE. EUGENE. WOLFE LORD CLIVE. MARLBORO
VILLARS. MONK BANNIER. TURENNE
COLIGNY. MAURICE BAYARD. BOURBON
CORTEZ. PIZARRO JOAN OF ARC. CON SALVO. HUNNIADES
W. TELL. BRUCE. BLACK PRINCE
Events in Willard's Universal History.
SWEDEN
RUSSIA
POLAND
S. BRITAIN.
REPUBLIC OF AMERICA.
MEXICO
BRAZIL
S. AMERICAN REPUBLICS
GERMANY.
FRANCE.
ITALY.
SPAIN
EGYPT.
TURKEY
BARBARY.
PERSIA.
INDIA
CHINA
Names of Battle-Fields.
INVENTED BY
EMMA WILLARD.

Test Ourselves!

-banjo

-hamburger

-gorilla

-trumpet

-cat

-chips

-soda

-piano

-dog

-guitar

-milkshake

-monkey

Can we create our own memory palace?

Test Ourselves!

-banjo

-hamburger

-gorilla

-trumpet

-cat

-chips

-soda

-piano

-dog

-guitar

-milkshake

-monkey

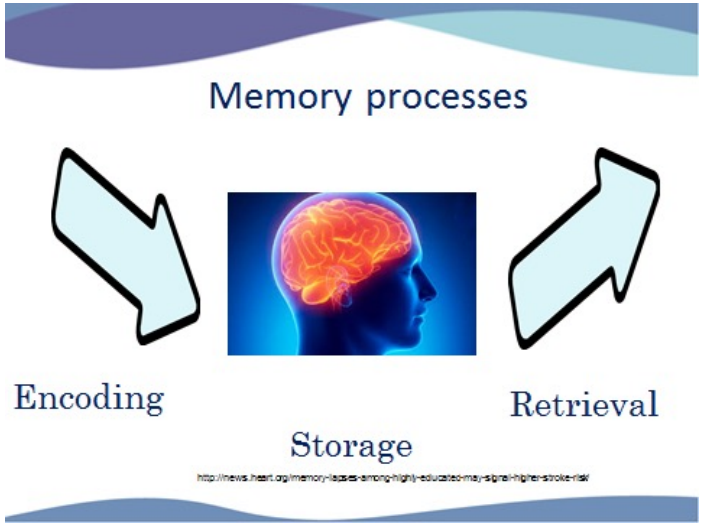
Memory Strategies

- The role of attention (Gold & Park, 2009)

- Write information down
- Practice good habits!

Retrieval Practice

- Powerful learning strategy



Memory Strategies

External memory aids

- Calendar / Lists / Notes

Internal strategies

- Attention “see it, and say it”
- Meaningful Encoding
  - Elaboration, personalization, acronyms, mnemonics (memory palaces), etc.

Goals of Strategies

- Increase knowledge about practical and effective memory strategies.
- Increase use of targeted strategies in everyday memory situations.
- These strategies take time to learn. But with practice, they can be incorporated into your life!

Factors Affecting Memory

- Medical disorders & diseases
- Medications
- Exercise
- Diet
- Stress and relaxation
- Thinking activities

Neuroplasticity

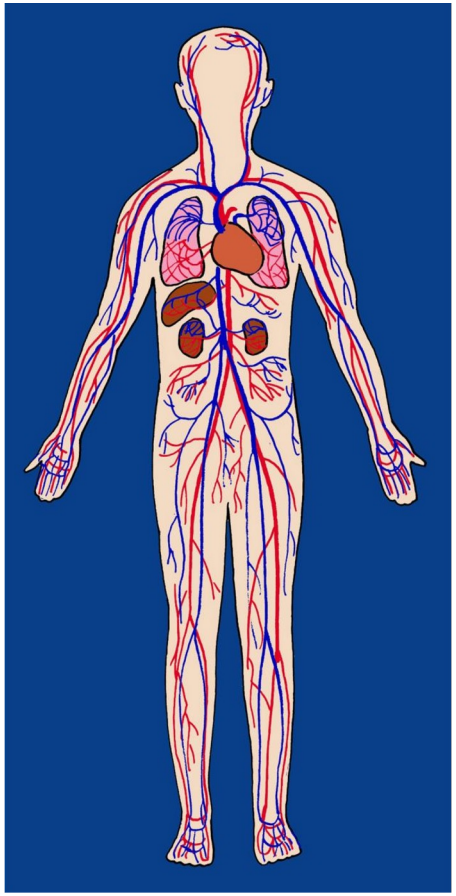
- Neuro = brain
- Plasticity = able to be remolded

- MAY EXPLAIN WHY THESE THINKING ACTIVITIES HELP US STAY SHARP AS WE AGE!!

Neuroplasticity

www.livestrong.com

Holistic Approach to Aging – The Mind & Body



Lifestyle - Exercise

- **Acute effects**:
  - Immediately after exercising, learning and memory are enhanced.
  - This is a short-term effect.

- **Long-term effects**:
  - Exercise lowers risk of heart disease and stroke.
  - Neurogenesis, nerve health, reaction time, etc.

Lifestyle - Diet

- Adequate nutrition and vitamins

- High fat and cholesterol

Lifestyle - Stress

- Cortisol is released.
- This affects the brain and memory.
- This effect is reversible.

Lifestyle - Relaxation

http://www.busymeditator.com/blog/

- Relaxation techniques:
  - Deep breathing
  - Visualization
  - Progressive muscle relaxation
  - Meditation

Lifestyle – Thinking Activities

- Involvement in intellectually-demanding activities correlates with:
  - better cognitive abilities
  - lower rates of dementias such as Alzheimer's disease

Lifestyle - Thinking Activities

- Working or volunteering
- Playing bridge or chess
- Doing crossword puzzles/ sudoku
- Reading books
- Learning a new language
- Traveling
- Playing a musical instrument
- Singing in a choir
- Attending theatre, symphony, lectures
- Visiting museums
- Socializing

Holistic Approach to Aging – The Mind & Body