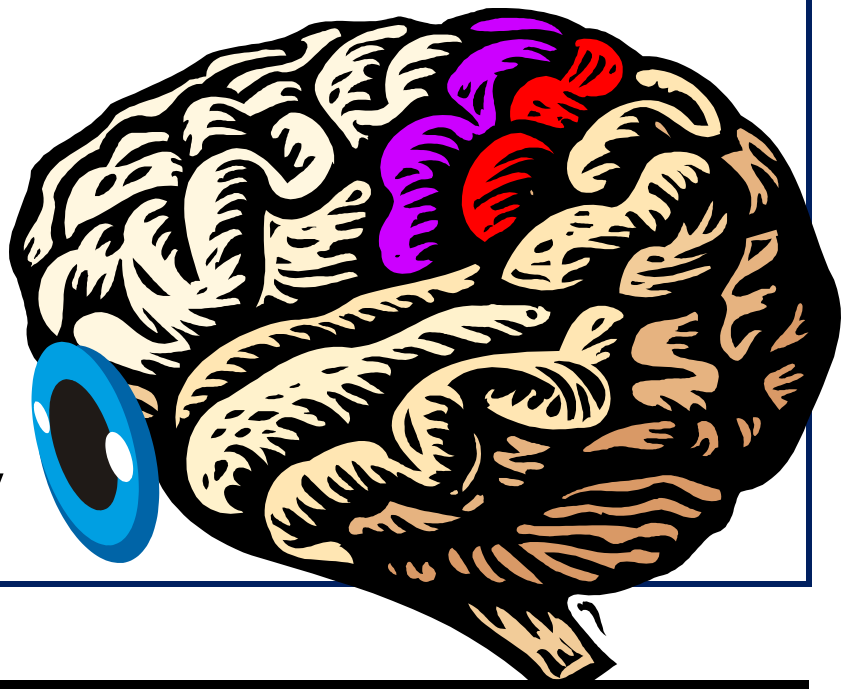
Exercise and brain function

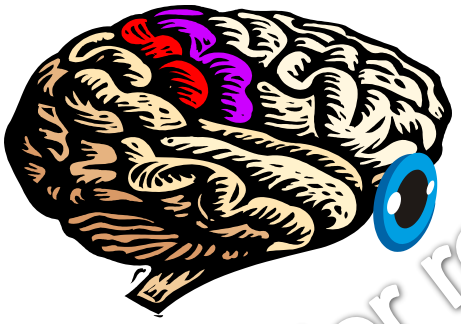
- Largest effect on executive control:
  - Memory
  - Planning
  - Scheduling
  - Multi-tasking
  - Dealing with ambiguity



Integration, planning, decision making, memory

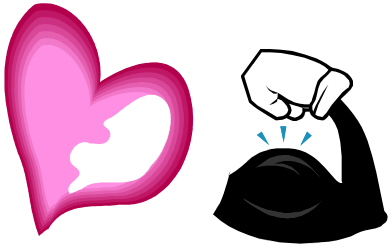
Overall brain functioning

"move"



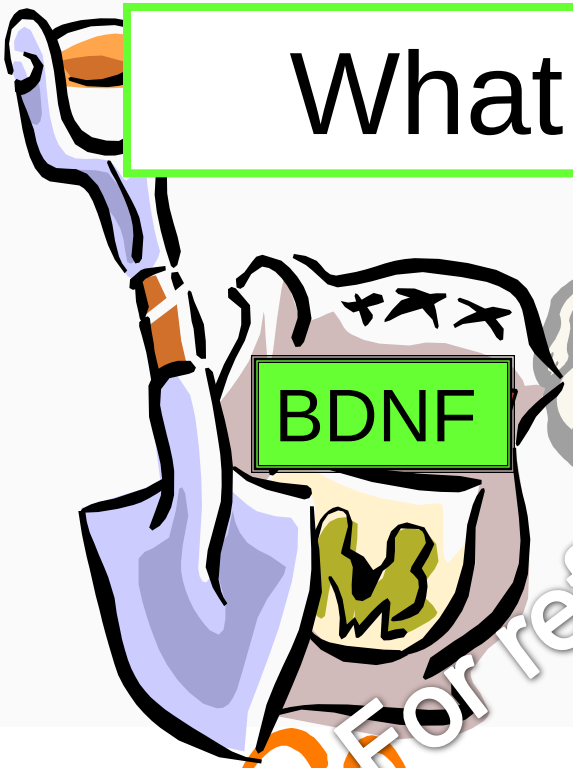
Integration, planning, decision making, memory

activity



Sensory input

What might be happening?

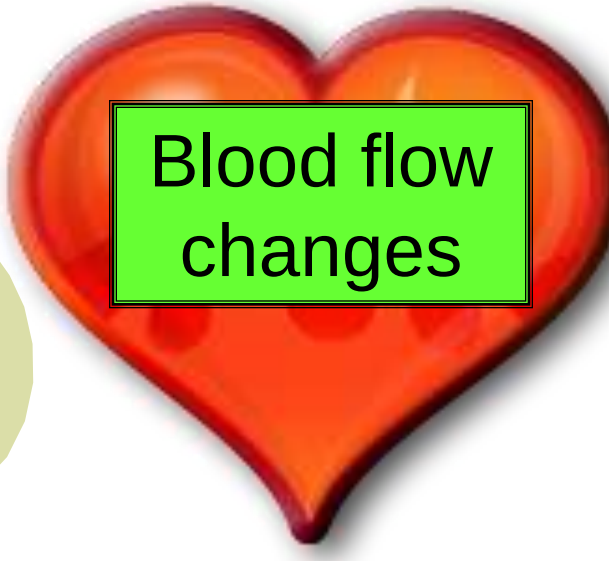


BDNF

Social stimulation

Depression reduction

CVD risk reduction



Blood flow changes

BDNF-mediated improvements

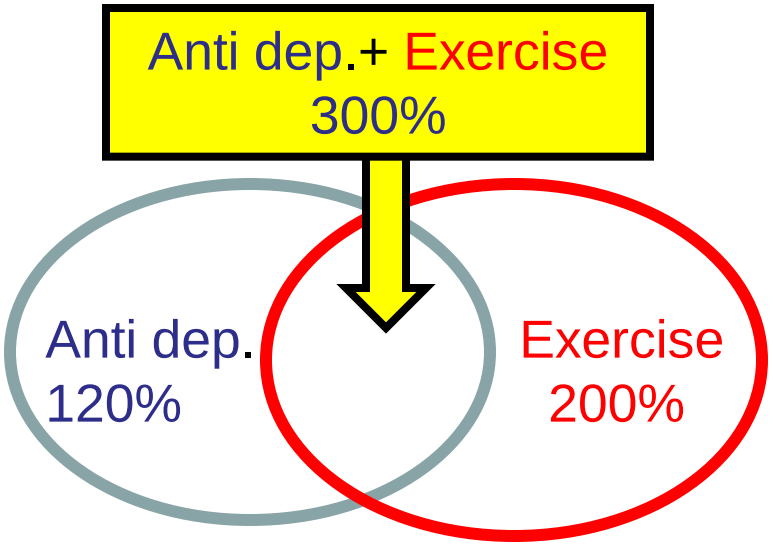
- BDNF: neuro-protective factor capable of sustaining neuron viability.
- Looking at sensory and motor areas
  - Found changes in hippocampus
    - Learning and memory (ALZ target)
- Ex ↑ BDNF (animal)
  - Less cortical atrophy
  - Improved cortical function

Causes of exercise/ Cognition changes

(Cotman & Engesser-Cesar, 2002)

BDNF mediated improvements

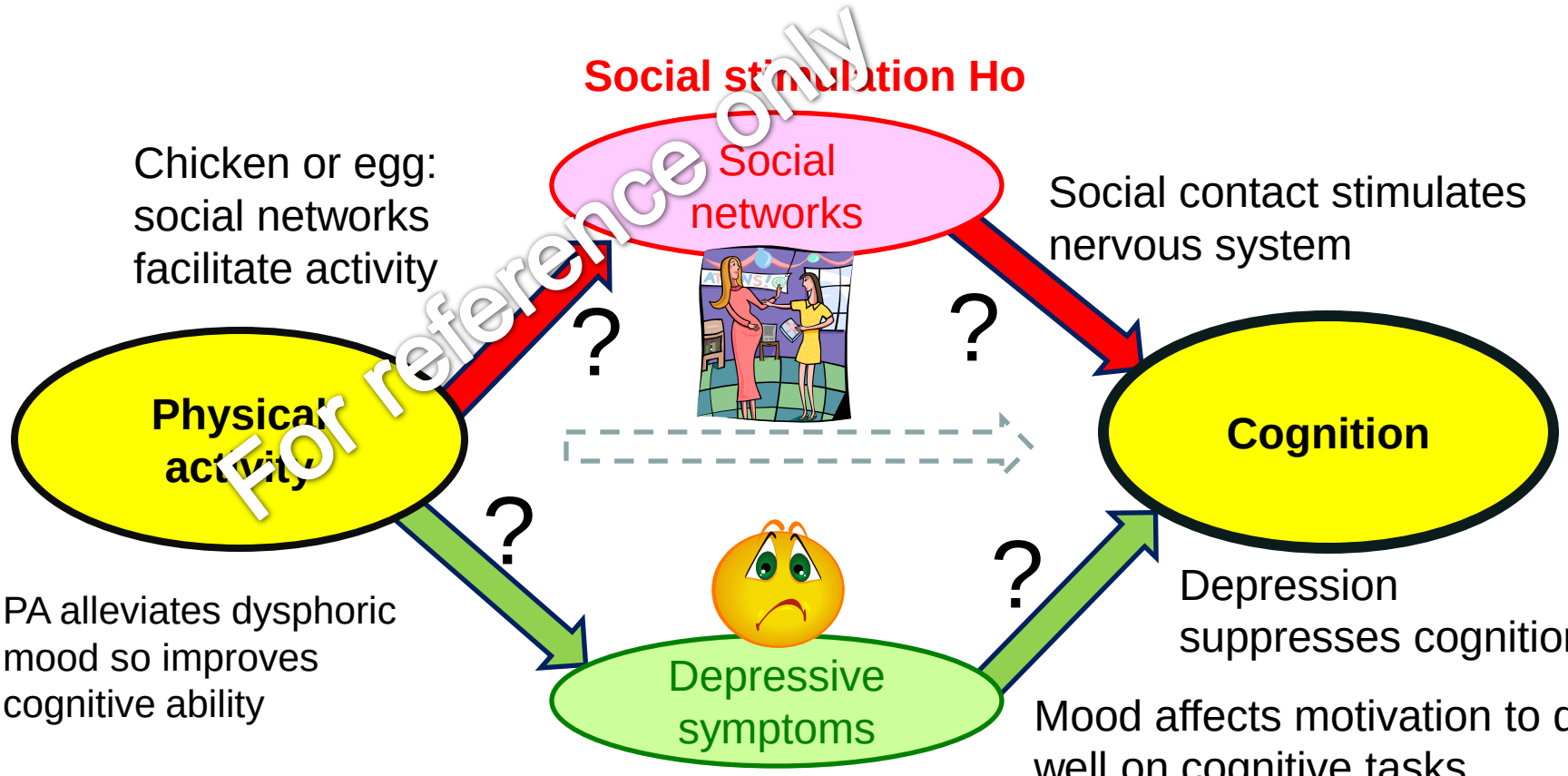
- Long term effects:
  - Plasticity
  - Neuro-protective
  - Improved learning
  - Resistance to stroke
- Depression
  - Compared to control



Causes of exercise/ Cognition changes

(Cotman & Engesser-Cesar, 2002)

Depression Reduction & Social Stimulation



Vance et al, 2005

Causes of exercise/ Cognition changes

Depression Reduction & Social Stimulation

RESULTS

Social networks

Indirect link between SN and Cog via DS

.28

.21

Physical activity

.32

Cognition

-.34

Depressive symptoms

PA **not** directly associated with DS, but might work other way.

Causes of exercise/ Cognition changes

Vance et al, 2005

Blood flow changes

- Blood flow changes do not occur globally across all regions of the brain
- Ex induced cerebral blood flow goes to localized areas of brain
  - Locomotion, equilibrium, CR control and hippocampus
- May induce angiogenesis

Causes of exercise/ Cognition changes

Pontifex et al, 2008

What sort of exercise?

BDNF	CVD risk reduction	Blood flow changes	Depression reduction	Social stimulation

- Most research has looked at aerobic exercise
- What about other forms of physical activity?
- Issue: Are the cognitive tests currently used sensitive to changes from RT, mobility, mixed exercise modes?

Pontifex et al, 2008

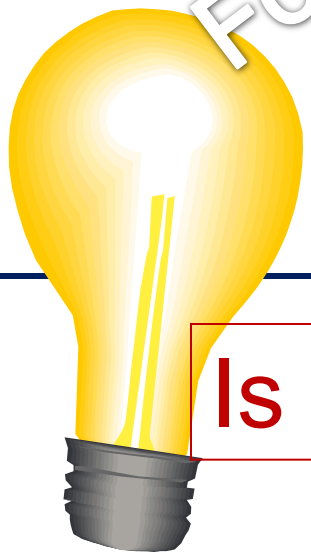
Enriched environment

- PA in enriched environments deceased cognitive impairments (rats)
- More active lifestyle

→ more enriched environment

↓

less likely to develop ALZ

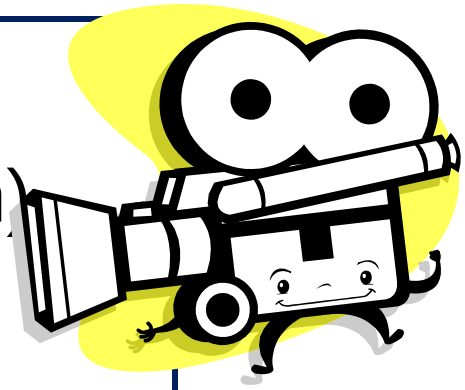


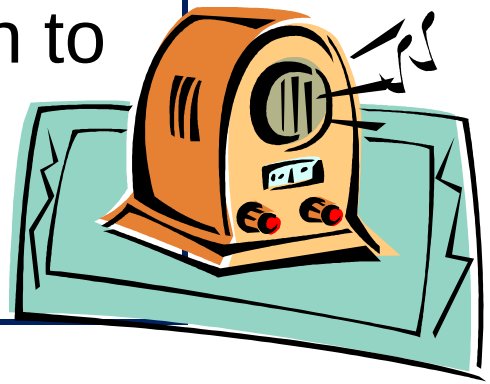
Is exercise a “rich environment”?

(Cotman & Engesser-Cesar, 2002)

Marshall McLuhan (1967, The Medium is the Massage)

- HOT media: e.g. Film
  - enhances one single sense (vision)
  - not much effort needed
- COOL media: e.g. Radio
  - much more conscious participation to extract value.
  - more effort to determine meaning





Marshall McLuhan-ish (modified and proposed)

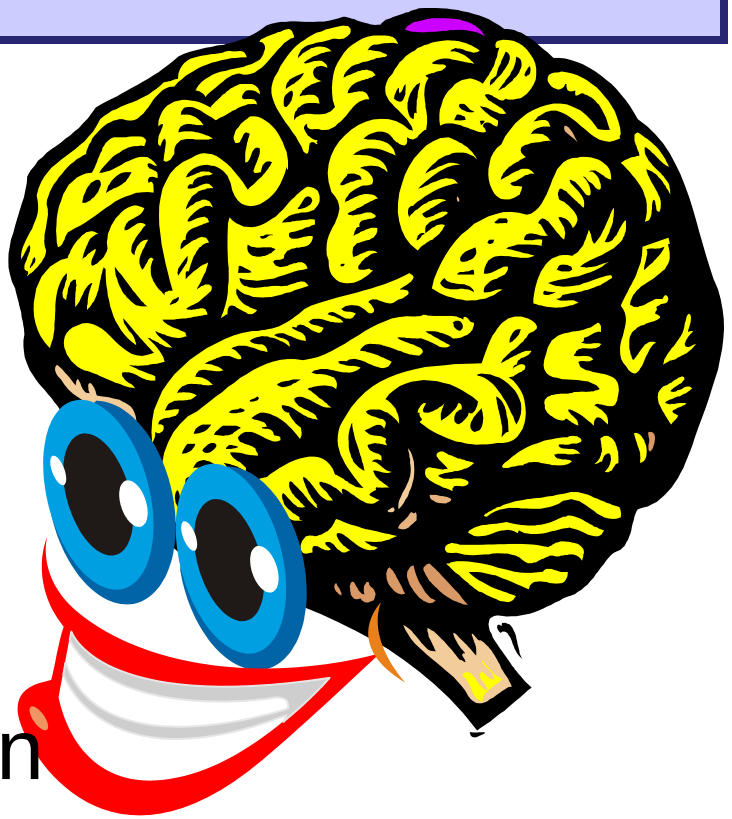
- HOT exercise: walking
  - enhance some parts of the brain
  - a person does not need to exert much thought into completing exercise
- ***C***  ***L*** exercise: variety program
  - much more variation in activity by the exerciser
  - more mental effort on the part of exerciser

- **Cognitive** (non active) training in healthy older individuals produces strong and persistent protective effects on longitudinal neuropsychological performance
- (7 RCTs with >3 month follow up, Valenzuela & Sachev, 2009)

- Can COGEX physical exercise contribute:
  - Develop mental reserve before loss
  - Combine Physical and Cognitive training?
  - "Exercise" all parts of the brain
  - Stretch brain to its limit to control body

A "*COOL*" exercise program

- Novel exercise
- Enriched environment
- Variety of challenges
- Push comfort zone
- Multi tasking
- Integration of whole brain



Exercise for older adults must maintain mobility and enhance reserve

Aerobic training >55 y.o. (11 RCTs)

- Largest effect:
  - motor function and auditory attention
- Moderate effect:
  - cognitive speed and visual attention
- Most studies: no significant results.

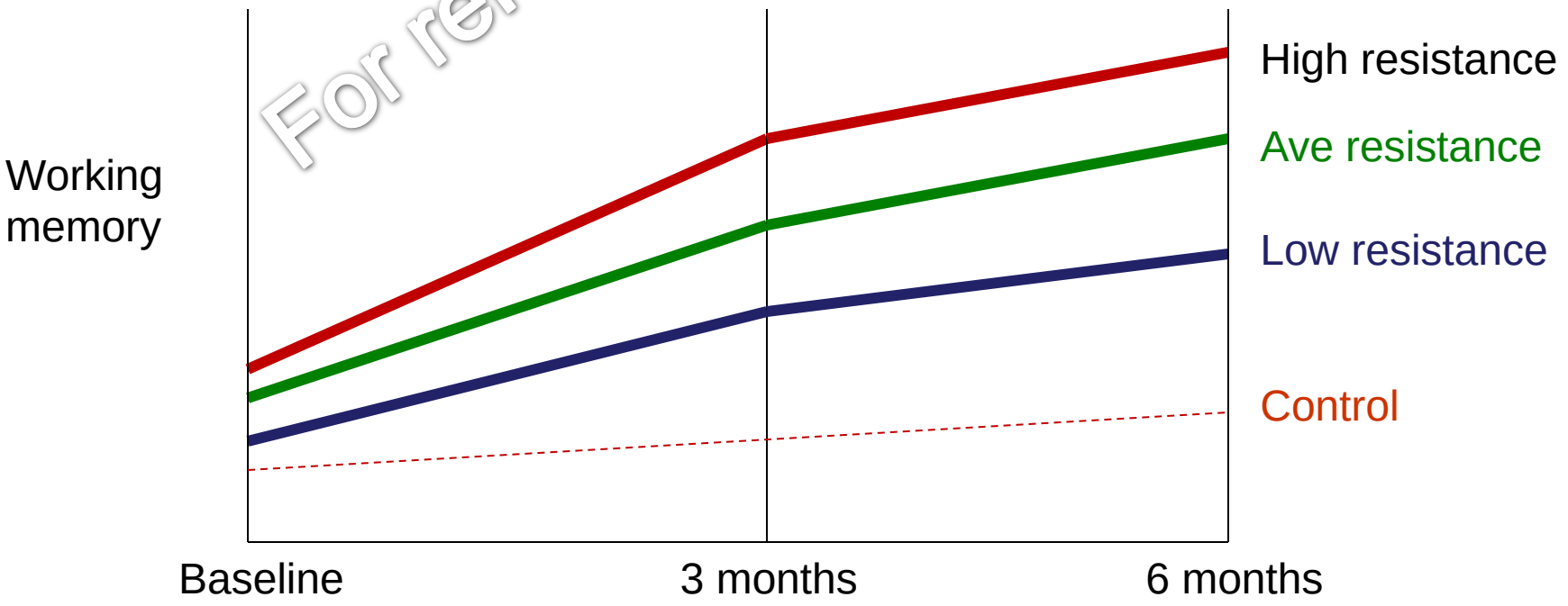
"Clinicians and scientists in the field of neuropsychology should seek mutual agreement on a smaller battery of cognitive tests to use, in order to render research on cognition critically relevant and transparent and heighten the reproducibility of results for future research"

Kramer, Erickson, & Colcombe (2006)

Resistance training

- Strength program RCT (bands at home)
  - No sig difference between exercise and control groups

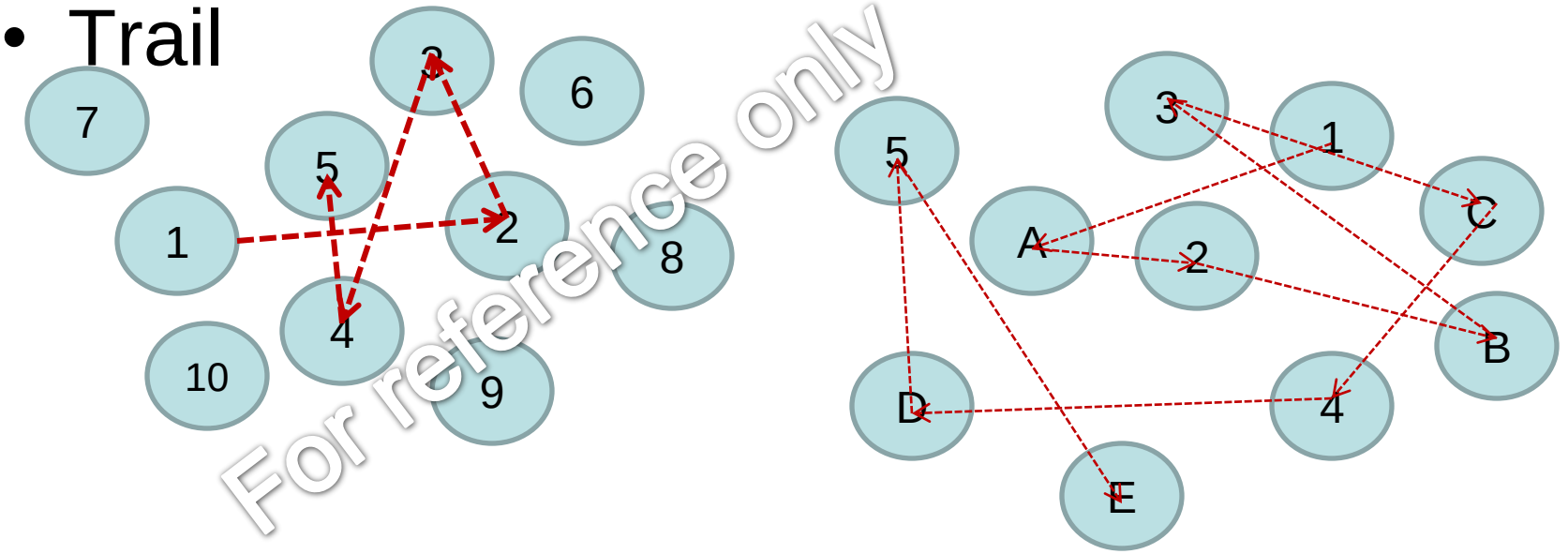
  BUT (within the strength group)
  - >strength gain assoc w/ > improvement in memory
  - 3 and 6 month test. el improved



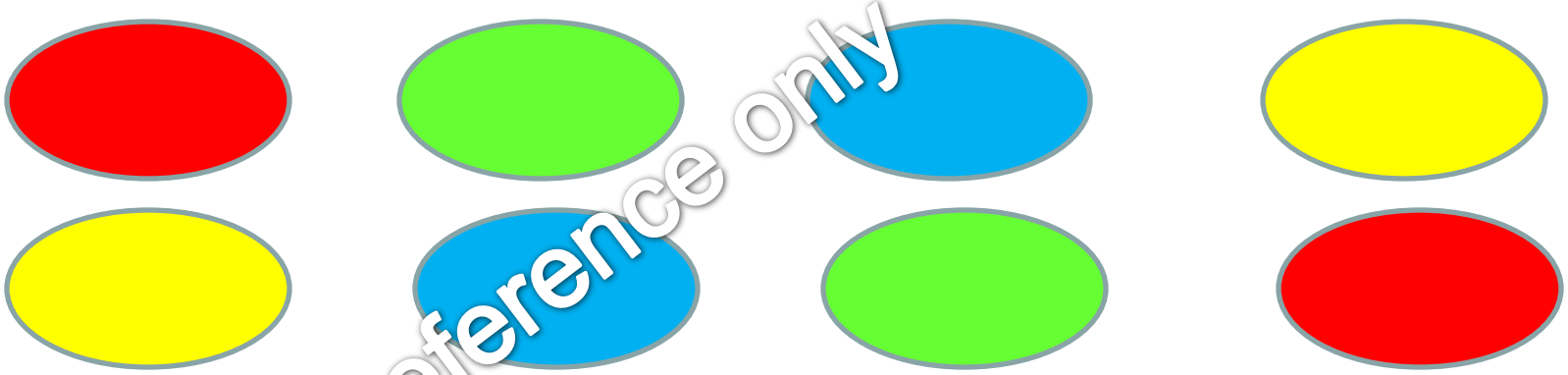
Strong for life (Lachman,2006)

Sample tests

- Trail



Stroop Color test (Say number that corresponds to color)



1 = RED 2 = YELLOW 3 = BLUE 4 = GREEN

Processing speed (executive function)

Stroop Test (Jensen & Rohwer, 1966, Stroop, 1935)

Stroop Color test (Select color #, not the word)

1 = RED 2 = YELLOW 3 = BLUE 4 = GREEN

Interference test (executive function)

Stroop Test (Jensen & Rohwer, 1966, Stroop, 1935)

Attention: Digit span test

• 687	356	637
• 5398	5293	9163
• 92492	61724	76814
• 297356	297865	824316
• 7394578	2286531	9765792

Backwards and forwards.
Words read at 1 second intervals

Resistance Training vs BT

1x or 2x week resistance vs balance/tone

- BT ROM, core strength, tai chi, stances.
- **"No evidence that (BT) exercises improve cog function"**

- Exec function (Stroop) improved more in RT than BT
- Task performance (Trail) improved in RT not in BT
- Brain volume decreased in RT but not BT .

Change pre/post	Stroop	Trail	Dig span	1RM	Power	Brain volume	Adverse events
RT 2x	5	11	-.47	70	13%	-.43%	11%
RT 1x	6	7.3	.06	44	-8%	-.32%	29%
BT	.26 *	9	-.64	18	-16%	0.0%*	9%

Liu-Ambrose, 2010

Acute ex (RT or CV) College aged

- 30 min exercise Randomized repeated measures
  - RT 80% 1RM, Aerobic 60-70% VO_{2max} , Rest
- 30 min resistance NSCA vs 30 min aerobic ACSM
- 21 u/grad.
- Test: Sternberg modified. Computer response.

GBNTM

?? t ??

XJDWRPL

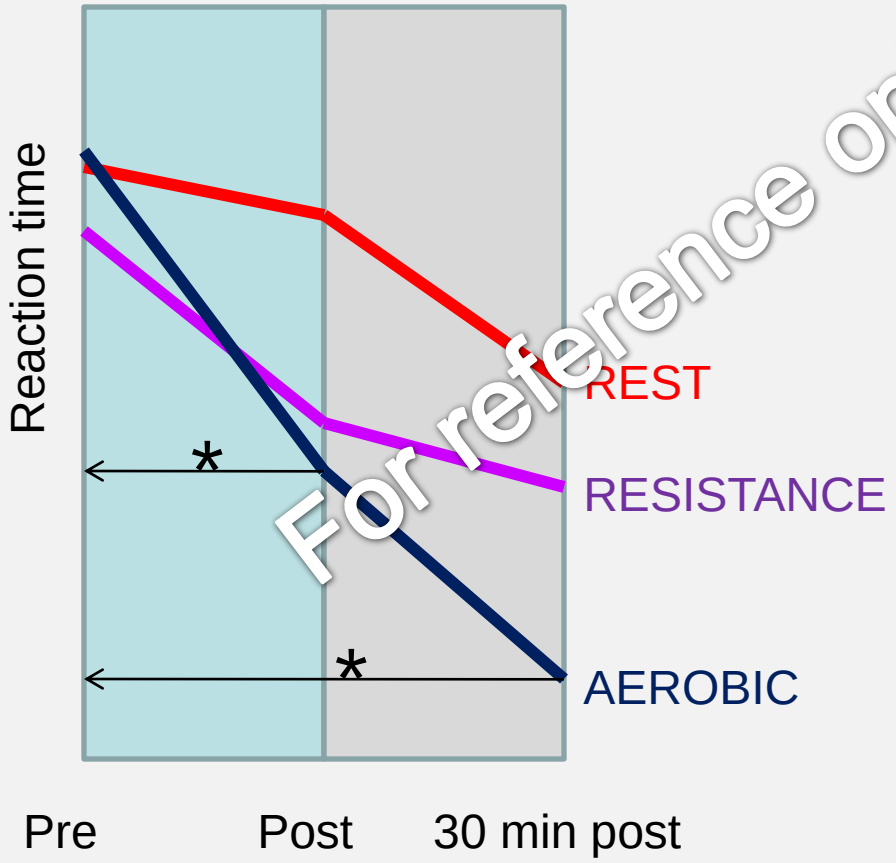
??? h ???

XSWBHLRP

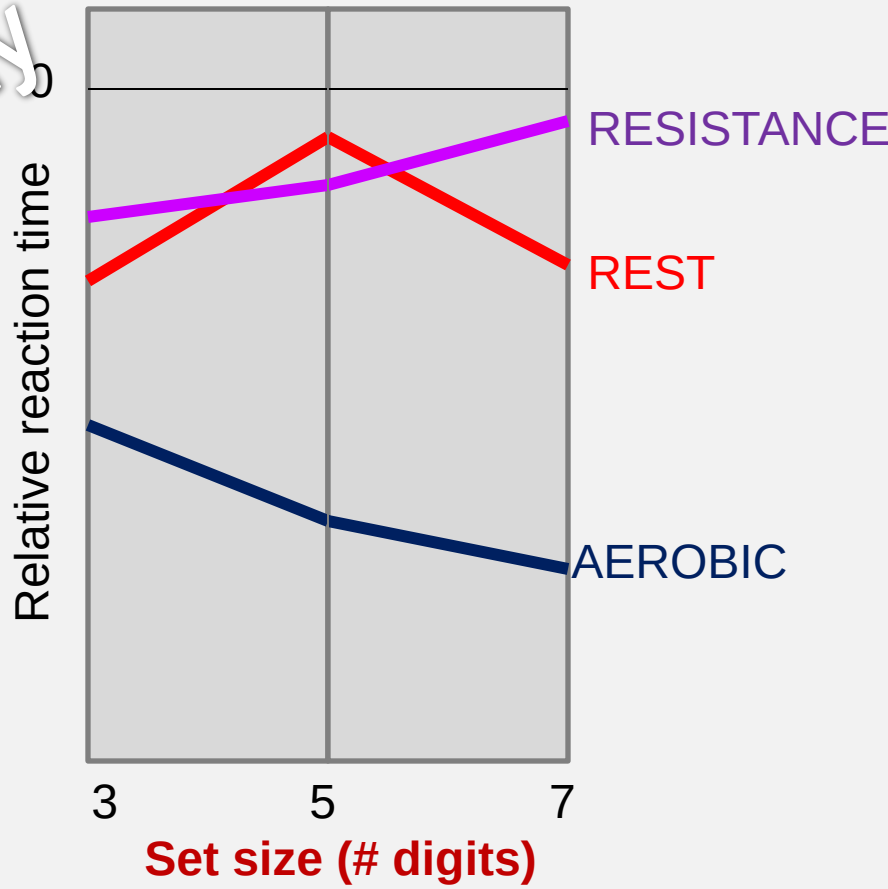
???? r ????

Pontifex et al, 2008

Change in Stroop reaction time (across difficulty levels)



Larger reduction in RT occurred after aerobic ex for more difficult task



Pontifex et al, 2008

The old brain is different

- Brain **improves** with age (wisdom)
  - Accumulated knowledge
  - Expert skills
  - Emotional savvy

- Higher order decision making **unchanged**
- Decision making **slows**
  - Fewer connections
  - Blockages to blood suppy
  - Decreased neurotransmitters

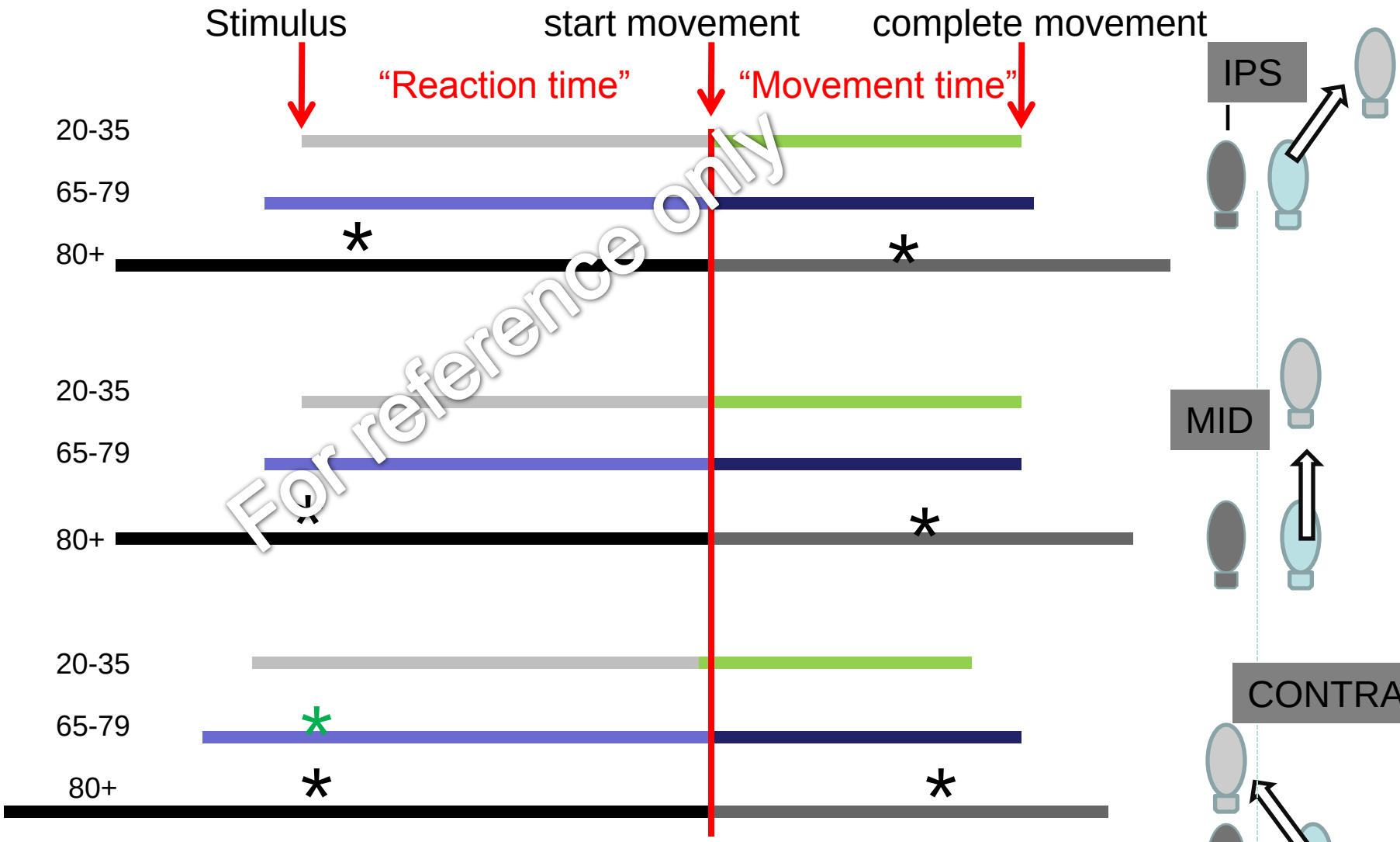
- Short term (working memory) declines

Doraiswamy, 2010

Multi tasking options in ex

- Walkie talkie test
- Balance training with counting
- Combining movements
  - Flexion/extension, abduction/adduction
  - Rotations w/linear moves and directions
- Integrating both sides of body
- Crossing the midline
  - Childhood suppression (9 y.o)
  - Older adults take much longer to plan and do

Older versus younger on reaction time and movement time from seated



*different from 20-35 *different from both age groups

Ref: Lombardi, J.A., Surburg, P., & Koceja, D. (2000). Age differences and changes in midline-crossing inhibition in the lower Extremities. J. Geron MED SCI 55A(5) M293-M298

Best practice: COOL

- CV RT BT
- Social interaction
- Enriched environment
- Involve all parts of the brain:
  - Cognitive involvement
    - Reverse letter Tai Chi
  - Crossing midline
    - Figure 8
  - Combine movements

Consider

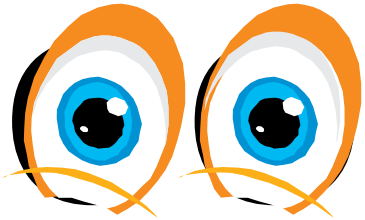
Stimulating environment

Social stimulation

Challenge all parts of the brain

Coordination

Fun

= C  L

Until the research is in consider McLuhan's cool stimulation to involve full person in exercise

EVA DVD

- Exercise from you brain to your toes
- Enquiries:
  - email Pmacfarl@niu.edu
  - Subject line: Eva is cool.
- DVD includes routines from a seated or standing position.
- Cost (includes mail in US):
  - 1 @ $ 20
  - Each additional to same address $ 15.

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