The effects of physical activity on children's cognitive development

Mona Have Sørensen

Institute of Sports Science and Clinical Biomechanics

University of Southern Denmark

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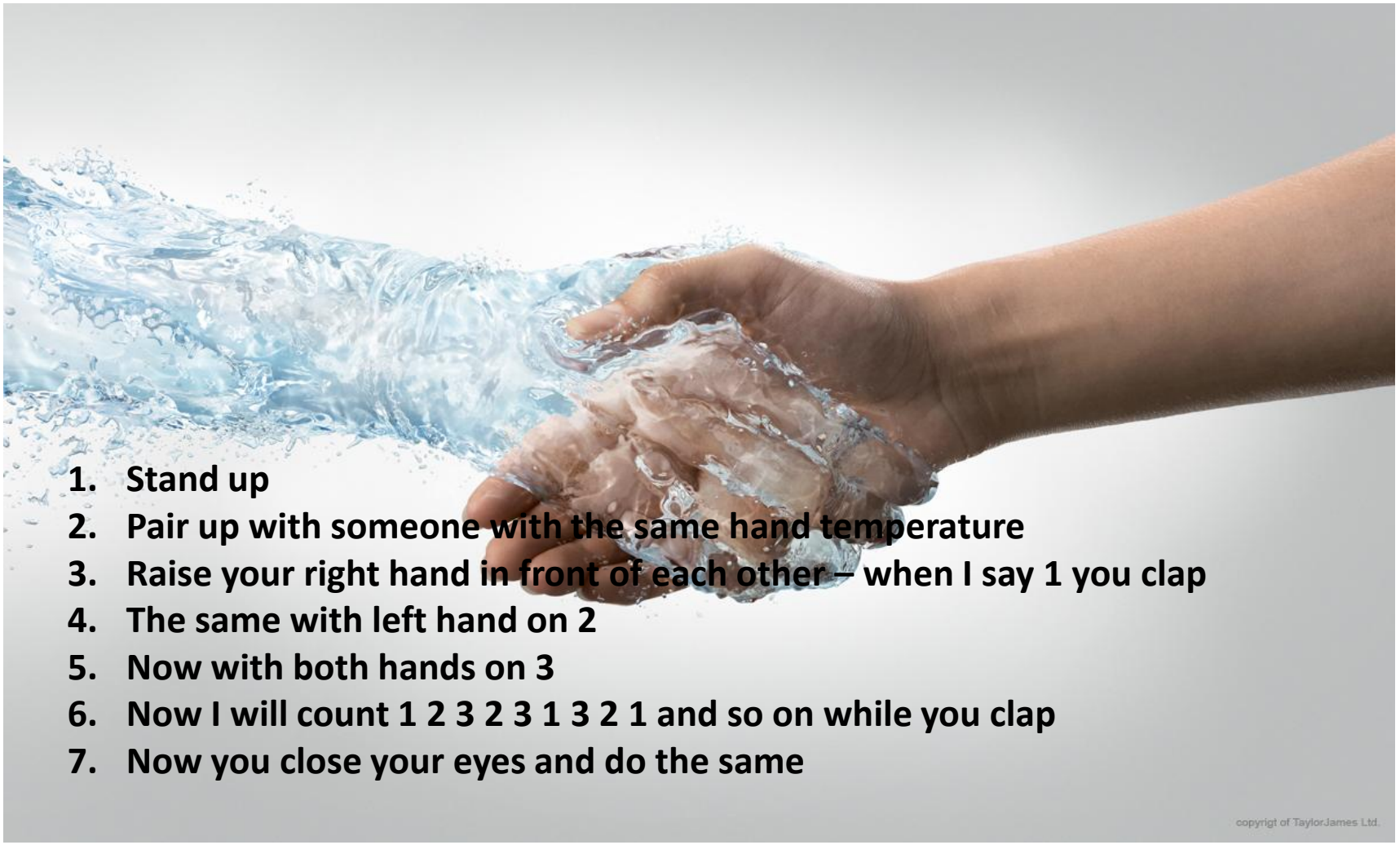
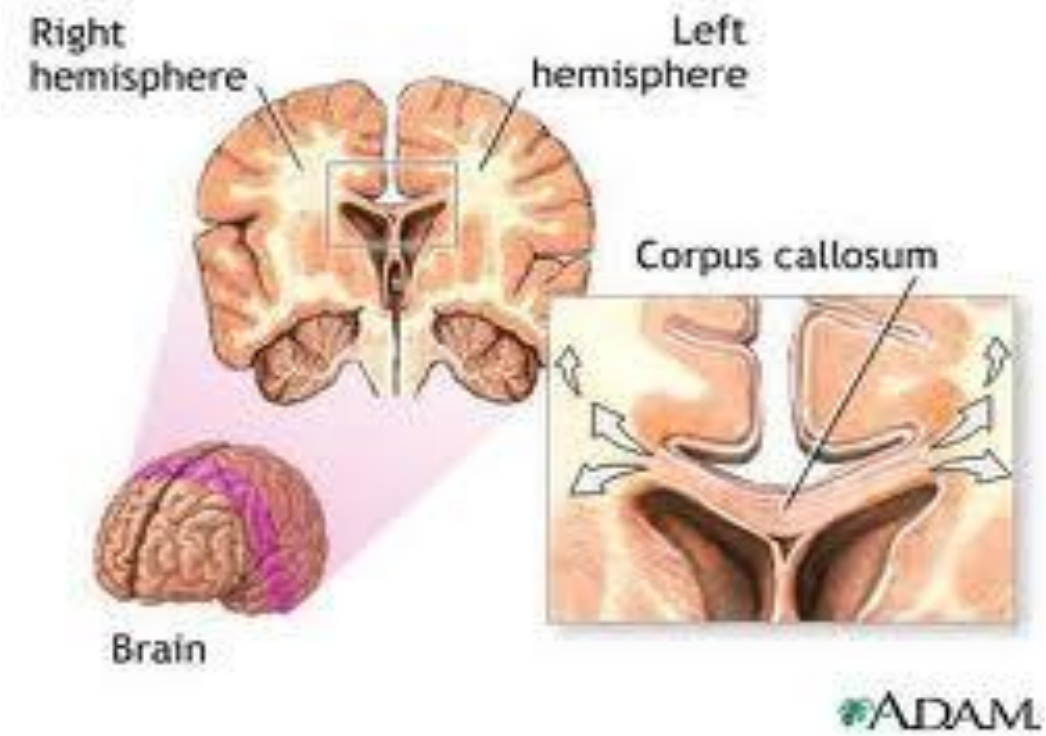
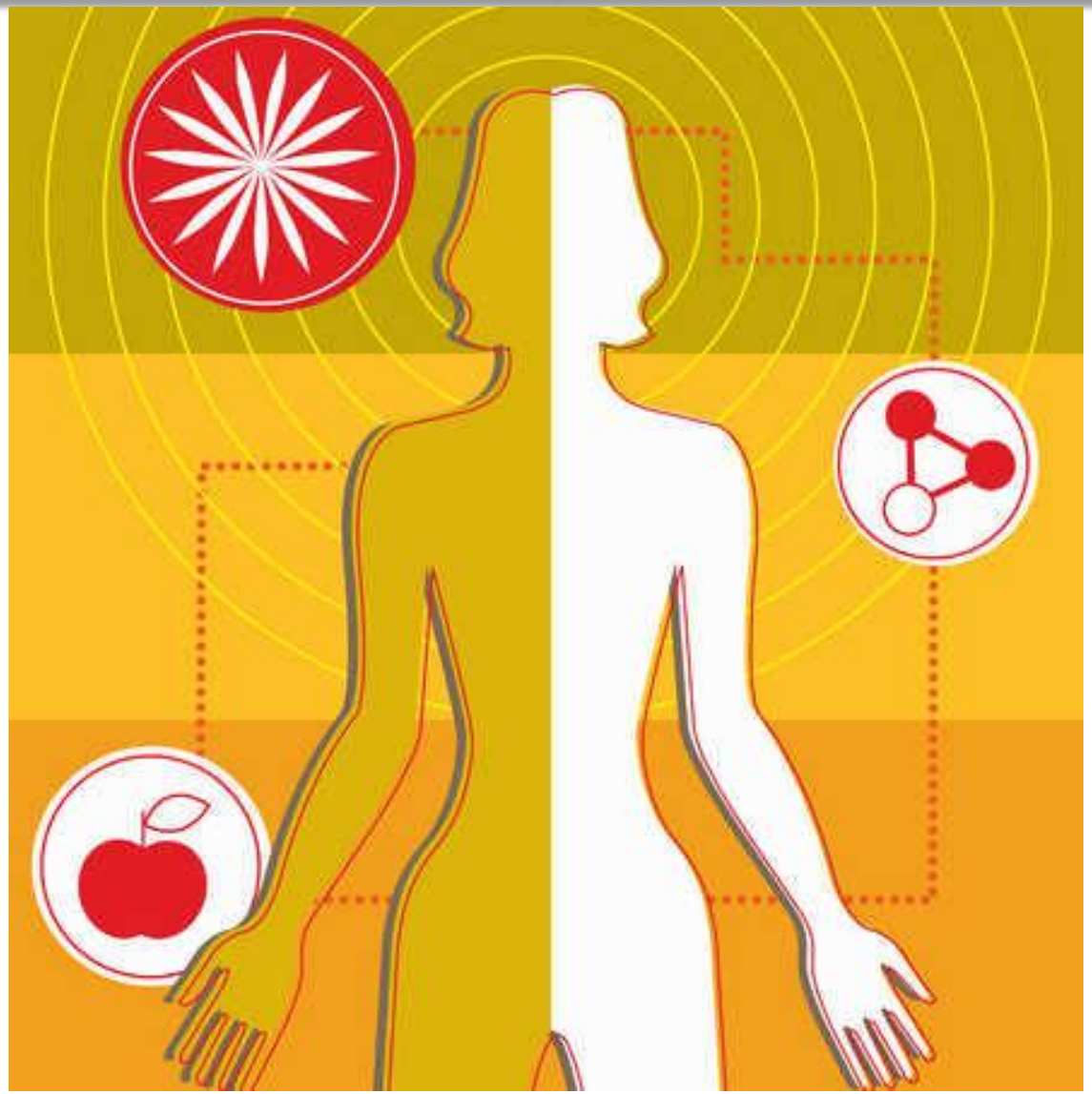


- Corpus callosum



What makes us move is also what makes us think.
(Dennison & Dennison, 1988; Hannaford, 1995; Promislow, 1999; Pica, 2006)

Benefits of crossing your midline



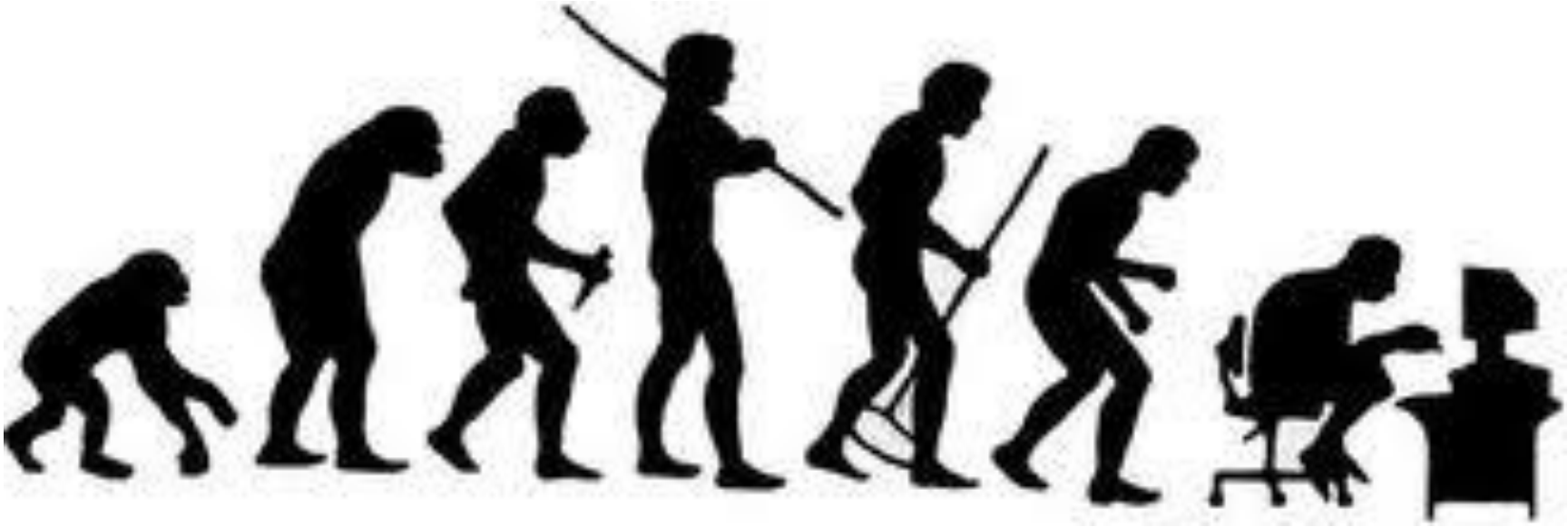
Agenda

- Purpose of the workshop
- Mind - Body association
- Activity
- Executive functions
- Presentation of the ongoing project in Svendborg/Kolding
- Workshop:
  - Developing activities
  - Presentation of activities
- Discussion and future directions

Purpose

- To provide
  - insight into how we use movement to promote cognitive functions
  - hands-on experience with activities and development of activities where physical activity is linked to academic skills/cognitive functions
- To discuss various aspects of the area such as usability, practical challenges, advantages / disadvantages of physical activity integrated in the classroom/as an individual stimulus outside class

"Somewhere, something went terribly wrong"



Ratey 2009

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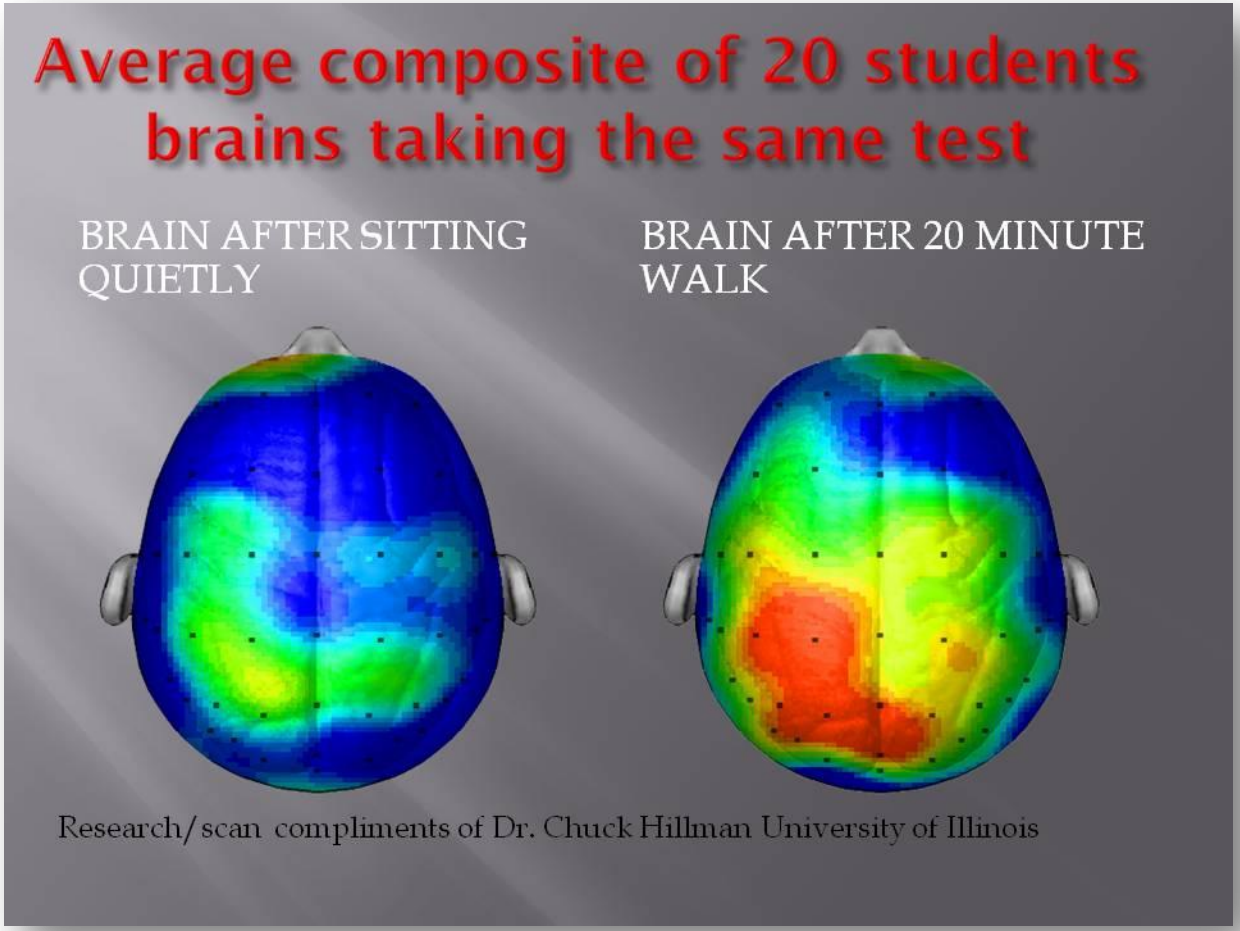

"Excessive sitting is a lethal activity"

Dr. James Levine, Mayo Clinic in Rochester, Minnesota

"Sitting in chairs for more than brief ten-minute intervals reduces our awareness of physical and emotional sensations." (Cranz 1998)

"[...] holding any posture for long periods of time is the ultimate problem, but holding the classic right-angle seated posture, in particular, has its special stresses, which no amount of ergonomic tinkering can eliminate." (Greico 1986)

"Pupils were not disciplined (when chairs were used) but annihilated" (Montessori 1912)

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Our early ancestors predominately consisted of **hunter-gatherer types ensuring the "Running Man" as a standard of fitness for their survival. If you did not run, you did not eat.** Individuals who could out-run & out-plan their peers would survive.

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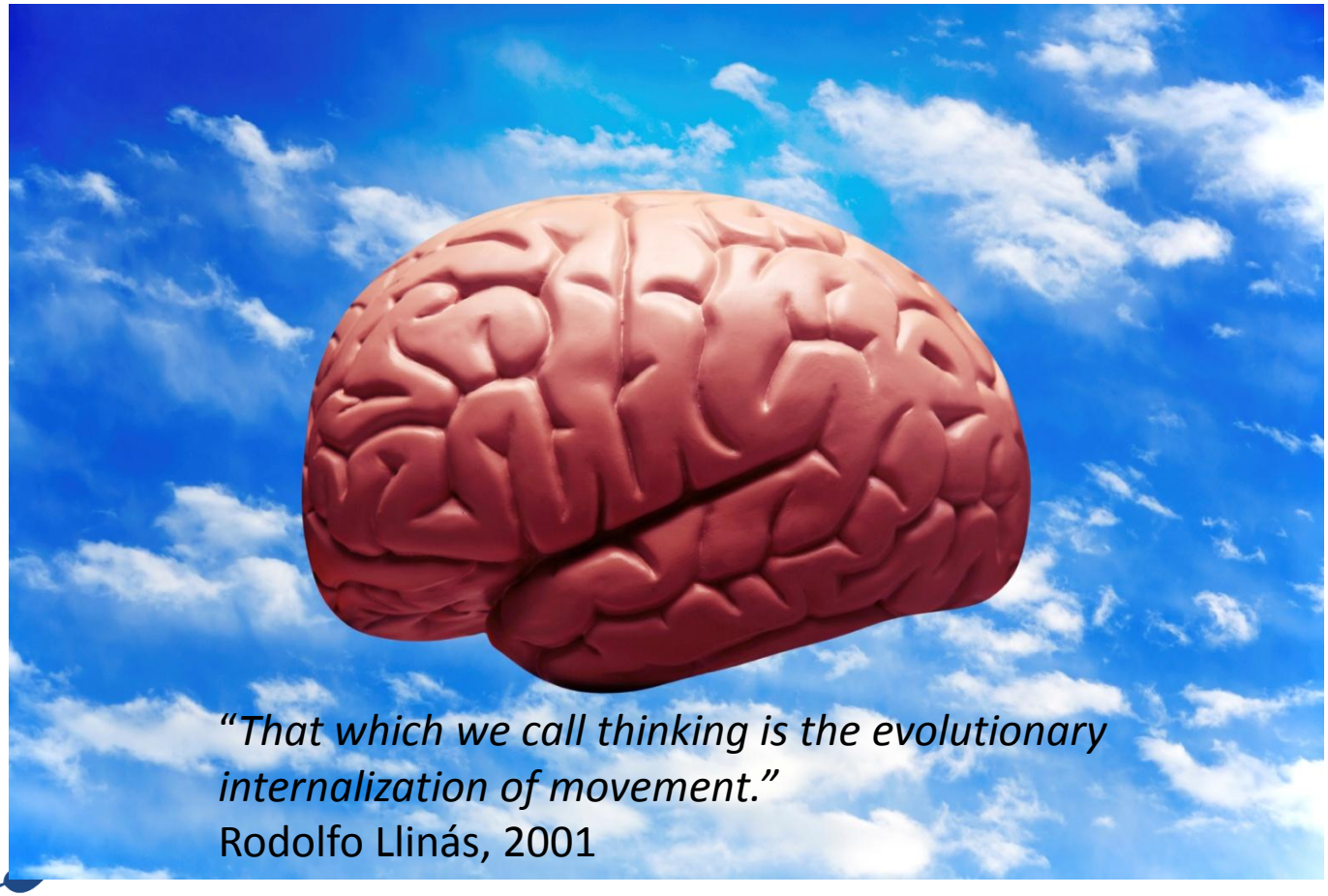


Motor development and cognitive development are fundamentally intertwined.

Diamond, A. (2000) Close interrelation of motor development and cognitive development and of the cerebellum and prefrontal cortex. Child Development, 71,44 56

The brain doesn't recognize the same sharp division between cognitive and motor function that we impose in our thinking.

The SAME or substantially overlapping brain systems subserve BOTH cognitive and motor function.

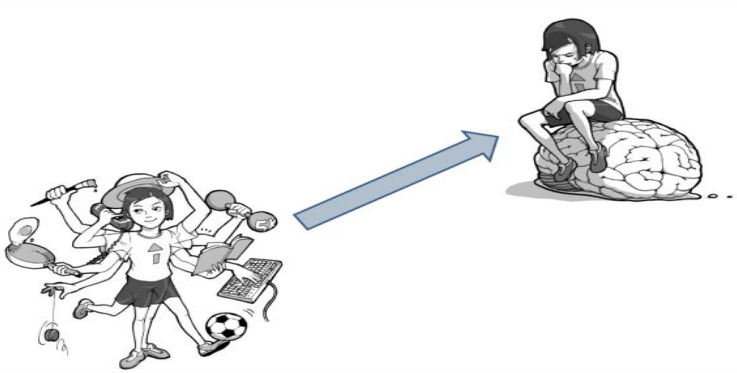
Diamond, A. (2000) Close interrelation of motor development and cognitive development and of the cerebellum and prefrontal cortex. Child Development, 71,44 56

Our body as a form of transport for the head

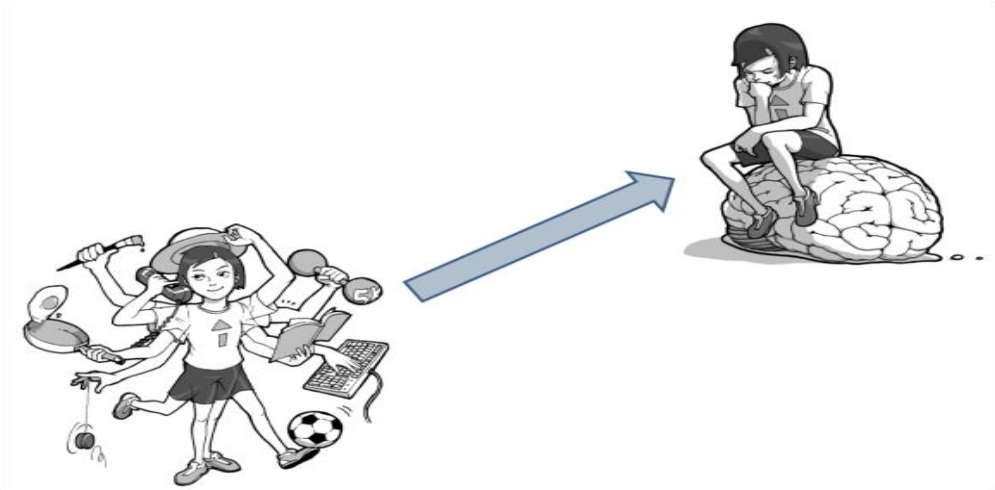
- Traditionally, scientists assumed that the brain functioned independently from the rest of the body.

- "Our body is the instrument which we learn and remember through. When we disconnect the body by ignoring it, we lose access to important information about the world. Information that we can only achieve with a body that is active. "

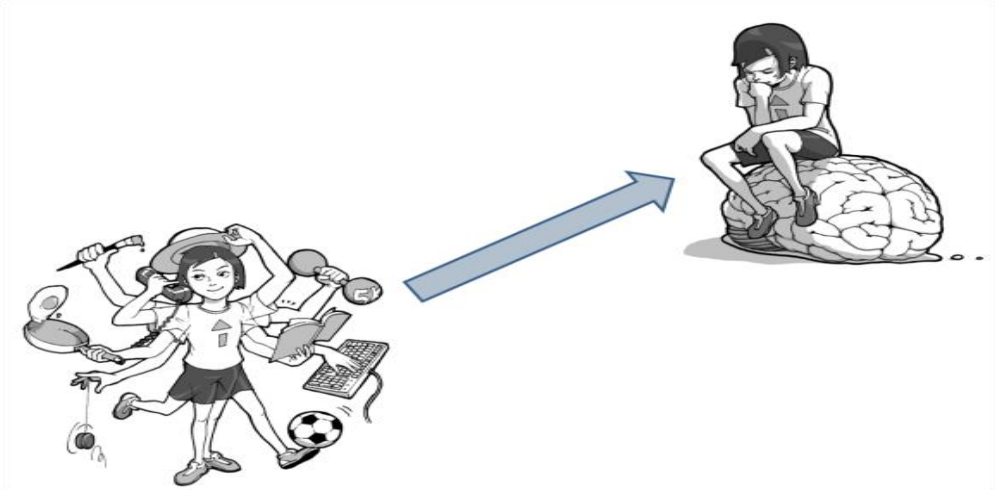
Shilhab et al.(2008)



- PA in learning

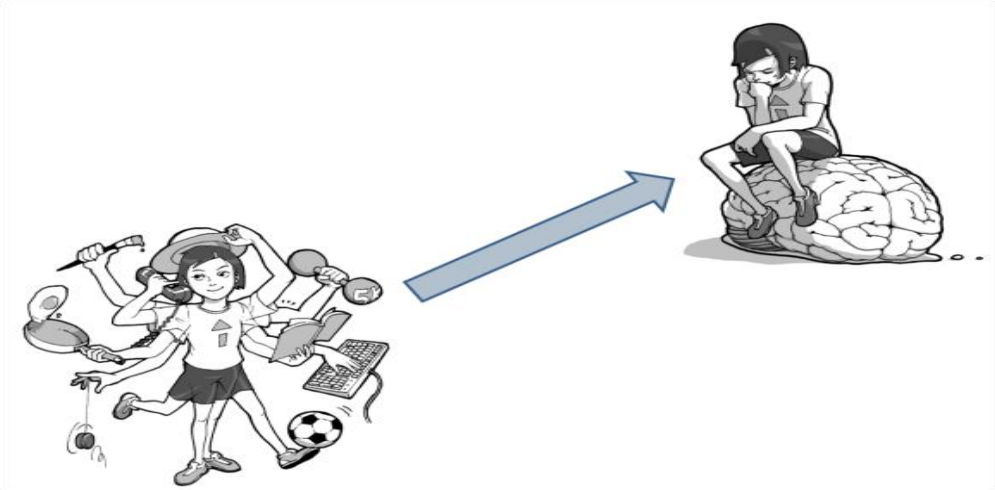


Your expectations?



Your expectations?

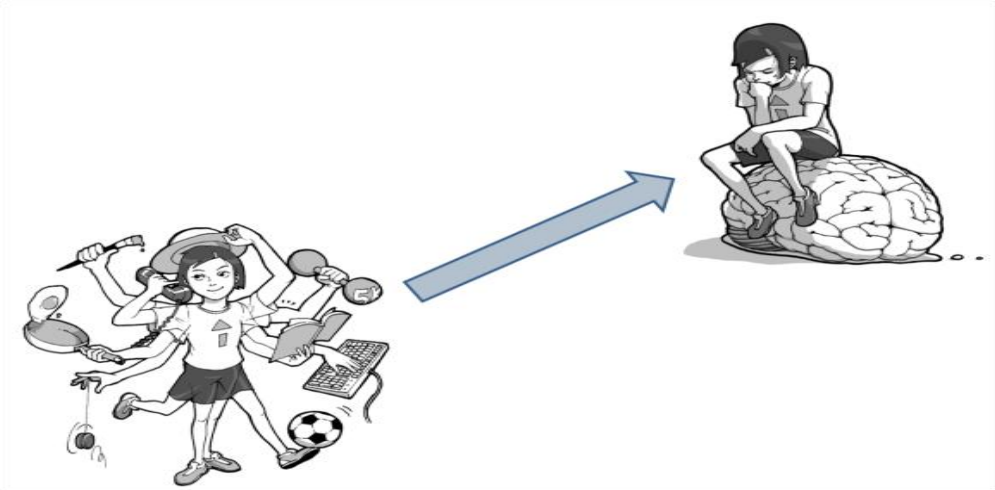
How do you consider the body in academic settings?



Your expectations?

How do you consider the body in academic settings?

Do you expect to be sedentary or moving?



Your expectations?

Your expectations?

Your expectations?

Tradition ?

Assumption:

- The brain function independently from the rest of the body

Effect:

- To learn: SIT STILL!

Rene Descartes (1596 – 1650)

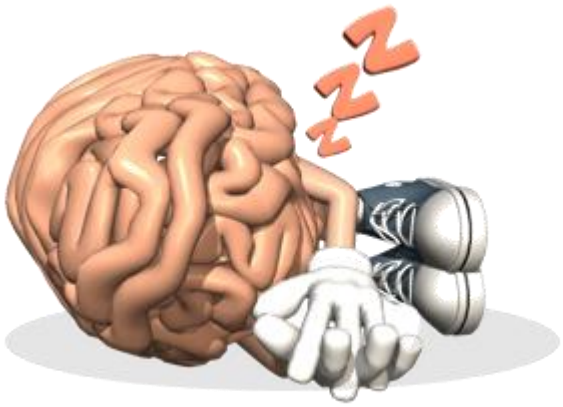
- The mind and body belong each to their particular substance and they are not compatible.
- Thus, the following famous words:
  "Je Pense, donc je suis." The phrase illustrates according to Descartes, our entire existence.
  "Cogito, ergo sum."

Dualistic tradition

- Distance to the body in academic contexts
- Internalization of the association between learning and sedentary activities
- Embodiment:
  - The body as the mediating element between the individual's physical world and cognition.
  - Influences the individual's perception of the world, since the individual organizes the world in relation to the physical experiences.

Brain motto:

"Do not wake me up unless something really interesting is going on"



Brainbreaker : Boldøvelse

1. **Red**
   Say your name
2. **Yellow**
   Say the name of the reciever
3. **Purple**
   Behind your back

4. **Colour**

Put it in without removing the others.
Run to the other circle and give the ball while you say your name

What happend in our brains during the activity?

pattern recognition system

- Executive Functions (EF) is an umbrella term that includes the cognitive processes responsible for organizing and controlling goal-directed behavior (Banich, 2009).
- Although still a matter of debate, one prominent theoretical framework suggests that EF consists of three foundational components: Inhibition, working memory, and cognitive flexibility (Diamond, 2006; Miyake et al., 2000).

Executive functions

Inhibition

Working memory

Cognitive flexibility

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Recent experimental research indicates that both acute and chronic aerobic exercise promote children's executive function.

Furthermore, there is tentative evidence that not all forms of aerobic exercise benefit executive function equally: Cognitively-engaging exercise appears to have a stronger effect than non-engaging exercise on children's executive function.

Best, J.R. (2010)
Verburgh (2013)

Executive Functions

- Core executive functions (Miyake et al. 2000)
  - Cognitive flexibility
  - Inhibition (self-control)
  - Working memory

Executive Functions

- Core executive functions (Miyake et al. 2000)
  - Cognitive flexibility (switch between different tasks)
  - Inhibition (self-control)
  - Working memory is the system that actively holds multiple pieces of transitory information in the mind, where they can be manipulated
- Important for school readiness (above IQ) (Blair et al. 2007)

Executive Functions

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Executive Functions

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  - Inhibition (self-control)
  - Working memory
- Important for school readiness (above IQ) (Blair et al. 2007)
- Predict math and reading competence throughout all school years (Gathercole et al. 2004)
- Remains critical for succes througout life in career (Prince et al. 2007) and marriage (Eakin et al. 2004) as well as positive mental and physical health (Dunn 2010)

- **"We are educating people out of their creativity"**

- Sir Ken Robinson

- "**We are educating people out of their creativity**"

  - Sir Ken Robinson

- 1,600 5-year-olds - creativity test used by NASA to select innovative engineers and scientists.
- Test results amongst 5 year olds: 98%
  Test results amongst 10 year olds: 30%
  Test results amongst 15 year olds: 12%
  Same test given to 280,000 adults: 2%
  - (Beth Jarman Land -Breakpoint and beyond ”non-creative behavior is learned” 1993)

The cognitive study in Svendborg

- Investigate
  - The effect of physical activity on children's cognition, as an integral part of the classroom teaching and as an individual stimulus outside the classroom.

The upcomming study

- Investigate
  - The effect of physical activity on children's cognition, as an integral part of the classroom teaching and as an individual stimulus outside the classroom.

  - Whether it is crucial to include physical activity in the academic subjects in order to demonstrate a clear correlation between physical activity and cognitive abilities, or whether the cognitive abilities are equally influenced simply by increasing the children's physical activity outside the classroom

Overview over types of combinations between physical activity (PA) and academic skills (AS)

Link between PA and AS	Example	Key terms	Aspect
Separated	Increased amount of PE in schedule – no change in classroom teaching	Intensity Duration	Health
Separated	Short phycical activities in classroom (brainbreaks)	Learning readiness	Health
Combined but without connection	Students run to different questions on the curriculum in history	Activity Curriculum	
Combined with connection	Students hold a glass of water and move it around while they learn phrases that includes "drinking a glass of water" in french	Relation Transfer Curriculum	Learning

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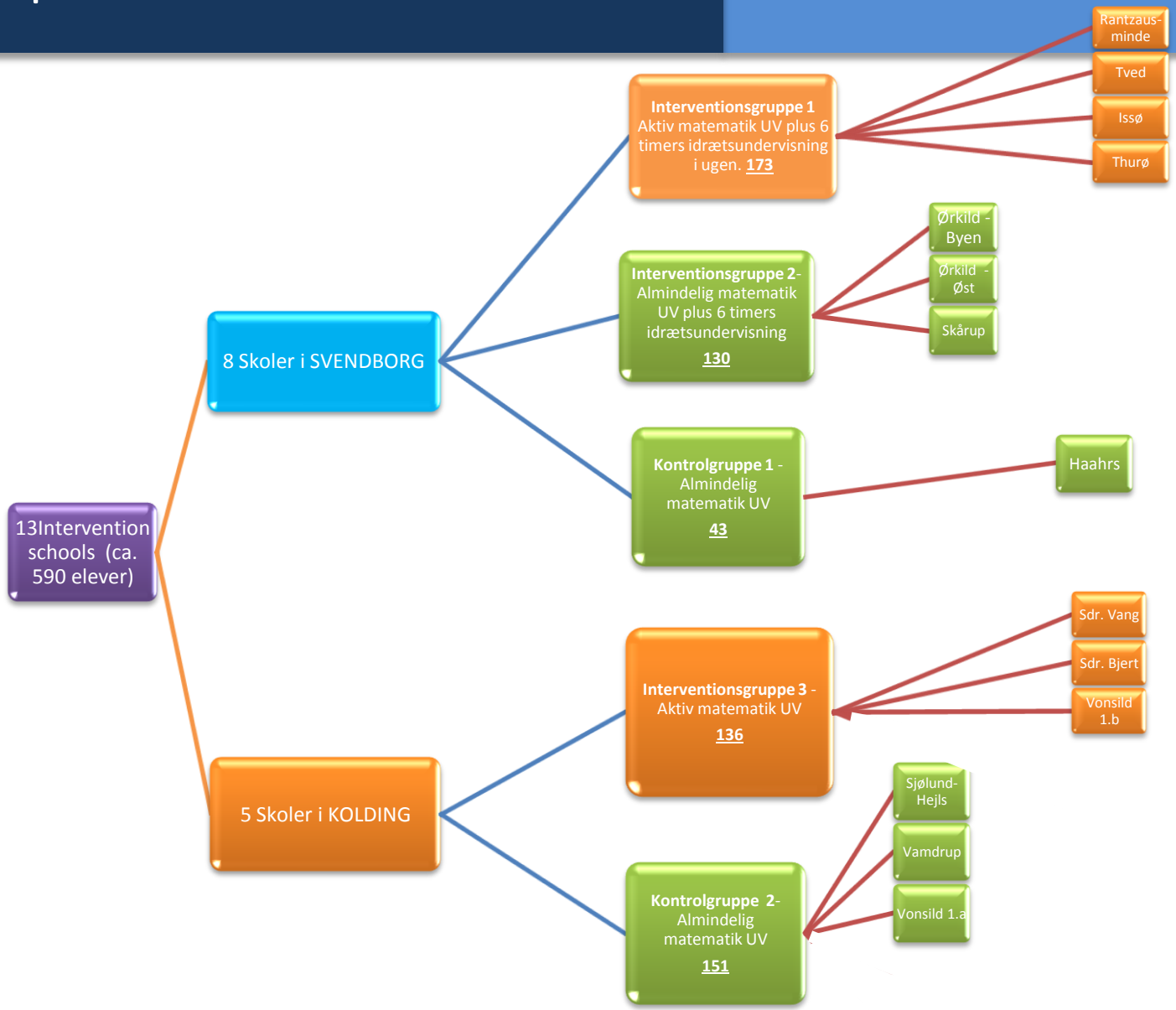
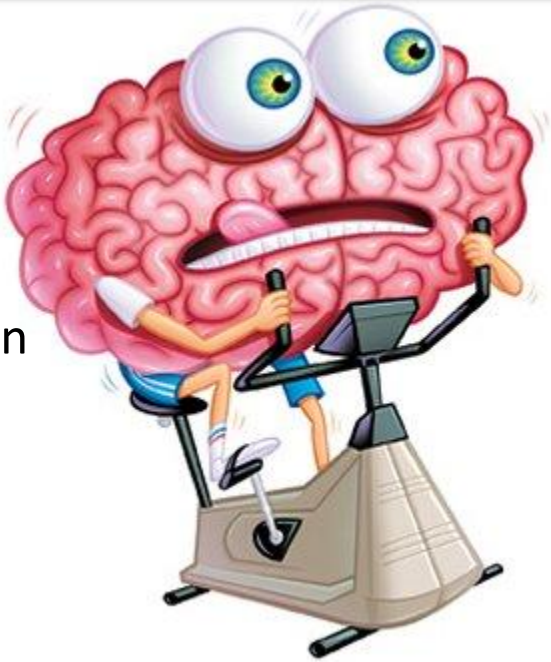


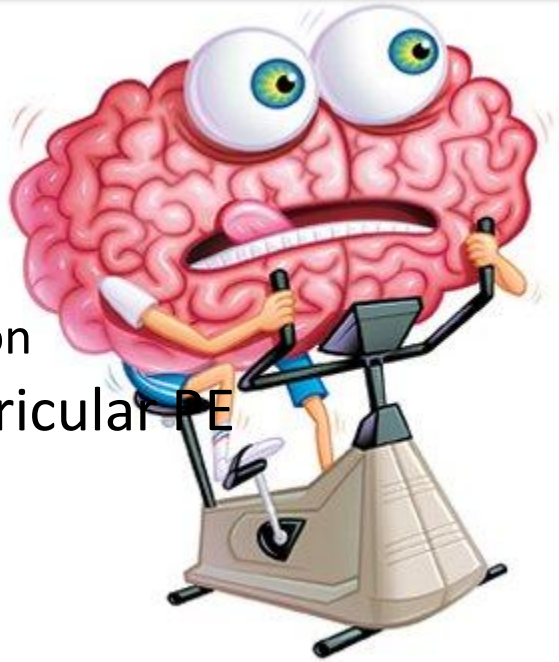
Tests:

- Total Physical activity
  - Accelerometer
  - Registration of daily participation in physical education



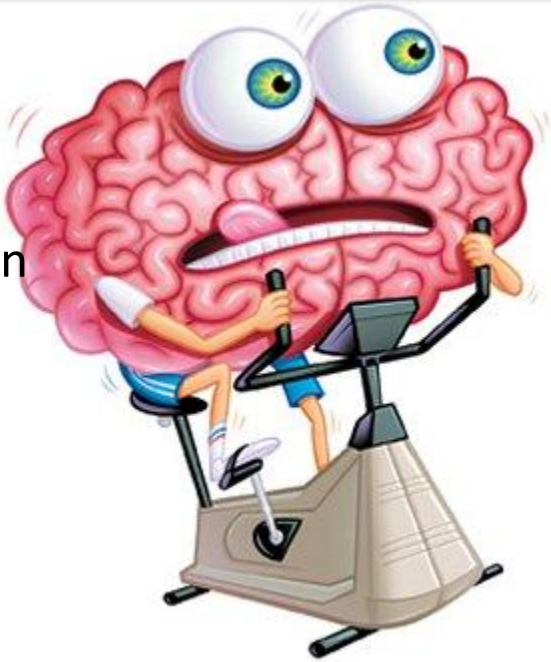
Tests:

- Total Physical activity
  - Accelerometer
  - Registration of daily participation in physical education
  - Registration of daily participation in extracurricular PE
- Fitness
- Andersen running test (Andersen et al. 2008)



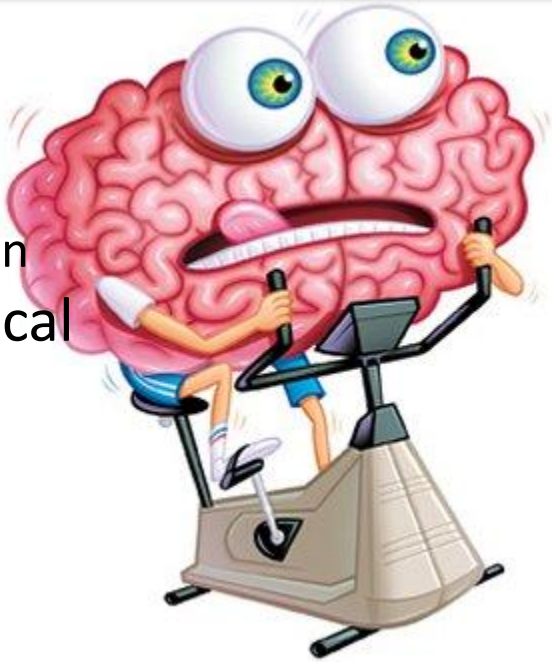
Tests:

- Total Physical activity
  - Accelerometer
  - Registration of daily participation in physical education
- Fitness
  - Andersen running test (Andersen et al. 2008)
- Mathematical performance
  - Standardized tests ("RM 1-7 – Regne-/matematikopgaver")

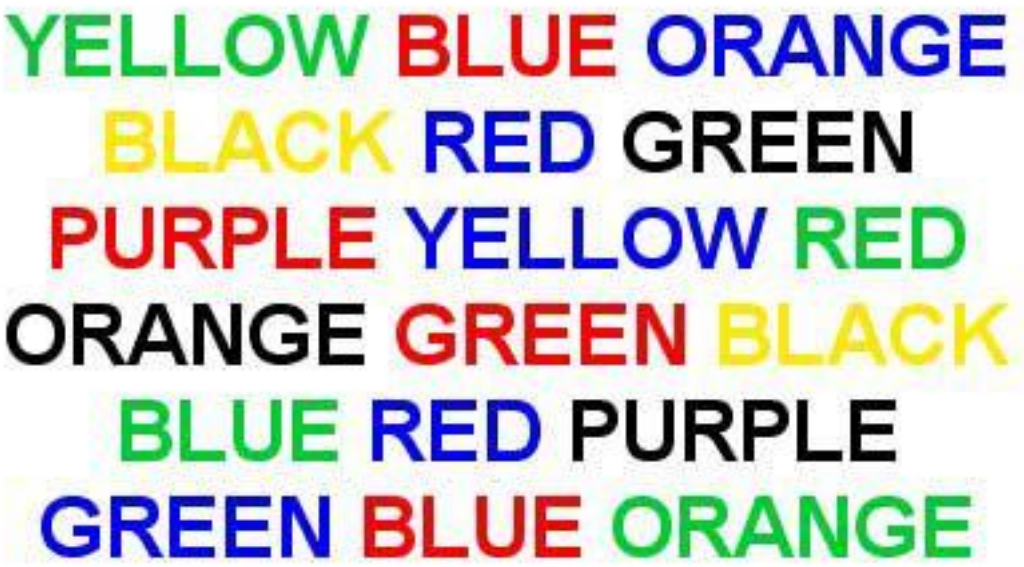


Tests:

- Total Physical activity
  - Accelerometer
  - Registration of daily participation in physical education
  - SMS registration of daily participation in physical education



- Physical condition
  - Andersen running test (Andersen et al. 2008)
- Mathematical performance
  - Standardized tests (MG-prøve - Hogrefe)
- Cognitive functions
  - Flanker
  - Torrance test of Creative thinking


YELLOW BLUE ORANGE
BLACK RED GREEN
PURPLE YELLOW RED
ORANGE GREEN BLACK
BLUE RED PURPLE
GREEN BLUE ORANGE

Flanker test – 5 minutes

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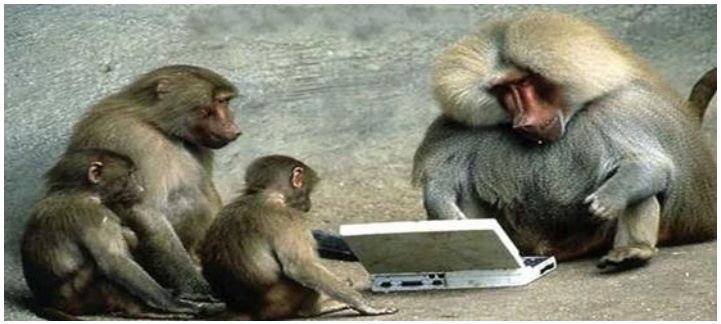
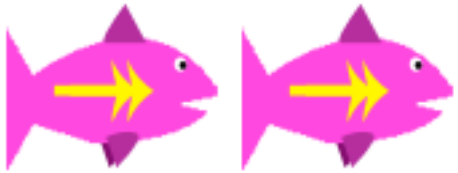
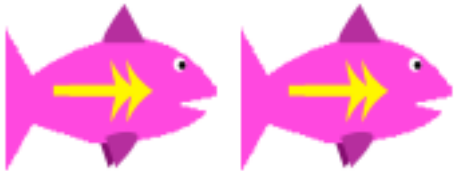


BLÅ betyder du skal fodre den MIDERSTE fisk

PINK betyder du skal fodre de YDERSTE fisk!





BLÅ – MIDTEN!

PINK – YDERST!

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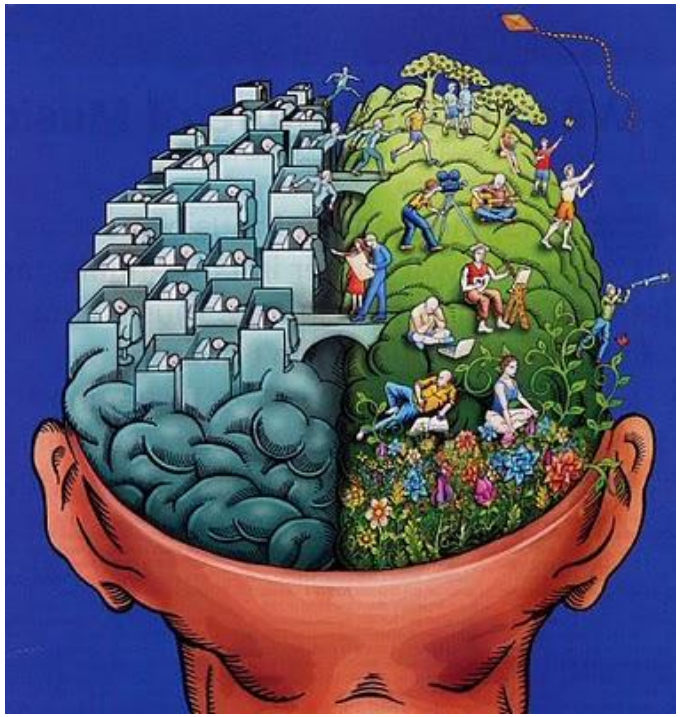
- The torrance tests of creative thinking (Bruton. 2011) are the most widely used tests of their kind since testing only requires the examinee to reflect upon their life experience.

- This is done via the subtest "Thinking creatively with pictures" which is appropriate for children. The test consists of three picture-based exercises to assess the following five mental characteristics: originality, resistance to premature closure, abstractness of titles, fluency and aboration



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- Overall, the extant literature suggests that childhood fitness and physical activity are associated with higher levels of cognition and differences in regional brain structure and function.

A Review of the Relation of Fitness and Physical Activity to Brain Structure and Brain Function in Children

- Laura Chaddock (2011)

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- Form 4 groups

•You are going to develop a physical activity

•The purpose of the activity is to learn/improve:

•An academic subject (eg. English, math, history)
•A cognitive function (eg. Memory)
• facts about PA-cognition

- Discussion

- Can it be done? How / why not?

- What was your experience about connecting FA to cognitive learning

- When did it work? Why?
- What did not work?
- Advantages/disadvantages by implementing physical activity into the academic learning.
- Which factors do we have to adjust for? (teacher's motivation)
- How can it be done?

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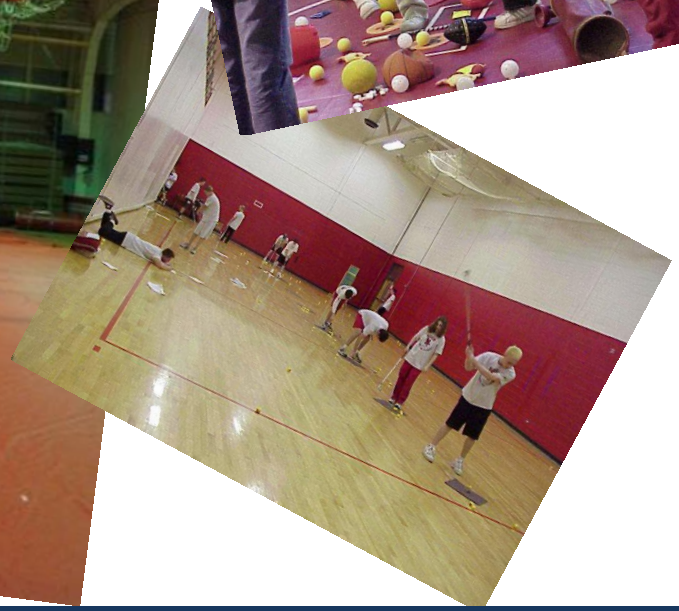
Naperville Central Highschool



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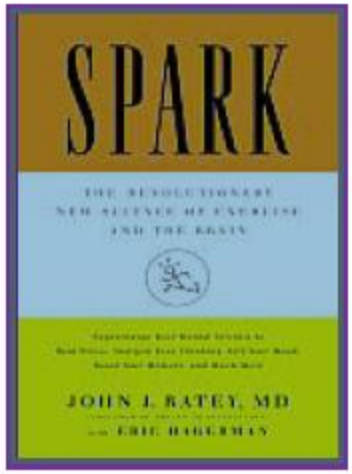

Enhanced Academic Performance

"Consistent exercise, and certain types of specific exercises, can both temporarily and permanently affect the way your brain is able to focus, its ability to deal with stress and anxiety, and its ability to learn ...

"Exercise is like fertilizer for the brain ... it's so good, it's like Miracle Gro".

- Dr. John Ratey, Harvard Brain Researcher

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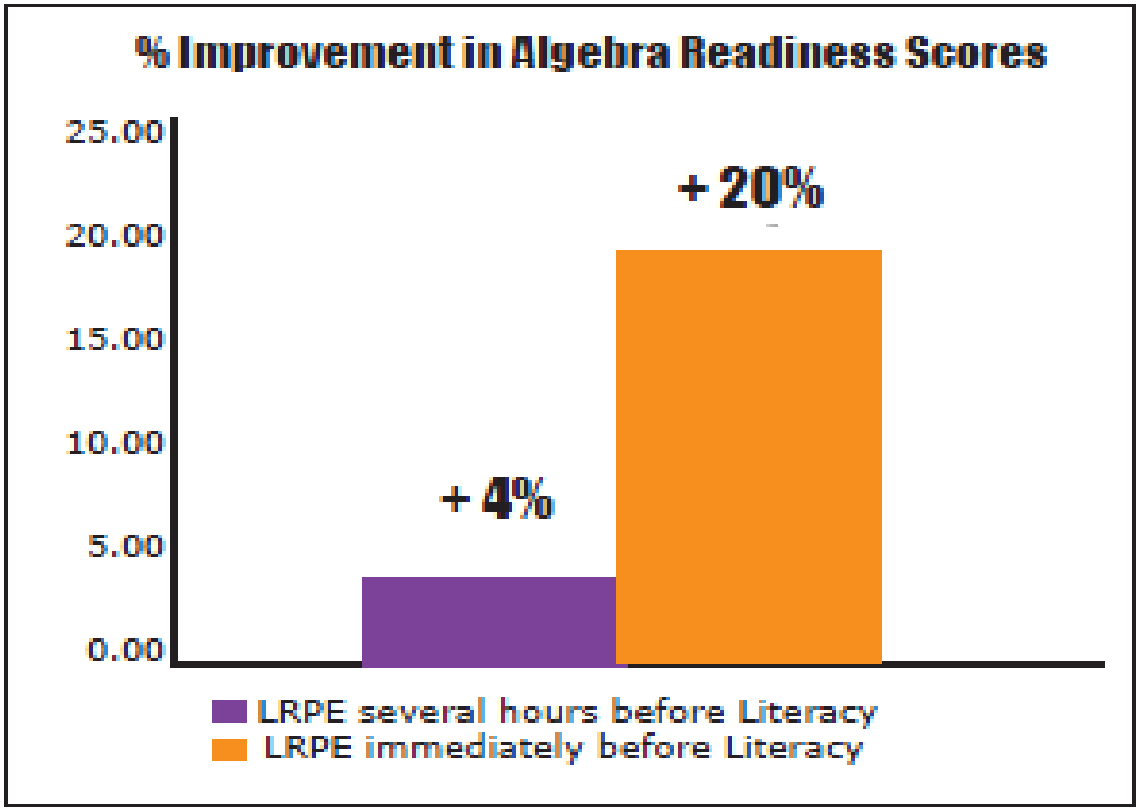

LRPE: Learning Readiness Physical Education

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Trends in International Mathematics and Science study (TIMSS)

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- US
  - 18 in science
  - 19 in math

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- US
  - 18 in science
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- Naperville
  - 1 in science
  - 6 in math

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http://www.learningreadinesspe.com/

- The best proof of a causal relationship - Maria Aaberg. 1.22 million Swedes!
- By examining data from military conscription examination and a follow-up 10-36 years after, Aaberg showed that general cognitive ability was correlated with physical fitness (Aaberg also tested for a correlation with strength, but could not document any such).
- Aaberg measured cognition with four different cognitive tests: logical thinking, linguistic skills, geometric perception and technical or mechanical skills.

- In addition to simply displaying the relationship between physical fitness and cognition, Aaberg did a few analyzes.
- Imagine two brothers. The two brothers have lived in the same family, received the same diet, comes from the same socioeconomic background, etc.
- One brother is in good shape - the other brother is in bad shape.
  As in the case of brothers, many of the factors that might otherwise affect their cognitive abilities (such as parental education level) is eliminated. But we still can not say with certainty that the difference in cognitive abilities is not caused by the genetic combination of brother who is in good shape.

- Now imagine two genetically identical twins.

- Now imagine two genetically identical twins.
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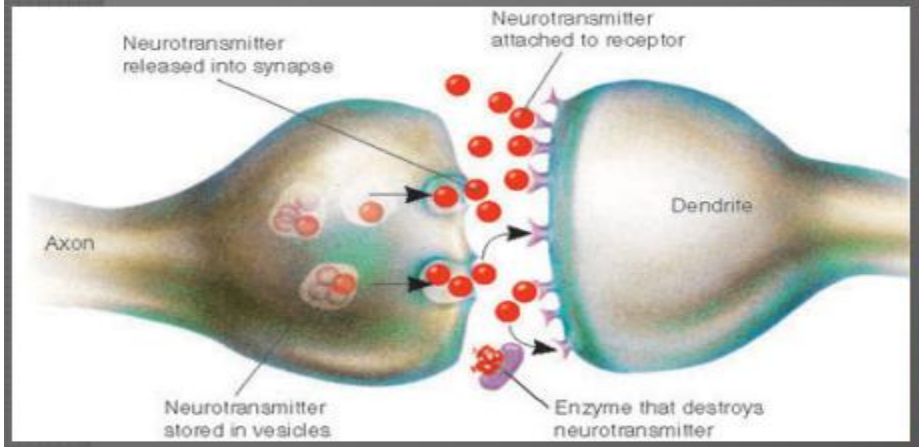
- On the other hand, if the difference in physical fitness contributes to better cognitive abilities, the brother who is in good shape will have better cognitive abilities.
- Aaberg's data showed that the difference in the cognitive tests between the two twins was almost as great as the difference between the other two brothers.

Nerve Cells Wiring = the Building Block of learning



- By increasing neurotransmitter activity, improving blood flow and producing Brain Growth Factors that I call Miracle Gro or Brain Fertilizers, exercise readies our nerve cells to bind more easily and stronger.
- Exercise does this better than any other factor we are aware of at the present time.

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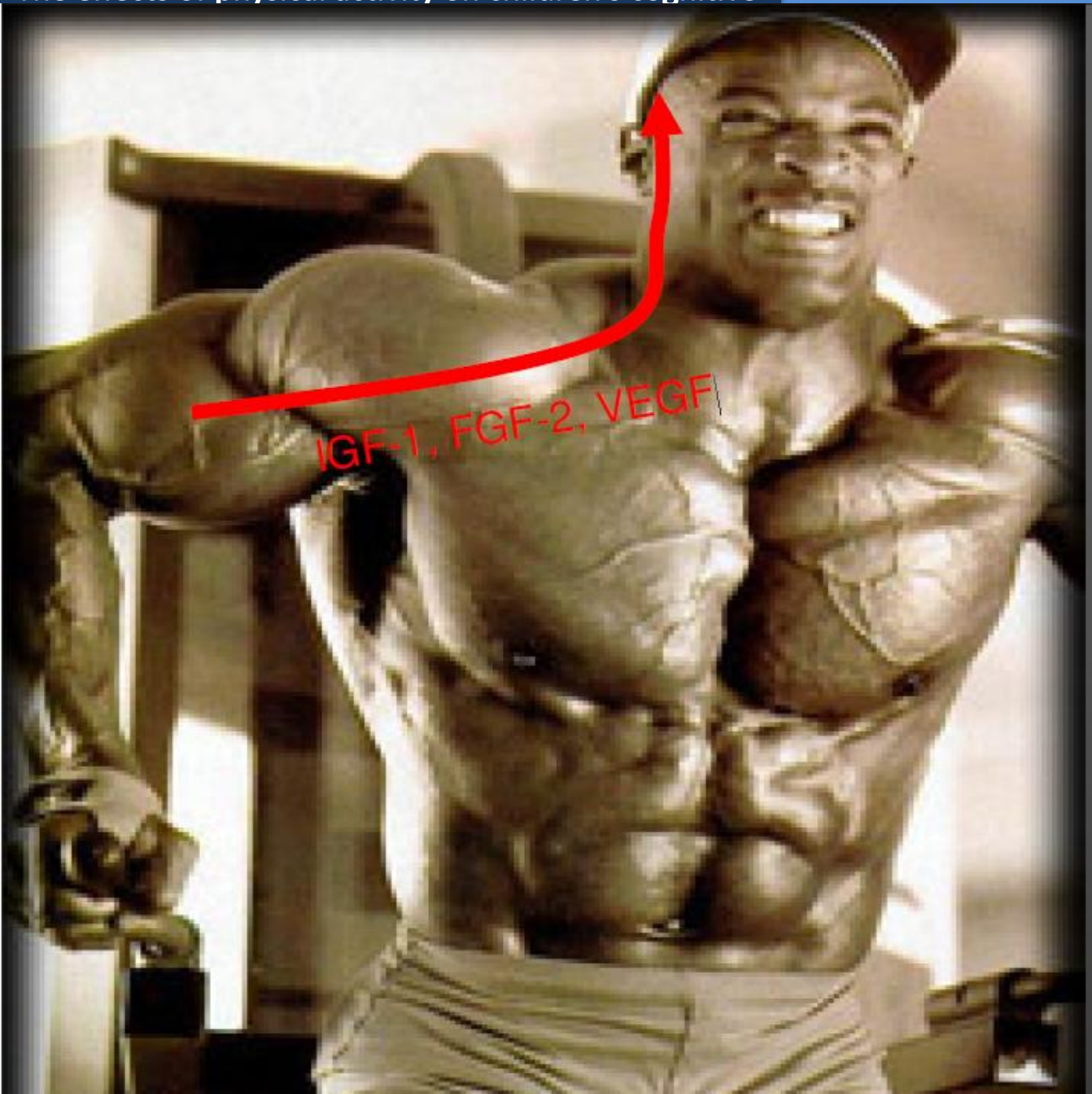


BODY ☞ BRA

IGF-1 Insulin-like Gro
Factor

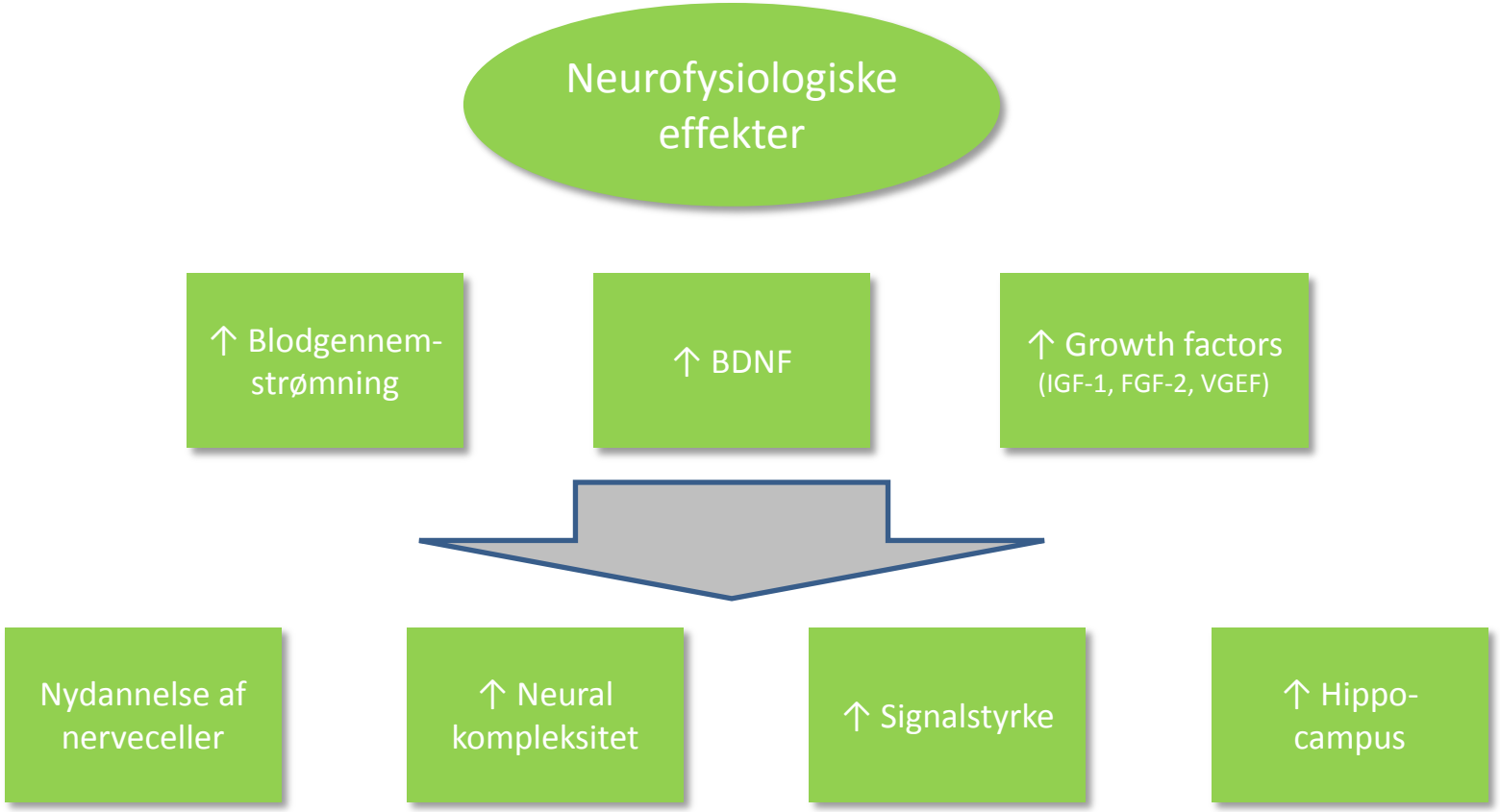
VEGF Vascular endot
factor

FGF-2 Fibroblast grow
factor

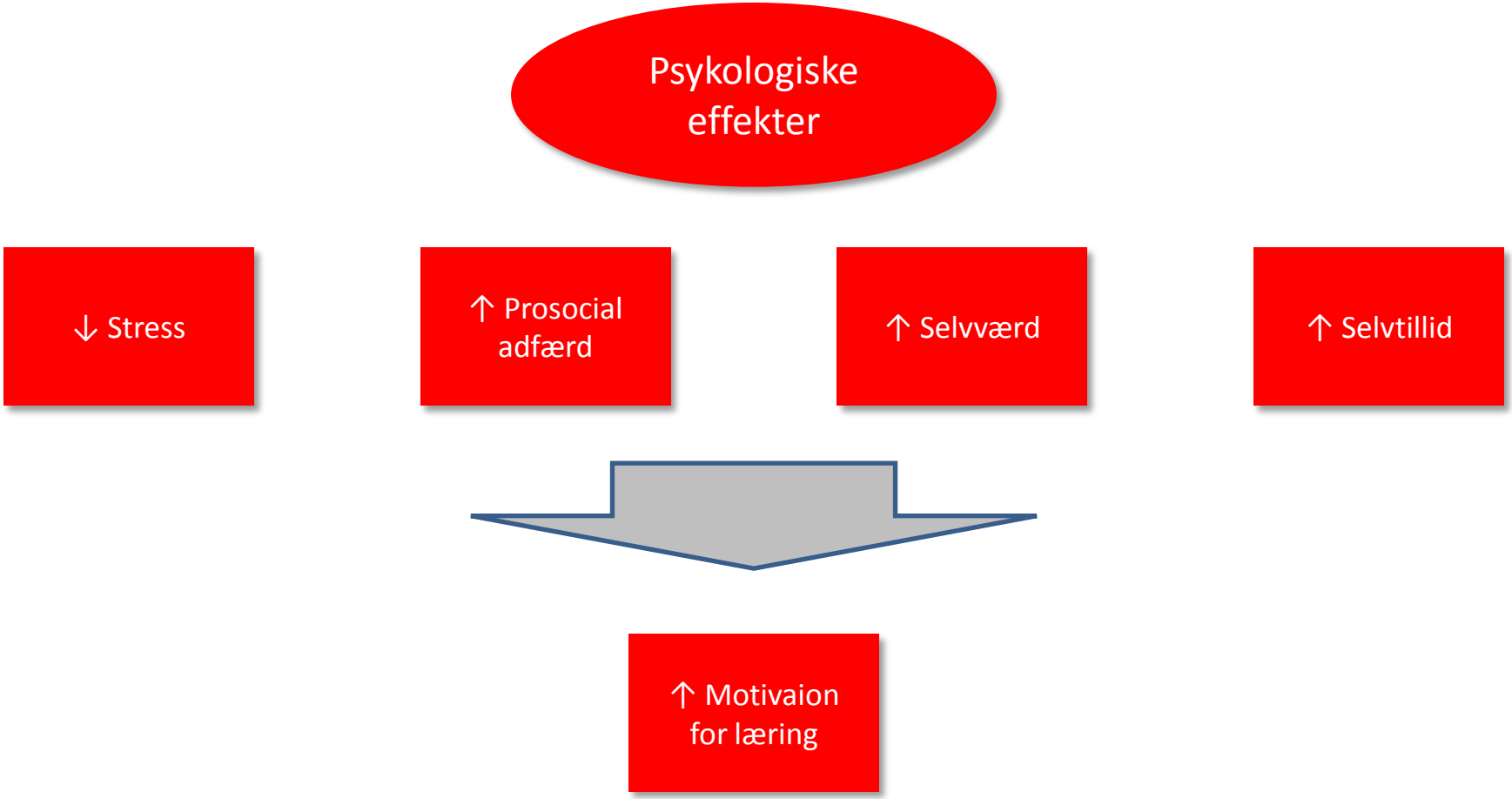
ANP- Atrial Natriuretic
Factor

ALL THESE COME FROM M
CONTRACTION AND TRAV
THE BRAIN AND HAVE AN
EFFECT ON LEARNING AN

Potentielle effekter af aktivitet



Potentielle effekter af aktivitet



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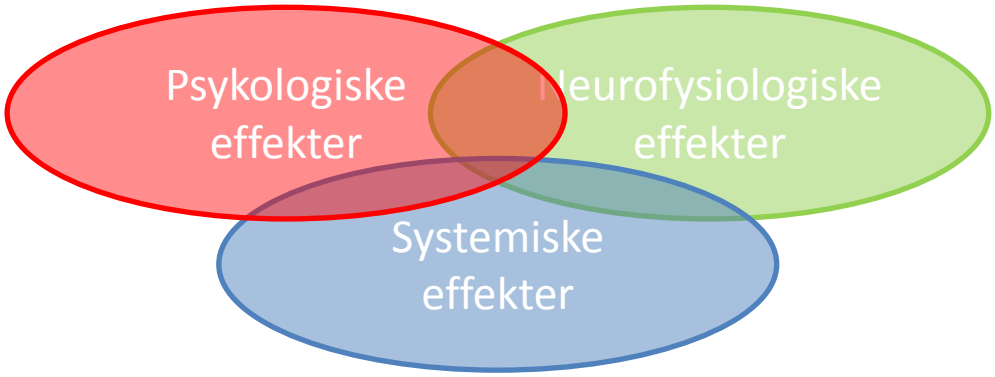

↑ Koncentra-tionsevne

↑ Hukommelse

↑ Motorik

↑ Motivation for læring

↑ Læring

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- Thank You

The Association Between School-Based Physical Activity, Including Physical Education, and Academic Performance

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention
National Center for Chronic Disease Prevention and Health Promotion
Division of Adolescent and School Health
www.cdc.gov/HealthyYouth

Revised Version — July 2010
(Replaces April 2010 Early Release)

Inclusion Criterias:

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Inclusion Criterias:

- Articles published after 1985

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Inclusion Criterias:

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  - Academic Behaviour (e.g. attendance, impulse control etc.)
  - Academic Achievement (e.g. performance tests, grades etc.)
- From 406 articles, 43 were included

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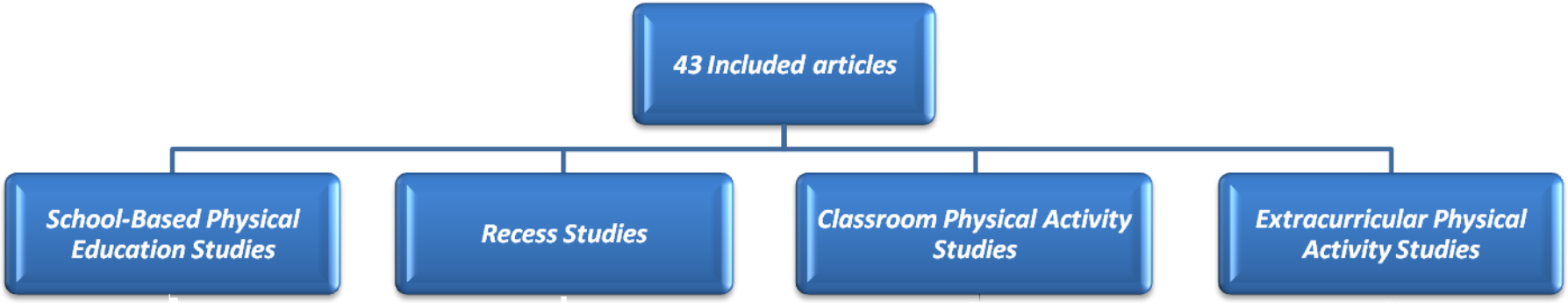
The effects of physical activity on children's cognitive development



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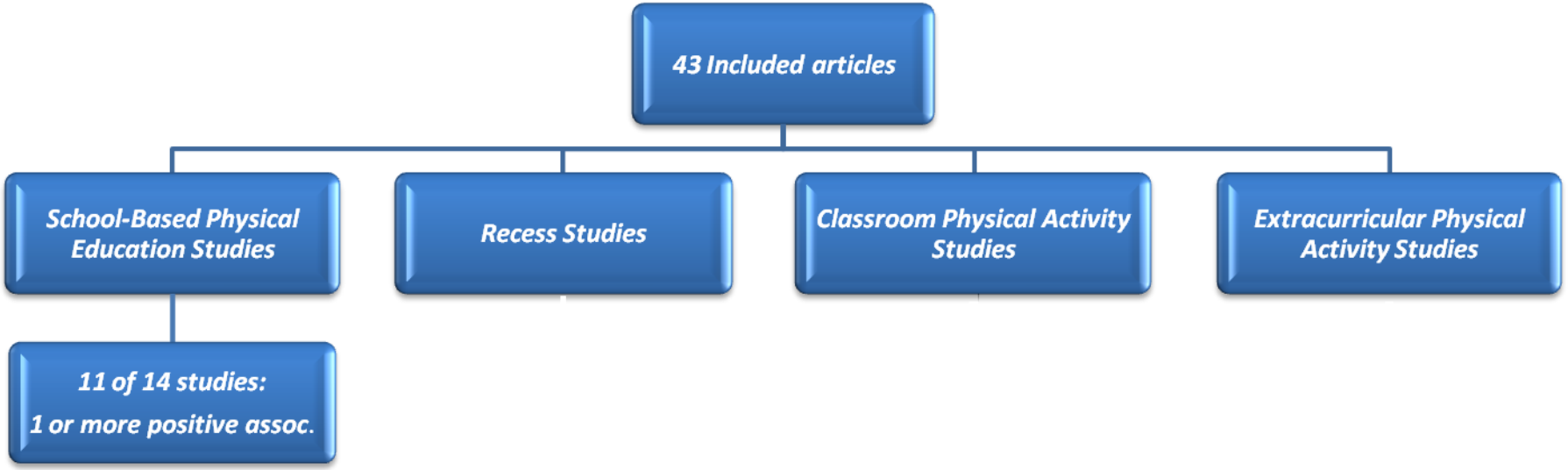
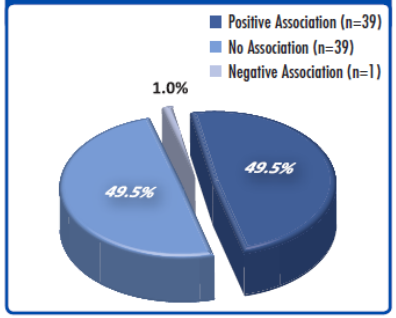


FIGURE 2:

Type of Association Observed for Cognitive Skills and Attitudes, Academic Behaviors, and Academic Achievement Outcomes Across All Physical Education Class Studies

(n=79 associations within 14 studies)



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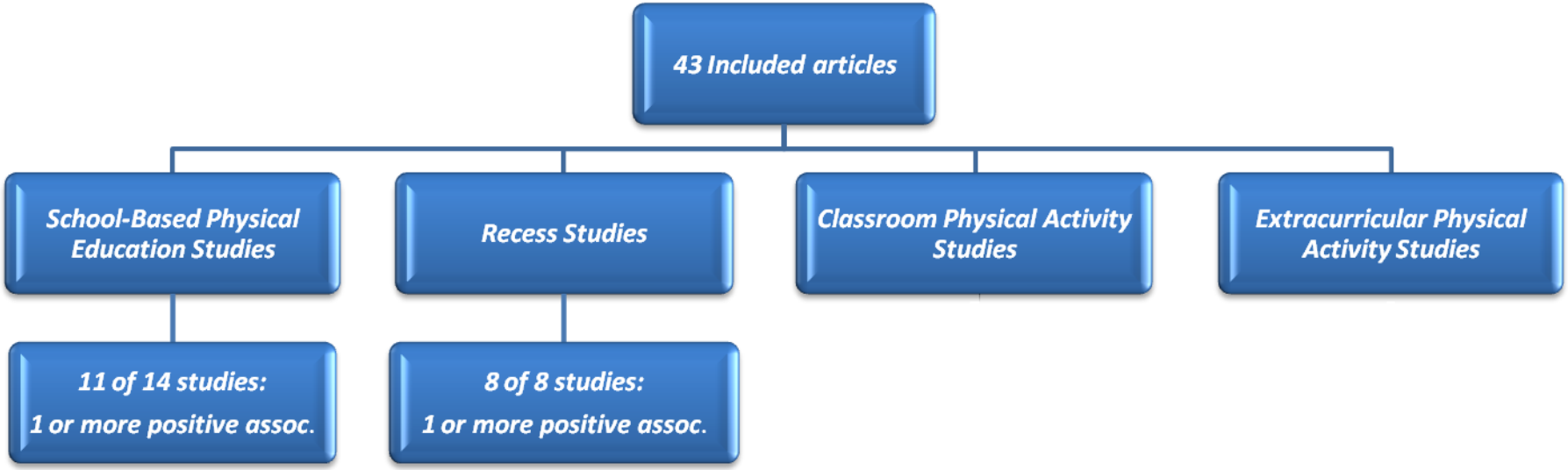

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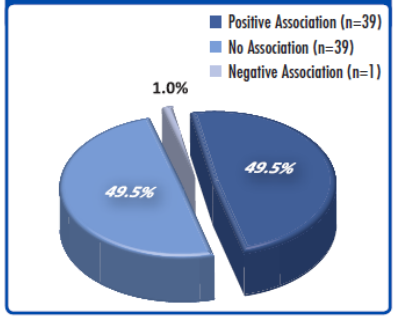
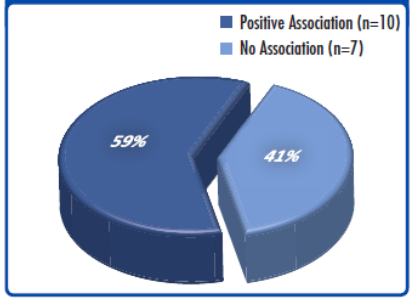


FIGURE 3:
Type of Association Observed for Cognitive Skills and Attitudes, Academic Behaviors, and Academic Achievement Outcomes Across All Recess Studies
(n=17 associations within 8 studies)



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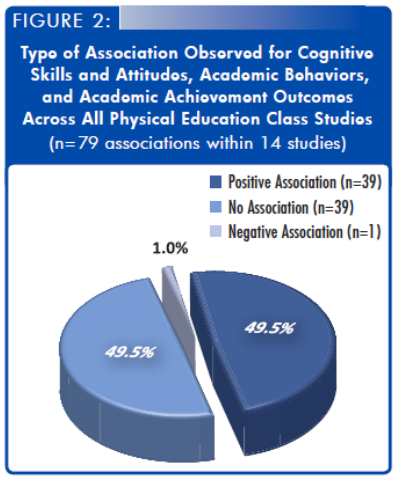
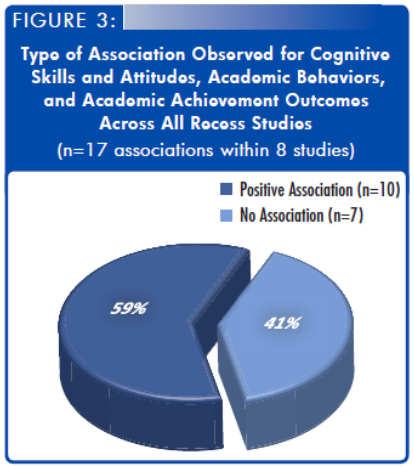
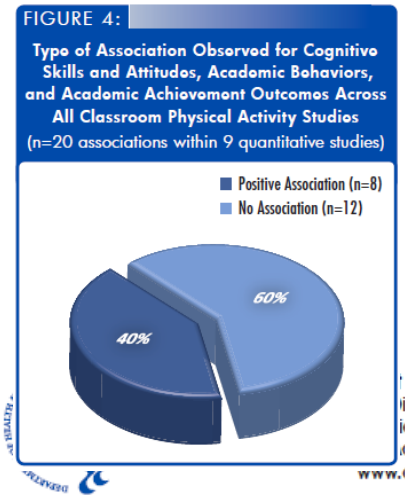
43 Included articles

School-Based Physical Education Studies	Recess Studies	Classroom Physical Activity Studies	Extracurricular Physical Activity Studies
11 of 14 studies: 1 or more positive assoc.	8 of 8 studies: 1 or more positive assoc.	8 of 9 studies: 1 or more positive assoc	







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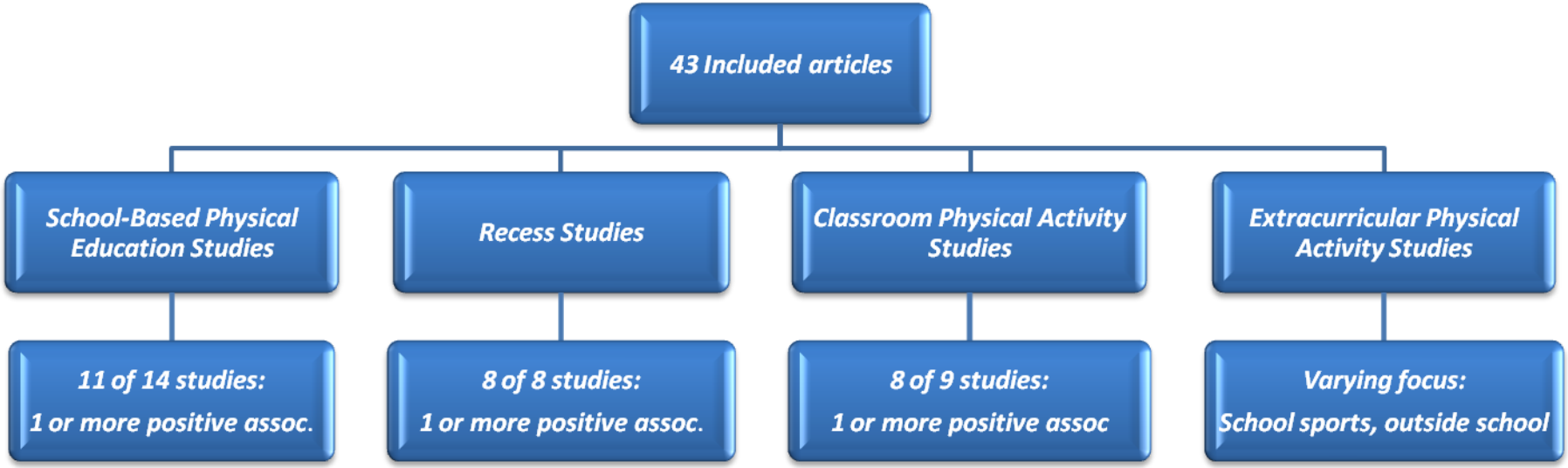

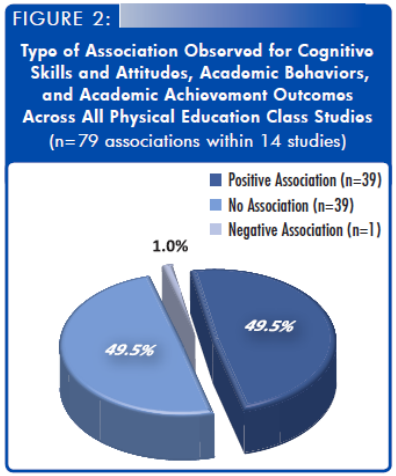

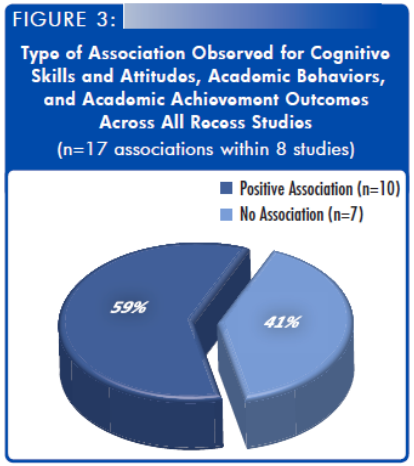

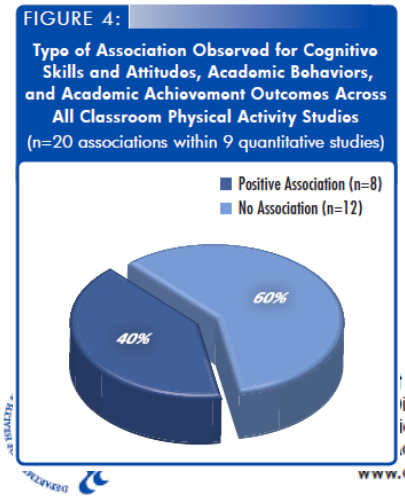

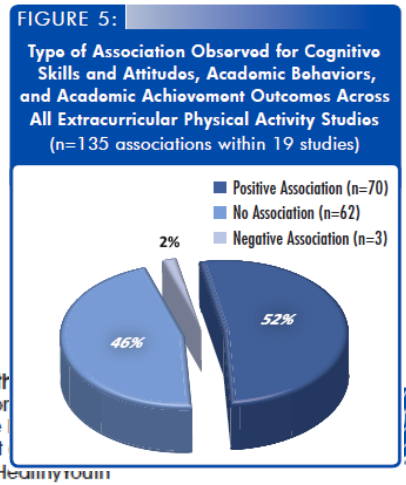

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Summary:

- 251 associations between Physical activity and Cognition were investigated

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Summary:

- 251 associations between Physical activity and Cognition were investigated
  - 50.5% were positive

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Summary:

- 251 associations between Physical activity and Cognition were investigated
  - 50.5% were positive
  - 48% showed no association

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Summary:

- 251 associations between Physical activity and Cognition were investigated
  - 50.5% were positive
  - 48% showed no association
  - 1.5% showed negative association

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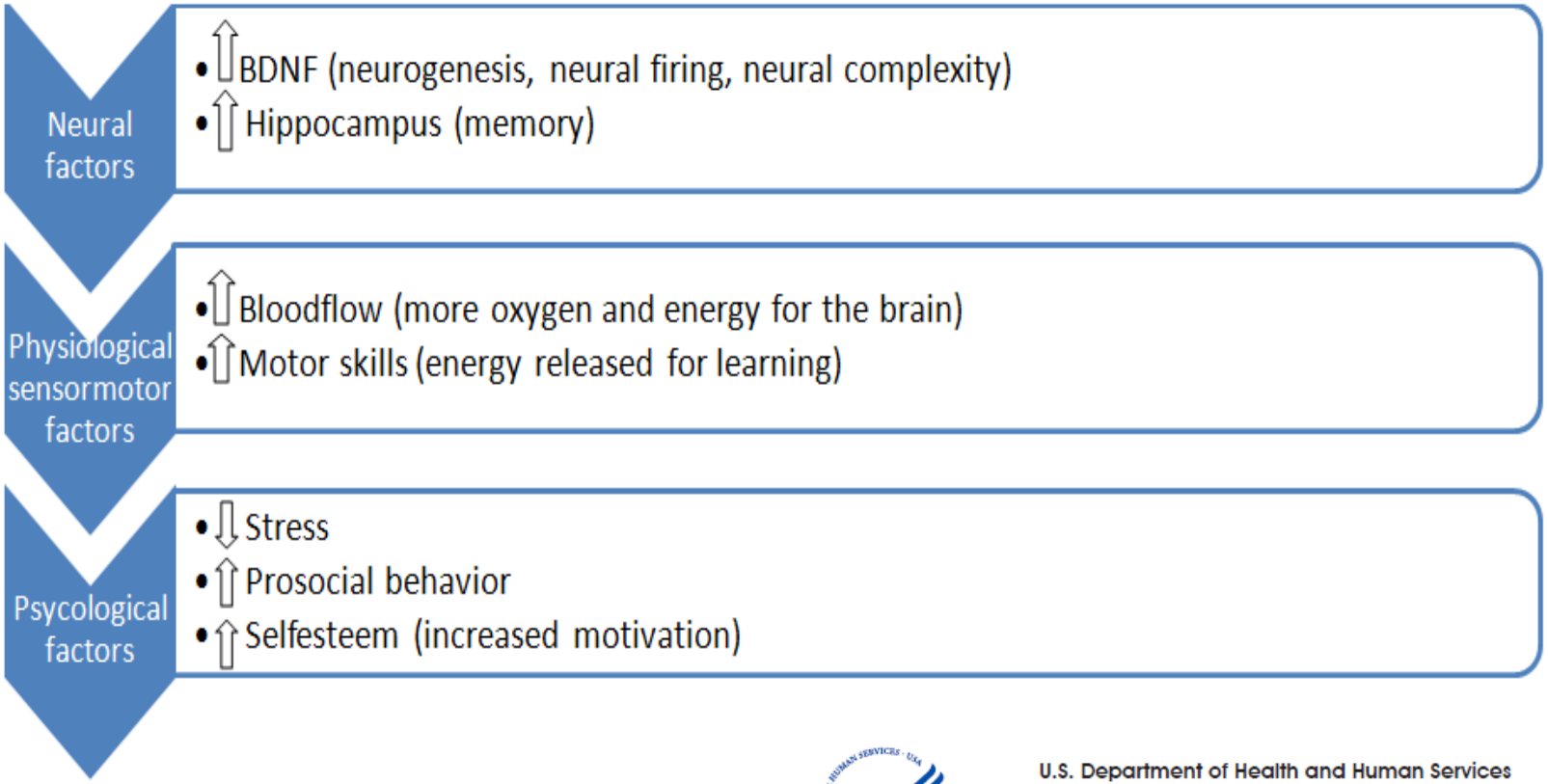
Factors affected by Physical activity



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Conclusion:

- Physical activity can be included in the school environment in a number of ways without detracting from academic performance

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- Studies highlight potential benefits of physical activity in

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Conclusion:

- Physical activity can be included in the school environment in a number of ways without detracting from academic performance

- Studies highlight potential benefits of physical activity in
  - Physical education classes

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Conclusion:

- Physical activity can be included in the school environment in a number of ways without detracting from academic performance

- Studies highlight potential benefits of physical activity in
  - Physical education classes
  - During recess

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Conclusion:

- Physical activity can be included in the school environment in a number of ways without detracting from academic performance

- Studies highlight potential benefits of physical activity in
  - Physical education classes
  - During recess
  - In regular classrooms

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- Studies highlight potential benefits of physical activity in
  - Physical education classes
  - During recess
  - In regular classrooms
  - Through extracurricular sports and other physical activity opportunities.

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