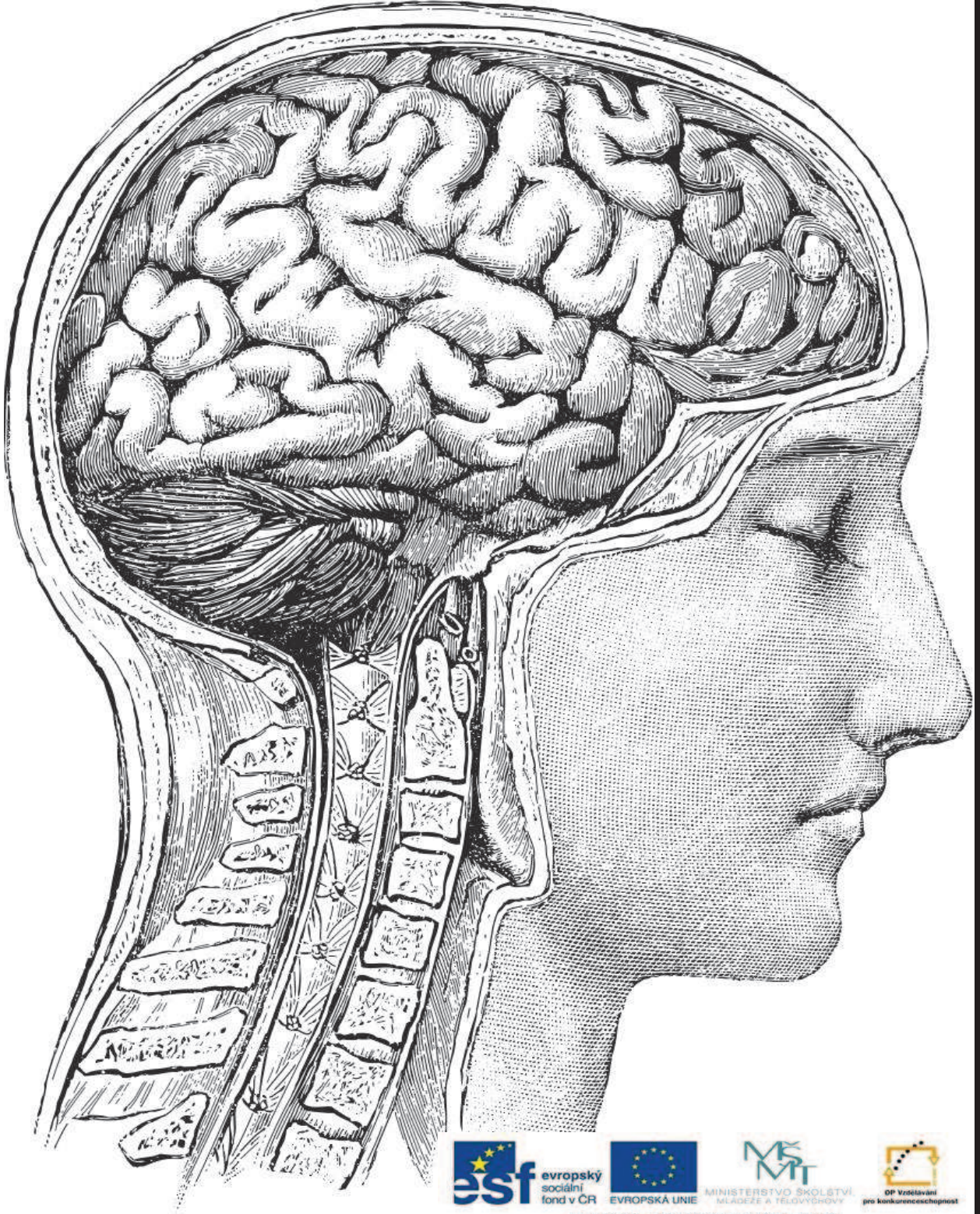

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Can We Make Our Brains More Plastic?

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Kateřina Kubáňová

evropský sociální fond v ČR
EVROPSKÁ UNIE
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY
OP Vzdělávání pro konkurenceschopnost
INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

„ A fully plastic brain is not very helpful. It learns everything but remembers nothing.“

Gred Kempermann, neuroscietist

Center for Regenerative Therapies Dresden

German Center for Neurodegenerative Diseases

- too much plasticity may also play a role in some neurological disorders, including epilepsy and schizophrenia

- understanding the flexibility of certain parts of the brain:
  - studying the development of sensory system
  - ↘ uncovered a network of genes and proteins that influence critical periods

- critical periods = windows of time in which the brain is primed for certain types of imput

Critical Periods

- brain becomes wired for certain tasks

↘ turning the signals received from eyes into recognizable images

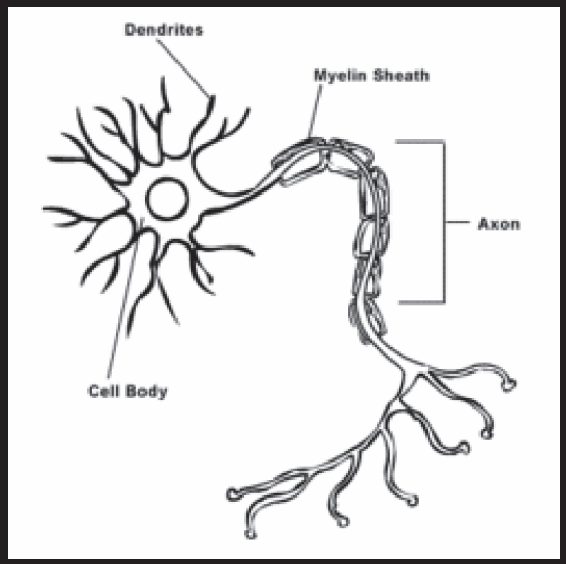
↘ distinguishing sounds present in spoken language

- lack of imputs during a critical period → hard recovering

Critical Periods

- earliest → development govern sences such as sight, hearing and balance
- later → higher-order skills such as language acquisition and social interactions

- most important → connection the neurons make with each other



Critical Periods close

- decrease of the plasticity-driving signals
- produce of signals that limit new connections between cells

- scientists used genetic tricks to remove the brakes on brain plasticity in mice

  → the critical periods last well into adulthood

„Just take away the brakes and the brain can perhaps recover its lost capabilities.“

Carla Shatz, neuroscietist

Stanford University in Palo Alto, California

❑ in lab animals it is possible

↘researchers bred mice that lack some of the genes that act as plasticity brakes

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Knock-out mice

- ❑ mutant mice recovered from stroke better
- ❑ several tests for neural activity
- ❑ good performance on the rotarod
- ↘ motor skills test for lab mice
- ❑ range of behavioral tests
- → supermice

„That‘s certainly not the whole story. There has to be some downside.“

Carla Shatz, neuroscietist

Stanford University in Palo Alto, California

- ❑ much rewiring can lead to short circuits in the brain → seizures
- ❑ knock-out mice responded to smaller dose of seizure-inducing drugs

- in humans → result of the unleashing brain plasticity might be epilepsy
- epilepsy → much more common in childhood

- closing critical periods may also provide a firm foundation for further brain development
- missing plasticity brakes are suspected not only in epilepsy but also in schizophrenia and Alzheimer‘s disease

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- ❑ brain plasticity can be augmented without completely removing the brakes
- ❑ certain kinds of sensory signals can rewire adult brains

↘ mainly sound and touch

Michale Merzenich neuroscientist, University of California

- ❑ specially designed computer games can improve performance on memory and other cognitive taks in both children and older adults

↘ even months after the training stops

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Daphne Bavelier neuroscientist, University of Geneva, Switzerland

- playing action video games can improve vision and several kinds of cognitive skills

The succes of games

- linked to the brain‘s reward and attention systems
- several of the molecules identified as plasticity brakes involve these pathways

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- two drugs enhance attention:
- fluoxetin (known as Prozac)
- Aricept

↘can lengthen or even reopen critical periods in experimental mice

- both drugs in clinical trials for reversing the effects of lazy eye in childhood
- fluoxetin → helped stroke patients recover lost motor skills

Fluoxetine

- ❑ influences the growth of new neurons
- ❑ most neurogenesis stops in childhood
- ❑ two areas of the brain keep producing new neurons:

↘subventricular zone (connects to olfactory bulb)

↘subgranular zone of the dentate gyrus (part of the hippocampus)

- several way how to boost the production of the new neurons in these regions

↘ increase physical exercise

↘ exposure to unfimiliar or complex environments

- fluoxetine and other antidepressants that act through the dopamine pathway also increase the neuronal birthrate and may keep the newborn neurons flexible longer

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- what this ongoing production of neurons means for the brain is unclear

- idea → new neurons may aid the brain in adjusting to new envitonments, perhaps by helping the brain detect unfamilian aspects of an otherwise familiar setting
- new neurons → have their own critical period, lasting roughly 4 weeks, during which they are particulary excitable (fluoxetine might lengthen this period)

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BLOOD TO BLOOD

KAROLÍNA VAVROUŠKOVÁ

ALŽBĚTA ZLOCHOVÁ

MBB

INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

- Nature
- 22 January 2015

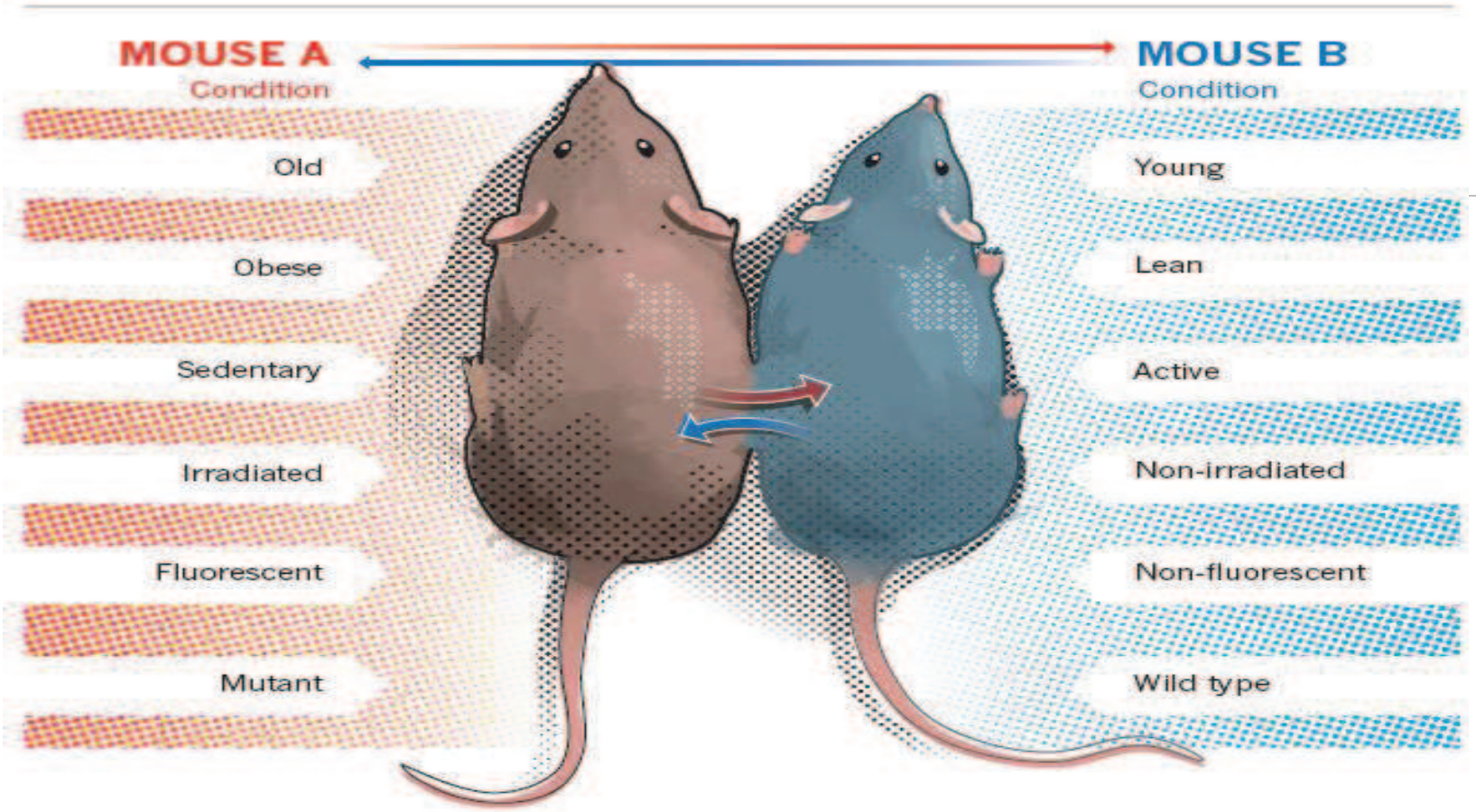
- Megan Scudellari

Parabiosis

- 150-year-old surgical technique that unites the vasculature of two living animals

- From Greek *PARA* → alongside
- *BIOS* → life

- Test what circulating factors in the blood one of the animal do when they enter another animal



Experiments

- Share the circulatory system of an old mouse and young mouse
- Remarkable results→ heart, brain, muscles
- Old mice→ stronger, smarter and healtier
- Bring new life to old bodies

- Now→ scientists have begun to identify the components of young bloood
- September→ a clinical trial in California-the first who have started testing young blood and Alzheimer´s disease

1864

- Physiologist Paul Bert → removed the strip of skin of two rats and stitched the animals together
- Hoped they could create a shared circulatory system
- He found that fluid injects into a vein of one rat passed easily into the other
- Won an award in 1866
- After him→ one team ruled out the idea that dental cavities are results of sugar in the blood by using a pair of parabiosed rats, only one was fed by glucose
- The rats→ same blood glucose levels, but only one rat had dental cavities

1956

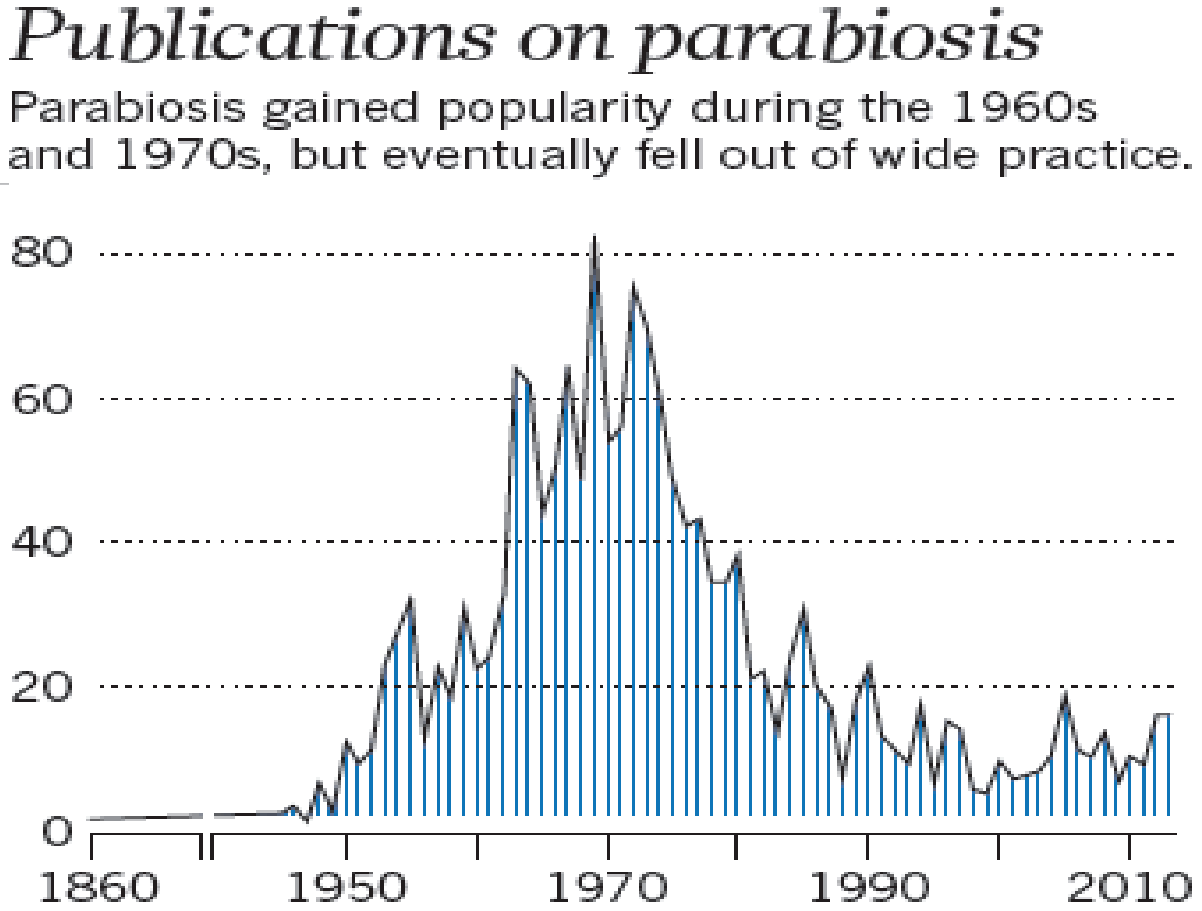
- Clive McCoy from Cornell University in New York→ the first one who apply parabiosis to the study of ageing
- 69 pairs of rats, all of different ages
- For example 1,5-month-old was paired with 16-month old rat→ the equivalent of 5-year old human with a 47-year old
- Not successful→ 11 pairs died, rats were not adjusted and they started eating each other
- Must be socialized with each other
- Results→ the older animals´ bones became similar in weight and density of the bones of younger rats

1972

- Two researches at Univeristy of California studied lifespans
- Older partners lived for four to five months longer → the young blood might affect longevity

Despite these findings, parabiosis fell out of use

Fell out of favour after 1970s



Blood components

- **What exactly in the blood is responsible for the rejuvenating effects?**
- OXYTOCIN→ a hormone of love
- Young blood can also help to form new neurons and reverse age-related thickening of walls of the heart

- start screening the proteins of young blood → GDF11
- → increase the strenght and stamina of muscles

- Start screening plasma→ plasma activates brain plasticity in older mice and increase memory

Future…

- Alzheimer disease→ neuron loss
- Experiment→ condition of one patient got better after he received a plasma transfusion

- Six of out a planned 18 people with Alzheimer´s, all aged 50 or above, have already begun to receive plasma harvested from men aged 30 or younger

Negatives

- Scientist are afraid of failure

- For now→ any claims that young blood or plasma will extend lifespan are false→ tha data are just not there

Thank you for your attention ☺