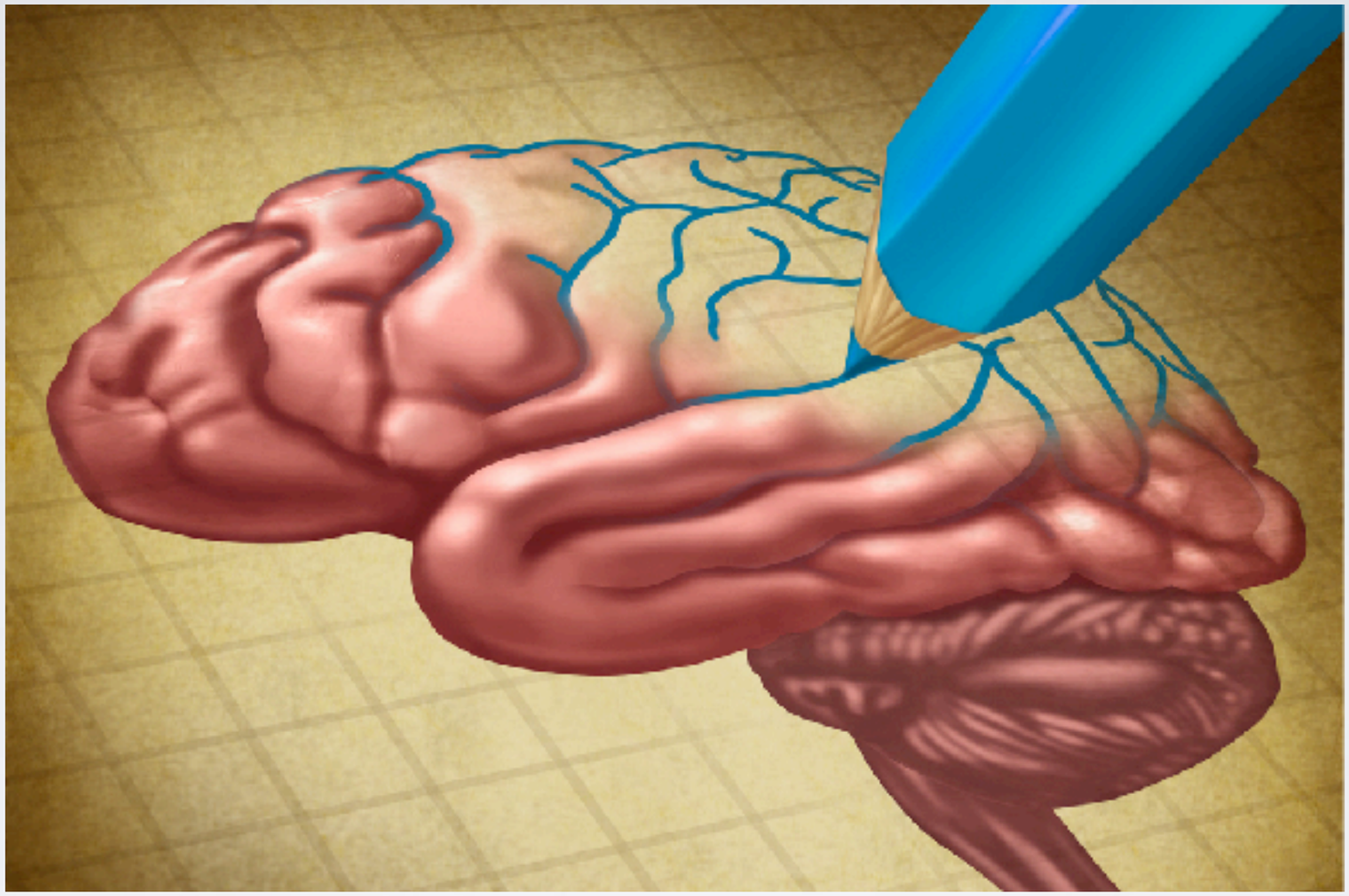


HJÄRNANS PLASTICITET

Johan Mårtensson, Fil. Dr.
IKVL, Lunds universitet

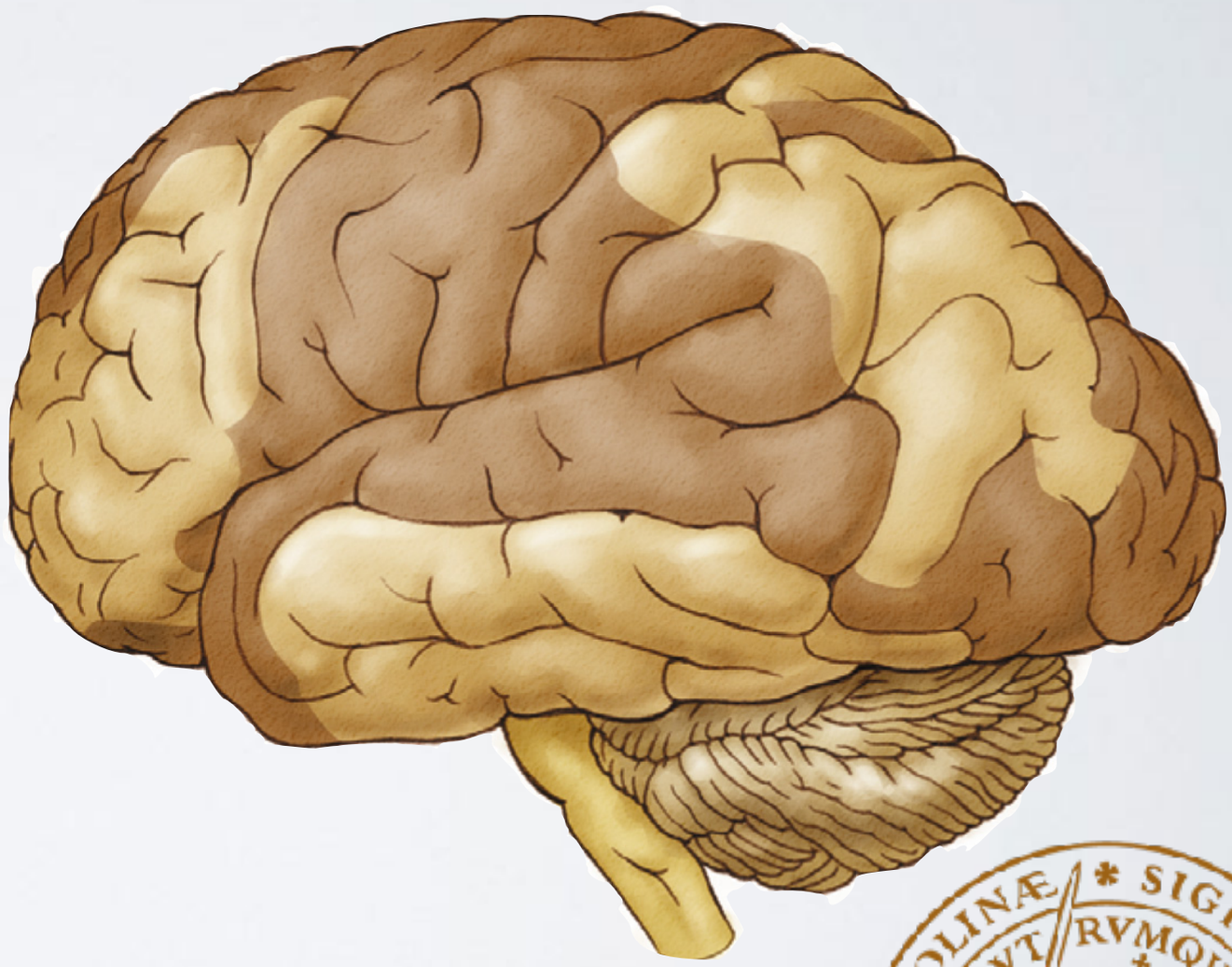
johan.martensson@med.lu.se

Bakgrund

Nervsystemets kapacitet till förändring

- Plasticitetsfältet står i kontrast till en statisk syn på den vuxna hjärnan. Barn utvecklas drastiskt, men även vuxna i viss utsträckning.

- Hjärnans plasticitet kan observeras på flera olika nivåer, från individuella neuron till förändringar på macronivå som vi kan se *in vivo* med t.ex. MRI.



johan.martensson@med.lu.se

När uppstår förändringar i hjärnan?

- Plasticitet uppkommer när det finns en diskrepans mellan förmåga och krav.

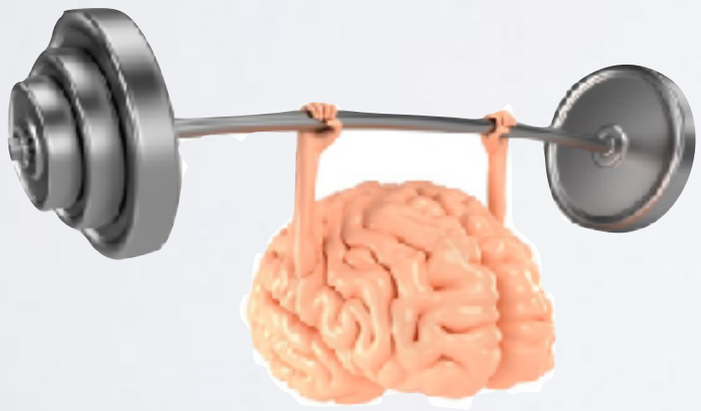
- Om alla krav ledde till neural förändring så vore det troligtvis maladaptivt.

- Det bör således finnas tröskelvärden i form av dos och intensitet som leder till mer beständiga förändringar.

johan.martensson@med.lu.se

Hade det varit bra om hjärnan förändrades väldigt lätt?

Dos och intensitet

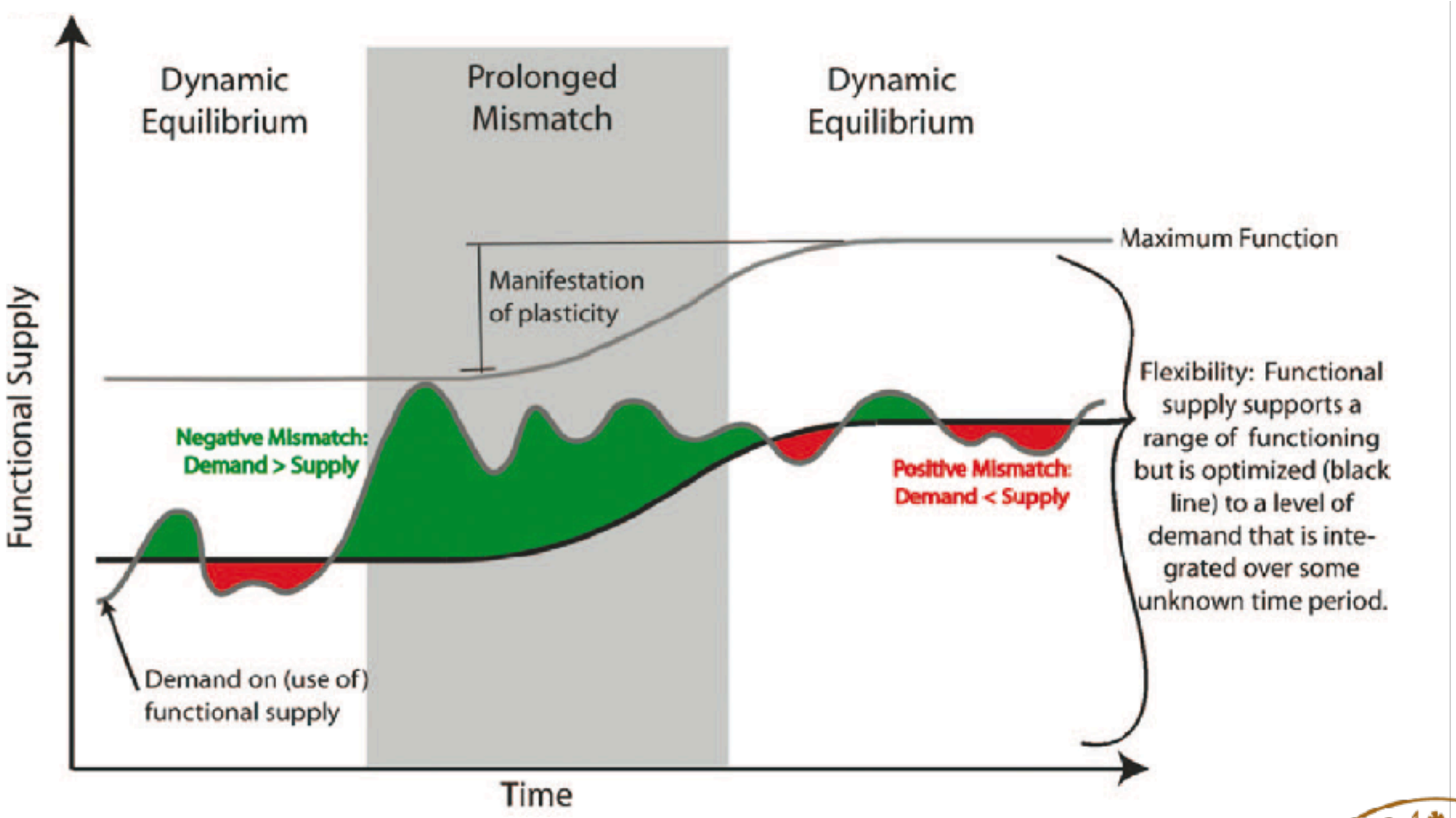


Vem får ut mest av träning?

Den vältränade

Eller jag?

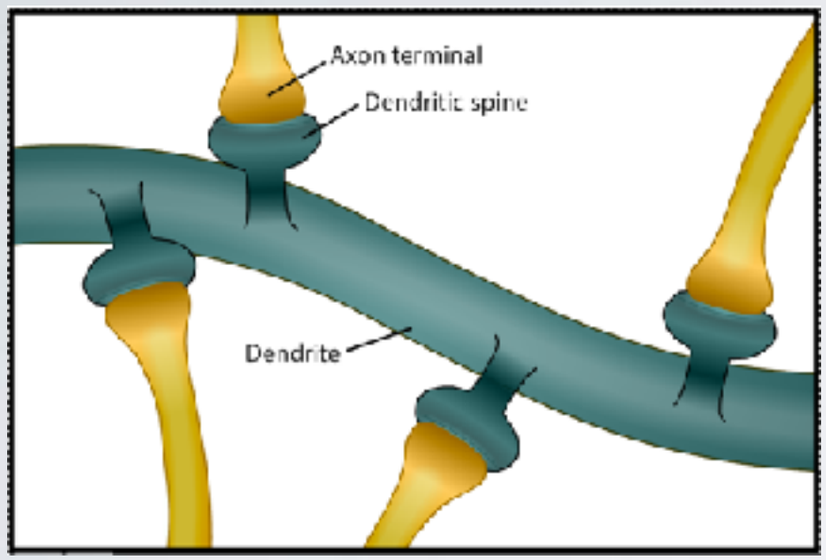
johan.martensson@med.lu.se

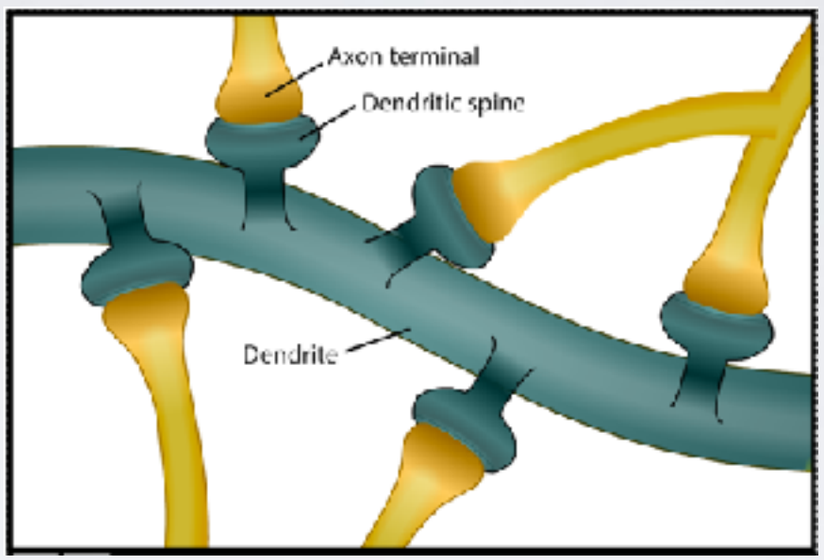


Lövdén, Bäckman, Lindenberger, Schafer, & Schmiedek 2010, *Psychological Bulletin*

johan.martensson@med.lu.se

Vad händer när det uppstår förändringar?





- Minnen är associerade med förändringar som sker på synaps nivå.
- Hos t.ex. Aplysia sker det förändringar i synapserna vid sensitisering och habituering.

johan.martensson@med.lu.se

Vad händer när det uppstår förändringar?

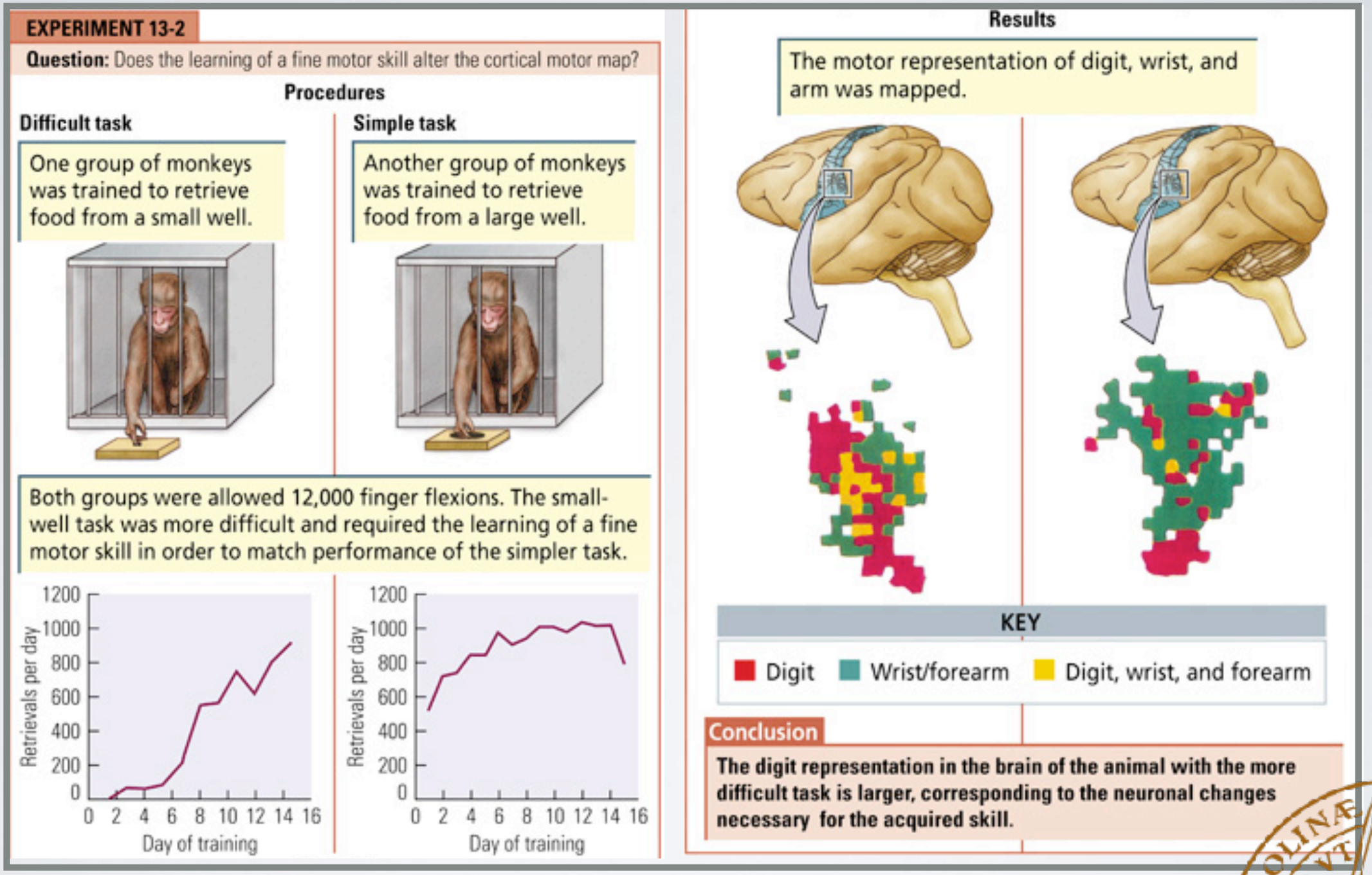
forts.

- Chang & Greenough (1982)
  - Råttor berövades input från ett öga i form av en ögonlapp.
  - Råttorna tränades i en labyrinth.
  - Visuella cortex på den tränade hemisfären hade mer dendriter.

johan.martensson@med.lu.se

Vad händer när det uppstår förändringar?

forts.



Nudo et al., 1997

(svårt att mäta *in vivo*..)

johan.martensson@med.lu.se

Det finns flera möjliga mekanismer för plasticitet

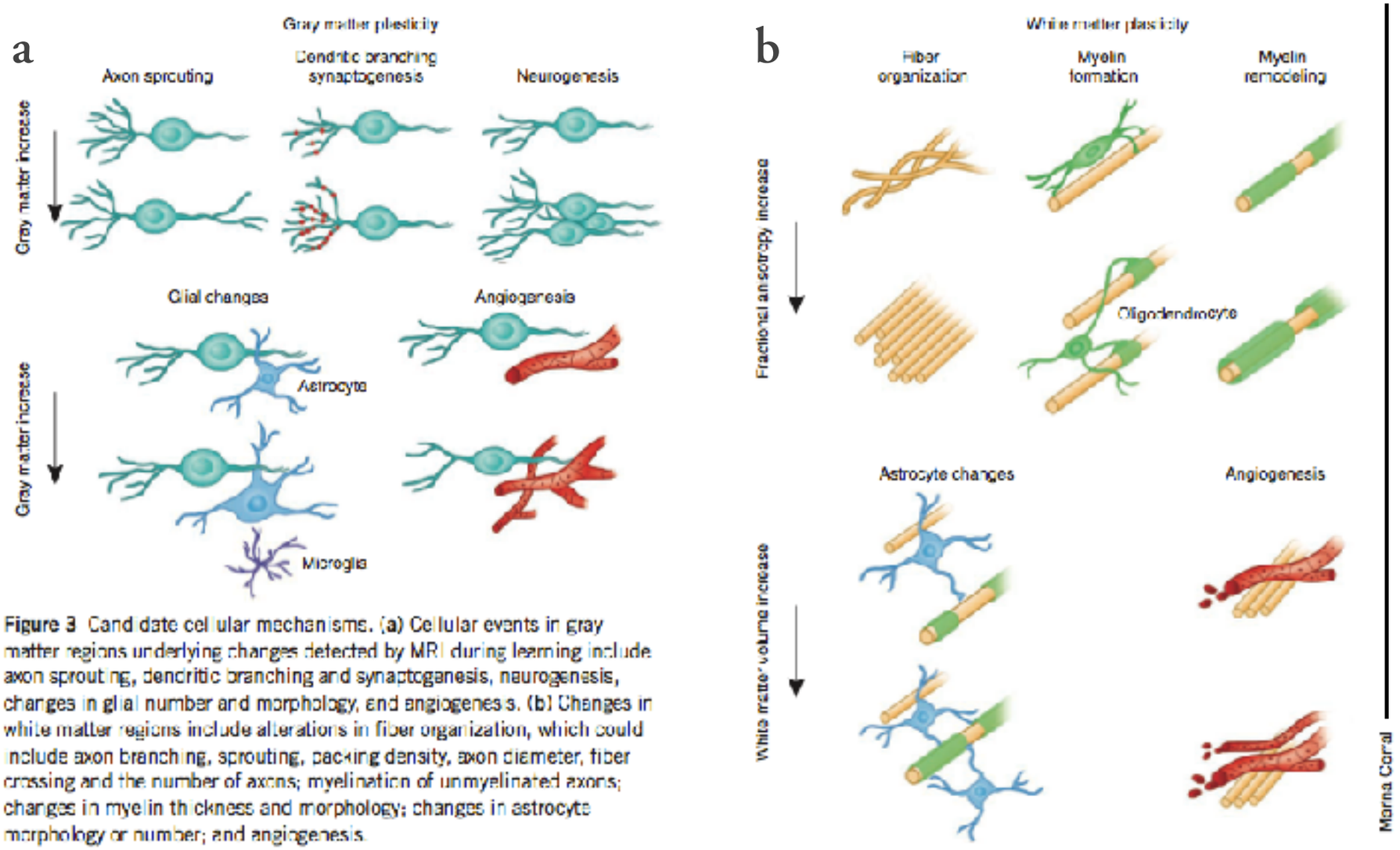


Figure 3 Candidate cellular mechanisms. (a) Cellular events in gray matter regions underlying changes detected by MRI during learning include axon sprouting, dendritic branching and synaptogenesis, neurogenesis, changes in glial number and morphology, and angiogenesis. (b) Changes in white matter regions include alterations in fiber organization, which could include axon branching, sprouting, packing density, axon diameter, fiber crossing and the number of axons; myelination of unmyelinated axons; changes in myelin thickness and morphology; changes in astrocyte morphology or number; and angiogenesis.

Robert J Zatorre[1,4], R Douglas Fields[2,4] & Heidi Johansen-Berg[3,4] NATURE NEUROSCIENCE VOLUME 15 | NUMBER 4 | APRIL 2012

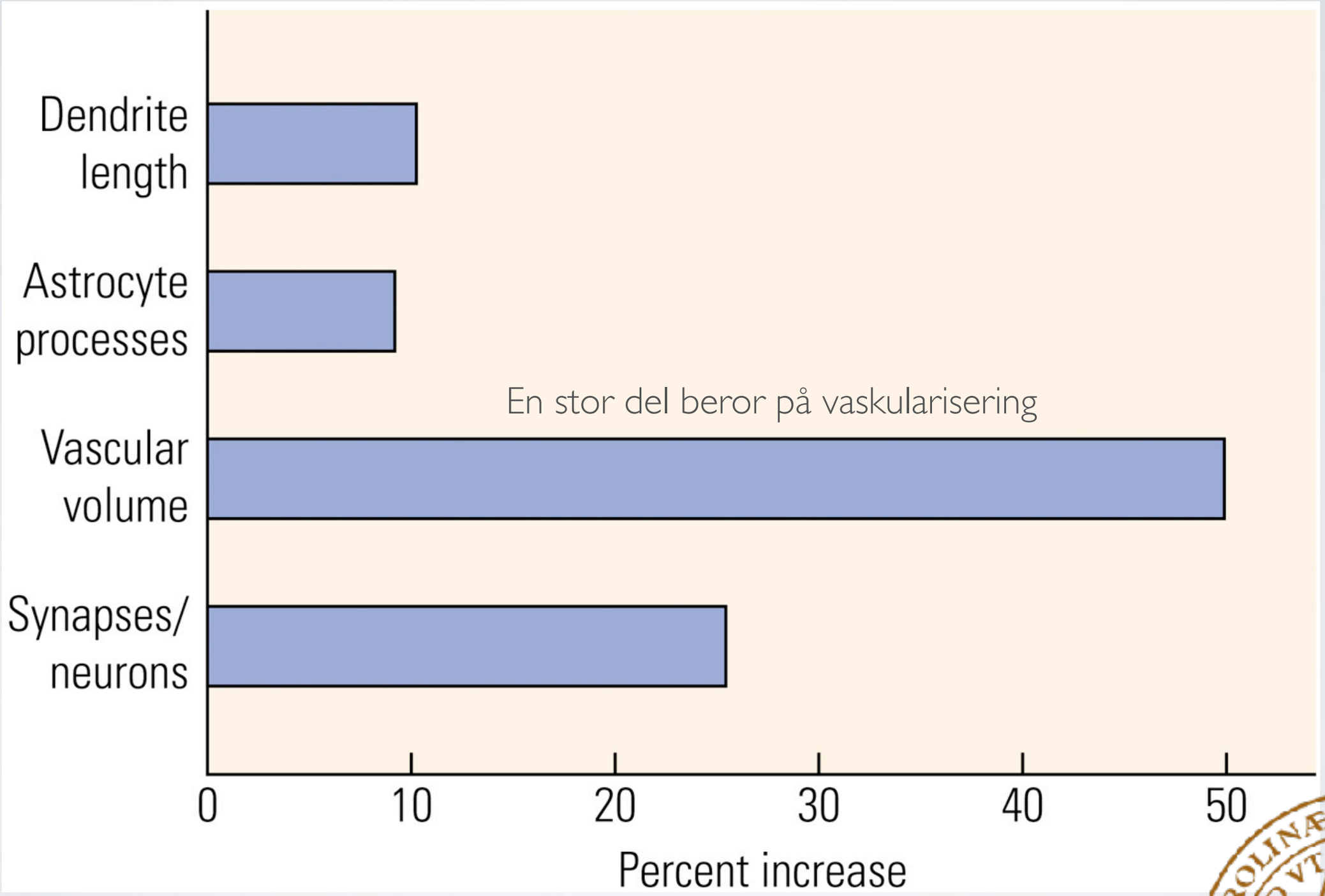
a Gråsubstans
Nervceller

b Vitsubstans
Hjälparceller och myelin

Och vi kan observera en del av dem via t.ex. MRI

johan.martensson@med.lu.se

Kortikala förändringar vid djurstudier



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Men nya fynd pekar på andra mekanismer vid snabb plasticitet.

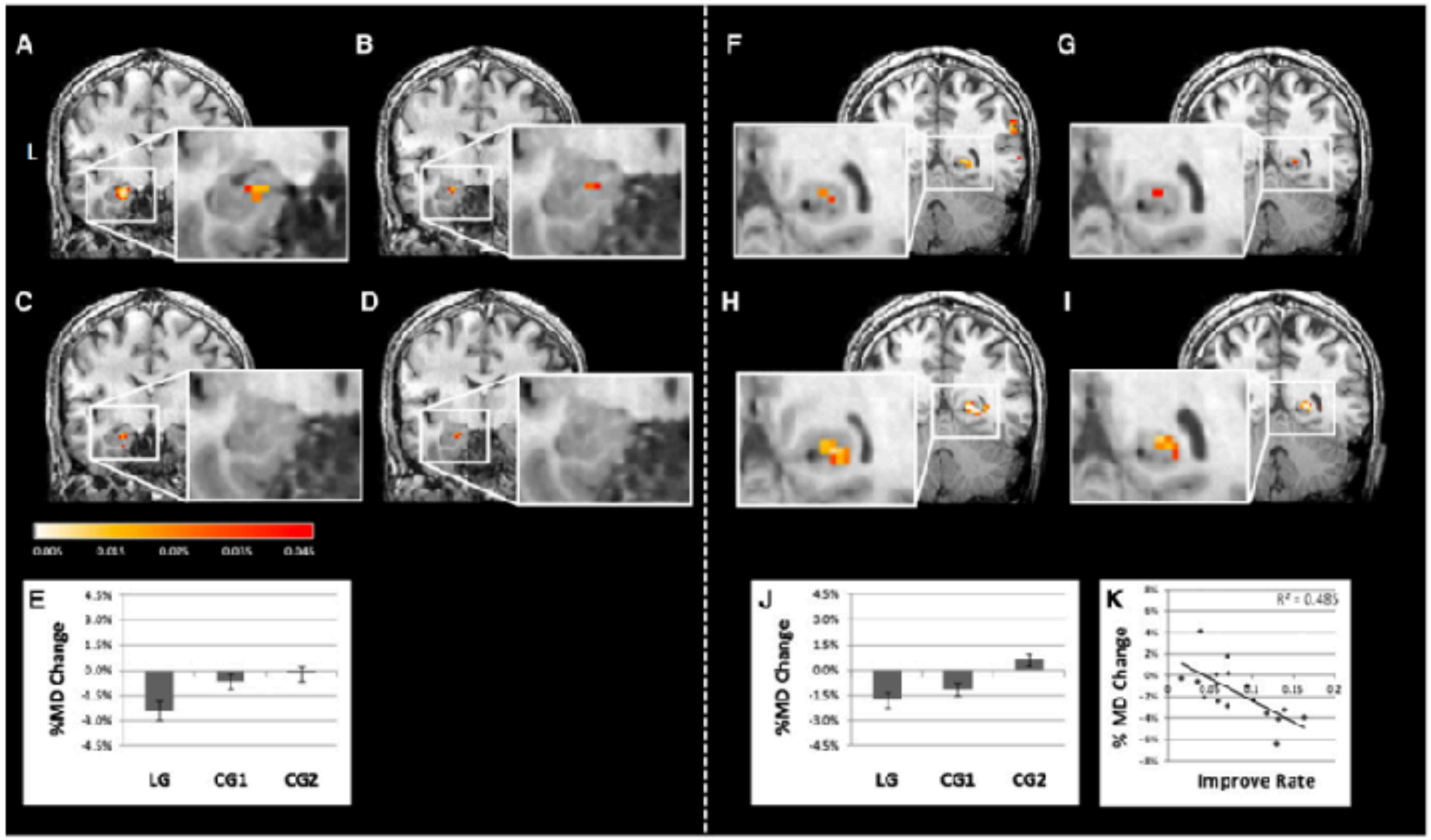


Figure 2. Structural Remodeling of Brain Tissue, Measured by DTI as Changes in MD after 2 hr of Training on a Spatial Learning and Memory Task

Yaniv Sagi,[1,2] Ido Tavor,[1,2] Shir Hofstetter,[1] Shimrit Tzur-Moryosef,[1] Tamar Blumenfeld-Katzir,[1] and Yaniv Assaf[1,*]
[1]Department of Neurobiology, George S. Wise Faculty of Life Sciences, Tel Aviv University, Tel Aviv 69978, Israel
[2]These authors contributed equally to this work
*Correspondence: assafyan@post.tau.ac.il
DOI 10.1016/j.neuron.2012.01.025

johan.martensson@med.lu.se

Men nya fynd pekar på andra mekanismer vid snabb plasticitet.

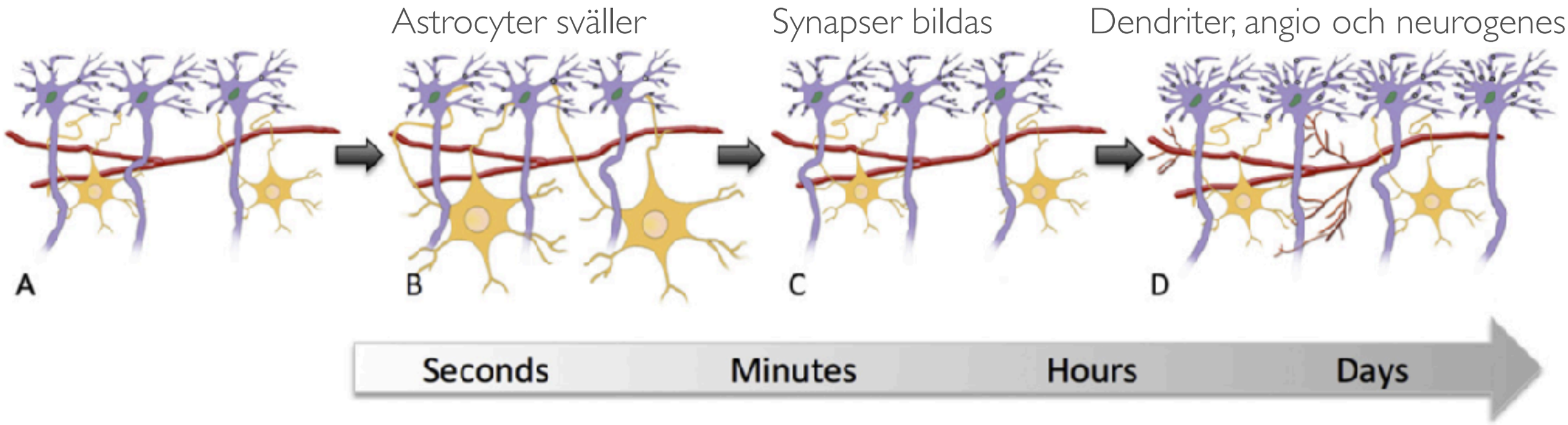


Figure 1. Possible Tissue Changes that Could Cause a Decrease in Water Diffusivity
A decrease in water diffusivity could reflect a number of different tissue changes, but not all could occur on the timescale observed in Sagi et al. (2012). Some candidate changes are illustrated here. Neurons are in purple, vasculature in red, and astrocytes in orange.
(A and B) (A) illustrates the baseline state. (B) shows the swelling of astrocytes in the presence of increased activity—a process that can occur over a course of seconds to minutes.
(C) Synapses (black circles) and their associated dendritic spines can be formed or modified over a period of minutes to hours.
(D) More elaborate structural change such as dendritic sprouting, neurogenesis, and angiogenesis occurs over a period of days to weeks.

Johansen-Berg et al., 2012

johan.martensson@med.lu.se

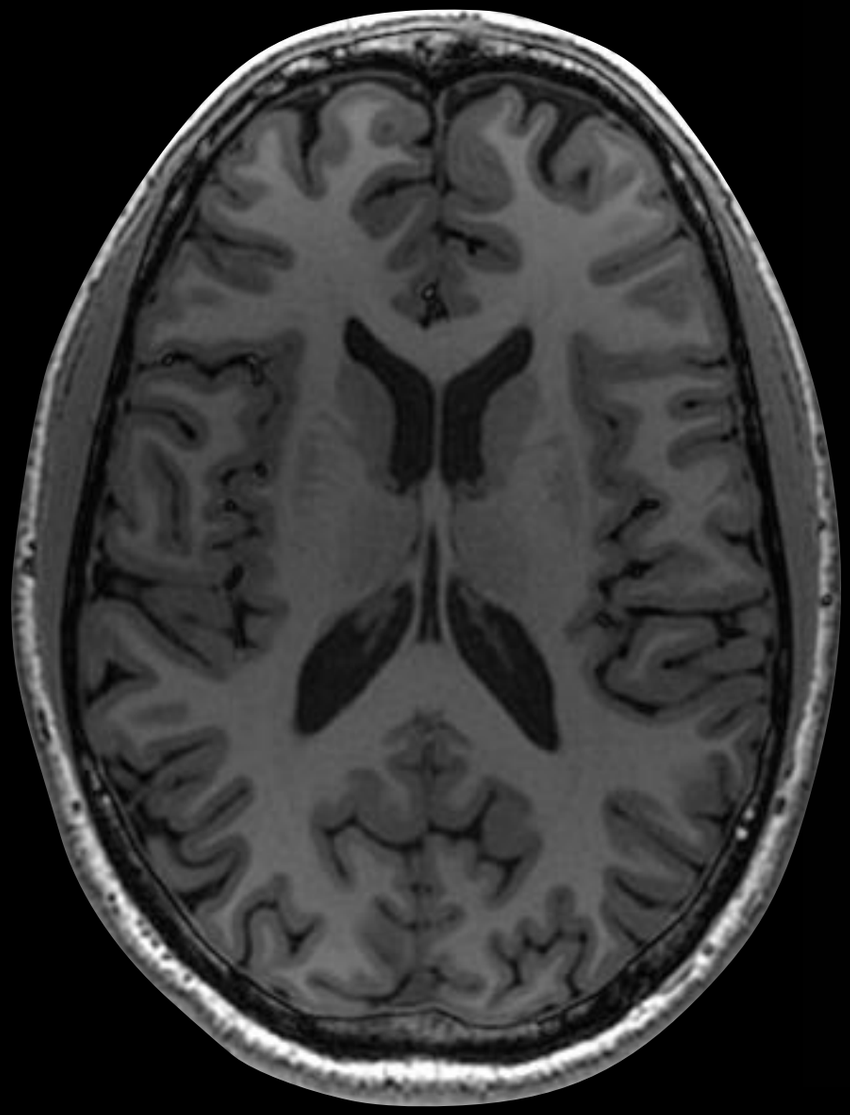
Hur mäter vi hjärnförändringar?

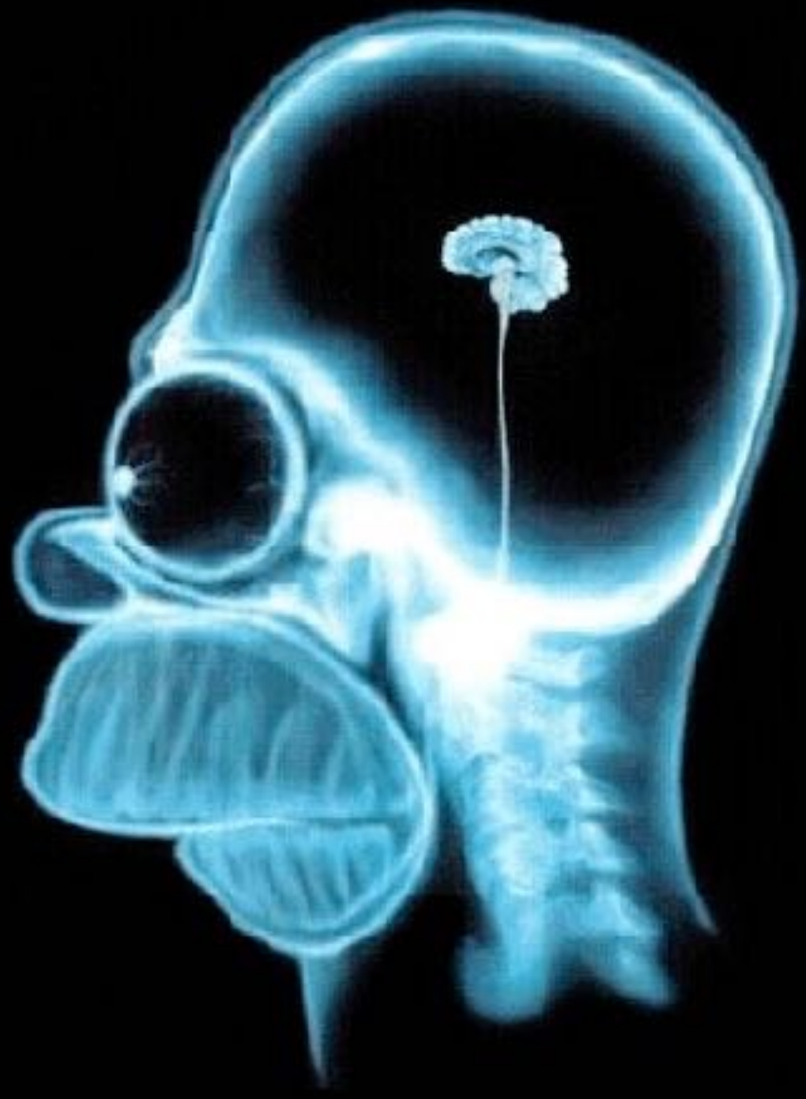
MRI. Men även t.ex. PET eller mått på funktionell plasticitet.

140000 gånger jordens gravitation

johan.martensson@med.lu.se

Gråsubstans





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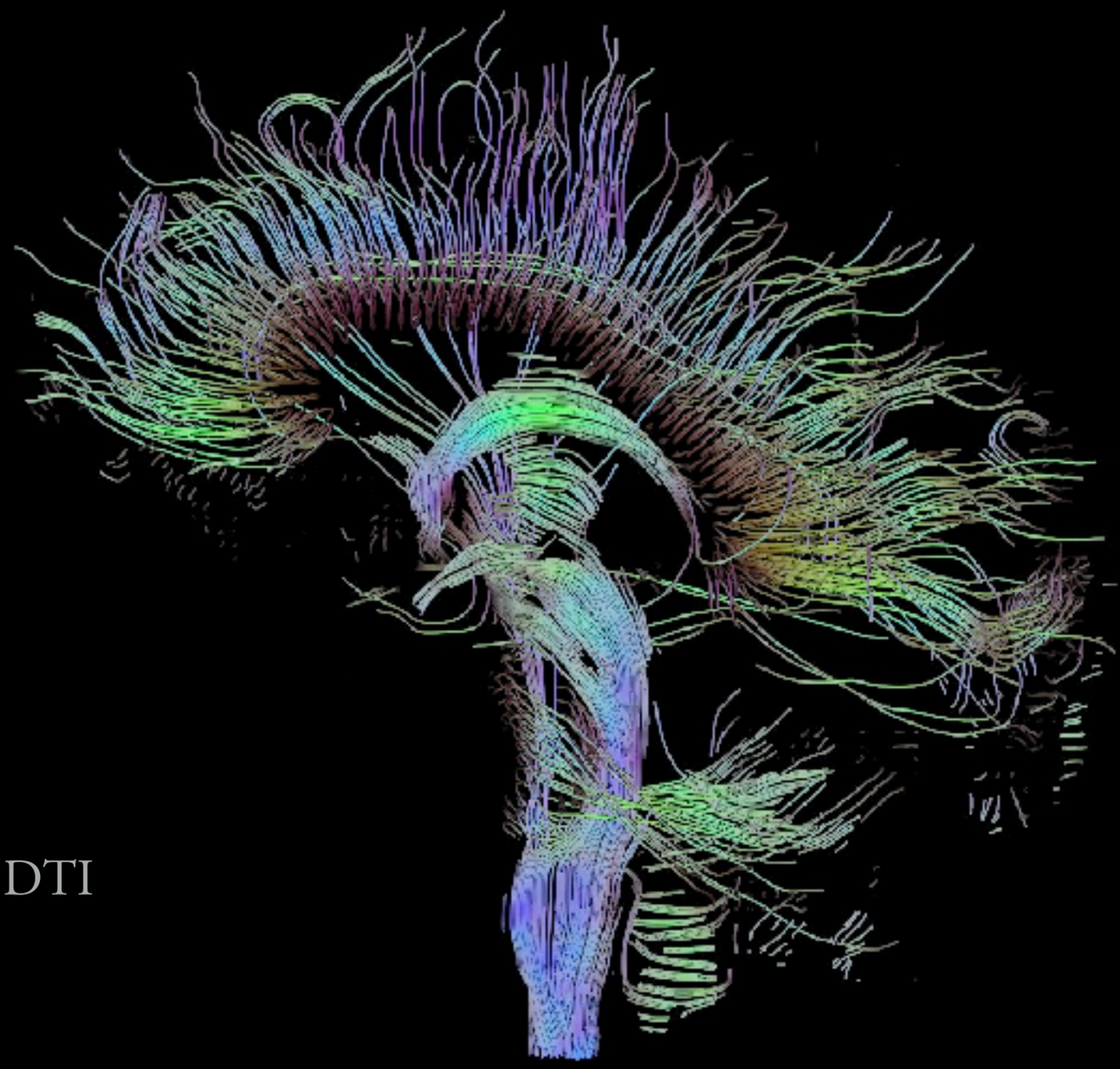
Vitsubstans



Mäts med t.ex. DTI

johan.martensson@med.lu.se

Diffusion Tensor Imaging (DTI)

Lite som ett glas vatten

johan.martensson@med.lu.se

Diffusion Tensor Imaging (DTI)

Men mellan trakter

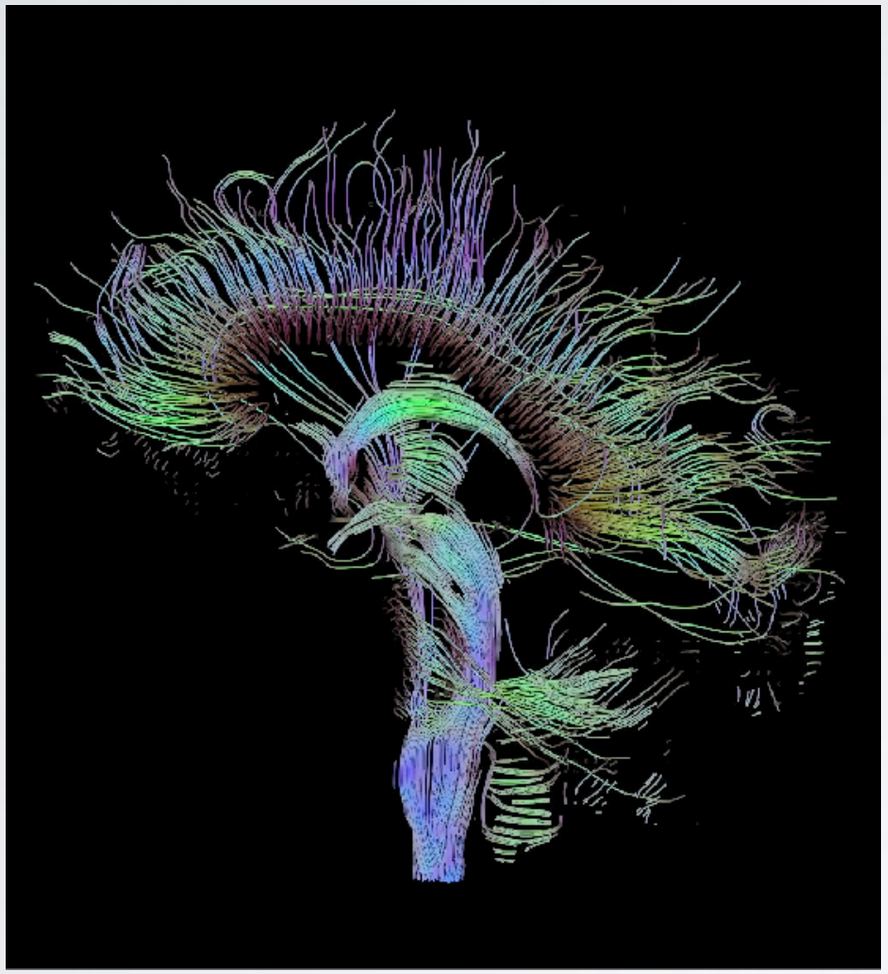
johan.martensson@med.lu.se

Diffusion Tensor Imaging (DTI)

Och formen ger oss en ledtråd

johan.martensson@med.lu.se

Vi följer banorna



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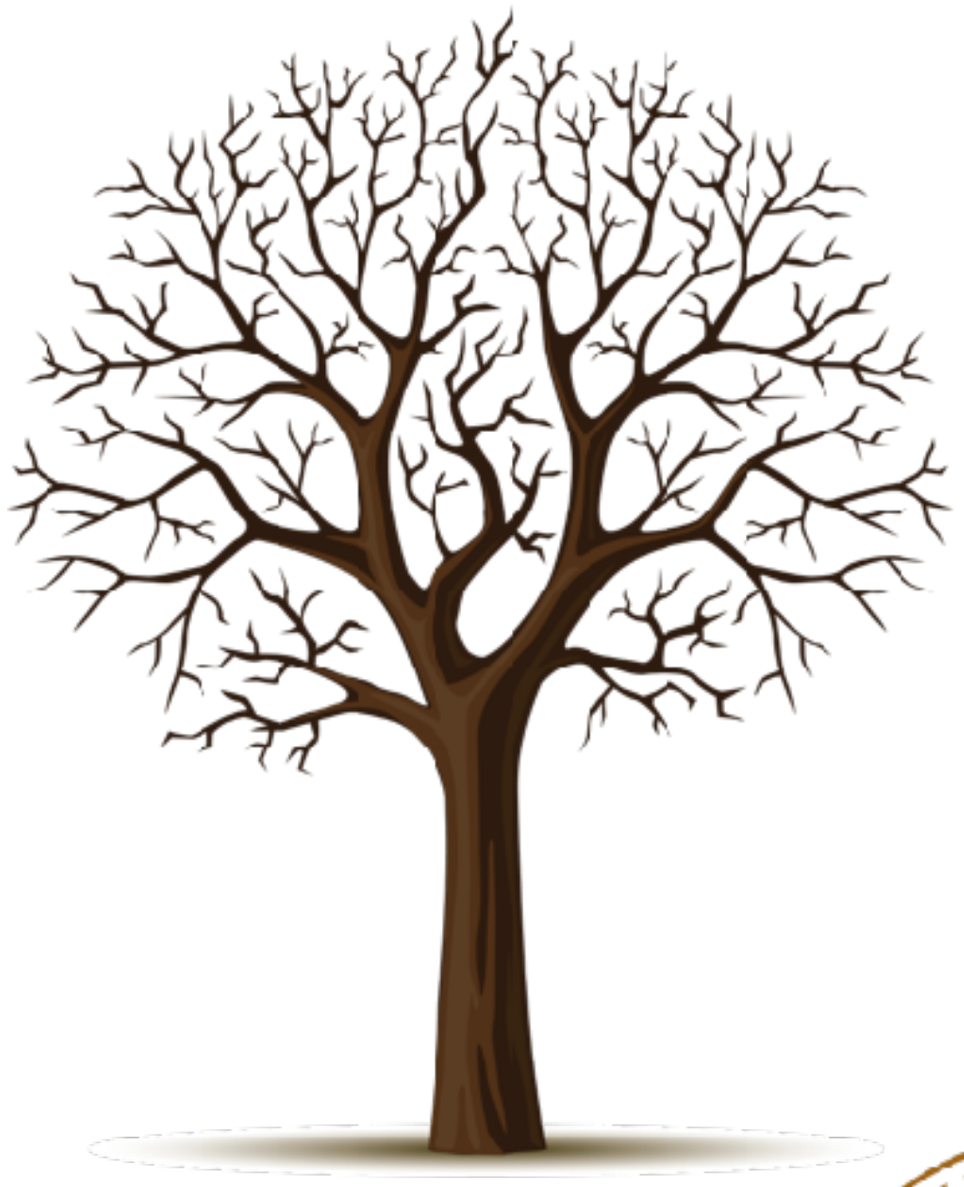
Eller grenarna..



johan.martensson@med.lu.se

Studier

Det finns en rik litteratur kring vuxen plasticitet idag

Study	Intervention	Analysis technique
Draganski et al., 2004	Juggling	VBM
Colcombe et al., 2006	Aerobics	VBM
Draganski et al., 2006	Studying for an exam	VBM
Boyke et al., 2008	Juggling	VBM
Driemeyer et al., 2008	Juggling	VBM
Ilg et al., 2008	Reading mirrored words	VBM
Teutsch et al., 2008	Pain stimulation	VBM
Ceccarelli et al., 2009	Cognitive learning	TBM
Haier et al., 2009	Tetris	CIVET
Scholz et al., 2009	Juggling	VBM
Thomas et al., 2009	Visuo-motor	VBM
Engvig et al., 2010	Mnemonic training	FreeSurfer cortical
Granert et al., 2010	Motor	VBM
Kim et al., 2010	Early postpartum	VBM
Schmidt-Wilcke et al., 2010	Deciphering morse code	VBM
Stein et al., 2010	Language training	VBM
Tang et al., 2010	Meditation	VBM
Taubert et al., 2010	Balancing	VBM
Erickson et al., 2011	Aerobics	FSL-FIRST
Hamzei et al., 2011	Motor task	VBM
Hölzel et al., 2011	Meditation	VBM
Kwok et al., 2011	Learning color names	VBM
Landi et al., 2011	Visuo-motor	VBM
Takeuchi et	Working	VBM

Navigation-related structural change in the hippocampi of taxi drivers

Eleanor A. Maguire*†, David G. Gadian‡, Ingrid S. Johnsrude†, Catriona D. Good†, John Ashburner†, Richard S. J. Frackowiak†, and Christopher D. Frith†

†Wellcome Department of Cognitive Neurology, Institute of Neurology, University College London, Queen Square, London WC1N 3BG, United Kingdom; and ‡Radiology and Physics Unit, Institute of Child Health, University College London, London WC1N 1EH, United Kingdom

Communicated by Brenda Milner, McGill University, Montreal, Canada, January 28, 2000 (received for review November 10, 1999)

Temporal and Spatial Dynamics of Brain Structure Changes during Extensive Learning

Bogdan Draganski,[1] Christian Gaser,[2] Gerd Kempermann,[3] H. Georg Kuhn,[4] Jürgen Winkler,[1] Christian Büchel,[5] and Arne May[1,5]

[1]Department of Neurology, University of Regensburg, 93053 Regensburg, Germany[2]Department of Psychiatry, University of Jena, 07743 Jena, Germany, [3]Max-Delbrück Center for Molecular Medicine, 13092 Berlin, Germany, [4]Institute for Neuroscience and Physiology, Gothenburg University, SE 405 30 Gothenburg, Sweden, and [5]Department of Systems Neuroscience, University of Hamburg, 20246 Hamburg, Germany

Översikt:

Lövdén, M., Wenger, E., Mårtensson, J., Lindenberger, U., & Bäckman, L. (2013). **Structural brain plasticity in adult learning and development.** Neuroscience and Biobehavioral Reviews. doi: 10.1016/j.neubiorev.2013.02.014

johan.martensson@med.lu.se

T.ex. Språk

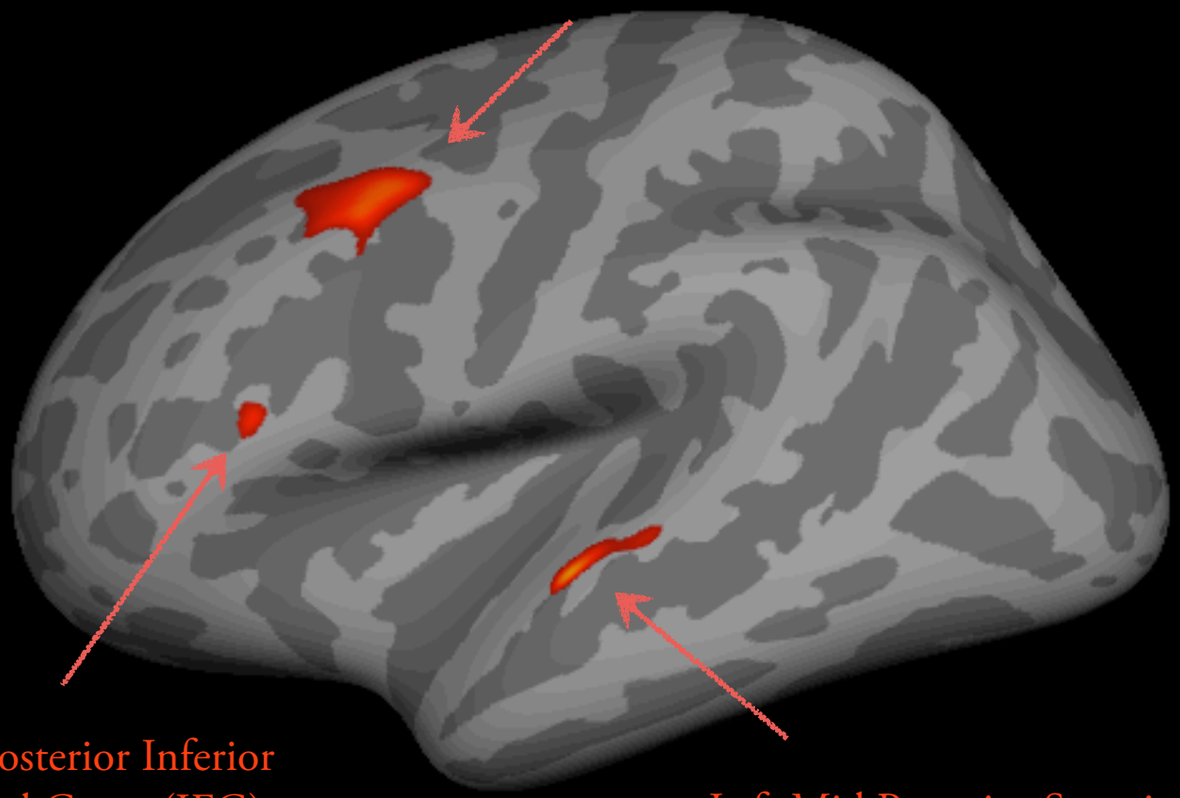
Mårtensson, Eriksson, Bodammer, Lindgren, Johansson, Nyberg & Lövdén (2012)

Swedish

Dari

johan.martensson@med.lu.se

Kortikala förändringar

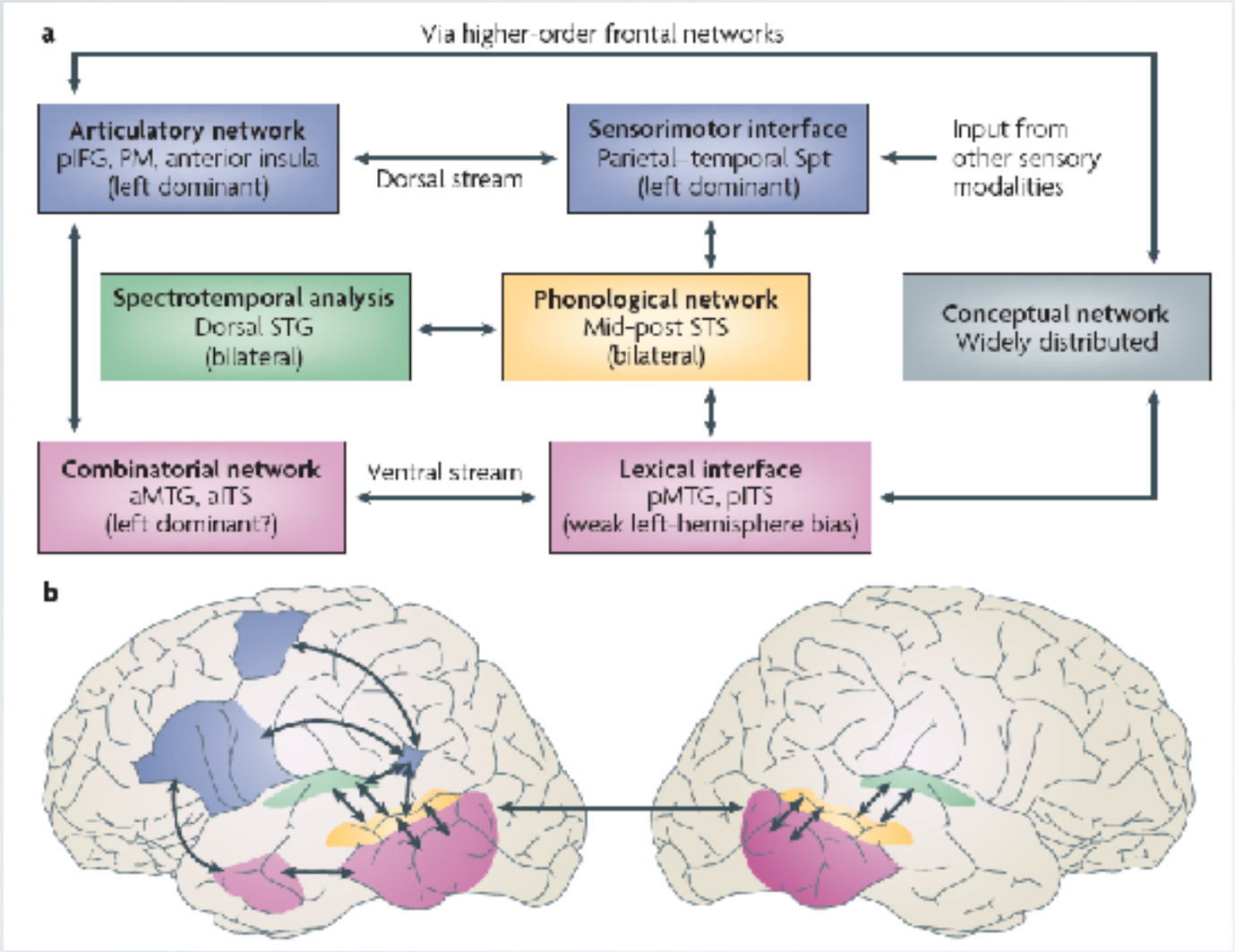


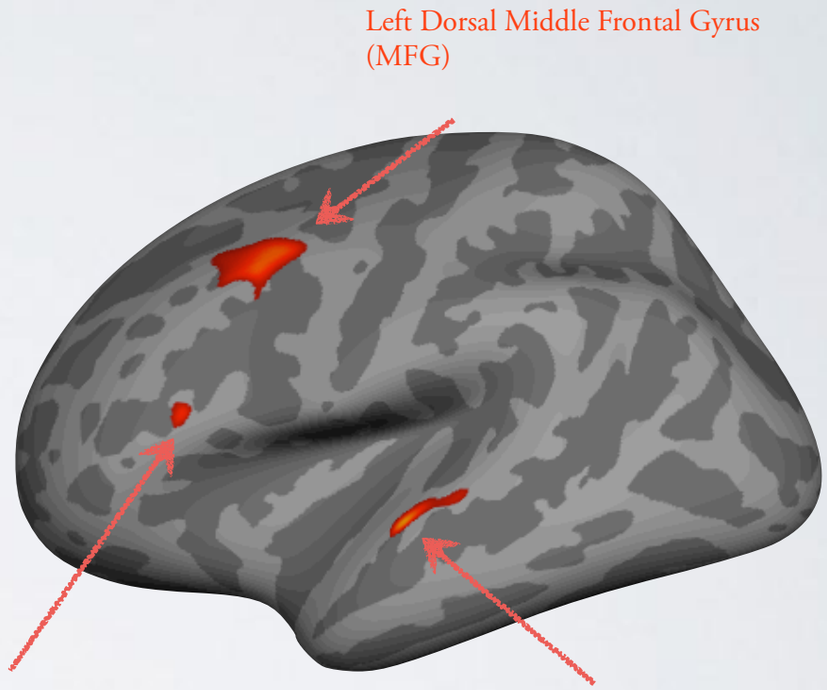
K = 100, p < .001
Image shows selective increases in cortical thickness with no decreases over time for interpreters.

johan.martensson@med.lu.se

Kortikala förändringar

forts.

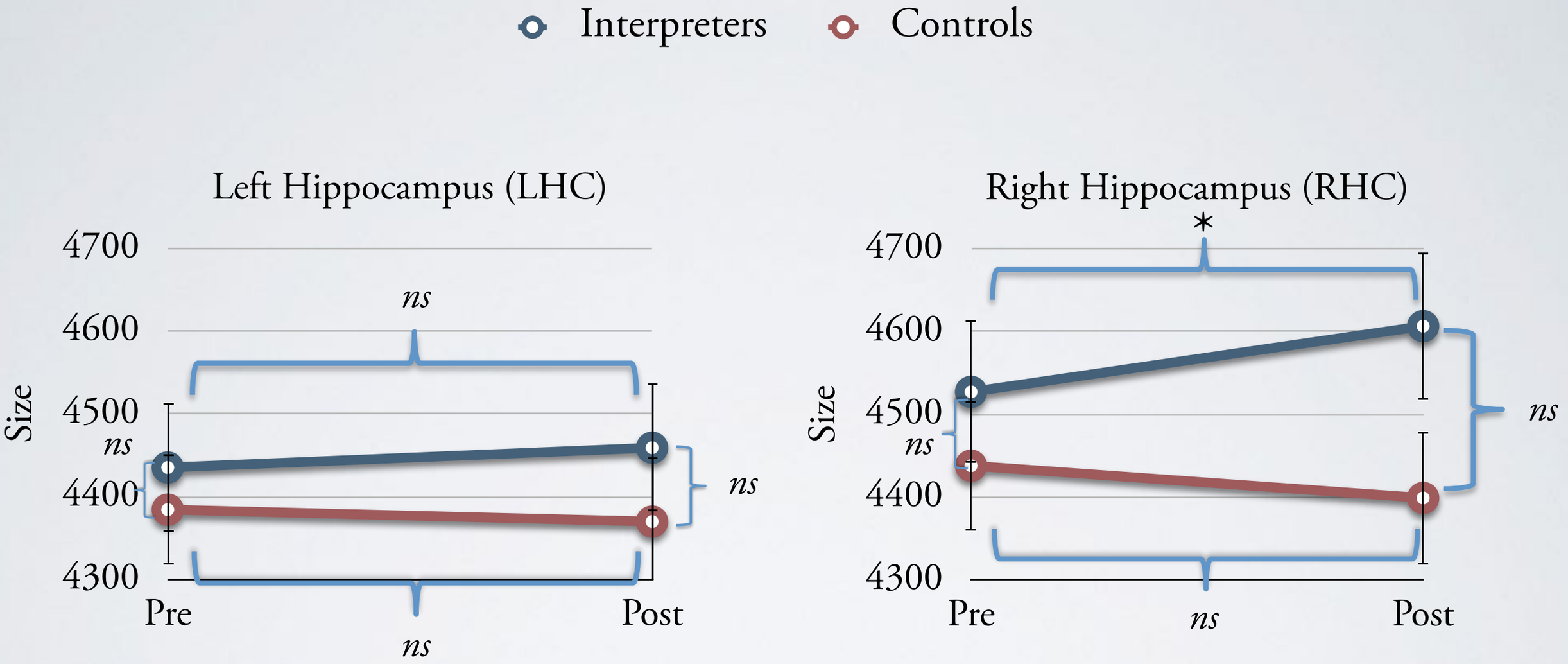




Hickok, G. & Poeppel, D. (2007). The cortical organization of speech processing. Nature reviews, neuroscience.

johan.martensson@med.lu.se

Subkortikala förändringar



F(1,29) = .90, p = .35

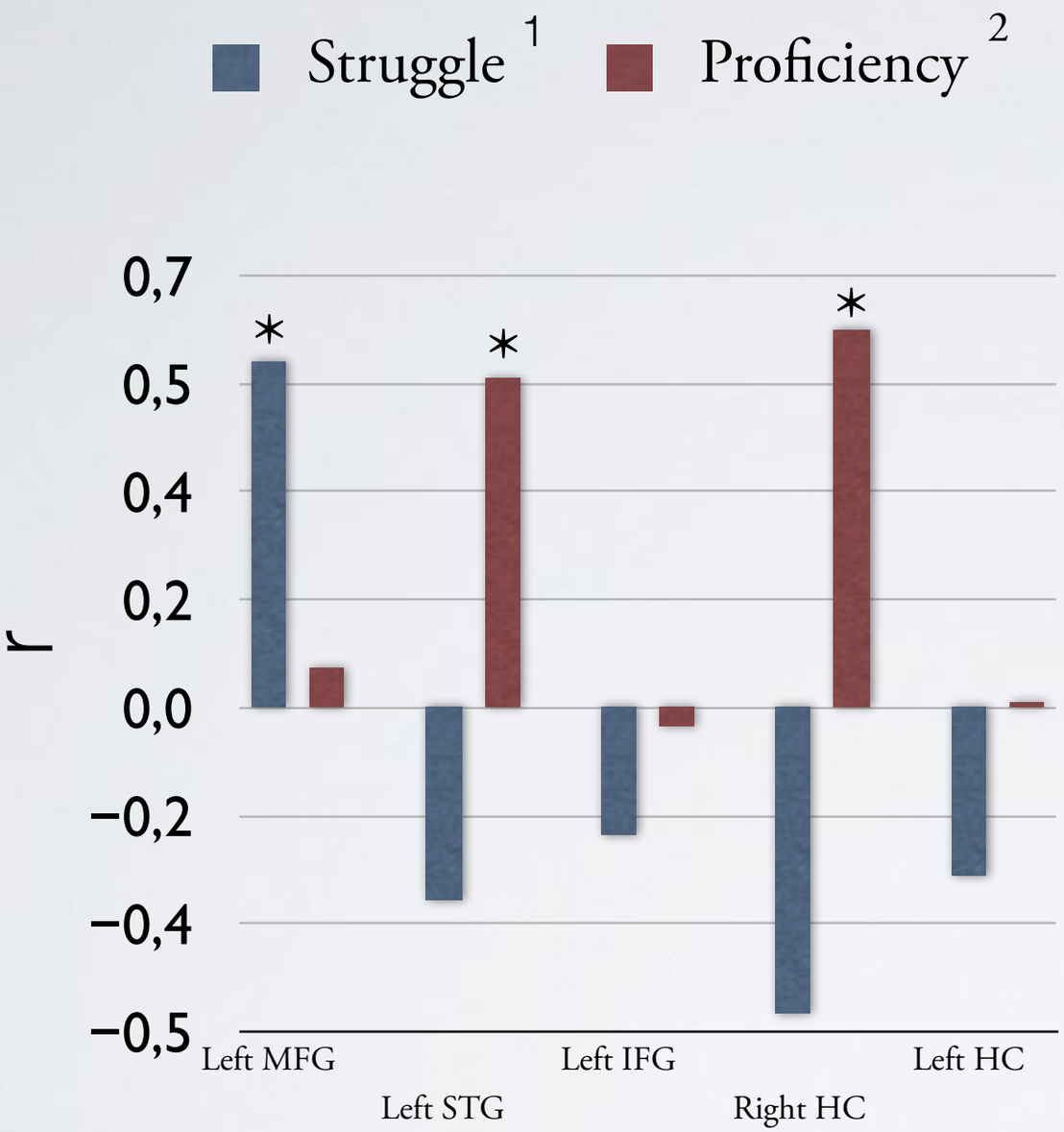
F(1,29) = 8.89, p = .01

* denotes p < .05

johan.martensson@med.lu.se

Relation till beteende

Vi lär oss olika,
möjligen med olika neurala system



* denotes p < .05

1 Teacher rating: ”Bedöm hur stor ansträngning som krävts av varje elev för att uppnå Tolkskolans mål för att få vara kvar vid utbildningen”

2 Test Score on their mid year exam. This exam is especially important, if they fail they have to leave the academy.

Strategy?

Language ability?

johan.martensson@med.lu.se

Språk, forts.

Vill du lära dig italienska?

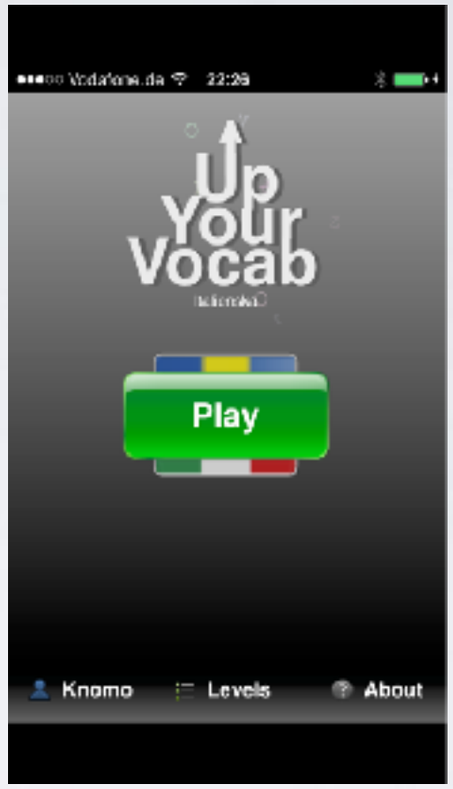
Delta i vår studie av språkinlärning och hjärnan. Vi står vi för kursavgiften och litteratur!

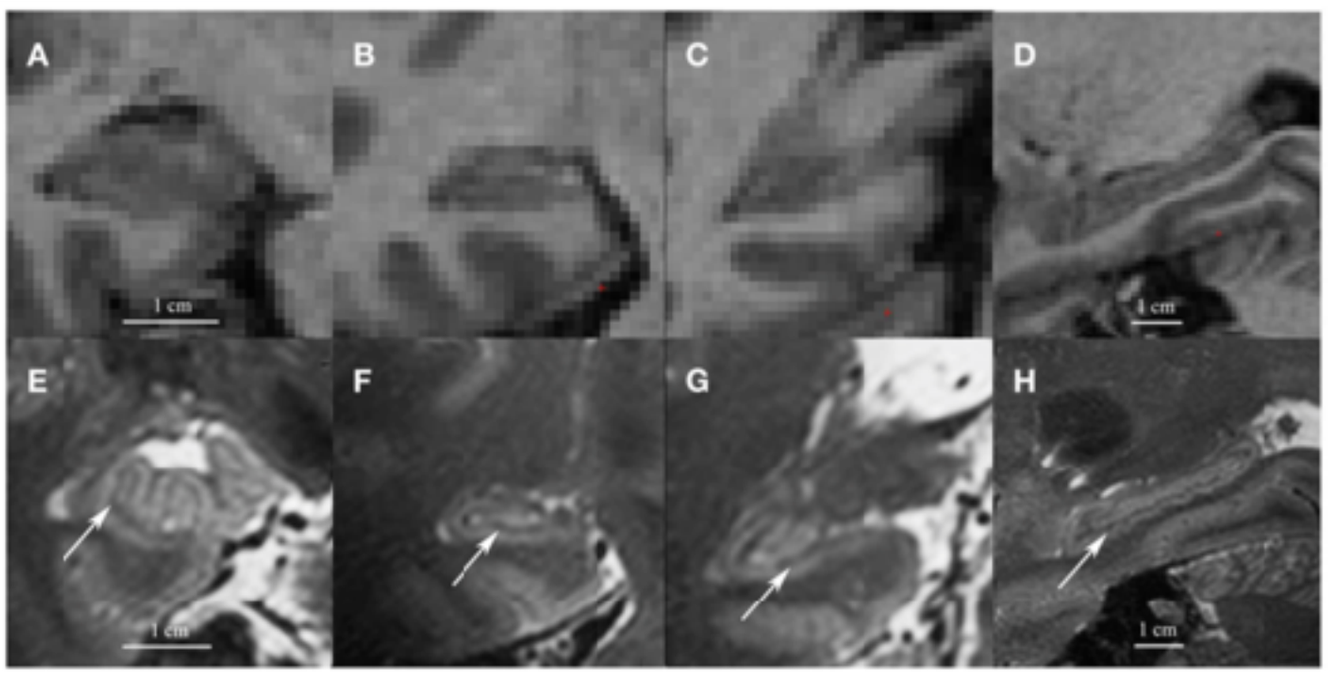
Som deltagare i studien medverkar du vid 10 undervisningstillfällen i italienska för nybörjare vid Medborgarskolan i Stockholm. Du kommer lära dig en stor mängd glosor varje vecka. Mätningar av minnesförmåga och hjärnstruktur genomförs i en magnetkamera på Karolinska Universitetssjukhuset. Du som vill delta ska vara 18-30 år och ha svenska som modersmål och ej kunna något latinskt språk.
Utöver gratis språkundervisning vid medborgarskolan får varje deltagare 500kr per mättillfälle (två). Ytterliggare prestationsbaserad ersättning kan tillkomma

Intresserad? Maila namn och telefonnummer till italienskaforhjarnan@gmail.com så kontaktar vi dig.

Ansvarig forskare: Martin Lövdén, Docent, Karolinska Institutet

Karolinska Institutet





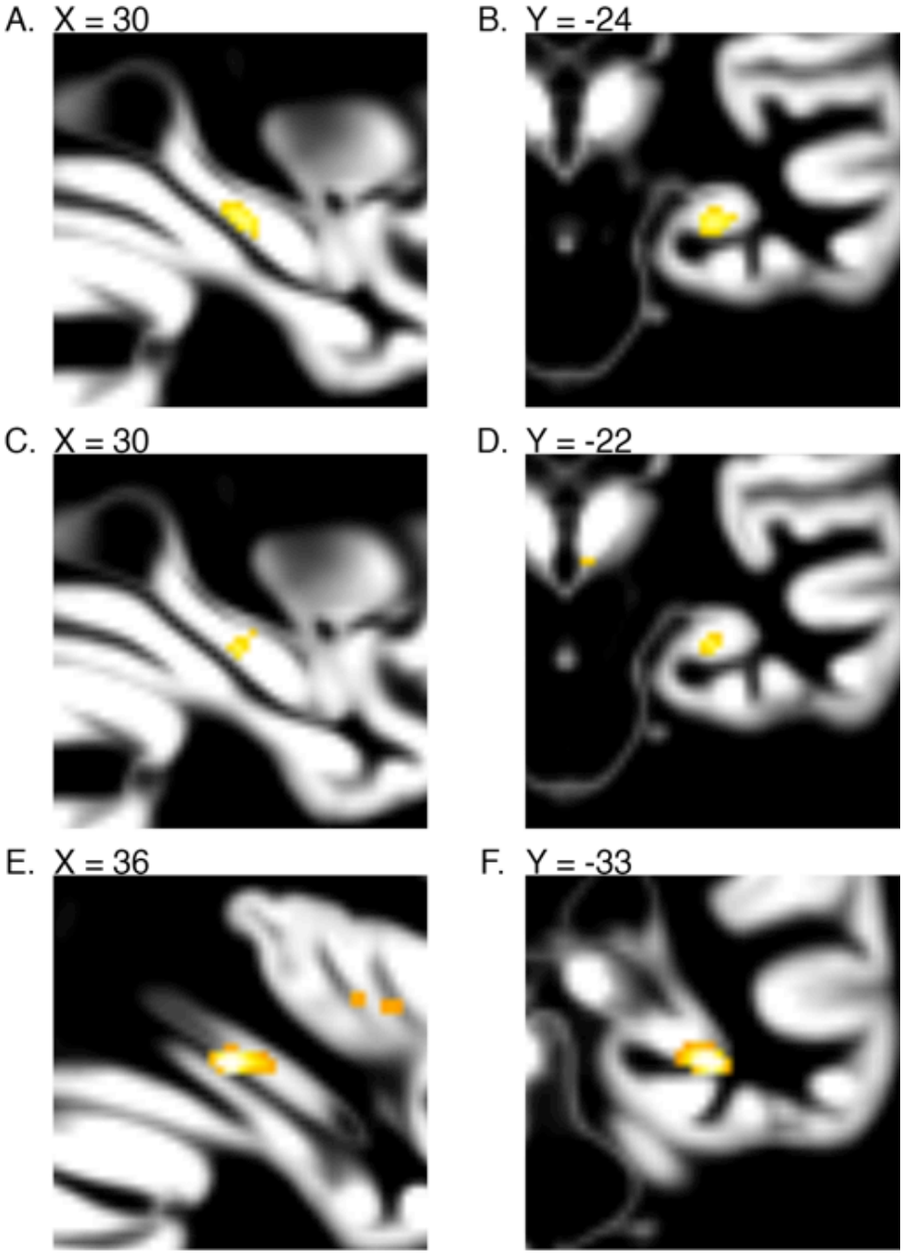
Wisse et al., 2014; Müller 2007

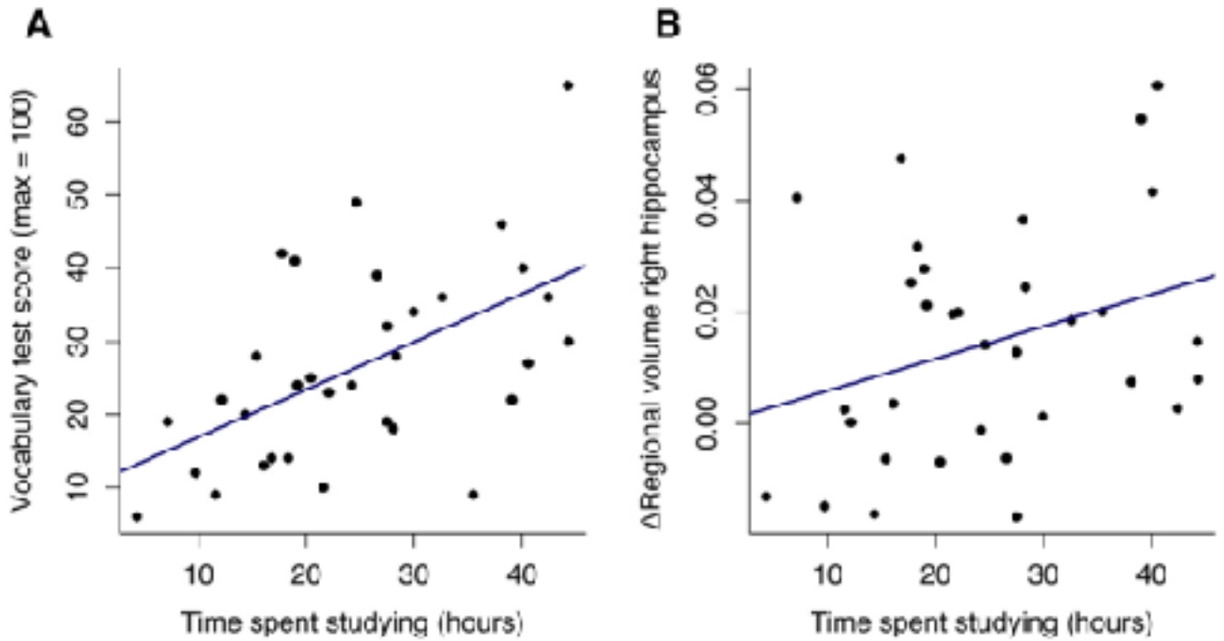
Josef Granqvist

Martin Lövdén

johan.martensson@med.lu.se

Tillbringad tid är den primära faktorn (i denna studien)

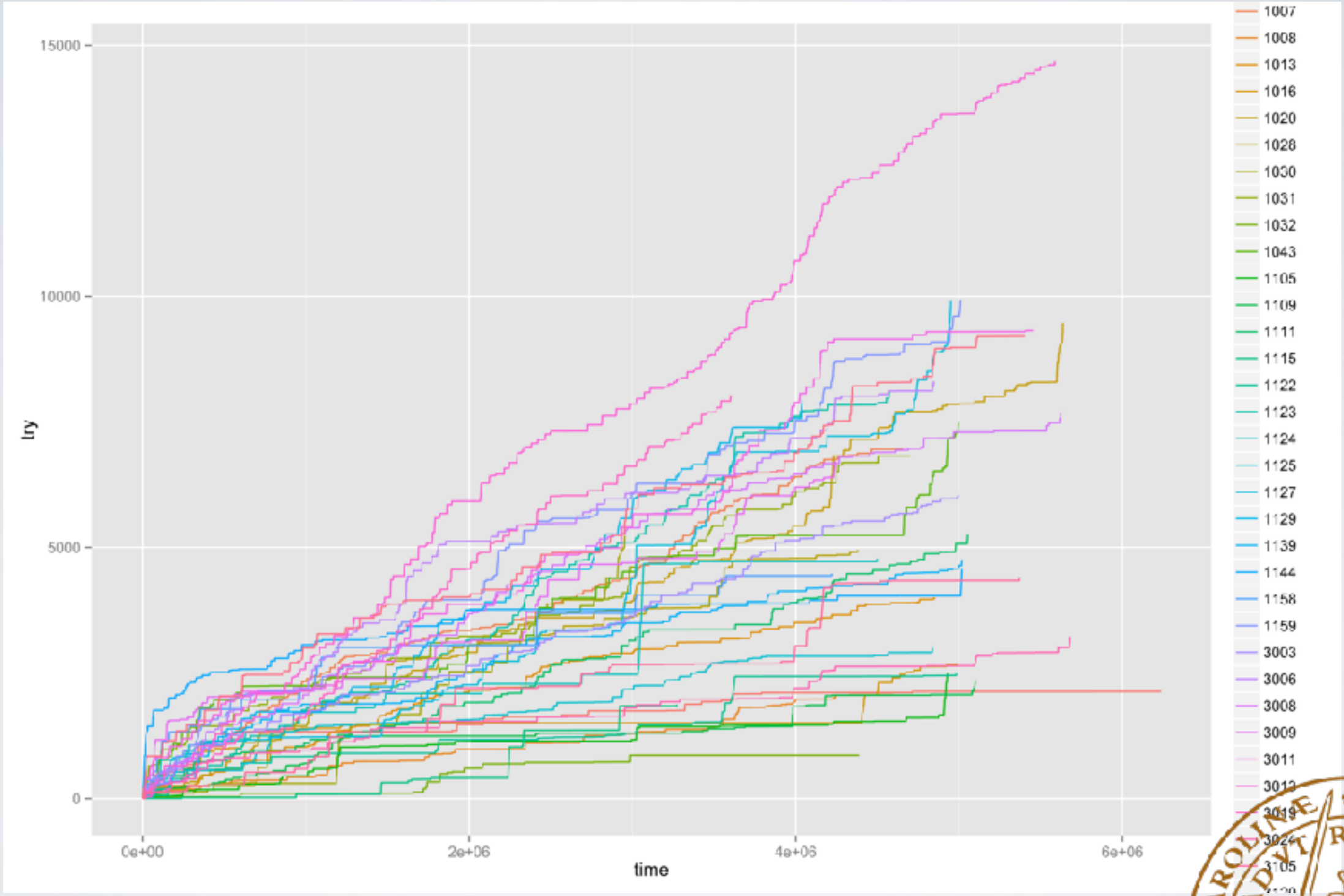




Right HC ↑

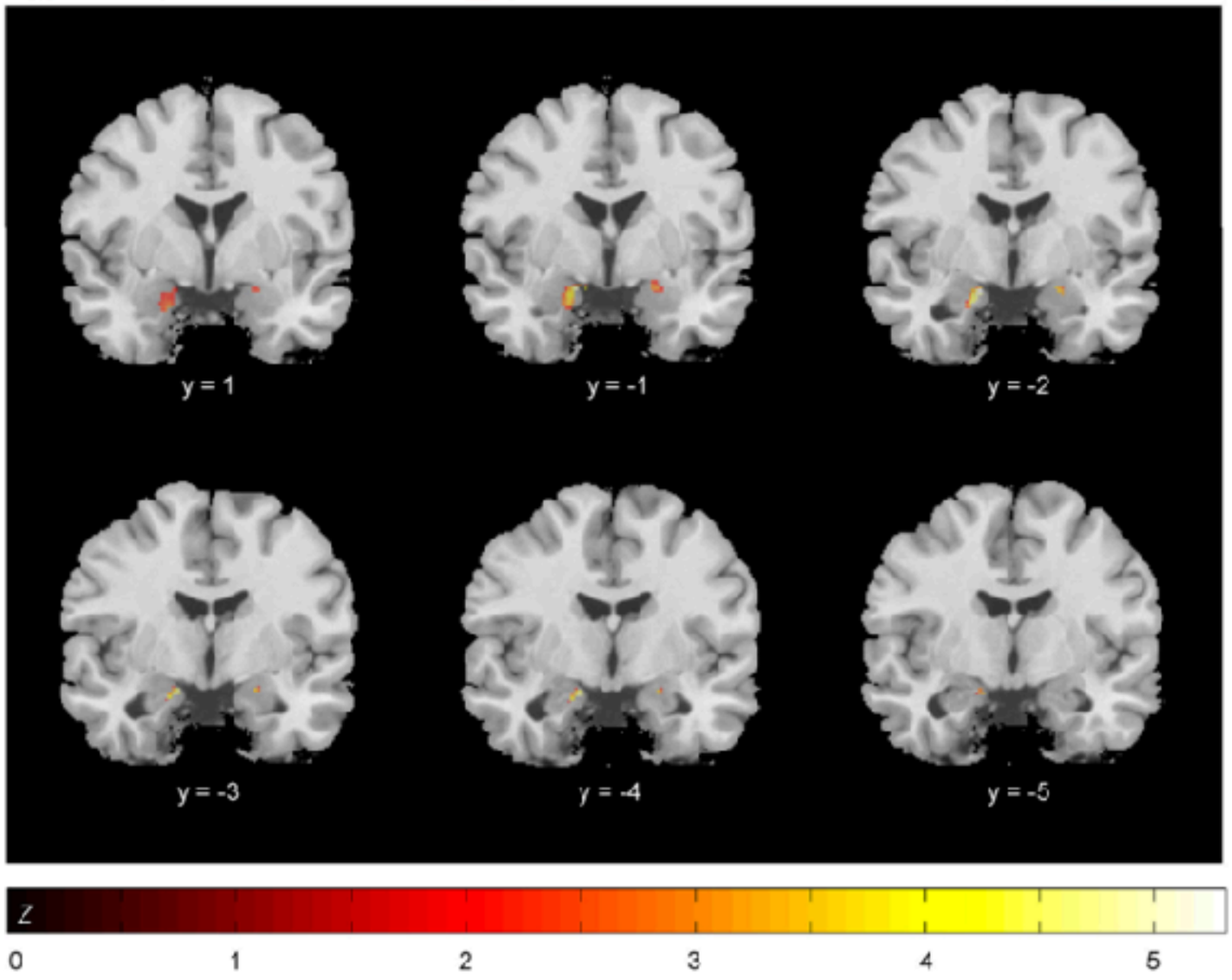
Bellander, M., Berggren, R., **Mårtensson, J.**, Brehmer, Y., Wenger, E., Li, T-Q., Bodammer, N-C., Shing, Y-L., Werkle-Bergner, M., & Lövdén, M. (2015). **Behavioral correlates of changes in hippocampal grey matter structure during acquisition of foreign vocabulary.** Neuroimage

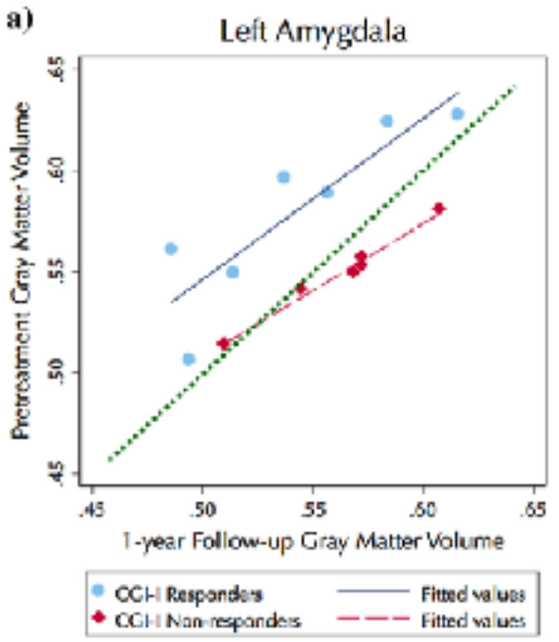
Tillbringad tid är den primära faktorn



~620 words over 10 weeks; range 86–1150; SD = 324 (!)
Average score on an Italian vocabulary test (max = 100) was 27 (range 6–65; SD = 13; skewness = 0.74; kurtosis = 0.61)

Eller KBT





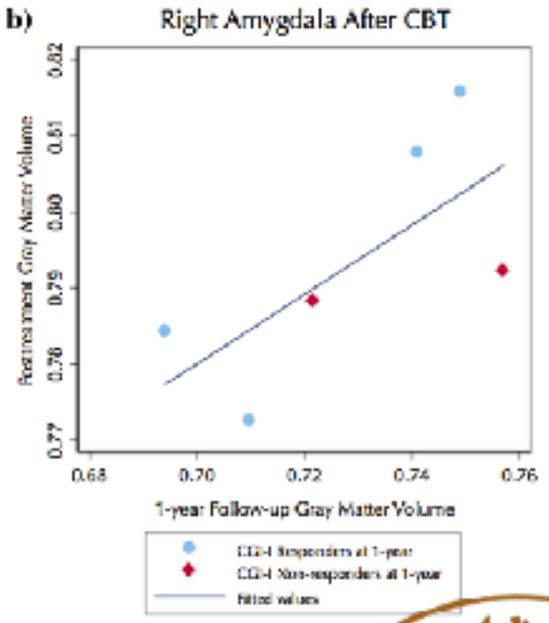


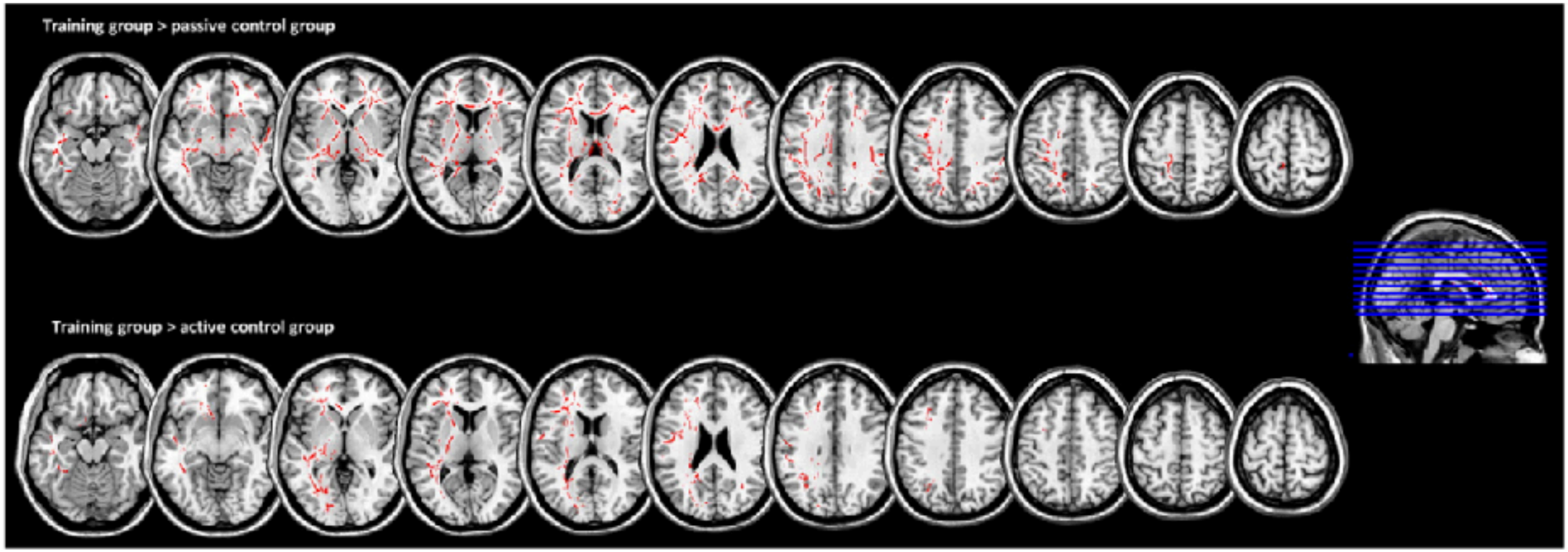
Fig. 3. Gray matter volume Time × Group interaction effect in the left amygdala is displayed on multiple slices (from y = −5 to y = 1) showing reduced volume (from pre- to 1-year follow-up) in long-term responders, relative to non-responders. Peak voxels in the left amygdala xyz[−16,−3,−17] and right amygdala xyz[18,−3,−15].

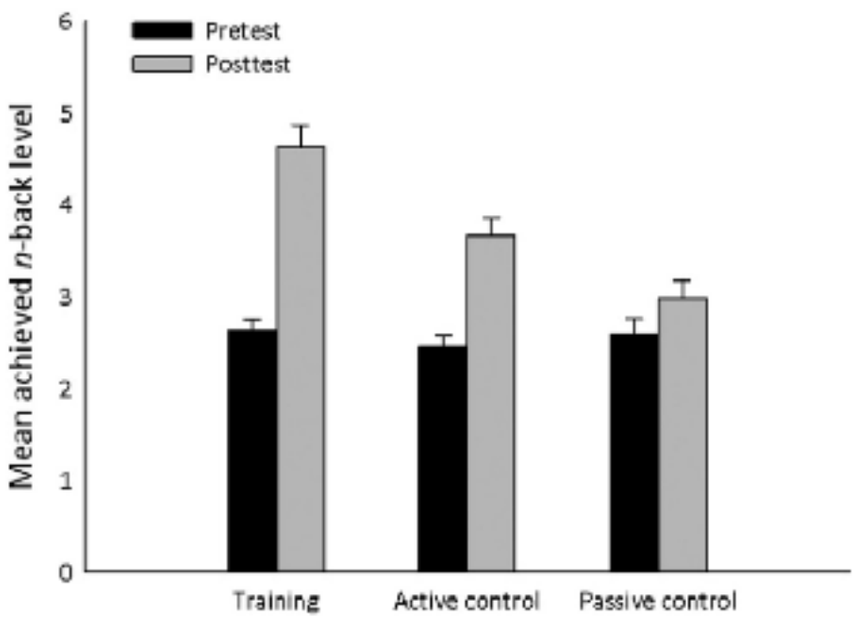
Structural but not functional neuroplasticity one year after effective cognitive behaviour therapy for social anxiety disorder

Kristoffer N.T. Månsson[a,b,*], Alireza Salami[c,d], Per Carlbring[e], C.-J. Boraxbekk[d,f,g], Gerhard Andersson[a,b], Tomas Furmark[h]

johan.martensson@med.lu.se

Eller arbetsminne



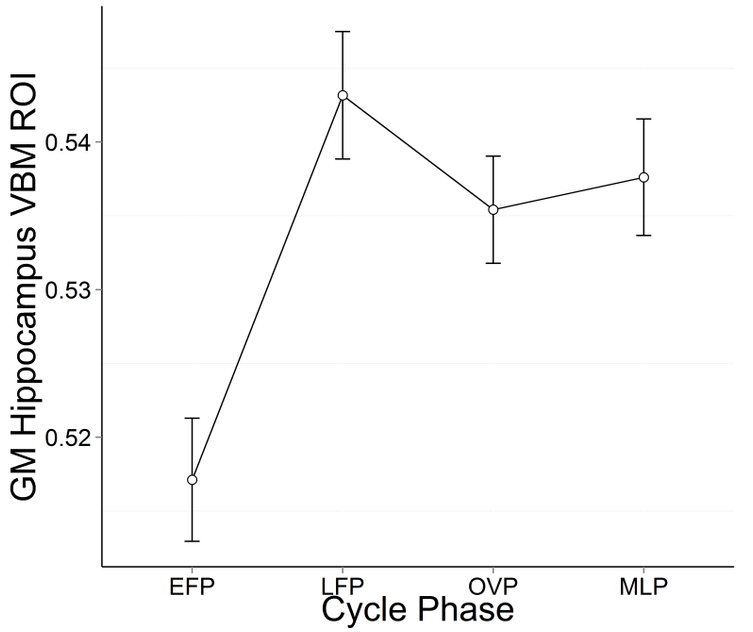


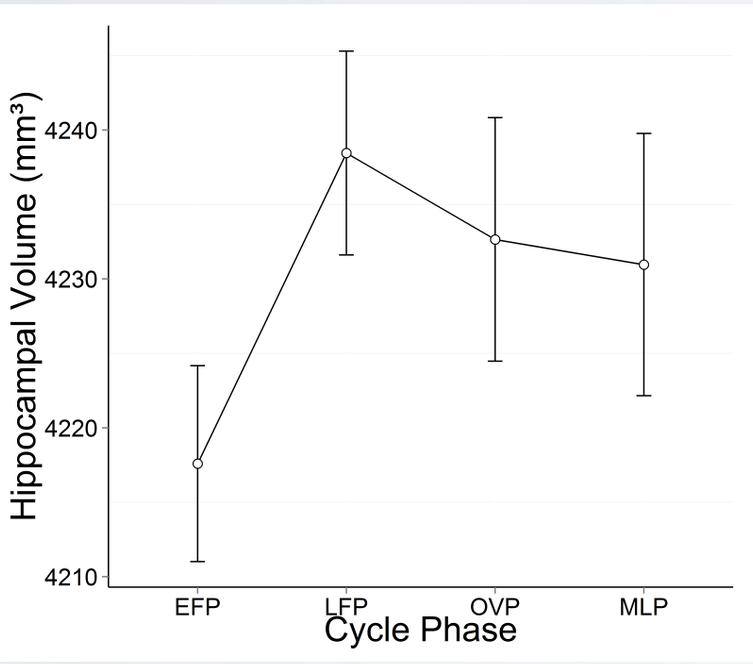
Tiina Salminen [a,*,1], Johan Mårtensson [b,**,1], Torsten Schubert [a], Simone Kühn [c,d]

[a] Department of Psychology, Humboldt University of Berlin, Rudower Chaussee 18, 12489 Berlin, Germany
[b] Department of Psychology, Lund University, Lund, Sweden
[c] Center for Lifespan Psychology, Max Planck Institute for Human Development, Lentzeallee 94, 14195 Berlin, Germany
[d] Clinic and Policlinic for Psychiatry and Psychotherapy, University Clinic Hamburg-Eppendorf, Martinistraße 52, 20246 Hamburg, Germany

johan.martensson@med.lu.se

Menstruationscykeln

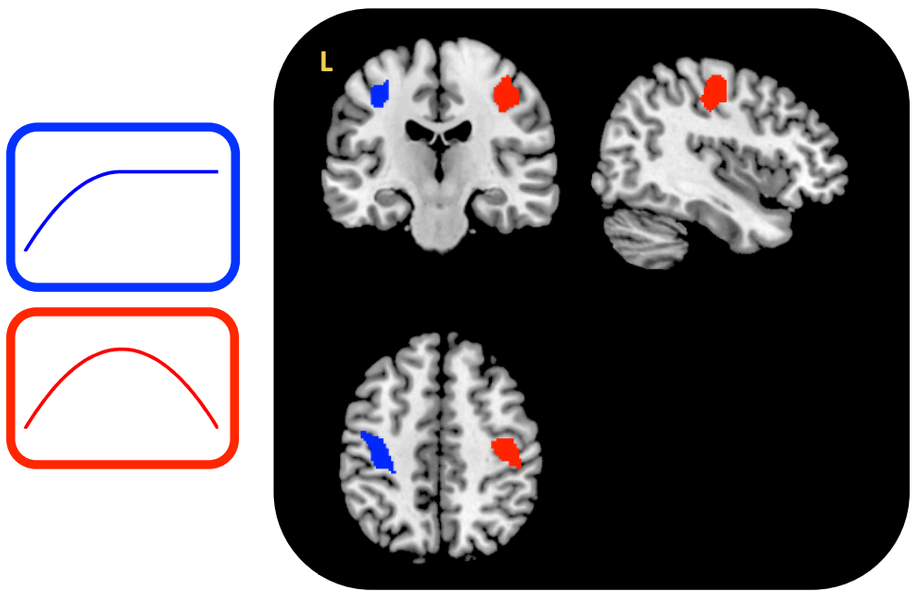




Lisofsky, N., Mårtensson, J., Eckert, A., Lindenberger, U., Gallinat, J. & Kühn, S. (2015). **Hippocampal volume and functional connectivity changes during the female menstrual cycle.** *Neuroimage.*

Motorträning

Structural Changes in Motor Cortex



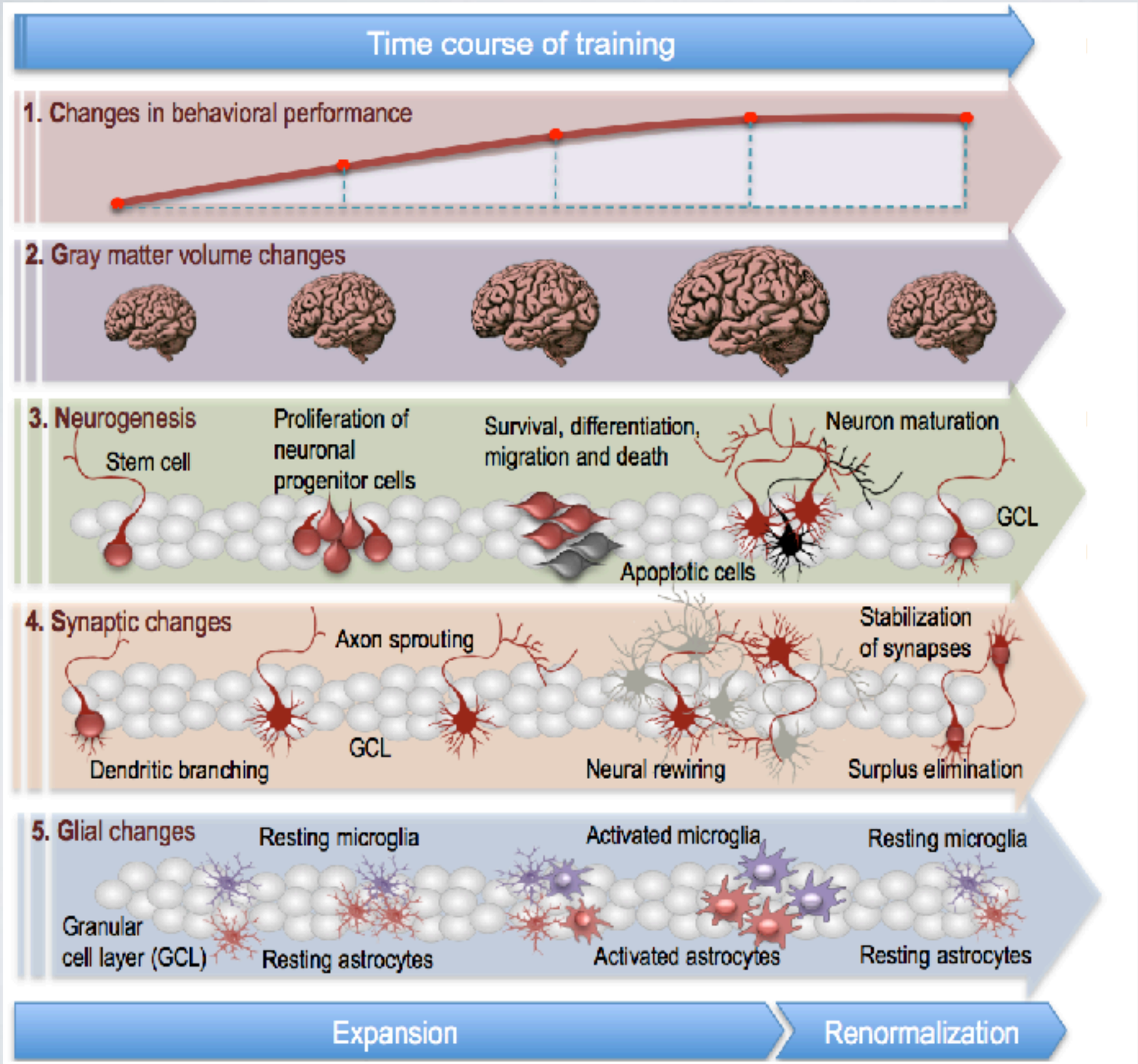
18 mätpunkter

Gråsubstans ökade under vänsterhandsträning för att sedan delvis normaliseras.

Wenger, E.,*, Kühn, S., Verrel, J., **Mårtensson, J.**, Bodammer, N-C., Lindenberger, U., & Lövdén, M. (2015). **The non-linear time course of human gray matter changes in response to motor training.** *Cerebral cortex.*

johan.martensson@med.lu.se

Plasticitet är inte nödvändigtvis linjär



- Tillväxt för att skapa diversitet, följt av selektion, gallring och stabilisering.
- Vi ser liknande mönster i neurogenes, synaptogenes, glia, kortikal plasticitet och utveckling

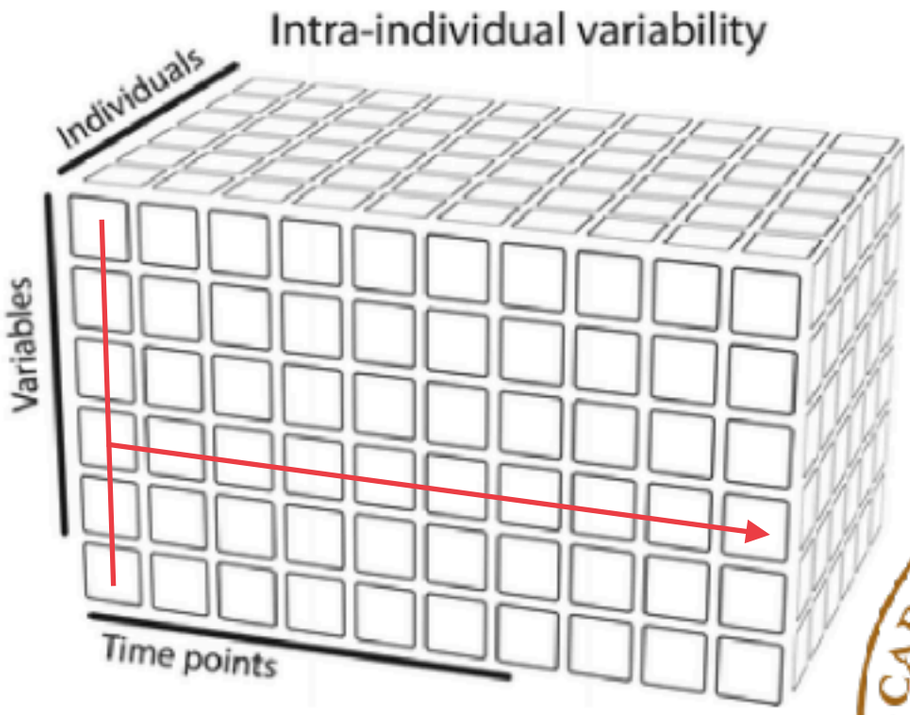
E.g.

Lövdén, M., Wenger, E., Mårtensson, J., Lindenberger, U., & Bäckman, L. (2013). **Structural brain plasticity in adult learning and development.** Neuroscience and Biobehavioral Reviews. doi: 10.1016/j.neubiorev.2013.02.014

Och variabilitet i hjärnsignal och struktur kan vara hög

Day2day: Investigating daily variability of magnetic resonance imaging measures over half a year

Nina Lisofsky[1,2*], Elisa Filevich[1*], Maxi Becker[1], Oisin Butler[1], Martyna Lochstet[1], Johan Martensson[1], Elisabeth Wenger[1], Ulman Lindenberger[1], Simone Kühn[1,2],



johan.martensson@med.lu.se

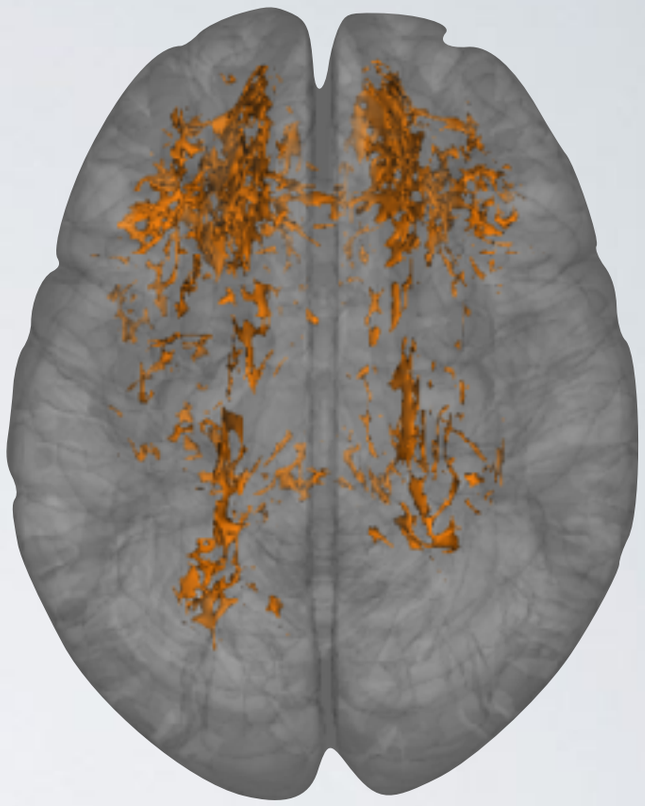
Predispositions and Plasticity in Music and Speech Learning: Neural Correlates and Implications

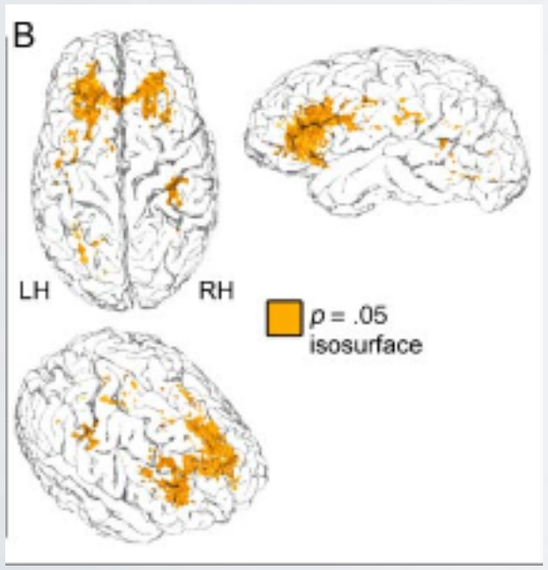
Robert J. Zatorre*

Kommer till Lund

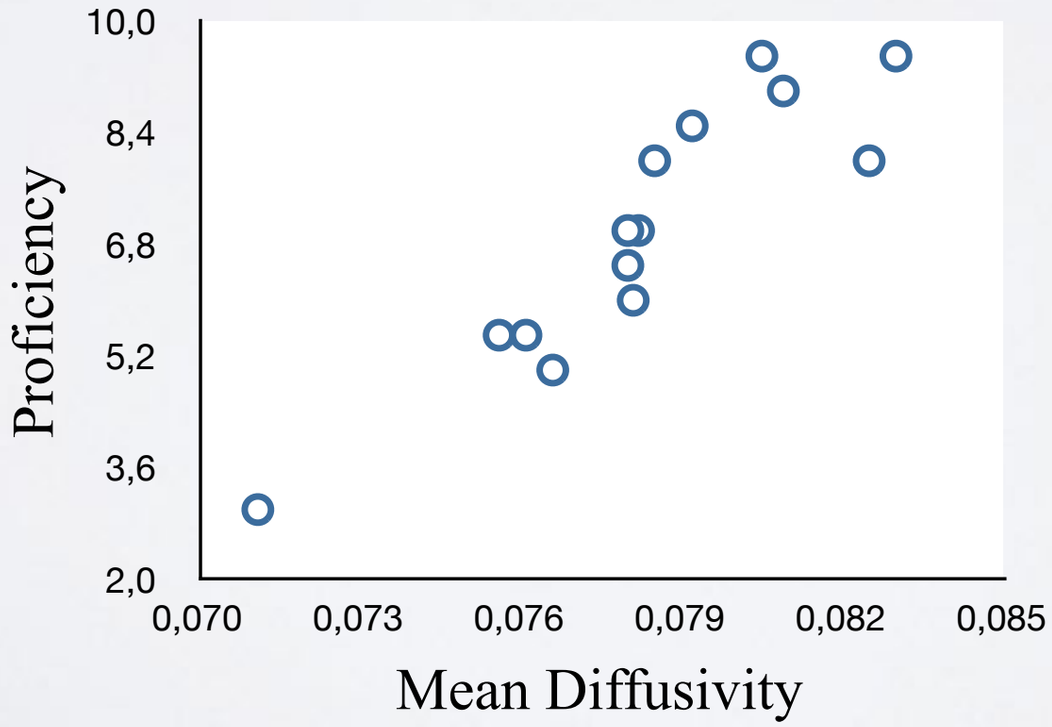
Speech and music are remarkable aspects of human cognition and sensory-motor processing. Cognitive neuroscience has focused on them to understand how brain function and structure are modified by learning. Recent evidence indicates that individual differences in anatomical and functional properties of the neural architecture also affect learning and performance in these domains. Here, neuroimaging findings are reviewed that reiterate evidence of experience-dependent brain plasticity, but also point to the predictive validity of such data in relation to new learning in speech and music domains. Indices of neural sensitivity to certain stimulus features have been shown to predict individual rates of learning; individual network properties of brain activity are especially relevant in this regard, as they may reflect anatomical connectivity. Similarly, numerous studies have shown that anatomical features of auditory cortex and other structures, and their anatomical connectivity, are predictive of new sensory-motor learning ability. Implications of this growing body of literature are discussed.

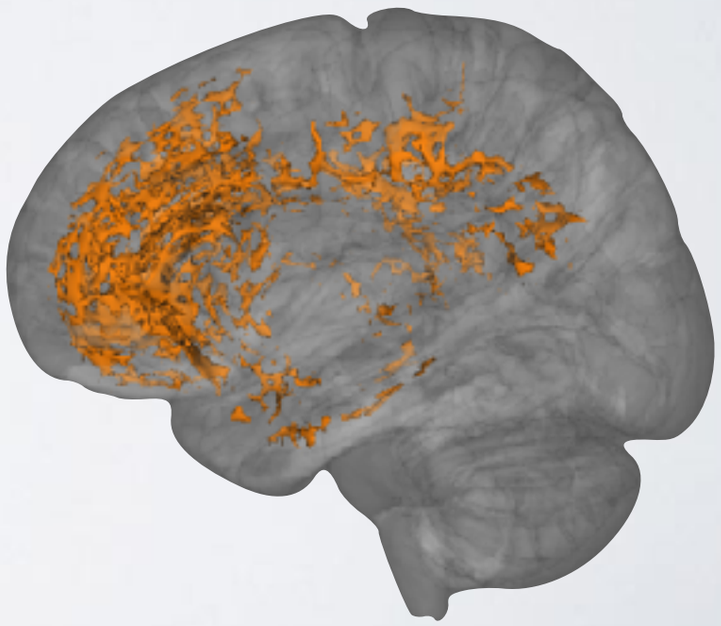
Predispositioner spelar roll





Schlegel, Rudelson and Tse (2012)





Sammanfattning

- Plasticitet kan beskrivas som nervsystemets kapacitet till förändring
- Dessa förändringar kan observeras på micro- och macro-nivå med modern hjärnavbildning
- Förändringarna består av olika effekter, t.ex. vaskularisering, dendritisering, glia celler som sväller
- En rad olika studier visar att plasticitet är möjligt i vuxen ålder, och att den vuxna hjärnan är högst dynamisk

Frågor?

johan.ma@gmail.com