Transition times.

Supporting the child and adolescent's transitions in Pediatric condition

2nd S.I.P.Ped. International Conference

November 7 – 9, 2019

Palermo, Sicily ,Villa Magnisi, Ordine dei Medici Chirurghi e Odontoiatri

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IEDPE Palermo

UNIVERSITÀ DEGLI STUDI DI PALERMO

Ordine degli Psicologi della Regione Siciliana

Origini psicobiologiche delle transizioni nell'infanzia e nell'adolescenza

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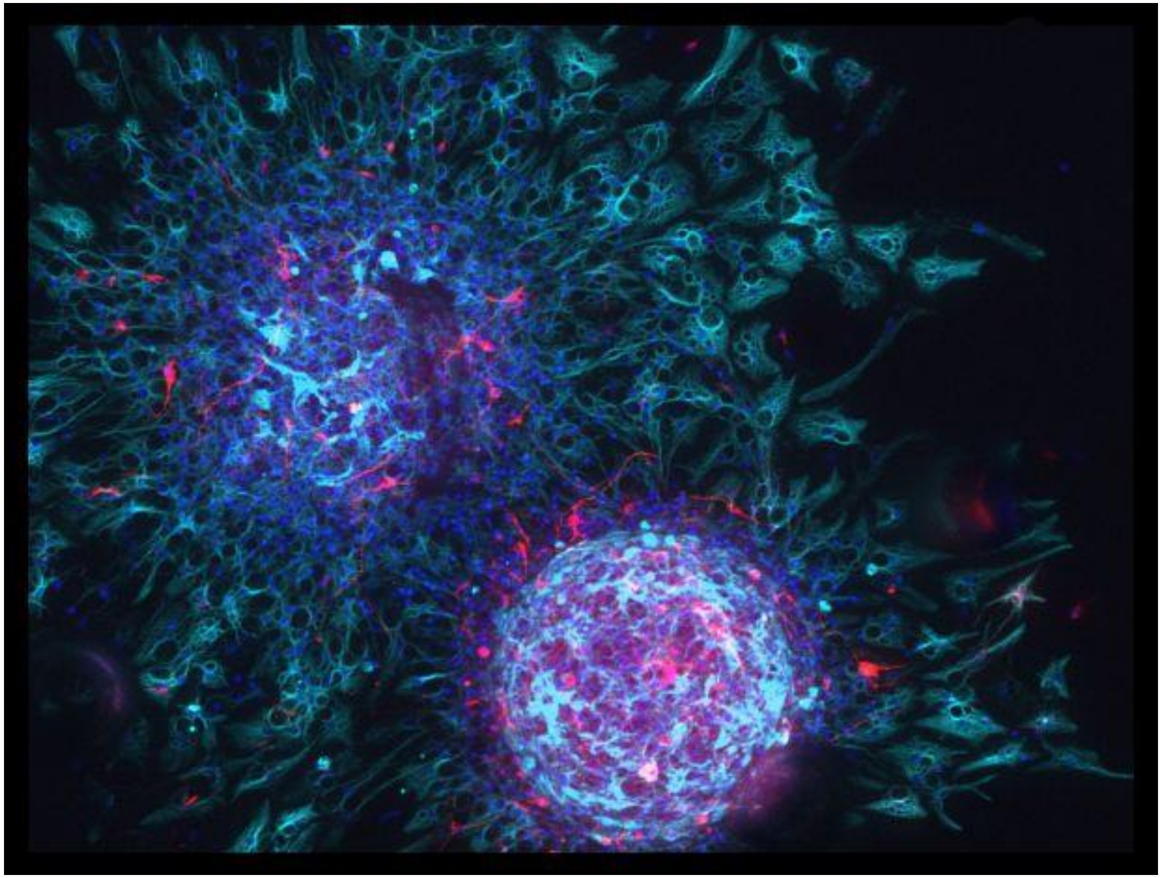
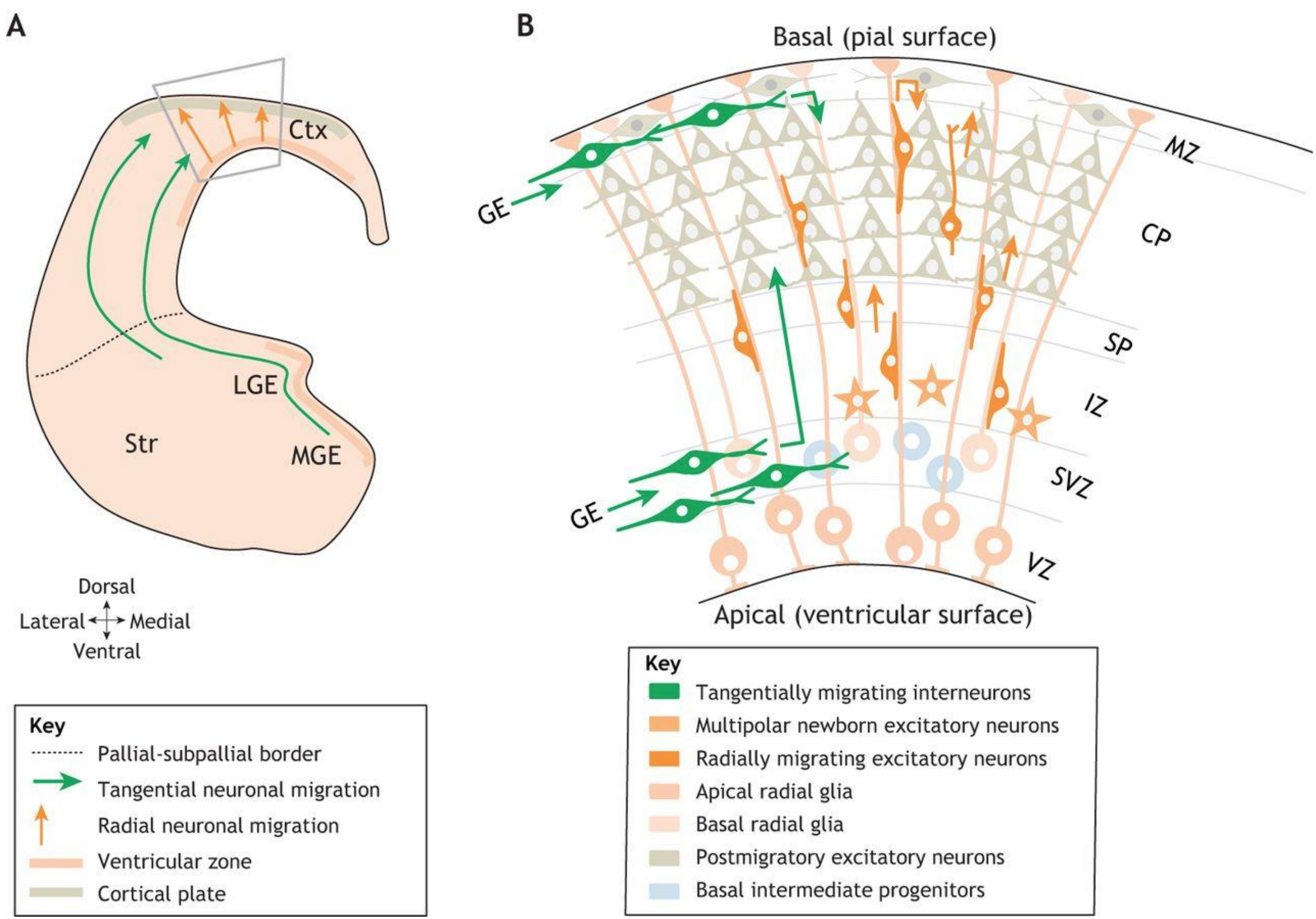
Spatiotemporal sequences during development

- Neurogenesis
- Neuronal migration
- Synaptic formation
- Dendritic arborization
- Axonal growth and myelination

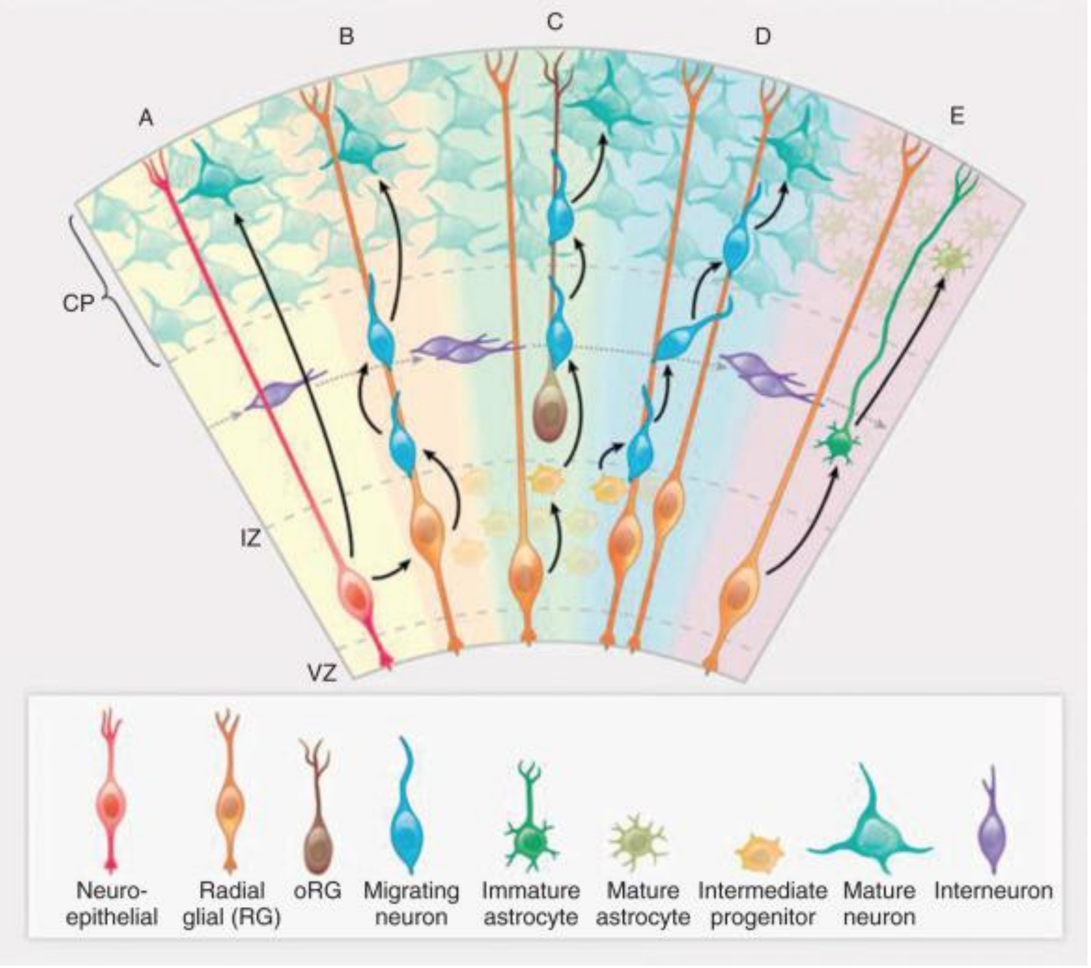
Neurogenesis



Neuronal migration

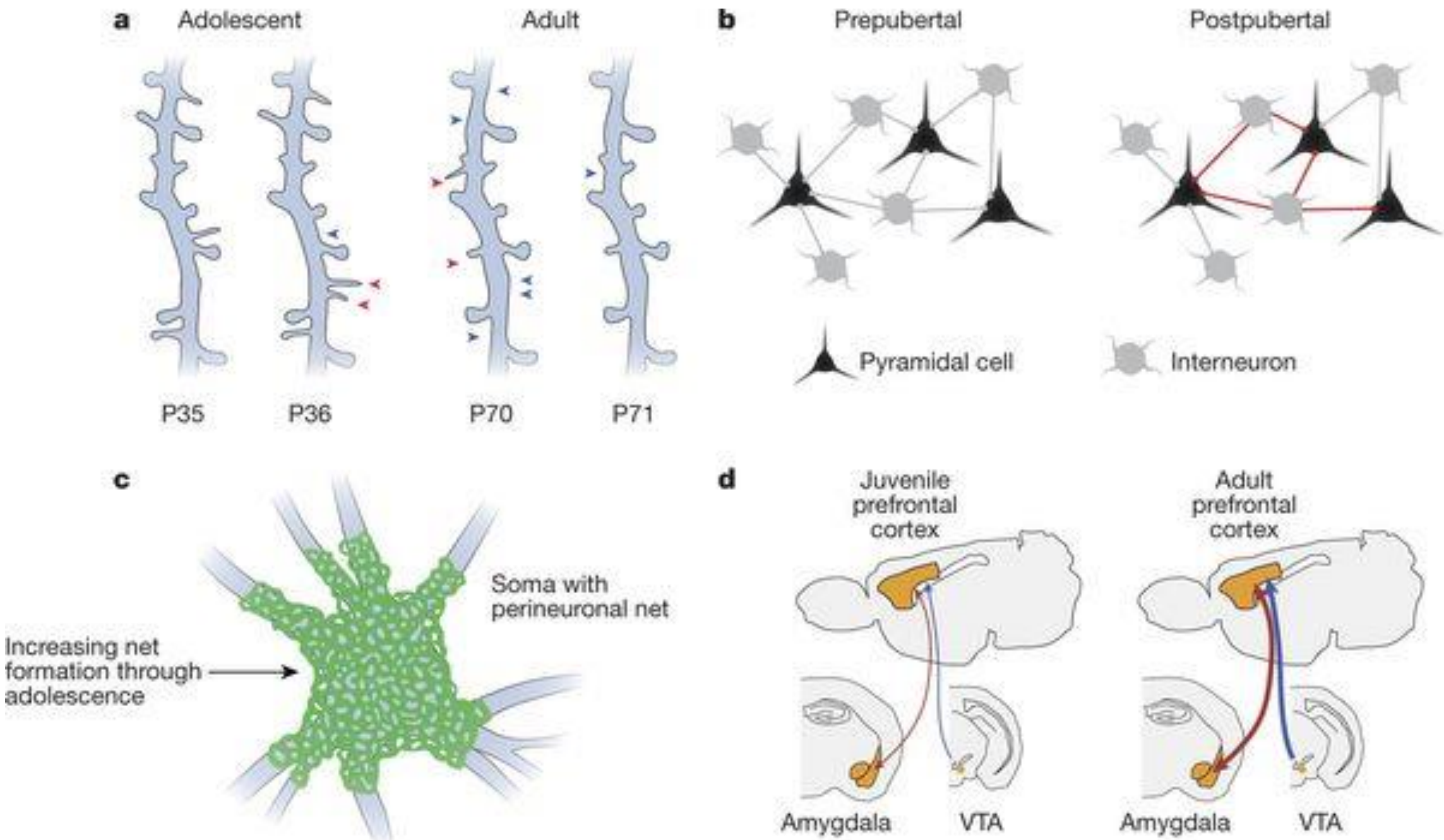


Neuronal migration

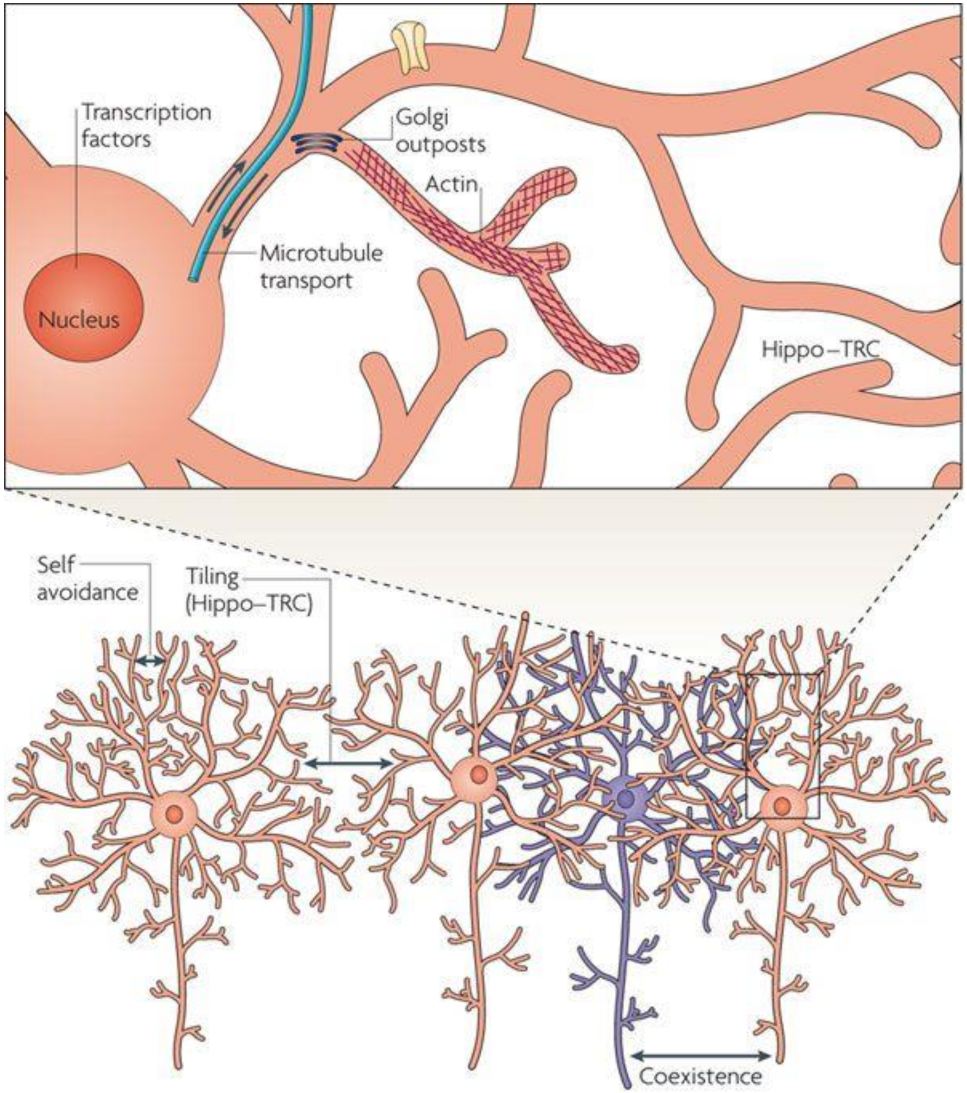


Example of maladaptive neuronal migration

Synaptic formation

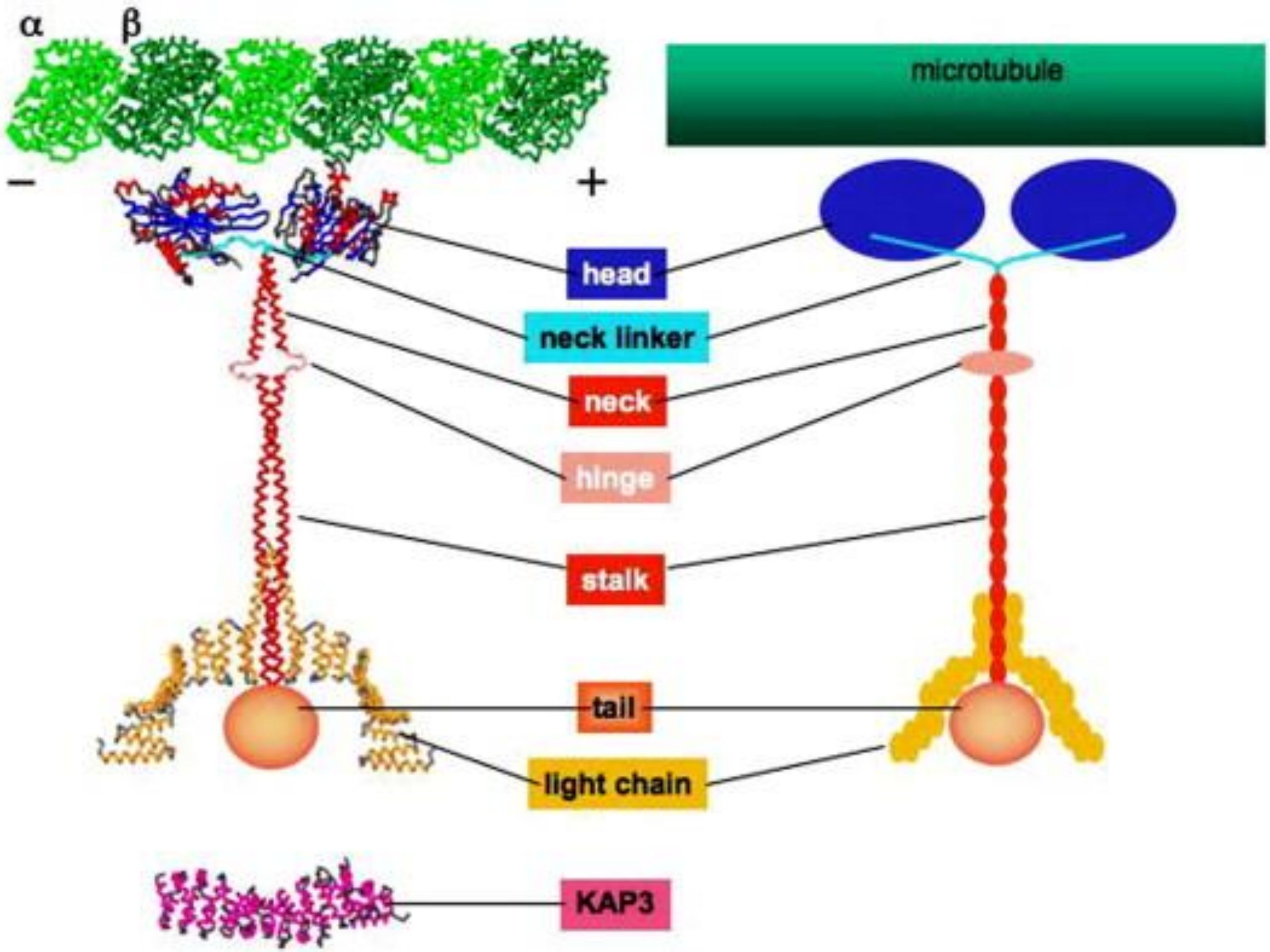


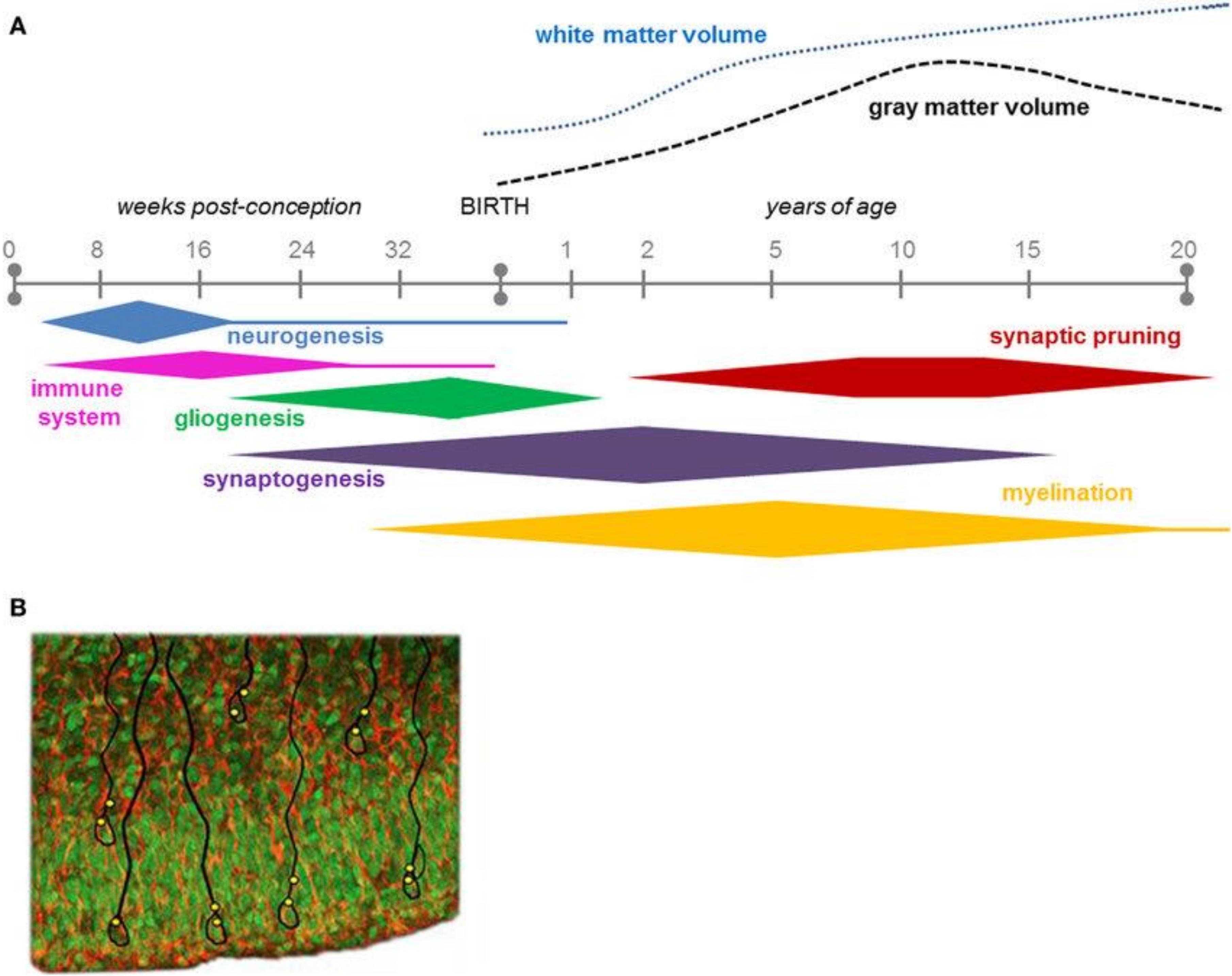
- **Dendritic arborization**

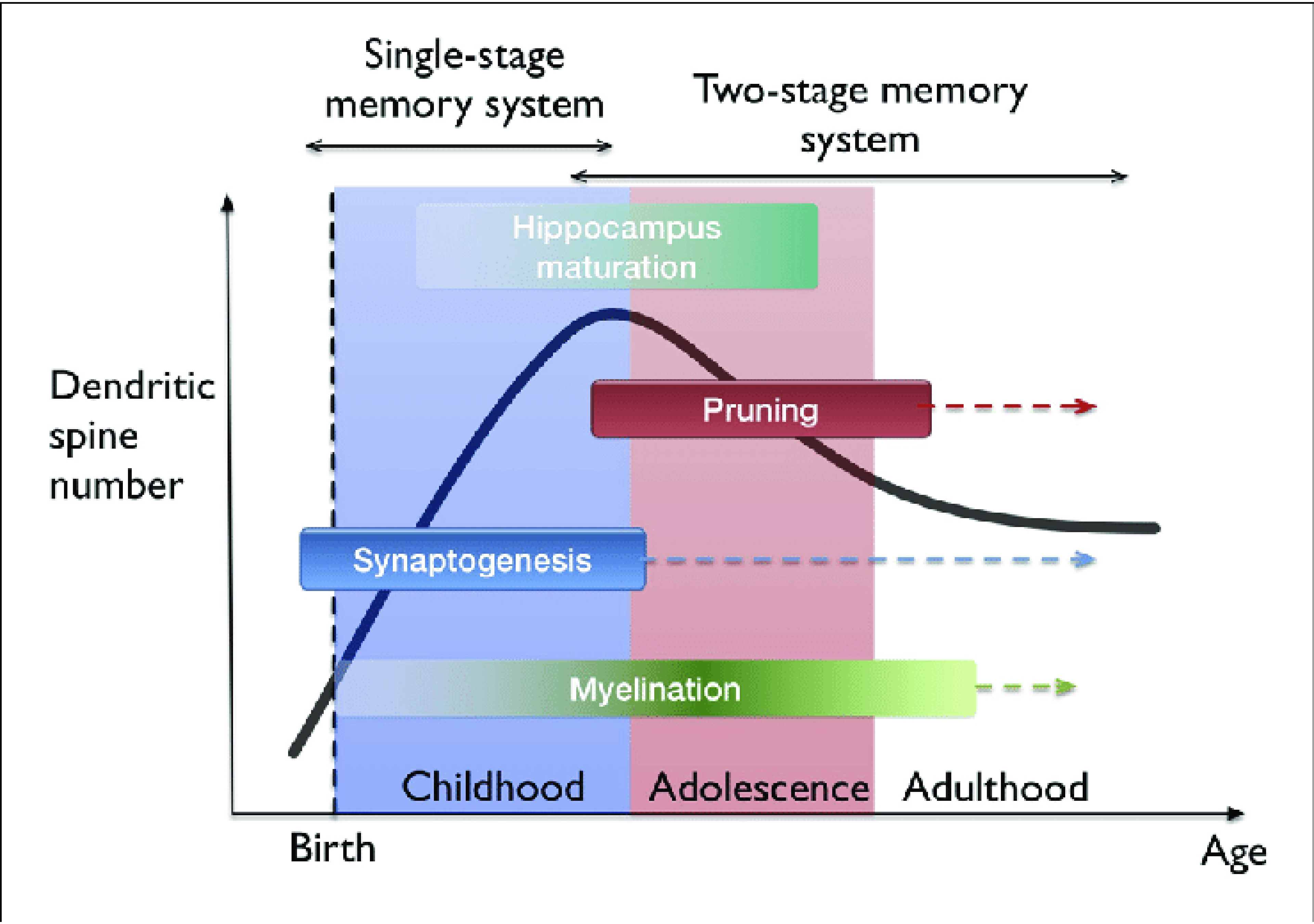


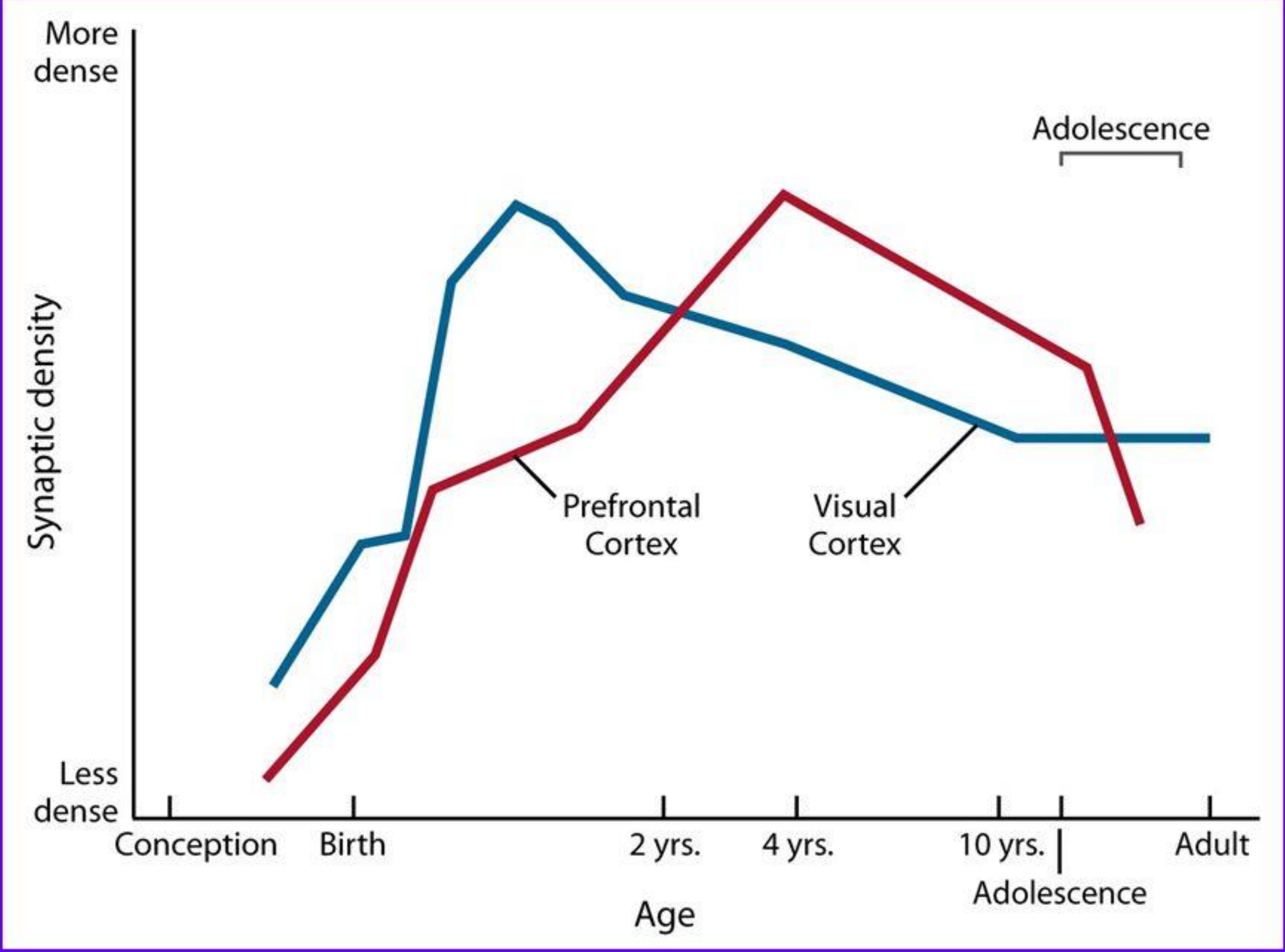
Nature Reviews | Neuroscience

Axonal growth and myelination

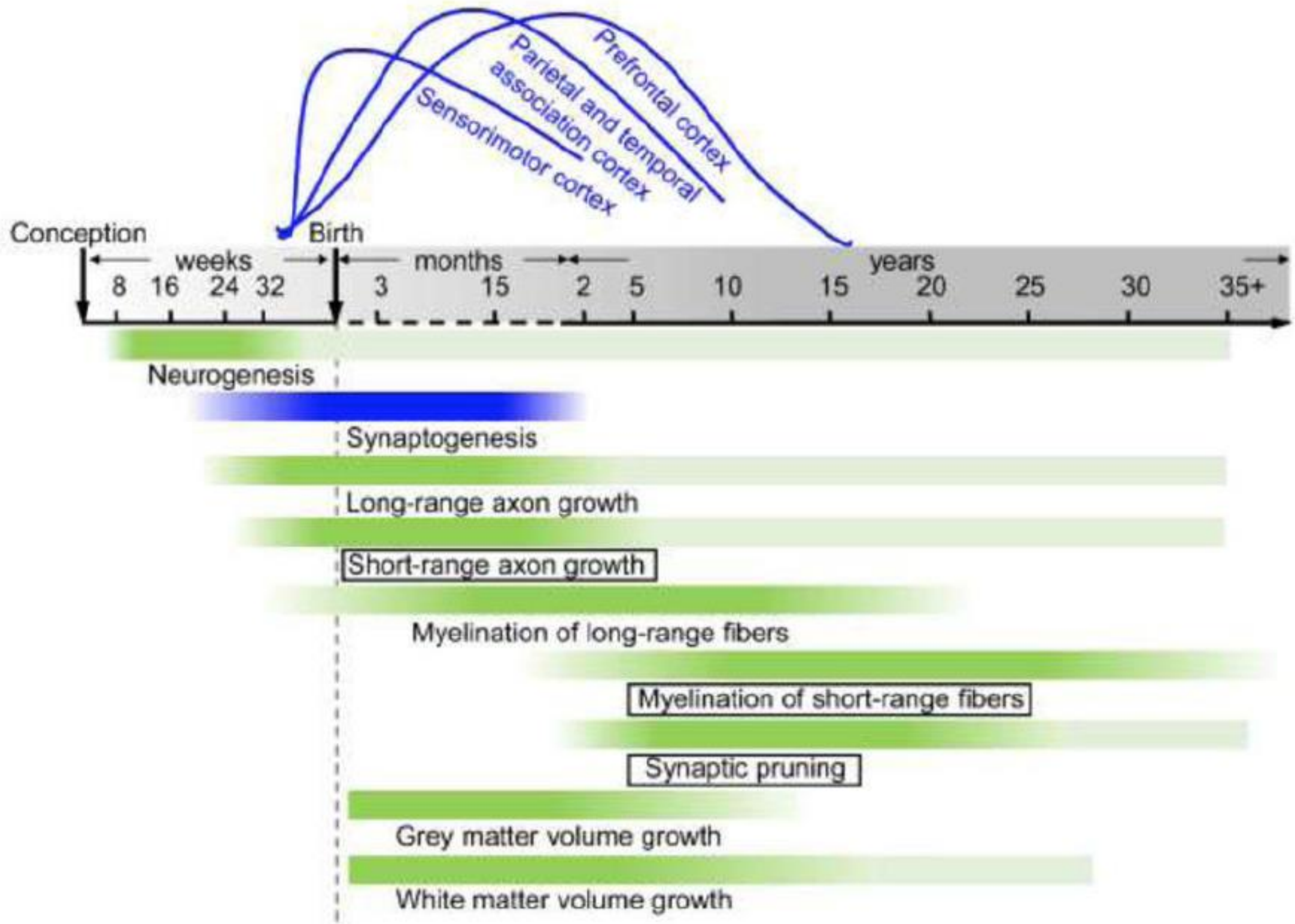


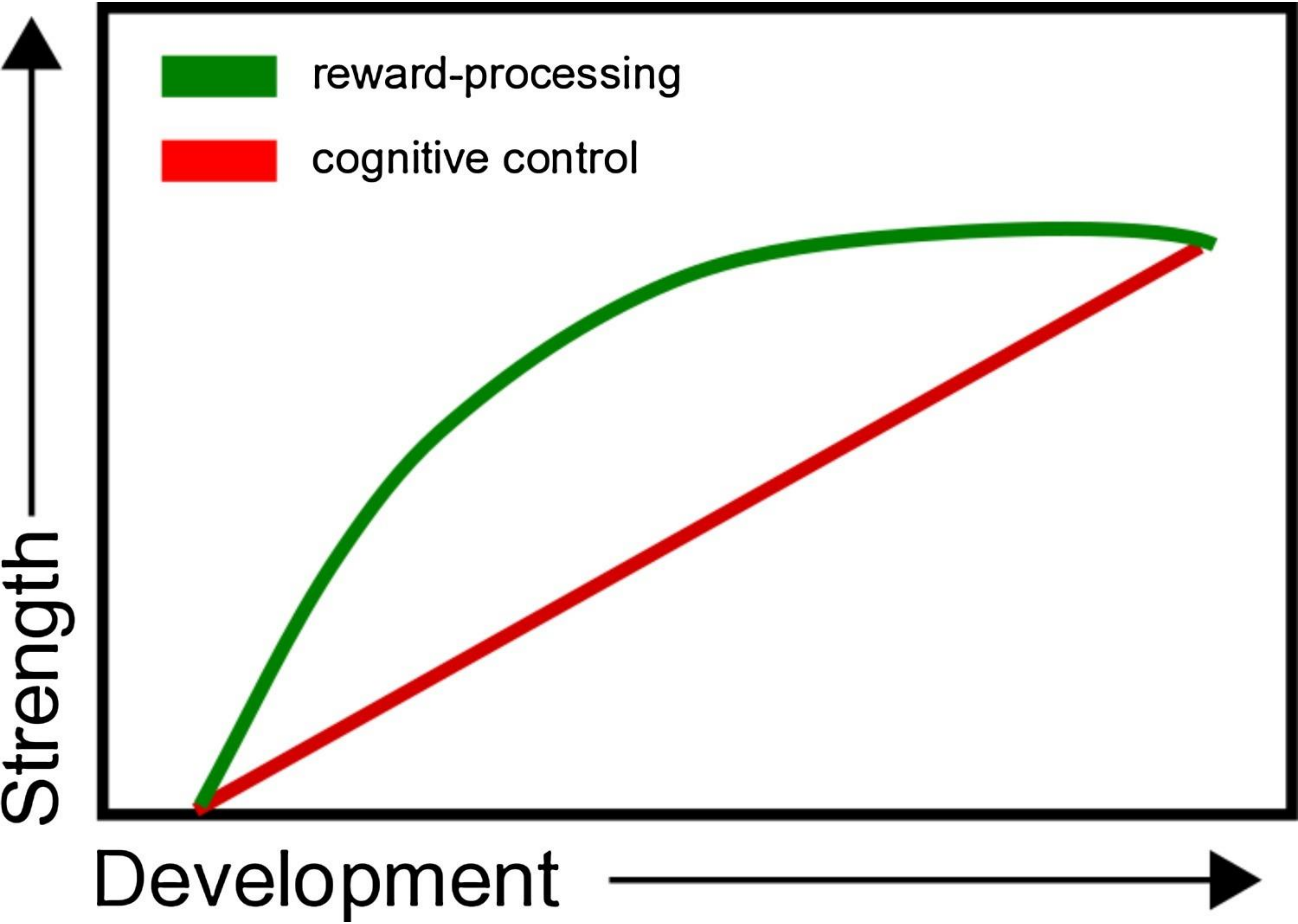

A
white matter volume
gray matter volume
weeks post-conception
BIRTH
years of age
0
8
16
24
32
1
2
5
10
15
20
neurogenesis
synaptic pruning
immune
system
gliogenesis
synaptogenesis
myelination
B


Single-stage memory system
Two-stage memory system
Hippocampus maturation
Dendritic spine number
Pruning
Synaptogenesis
Myelination
Childhood
Adolescence
Adulthood
Birth
Age

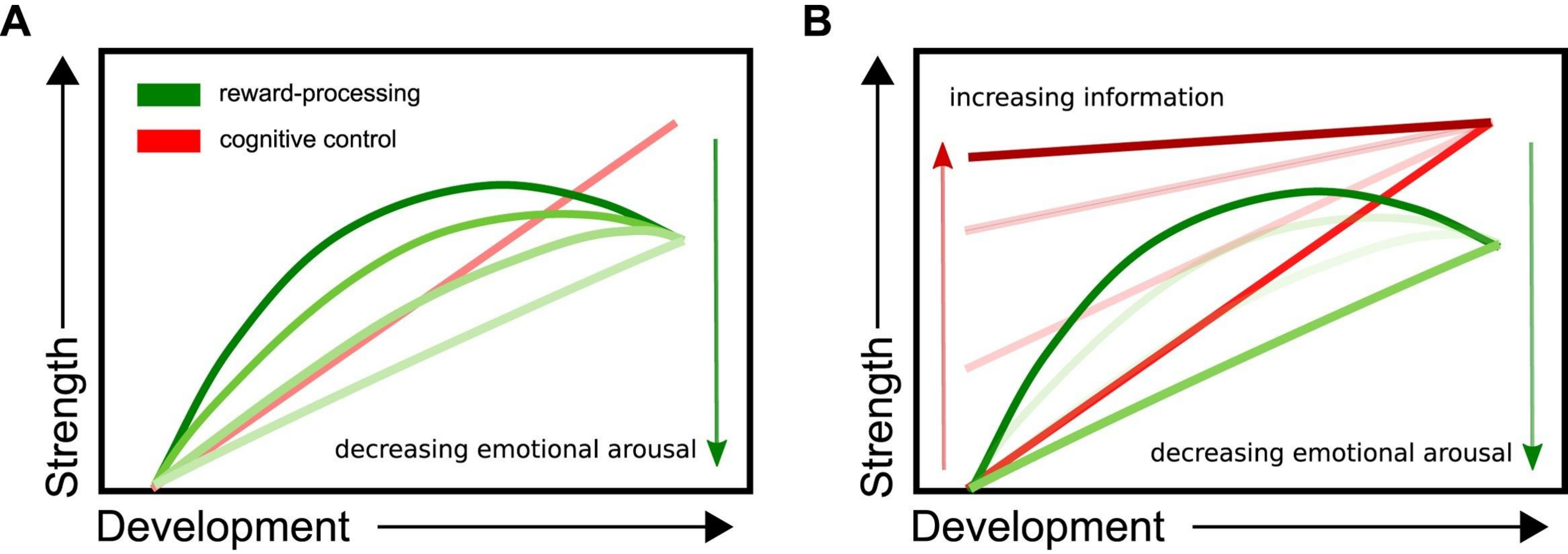

More dense
Less dense
Synaptic density
Adolescence
Prefrontal Cortex
Visual Cortex
Conception
Birth
2 yrs.
4 yrs.
10 yrs.
Adolescence
Adult
Age

Timeline of spatiotemporally distinctive human brain maturational processes

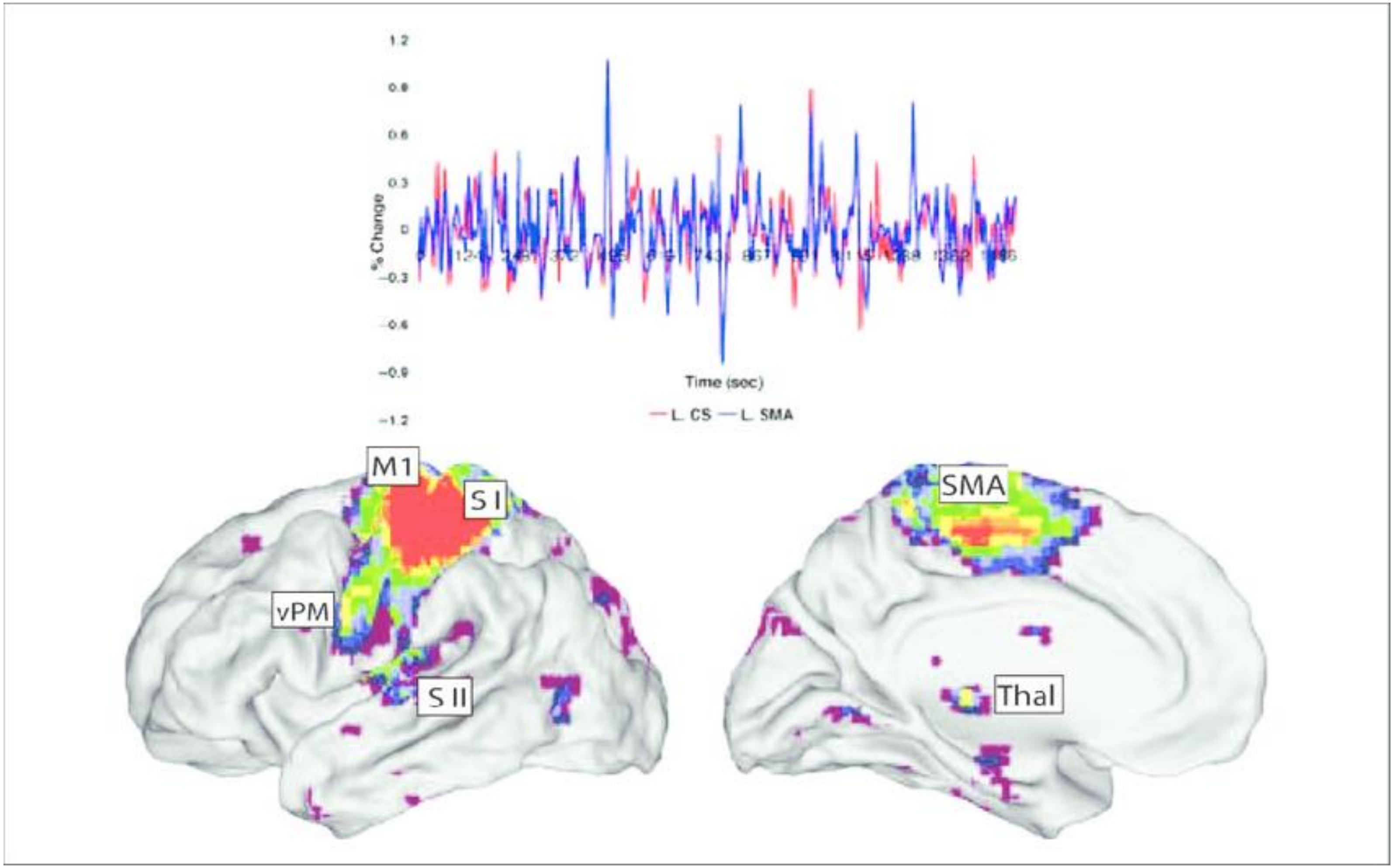



reward-processing
cognitive control
Strength
Development

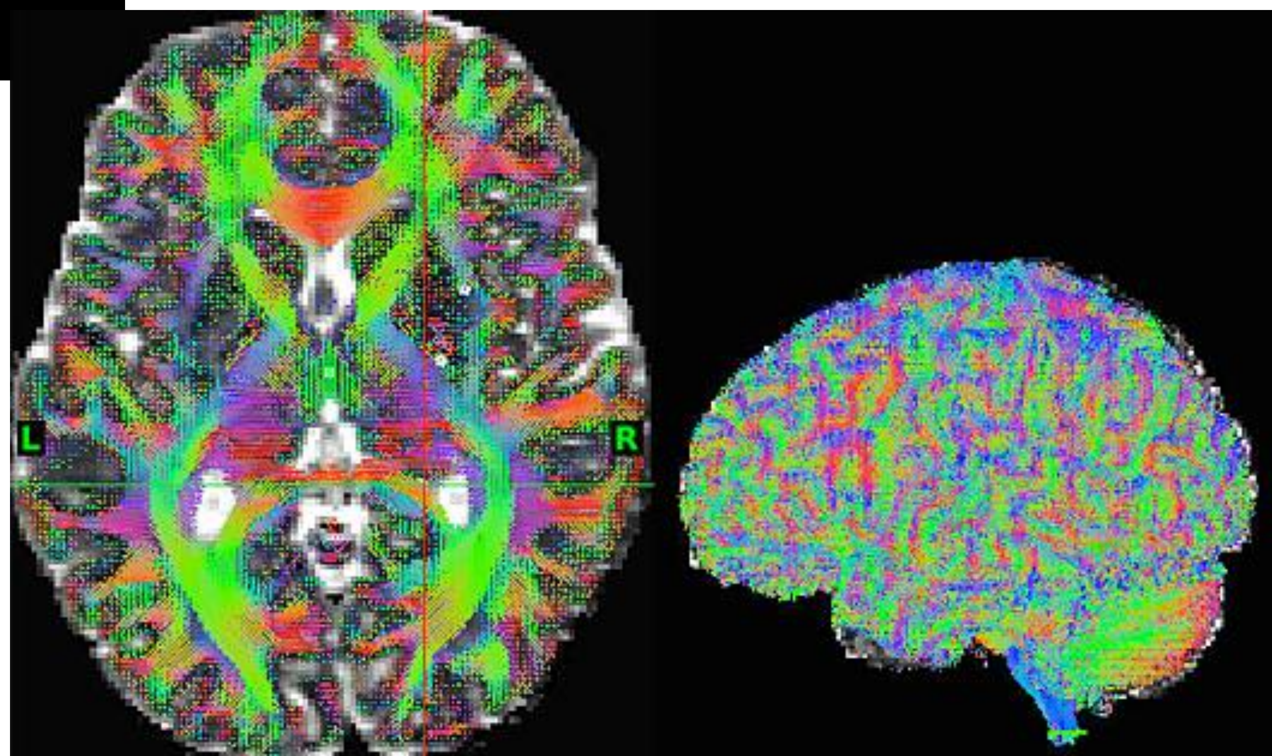
Limbic regions are flexibly recruited depending on whether a decision context is “hot” (affectively arousing) or “cold”.
The recruitment of PFC and cognitive control is also developmentally flexible based on information availability.

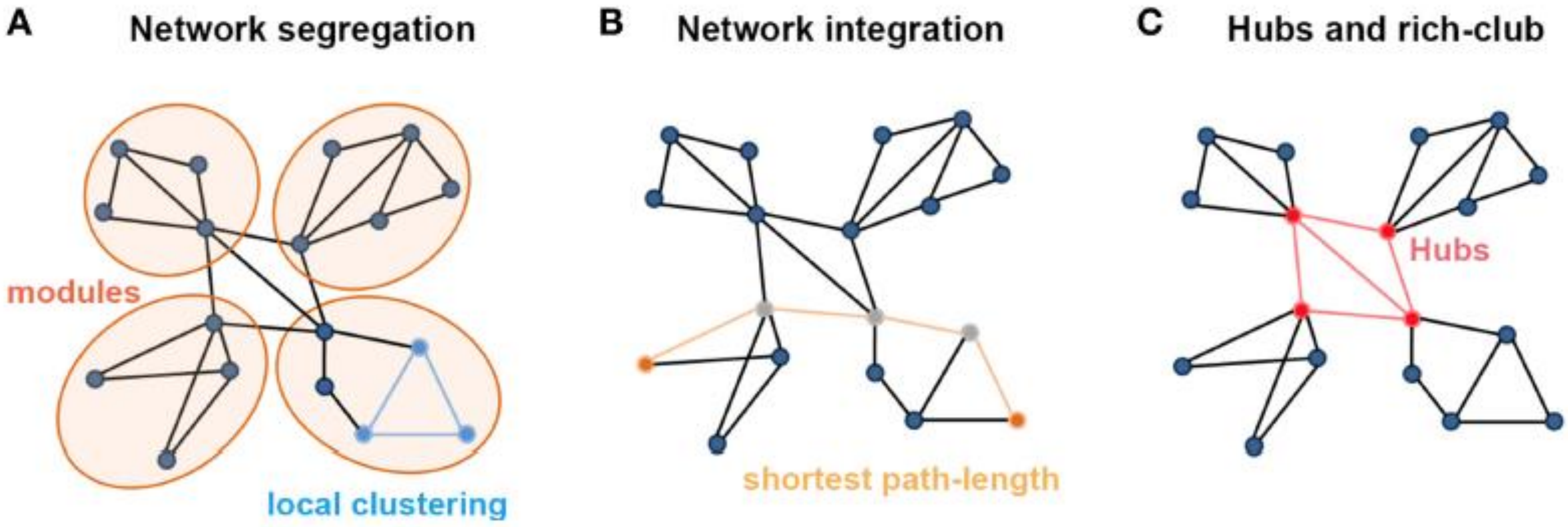


Calculating the temporal correlation between the fluctuations in measured electric, magnetic and blood oxygen level-dependent signals



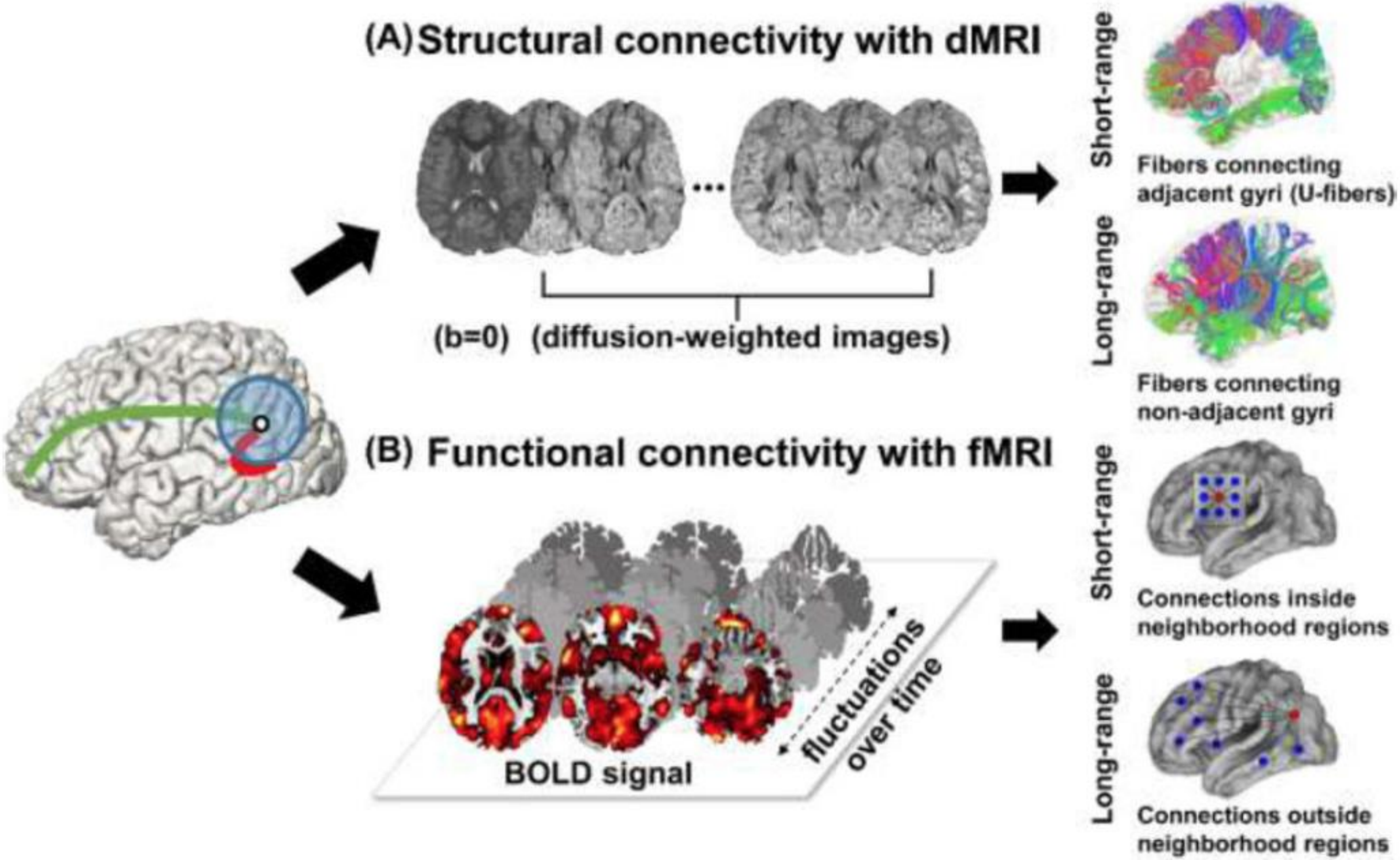
The Developmental Connectome





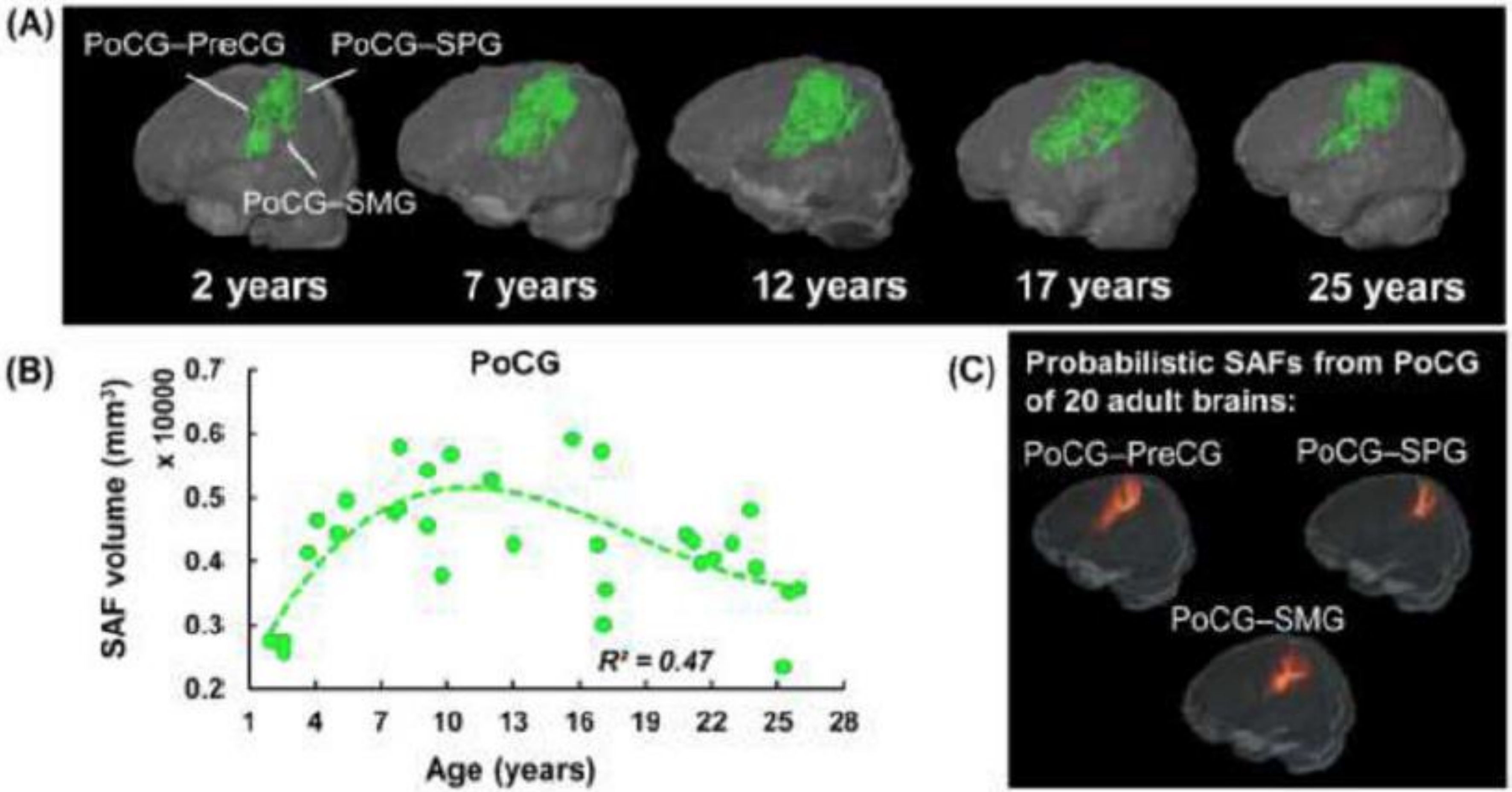
Development:

- minimizing wiring costs through reducing connection distance;
- allowing the emergence of ‘expensive’ but adaptively valuable topological patterns through increasing connection distance



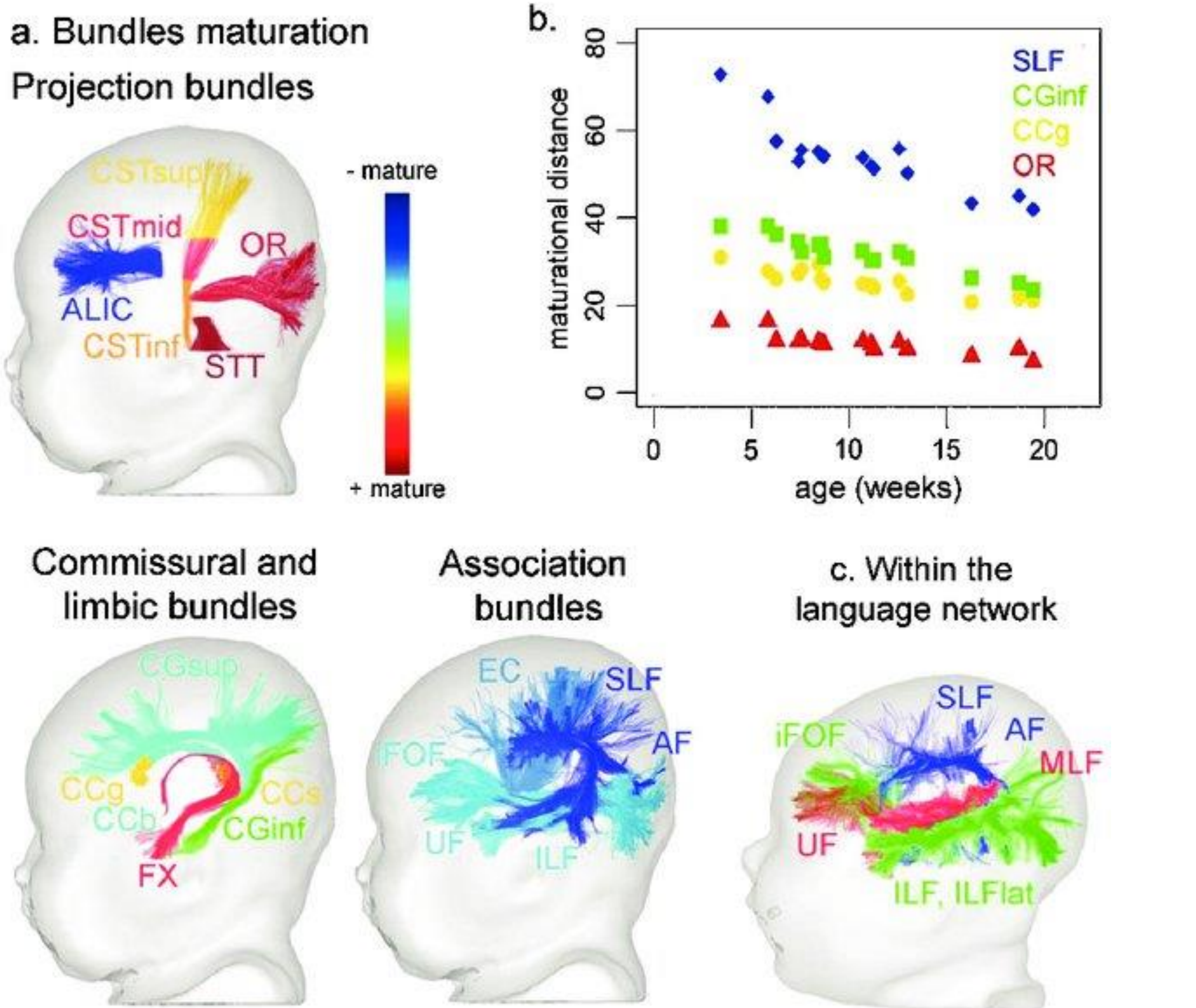
(A) Structural connectivity with dMRI
(b=0) (diffusion-weighted images)
Short-range
Fibers connecting adjacent gyri (U-fibers)
Long-range
Fibers connecting non-adjacent gyri
(B) Functional connectivity with fMRI
BOLD signal
fluctuations over time
Short-range
Connections inside neighborhood regions
Long-range
Connections outside neighborhood regions

Example of short-range structural connectivity changes of postcentral gyrus in typical brain maturation from 2 to 25 years



A decrease in the fraction of ‘low wiring-cost’ short-range connection and the emergence of ‘expensive’ long-range connections could result in higher efficiency of information transfer between distant brain regions

SAFs are among the slowest to myelinate, and may remain incompletely myelinated until the third decade of life



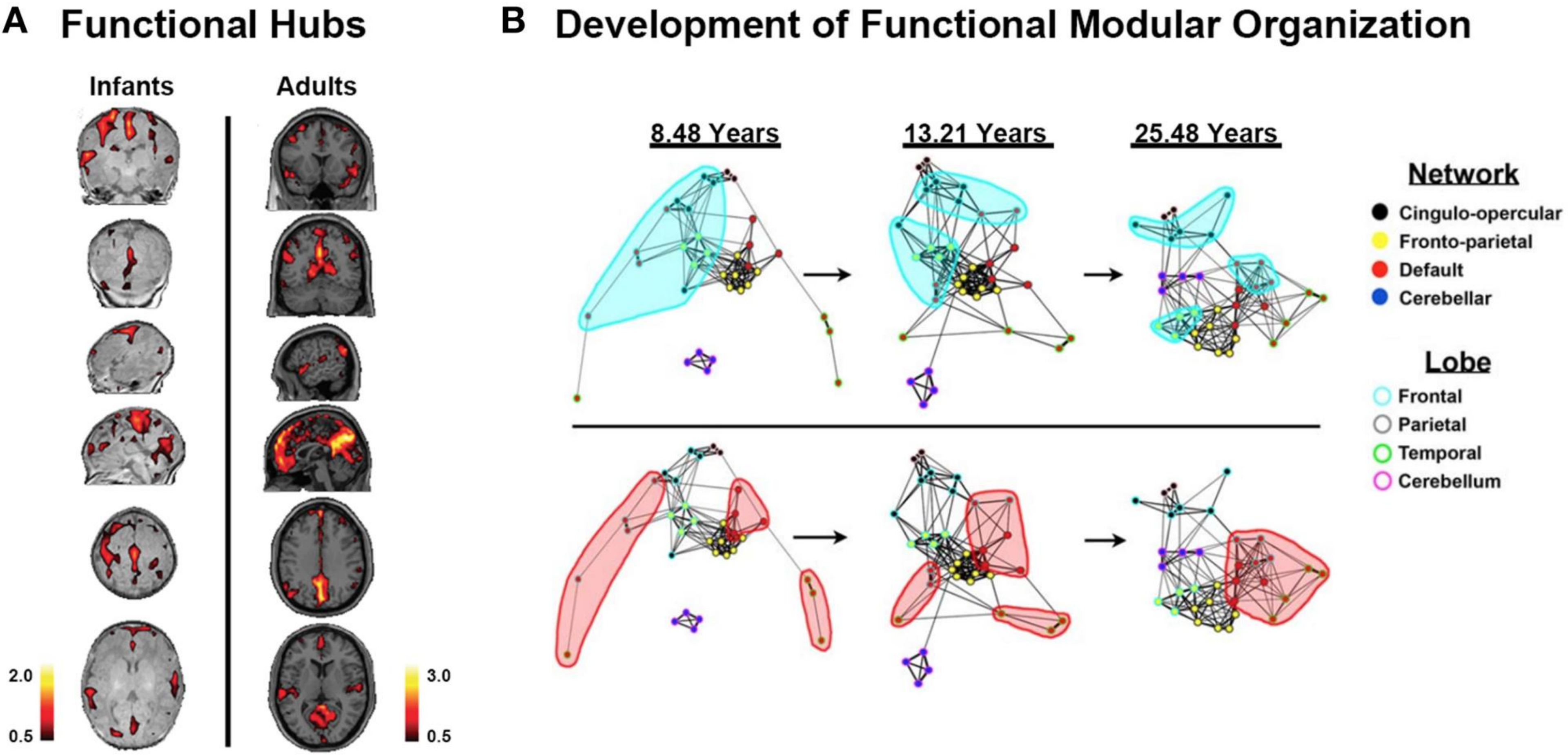
Intrinsic connectivity networks related to complex **social and emotional processing** exhibit the largest increase in long-range FC and decrease in diffuse short-range FC

Development:

- the nodal efficiency of the **medial** hubs and fronto-medial regions is significantly **increased**

- the nodal efficiency of the **lateral** regions **decreases** with age

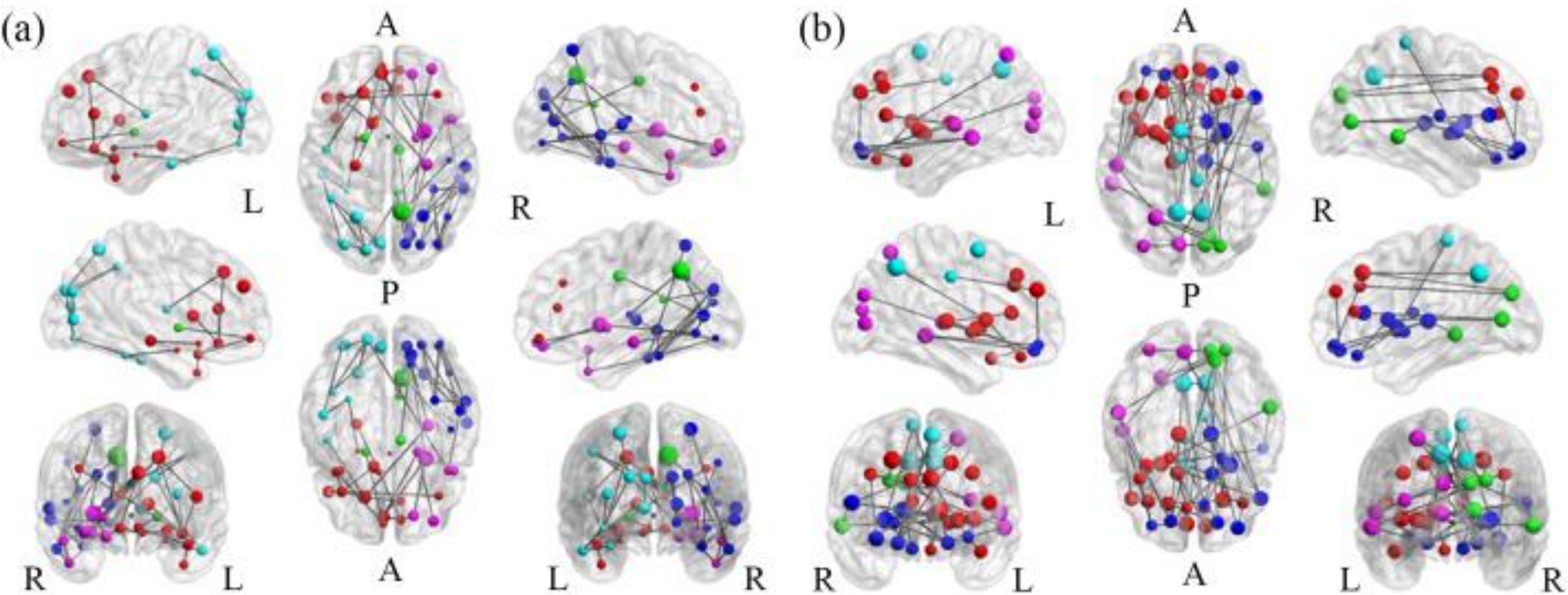
increased integration and decreased segregation

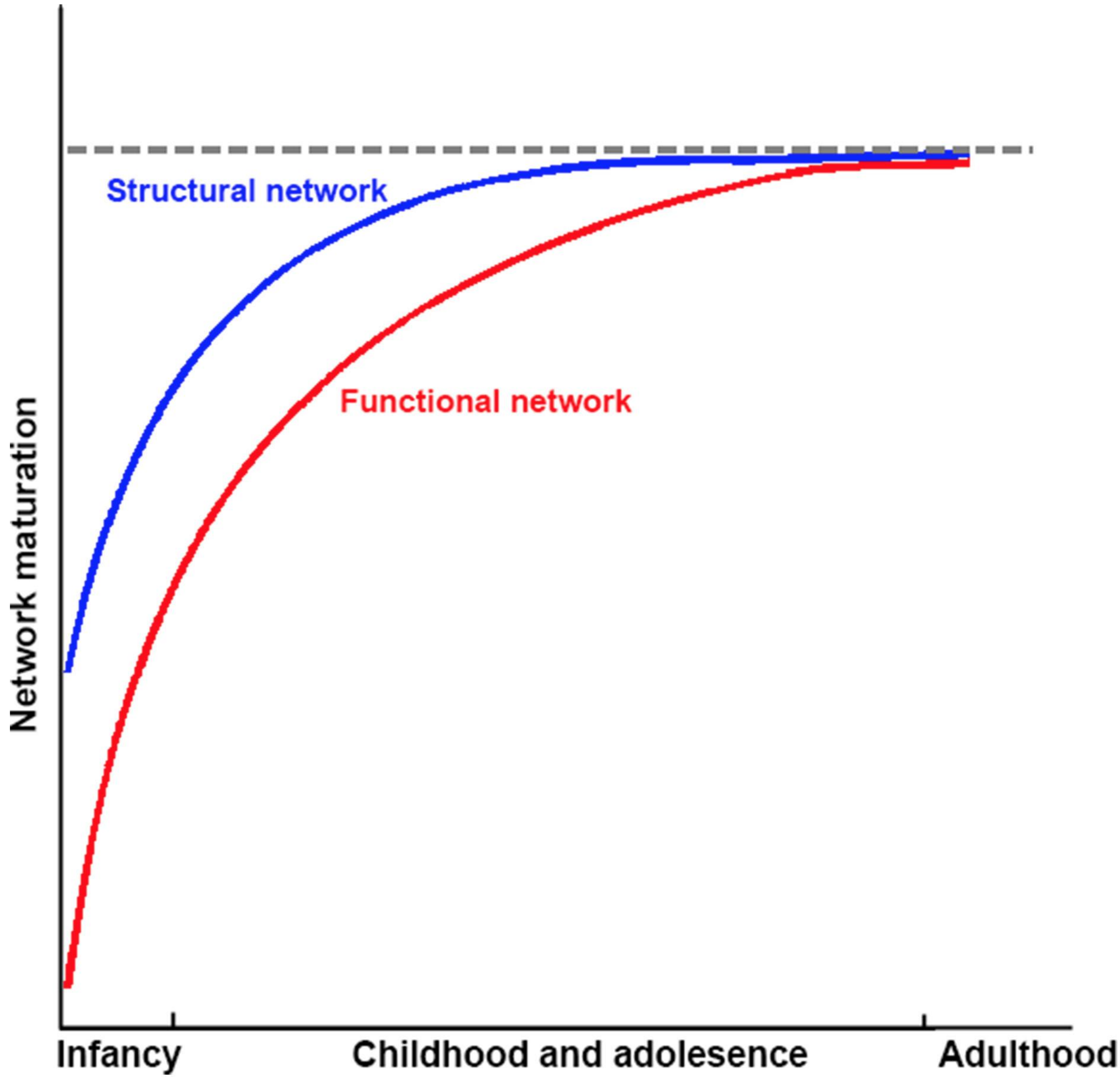


A
Functional Hubs
Infants
Adults
2.0
0.5
3.0
0.5
B
Development of Functional Modular Organization
8.48 Years
13.21 Years
25.48 Years
Network
Cingulo-opercular
Fronto-parietal
Default
Cerebellar
Lobe
Frontal
Parietal
Temporal
Cerebellum

Gender differences

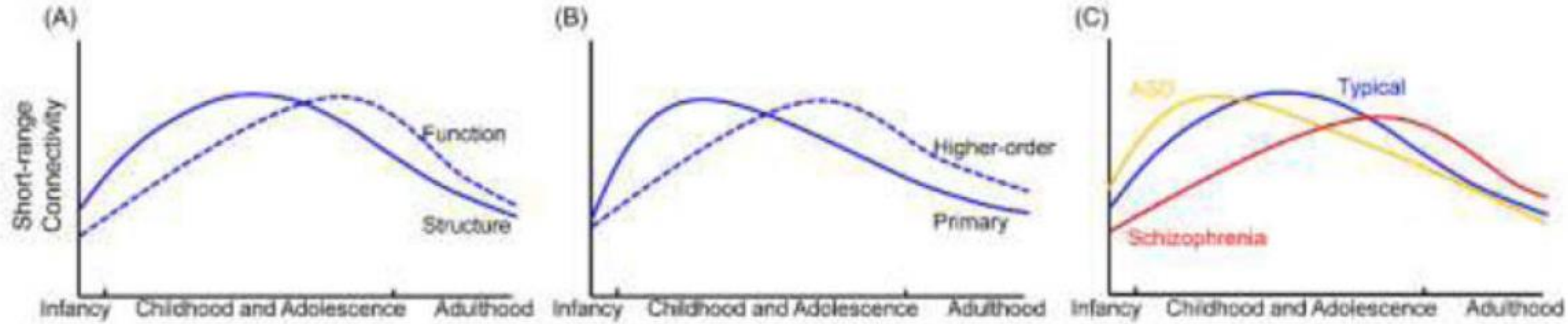
Significantly higher small-worldness and normalized local clustering in females than in males





Structural network
Functional network
Network maturation
Infancy
Childhood and adolesence
Adulthood

Disturbance of the balance of long-range and short-range connections is thought to be associated with mental disorders such as autism spectrum disorder (ASD) and schizophrenia (SZ)

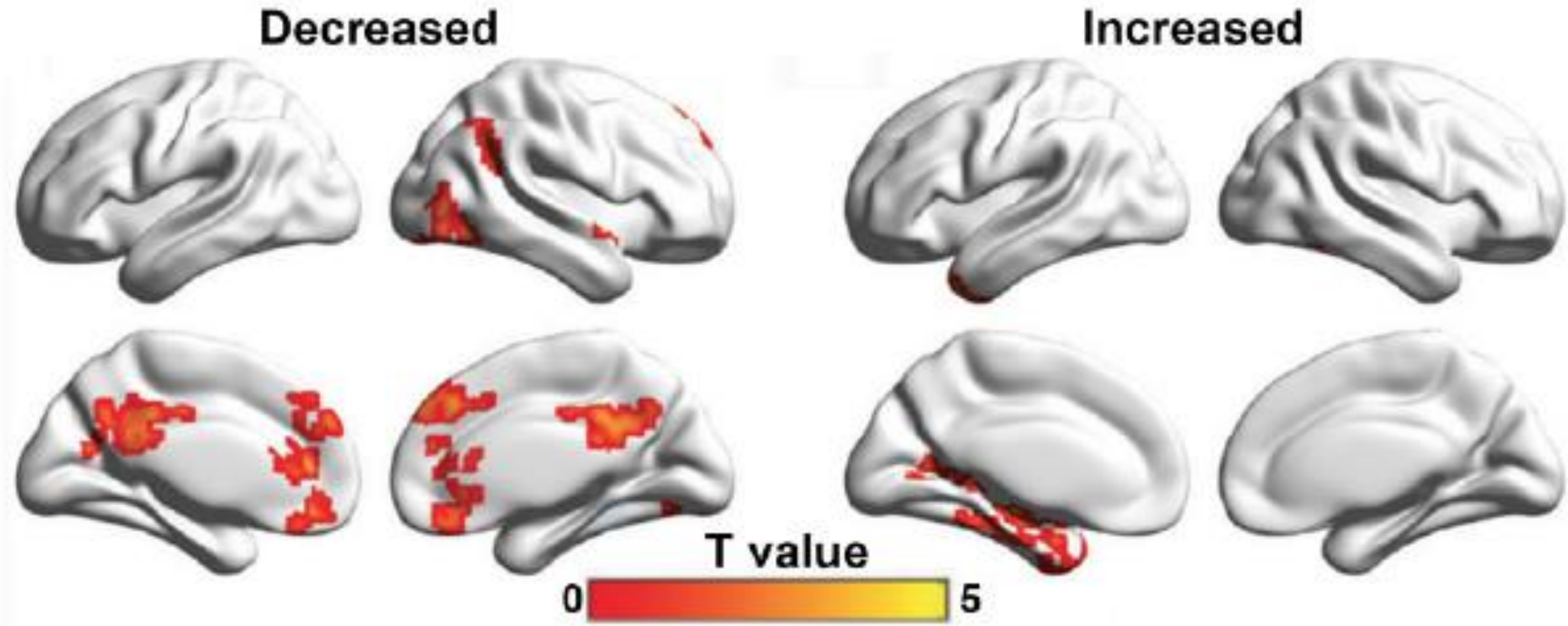


ASD and SZ are two common developmental brain disorders that are associated with alterations in short-range connectivity.

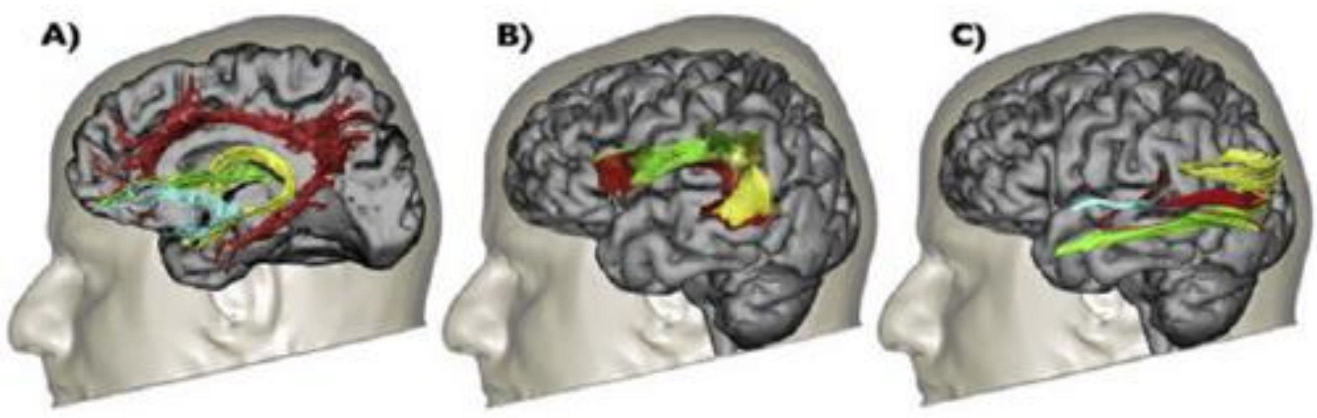
ASD is possibly associated with "hyperconnectivity" and SZ associated with "hypoconnectivity" in short-range connections

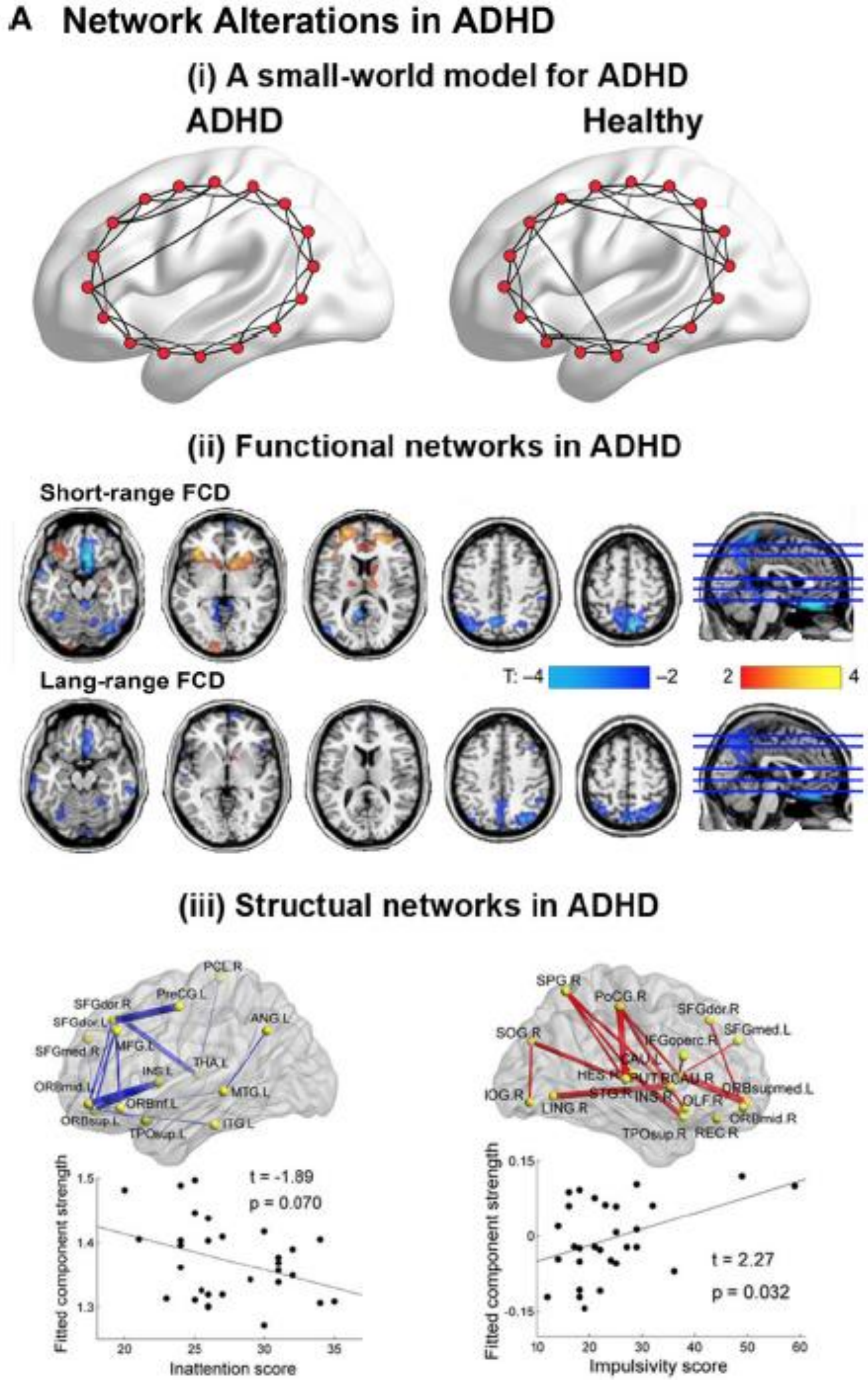
B Network Alterations in ASD

(i) Functional networks in ASD



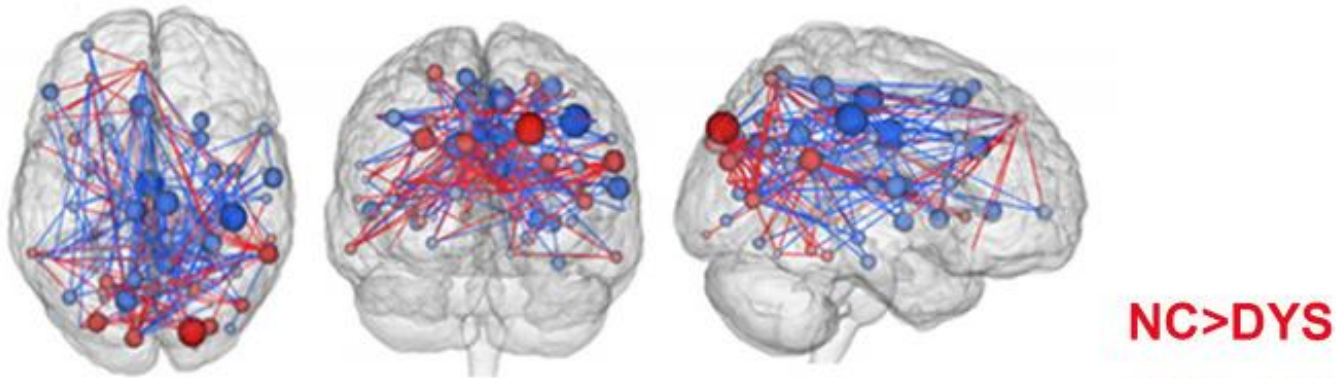
(ii) White matter tracts of socio-emotional system



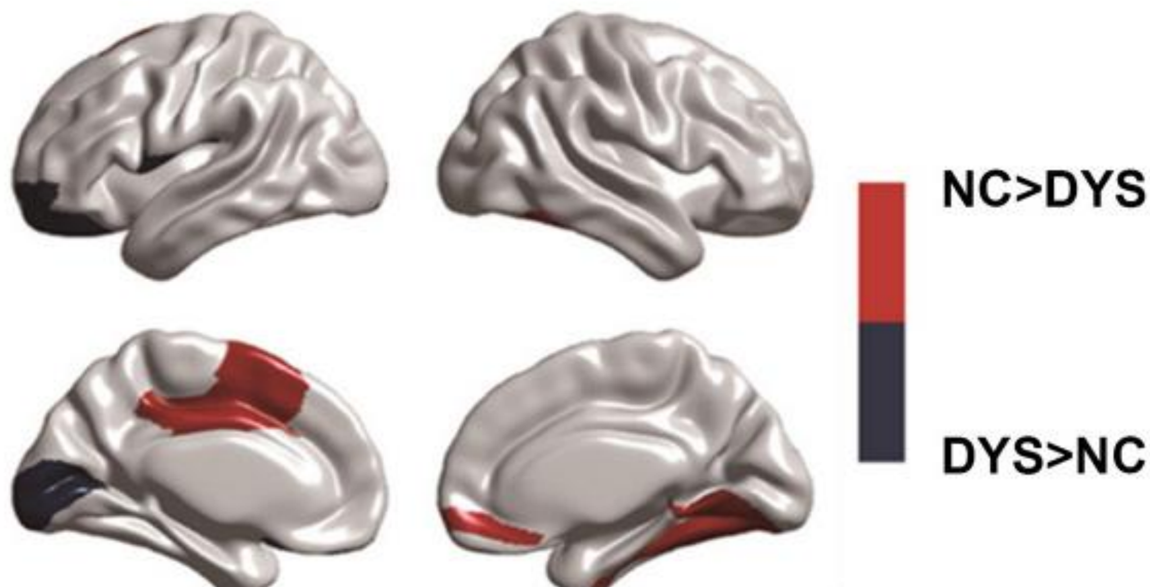

A Network Alterations in ADHD
(i) A small-world model for ADHD
ADHD
Healthy
(ii) Functional networks in ADHD
Short-range FCD
Lang-range FCD
T: −4
−2
2
4
(iii) Structual networks in ADHD
PCL.R
PreCG.L
SFGdor.R
SFGdor.L
ANG.L
SFGmed.R
MFG.L
THA.L
INS.L
ORBmid.L
MTG.L
ORBinf.L
ORBsup.L
ITG.L
TPOsup.L
SPG.R
PoCG.R
SFGdor.R
SOG.R
IFGoperc.R
SFGmed.L
CAU.L
HES.R
PUT.R
CAU.R
ORBsupmed.L
IOG.R
STG.R
INS.R
OLF.R
LING.R
ORBmid.R
TPOsup.R
REC.R
t = -1.89
p = 0.070
Fitted component strength
Inattention score
t = 2.27
p = 0.032
Impulsivity score

C Network Alterations in Dyslexia

(i) Functional networks in DYS



(ii) Structural networks in DYS



Importance of investing in adolescence from a developmental science perspective

Ronald E. Dahl, Nicholas B. Allen, Linda Wilbrecht & Ahna Ballonoff Suleiman

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