

Making of the Brain – Critical Windows during Brain Development

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Fetal alcohol syndrome

Small brain
Failure to thrive
Developmental delay
Epilepsia
Poor coordination
Learning difficulties
Hyperactivity



The Big Bang of Brain Development Milestones -

- Induction of the neuronal plate
- Ballooning of the brain
- 200 000 new neurons/min
- The great leap – migration of neurons
- 100 000 – 1000 000 new synapses/second
- Pruning the jungle



Induction

Brain Anlage
Neural tube
Alcohol may disturb the closure



Hans Spemann and Hilde Mangold discovered the induction of the brain in Freiburg 1922

- Mangold caught herself a light and died 1923
- Spemann received the Nobel Prize 1935



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Ballooning the hemispheres of the brain

Sonic hedge hog gene
Makes the ballooning



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Neurons - the atoms of the mind

They are round in the young brain and have few processes according to Ramon y Cajal



200 000 nouveaux neurones par minutes

Neuronal migration and the evolution of the human brain

A stream of neurons migrating from ganglionic eminence to thalamus
 A. LeDuc & P. Rakic
 Nature Neuroscience sept 2001

Fetal alcohol exposure

Decreases the number of nerve cells
 Disturbs the migration of nerve cells

Can we make new nerve cells in the adult human brain
 As in the canarian brain?

Stem cells – more hype than hope

No new nerve cells are formed after birth J Frisén

Nerve cells were labelled by C14 during the H-bomb era

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Synaptogenesis


100000 – 1000000 new synapses/sec

Formation des synapses

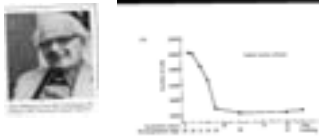
- Un million est formé chaque seconde chez le bébé

The fetal and neonatal brain is not a computer. It is a jungle.

G Edelman




Programmed nerve cell death was discovered by Victor Hamburger



Nerve growth factor important for the survival of the nerve cells

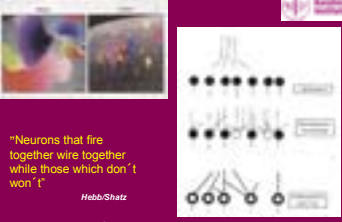
Discovered by Rita Lee-Montaloni and Stanley Cohen
Nobel Prize 1986



"Neurons that fire together wire together while those which don't won't"

Hebb/Shtatz

Optimal neural pathways are selected - J-P Changeux
Neuronal Darwinism - G Edelman

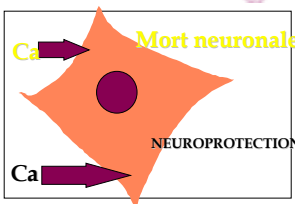



Mort neuronale

Ca

Ca

NEUROPROTECTION



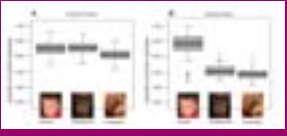
Alcohol kills nerve cells in the frontal cortex by apoptosis

Burke et al 2009



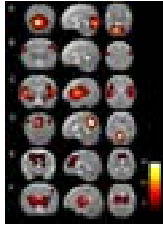
Expansion of the cortex makes the difference

Tomasello 2007




Fetal alcohol exposure reduces the maturation of the frontal cortex and executive functions






The infant brain is not blank!
Resting activity - "stream of consciousness"



from *Wagner et al*
PNAS 2008

Alcohol may disturb the spontaneous resting activity of the brain

**self-referential activity
mentalizing processes
memory retrieval**



from *Gau et al*
PNAS 2008



The enigma of fetal alcohol neurotoxicity

Disturbs the migration of nerve cells
Kills nerve cells
Disturbs the formation of synapses which affects the cognitive development
Disturbs the wiring of neuron circuits
Affects the maturation of the frontal cortex and executive functions

Thanks!



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from *Wagner et al*
PNAS 2008

NeuroBIO

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from *Wagner et al*
PNAS 2008

La synaptogenèse débute pendant la seconde moitié de la grossesse - culmine durant les deux premières années de vie - un second pic à l'adolescence



J-P Bourgeois