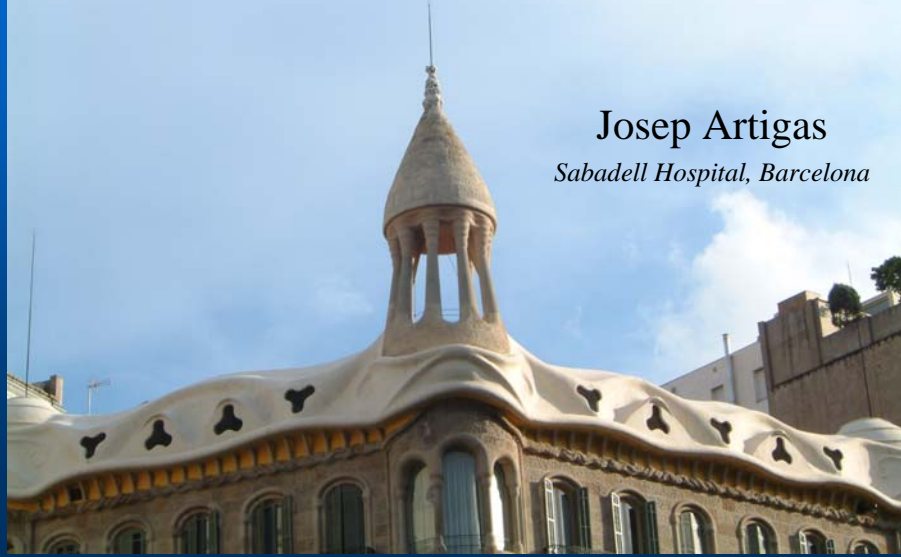


Biological Basis of ADHD

Josep Artigas

Sabadell Hospital, Barcelona



El error de descartes
Antonio Damasio

First References

- 1904: Meyer: attention deficit and impulsivity after craniocerebral trauma
- 1920: Sequels from Von Economo encephalitis
- 1937: Behaviour of children receiving Bazedrine. *Am J Psychiatry* 94: 33, 1937. "Arithmetic pills"
- 1948: Childhood behavior sequelae of asphyxia in infancy. *Pediatrics* 2: 74-84, State of unpredictable humour, hyperactivity, impulsivity, low attention capacity, irregular ability to evoke previously learned concepts and difficulty with mathematics
- 1966: MBD

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RECOVERY AFTER SEVERE INJURY TO THE HEAD.

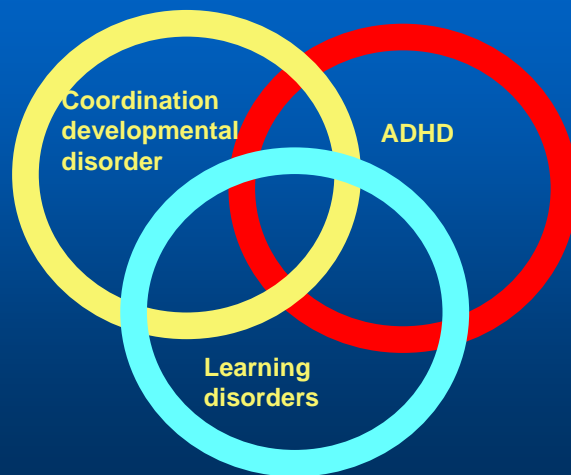
MR. PRESIDENT AND FELLOWS OF THE
MASSACHUSETTS MEDICAL SOCIETY:

I HAVE the pleasure of being able to present to you, to-day, the history and sequel of a case of severe injury of the head, followed by recovery, which, so far as I know, remains without a parallel in the annals of surgery. The case occurred nearly twenty years ago, in an obscure country town (Cavendish, Vt.), was attended and reported by an obscure country physician, and was received by the Metropolitan Doctors with several grains of caution, inasmuch that many utterly refused to believe that the man had risen, until they

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Minimal Brain Dysfunction



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Minimal Cerebral Dysfunction (Maximal Neurologic Confusion)

MANUEL R. GOMEZ, M.D.
Rochester, Minnesota

NEUROLOGY

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ADHD SUBTYPES

- Predominantly Disatentional Type
- Predominantly Hyperactive/Impulsive Type
- Combined Type

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Biological Basis of ADHD

The Genes



Nervous System



Cognitive Level



Symptoms

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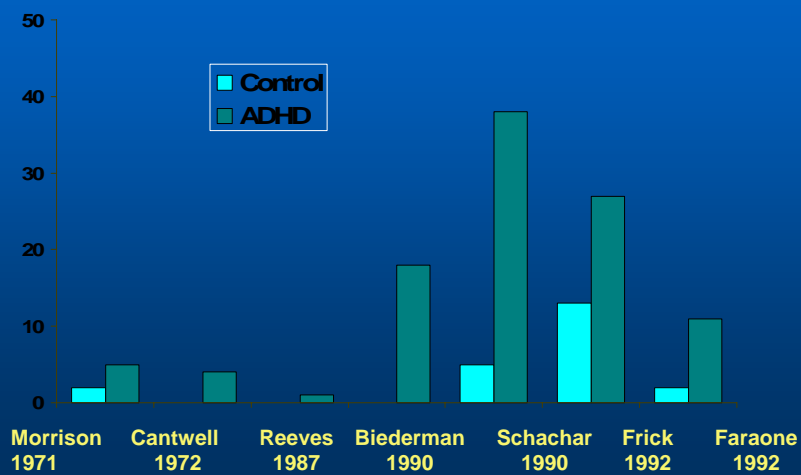
The genes

- Dopamine transporter gene: DAT
- D4 dopamine receptor: DRD4
- Norepinefrine ?

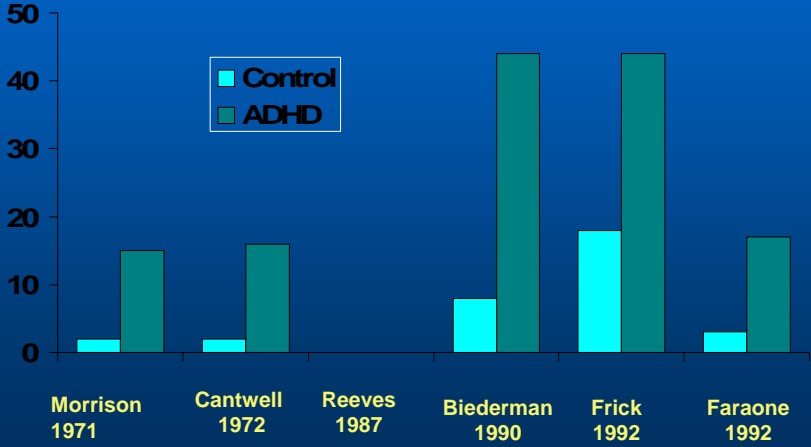
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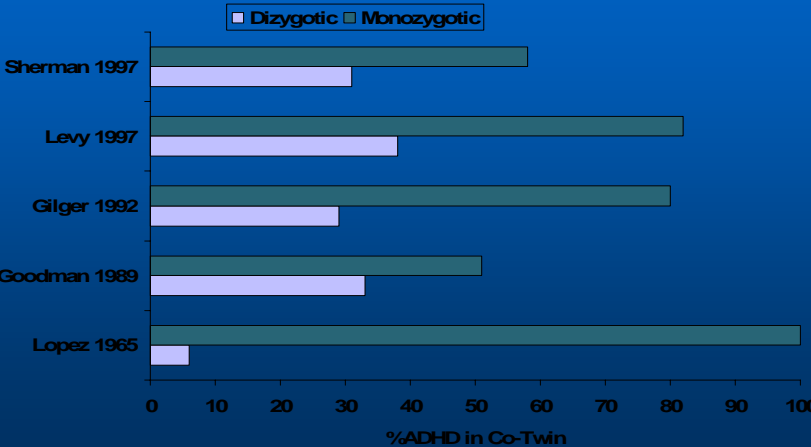
Percent ADHD in Mothers



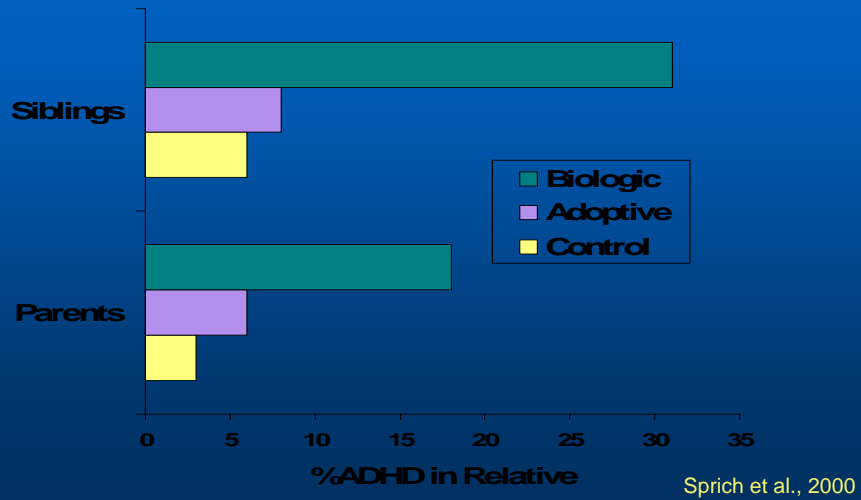
Percent ADHD in Fathers



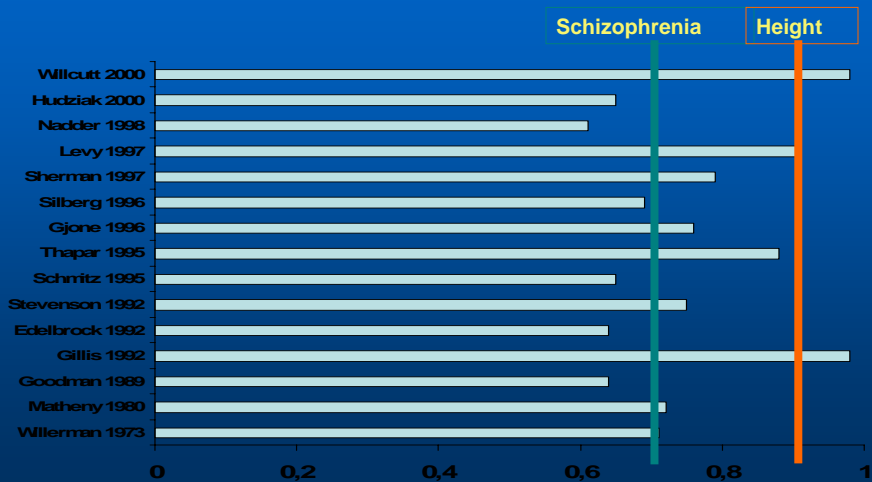
Twin Concordance for ADHD



Adoption Study of ADHD



Heritability of ADHD



Nervous System

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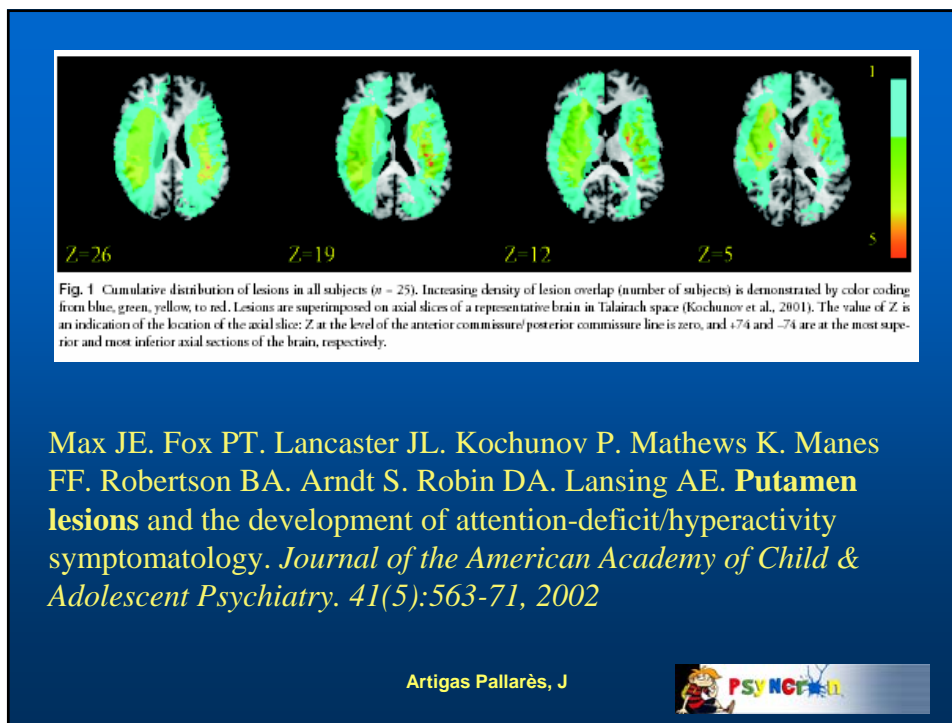
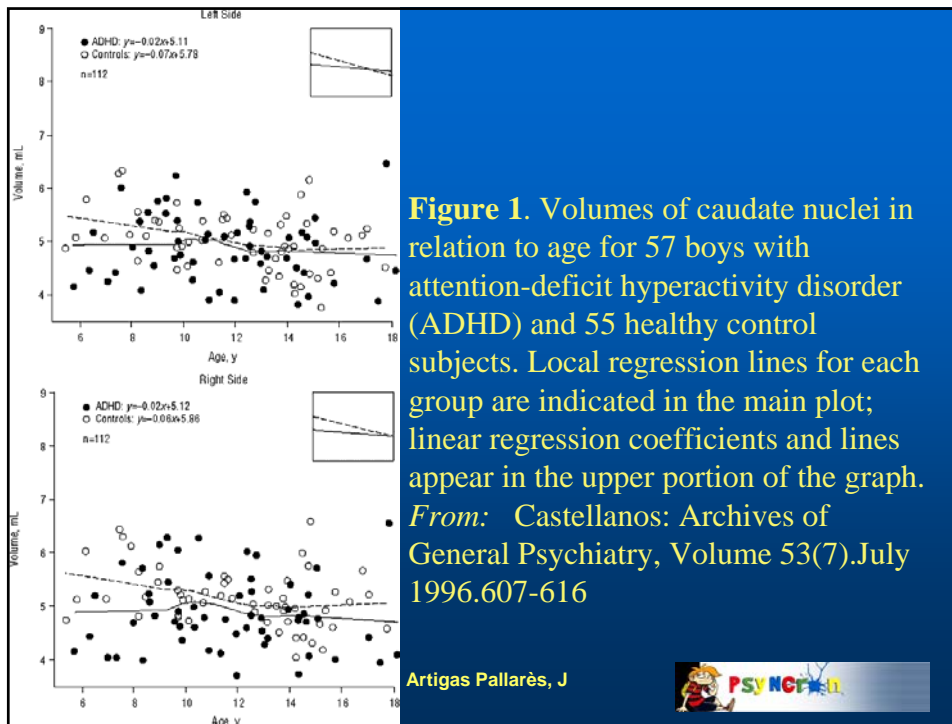


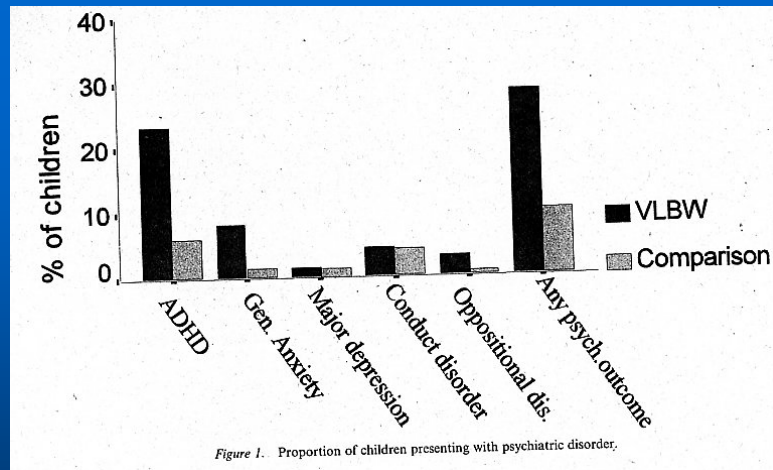
Neuroanatomy

- Reduction brain volume: 5 %
- Diminution size of:
 - Frontal right lobule
 - Corpus callosum
 - Cerebellum
 - Caudate head
 - Globus palidus
 - Putamen
- Central white matter deficits in left hemisphere

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Botting N. Powls A. Cooke RW. Marlow N. Attention deficit hyperactivity disorders and other psychiatric outcomes in very low birthweight children at 12 years. [Journal Article] *Journal of Child Psychology & Psychiatry & Allied Disciplines*. 38(8):931-41, 1997

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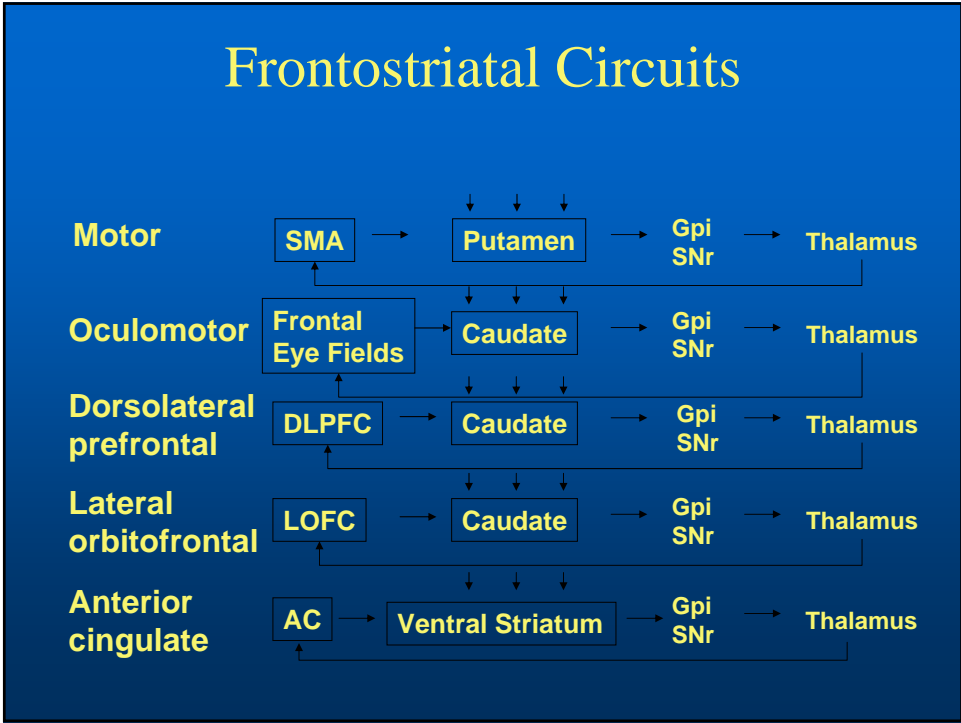
Frontostriatal Circuits

- Motor circuit
- Oculo-motor circuit
- Dorsolateral prefrontal circuit
- Lateral orbitofrontal circuit
- Anterior cingulate circuit

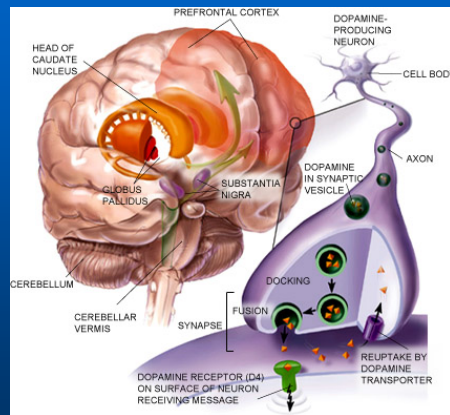
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Frontostriatal Circuits



Neurobiology of ADHD



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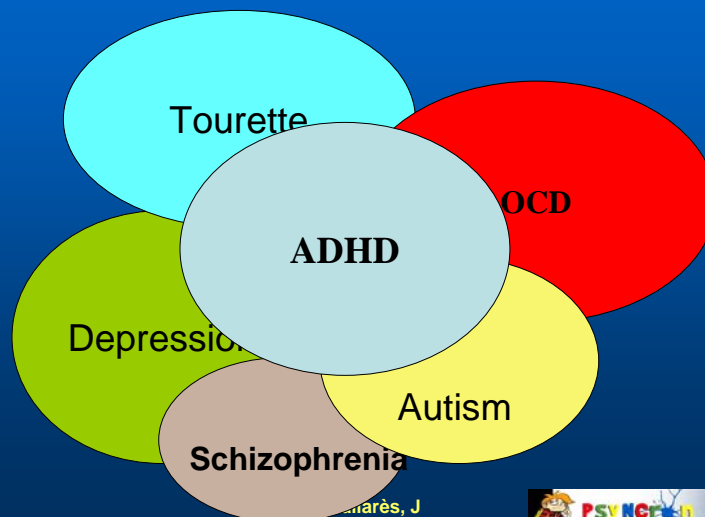
Child Developmental Disorders of the Frontostriatal system

- Tourette's Syndrome
- Obsessive Compulsive Disorder
- ADHD
- Schizophrenia
- Autism
- Depression

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Comorbidity of Developmental Disorders of the Frontostriatal System



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Features of Neurodevelopmental Disorders

- Same manifestations may be present in normal people.
- Boundaries between normality and disorders are unclear
- No biological markers
- High comorbidity rate
- No definite boundaries between different disorders

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Cognitive Level

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Dorsolateral Prefrontal Circuit (1)

- Capacity for autonomous behaviour without external guidance
- Capacity to persevere in absence of external direction
- Directed behaviour when a goal is remote or abstract
- Self-direction, self-regulation, self-monitoring
- Ability to organize a behavioral response to solve a new or complex problem
- Mental synthesis for non-routine actions
- Planning and regulation of adaptive and goal-directed behaviour
- Problem solving, generation of solutions to novel problems

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Dorsolateral Prefrontal Circuit (2)

- Initiative, motivation, spontaneity, judgement, planning, insight, strategic decision making
- Spontaneity and fluency of thought and action
- Cognitive flexibility
- Ability to search memory systematically
- Ability to shift or maintain set as appropriate
- Ability to focus or sustain attention
- **Ability to withhold or inhibit responses as appropriate (Barkley)**
- **Time perception ability (Taylor)**

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Biological Basis of ADHD: Summary

- Evidence for the biological basis of ADHD comes from:
 - Neuroimaging studies show changes in specific regions of the brain
 - Family and molecular genetic studies provide evidence for an inherited element in the development of ADHD
- In spite of biological evidence; for the moment, no biological markers are available.
- ADHD probably results from a combination of genetic and environmental factors which modify the developing brain and result in structural and functional abnormalities

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