



*Nature of developmental disorders*

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# Introduction<sub>1</sub>:



- The 2018 annually report for CDC, 16.7% of children have DD.
- In a survey until 2016, prevalence of ID and ASD (3-17yr) were 6-15%.
- Median costs ranged from 7613 to 54 884 (USD)/child/year.



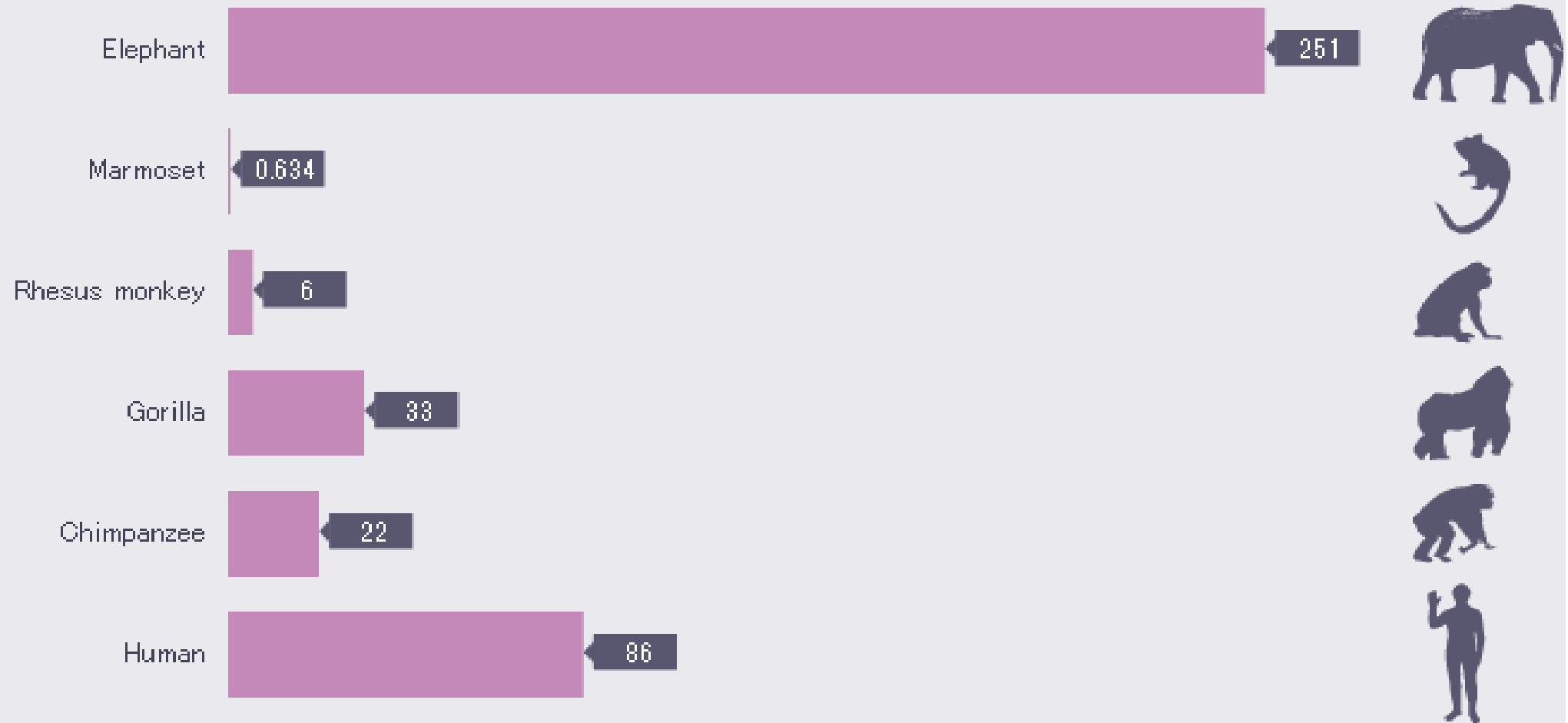
# Introduction<sub>2</sub>:



- 1- Brain weight
- 2- Cephalization quotient
- 3- Development

	Body weight (kg)	Brain weight (g)
Cow	465	423
Grey Wolf	36.3	119
Goat	27.6	115
Asian Elephant	2547	4603
Donkey	187	419
Horse	521	655
Cat	3.3	25
Human	62	1320
Rhesus Monkey	6.8	179
Kangaroo	35	56
Hamster	0.12	1
Mouse	0.023	0.4
Rabbit	2.5	12.1
Sheep	55.5	175
Chimpanzee	52	440
Rat	0.28	1.9
Pig	192	180

# Brain neurons (billions)



Sources: Suzana Herculano-Houzel; Marino, L. Brain Behav Evol 1998;51:230-238



- The elephant's [cerebral cortex](#) has about one-third of the number of neurons as a human's cerebral cortex
- The majority of mammals are born with a brain close to 90% of the adult weight, while humans are born with 28%.
- A newborn baby's brain weighs approximately 350 to 400 grams. The average adult human brain weighs about 1300 to 1400 grams.

Ref: Wikipedia, [https://en.wikipedia.org/wiki/Elephant\\_cognition](https://en.wikipedia.org/wiki/Elephant_cognition)





# Neuroembryology



- *Neural plate induction*
- *Neural proliferation*
- *Migration & Aggregation*
- *Axon growth & Synapse formation*
- *Cell death & Synapse rearrangement*



## Postnatal Cerebral Development Human Infants:

Postnatal growth is a consequence of

- Synaptogenesis
- Increased dendritic branches
- Myelination (prefrontal cortex continues into adolescence)







- The prenatal period and the 1<sup>st</sup> yr of life provide the platform for remarkable growth and development, setting the trajectory for a child's life.
- Neural plasticity, both positive or negative is at its peak.
- Total brain volume double in the 1<sup>st</sup> of life and increases by additional 15% over the 2<sup>nd</sup> yr.
- Total brain volume at age 1 mo. is approximately 36% of adult volume but by age 1 yr 72% and by 2 yr. 83%.

Ref: DOI: 10.1055/s-0043-1768703





- The nervous system is a network of interconnected neurons, and the architecture of cerebral circuits is influenced by both the genetically and environment.
- During development of the human brain from fetal life to adulthood, white matter tracts undergo significant changes.
- Functional connections develop, mature, and respond to environmental perturbation.
- Alterations in connectivity may include genetic, epigenetic, and traumatic disorders

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- Conditions including autism and schizophrenia are believed to be connectivity disorders of genetic origin.
- In contrast, alteration in the functional organization, that characterized in preterm population are attributed to environmental changes through pathways.
- Finally, injuries such as stroke, HIE, and concussion are all reported to result in traumatic disturbances of connectivity.

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## Environmental factors alter connectivity

- Pain influences microstructural connectivity.
- High-stress infants showed interhemispheric connectivity in temporal lobe language regions.

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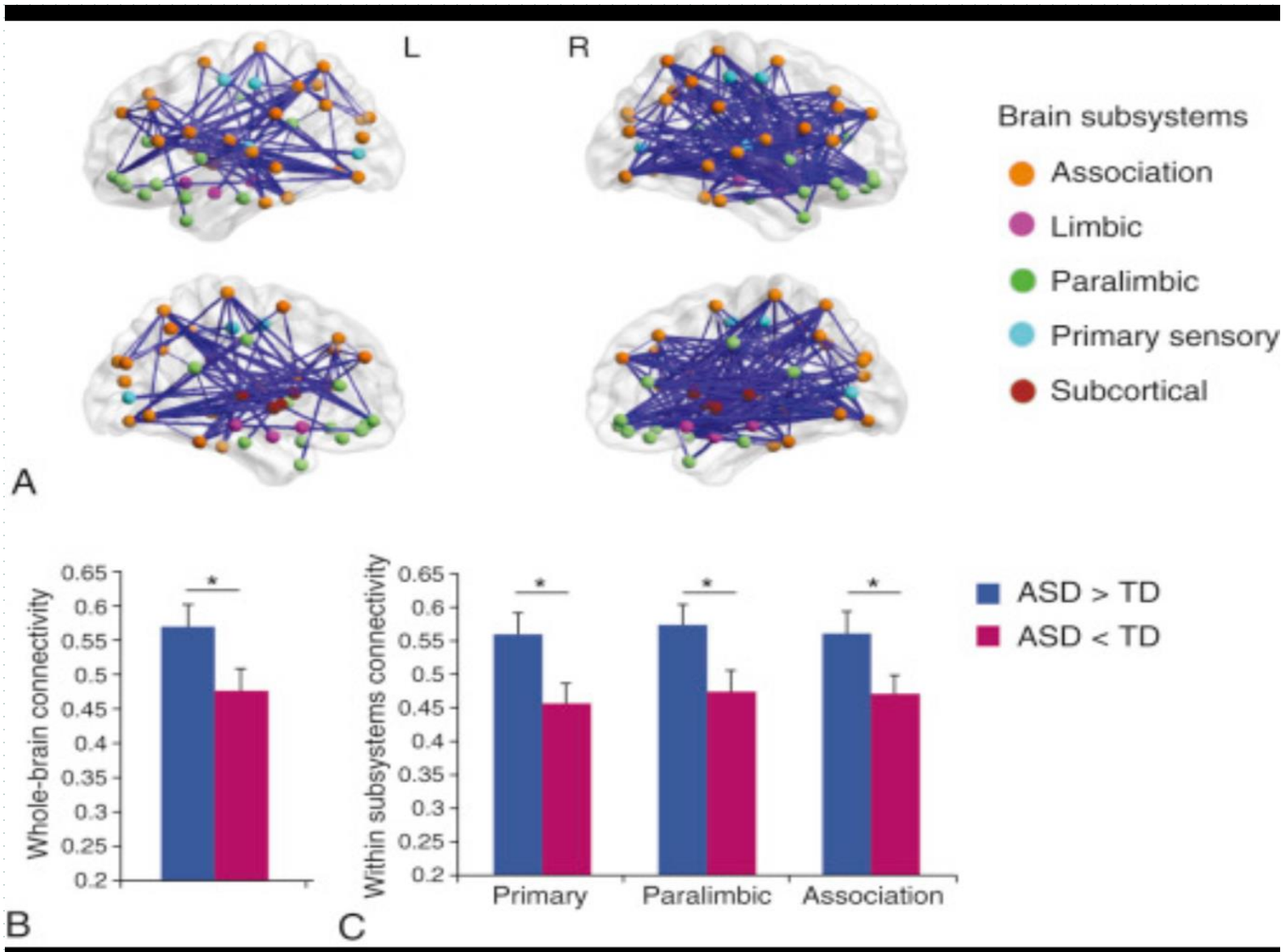




## ASD:

- 1-Disruption in microstructural connectivity, particularly in those tracts subserving social cognition.
- 2-dMRI demonstrate both increases and reduction in FA across frontal and temporal.
- 3-The frontal tracts in infants with ASD showed greater FA and volume than normal and decreased in the C.C.
- 4-Hyperconnected in systems related to cognitive, social, and affective processes.







## ADHD:

- 1- Reduced WM integrity in fronto-striato cerebellar, internal ca, C.C.
- 2- Decreased FA in the prefrontal circuits and increased FA in the orbital-fronto-cerebellar, correlated with inattentivity, hyperactivity and impulsivity.
- 3- fMRI showed extra-network hyperconnectivity.



doi: [10.1007/s11065-015-9291-z](https://doi.org/10.1007/s11065-015-9291-z)





In:

GDD, several kinds of epilepsy, CP, neonatal stroke, WM disease,  
... there are a lot of microstructural disorders.







# Summary

- 1- Functional and microstructural MR imaging have become part of routine brain mapping in pediatric patients with epilepsy or supratentorial tumors.
- 2- fMRI and dMRI strategies in CP, GDD and ASD suggesting potential strategy.



DOI: 10.7759/cureus.48291



Thank you

