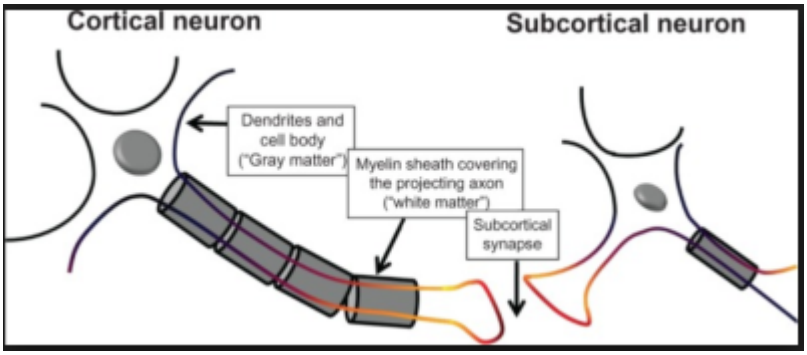
Cortical neuron



Cortical neurons are generated within the subventricular zone, next to the ventricles. At first, this zone contains progenitor cells, which divide to produce glial cells and neurons.

Cortical neurons are larger in humans than in other species, but it is unclear how their size affects synaptic integration.

Goriounova et al., finded that high IQ scores and large temporal cortical thickness associate with larger, more complex dendrites of human pyramidal neurons. They showed in silico that larger dendritic trees enable pyramidal neurons to track activity of synaptic inputs with higher temporal precision, due to fast action potential kinetics. Indeed, they finded that human pyramidal neurons of individuals with higher IQ scores sustain fast action potential kinetics during repeated firing. These findings provide the first evidence that human intelligence is associated with neuronal complexity, action potential kinetics and efficient information transfer from inputs to output within cortical neurons [1].

Beaulieu-Laroche et al. from Massachusetts performed direct electrical recordings from human dendrites and report enhanced electrical compartmentalization in layer 5 pyramidal neurons. Compared to rat dendrites, distal human dendrites provide limited excitation to the soma, even in the presence of dendritic spikes. Human somas also exhibit less bursting due to reduced recruitment of dendritic electrogenesis. Finally, they find that decreased ion channel densities result in higher input resistance and underlie the lower coupling of human dendrites. They conclude that the increased length of human neurons alters their input-output properties, which will impact cortical computation [2].

1)
Goriounova NA, Heyer DB, Wilbers R, Verhoog MB, Giugliano M, Verbist C, Obermayer J, Kerkhofs A, Smeding H, Verberne M, Idema S, Baayen JC, Pieneman AW, de Kock CP, Klein M, Mansvelder HD. Large and fast human pyramidal neurons associate with intelligence. Elife. 2018 Dec 18;7. pii: e41714. doi: 10.7554/eLife.41714. [Epub ahead of print] PubMed PMID: 30561325.
2)
Beaulieu-Laroche L, Toloza EHS, van der Goes MS, Lafourcade M, Barnagian D, Williams ZM, Eskandar EN, Frosch MP, Cash SS, Harnett MT. Enhanced Dendritic Compartmentalization in Human Cortical Neurons. Cell. 2018 Oct 18;175(3):643-651.e14. doi: 10.1016/j.cell.2018.08.045. PubMed PMID: 30340039.