

## **Human Synaptic Development: Bottom-up Meets Top-Down**

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Cortical synaptic development data of *Homo sapiens* is modeled from two different directions. The first is by an optimality/engineering approach. This method assumes that synaptic development, due to evolution, is optimal. This optimality is defined as maximizing the increase of synaptic (non-random) complexity. The optimality assumption yields an equation which correctly predicts 98% of the data's variance.

A bottom-up approach is also used. First the (logarithmic) number of possible synaptic configurations per neuron is computed by basic combinatorics. Second, empirical knowledge of the form of synaptogenesis is applied. Specifically, empirical data demonstrate that the efficacy of a newly formed synapse increases in a sigmoidal/exponential fashion over time. This empirical finding constrains the equation for the (logarithmic) number of possible synaptic configurations. In particular, it forces the second derivative to be zero. The resulting differential equation – and its solution are exactly the same as that predicted by the top-down model. Again, it correctly predicts 98% of the variance of the data.