914

SYNAPTIC DENSITY IN THE DEVELOPING NEOCORTEX OF CHIMPANZEES AND OTHER GREAT APES

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In humans and macaque monkeys, the most complex neurons are of the cerebral cortex are found in the prefrontal cortex, with a higher density of synapses than sensory or motor regions. Synapse density in the macaque prefrontal cortex exceeds all other neocortical regions throughout ontogeny, whereas, in contrast, synapse density in human prefrontal cortex is lower than in other areas of the neocortex until approximately five years of age. Consequently, humans exhibit a relatively delayed maturation of synapses in the prefrontal cortex as compared with macaques, a pattern which might have important implications for the brain's capacity for plasticity and learning. However, it is not known whether this asynchronous development of prefrontal synapses is unique to humans. To examine this question, we analyzed synapse density in four different neocortical regions of common chimpanzees (n=15) and western lowland gorillas (n=2) ranging from birth to eleven years of age. We counted the density of puncta that expressed the protein synaptophysin – a presynaptic marker identified in nearly all synapses of the central nervous system – in primary somatosensory cortex, primary motor cortex, secondary visual cortex, and prefrontal cortex (Brodmann's Area 10). We found that chimpanzees and gorillas were similar to humans, and differed from macaques, in displaying relatively lower synapse densities in the prefrontal cortex in comparison to sensory and motor neocortical areas throughout early development. These findings indicate that a slowly developing prefrontal cortex characterizes the evolutionary branch of all African apes, including humans, and might be important for increasing social learning capabilities.

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