Morphology and anatomy
Increase of visual cortical thickness1, dendritic branches3, higher order branches3 with changes in dentritic spines4, hippocampal thickness5, brain weight and number of granule cells in the dorsal hippocampus6, and increase of dentritic length, nodes and spines of pyramidal neurons in the hippocampus and layer III of the cortex7,8

Neurogenesis
Increase of proliferation, survival of BrdU positive cells5 and neurogenesis when enrichment protocols started at 610,10 weeks1, 21215, 31617, 41819, 1019 and 18 months of age20, or no change in 25 months old13

Neurotrophic and growth factors
Increase of BDNF mRNA in the dorsal hippocampus21,22 or no change23-25
Increase of BDNF protein level in the hippocampus26-29 or no change7,30-32
Increase of BDNF mRNA in the striatum33, decrease in the substantia nigra pars compacta34 or no change in the striatum and the cortex34
Increase of protein level of BDNF in the cortex, basal forebrain and the nindbrain28, the cerebellum, prefrontal cortex and the striatum35, occipital cortex36, superior colliculus and the visual cortex37 and retina37,38

Neurotransmitters receptors
Increase of NMDA subunit NR2A mRNA level in the right hemisphere37 and the hippocampus58
Increase of NMDA subunits NR2A and NR2B protein level in the forebrain59 but not in the anterior cingulate cortex60
No effect on NMDA subunit NR1 gene expression in the whole brain23,61, protein levels in the dorsal prefrontal cortex, but no effect on the ventral prefrontal cortex and the striatum37
Increase of AMPA subunits GluR2 and GluR4 mRNA in the hippocampus63
No effect on transcript and protein levels of GluR1, GluR2 and GluR3 subunits in the hippocampus58,64,65 and on GluR1 protein level in the nucleus accumbens65, in the forebrain59, in the visual cortex66 in the striatum and the frontal cortex34
No effect on GABA A receptor transcript level in the striatum57
Increase of dopamine 1 (D1) receptor protein level in the prefrontal cortex49

Immediate early genes
Increase of Zif268 mRNA in the CA271, CA3-CA451 and CA1 areas of the hippocampus72 and in the visual cortex73
Increase of Krox-20 gene expression in the cortex72,74, the hippocampus75 and in CA3 area of the hippocampus72
Increase of NGFI-B transcript level in CA1-CA2 area of the hippocampus71
Increase of Arc gene expression in the hippocampus71,74, in the striatum and the cortex74

Transcriptomic and proteomic large scale analysis
Changes in expression of genes whose products are involved in DNA/RNA synthesis, neuronal growth/structure, protease/cell death, protein processing and neuronal signaling in the cortex76

Increase in 34 genes and decrease in 14 genes involved in signal transduction, cell proliferation/differentiation, transcription and translation, structural rearrangements and metabolism77

Proteins implicated in the cytoplasmic organization and energy metabolism in the hippocampus are the most altered78

Long term potentiation (LTP)
No effect on LTP recorded from dentate gyrus of hippocampal slices79-81
Increase of LTP measured on slices in CA1 area82-85 and in the layer II-III of neurons in the anterior cingulate cortex86
Increase86 or no change87 of LTP in the dentate gyms of freely moving rats

Cognition and behavior
Enhanced performance in the Morris water maze test88-91 or no change92-94
Decreased anxiety-like behavior in the Elevated plus maze (EPM) test95-99 or no change100-103

Brain protection
Prevents memory deficit in Alzheimer’s disease18,104, reduces cell death in Parkinson’s disease33,34, improves motor symptoms in Huntington’s disease35, attenuates learning deficits in brain trauma36, improves motor coordination in Rett’s syndrome model37, ameliorates functional recovery in cranial irradiation38, protects against behavioral alterations in lead toxicity model105, reverse cocaine addiction106 and prevents cognitive impairment in epilepsy107,108.