

The Dynamic Brain: Neuroplasticity and Mental Health

Jill L. Kays, Psy.D., Robin A. Hurley, M.D., Katherine H. Taber, Ph.D.

Cover and FIGURE 1. It is now generally accepted that adult neurogenesis occurs in two locations in all mammals, including humans.¹⁻⁵ Neurons born in the subventricular zone adjacent to the caudate (solid blue area) migrate ventrally, then rostrally (blue dashes), to be incorporated into the olfactory bulb. Neurons born in the subgranular zone of the dentate gyrus (solid yellow area) are incorporated into the dentate gyrus (yellow dots). Although controversial, there is evidence in adult primates for generation of new neurons in other ventricular regions (solid orange areas) and incorporation of new neurons into other cortical and subcortical areas (orange dots).^{2,6-10}

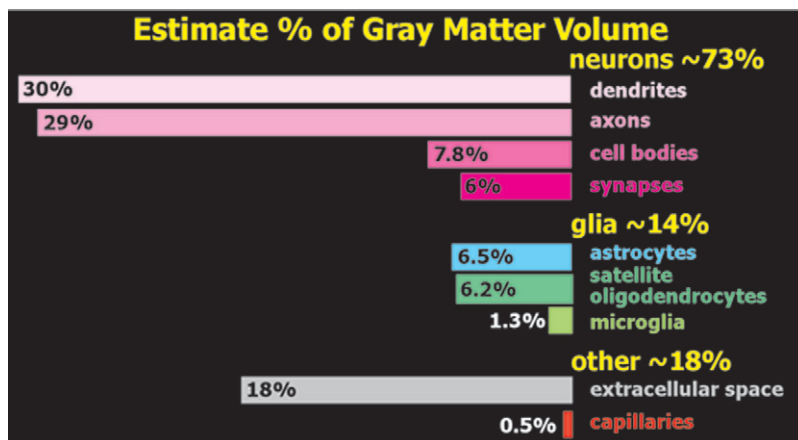
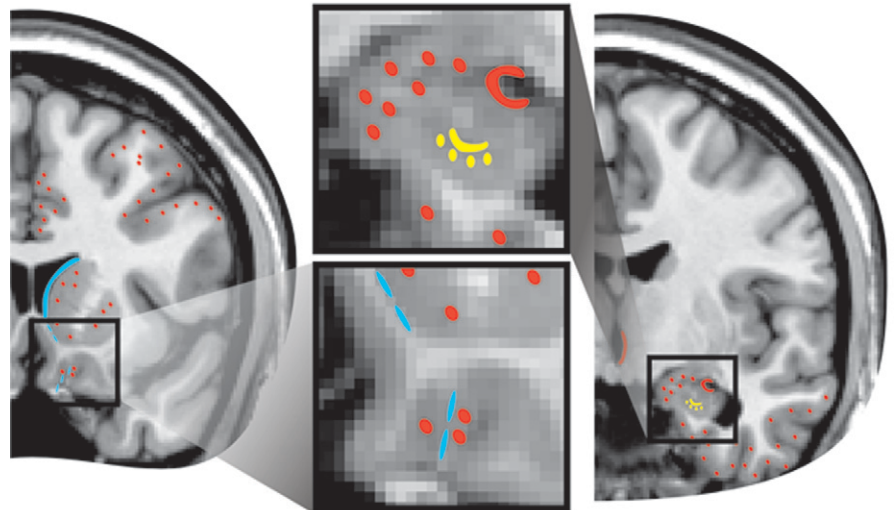


FIGURE 2. Imaging-based studies provide estimates of gray-matter volume associated with particular psychiatric disorders or treatments, but do not allow identification differences at the cellular level.¹¹ Of particular interest is whether reduced neuronal numbers are likely to be present in areas with less gray-matter volume. A recent review provided estimates of the volume fractions occupied by the major constituents of cortex (right).¹² Note that much of the cortical volume is occupied by neurons (shades of pink). Their analysis concluded that most gray-matter volume differences reported in depression are likely due to synaptic pruning and dendritic regression, rather than cell loss.

FIGURE 3. Exposure of rats to 6 weeks of unpredictable chronic mild stress (CMS; pink) induces depressive-like behaviors (e.g., anhedonia, learned helplessness) and multiple detrimental effects in the hippocampus and medial prefrontal cortex (mPFC), including decreases in neurogenesis, dendritic length, and synaptic density, as compared with control conditions (white). Both behavioral and structural deficits can be reversed by administration of antidepressants (Tx) during the final 2 weeks of CMS (CMS + Tx; blue).¹³ Schematic representations of mPFC neurons under the three conditions illustrate average dendritic changes. The authors of this study noted that these results were independent of neurogenesis, suggesting that restoration of normal dendritic length and synaptic density underlie behavioral recovery.

