Regulation of different aspects of neuronal plasticity by different sources of reactive oxygen species.

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Neurons are inherently plastic. In response to changes in activity neurons adjust their electrical properties, synaptic transmission and, structurally, the number and size of their synaptic connections. We recently identified that metabolic reactive oxygen species (ROS) are used as signals that are necessary and sufficient for activity-regulated plasticity in the developing nervous system in *Drosophila*. Moreover, we discovered that different sources of ROS regulate distinct aspect of structural synaptic plasticity: NADPH oxidases co-operate to generate ROS at the plasma membrane, which regulate the growth of synaptic terminals; in contrast, mitochondrial ROS direct the number of synapses within those terminals. Similarly, distinct aspects of synaptic transmission are also regulated by different ROS associated mechanisms.

At the circuit level, ROS signalling is required for network adjustment during the critical period of network development; disturbances in ROS levels lead to maladaptive networks, manifested by changes in cellular properties, network stability and animal behaviour.