

## **The environmental and social organization of the brain: Wiring and rewiring the brain in injury and normality**

Jesper Mogensen

Professor

Head of the Unit for Cognitive Neuroscience (UCN), University of Copenhagen  
Director of Research Centre for Brain Injury Rehabilitation (ReCBIR)

Two of the major categories of models describing the organization of the brain are: (A) the models emphasizing a “modular” organization in which specific “rules of computation” dominate within modules and (B) connectionist models in which backpropagation mechanisms modify flexible networks of (in themselves simple and uniform) “neuron” units. Neither A nor B can account for a number of empirically well-supported facts of the brain. For instance that cognitive “functions” are apparently both “localized” (to specific brain regions) and able to “recover” after focal brain injury (when functional recovery is defined as the posttraumatic return of originally impaired behaviour and/or conscious representations). Based on analysis of neural and cognitive reorganizations after brain injury, the REF (Reorganization of Elementary Functions) model has been developed. This model describes the brain as being organized as connectionist networks combining strictly localized, specialized functional modules. Thereby, the REF-model combines models of “massive modularity” with the backpropagation-shaped connectionist networks. While doing so, the model is able to account for both localization and posttraumatic recovery of cognitive functions. The implications of the model are, however, not limited to posttraumatic rehabilitation of brain injured patients. Implications include that the organization of injured as well as uninjured brains are highly dependent on the interaction of the individual with his/her physical as well as social environment. The neural and cognitive mechanisms mediating a particular behavioural or conscious manifestation are shaped and in case of injury posttraumatically reshaped via constant interactions with the broadly defined environment of the individual. In case of posttraumatic rehabilitation of patients, this realization urges the therapist to work in the most “ecologically valid” manner possible - and emphasizes the risk of little or no generalization from standardized training procedures to real-life situations. And in the context of the organization of the normal brain, it emphasizes that the physical structure as well as functional patterns of the brain are significantly influenced by the physical and social structure of the immediate as well as distal environment of an individual.