BIOGRAPHY

Prof. Dr. phil. Dr. rer. nat. habil. ***Gustavo Deco*** is Research Professor at the Institucio Catalana de Recerca i Estudis Avanats and Full Professor (Catedrático) the Pompeu Fabra University (Barcelona) where he is head of the Computational Neuroscience Group and Director of the Center of Brain and Cognition. He studied Physics at the National University of Rosario (Argentina) where he received his diploma degree in Theoretical Atomic Physics. In 1987, he received his Ph.D. degree in Physics for his thesis on Relativistic Atomic Collisions. In 1987, he was a post doctoral fellow at the University of Bordeaux in France. In the period from 1988 to 1990, he obtained a post doctoral position of the Alexander von Humboldt Foundation at the University of Giessen in Germany. From 1990 to 2003, he has been with the Neural Computing Section at the Siemens Corporate Research Center in Munich, Germany, where he led the Computational Neuroscience Group. In 1997, he obtained his habilitation (maximal academical degree in Germany) in Computer Science (Dr. rer. nat. habil.) at the Technical University of Munich for his thesis on Neural Learning. In 2001, he received his PhD in Psychology (Dr. phil.) for his thesis on Visual Attention at the Ludwig-Maximilian-University of Munich. He was lecturer at the universities of Rosario, Frankfurt and Munich. Since 1998 he is Associate Professor at the Technical University of Munich and Honorary Professor at the University of Rosario, and since 2001 Invited Lecturer at the Ludwig-Maximilian-University of Munich. Since 2001 he is also McDonnell-Pew Visiting Fellow of the Centre for Cognitive Neuroscience at the University of Oxford.In 2001 he was awarded the international price of Siemens "Inventor of the Year" for his contribution in statistical learning, models of visual perception, and fMRI based diagnosis of neuropsychiatric diseases. His research interests include computational neuroscience, neuropsychology, psycholinguistics, biological networks, statistical formulation of neural networks, and chaos theory.

He has published 4 books, more than 170 papers in International Journals, 260 papers in International Conferences and 30 book chapters. He has also 52 patents in Europe, USA, Canada and Japan. Recently, he was awarded with the “Advanced ERC” grant.

PROJECT

European Research Council Advanced Grant
Project acronym: **DYSTRUCTURE**
Project full title: **The Dynamical and Structural Basis of Human Mind Complexity: Segregation and Integration of Information and Processing in the Brain.**

Overview

Perceptions, memories, emotions, and everything that makes us human, demand the flexible integration of information represented and computed in a distributed manner. The human brain is structured into a large number of areas in which information and computation are highly segregated. Normal brain functions require the integration of functionally specialized but widely distributed brain areas. Furthermore, human behavior entails a flexible task-dependent interplay between different subsets of these brain areas in order to integrate them according to the corresponding goal-directed requirements. We contend that the functional and encoding roles of diverse neuronal populations across areas are subject to intra- and inter-cortical dynamics. The main aim of the current project is to elucidate precisely the interplay and mutual entrainment between local brain area dynamics and global network dynamics. We wish to better understand how segregated distributed information and processing are integrated in a flexible and context-dependent way as required for goal-directed behavior. More concretely, we hypothesize that coherent oscillations within frequency-specific large-scale networks and coherent structuring of the underlying fluctuations are crucial mechanisms for the flexible integration of distributed processing and interaction of representations. This project will allow us to comprehend the mechanisms underlying brain functions by complementing structural and activation based analyses with dynamics. We expect to gain a full explanation of the mechanisms that mediate the interactions between global and local spatio-temporal patterns of activity revealed at many levels of observations (fMRI, EEG, MEG) in humans under task and resting (i.e. no stimulation and no task) conditions. Besides, we will complement and further constrain our analyses by using more detailed characterization of brain dynamics via LFP (Local Field Potentials), and neuronal recording in animals under task and resting conditions. We also expect to demonstrate that the observation at the local level per se could reveal relevant information about the global level because of their mutual embedding of their dynamics (coming back in this way to a sort of global dynamics informed localizationism). A profound understanding of these operations will help elucidate the computational principles underlying higher brain functions and their breakdown in brain diseases. In the first sub-project, we will investigate computationally the interplay between local and global dynamics by studying a detailed global attractor large-scale spiking model of the whole brain. In the second sub-project, we will go beyond the numerical simulation of its dynamics, and develop theoretical descriptions of the large-scale model to gain a deeper insight into how network parameters control its dynamics. In the third sub-project, we will explore the effects of lesion and different types of damage in neuropsychiatric disorders.