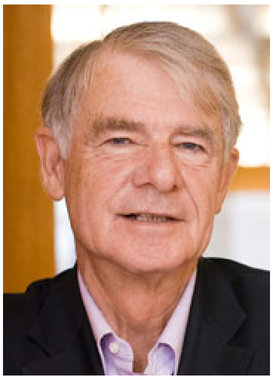
Wolf Joachim Singer



Date of Birth 9 March 1943

Place München (Germany)

Nomination 18 September 1992

Field Physiology

Title Professor

Professional address

Max-Planck-Institute for Brain Research
Deutschordenstrasse 46
Postfach 710662
D-60528 Frankfurt am Main (Federal Republic of Germany)

Most important awards, prizes and academies

Awards: Prize of the IPSEN Foundation (1991); Ernst Jung Prize for Science and Research (1994); Zülch Prize (1994); Hessischer Kulturpreis (1998); Körber Prize for European Sciences (2000); Max Planck Prize for Public Science (2001); La Medaille de la Ville de Paris (2002); Chevalier de la Légion d'honneur (2002); Ernst Hellmut Vits Prize (2002); Krieg Cortical Discoverer Award of the Cajal Club (2003); Betty und David Koetser Prize (2002); Communicator Prize (2003); Hans BergerPrize (2003); Dr. *honoris causa*, Univ. Oldenburg (2005); Aschoff Prize, Univ. Freiburg (2005); INNS Hebb Award (2006); Dr. *honoris causa*, Rutgers University (NJ) (2008); Kaloy Prize, University Geneva (2009); Order of Merit (First Class) of the Federal Republic of Germany (2011). *Academies*: Academia Europaea (1989); Pontifical Academy of Sciences (1992); Berlin-Brandenburgische Academy of Sciences (1993); Scientific Academy of the Johann Wolfgang GoetheUniversity Frankfurt (1993); Bavarian Academy of Sciences (1996); Academia Scientiarum et Artium Europaea (1997); Leopoldina (1999); Member of Collegium Europaeum Jenense, Jena (2002); Honorary Member of the World Innovation Foundation (2005); Foreign Member of the Russian Academy of Sciences (2006); Consultant of the Pontifical Academy for Culture (2011).

Summary of scientific research

Initially Prof. Wolf Singer's research concentrated on the physiology of thalamic transmission (summarized in *Phys. Rev*., 1977). Subsequently it turned towards studies of the development and the functional organization of the cerebral cortex using the visual system as a model. This led to a number of discoveries concerning mechanisms of experience-dependent development and synaptic plasticity (summarized in *J. Exp. Biol*., 1990, and *Science*, 1995). A new line of research began with the discovery that neurons of the neocortex synchronize their responses within and across cortical areas in a context and goal specific way. This finding has been interpreted as support for the hypothesis that the brain might use synchronization of discharges as a mechanism in order to select neuronal responses, to bind them together into functionally coherent assemblies for joint interpretation and to dynamically associate neurons into specific functional networks. Since then numerous experiments have been performed to test the predictions derived from this hypothesis (reviewed in *Annu. Rev. Physiol*, 1993, *Annu. Rev. Neurosci*., 1995, *Neuron*, 1999, *Trends Cogn. Sci*., 2001, *Neuron*, 2006, *Trends Neurosci*., 2007). This work emphasizes the dynamic nature of cortical processes and provides potential solutions for a wide range of coordination functions related to parallel distributed processing. It was also observed that the occurrence of synchronization is frequently associated with an oscillatory patterning of neuronal responses. This established new links between measurements of oscillatory brain activity in humans and micro-electrode investigations in animals. It also stimulated the search for oscillatory phenomena in general and led to numerous discoveries of oscillatory activity in a wide variety of brain structures of different species. The new approach to search for temporal relations among distributed neuronal responses rather than merely their amplitude revealed that cortical and subcortical networks exhibit surprisingly complex dynamics. It encouraged theoreticians in the field of neuronal computation to apply the methods of non-linear dynamics for the analysis of artificial networks and led to experimentation with models which use this putative coding strategy to resolve problems of dynamic coordination in a host of cognitive and executive functions. Recently this approach has been extended to clinical studies and revealed close correlations between clinical symptoms and disturbances in synchronized oscillatory activity in psychiatric diseases such as schizophrenia, autism and Alzheimer.

Main publications

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Neurosci*., 18, pp. 555-86 (1995); Singer, W., Development and plasticity of cortical processing architectures, *Science*, 270, pp. 758-64 (1995); Neuenschwander, S. and Singer, W., Long-range synchronization of oscillatory light responses in the cat retina and lateral geniculate nucleus, *Nature*, 379, pp. 728-33 (1996); Munk, M.H.J., Roelfsema, P.R., König, P., Engel, A.K. and Singer, W., Role of reticular activation in the modulation of intracortical synchronization, *Science*, 272, pp. 271-4 (1996); Fries, P., Roelfsema, P.R., Engel, A.K., König, P. and Singer, W., Synchronization of oscillatory responses in visual cortex correlates with perception in interocular rivalry, *Proc. Natl. Acad. Sci. 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