Vienna Circle Institute Library

Volume 3

Series-Editor:
Friedrich Stadler
Director, Institut Wiener Kreis
and University of Vienna, Austria

For further volumes:
http://www.springer.com/series/7041

Institut Wiener Kreis

Society for the Advancement of the Scientific World Conception

Advisory Editorial Board:
Nancy Cartwright, *London School of Economics, UK*
Robert S. Cohen, *Boston University, USA*
Wilhelm K. Essler, *University of Frankfurt/ M., Germany*
Kurt Rudolf Fischer, *University of Vienna, Austria*
Michael Friedman, *Stanford University, USA*
Maria Carla Galarotti, *University of Bologna, Italy*
Peter Galison, *Harvard University, USA*
Adolf Grünbaum, *University of Pittsburgh, USA*
Rudolf Haller, *University of Graz, Austria*,
Rainer Hegselmann, *University of Bayreuth, Germany*
Michael Heidelberger, *University of Tübingen, Germany*
Jaakko Hintikka, *Boston University, USA*
Gerald Holton, *Harvard University, USA*
Don Howard, *University of Notre Dame, USA*
Allan S. Janik, *University of lnnsbruck, Austria*
Richard Jeffrey, *Princeton University, USA*†
Andreas Kamlah, *University of Osnabrück, Germany*
Eckehart Köhler, *University of Vienna, Austria*
Anne J. Kox, *University of Amsterdam, The Netherlands*
Saul A. Kripke, *Princeton University, USA*
Elisabeth Leinfellner, *University of Vienna, Austria*
Werner Leinfellner, *Technical University of Vienna, Austria*
James G. Lennox, *University of Pittsburgh, USA*
Brian McGuinness, *University of Siena, ltaly*
Kevin Mulligan, *Université de Genève, Switzerland*
Elisabeth Nemeth, *University of Vienna, Austria*
Julian Nida-Rümelin, *University of Göttingen, Germany*
Helga Nowotny, *ETH Zürich, Switzerland*
Erhard Oeser, *University of Vienna, Austria*
Joëlle Proust, *École Polytechnique CREA Paris, France*
Alan Richardson, *University of British Columbia, CDN*
Peter Schuster, *University of Vienna, Austria*
Jan Šebestík, *CNRS Paris, France*
Karl Sigmund, *University of Vienna, Austria*
Hans Sluga, *University of California at Berkeley, USA*
Elliott Sober, *University of Wisconsin, USA*
Antonia Soulez, *Université de Paris 8, France*
Wolfgang Spohn, *University of Konstanz, Germany*
Christian Thiel, *University of Erlangen, Germany*
Walter Thirring, *University of Vienna, Austria*
Thomas E. Uebel, *University of Manchester, UK*
Georg Winckler, *University of Vienna, Austria*
Ruth Wodak, *University of Vienna, Austria*
Jan Woleński, *Jagiellonian University, Cracow, Poland*
Anton Zeilinger, *University of Vienna, Austria*

Associate Editor:
Michael Stöltzner

Editorial Address:
Institut Wiener Kreis
Museumstrasse 5/2/19, A-1070 Wien, Austria
Tel.: +431/5261005 (international)
or 01/5261005 (national)
Fax.: +431/5248859 (international)
or 01/5248859 (national)
email: ivc.zuef@univie.ac.at
homepage: http://www.univie.ac.at/ivc/

The titles published in this series are listed at the end of the volume.

Nicholas Tranquillo
Editor

Dream Consciousness

Allan Hobson's New Approach to the Brain and Its Mind

Springer

Vienna Circle Institute Yearbook

Editor
Nicholas Tranquillo
Harvard Medical School
Salem
New Hampshire
USA

ISSN 1571-3083
ISBN 978-3-319-07295-1 ISBN 978-3-319-07296-8 (eBook)
DOI 10.1007/978-3-319-07296-8
Springer Cham Heidelberg New York Dordrecht London

Library of Congress Control Number: 2014945251

© Springer International Publishing Switzerland 2014
This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed. Exempted from this legal reservation are brief excerpts in connection with reviews or scholarly analysis or material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work. Duplication of this publication or parts thereof is permitted only under the provisions of the Copyright Law of the Publisher's location, in its current version, and permission for use must always be obtained from Springer. Permissions for use may be obtained through RightsLink at the Copyright Clearance Center. Violations are liable to prosecution under the respective Copyright Law.
The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.
While the advice and information in this book are believed to be true and accurate at the date of publication, neither the authors nor the editors nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Editorial

Since 2001, the Institute Vienna Circle annually organizes the interdisciplinary Vienna International Summer University – Scientific World Conceptions (VISU/SWC) at the Campus of the University of Vienna. In 2010, the general topic was on "The Sciences of the Conscious Mind," with Uljana Feest (TU Berlin), Owen Flanagan (Duke University), and Michael Pauen (HU Berlin) as the main lecturers. As distinguished guest lecturer, we succeeded to engage J. Allan Hobson (Harvard Medical School) and on the occasion of the tenth anniversary of the Summer University, we decided to publish his renowned *William James Lectures*, commented on by experts in the fields of cognitive science, brain and dream research. This volume is the result of this joint effort, for which I am grateful to Allan Hobson, all the commentators, Nicholas Tranquillo, and Robert Kaller from the Institute Vienna Circle.

Vienna
July 2013

Friedrich Stadler
Professor for History and Philosophy of Science
University of Vienna
Institute Vienna Circle (Head and Director)

Foreword

A century separates Sigmund Freud's and Allan Hobson's interpretations of the putative functions of dreams. This "Vienna Circle" volume closes the cycle.

This book consists of three lectures by Allan Hobson and commentaries written by outstanding scholars whose expertise covers a wide range of scientific disciplines including philosophy. It illustrates impressively the extent to which scientific enquiry from a third person perspective can contribute to the understanding of phenomena accessible only from the first person perspective such as dreams. Freud's sources of knowledge were confined to his own experience of dreams, the dream reports of his patients, and the observation of the effects that dreams had on the psychodynamics of patients in a therapeutic setting. Allan Hobson and his commentators, by contrast, can capitalize on a huge amount of neurobiological data that have since been accumulated in the context of sleep research, much of which has been pioneered by Hobson and his colleagues at Harvard.

During the first half of the last century, the main motivation of brain research was to unravel the causes of neurological and psychiatric disorders. Hence, research focused on the investigation of the human brain and its pathologies. Due to methodological restrictions, this research was essentially confined to the postmortem analysis of structural abnormalities, and progress was slow. It was only after the Second World War that this problem-oriented approach was complemented by the strategy to search where the light is – and this light was provided by the use of animal models and the development of techniques that permitted invasive investigations of the living brain. It was now possible to establish a direct correlation between neuronal processes and associated behavior, and this paradigm shift has provided deep insights into the functional organization of nervous systems. Thanks to the more recent development of noninvasive analysis methods, this new approach can now be extended to the investigation of neuronal processes in human subjects and to relate them to mechanisms identified in animal experiments.

Following the seminal discovery of Giuseppe Moruzzi and his Pisa school in the 1950s that brain states such as sleep, arousal, and alertness are actively controlled by centers in the brain stem, sleep research became a scientific discipline. Their groundbreaking discoveries were based on the electrographic identification of brain states and their modification induced by transections performed at different levels of the brain stem and the mesencephalon. The results of these “encephale isolé” studies clearly indicated that sleep is not simply a cessation of brain functions but a sequence of controlled states characterized by distinct patterns of activity. The subsequent discovery of the so-called paradoxical sleep state, during which electrographic signals closely resemble those of wakefulness, reinforced the notion that sleep should be considered as a constitutive part of the brain’s operations. However, the functions of sleep remained obscure. This is about the time when Allan Hobson and his team entered the field. In the meantime, Michel Jouvet and his school in Lyon had established close relations between paradoxical sleep episodes and the occurrence of rapid eye movements and muscle jerks. Jouvet and his colleagues coined the term “rapid eye movement sleep” (REM sleep) and thereby provided further support for the notion that this sleep phase is closely related to processes otherwise observed only in awake, highly alert brains engaged in exploratory behavior. It also became clear that not only sleep, a phase of rest, but also REM sleep is a ubiquitous phenomena found in all species endowed with complex brains.

The evidence that there is a sleep phase during which the brain exhibits all electrographic signs of alertness and generates saccadic eye movements – a motor pattern closely related to attention and exploratory behavior – suggested that this may be the phase during which dreams are generated. Experimental support for this hypothesis came from the observation that subjects consistently reported having dreamt when they were woken up during phases of REM sleep. However, dreams were also reported after phases of slow wave sleep, suggesting the possibility that dreams may also occur during these deep sleep phases. It is still an unresolved conundrum to which extent dreaming occurs during both phases of sleep and to which extent the structure of dreams differs in the two sleep stages because it is difficult to infer from reports given after awakening when exactly the remembered dream had occurred. Whether a dream is reported depends of course also on whether it is remembered. As it is likely that only a small fraction of dreams is in fact remembered – some individuals report to never dream – it cannot be ruled out that dreams occurring during REM phases are simply more easily remembered than dreams occurring during other sleep phases.

Despite the rich and bizarre phenomenology of dream contents and the prominent role of dream interpretation in psychoanalysis, sleep research put little emphasis on the investigation of putative functions of dreaming *per se*, leaving the question unanswered whether it is an epiphenomenon of a particular brain state or whether the dream, and in particular its content, once remembered, has a particular function. Sleep research rather focused on the consequences of sleep deprivation, on the neurochemical underpinnings of the various sleep stages and the gating mechanisms that increase the thresholds for sensory input and motor output during REM sleep. These studies, many of which are reviewed in detail in the three lectures by Allan Hobson and the subsequent commentaries, provide unequivocal evidence that sleep has numerous important functions and is even necessary for survival.

Prolonged deprivation of both deep sleep and REM sleep causes severe disturbances of the organism's homeostasis, impairs a host of cognitive functions and finally leads to death. Studies of the neuronal mechanisms of sleep have also revealed that the various sleep stages are controlled by a complex interplay of modulatory systems that originate in the brain stem, the pons, and the mesencephalon such as the cholinergic, the noradrenergic, the dopaminergic, the serotinergic, and the histaminergic systems. More recent studies examined the role of sleep in the context of higher cognitive functions, especially the consolidation of memories and the resolution of problems requiring insight. These investigations suggest that sleep does indeed play a role in facilitating the consolidation of procedural memory. Electrophysiological evidence indicates that characteristic neuronal activation patterns accompanying learning are replayed during early phases of sleep and that this replay may be associated with differential changes in the efficiency of synaptic connections. Whether this replay is involved in memory consolidation awaits experimental verification. Likewise, it is still unclear whether this replay is related to the observation that some of the experiences made during waking become integrated into dreams produced in the following night. By contrast, experimental support is now available for the notion nurtured by folk psychology that sleeping contributes to problem solving. When confronted with tasks requiring a considerable amount of insight in order to find shortcut solutions, the probability of finding such solutions is enhanced if subjects are exposed to the problem and then are allowed to sleep before being retested.

Self-generated, in particular rhythmic, activity plays an important role in the shaping of neuronal connections during brain development. Together with the observation that infants spend much more time sleeping than adults, this led to the proposal that the prominent oscillatory activity characterizing sleep might have an important function in supporting activity-dependent shaping of neuronal architecture during development. Another, and perhaps related, finding is that in adults the proportion of REM sleep relative to deep sleep increases following intense learning during preceding wakefulness. It has been inferred from this correlation that REM sleep might serve the rescaling of synaptic weights after they had undergone differential changes following intense learning. Synaptic connections in developing brains are particularly susceptible to use dependent modifications. Moreover, young brains are confronted with more novel stimulus material than mature brains, suggesting that developing brains are more likely than adult brains to undergo learning-dependent modifications of their architecture. Thus, the disproportionately high occurrence of REM sleep episodes in the developing brain and the increased need for sleep in general may have to do with the enhanced need for synaptic rescaling and/or memory consolidation in early life.

All these sleep-related aspects are touched upon in this book, but its main focus is on the putative functions of dreaming *per se*. In his lectures, Allan Hobson considers dreaming as an altered state of consciousness and exploits the analysis of dream states as a tool to obtain further insights into the neuronal correlates of consciousness. This is a novel and fascinating perspective as it views dreams not as an epiphenomenon of sleep-related activity but as an expression of a state of consciousness that may be considered as a precursor of the higher level consciousness manifest in the awake brain. Only a few decades ago, the proposal to link dreams with consciousness would have appeared highly speculative. The reason is that back then neuroscientists considered consciousness as a phenomenon that eluded reductionist attempts to identify its neuronal correlates. However, with the introduction of noninvasive imaging technology and the conceptual advancements in cognitive neuroscience, search for the neuronal correlates of consciousness has become a well-established field of research that already provided deep insights into the relation between neuronal processes and the various characteristics of conscious processing. In order to clearly distinguish dream consciousness from the various manifestations of awake consciousness (phenomenal awareness, self-awareness, theory of mind, rational reasoning, etc.), Allan Hobson coined the term "protoconsciousness" for the dream state. In this book, Hobson gives a comprehensive account of the features that distinguish brain states supporting dreaming from brain states supporting awake consciousness and also of the differences in the subjective experience of dreams and awake consciousness.

At the neuronal level, these differences comprise different states of the above-mentioned modulatory systems and of the networks related to cognitive control and motor output. At the level of subjective experience, Hobson emphasizes differences with respect to emotional connotations, the logic of associations, cognitive control, and self-awareness. At first sight, it appears as if the meta-awareness of being aware or conscious of something appears to be reserved for states of awake consciousness, the state where cognitive control is fully expressed. However, Hobson exploits the phenomenon of lucid dreaming found in a minority of subjects to demonstrate that a trace of meta-awareness can even be retrieved in dream consciousness. Certain subjects report that they are sometimes aware of dreaming and that they even succeed to control the content of their dreams during states that are clearly identified by observers as sleeping states. Hobson proposes that these altered and intermediate states of consciousness could be fruitfully exploited to promote the understanding of conscious states in general and to instruct a specific search for neuronal correlates of consciousness. Several commentators, especially those interested in epistemic questions and philosophical approaches to consciousness, discuss the implications of Hobson's hypothesis that dream states are to be seen as protoconscious states that serve to prepare the brain for the maintenance of higher levels of consciousness both during development and maturity.

In conclusion, the data reviewed in this book and those retrievable in the scientific literature provide undisputed evidence that sleep consists of a well-organized sequence of subtly orchestrated brain states that undoubtedly play a crucial function in the maintenance of normal brain functions. These functions include both basic homeostatic processes necessary to keep the organism alive as well as the highest cognitive functions including perception, decision making, learning, and consciousness.

In view of current concepts on cognition, it is not unexpected that highly active brain states, such as occur during REM sleep, lead to self-generated patterns of neuronal activity that resemble those occurring in the awake brain during conscious processing of cognitive contents. It is commonly held that perception is based on a matching operation that compares incoming sensory signals with hypotheses, so-called priors, that correspond to activated memory traces stored in the brain's functional architecture. This notion agrees well with data from non-invasive imaging which indicate that imagery of a cognitive object is associated with spatiotemporal patterns of activity that closely resemble those generated when the respective object is actually perceived. Likewise, such investigations revealed that hallucinations go along with activation of exactly those brain structures that would also become active were they engaged in processing real stimuli corresponding to the hallucinated content. Thus, evidence indicates that strong, self-induced activation of cortical networks can lead to vivid experiences because the resulting patterns are similar to those occurring during perception of external stimuli. Such states are observed in a variety of pathological conditions such as migraine, fever, epileptic seizures, and psychosis, but at least in terms of electrographic signatures seem to occur also in REM sleep. In the latter, these self-generated activation patterns are not constrained by sensory signals from the outside world because during this sleep phase the sensory gates are closed.

One might speculate that it is this lack of constrainment that allows for the bizarre associations characteristic for dreamt contents. The evidence that only a fraction of dreams seems to be remembered might suggest that nature has implemented mechanisms that prevent memorization of dreams or at least prevent access of the dreamt material from conscious recall in the wake state. The fact that the aminergic systems are down regulated during REM sleep may be one reason for dream amnesia, as these systems are involved in gating synaptic mechanisms involved in memory formation. Thus, one might consider the possibility that nature has not only implemented mechanisms that decouple the sleeping brain from sensory input and motor output but also prevent the sleeping brain from becoming aware of the self-generated activity patterns. If so, one might speculate that these three processes serve to protect the sleeping brain from waking up prematurely. If this were the case, one would have to assume that awakening in the middle of the night as a result of strong dream emotions would simply indicate that the suppressive mechanisms have been overridden. Likewise, the increase of remembered dreams towards the end of a normal night would then be the consequence of the gradual increase of activity in the aminergic modulatory systems that precedes awakening and prepares the transition from sleep to wakefulness and the gradual recovery of cognitive control. This scenario would also be compatible with the indications that lucid dreaming occurs preferentially in this transition period.

If one adhered to this interpretation, one would have to conclude that highly evolved brains require periods during which they can activate internal representations unconstrained by sensory input and that nature has implemented mechanisms that protect these states from being interrupted by premature awakening that would result if the self-generated activity would trigger motor responses or have access to the level of conscious awareness. According to this interpretation, awaking from nightmares and remembering dreams would simply be a reflection of incomplete elimination of dream contents from conscious awareness. This in turn would imply that becoming aware of dream contents and remembering them has no adaptive function. If this were the case, it would, however, by no means imply that dream contents, if they penetrate into awareness and are remembered, have no impact on brain functions and are devoid of interpretable content. Those who remember dreams know only too well how strongly they can influence the cognitive and emotional dispositions in the following wake period, especially when they have been loaded with strong emotions. Likewise, the contents recombined in remembered dreams often do not only reflect fragments of experiences made during the preceding day but often recombine motifs that have distinct emotional connotations of biographical relevance. This cannot be otherwise since it is the dreamer's brain that generates these unconstrained and sometimes remembered activation patterns and it is the dreamer's brain that determines which of these patterns will penetrate into the workspace of consciousness and be remembered.

Prof. Wolf Singer
Max Planck Institute for Brain Research,
Frankfurt Institute for Advanced Studies (FIAS),
Ernst Strüngmann Institute (ESI) for Neuroscience
in Cooperation with Max Planck Society,
Frankfurt am Main, Germany

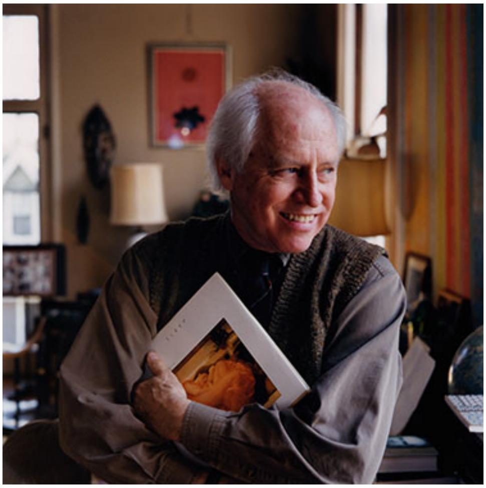
Acknowledgments

I am very grateful to Paul O'Pree and Jane Broadbent for their invitation, sponsorship, and administration of the William James Lectures given at the University of Roehampton in March 2008. It was there that I became aware of the residual Freudianism against which my theory is cast. To Professor Friedrich Stadler and his staff in Vienna, I am grateful for the opportunity to present and to publish this work. The collection of the commentaries and the production of the manuscript are the work of Nicholas Tranquillo, my longtime assistant and friend. The discussants responded to the ideas of these lectures with great enthusiasm, for which I am deeply appreciative. I am grateful to David Borodin and Jay Vogelsong for permission to publish their works of art.

J. Allan Hobson

Contents

Biographies



J. Allan Hobson (author) is an Emeritus Professor of Psychiatry at Harvard Medical School, where he conducted research on sleep and dreaming as the Director of the Laboratory of Neurophysiology at the Massachusetts Mental Health Center. This book represents his thinking about human consciousness as expressed in the William James Lectures at Roehampton University. He has written 12 previous books and published over 200 original scientific articles. He indulges his interests in art and architecture at his US home in East Burke, Vermont, and with his Italian family in Messina, Sicily.

Nicholas Tranquillo (editor) has been associated with Allan Hobson since 1997, when he was a student in Psychology E1450, The Biopsychology of Waking, Sleeping and Dreaming. Over the intervening years, he has served as a manager of the Laboratory of Neurophysiology at Harvard Medical School. In addition, he has been deeply involved and responsible for manuscript production, having worked on six successful books. In the preparation of the present volume, he solicited and edited the commentaries as well as taking full responsibility for readying the book for publication. Complementing his academic interests are commitments to culinary creation, remote and exotic travel, Qing Dynasty research, and the love of opera. He lives in Salem, New Hampshire.

Contributors

John Antrobus City College of New York, New York, NY, USA

Mercedes Atienza Laboratory of Functional Neuroscience, Spanish Network of Excellence for Research on Neurodegenerative Diseases (CIBERNED), University Pablo de Olavide, Seville, Spain

Susan Blackmore School of Psychology, University of Plymouth, Plymouth, UK

Jan Born Department of Medical Psychology and Behavioral Neurobiology, University of Tübingen, Tübingen, Germany

Allen R. Braun National Institute on Deafness and Other Communication Disorders, National Institutes of Health, Bethesda, MD, USA

José L. Cantero Laboratory of Functional Neuroscience, Spanish Network of Excellence for Research on Neurodegenerative Diseases (CIBERNED), University Pablo de Olavide, Seville, Spain

Vanessa Charland-Verville Coma Science Group, Cyclotron Research Centre and Neurology Department, University of Liège, Liège, Belgium

Michael Czisch Max Planck Institute of Psychiatry, Max Planck Society, Munich, Germany

Armando D'Agostino Section of Psychiatry, Department of Medicine, Surgery and Dentistry, University of Milan Medical School, Milan, Italy

Antonio Damasio Brain and Creativity Institute, University of Southern California, Los Angeles, CA, USA

Daniel C. Dennett Center for Cognitive Studies, Tufts University, Medford, MA, USA

Susanne Diekelmann Department of Neuroendocrinology, University of Lübeck, Lübeck, Germany

Martin Dresler Max Planck Institute of Psychiatry, Max Planck Society, Munich, Germany

Michael W. Eysenck Department of Psychology, Royal Holloway College, University of London, London, UK

Department of Psychology, University of Roehampton, London, UK

Dominic H. Ffytche Department of Old Age Psychiatry, Institute of Psychiatry, King's College London, London, UK

Karl Friston The Wellcome Trust Centre for Neuroimaging, Institute of Neurology, London, UK

J. Allan Hobson Department of Psychiatry, Harvard Medical School, Boston, MA, USA

Ludwig Huber Messerli Research Institute, University of Veterinary Medicine, Vienna, Austria

John F. Kihlstrom Department of Psychology, University of California, Berkeley, Berkeley, CA, USA

Don Kuiken Department of Psychology, University of Alberta, Edmonton, AB, Canada

Steven Laureys Coma Science Group, Cyclotron Research Centre and Neurology Department, University of Liège, Liège, Belgium

Joseph LeDoux Center for Neural Science, New York University, New York, NY, USA

Rodolfo R. Llinás Department of Physiology and Neuroscience, NYU Medical School, New York, NY, USA

Thomas Metzinger Philosophisches Seminar, Johannes Gutenberg-Universität Mainz, Mainz, Germany

Andrea Moro Center for Neurolinguistics and Theoretical Syntax (NeTS), Institute of Advanced Study, IUSS, Pavia, Italy

Adrian R. Morrison Department of Animal Biology, Laboratory for the Study of the Brain in Sleep, School of Veterinary Medicine, University of Pennsylvania, Philadelphia, PA, USA

Tore Nielsen Département de Psychiatrie, Université de Montréal, Montréal, QC, Canada

Valdas Noreika Department of Psychology, Centre for Cognitive Neuroscience, University of Turku, Turku, Finland

Department of Psychiatry, Oxford Centre for Human Brain Activity (OHBA), Warneford Hospital, University of Oxford, Oxford, UK

Edward F. Pace-Schott Department of Psychology, University of Massachusetts, Amherst, MA, USA

Michael Posner Institute of Cognitive and Decision Sciences, University of Oregon, Eugene, OR, USA

Allan Rechtschaffen Departments of Psychiatry and Psychology, College University of Chicago, Chicago, IL, USA

Antti Revonsuo School of Humanities and Informatics, University of Skövde, Skövde, Sweden

Department of Psychology, University of Turku, Turku, Finland

Silvio Scarone Section of Psychiatry, Department of Medicine, Surgery and Dentistry, University of Milan Medical School, Milan, Italy

Michael Schredl Central Institute of Mental Health, Mannheim, Germany

Wolf Singer Max Planck Institute for Brain Research, Frankfurt Institute for Advanced Studies (FIAS), Ernst Strüngmann Institute (ESI) for Neuroscience in Cooperation with Max Planck Society, Frankfurt am Main, Germany

Mark Solms University of Cape Town, Cape Town, South Africa

Arnold Pfeffer Center for Neuro-Psychoanalysis, New York Psychoanalytic Institute, New York, NY, USA

David Spiegel Stanford University School of Medicine, Stanford, CA, USA

Victor Spoormaker Max Planck Institute of Psychiatry, Max Planck Society, Munich, Germany

Giulio Tononi Department of Psychiatry, University of Wisconsin, Madison, Madison, WI, USA

Claus Vögele Unité de recherche INSIDE, Université du Luxembourg, Walferdange, Luxembourg

Ursula Voss Universität Bonn, Bonn, Germany

JW Goethe-Universität, Frankfurt, Germany

Renate Wehrle Max Planck Institute of Psychiatry, Max Planck Society, Munich, Germany

Lawrence Weiskrantz Department of Experimental Psychology, University of Oxford, Oxford, UK

Jennifer M. Windt Philosophisches Seminar, Johannes Gutenberg-Universität Mainz, Mainz, Germany

Hellmut Wohl Boston University, Boston, MA, USA