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Schousboe, Arne

*Published in:*  
Neurochemical Research

*DOI:*  
[10.1007/s11064-020-02983-7](https://doi.org/10.1007/s11064-020-02983-7)

*Publication date:*  
2020

*Document version*  
Publisher's PDF, also known as Version of record

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*Citation for published version (APA):*  
Schousboe, A. (2020). Preface for the Vittorio Gallo Honorary Issue of Neurochemical Research. *Neurochemical Research*, 45(3), 519-521. <https://doi.org/10.1007/s11064-020-02983-7>



## Preface for the Vittorio Gallo Honorary Issue of Neurochemical Research

Arne Schousboe<sup>1</sup>

Published online: 19 February 2020  
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This special issue of *Neurochemical Research* includes manuscripts from several investigators throughout the world who have been close colleagues and friends of Vittorio Gallo, and want to honor him for his contributions to our understanding of glutamatergic and GABAergic

transmission during brain development, and to his leadership in the field of neural development and regeneration.

While growing up in Rome, Italy, Vittorio displayed a very early passion for art. While his parents would have wagered that he would pursue a major in art history, Vittorio was inspired by how the brain processes visual stimuli to perceive art, leading him to study chemistry, with a specific interest in neurobiology and neurochemistry. His coursework in biochemistry, biophysics and molecular biology at the University of Rome provided him with a solid foundation to understand the functioning of the brain, as well as rigorous

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✉ Arne Schousboe  
arne.schousboe@sund.ku.dk

<sup>1</sup> Department of Drug Design and Pharmacology, Faculty of Health and Medical Sciences, University of Copenhagen, Universitetsparken 2, 2100 Copenhagen, Denmark

paradigms to be applied to his future research. All these aspects of his pre-doctoral studies converged when he was accepted to work with Prof. Giulio Levi at the Institute of Cell Biology (ICB) of the National Research Council (CNR) in Rome for his thesis—a decision that would completely change both his research career and his life.

ICB was an international and dynamic research institute directed by Nobel laureate Prof. Rita-Levi-Montalcini, who was Vittorio's co-mentor during his PhD thesis. At ICB, Vittorio worked for 4 years with Prof. Giulio Levi as a student and continued to collaborate with him for a number of years after his PhD. During these years, his research focused on amino acid neurotransmitters in the brain, in particular on mechanisms glutamate and GABA release from nerve terminals, and how neurons acquire different mechanisms of neurotransmitter release throughout development. His work was also influenced by a number of researchers who were investigating how metabolic compartmentalization in neurons and glia would affect utilization of different metabolic precursors of glutamate and GABA. The work by Arne Schousboe, Leif Hertz, Abel Lajtha and others continuously inspired his work during these years.

The environment at ICB strongly influenced Vittorio's career, as he decided that his work should focus on intact CNS neurons and the understanding of the mechanisms that would regulate their development, including acquisition of release mechanisms for specific neurotransmitters. Therefore, after obtaining his Ph.D. in 1979, Vittorio obtained an EMBO Fellowship to join the MRC Developmental Neurobiology Unit in London directed by Prof. Robert Balazs. During these years he focused his studies on cerebellar development and glutamatergic transmission. Specifically, he helped develop the cerebellar granule cell cultures as a model system to study how electrical activity and voltage-dependent calcium channels modulate granule neuron development and glutamate release. He also co-authored several important publications on topics related to release and uptake of the neurotransmitter amino acids glutamate and GABA. The adjacent review by the Guest Editor shows these publications had an important impact on the scientific work of the Guest Editor of this special issue of *Neurochemical Research*. Finishing the Post-Doc period in London, Vittorio went on to join the Laboratory of Preclinical Pharmacology at NIMH as an NIH Visiting Fellow (1983–1984) and, together with Dr. Flora Vaccarino, he developed a biochemical/neuropharmacological assay to monitor the effects of GABA receptor modulators on the activity GABA chloride channels in live neurons. In spite of geographical constraints Vittorio and Flora became lifelong friends and more recently collaborated on a number of projects focusing on neonatal brain injury and regeneration.

Vittorio then returned to Rome to work as Senior Investigator at the Unit of Neurobiology, Laboratory of

Physiopathology, Istituto Superiore di Sanita' for an 8-year period. While still being associated with the Institute in Rome, he worked again in London as an EMBO Fellow in the laboratory of Prof. Stuart Cull-Candy, where he sought to resolve a controversial topic in glial physiology, i.e. determining whether astrocytes expressed functional glutamate-activated membrane channels or only electrogenic glutamate transporters. He and Maria Usowicz, a doctoral candidate at that time, used patch-clamp recording and single channel analysis to demonstrate for the first time that indeed astrocytes expressed glutamate-activated channels that displayed functional properties similar to their neuronal counterparts.

In 1989, Vittorio moved to the US in the NIH intramural program, where he was Adjunct Scientist and NATO Fellow at the Laboratory of Developmental Neurobiology, NICHD. It was there that he characterized one of the spliced isoforms of the AMPA receptor subunit gene *Gria4*, and demonstrated that this isoform was highly expressed in cerebellum. He then became Chief of the Unit of Neurobiology, Laboratory of Cellular and Molecular Neurophysiology, NICHD, NIH (1992–1995), followed by continuing as a Tenured Investigator position from 1995 to 2001. During these years, he established his own research program with a focus on glial development and neuron–glial signaling in the CNS. He worked on oligodendrocyte progenitor cells (OPCs), their developmental and physiological properties, and the signaling pathways that regulated their proliferation and differentiation. During this time, he and his team demonstrated that both glutamate and GABA regulate OPC proliferation and differentiation. He also revealed that a number of membrane voltage-activated channels are tightly regulated in OPC during cell cycle progression.

In 2002, Vittorio made another critical decision in his career. Drawing from his years of concentration on brain development, he sought an opportunity to build a program around the central issue of how dysregulated neural development leads to neurodevelopmental disorders and neurologic disabilities. He moved from NICHD to Children's National Hospital, where he was tasked with building the Center for Neuroscience Research and Children's National Research Institute (CNRI). The environment of this new institution proved to be ideal for his goals to recruit young and dynamic investigators—both PhDs researchers and MD clinicians—to create a truly interdisciplinary neuroscience program that would integrate lab-based and clinical research. From 2002 to 2017 he has been Wolf-Pack Chair in Neuroscience, Director of Center for Neuroscience Research, and Director of the District of Columbia Intellectual and Developmental Disabilities Research Center (DC-IDDRC), one of the 14 IDDCs in the US supported by NICHD. During this time at CNRI, he not only continued his research on glial development and neuron–glia interactions, but also started a new collaboration with Prof. Flora Vaccarino at the Child Study

Center, Yale University School of Medicine. This collaboration was focused on neonatal brain injury, with an aim to understand the cellular and molecular basis of white matter abnormalities caused by hypoxic/ischemic injury of the brain and its functional and behavioral long-term consequences. During this time, he and Joseph Scafidi (a pediatric neurologist at Children's National who was being mentored by Vittorio) demonstrated that a non-invasive intervention based on intranasal EGF application after neonatal brain injury promoted oligodendrocyte and myelin regeneration, and subsequent functional and behavioral recovery. Vittorio's research program has significantly expanded in the years that he has spent at Children's, not only in the area of glial development and signaling, but also in neonatal brain injury and neural regeneration. His research has taken some exciting new directions, including recent publications on neuroprotection in congenital heart disease, in collaboration with Drs. Nobuyuki Ishibashi and Richard Jonas, both prominent clinician scientists at CNRI. In these studies, Vittorio and his colleagues used the piglet to study cellular dynamics associated with developmental brain injury, as the brain of this animal model is particularly close to human, including its white matter and subventricular zone structures.

At CNRI, Vittorio has built a successful Center for Neuroscience Research, which currently includes more than 50 investigators—12 of them lab-based developmental and translational neuroscientists. During these years at CNRI, he has also served as Professor of Pediatrics, Pharmacology and Physiology at the George Washington University School of Medicine and Health Sciences, and Adjunct Professor, Child Study Center, Yale University School of Medicine. In 2017, he was elevated to the position of Chief Research Officer, Children's National Hospital and Associate Dean for Child Health Research, George Washington University School of Medicine and Health Sciences. In his new role as Chief Research Officer, he is not only responsible for a number of CNRI programs at the institution, but he continues to focus his efforts in integrating clinical and translational research at Children's National and create opportunities for synergistic collaborations among investigators at different CNRI centers.

Vittorio has received a large number of national and international Awards, including the NINDS Javits Award in Neuroscience in 2018. His research efforts which started by fundamental studies of glutamatergic and GABAergic neurotransmission have evolved into detailed studies of gliogenesis and neurogenesis in the developing brain and the potential of stem/progenitor cells in regeneration and repair particularly in the developing white matter. In the course of these studies, he has uncovered new cellular and molecular mechanisms to promote protection and regeneration. His scientific success is attested by over 130 peer-reviewed publications—many in very high-profile journals—as well as over 30 review articles and book chapters. He has served on the Editorial Boards of many neuroscience journals, including *Glia*, and has been Reviewing Editor for *The Journal of Neuroscience*, all of which is a testament to the tremendous impact that his studies have had on the advancement of neurosciences.

Vittorio continues to dedicate a large proportion of his time to one of his greatest passions—mentoring of graduate students, postdoctoral fellows, and clinician scientists at different stages of their careers. During his career, he has mentored more than 50 postdoctoral fellows and graduate students. Many of these currently hold academic positions in the US and abroad. He has also mentored more than 30 junior PhD and MD faculties, who have obtained a variety of NIH awards, including many career transition awards. In his current roles, not only does he play a major role in establishing the programmatic vision of CNRI, but he is also responsible for recruitments of new faculty and for their mentorship at all levels. He has made diversity and inclusion one of his priorities in all his efforts, and not only created NIH-sponsored training programs with a large percentage of minority trainees, but also recruited a diverse faculty pool.

Arne Schousboe  
Guest Editor

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