

Interview Dr. Edvard Moser

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It is a distinct honor to welcome Professor Edvard Ingjald Moser to the pages of Conexão Ciência. Born in Norway and internationally recognized for his groundbreaking contributions to neuroscience, Moser has built a remarkable intellectual trajectory marked by scientific boldness, methodological sophistication, and an enduring capacity to pose fundamental questions about how the brain works. A graduate of the University of Oslo and currently a professor at the Norwegian

University of Science and Technology (NTNU), he has crafted an exemplary career that combines theoretical rigor, technological innovation, and institutional leadership.

Together with his long-time collaborator and research partner, May-Britt Moser, he made some of the most transformative discoveries in contemporary neuroscience, including the identification of grid cells, border cells, speed cells, and other elements that make up the brain's extraordinary internal navigation system. This body of work revolutionized our understanding of spatial cognition and provided key insights into how organisms encode space,

time, and memory. For these globally influential contributions, Moser received the 2014 Nobel Prize in Physiology or Medicine, alongside May-Britt Moser and John O'Keefe, a milestone that solidified his place as one of the most prominent voices in systems neuroscience.

Beyond his scientific discoveries, his career is distinguished by the creation and leadership of world-class research centers, such as the Kavli Institute for Systems Neuroscience, as well as by the development of large-scale neural recording methodologies that continue to reshape the field. His scientific output, numerous awards, and unwavering commitment to training young researchers constitute a body of work that blends intellectual depth with academic generosity.

It is therefore with great satisfaction and profound respect that we thank Professor Edvard Moser for making time in his always demanding schedule for this interview. His generosity not only enriches this conversation, but also benefits all readers, students, and researchers who will find in the following pages a rare opportunity to engage with one of the greatest neuroscientists of our time.

1. In 2005, your group revolutionized neuroscience with the discovery of the grid cells in the entorhinal cortex, revealing a key component of the brain's internal "GPS." Could you explain, in general terms, the role these cells play in spatial navigation and why this discovery has become so central to understanding how the brain represents space?

Dr. Edvard Moser: Grid cells are indeed a key component of the brain's internal GPS. They keep track of where we are in the environment and allow us to explore and compute routes toward other positions beyond our current location.

The navigation system, including grid cells, has become central in neuroscience because it is one of the few cognitive functions that we can explain in mechanistic detail. We can now point to specific cell types and describe how they work together to enable a cognitive function.

2. Beyond the grid cells, your laboratory identified several other essential components of the navigation system, such as border cells, speed cells, and additional functional units that form a coherent spatial map. How do these

different types of cells interact to create an integrated system for orientation and navigation, and what computational principles seem to emerge from this organization?

Dr. Edvard Moser: The navigation system is composed not only of grid cells but also border cells, speed cells, and additional specialized neurons. A key challenge is to understand how they work together. Grid cells are perhaps the cell type we understand best because we now know they collectively form an internal spatial map that continuously updates our represented position.

However, grid cells alone cannot perform the entire computation. They operate alongside cells that encode directional movement, speed of movement, and proximity to geometric borders, each essential for computing paths toward environmental goals. All these neuronal components contribute to a coherent spatial navigation system.

3. These discoveries culminated in the 2014 Nobel Prize in Physiology or Medicine, an honor that only a handful of scientists ever receive. How did this award transform your personal and professional trajectory? And how do you interpret the

broader impact of this recognition on the field of systems neuroscience?

Dr. Edvard Moser: The Nobel Prize changed my life in major ways, although some aspects remained the same. What did not change was my passion for pursuing questions in systems neuroscience, particularly how the brain enables cognitive functions such as the sense of location, the perception of time, and the ability to remember events.

What changed is that I now devote much of my time to communicating and advocating for science, encouraging young students to pursue scientific careers and helping decision-makers appreciate the value of science. These responsibilities now accompany my daily work running a laboratory and tackling fundamental questions. My workload has not decreased; I am extremely busy and struggle to find time. That is one of the major differences the Nobel Prize brought.

4. Your laboratory is renowned for combining advanced experimental neuroscience techniques, such as large-scale neuronal recordings using high-density probes, with neuroengineering tools that allow the monitoring of entire neuronal populations during natural

behavior. Could you explain how this methodological integration has expanded our ability to investigate the circuits that encode space, time, and memory?

Dr. Edvard Moser: Methodological advances have transformed how we study space, time, and memory. Over the past five to seven years, we have shifted from examining individual cells, such as a single grid cell, speed cell, or border cell, to asking how large populations of cells work together.

We now have access to the simultaneous activity of thousands of neurons in the navigation system. This allows us to ask how they operate collectively as a community rather than one at a time, giving us a vastly improved ability to understand the brain's functional mechanisms.

5. In recent years, your team has made significant progress in understanding how neuronal populations encode not only “where” but also “when” events occur, bridging spatial navigation and episodic memory. What is the next major scientific challenge your laboratory aims to tackle? What ambitious questions currently guide your research agenda?

Dr. Edvard Moser: Our central focus remains the mechanisms of navigation, how we know where we are and how we find our way. We use the navigation system as a gateway to understand cognitive functions more broadly.

Space is inseparable from time, and we need to understand the dynamics of the system, not just static representations, to uncover how space is actually perceived. Both space and time are elements of memory, and understanding how these aspects integrate is a substantial challenge.

The overarching question is to understand cognitive functions in general, and we believe that studying space, time, and memory will reveal principles that extend to many other cognitive processes. These questions will occupy us for many years.

6. Given your global leadership in systems neuroscience, which research topics do you believe will be the most promising, or disruptive, in the coming years? What emerging fields would you recommend that young researchers pay special attention to?

Dr. Edvard Moser: Understanding the brain's cognitive functions will be a central endeavor for decades to come. We

are only at the beginning. This field offers expanding opportunities for young researchers as it becomes increasingly computational and mathematical.

A major advantage today is the public availability of large-scale datasets collected in experimental laboratories. Anyone, anywhere in the world, can download these data and address key research questions even without an experimental lab. This dramatically broadens access and accelerates discovery.

7. Why do you think so many people today accept and spread false scientific information so easily, even when robust evidence is available in areas such as health and climate science? Are there cognitive mechanisms or neural processes that help explain this human vulnerability?

Dr. Edvard Moser: This is a key societal challenge. Part of the problem lies in how we select information, strongly influenced by the structure of social media. The information we receive is often a function of what we already seek, creating loops in which our preexisting beliefs are constantly reinforced.

This limits exposure to critical or contradictory information. Humans also

naturally prefer to affirm their existing values and opinions.

To counter this trend, we must ensure that people are exposed to a wide range of information and, crucially, invest in public education in critical thinking. People must learn to distinguish fact-based, scientifically grounded information from unreliable sources and to differentiate good research from bad research. Education, especially in schools, is key to reversing this worrisome development.

8. Your research group is internationally recognized for its scientific excellence and its strong commitment to training new talent. Which technical, intellectual, or personal qualities do you consider essential for a young researcher who aspires to join your laboratory and contribute to cutting-edge investigations?

Dr. Edvard Moser: Neuroscience is becoming increasingly technical, mathematical, and quantitative, so a background in physics, mathematics, or other quantitative sciences is very helpful. Still, neuroscience is broad, and some areas, especially clinical or translational divisions, require different skill sets.

However, the most critical attribute is one's attitude toward science. Success requires motivation, curiosity, passion, and a genuine desire to discover how things work. Science must be something one enjoys. A young researcher must find the questions they are truly curious about; this intrinsic drive is one of the most important predictors of success.

9. During your recent visit to Brazil (2025), you had the opportunity to interact with students and researchers. What were your impressions of the current state of scientific research in Brazil? And do you see concrete possibilities for future collaborations with Brazilian research groups?

Dr. Edvard Moser: There is tremendous potential in Brazil. Many young students are passionate about science, curious, and eager to understand the brain. The question is how to realize this potential.

I advise students everywhere, whether in Norway or Brazil, to plan a period abroad as part of their training. Experiencing different laboratories, scientific cultures, and ways of thinking can be transformative. Later, they may return to Brazil and build strong local research environments.

Funding remains a challenge, particularly for expensive experimental work, but computational neuroscience offers remarkable opportunities. Complex datasets are now publicly available, requiring only a computer and analytical skills.

10. Your career is marked by pioneering discoveries, institutional leadership, the creation of world-class research centers, and a scientific output of remarkable impact. What advice would you offer to young researchers who aspire to build a solid, productive, and innovative academic career, especially in highly competitive fields like neuroscience?

Dr. Edvard Moser: My advice is similar to what I said earlier. Curiosity and motivation are essential. It is important to broaden one's experience, work in different countries, learn from various laboratories, and be exposed to different scientific perspectives.

If one can synthesize these experiences and gradually build a laboratory, starting small, then expanding, this creates a strong foundation. Most importantly, young scientists must identify the key questions that truly matter to them. Not everything important is objective; what is

crucial for one person may differ for another.

Motivation, dedication, persistence, and the willingness to spend time on challenging questions are all essential for building a meaningful scientific career.