



International Society for Neuroethology

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The Prez Says

Eric Warrant
President of the ISN



Hello everyone, and greetings from Australia!

Just now I am nearing the end of a three-week field trip studying the remarkable migratory abilities of a small and apparently unremarkable brown moth – the nocturnal Bogong moth *Agrotis infusa*. Like its much better studied and much more beautiful day-active North American relative the Monarch butterfly, this moth migrates in the billions from a vast geographical area (from all over southeast

Australia) to a restricted number of cool alpine caves high up in the Australian Alps (yes we have them too ☺) where they spend the summer in a dormant state before returning in the autumn to where they were born (there mating, laying eggs and dying). The trip covers up to 1000 km in each direction and we now know that Bogong moths use information from the Earth's magnetic field and the starry austral night sky to find their way to and from the mountains. For me it is impossible not to stand in awe of the incredible navigational abilities of an animal whose brain and nervous system weighs a tiny fraction of a gram. The natural world is truly magnificent, and I know that my wonder is shared by all of you.

But as we all know, our own influence on the environment is straining the natural world as never before (as the recent special issue on the Anthropocene in *Current Biology* so worryingly shows). Just at the moment, here in southeast Australia, we are experiencing the third year of the worst drought in Australia's recorded history (and according to geologists, the driest period in over two million years), no doubt the product of advancing climate change. In the inland breeding grounds of the Bogong moth, this means three consecutive winters with almost no rain at all – and thus no food for the developing larvae. My last two annual summer visits to caves that normally house millions of tightly tiled moths, nestled in the labyrinth of cool stone walls and crevices, revealed *not a single moth*. You can imagine my alarm and anguish, an alarm also shared by researchers working on critically endangered alpine marsupials that depend on the massive influx of moths for food.

Incredibly though, despite no let-up in the drought, nature is fighting back. Completely inexplicably, migrating Bogong moths are now flying into the mountains in huge numbers. And equally weird, other insects are way up in numbers too. I haven't the slightest clue why or how this is possible. At the moment, I don't even care because I am so happy that somehow it has happened. It gives me hope that even small advances in reducing our impact on the planet might allow nature to rebound. As a scientific society, it is our duty to combat political forces that wage war against science to promote policies that increase human impact rather than reduce it. It is our duty to unashamedly and unceasingly uphold scientific truth, to agitate – and yes even become civilly disobedient if need be – in order to increase public awareness that we

are killing our planet. I am convinced that we still have time to do something about it. The amazing Bogong moths give me hope that we are not too late.

And talking of our society, much has happened since my last column – in particular, two truly excellent new initiatives have come from you, our members. The first of these has come from **Heather Eisthen** and **Lauren O'Connell**. Heather and Lauren wrote to me about 6 weeks ago to say that they wished to draft a Code of Conduct for our society (as is becomingly increasingly common in other societies like our own). The purpose of a Code of Conduct is to create a benchmark for good behaviour towards our fellow members (and non-members) at our congresses and within our society, to ensure that everyone, regardless of gender, race, religion or sexual orientation, feels welcome and included in all the activities of our society, in particular our congresses. I do freely confess that I was initially skeptical about our need for such a Code, because I couldn't imagine such behaviour from our members. But having spoken to a number of people – particularly women – I was stunned to hear some truly awful stories of sexual harassment. It was definitely an eye-opener! Thankfully, the phenomenon seems to be confined to a small group of people who repeat offend. But this is pretty bad nonetheless. I am now convinced that this Code is a much-needed addition to the society and I am extremely grateful to Heather and Lauren for initiating this.

Another of Heather's and Lauren's initiatives was to create a new Equity and Inclusion Committee (EIC), which is common in other societies. The first priority of such an EIC will be to ratify the new Code of Conduct, preferably before the abstract submission begins for the next ICN (likely sometime during December). That way, members can check a box stating that they agree to the Code of Conduct when they submit their abstracts. The EIC would also play a role in figuring out how to enforce the Code. Beyond that, the EIC will work on strategies or programs to increase diversity and inclusion in our society. I am very pleased to announce that **Ana Silva** from the University of Uruguay has agreed to chair the new EIC and will soon populate it.

The second new initiative comes from our two hard-working Early Career Representatives, **Miriam Henze** and **Sara Wasserman**. Miriam and Sara have created a Mentorship Program to pair younger researchers with

more experienced researchers. Most of us who are little more established will certainly remember a particular person who was instrumental for the advancement of our careers, and who may have taken us under their wing at a crucial time in our development and helped us to find our feet in the world of science. Miriam and Sara have created an excellent [handbook](#) that explains how mentorship works, and you can now register to become a mentor or a mentee by logging in to the membership area of the ISN website, selecting “My account” and clicking the sign-up button under the Mentorship section. Sara and Miriam will then match mentors and mentees according to various criteria, including research interests. I have already signed up as a mentor and I encourage other senior members of the society to do the same, thus supporting this excellent initiative. Many thanks to Sara and Miriam for creating this great new program!

And finally, a quick update on our next congress in Lisbon. The local organizing committee (under the leadership of **Rui Oliveira**) recently launched the [congress website](#) and I encourage everyone to make a visit there to find out more. You will, for instance, get a taste for the spectacular scientific program (thanks to our very able program committee under the leadership of **Cindy Moss** and **Uwe Homberg**) and see the magnificent venues where various parts of the congress will be held. And very soon registration and abstract submission will open – most likely in December – so do bookmark the congress website. I look forward to seeing you all in Lisbon!

I now note with some alarm that Christmas trees and other decorations have already started appearing in shops in Australia, and they do seem rather out of place in the bright sunshine and rising heat of an unfolding austral summer! But this means of course that we are rapidly approaching that time of year when we gather with family and friends to take a well-earned break from the pressures of university life. No matter which traditions you and your family adhere to, I hope that the coming holiday season is one filled with joy, happiness and renewal!

My very warmest wishes for the season!

Eric Warrant
President, ISN

REPORTS FROM THE 2019 HEILIGENBERG STUDENT TRAVEL AWARD WINNERS

Each year, ISN awards travel funding to qualified graduate student members. Current students should be on the lookout for a call for award applications early next year and make sure to renew their membership! In 2019, our winners were **Shubham Rathore** (University of Cincinnati) and **Lukas Weiss** (University of Giessen). Here’s what they did with their awards.

From Shubham Rathore: As a first year PhD student, travelling to another country to present my research is an exciting opportunity. This year I was selected to present my work as a poster at the International Conference on Invertebrate Vision, 2019 in Kristianstad, Sweden. However, the cost of travelling can sometimes be a bit much & getting the Heiligenberg Student Travel Award really helped me in that aspect! I used the grant to pay for a part of my travelling costs & was able to attend the conference which only takes place once in 4-5 years.



From Lukas Weiss: Thanks to the Heiligenberg Travel Award I had the opportunity to attend both the GRS and the GRC in Mount Snow this summer. I first came in contact with the Neuroethology community at the ICN2018 in Brisbane and I was looking forward to meet some friends again at the GRC. As I am about to finish my PhD, this was the perfect occasion to present the results of my project about amphibian olfaction. I was very excited that I was given the chance to give a talk at the GRS, which made it easier to start conversations with a lot of people right from the first day of the conference. The diversity of topics and animal behaviors presented at the conference was very inspiring and I found the input for my project and scientific future very valuable. The conference schedule with a lot of free time made it easy to connect and chat with many people and it was exciting to get to sit at dinner with the biggest scientific names in the field. Apart from the science itself, I really appreciated that the conference also addressed issues of diversity

and inclusiveness in science in the GRC Power Hour. I am thankful to the organizers of the GRS/GRC for the great meeting and the ISN for the financial support and I hope I can continue being a part of this community in the future.



PHYSICS AND BIOLOGY: THE COMPLEX PATH OF INTERDISCIPLINE

ISN Council member **Ana Amador** (University of Buenos Aires, anita@df.uba.ar) and colleague **Gabriel B. Mindlin** (University of Buenos Aires, gabo@df.uba.ar) discuss aspects of scientific work at the frontier between physics and biology.

Physics and biology have a long and fruitful history of interactions. Some were really spectacular, like the one established by the American biologist James Watson and the English physicist Francis Crick, leading to the elucidation of the structure of DNA. However, for any physicist / biologist who has interacted with a biologist / physicist, it is obvious that it is a non-trivial interaction. At a first glance, this difficulty can be attributed to a *language* barrier: someone trained in physics has a familiarity with mathematics that is different from those who have been trained in biology. However, this difficulty is usually only the emergence of a more profound difference, one that exists between the most central aspects of both disciplines. Aspects that are learned from the first lectures that a scientist attends, in one discipline or another.

A physicist is trained from a young age to unveil the basic mechanisms involved in a phenomenon. Much of their training consists precisely in identifying a hierarchy of importance among the mechanisms that may be at stake, designing experiments to eliminate less important factors, finding the “fundamental” mechanisms. It is implied that simplifying, idealizing, trimming nature to underline what is “essential” is not only valid, but is considered as a sign of rigor. The more comprehensive and simple the theory, the better. A biologist, on the other hand, also seeks to understand the fundamental aspects of life and nature. However, it is obvious from before she/he began to train as a professional scientist, that life demands a high degree of complexity below which an organism simply does not live. The idea of rigor, in biology, is often

associated with the ability to distinguish a subtle variation that properly places the problem in an evolutionary context. In this way, the absence of familiarity with the mathematical language that we mentioned at the beginning is the emergence of something more profound: large conceptual differences regarding how to approach the study of nature.

Despite the difficulties, the attraction between these disciplines is extremely intense. A contemporary scientist, whether approaching the study of nature from biology or physics, may conceive natural organisms in terms of some form of matter organization. This is one of the reasons why a physicist feels perfectly invited to study problems of biological motivation.

The relationship between physics and biology that arises from the atomic hypothesis is the most obvious (and perhaps the deepest that can be established between them), but by no means the only one. In the case of neuroscience, one of the most spectacular interactions between the vision of physics and biology gave rise to the equations of Hodgkin and Huxley (1952). This mathematical model was conceived to account for the temporal evolution of neuronal action potentials. It proposes a set of variables: the membrane potential of a neuron and three variables that respectively describe the activation of potassium channels, the activation and deactivation of sodium channels. In an absolutely Newtonian spirit, the model proposes a rule of interaction between these variables in terms of ordinary differential equations, as Newton would propose to account for the temporal evolution of the position and velocity of a particle. Given a set of initial conditions, the system of equations prescribes in a unique, absolutely deterministic way, the temporal evolution of the variables. In this way, knowing the initial conditions, it would be possible to describe the temporal evolution of the membrane potential of a neuron, obtaining the state of the neuron for each moment. This deterministic equation raises the following question: will it be possible to carry out numerical simulations, coupling units described mathematically by simple models, which would allow one to reproduce the functioning of the brain? A lot of interdisciplinary work has been done in this field during the past decades. Important breakthroughs have emerged, but we are still far from answering this question.

During the development of different theories in physics, to reconcile Newtonian dynamics with Thermodynamics, new mathematical tools and theories were needed: the body of knowledge we know as statistical mechanics. This allows us to go from the atomic scale to the mean-field scale in a rigorous way. However, this body of knowledge is based on a set of hypotheses that do not allow systems outside the equilibrium to be included, as is the case, for example, with neurons. In other words, there is no body of knowledge that allows us to go from the rules that govern the dynamics of a neuron, to prescribe the global behavior of the system, that is, of the organism as a whole. This means that physicists feel there is much to be gained by studying neuroscience, and for the same reason, physicists do not have the tools (yet) to apply already developed techniques. An interdisciplinary effort is needed to develop a qualitative new theory of how dynamical properties emerge from the interaction of active units.

The theoretical approach of interactions between physics and biology is relatively recent. Physics, as we pointed out at the beginning, has a particular attraction for simple systems, capable of being modeled and fully understood. For this reason, "complicated" systems such as those found in biology were not generally considered the domain of physics. It was not until the maturation of the field "Nonlinear Dynamics", or its continuation under the name of "Complex Systems", that topics such as those emerging from biology were studied intensely by physicists. The research in "Complex Systems", deals with "emerging" behaviors, that is, those in which the dynamics exhibited by a set of interacting units cannot be foreseen in the study of constitutive states in isolated form. Precisely the questions that interest physicists in this field are to what extent global properties of the interaction give rise to different kinds of emergent behaviors. This branch of physics allows us to characterize a system without having to explicitly solve the temporal evolution of each of the system's variables. At the time, this approach was really new and powerful: leaving aside the details, being able to qualitatively establish the state of a system allowing it to be extremely complex. To achieve this, leaders of this discipline, among which we can name Poincaré, Birkhoff, Arnold, and Feigenbaum, developed innovative mathematical tools that are currently used to characterize neuronal systems.

Beyond these methodological questions, behavior emerges from the deep interaction between the nervous system, a biomechanical periphery, and the environment. Therefore, it is difficult to conceive understanding behavior without a deep interaction between physics and biology. Independently of specific techniques, both theoretical and experimental, any curious scientist trained as a biologist or as a physicist, is at some point fascinated by the incredibly complex dynamics of life. The magnitude of the challenge will require multiplicity of trainings, multiplicity of perspectives.



INVITED SYMPOSIA ANNOUNCED FOR THE 2020 ICN IN LISBON, PORTUGAL



Program Committee chairs **Cindy Moss and Uwe Homberg** are pleased to announce the invited symposia for the 2020 ICN.

The neural basis of Collective Behavior
Organizer: **Amir Ayali**, Tel Aviv University

The emergence of novel group-level behaviors has been described in terms such as "swarm intelligence" or the "mind of the swarm", referring to the congruence in behavior of swarms composed of many different individuals. Quintessential examples include, swarms of locust, schools of fish, flocks of birds, human crowds, and even artificial autonomous agents (swarming robots). This symposium will comprise very recent findings, presenting novel insights into this important aspect of collective behavior. Advances in the study of collective behavior have always been the result of interdisciplinary collaborative efforts, where experimental work combines with theoretical modelling, and both support engineering endeavors.

Accordingly, the research presented in this symposium will include various techniques, from electrophysiology, via virtual reality and robotics, to molecular biology.

The evolution of sound localization circuits in land vertebrates.

Organizer: **Catherine Carr** and **Jakob Christensen-Dalsgaard**

It has been difficult to form coherent hypotheses about the observed variation in sound localization circuits in vertebrate auditory systems, but recently some of the confusion has been resolved in a way that focuses attention on neural coding of sound location. First, the eardrum and middle ear structures evolved independently, and from different elements, in mammalian and diapsid lineages. Second, work on lungfish provided insights into what the common ancestors of terrestrial vertebrates could hear and how they might have responded to sounds such as substrate vibrations. Third, new work suggests the first order auditory nuclei evolved independently in birds and mammals, resulting in a mixture of conserved, divergent and convergent features. Lastly, the different availability of binaural cues imposed distinct constraints on the “new” binaural circuits in the brainstem. We will emphasize the convergent nature of neuronal mechanisms to show how this understanding increases the explanatory power of studies of spatial processing in the vertebrate auditory system.

Overlooked for decades? Motoneuron involvement in rhythm generation

Organizers: **Erik Zornik** and **Boris Chagnaud**

Motoneurons are traditionally considered the last relay from the central nervous system to muscle control in a given motor behavior. Rhythm-generating circuits, Central Pattern Generators (CPGs), send projections to motoneurons, which in turn project to and generate appropriate muscle contractions. However, in several species and motor systems, there is evidence accumulating that motoneurons play a more complex role in pattern generation itself.

In this symposium, talks will explore current studies examining the role of motoneuron feedback activity across many different taxa and behaviors, and will examine how widespread motoneuron participation in motor circuits may be. The broad diversity of animal models in this symposium will highlight the importance of motor-premotor neuron interactions in patterning of motor activity across animals, which will encourage the audience to consider potential divergence and convergence of motor circuits across the animal phylogeny.

Redefining the boundaries of pheromone action: pheromones as neuromodulators of learning and memory

Organizers: **Martin Giurfa**, **Patrizia d’Ettorre**

Pheromones are defined as chemical messengers that are released to the environment by a sender and that induce changes in behavior of a receiver of the same species. They constitute the ubiquitous mode of information transfer among animal species and occur in multiple behavioral contexts such as food and mate search, predator avoidance, territoriality and navigation. The response to pheromones is, by definition, stereotyped and independent of experience. Yet, recent work, in both vertebrates and invertebrates, has revealed an unsuspected role of pheromones, namely their capacity to modulate learning and memory formation, beyond the original communication context for which they evolved. Here we propose to focus on this “non-canonical” role of pheromones and discuss if and how pheromones affect cognitive behaviors that are in principle unrelated to the chemical message conveyed. The fact that pheromones may facilitate or inhibit associative learning and memory formation deserves, in our opinion, a broadening of the definition of pheromone action and role, and a discussion of the mechanisms underlying this modulation.

The neuroethology of social parasitism: Exploring modifications in the neural and molecular architecture of avian brood parasites

Organizer: **Kathleen S. Lynch**, Hofstra University

Avian obligate brood parasites do not build their own nests, incubate the eggs or provision the young. Instead, these birds deposit and leave their eggs in the nest of another species and evade the many fitness costs of parental care. However, this type of social parasitism comes with a set of new ecological and behavioral challenges both for the juvenile and for the adult brood parasite. Here, we will address the neural, hormonal, developmental, and genomic mechanisms associated with meeting these challenges.

This symposium will explore the neural and molecular modifications associated with losing maternal care in female brood parasites. Brood parasitic behavior entails an increased need for spatial memory allowing female brood parasites to seek out and remember the location of active host nests. Brood parasitism also poses a unique challenge for social recognition and social learning as the developing young parasites are raised in nests without conspecifics.

New tools to study behaviour in the field: insights from insect navigation.

Organizers: **Michael Mangan**, Univ of Sheffield, UK; **Antoine Wystrach**, CNRS, France

The crux of neuroethology is to consider the neural mechanisms that give rise to complex behaviour in natural environments. Yet, many of the most advanced methods to probe behavioural mechanisms remain consigned to the laboratory. The field of insect navigation is bucking this trend by developing novel methods that blur the lines between laboratory and field studies, delivering significant advances in our understanding.

This symposium will bring together world-leaders from technical and biological disciplines to describe new in-field methodologies and the impact they have had on insect navigation research. Talks will offer a perspective on recent trends and look ahead to future directions in order to stimulate debate in the meeting. The focus on emergent technologies and their impact is particularly timely and innovative, with an integrative view ensured by securing speakers from disparate academic specialisms & locations.

Selective Attention and State-Dependency in Invertebrates

Organizer: **Vivek Nityananda**

The classical model of sensory behaviour posits that an organism receives an external stimulus which then elicits a specific response in a stereotypical fashion. However, several recent studies have shown that an organism's response is not stereotypical but also depends on its behavioural state. Such state-dependent responses have been shown in a range of species including primates, mice and insects. Importantly, these state-dependent responses have been argued to be analogous to responses that are dependent on attention. Thus, behavioural states, such as flying or walking, could be on a continuum with more psychological states such as attention. The study of selective attention in invertebrates has, however, progressed relatively independent of the study of state-dependent behaviour. Much recent progress in the neural and genetic basis of selective attention in multiple systems shows that this is an important, growing field. The goal of this symposium is to bring together experts in these two fields to discuss how state-dependency and selective attention could inform each other and how we can enhance studies in both fields by sharing theoretical ideas and techniques.

Insights into the fine tuning of social behavior: the brain as a source of steroid hormones

Organizer: **Laura Quintana**

The aim of the symposium is to bring together data from four research lines on steroid modulation of sexual

and aggressive behavior carried out in mammals, birds and teleost fish, to illustrate how studying behavior and the social brain areas involved across sexes and seasons has brought forth new ideas on hormone modulation of behavior.

Hormones, key agents of biological coordination, have long been known to affect and be affected by behavior. In the last twenty years, novel data have emerged that contribute to the existing foundation built upon the study of the role of steroid hormones in male breeding behavior. Current approaches have included three non-traditional standpoints: 1. female sexual behavior and aggression 2. social behaviors uncoupled from the breeding season and 3. the effects of brain-derived hormones. Research with these focuses has opened new avenues to understand the diversity of steroid modulation upon social behavior.

Sensory Integration

Organizer: **Lidia Szczupak**

Animal behavior is guided by a combination of multiple sensory cues present in the natural environment. In most cases behavior is driven not by a single but by multiple signals. Recent progress in our understanding of multisensory integration has emerged from a wide diversity of studies spanning from cellular levels to behavior, and in a wide variety of organisms, from invertebrates to vertebrates. This symposium will present advances that range from sensory integration along single command cells to integration across multiple cells in specific brain regions. The combination of techniques that allow precise subcellular mapping of activity with simultaneous recording of multiple neurons has provided this field with tools to evaluate the mechanisms by which the nervous system process salient and subtle signals from the ecosystem to extract the necessary information to carry out successfully a variety of vital functions. A more comprehensive approach that incorporates the concept of multi-signal integration and the neuronal computations that endow circuits with such properties will allow a more realistic understanding of the process that drives decision making.

Making Biorobots Behave: Connecting Engineering and Animal Behavior

Organizers: **Barry Trimmer** and **John Long**

This symposium will highlight the advances being made in bio-robotics and the challenges of building machines that behave like animals. Speakers will focus on the impact of neuromechanics and embodiment on the design and control of robots. These engineering approaches have in turn yielded important insights and tools that can be applied to neuroethological problems. A major goal of the symposium is to bring together engineers and biologists working on the mechanisms of adaptive behavior to discuss

the most recent cutting-edge research in their respective fields. Understanding how animals navigate and move around in the world is now having a major impact in the field of robotics. We will present the leading edge of research into bioinspired sensors, soft materials and neural control systems and their application to robots designed to operate in natural environments. Key questions will include, the role of central commands and distributed controls in complex movements, biomechanical interactions between animals and their environment and how evolutionary processes can shape an animal's body and behavior.

Neuroethology of 3D Spatial Navigation

Organizer: **Michael Yartsev**

This symposium aims to present and discuss the role of hippocampus in representing 3D space during navigation across a diverse set of mammalian taxa – rodents, lemurs, bats and primates. Specifically, the speakers will highlight both the similarities and differences in hippocampal function evident across these organisms and their respective relationship to the species' ethology. The presented data will also combine methodologies spanning from ethological studies in the animal's natural environment, computational modeling and experimental neurophysiological interrogation. Combined, this symposium will highlight the importance of a comparative approach in studies of the neural mechanisms underlying spatial navigation.

Memorial Symposium in honor of Barrie Frost and Jack Pettigrew

Organizer: **Hermann Wagner**

Speakers:

Eric Warrant

The Australian Bogong moth: an extraordinary nocturnal long-distance navigator

Henrik Mouritsen

Navigation in birds and insects

Leah Krubitzer

Cortical plasticity within and across lifetime

Michael Calford

Australian Animal models in Vision, Touch and Hearing

ICN 2020: INFORMATION FROM THE LOCAL ORGANIZING COMMITTEE

Hopefully many of you have saved the dates for the 2020 ICN (26-31 July, 2020) and are already fantasizing about eating bifana in Lisbon next summer. In the meantime, LOC chair **Rui Oliveira** wants to share some important logistics to help you prepare for registration and travel. Remember to check well in advance if you require a Schengen visa to travel to Portugal!



The Gulbenkian Foundation will serve as the main venue of the 2020 ICN, promising pleasant views from some of the lecture halls and meeting rooms.

- The conference website is now live and updated at www.neuroethology2020.com. Check there for information about the venue, scientific and social programs, registration, travel, satellite meetings, and more.
- You can catch updates about the meeting by following [@icn2020lisbon](https://twitter.com/icn2020lisbon) on Twitter. Let's spread the word about our favorite conference by mentioning this official account in our own tweets and retweeting the updates.
- TAP Air Portugal is the official carrier of Neuroethology2020 and that delegates can get a 15% discount using a promotion congress code that is available at the conference website
- Finally, online registration will open in early December so be on the lookout for that announcement!

