## Q & A

# Onur Güntürkün

*Onur Güntürkün is a Turkish-born Professor for Biopsychology in the Faculty of Psychology at the Ruhr-University Bochum (Germany). He is kept awake with questions such as: What are the neuronal fundaments of thought? Why do animals have asymmetrically organized brains? Or, can different kinds of brains produce the same architecture of cognition? He spent years of his life in different universities in Germany, France, the USA, Australia, Turkey and Belgium. Onur Güntürkün is a member of the German National Academy of Sciences, holds two honorary doctorates, and has received numerous national and international scientific awards, among them the Leibniz Prize 2013, Germany's highest science award.*

***What turned you on to biology in the first place?*** I didn't study biology, but psychology. But I was always interested in the biology of the mind. As a nine-year old kid, I collected bugs and confined them to little cardboard labyrinths that I crafted into small cassette tape boxes. For days, I then recorded their learning progress in finding the way to little drops of sugar water. Later, I started to condition my aquarium fish to find out if they can discriminate colors. They had to swim towards plastic panels that differed in color but not in luminance (at least, I thought back then that they didn't differ in luminance…). Looking back, I'm still the young boy that conducts experiments to study animal cognition. Now, I'm obviously much more professional, but in the very end, I'm doing the same as I did when I was a child.

***And what drew you to your specific field of research?*** In Turkish high school, we had psychology as one of the main subjects. Most of what I learned there was exactly what was at the core of my interest: "What are the mechanisms of mind"? However, courses of psychology at Turkish universities were for my taste too soft, too psychoanalytical. So, I decided to move to Germany to study psychology. I expected to learn something about the brain and behavior, but I was deeply frustrated that it was mostly 'brainless' psychology — utterly boring! Only one scholar, Juan Delius, did everything that fascinated me. He had been a student of Niko Tinbergen and combined the rich tradition of evolutionary science and ethology with behavioral neuroscience. His main subject of study were pigeons. Juan Delius created my academic home country, which I have never left since then. It is still my conviction that psychology can only by properly studied with experiments that are interpreted against a background of neuroscience and evolution. In addition, I inherited my love for birds from him.

***Who were your other early influences?*** I was fascinated with the findings of Eric Kandel and David Alkon in slugs. Here, I saw my future: to focus on an organism of modest complexity and to then identify the building blocks of learning and memory from synapse to behavior. My dream was to uncover the cogwheel-like mechanisms of 'thinking'. The smaller the particle of analysis, the more relevant it seemed to me. I moved from behavior to local field potentials, then to light-, and finally to electron microscopy. So began my downward voyage from behavior to synapses until I realized that I was wrong: it is a grave mistake to think that we can deduce details of behavior from genes or synapses. Behavior is obviously based on neural function, but brain and behavior are reciprocally intertwined. In addition, the generation of behavior from neural tissue involves so many diverse transformations at so many parallel entities of the brain that a 'read-out' of the details of behavior from brain structure amounts to pseudo-scientific nonsense. It is much more fruitful to study both brain and behavior with the same care and to then draw inferences about possible mechanisms.

***What is the best advice you've been given?*** Unfortunately, I never got a lot of advice. Mentoring in the way it is imperative today was regrettably not the rule for my generation. Possibly the 'best' advice I ever got came from an eminent scholar of German psychology at a conference during my early postdoc years. He approached me during the coffee break of a conference and said about the following: "We all see how fascinated you are with what you do. Unfortunately, this kind of brain research has no future in psychology within the German system. But you are young enough to change your subject". In the beginning, I was a bit shocked. But then I realized how much I love what I do and I went on with that. Today, cognitive neuroscience is one of the cornerstones in psychology worldwide, and of course also in Germany. The 'advice' I was given forced me to look at my scientific doing from a higher perspective. I realized the risk but also the extent of enthusiasm for what I did. So, my advice to young colleagues is simple: If you love it, don't give it up for simple-minded managerial career plans. Work hard for it and do it in the best possible way.

Photo: Marion Nelle.

***You study pigeons, magpies, humans, dolphins. Why this diversity?*** I study birds for obviously biographical reasons. After all, my first scientific advisor Juan Delius was working with pigeons. Meanwhile, I realize how much these animals shaped my approach to neuroscience. When you are working with an animal that is cognitively so capable, but has a brain anatomy that is so vastly different from us mammals, you start asking questions about our core concepts on the relationship between brain structure and function. So, I came to realize that very different kinds of brains can generate very similar kinds of mental operations. And when you realize this, you start asking yourself how exactly functions are generated in the brain. To take a comparative approach helps you to avoid the trap into which many neuroscientists step when they study mice and humans: Sometimes they think that since a certain function is generated by the same neural entity in mice and men, this neural structure must be a *conditio sine qua non* for this function. With a comparative approach, you may see that the same function can be generated by quite different structures. Thus, we should look for the commonality between, say, pigeons, mice, and humans, at a much deeper level. The differences between species therefore represent experiments of nature that help us to understand the invariant and divergent properties of the neural foundations of cognition. I do not see pigeons or dolphins as a model for us humans. And I also do not study humans to understand pigeons. I must confess that, scientifically speaking, I'm not interested in humans or pigeons or in all the other animals that I study. I'm interested in the mechanisms of cognition. Different animals provide different opportunities to study these mechanisms.

***Do you have a scientific hero (dead or alive)?*** Many. One of them is Juan Delius, whom I mentioned above. I got imprinted like a duckling by his relaxed attitudes, his fascination for discoveries, and his sheer joy for the conduct of science. Another hero is Ludwig Edinger (1855–1918), the leading comparative neuroanatomist of his time. His lifetime goal was to conceive a theory on the evolution of vertebrate brains and of vertebrate cognition. His conception was that of a stepwise addition of different brain components from fish to amphibians, to reptiles, to birds, and finally to mammals. According to his theory, the cortex was the last component that was added with the occurrence of mammals. His thinking dominated neuroscience for a century and had many spin-offs like, for example, the idea of the 'triune brain' in which our central nervous system was thought to consist of a sequentially added reptilian, a paleomammalian and a neomammalian complex. This idea was clearly inspired by Edinger but came out long after his death. The triune brain idea was wrong already when first formulated but still persists in all sorts of courses of managerial psychology. To summarize, the tragedy of Ludwig Edinger is that he was absolutely right in all of his observations, but nearly completely wrong in all aspects of his overall interpretation — and I'm among those who helped to end the dominance of his theory. But still Edinger has to be cherished as an outstanding scientist. He contributed tremendously to our knowledge and, based on what he could know in his time, his theory was just brilliant. I wish our current theories would stand a century.

***Do you have a deep scientific conviction?*** Yes, paraphrasing the famous quote of Dobzhansky, I'm convinced that nothing in neuroscience makes sense except in the light of behavior. Nervous systems evolved to produce behavior. It is futile to try to understand brains without keeping this in mind.

***If you would not have made it as a scientist, what would you have become?*** I cannot imagine myself as a clinical or as an industrial psychologist. Even the sheer thought feels like a nightmare. Possibly, being a taxi driver in a Mediterranean city would be a much more interesting alternative. Excellent weather conditions, long pauses full of daydreaming, and from time to time interesting customers that talk about their lives — that could have been a nice alternative.

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## Quick guide

# Freshwater sharks and rays

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***Hang on, I thought sharks and rays only live in the ocean?*** That's true for about 95%. However, there are species of elasmobranchs (sharks and rays) that occur regularly at low salinities, often beyond the tidal reaches of the sea. These make up around 5% of living elasmobranchs (roughly 56 out of 1154 described species). Species that are confined to freshwaters are termed obligate freshwater species, and comprise all the freshwater stingrays (family Potamotrygonidae) and several stingrays (Dasyatidae). Species that can tolerate a wide range of salinities, from freshwater to brackish and/or marine waters, are termed 'euryhaline species'. Euryhaline species include sawfishes (Pristidae), several whaler sharks (Carcharhinidae), one skate (Rajidae), and a number of stingrays (Dasyatidae). They range in maximum size from only 20–30 cm disc width in several freshwater stingrays, to at least 6.5 m total length in the Largetooth Sawfish (*Pristis pristis*).

***Was the colonization of freshwater a unique event?*** The invasion of and adaptation to freshwater environments has occurred independently many times in elasmobranch evolution. The mostly late Paleozoic, eel-like xenacanth sharks, for instance, occurred in freshwaters and were perhaps euryhaline, whereas the Eocene Green River stingrays (in present-day Wyoming) were true freshwater species. The modern obligate freshwater stingrays of Africa and Southeast Asia (dasyatids) and South America (potamotrygonids) result from multiple independent colonization events. The potamotrygonids, known from four genera and 28 species (with about 10 known undescribed species), are the only group to have significantly diversified in freshwaters

  