



MY WIKO FAMILY AND OTHER ANIMALS SZABOLCS HORVÁT

I am a complex systems scientist. In short, that means that I borrow methods and ideas from physics to study subjects in a wide variety of other fields. After an initial period of working on high-energy heavy-ion collisions, I became interested in interdisciplinary applications of quantitative methods and went on to study diverse topics such as the spatial distribution of tree species in rainforests, the emergence of spontaneous synchronization, the statistical mechanics of networks, and interpreting the wiring of the brain. Presently, my main research is concerned with understanding the structure and behaviour of complex networks, and in particular the study of networks in biology. I was born into a Hungarian-speaking Szekler family in Transylvania, Romania. I completed my doctoral degree in Theoretical Physics at the University of Bergen in Norway and the Babeş–Bolyai University of Cluj-Napoca, Romania. A series of different projects and postdoctoral positions took me through several countries including Italy, Malta, the USA, France, and finally Germany, where I currently work at the Center for Systems Biology Dresden and the Max Planck Institute of Molecular Cell Biology and Genetics. – Address: Max Planck Institute of Molecular Cell Biology and Genetics, Pfotenhauerstr. 108, 01307 Dresden, Germany. E-mail: szhorvat@gmail.com.

As I write this, almost a year has passed since we first arrived in Grunewald on a sunny, late August afternoon. Now that I'm settled back into my daily routine, my Wiko experience feels almost like a distant dream. We had the essentials of our life packed into a van: me, my partner Monica, her piano, two bicycles, a couple of suitcases with clothes, and of course a large birdcage for our cockatiel Bei. I knew that the Wiko was going to be a very

special place when the answer from the always-helpful Vera to my inquiry about bringing a pet parrot was: “Of course, it won’t be the only bird this year.” But I was also slightly nervous. I was about to spend six months in the company of respected senior scholars from prestigious universities, many of them from the humanities and arts, fields that were very different from my own and that I had little prior exposure to. Would I fit in, would I be accepted? As it turned out, my worries couldn’t have been more misplaced. The unique arrangement whereby most Fellows live in the same building and attend daily lunches together creates a wonderful sense of community and friendship, with full-time and Short-term Fellows as well as partners eager to get involved and support each other. This environment was particularly helpful to those of us who were also on the academic job market during the time of our fellowships.

Part of the appeal of the Wissenschaftskolleg is its unique location that provides equally convenient access to the hustle and bustle of the city with its restaurants, museums, and universities and to the pleasant seclusion of Grunewald, Berlin’s “green forest,” where foxes and wild boar were our daily visitors. Monica, my wife, who loves to teach children about music and nature, particularly appreciated the latter. With a recommendation from the Wiko and a bit of luck, she soon found a teaching job in a nearby kindergarten and did not hesitate to begin assembling our own home zoo from which she could pick exciting creatures to show to the children there. Her collection started with stick insects and leaf insects, looking so much like parts of a real plant that most guests in our apartment wouldn’t even notice them at first. They ate blackberry leaves, which we picked in the nearby woods. Then there was the pickle jar with tiny transparent newtlets, gathered from a pond back home just before leaving. They would accept only food that was alive and moving, so we soon needed to extend the collection with a bucket of lake water to house the swarm of *Daphnia*, tiny clumsy water crustaceans that newts love to slurp up, supplied by Jana Petri, the Scientific Coordinator of the College for Life Sciences. The Wiko takes very good care not only of its Fellows, but also of their animals! The pickle jar and bucket eventually gave way to a small aquarium – again thanks to Jana’s help – lined with gravel from the Grunewald sandpit, and its contents mirrored the lake ecosystem from the backyard of the Villa Walther: there were freshwater isopods, aquatic caterpillars, and myriads of copepods, much to the amusement of Tatenda, another Fellow who does research on these creatures. As time passed, the newts grew bigger, their round fish-eyes migrating to the top of their heads and turning frog-like, until they finally metamorphosed from aquatic larvae to terrestrial forms and climbed out of the water.

They were transferred to a moss-lined box, and small glass-bodied shrimp moved into their old home. The shrimp are still here on my desk, in the same small aquarium, a tiny piece of living Grunewald that we brought back with us. The zoo grew bigger and bigger, and by the time winter set in, there were praying mantises, crickets and grasshoppers, and a metallic green rose beetle that ate jam. All this of course was a delight to several of the children of Villa Walther, a great amusement to adults as well, and allowed me to pretend to be a biologist a little bit. After all, I was now in the College for Life Sciences.

When people ask me what I do, I like to say that I am “a physicist who studies anything that is not physics.” Galileo famously wrote that the book of nature is written in the language of mathematics. Since then, physicists have mapped out the fundamental laws of matter and energy and distilled them down into concise mathematical theories. But what about the laws that govern the behaviour of people, the motion of biological cells, or the dynamics of an ecosystem? Could we not apply the same methodology to these as well? Do such complex systems even have simple governing laws? We find that empirical data about them often contains strikingly simple patterns, suggesting that the answer is yes. While their individual components are sometimes hopelessly unpredictable – think of a mass of people – collectively they frequently produce entirely new and tractably simple behaviours, a phenomenon known as emergence. Typically, however, not all components relate to each other in the same way. Instead, there is a non-trivial network of connections that defines their interactions and that plays a great role in defining the nature of their emergent collective behaviour. This is the premise of network science: connectivity structure influences function and behaviour. Much of the work I do focuses on finding effective ways to uncover interesting structural features of various networks and determining which ones are relevant for their function.

I planned to use the time of my Wiko fellowship to think specifically about networks that exist in space, such as the neurons of the brain, the streets of a city, or vascular transport networks of the body. In all these, only those nodes tend to be connected that are physically near each other. This leads to a characteristic and strongly constrained structure, which requires new and specialized methods to extract meaningful information from it. I made progress on this work and incorporated it into the research programme that I propose in my still on-going job applications. I do, however, regret that the workload and stress created by being on the academic job market did not leave as much time and energy as I would have liked to fully exploit the possibilities of the fellowship. Additionally, I was greatly looking forward to inviting a long-term collaborator to the Wiko

and making progress on common projects, but to my great regret this plan was cut short by the mid-winter COVID wave. However, despite the raging pandemic, I was able to make contacts in Berlin and give some in-person talks.

The Wiko did deliver on its promise that originally drew me to apply: “unexpected encounters inspire new ideas.” In fact, I should warn future Fellows who might be reading this: be wary of the great many temptations you will face at the Wiko. It is all too easy to get distracted and start playing with the myriad of new ideas the Wiko environment will inevitably inspire, instead of finishing old work that you should be doing. I have especially fond memories of spending time with the other College for Life Sciences Fellows, Elisa, Rachel, Tatenda, Kullu, and of course Jana, who made sure that there would always be something new and exciting for us, from learning about the Bauhaus in Weimar to early-morning crane-watching tours and making scientific contacts in Berlin. I hope to find the time to flesh out all the ideas we discussed together: reconstructing food webs with Tatenda, thinking about how the tree-like shape of the lung impacts the dynamics of its microbiome with Rachel, modelling parasite evolution in the context of animal social networks with Greg and Mike, and wondering about the personal space of birds with Mark and Heiko. I think back fondly to sharing birding photos with Mark, Alyx, and Kullu, learning to play *go* with Anthony, listening to Xun’s stories about Chinese history while playing ping-pong, and exploring Berlin with Teresa: I miss you all!

I left the Wiko with a treasure box of new ideas waiting to be implemented. These couldn’t have been born without the stimulating environment, and without the gift of *time to think* that this fellowship brought. To all my fellow Fellows and the exceptionally supportive Wiko staff, *thank you!*