A HEMIGLOT YEAR
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It was a great year to be an evolutionary biologist at the Wissenschaftskolleg. We knew we would have a great working group on major transitions in evolution, with Koos Boomsma, Joan Strassmann, and me as long-termers, joined part-time by Ashleigh Griffin, Nancy Moran, and Howard Ochman. But we did not know that there would be another great working group looking at related questions: Mike Wade, Tim Linksvayer,

Jason Wolf, and Judie Bronstein. And we didn't know that the College for Life Sciences Fellows would also include young biologists interested in social evolution. I benefited hugely from seeing and talking to these people on a daily basis.

That said, my actual work was in some ways more solitary than usual. This was time away from (some of) the intensely social project of running a lab full of graduate students and postdocs, time to work ideas out in my own head. I'll come back to this later, because it is a bit technical, and first share some thoughts on my other major project here – trying to learn some German.

Native English speakers have a huge advantage in today's world. But they also have the disadvantage of not being incentivized to ever learn another language well. For various reasons, including that Joan speaks all of these, I have picked up some Italian, French, Spanish, and a bit of German. But I'm not a polyglot, more like a poly-hemiglot. I never become really fluent. With the possible exception of Italian, Joan speaks all of these languages better than I do. One of my goals was to continue to be able to understand Joan in all of her languages, as her German was bound to improve. She seems to vacuum up languages whole, whereas I ineffectually try to sweep them into little logical piles.

I did have a starting point. 45 years ago, I had one year of college German when I thought I might study history of science. With essentially no practice since then, it had mostly evaporated, but I hoped that some of it might recondense into something useful.

In November, eight months before we would set out to Berlin, I began listening repeatedly to the audiobook *Learn in Your Car German* to get some basic grammar, vocabulary, and expressions. I did not generally listen in my car, but I did adopt the principle of killing two birds with one stone, listening while doing something else that I needed to do anyway. I listened while walking to work, while doing the dishes, and even while running. I knew that I would not absorb everything while I was running myself into exhaustion, but I hoped that the stress might engender some sort of PTSD-like flashbacks to the German. I'm not sure that worked, but I must have learned more German by listening while running than I would have learned by running without listening. Maybe I killed one and a half birds with one stone.

Joan and I could not arrive for the beginning of the Wiko intensive German class, but joined it halfway through. Faced with a largely incomprehensible placement test, I joined some apparently lucky guesswork with some intricate quasi-logical processes of elimination to apparently get enough answers right to land me in the B2 class. As neither of those talents applies much to actual language skill, I found myself desperately dog-paddling in

an ocean of German, sucking in gasps of air in between huge gulps of head-spinning grammatical constructions, unfathomable idioms, and sesquipedalian vocabulary. Or maybe my guessing on the placement test wasn't really that good and they just placed me in B2 to keep me with Joan, so I would have a linguistic babysitter readily at hand. Anyway, it worked out OK. Joan did actually serve as a bridge, because I can understand what she says in any of her languages and eventually some of the rest of it began to make sense. But I would remain the slow student in the class, something I don't have much experience with, except for schoolboy violin lessons.

I have mixed feelings about German. I can't say I'm a big fan of German cases and genders. But I love the vocabulary. Here are some of my favorites. *Überkomplex* describes some of the evolutionary biology I'm trying to untangle. *Doch* is so useful at resolving answers that would be ambiguous in English; *Verschlimmbesserung* is the word Edmund Burke needed but did not have. *Muckefuck* is just funny.

None of this should be taken as advice to future Fellows on how to learn German. I am simply documenting my own follies. I have succeeded in adding German to my hemiglot list. Professionally, the time would have been better spent learning a computer language, but that can't be done while running or while watching *Krimis*. And I am certain that my year will be much more memorable for having struggled with German.

I wish I were fluent but I do find there are advantages to being a hemiglot. You escape the rutted trails of your own language and, since you don't yet recognize most of them in the new language, you ramble more freely across a novel landscape. Everything seems fresh; even clichés can seem bright and clever. All Germans I meet seem smart and interesting because they can communicate so much better than I can. And every advertising sign, instead of registering as a capitalist assault on my senses, becomes a little puzzle to be decoded.

My hemiglot experience at Wiko had other levels. At Wiko we all shared at least one language – English. And yet, even within English, we were speaking different disciplinary languages. The words were almost always familiar, but not necessarily their field-specific definitions and nuances. For me, listening to the Wiko colloquia was a weekly exercise in imperfect translation and suspect understanding. But, once you get past the idea that our languages are all the same, you gain some of the advantages of hemiglottism. You try to get out of your own ruts and see the landscape anew. That is the whole point of throwing together scholars from such different disciplines. You cannot necessarily predict when this will work and when it won't. I was not particularly looking

forward to a colloquium on Catholic theology. But in Günther Wassilowsky's reading of grace in the Catholic tradition I found much to think about for my own interest in biological altruism.

My professional project at Wiko involved mathematical modeling of the causes of social evolution. It pursues an approach that I have used occasionally over the years using the Price equation, which is a great way of breaking evolutionary change down into components. A main goal was to try to formalize the gene's-eye view of evolution, a perspective most often associated with Richard Dawkins, which views genetic replicators as the foundational actors in evolution. This perspective is widely used by biologists, but has also generated a lot of criticism. One of the chief criticisms is that it is just genetic "bookkeeping"; the differential reproduction of genes records the result of evolution, but doesn't say anything about the causes. So, my approach was to frame the gene's-eye view in terms of causal methods like Sewall Wright's venerable path analysis and more modern methods, like Judea Pearl's.

At this point, I am quite happy with the outcome. By coincidence, I was facing a manuscript deadline that exactly matched the departure date from Wiko. After squeezing in a couple of nice late-coming results, the manuscript was ready to go only a few days overdue (and, as I expected, well ahead of some of the other manuscripts for the same volume). In this manuscript, I ask first what other genes need to be included to understand the evolution of a focal gene of interest. The answer turns out to be quite simple: genes that are correlated with the focal gene and genes that interact synergistically with it. Pleasingly, the same simple equations apply for all kinds of genes, including those occurring in other individuals or even other species. I then show how these results relate to Fisher's average effect and his fundamental theorem of natural selection, showing that serious causal thinking about the gene's-eye view actually goes back to at least 1930. I hope and think the paper will clarify some of the foundational issues about how natural selection works.

That is my main output so far, apart from a couple of side-project papers I wrote during the year and of course some continuing output from the lab at home. But my ten months of thinking at Wiko has also set up what I think will result in three or four other related theoretical papers. One will be about the evolution of fitness: what causes can be expected to lead to adaptation and which are essentially externalities that change fitness in haphazard ways. Another may be about causal issues in the Price equation itself. It is usually described as dividing evolution into two parts, one due to selection and one to

transmission. But in fact, that division hides an interaction term and I suspect that breaking out that interaction term may help resolve some thorny issues. Another paper will be on what biologists call frequency-dependent selection, which is an extremely common and important form of selection that has never been properly treated in a causal framework. I think I can show that there are important common features is all forms of frequency-dependent selection.

Each of these projects is still a work in progress. Each is, in fact, still in the stage where I am a hemiglot, where I only half understand how I am going to express what I think needs to be said. That is where we all are when we are trying to push the boundaries of current understanding. I hope to attain fluency in these small areas (much more likely than with German!), but the hemiglot stage of struggling with the half-understood is where a lot of the fun is.