

WHEN THE BRAIN IS AT REST

Gaël Varoquaux – About ten years ago, I started the adventure of trying to understand the brain at rest. The idea is that, nowadays, we can have images of the activity of the brain—for example, using an MRI that allows us to have some sort of film of brain activity. Looking at this film, we see the brain regions that activate and those that do not activate. And, what's interesting is that it gives us a window on the mind, that is: thoughts. And my fascination was that a brain at rest actually is free thoughts. So, the question is: what can we draw from it? If we look at an individual who does not think about something that we control, whose thoughts are not guided, can we understand the behavior of the brain? Can we use it for medicine? The stakes, beyond the fascination, is to make experiments that are applicable to everyone, even to people who are not able to do a complicated calculation, who are stressed by a scanner. So there is a real potential practical benefit.

As a start, we tackled this as a so-called source separation problem in signal processing. The idea is that every network of the brain expresses itself as an independent source. For example, the language areas are not synchronized with the areas for decision making. And we can use this desynchronization during these uncontrolled thoughts to separate them. So this can lead us to a map of the brain at rest. One of the advantages of rest, from a statistical data processing point of view, is that it gives us lots of data. Then we can do a blind analysis which consists in trying to separate the independent signals in a blind way. So we can find quite complicated shapes, for example distant regions that often light up together. In fact, behind this, we are capturing the correlations between remote areas and therefore we can go further. And we can quantify these interactions between brain areas, and the challenge then becomes not to map, but to quantify the rest. That is, to use it as a measurement tool, a diagnostic tool. So, years after the, perhaps naive, dream of reading in the resting brain, now we use this rest activity as a marker that we can apply to people who are diminished. The kind of application that we will see coming is for example the diagnosis of people who are in a coma. So this is a real issue, and alley in which we start to have success is to study people who have autistic disorders, and therefore use rest as a marker that is an objective and biological marker of a psychiatric illness like autism.

At first I was so naive that I could only be attracted to something new by fascination, since I did not understand it. Then I had the chance to work with a lot of people who were complementary and who asked me a lot of questions and made me think, and we went from fascination to the idea that it could be used for something, and then to the will to show that it indeed was useful. If I can show that it can be useful for something, it probably has a truth value.