Amazing treatments.

University of Basel researcher Dr. Annette Milnik is searching the foundations of memory to find better treatments for memory-related diseases.

Sometimes the solution to the most difficult problems lies in just knowing where to look.

That statement captures both the challenge and the promise of Annette Milnik's effort to understand and treat memory-related diseases.

Dr. Milnik is a post-doctoral fellow at the University of Basel where she's part of a molecular and cognitive neuroscience research group investigating the molecular basis of memory. Their ultimate goal is to provide more effective treatment for memory-related diseases.

But science hasn't yet unlocked all the mysteries of how memory works. Milnik and her colleagues are searching for a still-missing link — the "memory molecules" — the genetic processes within human DNA that influence memory capacity. "There's no such thing as 'the' memory gene," Milnik says. "Rather there are many variations in the genome that, combined with other factors, form our memory."

Specifically, Milnik says if they can find patterns in genes related to memory it could explain how memory works and how it can be influenced. "Once we've located memory-relevant genes we can look at drugs that already exist and identify which ones could influence memory capacity." This knowledge would open up a broad new set of treatment options.

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But standing between Milnik and those memory-relevant genes is an exhaustive search through haystacks and haystacks of data for a tiny needle. So step one is simplifying the data — or in haystack terms, reducing the search to a single pile.

It's a perfect challenge for Milnik who gave up a career as a medical doctor to pursue this research. "I love data mining and data analysis," she says. "It's like a patient. If a patient tells you a complex story you have to filter out what the real problem is. For me, the patient here is data. Taking complex data, figuring out the problem and reducing it to its essence is what I love about this job."

She's working on narrowing the search by studying the impact of the genetic code on methylation. Methylation is a mechanism that interacts with DNA molecules. In doing so, it leaves a pattern of markers that can identify the function of a given cell. It's this pattern that could give clues for finding memory-relevant genes.

Using the Swiss National Supercomputing Centre's Cray supercomputer "Piz Daint," Milnik and her colleagues examined 500,000 genetic variations in conjunction with 400,000 methylation flag patterns to see how they interact. "I got the chance to work on one of the largest computers in the world," she says. "I like to make things simple but here I didn't have to make it simple. I was able to search in the largest model space, go through the full 'haystack' and see what came out."

Today what came out was a critical method for filtering the enormous datasets used for investigating memory capacity. Tomorrow it will be better treatment of memory-related diseases. And the next? The potential exists for amplifying our own memories. Says Milnik: "If we understand how learning and memory comes together and how memory builds up, maybe we can even improve how we teach."

SWISS NATIONAL SUPERCOMPUTING CENTRE (CSCS)

The Swiss National Supercomputing Centre provides crucial supercomputing capabilities to international and domestic researchers in academia, industry and business. Their supercomputer "Piz Daint" is a petascale Cray® XC™ system and the most powerful system in Europe.

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