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New technique unravels transport in living brain cells

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A new technique has made it possible to study the functioning of motor proteins in living brain cells. Previously, this could previously only be done under artificial conditions outside the cell. Motor proteins transport building blocks from one location to another in a cell. NWO researcher Lukas Kapitein managed to image how motor proteins find their way around brain cells. The research into transport systems inside brain cells may lead to an improved understanding of how brain disorders such as Alzheimer's disease progress. The new Cell Biology Department at Utrecht University, which opened on 7 October, will further develop and utilise this new technique.

Motor proteins organize the transport of substances in a cell. They 'walk' along minuscule tubes in the cell, called microtubuli. These microtubuli have plus and minus ends allowing the cell to organise the direction of protein traffic. Depending on the type of motor protein, the traffic runs from plus to minus or in reverse. The microtubuli in axons, the longest extensions of brain cells, all lie in the same direction. This makes it easy to predict the direction in which motor proteins travel in an axon and to know how certain substances travel from one point to another. However dendrites, the other extensions of brain cells, contain a highly irregular matrix of microtubuli. How protein transport was regulated had always been a big mystery. Thanks to biophysicist Lukas Kapitein, a method for studying this has now become available.

Kapitein investigated three types of motor proteins: kinesin, dynein and myosin, which all exist in various forms. Kapitein: "We discovered that

certain motor proteins only move to axons and never to dendrites. This means that these proteins can sense the difference between the two types of brain cell extensions. We now have a much better understanding of how selective transport in brain cells works."

Kapitein developed a technique to study the behaviour of motor proteins in living rat brain cells. He placed the cells under a special microscope and made a series of photographs of these. Adding a special substance made specific motor proteins bind to immobile particles in the cell. The motor proteins set these particles in motion. As motor proteins continuously set new particles into motion during their journey around the cell, the researchers could follow the movement of the motor proteins by observing the particle motion. "This yielded spectacular imagery,' says Kapitein (www.cellbio.nl). 'This technique is an enormous leap forward. We can approach the real situation in the body much closer than with tests outside the cell. We expect the results of this research to translate well to humans."

On 7 October, the Symposium 'Imaging Biocomplexity' took place at Utrecht University to celebrate the founding of the Department of Cell Biology under Casper Hoogenraad and Anna Akhmanova. Kapitein's Biophysics Research Group is an important part of the department. 'We are the only lab in the world that can study transport in living cells this well,' says Kapitein. He hopes that manipulating protein distribution in brain cells will improve our understanding of the progression of diseases that cause a gradual deterioration in our brain's function, such as Alzheimer's disease. The ultimate goal is to fully unravel the road map and traffic rules for motor proteins and building blocks in our brain cells .

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