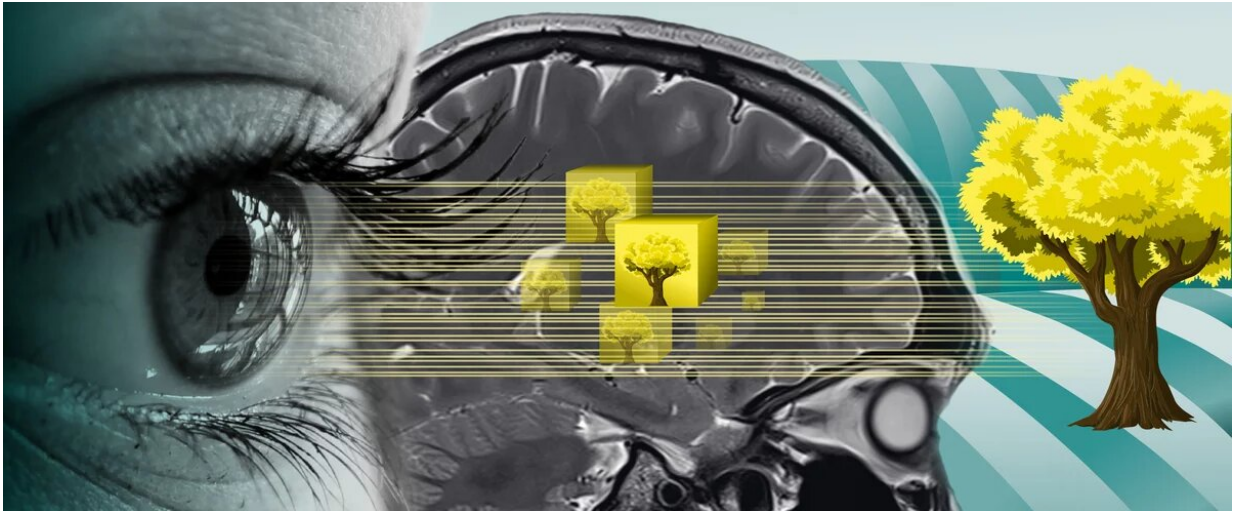# Artificial intelligence predicts eye movements

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The DeepMReye software uses artificial intelligence to directly predict eye position and eye movements from MRI images. Credit: © MPI CBS

A large amount of information constantly flows into our brain via the eyes. Scientists can measure the resulting brain activity using magnetic resonance imaging (MRI). The precise measurement of eye movements during an MRI scan can tell scientists a great deal about our thoughts, memories and current goals, but also about diseases of the brain. Researchers from the Max Planck Institute for Human Cognitive and Brain Sciences (MPI CBS) in Leipzig and the Kavli Institute for Systems Neuroscience in Trondheim have now developed software that uses artificial intelligence to directly predict eye position and eye movements from MRI images. The method opens up rapid and cost-effective

research and diagnostic possibilities, for example, in neurological diseases that often manifest as changes in eye-movement patterns.

To record eye movements, research institutions typically use a so-called eye tracker—a sensor technology in which infrared light is projected onto the retina, reflected, and eventually measured. "Because an MRI has a very strong magnetic field, you can't use standard cameras in it. You need special MRI-compatible equipment, which is often not feasible for clinics and small laboratories due to the high costs and time-intensive use" says study author Matthias Nau, who developed the new alternative together with Markus Frey and Christian Doeller. The high cost of these cameras and the experimental effort involved in their use have so far prevented the widespread use of eye tracking in MRI examinations. That could now change. The scientists from Leipzig and Trondheim recently presented their free and easy-to-use software "DeepMReye" in the journal *Nature Neuroscience*.

With it, it is now possible to track participants' viewing behavior even without a camera during an MRI scan. "The neural network we use detects specific patterns in the MRI signal from the eyes. This allows us to predict where the person is looking. Artificial intelligence helps a lot here, because we often don't know exactly which patterns to look for as scientists" Markus Frey explains. He and his colleagues have trained the neural network with their own and publicly available data from study participants in such a way that it can now perform eye tracking even in data the software has not been trained on. This opens up many possibilities. For example, it is now possible to study the gaze behavior of participants and patients even in existing MRI data, which were originally acquired without eye tracking. In this way, scientists could use older studies and data sets to answer entirely new questions.

Moreover, the software can also predict when eyes are open or closed, and tracks eye movements even when the eyes remain closed. This may

allow to perform eye tracking even when study participants are asleep. "I can imagine that the software will also be used in the clinical field, for example, in the sleep lab to study eye movements in different sleep stages" says Matthias Nau. In addition, for blind patients, the traditional eye-tracking cameras have rarely been used because an accurate calibration was very cumbersome. "Here too, studies can be carried out more easily with DeepMReye, as the artificial intelligence can be calibrated with the help of healthy subjects and then be applied in examinations of blind patients." The software could thus enable a variety of applications in research and clinical settings, perhaps even leading to eye tracking finally becoming a standard in MRI studies and everyday clinical practice.

The DeepMReye software is an open source application and can be downloaded from GitHub.

  More information: Markus Frey et al, Magnetic resonance-based eye tracking using deep neural networks, *Nature Neuroscience* (2021). DOI: 10.1038/s41593-021-00947-w

DeepMReye software: github.com/DeepMReye/DeepMReye/

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