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Why evolutionarily ancient brain areas are important

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Structures in the midbrain that developed early in evolution can be responsible for functions in newborns which in adults are taken over by the cerebral cortex. New evidence for this theory has been found in the visual system of monkeys by a team of researchers from the RUB. The scientists studied a reflex that stabilizes the image of a moving scene on the retina to prevent blur, the so-termed optokinetic nystagmus. They found that nuclei in the midbrain initially control this reflex and that signals from the cerebral cortex (neocortex) are only added later on. PD Dr. Claudia Distler-Hoffmann from the Department of General Zoology and Neurobiology and Prof. Dr. Klaus-Peter Hoffmann from the Department of Animal Physiology report in the *Journal of Neuroscience*.

To control sensorimotor functions (e.g. eye movements), the adult brain is equipped with different areas in the neocortex, the evolutionarily youngest part of the cerebrum. "This raises the question, why older subcortical structures in the brain have not lost the functions that can also be controlled by the neocortex" says Hoffmann. The neocortex of primates is, however, not fully functional shortly after birth and therefore cannot control the optokinetic nystagmus. "This is most probably also the case with people" says Distler-Hoffmann. Nevertheless, this reflex works directly after birth.

The researchers examined what information controls the optokinetic nystagmus in the first weeks after birth. During the first two weeks, the reflex is controlled by signals from the retina, which are transmitted to two nuclei in the midbrain. The neocortex then adds its information and

takes over during the first months of life. The optokinetic reflex, which was studied by the researchers also at the behavioural level, is almost identical under the control of the midbrain and the neocortex. It occurs, for example, when watching a moving scene. First the eyes follow the passing scene, then they move quickly in the opposite direction back to their original position. On this reflex, monkeys and humans build their slow eye tracking movements with which they keep "an eye" on moving objects.

The optokinetic nystagmus changes if the visual system does not develop normally. Lens aberrations, corneal opacity and strabismus affect the reflex. "These findings from research with primates are important for recognizing and treating maldevelopments in the visual system of infants and young children at an early stage" explains Distler-Hoffmann.

More information: C. Distler, K.-P. Hoffmann (2011): Visual pathway for the optokinetic reflex in infant macaque monkeys, Journal of Neuroscience, doi: 10.1523/JNEUROSCI.4302-11.2011

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