News about the light-dependent magnetic compass of birds

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Birds have a light-dependent compass in their eyes. This compass gives them information about the direction of the Earth's magnetic field. Prof. Roswitha Wiltschko's research group at Goethe University Frankfurt, together with French colleagues, has elucidated how this compass works at the molecular level.

Birds have two sensory organs for orientation and navigation in the Earth's magnetic field: They use their beak to measure the strength of the magnetic field, while their eyes provide directional information. One type of cone photoreceptors in the birds' eyes is sensitive to UV light and also contains a form of the protein cryptochrome. Previous studies of the Frankfurt researchers suggested that most likely it is this protein that enables birds to detect the magnetic field.

A cyclic reaction involving one light-dependent and one light-independent step takes place in the cryptochrome. Two radical pairs are formed during this cycle, and their unpaired valence electrons react to magnetic fields. The Frankfurt group, working in collaboration with Pierre and Marie Curie University Paris, have now discovered which of these two radical pairs is crucial for navigation in the Earth's magnetic field.

In a behavioural study on robins, the birds were subjected to two experimental conditions: (1) at one-second intervals, the researchers switched off either the light or the Earth's magnetic field while keeping the other stimulus constant; (2) the stimuli alternated in one-second

intervals, such that light and magnetic field were not present at the same time. Even in the latter condition the birds could still orient along the Earth's magnetic field lines. The group concludes that the light-independent radical pair is responsible for detecting the magnetic field lines. Light is only required to keep the cycle going.

"This is the first proof that the radical pair generated in darkness is the crucial one for the magnetic compass", says Prof. Roswitha Wiltschko. Since in other organisms cryptochrome is used exclusively for the perception of light, the study indicates that there has been a special evolutionary adaptation in birds.

More information: Roswitha Wiltschko et al, Light-dependent magnetoreception in birds: the crucial step occurs in the dark, *Journal of The Royal Society Interface* (2016). DOI: 10.1098/rsif.2015.1010

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