Chemical compass model of avian magnetoreception

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Abstract: Approximately 50 species, including birds, mammals, reptiles, amphibians, fish, crustaceans and insects, are known to use the Earth's magnetic field for orientation and navigation. Birds in particular have been intensively studied, but the biophysical mechanisms that underlie the avian magnetic compass are still poorly understood. One proposal, based on magnetically sensitive free radical reactions, is gaining support despite the fact that no chemical reaction in vitro has been shown to respond to magnetic fields as weak as the Earth's (50 μT) or to be sensitive to the direction of such a field. Here we use spectroscopic observation of a carotenoid-porphyrin-fullerene model system to demonstrate that the lifetime of a photochemically formed radical pair is changed by application of ≤50 μT magnetic fields, and to measure the anisotropic chemical response that is essential for its operation as a chemical compass sensor. These experiments establish the feasibility of chemical magnetoreception and give insight into the structural and dynamic design features required for optimal detection of the direction of the Earth's magnetic field. ©2008 Nature Publishing Group.

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