

# Possible Role of Magnetite in Connection to Grid Cells Memory, Linked to Alzheimer's Disease

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## Abstract

Both memory and spatial navigation are affected in early stages of Alzheimer's Disease (AD). It could be a link between the magnetic intermediate formed by the cryptochrome response to light in the retina and the navigation and memory systems in the grid cells in the brain. A disturbance in this system could be involved in the development of Alzheimer's disease.

**Keywords:** Alzheimer; Magnetite; Grid cells; Cryptochrome

## Introduction

To develop diagnostic tests and cure for AD, it is important to understand the underlying mechanisms involved in its formation. It could be a connection between the magnetic intermediate produced in retina when exposed to light, the magnetite in the brain and the grid cells. They are located in the entorhinal area which is involved in the brain's navigational system.

## Magnetite, the Key Compound in Memory Storage

Magnetite, an iron oxide ( $\text{Fe}_3\text{O}_4$ ), is found as nanocrystals in many organisms, including the human brain. Magnetite is the only compound in our body that is ferromagnetic and has electric conductivity. Magnetism allows us to sense Earth's magnetic field [1]. It was discovered in the human brain in 1992 with 5 million single domain crystals per g of most tissues [2]. Magnetite is suggested to be involved in converting electric impulses containing the information from the sense organs into a storable form in the prion protein in the neurons [3].

## The Possible Connection between Grid Cells, Magnetite and Cryptochromes

The special neurons named grid cells in the brain are involved in a GPS-like navigation system [4]. It is an interesting question if the grid cells contain magnetite. This mechanism for storing memory is likely the same as described for neurons, see above. Magnetite could then be involved in the navigation system in the grid cells where they could participate in the formation of the produced maps. Entorhinal area is one of the first to be infected by AD where the grid cells are damaged in the early stage of AD due to the accumulation of neurofibrillary tangles. They are composed of aggregates of the microtubule-associated protein tau which reduces the grid cell ability to fire [5]. Without sufficient signal strength, the neurons will not work properly and they will be disrupted and magnetite will be released. This may partly explain the problems with route learning and way finding in the early stages of Alzheimer's patients [6,7]. Could the grid cells be in the connection with the cryptochrome system in the eye? When cryptochrome in the retina is exposed to blue light, it undergoes series of complicated chemical reactions. One of these intermediates has magnetic properties that could be connected to the magnetite in the brain [8]. It could be a link between the magnetic stage of the cryptochrome in the retina, grid cells and magnetite. A disturbance in this system could be involved in the development of AD.

## Conclusion

The GPS in the grid cells is depending on the light signals and could be connected to the cryptochrome system in the eye where magnetism is involved. One thing is for sure. Magnetite is not in your brain for fun! Probably it is involved in both your memory and navigation systems albeit much is still unknown.

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