Fall 10-16-2012

Impaired spatial learning in otoconia-deficient mice

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Introduction

- Damage to head direction cell-containing brain structures causes deficits in spatial learning and navigation, suggesting the head direction signal is important for spatial performance.[1]
- Otoconia-deficient *tilted* mice have intact brains with degraded head direction cell signals.[2]

Aim

To determine whether the degraded head direction signal of *tilted* mice is associated with spatial deficits.

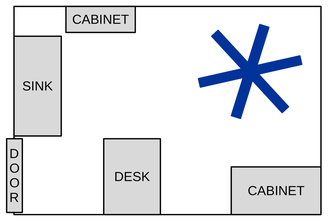
Methods

Subjects

- Male homozygous *tilted* mice and heterozygous littermate controls

Apparatus

- 6-arm Radial Maze in open room



Procedure

1. Pre-exploration:

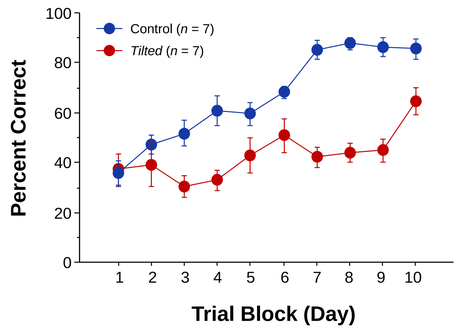
- All arms baited; maze in a different room
- One 10-min trial per day, for two days

2. Training:

- Two arms baited
- Four trials per day, for ten days

Results

Percentage of Correct Arm Choices

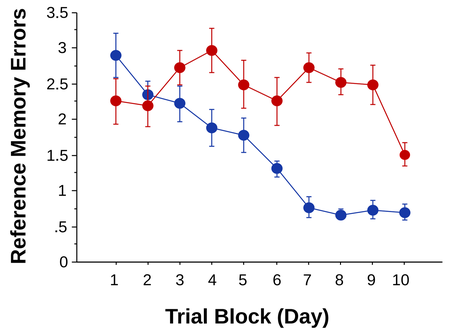


Group:
$F(1,12) = 64.8$, $p < .01$

Trial Block:
$F(9,108) = 14.2$, $p < .01$

Group x Trial Block:
$F(9,108) = 5.06$, $p < .01$

Reference Memory Errors

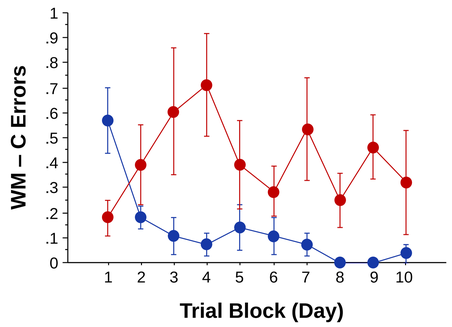


Group:
$F(1,12) = 38.9$, $p < .01$

Trial Block:
$F(9,108) = 8.80$, $p < .01$

Group x Trial Block:
$F(9,108) = 7.02$, $p < .01$

Working Memory - Correct

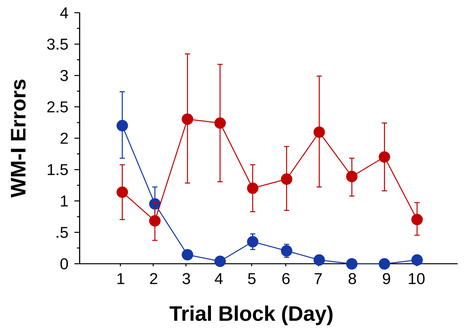


Group:
$F(1,12) = 11.1$, $p < .01$

Trial Block (n.s.):
$F(9,108) = 1.07$, $p = .39$

Group x Trial Block:
$F(9,108) = 2.68$, $p < .01$

Working Memory - Incorrect



Group:
$F(1,12) = 5.73$, $p = .03$

Trial Block:
$F(9,108) = 2.01$, $p = .04$

Group x Trial Block:
$F(9,108) = 4.78$, $p < .01$

Summary

Reference memory, working memory-correct, and working memory-incorrect errors occurred more frequently in *tilted* mice than in control mice.

Conclusion

Head direction signal degradation is associated with spatial deficits.

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2. Yoder RM, Taube JS (2009) Head direction cell activity in mice: Robust directional signal depends on intact otolith organs. *Journal of Neuroscience* 29: 1061-1076.

Funding

- NIDCD R15 DC012630
- IPFW Faculty Summer Grant