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Hippocampal functional adaptation to hypergravity exposure : new insights for cognitive alterations in astronauts

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Introduction

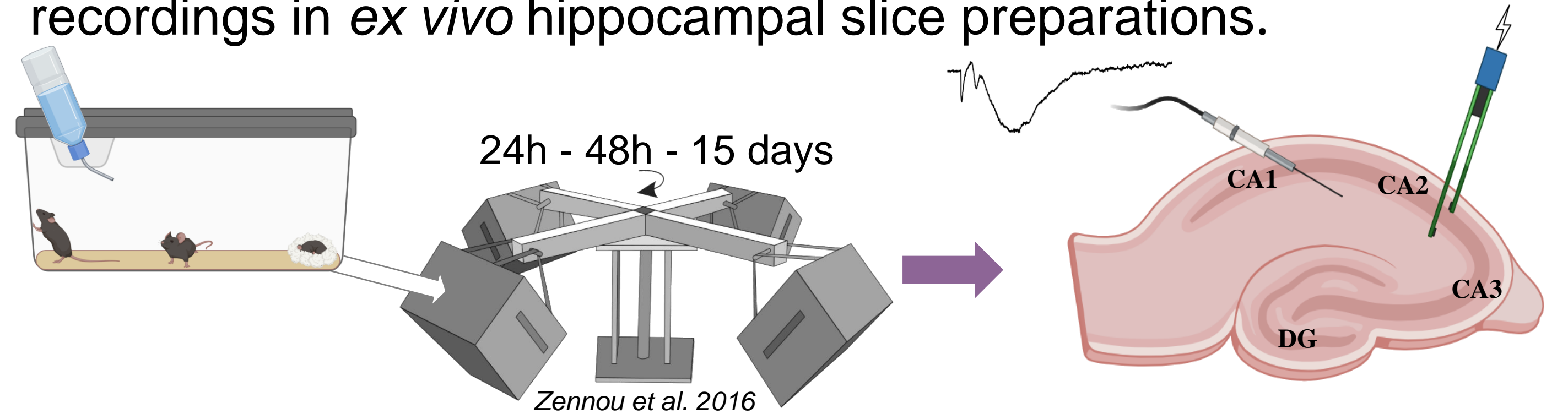
One of the difficulties for manned missions to Mars relies on exposure during flights to repetitive gravitational variations affecting in particular the vestibular system.

Given the vestibulo-hippocampal connections, hippocampal activity would be altered and could affect cognitive performances of the crew.

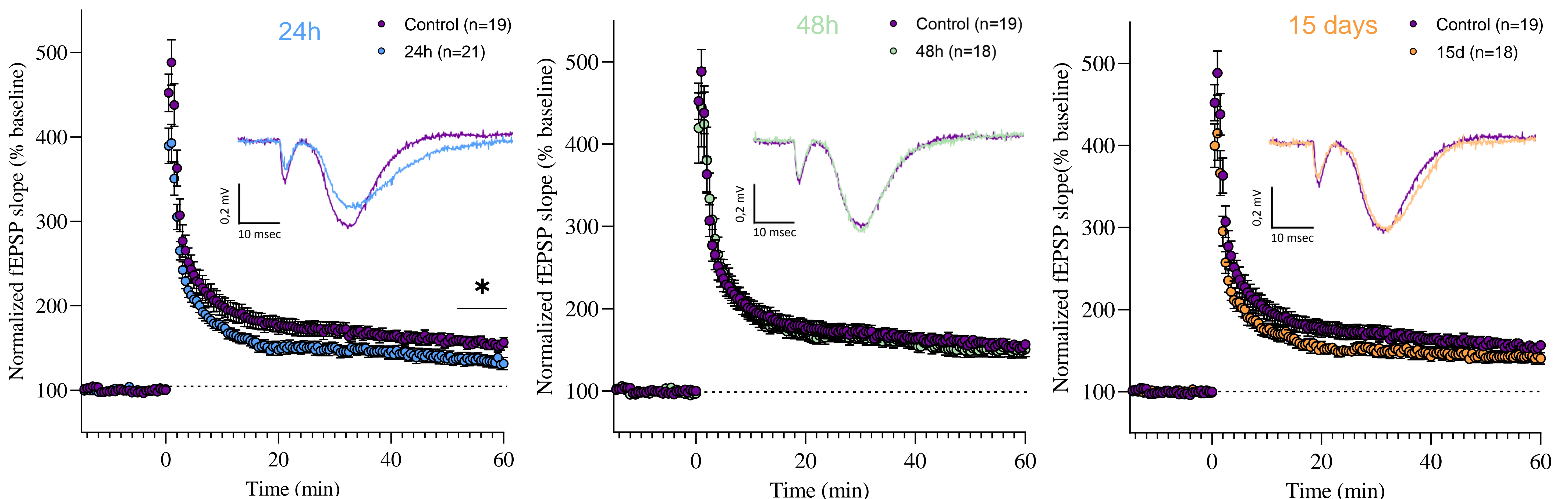
This study aimed to characterize functional alterations of hippocampal neuronal networks that could be induced by short- and long-term hypergravity exposure.

Materials and Methods

We studied the effects of a 24h, 48h or 15-day exposure to 2G hypergravity on 4-month C57BL/6JRj male mice hippocampus. Basal synaptic transmission and functional plasticity induced by conditioning stimulation at CA3/CA1 hippocampal synapses were investigated using electrophysiological extracellular recordings in *ex vivo* hippocampal slice preparations.

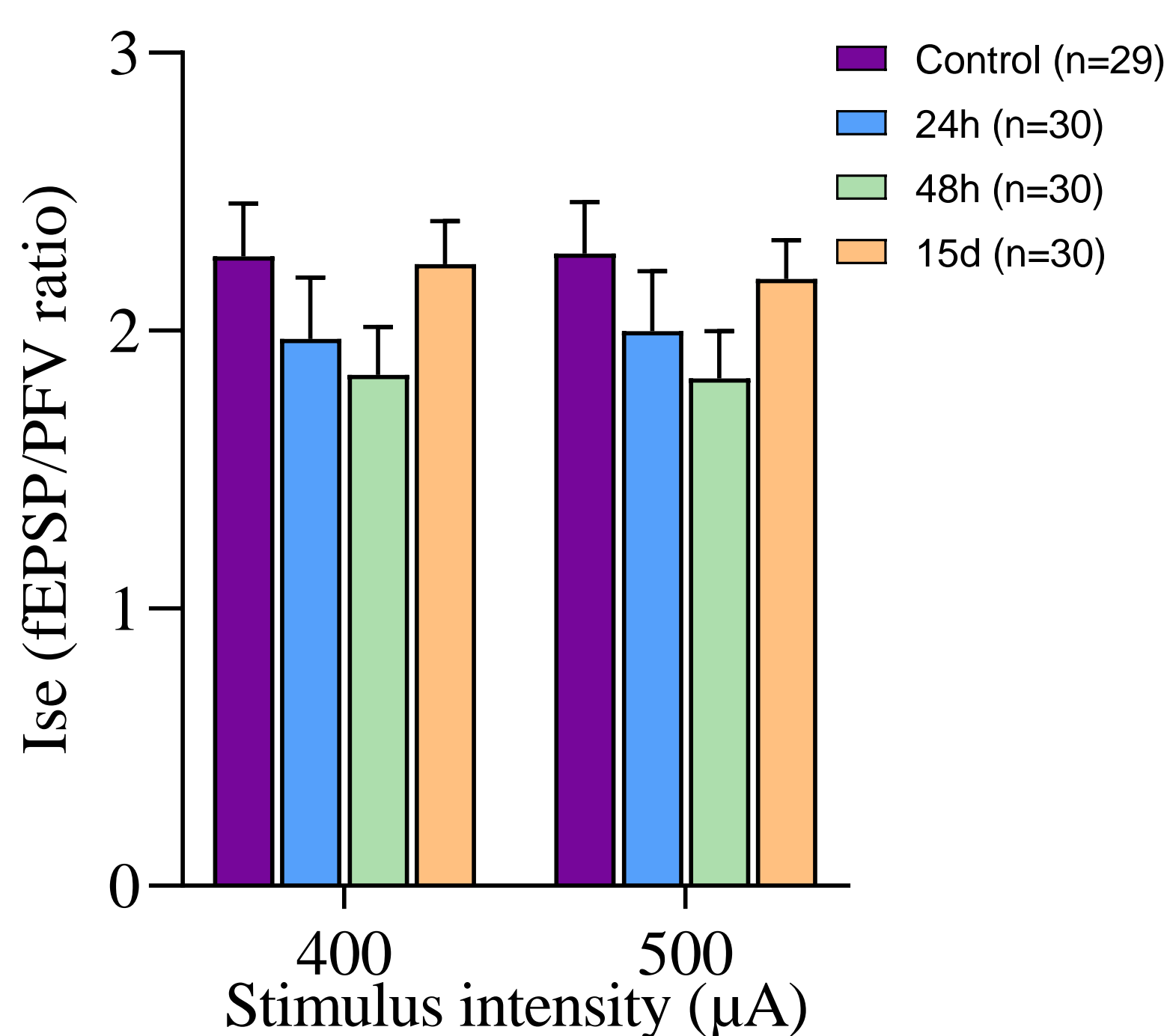


Functional plasticity (High Frequency Stimulation (HFS)-induced long-term potentiation)



Long term potentiation (LTP) induced by HFS was not affected regardless time exposure to hypergravity but the magnitude was depressed in 24h exposed mice (*Unpaired t test*, $*:p<0,05$; *Mean+/-SEM*).

Basal synaptic transmission



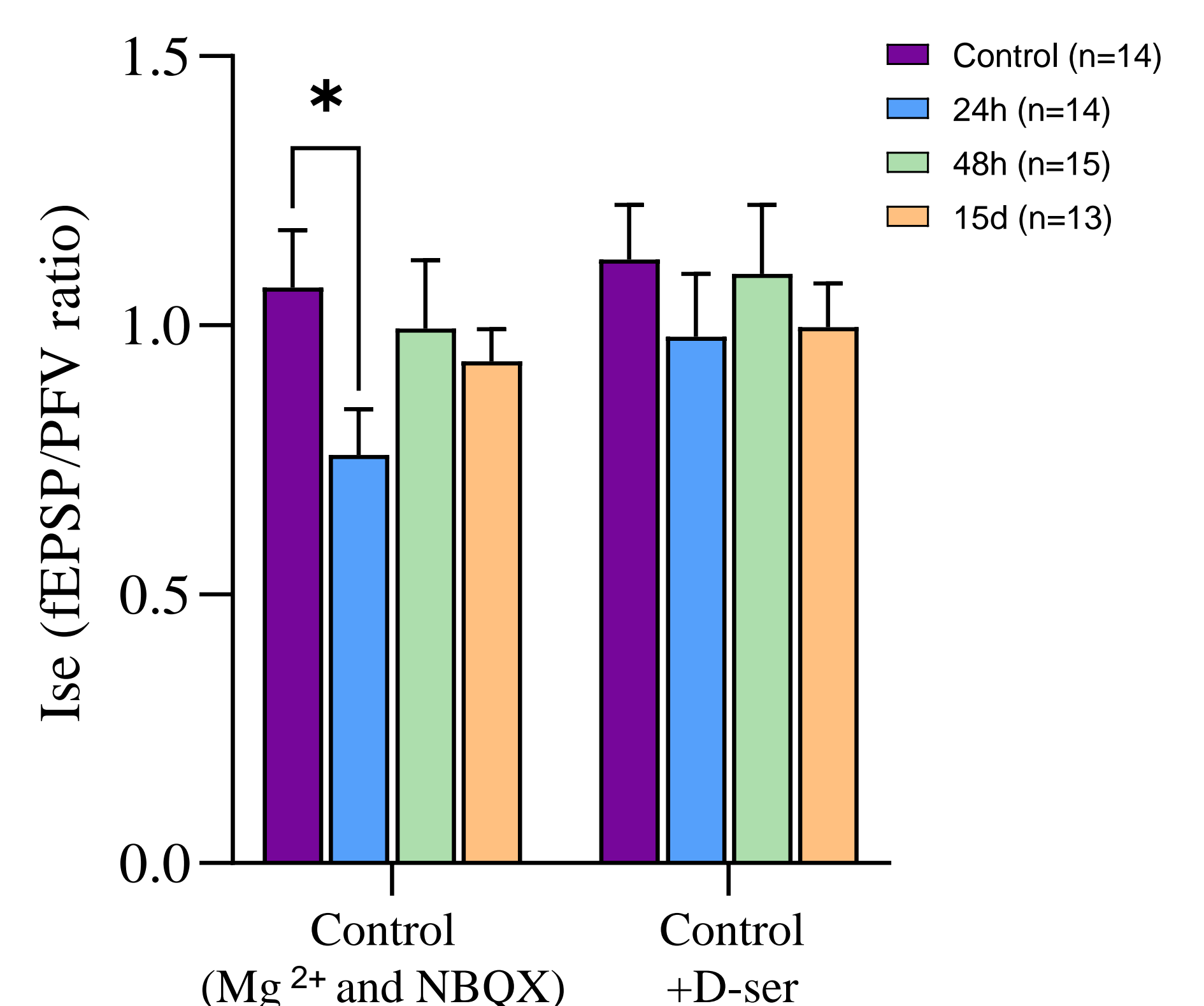
Basal synaptic transmission was unaffected regardless of time exposure to hypergravity.

NMDAr activation (isolated synaptic potentials)

Specific NMDA receptor activation (required for LTP expression) was impaired only after 24 hours of hypergravity. Interestingly, this alteration was compensated by saturating the slices with the NMDA co-agonist D-serine (100μM).

These results suggest that the NMDA-dependent LTP deficit could rely on a weaker synaptic availability of the endogenous co-agonist (D-serine or glycine) rather than changes in receptor density.

One-way ANOVA ; Mean+/-SEM



Transient changes in functional synaptic plasticity in CA1 hippocampal networks occur in mice exposed to hypergravity. Whether these changes could drive cognitive alterations is currently under investigation and will provide information for putative mechanisms leading to cognitive deficits in astronauts, notably after maneuvers with transient changes in gravity (launching and landing).

