Housing conditions affect memory performance and drug efficacy in the rat

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Introduction

Rats are naturally explorative and social-living animals. However, in laboratories rats are usually housed individually with a minimal amount of incentives. It is known that these solitary animals have underdeveloped brains and perform worse on cognitive tasks, compared to rats that are kept under more natural (enriched) conditions.

The Object Recognition Task (ORT) is a one-trial learning task for episodic memory, based on preference towards a novel object and has become a frequently used tool in neurobiological research. Phosphodiesterase type 5 (PDE5) inhibitor vardenafil improves performance of solitary animals in the ORT. In this study we investigated the effects of housing conditions on ORT performance and the efficacy of vardenafil, using Wistar rats.

Objectives

• Investigate whether performance of Wistar rats in the ORT can be improved when animals are housed socially or in an enriched environment.
• Investigate whether housing conditions may influence the efficacy of the PDE5-Inhibitor vardenafil.
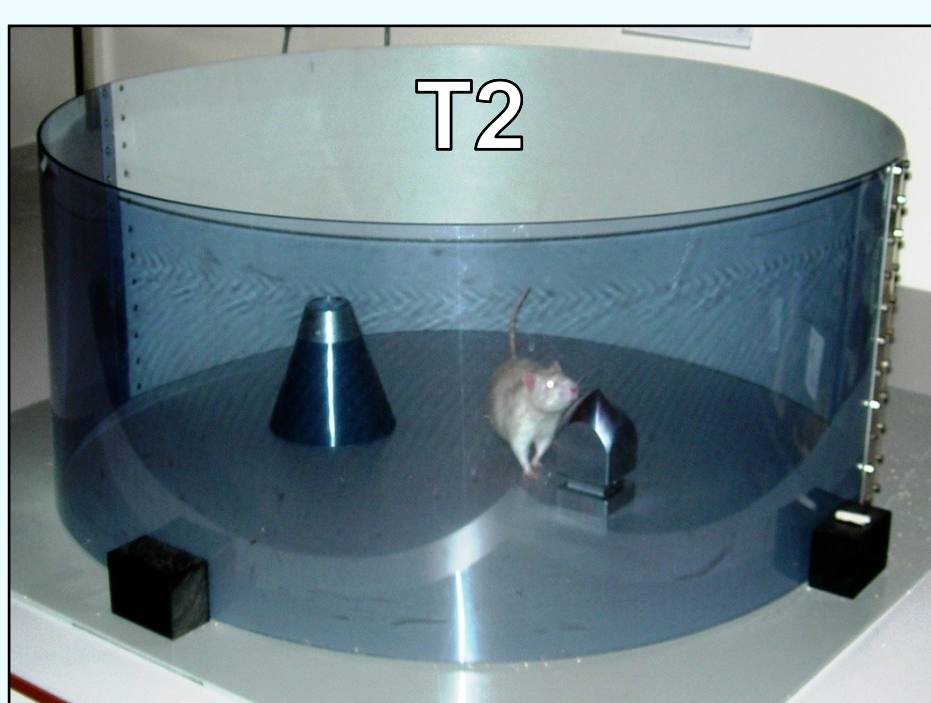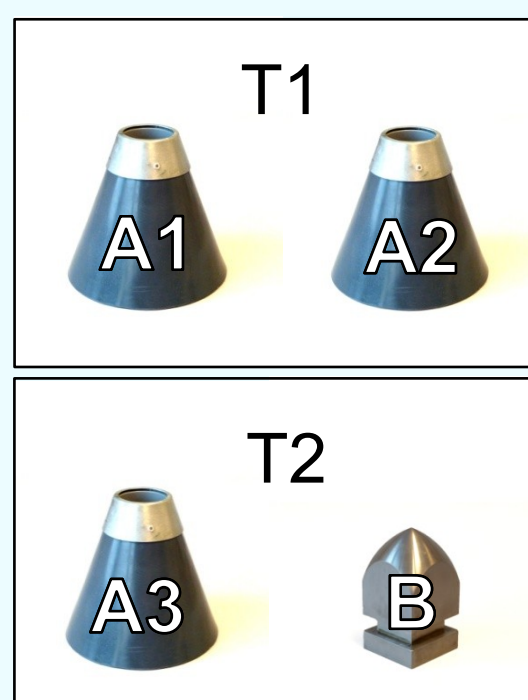
Methods

The Object Recognition Task

T1
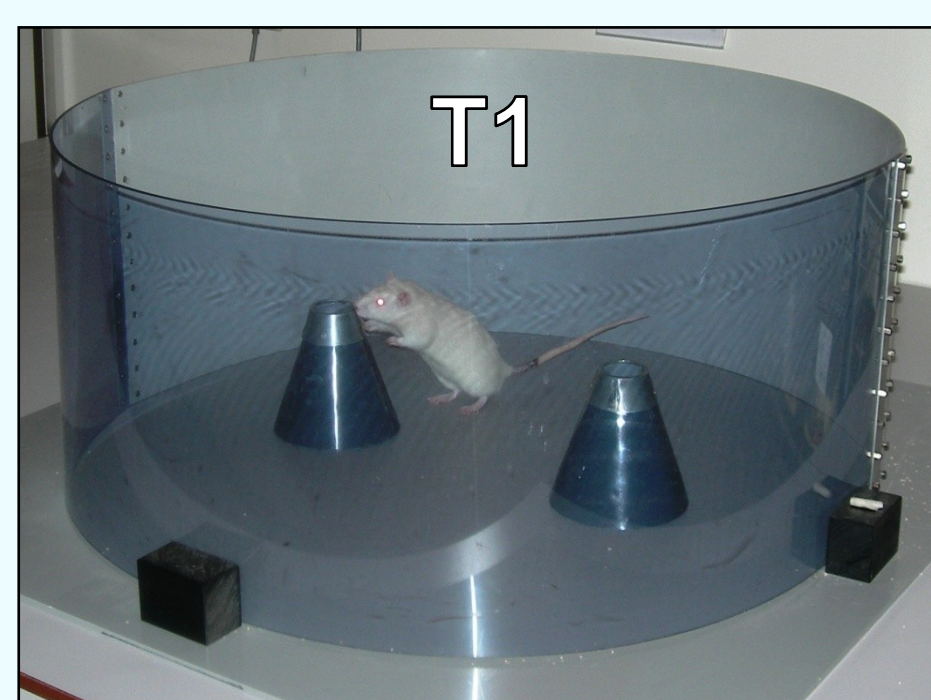
Sample trial

Retention interval (24h / 48h)

T2
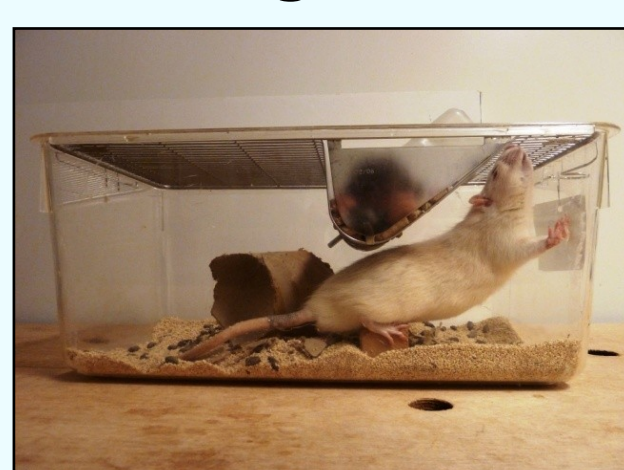
Test trial

Readout Parameters

T1
A1   A2

Exploration measures:
• e1 = A1 + A2
• e2 = A3 + B

T2
A3   B

Discrimination measure:
• d2 = (B - A3)/e2 (Relative measure, 0-1)

Housing conditions

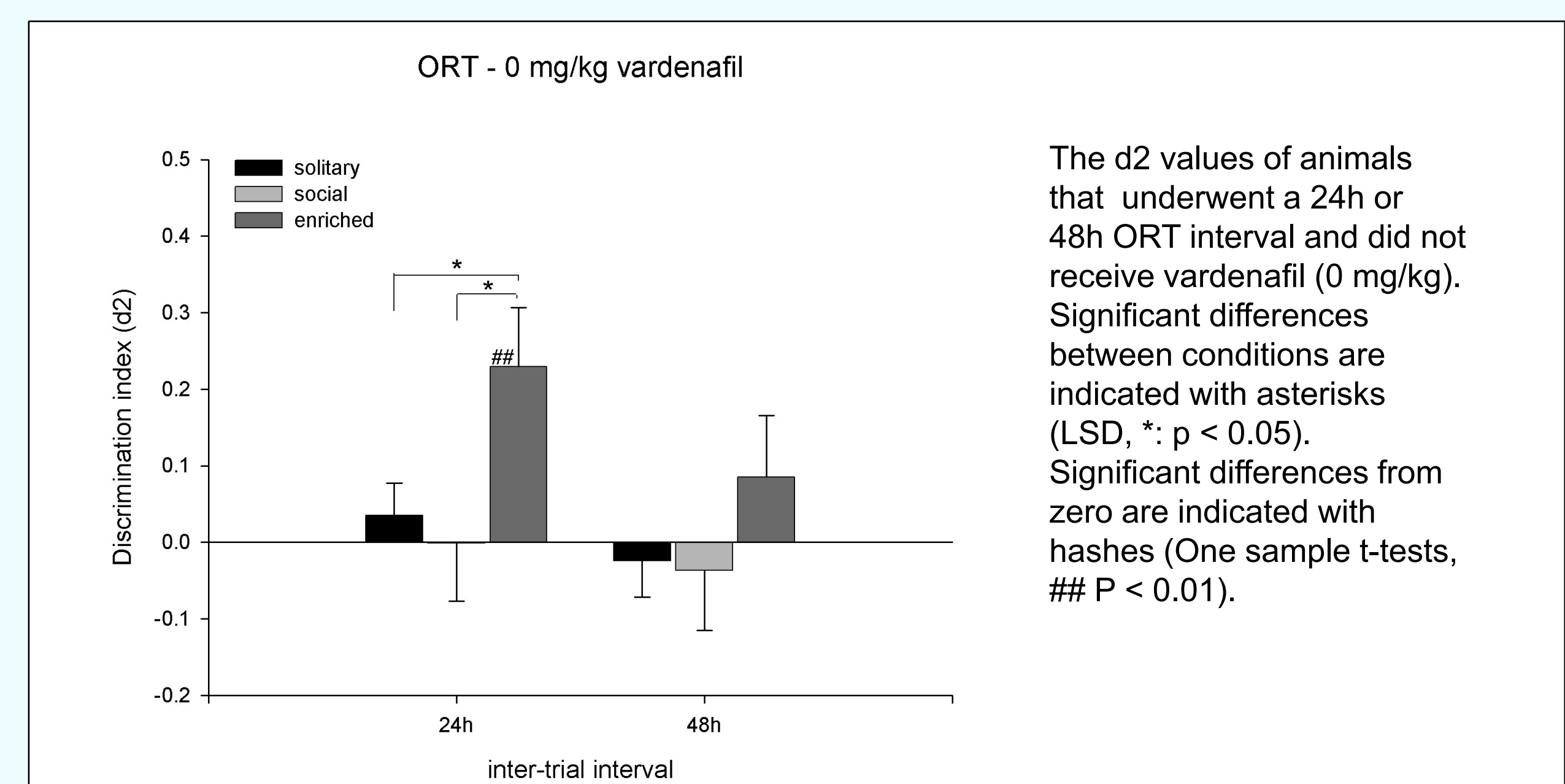Solitary (n= 22)

Social (n=18)
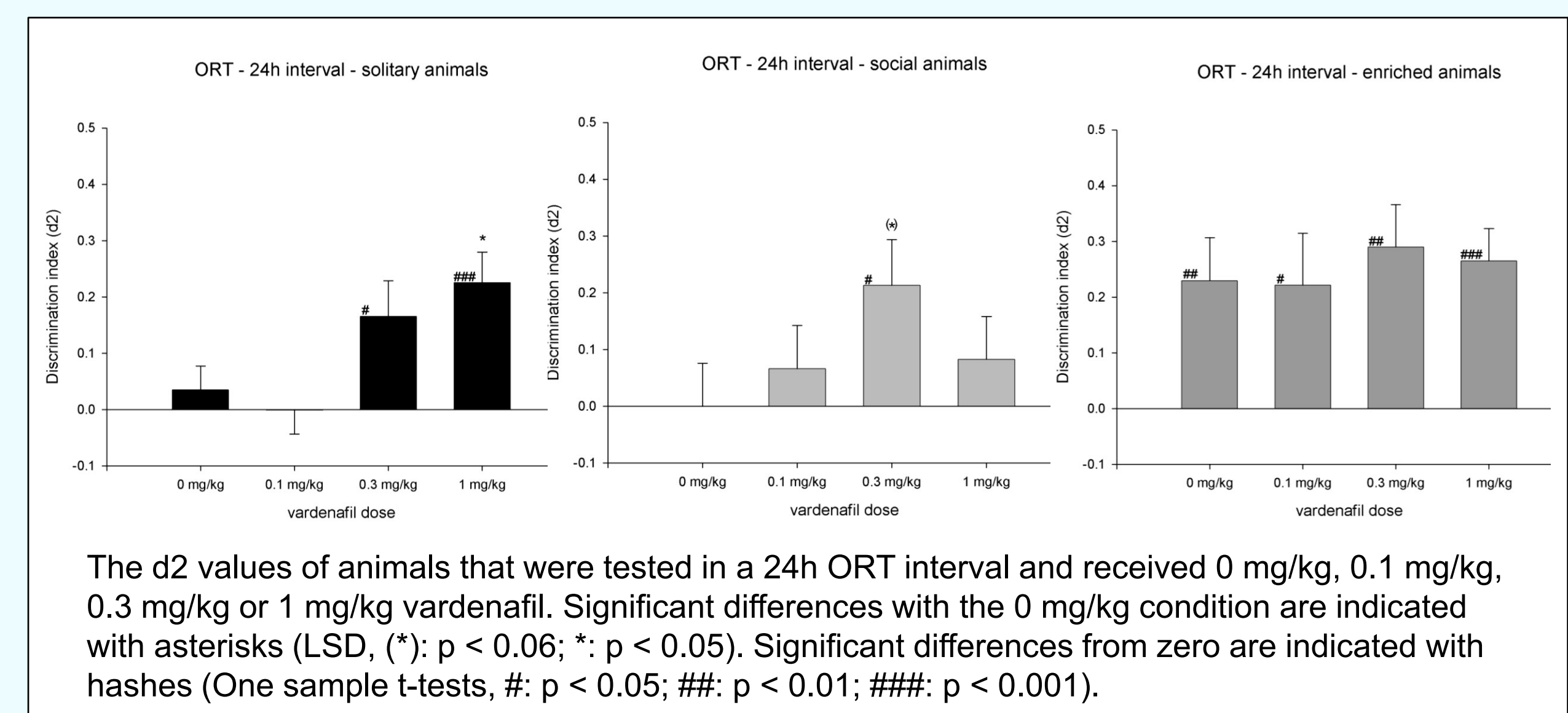
Enriched (n= 18)

Drug administration

Vardenafil was administered orally (1ml/kg), directly after T1. Doses tested were; 0 mg/kg, 0.1 mg/kg, 0.3 mg/kg, and 1 mg/kg.
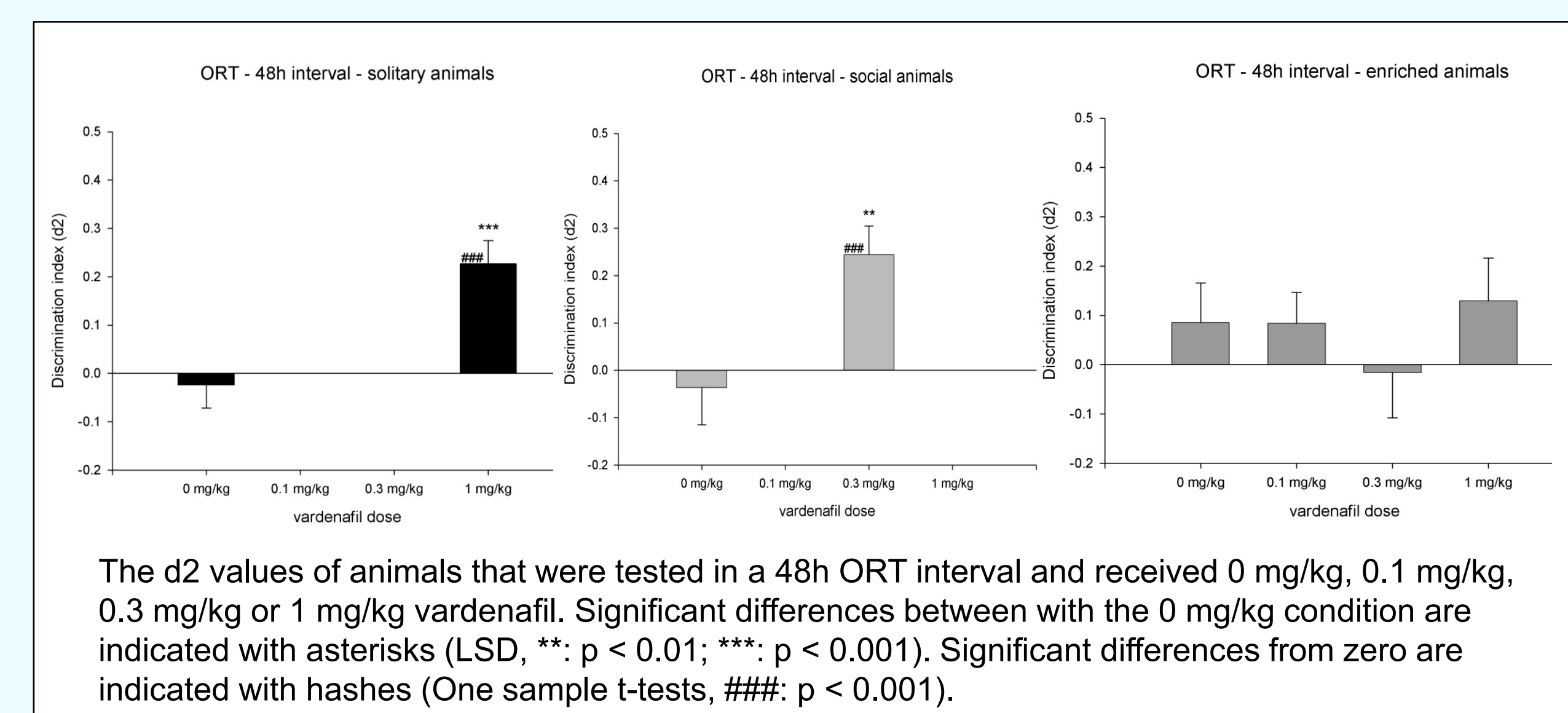
Results

Effects of housing on basal memory performance

ORT - 0 mg/kg vardenafil

The d2 values of animals that underwent a 24h or 48h ORT interval and did not receive vardenafil (0 mg/kg). Significant differences between conditions are indicated with asterisks (LSD, *: p < 0.05). Significant differences from zero are indicated with hashes (One sample t-tests, ## P < 0.01).

Effects of vardenafil in a 24h interval

ORT - 24h interval - solitary animals

ORT - 24h interval - social animals

ORT - 24h interval - enriched animals

The d2 values of animals that were tested in a 24h ORT interval and received 0 mg/kg, 0.1 mg/kg, 0.3 mg/kg or 1 mg/kg vardenafil. Significant differences with the 0 mg/kg condition are indicated with asterisks (LSD, (*): p < 0.06; *: p < 0.05). Significant differences from zero are indicated with hashes (One sample t-tests, #: p < 0.05; ##: p < 0.01; ###: p < 0.001).

Effects of vardenafil in a 48h interval

ORT - 48h interval - solitary animals

ORT - 48h interval - social animals

ORT - 48h interval - enriched animals

The d2 values of animals that were tested in a 48h ORT interval and received 0 mg/kg, 0.1 mg/kg, 0.3 mg/kg or 1 mg/kg vardenafil. Significant differences with the 0 mg/kg condition are indicated with asterisks (LSD, **: p < 0.01; ***: p < 0.001). Significant differences from zero are indicated with hashes (One sample t-tests, ###: p < 0.001).

Conclusions

• Untreated enriched animals discriminated between objects after 24h, whereas solitary and social animals did not. Compared to solitary and social animals.,the untreated enriched animals showed better discrimination.

• After 48h none of the conditions showed discrimination. No differences in performance were found between housing conditions.

• Discrimination performance of solitary animals was restored by vardenafil in a 24h interval (0.3 mg/kg and 1 mg/kg), as well as in a 48h interval (1 mg/kg).

• Discrimination performance of social animals was restored by 0.3 mg/kg vardenafil, in both the 24h and the 48h interval. The dose of 0.3 mg/kg vardenafil was ineffective.

• Enriched animals discriminated between objects in all 24h conditions, there were no differences in memory performance between dosing conditions.

• Enriched animals did not discriminate between objects in any of the 48h conditions, there were no differences in memory performance between dosing conditions.

• Compared to solitary animals, social animals seemed to require less vardenafil for memory improvement. Vardenafil did not affect performance of enriched animals.

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