

Reward-related impulsivity as a possible surrogate marker of motivation in aging Sprague-Dawley rats

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Introduction

Impulsivity is an umbrella term that encompasses many subdomains, most of which rely on the decision-making processes. It is reported that in the process of **healthy aging**, the two dimensions of impulse control, **cognition and motivation, are preserved or even improved**. On the other hand, the **attentive efficiency seems to decrease with age**.

Therefore, we **aimed** to investigate the **effects of healthy aging on impulsivity in rats** and the influence of food deprivation on impulsivity in aged rats as a strategy to enhance motivation. Additionally, we wanted to assess the gene expression for the **alpha5 GABAA receptor subunit** during aging, which plays a role in cognitive processes.

Methodology

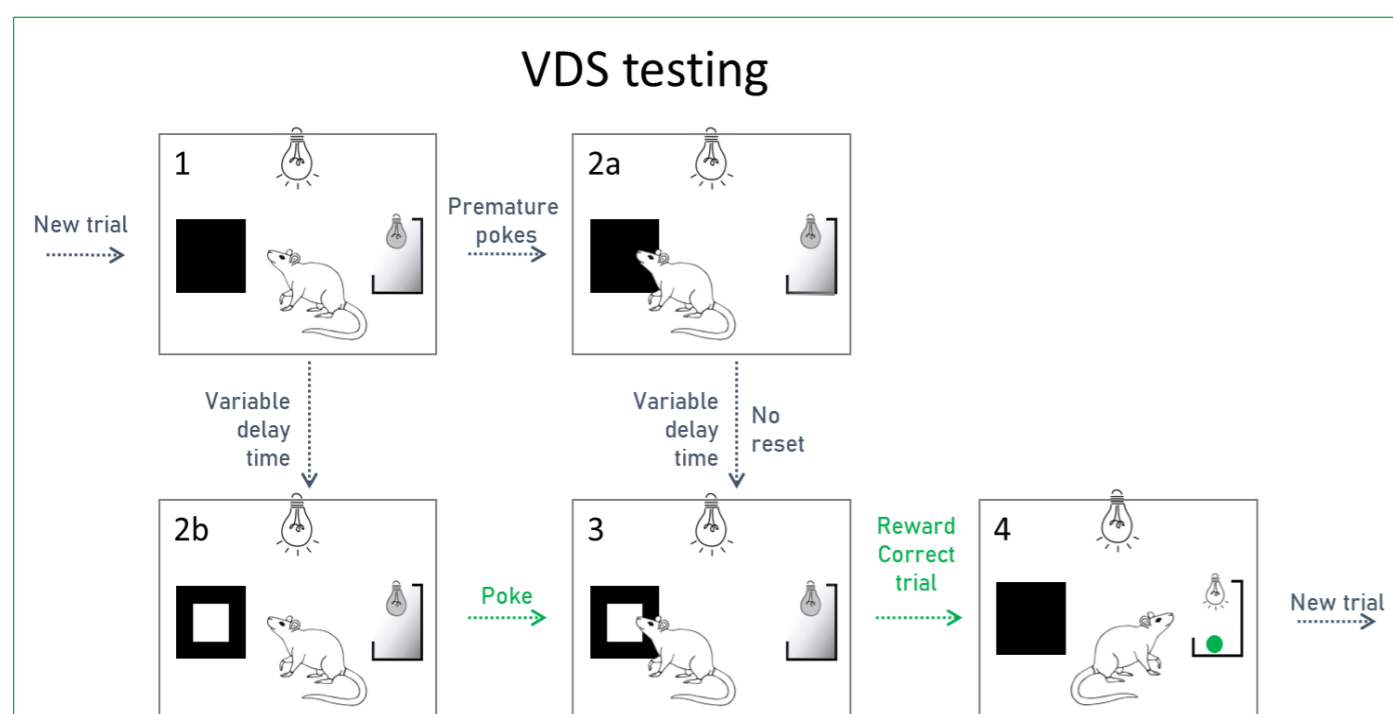


The **variable-delay-to-signal (VDS)** paradigm adapted to a touchscreen environment was used to assess impulsivity and attention in Sprague-Dawley rats at 2, 3, 5, 8, and 14 months of age.

After one week of training, animals were tested at different ages in 3-stage testing protocol. Additionally, prior to testing, animals were fed a restricted diet (16 g/animal). The first stage included 20 trials with inter-trial interval of 6s (ITI6si) that reflected motor impulsivity. The second stage, with 60 randomly distributed trials of ITI9s or 15s, was related to delay intolerance, while the final stage (ITI6sf), similar to the first, was related to reflection impulsivity.

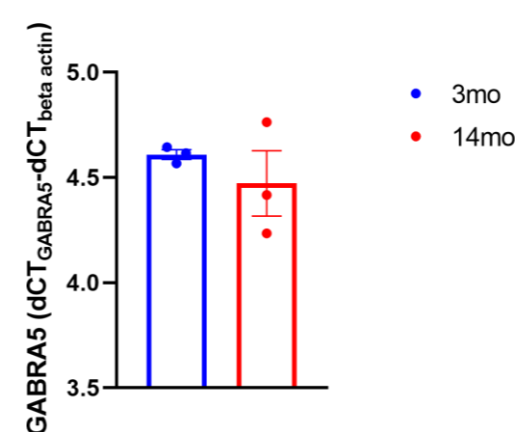
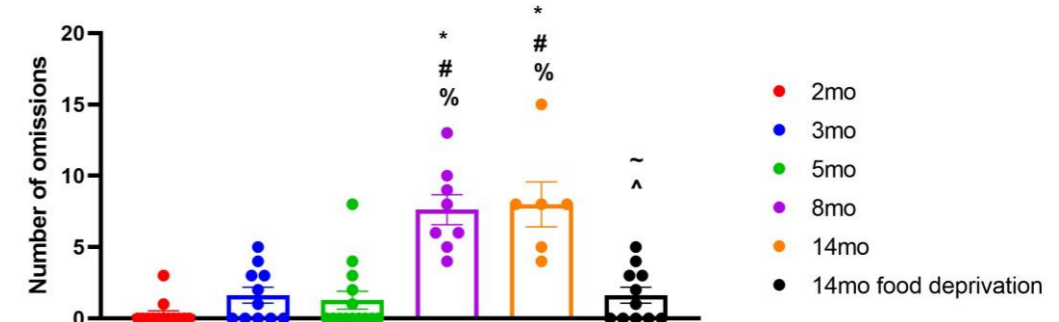
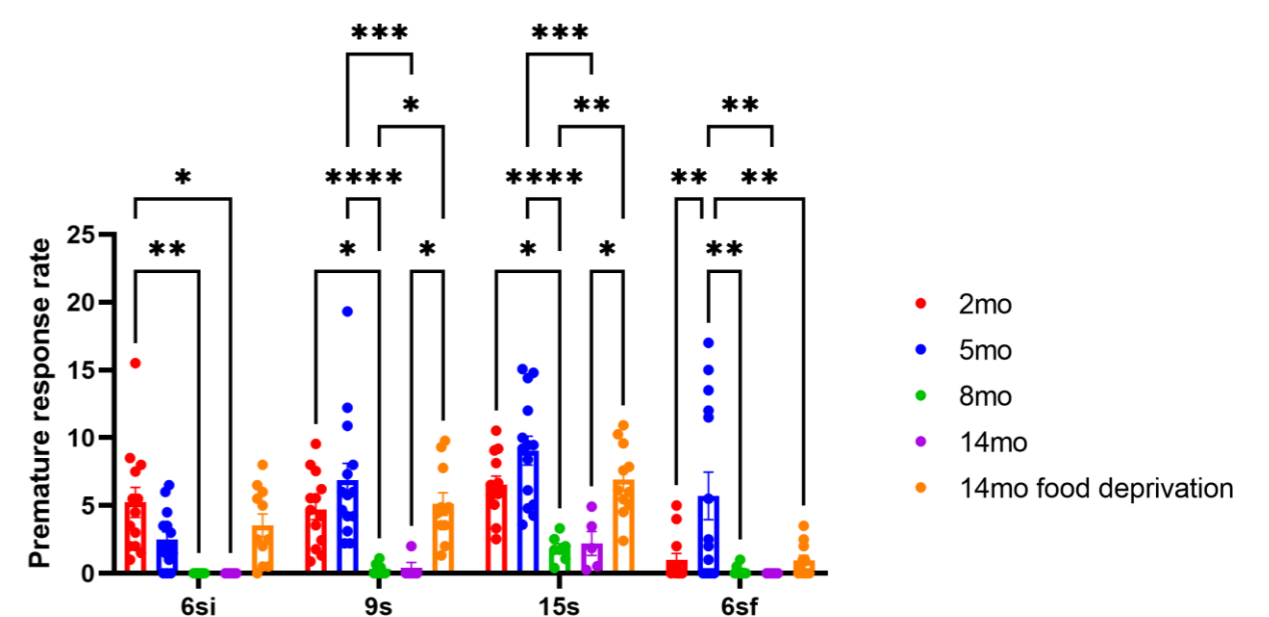
The **strict 3-day restriction diet** (24h food deprivation followed by 10g/day/animal and 8g/day/animal) was applied to 14-month-old animals before testing.

Gabra5 expression in the hippocampus was determined by **qPCR**. Results were analyzed by one-way ANOVA with or without repeated measures, followed by Sidak post-hoc test for impulsivity and attention parameters and by t-test for PCR parameters.



Results

Animals aged 8 and 14 months had reduced motor impulsivity ($p < 0.01$ for both groups) and delay intolerance ($p < 0.05$ for both groups) and higher number of omissions ($p < 0.05$ for both groups) compared to animals aged 2, 3 and 5 months of age. In addition, half of the animals were unable to successfully complete a task after 14 months. After rigorous food restriction in 14-month-old animals, the level of impulsivity (ITI9s and ITI15s) and attention (number of omissions) returned to the control level (2 and 3 months of age) compared to the performance of 14-month-old animals prior to rigorous food restriction ($p < 0.05$). Further, the peak of reflection impulsivity (ITI6sf) was reached at 5 months compared to all other groups ($p < 0.01$).



No changes in Gabra5 expression in hippocampus were detected in 14-month-old compared to 3-month-old animals.

Conclusion

From 8 months of age onwards, rats showed reduced impulsivity in the VDS stages where motor impulsivity and delay intolerance were tested, followed by attention deficits. After strict food restriction in 14-month-old animals, delay intolerance and attention were restored, suggesting the prominent role of motivation in controlling these processes, independently of Gabra5 expression levels in the hippocampus.

Since the VDS paradigm aims to assess reward-related impulsivity based on cognition and motivation, it is suspected that **results related to impaired cognition in older animals in other cognitive tests should be interpreted with caution, and with additional observation of motivation.**



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