

Environmental enrichment for adult rats: Effects on trait and state anxiety

Tiago Costa Goes, Fabrício Dias Antunes, Flavia Teixeira-Silva*

Departamento de Fisiologia, Centro de Ciências Biológicas e da Saúde, Universidade Federal de Sergipe, Cidade Universitária "Prof. José Aloísio de Campos", 49100-000 São Cristóvão, SE, Brazil

HIGHLIGHTS

- The effects on anxiety of late-life environmental enrichment were investigated in adult rats.
- Both trait (free-exploratory paradigm) and state (elevated plus-maze test) anxiety were tested.
- Environmental enrichment decreased trait anxiety of highly anxious rats.
- Environmental enrichment did not affect state anxiety.

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ABSTRACT

Experimental evidence indicates that enriched environment (EE) induces neurobiological and behavioural alterations. EE in early life improves learning and memory and reduces trait and state anxiety. However, the effect of EE established in adulthood has rarely been investigated. Thus, the aim of this study was to evaluate the possibility of modifying the levels of trait and/or state anxiety of adult rats exposed to EE. Seventy adult Wistar male rats were first tested in the free-exploratory paradigm (FEP) and were categorized according to their levels of trait anxiety (high, medium and low). Subsequently, half of the animals from each category returned to their home cages (standard condition; SC) and the other half was transferred to an enriched environment (enriched condition; EC). After three weeks, all animals were again tested in FEP. Seven to 10 days later, fifty of the seventy animals were tested on the elevated plus-maze test (EPM). In FEP, EE reduced locomotor activity in the second exposition independently of the anxiety category and, it decreased the levels of trait anxiety of highly anxious rats. No effect of EE was observed on EPM. In conclusion, EE established in adulthood was able to reduce high trait anxiety, a major risk factor for anxiety disorders.

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1. Introduction

Previous studies have demonstrated the influence of the environment on brain regulation and behaviour [1]. In these studies, the animals have been kept in an enriched environment (EE), i.e., housing condition containing different objects (assorted colourful toys, tunnels, running wheels, nesting material, ladders, etc.) which are frequently changed during the experiment [2,3].

These conditions provide enhanced sensory, cognitive and motor stimulation in comparison to standard housing conditions [2].

It is well documented that EE induces a number of neuroanatomical, neurochemical and behavioural alterations [4,5]. Behaviourally, the EE exerts positive effects on learning and memory [6] and decreases levels of anxiety [7,8]. However, most of the anxiety studies used the elevated plus-maze test. This model confronts the animals with an anxiety provoking situation, modelling the so-called state anxiety, which is the anxiety a subject experiences at a particular moment in time, when facing threat. However, there is another concept, trait anxiety, considered to be an enduring feature of an individual, relatively stable over time [9], and particularly important in anxiety patients, as they tend to present greater anxious trait in comparison to healthy subjects [10].

In 1999, Chapillon et al. [11] assessed the influence of environmental enrichment on trait anxiety levels in mice. In this study,

* Corresponding author at: Departamento de Fisiologia, Centro de Ciências Biológicas e da Saúde, Universidade Federal de Sergipe, Av. Marechal Rondon s/n, Jardim Rosa Elze, São Cristóvão, SE 49100-000, Brazil. Tel.: +55 79 2105 6645; fax: +55 79 2105 6414.

E-mail addresses: tiago@armatus@yahoo.com.br (T.C. Goes), efaucau@hucmail.com (F.D. Antunes), teixeira_silva@terra.com.br (F. Teixeira-Silva).