"Differential metabolic recruitment of cognitive, emotional and modulatory brain regions in infant and adolescent rats undergoing two-way active avoidance training."

Learning is not always reflected by behavioral changes. Infant rats (P17-P21), e.g., are not able to generate two-way active avoidance (TWA) behavior during repeated shuttle-box training covering five subsequent training days with 50 trials every day. In contrast, adolescent (P38-P42) and adult rats (P80-84) learn the TWA task significantly better[1].

Interestingly, the infant rats learn much faster than their naive littermates when re-trained in adulthood. Thus, the infant rats obviously store information about the TWA task during early training, which is not instantaneously observable as a behavioral change, but of potential cognitive benefit for them during later life[2].

Besides behavioral outcome, learning differences are reflected by neuronal changes, which determine the differential functional recruitment of brain regions involved in the generation of behavior. Thus, mapping 2-Fluoro-deoxy-glucose utilization, we compared the metabolic activity in 39 brain regions in infant and adolescent (P38-P42) rats during acquisition and retrieval of a TWA task. Basically, we hypothesized that brain areas related to association, decision and/or emotional processes as well as circuits involved in reward processes and the generation of behavior do not show identical task-provoked increases in infant and adolescent rats. In contrast, primary sensory and motor regions as well as regions primarily involved in encoding and storage of information show identical task-provoked increases both age groups[3]. We compared rats of different ages (infant vs. adolescent), training stages (acquisition vs. retrieval) and the respective control groups (novelty vs. familiarity). Regional metabolic brain activity was analyzed on three different levels. First, simple group comparisons of single regions were performed. Thereupon, inter-regional correlations of metabolic activity were calculated and the resulting patterns were correlated with the behavioral parameters. The data yielded evidence that 1) immaturity of the dopaminergic meso-limbic circuitry could account for the inability of the infant rats to adequately perform the TWA task. 2) Correlated metabolic activity differentially reflects acquisition and retrieval stages of TWA behavior in adolescent rats. 3) In contrast, correlated metabolic activity in the infant rats obviously reflects processing of the foot-shock after five days of TWA training.

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[1] Gruss M, Abraham A, Schable S, Becker S, Braun K. 2010. Cognitive experience during infancy and adolescence facilitates adult associative learning: critical impact of age, stimulus contingency and training intensity. *Neurobiol Learn Mem* **94:** 329-340.

[2] Schäble S, Poeggel G, Braun K, Gruss M. 2007. Long-term consequences of early experience on adult avoidance learning in female rats: role of the dopaminergic system. *Neurobiol Learn Mem* **87:** 109-122.

[3] Riedel A, Gruss M, Bock J, Braun K. 2010. Impaired active avoidance learning in infant rats appears to be related to insufficient metabolic recruitment of the lateral septum. *Neurobiol Learn Mem* **93:** 275-282.

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