DP IB Psychology: HL

Your notes

The Brain & Behaviour – Animals

Contents

Two Key Studies of the Brain & Behaviour: Animals

Your notes

Key Study One: Rosenzweig et al. (1972)

Note: *You learned about* ***neuroplasticity*** *in the SL Biological Approach (see the RNs on this site which cover the topic) using research by Maguire et al. (2000) and Luby et al. (2013) which both investigate neuroplasticity in humans. This key study looks at neuroplasticity in rats' brains so make sure that you DON'T use it when answering a question on neuroplasticity in relation to human behaviour i.e. only use this research for a HL Extension question on Paper 1 Section B.*

Aim: To investigate neuroplasticity in rats' brains when they are exposed to either a **highly enriched environment** or an i**mpoverished environment**.

Procedure: Three male rats were chosen from 3 separate litters. They were then **randomly assigned** to one of three **conditions**. One rat remained in the **laboratory cage** with the rest of the rats; another was assigned to the "enriched" environment cage; and the third was assigned to the "impoverished" cage. There were 12 rats in each of these conditions for each of the 16 **experiments**.

The three different environments were:

1. The standard laboratory cage - several rats in an adequate space with food and water available
2. The impoverished environment - a slightly smaller cage isolated in a separate room in which the rat was placed alone with adequate food and water
3. The enriched environment – six to eight rats in a large cage furnished with a variety of objects with which they could play and exercise on

The rats lived in these different environments for periods of four to 10 weeks. After this phase of the procedure they were **humanely sacrificed** so that **brain autopsies** could be conducted to investigate differences in the brains of the rats across the conditions.

Results:

- The **cerebral cortex** (the part of the brain that responds to experience and is responsible for **movement, memory, learning,** and all **sensory input**) of the rats who had lived in the enriched environment were significantly heavier and thicker than the rats who had lived in the impoverished environment
- There were no significant differences between the rats in terms of the number of **neurons** per brain but the enriched environment rats had larger neurons than the impoverished environment rats
- An **electron microscope** showed that the **synapses** of the enriched rats' brains were 50% larger than those of the impoverished rats

Conclusion: Living in an enriched environment may significantly increase the cerebral cortex of rats' brains compared to rats who live in an impoverished environment.

Evaluation of Rosenzweig et al. (1972)

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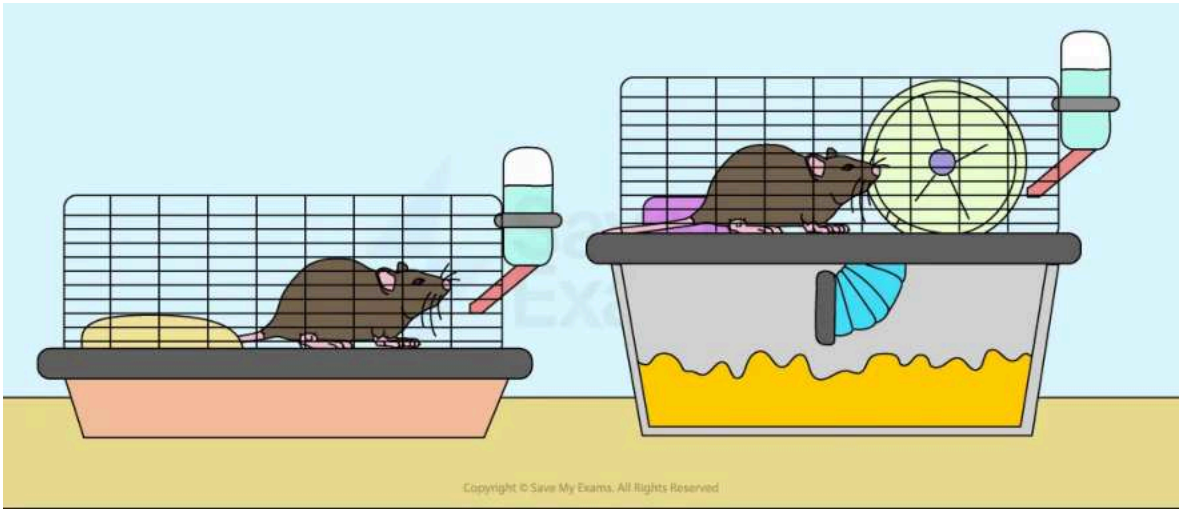
Strengths

- The use of a **standardised procedure** and **clinical methodology** to study the rats' brains means that this study has good **reliability**
- The findings of this study have some **application** to **therapeutic settings** e.g. with dementia patients (providing stimulation may help to offset or prevent further loss of brain function)

Limitations

- It is difficult to **generalis**e the findings as rats' brains are **simplistic** compared to human brains, so some caution is necessary when considering the results
- There are **ethical concerns** not only due to the fact that the animals were destroyed after the procedure, but the use of the impoverished environment may have caused some deterioration in the rats who were exposed to such a negative environment

Key terms: Cerebral cortex Enriched environment Impoverished environment



An enriched environment compared to an impoverished environment

Key Study Two: Fadda et al. (1996)

Note: *You learned about* ***neurotransmitters*** *in the SL Biological Approach (see the RNs on this site which cover the topic) using research by Fisher et al. (2005) and Brunner et al. (1993) which both investigate neurotransmitters in humans. This key study looks at neurotransmitters in rats' brains so make sure that you*

DON'T use it when answering a question on neuroplasticity i.e. only use this research for a HL Extension question on Paper 1 Section B.

Your notes

Aim: To examine whether rats' performance in a T-maze was associated with increased **acetylcholine** (**ACh**, a neurotransmitter associated with **memory** and **learning**) in the **hippocampus**.

Procedure:

- A group of rats selected to be in the **experimental condition** were deprived of food for 23 hours to make them hungry and at 80% of their body weight
- The rats were then trained using a **T-maze** (a maze in the shape of a 'T') on 12 consecutive **trials** (one trial = one session) in which they had to alternate between the right and left arms of the maze to find a sunflower seed
- On the first trial of each session, access to one of the arms was blocked, forcing the rat to enter only the opposite arm
- On each of the next 11 trials the food was placed in the arm opposite to that in the previous trial and both arms were unblocked (**free-choice** trials)
- A correct trial ended with the rat eating the food; an incorrect trial ended with the rat reaching the empty food cup
- Rats in the **control group** were introduced into the T-maze only on the day of the experiment but were handled in the same way and for the same length of time as the trained rats were
- Acetylcholine in the rats' brains was measured by use of a **specially implanted probe**.

Results:

- There was an increase in ACh in the hippocampi of the **trained rats** before the task, but not in the control rats
- This finding shows that ACh increases with **anticipation** of a **learning task**
- There was an increase in ACh in the hippocampi of the control group rats during the first ten minutes of the task, after which the ACh decreased back to the **basal level** and stayed there
- The ACh stayed high throughout the task for the trained rats and decreased slowly after the task

Conclusion: ACh may play a key role in rats' learning and memory.

Evaluation of Fadda et al. (1996)

Strengths:

- The control group rats were handled in the same way and for the same time as the trained rats prior to the experiment which should eliminate any bias in the treatment of the rats which increases the **internal validity** of the study

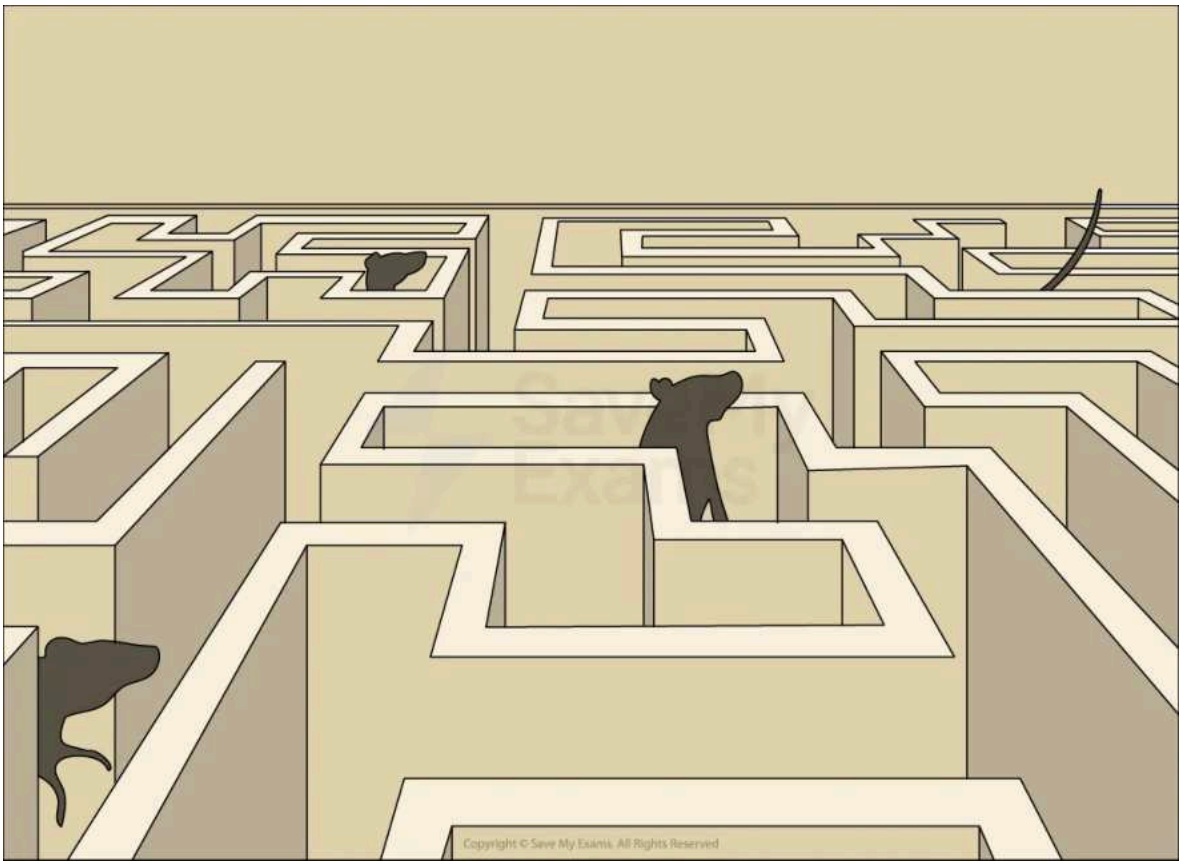
- Rats are highly sensitive, intelligent creatures which means that they are good subjects to use in research on learning such as this one

Limitations

- Using lab rats who live in captivity lacks **ecological validity** as this is not how rats use memory or learning in the real world
- The study does not mention if the control group rats similarly had their food intake reduced for the period before the test

Your notes

Key terms: Acetylcholine T-maze Hippocampus



ACh appeared to have a positive effect on rats' brains

Examiner Tips and Tricks

Remember that you won't be asked any HL Extension questions on Paper 1 Section A of the exam so make sure that you don't use any animal studies in your answer to any Biological Approach questions on this part of the exam.

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Worked Example

EXTENDED RESPONSE QUESTION (ERQ)

22 MARKS

The question is, '*Discuss the value of animal models to provide insight into the brain and behaviour*' *[22]*

Here is part of a worked response to the above question – note that the response is fully focused on the use of animal models and animal research:

There are several advantages to using animal models in research. Rats, for example, are bred specifically for lab research and are in easy supply which means that large numbers of them can be used to increase sample size and thus, reliability. Because animals live for a shorter period than humans (e.g. mice live for around two or three years), they allow longitudinal study across a whole lifespan. It is easier to control variables with animal subjects which in turn means that cause and effect are easier to demonstrate. Additionally, there are some shared brain functions and genetics between humans and many animals (69% shared genetic material between humans and rats; 98.8% between humans and chimps).

Fadda et al. (1996) used rats to investigate how acetylcholine (ACh) was related to anticipation of learning and memory of T-maze routes to demonstrate the effect of ACh. The results showed a positive correlation between anticipation of the task, performance of the task, and memory of the task, with the ACh rats out-performing the control group. The study may have relevance to human learning; the importance of practice in order to memorise a task e.g. to enhance exam performance it is necessary to practise likely questions (i.e. anticipation of possible questions) which may come up in the exam.