NEVR8014 INDIVIDUAL TASK (MODULE 6) 2018

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Topic : Translation of Spatial Navigation Memory in Different Dimensional Space

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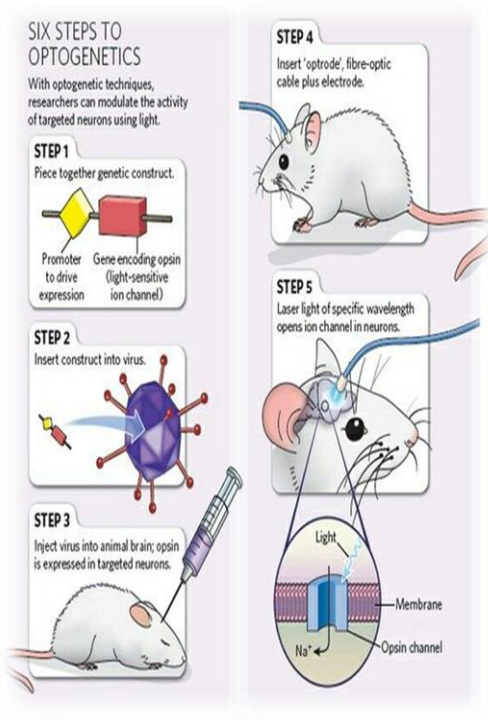
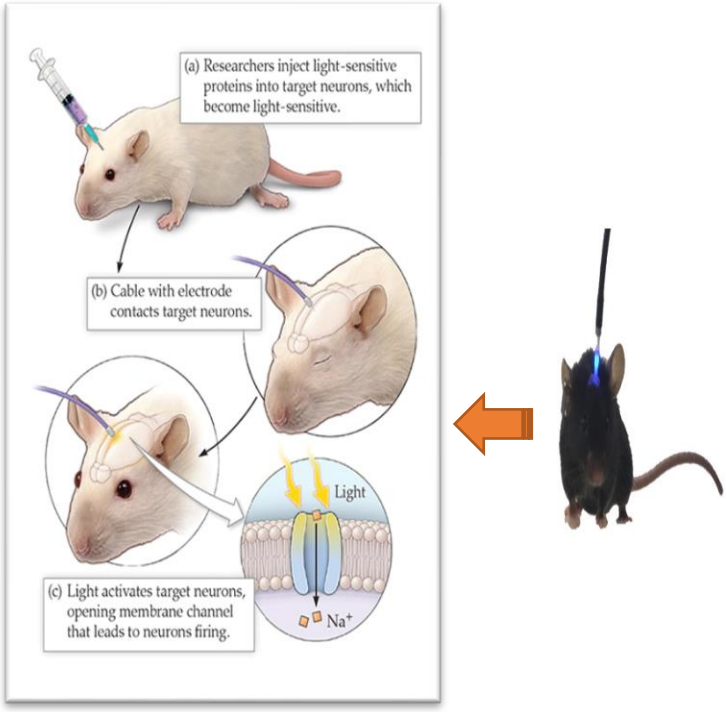
Date : 22-Nov-2018





Questions to Proposal Provided:

In the previous page you were presented with the EU commission's learning outcomes for this module.

Reflect on how these learning aims apply for the experiments that you are currently planning.

Task:

Based on what you have learned so far in this course, write a short public summary where you explain

1. The purpose of your study
2. Harm of the animals and potential severity classification
3. How you will apply the 3Rs (replacement, reduction and refinement)
4. How to design your experiment to get the maximum information out of as few animals as possible

Estimated length: 300 - 500 words

*** Answers to these questions are in next page.**

Pre-annotation: This study written is a real personal concept to my master thesis's ideas, which would be a subject to amend (largely?) because I will mainly be doing the computational part only.

Brief Introduction

The study works to evaluate how a mixed environment can help one in learning new skills resembling to a real-life experience and to apply the recognition ability into a physical environment. A mixed reality environment is a reality-assembled environment which designed using both the augmented reality and virtual reality technology to make the graphical environment look similar to the physical environment. As a baseline goal, the study is designed to investigate if mice still manage to perceive rewards similarly when they encounter transfer of visual dimension such as to apply the spatial memory in physical environment based on the directions they learnt in digital environment and vice versa. To make sure that the mice are learning the direction based on spatial navigation and not based on sense of smell, the mice underwent pre-experiment procedure to get their olfactory deprived.

A mixed environment maze space that resembles to the one we built physically is created. Real food are placed as actual rewards and the mice are to be placed in a big container box with flat surface and quite environment (to eliminate the learning of environment based on echoes) while wearing the special goggle prepared for their digital space navigation in the mixed environment. The mice will not be treated with any external stimulation every time they chosen the correct direction that will lead them to their rewards. However, a mild electroshock will be implemented when they go to the wrong direction or if they stay still for more than 10 seconds in a fixed position before they reach the target rewards. The learning process will be repeated for 3 times. Then, these cells that form the memory will be labelled with channelrhodopsin.

On the next day, the mice will be categorized into 2 groups before they are being placed onto the physical maze space. A group of them will get photo-stimulated via optogenetics technique to determine if the stimulation can actually quicken their reactions and to get the task done more accurately in timely manner. The other group will be placed to explore the maze space themselves to determine if they actually able to retrieve the memory out of the retention based on what they learnt on the previous day. Thereafter, the groups will encounter a switch to determine the rate of speed in performing the same task: the post-photo-stimulation mice are not getting photo-stimulation while the other group get photo-stimulation in the repeated task.

Right after, a deep learning model will be built based on the generated results in order to predict the outcomes in future experiments that designed to test on the effect of digital learning in animals and humans while judging if a stimulation probe may make the learning more effective. The model is predicted to be capable in transforming into a tool that potentially evaluate any new type of technology that evolved from this form of digital learning. However, an application of big data will make the model more precise, hence, if a digital learning has been proven to be rewarding to acquisition in the preliminary study, the study can then be extended into testing with human subjects non-invasively using both the invented technology as well as stimulant technique such as Neuroband, transcranial magnetic stimulation (TMS) or anodal transcranial direct current stimulation (tDCS).

The purpose of your study

To evaluate how a mixed environment can help one in learning new skills resembling to a real-life experience and to apply the recognition ability into a physical environment both with and without stimulation probes.

Harm of the animals and potential severity classification

Mild electrical shock is considered mild in severity as it is a non-invasive/noxious stimuli that caused only mild pain/distress/discomfort while implantation of biomedical device is considered as moderate severity. However, as the mice olfactory are getting mutilated which will cause them with persistent impairment, the overall severity classification of this study is considered as severe.

How you will apply the 3Rs (replacement, reduction and refinement)

- Replacement: As this study is designed to test on the spatial navigation learning, a petri-dish or robo-replacement alternative is not possible. Future replacement study can however be conducted non-invasively in human volunteers if the animals used in preliminary study showed no side effects such as nausea from the digital learning environment.
- Reduction: Similarly, as the animals shall only be used in preliminary studies to judge the potential advantages and side effects from digital learning, the number used in the experiment can be reduced to as little as 10 or less, because we will still need to conduct the extended study on human subjects since the technology created is meant to be mainly used by the humans at the first place.
- Refinement: Anaesthesia and analgesia will be applied for the device implantation and olfactory deprivation procedures. To reduce discomfort into adapting a handicapped condition, the mice will get the olfactory deprived early in their neonatal days. The welfare of the mice such as housing, food, water and social environment will also be taken into proper weightage of planning. The mice health conditions such as body scores and stress levels will also be monitored on timely manner. And it is very important to make sure that they are not suffering from any post-surgery infection. Professionals of the specialized area will be allocated to in-charge on the mice operations and daily welfare respectively. Advisory staffs will also be involved to evaluate the study planning strictly. All procedures will be applied with the responsible authority such as FDA and tight protocols set will be followed closely.

How to design your experiment to get the maximum information out of as few animals as possible

Optogenetics are used to assist and quicken the learning process while deep learning prediction model is to be built for future judgement and evaluation, without the need of utilizing more animals into supporting the proposal. Once the results are satisfied, we can move on to test out the learning models in humans non-invasively instead of extending the study on more animals.