



**CALIFORNIA STATE SCIENCE FAIR  
2017 PROJECT SUMMARY**

<b>Name(s)</b> Afelix Le	<b>Project Number</b> <b>S1310</b>
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**Project Title**  
**Environmental Enrichment Can Have a Positive or Negative Effect on Long Term Memory**

**Abstract**

**Objectives/Goals**  
The objective of this study is to examine if Environmental Enrichment (EE) encourages learning in FMR1-KO mice, a model for human autism. Another objective is to see if the memory consolidation process of WT mice, mice without defects, can be disrupted via EE.

**Methods/Materials**  
Approximately 30-40 mice total, home cages, Enriched Environment containment, 30x30 white chambers, small clear glass funnels, Ethovision NX, NOT Program. FMR1-KOs and WTs were placed in EE and were then trained and tested in the Object Location Memory (OLM) task. WT mice were put in OLM training, EE, then testing to determine memory disruption and consolidation. Measurements were recorded in how long mice interacted with displaced and stationary glass funnels during OLM in seconds. Both measurements were inputted into the discrimination index formula ( $100 * (\text{displaced time} - \text{stationary time}) / (\text{total exploration time})$ ) to determine learning scores.

**Results**  
Several mice were trained and tested in the OLM task, with EE placed at different times. FMR1-KO mice put in EE prior were able to perform the OLM task. WT mice weren't able to learn the task if exposed to EE (1, 6 hours) post-training, but could learn if exposed 24 hours post-training.

**Conclusions/Discussion**  
FMR1-KO mice exposed to EE learn effectively as WT mice. It emphasizes that environments can impact learning capabilities. Further studies could include researching the effects of EE on dendritic spine morphology of Fragile X mice. We would predict that EE fixed the dendritic protrusion malformation in KO mice, encouraging cognition. It is also concluded that mice need more uninterrupted time for memory consolidation.  
Applying EE to autistic subjects could serve as treatment. Applying EE to subjects with no mental deficits may enhance their learning ability and act as prevention towards mental disorders such as Alzheimer's disease. Students can gauge how much time is needed after studying for consolidation.

**Summary Statement**  
I showed that Environmental Enrichment can increase cognition, but can also be a part of memory disruption dependent on when mice are placed in EE.

**Help Received**  
Lab Technician Aliza Le in the Department of Anatomy & Neurobiology in UC Irvine assisted in handling the mice subjects. I also received advice and discussed results with Dr. Christine Gall from the same institution.