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USING A SUSTAINED ATTENTION TASK TO MEASURE VIGILANCE IN RATS

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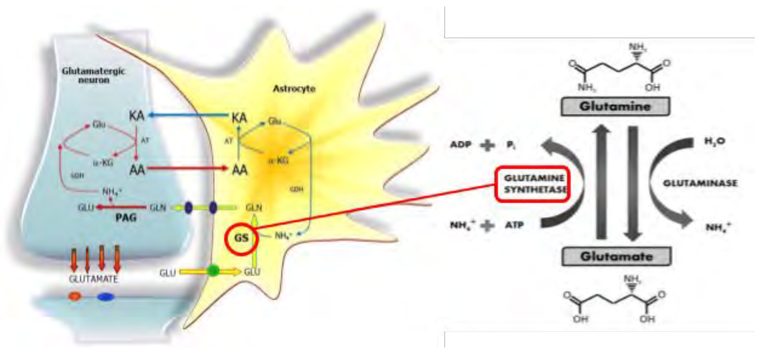
INTRODUCTION

Astrocytes have an important role in cognition as they possess the unique ability to recycle glutamate from synapses. Dysfunctional astrocytes often contribute to neurodegenerative disorders and changes in glutamate recycling have been implicated, but the impact of changes in glutamate recycling on cognition remains unclear. This study focuses on sustained attention, or vigilance, and how recycling of glutamate shifts with this behavior. We characterized the rat's performance based on accuracy and reaction times and assessed whether these behaviors correlated with glutamine synthetase activity. We hypothesize that having faster reaction times and a higher percentage in correct answers indicates better sustained attention and will correlate with higher glutamine synthetase levels. Additionally, we hypothesize that there is an effect of time with attention decreasing as the task progresses.



METHODOLOGY

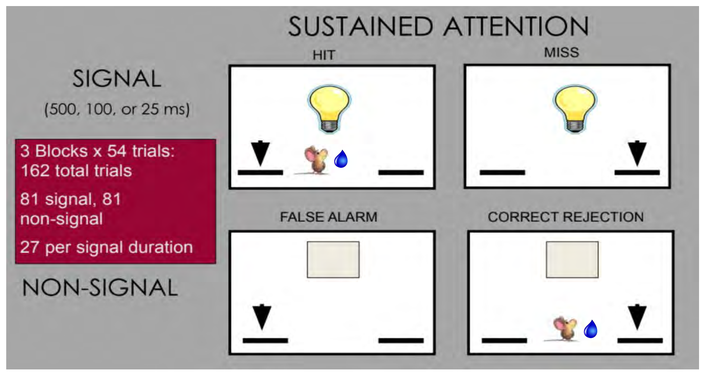
SUBJECTS:

Male and female Long-Evans Rats (bred onsite at Vassar College, NY, pair-housed, males n=20, females n=23) were used in this study. Animals were weighed twice a day when water restricted to ensure healthy weights. Animals were kept on a 12 hour light/dark cycle, lights on at 7 am.

SUSTAINED ATTENTION TASK:

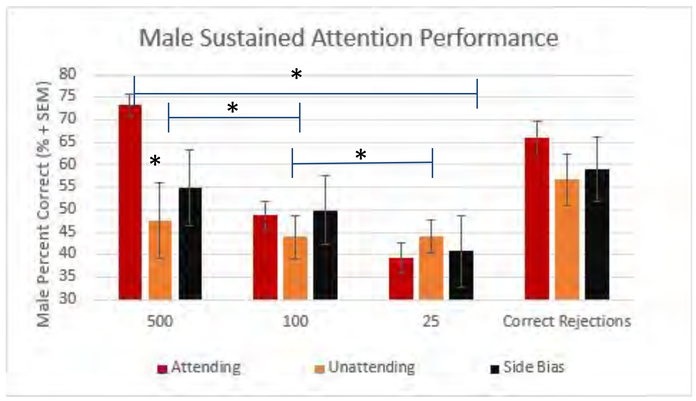
Subjects were trained on the sustained attention task, and then separated into an attending, unattending, and side bias groups based on their performance:

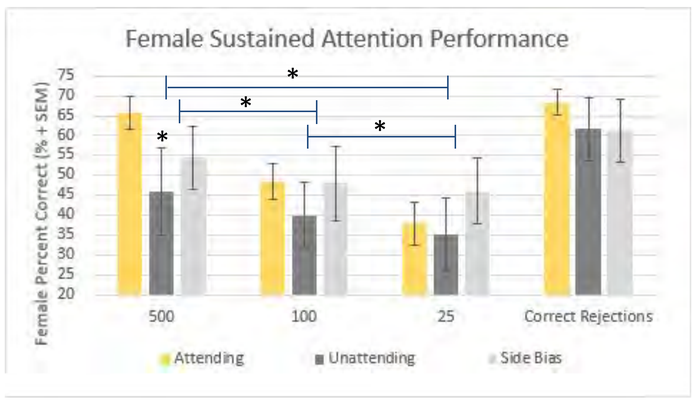
- Attending rats had at least above 70% correct during the 500 ms signal trial.
- Unattending rats averaged around chance performance (50%).
- Side bias rats achieved less than 30% on signals or non-signals suggesting they were pressing the same lever regardless of the signal/non-signal trials.



RESULTS

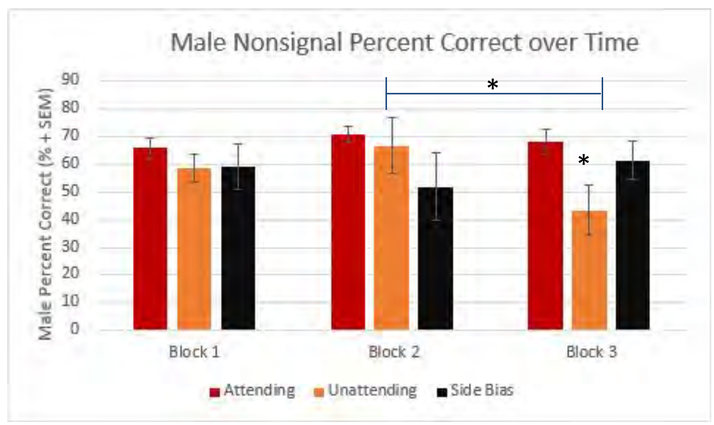
EFFECT OF SIGNAL LENGTH

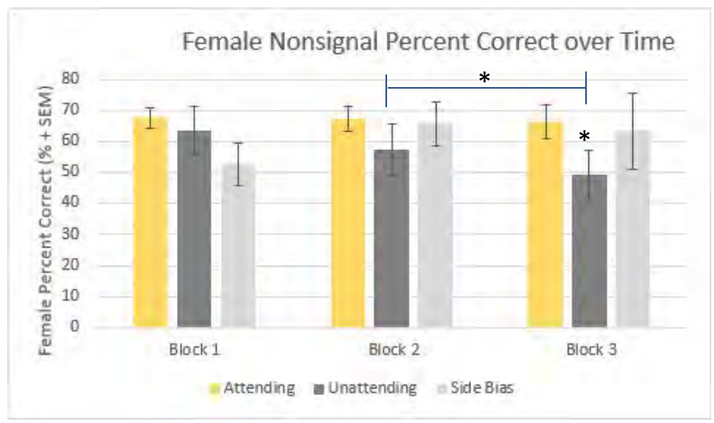




There is a significant effect of signal length on performance. The longer 500 ms signal had higher accuracy than shorter signal lengths, $F_{2,36}$=25.069, p < 0.001.
There is an interaction between signal length and attentional performance. Attending animals did significantly better than unattending ones on the 500 ms signal length, $F_{4,36}$=9.024, p<0.001.
There is a significant sex difference with male rats performing significantly better than females, p=0.012.

EFFECT OF TIME

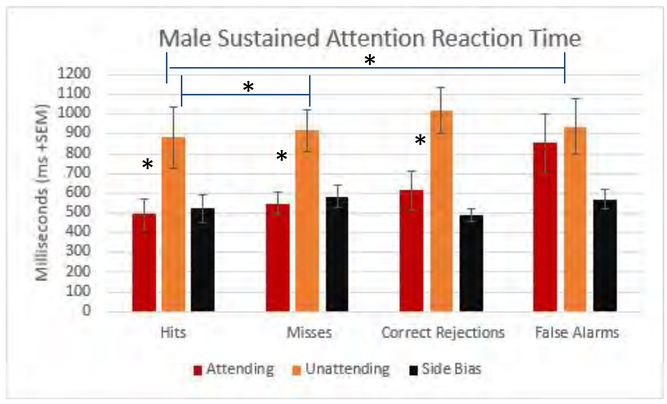


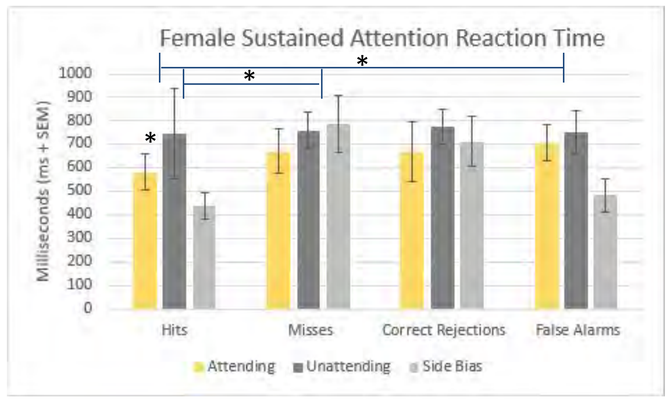


There is a significant effect of time, with performance decreasing as the blocks progress, $F_{2,48}$=7.11, p=0.002.
There is a significant interaction between block and attentional performance with attending animals performing better than unattending ones in the third block of trials, $F_{4,48}$= 6.596, p=0.006.
There is a significant sex difference, with females performing better than males, p=0.016.

RESULTS CONT.

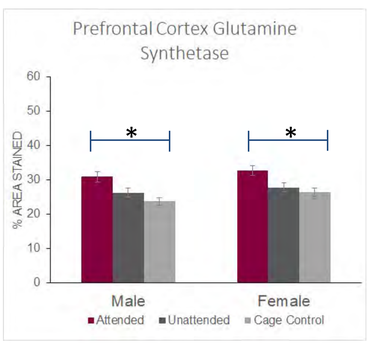
REACTION TIMES OF THE RATS

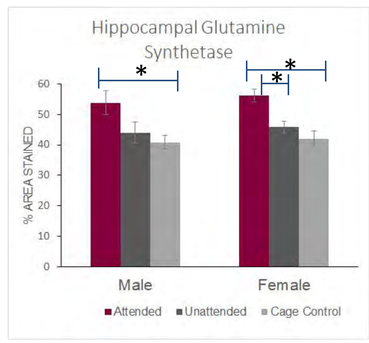




Correct responses were significantly faster than incorrect ones, $F_{1,36}$=16.339, p<0.001.
Signal trials were significantly faster than non-signal trials, $F_{1,36}$=8.594, p=0.002.
There was a significant interaction between signal trials and attendance with attending animals performing faster than unattending animals, $F_{2,36}$=4.882, p=0.013.

GS IMMUNOHISTOCHEMISTRY





In the PFC, attending animals had significantly increased percent area stained than the cage control animals: males, F=7.53, p<0.01; females, F=7.26, p<0.05. No significant sex differences.
In the Hippocampus, male attending animals had significantly increased percent area stained than the cage control animals, F=4.66, p<0.05. Female attending animals had significantly more percent area stained than the cage control animals, F=10.98, p<0.01. Female attending animals had significantly increased area stained than the unattending animals, p<0.01.

CONCLUSIONS

- Attending animals have overall better performances during the SAT and demonstrated higher levels of GS within the PFC and hippocampus, which are involved in attention and learning.
- Unattended animals have lower overall performance and lower levels of GS demonstrating that attention influences levels of GS.
- We can see a significant difference between correct and incorrect answers, indicating that rats take more time trying to assess correctness.
- Any sex differences are mostly likely attributed to sexual dimorphism with male rats being 2X larger than female rats. Because the water reward size was the same for both sexes, this may have contributed to differences in sex.

FUTURE PLANS

- We will process more brains for staining by IHC in order to quantify the levels of GS present.
- We will increase our sample size to increase our confidence and power and even the number of males to females.
- We will examine female rat vaginal smears to see if there is a correlation between estrous levels and cognitive performance.

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