

Binghamton University

The Open Repository @ Binghamton (The ORB)

Research Days Posters Spring 2020

Division of Research

2020

Effects of Maternal Care and Estrogen Treatment on Dopamine Receptor D2 Expression in the Ventral Hippocampus of Male and Female Long Evans Rats

Deven LoSchiavo

Binghamton University--SUNY

Ashley Bui

Binghamton University--SUNY

Follow this and additional works at: https://orb.binghamton.edu/research_days_posters_spring2020

Recommended Citation

LoSchiavo, Deven and Bui, Ashley, "Effects of Maternal Care and Estrogen Treatment on Dopamine Receptor D2 Expression in the Ventral Hippocampus of Male and Female Long Evans Rats" (2020). *Research Days Posters Spring 2020*. 47.

https://orb.binghamton.edu/research_days_posters_spring2020/47

This Book is brought to you for free and open access by the Division of Research at The Open Repository @ Binghamton (The ORB). It has been accepted for inclusion in Research Days Posters Spring 2020 by an authorized administrator of The Open Repository @ Binghamton (The ORB). For more information, please contact ORB@binghamton.edu.

Effects of Maternal Care and Estrogen Treatment on Dopamine Receptor D2 Expression in the Ventral Hippocampus of Male and Female Long-Evans Rats

Deven S. LoSchiavo, Ashley Bui, Veronica D. Wang, & Nicole M. Cameron

Introduction

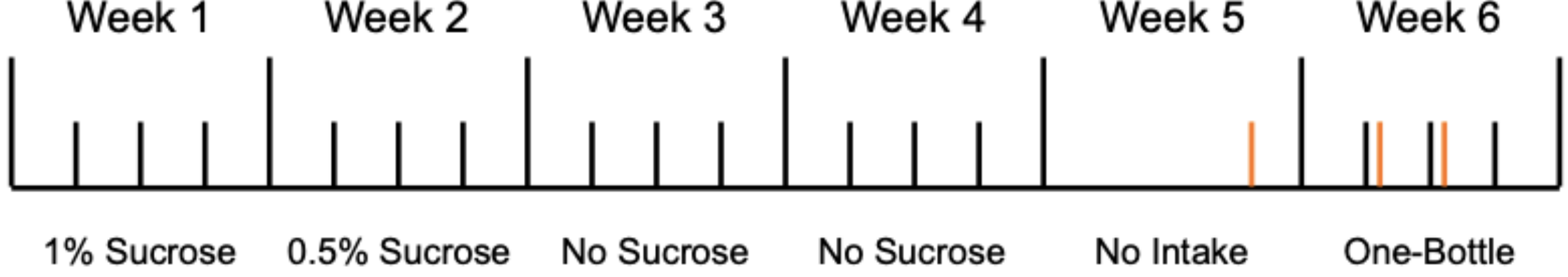
- The dopamine receptor D2 (D2R) has been studied extensively in connection with alcoholism. Experimentally increasing D2R expression in the rodent nucleus accumbens reduces ethanol consumption.¹ Conversely, knockout mice lacking the D2 long receptor drink more ethanol than mice with normal D2R expression.²
- The level of maternal care an animal receives during its first week postpartum affects ethanol intake. Our lab has shown that adult rats that received low amounts of licking/grooming (Low LG) drank more ethanol g/kg than High LG rats. This effect was especially driven by females (Fig. 1).³
- Interestingly, both High and Low LG rats decreased ethanol intake after an acute estrogen treatment (Fig. 2).³
- Estrogen administration has also been found to decrease D2R mRNA expression in the dorsal and ventral striatum.⁶
- Maternal care also influences D2R expression. Downregulation of D2R was found in the ventral tegmental area of Low LG control rats relative to High LG control rats. This effect was not found in the nucleus accumbens or dorsal striatum. No effect of sex was found in any of these regions.³
- Moderate alcohol consumption has been found to significantly decrease the production of new neurons in the hippocampus.⁴
- In this study we examined D2R expression in the ventral hippocampus (vHPC) of control and estrogen-treated High and Low LG male and female rats. We hypothesized that we would find lower levels of D2R expression in Low LG rats with no significant sex difference. We also expected to find decreased vHPC D2R expression in estrogen-treated rats, similar to results previously reported in the striatum.**

Methods

Subjects

- Maternal care behavior was scored postnatal days 1 through 6. Litters were categorized as High or Low LG if their LG scores were +/- 1 SD from the cohort mean, respectively.⁵
- Once offspring reached adulthood, a two-bottle intermittent sucrose-tapered test with 18-hour sessions was administered to quantify ethanol versus water consumption.
- One week later, a one-bottle test was administered with 2 hours of water deprivation prior to 2 hours of ethanol exposure. Animals in the estrogen treatment group received a sesame oil injection two days before the one-bottle test and again after the first day of drinking. After the second day of drinking, these animals received an estradiol benzoate injection.

Intake Timeline



- Each small black tick mark represents an intake session. Orange tick marks represent injections of sesame oil or estradiol benzoate. Tissue was harvested for western blotting after the final day of intake.

Western Blotting

- The vHPC was gross dissected from each brain. The tissue was homogenized and the protein content was quantified with a BCA assay.
- Samples were normalized and ran through electrophoresis gels for 2 hours. Following electrophoresis, samples were transferred from gels to polyvinyl difluoride membranes that were then probed for D2R and beta-actin.
- Chemiluminescence was used to detect protein bands on the membranes with photographic film. Optical densities were quantified using ImageJ software.

Results

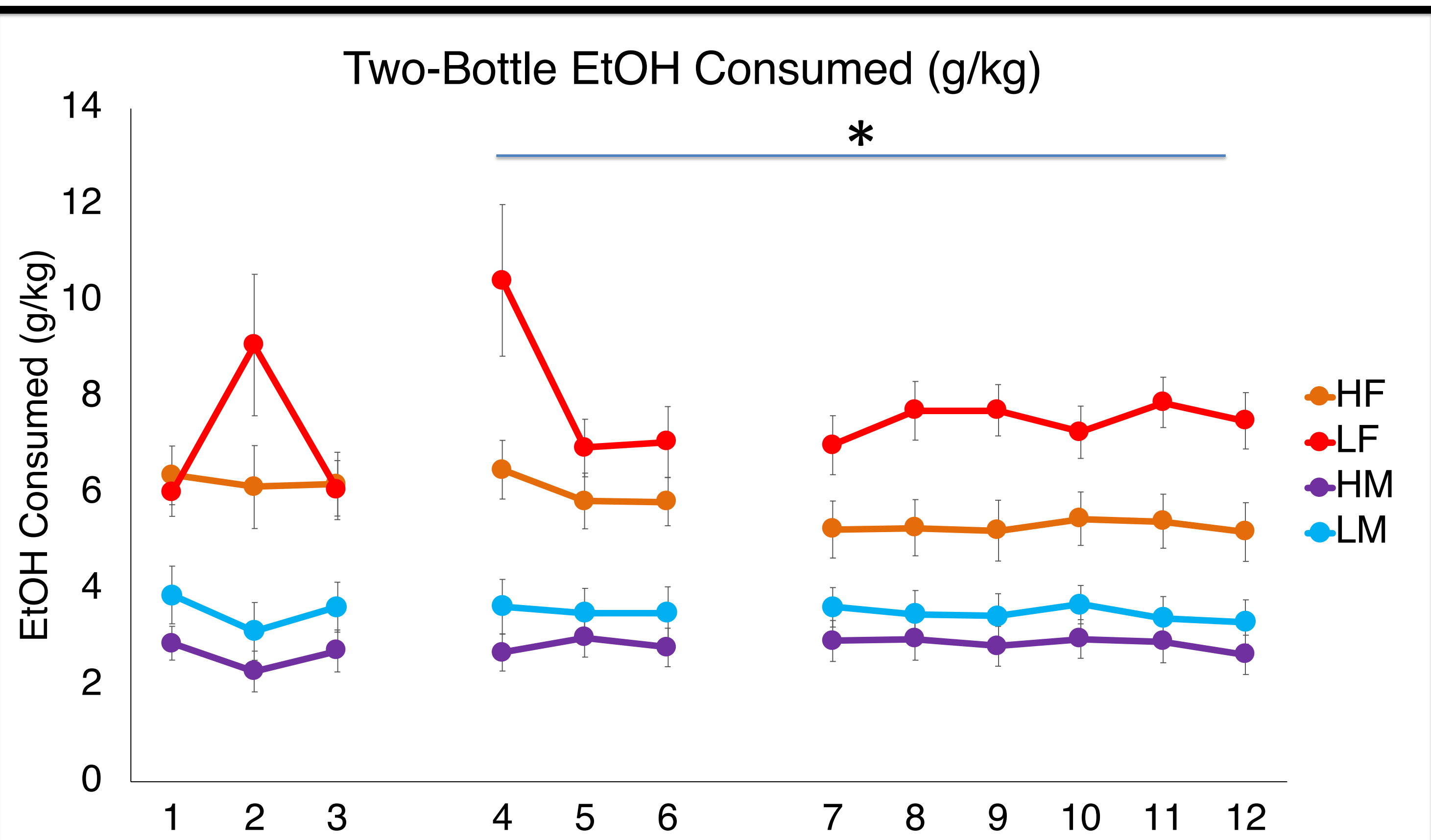


Figure 1. Mean (+/- SE) EtOH consumption g/kg during the two-bottle intermittent sucrose tapered test. Females drank more EtOH g/kg than males throughout the entire study. During weeks 2-4 Low LG animals consumed more than High LG animals. (* $p < 0.05$). HF: High LG females; LF: Low LG Females; HM: High LG males; LM: Low LG males.

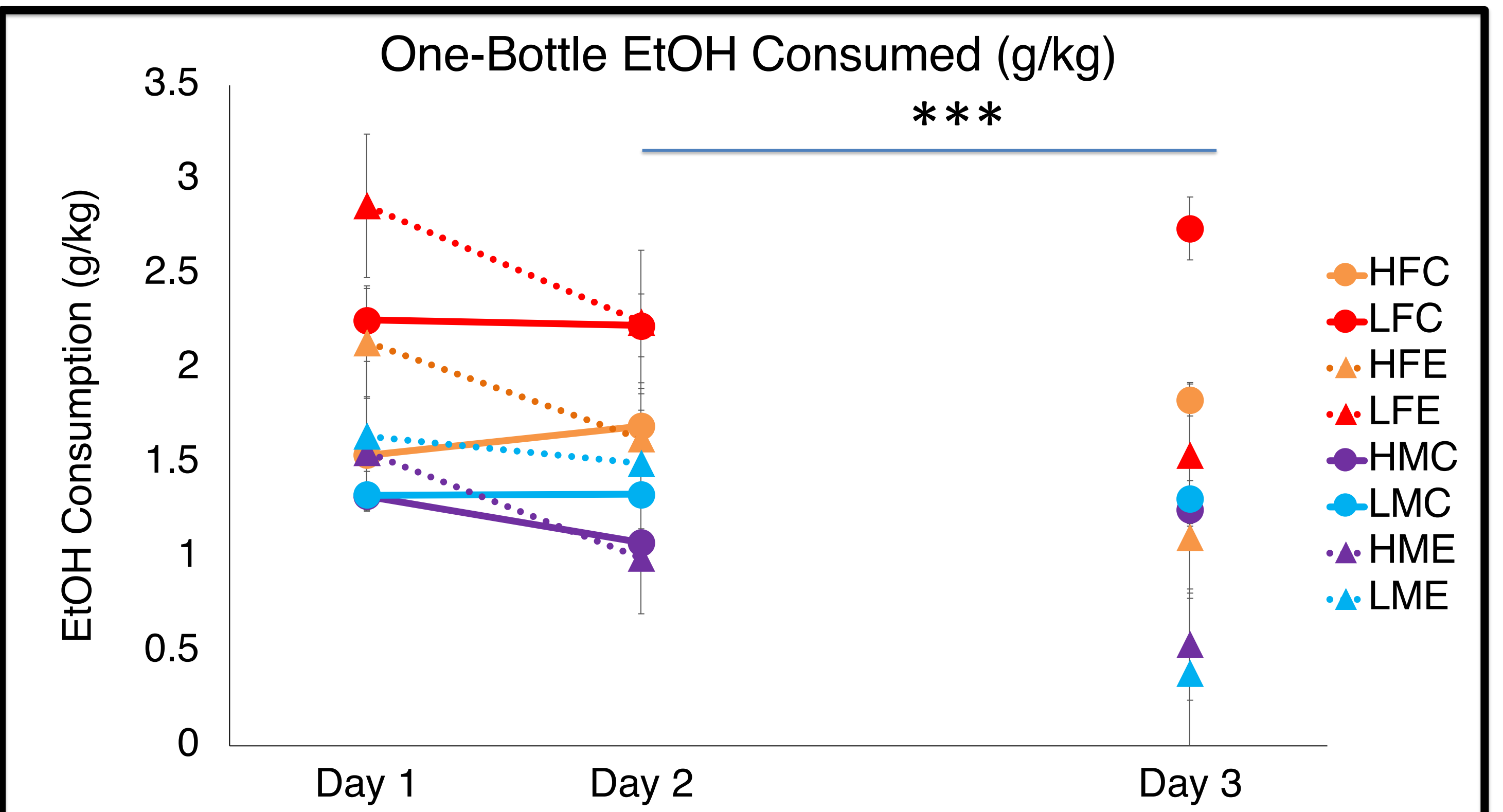


Figure 2. Mean (+/- SE) EtOH consumption g/kg during the one-bottle test. Estradiol treatment caused a significant decrease in consumption when comparing days 2 and 3 (** $p < 0.001$). HFE: High LG estradiol-treated females; HFC: High LG control females; LFE: Low LG estradiol-treated females; LFC: Low LG control females; HME: High LG estradiol-treated males; HMC: High LG control males; LME: Low LG estradiol-treated males; LMC: Low LG control males.

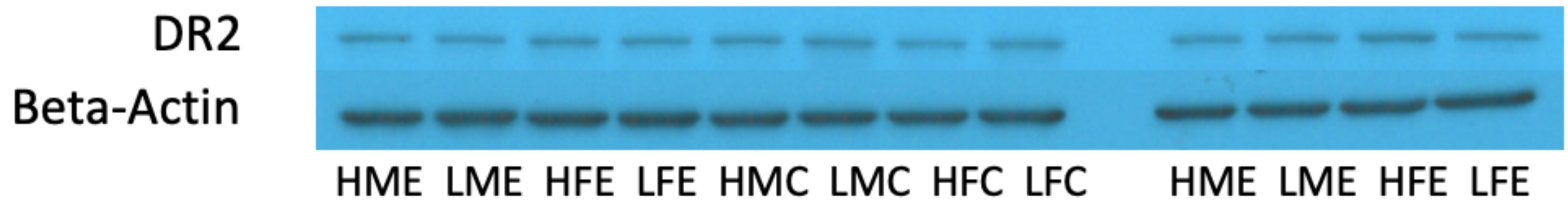
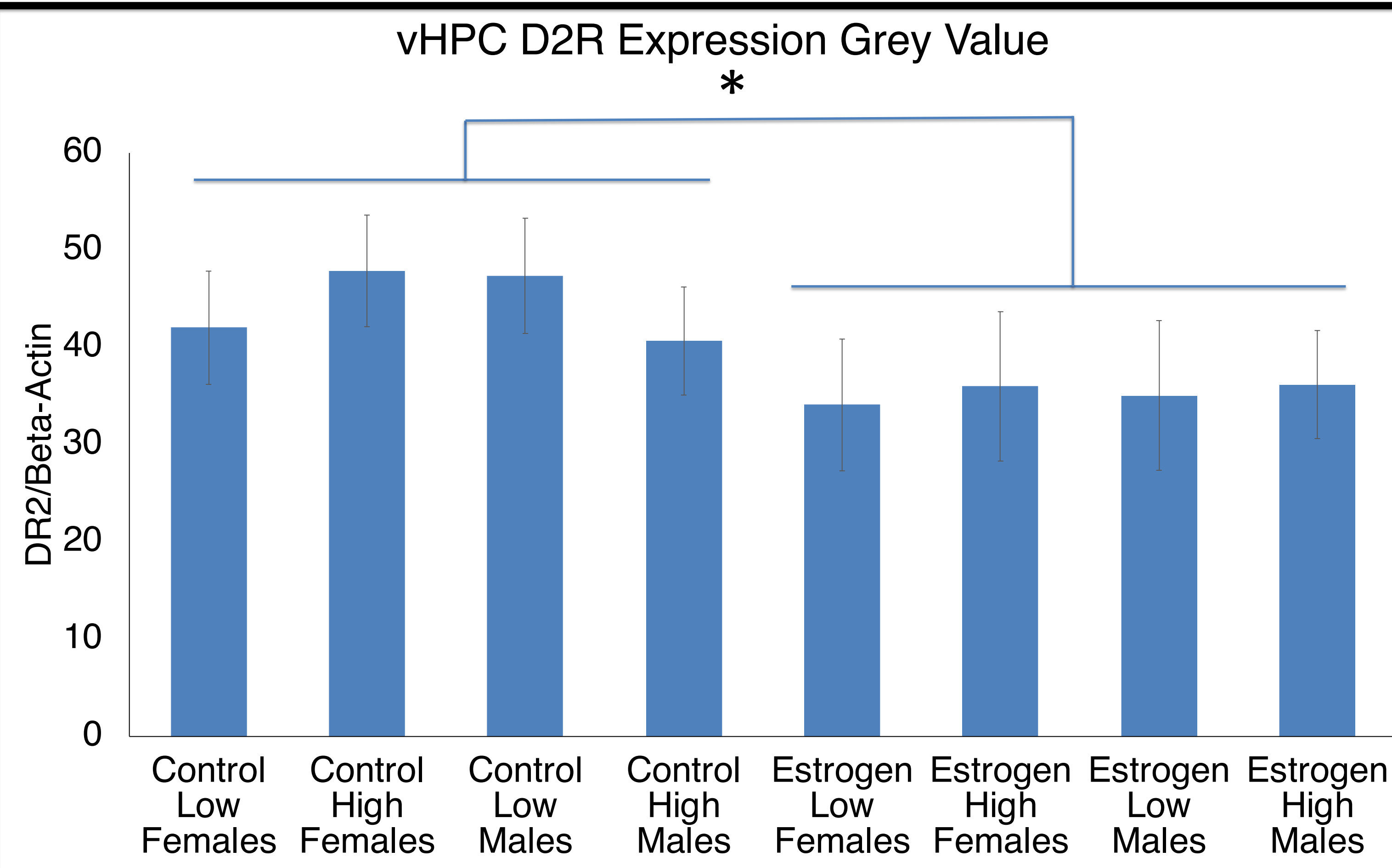


Figure 3. Mean (+/- SE) D2R expression in the vHPC as mean grey value ratios (D2R/beta-actin). Estrogen-treated animals had significantly less D2R expression than control animals (* $p < 0.05$)

Discussion

- We found no evidence that maternal care affects expression of D2R in the vHPC.
- We found an effect of estrogen treatment on vHPC D2R expression. Estrogen-treated High and Low LG rats displayed a significant decrease in D2R expression relative to controls (Figure 3).**
- In both sexes, estrogen treatment decreases both D2R expression in the vHPC and voluntary ethanol consumption.
- Few studies have explored how estrogen affects D2R expression, and fewer still have specifically looked at the hippocampus. Due to the important connection between D2 receptors and alcohol consumption^{1,2} we believe this area merits further investigation.

References

- Bulwa, Z. B., Sharlin, J. A., Clark, P. J., Bhattacharya, T. K., Kilby, C. N., Wang, Y., & Rhodes, J. S. (2011). Increased consumption of ethanol and sugar water in mice lacking the dopamine D2 long receptor. *Alcohol (Fayetteville, N.Y.)*, 45(7), 631–639. doi.org/10.1016/j.alcohol.2011.06.004
- Thanos, P. K., Taintor, N. B., Rivera, S. N., Umegaki, H., Ikari, H., Roth, G., . . . Volkow, N. D. (2004). DRD2 Gene Transfer Into the Nucleus Accumbens Core of the Alcohol Preferring and Nonpreferring Rats Attenuates Alcohol Drinking. *Alcoholism: Clinical and Experimental Research*, 28(5), 720-728. doi:10.1097/01.alc.0000125270.30501.08
- Bui, A. & Cameron, N. M. (2019). Maternal Care and Sex Effects on Anxiety and Alcohol Intake in Long Evans Rats. Master's thesis. Binghamton University.
- Anderson, M., Nokia, M., Govindaraju, K., & Shors, T. (2012). Moderate drinking? Alcohol consumption significantly decreases neurogenesis in the adult hippocampus. *Neuroscience*, 224, 202-209. doi:10.1016/j.neuroscience.2012.08.018
- Popoola, DO, Cameron, NM. Maternal care-related differences in males and females rats' sensitivity to ethanol and the associations between the GABAergic system and steroids in males. *Developmental Psychobiology*. 2018; 60: 380–394. https://doi.org/10.1002/dev.21607
- Lammers, C.-H., D'Souza, U., Qin, Z.-H., Lee, S.-H., Yajima, S. and Mouradian, M.M. (1999). Regulation of striatal dopamine receptors by estrogen. *Synapse*, 34: 222-227. doi:10.1002/(SICI)1098-2396(19991201)34:3<222::AID-SYN6>3.0.CO;2-J