



# Sex Differences in Mu Opioid Receptor Expression in Norepinephrine Neurons of the A2 Region



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Citations

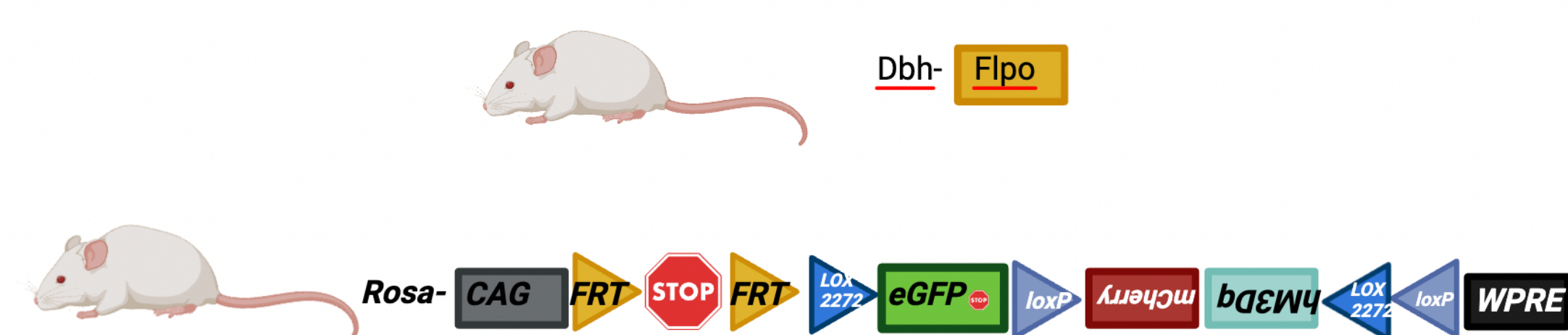
## ABSTRACT

- Norepinephrine (NE) is a neurotransmitter involved with attention, arousal, and mood. NE dysregulation is associated with depression, anxiety, addiction, etc.
- The mu opioid receptor (MOR) is the most expressed opioid receptor. MOR activation has been shown to moderate activation of NE neurons during stress
- Sex bias in neuroscience research has led to a lack of research on female animal models, despite higher rates of depression & anxiety in women

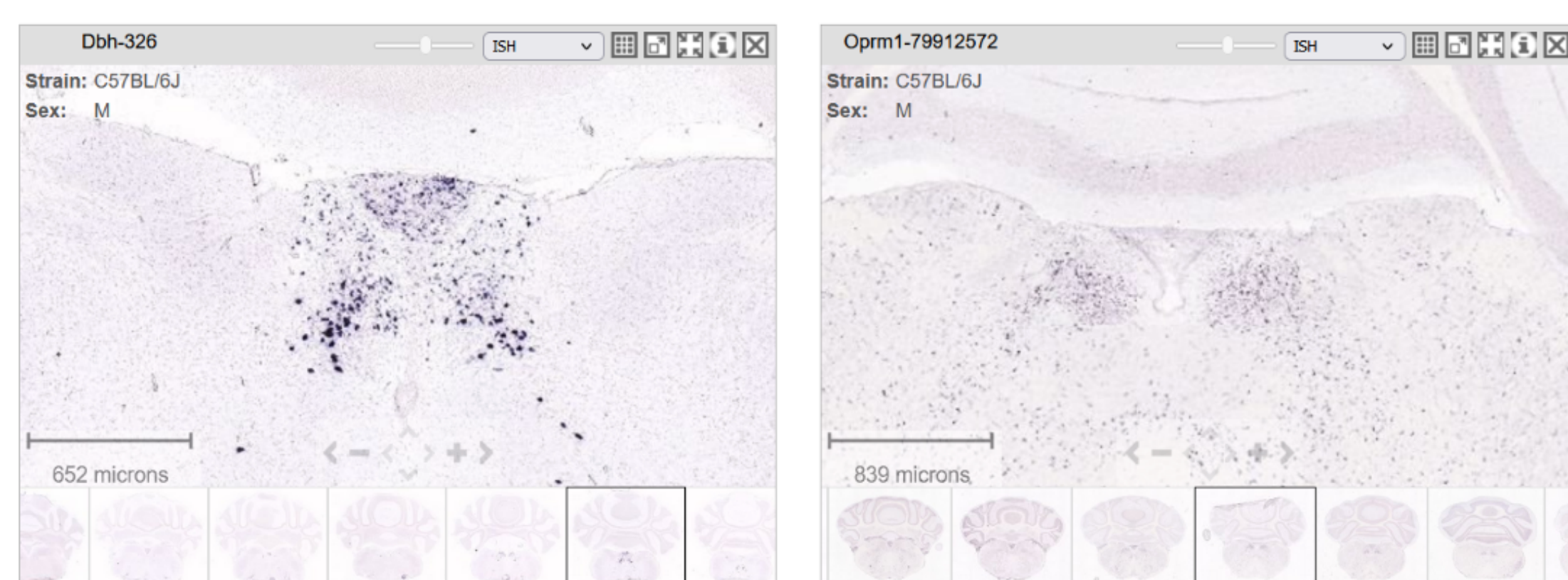
## HYPOTHESIS

Less MOR expression will be observed in the A2 nucleus of female mice compared to male mice.

## METHODS

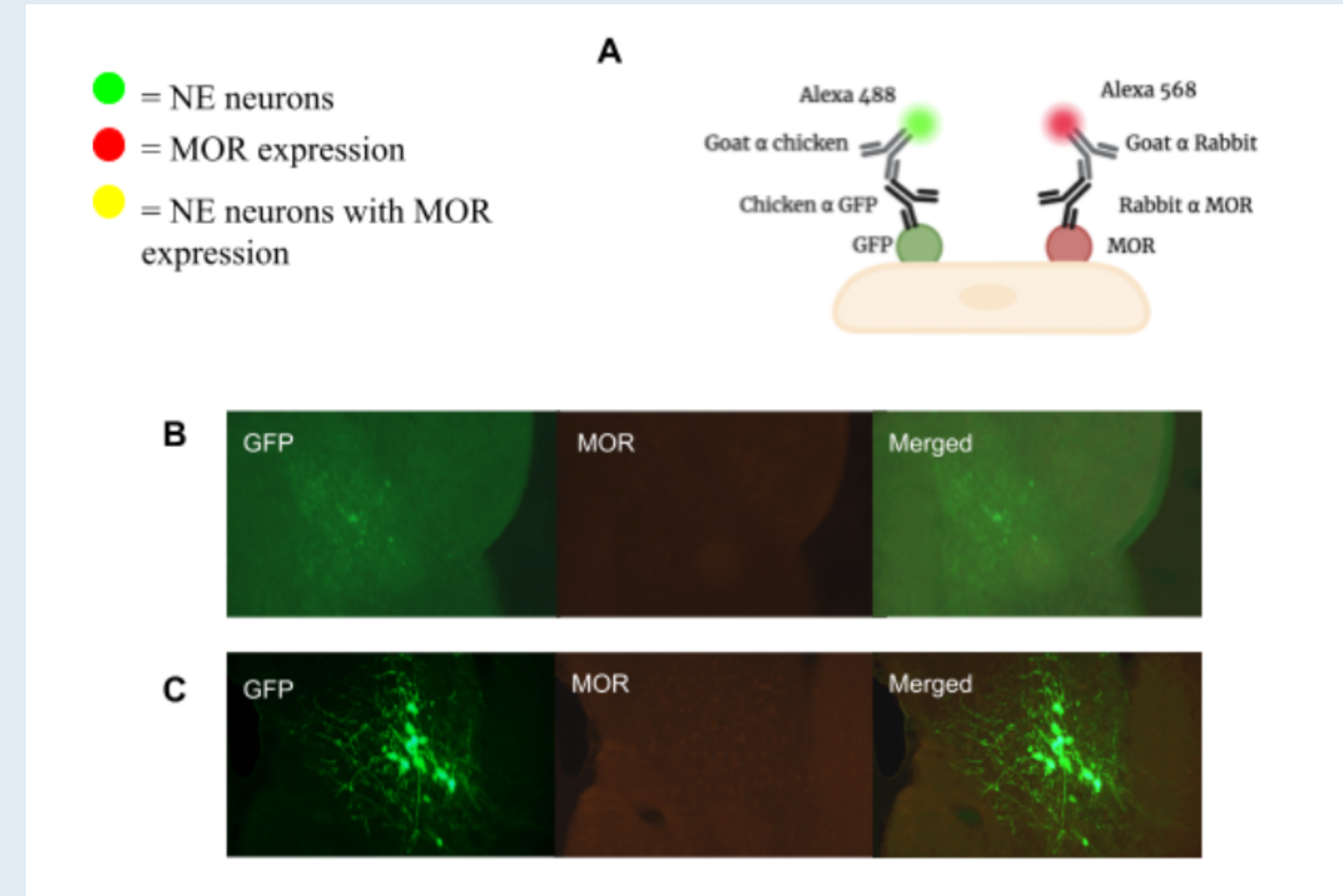


**Figure 1.** Visual representation of genetic modification of mice. (Top) Flpo driver allele for Dbh and (Bottom) dual recombinant effector allele

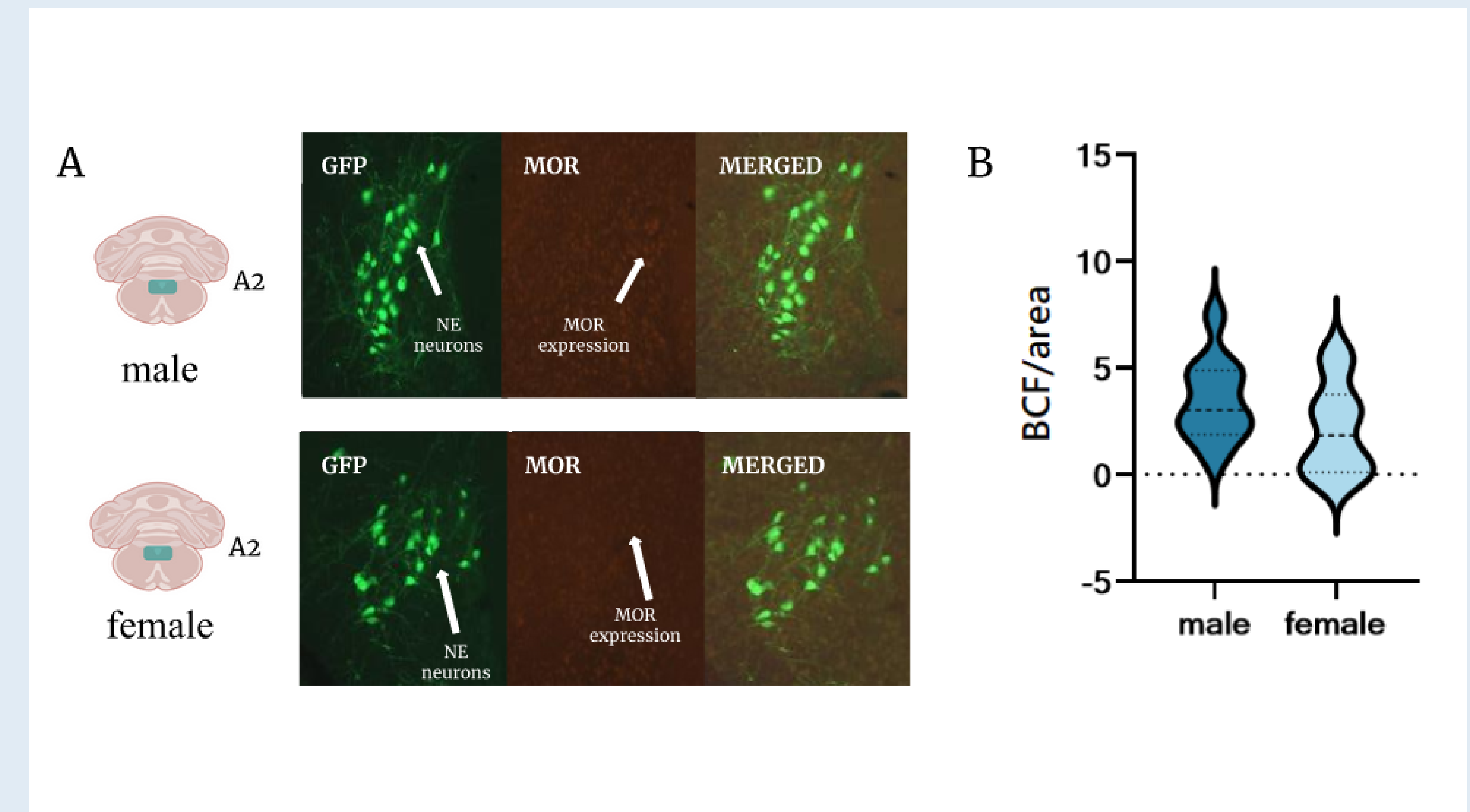


**Figure 2.** Allen Mouse Brain Atlas images of Dbh and MOR expression indicating potential MOR expression in the A2 norepinephrine nucleus. Zoomed in view of Dbh (left) and MOR (right) in the A2 region of the mouse brain.

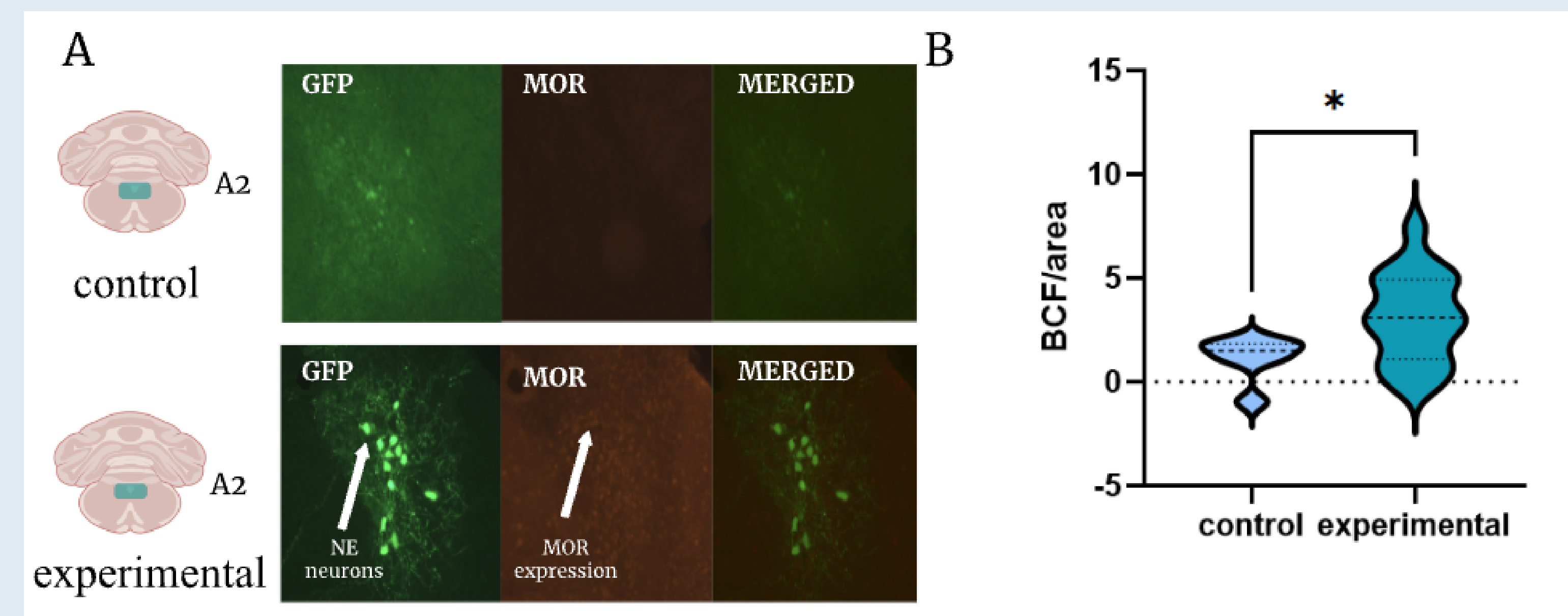
## RESULTS



**Figure 3.** Visualization of NE neurons and MOR expression through IHC. (A) Primary and secondary antibodies used in the IHC process. (B) NE neurons and MOR expression visualized with only secondary antibodies in a male control mouse sample. (C) NE neurons and MOR expression visualized with both primary and secondary antibodies in an experimental male mouse sample.



**Figure 4.** Quantification of standardized average pixel intensity (BCF/area) in male and female mice in the A2 subregion. (A) MOR expression in norepinephrine neurons of A2 region in male and female mice coronal brain sections and (B) mean BCF/area ratio across sex (n = 11 male and 10 female)



**Figure 5.** Quantification of standardized average pixel intensity (BCF/area) in male control and experimental mice in the A2 subregion. (A) MOR expression in norepinephrine neurons of A2 region in experimental and control male mice coronal brain sections and (B) mean BCF/area ratio across sex (n = 21 experimental and 6 control)

## Results Summary:

- Performed an unpaired t-test in GraphPad Prism comparing the mean BCF/area of the control and experimental groups
  - Control: n=1 animal, mean = 1.152
  - Experimental: n = 21 animals, mean = 3.086
  - p-value = 0.0466 (significant)
- Performed an unpaired t-test comparing the mean BCF/area of the male and female experimental groups
  - Male: n = 11 animals, mean = 3.488
  - Female: n = 10 animals, mean = 2.164
  - p-value = 0.1511 (not significant)

## CONCLUSION

While female mice had lower MOR expression in A2 compared to male mice, this difference was not significant. This suggests that sex differences observed in the locus coeruleus might not be observed across all NE nuclei.

## FUTURE DIRECTIONS

Characterize NE and MOR interactions based on developmental lineage and in an opioid-use experimental setting for a more precise understanding of sex-based differences at the cellular and behavioral level