Cerebellar Regulation of Fear Extinction Through the Limbic Thalamus

*Amanda G. Iglesias[1], Ksenia Vlasov[1], Martha-Root Mbah[1], Sara Camerero[1], Se Jung Jung[1], Evan G. Antzoulatos[1,2,3], Diasynou Fioravante[1,2]

[1] Center for Neuroscience
[2] Department of Neurobiology, Physiology and Behavior
[3] Department of Psychology
University of California Davis
*Corresponding author: aiglesias@ucdavis.edu

Keywords: Cerebellar Nuclei, Limbic Thalamus, Fear Extinction

Abstract: The cerebellum is an established regulator of motor control and has recently garnered novel focus for its modulation of affective processes. We previously characterized cerebellar projections to the parafascicular nucleus (PF), which modulates orienting responses and behavioral alertness. We identified an anatomical circuit between the deep cerebellar nuclei (DCN) and the basolateral nucleus of the amygdala (BLA) through the PF. Here we provide functional characterization of this circuit and examine whether and how the circuit might regulate affective processing. We show that optogenetic stimulation of DCN-PF projections reduces *c-Fos* expression in PF and modulates BLA neural activity. We optogenetically inhibited the DCN-PF projections during distinct phases of auditory fear conditioning. Optoinhibition during training has no consequence, but during extinction it results in faster extinction. This effect on extinction appears to be specific to the DCN-PF projection: optoinhibition of cerebellar projections to the centromedial thalamic nucleus (CM), an intermediary node between the cerebellum and amygdala, does not appear to modulate fear acquisition or extinction. Ongoing work is capturing potential neural signatures of fear regulation. Overall, our findings reveal a novel functional divergence between limbic projections of the cerebellum and establish future targets for exploring affective processes of relevance to neuropsychiatric disorders.

Funding Acknowledgements: This work was supported by R01MH12844, R21MH114178 and NSF1754831 to DF; a NARSAD 2018 Young Investigator Award to EA; KV was supported by NIMH T32MH112507 training grant.