Lawrenson, C., Koutsikou, S., Lumb, B., & Apps, R. (2017). S191 Cerebellar contributions to fear behaviour. *Clinical Neurophysiology*, e239. https://doi.org/10.1016/j.clinph.2017.07.199

Cerebellar and periaqueductal grey contributions to fear behaviour.

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Objectives: Various regions of the midbrain and cerebrum are known to play an important role in fear behaviour. This talk will present evidence that the cerebellum should also be added to this network.

Methods: Electrophysiological, lesioning and behavioural techniques in rats were used to study interactions between the cerebellum and the midbrain periaqueductal grey (PAG). Freezing was used as a behavioural measure to quantify fear before and after localized cerebellar lesions and was initiated innately e.g. via the predator odour test, or learned via auditory cued aversive foot shock fear conditioning. Electrodes were also implanted into the PAG and cerebellar nuclei, and neuronal activity was recorded during these fear paradigms.

Results: Our research has shown that a powerful physiological connection exists between the ventrolateral PAG and vermal lobule VIII (pyramis) of the cerebellum. Lesioning the pyramis disrupts innate and fear-conditioned freezing behaviour. In response to auditory cued fear conditioning there is an increase in beta and gamma local field potential activity in the cerebellar nuclei during presentation of the conditioned tone.

Discussion: Further work is needed to understand how cerebellar computations play a role in the affective and motor aspects of fear evoked freezing behaviour.

Conclusions: The cerebellar- PAG connection is a critical component of the neural network subserving emotionally related freezing behaviour.

Significance: These results highlight a role for the cerebellum in the neural networks underlying fear behaviour, raising the possibility of a new therapeutic target for fear related disorders such as post-traumatic stress disorder.