Flow of information through the brain during a sensorimotor task

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Group: Bubble

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Hypothesis

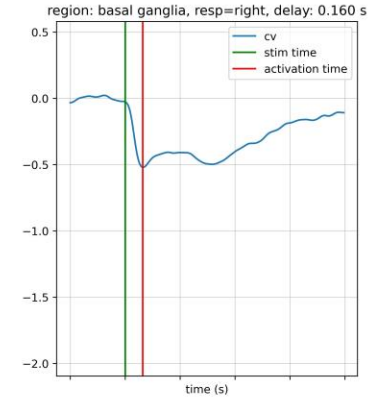
- Visual sensory data is carried through the brain across various brain regions, processed, before an output (a reaction) is returned. Using the dataset Steinmetz, et. al. , 2019, we reviewed recordings of neuronal activity from different cortical regions (Visual cortex, Hippocampus, Thalamus, etc.) of mice turning a wheel to the left or right according to controlled visual stimuli. Using the Wilcoxon signed-rank test, we can find periods of the highest information per brain region, thus find the delay and order of information propagation in the brain.

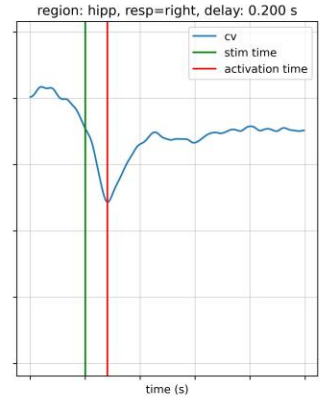
Finding the overall delay of each region using the minimum of Coefficient of Variance

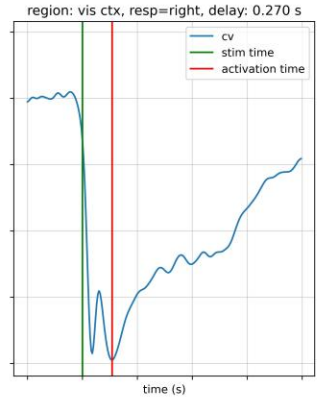
- **Our Algorithm:**

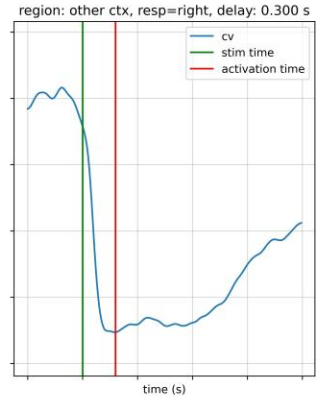
  - The CV if defined as: CV = std(data)/mean(data)
  - Take the neural activity of each region and find the CV over time for all neurons and all trials
  - Since the resulting time series is noisy, denoise it using a convolution with a gaussian filter
  - Find the time with minimum CV and take that as the activation time in that region.
  - Subtract the stimulus time from the activation time to get delay

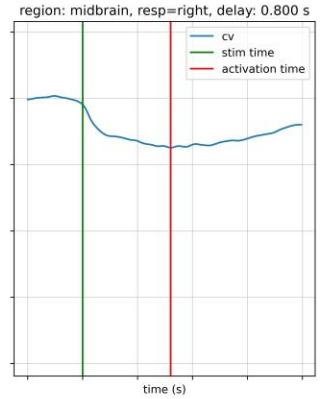
Results of delay in regions in increasing order for all possible response types

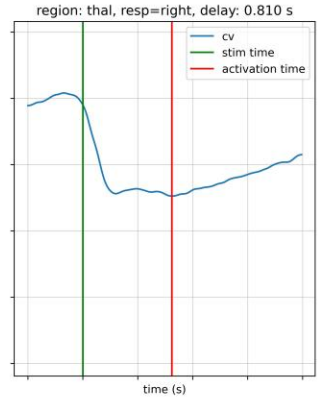


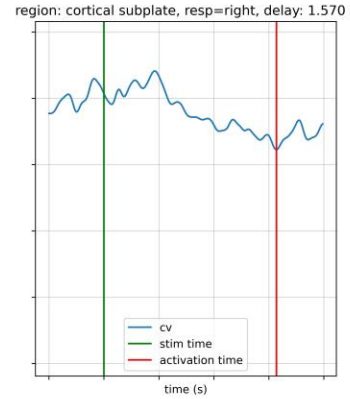


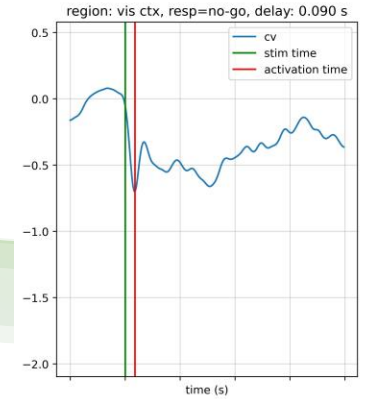


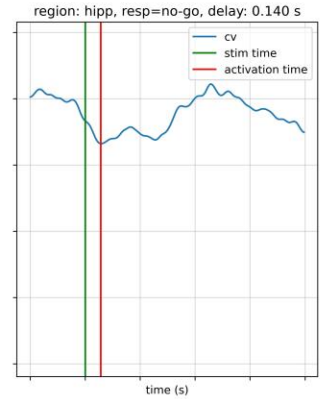


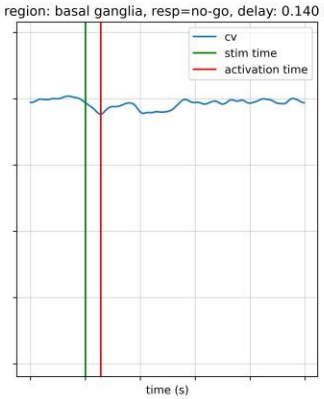


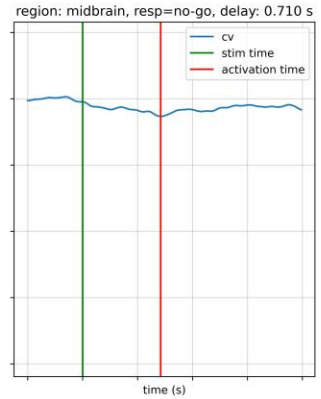


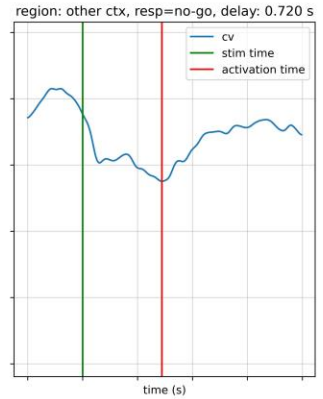


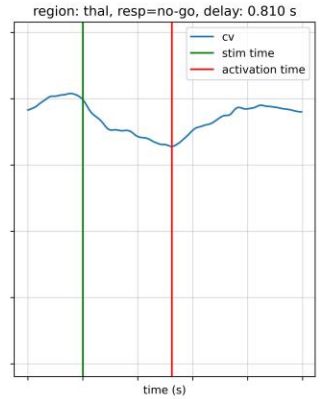


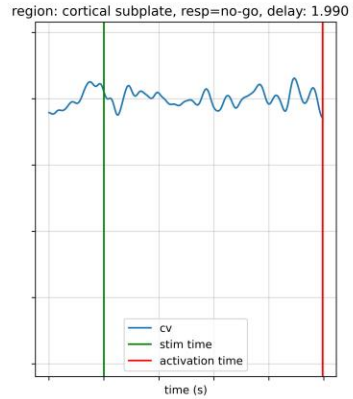


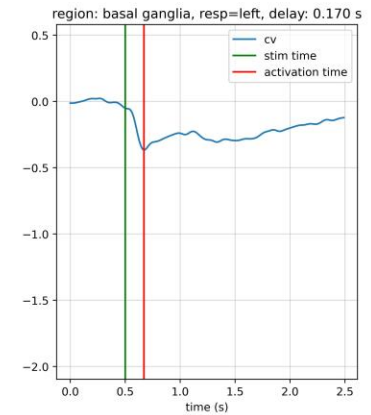


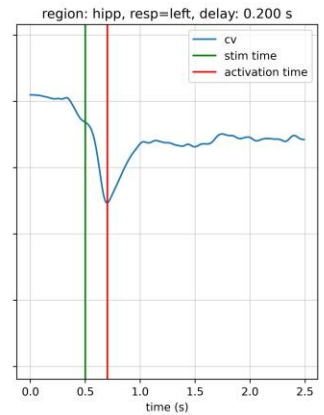


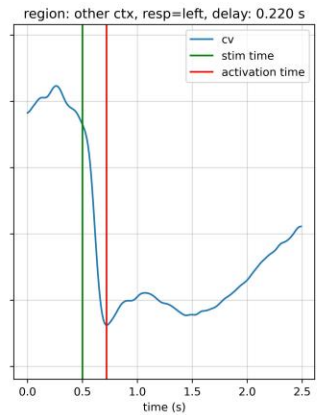


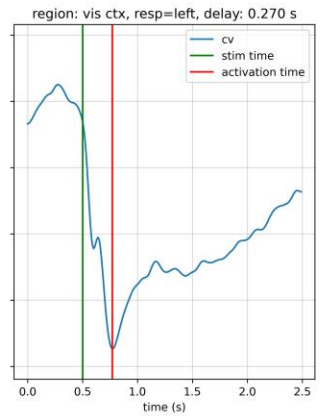


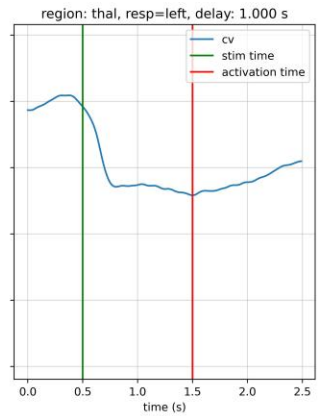


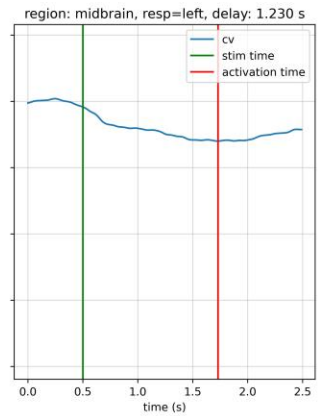


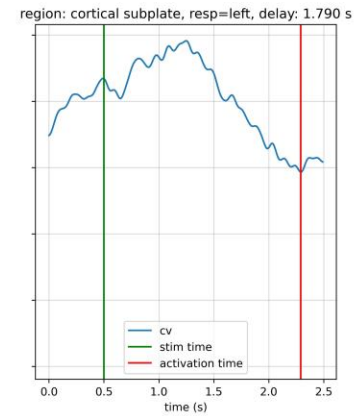




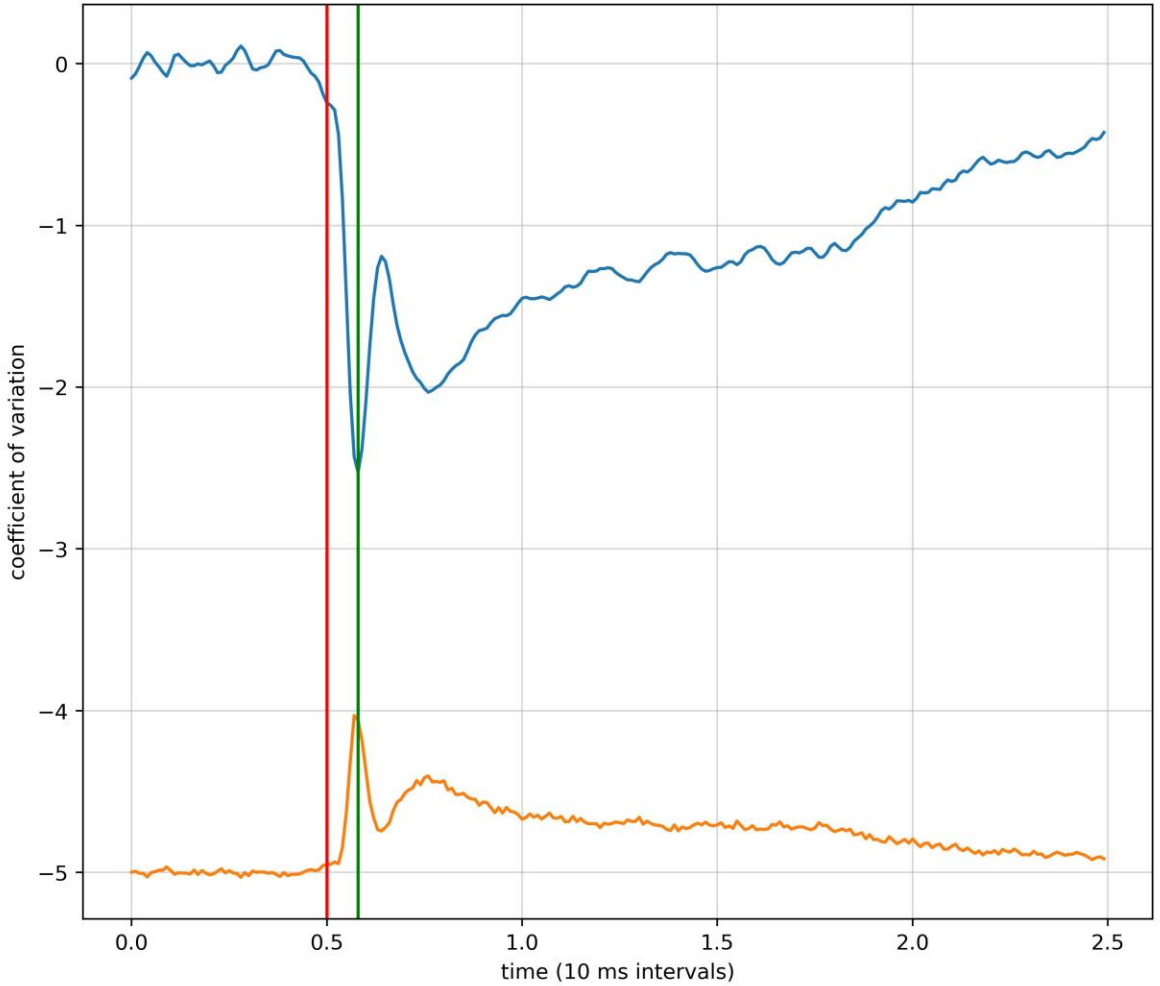


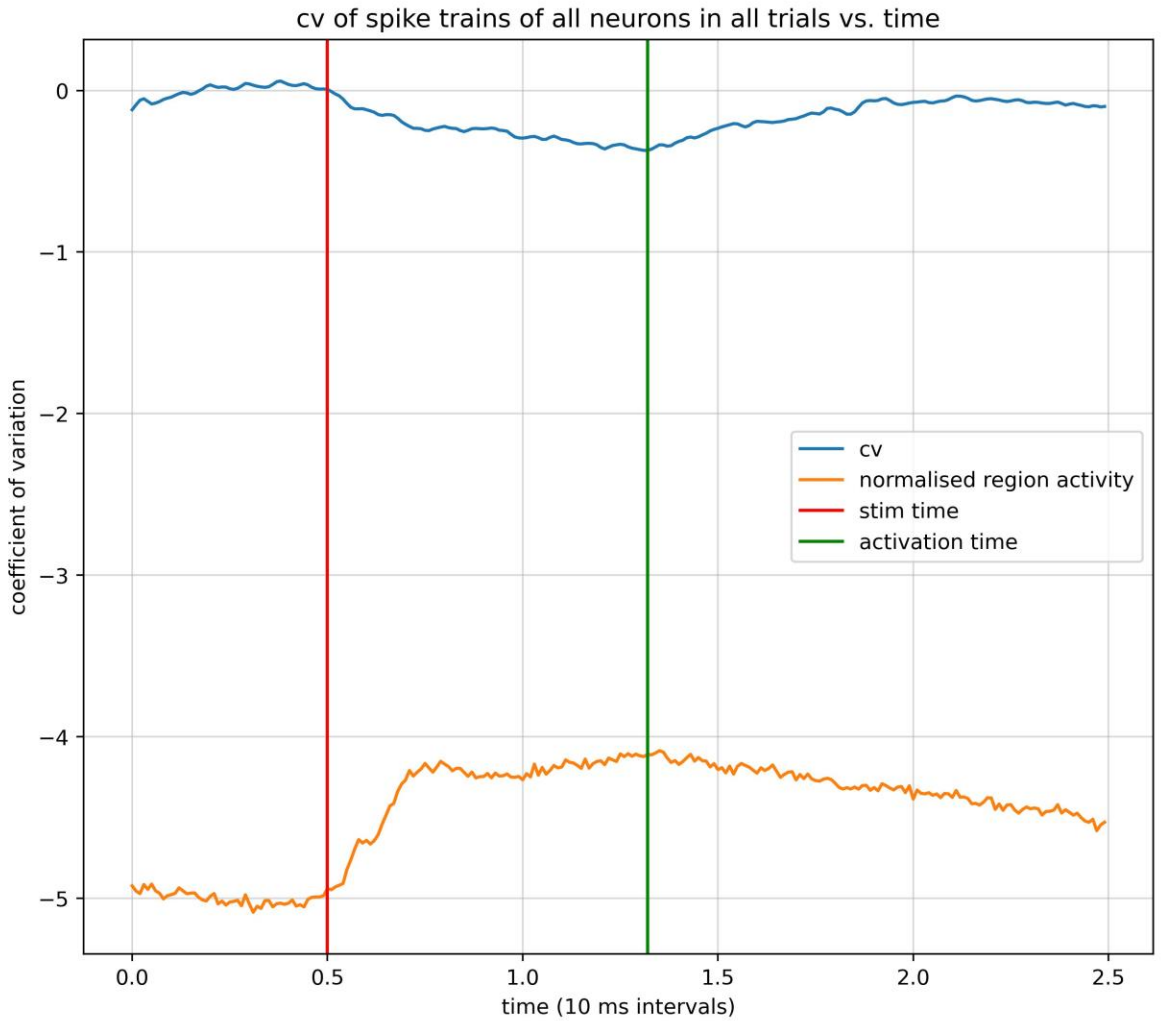




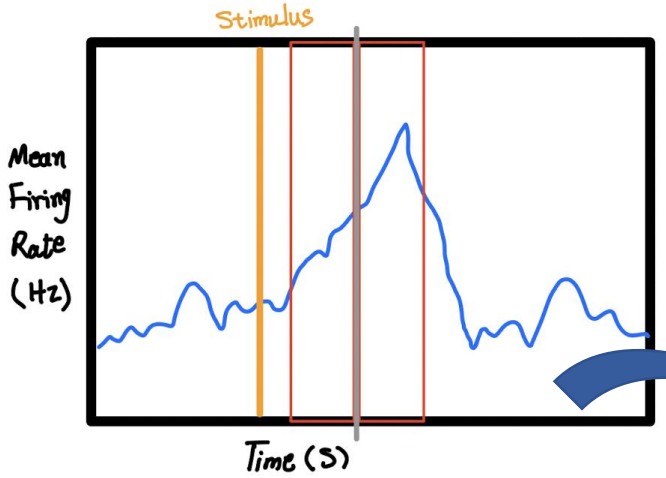


Relationship between delay time and mean firing rate in regions

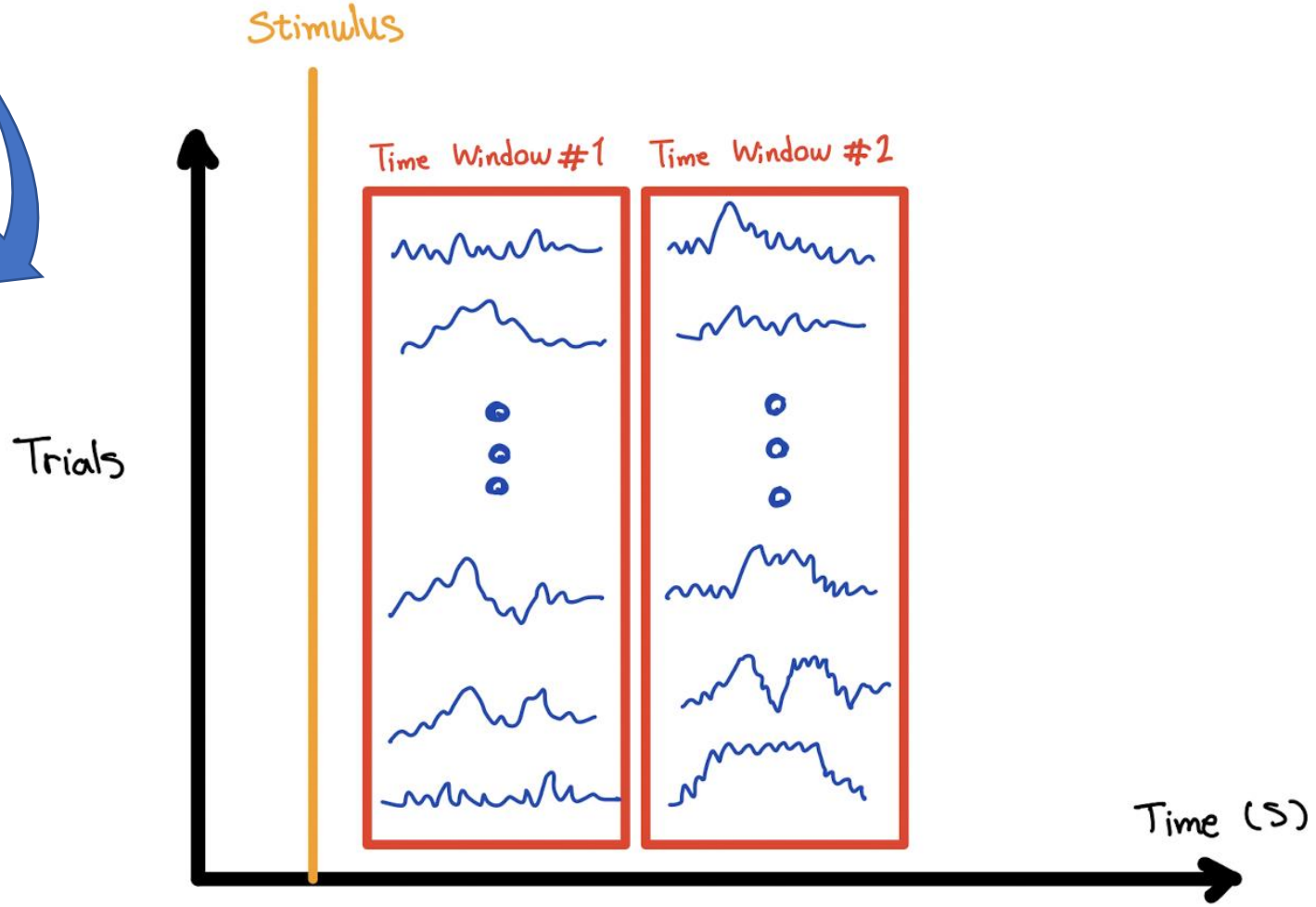




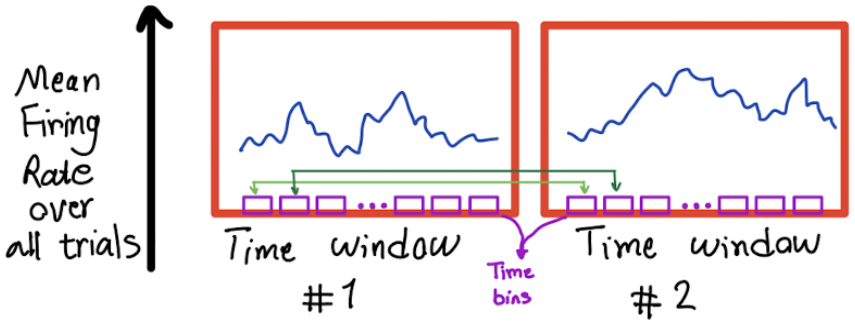
Detecting Neuronal behavior



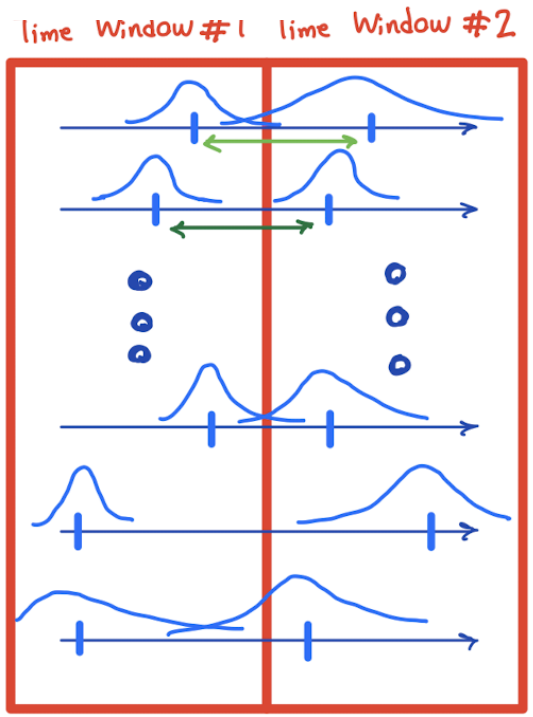
Let's look at it from different aspects!

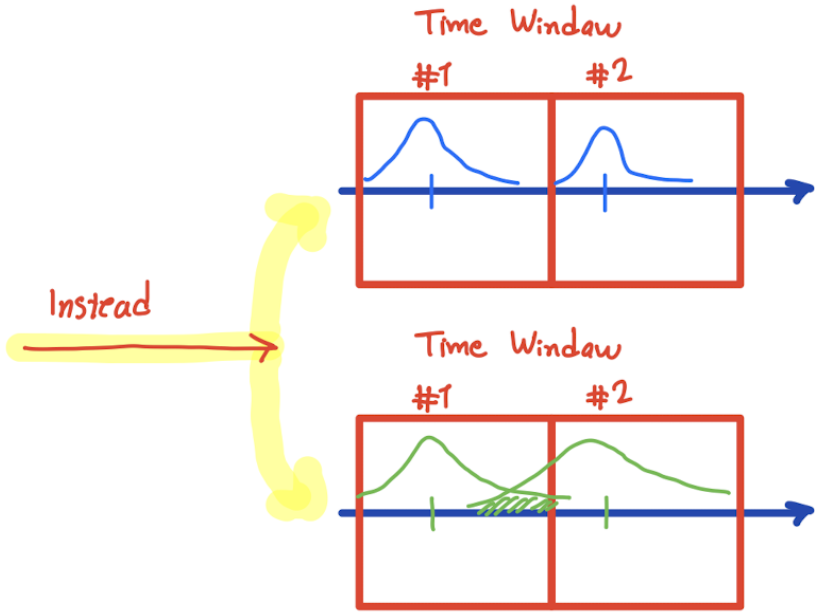


Detecting Neuronal behavior

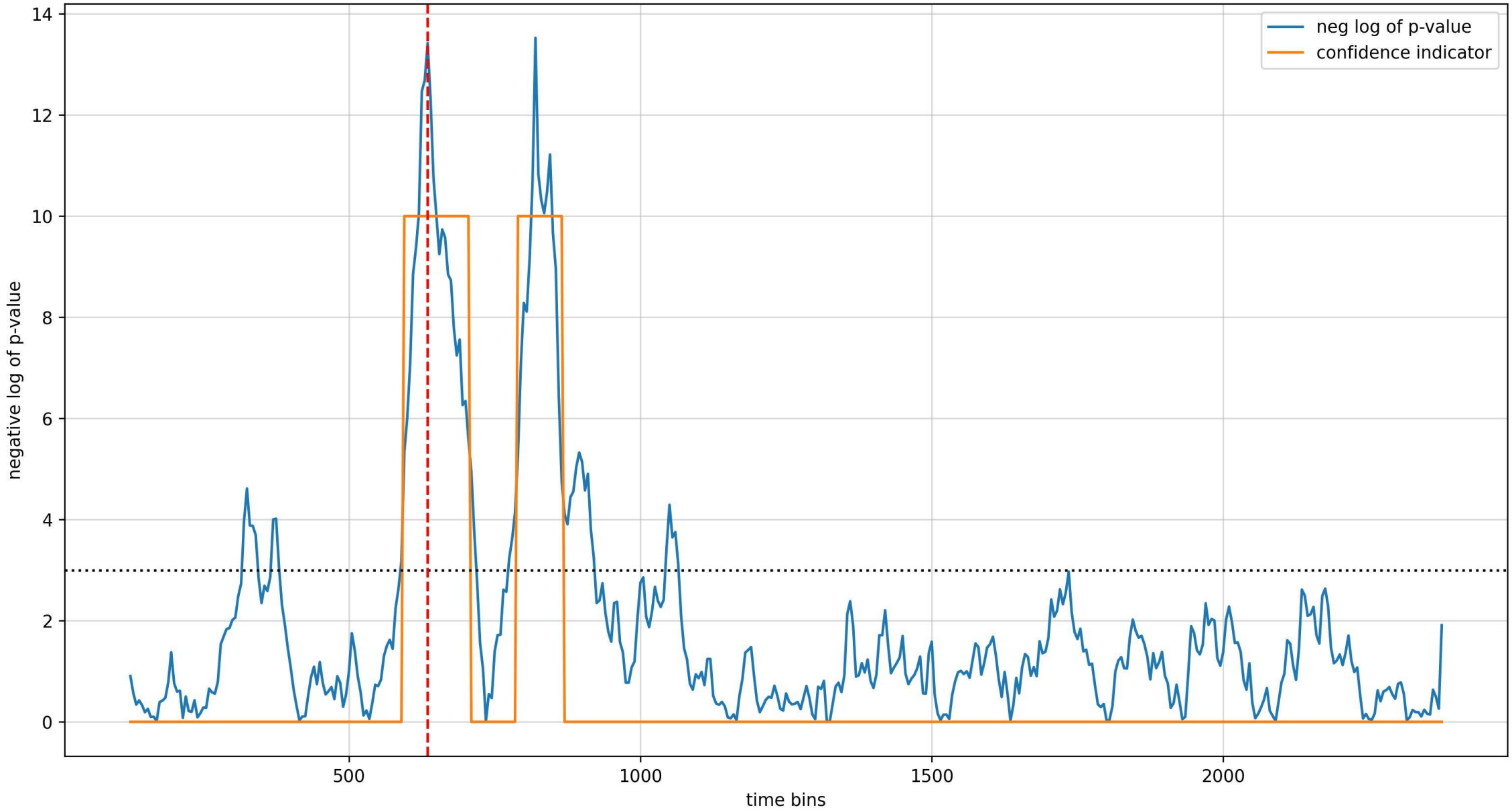


⚠ There is no evidence that the first time-bin in time-window #1 have any connection to the same time bin in time-window #2



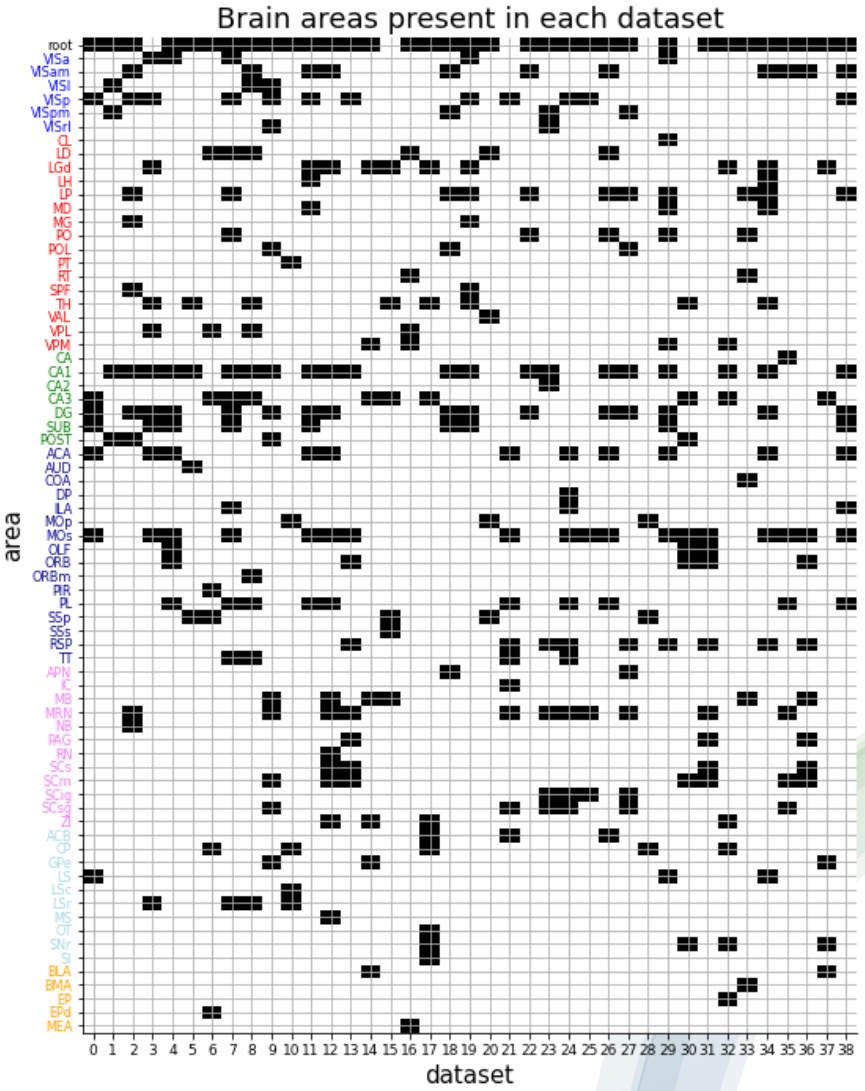


Our result on p_value

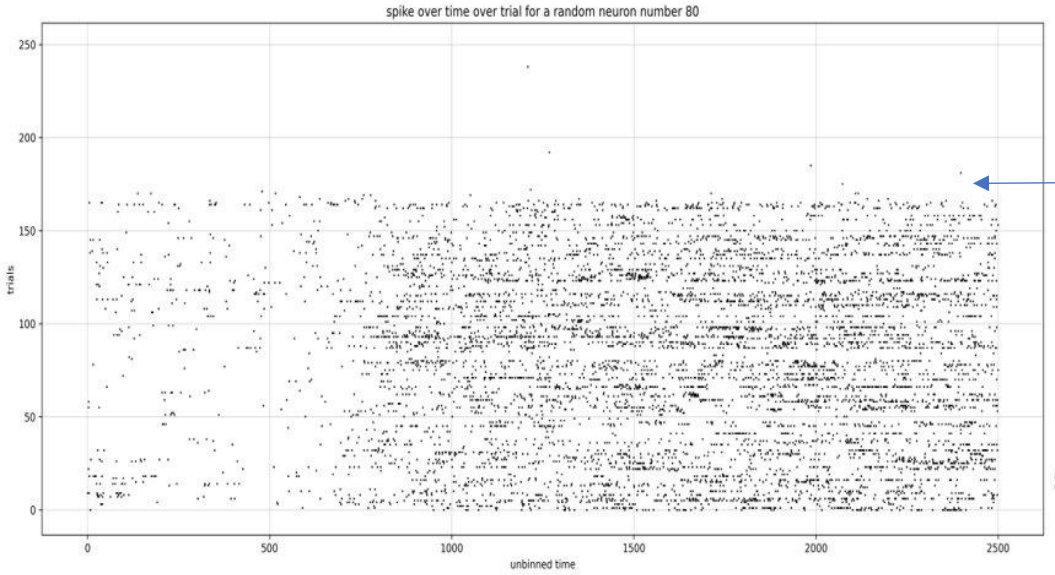


Limitations (1): Limited/uneven data

- The same brain regions were not mapped between trials. Some regions have more samples than others, and not all cortexes have the same data density.

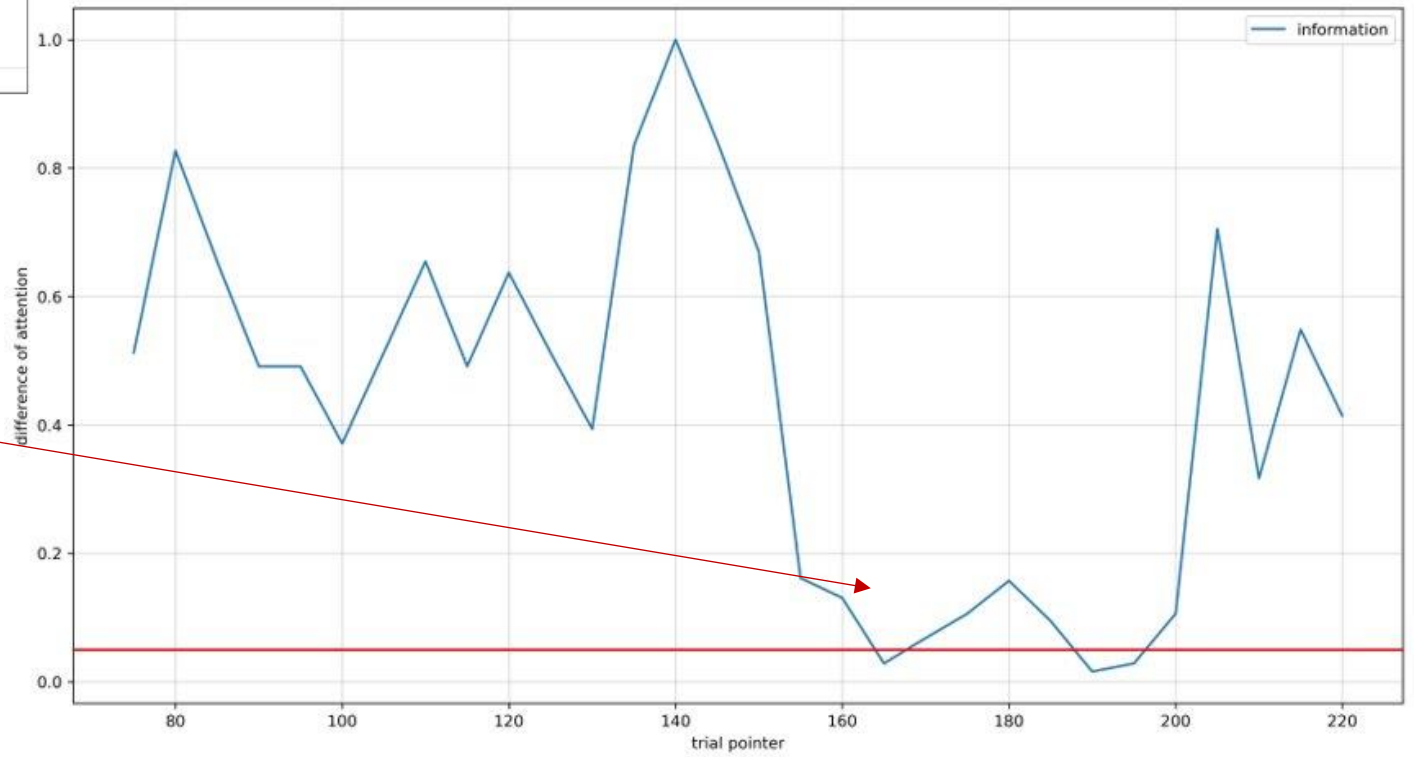


Limitations (2): Tired out mice



We can see after a certain number of trials, some neurons stop outputting data

We can see this reflected in the calculated attention of the mouse, as it seems to dip on those trials



Outro

- Comparison of all methods
- limitations
- future works and discussions.