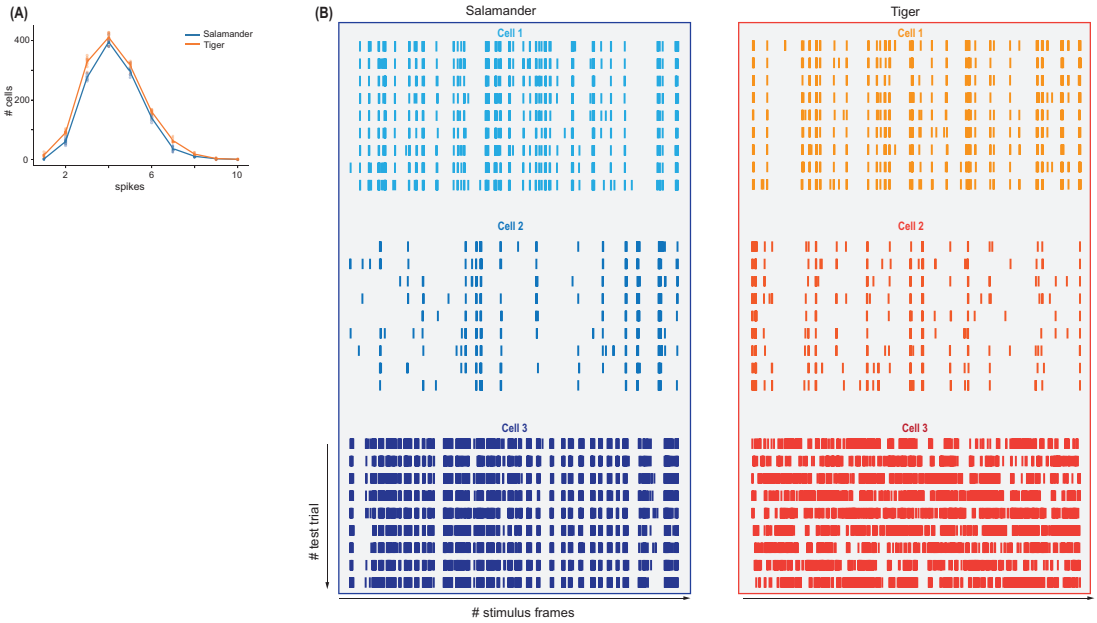

Fig. 1: Spike trains in salamander and tiger datasets. (A) Distribution of cells with maximal firing spikes to different stimulus frames in salamander and tiger datasets. The x-axis represents the number of firing spikes. And the corresponding colored points represent the cell numbers in 9 trials (blue for salamander and yellow for tiger). The lines are joined with the average values of the cell numbers in 9 trials. (B) We illustrated each 9 spike rasters of 3 respective cells in salamander and tiger datasets. We take the Cell 3 on the left panel as an example. The y-axis represents different stimulus frames (which are 1800 in salamander movie and 1600 in tiger movie), and the nine rows indicate firing rasters of 9 trials. Each bar with dark blue means this cell has fired at the very stimulus frame.

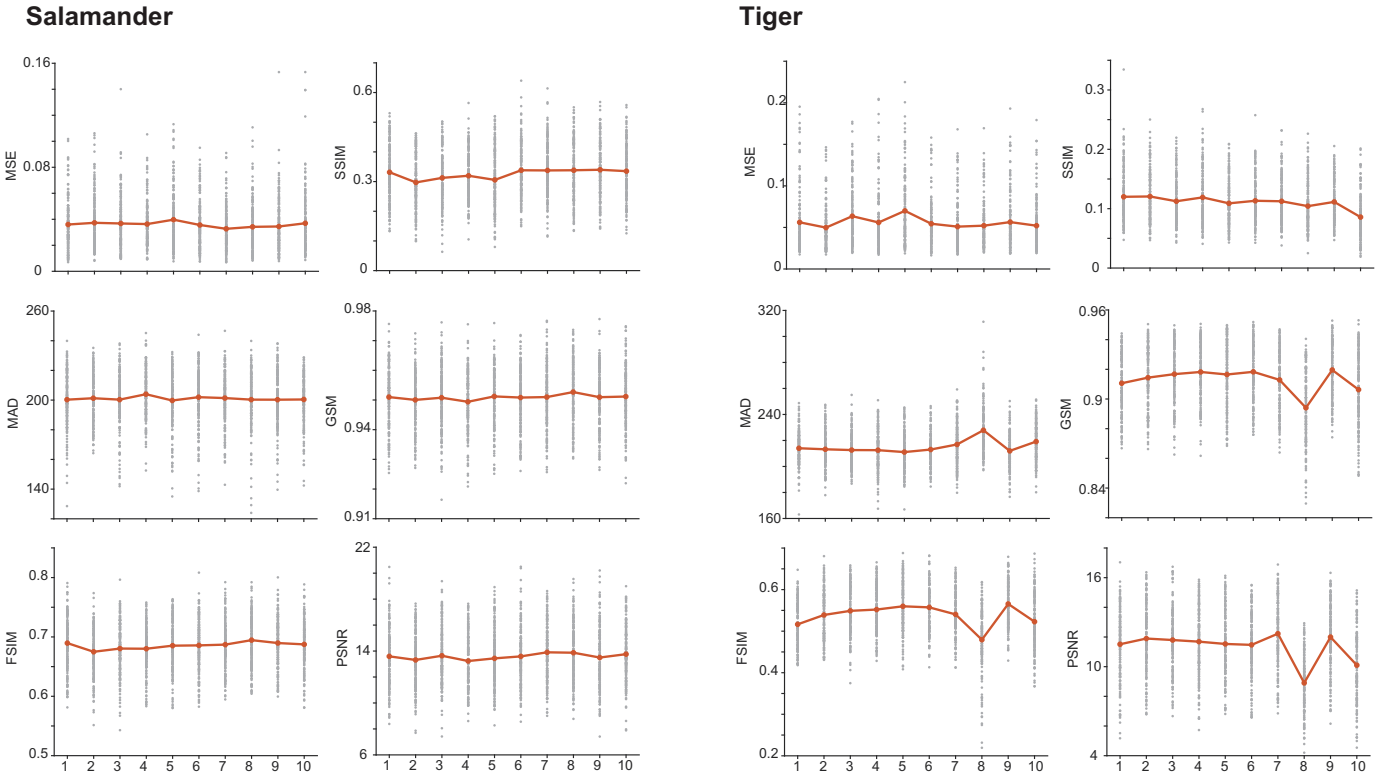

Fig. 2: Metrics of 10 decoding models of 100 RGCs. The x-axis represents 10 different decoding models trained with 100 randomly chosen RGCs from salamander or tiger dataset. The gray points are the metric value of each frame from half of the test set size, specifically, 90 for the salamander and 80 for the tiger. The red line indicates the average value of all frames from the test set.

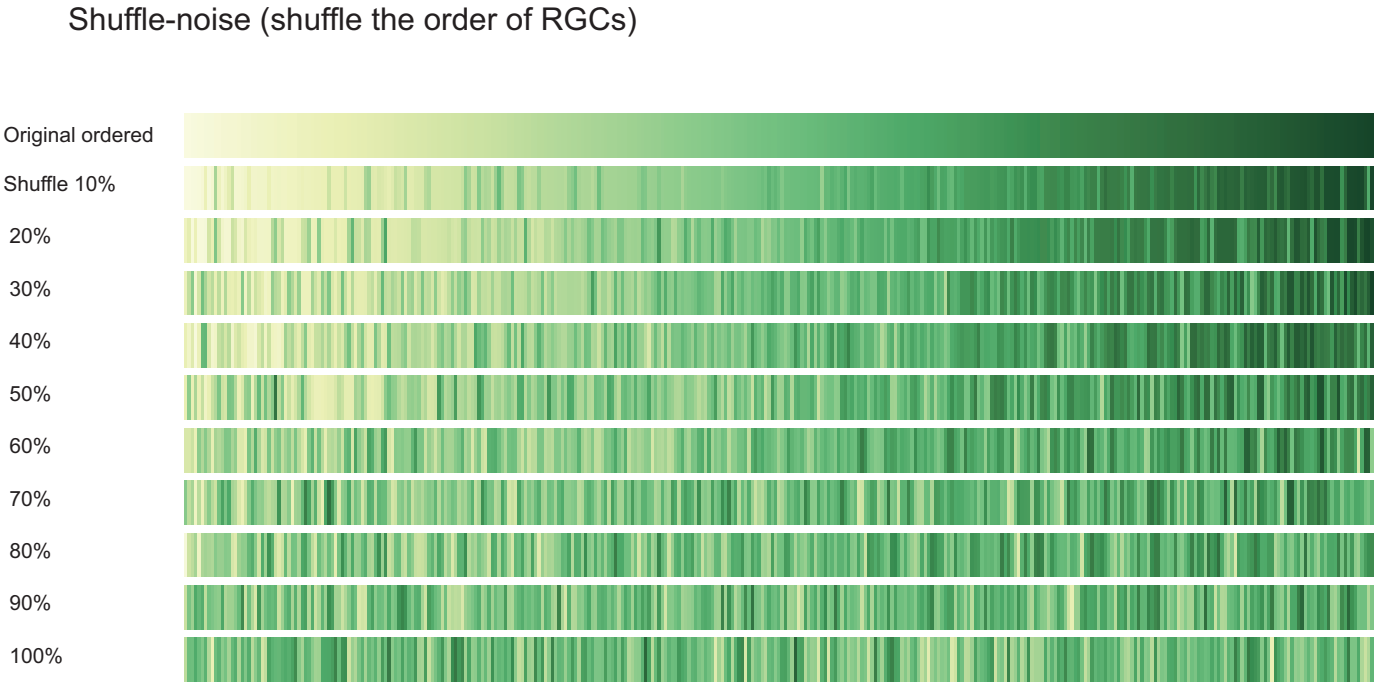

Fig. 3: Illustration of shuffle noise. We explain the principle of shuffle noise in this work. First, we assume the first row is the original order of RGCs, which are fed into the decoding model in the context of no-noise added. The whole color bar at the first row is the original color bar named 'YlGn', which can be divided into 1218 parts average at the x-axis, indicating 1218 cells. The original color bar indicates the color evolution from the left to the right uniformly, while more shuffle noise, more chaotic for the color evolution. Adding shuffle noise is to shuffle the input order of a certain percent of all RGCs, which are illustrated as following rows.

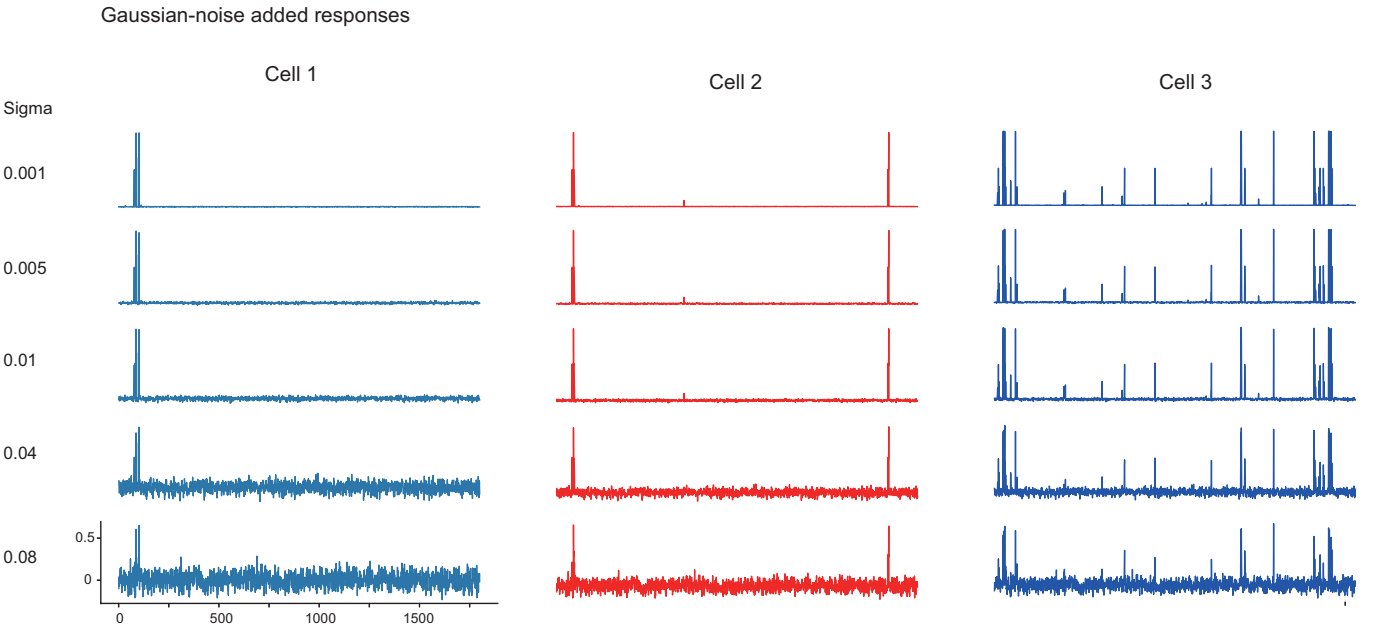

Fig. 4: Illustration of Gaussian noise. We add zero-mean Gaussian noise with different sigmas to the normalized spike trains of RGC response to 1800 stimuli. Here, we take 3 cells for instance, which represent different response cases of concentration firing, sparse firing to different stimuli, and strong firing to multi stimuli. Different cells are indicated by different colors. From up to down, each row represents the noise-added normalized spike train (added larger-sigma Gaussian noise).

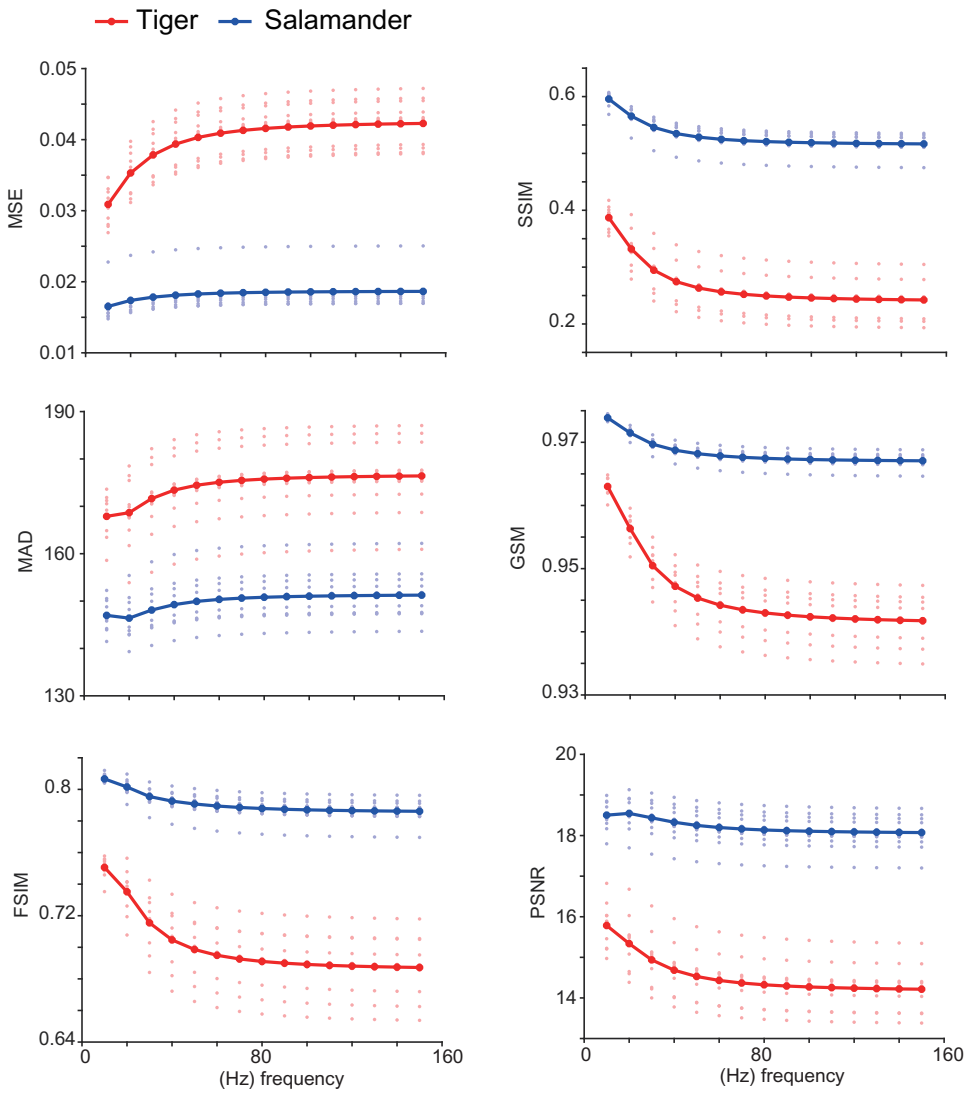

Fig. 5: **Image reconstruction metrics change through low-pass frequency (1-150Hz) reference frames in both datasets.** 10 light-color points at each x-axis represent metric values of 10 decoding models with different random initialization. The dark-color line indicates the mean metric values of 10 different models described above for each subplot.