# A Supplementary Material

A.1 Training Data

Electrophysiological data were acquired as broadband signal (0.5Hz-16kHz), from a pair of male rhesus macaque monkeys (*Macaca mulatta*), using 32 channel linear silicon probes (NeuroNexus V1x32-Edge-10mm-60-177). The data was spike-sorted, and single units were isolated based on unit stability, refractory periods, and channel principal component pairs. Visual stimuli were presented to the animals on a 16:9 widescreen HD LCD monitor at 100c̃m viewing distance. The animals were rewarded with juice if they maintained their gaze around a red fixation target throughout each trial. At the beginning of each recording session, the receptive fields (RFs) of the neurons were mapped in relation to a fixation target using sparse random dot stimuli, and the population RF was pulled towards the center of the screen by adjusting the fixation target. A collection of 24,075 images from ImageNet [56] was transformed into gray-scale and cropped to the central 420^2 px and had 8 bit intensity resolution. These images were presented as visual stimuli during standalone generation recordings of 1244 units and during closed-loop recordings of 82 units. For details on the closed loop paradigm, please refer to Willeke et al. [23].
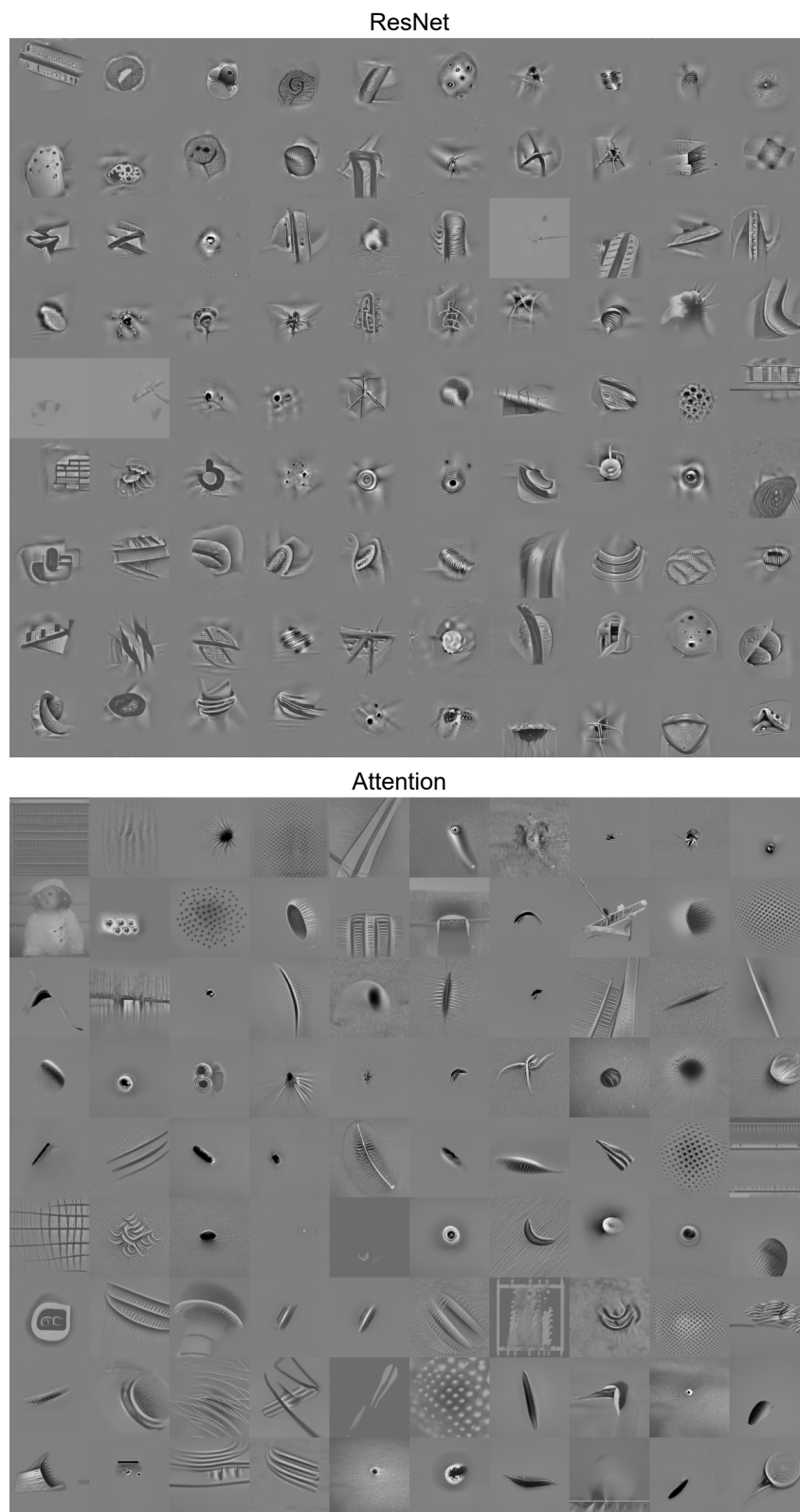
ResNet

Attention

Supplementary Figure S1: Examples of MEIs generated using EGG for the Attention readout and ResNet with Gaussian readout.
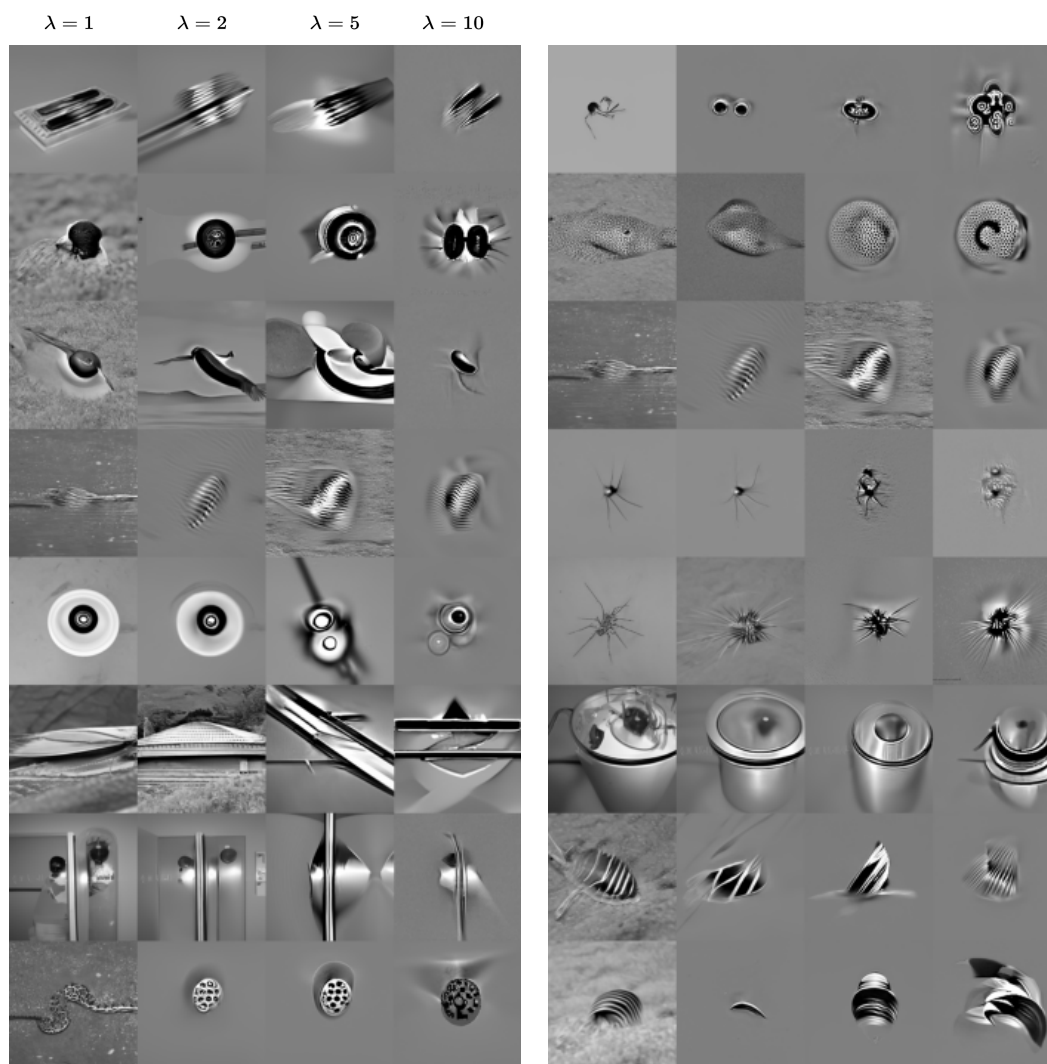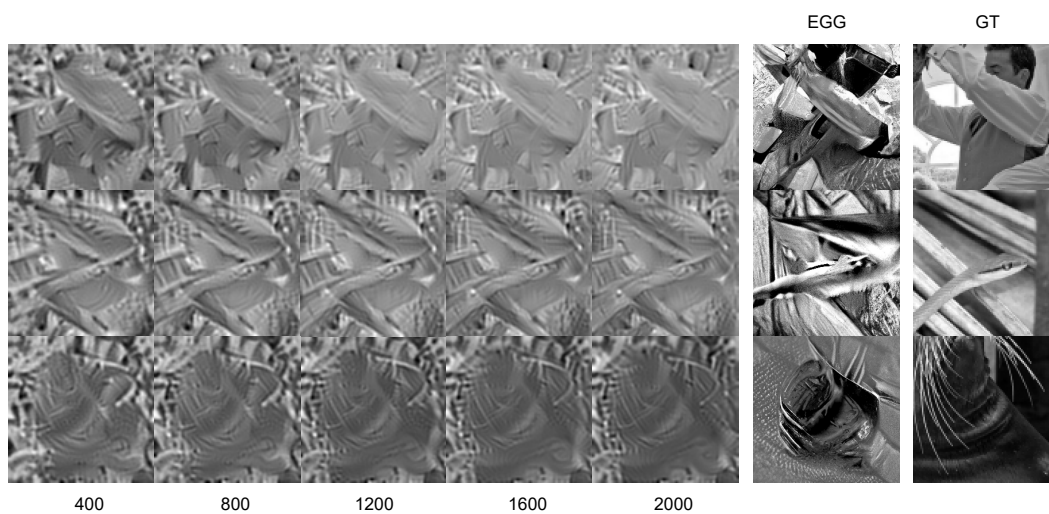
Supplementary Figure S2: Examples of images generated using EGG diffusion in the Monkey V4 with different energy scales $\lambda \in \{1, 2, 5, 10\}$. Generated for the ResNet model. Units not matched with the images shown for attention readout model.
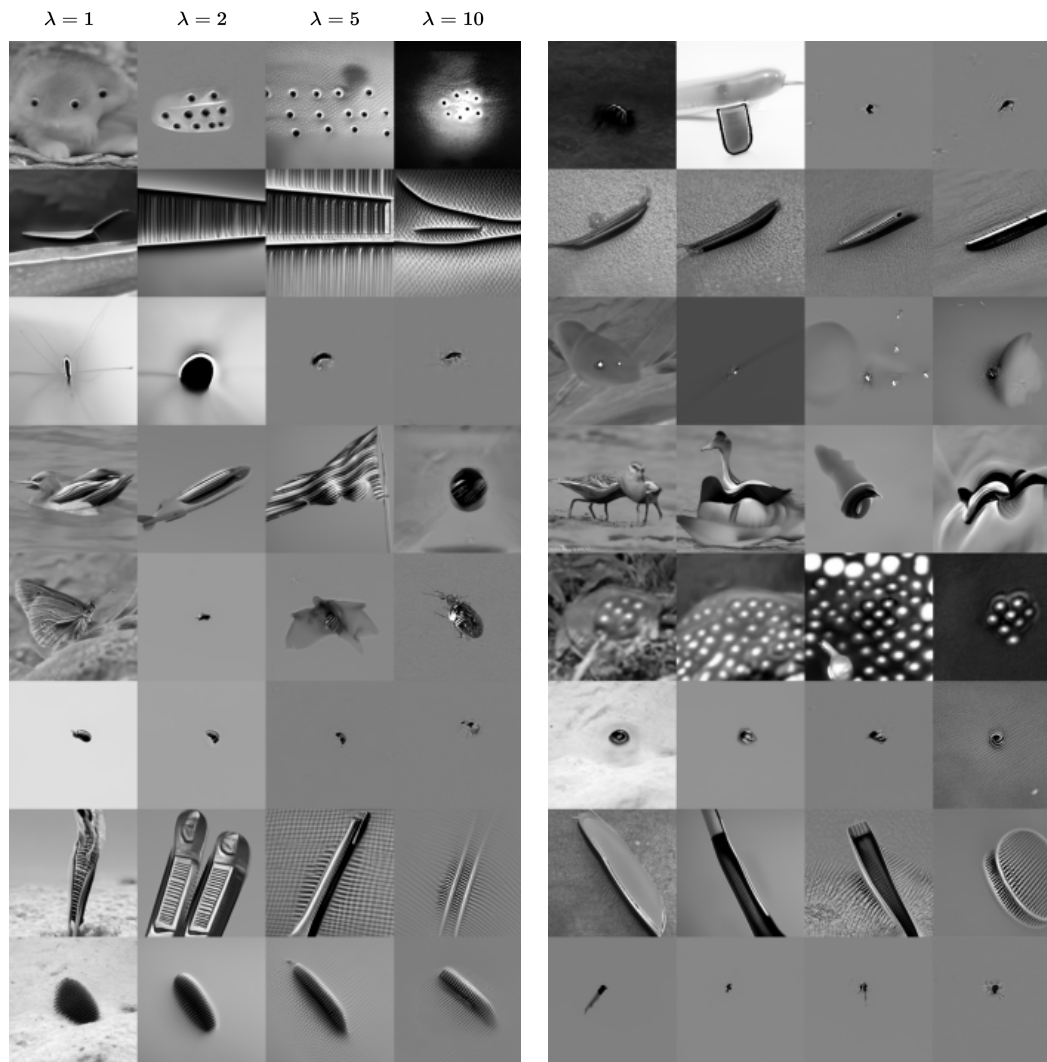
Supplementary Figure S3: Examples of images generated using EGG diffusion in the Monkey V4 with different energy scales $\lambda \in \{1, 2, 5, 10\}$. Generated for the data-drive with attention readout model. Units not matched with the images shown for ResNet model.

Supplementary Figure S4: Reconstruction examples from the ResNet with Gaussian readout model. Generated using EGG diffusion and gradient descent.

Supplementary Figure S5: Examples of reconstructions using GD across various training lengths. Increasing the training does not bring the generated image closer visually to the GT nor EGG.

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