Repetition Suppression and Enhancement in Macaque Dorsomedial Parietal Neurons during Free Viewing

（猕猴自由观看时背内侧顶叶神经元的重复抑制和增强）

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Introduction

This is a study in the field of cognitive neuroscience that aims to detect the underlying mechanism of how PPC processes visual information, especially research on repetition suppression and repetition enhancement.
此为一项认知神经科学领域内的动物研究，旨在探究猕猴后顶叶皮层处理视觉信息的底层机制.

Background

- When humans and many other species sense repeated visual information, they can expect the incoming content. This project aims to detect how our brains process repeated stimuli at the neural level. .
- 当人类或其他物种处理重复的视觉信息时，他们能够预判接下来的内容。这个项目旨在研究在神经层面，大脑如何处理重复刺激。

Neural Response (神经反应)

- **Repetition suppression** is defined as attenuated neural activities that can be observed when the subject receives a certain stimulus repeatedly.
- **Repetition enhancement** refers to enhanced neural activities that arise from the repeated presentation of a stimulus.

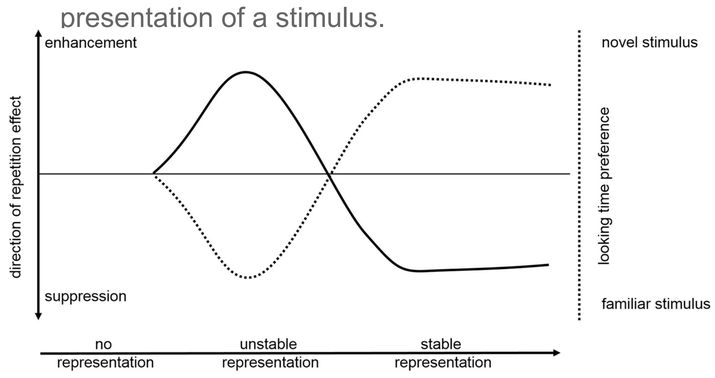

Figure1. Repetition Enhancement/Suppression

Modulation Mechanism

(加工机制)

How do the brain modulate the selective attention?
大脑如何加工注意选择

Top-down or bottom-up
顶层向下还是底层向上?

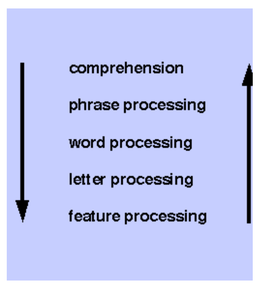

Figure2. Level of processing

Method

- 32 electrodes were inserted in the monkeys' Posterior parietal cortex(PPC) to record neuron activities. Inserted electrodes measure neural change in extracellular physiological activities.
- 32个电极被植入猕猴的后顶叶皮层区域（PPC）去检测大脑的神经活动。

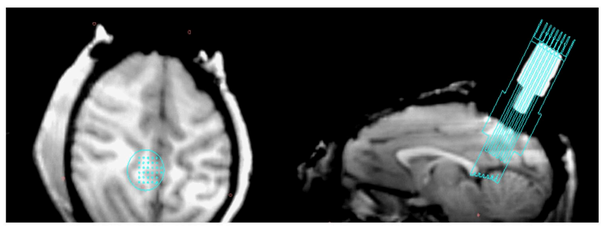

Figure3. Posterior parietal cortex (PPC)

- Plexon Offline Sorter was used to rule out noises and sort the pure spikes for each channel. In all, we obtain 16 effective neurons.
- 使用Plexon Offline Sorter软件去消除噪声来获得每个电极的有效神经元。经过筛选，一共得到16个有效的可研究神经元。

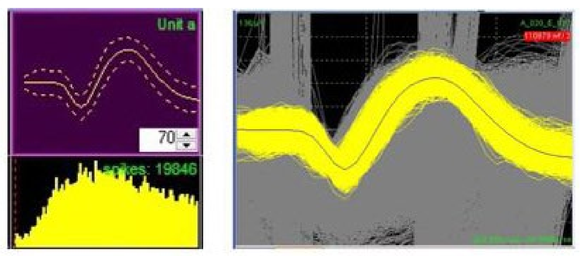

Figure4. pure spike

• Schema of Procedure

- Head-fixed monkeys performed free viewing of three types of pictures (Primate, Non-primate, Scenery) and two types of videos (Primate, Non-primate). Each type has 10 different pictures and each picture was played for 10 times. Each video was played for 60 times. 540 trials were conducted in one day.
- 头部固定的猕猴观看三种图片（灵长类、非灵长类动物、景观）和两种视频（灵长类、非灵长类动物）。每种图片有10张，每个播放10次，每个视频播放三十遍。每天一共进行540个试次。

Figure5. Picture Trial

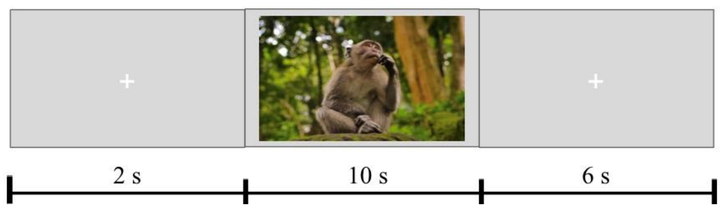

Figure6. Video Trial

Data Analysis

Normalize Timestamp(正则化时间戳)

- After sorting these 32 channels, we obtain normalized timestamps of these spikes and plot these spikes trains. One neuron's activations across picture viewing.
- 经过筛选，我们正则化这些有效神经发放的时间戳来展现每个实验中神经发放的出现情况。以下是观察图片时，一个神经元的神经发放情况。

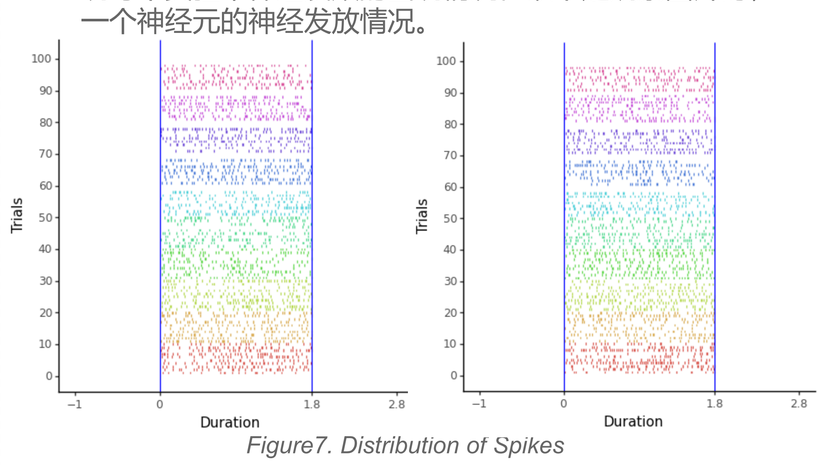

Figure7. Distribution of Spikes

Results

Linear Regression for Firing Rate (神经元放电频率线性回归)

- Record the firing rate of each repetition for one picture in a plot. Then, conduct linear regression to examine neurons' reactions to a repeated stimulus.
- 在每张图里记录同一个神经元对于一张重复十次的非灵长类动物图片的神经活动。

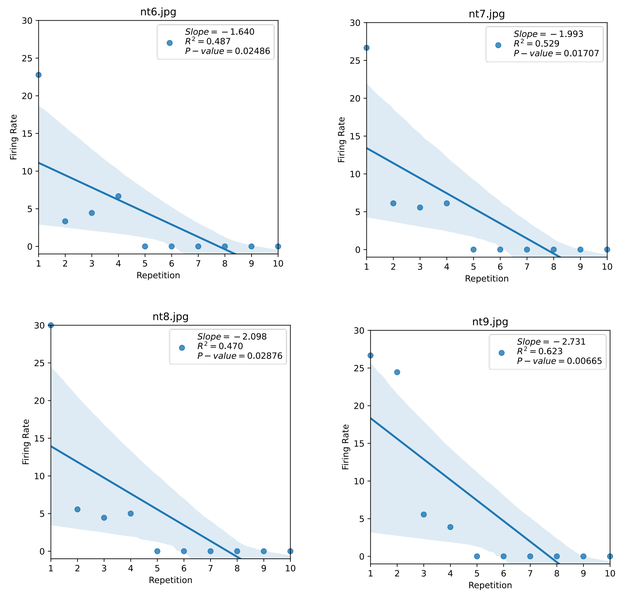

Figure8. one channel on non-primate pictures(E_025a)

Categorize the state of channels

(分类神经元的神经反应)

- Based on each channel's firing rate of videos and pictures, we categorized these channels.
- 基于每个神经元对于图片和视频的放电频率的反应，将16个有效神经元进行分类

PIC RS, VIDEO RS	PIC RS, VIDEO RE	PIC RE, VIDEO RS	PIC RE, VIDEO RE
E_010a, E_018a, E_024a	E_008a, E_025a, E_025b, E_027a	E_005a, E_019b, E_029a	E_019a, E_031a

Figure9. Category of channels

Ongoing Analysis

Difference between PIC/Video Categories

(不同种类照片/视频观看的差异)

- Based on categories above, we're going to detect the difference between picture and video categories and build the corresponding model.
- 基于已有的分类，我们将研究猕猴大脑神经活动在观察不同种类图片和视频时的细微差别，并建立相应的模型。
- Reveal the periodicity of each neuron's waveforms
- 研究每个有效神经元的脉冲波形周期
- Apply Generalized Linear Model: to examine how amplitude, period, wavelength vary and detect the underlying mechanism of repetition enhancement
- 运用广义线性模型去检测脉冲的振幅，周期和波长变化,并研究重复增强的底层机制

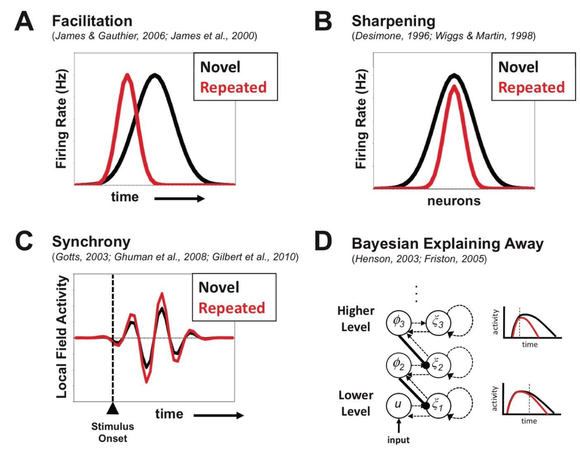

Figure10. Computational Models of Repetition Effects

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