POPULATION CODING IN SIMULTANEOUSLY RECORDED RETINAL GANGLION CELLS

Bonomini, M.P., Bongard M., Ferrandez, J.M
Instituto de Bioingeniería, Univ. Miguel Hernández, Alicante
Campus de San Juan, Aptdo. de correos 18, 3550 San Juan, Alicante, Spain
p.bonomini@umh.es, markus.bongard@umh.es, jm.ferrandez@umh.es

Pelayo F.
Departamento de Arquitectura y Tecnología de Computadores, Univ. de Granada
Facultad de Ciencias, Campus de Fuentenueva, 18071 Granada, Spain
fpelayo@ugr.es

Fernández E.
Instituto de Bioingeniería, Univ. Miguel Hernández, Alicante
Campus de San Juan, Aptdo. de correos 18, 3550 San Juan, Alicante, España
e.fernandez@umh.es

ABSTRACT

Relatively little is known how the brain encodes and represents single aspects of the outside world. Because of the parallel nature of the information that the retina sends to the higher visual centers, and because of the large response variability to repeated stimulus presentation, this process cannot be studied effectively using conventional single-cell recordings. Here we investigated with a multi-electrode array how populations of retinal ganglion cells encode simple visual stimuli. We asked whether it is possible to generalize the results, and to apply them to other experiments where different ganglion cell populations were recorded.

The responses of many ganglion cells were simultaneously recorded with a 100 microelectrode array in isolated, superfused turtle [3], rat and rabbit retinae. From each experiment the local minima- and maxima of the population activity in response to various light stimuli were determined and served as intrinsic "trigger" for analysis. Multivariate techniques and different neural networks architectures were then used to characterize the coding capabilities of the different retinal ganglion cell populations [1].

Our results shows that whereas single ganglion cells are poor classifiers of visual stimuli, a population of only 15 cells can distinguish stimulus color and intensity reasonably well. This suggest that visual information is coded as the overall set of activity levels across neurons rather than by single cells [2]. We also found that single members of the recorded ganglion cell populations can be sorted into different temporal response classes. The number of these temporal classes is finite and can be used to extract common features in population responses obtained from different experiments. This suggests that temporal features and dependencies play a relevant role for encoding visual information.

Keywords: Population, Coding, Retina.

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