Talk session 2. Bistable Perception

Decision making in a dish: fundamental mechanisms of bistable visual information processing in mouse visual cortical brain slices

Richard van Wezel[1], Naoki Kogo[1]

[1]Donders Institute for Brain, Cognition and Behaviour, Radboud University

Visual decision mechanisms are often studied using bistable stimuli. In a bistable visual stimulus the evidence for one visual percept is similar to the evidence for the other percept. We studied the basic mechanisms how the brain decides what percept arises. In an in vitro set-up we investigated the fundamental mechanisms of bistable perception. We developed a "hybrid" system where two real-life pyramidal neurons in a mouse visual cortical brain slice interact through a computer simulated mutual inhibition circuit. Simultaneous activation of the mutually inhibiting pyramidal neurons leads to bi-stable activity. We observed that the circuit exhibits dynamics strikingly similar to the known properties (Levelt's laws) of bi-stable visual perception. Furthermore, we investigated the effect of noise in those decision processes by minimizing noise by blocking intrinsic synaptic noise with GABA and glutamate antagonists. The results under those conditions show a reduction of the number of reversal frequencies, but bistability still occurs. We conclude that basic phenomena of bistable vision can be explained with the properties of real visual cortical neurons combined with modeled inhibitory interactions.

Corresponding author(s):
Richard van Wezel, r.vanwezel@donders.ru.nl,
http://www.van-wezel.nl

The effect of short-term monocular deprivation depends on the duration of deprivation: evidence from binocular rivalry and binocular combination.

Antoine Prosper[1], Martina Pasqualetti[2], Maria Concetta Morrone[2], Claudia Lunghi[1]

[1]École normale supérieure, PSL Research University, CNRS
[2]University of Pisa

The ocular dominance (OD) shift observed after short-term monocular deprivation (MD) is a widely used measure of visual homeostatic plasticity in adult humans. Binocular rivalry and binocular combination techniques are used interchangeably to characterize homeostatic plasticity, sometimes leading to contradictory results. Here we directly compare these two techniques by investigating the impact of the MD duration on OD in adult humans.

We measured the effect of 15 minutes and 120 minutes of MD in 15 adult volunteers. OD was assessed either by binocular rivalry (BR, orthogonal gratings: size 2°x2°, SF: 2 cpd, contrast 60%) or binocular phase combination (BC, sinusoidal gratings, size: 3.5°x3.5°, SF: 1 cpd, base contrast: 50%). Each subject underwent four deprivation sessions (2 durations x 2 conditions) in separate days and in a counterbalanced order.

We found that the effect of MD exhibited a strong dependence on the deprivation duration (BR: 15min vs. 120min: $F(1,14)=36.2$ $\eta 2=0.313$, $p < 0.001$; BC: $F(1,14)=27.0$ $\eta 2=0.278$, $p<0.001$), with longer deprivation inducing a stronger and longer-lasting effect for both