Speed history effects of visual stimuli

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In natural environments the speed of moving objects continually changes. To successfully interact with such objects it is useful to not only focus on the ongoing speed, but to also take speed changes into account. In the present study we were interested in whether area MT - the main motion area in the primate brain – represents not only information of the ongoing speed of a visual motion stimulus but also reflects recent stimulus speed history.
We recorded from MT neurons from macaque monkeys during visual stimulation. The stimulus consisted of random dots moving into the preferred direction of the neuron. Stimulus speed changed smoothly over time (either linearly accelerating (condition 1) or decelerating (condition 2). Both conditions contained the same actual speeds, but the speed history differed.
We found that the responses of most MT cells were influenced by the recent speed history of the visual stimulus. One main finding was a change in tuning width: The speed tuning was narrower when the stimulus was accelerating than when it was decelerating. This suggests that the system is less sensitive to speed changes when the stimulus smoothly decelerates. We investigated this in a psychophysical experiment with human subjects by determining detection thresholds to speed changes in a smoothly accelerating or decelerating stimulus. The results confirmed the prediction: during smooth deceleration, sensitivity was lower than during acceleration.
In summary we found that the recent stimulus speed influences the speed tuning properties of MT neurons and the speed perception of human subjects. This is further evidence that the visual system does not represent snapshots of the ongoing visual stimulation but integrates information over time. This integration is beneficial for survival in an ever changing environment.