The Dan Lab
Directed by Dr. Yang Dan

A. Afsharrad

T. Entesari

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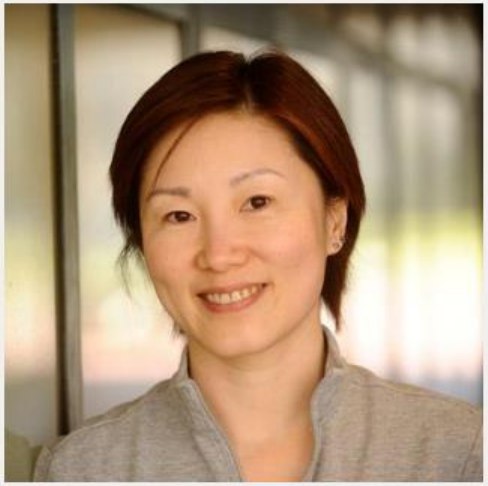
Basic Information



Yang Dan, PhD

Investigator / 2008—Present

Dr. Dan is also a professor of neurobiology at the University of California, Berkeley.

INSTITUTION
University of California, Berkeley

SCIENTIFIC DISCIPLINE
Neuroscience, Physiology

Basic Information

Basic Information

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Fields of Interest

- **Neural circuits controlling sleep**

  what circuits in the mammalian brain control sleep

- **Function of the prefrontal cortex (PFC)**

  mechanisms by which the frontal cortex exerts top-down executive control

Contents

Introduction to the Paper

A Hypothalamic Switch for REM and Non-REM Sleep

Kai-Siang Chen,[1,2,4] Min Xu,[1,2,4,5] Zhe Zhang,[1,2] Wei-Cheng Chang,[1,2] Thomas Gaj,[1,3] David V. Schaffer,[1,3] and Yang Dan[1,2,6,*]

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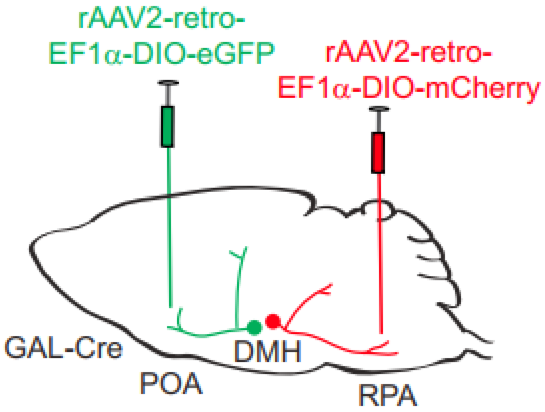
The Article Claims

- DMH galaninergic neurons consist of two distinct populations—REM-on and REM-off
- Separate DMH galaninergic neurons project to POA and RPA
- The POA-projecting neurons are REM-off, and their activity suppresses REM sleep
- The RPA-projecting neurons are REM-on, and their activity promotes REM sleep

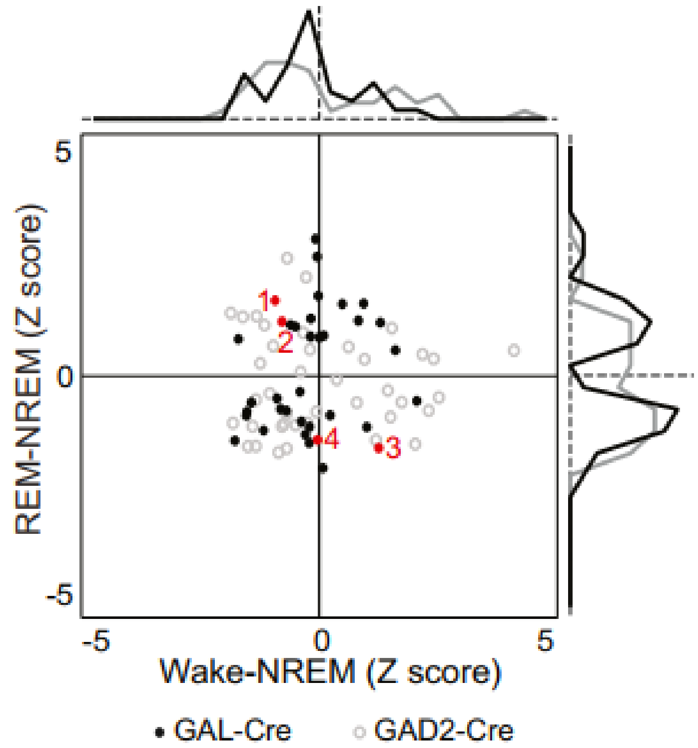
Materials and Methods

- Experiment done on a group of mice
- Invasive data
- Microscopic calcium imaging
- To test whether each subpopulation of DMH neurons play any causal role in sleep regulation, their activity was manipulated optogenetically
- Laser stimulation



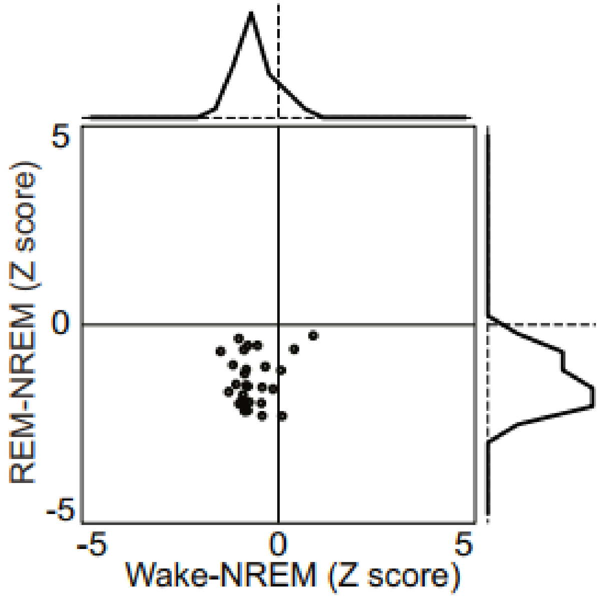
Results

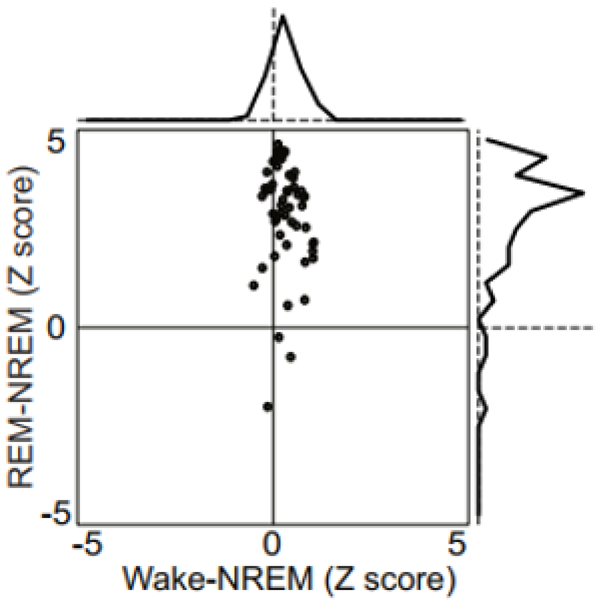
The neural ensemble under consideration, clustered into two groups



Results

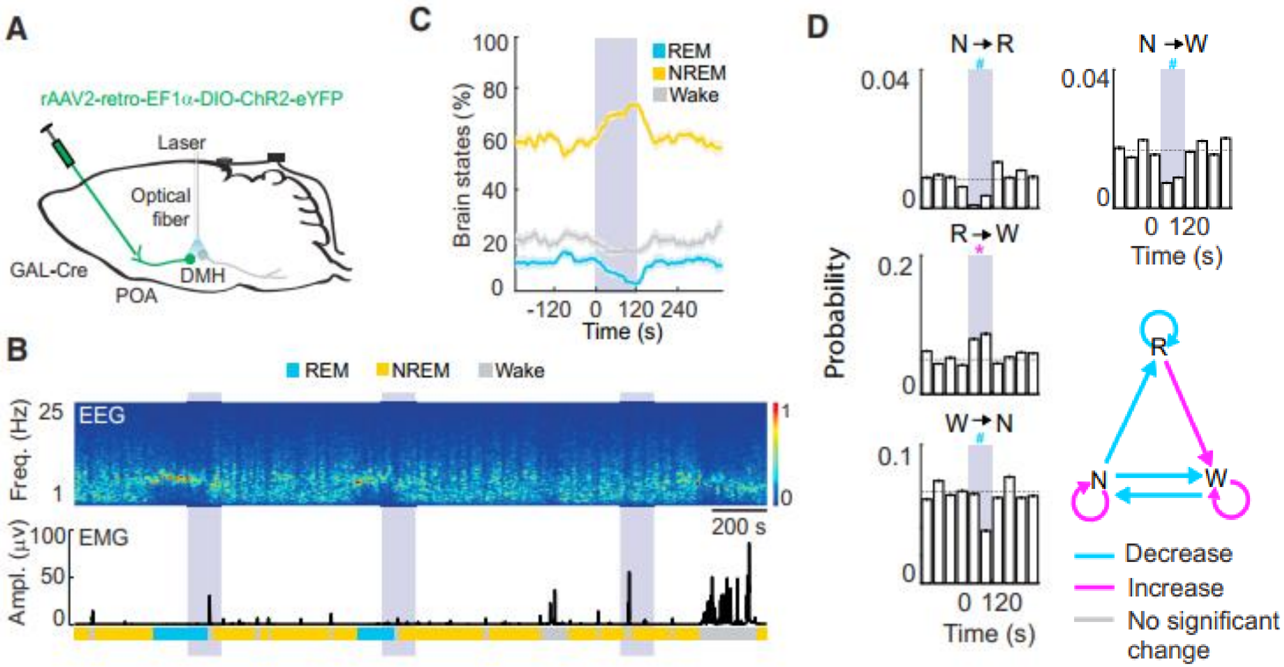
REM-sleep results, for POA-projecting neurons (on the left) and RPA-projecting neurons (on the right)





Results

The causal effect of stimulating POA-projecting neurons (using laser stimulus) on sleep state



Contents

Introduction to the Paper

nature neuroscience

Activity recall in a visual cortical ensemble

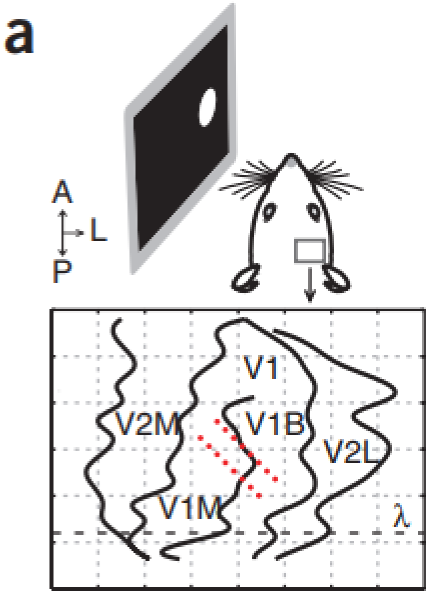
Shengjin Xu[1,2,5], Wanchen Jiang[1,2,5], Mu-ming Poo[1,3] & Yang Dan[3,4]

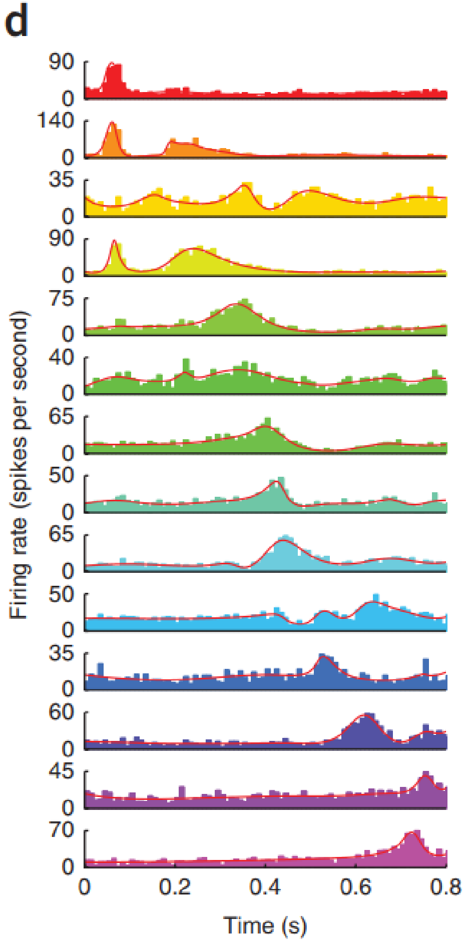
The Article Claims

- Cue-triggered recall of learned temporal sequences is an important cognitive function that has been attributed to higher brain areas
- After repeated stimulation with a moving spot that evoked sequential firing of an ensemble of primary visual cortex (V1) neurons, just a brief flash at the starting point of the motion path was sufficient to evoke a sequential firing pattern that reproduced the activation order evoked by the moving spot

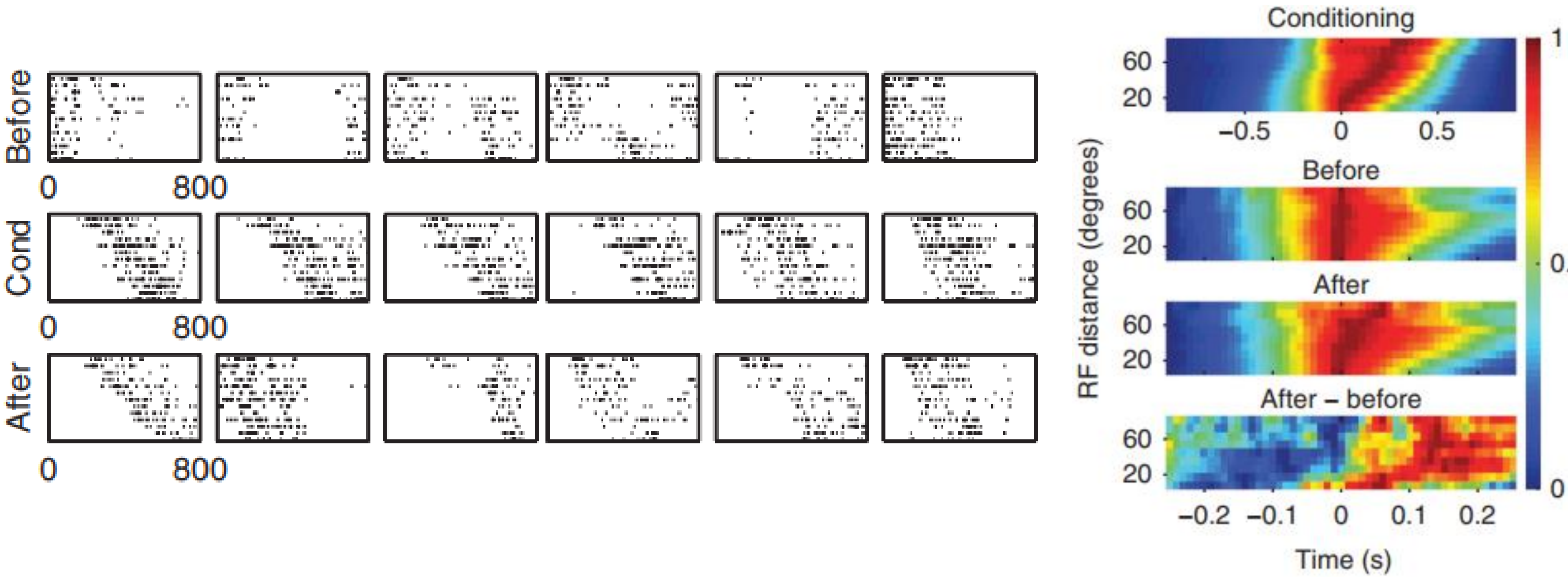
Materials and Methods

- Experiment done on a group of mice
- Invasive data
- Electrode array
- A moving-spot trigger





Results



- One final point: Anesthetized vs awake subjects

Contents

Introduction to the Paper

Motion-Induced Perceptual Extrapolation of Blurred Visual Targets

Yu-Xi Fu, Yaosong Shen, and Yang Dan

Division of Neurobiology, Department of Molecular and Cell Biology, University of California, Berkeley, California 94720

The Journal of Neuroscience, October 15, 2001, Vol. 21 RC172

The Case Under Discussion

- **Problem**: Processing delay in the neural pathway should cause a significant offset between the perceived and the actual positions of a moving object
- **Proposed Solution**: The visual system can compensate for the neural delay and reduce the perceptual misalignment by extrapolating the trajectory of the moving object

Previous Works

Supporters

- Nijhawan,1994, 1997
- MacKay, 1958
- Berry et al., 1999

Opponents

- Baldo and Klein, 1995
- Purushothaman et al., 1998
- Lappe and Krekelberg, 1998
- Whitney and Murakami, 1998
- Krekelberg and Lappe, 1999,2000
- Brenner and Smeets, 2000
- Eagleman and Sejnowski,2000
- Whitney et al., 2000

Flash-Lag Illusion

This Article Claims

Motion-Induced Perceptual Extrapolation of Blurred Visual Targets

Yu-Xi Fu, Yaosong Shen, and Yang Dan

Division of Neurobiology, Department of Molecular and Cell Biology, University of California, Berkeley, California 94720

In the motion-extrapolation hypothesis, the visual system can extrapolate the instantaneous position of a moving object from its past trajectory. The existence of such a mechanism in human vision has been intensely debated. Here, we show compelling perceptual extrapolation of both first- and second-order moving stimuli, the magnitude of which depends on blurring of the visual target. The spatiotemporal characteristics of the extrapolation can be quantitatively accounted for by a simple model based on temporally biphasic neuronal response, a property widely observed among sensory neurons. Thus, motion-induced perceptual extrapolation exists in human vision, and spatial blurring is an important factor in the interaction between motion and perceptual localization.

Key words: psychophysics; motion extrapolation; second-order motion; edge; blur; localization; biphasic

Processing delay in the neural pathway on the order of tens of milliseconds should cause a significant offset between the perceived and the actual positions of a moving object. An appealing hypothesis is that the visual system can com... neural delay and reduce the perceptual misa... trapolating the trajectory of the moving ob... 1994, 1997). Evidence for motion extrapolation... from the flash-lag illusion in which the positi... object is perceived to be ahead of a briefly flas... they are physically colocalized at the tim... (MacKay, 1958; Nijhawan, 1994, 1997). Howe... ies of this illusion have yielded results that ... with the motion-extrapolation model (Baldo a... Purushothaman et al., 1998; Lappe and Kr... Whitney and Murakami, 1998; Krekelberg an... 2000; Brenner and Smeets, 2000; Eagleman ... 2000; Whitney et al., 2000). In particular, Eag... nowski (2000) found no perceived displaceme... flashed and the moving targets if the latter stopped at the time of the flash (also see Krekelberg and Lappe, 2000), directly contradicting the prediction of the motion-extrapolation model. In this study, we have used a similar motion-stop paradigm but different types of visual targets to reexamine the existence of motion-induced perceptual extrapolation. We found compelling extrapolation of moving targets with blurred edges, and this effect was general for both first- and second-order motion stimuli. The dependence of the motion-induced perceptual extrapolation on the blur and the velocity of the target distinguishes it from the motion-extrapolation mechanism originally proposed to explain the flash-lag illusion (Nijhawan, 1994). These spatiotemporal characteristics, however, can be quantitatively accounted for by a simple model based on the temporally biphasic neuronal response, a mechanism that has been used to account for motion extrapolation (Berry et al., 1999).

After this work had been completed, it came to our attention ...

human vision has been intensely debated. Here, we show compelling **perceptual extrapolation** of both first- and second-order moving stimuli, the magnitude of which **depends on blurring of the visual target**. The spatiotemporal characteristics

... 100 msec interval between the stop and the disappearance of the targets (see Results) made it easier for the subjects to perceive the end positions of the targets, but eliminating this period did not significantly affect the magnitude of the perceptual extrapolation (t test, $p > 0.60$ for subjects YF and HG, measured at a velocity of 4°/sec; target luminance, 90 cd/m^2; background, 10 cd/m^2; and Gaussian width, 4°).

Population neuronal response model. The model consisted of an array of 500 neurons in a visuotopically organized circuit whose receptive fields tile the visual field along the dimension of target motion. The response of the ith neuron, $r_i(t)$, is modeled as a linear convolution of the stimulus $s(x, t)$ and the spatiotemporal receptive field $k_i(x, t)$ (modeled as retinal

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http://www.jneurosci.org/cgi/content/full/5710

Materials And Methods

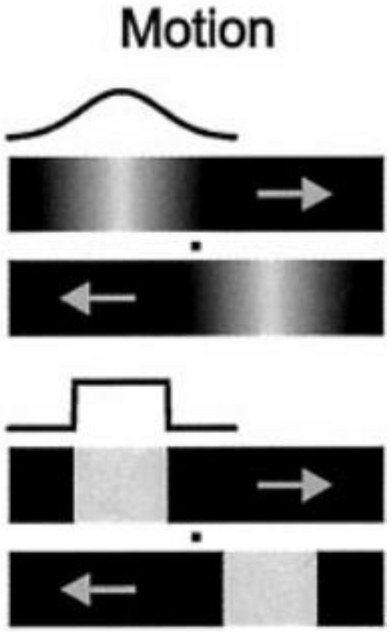
Psychophysical Experiments

- Two targets moving in opposite directions
- A staircase procedure to measure the perceptual displacement

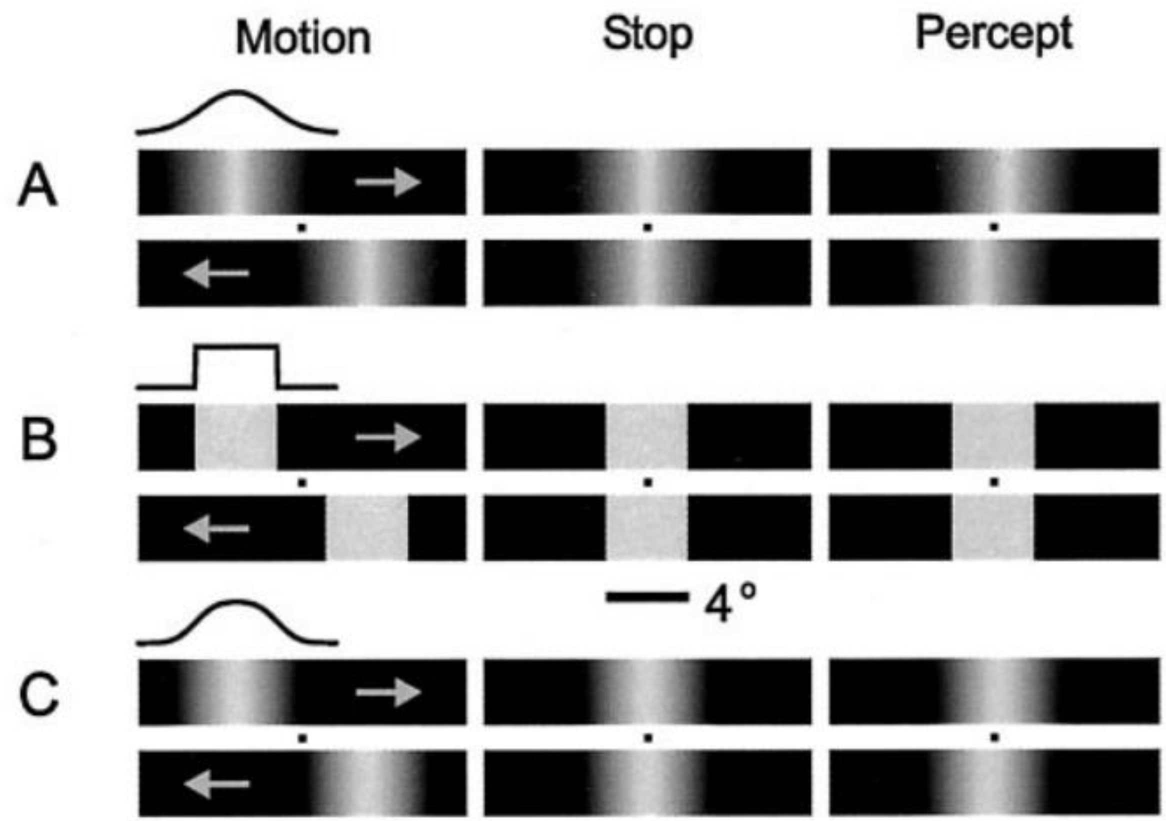
Population Neural Response Model

- An array of 500 neurons
- $$r_i(t) = \max\left[\int_{-\infty}^{\infty} dx \int_{-\infty}^{t} dt' s(x, t') k_i(x, t - t') - \theta, 0\right]$$

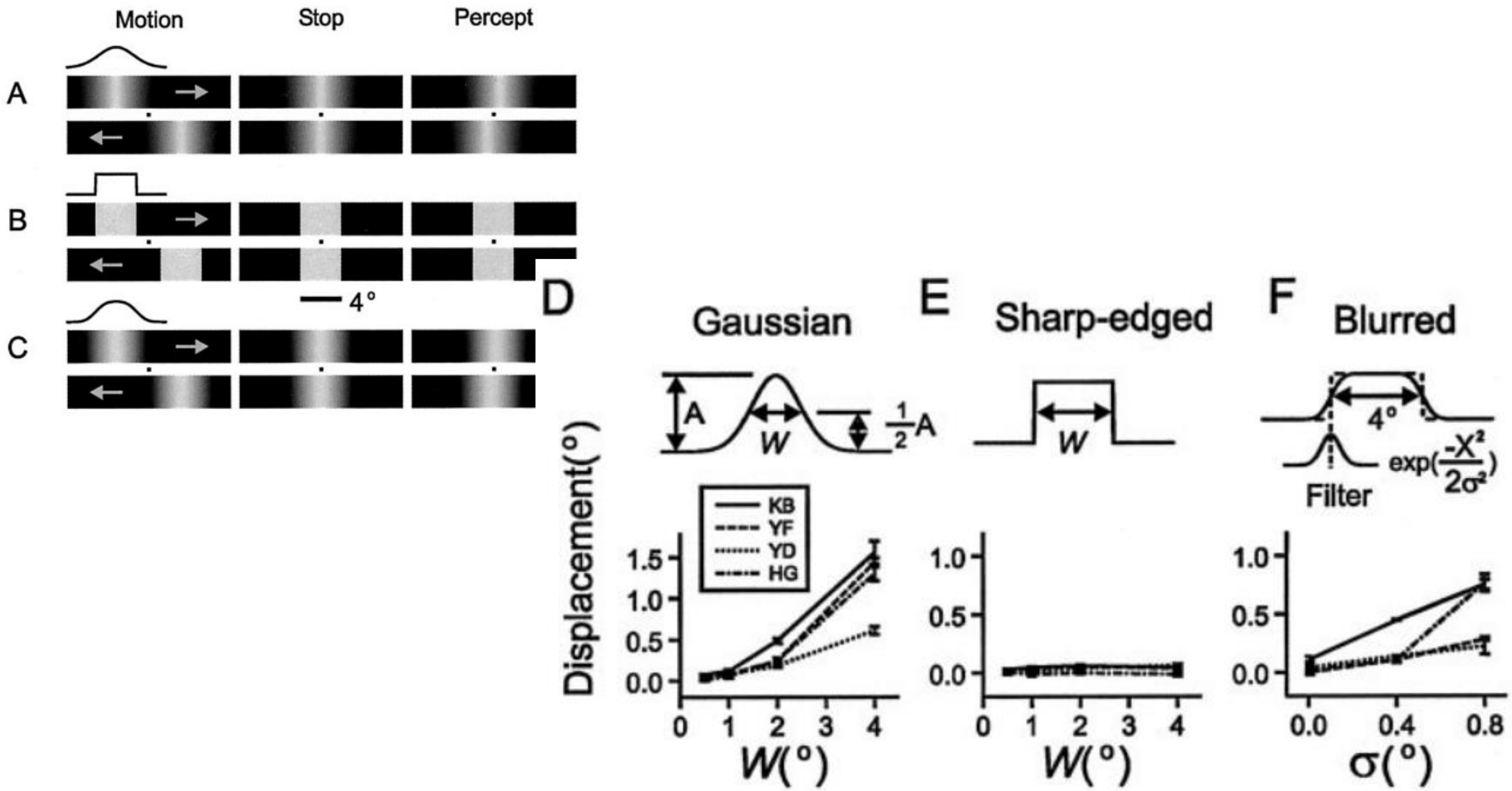
$$k_i(x, t) = [e^{-(x-x_i)^2/2\sigma_{k1}^2} - Ae^{-(x-x_i)^2/2\sigma_{k2}^2}] \times [te^{-at} - c^2 te^{-bt}]$$



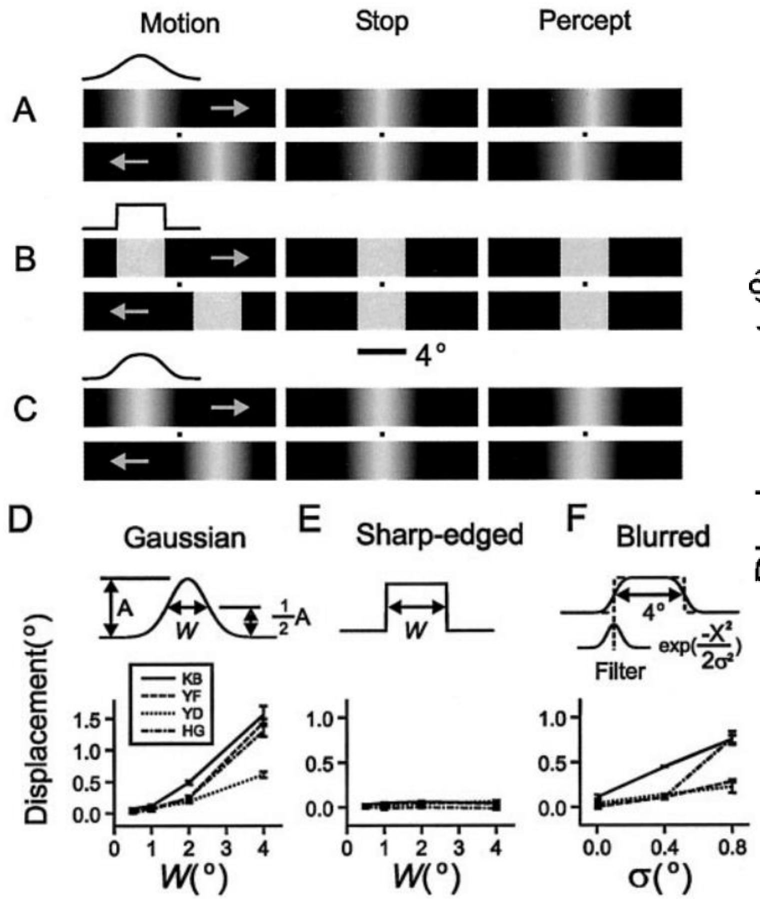
Results: blurriness

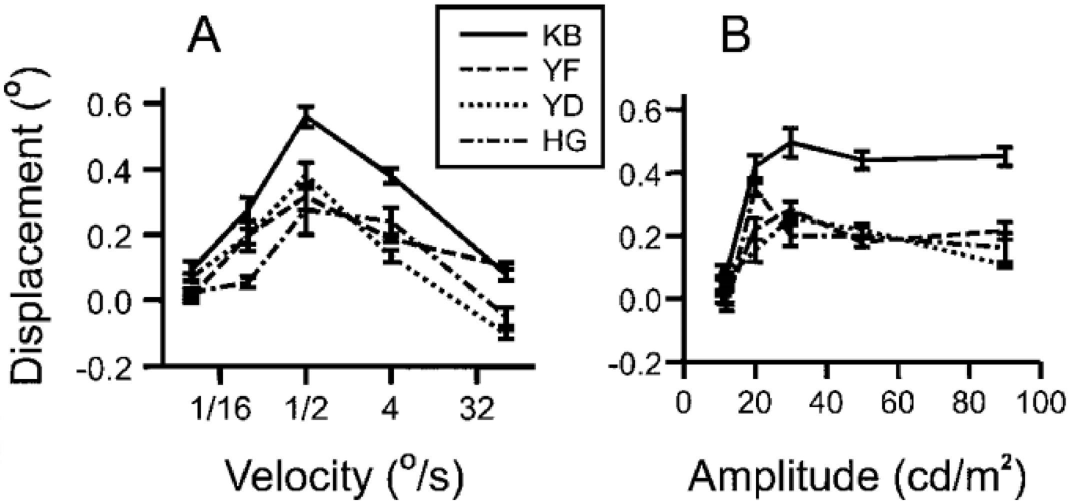


Results: width



Results: velocity and amplitude





A Neural Model for the Perceptual Extrapolation

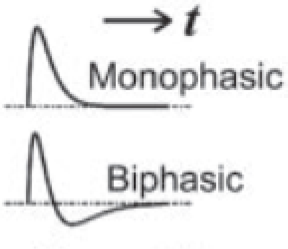
The Linear System Model:

$$r_i(t) = \max\left[\int_{-\infty}^{\infty} dx \int_{-\infty}^{t} dt' s(x, t') k_i(x, t - t') - \theta, 0\right]$$

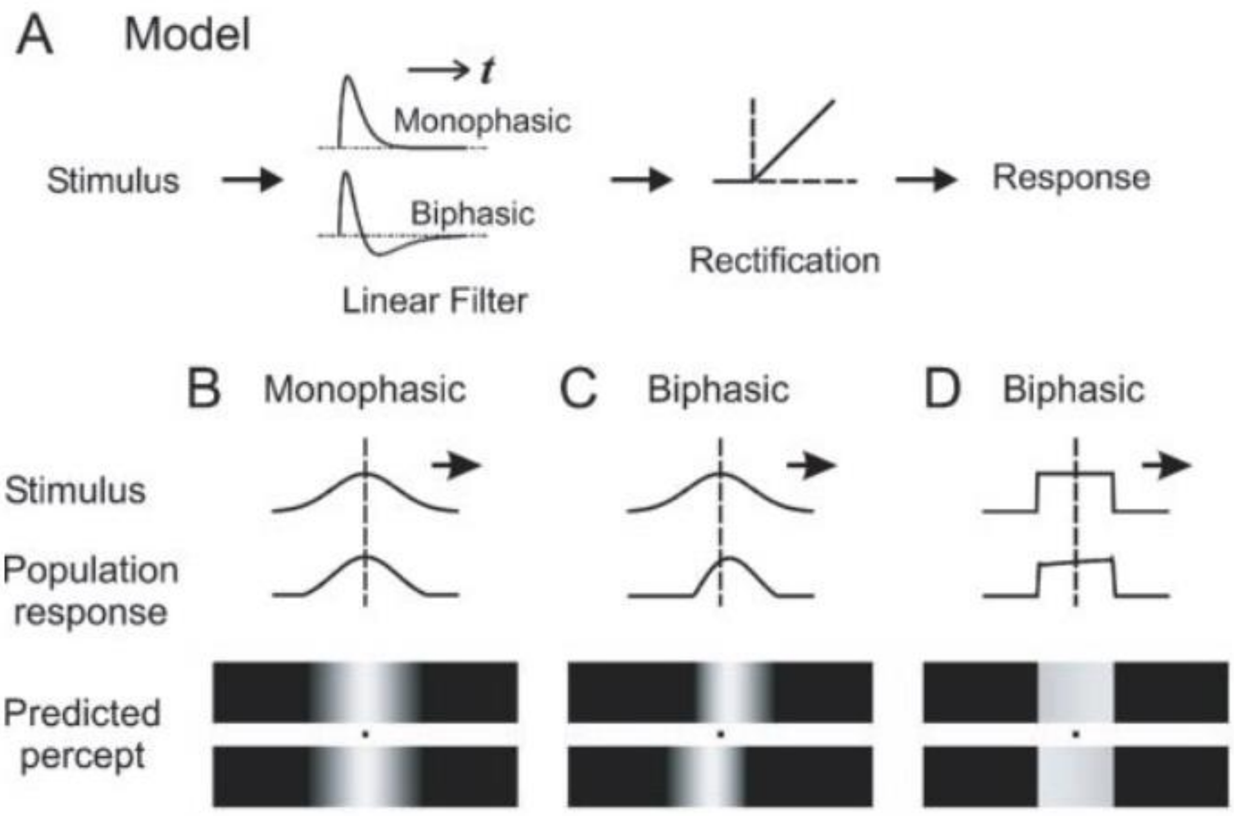
Suggested Filters:

$$k_i(x, t) = [e^{-(x-x_i)^2/2\sigma_{k1}^2} - Ae^{-(x-x_i)^2/2\sigma_{k2}^2}] \times [te^{-at} - c^2te^{-bt}]$$

- Monophasic Filter
- Biphasic Filter



Monophasic vs Biphasic



Data vs Biphasic Filter Model