

Role of dynamics in neural computations underlying visual processing

Laurent Perrinet



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- Rick Adams and Karl Friston @ UCL - Wellcome Trust Centre for Neuroimaging
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- Frédéric CHAVANE - INT



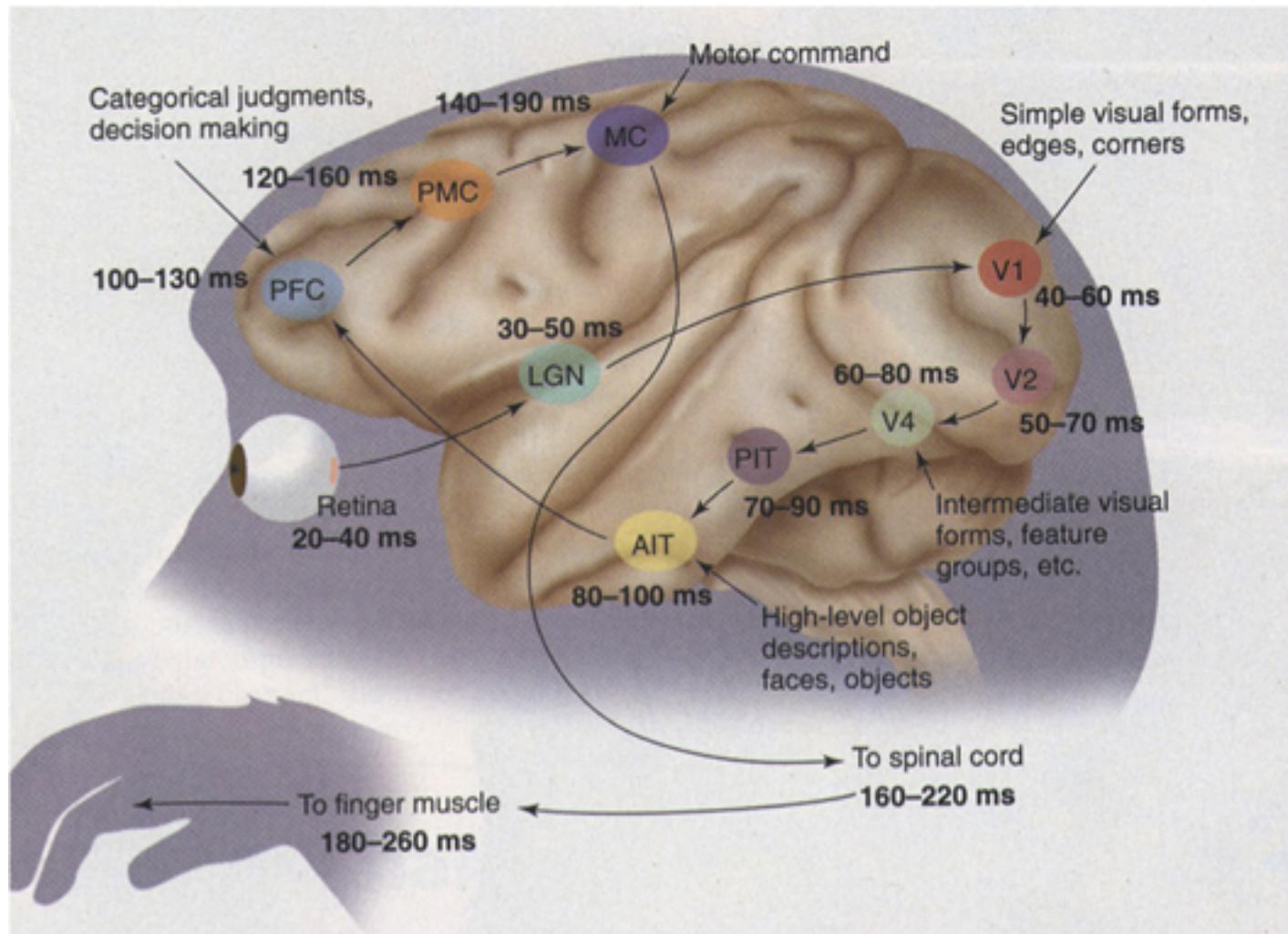
LACONEU 2019: 5th Latin-American Summer School in Computational Neuroscience, 17/1/2019

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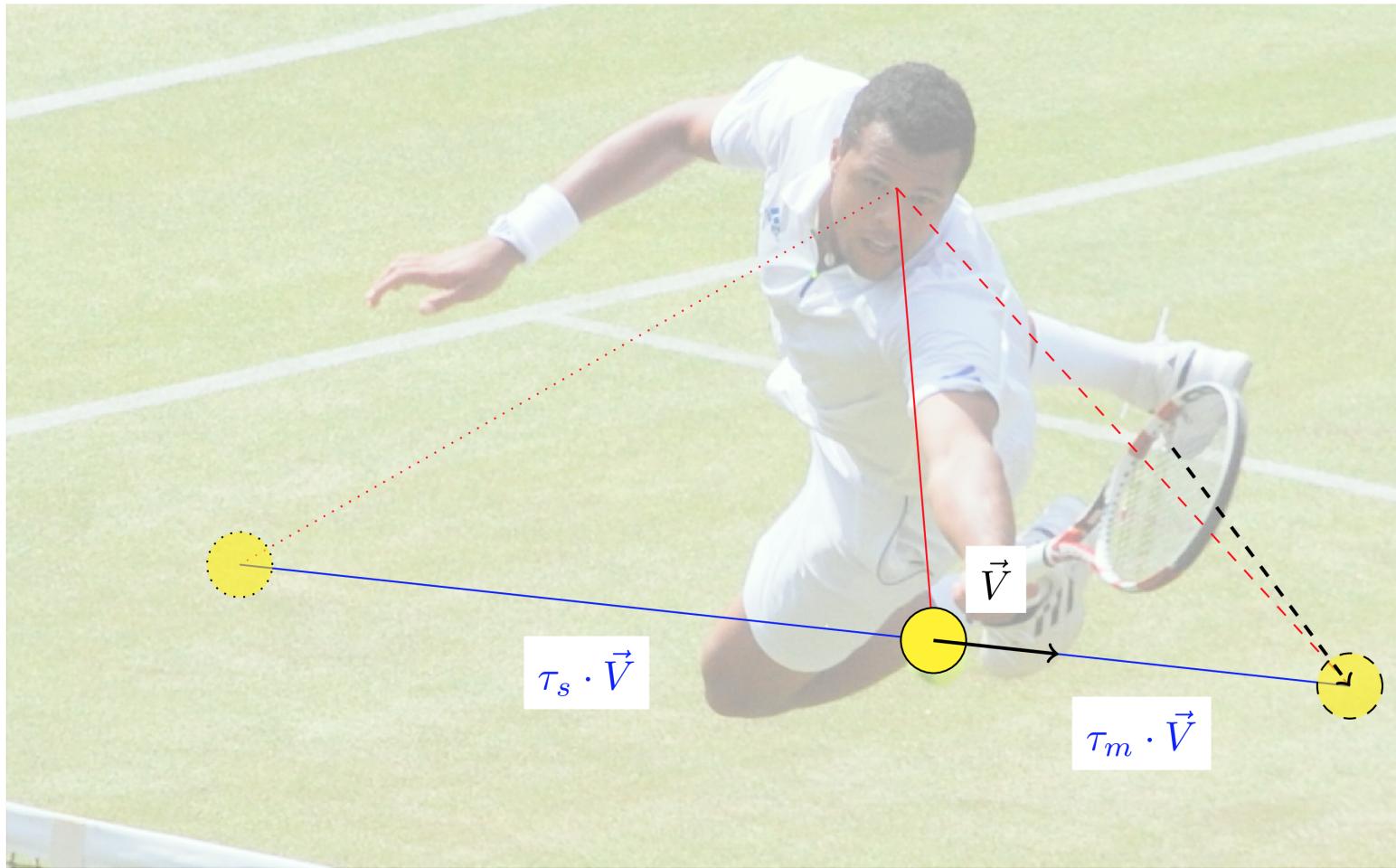
LP (2015) "Sparse models" in *Biologically Inspired Computer Vision*

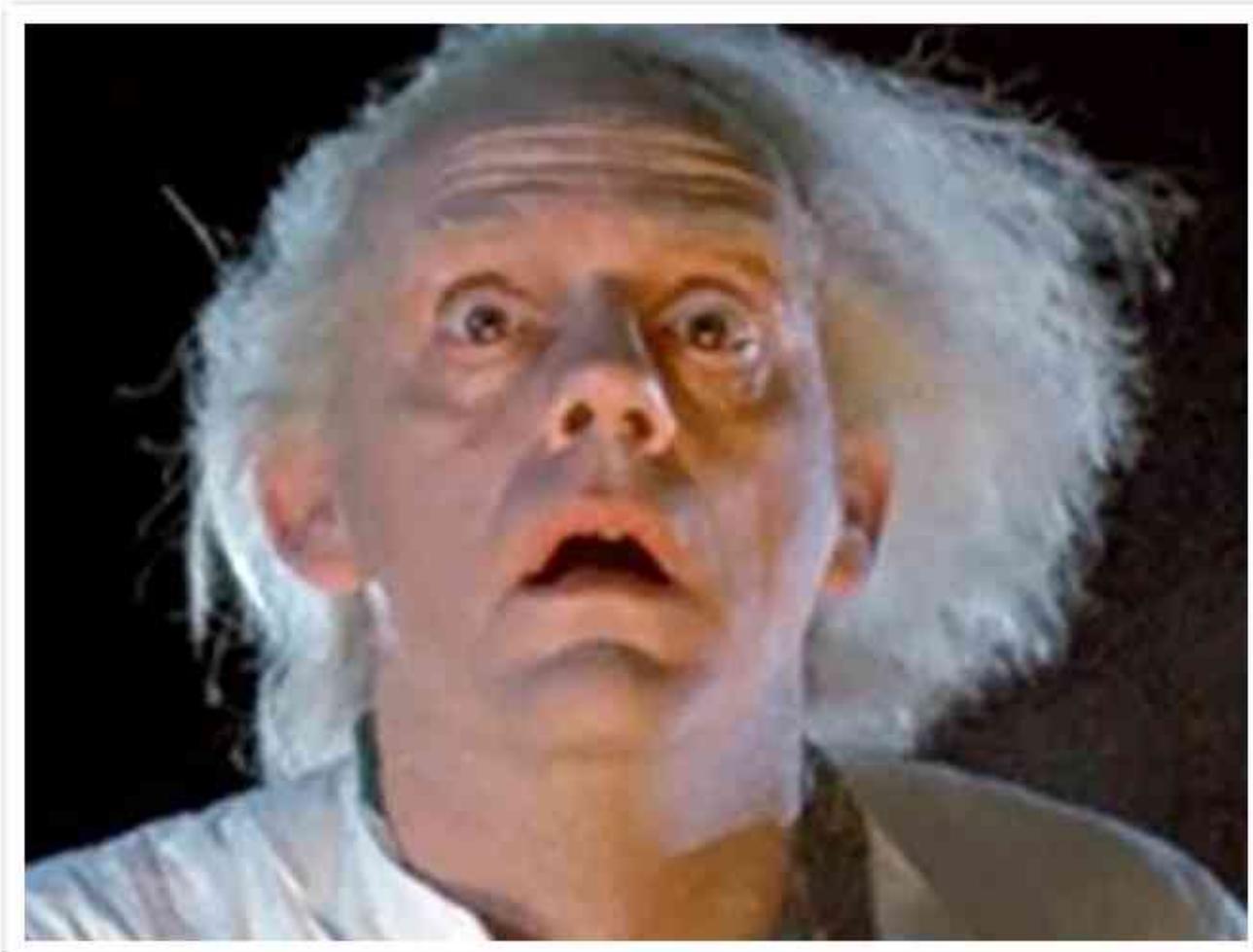
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LP (2015) "Sparse models" in *Biologically Inspired Computer Vision*









Outline

1. About Dynamics, vision and neurons
2. Active Inference
3. Back to the present
4. Perspectives ?

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Perceptions as hypotheses: saccades as experiments

Karl Friston¹*, Rick A. Adams¹, Laurent Perrinet^{1,2} and Michael Breakspear³

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Smooth Pursuit and Visual Occlusion: Active Inference and Oculomotor Control in Schizophrenia

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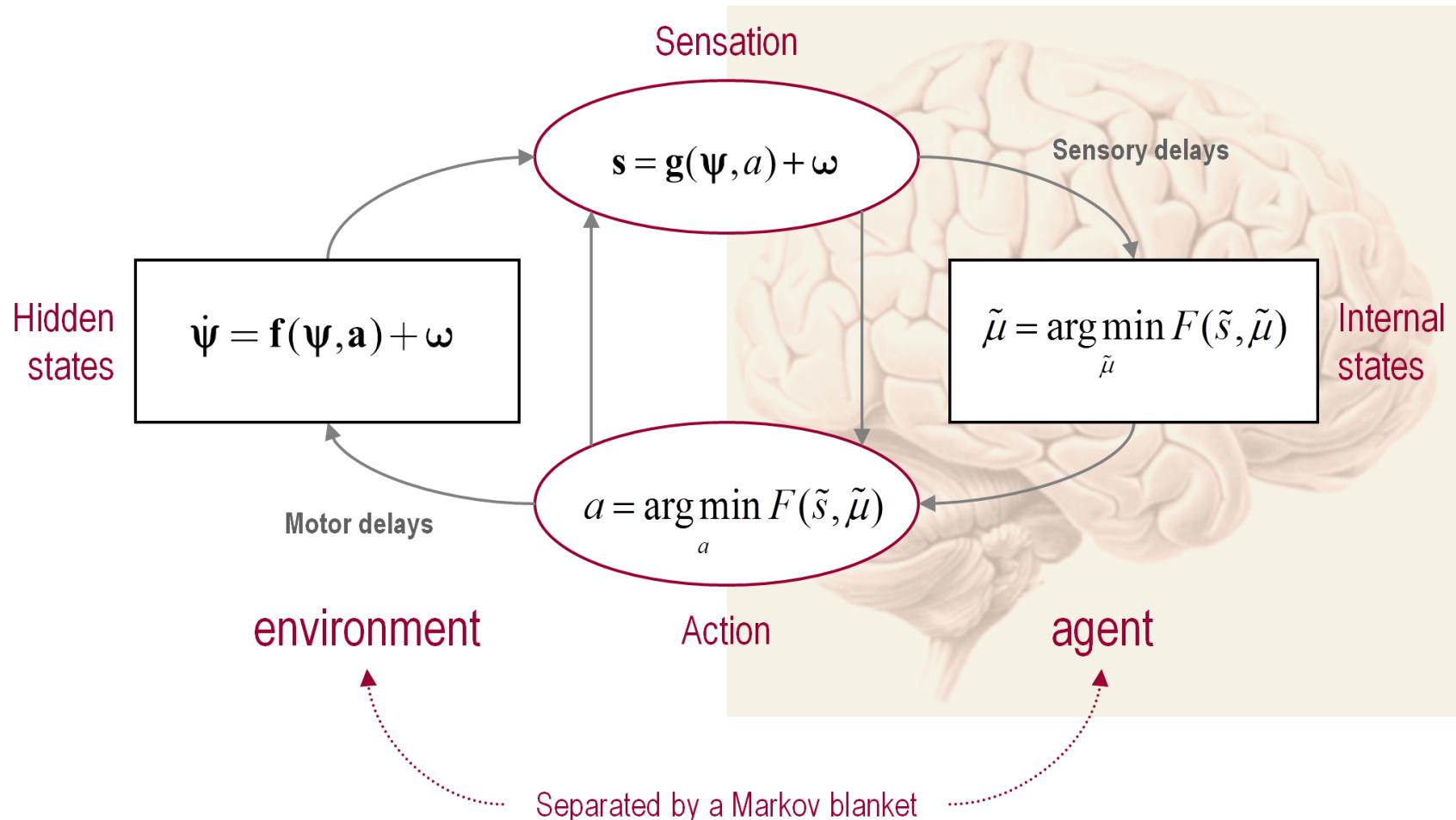
Biol Cybern
DOI 10.1007/s00422-014-0620-8

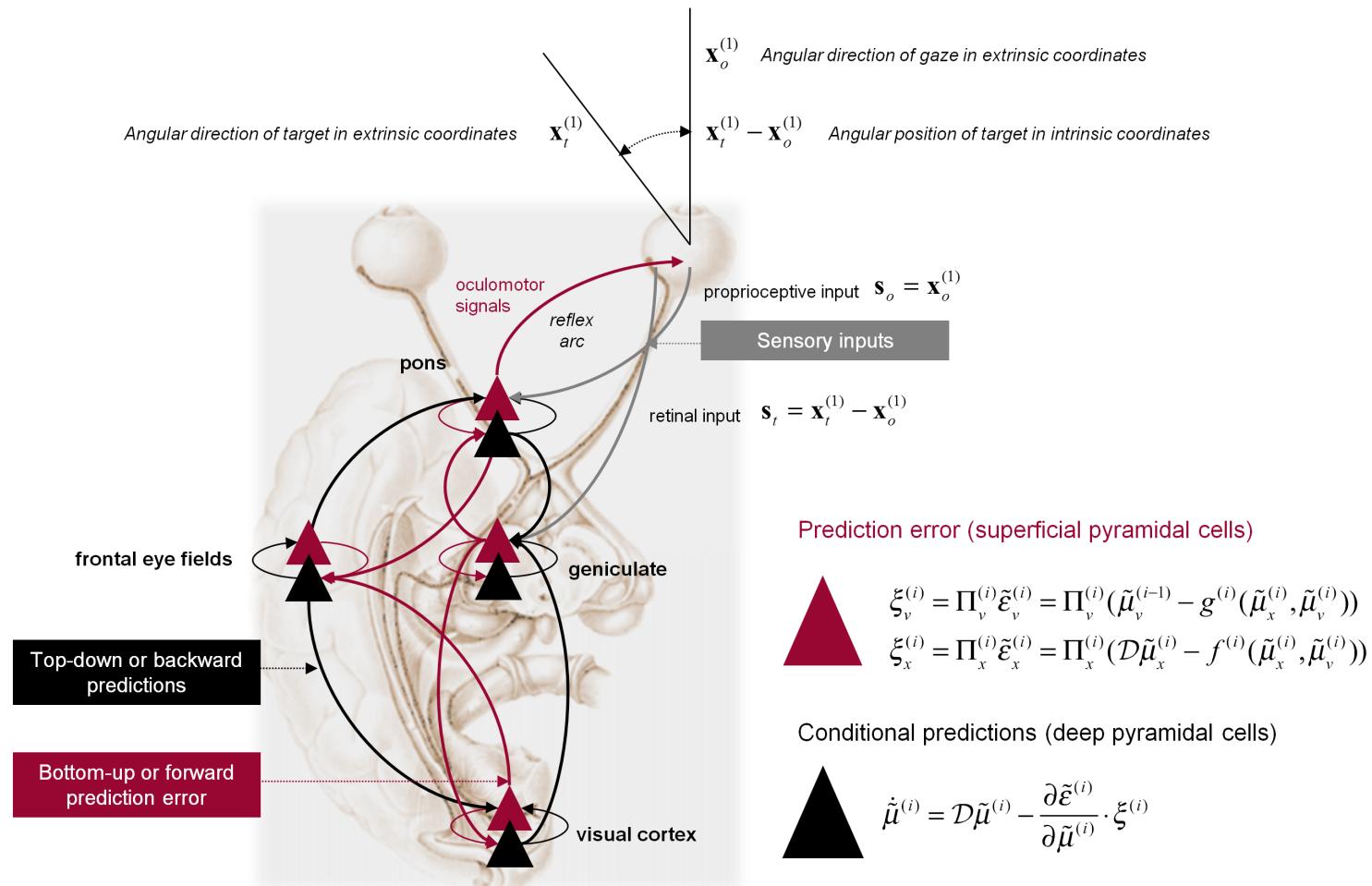
ORIGINAL PAPER

Biological
Cybernetics

Active inference, eye movements and oculomotor delays

Laurent U. Perrinet · Rick A. Adams · Karl J. Friston





$$T(\tau)\tilde{x}(t) = \tilde{x}(t + \tau)$$

$$T(\tau) = \begin{bmatrix} 1 & \frac{1}{1!}\tau & \frac{1}{2!}\tau^2 & \dots \\ 0 & 1 & \frac{1}{1!}\tau & \dots \\ 0 & 0 & 1 & \ddots \\ 0 & 0 & 0 & \ddots \end{bmatrix}$$

$$= \exp(\tau\mathcal{D})$$

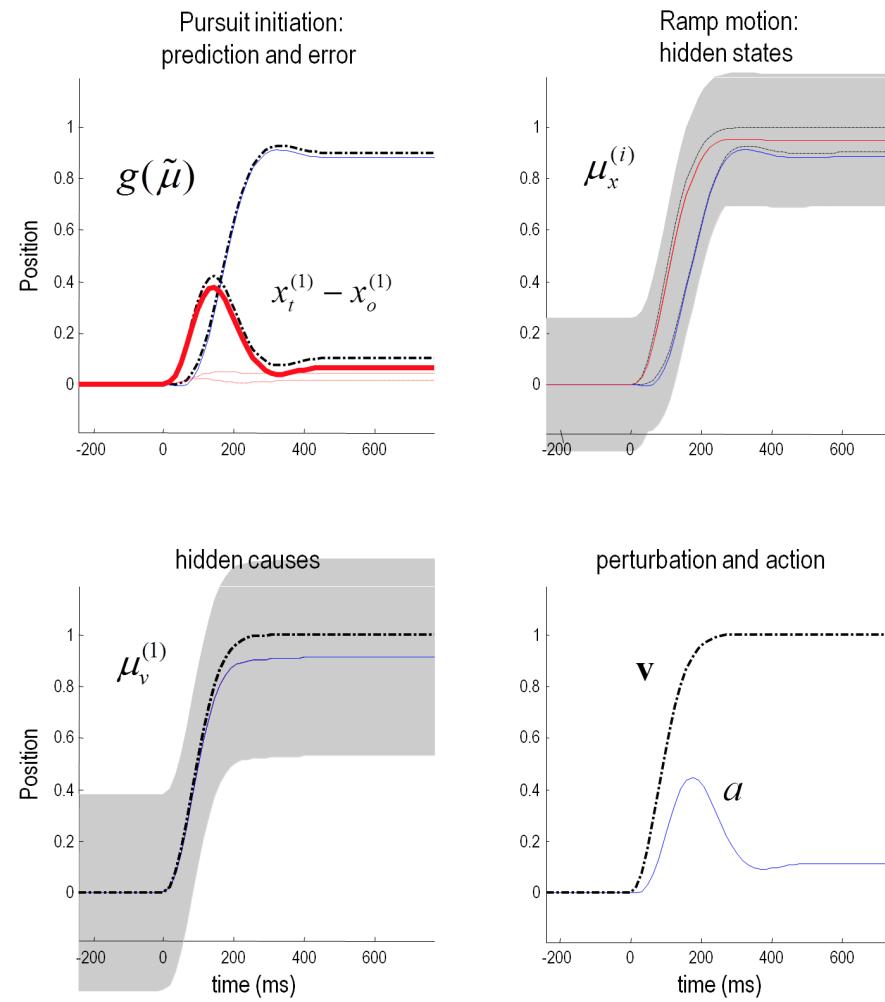
$$\text{with } \mathcal{D} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & \ddots \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

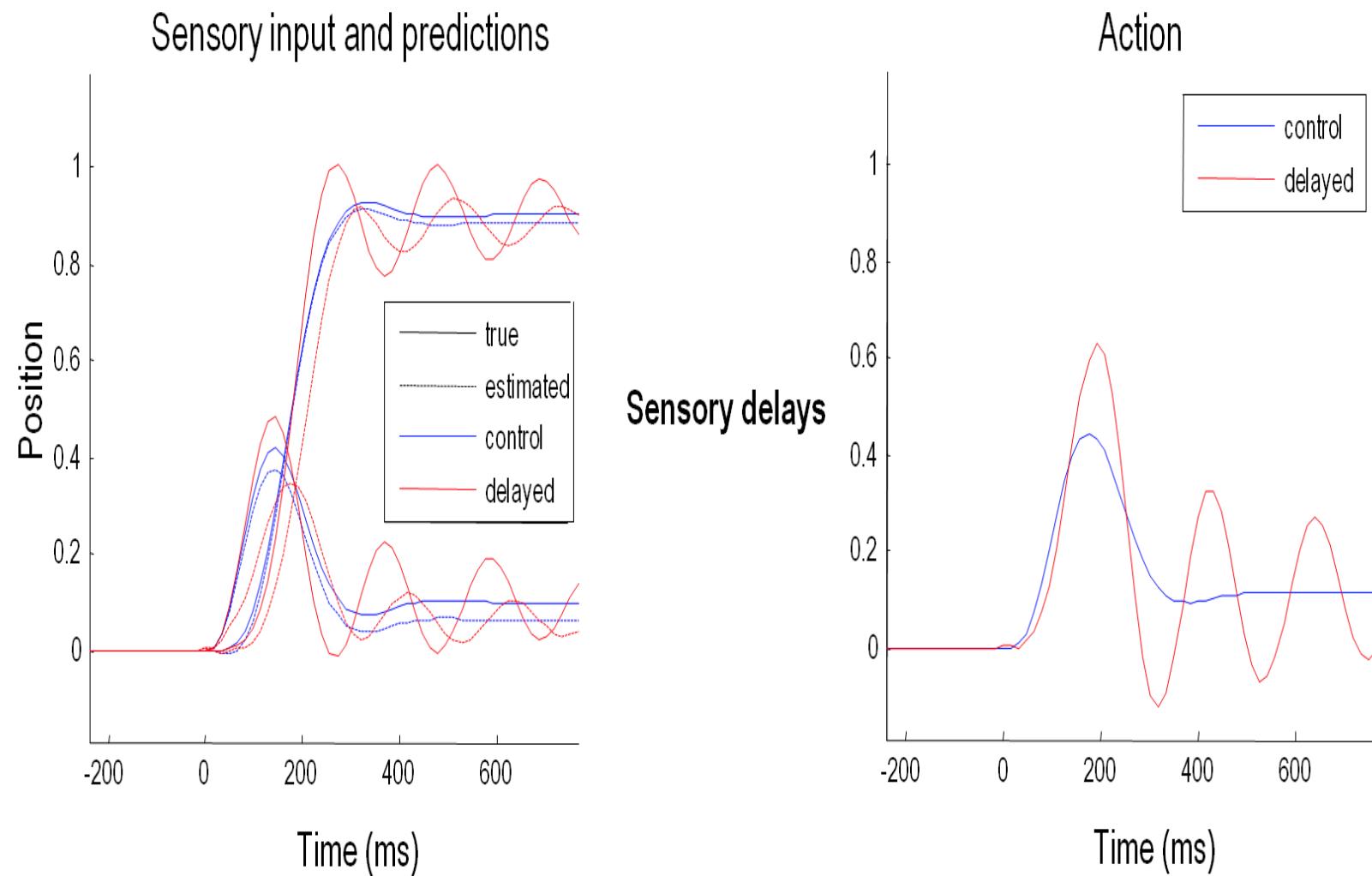
$$T(\tau)\tilde{x}(t) = \tilde{x}(t + \tau)$$

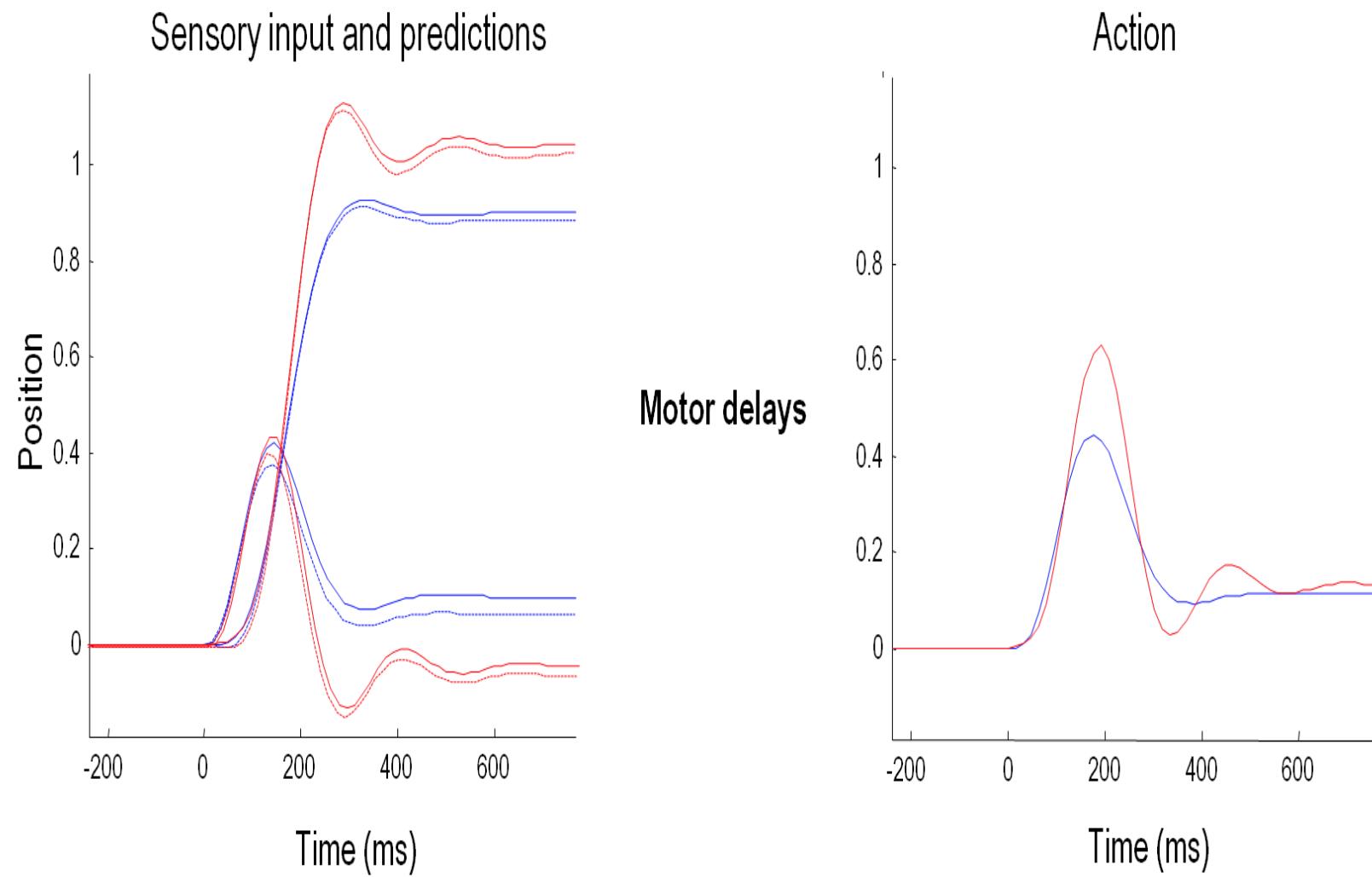
$$\begin{aligned}
T(\tau) &= \begin{bmatrix} 1 & \frac{1}{1!}\tau & \frac{1}{2!}\tau^2 & \dots \\ 0 & 1 & \frac{1}{1!}\tau & \dots \\ 0 & 0 & 1 & \ddots \\ 0 & 0 & 0 & \ddots \end{bmatrix} & \tilde{\varepsilon}_\nu^{(1)} &= T(\tau_s)\tilde{s}(t - \boldsymbol{\tau}_s) - \tilde{g}^{(1)}(\tilde{\mu}_x^{(1)}, \tilde{\mu}_\nu^{(1)}) \\
&= \exp(\tau\mathcal{D}) & &= T(\tau_s - \boldsymbol{\tau}_s)\tilde{s}(t) - \tilde{g}^{(1)}(\tilde{\mu}_x^{(1)}, \tilde{\mu}_\nu^{(1)}) \\
&& \dot{\mathbf{a}}(t) &= -(\partial_a \tilde{\varepsilon}_\nu^{(1)}) \cdot \Pi_\nu^{(1)} T(\tau_a) \tilde{\varepsilon}_\nu^{(1)}(t - \boldsymbol{\tau}_a) \\
&\text{with } \mathcal{D} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & \ddots \\ 0 & 0 & 0 & 0 \end{bmatrix} & &= -(\partial_a \tilde{\varepsilon}_\nu^{(1)}) \cdot \Pi_\nu^{(1)} T(\tau_a - \boldsymbol{\tau}_a) \tilde{\varepsilon}_\nu^{(1)}(t)
\end{aligned}$$

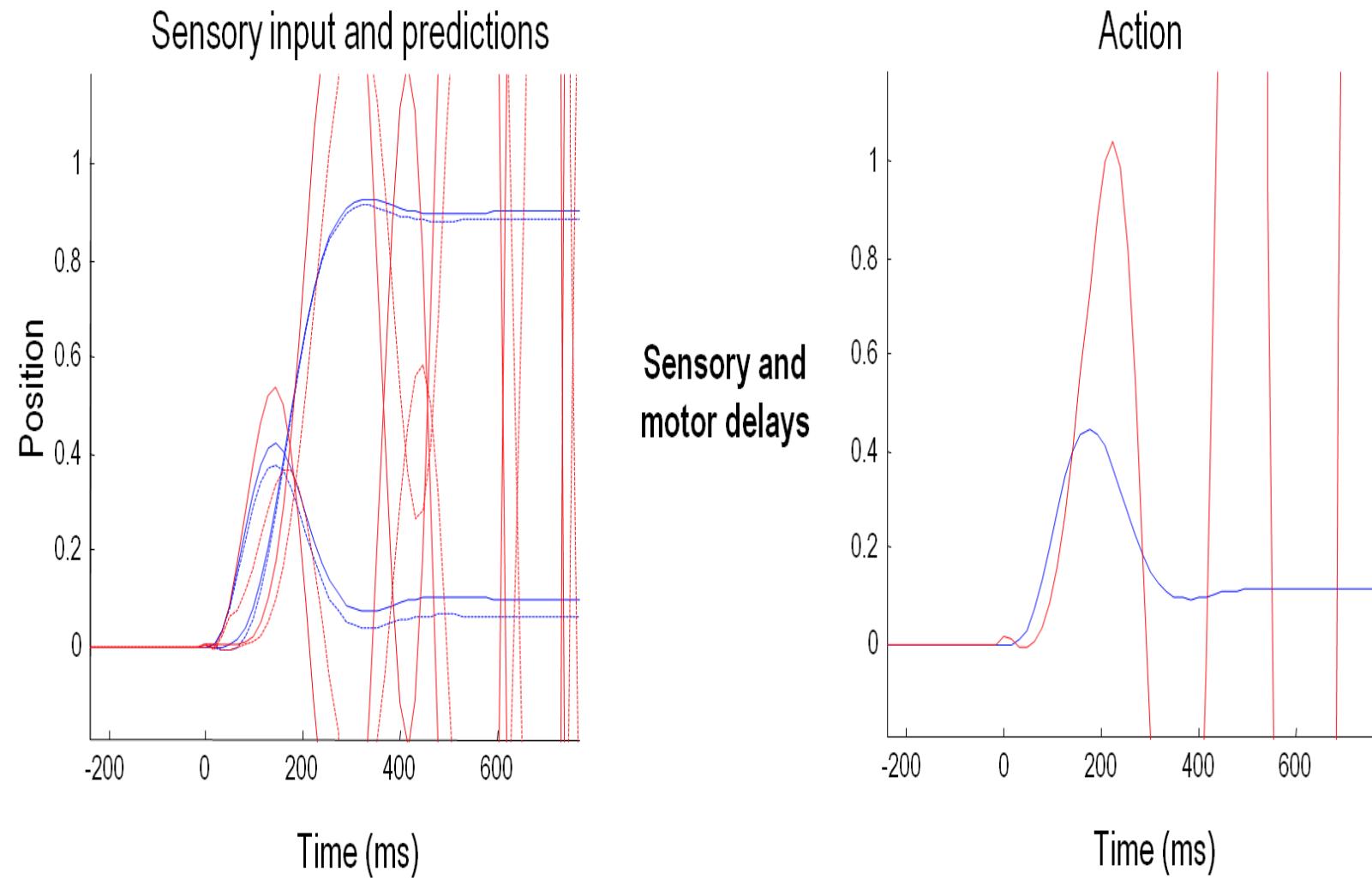
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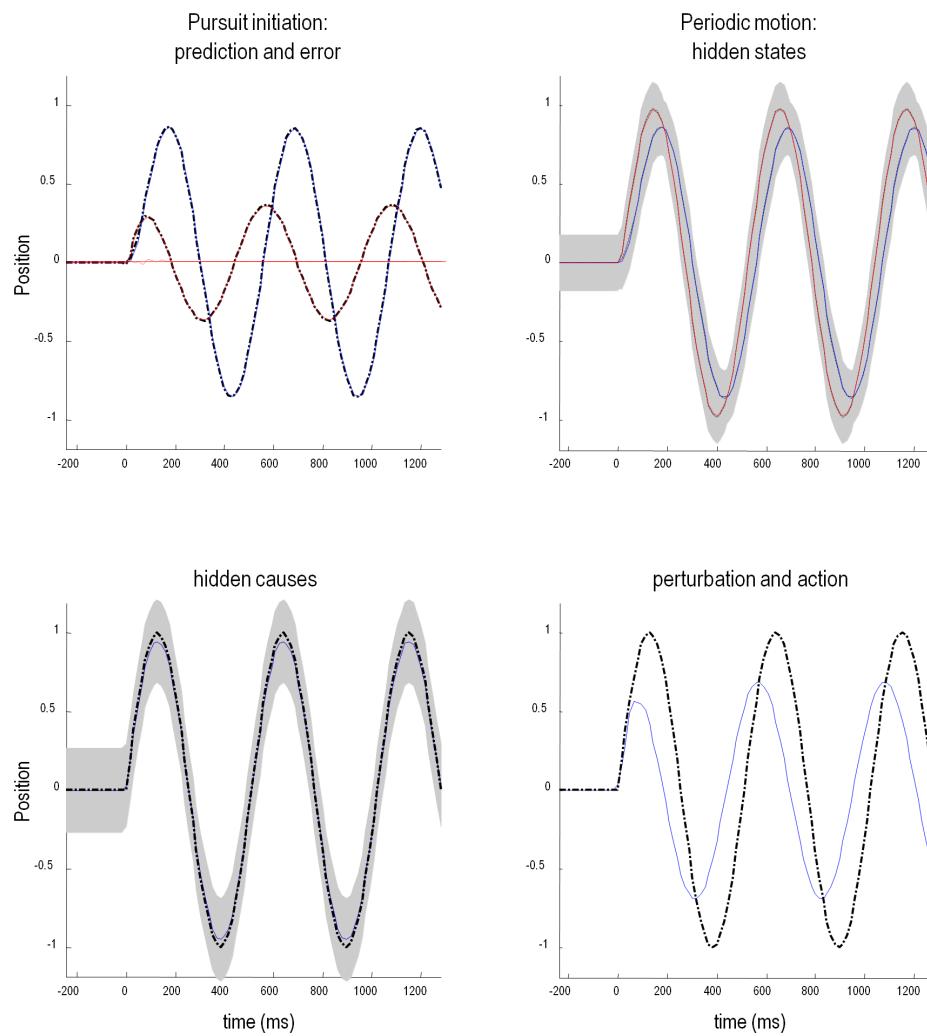


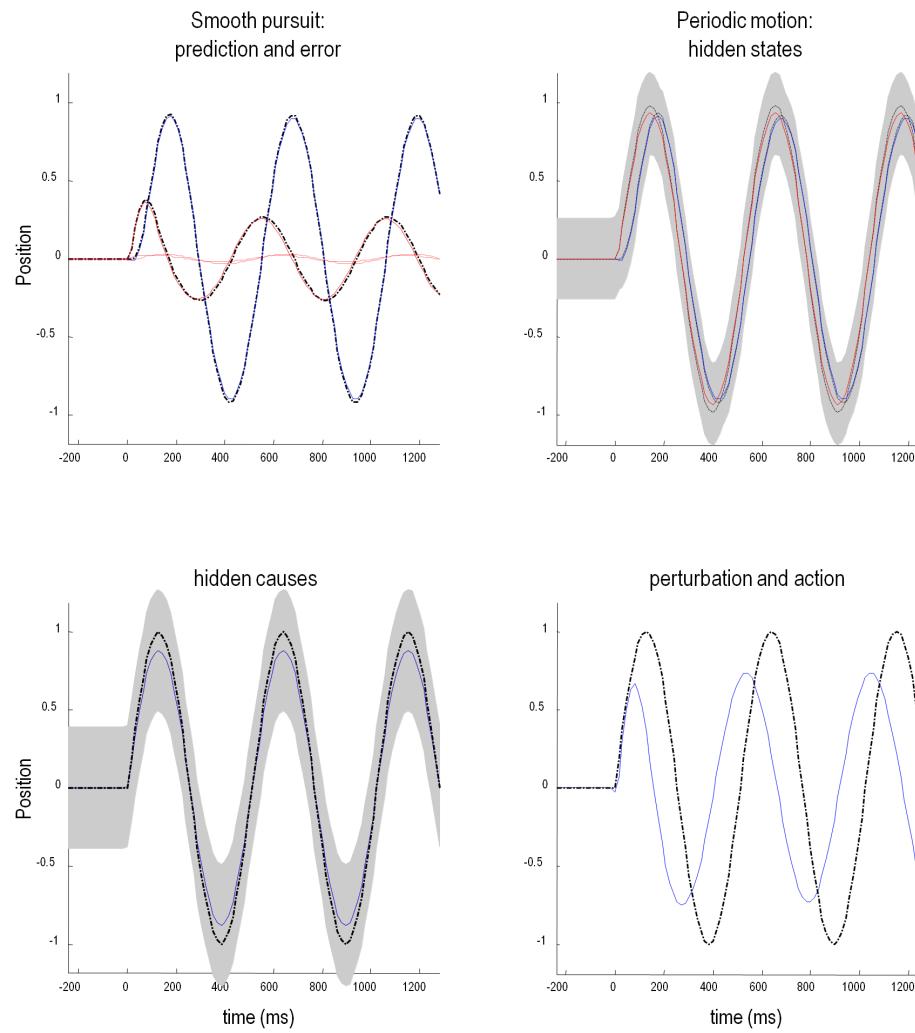




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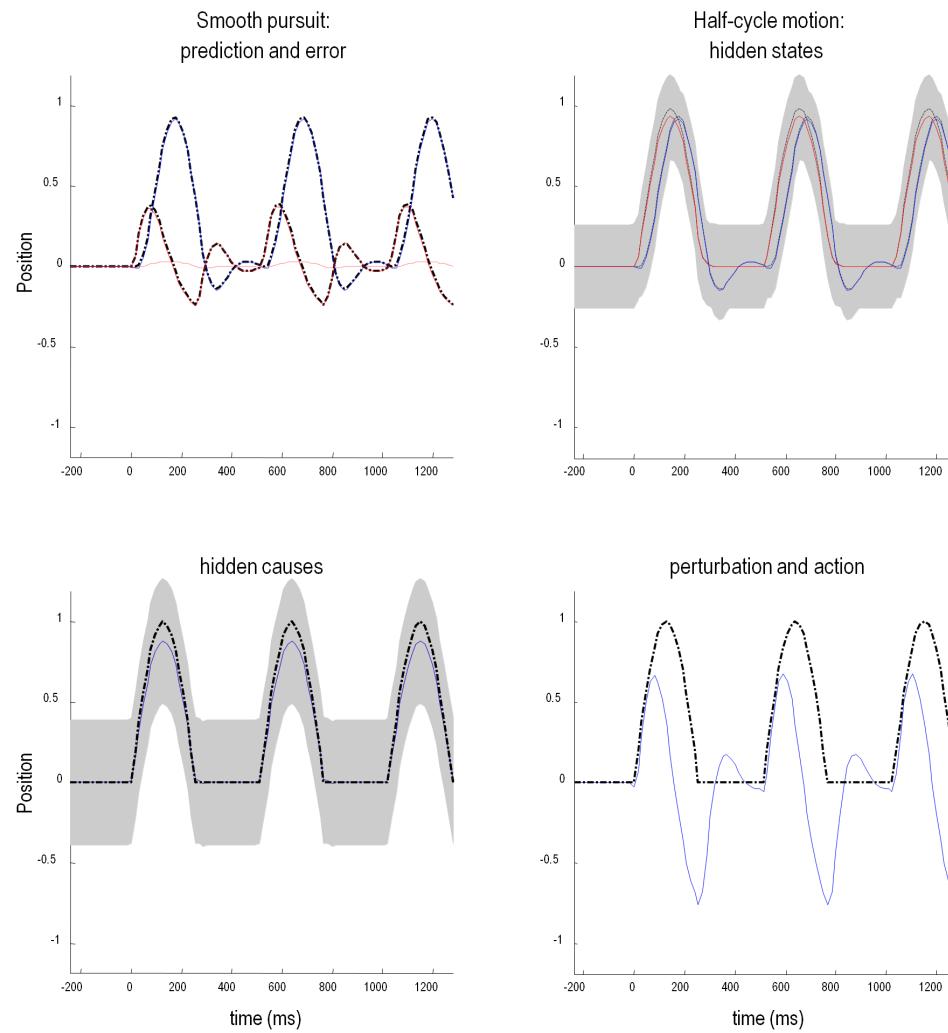
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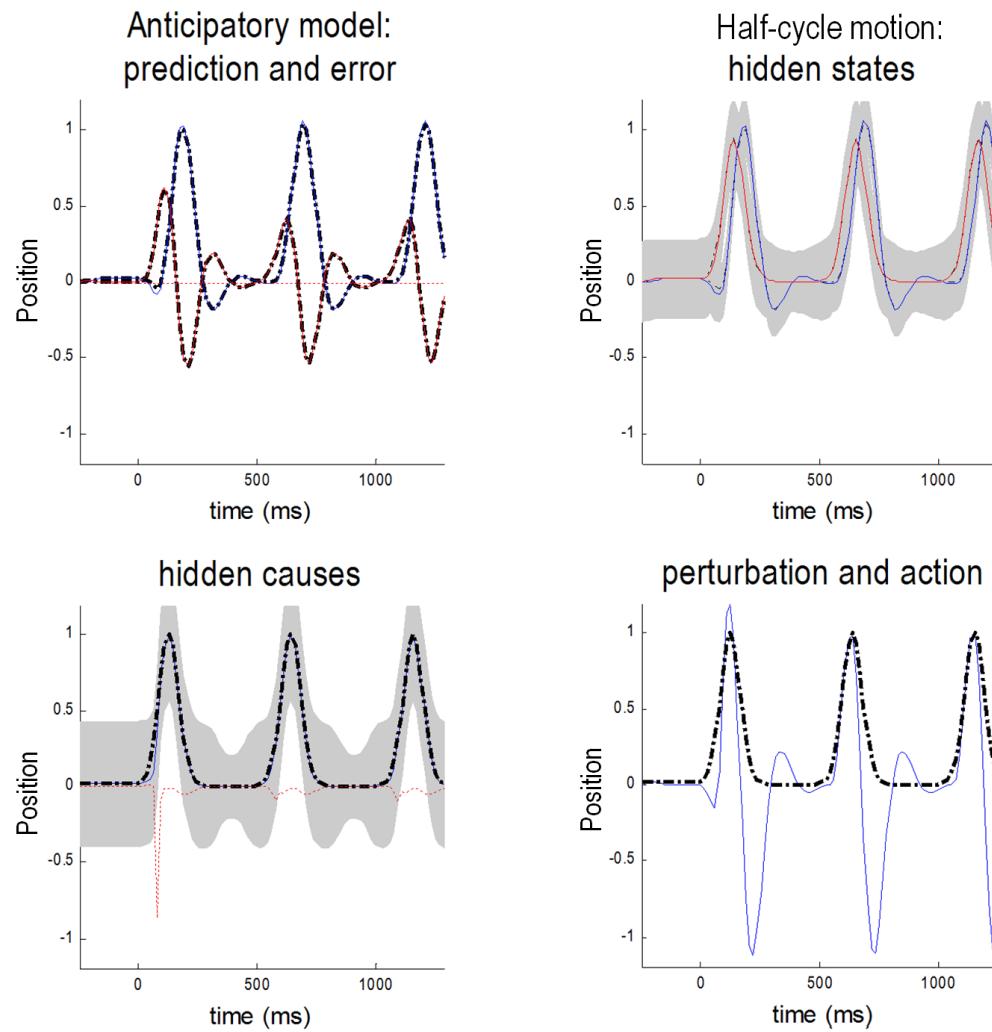




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2.15





Outline

1. About Dynamics, vision and neurons
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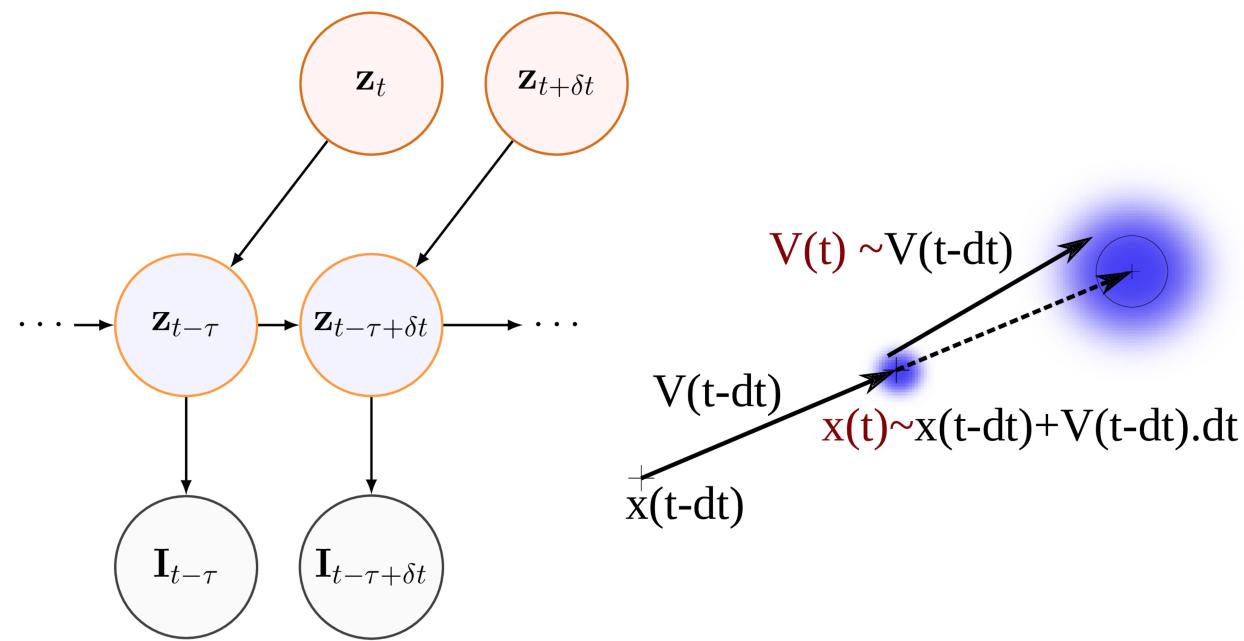
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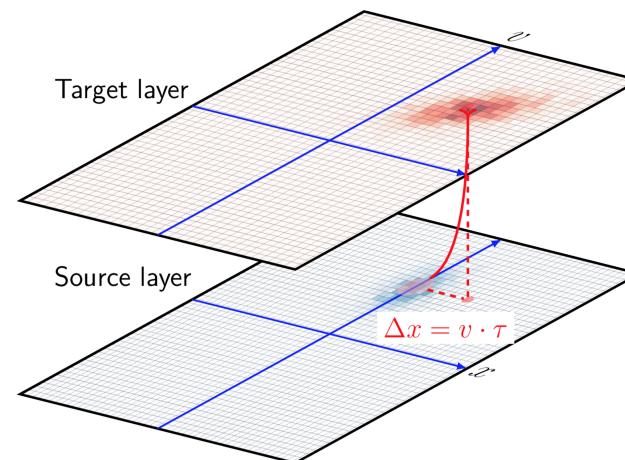
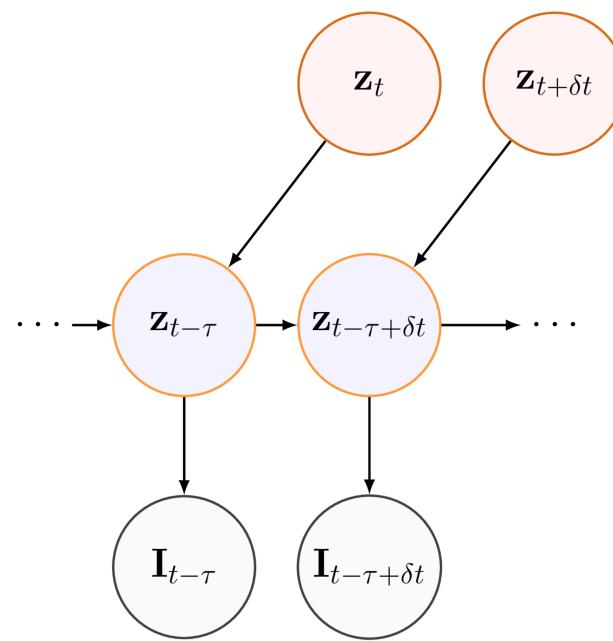
Khoei, Masson and LP (2017) *PLoS CB*

Back to the present

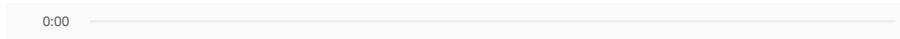


Khoei, Masson and LP (2017) *PLoS CB*

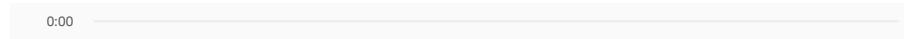
Back to the present



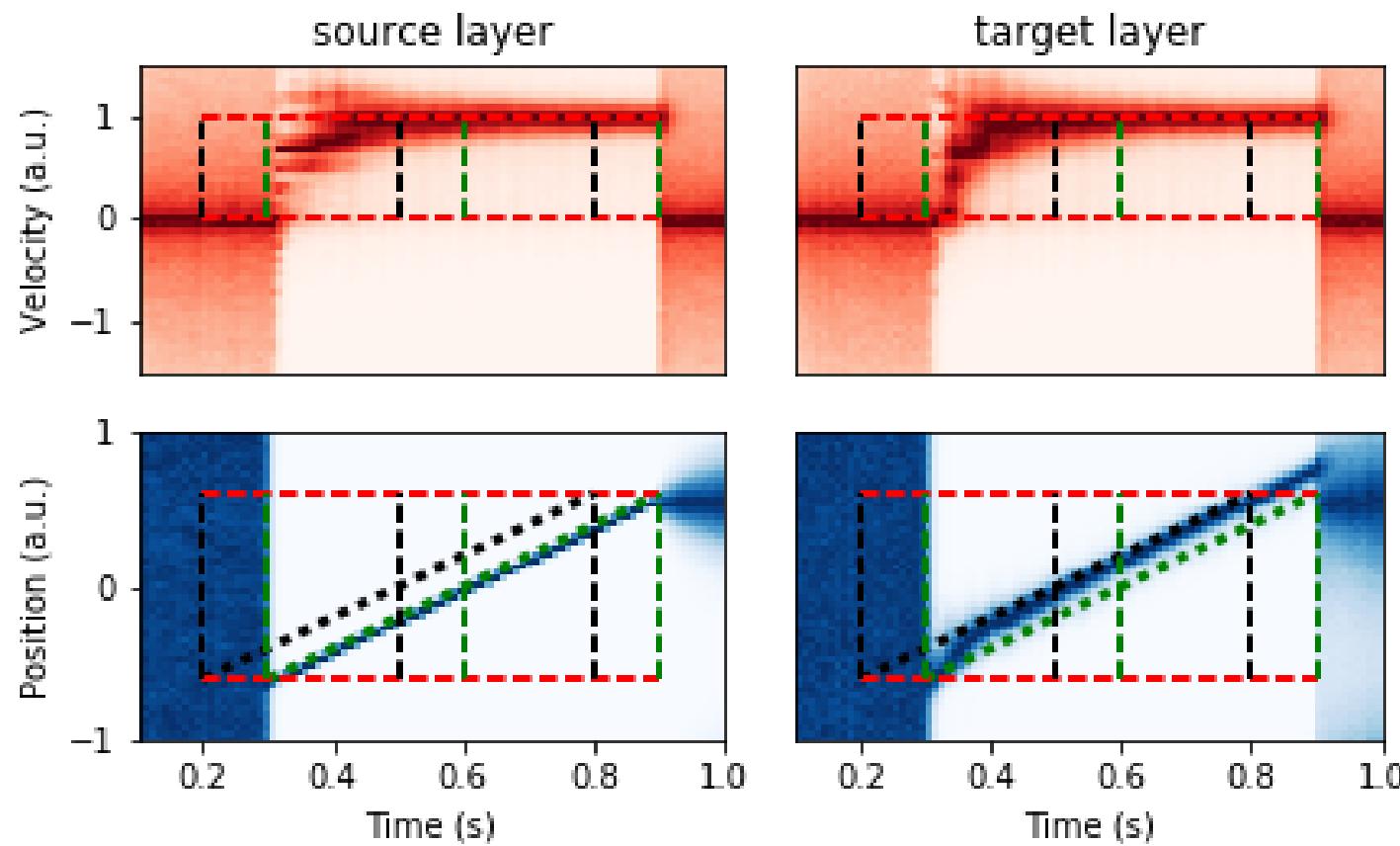
Khoei, Masson and LP (2017) PLoS CB



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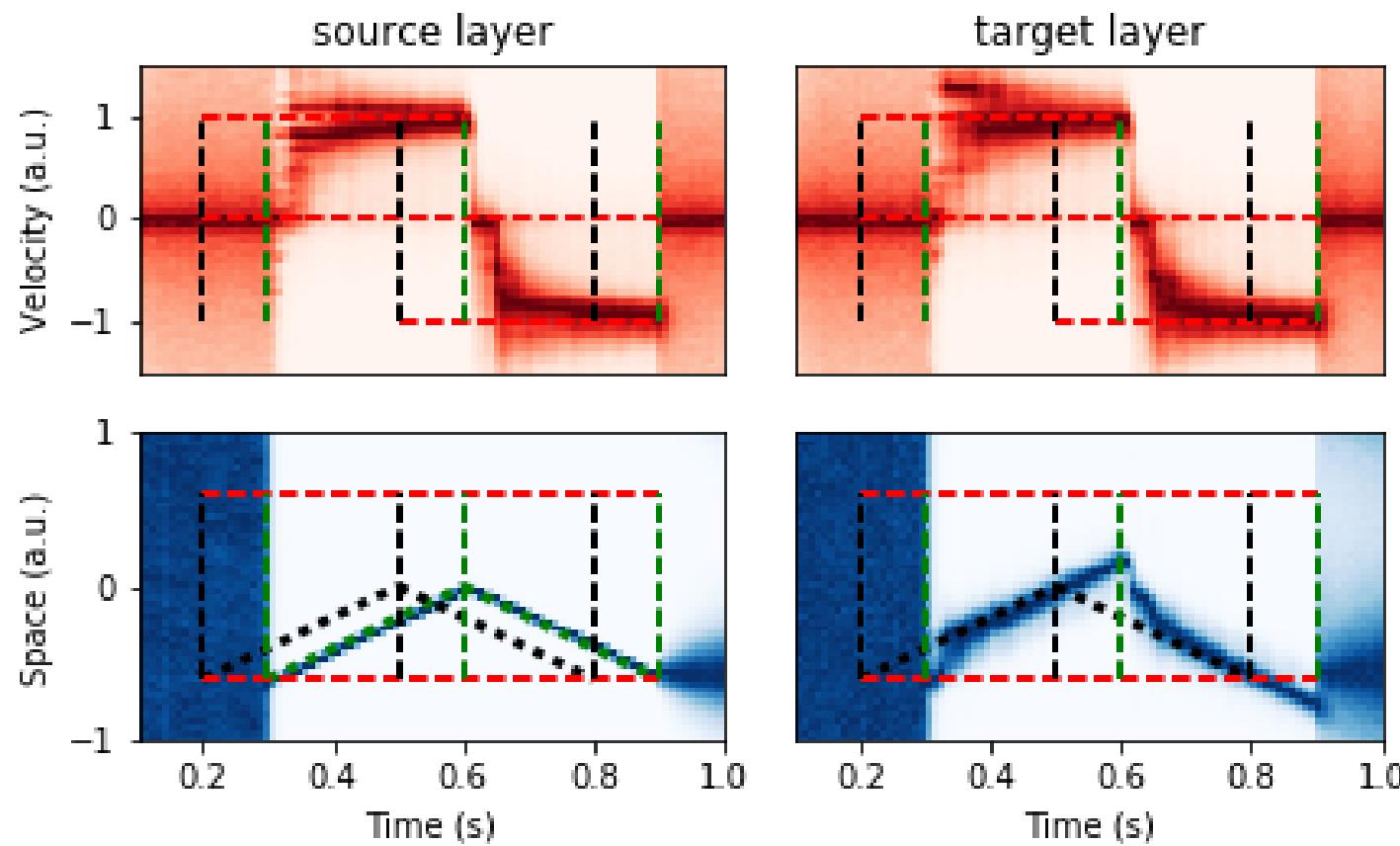


Back to the present



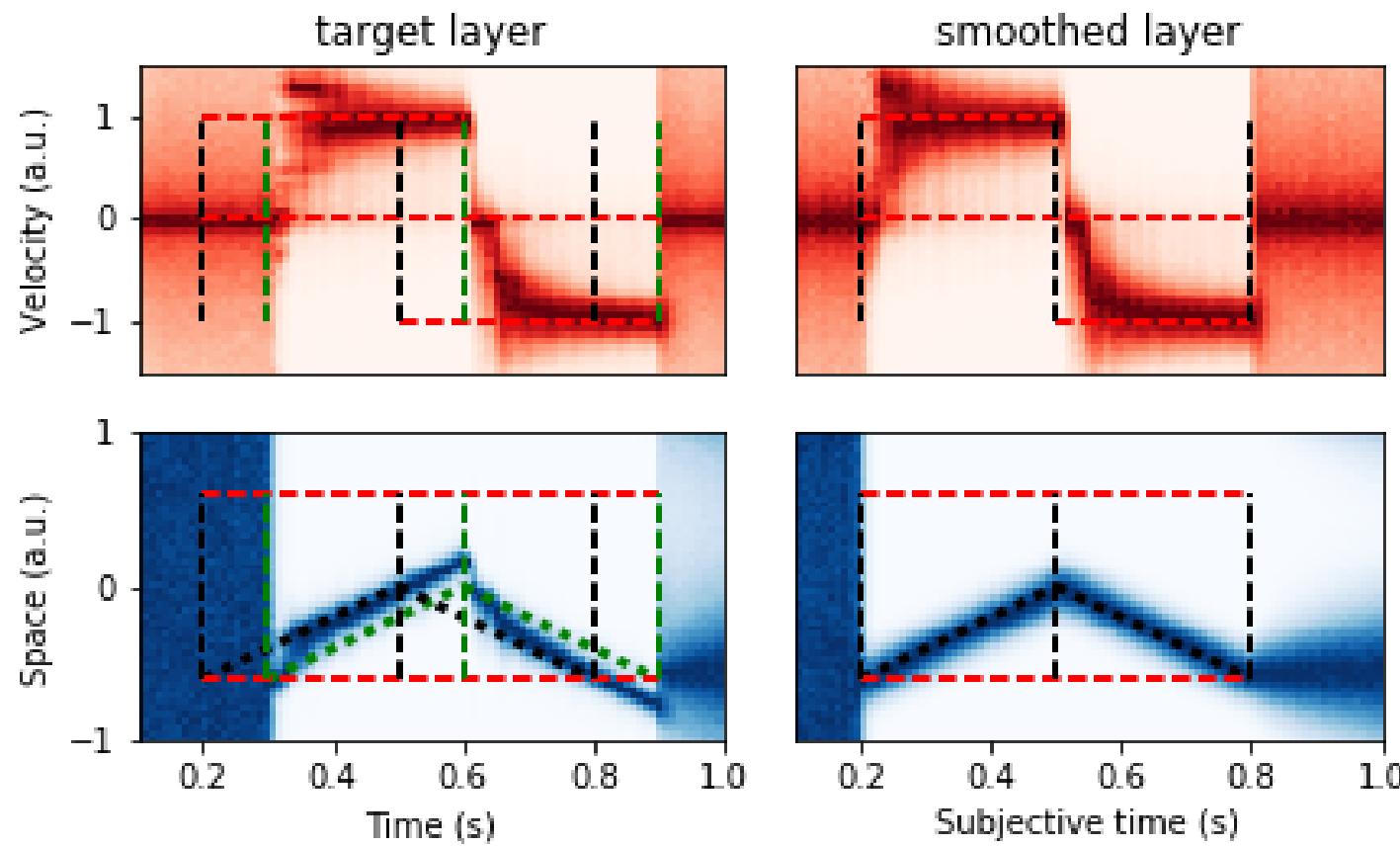
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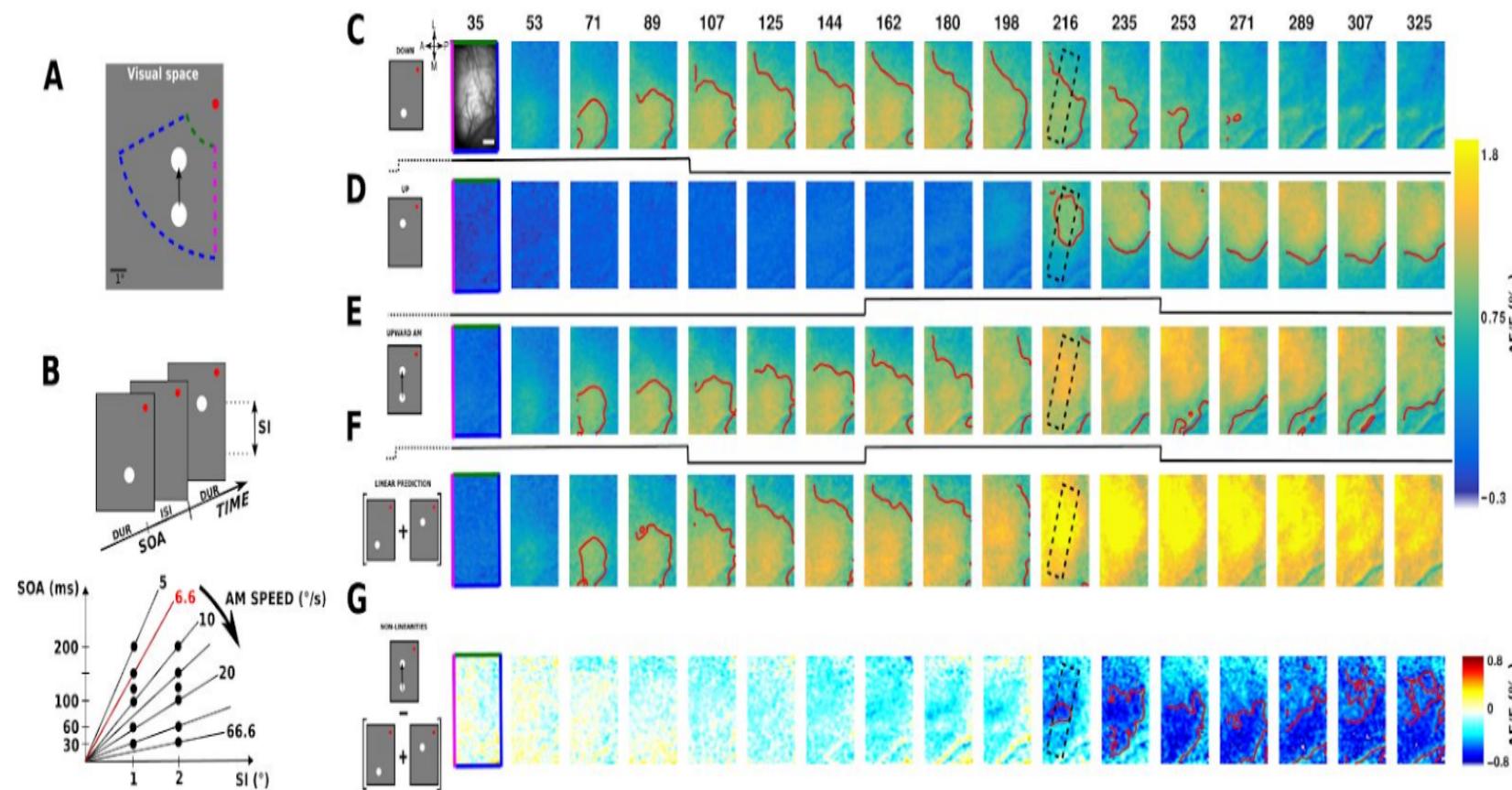
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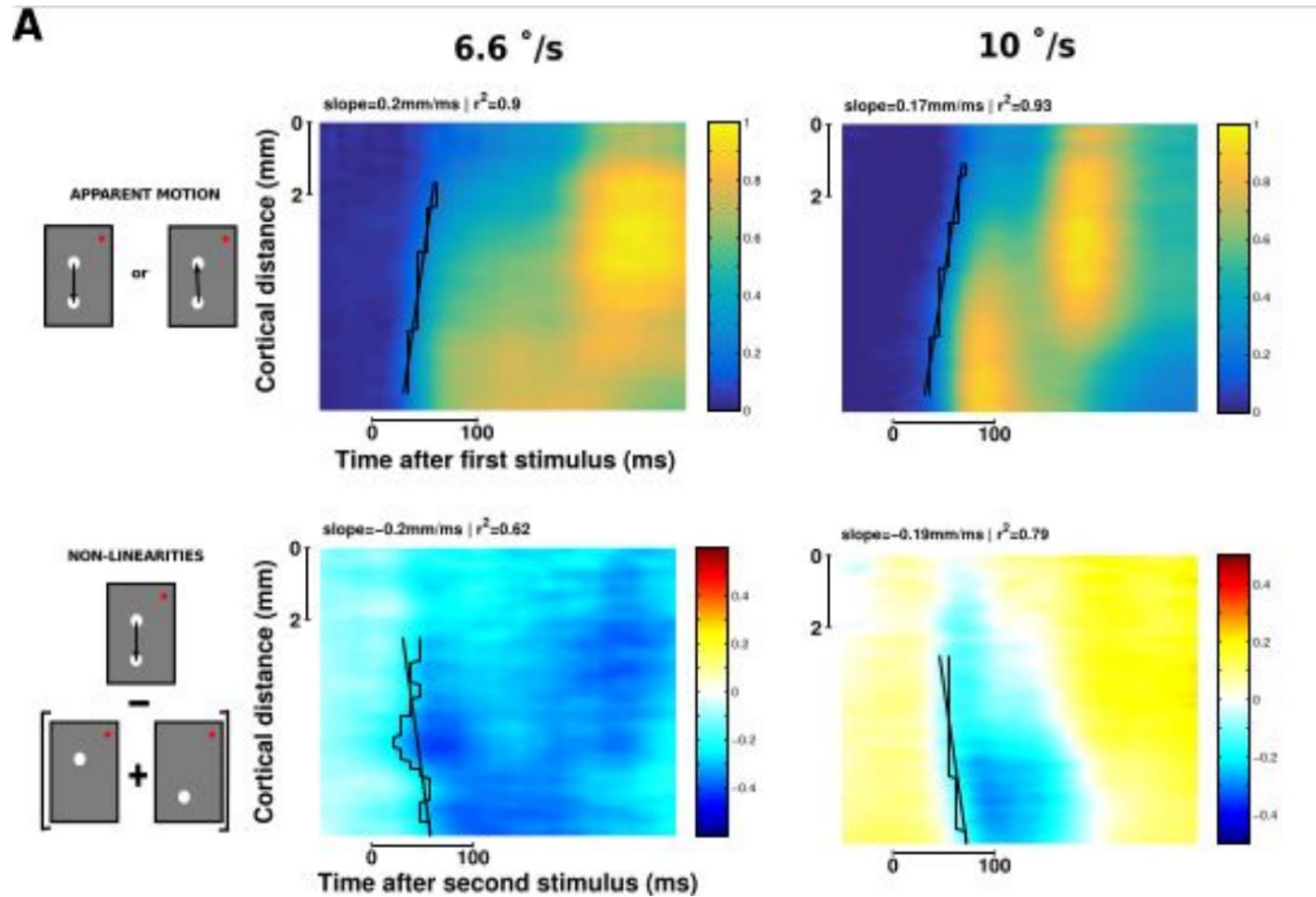
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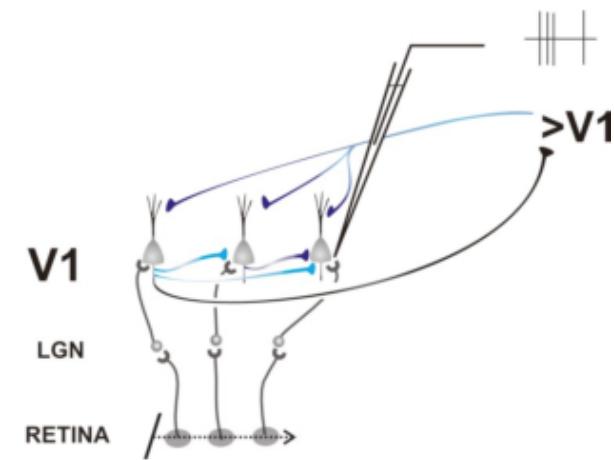
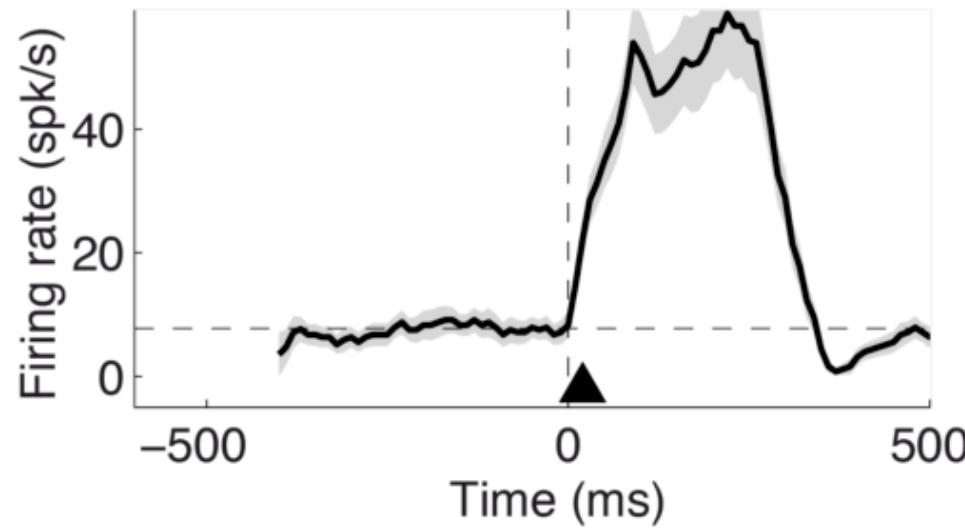
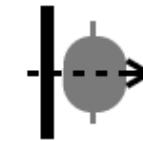
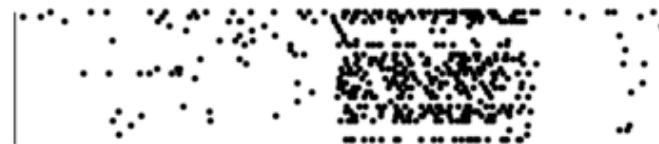


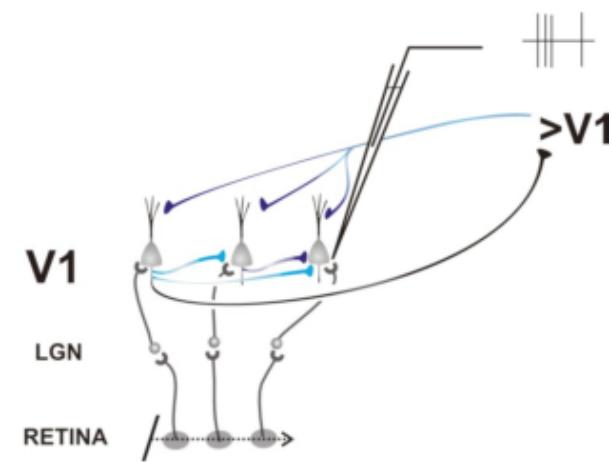
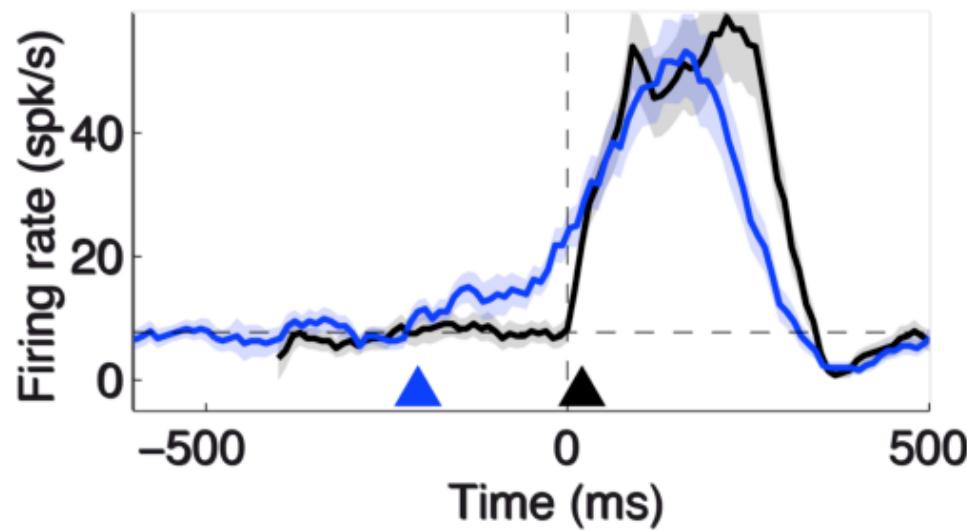
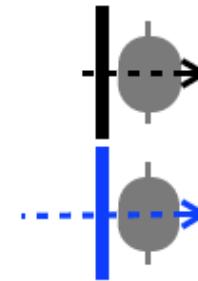
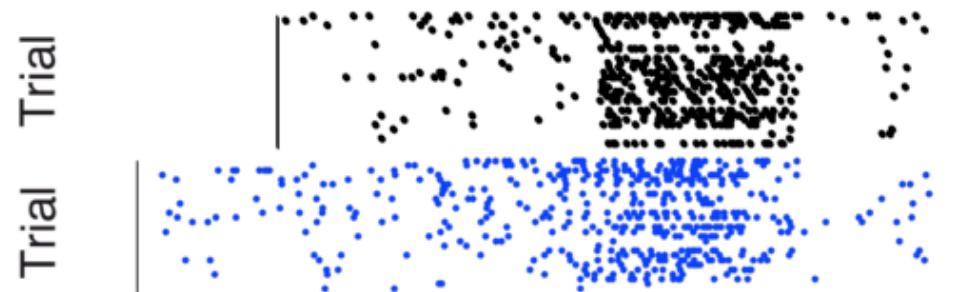
Chemla, Reynaud, di Volo, Zerlaut, LP, Destexhe, Chavane (2019) *in revision*



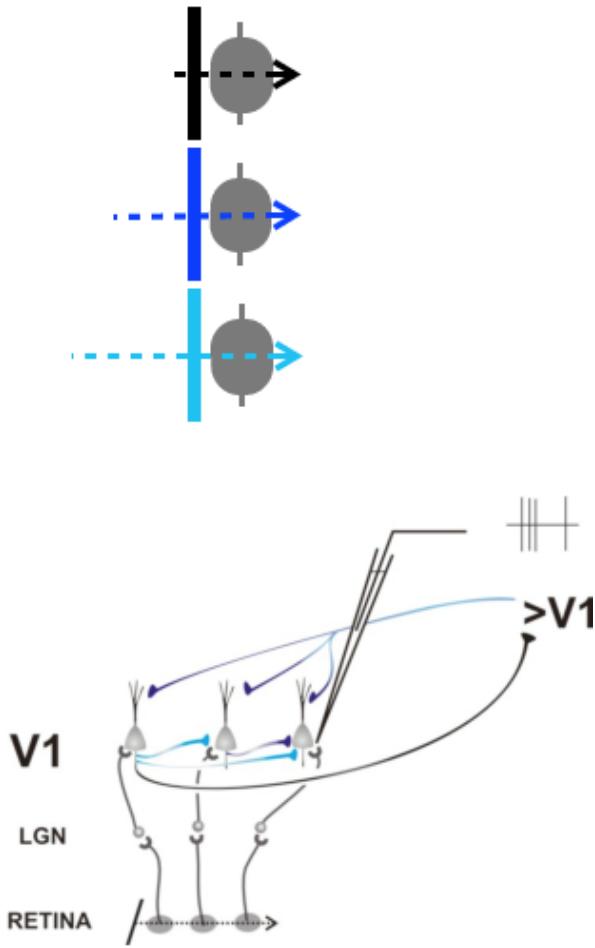
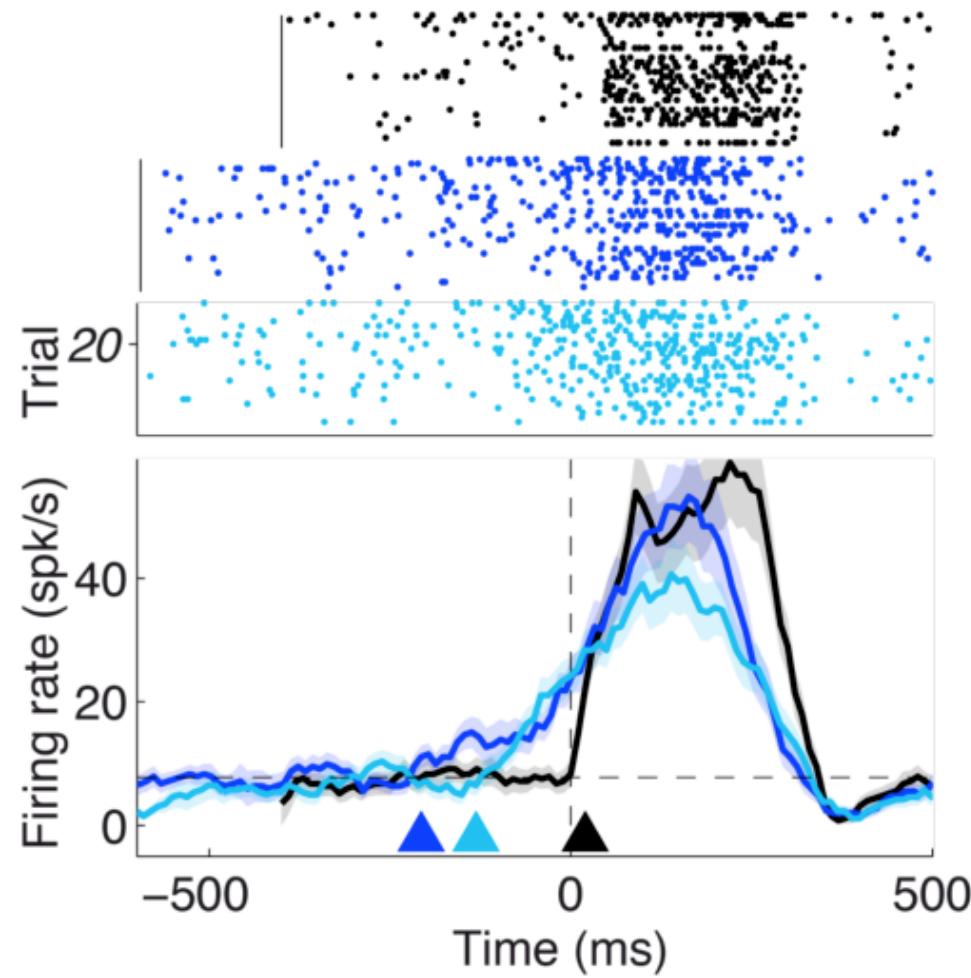
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Trial

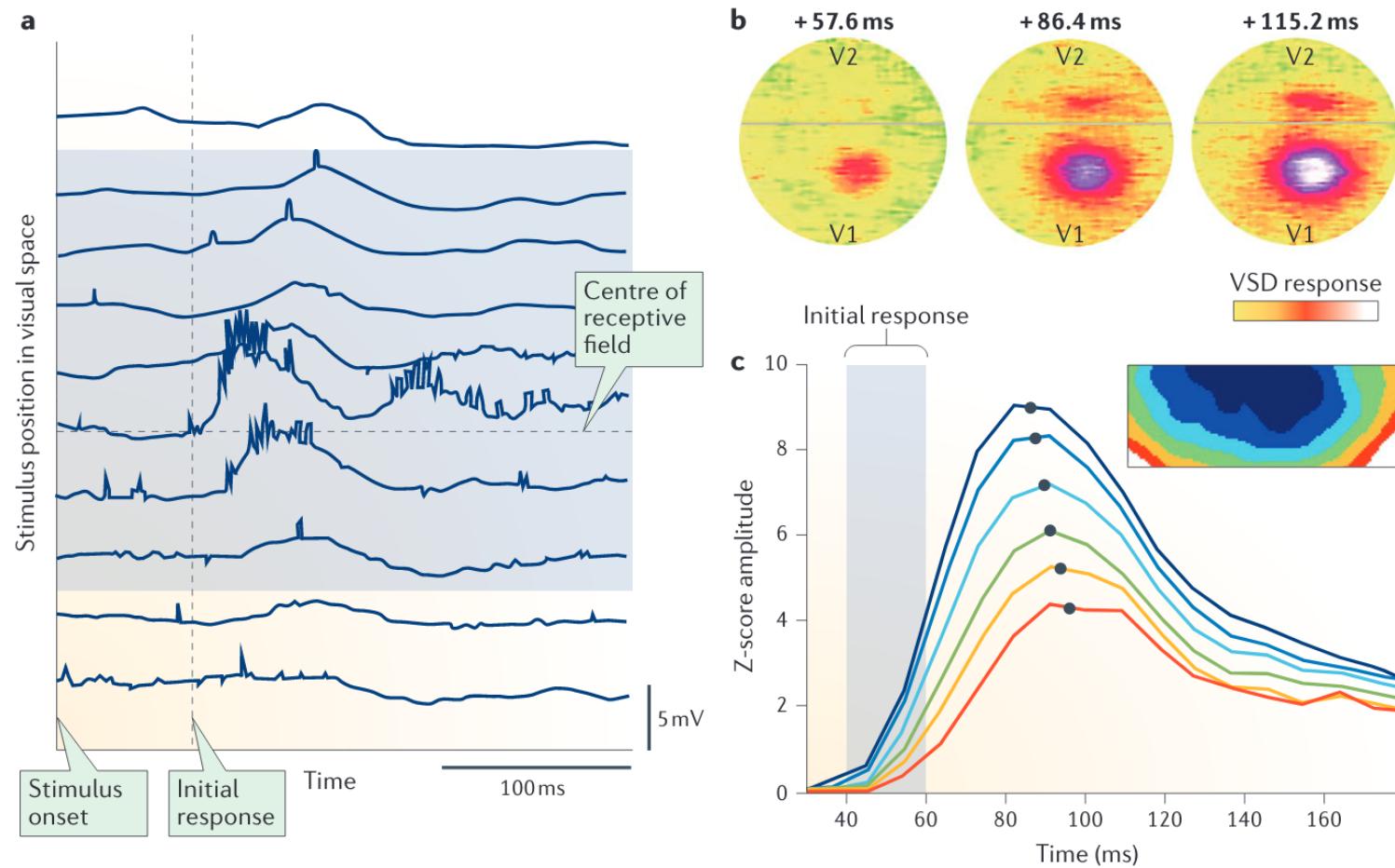
Benvenuti, Taouali, LP, Chavane () *in prep*



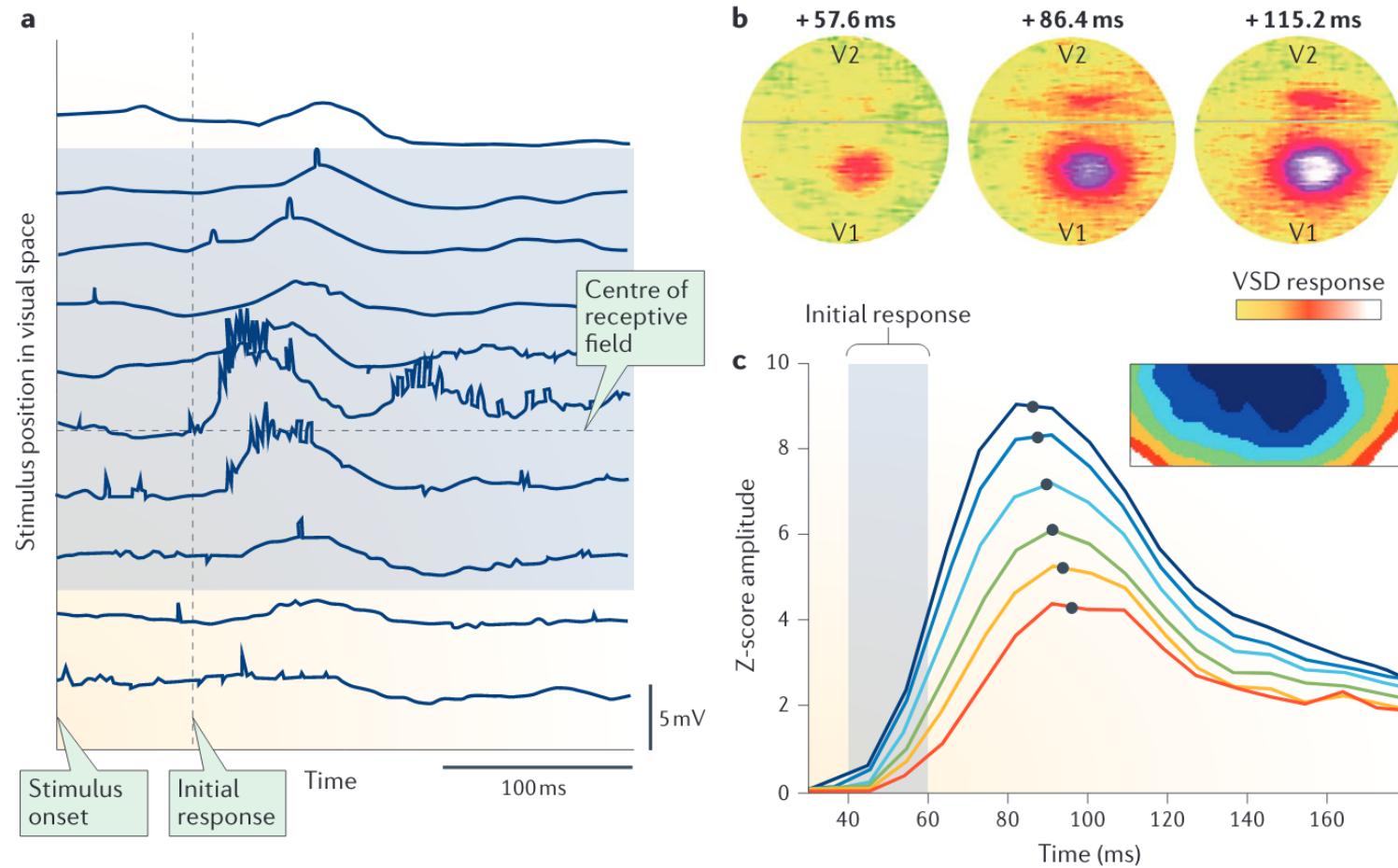
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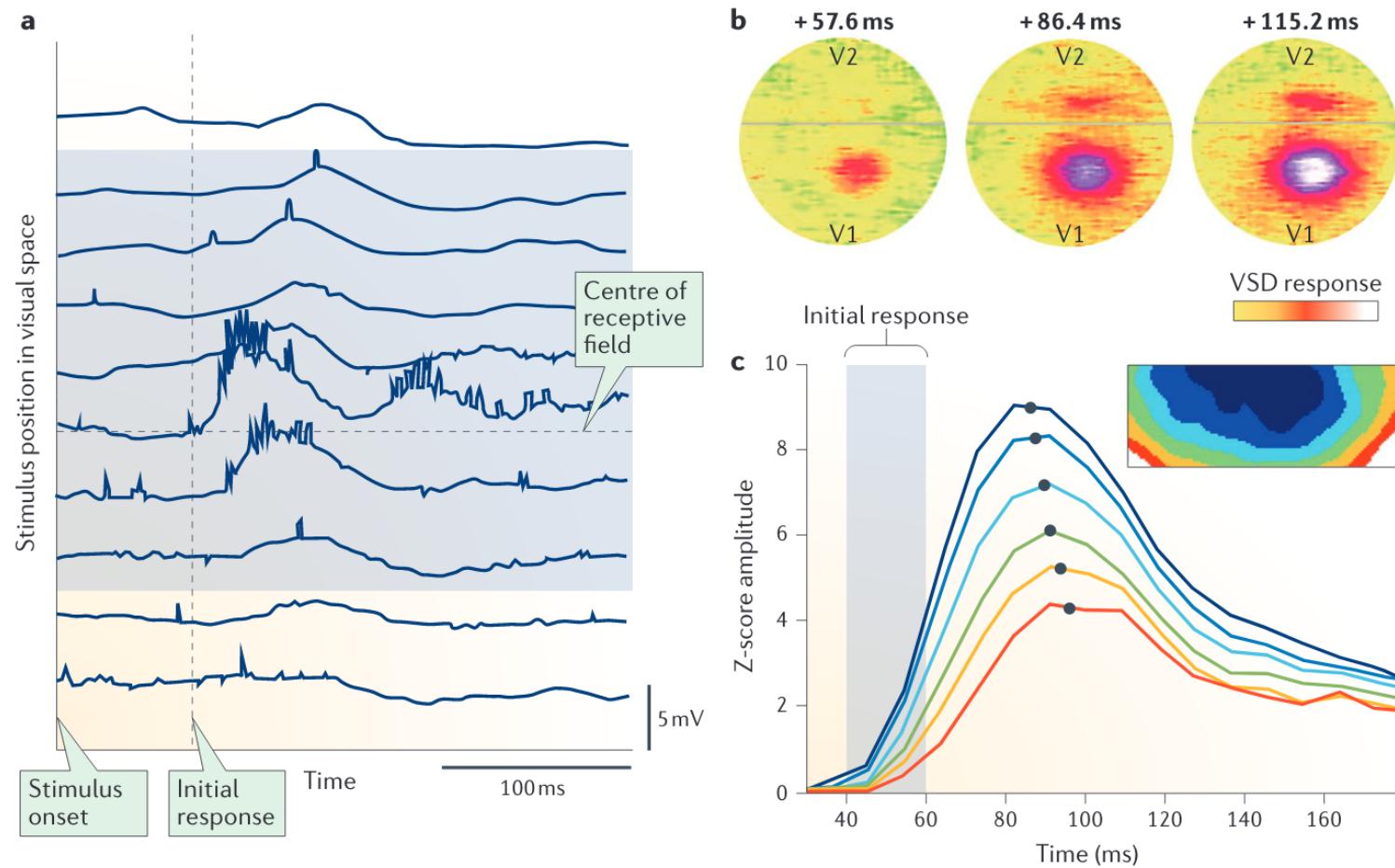
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Muller, Chavane, Reynolds, Sejnowski (2018) Cortical travelling waves: mechanisms and computational principles *Nature Reviews Neuroscience* 19 (5), 255



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