Primary motor cortex does not exhibit orderly dynamics during grasp

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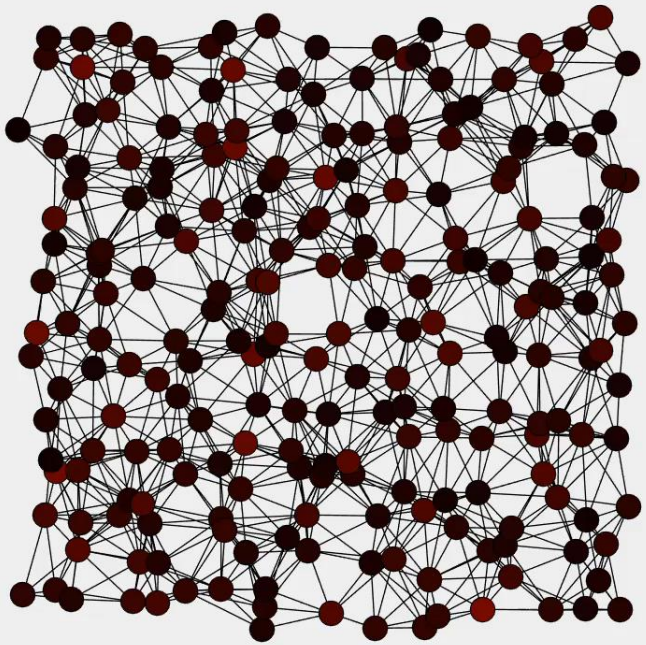
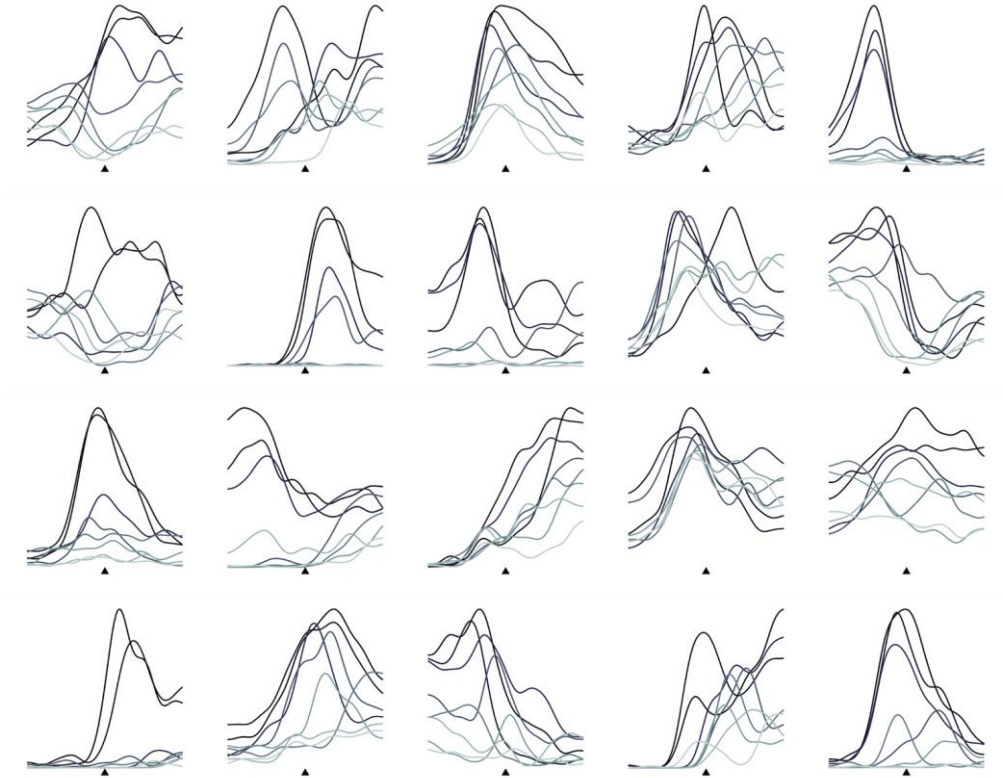
Aneesha K. Suresh
Elizaveta V. Okorokova
Matthew T. Kaufman
Nicholas G. Hatsopoulos
Sliman J. Bensmaia

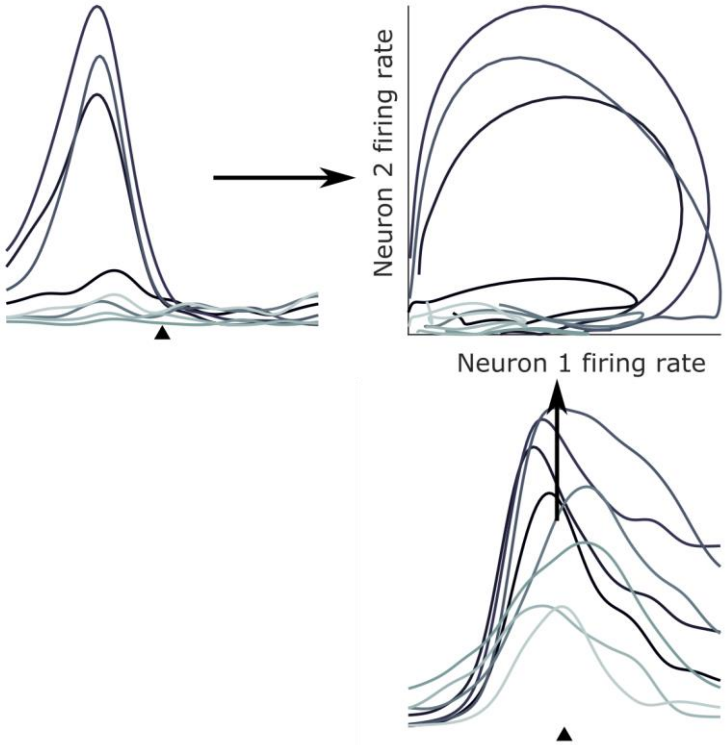
Neural populations and output generation



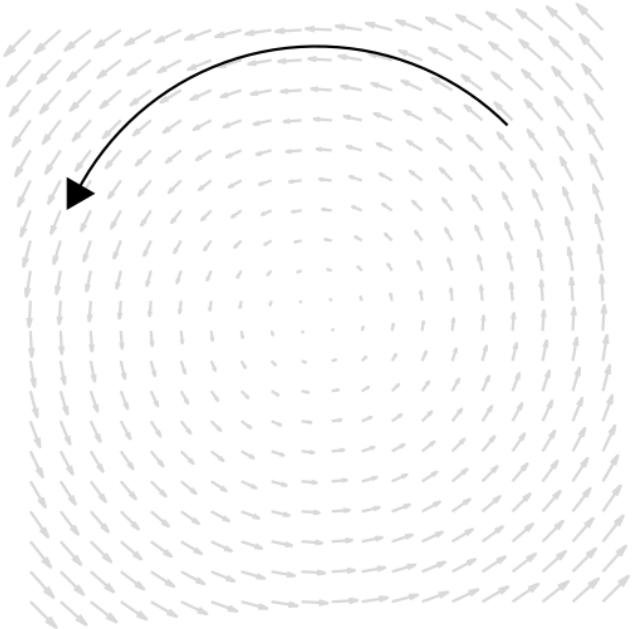
Single-neuron structure



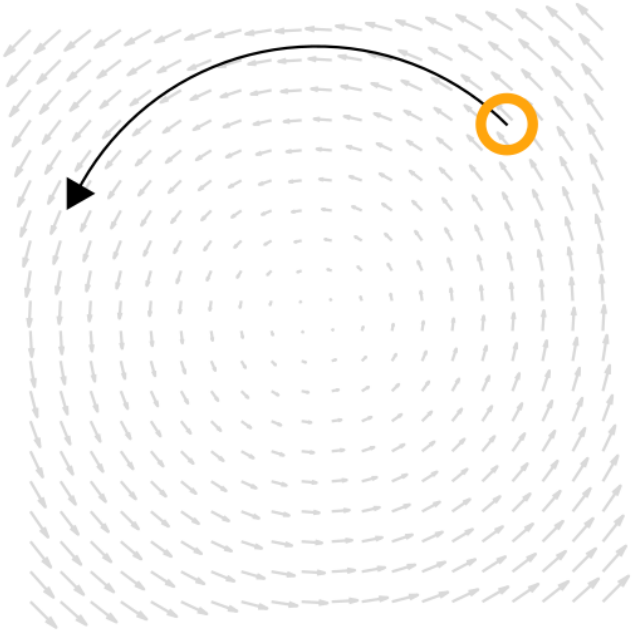
Neural “trajectories”



Dynamical systems



Dynamical systems



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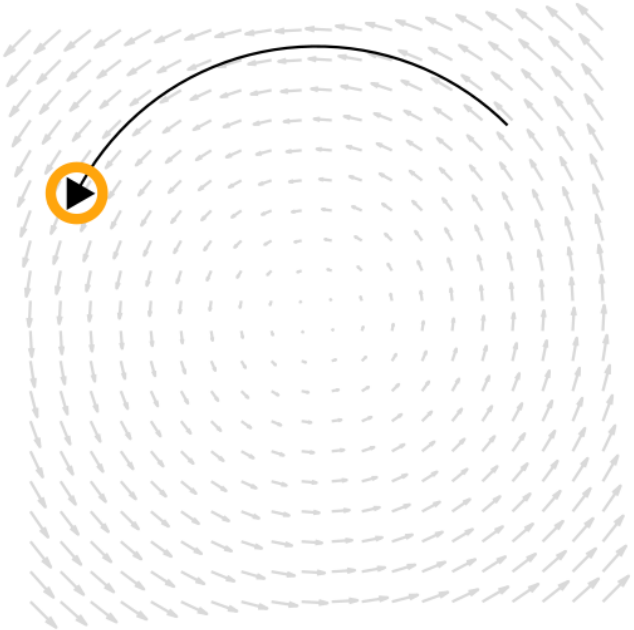
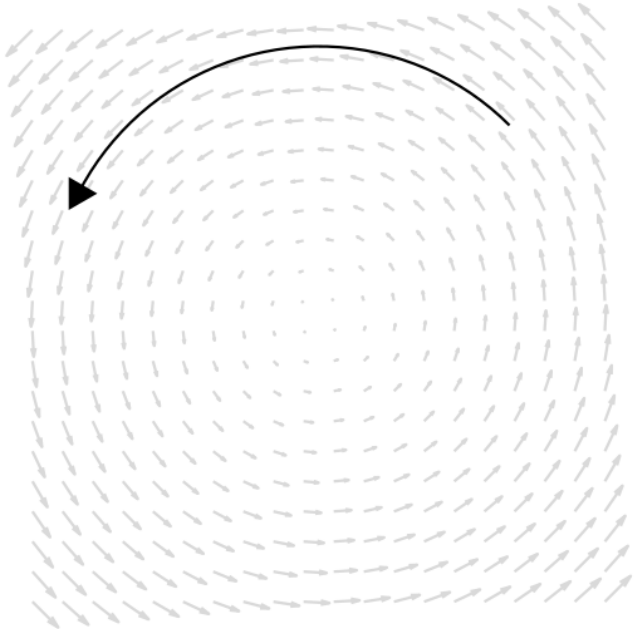


Varieties of dynamical system

- Autonomous
- Smooth
- Linear
- Rotational



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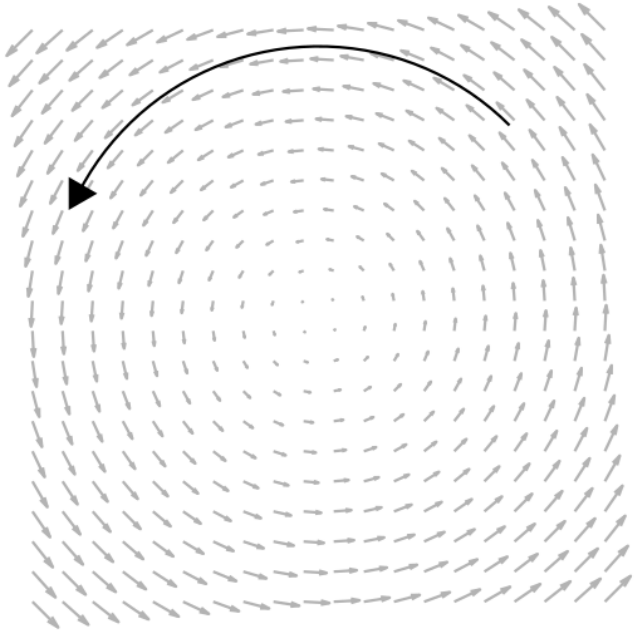

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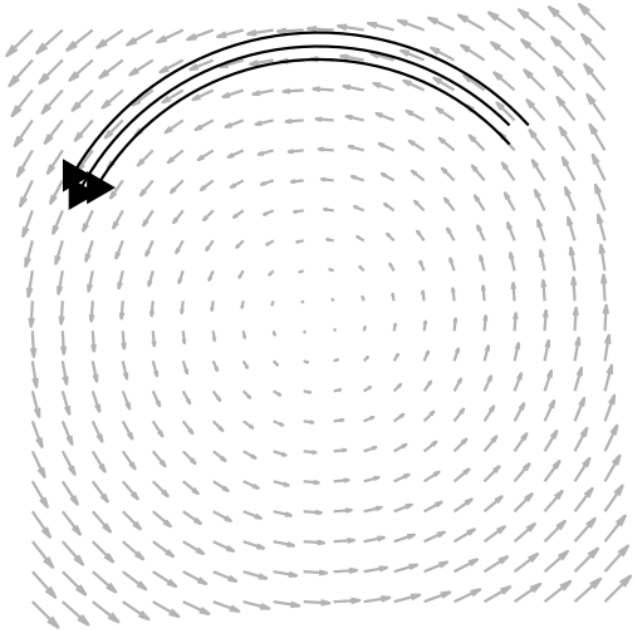

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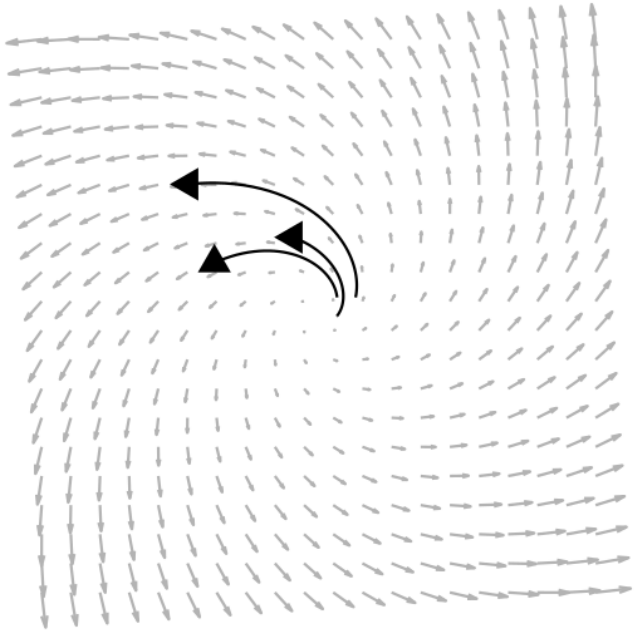

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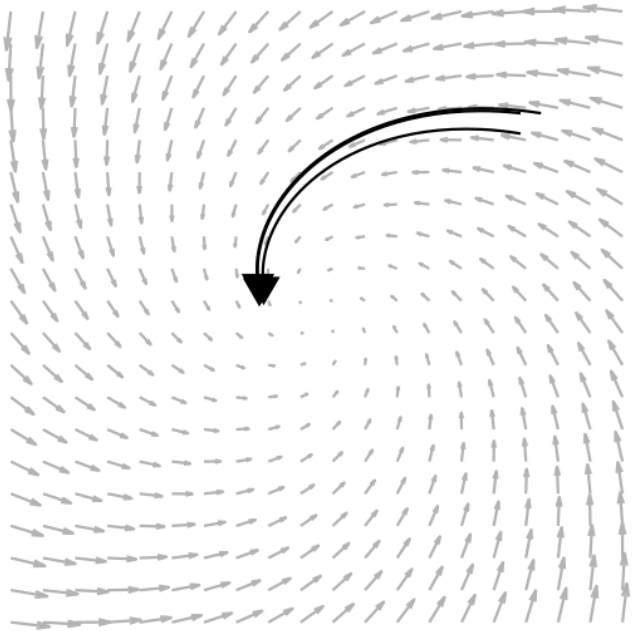

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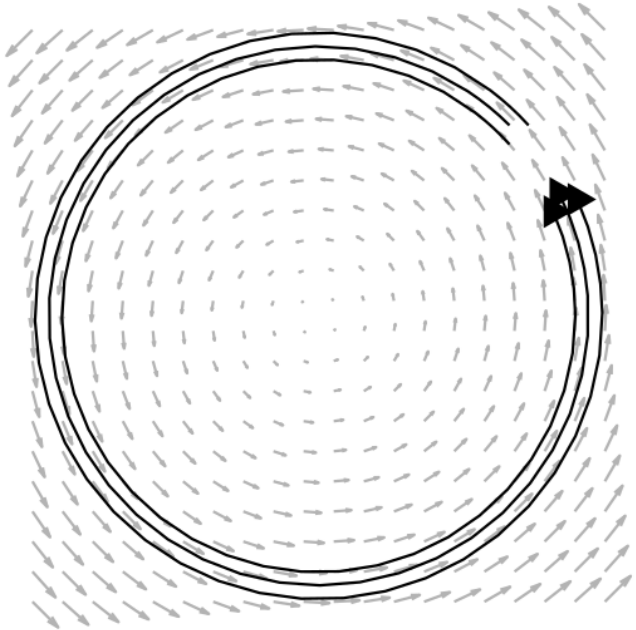
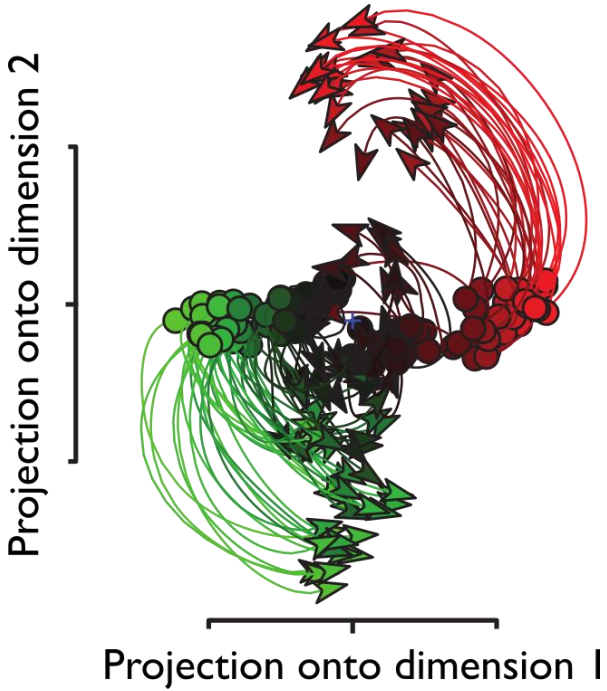
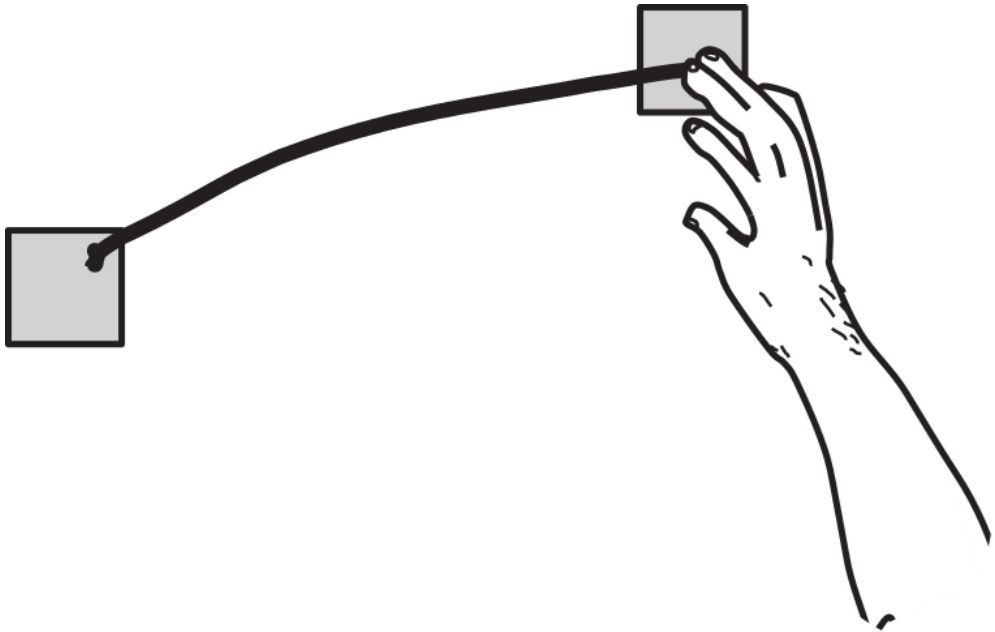


Rotational structure in neural populations



Churchland, Cunningham,
et al. 2012 *Nature*

Primarily seen during reach



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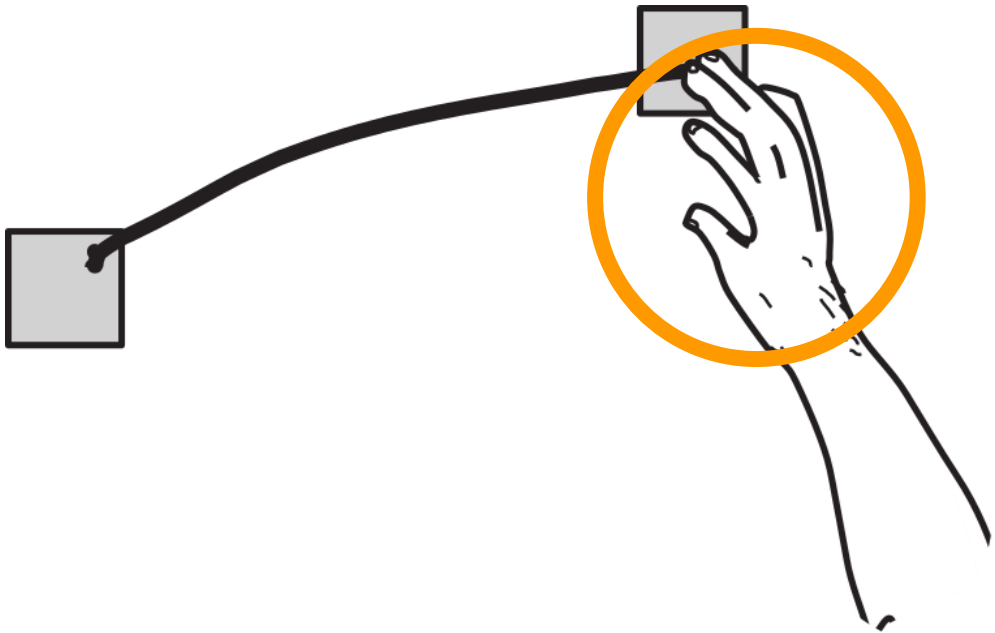
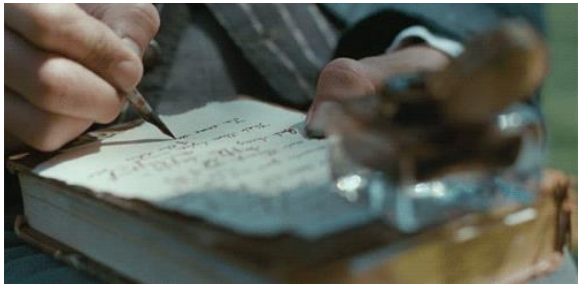
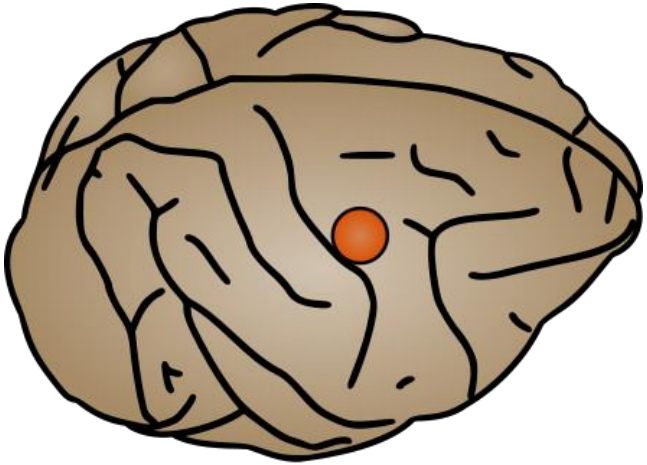
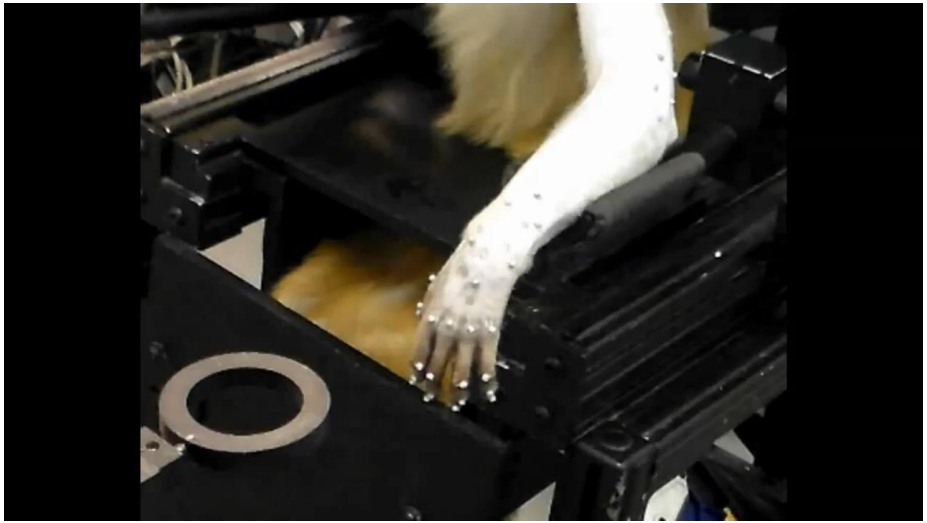


The versatile hand

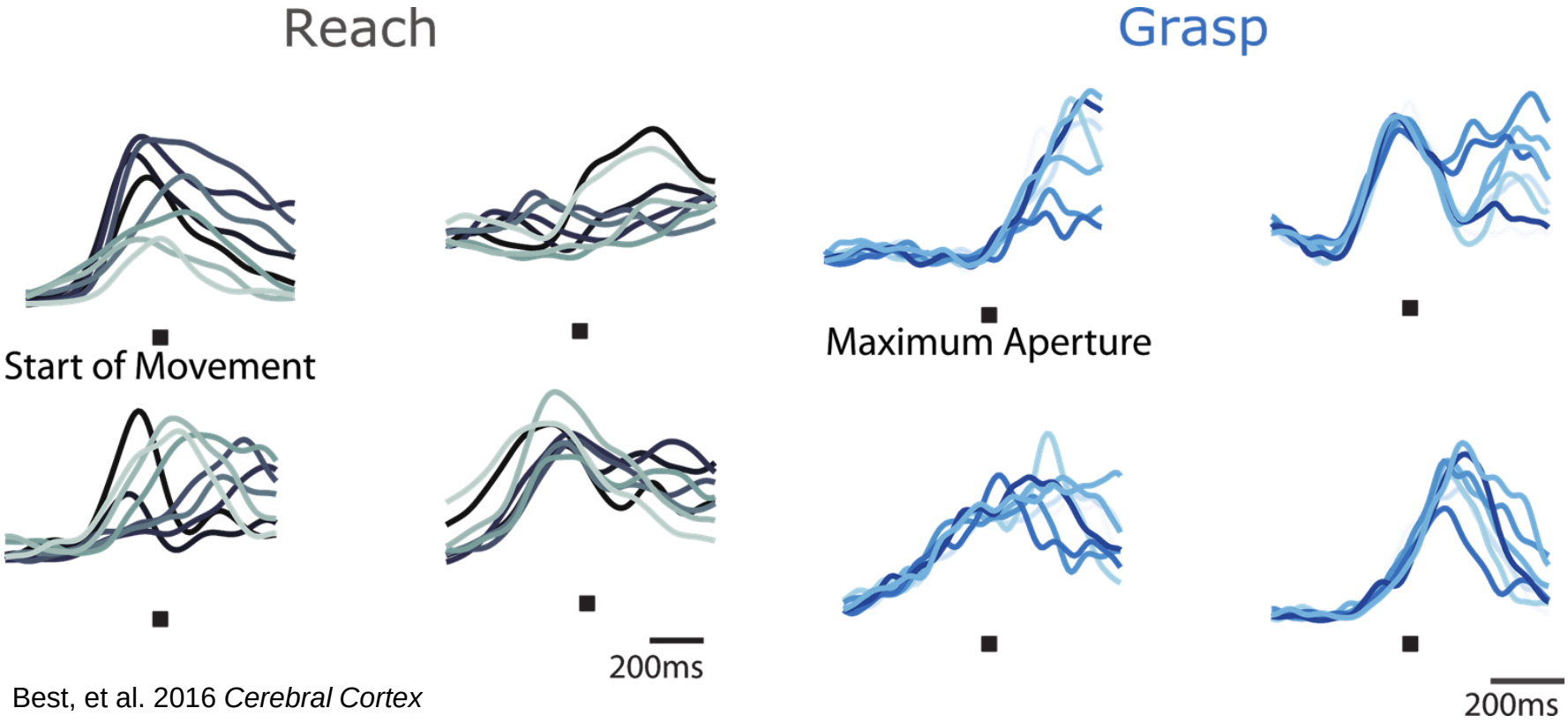


Grasp experiment



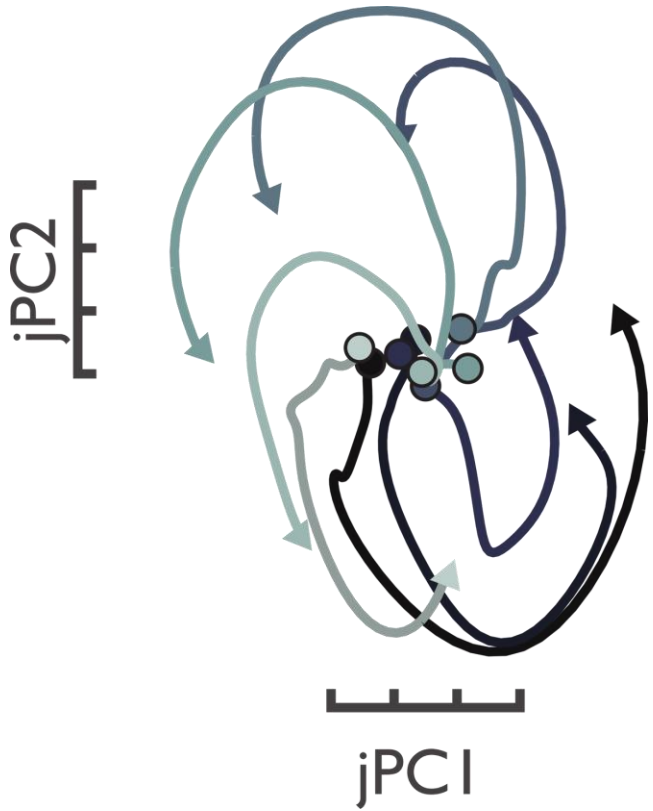


Single-neuron responses during reach and grasp

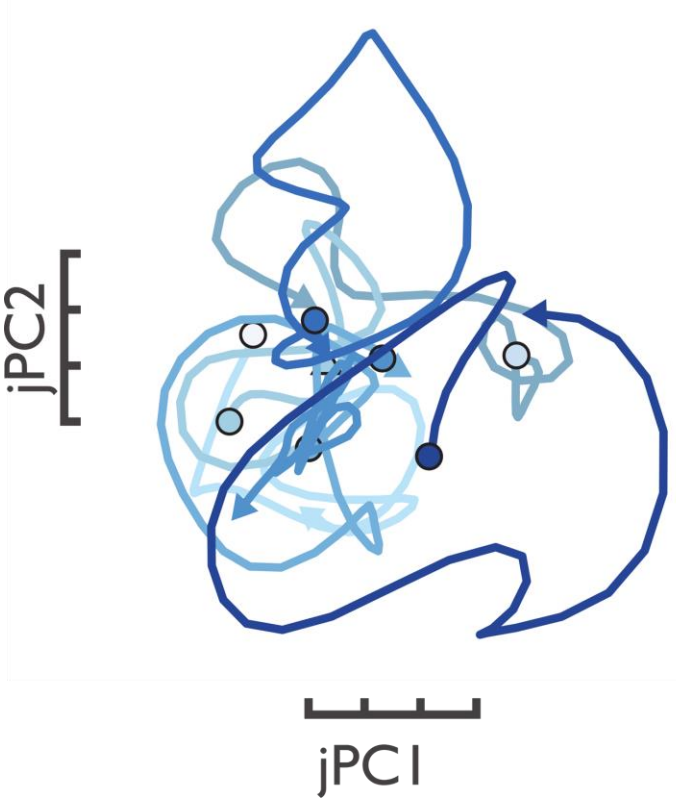


Best, et al. 2016 *Cerebral Cortex*

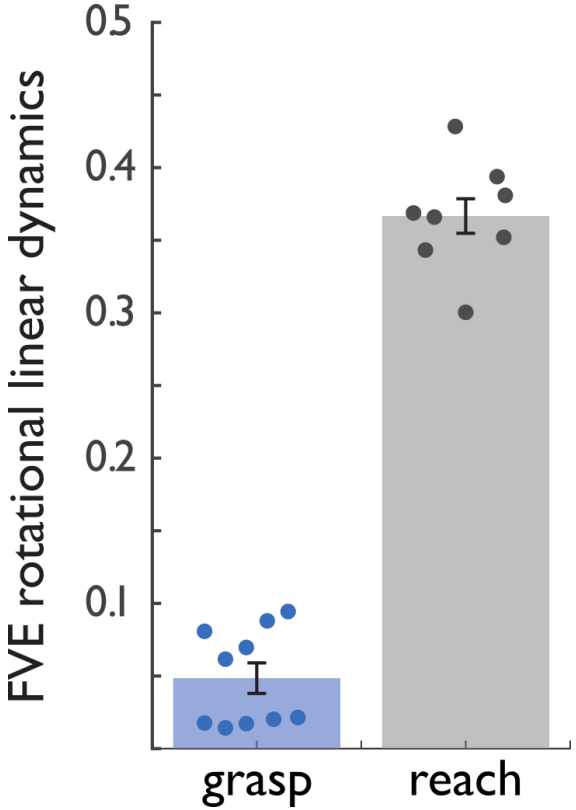
Rotational structure during reach



No clear structure during grasp



Variance explained by rotational dynamics



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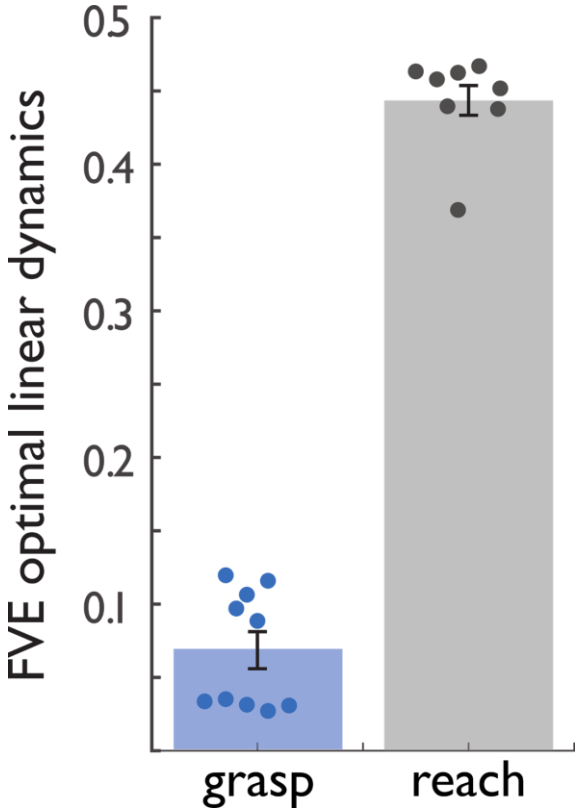
Variance explained by linear dynamics



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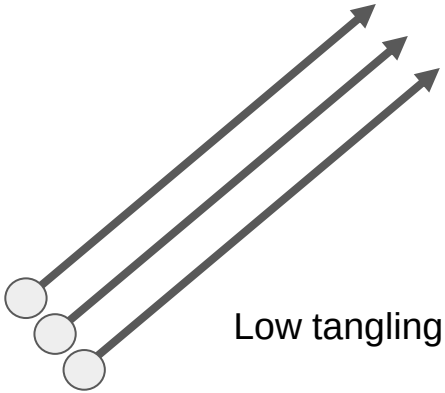
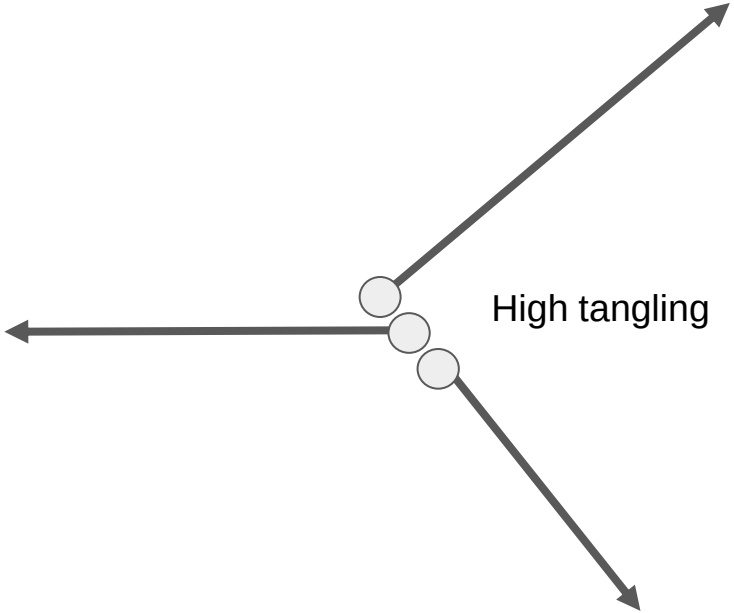
A metric of “tangling”



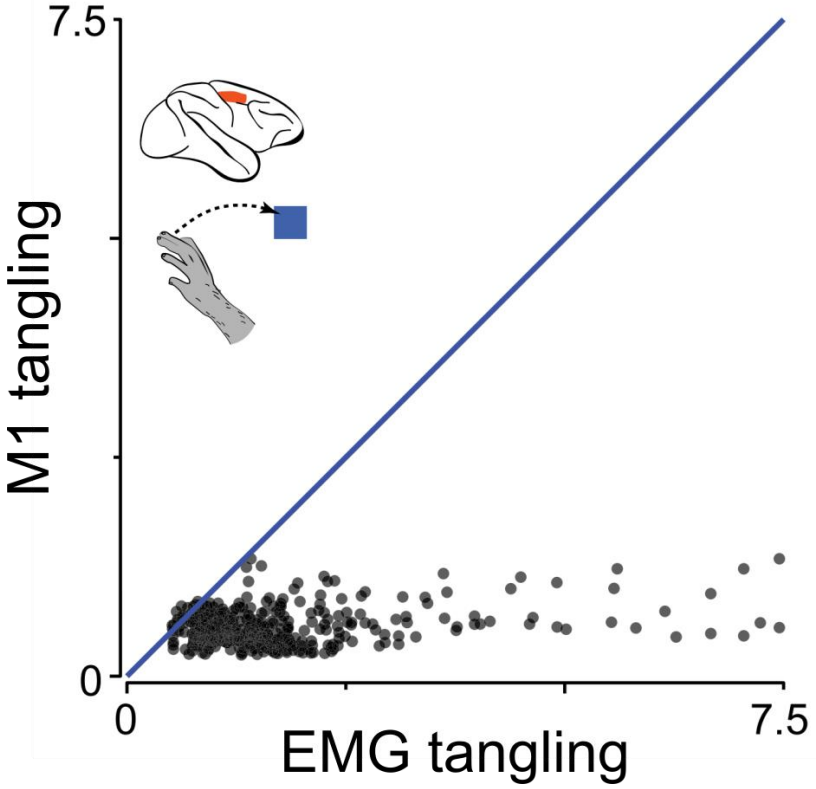
Low tangling



High tangling

Russo, et al. 2018 *Neuron*

M1 activity during **reaching** is untangled



Russo, et al. 2018 *Neuron*

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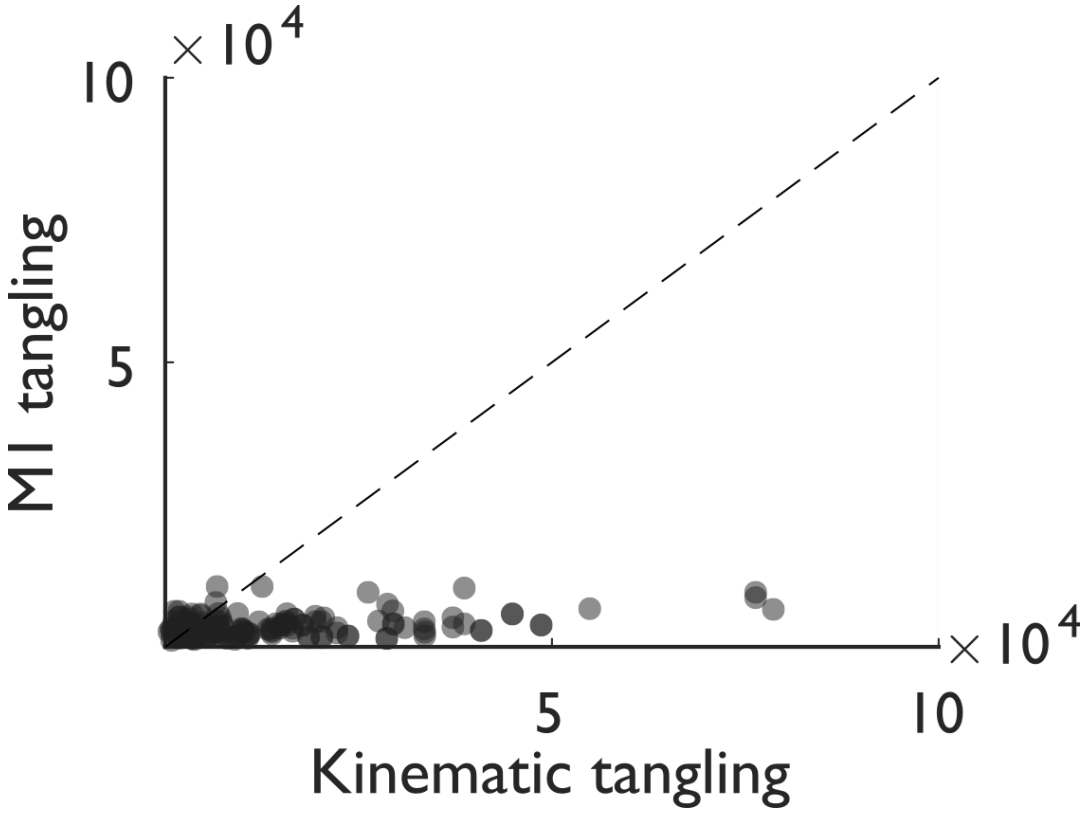
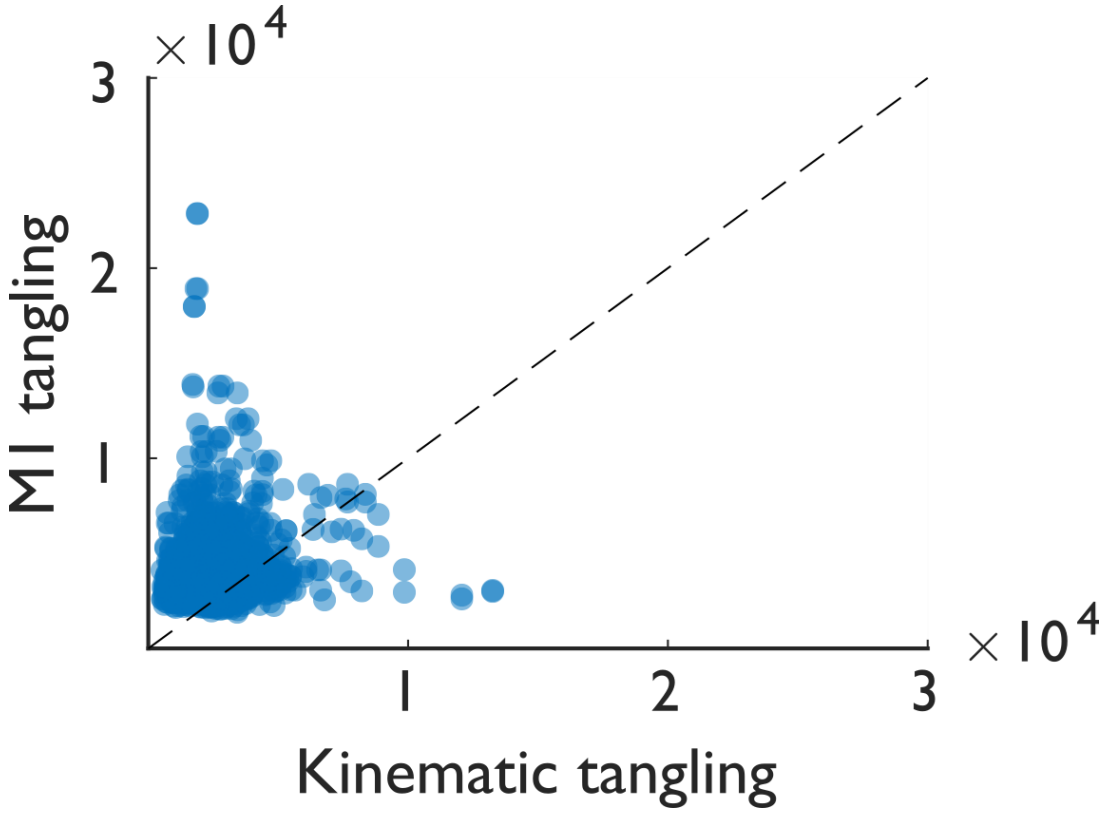
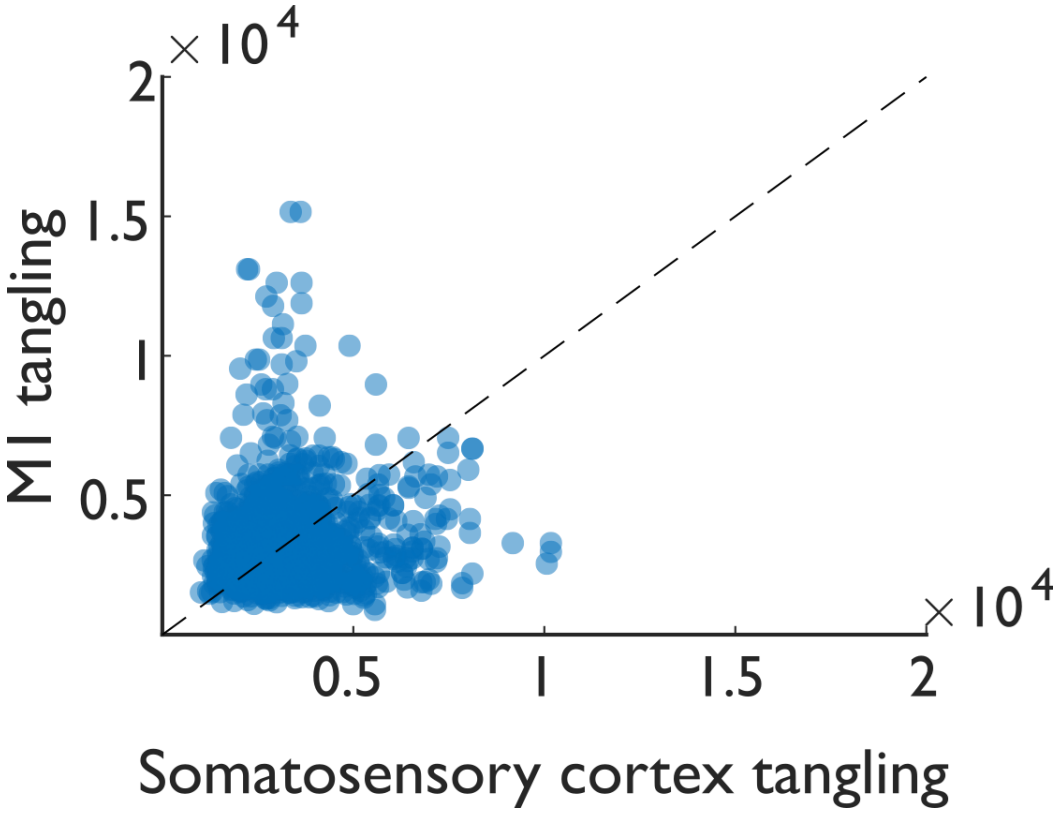


During **grasp**, M1 activity is *very* tangled



M1 and sensory cortex *similar* during **grasp**



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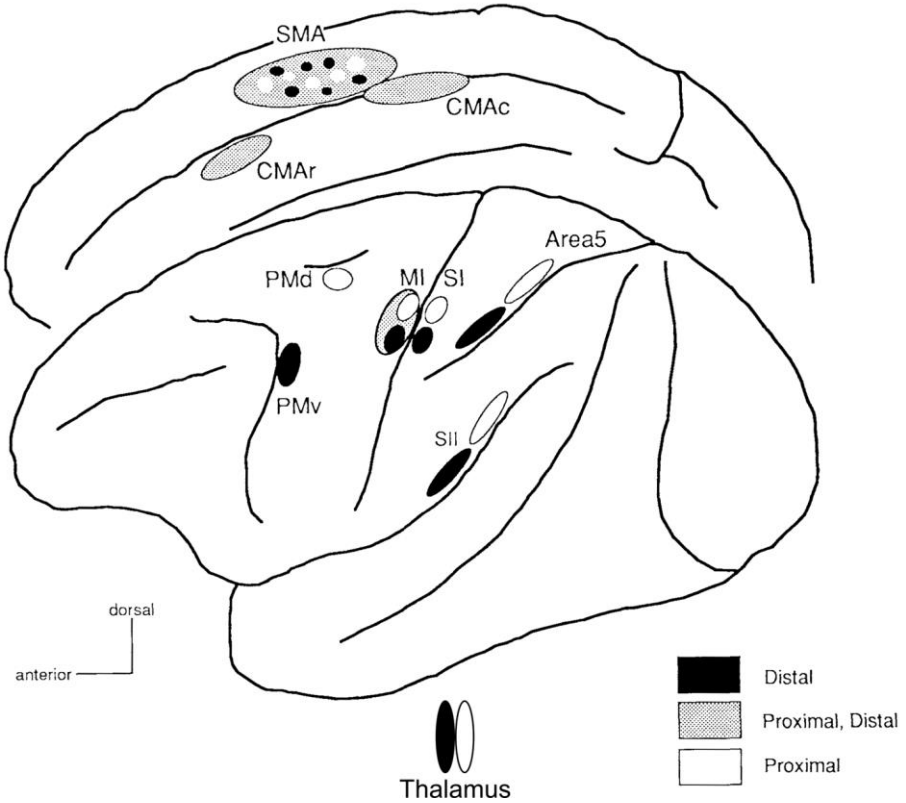
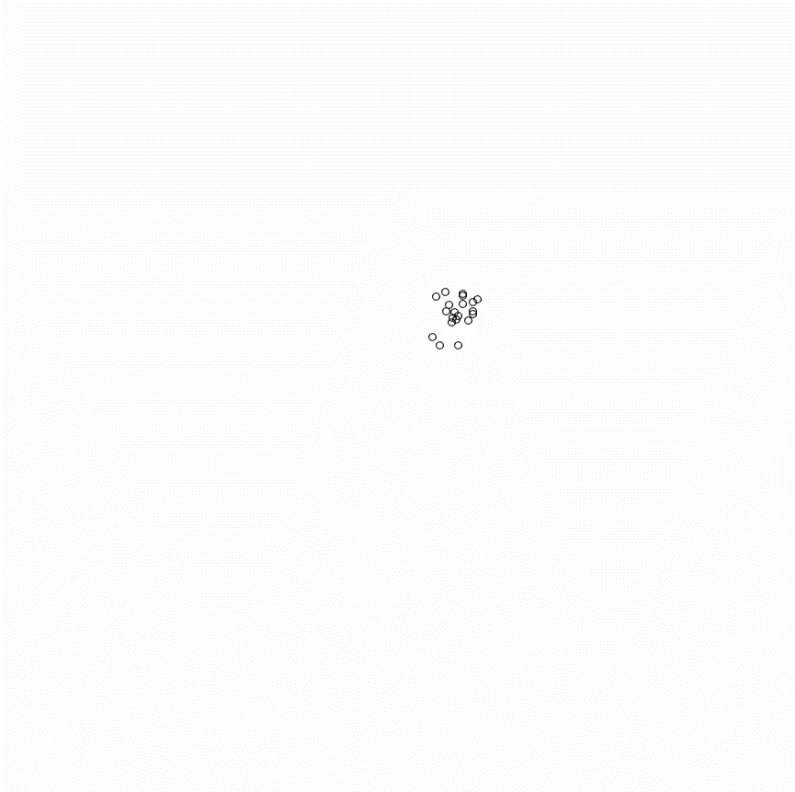
Non-autonomous dynamics

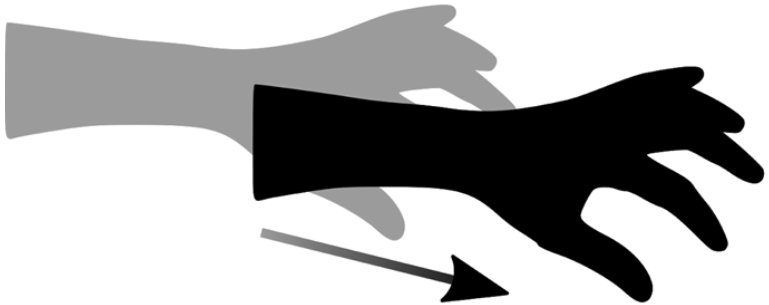


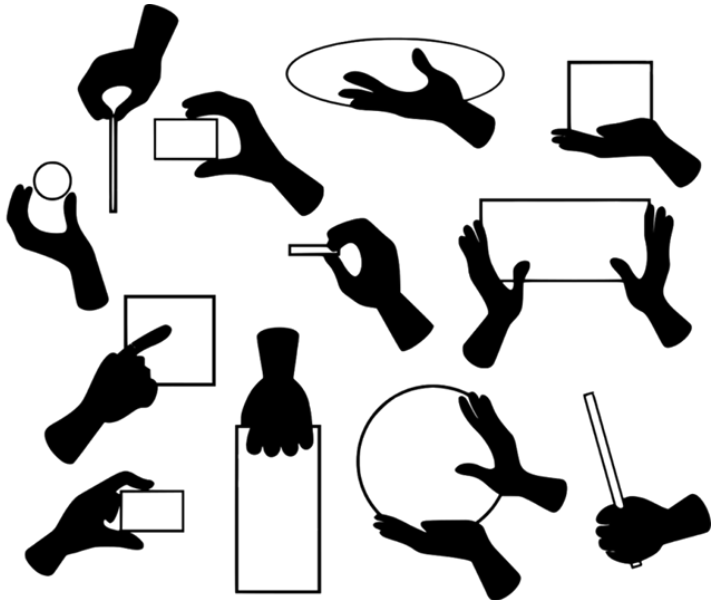
Tokuno & Tanji 1993 *J Comp Neurol*

Non-smooth, non-linear dynamics



Distinct movements, distinct dynamics





Acknowledgments

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