

Mechanisms of top-down attentional control in thalamic reticular circuit

Qinglong Gu, Norman H. Lam, John D. Murray

Yale University

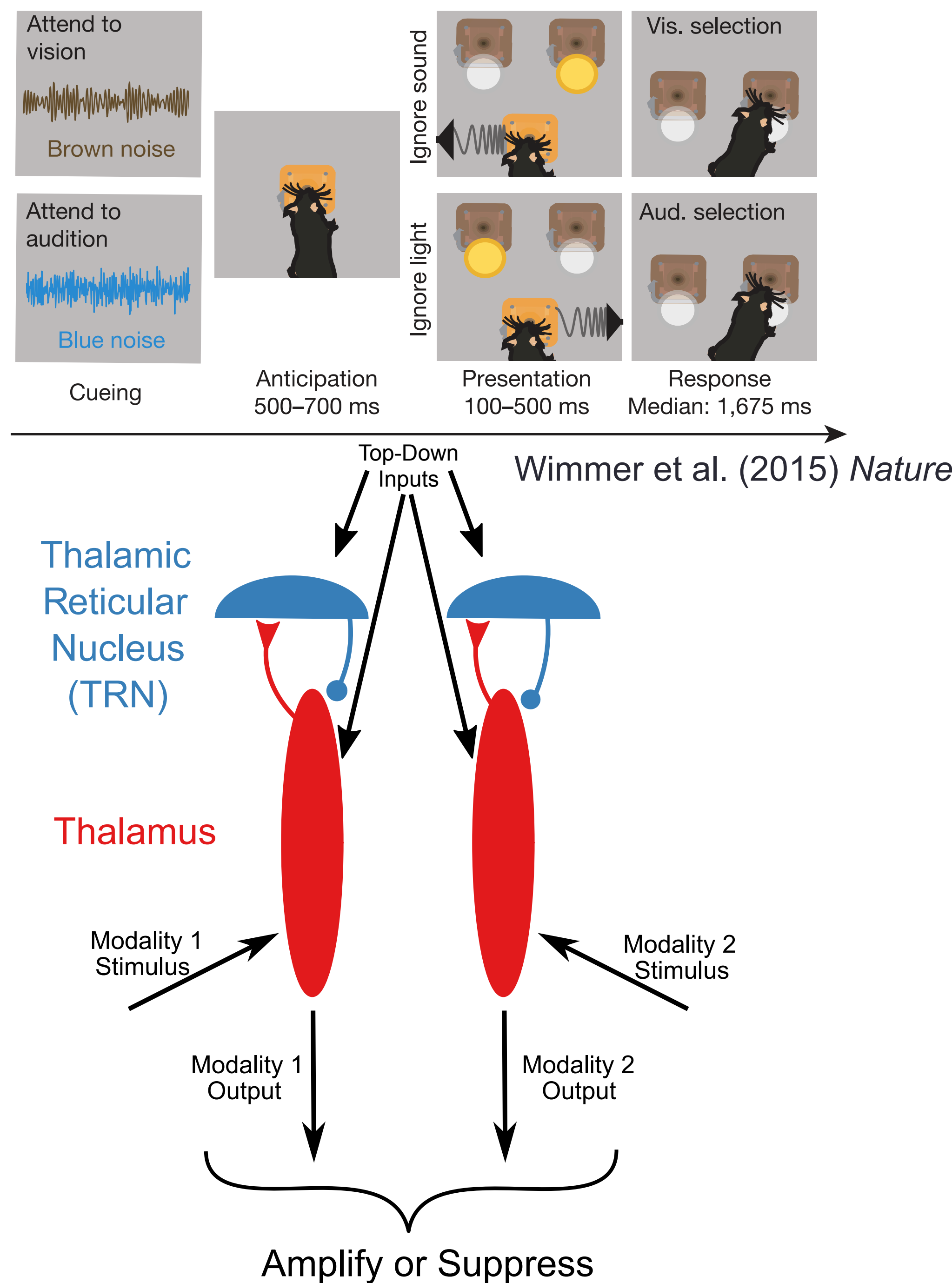
Contact: qinglong.gu@yale.edu, john.murray@yale.edu

Introduction

Attention is a critical cognitive process, allowing us to filter unwanted stimuli and focus on signals important to the current task. Thalamus is a key area for attention and is implicated in neuropsychiatric disorders such as Schizophrenia. There has been a growing body of studies recorded thalamus during behavioral tasks, in combination with pharmacology or optogenetics. A thalamic model in the in-vivo regime that could summarize empirical data and provide predictions is in dire need.

Here, we built a thalamic circuit model in an in-vivo awake state. Well constrained by empirical data, the model provides a framework to synthesize and reconcile distinct empirical findings.

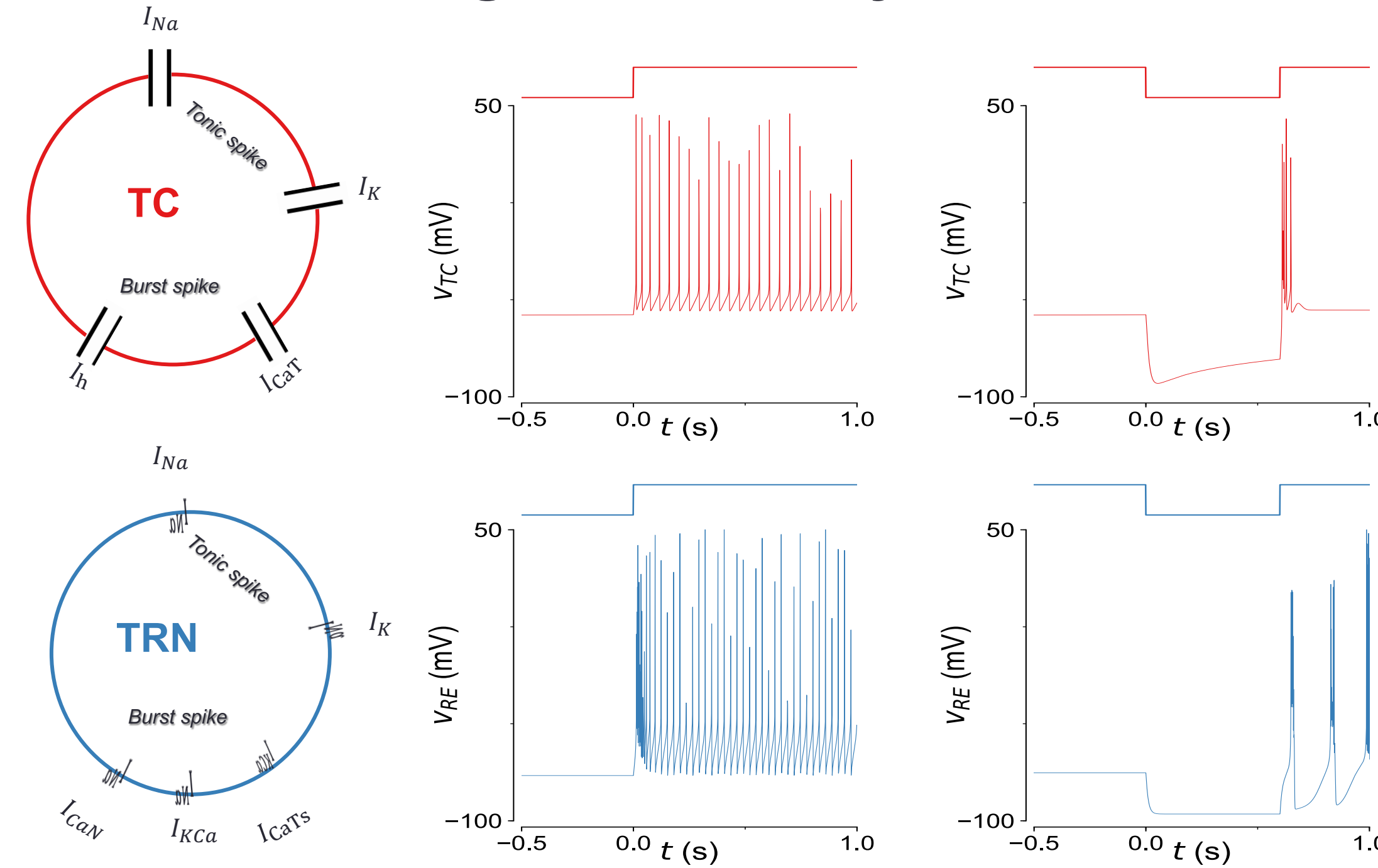
Attention and top-down control across thalamic modalities



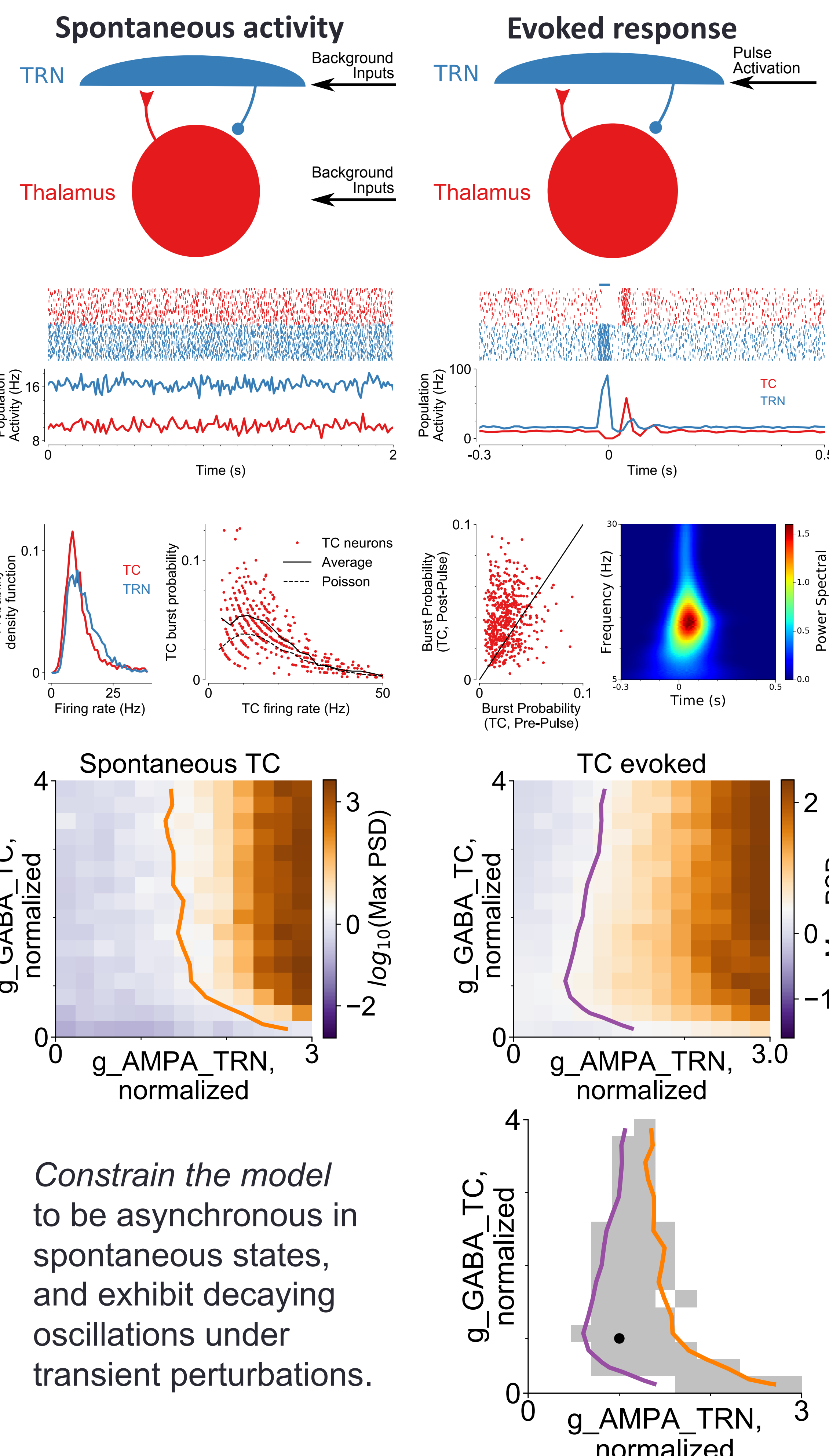
References: Halassa et al. (2011) *Nat Neurosci*; Wimmer et al. (2015) *Nature*; Halassa & Acsády (2016) *Trends Neurosci*; Nakajima et al. (2019) *Neuron*; Aizenberg et al (2019) *Cell Reports*

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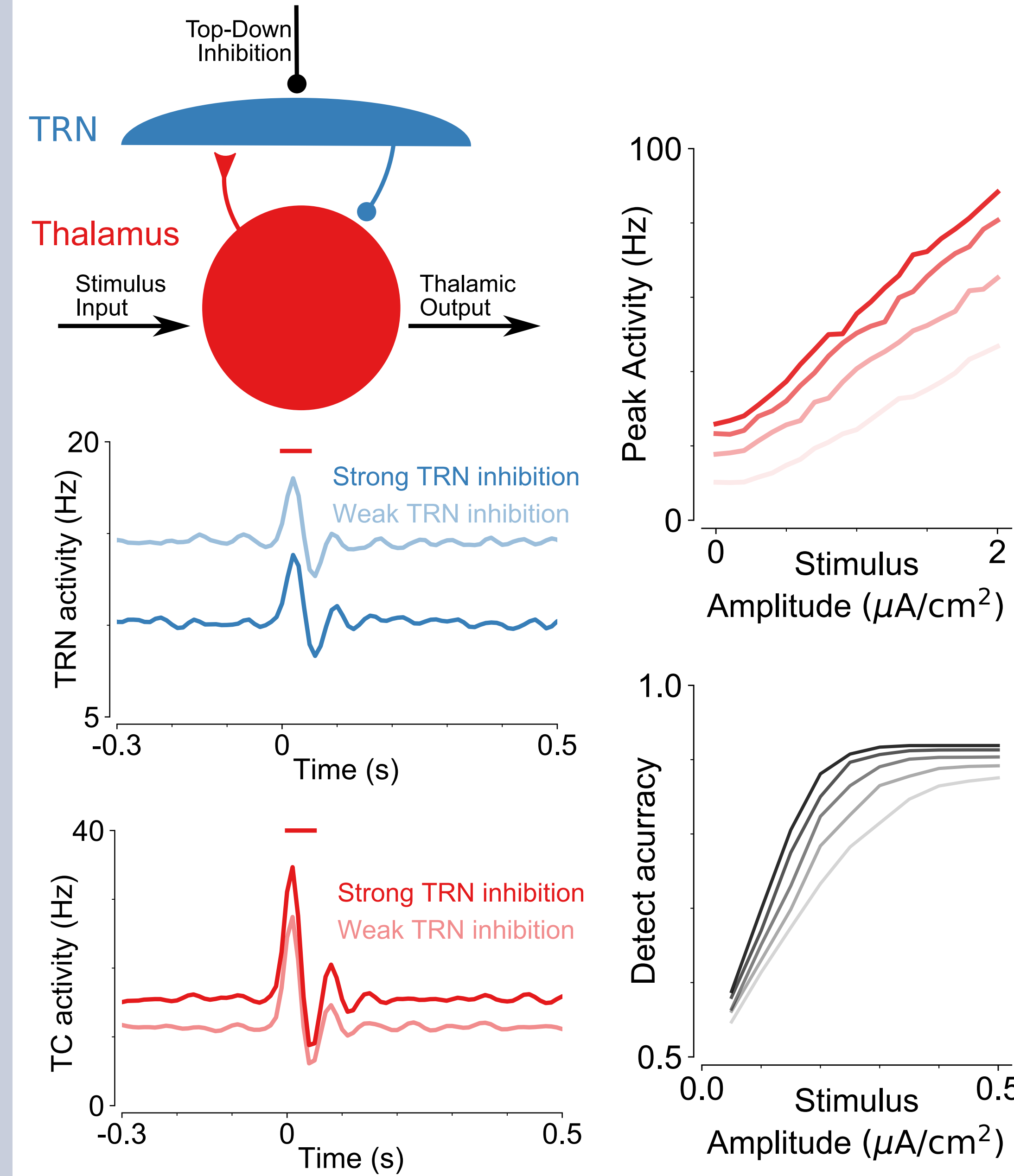
Single neuron dynamics



A circuit model in the in vivo regime

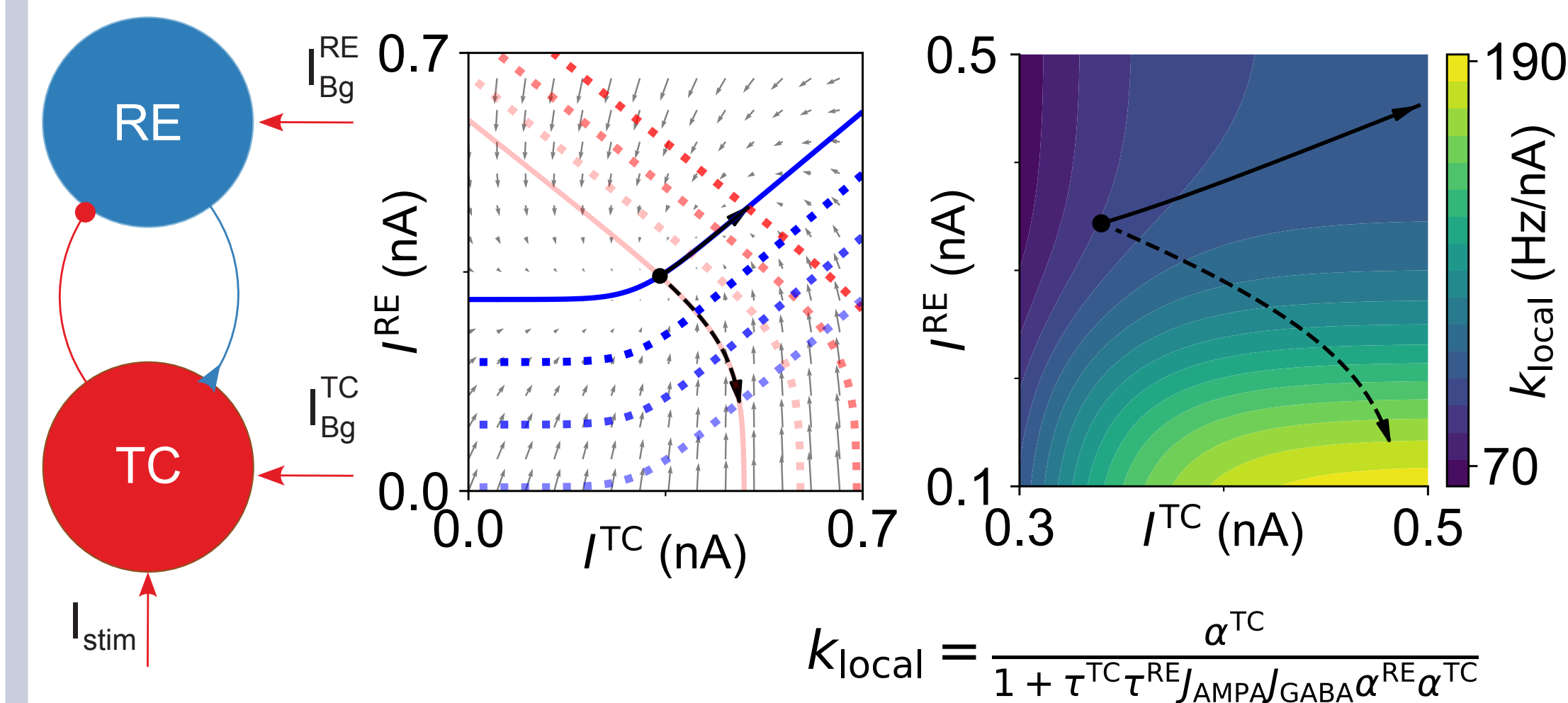
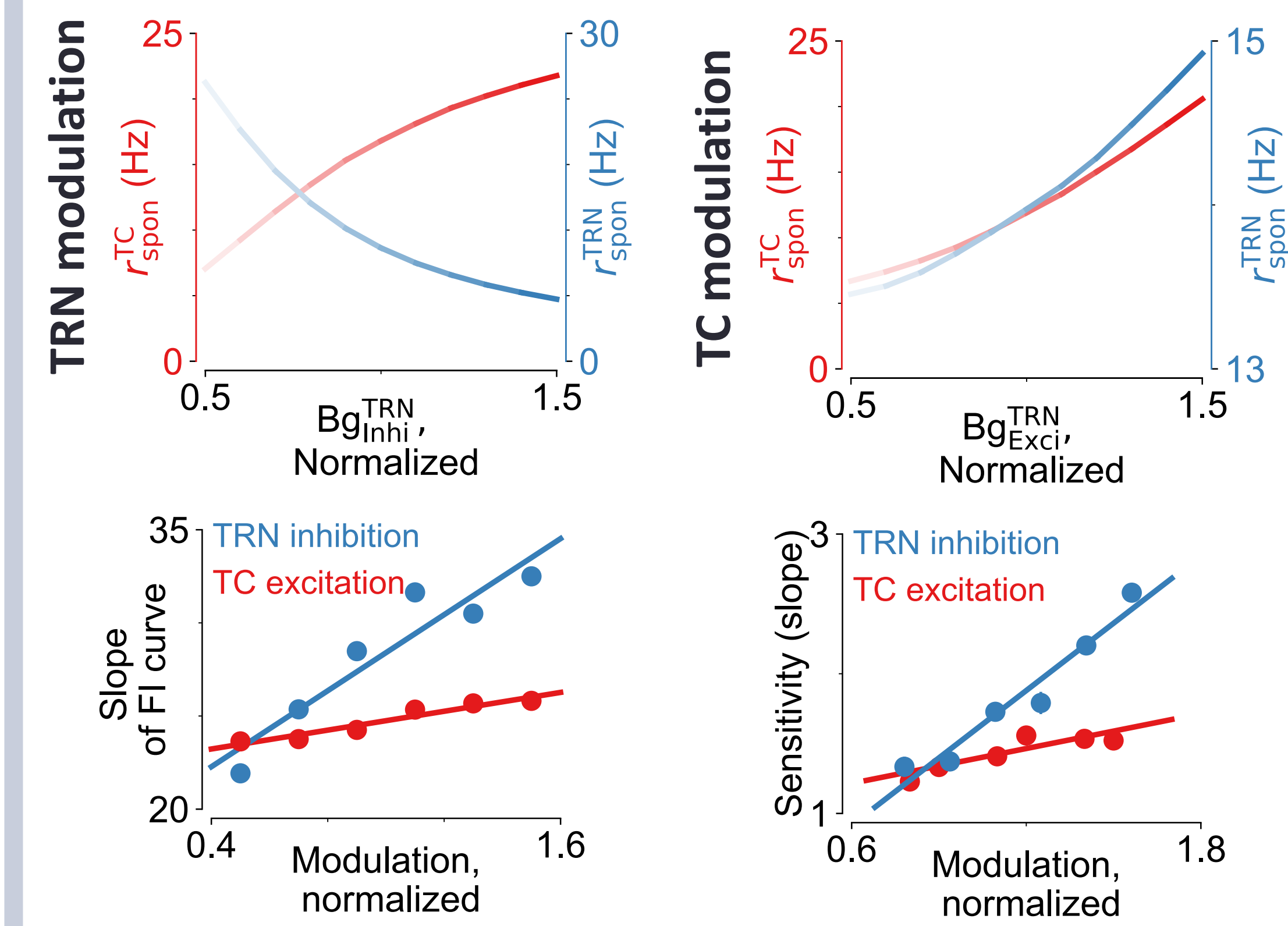


Attentional modulation on TRN

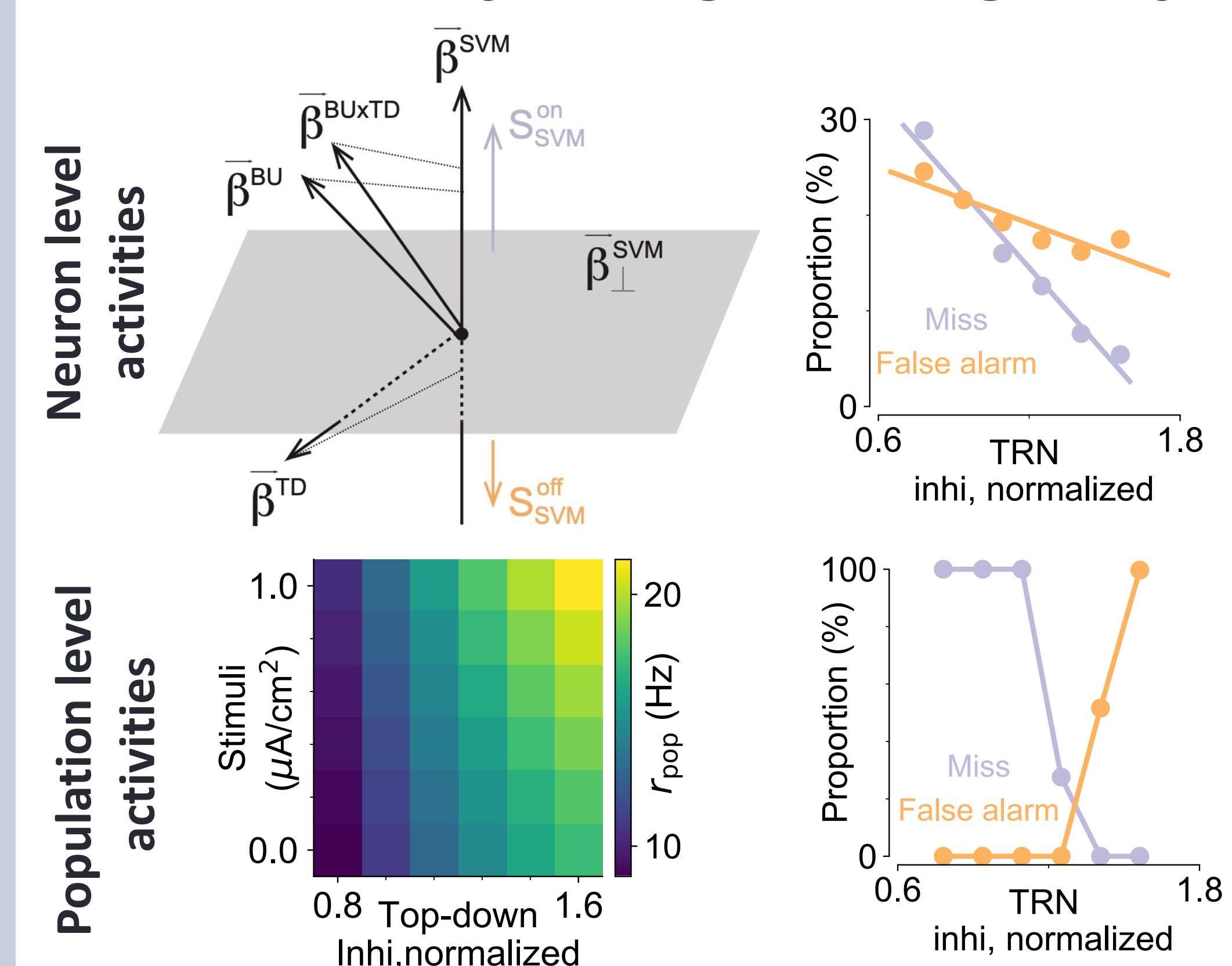


Top-down TRN inhibition disinhibits thalamus, modulating its response gain.

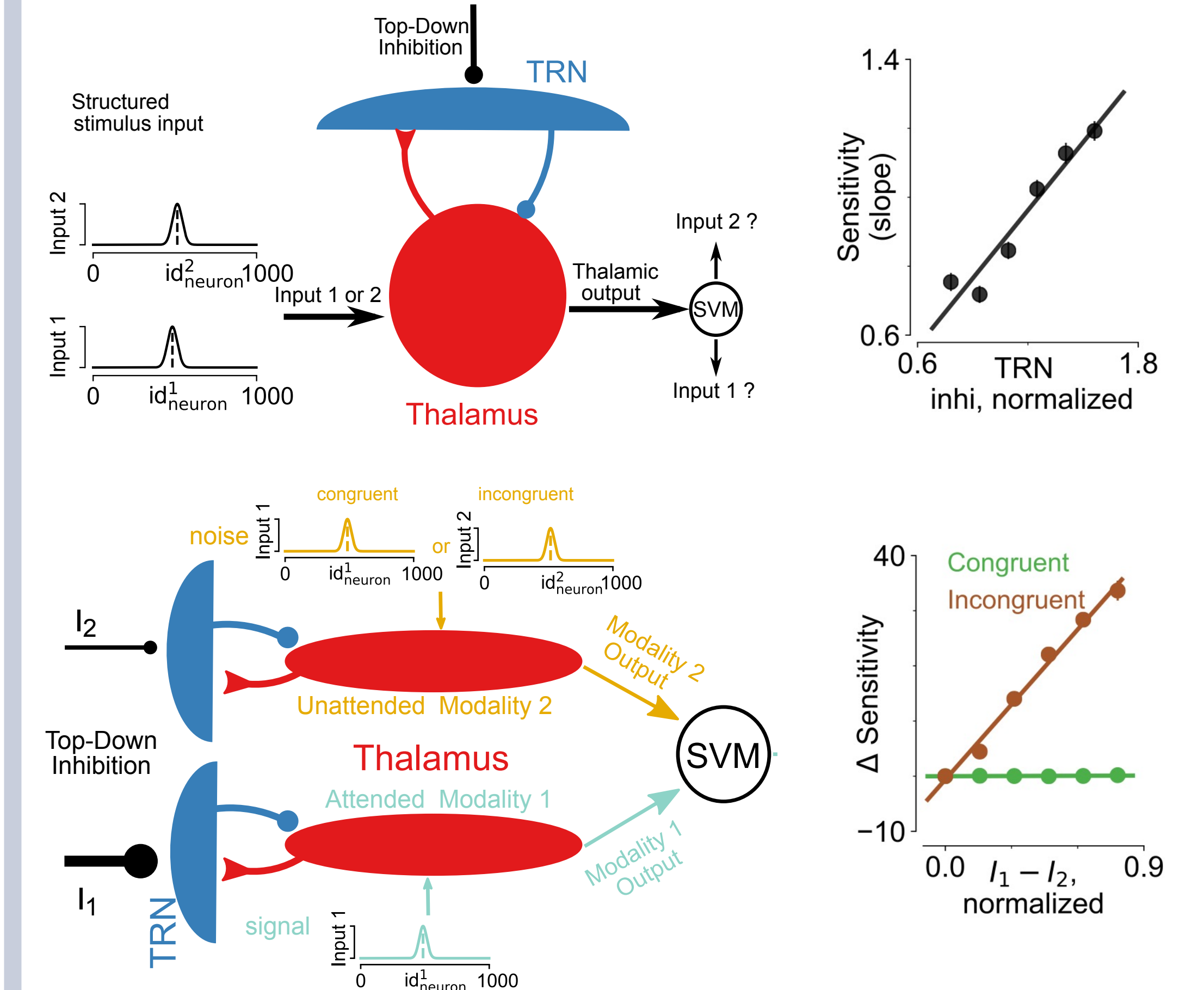
Attentional modulation on TC vs TRN



Attention improving detectability through heterogeneity



Attention effects on discrimination



Conclusion

- In vivo regime thalamic reticular circuit model
- Attention effects mediated by top-down modulation
- Distinct effects of bottom-up inputs and top-down modulations in the neuronal activity space

Future Directions

- Inhibitory dysfunction of attention modulation
- Disease-related mechanisms of dysfunction
- Distributed thalamocortical interactions