Self-tickle across cortical layers

– a project outline with preliminary results –

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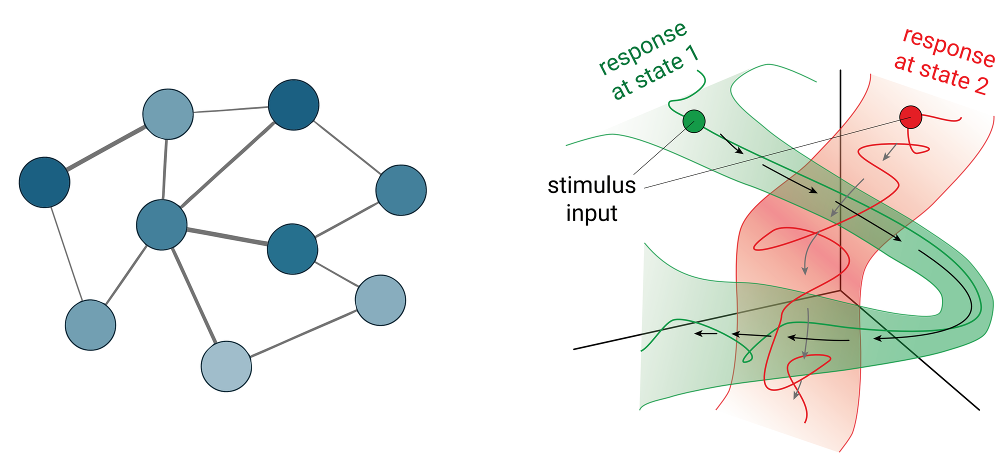
INTRODUCTION

In perception, no neural response is exactly the same, even to identical stimuli – why?

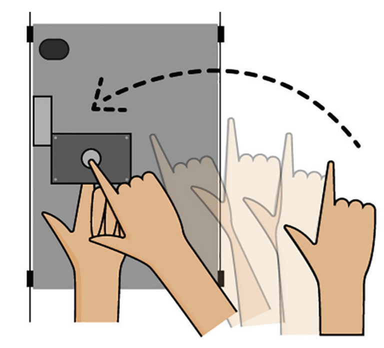
- Neural context shapes sensory processing. [1-4]



adapted from Baria et al., 2017

- This applies to all sensory modalities but a well-known example in the somatosensory domain with *qualitatively* different percepts is **TICKLE.**

(1) Why can´t we tickle ourselves?
- Theory of sensory attenuation: Self-touch elicits efference copies that attenuate somatosensory processing. [5,6]
- Previous fMRI studies on non-ticklish tactile stimuli: involvement of S1, S2, cerebellum. [7,8]
- Neural underpinnings of self-tickle cancellation remain elusive.

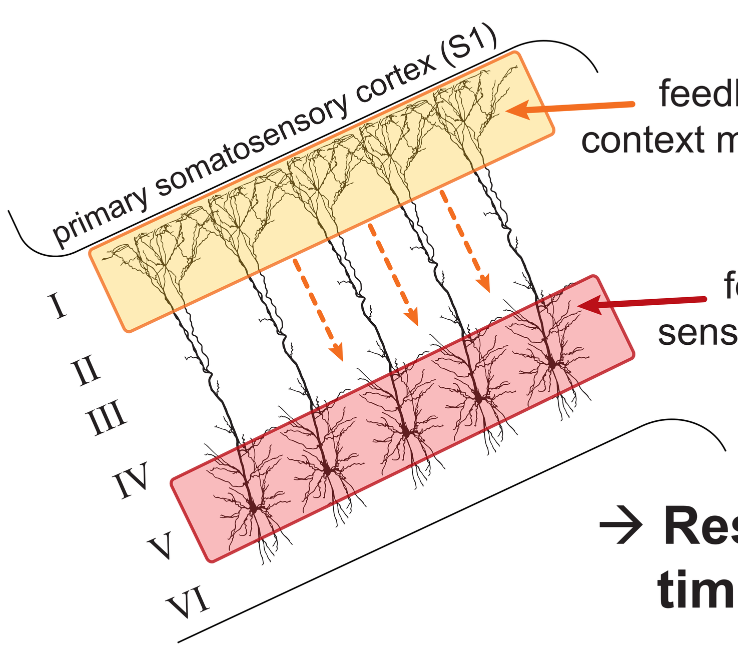


Kilteni & Ehrsson, 2022

(2) How might sensory attenuation be implemented on a neural level?
- Animal work [9,10]: Top-down modulatory signals arrive at apical dendrites (cortical layer I) of pyramidal cells while basal dendrites of the same neurons receive feedforward sensory input (middle and deep layers).
- Does sensory attenuation reflect such a top-down modulation mechanism and can this be generalized to humans?

HYPOTHESIS

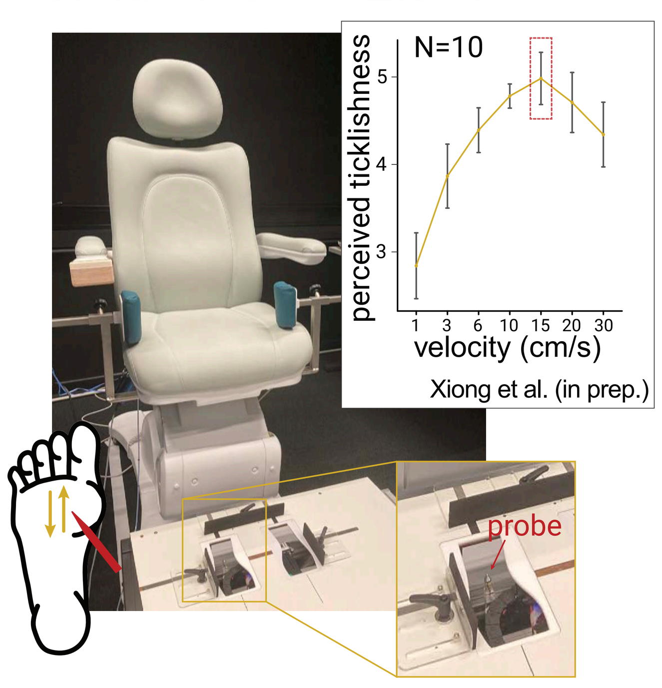
Efference copies/ prediction signals arrive in superficial layers of S1, interact with bottom-up sensory input (middle & deep layers), and attenuate tactile percepts in self-touch/ self-tickle.



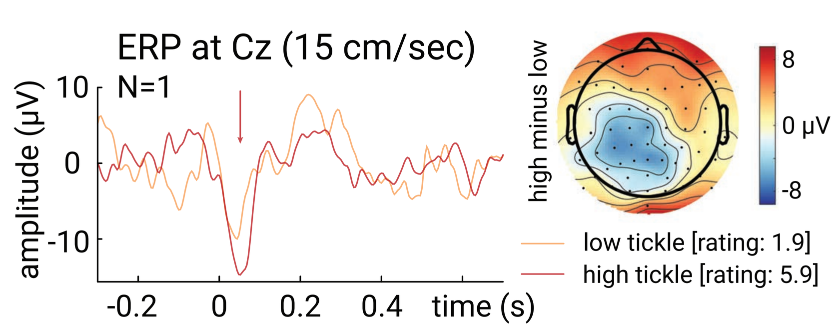
→ Resolve self-tickle cancellation in time and across cortical layers.

PROOF-OF-CONCEPT RESULTS

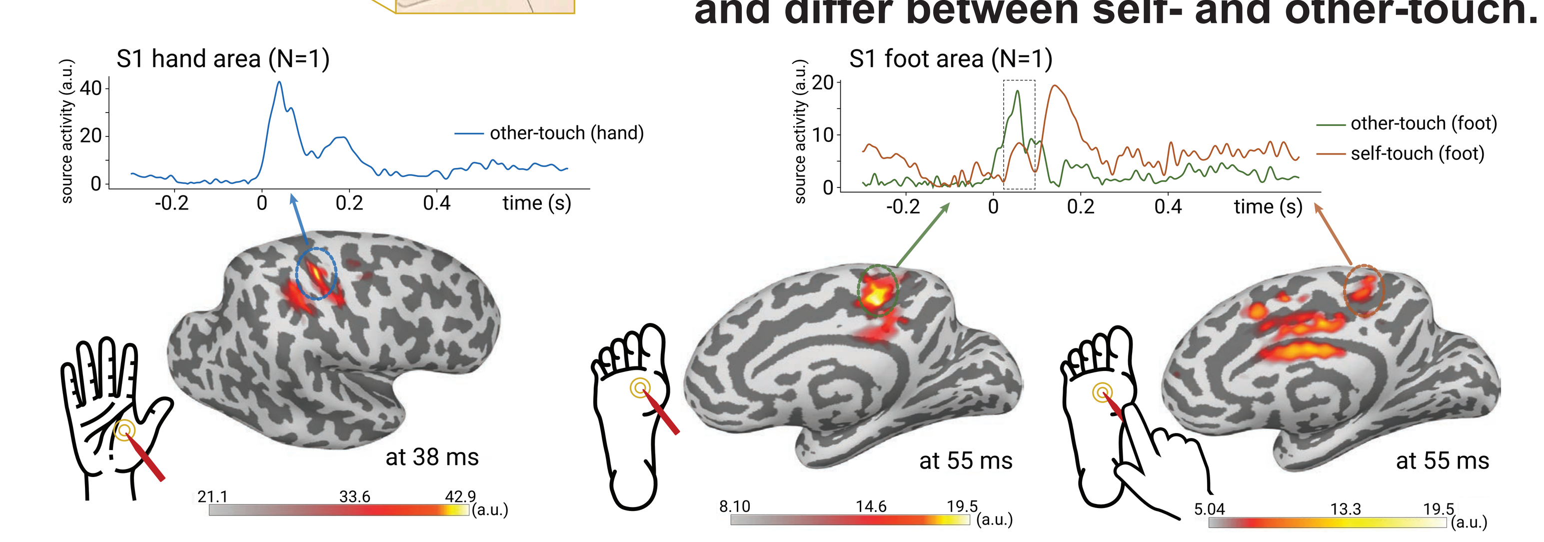
Tickle robot "Ektor"



EEG responses to stroke stimuli differ depending on ticklishness

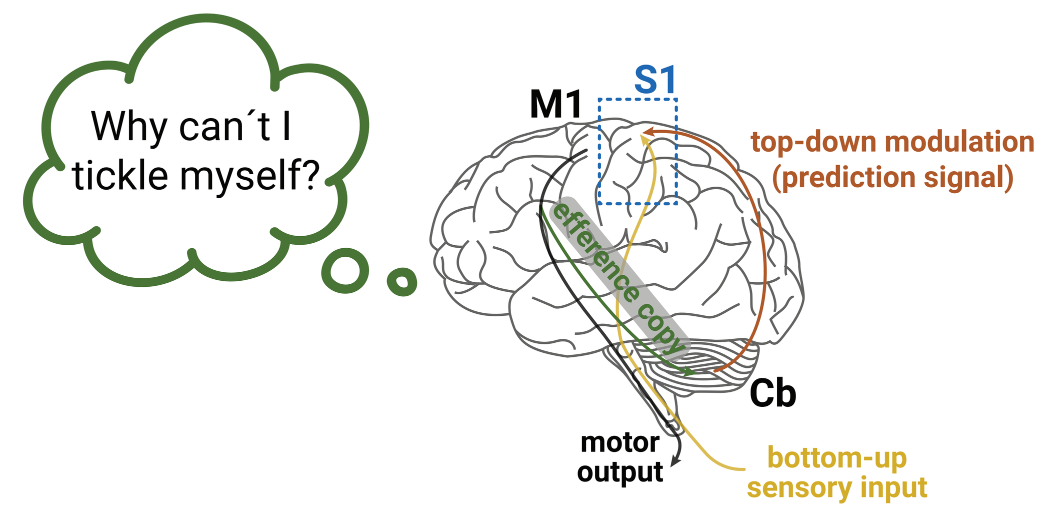


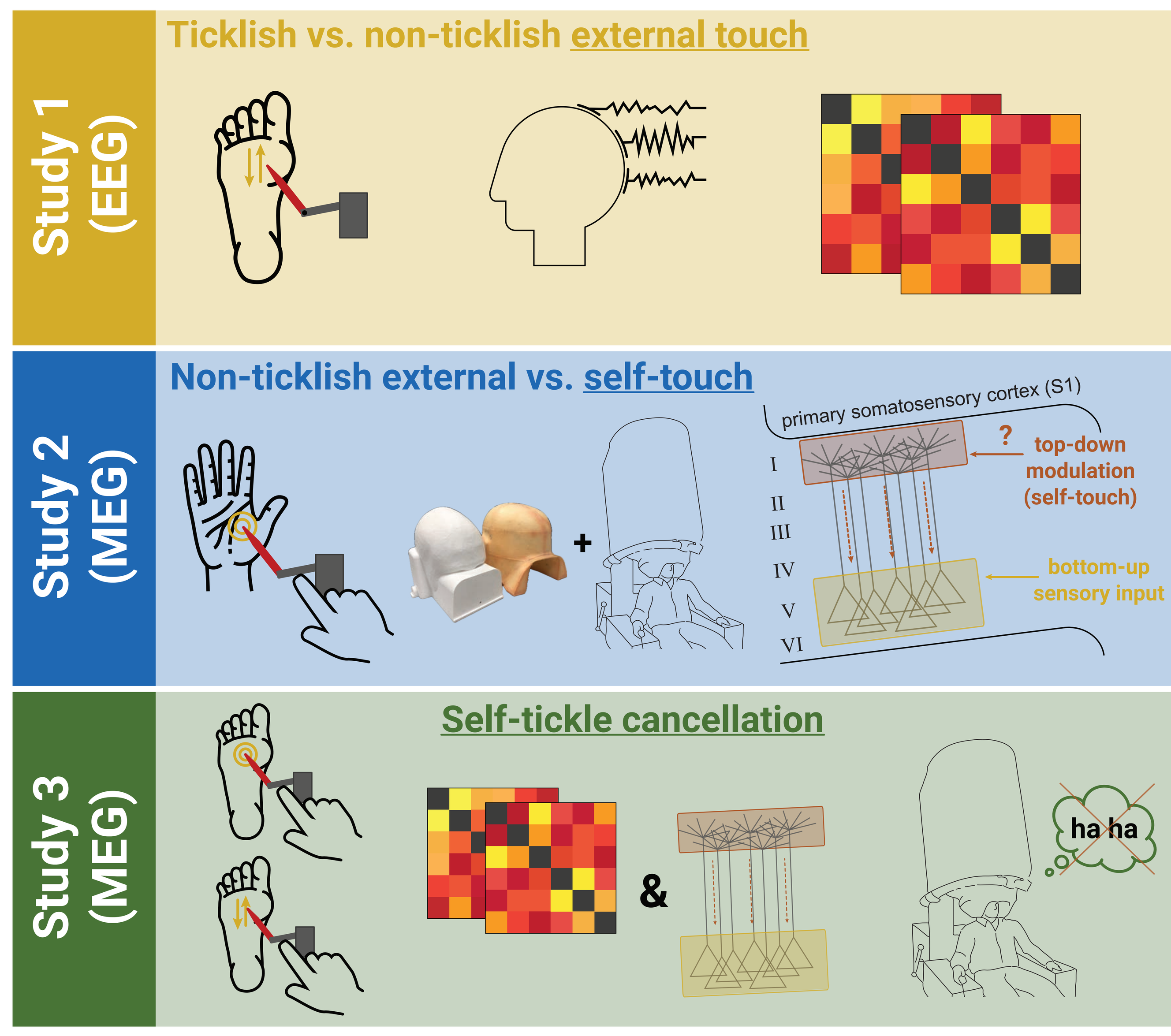
MEG responses to tactile poke stimuli can be measured from the foot region and differ between self- and other-touch.



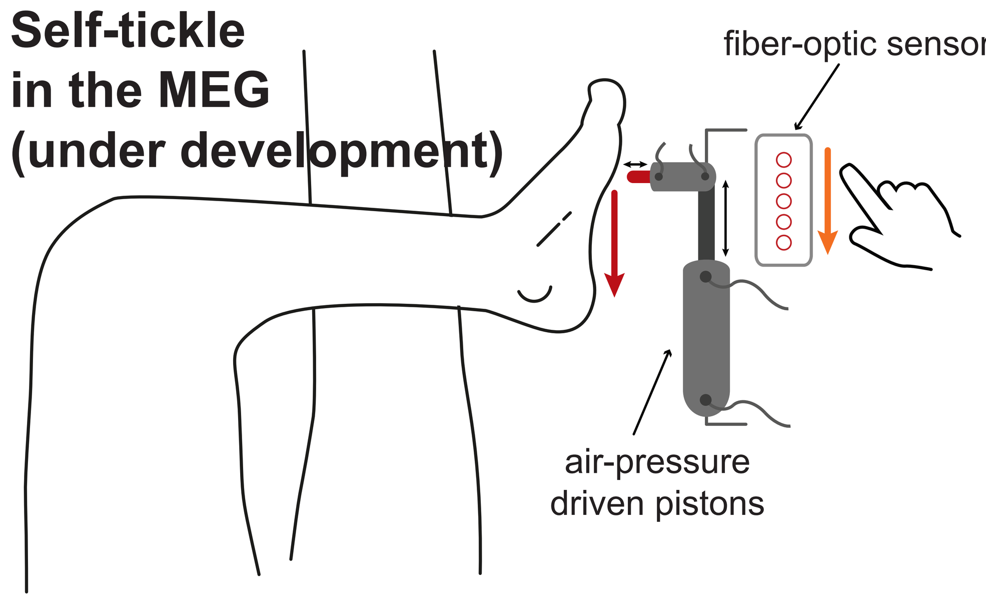
PROJECT OUTLINE

Self-tickle cancellation measured with laminar MEG [11,12]

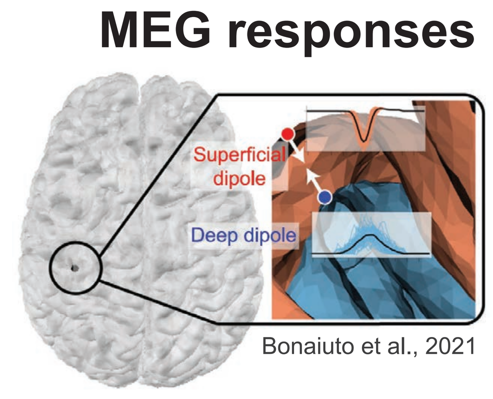




Self-tickle in the MEG (under development)



Layer-specific modeling of MEG responses



Bonaiuto et al., 2021

WHAT WILL WE LEARN?

- Better understanding of the neural mechanisms involved in self-tickle cancellation.
- Laminar MEG would complement previous studies on (non-ticklish) self-touch attenuation and generalize findings to different body part (foot sole).
- Interaction of feedback and feedforward processes across cortical layers (transfer of Dendritic Integration Theory to humans)?
- Technical advancement: Bringing laminar MEG to the somatosensory domain.

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...and very soon: