Modulations of somatosensory **interneural inhibition** according to the mode of perceptual processing: **combining** or **comparing** in tactile sensing

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Research question

Can the mode of perceptual processing (**comparing vs. combining**) be strategically selected by flexibly **adjusting lateral inhibition**?

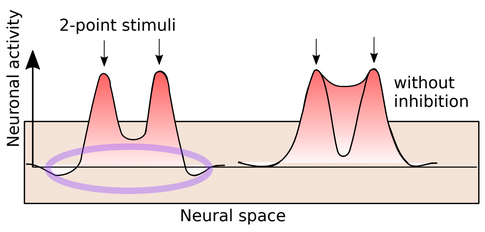
(In somatosensory system)

Introduction

Comparison
- What is the difference between sensations?
- Well researched ascpect of percetual processing[1,2]
- **Acuity mode**: effortful, differential capacity, best performance
- Supports selectivity, minimal resources

Combination
- What is the overall sensation?
- Neglected area of perceptual processing[3,4]
- **Averaging mode**: automatic, integrative capacity, maximal information
- Supports coherent reprsentation of events/scenes

Lateral inhibition

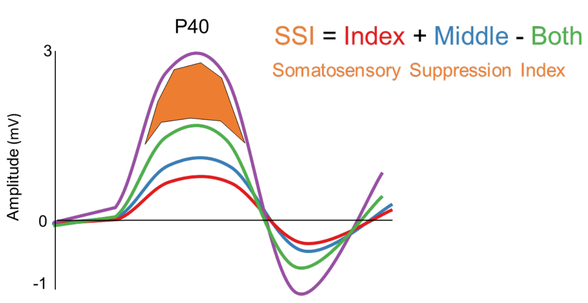


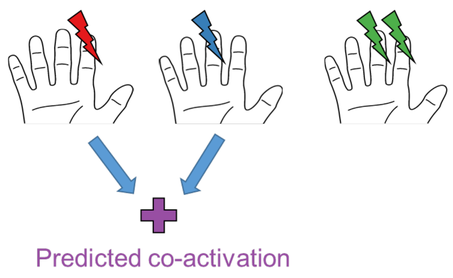
Built-in mechanism in sensory systems[5,6]

Strong inhibition is helpful for local details, but will distort combined percept[1]

System-level measure of lateral inhibition with EEG

Stimulation of adjacent skin sites gives under-additive neural response[7,8]

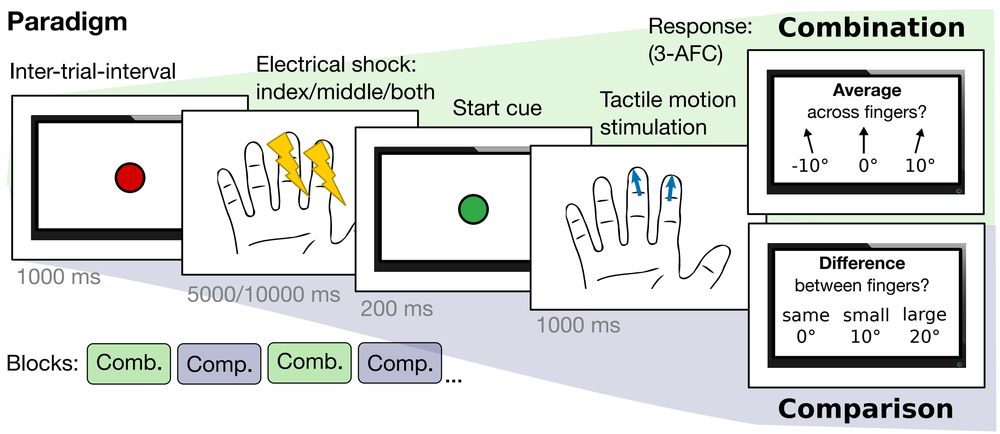




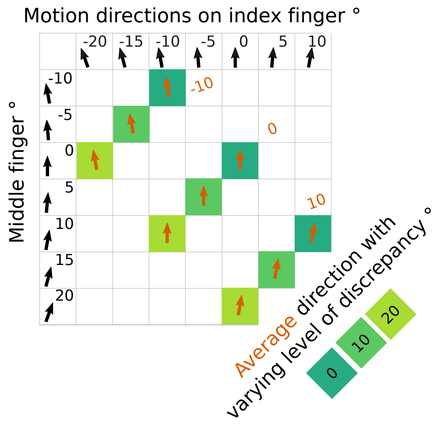
Methods

Record EEG in response to mild electrical shocks prior to perceptual task (n = 15) → Reveal preparatory tuning of somatosensory interneurons

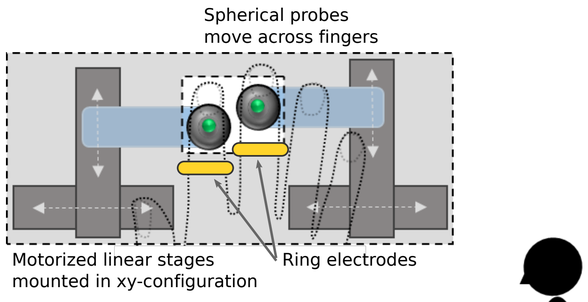
Paradigm



Stimuli



Apparatus



References:

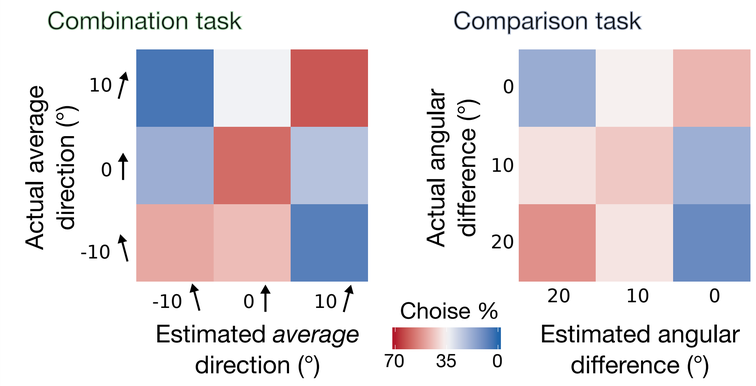
[1]Brown *et al.* (2004) *Brain Res*
[2]Driver & Grossenbacher (1996) *Attention&Performance*
[3]Kuroki *et al.* (2017) *Sci Rep*
[4]Walsh *et al.* (2016) *Cognition*
[5]DiCralo *et al.* (1998) *J Neurosci*
[6]Dykes *et al.* (1984) *J Neurophysiol*
[7]Gandevia *et al.* (1983) *Exp Brain Res*
[8]Cardini *et al.* (2011) *Cereb Cortex*

Hypothesis

Stronger inhibition in preparation to **compare** two stimuli, **reduced inhibition** when the stimuli need to be **combined**

Behavioral results

Confusion matrices illustrating behavioral performance

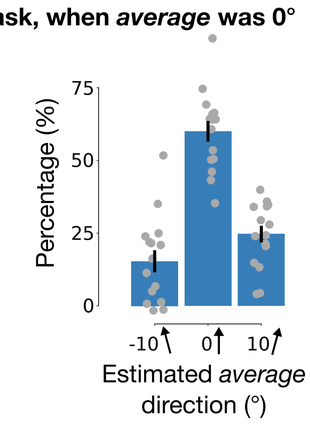


Accuracy (% correct): 0.56 ± .09 (Combination task) vs. 0.47 ± .08 (Comparison task)

Performance better in combination than in comparison

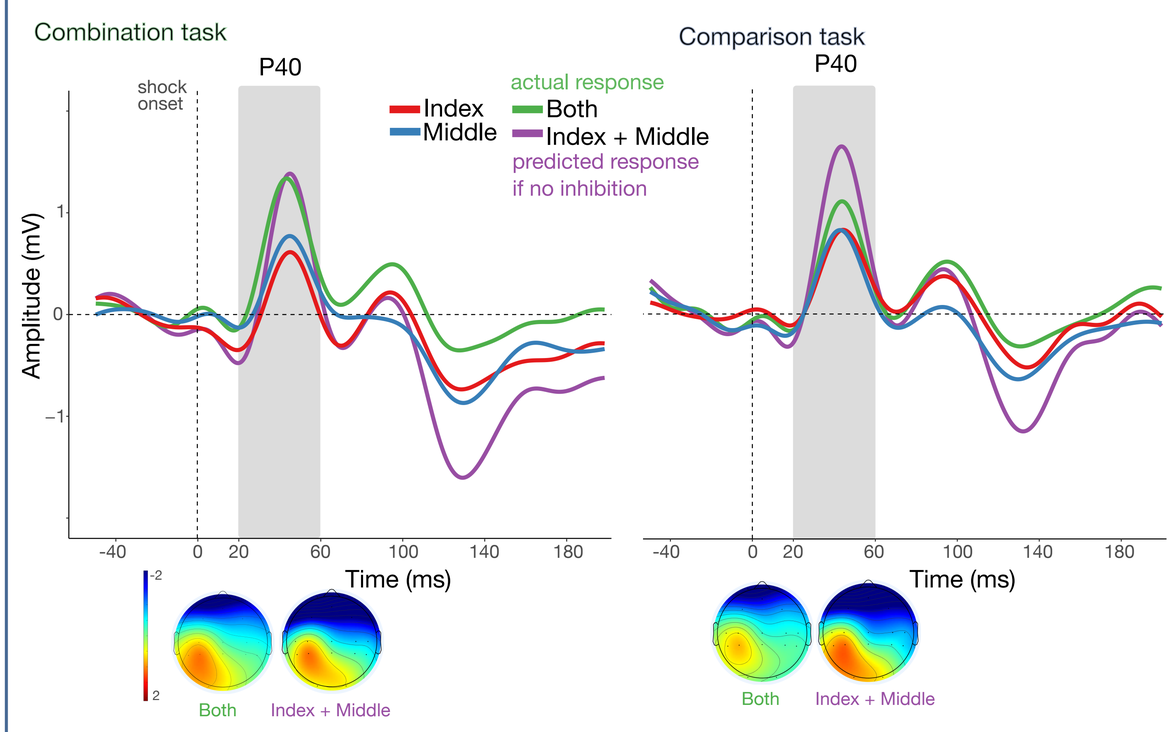
Stimuli can be combined even when dicerpancy between them is unclear

Response distribution in comb. task, when *average* was 0°

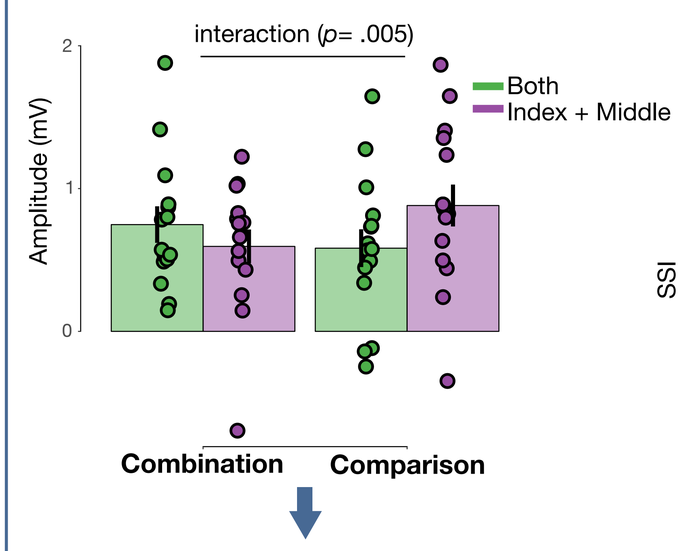


Participants truly averaged stimuli rather than selectively attended to either finger

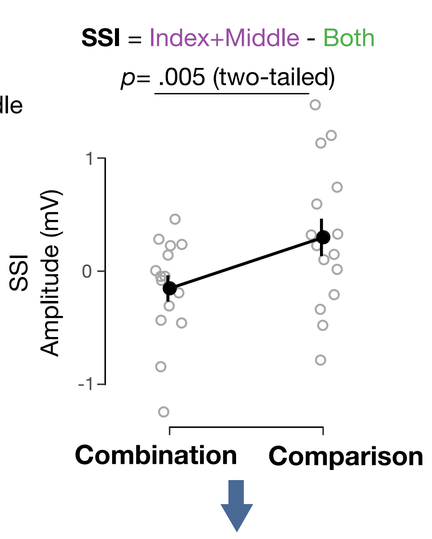
Somatosensory preparatory activity



Statistical analyses on SEP amplitude



Under-additive response varied across tasks



Supression reduced in combination

Conclusions

- **Degree of inhibition** between cortical representations of digits can be **preparatorily adjusted** according to the perceptual task at hand.
- Post-selection process, as both tasks had same stimuli and required attending to both fingers; difference in how information was related to one another
- Perception is not just about acuity; our every day perceptual experience consists of **unified continous stream**.
- Contrast between comparison vs. combination is core dimension of perception; it's present for simple perceptual tasks, but also for classification tasks (taxonomic identification), and even for political views (universalism vs. discriminative 'identity')
- We suggest that cognitive flexibility of tuning neural cicuitry underlying sensory system may play a key role in shaping how we experience the world around us.