

WP6:

Mechanisms of instrumental learning and the conscious experience of agency

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Main activities

1. Sense of agency and internal selection signals
(Nura Sidarus)
2. Sense of agency under sensorimotor conflict
(Emilie Caspar)

2013 Research Questions, Future directions

- Can we slow down action-outcome linkage to the timescale of neuroimaging?
- Why is agency learning so fast?
- Do we learn agency over our own body in the same way as over external events?

Roadmap

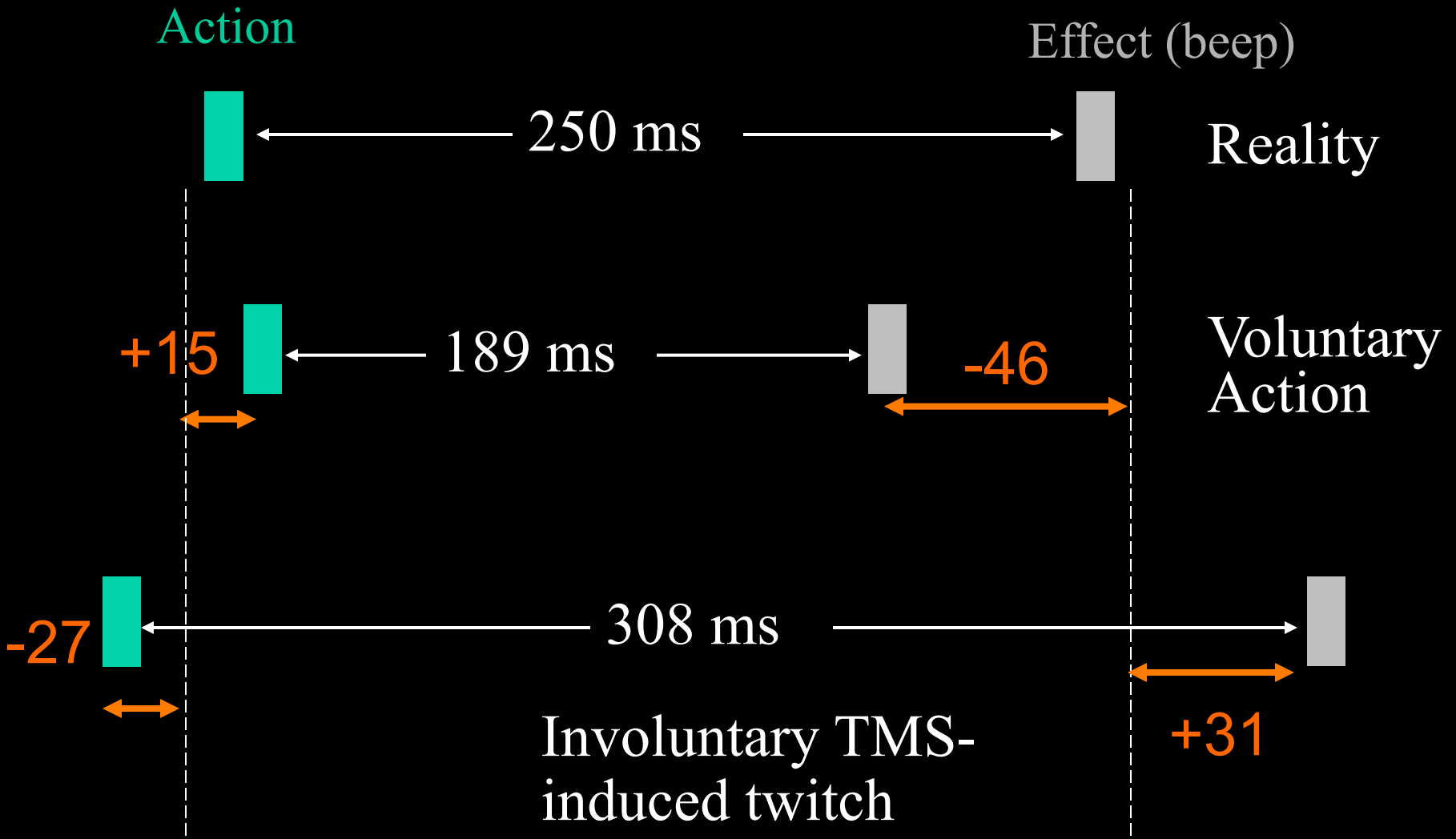
1. Agency and learning
2. Effects of agency on the body

Roadmap

1. Agency and learning
2. Effects of agency on the body

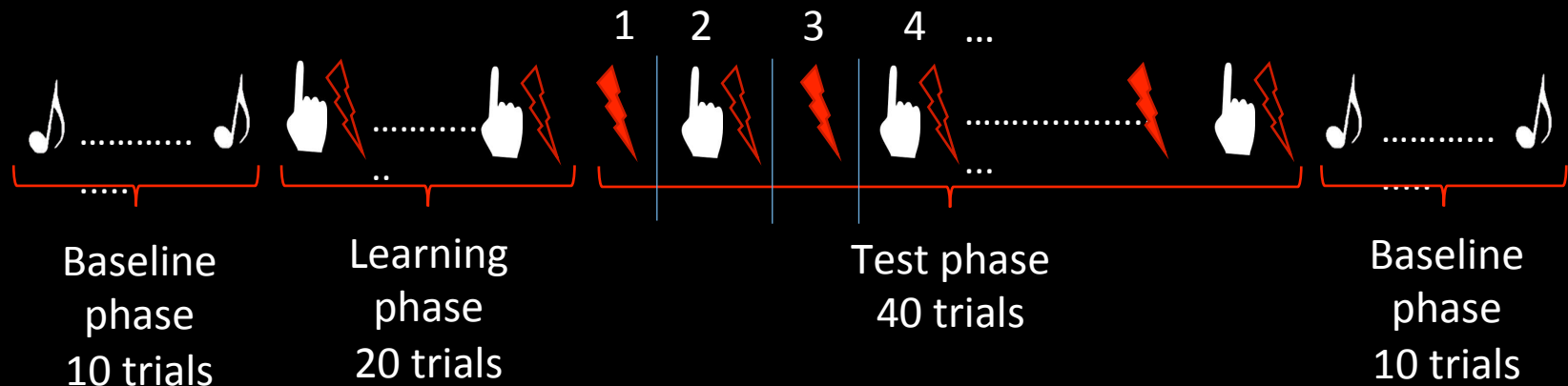
Intentional Binding


Haggard, Clark & Kalogeras, *Nature Neuroscience*, 2002





Can binding between a voluntary action and a tone transfer to involuntary action

Voluntary action of the right hand +
Involuntary TMS-induced twitches of the left hand
250 ms delay, then Tone
Judge time of tones on TMS-only trials

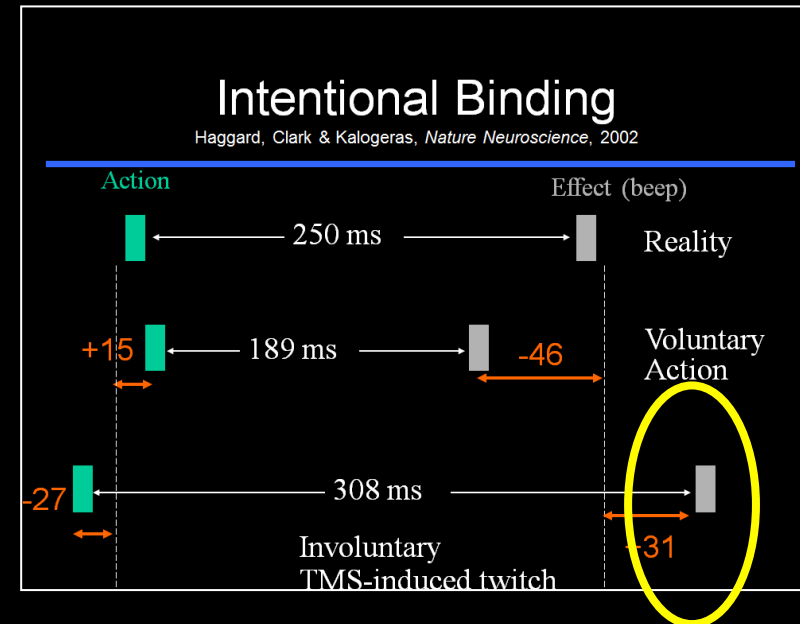
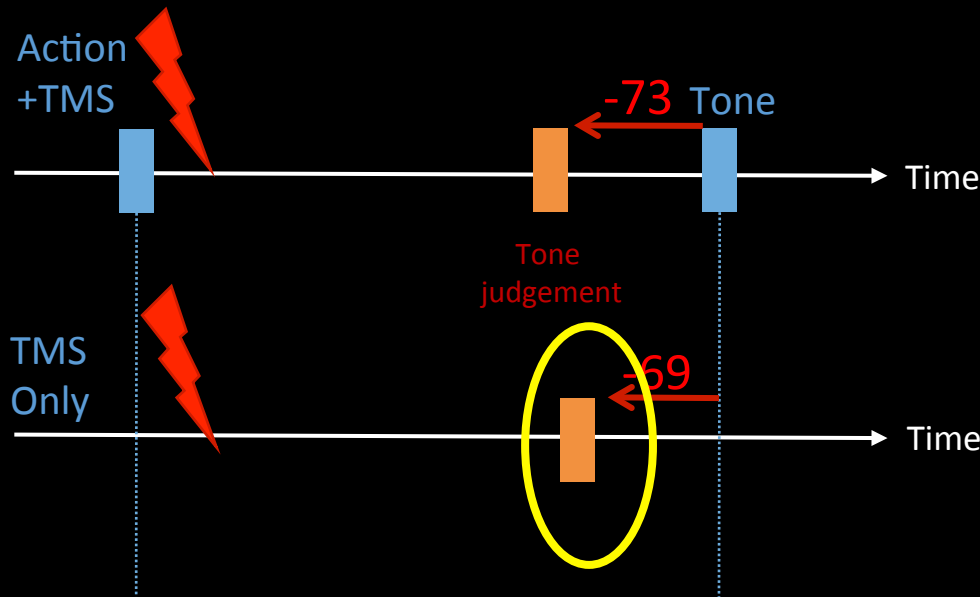


 Subject does not receive any TMS pulse. A tone would be played at a random time.
Subject reports time of the beep.

 Subject's voluntary keypress would be paired with a TMS-induced twitch of the other hand. Tone would be played after 250ms. Subject does not make any judgement.

 Subject receives TMS-induced twitches at a random time. Tone would be played after 250ms.
Subject reports time of the beep.

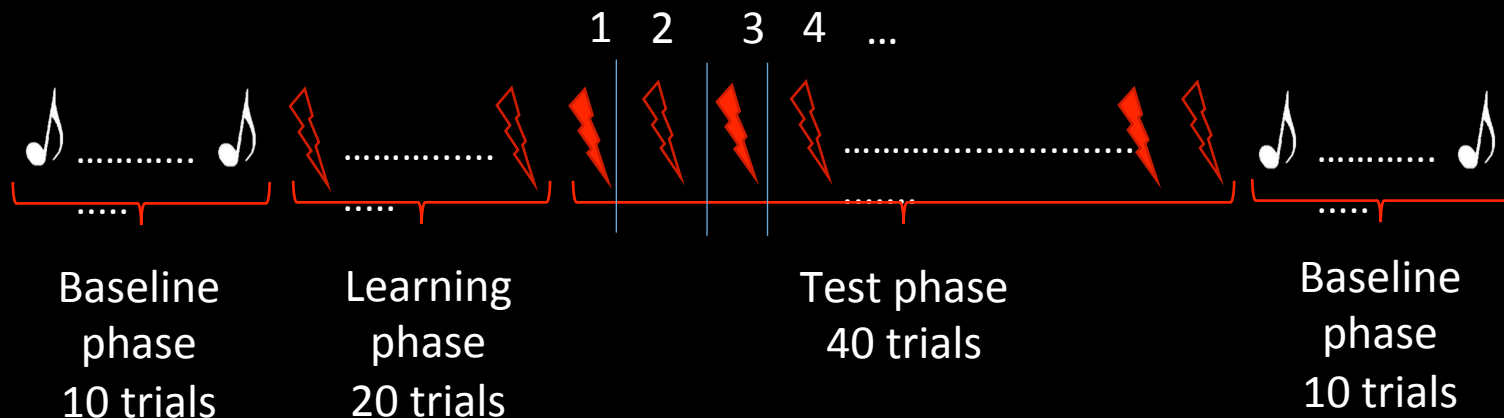
Tone binding results





- Learning an association between a voluntary action and an involuntary movement leads to the involuntary movement binding tone perception !
- Experience of volition can transfer from one movement to another


Necessary control condition (watch this space)

Mere repetition of involuntary movements should not produce
tone binding



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Subject reports time of the beep.

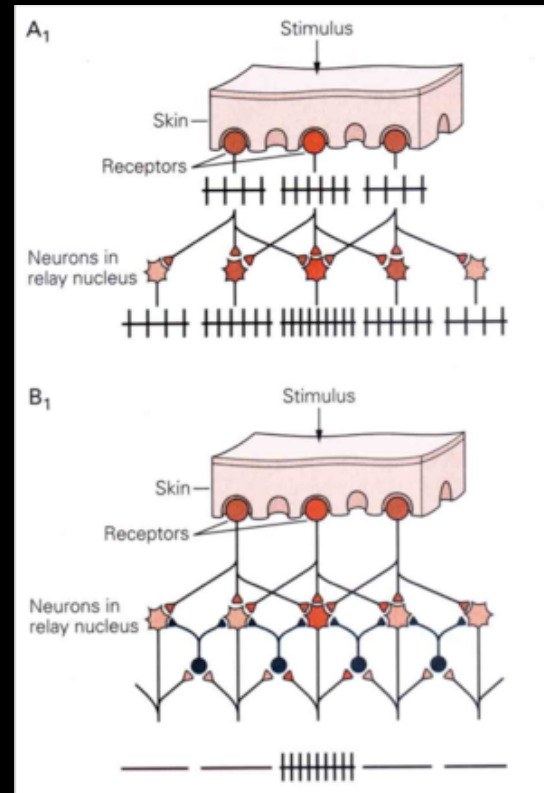
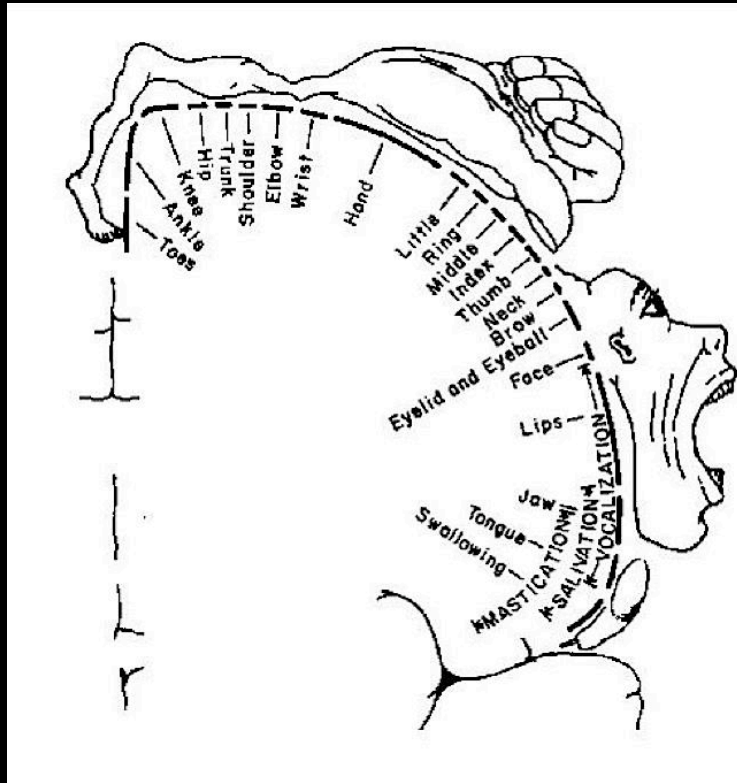
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Roadmap

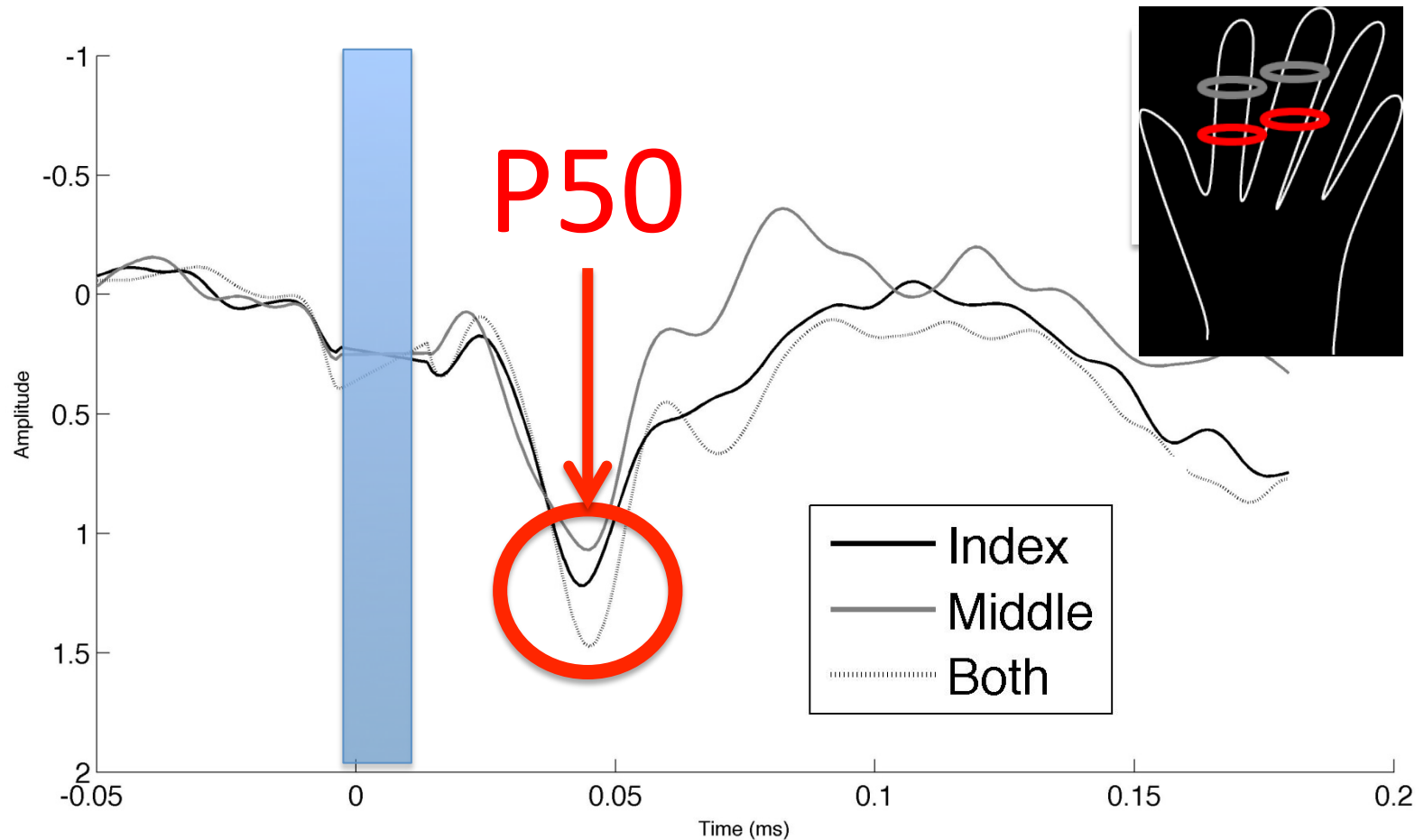
1. Agency and learning
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Inhibitory interneurons sharpen somatosensory representations



Research Question: Does action contribute to somatosensory tuning?

Suppression of double sensory evoked potential: an *in vivo* measure of lateral inhibition?



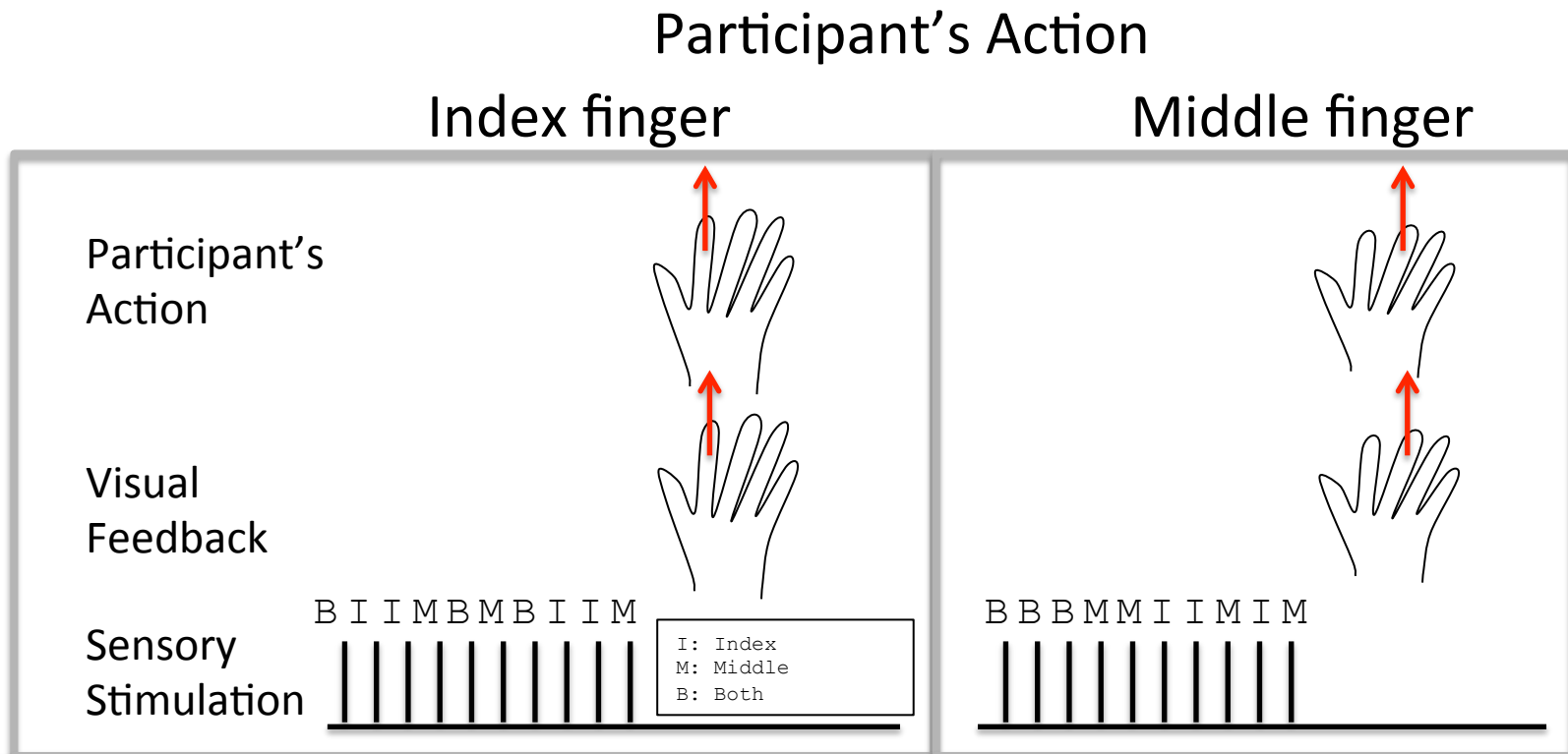
Master-slave robotic hand

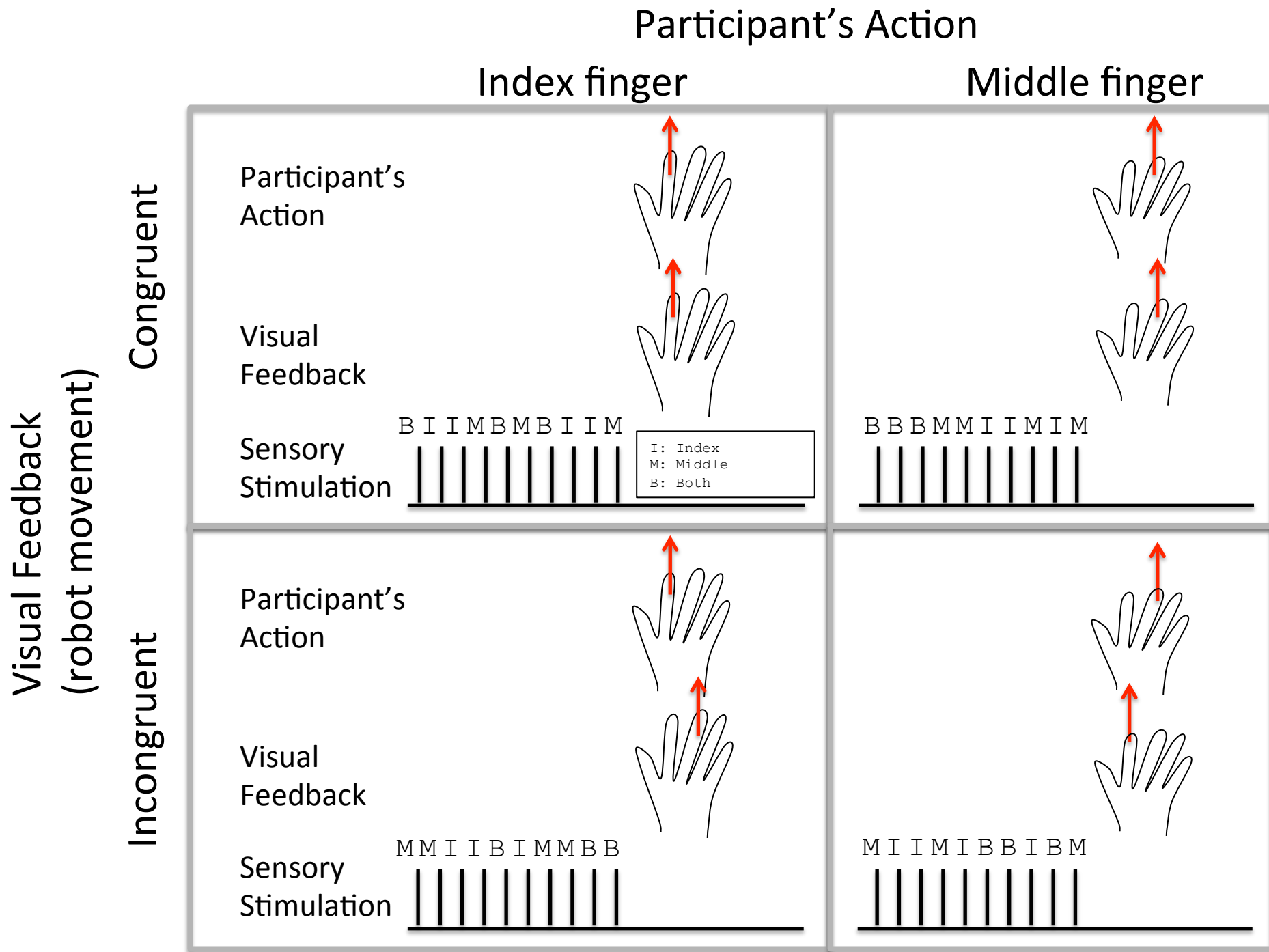
Congruent or **incongruent** visual feedback



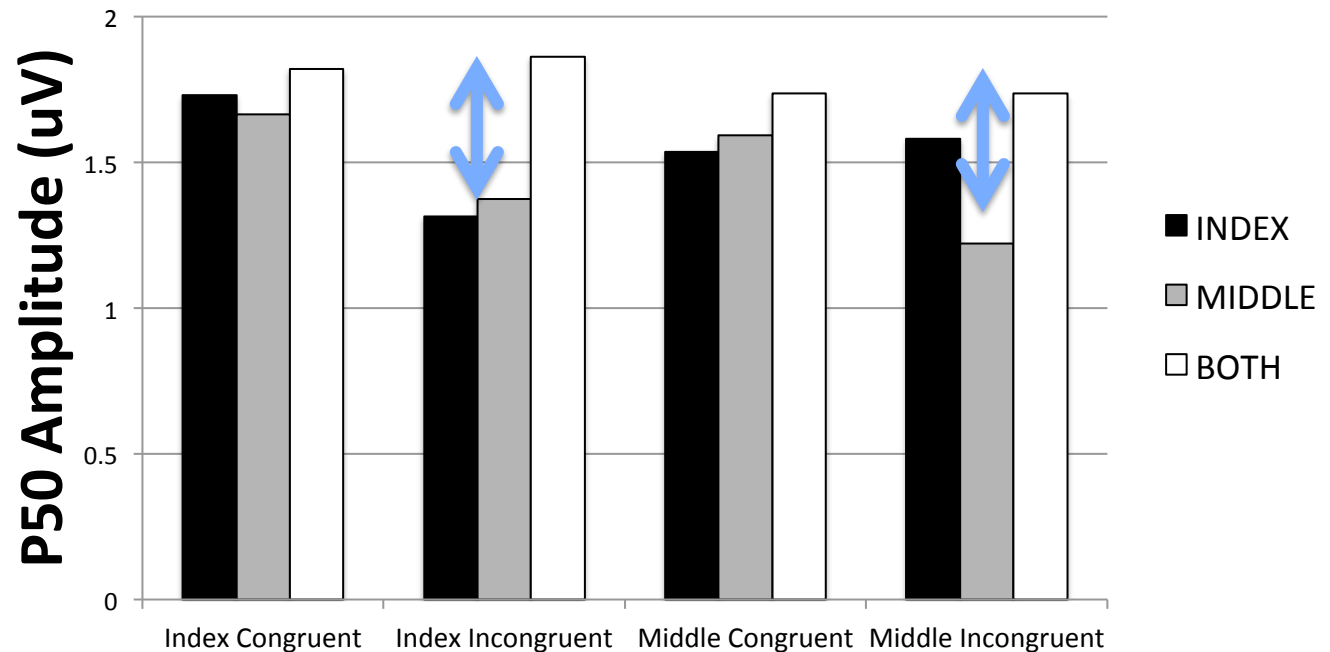
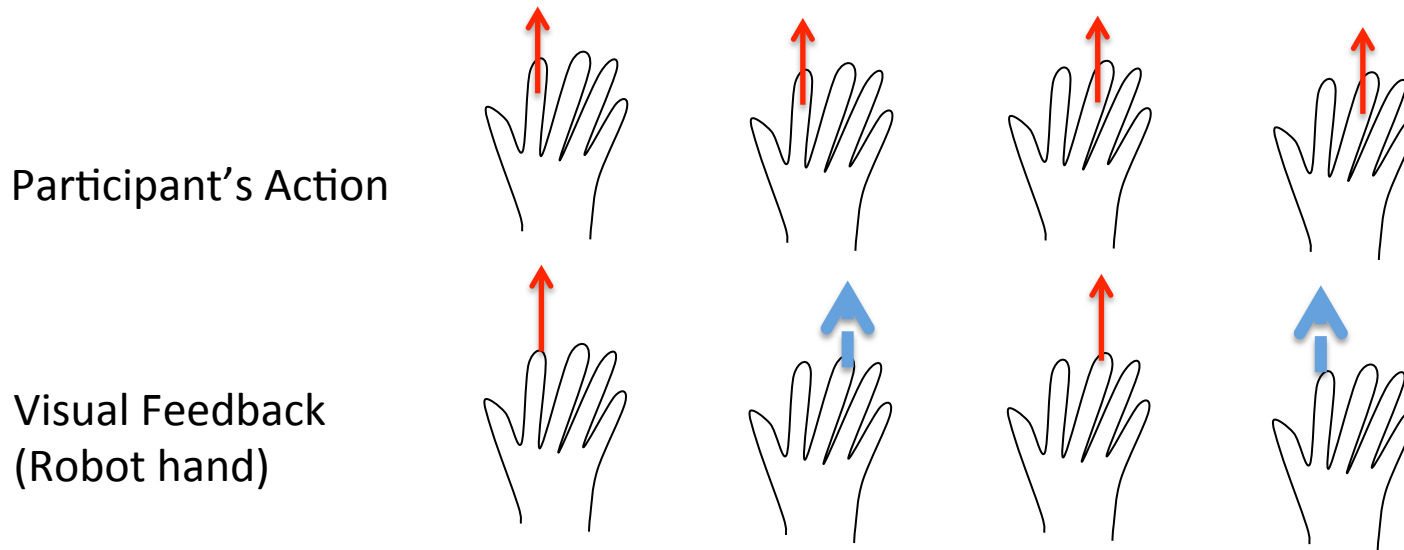
Visual Feedback
(robot movement)

Congruent





Visual-motor congruence and lateral inhibition

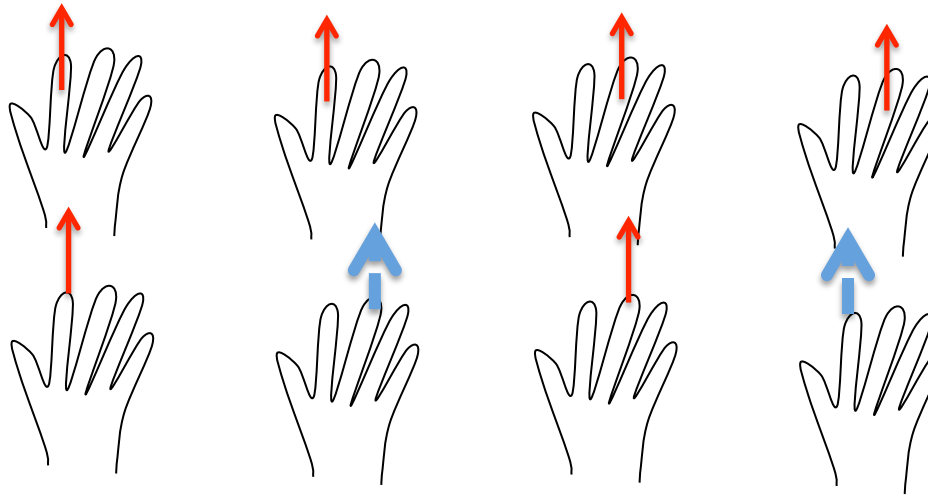


Sensory Suppression Index (SSI)

Index + Middle - Both

Participant's
Action

Visual Feedback
(Robot hand)

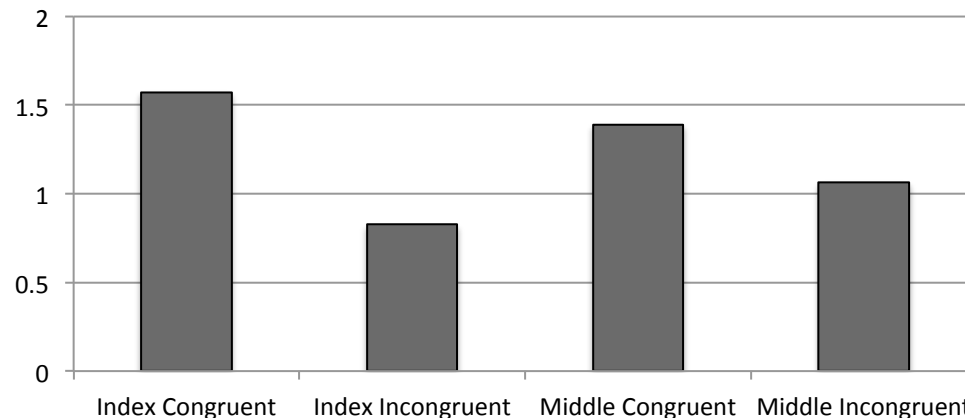


More

Lateral inhibition

Less

SSI



Condition

Discussion

- Visuomotor congruence boosts lateral inhibition, relative to incongruence
- Action signals may impose discrete organisation on somatotopic maps