SENSORIMOTOR PREDICTIONS AND MOVEMENT-RELATED TACTILE SUPPRESSION

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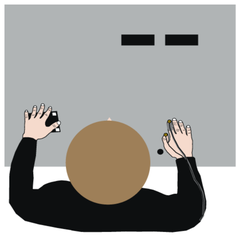
Background: Suppressing the outcome of self-initiated movement consequences

- Sensorimotor predictions lead to the suppression of the sensory consequences of our own movements
  - → Tickling yourself is impossible because the perceived touch is predictable and therefore suppressed
  - → Tactile sensations on the body part that is moving, or about to be moving, are also suppressed
- In addition to self-initiated touch (Blakemore et al., 1999), tactile suppression can be researched by testing the perceived intensity of short, externally applied vibrations (vibrotactile probes; Chapman & Beauchamp, 2006)

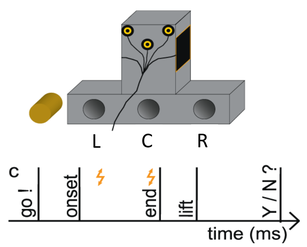
Modulation of tactile suppression by movement-relevancy

Movement-relevancy of object features (Voudouris et al., 2019)

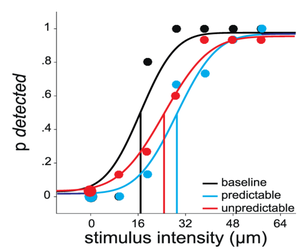
Setup



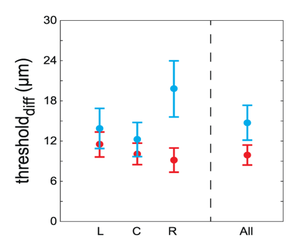
Object



Psychometric Functions



Results



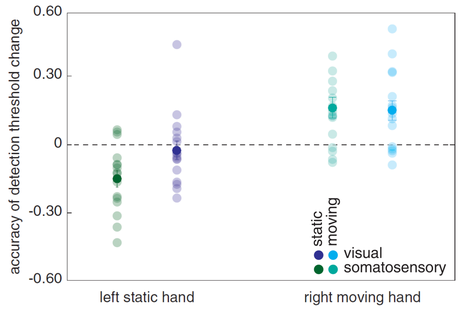
- Grasp and lift up object without letting it tip to one side
- Mass distribution (**L**eft, **C**enter, **R**ight) of object is **predictable** or **unpredictable**
- Vibrotactile probes of varying intensities during movement and at rest (**Baseline**)

- Elevated detection thresholds during movement compared to baseline → Tactile suppression
- More suppression when the movement-relevant object feature, i.e. the mass distribution, is **predictable** than when it is **unpredictable**

Movement-relevancy of sensory information (Voudouris & Fiehler, 2017)

- Reaches to unseen **static hand** (Somatosensory) or external LED light (Visual)
- Sensations at **static hand** are relevant for successful movement execution when it serves as the target

- Elevated detection thresholds (→ Tactile suppression) at moving hand compared to baseline and lower detection thresholds (→ Enhancement) at **static hand** when it is the reaching target



Summary

Somatosensory perception of external vibrotactile probes is modulated to suppress predictable information (Voudouris et al., 2019) or to enhance information relevant to the movement (Voudouris & Fiehler, 2017) .

Blakemore, S.-J., Frith, C. D., & Wolpert, D. M. (1999). Spatio-temporal prediction modulates the perception of self-produced stimuli. *Journal of Cognitive Neuroscience*, *11*(5), 551–559.
Chapman, C. E., & Beauchamp, E. (2006). Differential controls over tactile detection in humans by motor commands and peripheral reafference. *Journal of Neurophysiology*, *96*(3), 1664–1675.
Voudouris, D., & Fiehler, K. (2017). Enhancement and suppression of tactile signals during reaching. *Journal of Experimental Psychology: Human Perception and Performance*, *43*(6), 1238–1248.
Voudouris, D., Broda, M. D., & Fiehler, K. (2019). Anticipatory grasping control modulates somatosensory perception. *Journal of Vision*, *19*(5), 1–10.

Führer, Voudouris, Lezkan, Drewing & Fiehler (preliminary data): Somatosensory prediction in tactile suppression: General cancellation or sensation-specific attenuation?

Background

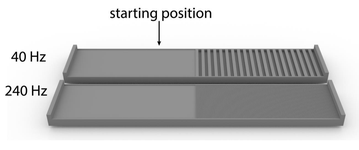
- Vibrotactile probes serve as a proxy for tactile sensations, but are unspecific to the movement

Aim

- What if the vibrotactile probes are predicted as the movement outcome?
- Is the suppression of external vibrotactile probes based on highly specific sensorimotor predictions or a general cancellation?

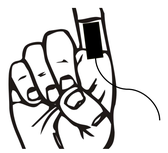
Methods

Object



- Single movements at designated speed across textured objects to elicit a consistent tactile feedback of a specific frequency and thereby a sensorimotor prediction

Vibrotactile probe



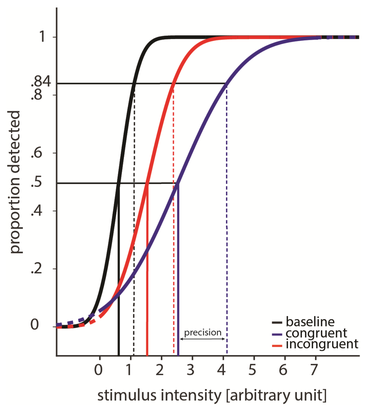
- Brief vibrotactile probe of varying intensities on moving finger around movement onset

Design

		Object: 40 Hz	Object: 240 Hz
Vibrotactile probe	40 Hz	congruent	incongruent
	240 Hz	incongruent	congruent

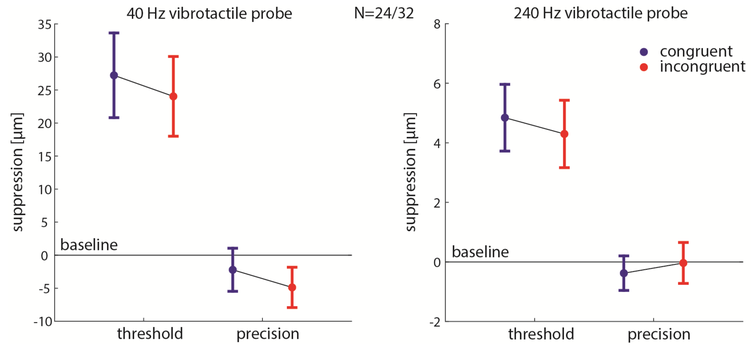
- Probe frequency **matches (congruent)** or **mismatches (incongruent)** frequency of sensorimotor prediction

Hypothesis



- If sensorimotor predictions are specific, detection thresholds should be higher when the probe **matches** the prediction

Preliminary Results



- Elevated detection thresholds in movement compared to baseline blocks → Tactile suppression
- Descriptively more suppression in **congruent** conditions, when probe **matches** the predicted movement outcome

→ The suppression of the probes may in fact be driven by specific sensorimotor predictions rather than just a general cancellation process