Mixed nerve and purely sensory somatosensory evoked potentials along the neuraxis

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Introduction

- Neuroscientific research on human somatosensation has largely focussed on cortical processes, although an ***extensive amount of processing already occurs in the dorsal horn of the spinal cord*** (Abraira et al., 2017; Paixao et al., 2019).
- Here, we non-invasively investigate somatosensory processing in the human spinal cord using somatosensory evoked potentials (SEPs; Cruccu et al., 2008).
- We aimed to replicate and extend earlier spinal SEP studies by making use of an adequately powered sample-size, a higher electrode density, and state-of-the-art acquisition and analysis methods.
- In ***Study 1*** we recorded SEPs to mixed-nerve stimulation from the peripheral nerves, the spinal cord, and the brain in order to provide a comprehensive picture of somatosensory processing.
- In ***Study 2*** we aimed to **i)** replicate these findings, **ii)** extend them by also stimulating purely sensory nerve fibers, and **iii)** investigate integrative processes at the level of the spinal cord.

Methods

Sample size:
- Study 1: 36 (18 female)
- Study 2: 24(12 female)

Stimulation type: 2000 non-painful electrical pulses

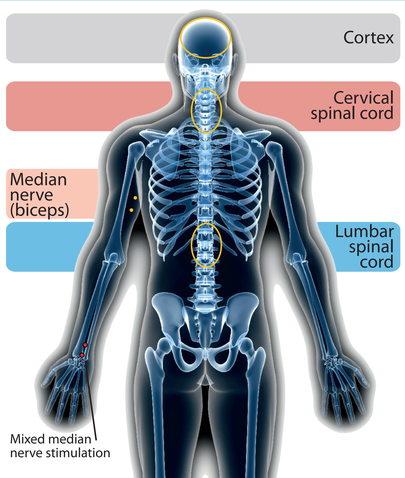
Stimulation frequency:
- Study 1: ~1.3Hz
- Study 2: ~4Hz

Recording: 64 cortical, 40 spinal, and 2 peripheral channels

Preprocessing: eye-blink removal in cortical channels, cardiac artefact removal in spinal channels, exclusion of all trials with amplitudes larger than 3 SD

Conditions Study 1:
mixed-nerve stimulation at
- wrist (median nerve)
- ankle (tibial nerve)

Conditions Study 2:
- mixed-nerve stimulation at
  - wrist
  - ankle
- median (*tibial*) sensory nerve stimulation at
  - finger II (*toe I*)
  - finger III (*toe II*)
  - finger II & finger III (*toe I & toe II*)

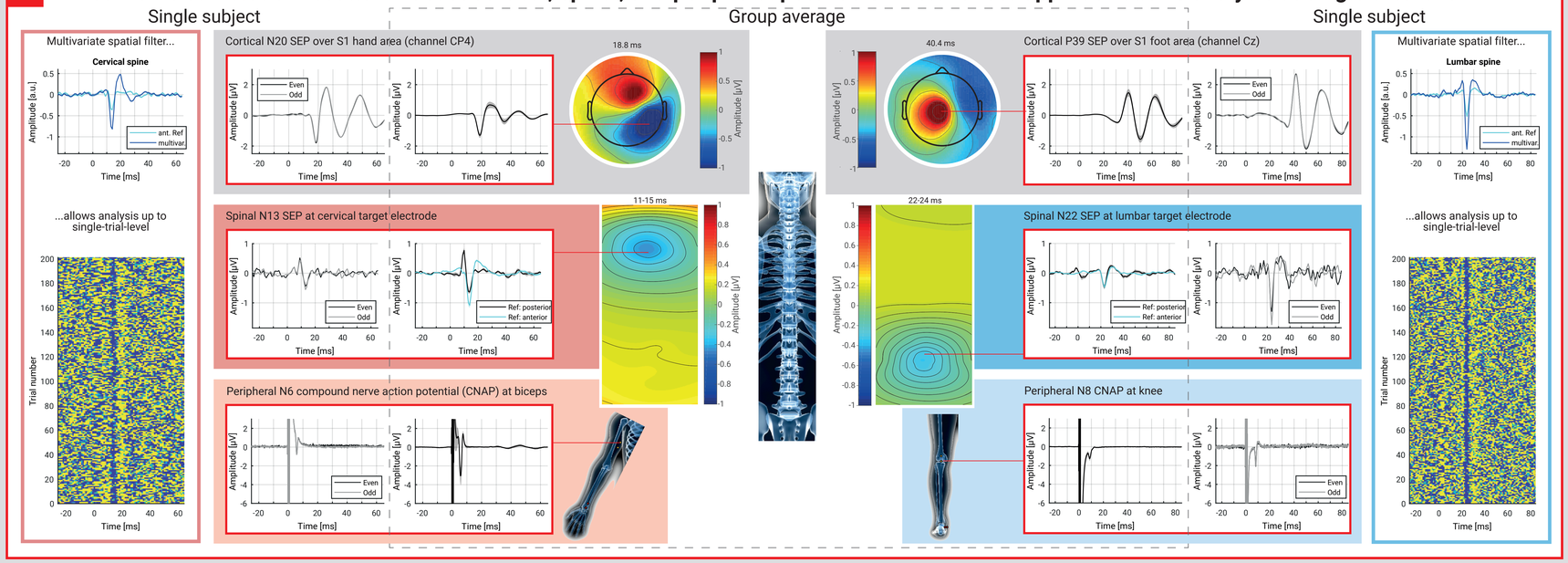


Montage of recording (yellow) and stimulation (red) electrodes. Locations of digit stimulation are displayed in Results.

Results

Median nerve stimulation | **Tibial nerve stimulation**

1 Mixed-nerve stimulation results in robust cortical, spinal, and peripheral potentials. Multivariate approach allows analysis at single trial level.



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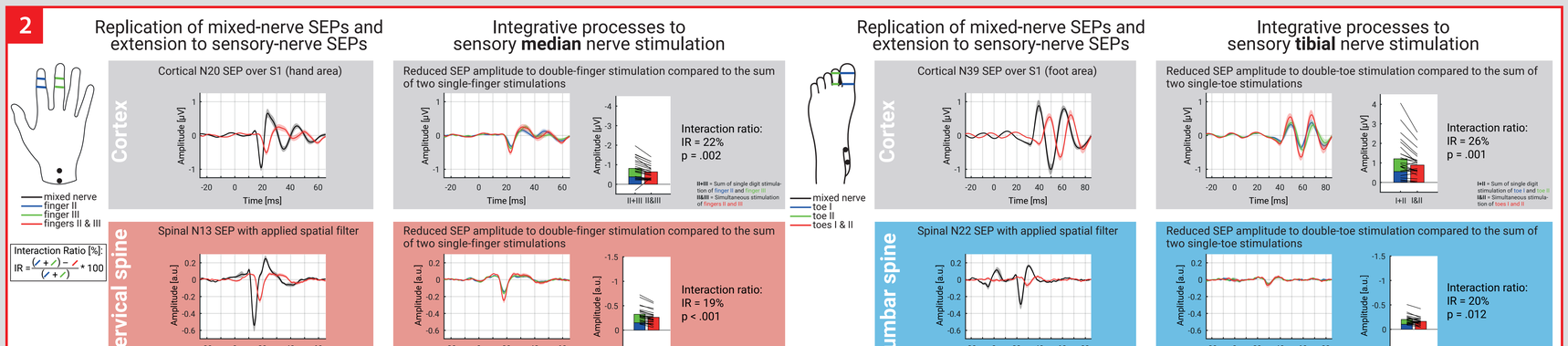

Discussion

- We demonstrate ***robust SEPs in the human spinal cord*** in response to electrical stimulation of upper and lower extremity mixed nerves, as well as purely sensory parts of these nerves.
- The SEP to double-digit stimulation was lower than the sum of SEP to the two single-digit stimulations, suggesting ***integrative processes on a cortical and spinal level***.
- Ultimately, we aim to use the approach we developed here to investigate ***spinal responses to natural nociceptive stimulation***.

References

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