

Hypothesis: Learning a new motor skill involves learning-related changes in somatosensory cortical processing.

Raw Stim_Pre.bin Data

TTL signal

Raw CP3_Pre.bin Data

N20 EEG recording

Raw SNAP_Pre.bin Data

Control EEG recording

Raw Stim_Post.bin Data

TTL signal

Raw CP3_Post.bin Data

N20 EEG recording

Raw SNAP_Post.bin Data

Control EEG recording

Load, time align CP3 and SNAP to Stim, and average to slice and denoise EEG pre data

Load, time align CP3 and SNAP to Stim, and average to slice and denoise EEG post data

Mean_Sliced_CP3_SNAP_Pre.csv
Processed Data

Two 1x500 arrays mean timecourse

Mean_Sliced_CP3_SNAP_Post.csv
Processed Data

Two 1x500 arrays mean timecourse

Raw Behavioural_Pre.csv

10 sequences x 3 times to complete (s)

Raw Behavioural_Post.csv

10 sequences x 3 times to complete (s)

Plot mean timecourses of CP3 and SNAP EEG signals time-aligned to stimulation pulses

Compute P2P amplitude of sliced pre and post data and mean of all behavioural data and combine learning and control groups into one file

Figures 1A and 1B

Overlaid timecourse EEGs .pdf

Summary_P2P_Behavioural.csv

Tabular data for all participants (30x7 Table 1)

Plot P2P and behavioural summary data

Statistically analyze P2P and behavioural summary data

Figures 2A and 2B

Box plot .pdf

Figure 3

Bar graph .pdf

Statistics for P2P CP3/SNAP and behavioural

Independent t-test

* The data processing steps apply to files collected from two groups of participants - control group (P0-P14) and learning group (P15-P29). General steps, applicable to both groups, are included for the sake of visual clarity. All participants in the control group are combined and all participants in the learning group are combined when processing data. We create a Processed Data directory which has two sub-directories - Control Group and Learning Group where we store processed data files before combining both groups in the Summary_P2P_Behavioural.csv file which has one row per participant and one column per variable.

Legend

- **Stim** - electrical stimulation applied to the median nerve at the wrist
- **.bin** - binary format
- **TTL** - Transistor-Transistor Logic signals from electrical stimulations used to synchronize (time-align) EEG data
- **.csv** - comma-separated value file, plain-text human-readable
- **CP3** - electrode measuring somatosensory excitability
- **N20** - evoked response in somatosensory cortex whose peak-to-peak amplitude is a measure of cortical excitability
- **SNAP** - Sensory Nerve Action Potential recording electrode used as a control for differences in N20 amplitude
- **Pre and post** - evoked responses measured before and after learning a set of finger sequences
- **Averaging** - to get a clean N20 peak so we can analyze the evoked response, the single time-aligned CP3 response recordings are averaged to reduce EEG noise, reducing the 300x500 arrays into 1x500 mean time course arrays
- **Behavioural** - measures of time to complete each finger sequence task
- **P2P** - peak-to-peak amplitude of EEG data, negative and positive peaks

Table 1. Summary of CP3 and SNAP Peak-to-Peak Amplitude and Mean Behavioural Measures for Participants in the Control (n=15) and Learning (n=15) Groups Pre- and Post-Learning of Ten Finger Sequence Tasks.

	CP3 P2P Pre	CP3 P2P Post	SNAP P2P Pre	SNAP P2P Post	Behavioural Pre	Behavioural Post
P0						
P1						
P2						
[...]						
P27						
P28						
P29						

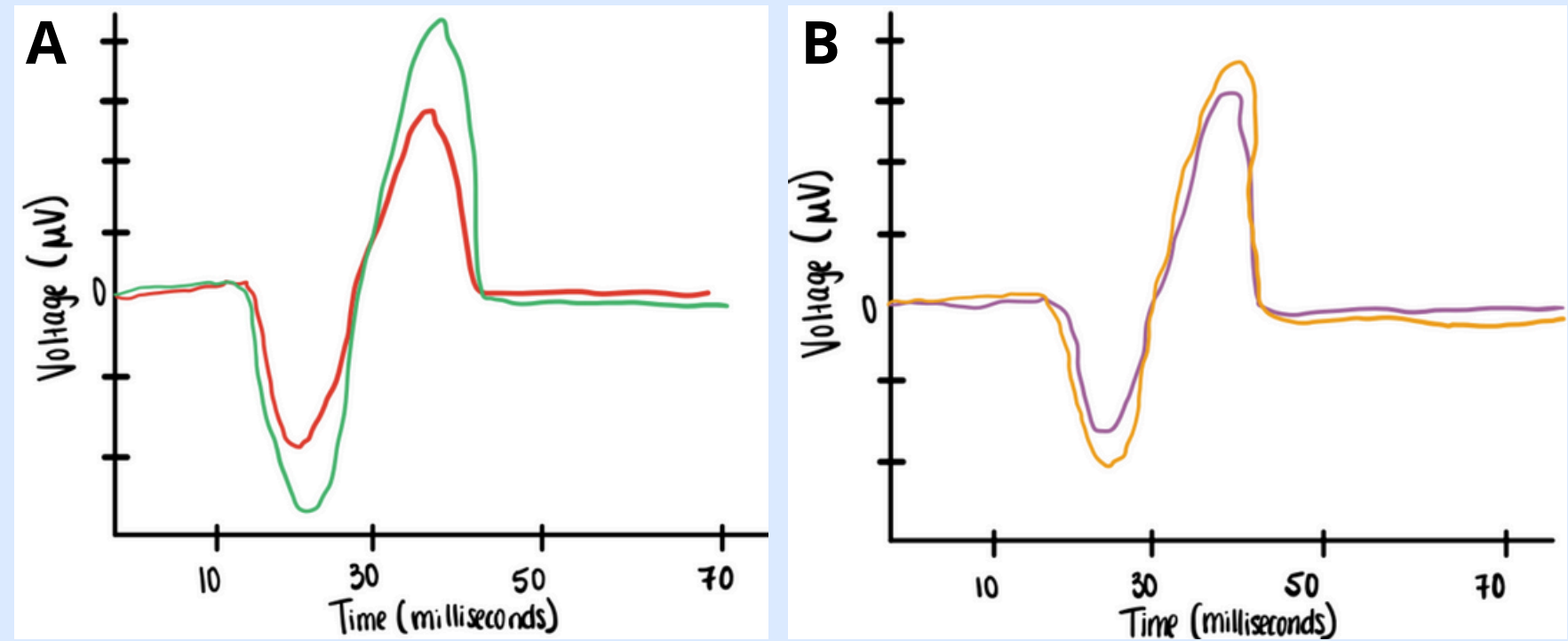


Figure 1. Learning changes the amplitude of the N20 peak in the learning group compared to the control group. Overlaid N20 peaks for participants in the learning and control groups pre- and post-learning of ten finger sequences. The negative N20 peak occurs at 20 milliseconds after median nerve stimulation and the positive peak a couple of milliseconds thereafter. **(A)** Time-aligned and averaged CP3 EEG data for one participant in the learning group shown pre-learning (red) and post-learning (green). **(B)** Time-aligned and averaged CP3 EEG data for one participant in the control group shown pre-learning (purple) and post-learning (orange).

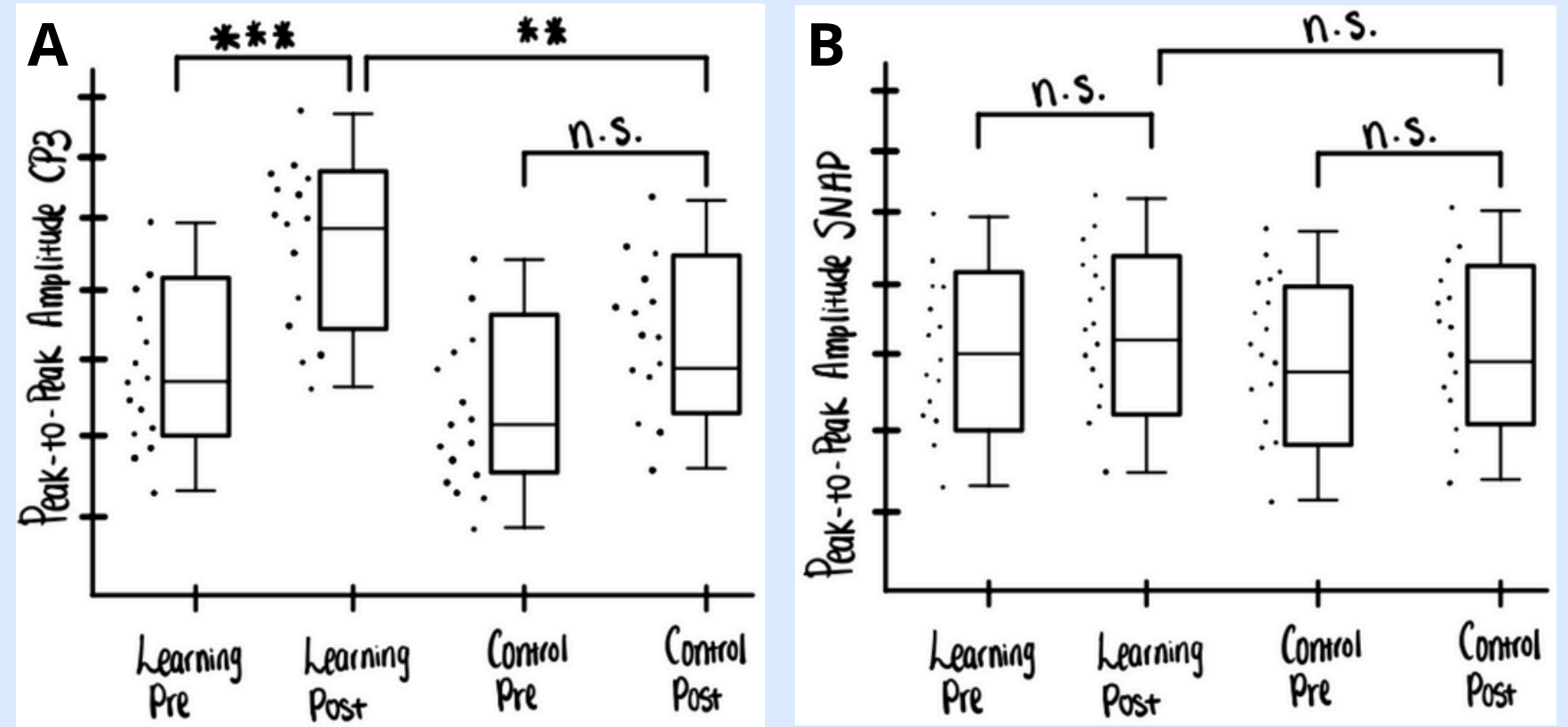


Figure 2. Learning increases the peak-to-peak (P2P) amplitude of N20 in the learning group compared to the control group, while SNAP P2P amplitude remains the same pre- and post-learning in both groups. **(A)** The mean of all CP3 P2P amplitudes was found for the learning (n=15) and control (n=15) groups, respectively both pre-learning and post-learning. An independent t-test was done to compare P2P amplitudes between the learning and control pre and post conditions, and the learning post and control post. *** means p-value < 0.01, ** p-value < 0.02, and n.s. means p-value > 0.05. **(B)** The mean of all SNAP P2P amplitudes was found for the learning (n=15) and control (n=15) groups, respectively both pre-learning and post-learning. An independent t-test was done to compare P2P amplitudes between the learning and control pre and post conditions, and the learning post and control post. n.s. means p-value > 0.05.

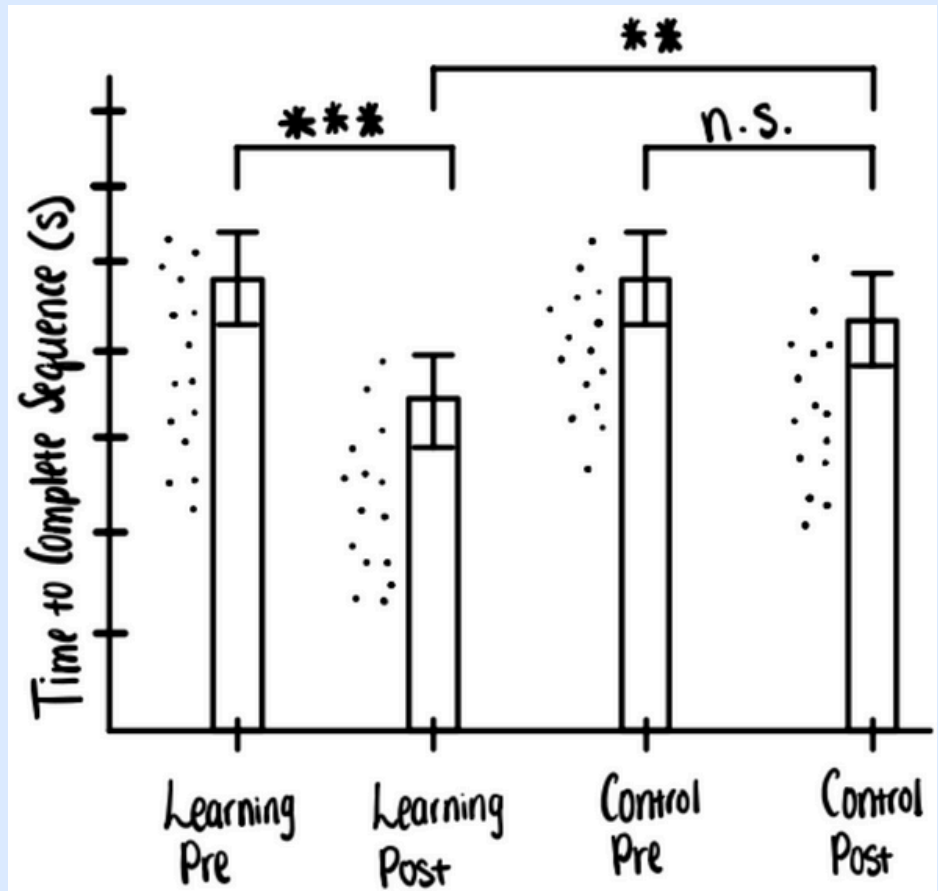


Figure 3. Learning decreases the time to complete finger tasks in the learning group compared to the control group. Participants in both groups performed ten finger sequence tasks pre- and post-learning and the time to complete them was measured (seconds). An independent t-test was done to compare times between the learning and control pre and post conditions, and the learning post and control post. *** means p-value < 0.01, ** p-value < 0.02, and n.s. means p-value > 0.05.