Methods: A rubber hand illusion (RHI) protocol was administered to induce a shift in the perceived hand position in six healthy subjects. We then examined the effects of three experimental protocols to dissociate agency and ownership. The internal sense of hand position was measured before and immediately after RHI induction, and after each protocol. The protocols are: (i) internally generated voluntary hand movements (VHM), externally generated movements elicited by (ii) transcranial magnetic stimulation (TMS) or (iii) ulnar nerve stimulation (UNS). In the VHM condition, subjects performed voluntary abduction of the index finger. In the TMS condition, single pulses (140% of the resting motor threshold) were used to elicit movements in the first dorsal interosseous (FDI) muscle comparable to the VHM condition. In the UNS condition, UNS intensities were adjusted to produce comparable movements in the FDI muscle. The kinematics of index finger movements were measured using an accelerometer, muscle activities were measured with surface EMG, and subjective ratings of ownership was determined through a questionnaire.
Results: RHI induced a shift in the perceived location of the hand. Only VHM recalibrated the sense of hand positions to the pre-RHI estimates, thus cancelling the illusion. The RHI-induced shift in hand position remained intact following externally generated movements in the TMS and UNS conditions.
Conclusions: These preliminary findings suggest that volitional drive associated with a sense of agency, but not movement per se, is necessary for removal of the rubber hand illusion.

P1090
Neuronal dynamic of TMS induced MEPs: a combined TMS-EEG study

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Question: The recording of motor-evoked potentials (MEPs) elicited by single pulses of transcranial magnetic stimulation (TMS) over the primary motor cortex (M1) is a widely used non-invasive technique to assess motor cortex excitability in humans. Recently, it was shown that the electroencephalogram (EEG) can be used to measure TMS-evoked brain potentials (TEPs). Following M1 stimulation, TEPs consist of early latency responses maximal over the stimulation site, followed by later responses hypothesized to originate from frontal and temporo-parietal regions. Here, we characterized the relationship between TEPs and MEPs using machine-learning techniques, with the aim of exploring the functional significance of these brain responses and their relation to M1 excitability. Furthermore, considering that M1 excitability may be expected to vary spontaneously according to intrinsic fluctuations in neuronal excitation, we also examined whether the EEG signal measured before the onset of the TMS pulse is predictive of the elicited MEPs.
Methods: The EEG was recorded using 31 scalp channels. Single pulses of TMS were delivered over the left M1 using an intensity corresponding to the resting motor threshold of the right FDI muscle. The second-order statistic (standard deviation) was calculated using moving windows of variable width (15-200 ms). Linear Discrimination Analysis (LDA) was used to classify trials with no MEPs (magnitude $<0.5\ \mu$V) and trials with MEPs (magnitude $>0.5\ \mu$V).
Results and conclusion: The occurrence of MEPs was determined by both pre- and post-stimulus EEG power, indicating that M1 excitability is dependent on spontaneous fluctuations in cortical oscillatory activity. Furthermore, the relationship between EEG power and MEPs was maximal 10-35 ms after TMS onset, indicating that M1 excitability is a strong determinant of both MEPs and early-latency TEPs.

P1101
Transient effects of transcranial magnetic quadripulses on the human motor cortex

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Question: Transcranial magnetic quadripulse stimulation (QPS) induces bidirectional long term plasticity depending on the interstimulus interval (ISI) and follows the Bienenstock-Cooper-Munro theory of synaptic plasticity. However, the exact electrophysiological mechanism determining this frequency dependent bidirectionality is not clear.
Methods: In 18 healthy subjects we investigated the effect of one burst of four monophasic TMS pulses at ISIs of 5 and 50 ms. Motor cortical excitability was evaluated by the motor evoked potential amplitude at 5 to 1000 ms after a burst.
Results: Both 5 and 50 ms bursts induced an early facilitation followed by a longer lasting inhibition. The facilitation lasted longer after the 5 ms burst, while the inhibition was more pronounced after the 50 ms burst.
Conclusions: Transsynaptic activation of pyramidal neurons by a single TMS pulse is characterized by an early facilitation and subsequent inhibition. Our results suggest a summation of both excitatory (EPSP) and inhibitory postsynaptic potentials (IPSP) by four pulses applied as one burst. The difference between the two conditions may be the frequency dependency of EPSP- or IPSP-summation. Since IPSP typically peaks at a longer latency, four pulses at 50 ms led to more pronounced summation of inhibition compared to those at 5 ms. These transient effects reflect pure electrophysiological property changes within the cell membrane or synapse and are different from the plastic changes after QPS resulting from synaptic efficacy changes based on some protein synthesis. However, this early frequency dependency may at least partly contribute to the bidirectional character of QPS plasticity.

LP64
Action perception: the mirror neuron system recognizes the temporal properties of movement

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Question: Recognition of movement might rely on both spatial (i.e., body posture) and temporal features (i.e., rhythm among the subcomponents of movement). A wealth body of evidence suggested that body posture modulates action perception. A question remains still open related to the ability of the mirror neuron system to selectively recognize the temporal features of movement.
Methods: To elucidate this topic we choose a type of movement (execution of un-paced finger opposition movements), of which we know the spontaneous tempo and in a first set of experiments, we recorded cortical excitability by means of TMS, from hand muscles, while subjects were viewing videos showing a hand performing finger opposition movements at a rate similar to, lower or higher than the spontaneous one. Then we tested whether an observational training, consisting in watching a 10 min-video of repetitive finger movements faster than the spontaneous ones, was able to modulate motor resonance, as tested with TMS.
Results: We found that cortical excitability measured in the hand muscle was significantly enhanced when the speed of execution of the observed action was congruent to the spontaneous one than when it was lower or higher than the spontaneous one. More, observational training induced a behavioural shift of the spontaneous execution rate and a modulation in the resonance of the motor system versus the “spontaneous” rate of the observed movements.
Conclusions: Here, we demonstrated that the mirror neuron system is able to selectively recognize temporal properties of a certain movement as belonging to the personal motor repertoire and that learning of temporal characteristics may occur by observational training, in terms of changes in motor behaviour and changes in motor resonance mechanisms. These results open the possibility to either develop tailored protocols of observational training in order to restore movement timing when it is lost and change the innate temporal properties of a certain movement.