Comunicazioni orali libere 1

Presentazione Orale

Cerebellar Direct Current Stimulation (ctDCS) for the treatment of painful and non painful phantom limb sensations (PLP).

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Introduction: Non-invasive brain stimulation techniques, as repetitive Transcranial Magnetic Stimulation (rTMS) and transcranial Direct Current Stimulation (tDCS), have recently emerged as promising tools for modulating pain experience in humans. In previous studies, we have proved that cerebellar tDCS (ctDCS) modulates nociceptive processing and pain perception, suggesting that cerebellum is engaged in the sensory-discriminative, as well as in the affective/emotional and cognitive dimensions of pain. The primary aim of this study was to modulate nociceptive processing and pain perception with cerebellar tDCS in patients with phantom limb pain (PLP).
Methods: Twenty patients underwent cerebellar tDCS (2.0 mA, 20' per day, five days a week). Each patient received both treatments in a cross-over design and carried out two separate experimental sessions helded at least three months apart, to avoid carry-over effects. Inclusion criteria were: 1) age older than 18 years; 2) unilateral lower limb amputation; 3) average pain of at least 4 on a numeric rating scale; 4) any medications dosages stable for at least four weeks prior the study. Clinical scores and electrophysiological parameters were assessed before tDCS, at the end of 5-days treatment, two weeks and one month after tDCS completion. Changes in Visual Analogue Scores (VAS) were evaluated (phantom limb pain, paroxysmal pain, stump pain, "telescoping" phenomenon and phantom movements). HADS, SF-36 and BPI were administered to each patient, in order to evaluate the effect of PLP on psychological well-being, daily living and efficacy of the treatment to improve the quality of life. LEPs were obtained using a Nd:YAP laser (wavelength 1.04 µm, pulse 164 duration 2–20 ms, maximum energy 7 J). The amputated limb was stimulated by laser pulses with short duration (5 ms) and small diameter spots (5 mm).
Results: Anodal tcDCS significantly improved paroxysmal pain ($p = 0.0022$) and non painful phantom limb sensations (phantom movement: $p < 0.001$; "telescoping phenomenon": $p = 0.005$), with effects lasting for one month after protocol completion (Figure 1); no change was found in Phantom Limb Pain ($p = 0.15$) and Stump Pain ($p = 0.28$) scores. Anodal polarization significantly dampened LEP amplitudes (N1: $p = 0.021$ and N2/P2, $p = 0.0034$), whereas sham stimulation left them unchanged.
Conclusion: Anodal ctDCS significantly improves both painful and non painful phantom limb sensations, which are induced by maladaptive changes in the sensorimotor network and posterior parietal cortex respectively. Cerebellar polarization may ultimately restore this connectivity, thus influencing pain experience through top-down and bottom-up mechanisms. Nonetheless, the lack of changes in stump and chronic pain may also suggest a predominant effect of ctDCS on lemniscal pathways rather than thalamocortical networks, as pain paroxysms are likely due to the involvement of large A-beta fibers.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18016/add_1_471871_ddb26b26-2e3c-4fb4-ada8-b2d60411a8b4.jpg

Caption 1: Figure 1 - Effects of anodal ctDCS on painful and non painful phantom limb phenomena, as assessed by changes in Visual Analogue Scores

Comunicazioni orali libere 1

Presentazione Orale

Real-time assessment of embodiment-related brain dynamics: a TMS-EEG study in immersive virtual reality.

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The sense that we own a body (ownership) and we are responsible of its actions (agency) is fundamental for embodiment and bodily self-consciousness. Immersive virtual reality (IVR) proved to be a powerful tool to induce the illusory experience of embodying a virtual body. The real-time neural mechanisms underlying the embodiment process of artificial limbs are still unclear. Here we combined for the first time the novel TMS-EEG (transcranial magnetic stimulation and electroencephalography) approach with IVR in order to investigate the real-time cortical dynamics underlying the embodiment of a virtual limb.
We tested 19 healthy volunteers in three TMS-EEG sessions during which they observed through a head-mounted display a virtual right upper limb, overlapped to the real one, from a first-person perspective (1PP). The participants were instructed to passively observe the virtual limb and to refer whether he/she feels it as a part of his/her body. In two sessions, the participants observed a full right upper limb and received 160 TMS single-pulses over the left (full-lM1 condition) or over the right primary motor cortex (full-rM1 condition) (fig. 1A). In another session, the participant observed the right upper limb with detached hand due to a missing wrist during TMS of the left M1 (detached-lM1 condition). All sessions were preceded and followed by a TMS-EEG block of stimulation during which 120 TMS single-pulses were delivered over the corresponding M1 to monitor possible long-lasting effects of IVR. Behavioral effects of IVR were investigated in terms of self-reported sense of ownership and agency, whereas neurophysiological effects were investigated in terms of TMS-evoked cortical excitability and oscillations.
Behavioral results showed that the observation of a right full limb induced the highest embodiment feeling ($p<0.01$). Neurophysiological results showed a strong reduction of TMS-evoked cortical activity ($p<0.001$) and alpha oscillations ($p<0.01$), when we stimulated lM1, during the observation of the right full virtual limb. These effects were found mainly over a region comprising left M1 and pre-motor areas (fig. 1B). A trial-by-trial analysis conducted during the observation of the full virtual limb, showed that suppression of cortical activity started concurrently with the self-reported feeling of embodiment (fig. 1C). No effects were found when the participant observed the detached limb nor when we stimulated the right M1 ($p>0.05$).
Our results provide the first evidence of the real-time brain dynamics underpinning the embodiment of a virtual limb. More specifically, embodying a virtual limb brings about a dramatic decrease of the motor cortex activity contralateral to the virtual limb, which could possibly reflect a disembodiment of the real hand. Interestingly, the timing of the cortical activity decrease was concurrent with the start of the embodiment self-reported feeling.

Comunicazioni orali libere 1

Presentazione Orale

Aberrant functional organization of cortical networks underpinning dynamic pain-cognition interactions at rest in patients with chronic migraine

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Objectives. In episodic migraine patients, we previously observed evidence for changes in functional connectivity (FC) between various independent networks using resting state functional magnetic resonance imaging (RS-fMRI) depending on attacks frequency and migraine phase (ictal/interictal). Here, we investigated RS-fMRI using independent component analysis (ICA) to determine the functional connectivity between networks in chronic migraine (CM) patients.
Method. Twenty patients with untreated chronic migraine (CM) without medication overuse underwent 3T MRI scans and were compared to a group of 20 healthy volunteers (HV). We used MRI to collect resting state data among three selected resting state networks, identified using group ICA: the default mode network (DMN), the executive control network (ECN), and the dorsal attention system (DAS).
Results. Compared to HVs, CM patients showed significant reduced functional connectivity between the DMN and the ECN. Moreover, in patients, the DAS showed significant stronger FC with the DMN and weaker FC with the ECN. The severity of headache attacks was correlated positively with the strength of DAS connectivity, and negatively with the strength of ECN connectivity.
Conclusion. These results provide evidence for large-scale reorganization at the level of the functional networks underpinning dynamic pain–cognition interactions during chronic migraine. They further suggest that the severity of migraine pain is associated with proportional inverse pattern of frontal executive and dorsal attentive networks connectivity.

Comunicazioni orali libere 1

Presentazione Orale

Exploring the role of phase synchronization: the recruitment of the attention network through the Superior Longitudinal Fasciculus

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Introduction

It is well known that the attentional inhibition of distracting inputs in order to select relevant information relies on local synchronization of alpha band neuronal oscillations in visual cortices. Additionally, evidence for long-range coupling of neuronal oscillations in the alpha but also in the beta frequency ranges between visual cortices and regions engaged in the anticipation of upcoming stimuli has been more recently demonstrated.
Nevertheless, as yet several questions in this regard are still under debate. On the one hand, the relation between long-range functional coupling and anatomical connections is still to be assessed and, on the other hand, the frequency specificity and the specific role of the alpha and beta frequency bands in the different processes underlying visuo-spatial attention still needs further clarification.

Method

We acquired magnetoencephalographic data in a cohort of 28 healthy subjects, performing a cued visuospatial attention task. Diffusion MRI data from the same subjects were also used to dissect the three branches of the Superior Longitudinal Fasciculus (SLF) as anatomical connection.
Using novel measures of linear (frequency-specific) phase synchronization, i.e. Multivariate Interaction Measure (MIM) and Phase Slope Index (PSI), and nonlinear (cross-frequency) phase-coupling, i.e., antisymmetric cross-bicoherence (ACB), we quantify functional connectivity between neuronal oscillations of brain activity in the alpha and beta frequency bands and we assess cross-frequency interactions between alpha and beta bands to account for higher order functional mechanisms. Finally, the relationship of frequency-specific functional connectivity to individual differences in anatomical characteristics of SLF and to performance is assessed.

Results

In both hemispheres alpha band phase synchronization between parietal and occipital cortices is modulated by the orienting of attention according to top-down mechanism reflecting behavior, and its hemispheric asymmetry is predicted by volume's asymmetry of specific tracts of the Superior Longitudinal Fasciculus (Fig.1). This occipito-parietal functional network is specific to the orienting of attention.
We also demonstrate the existence of a network comprising parietal regions and frontal regions, namely the right putative Frontal Eye Field but not the left, that is recruited through an alpha-beta cross frequency coupling (Fig.2). This network seems to be involved in the deployment of spatial attention but not in the orienting, and the alpha-beta cross-frequency coupling through which it is recruited represents the broadcast mechanism by which the fronto-parietal circuit operates.

Conclusions

Our study demonstrates that the visuospatial attention network features subsystems indexed by characteristic spectral fingerprints, playing different functional roles in the anticipation of upcoming stimuli and with different relation to fiber tracts.

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Picture 2: https://www.eventure-online.com/parthen-uploads/175/18016/add_467921_2a1cac3b-7e8a-4a84-9286-2388e245a8c0.png

Comunicazioni orali libere 1

Presentazione Orale

Superior Colliculus functional connectivity and changes in blindsight following V1 damage or hemispherectomy

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Patients with cortical blindness following a lesion to the primary visual cortex (V1) may retain non-conscious visual abilities; a condition known as Blindsight. While blindsight has been traditionally reported in patients with lesions confined to V1, there is convincing evidence of blindsight in a few patients with hemispherectomy. In such patients, the cortical mantle of one hemisphere has been entirely removed along with other subcortical structures such as LGN and Pulvinar, thus pointing to the pivotal contribution of the superior colliculus in (some forms of) blindsight. The comparative investigation of functional connectivity in these different blindsight patients could pinpoint the relevance of specific neuro-functional pathways during non-conscious visual processing. One method of investigating the intrinsic organization among several brain structures comes from resting state paradigm, which allows to profile the functional organization of neural networks. Here, we analysed resting state data from Human Connectome Project (~ 100 healthy subjects) and two patients with blindsight. Patient S.E. underwent hemispherectomy that left the ipsilateral SC intact, but removed LGN and pulvinar, whereas patient G.Y. has a lesion confined to V1. We computed SC connectivity derived from HCP and then compared it with the SC connectivity in the patients. SC connectivity in healthy subjects revealed major connections with V1, FEF, extrastriate (MT, TE), Precuneus (PCL, IPS), auditory cortex and cingulate cortex. These findings are coherent with tracer studies as well as with previous functional connections investigated in human and non-human primates. Compared with HCP, G.Y. shows an increased SC connectivity mainly with subcortical (right Amygdala/Hippocampus and right Pulvinar) and parietal areas. Connectivity in the SC of patient SE increased significantly with extrastriate cortex (MT, TE-TEO) and frontal lobe. Together these results indicate a differential adaptation of the SC activity following different brain damage. While in G.Y. there is a straightening of functional connections with subcortical structures, in patient S.E. the SC connectivity was enhanced with extrastriate structures.

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Comunicazioni orali libere 1

Presentazione Orale

The investigation by fNIRS-LEPs of Motor Function and pain in Fibromyalgia

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Background: Experimental evidences suggested a possible mutual relationship between motor function and pain control in people suffering from a chronic pain condition. The neurophysiological mechanisms that control this interaction are very complex and not very well known. Fibromyalgia (FM) is an invalidating disease with widespread pain. By functional Near-Infrared Spectroscopy (fNIRS), an optical and portable method, is possible to investigate the brain hemodynamic activity in real time. A neurophysiological assay to examine the nociceptive pathways is Laser-Evoked Potentials (LEPs). The lack of interference between the electrical signal and metabolic activity allows the simultaneous use of these investigation methods. The aims of this study were to explore the effects of motor activation and painful stimulation by CO_2 laser respectively on the motor areas and the whole cortex in FM patients and control subjects.
Method: We recruited 50 Fibromyalgia patients (3 males and 47 females, M_{age}= 46,24 SD= 11,98, age range from 18 to 63 years) and 25 control subjects (5 males and 20 females, M_{age}= 32,90 SD= 14,02, age range from 21 to 59 years). We used a fNIRS-EEG compatible cap. The emitters and detectors were positioned on the motor cortex (figure 1), constituting 20 channels of fNIRS recording. 61 electrodes on the whole scalp were used for the LEPs recording. The experimental protocol was made up of motor tasks and painful stimulation. 2 types of motor task were used: a finger tapping task (ftt) at fixed time intervals and one at the maximum speed of the individual movement. At the same time of the motor task, the subjects could or not received 30 laser stimuli on the right or left hand back.
Results: The analysis of fNIRS data showed reduced activation of the right motor cortex in the FM group compared to the control one in both movement conditions. Particularly there was an increase in oxyhemoglobin levels and a decrease in deoxyhemoglobin one in C3 area. There was a variation of the relationship oxy-deoxy hemoglobin evident in controls than patients, as index of activity, but only during the fast movement. Furthermore, changes in deoxyhemoglobin levels were significantly different between groups in all experimental conditions in the fNIRS channel 10. The conditions of movement during concomitant laser stimulation did not result in a relevant change in the LEPs.
Conclusion: This study supports a possible dysfunction of motor areas in FM patients that could have a pivotal role in the maintenance of chronic pain symptoms.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18016/add_1_477877_9974838b-788b-434e-80f9-f0103e1d2e32.jpg

Caption 1: Configuration of fNIRS Channels

Comunicazioni orali libere 1

Presentazione Orale

The Supramarginal Gyrus: a neural storage for order information in Short-Term Memory

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Background. In a seminal work, Hurlstone, Hitch and Baddeley (2014) have proposed the existence of serial order mechanisms shared across different Short-Term Memory (STM) domains. However, the neural correlates of these mechanisms are still undiscovered and debated. Recently, in the case of auditory-verbal STM, a cortical area that seems responsible for storing order information has been identified, namely the left Supramarginal Gyrus (SMG).
Aims. We speculate that the left SMG could retain order information regardless of presentation modality. Our study investigates this hypothesis by modulating the activity of the SMG with inhibitory repetitive Transcranial Magnetic Stimulation (rTMS). In a series of three experiments, we explored the role of the left SMG in the following STM domains: *(a)* verbal domain, with an auditory-verbal digit span task (*Experiment 1*); *(b)* visuo-spatial domain, with a computerized version of the Corsi span task (*Experiment 2*) and *(c)* motor domain, with a finger tapping span task (*Experiment 3*). Furthermore, we tested the selectivity of left SMG function (i.e., maintaining serial order and not a more general attentional role) using a visual pattern span task, a task where no order information has to be retained (*Experiment 4*).
Methods. Twenty healthy volunteers took part in each of the three main experiments. The design of these experiments was within-subjects. Each experiment included three randomized sessions. In two stimulation sessions, before the experimental task, ten minutes of 1 Hz rTMS was applied either over the left SMG or over the left Inferior Frontal Gyrus (IFG). This second cortical area served as a control site. The third session was behavioral-only, serving as a baseline measurement. In *Experiment 4 (control experiment)* fifteen subjects were tested in a two-sessions within-subjects experiment. In this case, rTMS was applied only over the left SMG.
Results. Results of the three main experiments show that for all the STM tasks that required serial order maintenance, the inhibition of SMG selectively impaired the proportion of order errors made by the subjects with respect to both the stimulation-free condition and IFG inhibition. Conversely, when the STM task did not require a sequential information to retain, as in *Experiment 4*, the stimulation of SMG exerted no significant effect on the performance. Interestingly, the inhibition of IFG produced an increased rate of item errors only in the digit span task revealing how, in line with previous literature, IFG stores verbal information.
Conclusion. Taken together our results suggest that left SMG retains order information in STM independently from the material type. This evidence not only brings new light to the anatomic bases of STM network and to the functioning of the network itself but could also offer novel insights in clinical disorders where order information is crucial.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18016/add_1_469403_433ea12e-c4c5-4a8e-bf02-7ad52c02e4a1.png

Caption 1: Results of the four experiments

Sessione Poster 1

Poster

Differential contribution of spatial frequency information in the comprehension of naturalistic actions

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Previous research suggests that action perception and object processing may differently engage the dorsal and ventral stream, respectively. There is evidence that information along these pathways involves the contribution of different neural cells, with the dorsal pathway primarily receiving magnocellular input (M), and the ventral parvocellular (P) one. M-cells predominantly respond to low-spatial frequencies (LSF) and convey the global aspects of a scene, whereas P-cells are more sensitive to high-spatial frequency (HSF) conveying local aspects. Thus, a common experimental manipulation to bias processing towards dorsal and ventral pathways consist in filtering stimuli so that they contain only LSF or HSF information, respectively. Here, we capitalized on this manipulation to disentangle the differential contribution of these pathways during the recognition of context-embedded actions. To this aim, we delivered TMS pulses and recorded motor-evoked potentials from a hand and forearm muscles while participants observed snapshots evoking ongoing but incomplete actions and predicted their unfolding. In addition, baseline muscle activity was recorded while participants observed a fixation cross. Snapshots depicted everyday actions performed in congruent or incongruent scenarios and congruency was manipulated in terms of compatibility between observed kinematics (precision vs. whole-hand grips) and the motor intention suggested by the ensemble of objects (context). We hypothesized that: (H1) if the ventral P-pathway is mostly sensitive to object-related features, HSF information would specifically modulate the congruency effect but not the global distinction conveyed by grip patterns; and (H2) if the dorsal M-pathway is preferentially involved in processing kinematics, LSF information would modulate the global distinction between grips but not the congruency effect triggered by local details related to objects. However, we also considered a third hypothesis (H3) based on current studies suggesting that the dorsal M-pathway can early activate the prefrontal cortex, which in turn generates ‘initial guesses’ and influences object recognition in a top-down fashion via projections to the ventral stream. In line with H1, we found that HSF-images specifically modulated the congruency effect, with increased CSE for actions observed in congruent as compared to incongruent contexts. Interestingly, we found that LSF-images modulated kinematics recognition (i.e., differentiated grips), but also the congruency effect showing increase CSE for actions observed in incongruent as compared to congruent contexts, mostly supporting H3 than H2. Collectively, our findings suggest that, during action prediction, the estimation of the intention from the context and the motor coding of movement kinematics rely primarily on dorsal activity, benefiting both from LSF information.

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Sessione Poster 1

Poster

The role of theta and alpha oscillations in prospective memory: an MEG study

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Introduction: Prospective memory (PM) is the ability to remember to accomplish pre-specified intentions in the future (Einstein & McDaniel 1990), such as remembering to put fuel in the car when you see a gas station. Two attentional processes are critical for PM tasks: monitoring the environment for the occurrence of the PM cue (e.g., the gas station in the example above), and maintaining the intention active in mind. According to a model we proposed (Cona et al., 2015), the attention needs to be allocated towards the external stimuli for monitoring and towards the internal 'stimuli' for maintaining the intention.
Previous fMRI studies showed that such processes are mediated mainly by anterior prefrontal cortex, dorsal fronto-parietal networks and saliency network, comprising insular and anterior cingulate cortex (Burgess et al., 2011; Cona et al., 2015).
Aims: The present study used MEG technique in order to delineate the neurocognitive mechanisms underlying PM monitoring and maintaining processes. MEG approach allowed us to focus on the cortical areas involved in these processes, specifying the timing and frequency bands of their contribution to PM.
Methods: 21 healthy young participants took part in the study.
The protocol encompassed a *baseline* ongoing task (i.e., a lexical decision task), which was executed first alone, and then simultaneously with PM tasks. Two PM tasks were used: *intention-load* and *monitoring-load* PM task. In the *Intention-load* task, participants had to take in mind three different intentions (associated with 3 distinct PM words). In the monitoring-load PM task, participants had to accomplish the intention pressing one single key when a nonsalient PM cue (i.e., a syllable in string of letters) was presented.
MEG signal was acquired with a CTF MEG system (MISL, Vancouver, Canada) with 275 MEG. We performed a regular pre-processing including source reconstruction (wMNE) based on individual MRI data. Time-frequency analysis was performed using Hilbert transform, focusing on theta (4-7 Hz) and alpha (8-12 Hz).
Results: We found that, as compared to the *baseline* task, the *intention-load* task was associated with an increase in the theta band over right frontal and insular regions (Figure 1) and over temporal regions, especially in the late time-windows. By contrast, as compared to the *baseline* the *monitoring-load* task was associated with a decrease in the alpha band over the occipital and parietal regions and over the left ventral frontal regions, in the earlier time windows (Figure 2).
Discussion and Conclusions: The increase in theta band mainly anterior regions might mediate the allocation of attention towards internal stimuli, a process critical for intention maintaining. On the other hand, attention towards external stimuli, required form monitoring the presence of the PM cue in the environment, might lead to a decrease in the alpha band, mainly over posterior regions.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18016/add_3_478222_bf630cc2-a5ad-40fa-8b42-66bdaf6f7f5a.png

Caption 1: Alpha decrease in monitoring task

Picture 2: https://www.eventure-online.com/parthen-uploads/175/18016/add_478222_bf630cc2-a5ad-40fa-8b42-66bdaf6f7f5a.png

Caption 2: Theta increase in intention maintaining task

Sessione Poster 1

Poster

Connectivity alterations underlying the breakdown of pseudoneglect in Alzheimer's disease.

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Recent evidence suggests that pseudoneglect, i.e. the behavioral bias which favors the processing of stimuli appearing in the left visual field, is observed across lifespan through healthy aging and persists even in mild cognitive impairment (MCI) but it vanishes in Alzheimer's disease (AD) during an enumeration task. Studies investigating the neural basis of pseudoneglect in neurologically healthy individuals ascribe this phenomenon to the right hemisphere dominance for visuospatial attention, which in turn is explained as a stronger fronto-parietal connectivity in right than in left hemisphere. The aim of the present study was to investigate the neural mechanisms subtending the breakdown of the pseudoneglect phenomenon in AD.
14 mild AD, 15 amnesic MCI (aMCI) and 14 healthy elderly controls (HC) took part in the present study. EEG was recorded while participants were performing a multiple objects enumeration task in which they had to enumerate a variable number of targets (from 1 to 6 green dots) among distractors (red dots) presented either to left or to the right of a fixation dot. Functional connectivity was estimated in theta (3-7 Hz) frequency band by means of Partial Directed Coherence (PDC), which provides strength and direction of the causal links between different brain areas. Two classes of graph theory indices were derived: 1) local indices describing the communication between different scalp areas (i.e, divisibility and fronto-parietal connections); and 2) global indices describing general properties of the network (i.e, global efficiency, local efficiency, characteristic path length and clustering coefficient).
Behavioral results confirmed that HC and MCI patients showed pseudoneglect (performing better when targets appeared in the left than in the right visual field), whereas AD patients did not. Connectivity analysis disclosed higher fronto-parietal connections in the right hemisphere as compared to the left hemisphere in HC and aMCI but not in AD patients. The divisibility index involving parietal areas increased going from normal aging, through aMCI, to AD, and interhemispheric parietal connectivity resulted significantly reduced in AD as compared to HC. No significant differences emerged when considering global indices.
The results of the present study support the hypothesis that the lack of pseudoneglect observed in mild AD patients is consistent with the loss of the right hemisphere dominance, which is specifically caused by the reduction of its fronto-parietal connections. In addition, AD patients showed an interhemispheric disconnection between homologous parietal regions thus revealing a disruption of callosal fibers. In conclusion, we suggest that the lateralization bias in AD patients relies on the degree of the selective degeneration of the right lateralized fronto-parietal network together with the degeneration of the posterior callosal projections.

Sessione Poster 1

Poster

Modality-Specific Sensory Anticipation of Upcoming Events

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Abstract
Background: Most of the events we experience every day do not occur unexpectedly: our brain is somewhat committed to anticipate future events and to prepare accordingly. In the present study, we test the hypothesis that the passive attendance of external stimuli activates the respective sensorial cortices in a proactive manner, according to the modality in which stimuli are presented. Namely, we leveraged the high temporal resolution of Event-Related Potential (ERP) technique to explore the pre-stimulus, anticipatory stage of processing while participants passively attended visual, auditory and somatosensory stimuli, in a laboratory setting.
Methods: High-resolution EEG was recorded on forty-five young adults to measure ERPs. Participants were divided into three homogeneous groups of 15 and performed a passive perceptual experiment, but each group in a different perceptual modality (visual auditory and somatosensory). Distinctive ERP waveforms were detected and measured at selected electrodes for each modality.
Results: Main findings were twofold: 1) we detected modality-specific pre-stimulus ERP components initiating 500-800 ms before stimulus onset: the visual negativity (vN), the auditory positivity (aP) and the somatosensory negativity (sN), with distinctive brain topographies; 2) following stimulus presentation, these scalp-recorded activities abruptly inverted their polarity peaking in the visual P1, the auditory N1 and the somatosensory P100 components. Further, neither motor preparation (i.e. the Bereitschaftspotential) nor proactive inhibitory (i.e. the Prefrontal Negativity) components emerged, since the participant did not receive any instructions to prepare or to inhibit responses to the presented stimuli.
Discussion: According to present findings, the vN, the aP and the sN components may represent the “sensory anticipation” postulated by the Bayesian Decision Theory and by neurophysiological models of anticipatory behaviour respectively for the visual, auditory and somatosensory modalities. The detected components confirm previous theories on sensory anticipation as the the thalamic gating theory and the threshold regulation theory. These models might indeed suggest that sensory-specific anticipation involves the modality-specific respective cortical areas only: vN, aP and sN might underlie top-down perceptual activities, which in turn give rise to bottom-up post-stimulus early-processing (P1, N1 and P100).
Conclusions: The present work expands the description of the family of slow-wave cortical potentials and suggests distinctive patterns of modality-dependent sensory anticipation of external stimuli. Indeed, in absence of any active task, the passive attendance of external visual, auditory and somatosensory stimuli uncovered distinctive perceptual enhancement for upcoming stimuli presentation

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Poster

Tool dependent motor imagery effects on primary motor cortex excitability in expert fencer.

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PURPOSE: Practice and experience lead to structural and functional changes in the brain. Since the development of internal models of action is a requisite for motor learning and for the production of skilled actions (Rosenbaum et al., 1993; Wolpert, 1997) one can suppose that even tools must be integrated in it. This has been demonstrated in athletes, through motor imagery (MI). Handling the sport-specific implement during MI affects this mental process in athletes inducing a better isochrony between real and imagined movement and a facilitation in cortical excitability (Fourkas et al., 2008; Bisio et al., 2014; Wang et al., 2014). In the present work we asked whether is possible to find an integration specific for a familiar tool in internal motor representation. In particular, we tested whether in a group of fencers the èpèe they use during training and a common one were differently integrated in athletes' body schema. Moreover, we investigated if the embodied tool is better integrated in fencers' motor programs.
METHODS: To this aim we tested through a multisensory integration paradigm (Serino et al., 2007) the extension of the peripersonal space (PPS) of the fencers while handling their personal (pE) or a common èpèe (cE), the same for everyone. Then we evaluated primary motor cortex excitability before (i.e., during the motor preparation) and during the MI of a specific gesture related to fencing (parry 4 – attack combo) while the athletes handled the tools.
RESULTS: We confirm that the personal tool is better integrated than the other in athlete's PPS (Biggio et al., 2017). Also, we found that the motor cortex excitability of fencers increased both during the motor preparation and the imagination of the gesture only when they handled pE, but no effect was detected when they handled the common tool. Furthermore, the increase of the cortical excitability during MI with respect to the rest condition positively correlated with the athletes' weekly hours of practice.
CONCLUSION: This preliminary data showed that the long-term physical training of athletes with a specific implement provoke a stably remap of the PPS representation in athletes, and also induce an integration in motor schema of the personal object with respect to a generic one that has the same purpose.

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Poster

Temporal and spatial features of interhemispheric information transfer in the motor system: a TMS-EEG and DTI study

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TMS-EEG is now an established method to study effective connectivity both in healthy and pathological brain. Here we test how TMS-EEG measures may be shaped by structural connectivity in the motor system.
Methods: We tested sixteen right-handed healthy volunteers. To obtain measures of microstructural integrity of the body of corpus callosum (CC), we calculated fractional anisotropy (FA), mean diffusivity (MD), axial diffusivity (AD), and radial diffusivity (RD), from DTI recordings. To obtain measures of interhemispheric effective connectivity, TMS-EEG data were collected separately on the left and right M1 during a modified ipsilateral silent period (ISP) paradigm: during TMS-EEG recording, the hand ipsilateral to the side of stimulation was contracted at 30-50% of maximal voluntary contraction while the contralateral hand performed a reaction time task or was at rest. The ISP paradigm is known to activate inhibitory connections through the corpus callosum. Moreover, its combination with an unimanual task has been shown to further increase such inhibition. We calculated TMS-evoked potentials (TEPs) for left M1 stimulation and for right M1 stimulation, separately. Finally, in order to test whether TEPs may represent the integrity of the CC, we correlated DTI measures of CC with amplitude of TEPs with a cluster-based correction for multiple comparison. These analyses were run separately for the left M1 and the right M1 stimulation and for the task and rest conditions.
Results: We were able to individuate TEP components up to 250 ms after TMS delivery. Their amplitude was modulated by the task conditions. Right M1 and left M1 stimulation showed the same components with reversed topographies, suggesting a directionality of signal propagation depending on the stimulated hemisphere.
Crucially, we found significant correlations between TEPs for left M1 and DTI in the CC body. Specifically, there was a significant negative correlation of MD and RD with TEPs over bilateral centro-frontal areas between 50 and 150 ms after TMS both in the task condition and in the rest condition ($p<0.05$). This correlation indicated that stronger microstructural integrity of the CC was associated with less negative potentials in bilateral regions.
Conclusions: Our results support a direct relationship between the anatomical integrity of the fibers connected to the stimulated area and the functional connectivity measured with TEPs. The negative correlation may suggest that stronger CC integrity produces more interhemispheric inhibition from M1 (therefore smaller negative potentials). Interestingly, these results were present for the stimulation of the dominant hemisphere, i.e. left M1, and not for the right M1. This result may indicate that TEPs may offer information on the directionality of fibers that cannot be inferred from DTI.

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Poster

Neural oscillations involved in adopting Intentional Stance towards an artificial agent

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Whenever we interact with others, we can predict or explain her/his behaviour by adopting the intentional stance (Dennett, 1971), i.e., attributing mental states (beliefs, intents, desires) with the assumption that they drive the observed behaviour. By adopting the intentional stance, we can also socially attune to another person. In our daily life, we no longer interact only with humans, but also with artificial intelligence or agents (e.g., vocal assistants) and, in the future, we will likely be interacting with social robots on a daily basis. Attributing mental states to these agents could lead to social attunement with them and, therefore, to human-robot interactions resembling human-human interactions. Neural correlates of intentional stance adoption towards artificial agents have never been explored and could be of crucial interest in understanding the social brain functions (Frith, 2007) during human-robot interaction.
To study the neural correlates of intentional stance, EEG activity was recorded from 35 participants while they performed a revised version of the InStance questionnaire (Marchesi et al, *under review*). In this questionnaire, participants were asked to choose the likelihood of an explanation (mentalistic vs. mechanistic) of the behaviour of a robot portrayed in a naturalistic scenario (34 sequences of three photographs each). EEG data (before the response was given) were analysed in the time-frequency domain, in order to investigate decisional processes involved in adopting either mentalistic or mechanistic stance, and were not specifically time-locked (Tallon-Baudry & Bertrand, 1999).
A preliminary analysis highlighted differences in specific low-frequency bands, suggesting different neural activity over networks of areas involved in attributing mental states. The results of this study may improve the understanding of the neurophysiological basis of intentional stance adoption and social attunement to an artificial agent. These pieces of evidence could lead to relevant future developments, e.g., understanding the neurocognitive difference between social attunement to humans vs. to artificial agents; how social attunement to human or artificial agents differs in conditions characterized by difficulty with communication and interaction (e.g., Autism Spectrum Disorders); and how to design humanoid robots that facilitate social interaction.
Acknowledgement: This project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation program (grant awarded to AW, titled "InStance: Intentional Stance for Social Attunement. Grant agreement No: ERC-2016-StG-715058)

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Poster

Baseline levels of alertness determine tES effects more than age per se

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Several studies suggest that behavioural modulations of phasic alertness improve visual processing and motor responses in healthy young adults, while investigations in normal aging yields non conclusive results. We have recently reported proof that bursts of transcranial electrical stimulation (tES) induce performance benefit during a continuous performance test in healthy young adults, consistently with a tES modulation of phasic alertness.
The aim of the present study was to investigate whether tES applied during a visual short-term memory (VSTM) task induces effects consistent with alertness modulations across the lifespan, by directly comparing behavioural and psychophysiological data in healthy young and older adults.
20 young and 20 older adults participated in the study. They performed a VSTM task, in which arrays of 8 letters were briefly presented. Participants were required to vocally report as many letters as they remembered. All participants completed two experimental sessions, during which sham or real bursts of high frequency transcranial random noise stimulation were applied concurrent with the stimulus array through a fronto-occipital montage. The proportion of the correct reported letters was evaluated as measure of behavioral accuracy. In addition, skin conductance was recorded as psychophysiological measure of alertness.
Statistical analysis on behavioral data revealed that real tES reduced significantly the amount of remembered high-salience letters in comparison to the sham condition in older participants, while tES did not affect the young participants' performance. Interestingly, when we split young and older participants according to their self-reported level of experienced alertness (measured with the STAI-Y State scale at the beginning of each session), and included the factor alertness in the analyses, we found that the level of subjective alertness affected the performance modulations induced by tES. We distinguished four groups with progressive levels of alertness: young/low, older/low, young/high, older/high. Going from one extreme to the other, we observed a tES-induced marginal improvement of the VSTM storage capacity only in the young participants reporting the lowest level of alertness, and a significant worsening of the performance only in the older participants reporting the highest level of alertness. The age group factor never interacted with tES condition, suggesting that alertness, but not age, affected tES effects. Statistical analysis on skin conductance revealed no consistent results relative to tES modulation, neither when we split participants according to their levels of alertness.
Consistently with recent evidence, these results confirm that several factors characterizing participants at baseline may affect response to tES. In this study, the general levels of activation, more than age per se, determined even opposite tES effects on behavioral performance to a VSTM task.

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Poster

Illusory body experience in microgravity: the role of vestibular and proprioceptive inputs in shaping the sense of body ownership

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Our body has evolved in terrestrial gravity and, consequently, unconventional gravitational conditions can alter body awareness. Here, to explore whether and how the sense of body ownership (SBO), i.e. the feeling that different body parts belong to ourselves, is dynamically shaped by gravitational inputs, we participated in a parabolic flight campaign organized by the European Space Agency. During parabolic flights, we experience microgravity (0G) conditions, known to make both proprioceptive and vestibular signals weaker and less reliable.
We took advantage of the Rubber Hand Illusion (RHI), during which participants watch a lifelike rubber hand (RH) being touched (visual stimuli) while their real hand (hidden from view) is touched synchronously (tactile stimuli). The brain integrates these visuo-tactile stimuli in a unitary multisensory experience, inducing the feeling that tactile sensations come from the embodied RH. During parabolic-flight, any difference on the RHI susceptibility can inform us about a gravity-dependent modulation of multisensory integration mechanisms on which the SBO relies.
In the *main experiment* (sample: n=5), a parabolic flight version of the RHI was induced during different phases of each parabola (n=30), including both microgravity (0G) and normal gravity (1G). A *preliminary experiment* (sample: n=24), in which the RHI paradigm was performed either during neutral-buoyancy (in a swimming pool) or on ground, was designed to control for the differential role of the proprioceptive system (altered in both microgravity and neutral-buoyancy) and the vestibular system (altered only in microgravity). In both experiments, explicit (embodiment-questionnaire) and implicit (proprioceptive-drift) RHI measures were collected after synchronous and asynchronous visuo-tactile stimulations.
The results showed that, irrespective of the stimulation conditions, a gravity-dependent modulation of the RHI measures was found. In both experiments, altered proprioceptive inputs induced a greater shift in the perceived position of the real hand toward the RH; i.e. the (implicit) proprioceptive-drift was significantly greater in 0G than 1G, as well as in neutral-buoyancy than on ground. However, only in the main experiment, when both vestibular and proprioceptive inputs were manipulated, the explicit ratings at the embodiment-questionnaire were significantly greater in 0G than in 1G.
These findings suggest that, during 0G condition, less reliable vestibular and proprioceptive inputs make the visual input from the rubber hand more effective in capturing the participants' SBO, thus leading to an increased experience of the RHI. Furthermore, they showed a differential role of proprioceptive and vestibular inputs in modulating implicit and explicit aspects of SBO. These data contribute to a better understanding of the mechanisms subserving body awareness, suggesting that internal brain models of gravity can play a crucial role.

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Poster

How to collect genuine TEPs: a Graphical User Interface to control data quality in real-time

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Besides observing spontaneous brain activity, collecting neuronal responses to stimulation provides useful complementary information for understanding brain functions. When sensory pathways are impaired and/or subject's collaboration is unreliable, electroencephalography (EEG) combined with transcranial magnetic stimulation (TMS) represents an ideal tool to investigate brain potentials (TMS-evoked potentials - TEPs) evoked by a direct and non-invasive perturbation of cortical neurons.
Differently from peripheral stimulation, general rules to define the optimal TMS parameters able to elicit measurable EEG responses are not available yet and normative data about TEPs waveform are still lacking. Moreover, the nature of TMS brings about special kinds of artifacts, including the electromagnetic pulse artifact, direct activation of scalp muscles, slow capacitive discharging of charges that accumulate at the electrode-gel-skin interface and spurious potentials evoked by the coil's click and vibration.
Effectively disentangling these artifacts from TEPs during data analysis can be difficult to achieve as well as computationally demanding: therefore, ideally one should, at the same time, minimize their contribution and maximize the signal-to-noise ratio of genuine brain responses already starting from data collection. In order to devise specific strategies for adjusting stimulation parameters and settings, the experimenter should be enabled to properly check TMS/EEG data quality in real-time.
Here, we present a Matlab-based (The Mathworks, Inc.) Graphical User Interface (GUI) that provides an optimal online data visualization tool for the EEG responses to TMS recorded with the BrainAmp amplifier (Brain Products GmbH, Germany). Specifically, this GUI allows i) to remove the pulse artifact that masks early electrophysiological responses; ii) to visually inspect single-trial responses in order to rule out the presence of unwanted muscle activation or capacitive discharging artifacts; iii) to dynamically reject artifact-contaminated channels during the recordings; iv) to compute the average reference from artifact-free channels only; v) to display the time course of average TEPs according to their topographical distribution on the scalp.
This GUI represents a fundamental software complement to the BrainAmp EEG system, which has an hardware compatible with TMS but does not provide enough visualization features to properly check data quality in real-time. Using the GUI, the experimenter is able to control, already during data collection, the contribution of artifacts to genuine TEPs, which are expected to show highest peak-to-peak amplitude at short latency nearby the stimulated site. Since many commercially available EEG systems also lack data visualization features tailored to TMS/EEG recording, this GUI could be taken as a standard for developing similar data visualization tools to be used with other TMS-compatible EEG amplifiers.

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Poster

The role of high and low spatial frequency in affective blindsight

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Behavioural, electrophysiological and neuroimaging studies suggest a key role of the Superior Colliculus –Pulvinar – Amygdala (SC-Pulv-AMG) pathway in the non-conscious processing of emotional stimuli in blindsight patients (Diano et al., Front Psychol, 2016). However, current evidence is essentially correlational, while the causal role of these subcortical structures remains unexplored. A method to test the key role of this neural pathway consists in spatial filtering to eliminate selectively high or low spatial frequency (Méndez-Bértolo et al., Nat Neurosci, 2016). Indeed, both the SC and the Pulv receive input from the magnocellular pathway, which is known to process low spatial frequency only. As a consequence, stimuli in high spatial frequency are relatively “invisible” to subcortical retino-recipient visual structures (Burra et al., Neuropsychologia, 2017).
In a combined behavioural and fMRI experiment we presented fearful and neutral faces filtered by high (HSF) and low spatial frequency (LSF) to two well-known blindsight patients, TN and GY, with bilateral and unilateral destruction of the visual cortex, respectively. Fearful and neutral facial expressions filtered in HSF, LSF and broadband spatial frequency (BSF) were presented. The behavioural task required patients to i) guess whether the unseen face has a neutral or fearful expression and ii) to rate their confidence on 4-point scale from “least” to “most” confident.
In the behavioural performance, both patients were able to discriminate significantly above chance fearful expression, but only in BSF and LSF presentation. Conversely, their ability to discriminate between neutral and fearful expression dropped at chance when the stimuli were in HSF. Along with the behavioural result, the fMRI data have shown activity in the SC-Pulv-AMG pathway during the presentation of BSF and LSF facial stimuli, but not during HSF stimuli presentation.

Our study reveals that the LSF information was sufficient to enable non-conscious emotion discrimination in two blindsight patients. This adept performance was coupled with enhanced activity in the SC-Pulv-AMG pathway. Conversely, when HSF stimuli were presented, which predominantly draw on geniculo-striate processing and are relatively invisible to subcortical extra-geniculate pathways, any evidence of implicit emotion discrimination disappeared and activation in the SC-Pulv-AMG dropped significantly. The results suggest a causal role for this alternative extrageniculo-striate pathway conveying coarse visual information to the AMG bypassing V1 and cortical processing of visual information.

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Poster

COGNITIVE FUNCTIONS OF BODYBUILDERS, THE ROLE OF LACTIC ACID

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Introduction
The term *Bodybuilding* literally means “building the body” and it is a discipline consisting of a progressive overload training. Today almost all scientists agree that, at certain concentrations, lactate would play a protective role against central fatigue, while, at higher doses, it would becomes an important physiological and pathophysiological marker. The aim of this research work is analyze, in a sample of Bodybuilders, the anaerobic component of a specific workout (WorkOut of the Day 15.5 – Crossfit® Open Days 2015) performed with Bodybuilding rhythms aimed at measuring its relationship with attention in terms of intensity and divided attention.
Materials and methods
Participants 15 male professional Bodybuilders participated in the study. Bodybuilders declared anabolic steroids use. *Workout performed* The same workout at the 15.5 Week 5 Open 2015 consisting of 27-21-15-9 reps for time of Row (calories) and Thrusters was performed by Bodybuilders at 1-minute recovery rate.
Results
Blood Lactate As shown in Figure 1A, resting blood lactate baseline value was 3.16 mmol/L (± 0.64 SD). At the end of the workout (end) it was 6.34 mmol/L (± 1.59 SD) to then return to values similar to the initial ones of 3.42 mmol/L(± 1.85 SD) after 15 minutes (15 end). *Blood Glucose* Figure 1B shows the values passing from 94.73 mg/dl at rest (± 7.93 SD), to 97.07 mg/dl (7.87 SD) immediately after exercise, to then return to 95.93 mg/dl (± 8.20 SD) after 15 minutes (15 end). *Reaction Time* Figure 1C shows the values passing from 183.4 ms at rest (± 26.19 SD), to 246.3 ms (± 29.64 SD) immediately after exercise, to then return to 178.4 ms (± 22.78 SD) 15 minutes after the conclusion of workout. *Divided Attention* Figure 1D shows the values obtained for the whole duration of the workout which pass from 425.3 ms at rest (± 18.85 SD), to 484.0 ms (± 13.52 SD) at the end of workout, and to 421.3 ms (± 15.98 SD) 15 minutes after the conclusion of training. Figure 1E shows the values obtained in errors which pass from 0.56 at rest (± 0.51 SD), to 2.5 (± 0.51 SD) at the end of workout, and to 0.75 (± 0.44 SD) 15 minutes after the conclusion of training. Figure 1F shows the values obtained in omissions which pass from 1.37 at rest (± 0.5 SD), to 2.81 (± 0.40 SD) at the end of workout, and to 1.56 (± 0.51 SD) 15 minutes after the conclusion of training.
Conclusion
These results would confirm our hypothesis: increased lactate levels, but however below the OBLA, can protect the frontal cortex and the prefrontal cortex (where high lactate concentrations reduce attention skills) from fatigue. Further studies are needed to evaluate the possible consequences on the cognitive sphere of a high and prolonged blood lactate level. In the light of the results obtained, it can be stated that regular physical activity leading to an increase in basal lactate rate to 3.16mmol/L can have a positive and improving effect on attentional skills.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18016/add_1_469067_7ddcda03-ee49-4e7d-980c-df3cc6b2f9bb.jpg
Caption 1: Figure 1. The figure illustrates the mean values (± standard deviation) of blood lactate (A), blood glucose (B), reaction time (C), execution time (D)

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Poster

Influence of Reward Interest on Tonic Pain Relief during Placebo Analgesia: Effects of EEG-Delta, and Heart Rate changes

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Here we report our recent findings on cold-pain modulation using a placebo treatment in waking condition. Fifty-eight healthy women participants were tested in eyes-open waking condition under two treatments (duration of 3.7 min each): (1) tonic cold pain (Pain), (2) tonic cold pain plus placebo analgesia (PA). To enhance placebo effect, a pain manipulation task was performed before of PA treatment. PA was induced by using a sham analgesic cream plus verbal suggestions inducing pain relief. At the end of each treatment, participants rated the experienced levels of pain and distress scores. Electroencephalographic (EEG) oscillations and cardiac inter-beat (R-R) time series were recorded during Pain and PA treatments. Stanford Hypnotic Susceptibility Scale, Form C (SHSS:C) to assess hypnotizability, and the Reinforcement Sensitivity Theory Personality Questionnaire (RST-PQ; Corr & Cooper, 2016) were administered. The RST-PQ served to assess behavioural approach system (BAS) and its facets (goal drive persistence, GDP; reward interest, RI; reward reactivity, RR; Impulsivity, Imp), behavioural inhibition system (BIS), and fight-flight-freeze system (FFFS). Numerical self-report rating scores were also obtained for Motivation, Hypnotic Depth, Involuntariness in PA, and Pain Expectation. Separate principal components factor analyses with varimax rotation were performed on heart-rate (HR) data for each condition. These analyses yielded a three-factor solution including HR frequency-power (factor-1), nonlinear complexity indices of HR dynamics (factor-2), and time-heart rate variability/EEG-delta power (time-HRV/EEG-delta, factor-3). Pain minus PA difference scores were calculated for each factor. Pain Reduction during PA was associated with greater BAS-RI, Pain Expectation, Involuntariness in PA responding, Hypnotic Depth, and enhanced time-HRV/EEG-delta activity. Multiple mediation analyses disclosed that personality trait of BAS-RI, potentially served by the dopaminergic system, through Involuntariness in PA responding, can alter placebo responding to laboratory pain. Our results also show that a linear compound of HR slowing and higher EEG delta activity during PA explains a substantial proportion of the variance in PA responses. The present finding is aligned with Thayer and Lane's dynamical systems model of emotion regulation (Thayer & Lane, 2000) wherein time HRV plays a key role in inhibition and is mediated by the parasympathetic system (specifically through the vagus nerve). Future studies should examine the potential role that these individual difference measures may play in patient responsiveness to treatments for clinical pain.

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Poster

Distraction suppression history biases oculomotor behaviour by shaping spatial attentional priority

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Attentional deployment in the visual space is guided by neural mechanisms that allow us to prioritize stimuli and locations witch are relevant for our goals. However, attentional processing is also susceptible to mere intrinsic proprieties of the stimuli, so that our attention (and our gaze) can be automatically captured by salient stimuli even when they are irrelevant, and overcoming such distraction is not always easy. Recent studies have shown that past experiences of attentional selection can shape the attentional priority across the visual space and elicit selection biases by facilitating the processing of stimuli and locations frequently associated with relevant information. In our study we wanted to explore if also the repeated experience of distractor filtering could shape attentional deployment, so that the automatic attentional and oculomotor capture by salient-but irrelevant items would be reduced in specific locations systematically associated with distraction (and its suppression). Thirty participants performed a visual search task in which they had to discriminate the orientation of a tilted bar located inside a colour singleton target (a grey circle within a stimulus array of six circles). In about half of the trials, an additional colour singleton (a red circle) was presented in one of six empty locations in the stimulus array, acting like an onset distractor. Crucially, while target locations were assigned randomly and equally within the stimulus array, distractor locations were pre-determined by design: the distractor could appear with High Frequency in two out of six possible spatial locations (HF; 76% of the distractor present trials), and with Low Frequency in the remaining four locations (LF; 24%). Both manual response time and eye-movements were recorded. We found that the distractor interference on the main task was strongly modulated by distractor location: when the distractor appeared in HF locations, manual RTs became faster, showing a reduced performance cost. Importantly, even if the task didn't explicitly require to make a saccade toward the target, oculomotor behaviour was also strongly modulated by distractor location. The first saccades were more often directed toward the target when the distractor, if present, appeared in the HF locations and consistently, this distractor led to less powerful oculomotor capture compared to the distractor appearing at LF locations, which maintained its attractive power. The results showed that distractor filtering becomes more efficient at locations that have acquired a significant suppression history, i.e. where distraction (and its suppression) has occurred more frequently. This study provides compelling evidence that the repeated experience of distraction suppression in specific spatial locations change their attentional priority, as shown by the reduction of reflexive oculomotor capture elicit by distractor appearing therein.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18016/add_1_472333_08490023-c56e-4839-8f28-18acb9f2bf0c.png
Caption 1: Experimental procedure. (A) Visual search task. (B) Distractor location probability.

Picture 2: https://www.eventure-online.com/parthen-uploads/175/18016/add_472333_08490023-c56e-4839-8f28-18acb9f2bf0c.png
Caption 2: Percentage of first saccades to the target (A) and to the distractor (B) as a function of distractor location.

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Poster

Electroencephalographic evidence of sustained spatial attention effects over anterior cortex: Possible contribution of the anterior Insula

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Electroencephalographic studies on visuo-spatial attention mainly focused on reactive brain functions related to stimulus processing along sensory pathways. Here, we studied the effects of spatial attention on event-related-potentials (ERPs) reflecting both proactive and reactive brain functions especially focusing on post-stimulus (reactive) prefrontal components not investigated before regarding spatial attention. Previous studies of these prefrontal components suggest that they reflect perceptual and sensory-motor awareness (the pP1 and the pN1 components) and stimulus-response mapping (the pP2) associated to the anterior Insula activity (e.g. Di Russo et al., 2016; Sulpizio et al., 2017).
Seventeen participants performed simple and discriminative response tasks, while voluntarily and steadily oriented sustained spatial attention to left or right hemifields in separate blocks.
Orienting attention to one hemifield did not produce lateralization effects on proactive (preparatory) components (the BP and pN), but it affected the pN1 and the pP1 components (see figure 1). We also confirmed the known effects on other post-stimulus components (larger P1, N1 and P3 for attended stimuli), and the advantage of visual-spatial attention on behavioral performance (faster responses).
Results extend sustained attention literature, showing that spatial attention affects the activity of anterior areas as the anterior insula, in addition to sensory components over occipital-parietal areas. Thus, top-down spatial attention is likely mediated by increased sensory and sensory-motor awareness for attended events.
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Picture 1: https://www.eventure-online.com/parthen-uploads/175/18016/add_1_468680_3bcb11e1-e210-4c62-919f-2484df936df0.jpg

Caption 1: CSD distribution of the attention effect (attended minus unattended) in the P1 and pN1 range (100-140 ms), in both left and right hemifields

Sessione Poster 1

Poster

Evoked and Induced response analysis of Mismatch Negativity: an MEG study.

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The mismatch negativity (MMN) is one of the most common electrophysiological measures. Given its robustness and replicability it has been widely studied in psychophysiological literature (Näätänen et al. 2004), both in basic and in clinical research. Regarding its clinical relevance, a reduced MMN is associated with brain dysfunctions (e.g., in Schizophrenia, Javitt and Sweet 2015). It still a matter of debate whether some of the most common ERP/ERFs (e.g. MMN, ERN) are merely a different way to visualize synchronizations in specific bands or vice versa, that some oscillatory responses are just a different way to visualize the ERPs/ERFs. For what concerns the MMN, some studies claims that non-phase locked theta oscillations are also an important response to deviant stimuli as compared to standard (Hsiao et al., 2009), some others that is mostly the phase activity of theta oscillations to be pivotal in response to deviant stimuli (Bishop et al., 2011). In this study we aimed at disentangling the evoked and induced response to MMN using MEG.
We recorded in 25 healthy participants brain responses to 240 standard and 60 deviant 100 ms auditory tones (500 Hz or 550 Hz), using an ISI of 500 ms. We analyzed the data with three methods: 1) *time and phase locked responses:* using a standard average procedure of broadband signal to obtain the ERF; 2) *all time locked responses* analyzing the Hilbert envelope of the signal in filtered responses on five frequency bands (theta: 4-7 Hz, alpha: 8-12 Hz, beta 13-30 Hz, low gamma: 30-60, high gamma: 60-80). 3) *time-locked but not phase locked responses*, that were obtained removing the ERF from each trial before calculating the Hilbert envelope. The difference between deviant and standard was analyzed via cluster-based permutation in the 0-300 ms time window, on all the timepoints.
In the analysis 1) on time-and phase locked responses (ERF), we obtained a clear MMN response (peaking at about 200 ms) localized on auditory cortices, insula and frontal cortex). Time Frequency analysis showed robust significant results only on theta (4-7 Hz), with a spatial distribution similar to the MMN, and with higher t-values. Both these effects were higher in the right than in the left hemisphere. These results replicate and expand what already has been described in the literature. However, results with analysis 3), on time-locked but not phase-locked response, did not evidence any reliable result.
Results from this study points to a strict relationship between Theta activity and the ERF response in MMN, and suggest that phase-resetting of theta oscillations could be a crucial aspect of MMN. However, Time Frequency analysis focused on theta activity can be used to enhance the possibility of detecting brain responses to deviant stimuli, for basic research - and foremost - clinical purposes.
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Sessione Poster 1

Poster

Body ownership modulation of multisensory integration: an fMRI study of visual enhancement of touch

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A fundamental component of the self-awareness is the feeling that different body parts belong to ourselves, the so-called sense of body ownership. Several lines of research suggest that multisensory integration mechanisms are crucial in order to achieve a coherent sense of body ownership. In particular, the integration between visual signals (informing about the body visual features) and somatosensory signals (informing about bodily tactile sensation and position sense) seems to be particularly relevant for this purpose. Here, we hypothesized that a contextual manipulation of body ownership, in which visual stimuli occurred either close to the one hand or close to an alien human-like rubber hand, could be able to modulate a multisensory integration effect. To test this hypothesis, we capitalized on the visual enhancement of touch (VET), revealing super-additive responses in the neural activity (i.e. greater than the sum of each unimodal input when delivered in isolation) only when visual cues appear near to the body district receiving tactile stimulation. We used functional magnetic resonance imaging (fMRI) to compare the neural correlates of super-additive responses during visuo-tactile stimulation, under different degrees of body ownership. In our paradigm (Fig. 1 A and B), visual stimuli (approaching colored spheres) were delivered to the own hand or to the alien hand, either in isolation (V_O; V_A) or during two visuo-tactile (VT) conditions. In the congruent VT condition, V and T stimuli were simultaneously delivered to the own hand (V_OT). In incongruent VT condition, T stimuli were delivered to the own hand while V stimuli simultaneously approached the alien hand (V_AT). Tactile stimulation of the own hand also occurred in isolation (T). In order to make multisensory stimulation as natural as possible, participants could directly see their own left hand and the alien left hand during the stimulation protocol. The results showed super-additive responses in the superior parietal lobule (SPL), intraparietal sulcus (IPS), ventral premotor cortex (PMv) and middle cingulate cortex (MCC) during the processing of visuo-tactile congruent stimuli (Fig. 1C). Similar responses were also observed during the incongruent visuo-tactile stimulation of the real and the alien hand in SPL, IPS, dorsal premotor cortex (PMd) and MCC, but not in the PMv. Moreover, the direct contrast between congruent and incongruent visuo-tactile conditions showed that the IPS and the PMv were stronger activated when the bimodal stimulation was delivered on the participant's real hand, compared to the incongruent condition. These preliminary findings show that a body ownership dependent modulation of VET occurs in two brain areas, such as PMv and IPS, known to play a crucial role in the multisensory integration process leading to the construction of a coherent bodily self-awareness.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18016/add_1_478327_69f50780-b4e0-4e17-b5dc-fafb8e6657a2.jpg

Caption 1: Figure 1. A) Experimental setup. B) Task design and conditions. C) Brain activation results.

Sessione Poster 1

Poster

EEG evidence of atypical visual crowding in autism

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Sensory and perceptual anomalies are hallmarks of autism spectrum disorders (ASD) and might be related to more complex symptoms that affect social interaction. Visual crowding refers to the difficulty in perceiving a stimulus that is surrounded by nearby flankers and some recent studies tested whether perception under a crowding regime might be different in individuals with ASD, showing mixed findings. With the present study we aimed to bring neurophysiological evidence of perceptual functioning in ASD under a crowding regime by using electroencephalographical (EEG) recording. A sample of N=18 children with ASD and N=20 typically developing (TD) peers matched for age, gender and intellectual abilities were asked to discriminated the orientation of a peripheral target letter. Three target-flanker distances were used to manipulate the strength of crowding (i.e. strong, mid and no crowding), while ensuring a proper control of basic stimulus characteristics. At the behavioural level, crowding impacted on response accuracy in a comparable way in both groups. Nonetheless, early event-related potential (ERP) components showed a different modulation as a function of crowding for the two groups. Specifically, while for the TD group the mean amplitude of the target-locked occipito-parietal N1 component (250-350 ms) was significantly reduced in the strong crowding condition, this effect was not observed in the ASD group, as evidence also by a significant interaction between crowding level and group. A similar trend was observed for the P1 component (150-250 ms). Overall, these results suggest that neural processing in ASD seems to be not or minimally influenced by crowding, despite a significant modulation of performance at the behavioural level. This study gives interesting insights on the hypothesis that visual perception in ASD is characterized by local overconnectivity in occipitotemporal region, where visual objects are processed.

Sessione Poster 1

Poster

Higher-order cognitive areas contribute to postural control in anticipating predictable and unpredictable lower limb perturbations

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Background. The contribution of higher-order cognitive areas such as the prefrontal cortex (PFC) to postural control is not completely understood yet. After a perturbation to upright posture literature showed the activation of the PFC. However, little is known concerning the preparatory brain activities occurring before an upcoming perturbation. In this study we aim at advancing our understanding on the contribution of higher-order cognitive areas prior to the onset of predictable and unpredictable lower limb perturbations.
Methods. High-resolution (64 active electrodes) electroencephalography (EEG) and surface electromyography (sEMG) of Vastus Lateralis (VL) and Vastus Medialis (VM) were recorded from thirteen healthy men (Age: 23.6±5.6 yrs.; Height: 1.83±0.08 m; Mass: 76.6±8.9 Kg; BMI: 23.8±2.7) while their lower limb underwent self-paced (predictable) and externally triggered (unpredictable) perturbations. Event-related potentials (ERP) associated with perturbation were compared between perturbation modality. Voltage, current source density topography, and sLORETA were used to localize the ERP sources. In addition, the time course of activation of the extrastriate body area (EBA), was estimated using a seeded sLORETA approach.
Results. The externally triggered perturbation elicited larger prefrontal Negativity (pN) over the left hemisphere in the -2/-1.5 s. Source localization analysis showed that this activity may originate in the PFC. The BP was clearly detectable in both perturbation modalities, but it was earlier and larger in the self-paced perturbation. Its premotor origin was confirmed by sLORETA. Moreover, we observed a negative bilateral activity over temporo-parietal areas that was larger in the externally triggered perturbation. Based on sLORETA estimate of time-course activation, we suggest that this area may contribute the ERP signal observed before the perturbations. In the self-paced perturbation, VM and VL sEMG presented earlier onset compared to the externally triggered perturbation.
Discussion. In this study we showed that the PFC is active also before the onset of a perturbation, either predictable or not. This activation can be interpreted in the light of the attentional load required by the task. In addition, before the onset of a perturbation, the posterior activity presumably generated by the EBA was enhanced in the unpredictable task this result is in agreement with previous literature we interpreted this area as a implicated in sensorial prediction of the upcoming motor command.

Sessione Poster 1

Poster

To deceive or to be deceived? The role of joint-action experience in the motor mapping of deceptive actions

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Previous studies showed that observing actions with deceptive intentions modulates the activity of the observer's motor system, independently from the mapping of the kinematic adaptations that are required for deceiving another person. However, it is unclear whether the modulation of the motor system for deceptive actions mirrors the inner replica of the deceptive movements based on previous experience as a deceiver, or whether it reflects the counteracting response to a deceptive attempt as a deceived person. Here, we assessed how previous experience as a deceiver or as a deceived partner might affect motor resonance for deceptive behavior. We used single-pulse transcranial magnetic stimulation to measure cortico-spinal excitability (CSE) from hand and forearm muscles in pairs of participants, with the two participants of each pair tested simultaneously, while they were asked to perform a weight discrimination tasks, namely predicting the weight of cubes lifted by actors who were asked to provide either truthful (truthful actions) or deceptive (deceptive actions) cues to the observers after receiving either truthful or fooling information (deceived actions) about the object weight. Crucially, CSE was measured after a motor training consisting for one of the two partners in lifting to offer a heavy or a light cube by performing deceptive actions, and for the other partner in receiving to grasp and place the object trying to resist to partner's deception. Results suggest that CSE is modulated in a complementary fashion by the experience of being a deceiver or a deceived person, supporting the idea that the motor modulation during observation of deceptive actions might reflect either the simulation of the deceptive movements or the preparation of compensatory motor plans.

Sessione Poster 1

Poster

THE PURPOSE OF LACTATE LEVEL DETECTION IN MIGRAINE AND FIBROMYALGIA

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BACKGROUND:
Lactic acid is a byproduct of both muscle metabolism and the central nervous system. Changes in metabolism are related to various physiological and pathological conditions. Fibromyalgia (FM) is a chronic syndrome characterized by generalized muscle pain, joint rigidity and intense fatigue, probably due to an abnormal amplification of pain signals in the spinal cord. Migraine (M) is a chronic neurological disorder characterized by recurrent monolateral, moderate-to-severe headaches, often in association with a series of symptoms of the autonomic nervous system, including nausea, vomiting, photophobia, phonophobia.
The aim of this study was to determine the relationship between migraine and fibromyalgia and lactate levels in blood.
METHODS:
We enrolled in the study 35 patients divided into two groups: 1) patients with fibromyalgia (n=10) (age 43.7 □ 21.2; height 158 □ 5.65 cm; weight 70 □ 28.9 kg); 2) patients with migraine (n=25) (age 49.7 □ 12.5; height 164.9 □ 6.62 cm; weight 68.6 □ 16.9 kg). Assessments included an analysis with a stabilometric platform (Sensor Medica Maxi 50x60 Software by Freestep), in order to evaluate balance and plantar support, with eyes open (EO) and with eyes closed (EC); furthermore, basal blood lactate was assessed using a portable lactacidometer (Accutrend Plus System Roche).
RESULTS:
The stabilometric assessments evaluated the ellipse surface, expressed in cm2, both with eyes open and closed and length of the clew in both groups. A T Test analysis showed a p value not statistical significant; performed a Pearson's analysis among the above mentioned stabilometric results and basal lactate levels (mean±sd: FM group = 1.78±0.9 mmol/L; M group = 1.45±1 mmol/L), we pulled out a different situation. As a matter of fact in FM group there was a positive trend of correlation between the length of the clew and lactate levels (r = -0.532; p= 0,1), what we have not seen in the M group.
DISCUSSIONS:
We did found abnormalities involving the metabolism of lactic acid both in fibromyalgia's patient and in migraine's group but the results obtained shows that patients with fibromyalgia have a higher value of length of the clew (518±195vs465±165) compare with the M group. This means that the FMs group, in order to optimize both static and dynamic coordination, they must use more complex and energy-intensive postural strategies. The highest level of lactate demonstrates a greater use of the anaerobic lactic acid energy system. The p value of 0.1 shows a trend that could be confirmed with a greater number of subjects enrolled in the study.

Sessione Poster 2

Poster

Effects of MRI acoustic noise on brain activity and connectivity measured with MEG

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During the last decade there has been an increasing interest in tracking brain network by means of resting state fMRI. fMRI, however, does not provide an ecological setting, as the participant is continuously stimulated by the Echo Planar Imaging sequence (EPI) MRI noise. In this study we focused on the effect of EPI sound on brain activity and connectivity and assessed it reproducing fMRI environment in magnetoencephalography (MEG). As compared to fMRI, MEG has no sensitivity to brain activity generated in deep brain structures, but captures both the dynamic of cortical magnetic oscillations with high temporal resolution and the slow magnetic fluctuations highly correlated with BOLD signal. Twenty-six healthy subjects were enrolled in a fully-randomized controlled design including three conditions: a) silent resting state, b) resting state while delivering EPI noise, and c) resting state while delivering white noise. Power Spectral Density (PSD), Phase-Locking Value (PLV) and amplitude envelope correlation (AEC) were estimated in standard delta to gamma frequency bands over the entire duration of each condition (8 minutes) and in a dynamic fashion over 1-minute long segments. Our results showed that both EPI and white noise have a significant effect on brain activity and connectivity, especially in the dorso-frontal regions and gamma band, higher for white noise as compared to EPI noise. The analysis of the time-dynamic over the 8-minute duration of each resting state revealed that the effect of EPI and white noise occurs already during the first minute of recording. The study also confirmed that participants tend to fall asleep very quickly and, surprisingly, sleep onset occurred earlier for EPI noise as compared to White noise and silent resting state. Finally, the influence of both EPI and White noise on brain connectivity was stronger for PLV than AEC, making magnetoencephalography significantly more sensitive to the dynamic of cortical connectivity. In conclusion, we proved that the assessment of resting brain connectivity from resting state fMRI is biased by environmental factors that should be careful controlled with appropriate experimental designs. Conversely, magnetoencephalography allows for a more ecological and sensitive estimation of the dynamic of cortical connectivity and should be preferred whenever the main focus is on cortical rather than subcortical networks.

Sessione Poster 2

Poster

An explorative study about the relationship between baropodometric parameters and Alexithymia in I and II occlusal classes people.

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Background. Literature provides studies evidencing that some emotions are expressed by multiple patterns of body movement (1). For example, it is well-known that facial expressions are responsible for the communication of emotions and the way face shows emotions is the same across cultures(2). Moreover, several studies demonstrated that body posture and dental occlusion are related to personality characteristics, emotional states, anxiety, eating and panic attack disorders (3). Within the research about human posture, some studies investigated the relationship between dental occlusion and baropodometric parameters, evidencing a pronounced postural change in individuals with temporomandibular disorders(4). However, no studies about the relation between postural parameters, dental occlusion and one particular kind of personality characteristic, alexithymia, i.e., the difficulty of individuals to recognize their own and the others' emotions, were found. **Method**. A sample of 46 adolescents (mean age= 12.54, SD= 0.81; 28 females, 18 males) were classified in relation to their dental occlusion in I (24 adolescents) and II classes (22 adolescents). The sample completed the TAS-20 Toronto Alexithymia Scale – 20. For assessing alexithymia and their baropodometric data (i.e. plantar pressure and plantar surface) were detected through a baropodometric platform. **Results**. Although the overall Alexithymia score is not correlated to the baropodometric variables, a strong positive relationship between the factor F3 (Externally oriented thinking) and the plantar surface was found in people belonging to the II occlusal class. **Conclusion.** No direct correlation between alexithymia and body posture was found. However, it emerged that people belonging to the second occlusal class seem to have a more pronounced plantar surface area and to have more externally oriented thoughts, meaning a difficulty on focusing on internal state and a preference towards a more practical thinking. Future research should investigate this domain for identifying possible explanations for these results.

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Sessione Poster 2

Poster

Benefits of Yoga practice on body posture and on psychological and cognitive functions in children aged 8-10 years

Valerio Giustino[1], Ambra Gentile[2], Rosanna Cannata[2], Ilenia Romeo[3], Jessica Brusa[2], Rosalba Contentezza[2], Angelo Iovane[2], Francesco Pace[2], Giuseppe Messina[2]
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Background. Many authors have reported benefits related to yoga practice. In particular, the scientific literature showed the influences of yoga on physical performance and cognitive functions. However, only few researches have examined the role of this training practice in children. For this reason, the purpose of the present study was to investigate the effects on body posture and features as self-esteem and attention in children aged 8-10 years.
Materials and method. Sixty-five subjects (male n=28, female n=37) aged 8-10 years and attending primary school were enrolled for the study and randomly assigned into an experimental group (EG) which included 28 participants and a control group (CG) consisted of 37 participants. Both groups performed the curricular physical activity. Moreover, the EG performed a 5-months yoga intervention (from January to May 2018) for once/week with 60 minutes/session that provided breathing exercises (Pranayama) and posture-holding exercises (Âsana). Each participant was evaluated before (T_0) and after (T_1) the yoga protocol in order to assess any changes on body balance and postural control and on two peculiar aspects such as self-esteem and attention. Body posture, first with eyes open (EO) and then closed (EC), was measured through a stabilometric platform (freeMed® platform and freeStep® software produced by Sensor Medica®, Guidonia Montecelio, Roma, Italy), instead, using the Self-Esteem Multidimensional Assessment (TMA test) and an Executive Functions Test (ESA test) were evaluated the above-mentioned psychological aspect and cognitive function.
Results. As concern stabilometric parameters, we found a significant difference ($p<0.05$) between T_0 and T_1 on Ellipse Sway Area (ESA) in the EG for both EO and EC conditions; moreover, our results showed a significant difference on the Sway Path Length (SPL) for the EG ($p<0.0001$) and for the CG ($p<0.05$). Furthermore, for the EG the ESA variable is correlated to the self-esteem in the EO condition as well as in the EC condition ($p<0.0001$).
Conclusions. Our findings suggest that yoga practice may induce an increase of body stability and this is related to an improvement of self-esteem. These results support previous researches that have reported cognitive advantages and physical health benefits amongst yoga practitioners versus non-practitioners.

Sessione Poster 2

Poster

Trait anxiety and postural balance: what possible correlation? Results from an integrated mind-body protocol.

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Aim. It is well known that body posture is determined by many characteristic features that includes mechanical and emotional factors, passing to environmental and work aspects. Among the elements above mentioned, the hypothesis of our study takes into consideration the emotional factor. Clinical evidences showed that the breathing reharmonization, the prevalent use of the diaphragm, the state of well-being and relaxation, positively influence postural attitude and the muscle chains involved in the human posture. The scientific literature shows several studies that correlate the trait anxiety with postural attitude but very few of these have investigated the effects of a mind-body relaxation protocols on stabilometric parameters. Starting from these evidences, we performed a research study in order to evaluate the following hypothesis: a path of autogenous training combined with diaphragmatic breathing exercises and self-stretching exercises, how is it able to influence body posture in subjects with high trait anxiety?
Materials and Method. For the study were enrolled 21 volunteers aged 20 to 40 in absence of relevant trauma, neurological or disabling diseases, recent bone fractures, psychiatric diagnoses, active scars. From the starting sample, 12 subjects with high trait anxiety were identified and divided into an experimental group (EG) and a control group (CG). Each participant performed: the State-Trait Anxiety Inventory questionnaire (STAI) to detect state and trait anxiety and a self-built anamnestic chart aimed at detecting certain aspects related to the style and quality of the life; a baropodometric test and a stabilometric test (with open eyes and closed eyes) using the FreeMed® platform by Sensor Medica® (Guidonia Montecelio, Roma, Italia). The EG performed an integrated mind-body protocol that included: diaphragmatic breathing exercises, self-stretching exercises and autogenous training sessions. The CG executed a protocol that provided only stretching exercises. Both groups were evaluated before (T0) and after (T1) the two different protocols.
Results. After the integrated mind-body protocol, the EG showed a decrease of the trait anxiety at T1, a greater postural balance and a reduction of the myofascial chains tensions. Moreover, at T1 we found a worsening on stabilometric parameters in the CG.
Conclusions. Our findings suggest that an integrated mind-body protocol can positively influence body posture and decrease the trait anxiety.

Sessione Poster 2

Poster

Transcranial direct current stimulation and visuo-spatial contextual learning reveal homeostatic regulatory principles in the human posterior parietal cortex

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Transcranial direct current stimulation (tDCS) is a non-invasive brain stimulation technique capable to modulate neuronal excitability and promote neuroplasticity. Previous studies on the motor cortex have demonstrated that homeostatic mechanisms are at play in order to regulate neuroplasticity and to ensure the stabilization of neuronal circuits within a functional range.
In the present study, we aimed to unveil the presence of regulatory homeostatic principles in the human posterior parietal cortex (PPC) through the interaction between tDCS and visuo-spatial learning processes.
The study was conducted in three separate experiments in a between subjects design. The effects of tDCS were evaluated in the context of changes in visuo-spatial contextual learning during the execution of a behavioral task. In Experiment 1, we probed for the effects of left-PPC anodal-tDCS (A-tDCS) at different timings (offline and online) and intensities (3 mA and 1.5 mA) with respect to the sham protocol. Experiment 2 was designed to control whether results from Experiment 1 could be explained in the framework of a balance between left and right PPC activity. For this reason, the stimulation protocol that produced the more robust effect in Experiment 1 was used with a flipped electrodes montage. Finally in Experiment 3, left-PPC 3 mA cathodal-tDCS (C-tDCS) was applied at different timings (offline and online) to test the effects of neuronal excitability reduction on task performance.
We observed that A-tDCS reduced visuo-spatial contextual learning when applied before task execution regardless of the stimulation side (Experiment 1 and Experiment 2), while no behavioral change was produced by the A-tDCS online protocols (Experiment 1). Further, C-tDCS applied before the task produced no facilitation of visuo-spatial contextual learning, while a significant reduction was evident when it was applied during the task (Experiment 3).
We conclude that homeostatic regulatory principles are evident in PPC. The reduced visuo-spatial learning produced by offline A-tDCS could be explained by the interaction of two excitability-increasing events (i.e., A-tDCS and visuo-spatial contextual learning) which may have hindered normal neuroplasticity phenomena.

Sessione Poster 2

Poster

Motor timing and time perception in children with Tourette Syndrome

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Time processing is regulated by several basic cognitive functions, as working memory, attention and decision making.Distortion in time perception is present in many neuropsychiatric conditions.Tourette syndrome (TS) is a neurodevelopmental disease characterized by dysfunctional connectivity between prefrontal cortex and subcortical structures with an impaired dopaminergic network.
27 patients with TS, diagnosed according to DSM5 criteria, were recruited and age-matched with 21 healthy controls. All subjects underwent a structured neuropsychological evaluation with cognitive test, screening for neuropsychiatric comorbidities, tics severity, problem solving abilities, visual digit span and Go-No-Go Inhibition test. A computer based neuropsychological assessment using Inquisit 5.0(Millisecond ®)was performed analysing motor timing and time perception.Comparison between groups were performed by using ANOVA or ANCOVA (where appropriate). Data were analysed with MYSTAT software.
4 out of 21 healthy subjects were excluded from the analysis because the neuropsychiatric screening resulted positive. Male-female ratio was in TS group 3:1, and 1:1 in control group.All subjects had a normal IQ and no difference was found in IQ scores between the group.
Motor timing, the temporal organization of motor behaviour, was measured by using three tasks:Finger tapping:TS group resulted more impaired than controls considering both dominant($p<0.001$)and non-dominant ($p=0.013$) hand;Sensorimotor synchronization:no statistical difference found between the two groups; Sensorimotor synchronization and continuation:statistical significance for 2000ms timing response($p<0.001$).Time perception, the ability to estimate, reproduce and discriminate stimuli:Duration discrimination(temporal discrimination between a short -100ms- and a longer-1000ms- auditory stimuli): using Weber fraction as measure of discrimination (0 higher to 1 lower), a statistically significant difference was found between TS and controls ($p<0.001$) in distinguish 1000 ms while no significance was found for the 100 ms.Temporal reproduction task: ability to reproduce previously presented tones.TS group resulted less accurate than controls for 3000 and 4000 ms ($p<0,001$).Prospective Time Estimation task:report the duration of an auditory stimulus (53 sec). No significant difference was found between the groups.Time wall Estimation:estimate when a moving object reaches a target point. A higher coefficient of error was evident for TS group ($p<0.010$).Furthermore, executive functions were found impaired in TS ($p<0.001$).Working memory abilities, analysed with a classical digit span test, and impulsivity, tested with GonoGo task, showed statistically differences in TS group ($p<0.040$).
We compared time processing abilities in TS patients and healthy control. Timing functions are associated with poorer results in TS group and our data suggest an altered perception of time.

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Sessione Poster 2

Poster

Low-Frequency rTMS of the Primary Motor Area Does Not Modify The Response Of The Cerebral Cortex To Phasic Nociceptive Stimuli

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Repetitive transcranial magnetic stimulation (rTMS) is a non-invasive technique of cortical stimulation. Although the exact mechanism of action is not clearly understood, it has been postulated that rTMS action on pain depends most on stimulation sites and stimulation parameters. Most studies concern high-frequency rTMS of the primary motor cortex (M1). High-frequency rTMS over motor cortex seems to induce an analgesic effect while contrasting results were reported after low-frequency rTMS. The aim of the current study was to investigate the effects of 1 Hz rTMS stimulation over the left primary motor cortex on subjective laser pain rating and laser evoked potential (LEP) amplitudes in healthy subjects. Subjects underwent two different sessions (real and sham rTMS) according to a cross-sectional design. In each session, LEPs and laser-pain rating to stimulation of both right and left hand dorsum were collected before 1 Hz rTMS over the left M1 area (baseline), which lasted 20 minutes. Then, LEPs and laser-pain rating were measured immediately after rTMS (T0), after 20 minutes from T0 (T0 + 20), and after 40 minutes from T0 (T0 + 40). We could not find any modification of both laser-pain rating and LEP parameters (latencies and amplitudes) following 1 Hz rTMS. Therefore, our results show that the low-frequency rTMS of the M1 area does not change the response of the cerebral cortex to pain.

Sessione Poster 2

Poster

Tonic thermonociceptive stimulation selectively modulates ongoing neural oscillations in the human posterior insula: evidence from intracerebral EEG

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The human insula is an important target for spinothalamic input, but there is still no consensus on its role in pain perception and nociception. In this study, we show that the human insula exhibits activity preferential for sustained thermonociception. Using intracerebral EEG recorded from the insula of 8 patients (Fig. 1) undergoing a presurgical evaluation of focal epilepsy (53 contacts: 27 anterior, 26 posterior), we “frequency-tagged” the insular activity elicited by sustained thermonociceptive and vibrotactile stimuli, by periodically modulating stimulation intensity at a fixed frequency of 0.2 Hz during 75 seconds (Fig. 2). Compared to vibrotactile stimulation, thermonociceptive stimulation exerted a markedly greater 0.2 Hz modulation of ongoing theta-band (4-8 Hz) and alpha-band (8-12 Hz) oscillations (Fig. 3). These modulations were more prominent in the posterior insula compared to the anterior insula (Fig. 4). The identification of oscillatory activities preferential for thermonociception could lead to new insights into the physiological mechanisms of nociception and pain perception in humans.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18016/add_477655_f014011f-668f-4652-b027-61f32e3780a9. 3.jpg

Picture 2: https://www.eventure-online.com/parthen-uploads/175/18016/add_2_477655_f014011f-668f-4652-b027-61f32e3780a9. 2.jpg

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Picture 4: https://www.eventure-online.com/parthen-uploads/175/18016/add_1_477655_f014011f-668f-4652-b027-61f32e3780a9. 4.jpg

Sessione Poster 2

Poster

Dopamine neuromodulation affects cortical excitability in parkinson's disease patients set in quiet wakefulness: an electroencephalographic study

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Background and aim. Parkinson's disease (PD) is characterized by motor symptoms but often goes hand in hand with subtle mild cognitive impairment at the disease onset. This cognitive dysfunction is progressive in most patients. Indeed, the percentage of PD patients progressing to dementia in 20 years is included between 60% and 80%. The patho-etiology of the cognitive deficits in PD is heterogeneous, and thus patients may need personalized treatments to mitigate the cognitive decline. Ideally, this should be done with biomarkers reflecting those neuropathological processes or the effects of those processes on brain functions. Among various candidates, resting state eyes-closed electroencephalographic (rsEEG) rhythms are cost-effective, non-invasive, and can be repeated several times. The present study tested the hypothesis that the dopamine neuromodulation may affect cortical excitability in PD patients set in quiet wakefulness, as assessed by the examination of resting state cortical alpha (about 8-12 Hz) rhythms.
Methods. Clinical and rsEEG rhythms in PD with dementia (PDD, N=35), PD with mild cognitive impairment (PDMCI, N=50), PD with normal cognition (PDNC, N=35), and normal healthy (Nold, N=50) older adults were available from an international archive. In a sub-group of PD patients (N = 13), rsEEG data were recorded in the late morning before (OFF) and after (ON) about 60 minutes from the acute administration of one daily dose of levodopa. eLORETA freeware was used for the linear estimation of the cortical sources activity of rsEEG rhythms. Receiver operating characteristic curve (ROCC) classified these sources across individuals.
Results. When compared to the Nold group, all PD groups (PDNC, PDMCI, and PDD) showed reduced activity in posterior alpha sources, which was associated with increased activity in widespread delta (about 2-4 Hz) sources. About the PD group, the PDMCI and PDD groups showed a greater reduction in occipital low-frequency alpha (about 8-10 Hz) source activity, associated with a greater increase in widespread delta source activities. However, interestingly, widespread frontal, central, and temporal high-frequency alpha (about 10-12 Hz) sources exhibited a paradoxical increase in activity in the PDD group compared with the PDMCI and PD groups. At the individual level, some delta and alpha sources showed moderate (AUROC > 0.7) to good (AUROC > 0.9) classification accuracies in the discrimination between Nold and PD individuals with cognitive deficits. Finally, a daily dose of levodopa induced a widespread reduction in cortical delta and alpha sources in the sub-group of PD patients under standard chronic dopaminergic regimen.
Conclusions. In PD patients set in quiet wakefulness, alpha cortical source activations may reflect an excitatory effect of dopamine neuromodulation. The long-term impact of daily dopamine supplementation on cortical excitability in PD patients should be tested in future studies.

Sessione Poster 2

Poster

Tactile acuity as an index of plasticity induced by a novel cross-modal PAS protocol

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In the past few years, an increasing number of studies have shown the existence of a Tactile Mirror System in the human brain. This system relies on a shared network of brain areas responding to both the experience of a tactile sensation and to the observation of the same tactile sensations experienced by others. One crucial area of this system is the primary somatosensory cortex (S1). A hypothesis put forward is that the cross-modal responses of the Tactile Mirror System could be a by-product of Hebbian associative learning: the contingency between a seen touch and a felt touch on one's own body may reinforce the synapses between somatosensory and visual neurons.
We developed a novel cross-modal paired associative stimulation (cmPAS) protocol to test the hypothesis that the mirror-like responses of S1 may arise from Hebbian associative plasticity mechanisms. In this new protocol, a Transcranial Magnetic Stimulation (TMS) pulse over S1 is repeatedly paired with the view of a hand being touched. The successful modulation of S1 reactivity by the cmPAS was assessed at a behavioral level, measuring changes in the observer's tactile acuity as tested with a 2-point discrimination task (2PDT).
In the first experiment, we investigated the efficacy of the cmPAS and the temporal specificity of the Hebbian plasticity mechanisms induced by it by varying the inter-stimulus intervals (ISIs) between the TMS pulse and the visual stimuli. In the second experiment, we examined the cortical specificity of our protocol applying TMS also over the primary visual cortex (V1). We found that cmPAS was effective in decreasing participants' sensory threshold, specifically when the ISI between the visual stimulus and the TMS pulse was of 20 ms, and only when TMS was applied over S1. In the third experiment, we investigated the specificity of the visual stimulus in eliciting changes in the sensory threshold: we assessed the effect of a control condition in which TMS pulses were paired with a picture depicting a static hand, that was not touched. Crucially, results showed that the cmPAS protocol induced tactile enhancement only when the visual stimulus paired with the TMS pulse depicted a touch. These results highlight the central role of mirror-touch mechanisms in the success of the cmPAS.
Taken together these findings prove the effectiveness of the cmPAS in modulating participants' tactile acuity as a consequence of the effective mirror-like recruitment of S1.

Sessione Poster 2

Poster

Can functional, anatomic and genetic connectivity influence the spread of structural brain alteration?

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Grey matter alterations are a distinctive sign of brain disorders. These neuroanatomical abnormalities have been found to spread, especially in neurodegenerative diseases, from a brain area to another, generating network-like patterns (Yates, 2012; Pandya et al., 2017) which seem to be influenced by brain connectivity (Zhou et al., 2012; Iturria-Medina and Evans, 2015; Oxtoby et al., 2017; Yuan et al., 2017; Cauda et al., 2018; Manuello et al., 2018; Tatu et al., 2018). If a relationship between brain connectivity and grey matter alterations exists, knowing the former should allow to predict the latter (Raj et al., 2012; Robinson, 2012; Zhou et al., 2012; Iturria-Medina et al., 2014). Indeed, it should also be possible to evaluate the contribution of functional, anatomical and genetic connectivity on the development of a certain structural co-alteration pattern, as well as to simulate the temporal evolution of these alterations. In order to investigate all these elements, we used a method recently developed by our group to analyze the whole voxel-based morphometry (VBM) section of the BrainMap database (Fox and Lancaster, 2002; Fox et al., 2005; Laird et al., 2005b). Given an altered brain area, our approach is able to detect possible other areas altered together with this (i.e. co-altered) (Cauda et al., 2018; Manuello et al., 2018; Tatu et al., 2018). We were able, in this way, to construct two transdiagnostic structural co-altertion network, one for the decrease condition (i.e. brain sites were pathological subjects show a reduction of gray matter compared to healthy controls), and one for the increase condition (i.e. brain sites were pathological subjects show an increase of gray matter compared to healthy controls). The decrease network was based on 642 experiments (15820 subjects), while the increase network was based on 204 experiments (4966 subjects). We then evaluated the functional, anatomical and genetic connectivity for the sets of nodes which compose each of the two co-alteration networks. Functional connectivity was computed by using resting state data from 200 healthy adult subjects part of the Q4 release of Human Connectome Project. Anatomical connectivity was computed by using diffusion tensor imaging (DTI) data of 842 healthy adult subjects part of the Q4 release of Human Connectome Project. Genetic connectivity was obtained by using the microarrays provided by the Human Brian Atlas Project. Results show that all the three types of connectivity can account for and predict the shape and temporal evolution of the co-alteration networks. This confirms that the spread of brain alteration does not occur in a random way. Of the three connectivity profiles considered, functional one is the one offering the better account of the co-alteration process. The present study provides a contribution toa better understanding of brain disorders, offering a possible interpretation of the mechanisms responsible for neuropathological processes.

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Sessione Poster 2

Poster

Interhemispherical co-activations, a meta-analytic approach to homotopic connectivity

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Homotopic connectivity is the connectivity between mirror areas of the brain hemispheres. Structural HC is likely to be mediated especially by the corpus callosum, which is the largest commissure of human brain, while functional HC is the strongest form of functional connectivity that can be observed for any cortical region (Stark et al., 2008). It can exhibit a marked and functionally relevant spatial variability, and can be perturbed by several pathological conditions. The voxel-mirrored homotopic connectivity (VMHC) is a technique devised to enquire this pattern of brain organization, based on resting state functional connectivity (Zuo et al., 2010). Since functional connectivity can be revealed also in a meta-analytical fashion using co-activations (Langner, Rottschy, Laird, Fox, & Eickhoff, 2014), we propose to calculate the meta-analytic homotopic connectivity (MHC) as the meta-analytic counterpart of the VMHC. We therefore downloaded all the online functional BrainMap database (Laird, Lancaster, & Fox, 2005), retrieving the foci of activation reported by more than 3000 studies. These foci were used to model an activation map for each experiment. The Patel's κ index (Patel, Bowman, & Rilling, 2006) was then calculated for each homotopic couple of regions to obtain their co-activation strength through the series of modelled experiments. These co-activation strengths are the meta-analytical version of the functional correlations of the VMHC, thus they constitute the MHC map. A regular VMHC has also been calculated on a resting state dataset of the FCP project (Biswal et al., 2010). The comparison between the two techniques reveals their general similarity, but also highlights regional differences associated with how HC varies from task to rest. Two main differences were found from rest to task: i) medial areas are characterized by a higher degree of homotopic connectivity, while lateral areas appear to decrease their degree of homotopic connectivity during task performance; this is possibly the consequence of a task-induced increase in short-range connectivity (Sepulcre et al., 2010) and ii) brain central hubs exhibit a stronger functional homotopic connectivity during rest compared to task, as already suggested by Tomasi and Volkow (Tomasi & Volkow, 2011). These findings show that MHC can be an insightful tool to study how the hemispheres functionally interact during task and rest conditions.

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Picture 3: https://www.eventure-online.com/parthen-uploads/175/18016/add_3_477574_6d2aaaaa-e163-45b5-a7a0-1aa5698c7b7d.png

Sessione Poster 2

Poster

Cerebellar tDCS improves proprioception in focal hand dystonia: preliminary results from a RHI study

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Focal hand dystonia (FHD) is a movement disorder characterized by abnormalities in hand movements during specific tasks (e.g., writing or playing an instrument). There is accumulating evidence that the cerebellum may play a role in the pathogenesis of disease. The cerebellum is involved in a number of cognitive functions related to motor control, like the sense of body ownership. In this regards, a recent study investigating the sense of body ownership by means of the rubber hand illusion (RHI) task, found that the proprioceptive displacement typically observed during the RHI was interrupted in the affected hand of FHD patients. This finding was interpreted as the behavioural effect of a dysfunction in a network comprising the cerebellum. However, the precise contribution of this structure remains still unclear. The present study investigates the role of cerebellum in the pathogenesis of FHD by combining cerebellar tDCS with the RHI task. The RHI is induced by simultaneously stroking a visible rubber hand with a person's unseen hand. This type of stimulation evokes the subjective feeling that the rubber hand belongs to the participant's body. Moreover, synchronous stroking also determines a proprioceptive recalibration of the perceived position of the participant's hand toward the rubber hand (i.e., proprioceptive drift). Here subjective reports (i.e., questionnaire) of the illusion and the proprioceptive drift were compared among 6 FHD patients and 8 healthy controls. Anodal and sham tDCS were applied before the RHI induction, in two separate sessions. Preliminary results show that healthy controls presented the illusion as measured with the questionnaire and proprioceptive drift, regardless of the type of tDCS. FHD patients, instead, did not feel the illusion as measured with the questionnaire after both anodal and sham tDCS. Interestingly, however, the proprioceptive drift occurred after anodal but not sham tDCS. No differences between groups were found. These preliminary results suggest that anodal tDCS might contribute to ameliorate proprioception in focal dystonia by facilitating the cerebellar activity. Additional investigations with a larger sample are needed to further support these promising findings.

Sessione Poster 2

Poster

Stimuli, Presentation modality and load-specific brain activity patterns during n-back task

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Working memory (WM) refers to a set of cognitive processes that allows for the temporary storage and manipulation of information, crucial for everyday life skills. WM deficits are present in several neurological, psychiatric and neurodevelopmental disorders, thus making the full understanding of its neural correlates a key aspect for the implementation of cognitive training interventions. Here we present a quantitative meta-analysis focusing on the underlying neural substrates of performance at the n-back task, one of the most commonly used task for WM assessment, as highlighted by functional magnetic resonance imaging (fMRI) and positron emission tomography (PET) investigations. Relevant published work was scrutinized through the Activation Likelihood Estimate (ALE) statistical framework in order to generate a set of specific maps related to four stimuli types, six presentation modality, three WM load and their combinations. Our results confirm the known involvement of fronto-parietal areas across different types of n-back tasks, as well as the recruitment of subcortical structures, the cerebellum and precuneus. Moreover, functional overlap with resting-state networks highlighted a strong similarity between n-back regions and the Dorsal Attention Network, with less overlap for other networks (e.g. Salience, Language and Sensorimotor). Clinical and functional implications are hereby investigated, aiming to provide potential targets for non-invasive brain stimulation and cognitive enhancement/rehabilitation interventions.

Sessione Poster 2

Poster

Hand Blink Reflex in virtual reality: the role of vision and proprioception in modulating defensive responses

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The present study focused on the role of visual and proprioceptive information in modulating a defensive reflex (Hand Blink Reflex, HBR). The HBR is evoked by electrical stimulation of the median nerve and its magnitude is enhanced when the threated hand is near to the face, inside the defensive peripersonal space. It has been observed that proprioceptive inputs are prioritized for the HBR enhancement, which is still present when visual feedback is precluded. In order to further address the role of visual and proprioceptive information in the HBR modulation, we capitalized on virtual reality (VR), presented through a Head Mounted Display (HMD), which allowed to substitute the participant's real body with a virtual one and thus to manipulate and dissociate visual and proprioceptive inputs (i.e. by showing a virtual hand in a same or different position of the real one). Four different experiments were performed. In Experiment 1, the HBR was recorded through the classic HBR setup (without VR). Participants' hand was stimulated at 3 distances from the face, namely far (60 cm), near (20 cm), ultra-near (4 cm). We replicated previous results by showing a significantly greater enhancement in the ultra-near condition compared to far ($p=0.03$). In Experiment 2, participants wore the HMD and performed the far/near postural manipulation in absence of visual feedback, i.e. they observed an empty virtual scenario without the virtual body. We found a significant HBR enhancement in near compared to far position ($p=0.01$), confirming the fundamental role of proprioception when vision is not relevant. In Experiment 3, participants kept their stimulated hand still while they observed the virtual body performing the far/near postural manipulation, thus proprioceptive signals from the participants' body were not informative. We observed that the HBR was significantly enhanced in near compared to far position ($p=0.02$), suggesting that, when proprioception is not relevant, visual information plays a role in modulating the HBR. In Experiment 4, we investigated the HBR when multisensory visuo-proprioceptive conflict occurs. Both participants and virtual body performed the far/near postural manipulation, either congruently (with both of them being far/near) or incongruently (with one of them being near, while the other being far). The 2x2 ANOVA showed a significant interaction between condition (congruent/incongruent) and position (far/near) ($p<0.01$), suggesting that the HBR enhancement in near compared to far position was present only in congruent condition. In incongruent condition, the conflict between visual and proprioceptive inputs confounds the system, abolishing the difference between far and near positions ($p=0.36$). Taken together, these findings suggest that both visual and proprioceptive information weight in the HBR modulation and contribute to obtaining the most reliable defensive reaction.

Sessione Poster 2

Poster

The effect of social support on social pain: an fMRI study

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Human beings have a fundamental need to interact with each other. Ostracism (social exclusion) threats this need and has various effects on cognition, affect, and behavior. It is often associated with experiences of (social) pain, defined as the distressing experience arising from the perception of actual or potential psychological distance from close others or a social group. Several authors refer to it as one of the most painful and emotionally unpleasant conditions that the individual can live with the consequent risk of damaging his ability to relate with other individuals. It is therefore understandable why growing interest toward the mechanisms that can alleviate such psychological condition has raised in the scientific community. In particular, social support, the perception of help received from others, is a psychological resource used to cope with social pain and stressful conditions in general. This study aims to investigate the role of social support in modulating the neural correlates involved in social exclusion. We focused on two different forms of supports: physical and cognitive. By physical support we refer to physical contact; by cognitive to the communication of useful information about social exclusion experience. 81 women divided in three group - cognitive support (N= 26), physical support (N=26) and control group (N=29) - participated to the study. Experimental fMRI session was composed by 3 phases. (A) Social exclusion I: each group was scanned while playing the virtual Cyberball game. During Cyberball two (virtual) persons play with a ball, and they keep out of the game the experimental subject. (B) Social support: experimental group received physical or cognitive support while control group did not receive any kind of social support. (C) Social exclusion II: each group was scanned for the second time during the exclusion experience. fMRI results show that during social exclusion (II) physical support modulates the activation of Anterior Insula (AI), usually associated with visceral pain and negative affective experience, and that cognitive support modulates the activation Temporal Parietal Junction (TPJ), area usually involved in the representation of mental states of other individuals. Understanding the role of social support on social pain can unearth new perspectives on possible applications in clinical and social contexts.

Sessione Poster 2

Poster

The effect of complexity on pre- and post- stimulus phases in discriminative response task

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It is well-known that task complexity modulates cognitive resources, but the brain correlates of this effect, especially in the preparatory phase, are still unknown. In the present study, a simple and a complex visual discriminative response task (DRT) were compared to investigate the effect of task complexity on motor and cognitive brain preparation. We recorded event-related potentials (ERPs) from 32 participants (15 females; mean age 21.9 years, SD=2.6). A first group of 16 participants performed the simple DRT requiring discrimination between two configurations only. One stimulus was designed as target and the other (with equal probability) as non-target. A second (age- and gender-matched) group of 16 participants performed a more complex task with four configurations (two targets and two non-targets). The main prediction was that the simple task would have need less motor and cognitive preparation, as shown by the well-known Bereitschaftspotential (BP) and the prefrontal negativity (pN), which has been found in complex DRTs (Berchicci et al., 2012). At post stimulus level, we predicted smaller activity for the ERP components (pP1, pP2, pN1) associated with visuomotor awareness and stimulus-response (S-R) mapping, as well as for the well-known N2 and P3 typically associated to response conflict or inhibition and task closure, respectively. At behavioral level, response time and commission errors were smaller in the simple task. About pre-stimulus ERPs, the scalp topography of components was similar in the two conditions, but the BP and the pN showed earlier onset and larger amplitude in the complex task. As regards post-stimulus ERPs, compared to the complex task, the prefrontal pP1 and Pp2 were smaller, the N2 was larger, and the P3 was smaller in the simple task. Early visual components (P1 and N1) were similar in both tasks. Results seem to confirm our initial hypotheses. The simple task requires less motor and cognitive preparation in premotor and prefrontal areas. Considering that simple DRTs are traditionally used in literature, the recent pN discovery can be due to the use of more complex tasks. Moreover, the smaller P3 could be credited to the less intense need of task closure. Finally, as for the N2, we propose that it does not reflect greater response conflict or inhibition because it was larger in the simple task requiring less levels of conflict monitoring and inhibitory control. On the contrary, according to the epiphenomenal N2 theory (Perri et al., 2017), the N2 effect might be partly due to the pP1 and pP2 scalp modulation and not to additional brain activity.

Sessione Poster 2

Poster

Mirror Neuron System and (dis)embodiment in Parkinson disease: preliminary fMRI findings.

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Recognition of other's goal-directed motor behaviour mediated by brain processes of internal simulation is the core function of the mirror neuron system (MNS). Indded, The the MNS existence provides for a phenomenon of "immediate neuronal resonance". Moreover, MNS properties - while being innate - rely on personal motor repertoire and can be modified by experience. An interesting problem was to shed light on the the relationship among MNS recruitment, the personal motor repertoire and emotionality, during the observation of complex behaviors like the choreutical arts are. This issue was addressed by a famous neuroimaging study by Calvo-Merino et al. (2005). Todate, little is known about the MNS in chronic motor disorders. The purpose of our piloting study was to investigate potential MNS (dys)function in Parkinson's Disease (PD) patients.
30 right-handed retired male ballet dancers have been recruited: 15 cognitively non-impaired idiopathic PD patients, presenting typical levodopa-induced dyskinesias and motor fluctuations , and 15 age-matched healthy subjects (HS) . Subject were evaluated with the Calvo-Merino's fMRI paradigm, implying the observation of highly complex and experiential movements, such as those of ballet.
In the "complex vs common" fMRI-contrast, HS showed higher activation in the bilateral posterior intraparietal sulcus (p-IPS); PD exhibited higher activation in the paramedian midbrain. Significant correlations were found between the MDS-UPDRS-III subscores and individual fMRI responses in left (p=0.041) and right (p=0.038) p-IPS, and in the midbrain (p=0.048).
On equal motor expertise, the stronger activation within the MNS (bilateral p-IPS) in HS during the observation of complex dance figures would indicate intrinsic disturbances of mirroring functions in PD, which in our opinion might be cautiously interpreted as a proof of concept of (pathological) motor (dis)embodiment. Indeed, PD may affect patients' motor effectiveness "as a whole", i.e. not only in their actual (overt) motor performance, but also in terms of internal (covert) motor simulation mechanisms. PD showed also increased activation outside the MNS, specifically in the midbrain. Enhanced recruitment of these subcortical pathways directly involved in several aspects of motor functions beyond MNS properties (like motivation and reward processes, associative learning, motor planning, initiation and monitoring) might represent a (failed) attempt to compensate for patients' acquired cortical impairment of motor simulation mechanisms elicited by the observation of unlearned kinesthetic patterns. Alternatively, this extended activity might be merely seen as a failure to keep neural coherence confined to the MNS thus resulting in poor mirroring functions.
To our knowledge, this is the first report showing peculiar features of MNS (dys)function in chronic motor disorders. Therefore, we thought it would be worthy of preliminary attention from scientific community.

Sessione Poster 2

Poster

Effects of aging on the attention networks functioning

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Effects of aging on the attention networks functioning

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Healthy aging is associated with progressive changes in cognition which frequently may impact upon function and interpersonal relationships. Cognitive functions such as processing speed, executive function, and working memory are particularly sensitive to changes that arise from morphological changes (indexed by volumetric size and thickness) in prefrontal, hippocampal, and parietal cortices that are thought to underpin progressive age-related cognitive changes.

The aim of this study was to evaluate the effects of aging in the attention network efficiency measured by the Attention Network Test.

Thirty young subjects (20-30 years) and thirty-three elderly subjects (60-80 years) performed the ANT task. The main ANT outcome measures (i.e. the efficiency of the alerting, orienting and executive networks calculated according to the subtraction method, the mean overall RT, and the overall accuracy calculated as the percentage of correct responses) were analysed separately by means of Student t-test.

Overall RT and accuracy were comparable between groups. As regards the efficiency of attentional networks, the alerting ($p<0.001$) and the orienting ($p=0.001$) were significantly more efficient in the young subjects. On the contrary, elderly subjects displayed a significant higher efficiency of the executive network ($p=0.001$). RT according to different cues and targets are displayed in table 1.

The information carried by alerting or spatial cues allows elderly subjects to obtain the same level of performances displayed by the young subjects, even if the RT to the non-facilitated trials (no-cue and center-cue) were lower than the ones displayed by the young subjects. On the opposite, the physiological prolongation of RT induced by incongruent targets (with the respect of those induced by the congruent targets), was less prominent in the elderly than in the young subjects.

Taken together these data indicate that healthy elderly subjects, in order to keep high levels of performance, comparable to those of the young subjects, need to recruit the executive network at their most efficient level, while the orienting and alerting networks are less effective indicating the possible presence of age-related structural changes in cortical thickness of the brain areas related to the functioning of these specific attention networks.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18016/add_1_478123_b9ba0f78-5b3e-4aed-9343-149ddba89ae7.1 aging ANT.jpg
Caption 1: Fig.1: A) Attentional Networks Efficiency; B) Mean Accuracy; C) Mean reaction times; D) Table 1: Mean reaction times under each condition

Sessione Poster 2

Poster

IL-6 alters amyloid-β homeostasis and synaptic plasticity, influencing cognitive functioning in Multiple Sclerosis

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Background: In Multiple Sclerosis (MS), processing speed and episodic memory deficits can be observed all along the disease course. Demyelination and gray matter atrophy have been traditionally seen as the main responsible of cognitive deficits in MS. More recently, the role of neuroinflammation is emerging as a crucial factor influencing neuronal activity and cognitive symptoms. Altered amyloid-β (Aβ) metabolism has been identified as a key factor influencing synaptic plasticity in different neurological conditions. Alterations of long-term potentiation (LTP)-like plasticity occurring within the hippocampal structures may be responsible of learning and memory deficits already observed in the early phases of MS. In particular, inflammatory cytokines altering Aβ metabolism may subvert synaptic plasticity mechanisms.
Objective: In the present study we explored the correlation between the concentrations of the proinflammatory cytokine interleukin (IL)-6 and the levels of Aβ 1-42 in the cerebrospinal fluid (CSF). In addition, we tested whether IL-6 influences synaptic plasticity both in vitro in mice hippocampal slices and in vivo in MS patients using transcranial magnetic stimulation (TMS).
Methods: In a group of 105 RR-MS patients the CSF levels of IL-6 and Aβ were assessed at the time of diagnosis. In a subgroup of 36 MS patients LTP-like synaptic plasticity was probed using the paired associative stimulation (PAS) protocol. Finally, in vitro electrophysiology was conducted in mouse hippocampal slices to test the effect of IL-6 incubation on LTP induction.
Results: A negative correlation emerged between the CSF levels of IL-6 and Aβ. In addition, a negative correlation emerged between the CSF concentrations of IL-6 and the PAS-induced LTP-like plasticity. Finally, LTP induction in vitro was abolished by incubation with IL-6.
Conclusions: Our findings show that elevated intrathecal levels of IL-6 are associated with altered Aβ homeostasis in the CSF and reduced PAS-induced LTP-like plasticity in MS patients. Moreover, IL-6 blocked hippocampal synaptic plasticity induction in vitro. These results suggest that neuroinflammation may promote cognitive dysfunction in MS patients altering synaptic plasticity expression.

Sessione Poster 2

Poster

The placebo effect on a motor learning task

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Motor learning is a key component of human motor functions as it allows to acquire new skilled movement by practice, such as playing an instrument or using a keyboard. In this study, we seek to address how the placebo effect, consisting of verbal suggestion, can influence the learning of a sequence of finger movements through an implicit motor learning task. Moreover, we aimed at investigating whether the verbal suggestion directed to the improvement of either the motor functions or the cognitive functions may play a different role on the implicit learning of the motor sequence.
Forty-five healthy participants were recruited and randomized in three groups (placebo-TENS vs. placebo-tDCS vs. control). Participants were asked to perform a serial reaction time task (SRTT) in three sessions (baseline, learning, final) with the first four digits of the right hand. Subjects were instructed to press the button corresponding to the position of a square presented on the screen as fast and accurate as possible. Before the learning and final session, we applied the placebo procedure in the experimental groups. The placebo-TENS group received an inert treatment with transcutaneaous electrical nerve stimulation (TENS) on the hand involved in the task together with verbal information about the positive effect of the TENS in increasing muscle activity and speed. The placebo-tDCS group received a sham transcranial direct current stimulation (tDCS) on the supraorbital areas along with verbal information about the positive effect of tDCS in increasing concentration and attention. Conversely, the control group did not receive any treatment during the experiment and served as a natural history group.
Performance was evaluated in terms of response time during the execution of the sequences. Subjective parameters were also collected, specifically perception of mental fatigue, physical fatigue and expectation about the treatment.
Results showed a general improvement of SRTT in all the groups, suggesting that the placebo effect does not modulate the implicit motor learning. Interestingly, participants of the placebo-tDCS group showed a reduction of mental fatigue compared to placebo-TENS and control groups. These findings suggest that the placebo effect can reduce mental fatigue during an implicit motor learning task, only if a “cognitive” placebo is applied. The behavioural component of the task is not strongly affected by the procedure.

Sessione Poster 3

Poster

The proprioceptive drift in the rubber hand illusion is influenced by the peri-hand space rather than the body midline

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The rubber hand illusion is widely used to study the sense of body ownership. In this illusion, simultaneously stroking the participant's hidden hand and a visible rubber hand induces a feeling of ownership over the latter. There is conflicting evidence of whether the illusion might be influenced by either the distance of the hands from the body midline or the distance between them. We investigated whether the illusion is modulated by the distance between the hands and/or by their distance from the body midline. We performed three different experiments. In experiment one, the rubber hand was placed at 6 cm far from the body midline, while the real hand was moved at three different distances laterally to the rubber hand in 3 separate conditions (specifically, at 20, 34 and 48 cm from the midline). In experiment 2, the position of the hands was inter-changed and the rubber hand was moved laterally to the participants' hidden hand across the 3 conditions. In experiment 3, the intermanual distance was kept constant (14cm), and both hands were moved laterally across the 3 conditions. The illusion was measured by means of proprioceptive drift (e.g., proprioceptive recalibration of the perceived position of the participant's hand toward the rubber hand) and subjective reports (i.e., 9-statement questionnaire). Fourteen participants were recruited for each experiment. The subjective experience of the illusion was evoked in all experiments and in all conditions. Conversely, in the first 2 experiments, a significant proprioceptive drift was observed only in the first condition, where the two hands were placed at 14cm from each other and close to the body midline. In experiment 3, instead, a significant proprioceptive drift occurred in all conditions. No differences between experiments have been found. We have here demonstrated that the proprioceptive drift is influenced by the distance between the rubber and real hand, while it is not affected by their distance from the body midline. This suggests that the rubber hand should be placed within the peri-hand space for the proprioceptive recalibration to occur, regardless of their relative distance from the body midline. Instead, within the reaching space, the subjective experience of the illusion is not influenced by either the intermanual distance or their distance from the body midline.

Sessione Poster 3

Poster

Neural correlates underlying the comprehension of deceitful and ironic communicative intentions in schizophrenia

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In patients affected by schizophrenia, deficits in the understanding of deceitful and ironic communicative acts (AC) have been highlighted. A recent fMRI study, conducted on healthy participants, highlighted the recruitment of different neural correlates in the understanding of different types of AC, uttered with different communicative intentions, i.e., sincere, deceitful or ironic. It showed that the lMTG, the left middle temporal gyrus, seems to be more recruited in the comprehension of ironic versus deceitful communicative intention, thus suggesting its specific role in the semantic integration of word and of meaning in irony recognition.
The present research applied the experimental paradigm of the latter study to 17 patients with schizophrenia (SCZ) compared to group of 18 control subjects (CTRL). The task consisted in reading and understanding 12 AC, each declined according to 3 different communicative intentions (IC): sincere (Sin), deceitful (Ing) or ironic (Iro). During the fMRI acquisition with a magnetic field of 3.0 T, for a total of 36 times, the patient had to understand the AC and choose among the 3 options: Sin, Ing or Iro. AC comprehension performances and neural correlates were measured following AC reading. These data were compared based on the type of AC (Sin, Ing or Iro) between the two groups (SCZ and CTRL) using Mann-Withney U test (behavioral data) and contrasts (fMRI data).
The percentage of correct answers for the three types of AC was as follows: CTRL: Sin = 94%, Ing = 83%, Iro = 81%; SCZ: Sin = 84%, Ing = 54%, Iro = 47%. In the comparison between groups, significant differences were found ($p < 0.001$) between the two groups in all 3 types of AC, more pronounced for deceitful and ironic AC. A comparison between groups of fMRI data related to correct answers for sincere AC emerged a marked activation of the left average temporal gyrus (lMTG) in patients affected by schizophrenia.
The SCZ group show greater difficulty in understanding AC Sin, Ing and Iro. This difficulty in understanding sincere AC would be associated with the recruitment of the lMTG. This area was described in a previous study as a specific area for understanding ironic AC and it was associated with the understanding of non-literal ACs, which require articulated inferential processes. It is therefore peculiar the marked, involvement of this area in the patients affected by SCZ for the understanding of sincere AC. In conclusion, we believe that the recruitment of lMTG in patients with schizophrenia could be the basis of the difficulties encountered in understanding and recognition of three types of AC.

Sessione Poster 3

Poster

Gondola: An open source toolbox for fast and replicable brain network analysis

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Brain architecture is characterized by functionally and anatomically connected regions. Recent trends in neuroscience are shifting the focus from single brain regions to the brain connectivity between areas and complex network analysis. The main approach to study the patterns of brain connectivity is that of complex network analysis, a branch of mathematics which studies the properties of complex system by quantifying the topologies and properties of the networks (Bullmore and Sporns 2009; Sporns 2013).

Although several toolboxes are available for network analysis of fMRI, EEG, and MEG data, they have some limitations. Some of them are based on a graphical user interface, which, although user-friendly, does not allow reproducible analysis pipelines (e.g., GraphVar, Brovkin et al. 2018). Some other (i.e. BCT, Rubinov and Sporns 2010), are only collections of matlab functions and require advanced programming skills. Furthermore, the interaction between softwares to perform basic data analysis and connectivity/network analysis is often very difficult, as every toolbox uses its own input-export data structure.

To overcome the existing limitations, we designed *Gondola*, an open source Octave/Matlab toolbox to easily perform network analysis, combining the strengths of the approaches of existing toolboxes.

Gondola is based on matlab code (i.e., scripts), but requires minimal Octave/Matlab knowledge in order to be used. Among the other things, *Gondola* allows to: import connectivity matrices data from the major toolboxes (e.g. Brainstorm, Fieldtrip) or from ASCII files, make exploratory graphics of connectivity matrix and of individual brain networks, and perform mass univariate analysis with statistical corrections and permutation tests.

Following the spirit of Open Science and of good practice in coding (Goodman et al. 2014), *Gondola* allows to easily share full network analysis pipelines, that can be re-used for different studies and across-laboratories comparisons. Finally, *Gondola* allows to easily “travel” across the most widespread existing toolboxes (*BCT* for network measures, *BrainNetViewer* for high quality graphics, and *NBS* for GLM based network analyses).

Gondola is a toolbox created at S. Camillo Hospital IRCCS and made freely available to the scientific community to boost the diffusion of reproducible network analysis in neuroscience.

Gondola is available at:
Gondola%20is%20available%20at:%20https://github.com/giorgioarcara/Matlab-code-Misc/tree/master/Gondola

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Picture 1: https://www.eventure-online.com/parthen-uploads/175/18016/add_478231_343715f4-75a6-4ecd-a08b-4c651708ac64.jpg

Sessione Poster 3

Poster

Embodying action errors in virtual reality: preliminary EEG data on Parkinson's Disease

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Even simple daily actions, such as grasping a glass, can become challenging in patients with Parkinson's Disease (PD). In addition to the motor execution deficits, PD patients seem to show a deficient functioning of the performance monitoring system (Farooqui et al., 2011). Previous studies on error monitoring in people with PD showed contrasting results; a few studies found the typical error-related signatures (i.e. error-related negativity, ERN; positivity error, Pe; theta oscillations) comparable to the ones showed by healthy elderly, while others showed a general decreased cortical response to erroneous actions. In particular, the evidence on the effects of the dopaminergic medication on the brain response to errors is still unclear (Holroyd et al., 2002; Stemmer et al., 2007; Willemssen et al., 2008; Cavanagh et al., 2018).
In the present work, by combining EEG and immersive virtual reality (CAVE system), we investigated the mechanisms underlying the performance monitoring system in PD patients during the observation of reach-to-grasp a glass actions performed by an avatar in first person perspective. The preliminary sample included 8 PD tested twice, at a 2-weeks interval. Each patient was tested in two different states namely soon after assuming dopaminergic medication ('Dopa-ON') and 12-hour after assuming the medication (overnight washout; 'Dopa-OFF'). The order of the medication state was counterbalanced across patients. 10 healthy elderly controls were also tested.
Preliminary results replicate and expand our previous findings in young healhty participants (Pavone et al., 2016; Spinelli et al., 2017; Pezzetta et al., 2018) by showing that also healthy elderly exhibit an increased theta power activity (4-8Hz) after the observation of erroneous actions. Interestingly, the same pattern was not found in the PD group, regardless of whether they were in Dopa -ON or -OFF state. We also found a significant difference between correct and erroneous actions in the beta range (12-30Hz), with greater beta power in the erroneous actions, in elderly controls and Dopa-OFF participants. No such result was found in Dopa-ON participants, suggesting a link between the dopaminergic intake and the beta response to actions. Concerning the time-domain, we did not find an ERN, but all three groups showed the typical Positivity Error in response to the erroneous actions. However, in both Dopa-ON and -OFF groups the cortical potential showed lower amplitude compared to the healthy elderly.
Although preliminary, these data can help to better understand the neural dynamics of action monitoring in Parkinson's Disease.

Sessione Poster 3

Poster

The topography of visually-guided grasping in the premotor cortex: a dense TMS mapping study.

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Background and Objective: Performing target-orientated actions is crucial in everyday behavior; to execute these movements, we need to accurately represent the target object's geometry to produce an appropriate distal limb configuration during the reaching motor plan. Evidence from both human and non-human primates proved that the so-called "ventral parieto-frontal circuit" is crucial in integrating sensory and motor information to perform accurate target-oriented actions of different complexity. Electrophysiological studies in the monkey suggested that the ventral premotor cortex (PMv), namely the F5 area, is specialized in processing *what* to reach-grasp in space, together with its parietal counterpart, area AIP (Rizzolatti et al. 2014). Beyond this, recent evidence extended the grasping network to area F6 (pre-supplementary motor area)(Lanzilotto et al. 2016), located on the medial wall of the hemispheres. Although several investigations were conducted also on human primates, the results did not lead to a unique map of the premotor region in target-orientated actions. In this light, systematic mapping of the entire PM is needed to identify the functional specialization of this area in the production of visually-guided actions**.**
Methods: To this end, we tested our participants during a grasping task, measuring the grip aperture of their right hand during reaching by means of a flexion-sensor based glove. Participants had to grasp a cylindric object of three different sizes with their right hand. Vision of the object was controlled by glasses with LCD shutter lenses. Shutter opening was the "go" signal for the reach-grasp movement. 100 ms after the "go" signal we applied online single-pulse transcranial magnetic stimulation (spTMS) over one of 8 different sites of left PM covering the whole of the precentral gyrus, from the inter-hemispheric fissure to the Sylvian region. In each subject all 8 spots were stimulated in different trials.
Results: Our results suggest a multifocal representation of object geometry for grasping in the premotor cortex. Specifically, our preliminary results show that TMS (compared to sham TMS) altered grip aperture while reaching an object when applied over two spots located at the dorsal-ventral premotor border and in the anterior ventral premotor cortex and over another single spot located near the midline. This is in partial agreement with previous evidence from non-human primates, in which only the ventralmost PMv (area F5) seems to be crucial in similar grasping tasks. Furthermore, our findings would corroborate the monkey data that indicate also medial areas of premotor (area F6) to be involved in objects grasping.

Sessione Poster 3

Poster

ERP recording shows subclinical differences in ADHD patients with and without Tuberous Sclerosis

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ERP recording shows subclinical differences in ADHD patients with and without Tuberous Sclerosis

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Objective: To investigate whether among children and adolescents with attention deficit and hyperactivity disorder (ADHD) those with Tuberous Sclerosis (TS) show specific abnormalities of event-related potentials (ERPs).
Methods: We recruited 10 ADHD patients: 5 with TS (mean age: 12.6±4.3 years) and 5 without TS (mean age: 11.6±3 years). By using an oddball paradigm, auditory mismatch negativity (MMN) and P3b responses were recorded from Fz and Pz electrodes, respectively. All patients were administered with cognitive, executive functioning, and behavioural questionnaires.
Results: No difference was found in cognitive and executive functioning between two groups. The P3b amplitude was significantly higher in TS patients (15.6±9 μV) than in children and adolescents without TS (5.5±2.7 μV) (p=0.04). The MMN amplitude was higher in TS patients (19±18 μV) than in those without TS (9±6.9 μV), although the difference was not significant (p=0.3).
Conclusions: Our results show that P3 and MMN amplitudes are higher in ADHD patients with TS than in those without TS. This means that among children and adolescents with ADHD involuntary and mostly voluntary attention capabilities are better in those with TS. Since this difference was not found by neuropsychological testing, ERP recording can be useful to unravel subclinical differences between two groups.

Sessione Poster 3

Poster

Losing awareness during voluntary actions after virtual lesion of the premotor cortex

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Willed actions are generated through a chain of unconscious events, although we are usually aware of moving (or not moving) according to a desired state. How is this motor-awareness built up in our brain? Here, we investigated the neural substrate of the motor-awareness by using direct electrical stimulation (DES) in patients with left-brain tumor undergoing awake-surgery. Awake patients were asked to voluntary move their right-hand and to verbally monitor their real-time motor performance, while different brain-areas were transiently impaired by DES. Based on anatomo-clinical evidence from motor-awareness disorders following brain-damage, the premotor cortex (PMC) was selected as *target* area while the primary-somatosensory cortex (S1) as *control* area. Despite the effect of DES on both PMC and S1 interrupted the movement execution, only DES applied on PMC dramatically altered the patients' motor-awareness, making them unconscious of the motor arrest. These results shed light on the anatomo-functional mechanisms underlying the human motor-awareness.

Sessione Poster 3

Poster

Attenuation of real and illusory self-touch: an ERPs study

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Sensory attenuation (SA; i.e. a reduction of subjective intensity of self-generated stimuli compared to identical externally-generated stimuli) is known to rely on motor intention and sensory prediction (i.e. efferent signals). However, we previously showed that SA can also be triggered by multisensory signals sub-serving body ownership: when a fake embodied hand (embodiment induced by the rubber hand illusion, RHI) delivered somatosensory stimuli to participant's body, the SA was comparable with SA of self-generated stimuli. Here, we aimed at investigating whether this interesting behavior has an objective electrophysiological counterpart.

Methods

Fourteen healthy right-handed volunteers (age – 23.5±3.8) received non-painful somatosensory electrical stimuli across four experimental conditions, depending on the agent that pressed the stimulation button: the participant herself, a fake hand, an embodied fake hand (synchronous stimulation in vertical RHI setting) or a non-embodied fake hand (synchronous stimulation with the hand rotated 180°). We recorded subjective ratings of stimuli intensity (on a 0-7 Likert scale) and somatosensory evoked potentials (SEPs) in response to them. In addition, the participants rated the feeling of ownership of the hand that performed the movement (an ad hoc questionnaire with a -3/+3 Likert scale).

Results

The intensity of self-generated stimuli was attenuated (lower subjective ratings and reduced amplitudes of SEP N1 and P2 components) with respect to other-generated stimuli. Moreover, when the fake hand was embodied (i.e., subjective ownership was comparable with ownership of the own hand), similar SA effect was observed, which was also represented both by subjective intensity ratings and reduction of SEPs amplitude. No SA was present when the stimuli were delivered by the non-embodied fake hand.

Conclusions

These results suggest a top-down modulation of body-ownership on SA mechanism, showing a similar physiological signature for SA of self-produced stimuli (i.e. motor-related signals) and stimuli delivered by an embodied fake hand (i.e. body-related signals).

Sessione Poster 3

Poster

Near or far? Electrophysiological evidence of tool-use dependent spatial remapping in humans

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The peripersonal space (PPS) represents a portion of space immediately surrounding the body, where we can interact with external objects, as opposed to the far space, where objects cannot be reached. PPS representations are known to be highly plastic, changing with the experience. As shown by electrophysiological studies in monkeys and by behavioural experiments in humans, PPS widens after a training where a tool is employed to reach objects in the far space. However, to the best of our knowledge, electrophysiological evidence of such tool-use dependent plasticity in the human brain is missing, and we aimed at investigating it here.
To this aim, we capitalized on multisensory integration spatial rule, stating that when stimuli belonging to two different modalities are presented at the same location, responses at that spatial location are boosted (i.e. super-additive responses). Accordingly, previous studies showed that response times (RTs) are enhanced in response to bimodal audio-tactile stimulation, only if auditory stimuli occur within the boundary of the nearby space (i.e. close to the stimulated body district). After tool-use, when the tool is incorporated into the own body-representation, the boundaries of the PPS should enlarge, thus inducing enhanced responses even when the auditory stimulation occurs in the previously considered “far” space, now remapped as “near” space.
In the present EEG study, we investigated audio-tactile integration in the space around the hand and in far space, by comparing conditions in which an audio-tactile task was performed either after tool-use (a 20-minute reaching task, performed using a 145 cm-long rake) or after a visual training (a 20-minute mismatch detection task). During the audio-tactile task, participants had to respond to tactile (electrical) stimuli, delivered to their right hand, either in isolation (i.e. *unimodal condition*) or combined with auditory stimulation. Auditory stimuli could occur near to (i.e. *bimodal-near condition*) or far from (i.e. *bimodal-far condition*) the participant’s stimulated hand.
As predicted by multisensory integration spatial rule, faster RTs and greater super-additive ERP responses to tactile stimuli were found with auditory stimuli occurring near to the stimulated hand, as compared to auditory stimuli occurring far. Crucially, after tool-use, this far-near differential response was significantly reduced with respect to the visual training, in both RTs and ERPs.
Altogether our results show a multisensory integration-related enhancement always present in bimodal-near conditions and modulating bimodal-far responses selectively following tool-use remapping. The present finding might be considered as an electrophysiological evidence of tool-use dependent plasticity in the human brain.

Sessione Poster 3

Poster

The rubber hand illusion induces pseudo tactile extinction in healthy subjects

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The sense of body ownership (SBO), the feeling that different body parts belong to ourselves, is something that we typically take for granted. However, SBO can be experimentally manipulated in healthy subjects, as during the rubber hand illusion (RHI). Participants watch a human-like rubber hand (RH) being touched, while their real hand, hidden from view, is touched synchronously. This induces the feeling that the RH has become part of their own body (the so-called “embodiment”), while their real hand is subject to a sort of “disembodiment”. How does the brain generate this illusory SBO? Within the framework of the predictive coding theory, it has been suggested that the RHI emerges through the attenuation of somatosensory precision as an attempt to resolve the visuo-tactile conflict between the RH and the real hand, so that the tactile sensation coming from the real hand is perceived as coming from the RH.
Here, to test whether and to what extent the somatosensory precision of the hand exposed to the illusion is attenuated, we capitalized on a well-known neuropsychological deficit emerging as a consequence of brain lesions, i.e. tactile extinction (TE). TE consists of a failure in detecting contralesional tactile stimuli when simultaneously delivered with competing ipsilesional ones. If, during the RHI in healthy subjects, the altered SBO relies on an attenuated somatosensory precision, immediately after the RHI bilateral tactile stimulations should result in a pseudo TE of stimuli delivered to the hand exposed to the illusion.
Participants (n=16) performed a tactile detection task (TDpre), including both unilateral and bilateral electrical stimulations of the hands dorsum at the sensory threshold level. The TD task was repeated after the RHI procedure (TDpost), including either synchronous or asynchronous visuo-tactile stimulation of the participants’ right hand and of the RH. To maintain the illusory experience during the experiment, each TDpost trial was acquired after 13 secs of visuo-tactile stimulation. The RHI effectiveness was measured by the Embodiment and Disembodiment Questionnaire, which revealed, as expected, a greater feeling of ownership over the RH and disownership over the real hand after synchronous than asynchronous stimulation. To analyze TD data, the percentage of TE errors was considered as dependent variable in a 2x2x2 ANOVA with *condition* (Synchronous/Asynchronous), *time* (TDpre/TDpost) and *side* (Right/Left) as within-subjects factors.
The results showed a three-way interaction ($F=5.77$; $p=0.029$), with a significantly greater TE rate in the Synchronous TDpost Right condition than in all the other conditions (p always <0.05). This finding indicates that the RHI induces a pseudo TE in the disembodied hand, thus demonstrating that, during the illusion, the altered SBO relies on an attenuated somatosensory precision, which could represent an attempt to resolve prediction errors generated by conflicting multisensory inputs.

Sessione Poster 3

Poster

Dual tDCS of the Parietal Posterior Cortex prevents fatigue during near-threshold visual stimuli detection

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Transcranial direct current stimulation (tDCS) of the posterior parietal cortex (PPC) can effectively modulate visuospatial attention. However, previous results are conflicting: some data evidence the role of PPC in biasing attention contra- or ipsilaterally depending upon stimulation polarity, as predicted by Kinsbourne's 'hemispheric rivalry account', others findings suggest that PPC controls spatial attention across the entire visual field.
We investigated the effects of two opposite polarities of dual tDCS over bilateral PPC (P3 and P4 of the EEG 10-20) on deployment of spatial attention during a visual detection task in healthy volunteers. Near-threshold luminous stimuli were presented, before and after dual tDCS of PPC (i.e. right cathodal-left anodal or RC-LA and, vice versa, RA-LC) or sham stimulation. RC-LA tDCS prevented fatigue on the detection task, compared to sham and RA-LC tDCS: detection performance dropped after RA-LC and sham stimulation but not after RC-LA. This effect was independent from the side of stimuli presentation.
Our findings support the role of PPC in top-down attentional control and suggest that dual right 'inhibitory' cathodal/left 'facilitatory' anodal tDCS of PPC enhances detection of near-threshold visual stimuli, regardless of hemifield. These findings may have important theoretical implications for translational research.

Sessione Poster 3

Poster

PREDICTING DREAM RECALL ACROSS LIFESPAN: A comparison of oscillatory EEG activity between young and older subjects

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Neural correlates of dreaming in elderly people are still largely unknown. Several studies in healthy young subjects showed that EEG background during sleep predicts the subsequent dream recall. It has been demonstrated a relationship between high-frequency and dreaming consistently with the “Activation Models”, while other studies point to a pivotal role of frontal theta oscillations during REM sleep for dream retrieval.
Our study aimed to investigate whether specific EEG oscillations during REM sleep in elderly may predict a subsequent dream recall (REC) or non-recall (NREC). Furthermore, we provided a comparison between young and older subjects on EEG correlates of dreaming.
Dreams of 20 young (mean age=23.48±2.76) and 21 older (mean age=69.19±6.07) were collected upon morning awakenings from REM sleep. Since conventional methods do not differentiate EEG power due to rhythmic versus non-rhythmic activity, the quantitative EEG analyses were performed by the Better OSCillation detection method separately for each frequency of interest (0-50 Hz) and electrode. To determine the individual’s frequency peak, we identified the bin corresponding to the highest oscillatory activity detected within the 0–50 Hz range, for each cortical derivation.
Our results showed the prevalence of oscillatory activity within the theta-alpha bands, compared to other frequency ranges, and significant differences between REC vs. NREC groups both in terms of frequency peak and amount of oscillations. Specifically, the statistical comparisons revealed that: a) older NREC group showed a lower peak frequency over centro-frontal areas than both older REC group and young NREC group; b) the REC showed a higher proportion of oscillatory activity than NREC over frontal and the right occipito-parietal areas; c) the older showed lower occipito-parietal and centro-frontal oscillatory activity than young group.
Our results confirmed that dreaming is related to prefrontal and occipito-parietal areas, as indicated by the several studies on neuropsychology of dreams. Accordingly, we demonstrated, for the first time, that the presence of dream recall in older individuals is related exactly to a greater amount of oscillatory activity in the theta-alpha range over occipito-parietal region than NREC. However, we underlined that elderly people show low-individual’s peak frequencies when they do not retrieve their mental sleep activity. This is consistent with the so-called “cortical slowing” in elderly people. Interestingly, the difference between older and young groups disappears in the case of successful dream recall, indicating that EEG correlates of dreaming do not significantly change across lifespan. Finally, under the assumption that oscillatory activity in the theta-alpha range is a marker of cognitive and sensory encoding, it has been confirmed that mental activity during sleep shared similar neurophysiological mechanisms with the waking state.

Sessione Poster 3

Poster

Sense of agency and obesity: evidence of the alteration of sensory attenuation mechanism in affected individuals.

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During voluntary actions, somatosensory predictions modulate the perception of both tactile and painful stimuli: intensity of self-generated stimuli are perceived as attenuated compared to the same stimuli generated by someone' else. This mechanism, known as *sensory attenuation* (SA), occurs when subjects perceive a cause-effect relationship between own actions and the sensory events: it has been proposed as an implicit marker of *sense of agency*. Coherently, in pathological conditions in which the sense of agency is impaired, such as in schizophrenia, SA is impaired as well.
Obesity is a complex medical-physiological and psychological condition, in which alterations of eating behavior are observed: one of the most frequent is the binge eating, in which the consumption of large amounts of food is associated with a feeling of loss of control over eating. This behavior can be interpreted as a difficulty to control impulses that, in turn, might be related to an alteration of the sense of agency. If obesity is associated with a decreased sense of agency, we might expect an impaired SA.
To test our hypothesis, we enrolled 16 individuals affected by obesity matched with 16 healthy-weight individuals. In the experiment, participants had to rate on a Likert scale the perceived intensity of *painful stimuli (*electric-shocks on the lateral dorsal section of the right hand), *during either* "self-generated" condition, when participants had to press a button with their left index finger to generate the stimulus, *or* "other-generated" condition, when the experimenter pressed the button. Subjective intensity ratings were analyzed by means of a 2*2 repeated measure ANOVA with *Condition* (self-generated vs other-generated) as within subject factor and *Group* (individuals with obesity vs healthy weight individuals) as a between subject factor. We found a significant interaction *Condition*Group* [$F_{(1,30)}$=13.73; p= 0.001]: only the control group showed a significant attenuation of the perceived intensity in the self-generated condition compared to the other-generated condition (p=0.002). Instead, no difference between the two conditions emerged about individuals with obesity (p=1).
This novel result might suggest an alteration of the sense of agency in obesity. Future research is needed to investigate its origin, considering that, in obesity, alterations of the sensory perception during unimodal and multimodal stimulations, as well as of pain perception, have been reported (bottom–up process). Moreover, obesity is known to be characterized by pervasive psychological concerns about body and social interaction, which might affect the SA, and thus the sense of agency (top-down process).
Keywords: obesity; sensory suppression; sense of agency.
Figure 1. Graphical representation of the significant interaction *Condition*Group.* * denotes a significant difference.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18016/add_1_477268_c216c1db-df30-4934-a6eb-b49343042eb9.jpg

Sessione Poster 3

Poster

Motor Representation in Acting Together

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Many of the things we do are done together with others. We play duets, move pianos together and drink toasts together. We also fill rooms with noise together, damage furniture together and spill drinks together. As these examples hint, acting together is sometimes but not always done with a purpose. Filling a room with noise is something that we typically do together, but it is not usually something done with a purpose. By contrast, in playing a piano duet we are acting together with a purpose in at least this sense: the actions we each perform in playing are directed to an outcome, the performance of the duet, and this is not, or not only, a matter of each of our actions being individually directed to this outcome.
Acting together with a purpose is puzzling in a way that just acting together is not. Given that actions are events, there is no special mystery about how actions in particular can collectively have effects such as filling a room with noise: this is just a matter of events having common effects. By contrast, it is less obvious how two or more actions might be directed to an outcome without this being merely a matter of each action being individually directed to that outcome. When people act together with a purpose, in virtue of what are the actions they perform collectively directed to outcomes?
At first glance you might think that existing discussions have long since settled this question by invoking shared (or 'collective') intention. I take it to be almost uncontroversial that this answer is correct in many cases. But does it cover *all* cases? Or are there cases in which some psychological structure other than, or additional to, shared intention is needed to explain in virtue of what actions performed in acting together are collectively directed to outcomes?
In this talk I shall argue that in some cases it is a certain interagential structure of motor representations which links actions to outcomes. When acting together with a purpose, it is sometimes motor representations rather than shared intentions in virtue of which actions are collectively directed to outcomes. In defending this claim, I shall examine first the possibility that, when people act together with a purpose, the outcomes to which their actions are collectively directed are sometimes represented motorically. Recent scientific discoveries suggest that this is indeed the case. I shall propose then a conjecture: motor representations of outcomes can be components of interagential structures, and these structures can facilitate interpersonal coordination of actions around the represented outcomes. Finally, I shall show that the conjecture is empirically motivated. Understanding in virtue of what the actions we perform in acting together are collectively directed to outcomes requires invoking not (or not only) shared intentions but (also) interagential structures of motor representation, or so I shall argue.

Sessione Poster 3

Poster

The role of movement kinematics in neural chain selection during action observation.

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The ability to understand intentions based on another's movements is crucial for human interaction. This ability has been ascribed to the so-called *motor chaining* mechanism: any time a motor chain is activated (e.g., grasp-to-drink), the observer attributes the corresponding intention to the agent (e.g., drinking) from the first motor act (e.g., the grasp-to). However, the mechanisms by which a specific chain is selected in the observer remain poorly understood. In this study, we investigated the possibility that, in the absence of discriminative contextual cues, slight kinematic variations in the observed grasp inform mapping to the most probable chain. Chaining of motor acts predicts that in a sequential grasping task (e.g., grasp-to-drink), electromyographic (EMG) components that are required for the final act (e.g., mouth-opening mylohyoid muscle, MH) show anticipatory activation. In Experiment 1, we tested this prediction by measuring MH activity during the execution of grasp-to-drink and grasp-to-pour actions. Having established that MH activity selectively anticipates the execution of drinking, in Experiment 2, we combined predictive models of movement kinematics with transcranial magnetic stimulation (TMS) to ascertain whether MH excitability during action observation, assessed by motor evoked potentials (MEPs), varied as a function of the kinematics of the observed act (grasp-to-drink vs. grasp-to-pour) in the absence of discriminative contextual cues. We found that at grasp contact, MEP areas were significantly larger during the observation of grasp-to-drink compared to during the observation grasp-to-pour actions. Our results provide the first demonstration that, in absence of discriminative contextual cues, subtle changes in movement kinematics drive the selection of the most probable motor chain, allowing the observer to link an observed act to the agent's intention.

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Poster

Cannabinoid receptor type 1 function affects mood homeostasis in multiple sclerosis

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Background: the type-1 cannabinoid receptors (CB1Rs) are heavily involved in multiple sclerosis (MS) pathophysiology, and a growing body of evidence suggests that mood disorders reflect specific effects of cytokines on neuronal activity. We have previously demonstrated that the loss of sensitivity of CB1Rs in the striatum represents a synaptic counterpart of the anxious-depressive state induced by chronic stress and by central inflammation. The effects of proinflammatory cytokines on CB1R function is relevant for the pathophysiology of mood disorders associated with animal models of MS (i.e. experimental autoimmune encephalomyelitis, EAE), supporting the concept that inflammatory cytokines are involved in emotional disturbances in this neuroinflammatory condition and, possibly, in MS by interacting with the endocannabinoid system.
Objective: to explore in a group of MS patients the influence of different single nucleotide polymorphisms (SNPs) of the CB1R gene (CNR1) on clinical measures of anxiety and depression. Moreover, we tested in mice the effect of genetic ablation of the CB1R on the behavioural consequences of EAE induction.
Methods: we explored in a group of 110 MS patients the association between 4 different SNPs of CNR1 gene and clinical, neuropsychological and psychometric measures. In addition, in wild type (WT) and CB1R-KO mice the behavioural measures of anxiety and depression were explored before and after EAE induction.
Results: a significant association emerged between CNR1 rs806368 polymorphism and the presence of mood disorders in MS patients. In particular, patients presenting the C allele (CC or CT) showed higher scores in clinical scales exploring the presence of anxiety and depression. No significant correlations emerged between clinical characteristics and the other SNPs of CNR1 gene explored. Experimental data showed that CB1R-KO mice were significantly more anxious than WT either before and after the induction of EAE.
Conclusions: these results confirm that cannabinoid system is involved in the genesis of mood alterations in MS. In particular, enhanced CB1R function could exert a beneficial effect on mood in MS patients. Nevertheless, the observation that in mice the genetic ablation of the CB1R induces anxious behaviour per se, suggests that the endocannabinoid system could represent a key regulator of emotional homeostasis even independently of neuroinflammation.

Sessione Poster 3

Poster

Using TMS-EEG to better understand the effects of cathodal direct current stimulation on cortical excitability and connectivity

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Despite transcranial direct current stimulation (tDCS) is a widely used non-invasive brain stimulation techniques, the cathodal tDCS effects on task performance are still controversial and unclear. A deeper understanding of the plastic changes induced by cathodal tDCS would be crucial to improving the refinement of stimulation protocols for clinical and research purposes.
In a previous study, we investigated the effect of cathodal tDCS on cortical excitability at a resting state, using a combination of Transcranial Magnetic Stimulation (TMS) and Electroencephalography (EEG). Results showed no significant modulation effects during and after cathodal stimulation in comparison to a pre-tDCS session. In the present study, we used the same paradigm to study the effect of cathodal tDCS during a task. Single TMS pulses were delivered over the left posterior parietal cortex (PPC), before and after 15 minutes of cathodal or sham tDCS over the right PPC, while recording hd-EEG. During the tDCS stimulation, the subjects were involved in a Posner task that requires visual-attentional abilities, likely involving the PPC. We opted for the Posner task in our experimental protocol on the basis of the results of a pilot study in which we found that cathodal tDCS over the right PPC reduced the performance at the same task, increasing reaction times.
As in the previous study, we estimated the indexes of global and local cortical excitability, both at sensors and cortical sources level. At sensors, global and local mean field power (GMFP and LMFP) were computed for three temporal windows (0-50, 50-100 and 100-150 ms), in all channels (GMFP), and in four different clusters of electrodes (LMFP, left and right, in frontal and parietal regions). After source reconstruction, Significant Current Density was computed at a global level, and in four Broadmann's areas (left/right BA 6 and 7). At a behavioural level, we expected to replicate the results of the pilot study; while at a neurophysiological level we predicted a reduction of cortical excitability only in the areas strictly involved in the task performance. Such results would confirm the hypothesis of a causal interaction between the spontaneous ongoing cortical activity and the electric stimulation.
Keywords: cathodal tDCS, TMS-EEG, cortical excitability, Posner task

Sessione Poster 3

Poster

Pain pathways dysfunction in patients with Fibromyalgia: a clinical, neurophysiological and skin biopsy evaluation

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Fibromyalgia (FM) is a disorder of uncertain origin associated with widespread pain, tenderness, muscular spam, fatigue, sleep disturbance and cognitive dysfunction. Abnormalities in pain processing appear to play an important role in the pathophysiology of FM. A dysfunction of pain processing at central and peripheral level was reported. A reduced habituation of nociceptive evoked potentials is the neurophysiological sign of abnormal central elaboration of pain in patients with FM. The co-existence of neuropathic features of pain and the finding of small fiber axonal loss in these patients, has raised the question of whether the pain in FM is actually a neuropathic phenomenon. In this study we aimed to explore the presence of changes of the peripheral nociceptive pathway, the possible correlations with the disfunction in the central pain processing and with the comorbidity with migraine and inflammatory/dysimmune and psychiatric pathologies in patients with FM. 63 FM patients underwent Laser Evoked Potentials (LEPs) by the right hand, knee and foot and skin biopsy from the right thigh (PTH) and right ankle (DL). The clinical evaluation explored the presence of comorbidities, WPI and SS score, Zung Self-Rating Anxiety Scale (SAS), Zung Self-Rating Depression Scale (SDS), Fibromyalgia Impact Questionnaire (FIQ), Visual analogue Scale (VAS) after laser stimulation series. Skin biopsy impairment, with a reduction in the density of small fibers, was found in about 80% of patient in PTH and 16% in the DL. A reduced habituation of the laser stimulus has been detected for all stimulation sites, with a tendency to the increase of the response evoked by the repeated laser stimulation of the knee and the foot. We didn't find a significant correlation with skin density, and Knee and foot N1 and N2P2 amplitude. Regarding clinical features, migraine was present in the 51% of cases, psychiatric comorbidity in the 25,5%, autoimmune diseases in the 21,6%; pain diffusion, as measured by WPI, prevailed in patients with associated migraine and psychiatric comorbidity (linear regression analysis: 10.74 p 0.0033). The FIQ seemed reduced in patients with compromised distal epidermal fibers (linear regression analysis -2.12 p 0.040). The presence of auto-immune diseases and proximal neuropathy did not influence FM features. Fibromyalgia patients have shown biopsy findings of non-length-dependent small fiber neuropathy. Reduced habituation to laser pain is a feature of Fibromyalgia. Migraine and psychiatric comorbidities could account for a more severe pain diffusion, confirming that FM phenotype is mainly explained by a disturbance of pain modulation at central level. Further studies are needed to explore if the peripheral involvement of the small fibers can cause the impairment of the central modulation of pain systems or, on the contrary, the peripheral involvement of the small fibers may be the consequence of the impairment in central nociceptive processing.

Sessione Poster 3

Poster

Improving balance control with the placebo effect

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Balance is a very important human motor function, as it allows us to maintain a stable and upright stance needed for many daily life activities and for preventing falls. In the present study, we aimed at investigating whether balance control could be improved in healthy participants by a placebo procedure consisting of verbal suggestion, with the potential future aim of exporting this approach to patients affected by postural deficits.
Thirty healthy participants were recruited and randomized in two groups (placebo vs. control). Participants were asked to perform a single-leg stance task in three sessions (T0, T1, T2). In each session, subjects were told to stand on the floor as steadily as possible with the dominant leg for 30 seconds while keeping the arms along the body. The task was repeated for 10 trials in each session. Before T1 and T2, we applied an inert treatment on the gastrocnemius muscle with different verbal information to the groups. The placebo group was informed about the positive effects of the treatment on balance. Conversely, the control group was informed that it was completely inert.
Sensors were applied to participants' leg in order to measure legs displacements during the task. To evaluate balance control, we defined two indexes: relative leg angle (RLA) and normalized hip displacement (NHD), as measures of the discrepancy between the current position of the leg and the position obtained at the beginning each trial. We defined RLA and NHD in different ways: as the mean value of maximum RLA and maximum NHD obtained in the three-dimensional space, in the frontal plane (representing the body sway in the lateral-medial direction) and in the sagittal plane (representing the body sway in the anterior-posterior direction). Higher values of RLA and NHD represent worse balance control. Additionally, subjective parameters were also collected, like perception of stability, expectation of the treatment and perception of treatment efficacy.
Results showed that the placebo group showed lower levels of RLA and NHD than the control group at T2, both in the three-dimensional space and in the frontal plane (and with a tendency also in the sagittal plane). Furthermore, the placebo group perceived to be more stable than the control group.
In summary, this study represents the first behavioural evidence that a placebo procedure in the motor domain can also improve balance control and perception of stability**.**

Sessione Poster 3

Poster

RP11-819C21.1 and ZNRD1-AS long non-coding RNA changes following painful laser stimulation correlate with laser-evoked potential amplitude habituation in healthy subjects

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Introduction: Long non-coding RNAs (lncRNAs) are a heterogeneous group of non-coding RNAs of 200 nucleotides in length that act as regulators of gene expression through interaction with histones or through interaction with complementary DNA sequences and they are implicated in various human diseases such as cancer, cardiovascular diseases, autoimmune and neurodegenerative disorders. Moreover, lncRNAs have been reported to be involved in the modulation of neuropathic pain. We aimed to study whether: 1) lncRNAs modifications could be found in an experimental model of pain and 2) there was a correlation between the lncRNA changes and an objective measure of pain perception, such as laser evoked potential (LEP) amplitude.
Methods: LEPs were recorded from 12 healthy subjects to both left hand and perioral region stimulation. Three consecutive averages were calculated for each stimulation site in order to investigate the LEP amplitude habituation. Serum from blood samples were obtained immediately before LEP recording (baseline) and 30 minutes after the recording of the last LEP average (post-pain). We screened 84 lncRNAs, involved in autoimmunity and human inflammatory response.
We used the following criteria for lncRNAs analysis: fold change >2 and $p < 0.05$.
Results: By Real-Time PCR, we identified 2 lncRNAs up-regulated at the post-pain time, as compared to the baseline: *RP11-819C21.1* (fold change=8.2; p=0.038) and *ZNRD1 antisense RNA 1 non-protein coding* (*ZNRD1-AS*) (fold change=6.3; p=0.037). We found that the up-regulation of both lncRNAs showed a significant positive correlation with the LEP habituation to perioral region stimulation (p=0.04 and p=0.01, respectively).
Conclusions: This is the first study showing lncRNA changes in an experimental model of pain. Moreover, *RP11-819C21.1* and *ZNRD1-AS* shows as direct target *miR-19a* and *miR19b*, a class of microRNAs involved in the modulation of multiple potassium channel α subunits.
The correlation between the up-regulation of 2 lncRNAs and the LEP amplitude habituation suggests that these lncRNAs could be involved in the pathophysiology of painful diseases characterized by reduced habituation to pain, such as migraine and fibromyalgia.

Comunicazioni orali libere 2

Presentazione Orale

Perceived emotional experience explains brain activity elicited by an emotionally-charged movie in an independent sample

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Introduction: Everyday life is greatly influenced by emotions, complex states considered stable across cultures(PMID:3681648), that can arise simply by observing social interactions. Indeed, during movies viewers can easily relate to the events and characters' states, ultimately leading to emotional contagion. Here, we tested whether the timecourse of inner emotional experience elicited by an emotionally-charged movie could explain brain hemodynamic activity in an independent sample exposed to the same stimulus. **Methods:** We employed fMRI data of 14 subjects (6F, age range 20-40), available at studyforrest.org (GRE-EPI, TR 2s, TE 30ms, FA 90°, 3599 tps): anatomical images were brain extracted, intensity adjusted and non-linearly transformed to match the MNI152 (ANTs, AFNI). Functional data were thoroughly preprocessed, smoothed (6mm FWHM, 3dBlurToFWHM), corrected for phase distortion and warped to match the MNI152. We ruled out confounding effects of signal drifts, head motion and heartbeat on brain activity (3dDeconvolve). Preprocessed data were averaged across subjects and temporally smoothed (moving average: 10s window). Further, low-level acoustic and visual features of the movie were regressed out from group-level activity. Twelve independent subjects (5F, age range 24-34) were asked to give a rating of the perceived intensity of 6 basic emotions (happiness, surprise, fear, sadness, anger and disgust) throughout the movie. The resulting 6 regressors of interest were downsampled to match the fMRI temporal resolution, averaged, lagged to consider the hemodynamic delay (2s) and temporally smoothed (10s window). A Principal component (PC) analysis on the group-level emotional rating identified 6 orthogonal dimensions and voxel-wise encoding was performed to measure the association between brain activity and this model (6 PCs). We assessed the significance of the fitting with a permutation approach which generated 10000 null encoding models, obtaining a null distribution against which the actual behavior-to-brain activity association was tested. **Results:** The first 3 PCs were interpreted as measures of polarity (valence), conflict (ambivalence; positive and negative emotions having the same load) and intensity (arousal); together they explained ~85% of the variance. After correcting for multiple comparisons, the activity of a set of brain regions, mainly located in the right hemisphere and including the inferior and rostral middle frontal gyri, the precentral sulcus and the posterior superior temporal sulcus/temporoparietal junction, was significantly associated to our emotion dimensions model. **Conclusions:** Here, we demonstrated that the inner emotional experience of subjects during an emotionally-charged movie, measured through a continuous behavioral rating and expressed by an emotion dimensions model, explains brain activity changes in an independent sample.

Comunicazioni orali libere 2

Presentazione Orale

Functional connectivity methods to study large-scale synchronization in ongoing brain activity with MEG

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In the last 20 years system neuroscience has seen a paradigm shift in the way ongoing brain activity is considered, moving away from the concept of idling state towards the idea of a spatiotemporal substrate shaped by experience. A prominent role in this framework has been played by functional Magnetic Resonance Imaging with the notion of resting state networks (RSNs), only more recently non invasive electrophysiology and specifically EEG/MEG functional connectivity have contributed along this line.
While the latter techniques have the clear advantage to be able to detect frequency specific brain networks in the range 1-100 Hz, they require solving an electromagnetic inverse problem to infer connectivity among brain regions. The solution of the inverse problem results into sets of vector signals, as compared to channel data which are sets of one-dimensional signals. Usually, these vector signals are reduced to a scalar by imposing orientation constraints prior to estimating connectivity. This procedure can nevertheless be suboptimal, since it can lead to neglecting a significant part of the actual sources connectivity.
Here, I propose novel measures for frequency resolved functional and directed connectivity which, being multidimensional in nature, do not require the dimensionality reduction step. Namely the Multivariate Interaction Measure (MIM) and the Multivariate Phase Slope Index (MPSI) will be introduced, which, being a multivariate extension of the Imaginary Part of Coherency (ImCoh) and of the Phase Slope Index (PSI), are less sensitive to source-leakage effects. We designed extensive simulations with several ranges of complexity and biological plausibility, the results of which show that the multivariate methods detect meaningful connectivity patterns with superior reliability in comparison to their bivariate counterparts, i.e. ImCoh and PSI.
The methods are also applied to resting state magnetoencephalographic data (3 sessions lasting 5 minutes each) from 61 subjects acquired in the framework of the Human Connectome Project to derive directed coupling between brain areas. Specifically, we investigated the coupling within the extended visual system and between this and other brain systems in the alpha band (8-12 Hz). The results show that the multivariate approach detects more connected areas in comparison to the bivariate ones. Last but not least, the relevance of the results attained with the multivariate methods to neuroscience is discussed in the framework of RSNs. As an example of the findings provided by the MPSI, a clear pattern of directed coupling from the bilateral parietal cortices to the primary visual cortex is detected in the alpha band which could index a top-down mechanism exerted by the parietal cortices over the primary visual cortex in the resting brain similar to that observed in visual attention tasks.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18016/add_1_467726_069f3f72-a58d-4a3d-94bb-690257fc8224.png

Comunicazioni orali libere 2

Presentazione Orale

Network-targeted vs bifocal tDCS: effects on resting-state fMRI functional connectivity

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Non-invasive brain stimulation (NIBS) techniques allow to directly target regions of interest within the brain. Recently, the importance of brain functional networks has further driven research efforts from traditional bifocal stimulation montages toward multi-electrodes arrays, enabling to target multiple network nodes. Here we used concurrent tDCS/fMRI to compare two tDCS approaches targeting the motor system, i.e. traditional (bifocal) tDCS focused on the left motor cortex, and a multi-electrodes tDCS array optimized to target the sensorimotor fMRI resting-state network (RSN). Twenty healthy participants were recruited and underwent both active and sham stimulation while at rest in the MRI scanner. Half of the subjects were randomly assigned to either bifocal or network-targeted tDCS. For both groups, fMRI data were acquired before, during and after stimulation. At the end of each session, a questionnaire investigating the sensations elicited by tDCS was also administered, assessing montage-specific scalp sensations and potential discomforts. Network-targeted and bifocal stimulation were evaluated in their effectiveness to modulate BOLD-related activity over the target network as well as seven other RSNs identified by means of Independent Component Analysis (ICA). Network stimulation induced greater right motor cortex BOLD activation as compared to bifocal tDCS, both during and immediately after stimulation. Outside the motor network, involvement of additional RSNs was observed in both conditions, especially over visual and fronto-parietal network nodes (for bifocal and network-targeted interventions respectively). Moreover, the effect of network-targeted tDCS in engaging brain networks was confirmed by the modulation of functional connectivity between the stimulated areas (i.e. sensorimotor network) and their most negatively correlated brain region. Nevertheless, both approaches were found to elicit comparable subjective sensations. Network-targeted tDCS is a promising tool for brain networks modulation, however further optimization of electrodes placement and current distribution are needed to enable a reliable comparison with canonical tDCS approaches.

Comunicazioni orali libere 2

Presentazione Orale

Breathing avatars probe impact of respiratory, visual and spatial signals on bodily awareness

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Recent theories posit that visceral signals contribute to corporeal awareness – the basic feeling that one has a body (body ownership) which acts according to one's will (body agency) and occupies a specific position (body location). However, these signals are notoriously difficult to manipulate. Using immersive virtual reality, we found that an ecological mapping of real respiratory patterns onto a virtual body led to illusory changes of corporeal awareness. This new bodily illusion, called 'embreathment', revealed that breathing uniquely influences corporeal awareness over and above other bodily cues. In particular, breathing turned out to be almost as important as visual appearance for inducing body ownership, and more important than any other cue for body agency. By showing that respiratory, visual and spatial signals exert an interoception-mediated, specific, and weighted influence on the fundamental feeling that one is an embodied agent, we provide a comprehensive hierarchical model of corporeal awareness.

Comunicazioni orali libere 2

Presentazione Orale

Cognitive Reserve: an index for the choice technologic or conventional rehabilitation

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Rehabilitation plays a central role in neurological diseases recovery and it is constantly evolving and needs further evidence. It is strongly encouraged a personalized therapy. This is particularly critical because now different rehabilitative approaches are available. Besides conventional therapy, rehabilitative technological treatments have become available. About technological rehabilitation, its effectiveness, efficiency and appropriateness are not yet well defined, hence researches focused on different variables impacting the recovery in neurological disease are urgently needed. Recently, results from literature identified a variable impacting on the cognitive outcome of rehabilitation: Cognitive Reserve (CR). CR is the cultural baggage of the premorbid life and influences the ability to cope with brain damage thanks to pre-existing cognitive processes. In a very recent research, results have shown the relationship between CR and rehabilitative motor outcome in Parkinson disease: patients with higher CR, treated with conventional rehabilitation, benefit less than patients with a lower CR. This is likely because patients with a higher CR need to be more motivated and cognitively stimulated than conventional rehabilitation can do
The aim of our study is to evaluate whether the CR influences the motor outcome in patients after stroke treated with conventional or robotic therapy and if CR may address towards one treatment rather than another.
Seventy-five patients were enrolled from five centers of the Don Carlo Gnocchi Foundation (Milano, Firenze, Marina di Massa, Fivizzano, Roma). Patients were assigned either to a Robotic group (RG), rehabilitation by means of robotic devices, or to a Conventional Group (CG), where a traditional approach was used.
Patients were evaluated at baseline (T0), after rehabilitation treatment of 6 weeks (T1) through Motricity Index (MI) and Barthel Index (BI). CR was assessed at T0 using the Cognitive Reserve Index questionnaire (CRIq).
In the CG a positive linear correlation was found between the CRI related to leisure time and MI evolution (r:0.39; p=0.013). Among the patients who performed a robotic rehabilitation a positive linear correlation emerged between the CRI related to working activities and the MI evolution (r:0.41; p=0.011). No correlations between the CR score and the change in the BI were found.
Our results showed that CR may influence the motor outcome and, in particular, CR-Leisure Time and CR-Working have a different impact on the two treatments performed. For each patient, the CR and its subcategories should be considered in the choice between conventional and robotic treatment.
In conclusion, technological rehabilitation requires an important research effort to exploit its potential. Further studies will have to focus on various aspects: cost/benefit ratio, technology/patient interface, characteristics of future generations of patients, etc.

Comunicazioni orali libere 2

Presentazione Orale

Unattended shape formation: coding of complex objects during passive viewing

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We can easily recognize objects under different lighting conditions, or from multiple view-points. This is possible because object features are continuously extracted and processed along our visual pathways. Even if, our understanding of these processes has greatly improved in recent years, two questions still remain unanswered: where are transformation-resistant features of complex shapes encoded? And, is the process of shape formation occurring even when attention is diverted from the objects in a scene?
To answer these questions, we used functional MRI to acquire brain activity in 14 healthy adults fixating grayscale pictures of common-use and unfamiliar objects, while performing a feature-based attention task directed towards an unrelated distractor property (i.e., the color of the fixation cross). A representational-based searchlight encoding procedure was employed to disclose the unique predictive impact of five competing models: two low-level descriptions (i.e., silhouette and inked area), two resistance-invariant shape representations (i.e., contour curvature and medial axis transform) and object category. For each model, we obtained a Threshold Free Cluster Enhancement (TFCE) corrected map, representing the group-level similarity between each model and brain activity.

Most of ventral and dorsal stream preferentially represents low-level information, while categorical representation shows a better predictive accuracy in a limited number of parietal voxels only. However, portions of left posterior fusiform gyrus, left parahippocampal gyrus, bilateral inferior temporal cortex and posterior intraparietal sulcus preferentially encode resistance-invariant representations of shape, with curvature being more represented than medial-axis.
By considering several competing shape descriptions, these results reveal which cortical areas encode transformation-resistant object representations. The low performance of the categorical model can be explained by the task design, which specifically aimed at minimizing the impact of semantic knowledge (most objects were unfamiliar to the subjects, and stimuli were projected for 500ms only); however, the encoding of transformation-resistant shape features is a remarkable evidence that shape formation occurs even when attention is diverted from viewed objects - i.e. when they are in the background. Moreover, we observed that, as transformation-resistance increases, the cortical representation devoted to these shape features decreases, suggesting a cortical transition from stimulus-specific/task irrelevant to stimulus aspecific-task oriented representations, whose balance is probably modulated by an attentive mechanism. These results challenge compartmentalized and hierarchical theories of object processing, calling for a model-based definition of shape in neuroimaging studies.

Comunicazioni orali libere 2

Presentazione Orale

Evaluation of Gamma-band activity after painful cutaneous laser stimuli

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In the pain literature, different EEG studies have found an increase in high-frequency oscillations (gamma-band) between 150 and 350 milliseconds after painful laser stimulations. Some researchers found that this is related to subjective pain perception. However, there is still debate about the existence and relevance of gamma-band oscillations in pain processing as it is difficult to disambiguate muscular artefacts from brain activity. A topographical investigation of the gamma-band activity can give some insight as we expect the gamma-band oscillations induced by pain to be present around central somatosensory electrodes while high-frequency oscillations around temporal electrodes would be more suggestive for muscular artefacts. In a group of 21 healthy controls and 21 migraine patients without aura, we investigated whether and when increased gamma activity can be found after laser stimulation. Both groups received 15 laser stimulations on the dorsum of their right hand and 15 on their right forehead. The data was preprocessed, with special attention to removing muscle artifacts, in MATLAB, using EEGLAB. Time-frequency analysis was performed by using complex Morlet wavelets. For every subject, the median over trials was calculated and the data was then converted to decibel change from baseline. As baseline we considered the time between 1500 and 800 ms before laser onset to avoid expectation reactions. Decibel change in power from baseline between 70 and 90 Hz was averaged for every subject to represent gamma-band activity. Then for each group separately we tested at every time-frame and every electrode whether this gamma-band activity is significantly different from baseline activity (i.e., H0: dB change from baseline = 0). Nonparametric permutation (1000 permutation, randomly shifting time-series) one-sample t-tests were used with the maximum statistic approach to correct for multiple testing. For both groups we did not find significant changes in gamma-band activity with respect to baseline. Further analyses on a larger sample with a multitaper time-frequency analysis could clarify if high-frequency oscillations occurring in bursts are less time-locked to the stimulus and thus cancel out when aggregating trials. Finally, further analyses could clarify if the variability in gamma-band activity after laser stimulation is associated with clinical features, or to other factors.

Comunicazioni orali libere 3

Presentazione Orale

Wired actions: How the representation of others' upcoming movements shapes our kinematics.

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Our actions occur hardly ever in a lonely environment. Most of the times, we act jointly with other people. We walk, work or play games together.
A vast literature suggests that our movements are different in a social setting (Becchio et al., 2010; Krishnan-Barman et al., 2017), and that they are highly influenced by other people's movements. Indeed, when we observe someone else performing an action, our motor cortex becomes active, and when the action is different from ours, a motor interference effect can occur.
Interestingly, recent studies have shown that when the nature and the onset time of an upcoming action are known, the observer's motor system activates even prior to the onset of the other agent's movement (Kilner et al., 2004). This seems to suggest the existence of a sophisticated prediction system, useful to interact and to coordinate with others by anticipating their movements. These findings however open the way for new questions: what is the level of specificity of this early motor activation? Is it a general, unspecific activation, or does it include specific kinematic information about the upcoming movement?
To answer these questions, we investigated the characterization of movement kinematics in pairs of participants performing a sequential motor task together, where they had to move a pawn towards different targets. While the first agent's task was kept constant throughout the entire experiment, the actions of the second agent varied in difficulty depending on the size and the position of his target. Results showed that the kinematics of the first agent were influenced by the action that his partner would have performed immediately after. Moreover, this effect seemed to be movement-specific, suggesting that the interference observed on the first agent was not simply related to the difficulty of the other's task, but that it was related to the specific kinematic profile that the other agent was about to carry out.
These results explore and expand previous findings on predictive motor activation, suggesting that, when the upcoming action is known, this activation can be very specific, tightly related to the precise kinematics that the other will display. This seems to suggest that people do not simply predict *that* their action-partner will move, but that they can predict *how* he will move, in a motor-specific way.

Comunicazioni orali libere 3

Presentazione Orale

The predictive nature of human interactions in the ventral premotor cortex neurophysiology

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Action observation triggers imitation, a powerful mechanism supporting interpersonal coordination. Coordination, however, also occurs when the partners' actions are non-imitative, like for dancing or playing different instruments in a duet, providing that the partners share a common goal. This suggests that shared goals tune how the brain processes the gestures of others, a hypothesis that we aimed to test here. Specifically, we aimed to characterize the neurophysiological signatures describing how a partner's action is represented as a motor interaction unfolds.
In two experiments, we tested with functional magnetic resonance imaging (fMRI) whether the neural correlates of action observation are modulated by the presence (Interactive condition) or absence (Non-interactive condition) of a collaborative goal shared by the interactive partners. Crucial for our aims, both perceptual features and low-level motor requirements were kept constant throughout the Interactive/Non-interactive social contexts, and trials required either imitative or non-imitative responses to the partner's movements.
Whole-brain analyses showed that the recruitment of the left ventral premotor cortex (lvPMc) was strongly modulated by task interactivity: it was activated during interactions when participants had to infer the shared goal from observation of the partner, but not when observation occurred in perceptually-matched non-interactive contexts, independently of action congruency, i.e., both in imitative and non-imitative exchanges. In a second fMRI experiment, we show that the same portion of the lvPMc was responsible for anticipating the conclusion of observed actions during an explicit action-prediction control task.
Altogether, these results show that task interactivity shapes the sensorimotor mechanisms involved in action observation: the presence of a shared goal guides motor planning in interactive settings, generating motor predictions for cooperation beyond low-level imitation.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18016/add_477475_f03e9b72-b3ff-49ee-889e-c6dacb6ddd2b.png

Picture 2: https://www.eventure-online.com/parthen-uploads/175/18016/add_1_477475_f03e9b72-b3ff-49ee-889e-c6dacb6ddd2b.png

Comunicazioni orali libere 3

Presentazione Orale

The disinterested interest: aesthetic appreciation inhibits motor response

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ABSTRACT

From Kant to current empirical aesthetics, the perception of beauty has often been described as *disinterested,* i.e. focused on the stimulus perceptual features and neglecting self-referred concerns. Neurophysiological evidence suggests that *disinterest* might reflect the enhancement of attention and concomitant inhibition of motor response induced by the perception of beautiful objects.
To test the *motor inhibition hypothesis* we registered the EEG of 22 healthy participants while they were asked to: judge the beauty of musical chords (aesthetic judgement task); to press a button as soon as they heard a chord (Detection task). In a third Experiment 22 healthy participants performed a Go-NoGo task where they had to press a button only when hearing white noise and avoid responding when chords were presented.
Single subjects' mean aesthetic judgements for different chord types were found to be positively correlated to response times of the detection task, evidencing slower motor responses for more appreciated chords. Secondly, electrophysiological indexes of attentional engagement and motor inhibition were enhanced for more appreciated chords: P2 and N2 components registered during the aesthetic judgement task, as well as N1 and P3 amplitudes registered during the Go-NoGo task, were significantly correlated to aesthetic judgements, while N2 amplitudes registered during the detection task were correlated to response times.
We suggest that the perception of beauty constitutes an evolutionary advantageous feedback on knowledge acquisition dynamics, signalling to the cognitive system the profitability of focusing on present stimuli with high informational value, instead of actively sampling sensory inputs through action.

Figure caption

Panel **A** shows grand-average auditory evoked potentials (AEPs) recorded during the Aesthetic Judgement task. AEPs elicited by different chords during the *Detection* and *Go-Nogo* task are represented in panel **D** and **H** respectively. Waveforms were similar among fronto-parietal electrodes. Therefore, we only show amplitudes at F_z. Shaded areas represent significant time-clusters evidenced by the point-by-point ANOVA. Scalp-maps represent voltage distribution registered during the AJ (panel **B**) and *Detection* task (panel **E**) at 100 ms (N1), 200 ms (P2), 260 ms (N2). Panel **I** shows voltages on the scalp registered at 310 ms post-onset (P3) during the *Go-NoGo* task.
Panels **C**, **F** and **J** depict AJs from *Experiment 1,* RTs from *Experiment 2* and AJs from *Experiment 3*, respectively. Significant differences in AJs and RTs of different chord types evidenced by two-tails t-tests are represented by asterisks, with one asterisk representing $p<0.05$ and two asterisks representing $p<0.01$.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18016/add_1_469058_93f65c39-cb59-432c-90a4-cce37e1790c7.png

Comunicazioni orali libere 3

Presentazione Orale

Body representation modulates the perception of space for action after a Spinal Cord Injury

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Our body is the most fundamental tool for interacting with objects and people in the environment. Moreoverour t body modulates many cognitive functions, such as space representation (*1*, *2*), action representation (*3*, *4*).
Individuals affected by a complete spinal cord injury (SCI) have the part above the lesion with normal sensorimotor functions, and the part below the lesion, with complete paralysis and anaesthesia (*5*). However, they do not have direct damage in the brain, a characteristic that makes SCI results very interesting for the debate concerning the embodied cognition theories (*6,7*).
This study aims to investigate the integration between body, space and action representations by means of two experimental tasks.
In a first task, the embodiment of the wheelchair was tested, by exploiting the body enhancement effect (i.e., stimuli administered to the body are detected faster than those administered elsewhere). SCI participants were requested to click on a mouse-key when they saw an LED flashing. 12 LEDs were positioned on their trunk and legs and on the wheelchair in three counterbalanced conditions: i) when they were sitting in their wheelchair, ii) in another wheelchair, or iii) with the LEDs on a wooden bar. Results show the response of embodiment only for the LEDs positioned on the upper body parts (not on the deafferented legs) and on the participants' wheelchairs (not in the others' wheelchair) (see Figure 1).

Figure 1 about here
Caption: Bayesian Posterior Distributions of the Body Enhancement Effect Task. The boundaries of the boxes are the 97% Highest Density Interval, the line in the middle is the mode and the whiskers are the limits of the whole distribution. Boxes connected by the lines are different among them.
Moreover, we studied if the embodiment of the wheelchair can modulate the extrapersonal space representation. SCI participants, after executing some simple exercises on their own and others' wheelchair, were asked to estimate a series of different slopes of a ramp and the distance of a flag displayed in virtual reality. The results show that when sitting in their own wheelchair, participants estimated the spatial distance to be shorter than when sitting in another wheelchair.
Taken together these results offer the first evidence that the body representation may modify the perception of extrapersonal space where an individual could moveor imagines to move.
These results, along with previous data on the effects of deafferentation and deefferentation in cognition, hint at the crucial role of somatosensory and bodily representation in building, modulating and maintaining cognitive functions.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18016/add_1_477646_8731f00c-6ea8-4ab1-a93e-ee1572822939.png
Caption 1: Bayesian Posterior Distributions of the Body Enhancement Effect Task. The boundaries of the boxes are the 97% Highest Density Interval, the line in th

Comunicazioni orali libere 3

Presentazione Orale

Different rhythm modulations serve different mechanisms during reorienting of visuospatial attention

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Background Endogenous maintaining and reorienting of visuospatial attention toward stimuli which appear within or outside the attended location are mediated by dorsal attention network (DAN) which biases activity of the visual cortex (VIS) (1). While neurophysiological studies have focused on local oscillatory mechanisms associated with attentional orienting and reorienting to unexpected targets, little is known about cortical dynamics involved in endogenous reorienting. Here we investigated the differences between the time-frequency profiles of activity in DAN and VIS during reorienting versus maintenance of attention and their link with task performance.
Methods We recorded MEG activity in 18 healthy subjects during an attention task in which cues indicated either to maintain (stay cues) or to reorient covert attention (shift cues) toward one of two peripheral locations to detect visual targets (1). In regions of DAN (dFEF, SPL, pIPS) and VIS (MT, V3a-V7, V4-V8) we examined how attentional operations modulated the dynamics of rhythms (event-related desynchronization and synchronization - ERD/ERS) in different frequency bands (δ, θ, α, β, γ). For each condition (i.e. ipsilateral/contralateral stay/shift cues) we extracted duration, latency and amplitude of ERD/ERS peaks. ANOVAs were conducted for each band with Network (DAN, VIS), Cue Type (stay, shift) and Hemisphere (contra, ipsi) as within-subject factors. For shift cues only, ANOVAs with band as factor were conducted on ERD/ERS dynamic properties to compare across-band timings.
Results Shift versus stay cues induced stronger ERS in θ band (p<0.05). Notably, the peak latency of θ ERS occurred prior to power modulations in other bands (all p-values<0.05). After θ ERS, prolonged shift-related ERD of β band was observed in DAN regions (p<0.05; especially in dFEF, p<0.01) that was further related to better target discrimination (r=0.7, p<0.005). In addition, shift cues induced spatially selective modulations of ERD/ERS in α (p<0.005; ERD amplitude shift contra>shift ipsi) and γ (p<0.05; ERS duration shift contra>shift ipsi) bands, specifically in the VIS. Notably, ERS in γ band was the latest in visual cortex.
Discussion The present results suggest that the shift of attention involved a combination of frequency-specific power modulations, possibly encoding different events that unfolds during the process. First, the early and stronger ERS in θ band suggests its involvement in an early phase of the shift, possibly related to the breakdown of the current state. The prolonged shift-related ERD of β band might represents the neural correlate of control signals exerted from DAN, especially from dFEF, during shifts of attention. Finally, the spatially selective power modulations observed in VIS might reflect the enhancement of sensory processing at the new cued location, consistent with the inhibitory/facilitator roles of α/γ bands.

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Comunicazioni orali libere 3

Presentazione Orale

Investigating cross-modal properties of the primary somatosensory cortex by means of a novel cross-modal Paired Associative Stimulation protocol

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A growing body of evidence suggests the existence of a Tactile Mirror System in the human brain: the observation of tactile events activates the same cortical network implicated in tactile perception, including the primary somatosensory cortex (S1). It has been suggested that such cross-modal, mirror-like, responses of S1 may arise from Hebbian associative learning: the contingency of seeing a touch and the feeling of a tactile sensation may reinforce synapses between visual and somatosensory neurons. The neurophysiological mechanism underlying the Hebbian associative learning is referred to as Spike-Timing Dependent Plasticity (STDP), in which the relative timing of action potentials between pre-synaptic and post-synaptic neurons determines the strength of neural connections. The Paired Associative Stimulation (PAS) represents an especially suitable protocol to non-invasively investigate the mechanisms of STDP in humans. In classic PAS protocols, a pulse of Transcranial Magnetic Stimulation (TMS) over the cortical area of interest (e.g., S1) is repeatedly paired with a peripheral stimulation (e.g., electrical stimulation of the median nerve).
In the present study, we have developed a novel cross-modal PAS (cmPAS) with the aim of investigating the involvement of STDP mechanisms in the cross-modal properties of S1 in healthy individuals. In the cmPAS, the peripheral stimulation was replaced with a cross-modal stimulus, i.e., a visual stimulus depicting a hand being touched, which was paired with the TMS pulse over S1.
We investigated the efficacy of the cmPAS in a series of three experiments, controlling for factors such as: the inter-stimulus interval (ISI) between the seen touch and the TMS pulse, the cortical site of stimulation and the content of visual stimulus. Plasticity effects induced by the cmPAS were assessed in terms of changes in tactile acuity and, in the last experiment, also by means of a neurophysiological index, i.e. the somatosensory evoked potentials (SEPs).
The cmPAS induced a consistent and significant improvement in tactile acuity only at selective ISI (20 ms), site of stimulation (S1) and visual stimulus (a hand being touched). Furthermore, preliminary results showed a modulation of SEPs by the cmPAS, whose efficacy was compared to a control PAS protocol, corroborating behavioral findings and suggesting that plasticity mechanisms occur at the cortical level, possibly in S1.
Taken together, the present findings showed the efficacy of the cmPAS in driving plasticity, suggesting that Hebbian associative learning within S1 can be effectively induced through vision.