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**ANALYSIS OF EEG RHYTHMS DURING INTEGRATIVE VISUOMOTOR BEHAVIOR IN CEREBELLAR PATIENTS: A PRELIMINARY REPORT**

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It was recently proposed that the cerebellum assists the cortex in developing the neural dynamic patterns which underlie behaviors by modulating intra- and inter-area cortical synchronization. To verify this hypothesis in humans, the changes in power and coherence of the EEG signal were studied in control subjects (n=5) and in cerebellar patients (n=3) which performed a visuomotor tracking task (VM), i.e. a task which depends critically on functional coupling of the motor areas of the brain with those areas processing sensory information. In particular, subjects were asked to track a target signal that moved sinusoidally on an oscilloscope screen at 0.3 Hz by rotating with their thumb and index a potentiometer to produce a second trace on the oscilloscope. Data recorded from 19 monopolar EEG channels were analysed by using independent component analysis (ICA) to separate EEG sources mixed at scalp electrodes and to identify the components (ICs) of interest on the basis of their spectrum and their topographical mapping. In all subjects 7 ICs were selected, four of which were “symmetric”, two projecting maximally to electrodes C3 and C4 overlying the left and right sensorimotor areas (left and right mu rhythms, respectively), the other two projecting maximally to electrodes P3 and P4 overlying the left and right dorsal parietal areas (left and right dorsal parietal ICs, respectively). The remaining 3 ICs projected maximally to midline electrodes Fz, Cz and Pz overlying the mesial frontal cortex, the vertex and the mesial parietal cortex, respectively. Spectral power and coherence of IC activities were calculated at rest and during VM, using the individual alpha frequency as an anchor point to obtain values in 9 different frequency bands ( $\delta$ ,  $\theta$ ,  $\alpha_1$ ,  $\alpha_2$ ,  $\alpha_3$ ,  $\beta_1$ ,  $\beta_2$ ,  $\gamma_1$  and  $\gamma_2$ ).

In control subjects spectral *power* decreased during VM with respect to rest in the  $\alpha_2$ ,  $\alpha_3$  and  $\beta_1$  bands, especially in sensorimotor and dorsal parietal ICs, while it increased in both  $\gamma$  bands mainly in the parietal ICs, to indicate activation of the related cortical areas during this task. In addition, the decrease in power in  $\alpha_1$  frequency range in almost all ICs and the increase in power in  $\theta$  frequency range in the frontal mesial IC could represent the EEG correlate of phasic alertness associated with attention to action and/or error processing. During VM as compared to rest *coherence* increased in controls in almost all IC pairs and frequency bands (particularly  $\beta$  and  $\gamma$ ) with the exception of the  $\alpha_2$  and  $\alpha_3$  bands, indicating an increase in cooperation between executive (frontal), sensorimotor and associative (parietal) areas.

The occurrence of a unilateral cerebellar lesion in the 3 patients, though different for distribution and evolution, affected task-related changes both in *power* and in *coherence*. As compared to control subjects, cerebellar patients exhibited during VM: 1) a more pronounced and diffuse power

reduction in the  $\alpha_1$  band indicating an increased attentional effort during execution of the task; 2) a deficit of activation of selected areas as indicated by suppression/reduction of power decrease in  $\alpha_2$  and  $\alpha_3$  frequency range for sensorimotor and parietal ICs (in 2/3 patients) and suppression of power increase in  $\gamma$  frequency range especially for dorsal and mesial parietal ICs. All these effects were particularly evident when the patients performed the task using the hand controlled by the lesioned hemiserebellum. The most noticeable difference in coherence change in cerebellar patients with respect to controls was the replacement of coherence reduction with coherence increase during VM in the  $\alpha_2$  and  $\alpha_3$  bands for almost all IC pairs.

These results suggest that: a) the cerebellum exerts an activating action on the cortex, which seems to be spatially focused according to modular organization of the cerebello-cortical projection; b) the increase in coherence in the  $\alpha_2$  and  $\alpha_3$  bands that we found in cerebellar patients during the execution of a visuomotor task may reflect the request for cooperation within a great number of cortical areas in the frequency range of intermittent motor control, since loss of cerebellar assistance forces the brain to adopt a more pulsatile, less automatic and more feedback-dependent strategy of motor control.

MODELLI DI RITMI CEREBRALI DELL'UOMO DURANTE MEMORIA EPISODICA A BREVE E LUNGO TERMINE: IL CONTRIBUTO DELL'EEG AD ALTA RISOLUZIONE

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Left and right prefrontal areas (LPF and RPF) are preferentially engaged in encoding and long-term retrieval of visuospatial information, respectively (HERA model). Here we investigated the role of brain rhythmicity and the effective impact on memorization of this cortical functional asymmetry. During encoding, “internals” of apartments (figures) were randomly intermingled with “landscapes”. During retrieval (1 hour later), these “internals” were randomly intermingled with other “internals” (“distractors”). EEG data were recorded (46 electrodes; 10 subjects) and spatially enhanced by Laplacian transformation. HERA prediction was fitted only by EEG gamma responses (about 40 Hz) in posterior parietal areas, thus disclosing a possible role of “binding phenomena” in the dorsal stream subserving visuospatial episodic memory. For short-term memory (STM), EEG/MEG (separate sessions) were recorded during a visuospatial task including cue stimulus (two vertical bars), retention period lasting few seconds, go stimulus (no probe), and motor response compatible with taller bar. In the control (NWM) task, cue stimulus lasted up to the go stimulus. The STM induced a prolonged 6-10 Hz alpha desynchronization of EEG-MEG data (i.e. attention) mainly distributed over right "visuo-spatial" hemisphere. Whereas, a concomitant 10-12 Hz alpha desynchronization (i.e. task-specific processes) was preponderant mainly over left "phonological" hemisphere. These results suggest that parallel attentional and task specific processes would impinge upon the two hemispheres.

SUPRATHRESHOLD 0.3 HZ REPETITIVE TMS PROLONGS THE CORTICAL SILENT PERIOD. POTENTIAL IMPLICATIONS FOR THERAPEUTIC TRIALS IN EPILEPSY.

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**Objective.** To investigate the after-effects of 0.3 Hz rTMS on excitatory and inhibitory mechanisms of the primary motor cortex, as tested by single-pulse TMS. **Material and Methods.** In 9 healthy subjects, we studied a wide set of neurophysiological and behavioral variables from the first dorsal interosseous before (Baseline), immediately after (Post 1), and 90 min after (Post 2) the end of a 30 min-long train of 0.3 Hz rTMS delivered at an intensity of 115% resting motor threshold (RMT). Variables under investigation were: maximal M wave, F wave, and peripheral silent period after ulnar nerve stimulation; RMT, amplitude and stimulus-response curve of the motor evoked potential (MEP), and cortical silent period (CSP) following TMS; finger-tapping speed. **Results.** The CSP was lengthened at both Post1 and Post2 compared with Baseline. The other variables did not change significantly. **Conclusions.** These findings suggest that suprathreshold 0.3 Hz rTMS produces a relatively long-lasting enhancement of the inhibitory mechanisms responsible for the CSP. These effects differ from those, previously reported, of 0.9-1 Hz rTMS, which reduces the excitability of the circuits underlying the MEP and does not affect the CSP. This provides rationale for sham-controlled trials aiming to assess the therapeutic potential of 0.3 Hz rTMS in epilepsy.

## MILD COGNITIVE IMPAIRMENT: AN EEG ANALYSIS DURING FACE GENDER RECOGNITION TASKS

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**Objective:** Previous studies [1] demonstrated, although in younger subjects, the existence of neurophysiological correlates of face gender categorization processes. Aim of this study was to investigate the presence of such correlates in patients with a Mild Cognitive Impairment (MCI).

**Materials and Methods:** 8 MCI patients were enrolled (6M and 2F, mean age $\pm$ SD 72.4 $\pm$ 5.3 years). Cognitive impairment was assessed with an extensive battery of neuropsychological tests. All the patients were also examined to exclude any visual impairment and were fully corrected to the viewing distance. Visual stimulation for EEG recording was performed with 64 pictures of human faces (32M, 32F) shown in random sequence on a PC monitor. EEG signals were recorded on the scalp with 32 electrodes. ERP signal obtained from female faces was subtracted from the signal obtained from male faces. EEG maps were also calculated. Statistical analysis was performed with Student's t-test. **Results:** Significant differences ( $p < 0.05$ ) were detected bilaterally in parieto-temporal regions with a mean latency of 340ms. No significant differences ( $p > 0.05$ ) were recorded at 140-250ms. **Conclusions:** Although all the subjects were still capable to correctly distinguish male and female faces, it was not possible to record any significant difference in electrical brain activity, especially at 140-250ms from stimulus onset, a critical time interval for face processing.

**References:** [1] Borghetti et al (2003) Neurophysiological correlates of face gender categorization. Perception (in press).

## MILD COGNITIVE IMPAIRMENT: A STUDY WITH MMN AND INDEPENDENT COMPONENT ANALYSIS

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**Objective:** Auditory sensory memory represents one of the simplest type of short-term memory that can be studied electrophysiologically with mismatch negativity (MMN), a specific auditory event-related potential (ERP) indexing automatic comparison of meaning stimuli to an existing memory trace. Independent Component Analysis (ICA) allows decomposition of complex signals, like ERPs, into simplest independent components. Aim of this study was to investigate MMN responses in patients with a well established Mild Cognitive Impairment (MCI), using ICA.

**Methods:** We selected 10 patients (mean age  $\pm$  SD:  $72.4 \pm 5.3$ ; range 65-79 years) among those referring to the ambulatory for cognitive disorders of our department, with a diagnosis of MCI (MMSE: mean=  $28.4 \pm 0.96$ ). All patients were previously evaluated with a large battery of neuropsychological test (i.e. verbal, spatial, visual, immediate and long-term memory, attention). Event-related evoked responses (MMN) were recorded by a 32-electrodes cap using a Synamps<sup>®</sup> Amplifier device (Neuroscan EGG System, Neuroscan<sup>®</sup> Inc.). The MMN was obtained using duration deviant acoustic stimuli. ICA was performed with EegLab Toolbox V4.1 for MatLab. Independent components (ICs) obtained from decomposition were analysed in their spatial distribution, time variations and frequency spectrum: ICs resulting from artifactual activities were removed. ICs obtained from standard stimuli were compared with those obtained from deviant stimuli with a Student's t-test.

**Results:** Significant differences were detected in ICs localized in right temporal and parietal regions with a latency of 200-300ms. One significant component was localized bilaterally in frontal regions with a latency of about 500ms.

**Conclusions:** These data agrees with those obtained in different ways from other studies: an early right temporal activation, generated by acoustic mismatch, and a late activation, caused by frontal attentional processes.

## INHIBITION OF AUDITORY CORTICAL RESPONSES TO IPSILATERAL STIMULI DURING DICHOTIC LISTENING: MEG EVIDENCE

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**Aim.** It is well known that primary auditory cortex responds stronger to a contralateral than ipsilateral monaural auditory stimulation. Here we tested the hypothesis that, during dichotic listening, the contralateral auditory stimulation inhibits the responses of the primary auditory cortex to a concomitant ipsilateral stimulus.

**Methods.** Activity of right primary auditory cortex was recorded by a magnetoencephalographic system in 6 subjects during passive listening of monotic and dichotic pairs of complex tones. These pairs included the tones A (261.5 Hz) and B (293-391 Hz). The tone A had always the same intensity (60 dBA), while the tone B could have three different intensities (60, 70, or 80 dBA). The tones were presented in the following combinations: A + B(60 dBA), A + B(70 dBA) or A + B(80 dBA). In the monotic condition, the tones A and B were both delivered to the ear ipsilateral to the right primary auditory cortex. In the dichotic condition, the tones A and B were delivered contralaterally and ipsilaterally to this cortex, respectively. The amplitude of the auditory evoked magnetic fields (AEFs) was measured in a period including 80m, 100m and 120m components. Statistical analysis was performed by ANOVA for repeated measures and Duncan post-hoc test ( $p < 0.05$ ). The ANOVA factors were Stimulation (monotic, dichotic) and Tone B intensity (60, 70, or 80 dBA). The prediction was that right primary auditory cortex would increase its response with the tone B intensity only in the monotic condition, in which there would be no interference between contralateral and ipsilateral stimuli.

**Results and Conclusions.** A significant ANOVA interaction was observed between the factors Stimulation and Tone B intensity ( $F_{(2,10)}=4.33$ ,  $p=0.04$ ). The post-hoc test indicated a significant ( $p=0.01$ ) increase of the contralateral AEF amplitude along with increasing tone B intensity during the monotic but not dichotic condition. These results supported the working hypothesis that the responses of the primary auditory cortex to ipsilateral stimulation are inhibited when a concomitant stimulation is delivered to the contralateral ear (dichotic listening).

## VISUOSPATIAL WORKING MEMORY: AN EVENT-RELATED-POTENTIALS STUDY

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Both posterior parietal cortex (PPC) and prefrontal cortex (PFC) are known to be involved in the control of memory-guided saccades. In this study we attempt to clarify the precise timing of activation of these cortical areas in a task requiring the execution of saccades towards remembered targets. EEG from 29 scalp electrodes was recorded in 20 normal subjects, performing two delayed-response saccadic tasks. In the working-memory task (WM) saccades had to be directed to the remembered location of a flashed visual cue, after a 2 seconds delay period. In the no-working-memory task (NW) cues were informative only of the side of the target. ERP analysis showed a WM-NW difference in the negative potential over the posterior and central scalp during the visuospatial coding, starting at about 150 ms after visual cue onset. No differences were instead observed over dorso-lateral PFC region up to about 400 ms, when a large positive ERP variation built-up in WM with respect to NW for about 600 ms. Interestingly a WM-NW difference ramp-like negative shift was observed starting at about 650 ms and lasting for the all delay period. Data support the hypothesis that PPC is responsible for encoding target spatial location and is engaged during the retention period. Delayed PFC activation is compatible with its crucial role in spatial working memory.



## DIRECT AND INDIRECT SUGGESTIONS DIFFERENTIALLY AFFECT BODY SWAY DURING WAKEFULNESS AND HYPNOSIS

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Hypnotic suggestions aimed to alter perception are usually structured as specific requests to inhibit or enhance the effectiveness of a selected sensorial modality. On the contrary, nothing is known about the possibility that highly hypnotizable subjects (Highs) could modify their sensory-cognitive setting when the hypnotist does not describe the sensory alteration corresponding to a suggested complex situation. Thus, we studied the body sway during the suggestion of a carpet (which was really positioned under their feet) that "was pulled forward" while subjects were standing on it (implicit suggestion) in awake and hypnotized Highs and compared the observed movement with that induced by the description of "falling behind"(explicit suggestion). Our hypothesis was that, if subjects really perceived a sensory modification congruent with the described situation, their body inertial load should elicit a backward sway and that the forward compensatory movement should be smaller than that induced by the explicit suggestion. Results confirmed our hypothesis and showed that the trunk oscillated as a rigid system having the left leg as a support. Differences between wakefulness and hypnosis were only quantitative. The appearance of a backward sway during the implicit suggestion implies that the suggestion elicited an imagery generating a perception entirely similar to that produced by the real stimulation. A different interpretation could be a possible automatism of the response depending on the physical memory of daily experiences (i.e., on the bus); however, this seems unlikely because non hypnotizable subjects did not exhibit any suggestion-related sway modulation.

## LA RIMOZIONE DEGLI ARTEFATTI OCULARI NEI POTENZIALI LETTURA CORRELATI: METODO ED APPLICAZIONE CLINICA.

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L'obiettivo dello studio è la riduzione degli artefatti oculari presenti nelle registrazioni dei potenziali lettura-correlati effettuate in bambini normali e dislessici.

I potenziali lettura-correlati sono stati acquisiti durante prove che prevedevano la lettura passiva ed attiva di singole lettere dell'alfabeto e di simboli non alfabetici. La registrazione dell'EEG è stata effettuata tramite 10 elettrodi posizionati sullo scalpo secondo il sistema 10-20. L'EOG è stato registrato utilizzando un montaggio di tipo diagonale. La riduzione degli artefatti oculari è stata realizzata applicando la tecnica della PCA (Principal Component Analysis): osservando le registrazioni, si è visto che le prime due componenti principali rappresentavano la maggior parte della varianza contenuta nei dati e che quindi riflettevano la diffusione dell'attività oculare sullo scalpo. Di conseguenza, la prima o la seconda componente principale veniva sottratta quando il coefficiente di correlazione tra la componente e l'EOG era maggiore o uguale a 0.9 e 0.95 rispettivamente. Il metodo è stato applicato sui singoli trial: attraverso un confronto tra i tracciati prima e dopo la sottrazione dell'artefatto, si è analizzato il suo effetto sia sulle singole registrazioni che sulle medie. Inoltre, per valutare l'efficacia del metodo sono state eseguite delle simulazioni variando l'ampiezza dell'EOG e le caratteristiche di trasmissione dell'artefatto.

L'applicazione del metodo alle registrazioni reali effettuate in bambini normali e dislessici ha determinato un incremento significativo del numero di trial utilizzabili nel calcolo dell'averaging. Nei bambini normali è stato recuperato il 41.0% dei trial esclusi dalla media nelle prove passive e il 39.1% nelle prove attive. Nei bambini dislessici il recupero è stato pari al 36.7% nelle prove di lettura passiva e al 32.2% in quelle di lettura attiva.

In conclusione, il metodo presentato in questo lavoro consente di incrementare il numero di trial utili per il calcolo dell'averaging, di migliorare in modo significativo la qualità dei potenziali lettura-correlati e di ridurre la durata complessiva delle registrazioni. Lo sviluppo di questo software non richiede particolari conoscenze matematiche, può essere facilmente integrato in qualsiasi sistema ed è di pronto uso.

## SEX DIFFERENCES IN FACE GENDER RECOGNITION

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**Objective:** Face gender recognition is an extremely efficient cognitive process, reaching almost 100% correct guesses for adult subjects. Aims of this study were to assess if gender recognition of male and female faces is equally efficient, and if male and female subjects are equally efficient at recognising face gender.

**Methods:** To measure the minimum information required for correct gender classification, we used two different but complementary spatial filtration techniques to mask pictures of male and female faces: a pixelation filter, which reduced frontal pictures (28,672 pixels) of male and female faces to 7168, 1792, 448 and 112 pixels, and a gaussian noise filter, which destroys information concerning average colour composition of the image leaving detection of high-contrast edges relatively spared. A total of 228 healthy subjects participated at the study: they observed a randomised sequence of 50 faces that were extracted from the set of 250 pictures. A specific software recorded, for each subject, the percentage of correct guesses for the filtered and unfiltered pictures.

Statistical analysis was performed using Canonic Variate Analysis (CVA).

**Results:** We found a striking difference in categorisation of male and female faces. Categorisation of female faces reduced to 1792 pixels is at chance level whereas categorisation of male faces is above chance even for 112 pixel images. In addition, the same difference in the efficiency of categorisation of male and female faces was detected using a gaussian noise filter.

A clear sex difference in the efficiency of face gender categorisation was detected as well. Female subject were more efficient in recognising female faces regardless whether they were filtered using pixelation or gaussian noise filters.

## PSYCHOPHYSIOLOGY OF READING PROCESSES

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This study compares the brain electrical responses of patients with developmental dyslexia and normal subjects when actively engaged in reading letters aloud, and when passively viewing letters of the Italian alphabet. 57 normal children and 28 with developmental dyslexia ranging from 8 to 10 years old participated in the study. The subtype of developmental dyslexia was assessed with the reading and spelling direct test, adapted and standardized to Italian language from the Boder test. Normal subjects had a reading quotient adequate to their chronological age. Among the 28 children with dyslexia, 19 had a dysphonetic reading pattern and 9 a dysphonetic- dyseidetic reading pattern. Analyses of variance and multiple linear regressions showed that significant differences were present between normal and dyslexic subjects both during active and passive reading conditions. The evoked cerebral potentials of dyslexic children were significantly lower in amplitude and longer in latencies, beginning at 50 msec up to 600 msec after stimulus onset on different head regions. This study suggests that dyslexia is not only a perceptual deficit but involves higher cognitive processes related to programming, timing, feedback analysis that lead dyslexic subjects, independent of the subtype of dyslexia to be slow and incorrect in reading.

## EEG AND VISUAL EVOKED POTENTIALS RECORDED SIMULTANEOUSLY WITH fMRI: A VALIDATION OF ARTIFACT REMOVING PROCEDURE

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**Introduction:** Interest on integration of simultaneous electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) recording in investigating cortical function is progressively increasing. One of the main technical limitations of this approach is that the EEG signal is greatly affected by static and changing magnetic fields of fMRI, so that post-processing procedures for artifact removal become necessary. This task becomes technically more demanding when EEG signals of small amplitude, such as Evoked Potentials, are to be recorded. The aim of this study was to assess the feasibility of Visual Evoked Potentials (VEPs) recording during fMRI acquisition and of subsequent artifact removal.

**Methods:** Ten normal subjects performed a visual reaction time task to word stimuli. EEG was recorded using MRI compatible 32-channel amplifier and electrodes. With the subject in the scanner, 100 stimuli were administered with no fMRI acquisition, followed by 100 during fMRI scanning. For removal of scanning and pulse artifacts, we subtracted an averaged artifact waveform from the signal; a pulse template in each channel was subtracted at the EKG R-peaks. The validation of the algorithm was made comparing physiological parameters (amplitude and latency of P100 and N140 waves) computed from data acquired with or without fMRI scanning.

**Results:** For both P100 and N140 waves, the latency ratio (with/without fMRI acquisition) and the amplitude ratio were very close to 1, showing that similar VEPs waveforms could be recorded in the two recording situations.

**Conclusions:** These findings indicate that reliable continuous EEG and evoked potentials signals can be recorded during fMRI acquisition.

## VISUO-MOTOR LEARNING IN MULTIPLE SCLEROSIS: EVALUATION WITH A VIRTUAL REALITY SYSTEM

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**INTRODUCTION:** The success of the motor rehabilitation in multiple sclerosis (MS) depends on the extent of the involvement of primary sensory-motor functions and of higher level of central integration.

**OBJECTIVE:** Evaluate the effects of a single training session on motor abilities using a 'virtual reality system'.

**METHODS:** Twelve right-handed progressive or relapsing MS patients (7 M and 5 F, age 43.6+/- 11, EDSS 4.8 +/- 1.5; education 11.5 +/- 3 yrs) and 12 pilot subjects (4 M and 8 F, age 45.7+/-9; education 13.5 +/- 4 yrs) performed a motor-tracking task: the right index finger had to imitate in space the multi-segment trajectory produced by an object moving on a screen, both in clockwise and anti-clockwise directions. Hand movement was recorded using a sensor on the index finger and projected on the screen allowing an online visual feedback. The whole session was composed by a basal test (3 trials clock-wise and 3 anti-clockwise), a training test (12 trials anti-clockwise) and a post-learning test (3 trials in each direction). Distances between the subject's mean trace and ideal trace in the 3 dimensional planes were computed.

**RESULTS:** Both patients and normals had more difficulty (higher deviation from ideal trajectory) in planes involving depth compared to the frontal plane. Patients performed worse than normal subjects in each test; significant differences ( $p < 0.05$ ; Student's T.test) were present for all tests in the frontal plane, but only after training in planes involving depth. After training, a significant improvement was observed for both normals and patients in frontal plane; on the contrary the performances on the depth planes significantly improved only in normal subjects and not in MS patients.

**CONCLUSIONS:** The interactive virtual reality system provided an accurate estimation of the motor performances, which, as expected, were significantly impaired in MS patients. Motor learning was impaired in MS patients for task features requiring a more complex integration of visual and sensory-motor information. Implication for rehabilitation strategies will be discussed

## DISCRIMINATION OF EMOTIONAL AND NEUTRAL PICTURES IN PHOBIC AND NON-PHOBIC SUBJECTS.

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The general aim of present work is to study the influence of emotions on cognitive processes..

We have investigated whether the emotional valence of stimuli may affect speed and accuracy of responses to visual stimuli in Go/No-go discrimination task. Subjects with specific spider-phobia and non-phobic controls performed two tasks: in the first the reaction times (RT) to generally aversive (mutilations) and non-aversive pictures were measured; in the second task, we compared the RTs to pictures of fear-relevant animals with those of non-fear relevant animals .

The results show that :

1. Both groups of subjects react to the generally aversive stimuli significantly faster than to the non-aversive stimuli;
2. Only the phobic subjects discriminate the pictures of spiders much faster and more accurately than the pictures of other animals.

Preliminary records of electrodermal activity suggest that in control and phobic subjects the presentation of generally aversive images is effective to evoke a skin conductance response (SCR); SCR to the spider pictures occurs only in phobic subjects.

## STABILITY OF TOPOGRAPHICAL EEG MEASURES DURING NREM SLEEP: DOES AN INDIVIDUAL “FINGERPRINT OF HUMAN SLEEP” EXIST?

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**Introduction.** Recent topographic analyses of sigma EEG activity during NREM sleep pointed to the existence of two distinct sleep spindle (SS) types: "slow" spindles at ~12 Hz more pronounced over the frontal sites, and "fast" SS at ~14 Hz more pronounced over centro-parietal sites; the former declining and the latter increasing over consecutive sleep episodes. Functional dissociations have also been reported, as a function of age and maturation, homeostatic and circadian factors, menstrual cycle phase, pregnancy and pharmacological agents [1]. These results have been interpreted according to two functionally separated spindle generators. On the other hand, lower and higher frequencies of SS have been attributed to a single mechanism, namely, the duration of hyperpolarization-rebound sequence in thalamocortical neurons; and cortical areas on which "slow" SS have been detected are related to those thalamic nuclei in which relay cells display long hyperpolarizations [2]. In fact, most studies showing the two cortically-independent SS bulk the bounds of sigma band from the traditional 12-14 Hz range, including frequency bins traditionally considered within the alpha band [1]. Secondly, there are great inter-individual differences, and topographical analyses on between-subject averaged data could confound individual (different) cortical topographical distributions with the existence of different topographically-specific SS [1]. Finally, spindle frequency could change as a function of the same variables differently affecting the two types of SS.

The aim of this study is disentangling the question by mean of a topographical EEG analysis in single subjects.

**Method.** A database of sleep recordings (Fz-A1, Cz-A1, Pz-A1, Oz-A1) of 10 normal males (mean age=23.4 years), who participated in a slow-wave sleep (SWS) deprivation study (six consecutive nights: one adaptation, two baselines, two nights without SWS, one recovery) [3], has been considered. In this single-subject analysis, EEG power values have been calculated across a 8.0-15.5 Hz range in a 0.25-Hz resolution for non-REM sleep episodes.

**Results and Conclusions.** Four subjects had one spectral peak in the range of SS frequencies (12.25-13.25 Hz) on all brain sites; three subjects had two spectral peaks on different sites, with one peak, higher on Fz (10.25-11.25 Hz) and a second one, higher on Cz-Pz (13.50-13.75 Hz); the last three subjects had two spectral peaks discernible only on Fz (respectively at 10.00-10.50 and 12.50-13.00 Hz). Therefore, results show only one kind of SS, ranging within the 12.25-13.75 Hz, and in some subjects alpha activity peaking on more anterior brain sites.

On the other hand, the analysis of single cases pointed to a high invariancy of the antero-posterior EEG power topography. The frequency x EEG power matrices resulted highly inter-correlated within each individual: grand mean of individual correlation coefficients was  $r=0.93$ , while the mean of all the possible intercorrelations between different nights/subjects yielded a coefficient of  $r=0.56$ . The difference between these correlation coefficients was highly significant ( $p < 6.9 \cdot 10^{-25}$ ). This stable, frequency-specific pattern of EEG power topography along the antero-posterior cortical axis during NREM sleep distinguishes each individual, like a “fingerprint”. It remains substantially invariant during different nights characterized by massive changes of sleep structure and homeostasis; therefore, it may be related to individual differences in genetically determined functional brain anatomy rather than to sleep-dependent mechanisms.



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## EFFECTS OF EMOTIONAL VISUAL STIMULI ON AUDITORY INFORMATION PROCESSING: A TEST OF J.A. GRAY'S THEORY

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This experiment tested J.A. Gray's Reinforcement Sensitivity Theory (RST), which states that the emotional component of information is the product of two systems: the "Behavioral Inhibition System" (BIS), responsible for the temperamental dimension of Anxiety; the "Behavioral Activation System" (BAS) which is responsible for the temperamental dimension of Impulsivity. A total of 61 subjects participated in this study. Participants were assigned to either a "low" or "high" group in Sensitivity to Punishment (BIS- or BIS+) and in Sensitivity to Reward (BAS- or BAS). Subject's EEG was recorded (on Fz, Cz and Pz scalp sites) while they heard tones that were presented using a paradigm to evoke the Mismatch Negativity (MMN). The sounds were presented in four different conditions: (1) while reading text; (2) while watching emotionally positive pictures; (3) while watching emotionally negative pictures; (4) while watching neutral pictures. Results show patterns of MMN responses that are in partial accordance with what gray's theory predicts. Specifically, in accordance with this theory (A) BIS+ subjects, compared to BIS- ones, displayed a greater MMN amplitude on the Fz and Cz scalp sites while they watched negative pictures; (B) contrary to previsions, BAS subjects displayed a response pattern that was not in line with the theories prevision. Results in this study show the need for a better operational definition of individual susceptibility to reward.

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#### 40-Hz EEG OSCILLATIONS, PAIN PERCEPTION AND HYPNOSIS MODULATION OF PAIN

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Although it has been shown that the activity of some areas in the brain contributes to subjective pain perception, the neural mechanisms through which pain is experienced have not been fully established. This study is an attempt to understand some aspects of neural mechanisms involved in pain by considering the relationship between phase-ordered 40-Hz EEG activity in response to a painful stimulation in waking and hypnosis conditions. Somatosensory event-related phase-ordered (40-Hz) oscillations to painful standard stimuli under an odd-ball paradigm were analysed at F3, F4, P3, P4, Fz, Cz and Pz sites in 13 high, 13 medium, and 12 low hypnotizable subjects during waking, hypnosis, and alert-hypnosis conditions. Alert-hypnosis was induced by a post-hypnotic suggestion drawing waking subjects to fall into a deep hypnosis with opened eyes. During these conditions, subjects received a suggestion to produce an obstructive hallucination of stimulus perception (Focused Analgesia), as a cognitive treatment for pain reduction; a No-Analgesia treatment served as a control. During these treatments, subjects were required to count the number of delivered target stimuli. High hypnotizables, compared to mid and low ones, experienced significant pain and distress reductions for Focused Analgesia in hypnosis and even more in alert-hypnosis. Correlational analysis of EEG sweeps of each individual revealed brief intervals of phase ordering of 40 Hz EEG patterns lasting approximately three periods. For Fz and Cz sites significant relationships between phase-ordered 40-Hz EEG peaks and pain and distress rating scores were found during Focused Analgesia in hypnosis and alert-hypnosis conditions. High and medium hypnotizable subjects showed significant reductions in phase-ordered 40-Hz EEG patterns for Focused Analgesia during hypnosis and alert-hypnosis conditions; this effect was found, however, more pronounced in high hypnotizable subjects. Low hypnotizables failed to evidence similar effects. This study provides evidence for the role of phase-ordered 40-Hz EEG oscillations in the subjective experience of pain. In particular, hypnotic analgesia was found to tune phase-ordered 40-Hz/pain relation, suggesting that hypnotic analgesia modulates normal anterior-central function involving a highly ordered attentional system

## REGIONAL DIFFERENCES AND EEG TOPOGRAPHIC MAPPING DURING NREM SLEEP **Ferri R.**

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The analysis of the so-called “*Cyclic Alternating Pattern*” (CAP), a phenomenon which is typical of NREM sleep, has been previously confined to its first-order time features and particular attention has been paid to its rate which is the percentage of each sleep stage occupied by CAP sequences CAP (Terzano et al. 1985, 1988). This type of approach has been conditioned by the common practice in sleep labs of including only a limited number of EEG channels in the polysomnographic recordings, because of the need of simplicity and the requirement of only one EEG channel by the internationally accepted rules of recording sleep. However, the significant technological advancements in computer of the last years, allows now the recording and analysis of a large number of channels with limited additional effort. This allows us to have a better representation of the EEG over the scalp, also during sleep.

In particular, for this study, we obtained polysomnographic recordings including 19 scalp EEG electrodes (10-20 international system) from 5 young and healthy normal subjects, for the whole night; subjects went to bed at their individual usual time and slept *ad libitum*.

Since its original description, CAP has been characterized by 2 main frequency components: a slow component (in the range of the delta band), which typically represents the A1 phase subtype of CAP and a fast component (frequencies higher than 7 Hz), typically detectable in the A3 phases of CAP. A2 phases, finally, are characterized by a combination of these two components which seem to be equally represented, at visual inspection (Terzano et al. 1985, 1988). Moreover, during A2 phases the slow component most frequently precedes the onset of the fast-frequency activity. The spectral analysis of these different A phase subtypes by means of the FFT supports these findings obtained by visual analysis and confirms their existence. For this reason, our following analyses have been centered on these two frequency components, rather than on the classical subdivision of the CAP phases in to A1, A2 or A3.

The topography of the two bands cited above has been studied by drawing colour maps of the scalp obtained by means of the so-called 4-nearest neighbours method. In particular, the low-frequency band (0.25-2.5 Hz) showed in all subjects included a clear prevalence over the anterior frontal regions, mostly over the midline and symmetrically spreading over the two hemispheres. On the contrary, the high-frequency band (7-15 Hz) involved mostly the parietal-occipital areas; also in this case, a symmetrical distribution was evident with the peak over the midline. In this band, a more variable distribution than that of the slow-frequency band was detectable in the different subjects.

The analysis of the cortical generators of the two frequency bands of CAP was carried out by means of the “low resolution brain electromagnetic tomography” or LORETA (Pascual-Marqui et al. 1994, 1999) in order to characterize better the structures responsible for the scalp electrical fields described above.

With this approach, the generators of the low-frequency component of CAP seem to be localized mostly over the frontal midline cortex; on the contrary, those of the high-frequency band involve both midline and hemispheric areas within the parietal and occipital areas.

Synchronizing mechanisms during sleep are usually thought to be subserved by thalamocortical pathways and, as an example, there is experimental evidence that thalamocortical neurons may oscillate either in the delta or sigma frequency range depending on their membrane potential (Steriade et al., 1993; Contreras and Steriade, 1995) during nonREM sleep. We think that, based on our results, the CAP slow component is the cortical expression of this cortical-subcortical interaction. On the other hand, the high-frequency CAP component is the expression of the

activity located at the level of the same structures thought to generate alpha waves during wakefulness within the cerebral cortex at the level of the pyramidal neurons in layers IV and V (Lopes da Silva and Storm van Leeuwen, 1977) with a system of surface-parallel intracortical neurons involved in its spread (Lopes da Silva and Storm van Leeuwen, 1978, Lopes da Silva et al., 1980).

In conclusion, the results of these study and the data available on sleep neurophysiology seem to indicate that CAP is generated by the same intrinsic mechanisms of sleep and wakefulness which interact in a complex but highly integrated way.

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## MILD COGNITIVE IMPAIRMENT: A STUDY WITH MISMATCH NEGATIVITY AND P300

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**Objective:** Auditory sensory memory represents one of the simplest type of short-term memory that can be studied electrophysiologically with mismatch negativity (MMN), a specific auditory event-related potential (ERP) indexing automatic comparison of meaning stimuli to an existing memory trace. The P300 ERP from oddball paradigm reflects the “closure” of sensorial information process and the P300 from novel stimuli measures shifts of attention towards novel, unexpected events, for which no task is demanded. Aim of this study was to investigate these two ERP responses in patients with a well established Mild Cognitive Impairment (MCI).

**Methods:** We selected 10 patients (mean age  $\pm$  SD:  $72.4 \pm 5.3$ ; range 65-79 years) among those referring to the ambulatory for cognitive disorders of our department, with a diagnosis of MCI (MMSE: mean=  $28.4 \pm 0.96$ ). All patients were previously evaluated with a large battery of neuropsychological test (i.e. verbal, spatial, visual, immediate and long-term memory, attention). Event-related evoked responses (MMN) were recorded by a 32-electrodes cap using a Synamps® Amplifier device (Neuroscan EGG System, Neuroscan® Inc.). The MMN was obtained using duration deviant acoustic stimuli and acoustic P300 with oddball and novel paradigm.

**Results:** The acoustic P300 primary N100 component and the MMN were obtained in all patients; the P300 oddball and novel were elicited only in 1 out of 10 patients. Latencies and amplitude of P300 waves and latencies and area of MMN were measured (mean latencies: P300 oddball= $396 \pm 41$  ms; P300 novel= $365 \pm 39$ ; MMN= $212 \pm 48$ ). P300 oddball was abnormal in 4 patients and absent in 1 patient. No correlation was found between the electrophysiologic findings and neuropsychological rating (verbal immediate and long-term memory and attention). **Conclusions:** These data do not confirm the utility of event-related responses in the assessment of MCI. We hypothesize that electrophysiologic responses investigate simple mechanisms of orientation of attention and storage of sensory information that still works in such patients.

## FORMER BOXER WITH PARKINSONISM AND COGNITIVE IMPAIRMENT: 10-MONTHS FOLLOW-UP WITH PRAMIPEXOLE THERAPY

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Chronic traumatic encephalopathy associated with boxing is referred to occur in approximately 20% of professional boxers, and represents a risk factor especially for the inferior divisions (Jordan, 2000; Mawdsley and Fergusson, 1963). The permanent brain damage in both, the amateur and the professional boxers, manifests itself in several clinical syndromes in which the pyramidal, the extrapyramidal and the cerebellar systems are involved (Unterharnscheidt, 1995). A Parkinsonian syndrome in boxers is quit rare and extrapyramidal symptoms could occur decades after stopping fighting (Lees, 1997). We report the case of a man (70 years, 8-year-schooling level, right-handed) who referred to our observation complaining for 1 year the presence of tremor and hyposthenia in the left arm. Cardiovascular and laboratory data were normal. He did not smoke and did not abuse of alcolics. Since five years ago he worked in the local administration and the familial history did not reveal neurological diseases. He referred a 12-year boxing career, three of them as a professional boxer, with about 150 fights in fly and bantam divisions between the age of 17 and 29 without any knockout. Neurological examination revealed tremor at rest and moderate rigidity on the left arm. Brain MRI showed abnormalities of the septum pellucidum and ischemic lesions of the subcortical white matter, and perfusional SPECT confermed cerebral vasculopathy, while SPECT DAT-scan revealed basal ganglia asymmetry typical for Parkinson's disease. Psychometric tests evidenced executive dysfunction and predominant language disturbances. Event-related potentials confirmed the cognitive deterioration. After a 10 months period of dopaminergic treatment (pramipexole 0,75mg/daily) reduction of tremor and rigidity and improvement of cognitive impairment were observed.

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## ANOMALIE DEI POTENZIALI EVENTO-CORRELATI PERSISTONO IN PZ SCHIZOFRENICI IN REMISSIONE PARZIALE.

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I potenziali evento correlati sono stati ampiamente esaminati in pazienti schizofrenici in fase acuta. Sono invece relativamente scarsi i dati riguardanti condizioni di esito della malattia.

Scopo di questo studio preliminare è verificare l'eventuale persistenza delle anomalie dei potenziali evento-correlati in soggetti schizofrenici in risoluzione parziale della malattia.

I Potenziali Evento correlati sono stati studiati in 4 soggetti schizofrenici (2 m, 2 f), esitati in una risoluzione parziale della malattia, condizione che dura da almeno 2 anni per tutti i soggetti. Come gruppo di controllo sono stati utilizzati 13 soggetti (7 m, 6 f).

E' stato utilizzato un paradigma odd-ball in modalità acustica in modalità Attiva e Passiva. Inoltre è stato somministrato anche un paradigma per registrare la Mismatch Negativity. Le registrazioni sono state eseguite mediante cuffia precablata a 20 elettrodi mediante Apparecchio Mizard/GalNT per la successiva analisi.

Tutti i soggetti sono stati in grado di eseguire le registrazioni. Nella prima prova attiva il numero degli errori è stato basso ma nella seconda serie mentre i soggetti di controllo ne riducevano il numero, i pz ne commettevano un numero maggiore rispetto alla prima serie [GruppoSerie:  $F(df 1,15) 5,4; p=0,03$ ].

La N100 risentiva in modo significativo di un effetto abitudine in quanto nella seconda serie di ogni modalità era di latenza aumentata in tutti i soggetti [Serie:  $F(df 1,10) 26,7; p = 0,0004$ ] ma in misura significativamente maggiore nei pz schizofrenici [GruppoSerie:  $F(df 1,10) 5,01; p = 0,04$ ]. Stesso effetto abitudine era evidente anche per l'ampiezza della N100 nei pz schizofrenici ma relativamente alla sola modalità passiva [GruppoSeriexElettrodo:  $F(df 2,24) 7,06; p=0,004$ ]

La latenza della P200 era simile in tutte le condizioni nei due gruppi di soggetti, mentre l'ampiezza era minore negli Schizofrenici nelle risposte agli stimoli frequenti [GruppoStimoli:  $F(df 1,15) 5,91; p=0,02$ ]. La N200 non presentava né per latenza né per ampiezza differenze significative.

La latenza della MMN era significativamente aumentata nei pz schizofrenici [Gruppo:  $F(df 1,15) 5,60; p=0,03$ ] in tutti gli elettrodi esaminati (GruppoElettrodo NS). Per quanto concerne l'ampiezza la topografia della MMN indicava una inversione del fisiologico gradiente antero-posteriore della MMN, a causa di una marcata riduzione di ampiezza della MMN nelle derivazioni frontali e centrali nei pz Schizofrenici [GruppoElettrodo:  $F(df 1,4) 5,36; p=0,003$ ]. Infine per quanto concerne la P300 era presente una attenuazione della risposta negli elettrodi temporali nella seconda serie di stimolazione [GruppoSeriexElettrodo:  $F(df 4,60) 2,80; p=0,03$ ]

L'interpretazione dei risultati è in parte condizionata dal limitato campione che si è potuto studiare, anche per la difficoltà nel reclutare questo tipo di soggetti. Questi risultati preliminari comunque indicano che anche in pazienti in risoluzione parziale permane una alterazione della processazione degli stimoli, già a partire dalla componente N100, come espressione di un deficit di attenzione espresso soprattutto come difficoltà nel mantenimento di essa quando il paradigma era meno impegnativo (modalità passiva). Persistono inoltre marcate anomalie della MMN espresse da un aumento di latenza e soprattutto riduzione di ampiezza nelle regioni fronto-centrali. Per la P300 era evidente una riduzione di ampiezza nelle derivazioni temporali nella seconda serie associata ad un incremento degli errori.

La alterazioni degli ERP evidenziate costituiscono quindi un tratto distintivo della Schizofrenia permanendo anche in pazienti in trattamento farmacologico in fase di remissione parziale di malattia.



## P300 DURING TRANSIENT GLOBAL AMNESIA

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**Objective:** to detect changes in the auditory P300, EEG and SPECT during an attack of Transient Global Amnesia (TGA).

**Patient and method:** a 58-year-old female was admitted to the emergency ward of our hospital for a severe impairment of recent memory (anterograde amnesia), whereas remote memory was preserved. Clouding of consciousness as well as other cognitive defects were absent. There were no focal neurological signs. Seven hours later the patient recovered her memory completely. At the emergency unit, EEG and CT scan showed no abnormalities. Auditory P300 (oddball paradigm, count-rare task) was recorded three hours into the TGA. SPECT examination was conducted 6 hours into the disorder, while the patient was still profoundly amnesic. SPECT and P300 were recorded again on day 3 and 360 following the attack.

**Results:** SPECT showed severe bitemporal and bifrontal hypoperfusion, mostly evident on the right hemisphere. Cerebral perfusion returned to normal after recovery. The latency and amplitude of the auditory P300 during TGA were within normal ranges at the midline electrodes (Fz, Cz, Pz). However, no P300 was detected over the temporal leads (T5, T6). Correct detection rate for rare (target) auditory stimuli was 99%. On day 3 following the TGA, P300 over temporal lobes recovered its amplitude, with a slight asymmetry (left > right).

**Conclusions:** P300 (P3b) in auditory oddball task is generated in multiple cortical areas, including hippocampus, superior temporal sulcus, lateral orbitofrontal cortex, intraparietal sulcus. The P300 recorded during TGA (when SPECT shows profound temporo-limbic hypoperfusion) suggests that the mesial temporal lobe contributes to the scalp P300 only at the corresponding temporal region and does not influence its general waveform and predominant distribution over the scalp.

## THE VEGETATIVE AND THE MINIMALLY CONSCIOUS STATE: ERP STUDIES.

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**Objective:** to determine the diagnostic/prognostic role for the neurophysiological investigations of the persistent/permanent vegetative state (PVS) and the minimally conscious state (MCS).

**Methods:** review of the electrodiagnostic studies (electroencephalogram, EEG; somatosensory evoked potentials, SEPs; brainstem auditory evoked potentials, BAEPs; long-latency event-related potentials, ERPs) conducted in patients with PVS or MCS. Findings from EEG and SEPs recorded in 35 patients with anoxic-ischaemic coma were also examined. ERPs were recorded in 5 PVS patients and 7 patients with MCS.

**Results :** bilateral absence of SEP cortical N20 is the most reliable factor to predict nonawakening from coma (outcome PVS or death) in patients with anoxic-ischaemic (95% Confidence Interval: 0-1%), traumatic (CI: 4-10%) or hemorrhagic (CI: 0-4%) coma. Burst-suppression or isoelectric EEG also has a good prognostic accuracy for nonawakening (CI: 0,2-5,9%) in anoxic coma.

EEG, SEPs and BAEPs provide little useful information once the diagnosis of PVS is established. A relevant contribution for the identification of minimal consciousness was brought about by ERPs, though. MCS patients presented with long-latency auditory components (N1, P2) which were always missing in PVS patients. P300 could not be identified in anyone of the patients examined.

**Conclusions:** neurophysiological investigations can provide a relevant contribution to the assessment of residual brain function in patients with PVS or MCS.

## DOES SPONTANEOUS BLINKING REFLECT RELATED HUMAN CONSCIOUSNESS PROCESSES

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Consciousness would be composed of a serial mechanism continuously integrating the individual with the outer world, implemented by attention and Short-Term Memory (STM). This serial feature is automatically maintained, and somehow mirrored in the Spontaneous Blink (SB). The continuous consciousness content updating integrative process, occurring at the end of a variable length attention phase, is terminated by SB. Actually, during SB the ending of the mental experiences that compose the Temporal Segment to be Elaborated (TSE) is implemented. Such a repetitive and discrete way ensures the consciousness processes stability. The TSE may be regarded as the time sampling through which the nervous system controls and updates its own subjective consciousness. The likelihood that low coherence rapid neuron oscillations become significantly coherent for short time intervals after a relevant stimulus suggests a link between these mechanisms and SB in order to maintain the attentive tonus. Assuming a neurochemical view, three neurotransmission systems are involved in SB control: the dopaminergic one, the cholinergic one and the GABAergic one. The first has excitatory effects, the other two inhibitory ones. Generally speaking, referring to basic functions (attention and memory,) the tasks that request attentive abilities decrease BR, while those requesting mnemonic abilities increase it. Causal relation between SB and P300 are still to be defined. By analyzing the two phenomena characteristics, we can infer that both represent the manifestation of ending and memorization of on-going mental processes: probably both them are roused by common mechanisms. Mental state of object focalization shows a first significant blinking serial device, i.e. to contrast the habit psychophysiological phenomena that would provoke a subjective thought activity weakening, whether the latter originates from a perceptual clue or it is a reflection concerning mnemonic scenarios. In the temporal interval between two consequent SBs, brain electric activity coherence occurs. The latter is rigorously linked to attentive concentration and would weaken as a consequence of habit processes. Blinking underlying mechanisms could intervene on memorization processes through few second intervals, such acting on STM phenomena. In this sense, it is necessary to highlight, as synaptic plasticity owns some short-term components, including at least three exponential constituents. At the end of the blinking period, contextually with the blinking act, mental activity in progress could be stored in STM. Which and how many of these synaptic plasticity phenomena are activated will depend upon on-going mental process features.

## KINEMATIC STRATEGIES OF UPPER LIMBS LOWERING DURING SUGGESTIONS OF HEAVINESS: A REAL-SIMULATOR DESIGN

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The aim of the experiment was to study the possible differences between the kinematic strategies of the "involuntary" arm lowering of hypnotized highly susceptible subjects (H-Highs) and of the voluntary movement of non hypnotizable simulators (Sim) during suggestions of arm heaviness. In addition, the comparison between awake susceptible subjects (W-Highs) and H-Highs was carried out to clarify the specific role of the hypnotic state and hypnotizability. Subjects' absorption and attentional/ imagery capabilities were evaluated through neuropsychological tests. Their arms movements were three-dimensionally monitored at hand, wrist and elbow level through a Fastrack™ Polhemus system. A final interview collected self-reports concerning the perception of the movement involuntariness. Neuropsychological tests showed better "absorption" and imagery capabilities in Highs. At the interview, H-Highs perceived a higher involvement in the task and greater involuntariness and difficulty to contrast the arm lowering with respect to Sim. Kinematics analysis showed significant differences between H-Highs and Sim in the arms displacement along the vertical axis and on the horizontal plane. In fact, the former lowered more and earlier the left than the right arm; on the horizontal plane, a forearm flexion was observed in H-Highs on the right side. In the comparison between W-Highs and H-Highs, hypnosis appeared to magnify the wakefulness motor strategies, but also to induce specific changes, mainly concerning the horizontal plane. Results cannot be interpreted on the basis of "role playing" and socio-cognitive factors. They are discussed as a balance between the effectiveness of the frontal executive control on the selection of behaviours and movement automaticity and are in line with the neo-dissociation theory of hypnosis.

EEG AND VISUAL EVOKED POTENTIALS RECORDED SIMULTANEOUSLY WITH FMRI:  
A VALIDATION OF ARTIFACT REMOVING PROCEDURE  
EXECUTIVE DYSFUNCTION IN MILD COGNITIVE IMPAIRMENT:  
ELECTROPHYSIOLOGICAL EVIDENCE.

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**Objective:** We previously found abnormalities of reaction times (RTs) and Event-Related Potentials (ERPs) to the Stroop test in Alzheimer's disease (AD), indicating involvement of executive functions in this disease. Mild Cognitive Impairment (MCI) may represent in some cases an early stage of AD. The aim of this study was to test whether ERPs and RTs may detect frontal lobe dysfunction in MCI.

**Methods:** Fifteen patients with probable AD (age  $73 \pm 8$  yrs), 15 patients with MCI (mean age  $69 \pm 5$  yrs), and 14 normal subjects (mean age  $61 \pm 6$  yrs) participated in the study. RTs to the Stroop test were evaluated in simple, choice and Go-No Go paradigms. ERPs during mental performance of the Stroop test were obtained from 58 channels.

**Results:** RTs were significantly slower in AD group in all tasks compared to normal subjects, while MCI were slower than normal only for the most difficult task (choice RT); AD patients made more errors compared with normal subjects and MCI in all tasks ( $p < 0.01$ ). The frontal P300 ERP component had significant amplitude reduction in AD patients compared both to normal subjects and MCI, while the later positive component was significantly reduced in both groups compared with normal subjects.

**Conclusions:** These results, by providing behavioural (RT) and electrophysiological (ERPs) abnormalities to the Stroop test in mild cognitive impairment with neuropsychological involvement confined at memory deficits, suggest the possible usefulness of these measures in the assessment of MCI, being able to detect subclinical abnormalities of executive dysfunction

## HYPNOTIC MODULATION OF MENTAL STRESS INDUCED ENDOTHELIAL DYSFUNCTION.

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Recent results from our laboratory suggest that individuals highly susceptible to hypnosis are able, when awake, to suppress the autonomic effects of moderately aversive stimulation through an active mechanism (escaping) that would allow them to dissociate the autonomic output from the cerebral activity (EEG) typical of arousal. Then, hypnotizable subjects would be protected against the negative effects of stress.

It is known that acute mental stress produces a transient alteration of the endothelial function (FMD), which can be measured, through a non-invasive echographic technique, as a reduction of the brachial artery diameter post-ischaemic dilation.

Aim of our study was to verify whether the hypnotic trait and/or state are able to modulate the acute mental stress effects on FMD.

FMD was measured in 18 healthy volunteers, 9 non susceptible (Lows) and 9 highly susceptible to hypnosis (Highs), during an experimental session consisting of 4 successive periods: control with open eyes, simple relaxation, mental stress and post stress. Mental stress was the mental computation of serial subtractions and multiplications. All subjects evaluated the mental calculation as moderately stressing. However, at difference with Lows in which mental stress significantly reduced FMD, Highs did not show any FMD dysfunction. Similar results have been obtained in Highs and Lows submitted to the same mental stress after a hypnotic induction.

In conclusion, these results suggest that the hypnotic trait can be considered a protective factor against the toxic effects of stress at vascular level.

## ELENCO ULTERIORI CONTRIBUTI

IL TEST DI ASCOLTO DICOTICO NEI DISTURBI SPECIFICI DEL LINGUAGGIO E DELL'APPRENDIMENTO.

**Brizzolara D.**, Casalini C., Chilosi A., Cipriani P., Ferretti G., C. Pecini, *(Pisa)*.

CONTRIBUTO DEL NEUROIMAGING FUNZIONALE ALLO STUDIO DELLA MEMORIA SEMANTICA

**Cappa S.**, *(Milano)*.

LO SPETTRO DELL'UMORE.

**Cassano G. B.**, *(Pisa)*.

PERCEZIONE DEL SESSO E DELLA BELLEZZA DEI VOLTI: PSICOFISIOLOGIA ED ELETTROFISIOLOGIA

**Cellerino A.**, Borghetti D., Sartucci F., *(Pisa)*.

STUDIO DELLA PLASTICITA' NELLA SCLEROSI MULTIPLA.

**Comi G.**, *(Milano)*.

COSA L'ASSENZA DEL CORPO CALLOSO CI HA INSEGNATO CIRCA IL CERVELLO?

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RUOLO DEL CORPO CALLOSO NEL TRASFERIMENTO INTEREMISFERICO DELL'INFORMAZIONE TATTILE: STUDIO FMRI NEI PAZIENTI CALLOSOMIZZATI.

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**Grippo A.**, *(Firenze)*.

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MODELLI COMPUTAZIONALI DELL'APPRENDIMENTO DEL LINGUAGGIO.

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