

Wednesday, September 5th, 2018

Early morning session: 08.30 – 10.00 a.m.

Symposium A: Reciprocal interactions between wakefulness and sleep: behavioral and brain morpho-functional correlates

(Bernardi G. – Lucca, Italy)

Experience-dependent regulation of sleep-need: effects on brain functioning and behavioral performance

G. Bernardi

IMT School for Advanced Studies, Pisa, Italy

Sleep has been classically regarded as a global phenomenon simultaneously affecting the brain in its entirety. In this view, sleep and wakefulness were considered as two mutually exclusive states in light of their peculiar electroencephalographic (EEG) signatures and neuromodulatory patterns. However, this assumption is now challenged by a growing body of evidence indicating that sleep and wakefulness are, at least in part, locally regulated, and may often coexist in physiological conditions. In this talk, I will present a series of studies in which we investigated the local regulation of sleep as a function of prior experience by combining controlled behavioral activities and high-density EEG recordings during both wakefulness and sleep. In line with previous findings in the sensorimotor domain, we showed that a classical hallmark of sleep – the NREM *slow wave* – may display regional changes in occipital areas following an experimental modulation of visual experience affecting the ‘use’ (i.e., functional recruitment) of the same brain regions. Such changes have been suggested to reflect an increased (or decreased) ‘*sleep need*’ of the specific neuronal populations that are extensively activated (or inactivated) during the day. In another study, we demonstrated that the use-dependent increase in *sleep need* is already manifested during wakefulness with a local ‘*functional fatigue*’, characterized by the occurrence of neuronal silent-periods resembling those observed during actual *slow waves* of NREM sleep. We also found that these ‘*local sleep*’ episodes coincide with specific performance errors when occurring in task-related regions in humans. Finally, using an ‘extended wakefulness’ paradigm and MRI investigations, we showed that prolonged task practice is associated with both global and local functional and structural brain modifications that have a direct correlation with changes in the level of alertness and cognitive performance. In all examined conditions, sleep counteracted structural, functional and behavioral changes accumulated during waking activities.

Beneficial effects of napping on impulse control

U. Faraguna

University of Pisa, Pisa, Italy

Among the many beneficial effects of sleep, an improvement in impulse control has been repeatedly shown. Conversely, sleep deprivation significantly compromises subjects' performance in tasks involving impulse control. Napping has been strongly correlated with improvements in attention, memory, and alertness. Positive napping effects on declarative, procedural and motor memory, have been shown to depend on which sleep phases were experienced during the nap and thus on its length. As an example, it was shown that afternoon napping can reduce the accident rate of professionals working on night shifts. There are meta-analytic evidences suggesting that napping is an effective counter measure to mitigate some of the adverse effects of sleep deprivation. Short naps (5-15 minutes) can positively affect vigilance in the next 1-3 hours and are not followed by significant sleep inertia.

Effects of sleep loss on the cortical microstructure

M Bellesi

Università Politecnica delle Marche, Ancona, Italy

Sleep loss impairs many cognitive functions, from attention and learning ability to verbal fluency and inhibitory control. Studies performed so far have identified many molecular, biochemical, and electrophysiological correlates of sleep deprivation. Yet, we do not know whether brain microstructure looks different as a consequence of sleep loss. In his talk, Dr. Bellesi will discuss recent morphological evidence describing the ultrastructural changes occurring in the cerebral cortex across the sleep and wake cycle and after sleep loss.

Fluid boundaries between wake and sleep: experimental evidence from Stereo-EEG recordings

S. Sarasso

University of Milan, Milano, Italy

Sleep and waking have been traditionally considered global behavioral states regulated by subcortical neuromodulatory circuits in a top-down fashion. Sleep disorders, such as sleepwalking, suggest that electroencephalographic (EEG) features of sleep and wakefulness might be simultaneously present across different cerebral regions. Recently, intracranial EEG recording techniques, mainly applied for the presurgical evaluation of drug-resistant epileptic patients, have provided new and interesting information on the activity of different cortical

and subcortical structures across the wake/sleep cycle in humans. Supported by this technological development, over the last years, we have been experiencing a paradigm shift towards a view that both wake and sleep are in essence local processes. This talk will review clinical and basic research works that support this view by taking advantage of stereotactic electroencephalography (Stereo-EEG, SEEG) recordings performed in epileptic patients. Specifically, a growing body of evidence showing how electrophysiological features of sleep and wakefulness are coexisting across diffuse brain areas in pathological as well as physiological conditions, together with their implications for sleep medicine will be discussed.

Dreaming: a window into consciousness

F Siclari

CHUV, Lausanne, Switzerland

Dreaming is a form of consciousness that occurs during sleep, while we are functionally disconnected from the environment. Traditionally, dreaming has been linked to REM sleep, a behavioral state characterized by fast, desynchronized electroencephalographic activity similar to wakefulness. In recent years however, it has become clear that dreaming can also occur in NREM sleep, in which EEG activity is dominated by slow waves and spindles. This has challenged the understanding of the neural correlates of conscious experiences in sleep. In the present talk I will present a series of studies in which we investigated the neural correlates of conscious experiences during sleep using serial awakenings paradigms and high-density EEG recordings. We found that dreaming, irrespective of sleep stage, is associated with a local reduction of low-frequency activity in posterior cortical regions. By monitoring brain activity in these regions in real time, we were able to predict the presence or absence of dreaming in NREM sleep with a high accuracy. In addition, we found that specific dream contents were associated with localized high-frequency increases within these posterior cortical areas. Taken together, these local EEG correlates may account for the presence of conscious experiences in behavioral states with radically different global EEG signatures.

Symposium B: The signature of pain in the brain: how to dissect attention from nociception

(Symposium of the Italian Society of Psychophysiology and Cognitive Neuroscience)

Laser Evoked potentials: a pain related signal beyond the stimulus salience

M. Valeriani

Ospedale Bambino Gesù, Rome, Italy

Laser Evoked Potentials: a pain related signal beyond the stimulus salience

Massimiliano Valeriani

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The network of the cortical areas which are thought to process the nociceptive input is commonly known as "Pain Matrix". In the last decades, new neuroimaging and neurophysiological techniques have increased our knowledge about the physiology of these brain regions. However, the concept itself of "Pain Matrix" has been recently challenged by studies which showed that the cortical activities following a painful stimulation can be evoked by salient non-painful stimuli of different modalities. The hypothesis has been made that the pattern of cerebral activation, traditionally considered as a marker of pain perception, is a mere expression of the salience of the incoming input, independently of its nociceptive quality. On the other hand, the laser evoked potential (LEP) recording is still considered as the gold standard for the functional assessment of the nociceptive pathways. Indeed, infrared laser pulses have been demonstrated to activate the thin nociceptive fibers selectively, without any concurrent stimulation of the large myelinated fibers. In conclusion, although the brain responses recorded to painful laser stimulation of the skin are confidently generated by a pure nociceptive input, we became doubtful whether the same waves could be obtained even by non painful, but salient, stimuli.

Habituation to pain and sensitization mechanisms

G. Coppola

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Introduction

According to the dual-process theory, two opposing processes, habituation and sensitization, compete to determine the final behavioural outcome after repetitive stimulations. These two processes are considered most useful for studying the neuronal substrates of information processing in the CNS. Although these phenomena have been enormously studied using innocuous stimuli, researchers paid less attention to the mechanisms of habituation/sensitization in response to repetitive presentation of noxious stimuli.

Methods

The purpose of this review is to provide a comprehensive overview of the findings of clinical, electrophysiological and functional neuroimaging studies aimed to investigate how repetitive presentation of noxious stimulation is elaborated and perceived in healthy controls and patients.

Results

Once avoided the fatigue of peripheral nociceptive neurons, a clear habituation to pain within the central system

exists, as observed with pain-related neurophysiological responses, mostly using laser/heat or electrical stimuli. Neuroimaging studies have shown that the decreased perception of pain over time is reflected in diminished BOLD responses to noxious stimuli in brain areas anchored to the so-called “pain matrix”, now known as salience network. The involvement in this behavioural process of the endogenous opioid system is still under debate. Nonetheless, BOLD signal within the frontal descending antinociceptive system, i.e. the subgenual anterior cingulate cortex, was found to increase over time, suggesting that habituation to pain is at least in part mediated by increased antinociceptive activity. Moreover, monoaminergic neurotransmission, especially serotonergic and dopaminergic, may play a specific role for the habituation to repetitive noxious stimuli. An augmentation of sensory signalling in the central nervous system because of repetitive painful stimulation is a general behavioural response in several painful conditions, overall characterized by a transient or persistent state of higher cortical reactivity called “central sensitization”.

Conclusions

We hope that a better understanding of the neural circuitry subserving these physiological behavioural phenomena provides an important opportunity to develop new treatment strategies for and eventually even prevent pain.

Self-related and moral contextual cues modulate pain perception during social interactions. Behavioural and EEG correlates.

V. Nicolardi

Sapienza University of Rome, ROMA, Italy

Satisfying social interactions represent one of the most rewarding aspects of our life. Studies indicate that changes in our emotional or cognitive state affect and modulate our pain perception and its neural processing when referring to acute pain sensation. Interestingly, they also play a relevant role in the process of chronification, as well as they could constitute a predispositional factor for the development of a chronic pain condition. Moreover, also social support modulates pain experience in healthy participant and chronic pain patient as well. Despite this, inconsistency between these findings is still present and controlled studies able to disentangle the different effects that social interactions can have on the perception of pain are still needed. Cognitive control-related brain network could also play a role in pain-processing modulations, by shaping cognitive resources allocation according to affective salience attribution. Following this vein, we aimed to obtain a fine-grained picture of how the valence of different features characterizing a social interaction, can influence pain perception. We used the Dictator game, an economic paradigm, in order to disentangle the effect of the objective equanimity (Moral Valence) from the effect of the self-relevant feature of the context (Personal Valence) in pain perception. Moreover, considering the role that emotional and cognitive modulation can have in central sensitization and chronification of pain, we collected behavioral and EEG correlates from healthy participants and chronic tension headache patients as well, in order to test whether those modulation vary between these two different samples.

Symposium C: Understanding neural synchronization by combining good practice and novel methods in electrophysiological functional connectivity analysis.

(Marzetti L. - Chieti, Italy; Pizzella V – Chieti, Italy)

Understanding neural synchronization from source space magnetoencephalographic and electroencephalographic data

Marzetti Laura

Istituto di Tecnologie Avanzate Biomediche, Chieti, Italy

This lecture will cover several aspects related to MEG/EEG functional connectivity analysis with emphasizing the strengths and weaknesses of the different possible choices that can be made when designing an analysis pipeline for functional connectivity estimation from non-invasive electrophysiological data. To this end, the lecture will be composed of two complementary parts: i) a theoretical and computational part based on simulated data, and ii) an experimental part based on real MEG data. In this framework, I will discuss MEG/EEG sensor space functional connectivity analysis as opposed to source space analysis, both in general and in relation to different connectivity metrics. The impact of the choice of the source localization techniques used to derive brain level signals will be discussed in the framework of source space connectivity analysis with specific emphasis on intrinsic spatial limitations of MEG/EEG. Finally, the relation to MRI/fMRI connectivity will be assessed.

Understanding phase amplitude coupling from bispectral analysis

Nolte Guido

University Medical Center Hamburg-Eppendorf, Hamburg, Germany

This is a mostly conceptual talk about how to estimate cross-frequency-coupling observable in electrophysiological data like EEG/MEG/LFP.

Measures of phase-amplitude-coupling (PAC) attract many researchers, e.g. to observe coupling between theta and gamma rhythms. Analyzing those measures in relation to bispectra leads to the following conclusions. The measures of PAC should always be calculated using a filter for the high frequency signal as wide as the low

frequency. For all other choices either PAC cannot be detected or results are smeared in the frequency domain. However, even in relation to an optimal calculation of measures of PAC, we recommend to rather calculate bicoherence, the normalized version of a bispectrum.

Bicoherence has an optimal frequency resolution allowing for an easy detection of higher harmonics, the computational cost is hundreds of times lower than for measures of PAC, it is more general, and there is nothing which will be missed in comparison to standard measures of PAC. In essence, bicoherence is like Cinderella, waiting for her true values to be acknowledged.

In the application part of this talk, I will present results for localizing univariate bicoherence in the brain representing alpha-beta coupling. The main results for resting state EEG data are: a) at high alpha, bicoherence is detected in motor areas, which is not detectable using power, and b) schizophrenic patients are significantly different from healthy controls.

Are there cortical correlates of muscle synergies?

A Daffertshofer

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Muscles synergies are coordinated activation patterns of groups of muscles. Animal locomotion, for instance, strongly relies on rhythmically active muscle synergies for the spatiotemporal positioning of the extremities. There, small spinal circuits are believed to underly these synergies. Here we ask, whether a resemblance of neural activation and muscle synergies also extends to the cortex. We report studies of high-density EEG and multivariate EMG during different postural tasks. By using EEG source localization and non-negative matrix factorization to distill muscle co-activations, these studies indicate cortical correlates of balance-related muscle synergies.

Symposium D: Brain processing of word morphology

(Medvedev S. and Chernigovskaya T. – Saint Petersburg, Russian Federation)

The neural correlates of case and inflection in the processing of morphologically complex words: An fMRI study of Russian nouns

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The issue of how the morphological processing of inflected words is represented in the brain has attracted a lot of attention in neurolinguistic research. Although a number of studies have been devoted to this issue, there is still an ongoing debate about whether inflected words are processed as a whole or decomposed into constituent morphemes. Additional methodological problems arise from the fact that morphological decomposition as affix stripping is conflated with the processing of morphological information carried by the inflected word as a member of an inflectional paradigm. Furthermore, the combinatorial processes are often confounded with lexical factors such as word frequency and word length. These problems could not be resolved by relying on English and other Germanic languages, which have been mainly used in functional neuroimaging studies. Taking this into account, the current functional MRI study has aimed to dissociate the hypothesized decomposition as affix stripping, and morphological case processing. It has focused on lexical access of morphologically complex inflected nouns in the Russian language, which has an inflectional paradigm with six cases. The rationale for using Russian nouns was an opportunity to manipulate the type of inflection (<i>-a</i> or zero) independently of case (citation form: the nominative vs. oblique case: the genitive), with two forms in the nominative, <i>fontan</i> and <i>raket-a</i>, ('fountain', 'rocket') and two forms in the genitive, <i>fontan-a</i> and <i>raket</i> ('of fountain', 'of rockets'). The event-related fMRI study was conducted with 18 monolingual Russian speakers (aged 20-36 years old, average 25 years old, male =12) using a 3T fMRI scanner (Philips Achieva). Results revealed changes in the fMRI-signal that corroborate the decompositional account of lexical access of morphologically complex words by demonstrating a greater level of functional activity within the left inferior frontal gyrus (LIFG). This finding supports the central role of the LIFG in the left-lateralized frontotemporal decompositional network. In addition, a greater involvement of the LIFG in morphological decomposition was observed for the words inflected in the oblique case compared with the citation form. At the same time, a greater engagement of the bilateral lexico-semantic network was observed for the citation form regardless of its inflectional status (overt <i>-a</i> or zero inflection) compared to the oblique case. The experimental findings for the first time dissociate the roles of morphological decomposition as affix stripping, and of the inflectional paradigm and case hierarchy in the processing of morphologically complex inflected words in the brain.

Differential involvement of prefrontal cortex in the processing of case agreement attraction in Russian: an fMRI study

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Grammatical agreement often becomes the subject of experimental studies: this is one of basic linguistic operations that exhibits interesting cross-linguistic similarities and differences and allows exploring how linguistic dependencies are established and how different features (number, gender, person etc.) are represented and manipulated in the mental grammar. However, most experiments use behavioral methods so far, a number of studies relies on EEG, and neuroimaging experiments are still very infrequent. They revealed a number of facts regarding different functional roles played by the brain areas comprising the frontotemporal language processing brain system: their involvement in semantic or syntactic analysis, in person and number agreement error detection etc.

Nineteen healthy right-handed subjects (23±4 years old) participated in the current fMRI study aimed to extend these findings focusing on adjective-noun agreement, which has not been studied before, and on a novel feature: case. Russian has six cases, and adjectives agree with nouns in case, as well as in number and gender (in singular). Grammatically correct sentences as well as sentences with two types of agreement errors were compared: involving or not involving agreement attraction (attraction in subject-predicate number and gender agreement has been extensively studied using behavioral methods and EEG, but not using fMRI). All adjective-noun pairs were introduced by prepositions that unambiguously indicated which case should be used.

We found that the left inferior frontal gyrus (LIFG, BA 45/47) and the supplementary motor area were involved in error processing in all conditions (with or without attraction). At the same time, the relative decrease in local activity within the left middle frontal gyrus (LMFG, BA 10) was demonstrated for the sentences with attraction errors. The revealed differential involvement of the LIFG and LMFG in the processing of agreement errors supports the domain general role of the LIFG and the language-specific involvement of the LMFG sensitive to morphological features of the form-to-meaning mapping process.

The study was supported by the Russian Science Foundation grant # □'- 16-18-00041.

Organization of functional interactions within the fronto-temporal language brain system underlying production and perception of regular and irregular Russian verbs

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It is largely accepted that the brain system comprising the left inferior frontal gyrus and bilateral areas of the temporal cortex is specifically involved in morphologically complex word processing. Despite a substantial number of experimental neuroimaging studies, the principles of functional organization of this system remain controversial. For instance, a number of studies point to different regimes of involvement of the left IFG and bilateral temporal regions in the processing of regularly or irregularly inflected forms. It is assumed that regular forms are processed using a combinatorial stem-affix rule and that this process is mainly supported by the left IFG and the left superior temporal gyrus (STG). On the other hand, processing of irregular forms is subserved by lexical memory supported by brain areas located in the bilateral STG.

Also there is a controversy in the experimental findings demonstrating different directions of changes in the levels of functional activity in the IIFG and STG regions associated with processing of regularly or irregularly inflected forms. Therefore, it is hard to consistently support the claim of differential involvement of this system in the rule or memory-based processing. Since there is a lack of studies dedicated to the investigation of functional interactions within this fronto-temporal brain system it is also hard to infer the principles of its functional organization.

To fill this gap we recently conducted two fMRI studies in which healthy participants actively and overtly inflected or passively perceived and actively selected regular and irregular Russian verb forms. Irrespective of the task type, processing of irregular forms was associated with the greater levels of local functional activity in a number of brain regions including the left IFG. In contrast, the analysis of psychophysiological interactions of the IIFG revealed greater connectivity with brain areas located in the STG for both generating and selecting regular verb forms, as compared to irregular ones. Revealed differential relations between the changes in local activity and distant functional interactions can be seen as alternations in the regime of fronto-temporal network activity as a function of morphological process involved.

The study was supported by the Russian Science Foundation grant #16-18-00041.

Build-up of neocortical representations for morphemes: E/MEG studies

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Humans learn new language elements rapidly, an essential skill which ensures high efficiency of our communication system. However, the neural bases of this important ability are poorly understood. How exactly are words,

morphemes and their combinations acquired by our brain, and can we track this process neurophysiologically? To this end, we suggested using ERP/ERF indices of (1) long-term memory trace activation, seen in the form of enhanced brain responses to familiar morphemes, and (2) connections between morphemic representations, manifest as priming effects leading to ERP/ERF reduction when connected morphemes cooccur. Using this approach, we addressed the brain mechanisms of online learning of new language representations for monomorphemic meaningless wordforms, new meaningful words and, finally, novel affixes in the native or second languages. We find that the temporal and inferior-frontal areas of the neocortex exhibit complex changes in activation patterns in the process of acquiring novel linguistic representations. These become exhibited as both an increase in activation for newly formed representations, and a decrease of response amplitudes for morphologically primed elements. These effects are (1) to a substantial degree independent of attention, reflecting a largely automatic nature of initial word acquisition stages, (2) most efficient for the native language, (3) present both immediately and after an overnight consolidation, and (4) operate in different modalities. These experiments demonstrate that our brain is capable of a rapid formation of new cortical circuits online, as it gets exposed to novel linguistic patterns in the input, and suggest E/MEG as a useful tool for tracking dynamic processes of neural memory-trace build-up and activation.

Early Afternoon Session: 1.30 – 3.30 p.m.

Symposium A: Fact and Fallacy in EEG analysis

(Dezhong Y. – China; Valdes Sosa P. – Cuba)

Fact and Fallacy for EEG and ERP reference

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Which reference should we choose for scalp ERP and EEG is remained as a puzzle problem in the domain, and debates were never stopped since the report of human EEG in 1929. Definitely, ideal reference would be a point with zero or constant potential. However, it is well known that there is no point on the body surface where the potential is zero or constant. In current EEG and ERP practices, more than ten different references were used alternatively by different laboratories, seriously disturbed the knowledge dissemination obtained from various laboratories, and a rational recommendation is expected in this domain for a long time. In this talk, current typical references, REST (reconstructing zero)/average reference (AR)/linked-mastoids/ears (LM), are compared systematically, and REST is recommended as the best in general.

The 90 degree phase gap in the EEG connectivity community

TK Thomas

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EEG and MEG based connectivity analyses are uniquely attractive, because they model highly time-resolved brain functional data in terms that are at the core of the “network turn” that cognitive neuroscience has taken. At the same time, these analyses are notoriously confounded by volume conduction, partially because researchers are not sufficiently aware of the omnipresent volume conduction effects in such data, and partially because it remains an analytical challenge to isolate “true” functional connections from those confounded or explained by volume conduction. These problems have essentially led to a bifurcation of strategies: One family of approaches makes local claims about pairs of interconnected nodes, and typically attempts to eliminate volume conduction effects by quantifying solely interactions that have particular, and typically relatively **large** phase lags that cannot be explained by volume conduction (i.e. lagged coherence, PLI, and others). The other approach packs scalp activity into a set of potentially global processes that each has **no** lags among the sources, but remains rather uninformative about the underlying sources (i.e. ICA or microstate analysis). The two approaches thus have, in terms of lags, an a-priori incompatible definition of connectivity. In my contribution, I will discuss thus look at the issue from a third, and more a-posteriori perspective, namely from the potential functional significance of different lags among interacting brain network nodes.

Fact and fallacy of EEG connectivity

Marzetti Laura

Istituto di Tecnologie Avanzate Biomediche, Chieti, Italy

The investigation of brain functional connectivity from channel level EEG data is still common practice in clinical applications. Nevertheless, channel level functional connectivity analysis can easily lead to wrong conclusions. For example, if one would unrealistically assume that only one brain area is active, all sensors would measure the

activity of this area inducing a fallacious connectivity profile between EEG channels even in the absence of any brain functional connectivity. In this case, solving an electromagnetic inverse problem would clarify the presence of only one active brain source by providing an estimate of its location and strength. Unfortunately, fallacious results can arise also when functional connectivity is estimated at the level of brain sources. Indeed, the estimated activity of one brain source is influenced by and influences the activity at other brain locations in a way that depends on the properties of the specific inverse method used. This is quantified, e.g., by the Point Spread and Cross Talk Functions (Hauk et al. 2011). For example, the spatial dispersion of the Cross Talk Function informs about how different brain areas (erroneously) contribute to the reconstructed activity of a given brain source, thus providing an index of the disposition to fallacious connectivity of the inverse method used. Additionally, different connectivity metrics show different sensitivities to this issue. These facts need to be taken into account when estimating EEG functional connectivity in order to design reliable analysis pipelines.

Fact and Fallacy of EEG ICA

Valdes Sosa Pedro

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Independent Component Analysis (ICA) has proven to be an essential tool in current EEG analysis. With proper care it can help eliminate artifacts, identify important components, and provide features for further pattern analysis. A common procedure is to carry out ICA on the EEG and then identify the sources of the components. This is not necessarily the optimal procedure. An alternative is to carry out ICA at the source level thus incorporating biophysical constraints from the beginning. Advantages and disadvantages of each approach are discussed and illustrated.

'Fact and fallacy of EEG nonlinearity'

Nolte Guido

University Medical Center Hamburg-Eppendorf, Hamburg, Germany

It is easy to show that EEG and MEG data contain substantial nonlinearities as can be expressed in the coupling of oscillations of different frequencies. However, when relations between signals of the same frequency are studied, quantities, which seem to reflect nonlinear properties of the data, are in general perfectly consistent with linear dynamics. An example of this is power-power coupling.

At first sight it appears to be a nonlinear phenomenon independent of phases and conceptually very different from what can be observed with a linear measure like coherence being a weighted measure of phase-phase relationships. However, for linear dynamics these two quantities are formally equivalent. The question then arises whether e.g. power-power coupling contains any valuable information or whether it is just a complicated look at trivialities. Without coming to a final conclusion, results for empirical EEG data will be presented which might be useful as a basis for discussion.

Influence of the volume conductor problem in EEG brain connectivity at the scalp level

Jorge Bosch-Bayard

Institute for Neurobiology, National Autonomous University of Mexico (UNAM)

A methodological study on the negative influences of the volume conduction and the reference electrode in the EEG brain connectivity at the scalp level will be presented, with mathematical evidences in simulations to illustrate the fact. At the same time, answers will be provided for some of the common beliefs that neurophysiologists have when doing connectivity analysis based on EEG recordings at the scalp: a) when doing statistical analysis of brain connectivity, subtracting two conditions is a way to avoid the volume conductor effect and also, at the same time is a way to eliminate all the common brain activations present in the two conditions, leaving only the connections which are different between the conditions; b) the measurements of phase connectivity are free of the volume conductor effect.

Symposium B: Perspectives on ERP markers of cognitive and emotional processing

(Barry R. – Wollongong, Australia; De Blasio F. Wollongong, Australia)

Subcomponents of the Late Positive Complex (P300)

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The dominant ERP feature in many cognitive paradigms is the P300, a large centroparietal positivity. Almost 50

years ago it was suggested that P300 was better conceptualised as the Late Positive Complex (LPC), rather than a single component, but this has largely been ignored, to the detriment of theory development in this field. Our thesis contends that the LPC contains four identifiable subcomponents that occur together in a fixed order, in proportions that vary between experimental paradigms: P3a, P3b, Novelty P3 (nP3), and Slow Wave (SW). We test this thesis using a traditional habituation paradigm and relatively long interstimulus interval, and decompose the LPC via temporal Principal Components Analysis (PCA). We include the Skin Conductance Response (SCR) as a “gold standard” index of Orienting Reflex (OR) habituation to help confirm the identification of the nP3.

Thirty undergraduate students (aged 18 to 47 years) were presented with a mix of 1000 and 1500 Hz tones (counterbalanced between participants), each of 50 ms duration with rise/fall times of 15 ms, at 60 dB SPL. The ISI varied between 13 and 15 s, and the sequence contained 10 standards at one frequency, followed by a deviant at the alternate frequency. The EEG data from –100 ms to 700 ms around stimulus presentation at each trial was downsampled to 500 Hz, and the covariance matrix was submitted to PCA. All 190 components were extracted and Varimax rotated. The first 9 components each carried more than 3.0% of the variance and accounted for a total of 90.8% of the variance; these were all identifiable as expected components based on previous literature.

In the LPC range, these components contained P3a at 258 ms, P3b at 294 ms, nP3 at 344 ms, and a positive SW at 384 ms. Of these, only nP3 matched the trial-by-trial profile of SCR in demonstrating significant decrement over the 10 repeated standards, and significant recovery at the deviant trial.

These results support our thesis concerning the occurrence of the subcomponents in the LPC, confirm their temporal sequence, and validate use of the Novelty P3 label. We argue that the way forward for ERP investigators in cognitive and affective neuroscience is to abandon the monolithic P300/LPC, and to focus instead on its robust and unique subcomponents. These individual subcomponents have demonstrably-different relations with eliciting conditions, and thus allow a richer theoretical framework for future research and development.

Late Positive Potential (LPP) or Slow Wave (SW)? Revisiting Slow Cortical Potentials After the P3 component

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Introduction: The falling edge of the P3 (P300) wave of the event-related potential (ERP) is usually overlapped with a slow potential component. This slow potential occurs around 500–1000 ms after stimulus onset and has been identified in early P3 research as a late positive potential (LPP) or slow wave (SW). Affective pictures often elicit an LPP that is dominant at centroparietal scalp sites. However, alternate LPP or SW components have been found at similar latencies, with different scalp distributions or polarity. Characterizing these slow potentials has been complicated, given that low-frequency potentials are affected by high-pass filter settings. The purpose of this study is to provide a brief overview of the ERP components after the P3.

Method: We reanalyzed our previous ERP datasets using different reference systems, temporal-spatial principal component analysis, and source estimation with the standardized low-resolution electromagnetic tomography (sLORETA). The effects of high-pass filter settings on the waveform were examined using a simulation model.

Results: At least three types of slow cortical potentials overlapping the tail of the P3 wave were found: (1) centroparietal LPP, which is typically elicited by arousing affective pictures; (2) frontocentral LPP, which appears to be related to a controlled, evaluative judgment of non-arousing pictures; and (3) posteriorly positive and anteriorly negative SW, which is associated with effortful processing after target recognition, and reflects activation of the prefrontal cortex. The simulation study showed that an inappropriate high-pass filter can diminish the amplitude of slow potentials and produce an artificial deflection with the opposite polarity in the waveform.

Conclusion: The slow cortical potential after the P3 wave is not a single entity. Its scalp distribution differs depending on experimental stimuli and tasks. To examine the nature of slow cortical potentials, it is advisable to use an appropriate high-pass filter and record ERPs from electrodes at frontal poles and occipital sites in addition to centroparietal sites.

A systematic review of event-related potential indices of facial emotion perception in healthy adults

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Introduction: Over the last 50 years, the electrophysiological mechanisms underlying facial emotion perception have been widely investigated across studies. However, the integration of an event-related potential (ERP) model of emotion perception is often impeded by mixed reports arising from the diversity of samples, experimental paradigms, and ERP recording/data quantification methods. The present study aimed to synthesise these findings by conducting a focused systematic review of experiments investigating ERP indices of conscious facial emotion perception in healthy adults.

Method: Articles were searched using PubMed, PsycInfo, Scopus and Web of Science and identified using a set of predefined inclusion criteria. The experiments in each study were categorised into three types of paradigms, based on the level of attention required to process emotional expressions on faces: passive, active implicit, active explicit. Finally, information regarding the effects of emotion on ERP amplitude and ERP reference schema were collected for all ERP components examined across studies.

Results: Twenty-six studies with 32 experiments were included for qualitative synthesis. Studies reported effects

across on a range of ERP components: early- (N1, P1, N170, Vertex Positive Potential), mid- (N2, P2, Early Posterior Negativity), and late-latency components (Late Positive Complex). The most commonly examined ERP components were posteriorly distributed, however emotion effects on anterior peaking components were least examined. Nonetheless, it was revealed that the majority early- and mid-latency ERP components elicit enhanced ERP responses to negative facial stimuli regardless of the depth of emotion processing, whereas the findings for late-latency components were mixed. In addition, the review also found that reference schema choice affected the outcome of emotion effects for some ERP components.

Conclusions: The current systematic review revealed that the processing negative facial expressions takes primacy over positive and neutral expression during early and mid-stages of perception, but this effect may be modulated by attention at late stages of processing. However, the findings of the present study were limited to commonly examined posterior peaking components. The use of data-driven approaches (i.e., principal components analysis) in future research may help to further elucidate the functional significance of anterior and posterior processes underlying facial emotion perception.

Symposium C: Oscillatory activity - a general property of living systems (from microbes to man). (Danilova N. – Moscow, Russia; Grechenko TN – Moscow, Russia)

The influence of eye movement's oscillations on vestibular function in virtual reality

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Vection describes the sensation of ego-motion induced by moving visual stimuli that cover a large part of the visual field. The research was aimed to study 1) whether perception of visually induced circular vection is changed if rotational velocities of 30, 45 or 60 °/s of stimuli are used, and 2) what is the role of optokinetic nystagmus (OKN) in the emergence of the illusion. In the experiments we used the eye tracking to examine parameters of OKN during vection perception. Vection was provoked by the rotating optokinetic drum with black and white stripes in CAVE virtual reality system. 17 volunteers with healthy vestibular systems took part in this study. Subjects passively observed rotating stimulation and pressed the button to indicate the vection onset. 18 trials (3 velocities x 2 directions (left and right) x 3 repetitions) were presented in pseudorandom order. The duration of each trial was 2 min. Several dependent variables were obtained: vection onset latencies, vection intensity, Simulator Sickness Questionnaire (SSQ) scores to evaluate motion sickness strength. Moreover, for analysis we used the relative values of OKN slow-phase durations (SPD) measured by 10 s time-windows (epoch). The center of each epoch was the moment of pressing the button by subjects to indicate vection onset. Thus, the relative value of OKN SPD was calculated as the following ratio: OKN SPD during vection perception/OKN SPD in non-vection period. It was found that for all stimuli rotation velocities relative value of OKN SPD were significantly lower compared to non-vection periods ($F = 44,5$, $p < 0,01$). During 60 °/s rotations SSQ scores and vection intensity rates were the highest, and vection onset times were significantly shorter. Relative values of OKN SPD during 60 °/s were also lower in comparison to other velocities. We revealed the temporal relationship between OKN dynamic and vection perception. It is suggested that the increase in OKN SPD because of OKN habituation led to increase the sensory conflict between visual and vestibular sensory channels. Therefore, the OKN dynamics may be considered as a part of psychophysiological mechanism of vection perception.

Brain activity in face-name memory

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Introduction. Face-name memory (FNM) is a specific kind of human memory which provides an association between a name and a face. Retrieving a name by visually presented face requires con-functioning of visual and verbal memory. Both visual and verbal memories have been widely investigated separately but the psychophysiological mechanism of their cooperation has not been fully studied. This research gives further analysis of brain activation in an FNM task. Methods. The participants (N=26, 13 females, mean age=21.9, SD=1.9) viewed portrait pictures of movie stars. Such stimuli were chosen in order to provide face recognition. Participants responded by pressing different buttons according to whether they were able to remember the name of the presented movie star (for detailed description of the experiment see Kozlovskiy, Shirenova et. al., 2017). Brain activation in the FNM-task was recorded using fMRI (block design; Siemens Verio 3T; 65 slices, TR=2200 ms, TE=25 ms, voxel size=2x2x2 mm, FA=90°, MB 5 (CMRR); SPM12; $p < 0.01$, FWE-corrected). Results. Brain structures involved in visual perception (L&R occipital poles) and face recognition (L&R fusiform gyri) were active. Activation of the medial supplementary motor cortex, the putamen and the precentral gyri was also present. It was probably associated with motor response. We also observed activation of the anterior insula (L&R). It was shown in the previous studies that anterior insula is involved in recognition memory (Bermudez-Rattoni, 2014). Right temporal pole was active in this FNM task as well. It is known that this brain area functions as name storage and contributes to semantic memory (Chadwick et. al., 2016). Another area of activation was found in the middle frontal gyri. Supposably, activation of these cortex

areas reflects association between a face and a name. Conclusions. Our data suppose that FNM is achieved by coordinated functioning of the fusiform gyri, the anterior insula, the temporal pole and the middle frontal gyri. These brain areas act as a functional system allowing a subject to retrieve a name by visually presented face.

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Frequency-selective generators of oscillatory brain activity (EEG) are predicting the earlier stage of Parkinson's disease

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We focused our attention on the mechanism of semantic categorization and the anticipation as a special type of the memory. The experiment included the identification of semantic categories during the visual presentation of words belonging to two group stimulus: 'animals' and 'objects'. Our method of "Microstructural analysis of oscillatory brain activity" (Danilova, 2002) based on the pacemaker hypothesis of the rhythmogenesis was used to study the cognitive disturbances in patients with Parkinson's disease. The method calculated mobile current dipoles for narrow-band frequency-selective generators extracted from the in the range of 1-80 Hz with a pitch of 2.5 msec and determined their localization in the brain structures by the coordinates of the "Stereotactic Atlas of the human brain" (Talairach, Tournoux, 1988). The mechanism of the categorizations, which is normally groups quite easily formed for the "animals" category, has been destroyed in the patients with Parkinson's disease. This is confirmed by the increase in the number of errors and the lengthening of the latent period of motor reactions during the identification of the category "animals" in relation to the category "objects". We compared each group of patients (Yakhno N. N. and Levin O. S.) with norm group. The greatest convergence of the latent period of motor reactions during the identification of two categories of stimuli ("animals" and "objects") were identified in the group of the patients - Levin O. S. (36,8061). A lesser similarity of lateral periods was found in the patients of the group -Yakhno N. N (48,1786). The greatest difference between latent periods was revealed in the group of age norm (85,6879). In the patients the anticipation is preserved and it occurs before the category - "animal". Thus, in patients with BP, two new markers were identified: categorization mechanism and linking the anticipation reaction to another category of stimuli that distinguish them from the norm. This conclusion is confirmed by an increase in the depression of the alpha rhythm, which, like the theta rhythm, appears in patients before the category "animals", and not before the category "objects". Thus, in patients with BP, two new markers were identified: the categorization mechanism and linking the anticipation reaction to another category of stimuli that distinguish them from the norm. <i>The work is supported by Russian scientific Fund grant □'- 14-18-03253</i>

Characteristics of biorhythms of living organisms of the different evolutionary age

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The availability of oscillations of similar frequencies in the living beings of different taxonomical position and evolutionary age was checked experimentally. It is supposed that all available set of rhythms is prepared evolutionarily. We registered the electrical activity by glass macroelectrodes in the cyanobacteria <i>Oscillatoria terebriformis</i> and <i>Geitlerinema sp</i>, the yeast <i>Saccharomyces cerevisiae</i>, hay bacterium <i>Bacillus subtilis,</i> the ciliates <i>Paramecia caudatum</i>, the leech <i>Hirudo medicinalis</i>, the fruit body <i>Myxomycetes,</i> the mollusk <i>Helix lucorum.</i> For check of the idea about evolutionary conservatism of the main rhythms of oscillometric activity electrophysiological experiments on cuts of fruits- <i>Malus domestica 'Jonagold'</i> apples and <i>Daucus carota subsp carota Sativus</i> and rootlet of peas - were executed. Spectral analysis using a fast Fourier transform showed localization of peaks of rhythmic activity in the area 0,5 – 6, 7-12, 15-20, 28-32 Hz. The frequency peaks of rhythmic oscillations were located at the points that correspond to the known rhythms identified in human EEG. It was assumed that to clarify the functional significance of the electrical activity not only the oscillation frequency is essential, but also the temporal structure of their sequences, the specific pattern that determines the level of activity of an organism. The autocorrelation analysis revealed that the patterns registered from the same object are numerous and have different structure. The patterns are stable and repeatable in registrations from different specimens of the same species. The same pattern is reproduced many times in one and the same object. Patterns identical in structure were found in biological objects of different evolutionary level. It is supposed that the temporal structures of the oscillatory activity are biologically conservative and may be biological constants unchanging in evolution. The crosscorrelational analysis of the activity which is taken away at the same time by two electrodes revealed dynamic communications between different zones of under investigation object. It

was revealed that synchronized electrical activity in association of microorganisms arises with biosocial systems formation. It is supposed that the life of the first cellular structures on the Earth began with cooperation – “social” behavior. The role of oscillators in complex live systems’ formation is discussed. The conclusion was drawn that oscillatory processes constitute a common mechanism by which interaction of individual cells – from association of prokaryote to complex multicellular organisms - is organized.

<i>The work is supported by Russian scientific Foundation grant □'-14-28-00229</i>

Symposium D: Nonlinear Modeling and Complexity Measures of Brain Dynamics: Methodological Issues and Interpretation

(Vanello N. Pisa, Italy; Gentili C. Padua, Italy)

Stationary Detrended Fluctuation Analysis in the Fourier domain

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Detrended Fluctuation Analysis (DFA) is a standard method to analyze long range temporal correlations. The cumulative

sum of a time series is divided into segments, and the fluctuation, i.e. the standard deviation, is studied as a function of segment length after linear detrending in each segment. If the fluctuation is linear as a function of segment length in a double logarithmic plot, this indicates a scale free dynamics.

We first note that this standard procedure is inherently non-stationary: fluctuations for each time point systematically depend

on the position of that time point within the respective segment. We here present an alternative procedure which is strictly stationary and which can be effectively calculated in the Fourier domain.

Most importantly, it allows to calculate the slope of the logarithm of fluctuations analytically as the respective derivative.

In contrast, the standard non-stationary procedure requires the fitting of a linear function

over a large range of segment lengths. A local calculation, let alone the calculation of the derivative, is not possible with the standard approach.

We will report results for the analysis of amplitudes of rhythmic activity in EEG, MEG and LFP data.

Age and Brain Structure Maturation Contributions to the Development of Fluid Reasoning from Childhood to Adolescence

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This paper illustrates the use of longitudinal models to investigate the development of fluid reasoning from childhood to adolescence (years 6 to 19) as well as the influence of brain structure on such development. First, a latent fluid reasoning factor is defined based on four cognitive measures taken at up to three time points. All the cognitive functions as well as the underlying brain structure markers develop nonlinearly, most clearly following an exponential function with rapid acceleration during childhood and early adolescence, slowing down and reaching a plateau by late adolescence and early adulthood. Second, invariance in the fluid reasoning factor is examined across the measurement occasions so developmental changes in such a factor can be quantified over time. Third, dynamic models based on first differences are used to investigate the contribution of brain structure maturation (via white matter integrity) to such developmental changes in fluid reasoning from childhood to adolescence. The interrelations between the brain markers and fluid reasoning involve complex patterns of developmental sequences in which brain structure at a current age is related to subsequent changes in reasoning, with different sequences across the developmental period.

The application of non-linear metrics to resting state fMRI data analysis

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Resting state fMRI data analysis has gained a rising popularity in the last 15 years. Although the most popular approach is based on functional connectivity several new methods were developed.

Here we discuss our experience in non-linear analysis of resting state fMRI data presenting results of two different experiments mainly focusing on Hurst Exponent (HE).

In the first experiment conducted on 36 individuals with different degrees of Social Anxiety. We showed that the degree of social anxiety as measured with LSAS correlated positively with HE in the precuneus, in the inferior parietal sulci and in the parahippocampus. These findings suggest that social anxiety is a trait characteristic that

shapes brain activity and predisposes to different reactions in social contexts. Moreover, we suggested that HE can be a measure of flexibility of the brain areas to react to external information. In subjects with high social anxiety spontaneous brain activity could become less 'free', more predictable and 'rigid', as if the flow of information from other districts is reduced and less able to interfere with the system and make it less 'stable' and less 'predictable'. Interestingly, HE results are consistent with the one obtained by fALFF, suggesting how the two metrics share some part of the portrayed information. This consistency brought us to another question, which is whether one metric is enough to define biological correlates of psychological dimensions.

To assess this question we assess how neuroticism modulates neural activity at rest, measuring different traditional and non-linear metrics. Thirty-one healthy volunteers fulfill the Zuckerman-Kuhlman Personality Questionnaire.

Resting state activity was measured using ALFF, fALFF, regional homogeneity, HE, global connectivity (GC) and amygdalae functional connectivity. As expected we found how different metrics were modulated by neuroticism in different areas. Interestingly, there is no region in which all the metrics are modulated.

To conclude the use of HE seems to offer the possibility to describe property of fMRI resting state not otherwise portrayed by other, more traditional measures. Further studies need to clarify the neurobiological meaning of HE to provide a stronger neurobiological interpretation of results obtained with this technique.

Symposium E: Neurophysiology of creativity

(Razumnikova O. Novosibirsk, Russia; Nagornova Z. Saint Petersburg, Russia)

Resting-state brain activity underlying social creativity

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Introduction. Previous EEG and fMRI studies have highlighted the functional neural correlates of verbal and non-verbal creativity, providing evidences that a number of brain regions are needed to production of original ideas. However, it remains unknown the brain functions underlying social type of creativity.

Methods. We have studied EEG correlates of the social creativity by testing fluency, flexibility, and originality indices induced by interpretation of specially created pictures of social situations together with a search of the relationships between verbal, figural, and social components of intelligence and resting-state brain activity. Forty university students performed Russian versions of the Amthauer's and Guilford-Sullivan's tests before multichannel EEG registration at rest with closed eyes.

Results. We found positive correlations of social originality with low- frequency alpha oscillations but fluency and flexibility indices with high-frequency alpha in anterior cortex. Increase of the verbal component of social intelligence was related to power reduction of the delta and theta rhythms and to enhancement of the beta and gamma oscillations with more expansion of this effect on the right hemisphere. Similar relation was found for the figural component of IQ with more pronounced effect in the central and posterior cortex. Reciprocal relations between social creativity and intelligence were obtained for the resting-state cortical activity on low frequency but congruent relations - on high frequency oscillations in the prefrontal cortex. However, only positive correlations were obtained between social creativity and IQ components.

So, different intelligence-associated patterns of resting-state EEG rhythms were mostly observed in cortical areas overlapping with the DMN whereas social creativity was presented by alpha synchronization in the anterior cortex in line with the association of alpha frequencies with internal attention or 'defocused' selective processes.

Conclusion. The results illuminate different oscillatory mechanisms in widespread neuronal networks which may be involved to perspective social cognition and original solving social problems depending on IQ structure and the individual strategies of search of ideas. The findings prompt an assumption that ongoing activity with internal attention to successful bringing social roles and various events from the past knowledge to the new mind are needed for social creativity.

The connections between intelligence, creativity and the sensorimotor integration in children of different ages

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Introduction. The results of further studies on the connection between creativity and intelligence have been extremely contradictory. On the one hand, there are findings that show a significant correlation between these two parameters (Hennessey, Amabile, 2010); on the other, there is data that proves such a link to be insignificant. There is an opinion that any and all combinations of intelligence and creativity are possible (Deary, 2012), which is why there are individuals with high levels of both parameters and low test scores, as well as people with a high level of one parameter and a low level of the other.

It can be assumed that the particular nature of the interplay between creativity and intelligence is determined not only by the conditions in which a person develops and their personality traits (Haier, 2009), but also their age.

Methods. The purpose of the report was to compare the interactions between creativity level and intelligence level of the 7-8-year-old children and 12-13 year-old teenagers and to study how 7-8-year-old children and young teenagers (12-13 years old) with different levels of intelligence and creativity assimilate stochastic signals. In all, 160 children

took part in the study, 80 first- and second-graders who were 7-8 years old (37 boys and 43 girls), and 80 fifth-graders, aged 12-13 (40 boys and 40 girls). We used the following procedures Raven's Progressive Matrices ; A battery of creative thinking tests, amounting to a modification of Guilford and Torrance's tests, in a Russian adaptation created by E. Tunik, the computer reflexometric method. Results and conclusions. Our findings show that the relationship between the level of intelligence and the level of creativity is different in the two age groups. With the 7-8-year-olds, they are independent of each other, whereas with the 12-13-year-olds there is a weak but significant link between them. With the 7-8-year-old children, the level of creativity predetermines the ability to detect the structure of a sensory stream that is organized in a complex way. At the ages of 12-13, neither the level of creativity nor the level of intelligence is connected with the parameters of sensorimotor integration, but they are interconnected. The study is funded by Russian Foundation of Fundamental Research, project #18-013-00323

BIOELECTRICAL ACTIVITY OF CEREBRAL CORTEX AT DIFFERENT STAGES OF THE CREATIVE ARTISTIC PROCESS IN ARTISTS

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Investigation of different stages of creative process may enlarge our understanding of the brain mechanisms of creativity in situation of rather controversial neurophysiological data, "unveil the mystery" of the human brain to create new works of art.

The aim of our empirical research was to study the bioelectrical activity of cerebral cortex at different stages of the creative artistic process in artists.

Methods. 95 right-handed specialists (aged 21-32) working in field of art took part in the research: 50 artists (16 male, 34 female) and 45 actors (8 male, 37 female). The mono-typing technique was used to model the creative artistic process. The EEG signals were recorded (0.5-35 Hz, 21 leads, 10-20 system) while the subjects were in a resting state (eyes open), and during the four stages of creating an artistic image: internal readiness, preparation, image finding, and developing the created image. The EEG spectral power and coherence indexes were analyzed. For statistical analysis, we used the 3-way MANOVA and the comparative post hoc analysis according to the Tukey criteria. The processing was conducted with the help of STATISTICA 13.0 computer software.

Results. At the internal readiness stage the distinguishing EEG patterns in the artists, as compared to the actors, are the expressed indexes of spectral power and coherence in the anterior and posterior cortex regions for alpha1 and alpha2 bands ($p \leq 0.05$).

At the preparation stage in the artists the EEG correlates of creative artistic processes show in the left hemisphere for the low-frequency bands, in the anterior cortex regions for alpha1 and alpha2 bands, in the right hemisphere for the high-frequency bands ($p \leq 0.05$).

At the image finding stage the distinguishing EEG patterns in the artists are the expressed coherent interhemispheric connections between the posterior and the anterior cortex regions for alpha1 band, the spectral power and coherence indexes in the left hemisphere for high-frequency bands ($p \leq 0.05$).

At the image development stage the EEG correlates of the creative artistic process in artists show the "cognitive axis" for low-frequency bands ($p \leq 0.05$), in the left anterior cortex regions for high-frequency bands ($p \leq 0.05$); low levels of spectral power in the frontal area for alpha2 band ($p \leq 0.05$).

Conclusions. It has been shown that the EEG correlates of the creative artistic process in artists are the systems of frequency-spatial patterns of the bioelectrical cerebral cortex activity, the temporal dynamics of which shows the stages of creative artistic process.

The EEG frequency changes in conditions of overcoming self-induced stereotypes in narrative creation

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Introduction. Stereotype thinking prevents creativity and needs to be overcome for successful creative production. The study aimed to reveal EEG frequency structure changes in the condition of self-induced stereotypes overcoming in narrative creation. We hypothesized that creative effort necessary for overcoming of self-induced stereotype could be described by an own EEG pattern - distinct from both - mental load and free creative thinking.

Methods. Eighteen right-handed healthy adults (19.3 ± 1.1 [SD]) created stories on the base of presented situational pictures from social IQ test (O'Sullivan, Guilford, 1976) during EEG registration (21-AgCl, 10-20%, 0.3-30Hz, 500Hz, 50Hz notch filter, Mitsar Ltd., Russia). Subjects had to press the button when they were ready to tell the story, but further, they were asked to create mentally new events and change the story plot during next 2-3 minutes. EEG frequency structure was explored during creative task performance and resting EEG with open eyes as follows: the intervals' durations between points of the isoline intersections by EEG curve(ms) were transformed to frequencies (Hz) and analyzed with one Hertz steps (Soroko et al., 2014) in 2-30Hz range. RM ANOVA was used for statistical analysis of each frequency percentage changes between rest and narratives creation (with/without self-induced stereotypes).

Results. Subjects' reports suggested the formation of self-induced story plot stereotype during self-regulated creative production (first), which was hard to overcome in an additional time period. Significant effects for factor TASK were revealed for: 9-10Hz: $F(2,32)=11.0, e(H-F)=0.9, p < 0.001$; 10-11Hz: $F(2,32)=11.5, e(H-F)=0.8, p < 0.001$. TASKxZONE interaction effect in 9-10Hz: $F(40,640)=1.7, e(H-F)=0.5, p < 0.05$; 11-12Hz: $F(40,640)=1.6, e(H-$

F)=0.6, $p < 0.05$ was obtained. Creative tasks fulfillment was characterized by the decrease of 9-12Hz waves percentage in comparison with resting condition. The narrative creation in a condition of self-induced stereotypes overcoming in comparison with free story creation was accompanied by an increase of 9-12Hz frequencies percentage in temporal, occipital areas that might support defocused attention need for the search in a wide associative field for stereotype overcoming.

Conclusions. The mental effort of overcoming self-induced stereotypes during creative task performance was characterized by an increase in the alpha frequency percentage, as measured by EEG. That was distinct from the described only for the mental load without creative processes. The value of narrow frequency ranges within an alpha band in the maintenance of creative processes was stressed. We also can suppose that the condition of overcoming a stereotype resulted in the necessity to suppress various first-level trivial associations and activate more remote semantic associations. Carried out within the assignments of FASO of RF.

Rearrangements of EEG frequency patterns under EEG-neurofeedback training for enhancement of the creative tasks performance

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Introduction. Nowadays when neurophysiology of creativity is no more “non-considerable” problem - a finding of neurophysiological markers for creativity enhancement is desired. The combined approach of the individual EEG characteristics assessment at resting states (described to be linked to cognitive and creative thinking performance (Wu et al., 2014)) and neurofeedback(NfB) training was applied. Two studies aimed to analyze EEG-NfB training effects on EEG frequency changes and creative tasks performance during one day and three weeks lasting training. Investigations were based on previous observations related to EEG spectral, frequency changes during creative thinking. An increase of 9-12Hz EEG percentage frequencies in stereotypes overcoming task and 8–9, 10–11, 13–14, 17-20Hz in associative search tasks were observed (Shemyakina, Nagornova, 2014). Participants with higher originality scores (by means of Alternative uses task) in comparison with those with lower scores were characterized by the increased percentage of 11-12Hz regardless of the tasks performed.

Methods. An increase of upper alpha band power (>10Hz) in individually defined EEG ranges was used as the trained parameter in 19 subjects (20.1 ± 0.8 [SD]) via 3 EEG-NfB sessions; in 4 subjects (34.5 ± 4.1 [SD]) via more than 30 training sessions. EEG frequency structure as the percentage of EEG frequencies with 1Herz step (Soroko et al., 2014) was explored before, after & during NfB sessions (registered - 21AgCl, 10-20%, 0.3-30Hz, 250Hz, NF-50Hz, Encephalan131-03, Russia). RM ANOVA was used for analysis of each frequency percentage changes.

Results. In short NfB training significant effect for factor “training session parts” (increase of 8-12 & 13-14Hz percentage in the last part of each session) was observed: 8-9Hz: $F(1,18)=12.3$, $p < 0.01$; 9-10Hz: $F(1,18)=17.1$, $p < 0.001$; 10-11Hz: $F(1,18)=9.6$, $p < 0.01$; 11-12Hz: $F(1,18)=5.3$, $p < 0.05$; 13-14Hz: $F(1,18)=12.5$, $p < 0.01$; changes were extended to wider frequency range, than have been individually chosen for trainings. Participants of the long-lasting training shown the increases of alpha waves percentage during training parts compared to rest states between the training – widespread in frontal areas.

Conclusions. Revealed effects in self-regulation via EEG-NfB with individually chosen EEG parameters correspond to those characterizing subjects with more creative originality scores in our studies and higher creativity in (Razumnikova et al., 2009; Fink, Benedek, 2014). Obtained data could be argued as the promotion for creative activity enhancement. Was carried out within the assignments of FASO of RF

Late Afternoon Session: 5.00 – 6.30 p.m.

Symposium A: EEG MEASURES OF DISTRIBUTED CORTICAL ACTIVITY AND INDIVIDUAL CASE ANALYSIS

(Luis Basile, Brasil)

Plasticity and brain connectivity

F Miraglia

IRCCS SAN RAFFAELE PISANA, ROME, Italy

A relatively new approach to brain function in neuroscience is the “functional connectivity”, namely the synchrony in time of activity in anatomically “distinct but functionally” collaborating brain regions. There is increasing evidence to support the concept that brain plasticity involves distinct functional and structural components, each requiring several cellular mechanisms operating at different time scales, synaptic loci, and developmental phases within an extremely complex framework. However, the precise relationship between functional and structural components of brain plasticity/connectivity phenomena is still unclear and its explanation represents a major challenge within modern neuroscience. It is believed that effective connectivity and optimal network structure are essential for proper information processing in the brain; indeed, functional abnormalities of the brain are found to be associated with pathological changes in connectivity and network structures. An integrated approach utilizing neurophysiological techniques, including electroencephalography (EEG), event-related potentials (ERPs), and transcranial magnetic stimulation (TMS), together with biological markers and structural and functional imaging (MEG, fMRI) is a promising

and non-invasive method to test these phenomena. Particularly, modern analysis of electroencephalographic (EEG) rhythms provides information on dynamic brain connectivity. In this context, an approach to the characterization of complex networks is the use of the “graph theory”. A graph is a representation of a network, which is expressed by its nodes (“vertices”) and connections (“edges”). Graphs can be described by several parameters and particularly by a clustering coefficient (C) and characteristic path length (L). The clustering coefficient is a measure for the local connectedness of the graph, whereas the characteristic path length is an indicator of overall connectedness. It has been shown that graphs with many local connections and a few random long distance connections are characterized by a high clustering coefficient and a short characteristic path length. These networks, which act as intermediaries between an ordered and a random organization, have been defined as “small world networks”. Such a topology is responsible for high local and global efficiency with low energy and wiring costs. Neuronal networks behave as a small world phenomenon, which is also an optimal organization for time-varying dynamic synchronization of neuronal activity among different brain regions.

Behaviour and motor performance in a cognitive-motor task during learning processes: evidence from EEG network analysis

F Vecchio

IRCCS San Raffaele Pisana, Rome, Italy

Behavioral, cognitive, motor or learning acts require a finely tuned balance between triggering and blocking processes to provide appropriate preparation, initiation, on-line control, and timely inhibition of this act. Understanding the relation between structure and function of the brain is one of the basic questions of neuroscience. Although a large body of knowledge has been gathered over the last decades, we still have a poor understanding of their exact relationship. Human behavior and cognition are characterized by engagement of functional distributed networks within the brain. Such networks organization is especially significant in learning and for higher functions including abstract reasoning, memory and action planning and requires a high degree of intra-modal and inter-modal integration of information flow. These networks dynamically connect -with time-varying binding/unbinding mechanisms- adjacent and/or remote cortical neuronal assemblies via cortico-cortical connections. A novel approach, applying concepts from graph theory to neurophysiological data, is a promising new way to characterize brain activity. It provides a method to evaluate whether the functional connectivity patterns between brain areas resemble the organization of theoretically efficient, flexible or robust networks, based on the strength of synchronization of different brain regions. During talks, it will be investigated brain connectivity in physiological aging by graph theoretical analysis of resting-state EEG recordings. Furthermore, evidences will be explained providing direct confirmation for a stochastic linking of cortical areas, as revealed by oscillatory synchronization of the two hemispheres, in determining behaviour performance in a cognitive-motor task during learning processes.

MAJOR INDIVIDUAL VERSUS NO SYSTEMATIC TASK DIFFERENCES IN SLOW POTENTIAL GENERATORS

LF Basile

Universidade Metodista, Sao Paulo, Brazil

Average slow potentials (SPs) can be computed from any voluntary task, minimally involving attention to anticipated stimuli. Their topography when recorded by large electrode arrays even during simple tasks is complex, multifocal, and its generators appear to be equally multifocal and highly variable across subjects. Various sources of noise of course contaminate such averages and must contribute to the topographic complexity. Here we report a study where the non-averaged SP band (0 to 1 Hz) was analyzed by independent components (ICA), from 256 channel recordings of 18 subjects, during four task conditions. We intended to verify whether the replicable (between two separate day sessions) SP generators modeled as current density reconstruction on individual MRI sets were individual-specific, and if putative task-related differences were systematic across subjects. Typically, 2 or 3 ICA components (out of 10) explained SPs in each task and subject, and their combined generators were highly variable across subjects: although some occipito-temporal and medial temporal areas contained generators in most subjects, the overall patterns were obviously variable with no single area common to all 18 subjects. Linear regression modelling to compare combined generators (from all ICA components) between tasks and sessions showed significantly higher correlations between the four tasks than between sessions for each task. Moreover, by plotting task-subtraction results, it was clear that no systematic task-specific areas could be shown across subjects. Those results represent one more instance in which individual case analyses favor the hypothesis of individual-specific patterns of cortical activity, regardless of task conditions. We discuss this hypothesis with respect to results from the beta band, from individual-case fMRI studies, and its corroboration by functional neurosurgery and the neuropsychology of focal lesions.

Increased variability in visual evoked potentials following markedly improved visual acuity after anti-VEGF intravitreal injections in macular degeneration.

I. M. Tarkka

University of Jyväskylä, Jyväskylä, Finland

Increased variability in visual evoked potentials following markedly improved visual acuity after anti-VEGF intravitreal injections in macular degeneration.

Tarkka Ina M.¹, Vottonen Pasi², Pääkkönen Ari³ & Kaarniranta Kai²

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Introduction: Recently intravitreal injections of anti-VEGF agents have produced improved visual acuity in patients with exudative wet age-related macular degeneration. As vision improves relatively quickly with this treatment strategy, we aimed to assess if the cortical visual processing is modified as well.

Methods: Visual evoked potentials (VEP) were recorded with a 64-channel electrode cap. Pattern reversal VEPs were elicited by a high contrast black and white checkerboard stimulus using STIM2 software (Neuroscan Inc., USA). To cover the macular area with the stimulus, a circular stimulus field with a diameter of 10.3 degrees was used. The check size was 35 min of arc. For each eye and a recording session (separated by 4 months), responses to two blocks of 120 stimuli were recorded, with an undilated pupil under full refractive correction. The artefact-free epochs were averaged separately for each eye and recording session. Statistical difference was tested at probability level of $p < 0.05$ at least over 8 ms.

Results: In 5/6 patients changes were consistent with improved vision. Changes were varied, e.g. decrease in P100 latency and/or an increase in P100 amplitude, or opposite changes and additionally changes outside the P100 component.

Conclusions: We can only speculate the reasons for varying responses, e.g. *BDNF* polymorphism is known to affect neuroplasticity in humans. Better understanding of the role of individual differences in recovery process would contribute to individualizing patient care.

Genetic effect on connectivity and topological properties of resting state EEG networks.

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¹Institute of Physiology and Basic Medicine, Novosibirsk, Russian Federation
, Russian Federation

Serotonin transporter is one of the most widely investigated genetic markers of individual variation in serotonergic function. The promoter region of the serotonin transporter gene (5-HTTLPR) contains long (L) and short (S) variants with the latter one having reduced transcriptional efficiency. S allele has been found to increase the risk of depression and other mental health problems, but some evidence suggests that S-allele carriers outperform subjects carrying the long allele in an array of cognitive tasks. Functional magnetic resonance imaging studies demonstrate a heightened amygdala response to negative emotional stimuli and diminished connectivity among key areas involved in emotion regulation in S allele carriers. However, evidence linking this polymorphism with individual variation in electrophysiological properties of resting state brain networks is still very limited. This study investigated the effect of 5-HTTLPR polymorphism on EEG current source density, connectivity, and topological properties of resting state networks. As compared to L homozygotes, S-allele carriers showed lower current source density and connectivity in most frequency bands in areas overlapping with the default mode and emotion regulation regions. The analysis of graph-theoretical measures showed that as compared to L homozygotes, S-allele carriers have less optimal topological properties of brain networks in theta, but more optimal in alpha band. This dissociation may reflect predisposition to emotional disorders, which is inherent to S allele carriers, and, on the other hand, their superior functioning in some cognitive domains.

Symposium B: Frontiers in Behavioral and functional Neuroeconomics

(Innovation Center Lab-Neuroscience, Lucca Italy)

Organizational behavioral economy and neuroeconomy.

R. Palumbo

Università degli Studi „G. d’Annunzio,- Chieti - Pescara, Chieti-Pescara, Italy

The presentation will introduce the main shreds of evidence that have produced a step change in the economic studies in the economic studies by contextualizing it within the organization. The main progress of neuroscience and the behavioral economy will be introduced as supporting services to companies. The overcoming of many clichés on the economic decision, attributable to the revolution of behavioral economy and neuroeconomy, will be highlighted in the context. Moreover, a study on the association between 'loss aversion' and 'cheating', as exemplification and implementation of the experimental/behavioral method in the economic setting, will be presented.

Personalized Behavioral Finance.

E. M. Cervellati

Università Ca' Foscari - Venezia, Venezia, Italy

Behavioral scholars, but also practitioners recently started considering investors' personalities into behavioral studies. They structured what I now personally call Behavioral Finance 3.0 or Personalized Behavioral Finance. Personalized behavioral finance aims at creating a model of Behavioral Investor Types (BIT) because a specific BIT is more prone to some biases than others. Linking cognitive biases to personalities is thus important in several

respects. I will introduce personalized behavioral finance as its application in the investment sector has started gaining more interest in recent years.

Risk Seeking or Risk aversion? Phenomenology and Perception

C. Lucarelli

Università Ca' Foscari - Venezia, Venezia, Italy

My presentation will introduce how the application of biometric data has been used in my most recent works on risky choices and emotion-based learning.

We have been able to conclude that a person can theoretically behave either as risk-seeker or risk-averse, further relaxing any assumption on individual attitude towards risk. When we check empirical behaviors in relation to two opposite selection rules of risk-taking, we find evidence of behaviors classifiable as risk-seeking, if observed through the exterior phenomenology of the monetary payoff of their investments. Conversely, the same individuals are discovered to adhere to a risk-aversion paradigm, when values of their choices are balanced with the individual emotional experiences, and risk is thought to be mentally projected within a standard deviation formula. I will formulate on risk preferences and emotions through the implementation of psycho-physiological measures.

Symposium C: The psychophysiology of effort: New perspectives

(Gendolla G.H.E. – Geneva, Switzerland)

The effect of hearing impairment, hearing aid technology and task difficulty on listening effort as indicated by the pupillary response

D. Wendt, T Lunner

Oticon, Snekersten, Denmark

Listening to speech in noise can be effortful in particular for people with hearing-impairment. The pupillary response is an objective measure sensitive to increased effort related to difficulties associated with speech recognition in noise. Different studies will be presented that explore the effect of hearing status, hearing-aid signal processing and task difficulty on listening effort by means of pupillometry. Results indicated a clear effect of both hearing status and hearing aid signal processing on the pupil dilation and, thus, listening effort. While participants with hearing impairment show increased effort in listening situation with high speech intelligibility, hearing aid technology can decrease the effort required for speech recognition in noise. Furthermore, the results suggested that pupil dilation changes with task difficulty. Pupil dilations were largest for performance accuracies ranging between 30%-70% correct. Altogether, those studies will give an insight into listening effort across a broad range of acoustic scenarios including ecological valid listening situations.

Cardiovascular correlates of listening effort

M. Richter, K. Slade

Liverpool John Moores University, Liverpool, United Kingdom

According to Brehm's motivational intensity theory, effort should be a direct function of task difficulty if success is possible, if the required effort is justified by success importance, and if information about task difficulty is available. If task difficulty is unknown, effort should be a direct function of success importance. Two studies examined an application of these predictions to listening effort using autonomic nervous system responses to assess effort mobilization. Study 1 examined the impact of listening demand on sympathetic and parasympathetic activity manipulating the difficulty of a speech-in-noise task across four levels. Study 2 varied the importance of understanding speech in noise by manipulating reward value across four levels to examine the impact of success importance on sympathetic and parasympathetic activity under conditions of unclear task difficulty. As predicted, increased task demand (in Study 1) and increased success importance (in Study 2) resulted in increased pre-ejection period reactivity—indicating increases in sympathetic activity—and reduced respiratory sinus arrhythmia—suggesting reduced parasympathetic activity. These results complement and extend existing findings on autonomic mechanisms underlying effort investment in cognitive tasks.

Boundary conditions of implicit affective influences on effort-related cardiovascular response

G.H.E. Gendolla, D. Framorando

University of Geneva, Geneva, Switzerland

Several studies from our laboratory have brought replicated evidence for the systematic impact of implicitly processed affective stimuli on effort-related cardiovascular responses in cognitive tasks. As long as success is possible and justified, implicit activation of the sadness or fear concepts during task performance results in stronger

effort-related responses in the cardiovascular system than implicit happiness or anger. However, recent studies revealed that these effects depend on people's unawareness of this affective influence. Making people aware of affect primes' occurrence or effects was a boundary condition of implicit affects' systematic impact on effort mobilization. Implications of these findings for implicit motivation are discussed.

Perception of effort during physical tasks: implications for obesity

S Marcora

University of Kent, Chatham, United Kingdom

Obesity is a leading cause of morbidity and mortality in western societies and increasingly so in developing countries. It is therefore urgent to identify novel targets and interventions to reduce energy intake and/or increase energy expenditure. I will argue that perception of effort is part of the complex system that regulates fat mass, and present studies from our and other laboratories suggesting that perception of effort during physical tasks reflects the activity of premotor and motor areas of the brain rather than afferent signals from the body. I will then present our data suggesting that a pharmacological reduction of perception of effort can facilitate physical activity behavior, one of the main components of energy expenditure.

Symposium D: The concepts and brain models in context of modern psychophysiology (Russia)

(Kuznetsova T. Kamenskaya V. Shibkova D. Popova T. Halfina R. Bartosh T. Andrushchakevich A. Novgorod N. – Russian Federation)

Stochastic principles in dynamic models of the brain

V. Kamenskaya, L. Tomanov

Bunin Yelets Government University, St.Petersburg, Russian Federation

The brain dynamics is one of the main problems of psychophysiology, both in Russia and abroad (1). As a model of the brain activity it has two main ways of describing: temporal and spectral frequency areas. Frequency spectral analysis enrich Cardiology healthy and sick people through the inclusion of measures the degree of chaotisation rhythm: from chaos to fractal. The ratio of the value of this index and the degree of variability of heart rhythm fluctuations specifically assess the measure of human health. Only in certain ratios of these numerical characteristics of the pulse dynamics is described as normative health status. The degree of deviation of the specific values of this index and the degree of pulse variability from normative indicators characterizes deviation towards health illness or risk of psychosomatic illnesses (2). All processes of the brain characterized by fatal variability parameters that have probabilistic nature. The optimal functioning of the body and its systems is normal, when fluctuations of parameters are seen in certain ranges. Output fluctuations the optimum range is threatened and the formation of pathological conditions or loss.

The main purpose of the article is evidence the significance of the stochastic dynamical brain description of health status and functional norm of brain processes. Stochastic principles of brain dynamics, takes a look at the example RR-intervals fluctuation power spectrum recorded during 5 minutes and processed using the software package Uritsky V.M. (3). On the subjects of different ages (more than 1000 people) found that classic cardiology features: heart rate, its variability and derived parameters are insensitive to changes in Wednesday conditions and activity, health state. Such sensitivities obtain stochastic power spectrum rr-interval's fluctuations obtained by fast Fourier transform-fractal index and spectral density at the lowest frequency. These rates vary with age reliably, increasing in magnitude; have a certain momentum when performing various cognitive tasks, significantly reduced from psychosomatic patients. Therefore, the inclusion of stochastic principles described brain dynamics and evaluated the measure of brain systems, gives the new and useful information to evaluate the State of the brain and human. Partha Mitra, Hemant Bokil. Observed Brain Dynamics. Oxford University Press/ - 2008 Muzalevskaja n.i., Kamenskaya v.g., Score Adaptive resource and health status of high school students by the method of Nonlinear Stochastic cardiology// Human physiology. T. 33. No. 3. C. 60-68. -2007. Uritsky V.M. Package software for the selection and analysis of fluctuation RR-intervals (1999-2001). Uritsky @ pop600.gsec.nasa.gov.

Dynamic markers of perception musical compositions of different directions by girls and boys

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The aim of the study is to identify the brain dynamic's differences at process music perception different directions in childhood and adolescences. It is known the musical compositions of different directions have the particular power spectral structure and characteristics of subject's perception. We have fulfilled the psychophysiological experiment in which listening to certain musical compositions are accompanied by the registration of dynamic parameters heart

bits.

As an adequate physiological method was selected the non-linear stochastic RR-intervals (NSC), which makes it possible to estimate the stochastic features of system processes perception of musical works. Every musical direction (classical, spiritual, rock and house music) was sounded for 5 minutes in a closed dynamic headphones Philips (power 500 MW with a frequency range of 15-22000 Hz) and was accompanied by a simultaneous rr-interval registration. Heart beats were processed on-line and presented in a digital form (Software package by Uritski V.M.). There were recorded mean values of RR-intervals, S_0 - spectral power at the lowest frequency of the power spectrum obtained by fast Fourier transform. The parameter S_0 is associated with an activation of cortical fields. Fractal β index is an indicator of the degree of system integration and organization of the cortical control of the heart rhythm. We founded the lower the value of the fractal index reflected the increase of homeostasis chaos in higher levels of the heart rhythm control system is. The optimization of the cardiac rhythm control system is observed in the range of the fractal index from -0.8 to -1.0.

A total of 206 subjects were observed: 50 boys and 54 girls aged 7-8 years; 48 boys and 54 girls aged 14-16 years. All subjects had 1 and 2 health group. We have founded that the perception of music of different areas of children 7-8 years and teenagers 14-16 years was accompanied by changes only at the cortical functional activity mechanisms of regulation. Relations such parameters as S_0 and β with age of subjects, musical preferences, as well as music education show failed. Young men maximum pulse reaction have with music style rock and House, the spectral power of which have features of chaos, girls have maximum sensitivity when they percept of classical music. The fractal index β and S_0 of girls possessed maximal values when they were listening to classic music by I.V Mozart.

Influence of different musical styles on some psychophysiological students parameters

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⁵Russian state pedagogical University by A. I. Herzen, Saint-Petersburg, Russian Federation

The work continues the discussion of the issue of the music's influence on the psychophysiological characteristics of brain in the context of the dynamic model of the brain. The aim of this research was to compare the dynamics of background indicators (EEG and blood pressure) and indicators after listening to different types of music. 75 students were examined (the average age of whom was 20.1 ± 0.4 years.) They were divided into three groups, each of which listened to a different type of music:

- 1) Russian popular and Western (“trance”) music;
- 2) Chinese and Oriental ethnic music;
- 3) ‘Aleatoric’ music.

Students listened to music via intra-channel headphones for one hour. In the first two groups, the following was determined: Bourdon's correction test, EEG wave patterns, vegetative Kerdo index, in third group - “Reactive anxiety” and EEG patterns.

Results:

After listening to modern Russian popular music, all the indicators changed insignificantly.

After listening to Western music, both the attention and attention switching parameters changed significantly for the worse. Students' heart rate increased. The nervous system passed into a state of moderate sympathetic dominance from a state of parasympathetic dominance. The beta-rhythm of the EEG increased (significantly).

Chinese music improved students' attention span, lowered the heart rate, increased the frequency of breathing, but did not change the intersystem. On the EEG, we can also observe an increase in the patterns of beta rhythm alpha rhythm (significantly), which does not indicate excitement, but comfort.

Eastern Ethnic music improved students' concentration and attention span, increased breathing and optimized intersystem interaction. EEG rhythms are similar to rhythms after exposure to Russian and Western music.

Exposure to “Aleatoric” music significantly increased reactive anxiety in girls, whereas a decrease in this was observed in young men. Arterial diastolic pressure also noticeably decreased and the degree of change in the pain threshold in girls was 24%, and in boys - 56% upwards, respectively. The EEG dominated the beta-rhythm (significantly in all leads) and asynchronous low-wave activity.

Thus, we can see that listening to music not only affects a person's emotional state, but also a whole range of psycho-physiological indicators. At the same time, the impact of different styles of music is not the same. Both the force and the direction of the impact are uneven. It is necessary to conduct further research in order to establish the mechanisms of such influence.

Peculiarities of neurodynamic indicators of perception by different ethnic groups of adolescents of the North-East of Russia

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²Bashkir State Pedagogical University. M. Akmulla, Ufa, Russian Federation

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The dynamic model of the brain involves the analysis of temporal characteristics detection and perception of Visual information by RT-fixation of sensory stimuli. Information about the features of motor responses to Aboriginal and white teen populations living in conditions of Northeast Russia, which are largely determined by the functional State of brain, few and far between, which determined the relevance and objective of our research.

The purpose of article is the study of differences in the temporal characteristics of visual perception in teens of two ethnic groups, the evolution of which took place in various conditions Wednesday.

We examined 123 male teens at 14–15 studying at boarding school in the remote settlement of Evensk located 535 km north from the city of Magadan. Examinees were divided into two groups: 58 people of Aboriginal origin (Koryaks, Evens; Group 1) and 65 Europeans who were born in the north in the 1st–3rd generation (Russians, Ukrainians; Group 2). “NS PsychoTest” (“Neurosoft”, Ivanovo) was used to record the following parameters: Simple Visual Motor Reaction (SVMR) and Complex Sensor Motor Reaction of Choice (RC).

The results obtained on the rate of SVMR reported a longer ($p < 0.05$) latent period of the Aborigines’ response featuring weaker excitement, power and balance of nervous processes in the cortex. Average rate of response demonstrated by Aborigines exceeded corresponding average norms of the age (273 ms). Long-rated SVMR were observed in 43 % of Aboriginal and 22 % of European subjects.

As for Reaction of Choice, we found a longer time of response ($p < 0.05$) in Group 1 who had shown more inhibition and instability of the nervous processes. We established low functional state (4–10 incorrect responses) reported by 37 % and 32 % of Group 1 and Group 2, respectively, as well as weak concentration of their attention and fatigue of the central nervous system.

From our study we have concluded that, Aboriginal subjects demonstrate passivity of nervous processes, prevalence of inhibition, poor attention and low functional state of the central nervous system as compared to European agemates. At the same time the similar results were observed in third of Europeans who live in remote north settlements. These results suggest a direct manifestation of the dynamics of the brain in the form of basic processes of excitation and inhibition in the temporal properties of perception among adolescents the two ethnic groups living in the North-East of Russia.

Cross-correlation analysis of the EEG and α -rhythm's asymmetry in preschool children with the goal's achievement

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The author used the technique of approaching target (MPI), which is the conveyor belt length 1000 mm. At the far end has placed the goal object. The speed of the target was set by the researcher and ranged from 250 to 5 mm/s and the subject on command “Attention, work!” started the device with the button in front of it.

During the study, a video was recorded to analyze the behavioral reactions of self-regulation with parallel registration of EEG from 10 leads: Fp1, Fp2, F3, F4, P3, P4, T4, O1, O2, located according to the international scheme 10-20, monopolarly with a combined ear electrode on the 21-channel amplifier unit of the company “Mizar EEG” and a personal computer. The EEG processing was performed in the program “MitsarWinEEG”.

Considered changes of cross-correlation relations of the EEG, the dynamics of the frequencies of α -rhythm and the asymmetry of its distribution across the electrodes for a period of at least 60 s for each of the presented speeds with the following averaging over the group of subjects.

Statistical analysis of the results was carried out on The basis of StatSoft Statistika 6.0 software package using nonparametric Wilcoxon t-test. Differences of at least $P < 0.05$ were considered significant.

The changes in the cross-correlations of EEG and α -rhythm asymmetry by elders preschool children was investigated in process of achievement the aim, approached with different speeds. It was suggested, that the increase in activity of α -rhythm in band 8-13 Hz in associative areas of the right hemisphere, apparently, constitute general mechanism in the perception of emotional significant stimulus independently of human age. The study detected significant right asymmetry of α -rhythm in low-frequency sub-band (7-8 Hz) practically on all leads in children. Left asymmetry of α -rhythm predominated in medium- and high-frequency sub-bands (8,75-9,75 and 10,0-13,5 Hz accordingly). This asymmetry of α -rhythm does not reflect the emotional significance of the stimulus, but shows the lack of maturity of central nervous system in preschool children.

The paper shows that in children 6-7 years, as well as in adults, increased activity of α -rhythm in the range of 8-13 HZ in the associative zones of the right hemisphere and its asymmetric distribution in the parietal-temporal regions is a common mechanism in the perception of emotionally significant stimulus regardless of age.

Thursday, September 6th, 2018

Early Morning session: 08.30 – 10.00 a.m.

Symposium A:- New techniques in deception research

(Sartori G. Padua, Italy; Rosenfeld J.P. IL, USA)

The Effect of Choice and Embarrassment on the Behavioral and Autonomic Correlates of Deception

K. Suchotzki, M. Gamer

University of Würzburg, Würzburg, Germany

Introduction: Previous research investigating deception has often used relatively neutral questions and instructed participants when to lie and when to tell the truth. Studies using more emotional or embarrassing questions and/or giving participants the choice to decide themselves when to tell the truth and when to lie are so far scarce and their results inconsistent. **Method:** In the current study ($n = 47$) we aimed to investigate the impact of those two practically relevant factors on the behavioral (i.e., reaction times) and autonomic (i.e., skin conductance responses and heart rate changes) correlates of deception. To that means, we used a Sheffield Lie Test, in which participants were either instructed by a color cue when to lie and when to tell the truth or could, in another condition, decide freely. We used both relatively neutral questions (e.g., “Have you ever been to the cinema?”) as well as more embarrassing ones (e.g., “Did you ever fake an orgasm?”). **Results:** Results replicated previously found longer reaction times and stronger skin conductance responses for lying compared to truth telling. Those differences were, however, only present in the condition in which deception was instructed and not when deception was freely chosen. Effects were less clear in the heart rate changes. No interaction of question type with deception was observed. **Conclusion:** Those results are interesting as they implicate crucial differences between instructed and freely chosen deception, with the latter being more ecologically valid yet at the same time, at least in our experiment, leading to a disappearance of typically observed behavioral and physiological differences between lying and truth telling.

What mechanisms underlie ERP-based concealed information detection?

N Klein Selle¹, C Gueta², G Ben-Shakhar², L Deouell²

¹Hebrew University of Jerusalem, Hadid, Israel

The Concealed Information Test (CIT) is a well-validated tool for physiological and behavioral detection of concealed knowledge. Klein Selle, Verschuere, Kindt, Meijer & Ben-Shakhar (2016, 2017) examined the underlying processes of the autonomic-based CIT by comparing the classical conceal with a reveal condition. The authors showed that while the Skin Conductance Response, which was unaffected by the manipulation, is a pure measure of the orienting response, the Respiration Line Length and Heart Rate reflect attempts at arousal inhibition. The present study intends to extend this earlier work using event-related potential (ERP) measures. All participants were tested on two high salient and two low salient personal items. Importantly, each participant underwent two testing sessions which were separated by 6-8 days. In one of these sessions participants were motivated to conceal their personal details (conceal condition), while in the other session participants were motivated to reveal these details (reveal condition). Preliminary results revealed a stronger P300 CIT-effect when motivated to reveal, compared to when motivated to conceal. Theoretical and applied implications will be discussed.

The lie detection in the online environment

M. Monaro, G. Sartori

University of Padova, Padova, Italy

Reaction times (RT) are currently the most used behavioural measure to study deception. More recently, newest behavioural techniques have been proposed, such as the analysis of mouse movements (mouse dynamics) and the analysis of the typing pattern on the computer keyboard (keystroke dynamics). Differently from RT-based lie detection methods (e.g., the aIAT and RT-CIT), these new techniques have the advantage that they can easily be incorporated into the online existing applications. Thus, they can be potentially applied to the detection of online deception. Indeed, the creation of fake social network profiles, the wide spread of fake news and fake reviews, the identity theft to perpetuate online financial frauds, are only few examples of the malicious use of internet in the current historical and cultural framework. Here we present some contributions to online deception detection through the study of human-computer interaction. After a brief overview of the current lie detection methods, focusing on their advantages and disadvantages for online application, we present a series of experiments investigating the possibility to detect deception measuring indices deriving from the interaction between the user and the pc (e.g., mouse dynamics, keyboard dynamics). Finally, potential applications in the online environment are introduced.

Symposium B: What constitutes regularity in studies of auditory inference?

(Juanita Todd, New Castle Australia)

The concept of meta-models in auditory inference.

J Todd¹, J Frost²

¹University of Newcastle, Callaghan, Australia
, Australia

The concept of perceptual inferences being formed over multiple timescales simultaneously raises questions about how the system can balance the demands of remaining sensitive to local rarity while utilising more global longer-term predictability to modulate cortical response. In this presentation I will present a data set in which auditory evoked potentials were recorded to four presentations of the same sound sequence containing predictable structure on a local (milliseconds to seconds) and more global (many minutes) timescales. The results demonstrate that predictions about both local (internal predictive models) and global (meta-models that define expected patterns in repeated internal model states) regularities are formed. I will demonstrate how the P1 component of the auditory evoked potential is sensitive to modulation based on the predictable longer-term structure of the sound sequence. The results will be discussed in relation to the free-energy principle and how meta-models might help to preserve energy when modelling the acoustic environment.

Large-scale functional brain network correlates of speech predictability effects on speaker separation

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The predictability of speech influences the quality of comprehension, especially in noisy environments. We explored the large-scale functional brain networks underlying speech perception in the presence of an interfering stream while varying semantic predictability. Two speech streams were presented concurrently to young adults while the electroencephalogram was recorded. The speech material was selected from a collection of news articles and lasted ca. 6 minutes duration, each. One of the streams was designated as the target of attention while the other one served as distractor. The semantic predictability of the speech streams (either the target, or the distractor) was manipulated separately or together at four levels (conditions): normal speech; "word-salad" (words presented in random order); sequences of pseudowords, and spectrally rotated speech. The highest inter-stream interference was found in the "word-salad" condition, in which many words triggered involuntary attentional switches while semantic predictability was low. In line with these behavioral effects, functional connectivity measures revealed frequency-specific (especially slow oscillatory) links between frontal and temporal brain regions, which were significantly higher with stronger inter-stream interference. This suggests interactions occurring at the level of semantic inference, which is carried by large-scale slow oscillatory brain networks.

A Sweet Spot for Stimulus Encoding in the Delta Band

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Periodicity defines temporal regularity from a stimulus perspective, but what does really count as regular, for the brain? In other terms, how sensitive is the brain to violations of periodicity? To answer this, we tested twenty young healthy adults using a roving standard paradigm, and parametrically varied the amount of jitter at stimulus onset (periodic, 10%, 30%) as well as the stimulus onset asynchrony interval (250 ms = 4Hz, 500 ms = 2 Hz, 1000 ms = 1 Hz). Response times were detrimentally impacted by either small or large jitter values at 1 Hz and 4 Hz mean stimulation frequency. However, at 2 Hz, periodic and 10% jitter stimulus trains yielded a comparable performance, suggesting the existence of a more flexible notion of 'stimulus regularity' from a brain perspective at around 2 Hz.

Motor-auditory regularities and self-generation effects on sound processing

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When I clap my hands, the sound produced by my action does not sound the same to me as it does to the people around me. Well-established motor-auditory regularities such as this one have an impact on sensory processing and the related neurophysiological indices. Studies investigating motor-auditory regularities have reported similar signals as those investigating auditory-only regularities, including mismatch-like and P3 responses to unexpected sounds, and attenuation of responses to expected sounds. These effects have been related to the establishment of internal models of the regularities, which are then used to formulate specific sensory predictions. However, sounds generated by self-action can be highly variable and self-generation effects have been described also in relatively

non-predictive contexts, pointing to the contribution of other, non-predictive, processes. Moreover, self-generation effects have been generally studied employing highly constant action-sound regularities, while there is a lack of studies tracking the development of internal models in dynamic contexts, from the detection of a regularity to its dissolution. We investigate how action-sound regularities are discovered, learned and unlearned, and the contribution of predictive and non-predictive processes to the self-generation effects observed on psychophysiological indices of sound processing.

Symposium C: Neurophysiological correlates of hypnotizability and hypnosis

(Santarcangelo EL, Pisa, Italy)

Topology highlights mesoscopic functional equivalence between imagery and perception

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The theory of “functional equivalence” (FE) of imagery and perception or action claims that these two cognitive activities share the same neurophysiological bases, as imagery is a simulation of perceptual and motor experience [1, 2]. Evidence of shared mechanisms has been provided mainly by neuroimaging studies showing partially overlapping brain activations during action or perception of all sensory modalities and the correspondent mental images [3–5]. However, spatially overlapping activations of regions do not imply that the temporal activation profiles of such regions are related too. Here we analyse, using algebraic-topological techniques [6], EEG correlation networks obtained from recordings of a population for which behavioral studies have suggested a higher polarization of FE, that is the subjects with high scores of hypnotizability (Highs) opposed to low hypnotizable individuals (Lows). Subjects were asked to perform two imagination tasks (visual and kinesthetic) before and after having performed the actual task (real head rotation). The rationale for adopting topological tools is that they provide a natural language to describe local, mesoscopic and global features of data, and are therefore well-suited to capture the mesoscale functional reorganization of activation patterns [7].

Our results provide the first evidence of topological FE and confirm quantitatively previous behavioural findings [8]. In particular, we show that: i) for each task, the cognitive effort reported by subjects is explained by the topological deviation between pre-task basal and task states, similarly to an activation cost; ii) vividness of imaginations is associated with the topological similarity between the imagined and the target real states; and iii) skilled imaginers (Highs) immediately reduce their topological deviation (and effort) after the real task while maintaining the same vividness in imaginations, pointing to an enhanced sensori-cognitive information processing scheme in Highs with respect to Lows.

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Changes in EEG upper-alpha band functional connectivity between cortical regions engaged in retrieval of memory for faces mediates reversible disruptions in recall during a hypnotic face-amnesia suggestion.

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This study employs eLORETA source localization of EEG recorded during a New-Old Face recognition paradigm to demonstrate enhanced upper alpha activity in cortical regions supporting the retrieval of face information during hypnotically suggested face amnesia but not during normal forgetting. We demonstrate enhanced upper-alpha functional connectivity in this network of regions supporting face recognition during hypnotic amnesia but not during normal forgetting. These findings extend earlier studies which indicate a functional role for the alpha rhythm in gating the availability and influence of specific forms of information during different types of human cognition. These results provide the first direct evidence for a mechanism by which selective forms of information processing may be inhibited in response to specific hypnotic suggestions that is for 'negative' hypnotic hallucinations. This provides a

model not only for hypnotic dissociation but for other forms of psychogenic dissociation, guided by response expectancies, which occur in many conditions outside of the hypnotic context.

THE INFLUENCE OF HYPNOTIZABILITY, CONTEXTUAL FACTORS, AND BEHAVIOURAL APPROACH SYSTEM ON TONIC PAIN RELIEF DURING PLACEBO ANALGESIA: ERP, EEG, AND HEART RATE DYNAMICS

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Here are reviewed findings from our recent experiment on psychophysiological correlates of cold-pain modulation using placebo treatment in waking and hypnosis conditions. In a first study, healthy women participants were tested in waking and hypnosis conditions by delivering binaural auditory startle probes under three treatments: (1) Baseline; (2) tonic cold pain (Pain); and (3) tonic cold pain plus placebo analgesia (PA), as obtained using a sham analgesic cream with suggestions inducing pain relief. PA in high hypnotizable participants (HHs) produced significant pain and distress reduction in both waking and hypnosis conditions. Pain Reduction was associated with larger startle responses and ERP amplitudes within the frontal, parietal, and anterior and posterior cingulate gyres. P200 wave was larger in the frontal left hemisphere during waking PA in HHs, whereas during hypnosis PA this difference was spread throughout the whole left hemisphere. These differences indicate that hypnosis and waking PA reflect different processes of top-down regulations. A second study was derived by analyzing the EEG oscillations and cardiac inter-beat (R-R) time series using the original electrophysiological dataset in waking condition. The Reinforcement Sensitivity Theory Personality Questionnaire (RST-PQ; Corr and Cooper, 2016) was used 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). 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. BAS-RI, Pain Expectation, Involuntariness in PA responding, and Hypnotic Depth were positively associated with Pain Reduction, whereas time-HRV/EEG-delta factor was negatively associated with Pain Reduction. Using multiple mediation analyses, we found that higher BAS-RI influenced Involuntariness in PA responding and both measures accounted for pain reduction (Figure 1). Smaller negative difference scores in time-HRV/EEG-delta factor accounted for higher BAS-RI and both variables produced higher pain reduction. An indirect path effect on Pain Reduction was also found that included time-HRV/EEG-delta, BAS-RI, and Involuntariness in PA scores (Figure 2).

A critical approach to research on brain markers of hypnosis and suggestibility

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Introduction

Research in hypnosis can be intrinsic (investigating the nature of hypnosis itself) or instrumental (investigating the role of hypnosis as a method to induce changes in specific conditions, e.g. pain). Neuroimaging studies are increasingly adopted in both areas, as well as in assessing the role of suggestibility/hypnotisability. Much work over the years has been conducted using EEG and ERP techniques to investigate the nature of hypnosis itself, with interesting but mixed results. More recently, PET and fMRI studies have investigated changes in the brain linked to hypnosis and hypnotic suggestions mostly when they are used to affect other conditions.

Here, I review some of these studies, and show that the brain areas activated after a hypnotic induction depend on whether hypnosis is neutral (no suggestion given) or whether a suggestion is given. The pattern of brain activation is also a function of the type of suggestion provided. I will also report the results of two studies investigating brain markers linked to hypnosis.

Method

The first fMRI study involves High suggestible individuals who, after the hypnotic induction, received a visual/perceptual suggestion to see colour in a visual pattern of shades of grey, and to see grey in a coloured pattern. In this study brain activation was in the lingual gyrus, which is known to be involved in colour perception. In the second study reported, brain markers specific to hypnosis have been investigated with fMRI in High and Low suggestible individuals who were given a hypnotic induction but no suggestion. fMRI data were collected during a series of resting periods. The results revealed specific activation of anterior default mode areas.

Conclusions

Both previous work and the two studies reported here converge in indicating that the presence of suggestion specifically affects the location of brain activation, which is congruent with the content of the suggestion. However it is possible to identify also markers that are specific to neutral hypnosis. This however requires research designs that include different level of suggestibility/hypnotizability, and compare brain activation with and without hypnotic induction. More specifically I will argue in favour of a 'complete design' in which also the presence/absence of specific suggestions are considered and conclude that only the complete design can provide a reliable answer on the existence of specific brain markers for hypnosis.

Symposium D: Neuroimaging Assessment and Outcome Prediction in Traumatic Brain Injury (Van Horn J. – CA, USA)

Effects of cerebrovascular micro pathology upon cognitive impairment and brain aging trajectories subsequent to geriatric traumatic brain injury

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Cerebrovascular neuropathology plays an important role in the clinical outcome of patients with mild traumatic brain injury (mTBI). In geriatric mTBI patients, cerebral microbleed (CMB) findings on susceptibility weighted imaging (SWI) may be of uncertain etiology, since they can be associated with the mTBI or with pre-existing conditions such as cerebral amyloid angiopathy (CAA). In an effort to clarify how CAA and the cerebrovascular sequelae of geriatric TBI can modulate post-traumatic mild cognitive impairment (MCI) and neurodegeneration, we have combined magnetic resonance imaging (MRI) with diffusion tensor imaging (DTI) to investigate how the physical properties of perilesional white matter (WM) fiber bundles vary as a function of the topological distance between CMBs and WM connections. In particular, we sought to determine whether CMBs affect language functions typically mediated by the arcuate fasciculus (AF). Because the AF is a WM structure with a prominent role in language generation and processing, we sought to clarify the relationship between the CMB presence and AF atrophy across six months after injury. A total of 26 geriatric mTBI cases were included in the analysis in addition to 26 healthy control (HC) subjects matched according to sex- and age. The study was undertaken with local IRB approval. All participants were imaged at 3T both acutely (fewer than 7 days post-injury) and approximately 6 months after injury using an MRI protocol which included anatomic T1 and T2 MRI, FLAIR, GRE/SWI and 64-direction DTI. Of the 26 mTBI participants, 21 were found to have CMBs, and four additionally exhibited statistically significant ($p < 0.03$) changes in the mean fractional anisotropy (FA) of the AF, above and beyond the extent of similar FA changes observed in the age- and sex-matched HC volunteers. A network-theoretic analysis of the patients' connectome revealed the fragmentation of their language-related pathways, with significant decreases in modularity ($p < 0.04$) and average path length within the AF ($p < 0.02$). At the time of the chronic scan, all four participants reported speech impediments which they had not experienced prior to their traumatic event. These case study findings suggest a potential relationship between CMBs, mTBI and language-related MCI which cannot be explained by CAA alone. In conclusion, we propose that magnetic resonance imaging (MRI)--when appropriately combined with diffusion tensor imaging (DTI) and with network-theoretic analysis of the injured connectome--can assist researchers to establish the relationship between CAA, mTBI and cognitive decline throughout senescence.

Mild cognitive impairment and structural brain abnormalities in a sexagenarian with a history of childhood traumatic brain injury.

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In this presentation, we illustrate a case study describing an older, female subject having a history of pediatric traumatic brain injury (TBI). Magnetic resonance imaging and diffusion tensor imaging were obtained from the patient in question, her brain volumetrics and morphometrics were measured, and these were then systematically compared against corresponding metrics obtained from a freely available sample of older healthy control (HC) subjects as well as from subjects in various classes of mild cognitive impairment (MCI) and Alzheimer disease (AD). Our analyses noted that the patient's brain morphometry and connectivity was most statistically similar to those of patients classified as having early-onset MCI, in contrast to HC, late MCI, and AD samples. The examination and discussion of this case will be of particular interest to those interested in assessing the clinical neurophysiology and clinical outcomes in older patients having suffered TBI earlier in life, in contrast to those who incur incidents of head injury during old age.

Early Afternoon Session: 1.30 – 3.30 p.m.

Symposium A - IMPAIRED BRAIN: A NEURODYNAMIC APPROACH

(Sequeira H. Lille, France; Güntekin B. Istanbul, Turkey)

EMOTIONAL VISION AND ANXIETY: BEHAVIORAL AND MEG DATA

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Emotional processing is known to be modulated by several psychopathological dimensions. In particular, anxious

behavior is associated with an attentional bias toward emotional information often characterized by contradictory manifestations at neural and behavioral levels. In healthy participants, the emotional visual stimuli have been shown to capture differently the attentional resources when presented in central (CV) or in peripheral vision (PV). Hence, it seems interesting to use the model of CV vs PV presentation in order to explore the impact of emotional stimulations in anxious individuals as compared to healthy controls. The aim of this presentation was to analyze the magnetoencephalography (MEG) and behavioral data illustrating the impact of emotional pictures presented in CV (0°) vs PV (-12° and +12°), in healthy controls, in sub-clinical anxious individuals, and in patients with generalized anxiety disorder (GAD). Main results revealed that 1/emotional information presented at peripheral eccentricities grabs attentional resources needed for the performance in the center of the visual field, 2/ state-anxiety modulates the CV impact of emotional saliency occurring in PV, 3/ patients with GAD showed greater efficiency in emotional condition than HC. In brief, patients with GAD exacerbate the processing of emotional information appearing in the CV and PV. The high level of alertness for emotional cues in PV could help to understand the causation and maintenance of anxiety disorders.

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Electrophysiological evaluation of Tourette syndrome and prediction of treatment outcome

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Context: Tourette syndrome (TS) is an important neurodevelopmental psychiatric disorder which is mainly characterized by multiple motor and phonic tics. First-line treatments for TS symptoms are pharmacotherapy and cognitive-behavioral therapy (CBT). The latter has the advantage of presenting less adverse side effects, but may require more dedication from patients. Among known causes of TS, excessive dopamine and cortico-striato-thalamo-cortical impairments have been widely demonstrated and may have an impact on motor selection and inhibition, favoring chronic tics. However, their impact on electrocortical activity is not fully understood. Therefore, event-related potentials (ERP) and lateralized readiness potentials (LRP) have the potential to provide a valuable insight to the underlying neurophysiological mechanisms of TS and its treatment. **Main goals and hypotheses:** The current investigation focused on various ERP and LRP markers in TS patients, and their ability to predict CBT outcome. We expected that LRP would discriminate TS patients and healthy controls and that they could predict successful improvement in tic symptoms. **Method:** ERP and LRP were recorded in 26 adults with TS and 26 healthy controls. These measures were acquired during a stimulus-response compatibility (SRC) task before and after CBT in TS patients, and before and after a four-month interval in healthy controls. Linear regression analyses were performed to test whether ERP components acquired before CBT could predict reduction of motor and phonic tic severity following CBT. **Results:** Prior to CBT, the stimulus-locked LRP (sLRP) onset was delayed and the response-locked LRP (rLRP) was significantly larger in TS patients, in comparison with healthy controls. Furthermore, there was a trend toward reduced P300 in TS patients. Both LRP measures were normalized following CBT, but not the P300. Finally, the incompatible sLRP onset, as well as other ERP components elicited by the SRC task prior to CBT, had a predictive value regarding the outcome of the CBT. **Conclusion:** All in all, ERP proved to be a useful technique to assess motor and cognitive impairments in TS patients, and to predict the clinical outcome following CBT. Since CBT requires a serious commitment from patients, finding reliable predictors of treatment outcome is important in order to choose the right treatment avenue. In future years, ERP could be used in combination with other techniques to improve treatment outcome prediction.

ALPHA and THETA BRAIN OSCILLATIONS DURING VISUAL PERCEPTION IN SCHIZOPHRENIA

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Schizophrenia is a complex mental disorder with impairments in integrating sensory and cognitive functions. Pathological changes of alpha, theta and gamma activities related to schizophrenia provide an appropriate model to investigate integrative processes of the brain and the potential impact of failures in object perception due to psychiatric illness.

The aim of this study was to investigate event related alpha and theta oscillations during perception of an ambiguous stimulus termed stroboscopic alternative motion (SAM). We recorded EEG during the continuous perception of both, the ambiguous and unambiguous control stimulus. In our study 19 patients and 19 healthy controls were investigated. All patients were recruited as in-patients after clinical stabilization.

Time frequency analysis was conducted. For each participant amplitude modulations between perceptual stability and perceptual changes were determined for each single trial for both tasks (ambiguous and unambiguous) and a wide frequency range.

The reduced modulation of theta activity in patients within the theta range may be related to differences in sensory motor integration between patients and healthy controls. This results mirrors studies utilizing a wide range of tasks and might reflect impairments of top-down capacities within the perception-action cycle. During phases of perceptual stability alpha activity of patients is increased when compared to controls and may indicate increased dependency of the patients' perception on bottom-up processes. Higher and lower alpha-subbands may be affected differentially during ambiguous and unambiguous perception.

We conclude that, alterations in alpha and theta activities were more apparent in the ambiguous condition. In patients with schizophrenia, the balance of top-down and bottom-up mechanisms of visual perception seem to be

disturbed.

Amnesic MCI and Parkinson MCI Differ in Brain Dynamics and Topography

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Mild cognitive impairment (MCI) is a common syndrome that is defined as a condition between normal cognition and dementia. The underlying causes are mostly Alzheimer's disease (AD) and Parkinson's disease (PD). Pre-Alzheimer state is mostly presented with amnesic MCI, while PD is associated with PD-MCI. In the present presentation, we aim to discuss the differences in these MCI two types by means of event-related responses in slow wave frequencies.

Three different methodologies were used; filtered responses' amplitudes, event-related perturbation and the intertrial coherence in three frequency ranges (delta, theta, alpha) after visual stimulation with a classical oddball paradigm in 30 participants with the diagnosis of amnesic MCI (20 males, 10 females; mean age: 70.43±5.5) according to the Albert et al. (2011) criteria, 25 patients with PD-MCI (18 males, 7 females; mean age: 68.08±6.25) according to the Movement Disorder Society (MDS) Level 2 criteria (Litvan et al., 2012) and 28 age-, gender- and education-matched healthy elderly controls (19 males, 9 females; mean age: 68.04±5.69).

The differences were similar in both MCI types regarding amplitudes and power enhancement, being lower than healthy controls. Among the three groups, PD-MCI group showed the lowest values. The difference between amnesic MCI and PD-MCI was striking in phase locking, being saved in aMCI and disrupted in PD-MCI. It can be speculated that the involvement of subcortical driving centers in PD-MCI may have affected phase-locking in PD-MCI. Topographically, aMCI group showed decreased power enhancement in frontal, central and parietal locations, and increased values in occipital region than PD-MCI. Topographical differences may be resulted from differentially involved cortical regions, as the cortical involvement in PD-MCI tends to be more posterior including occipital regions.

These different patterns in two types of MCI may be useful in understanding underlying brain dynamics. In future, electrophysiological markers such as event-related responses may be helpful for clinical diagnosis.

EEG THETA AND ALPHA RESPONSES IN PATIENTS WITH PARKINSON'S DISEASE WITH AND WITHOUT HALLUCINATIONS

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Background: Hallucinations in Parkinson's disease (PD) could affect about one-quarter of the patients. There are limited studies on how the hallucinations affect cognitive states of the patients with Parkinson's disease. EEG-Event related oscillatory dynamics of this patient group is also unknown. The present study aims to fulfill these gaps in the literature. Event related EEG-theta and alpha responses are the essential components of Event related oscillations that is strongly related to cognitive demands. In the present study, Event related EEG-theta and alpha responses of the PD patients with and without hallucinations was investigated during a visual cognitive task.

Method: Three different group of Parkinson's disease patients were included in the study. 15 PD patients without cognitive deficits and without hallucinations (MMSE=26.8±1.89), 22 PD patients with cognitive decline and without hallucinations (MMSE=22.13±5.56), 12 PD patients with cognitive decline and with hallucinations (MMSE=19.91±4.03) and 18 aged-matched healthy controls (HC) (MMSE=28±1.25) were included in the study. EEG from 32 different locations was recorded during visual oddball task. Event related power spectrum and phase locking factor were analyzed for the theta frequency band (4-7 Hz) and two different alpha frequency band (8-10 Hz, 10-13 Hz) for all group of subjects.

Results: The results of the present study showed that healthy controls had increased theta power and theta phase locking during the increased cognitive task. On the other hand, PD patients with cognitive decline had decrease theta power and theta phase locking in comparison to healthy controls ($p<0.05$) and as well as in comparison to PD patients without cognitive decline and hallucinations ($p<0.05$). PD patients with hallucinations and cognitive decline had the worst theta power and phase locking in comparison to all other groups. In the analysis of event related lower alpha power (8-10Hz), there was a significant conditionXlocationXgroup effect ($p=0.03$). Post hoc comparisons showed that healthy controls had higher alpha power, especially in parietal locations during "target" stimulation in comparison to all Parkinson patient groups.

Conclusion: The present study showed that cognitive decline in Parkinson's disease is reflected with decreased theta responses and decreased parietal lower alpha (8-10 Hz) responses. Furthermore, hallucinations had a very adverse effect on cognitive states of PD patients. The abnormality of the theta and alpha responses could be an essential candidate for biomarkers for cognitive decline in Parkinson's disease.

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Symposium B : Visual mismatch negativity: Unique contributions to visual cognitive sciences (Czigler I. ; Kimura M.)

Emotional Visual Mismatch Negativity - two possible sources of confusion

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Processing emotional content (e.g. facial expressions, arousing or disturbing pictures, etc.) is simultaneously simple and complicated. On one hand, it happens all the time and relatively fast, on the other hand, it is practically and methodologically very difficult to catch. It has been shown that our brain can automatically detect unexpected changes in a stream of sensory input (a phenomenon known as mismatch negativity, MMN, Näätänen, Gaillard, & Mäntysalo, 1978), and this has been applied to emotional stimuli (e.g., Kreegipuu et al., 2013) or conditions (like anxiety or depression, e.g., Chang et al., 2010), too. As different laboratories employ different methodology, there are at least two big possible sources of confusion in the experimental field: (1) features of emotional stimuli may coincide with emotional content, and (2) discrimination between hot and cold emotional processes (i.e., feeling and recognizing) is not always clear. These two aspects will be systematically analyzed in the talk. Clarity in these issues is needed as we have recently shown in a review paper (Kremláček et al., 2016); the lack of standardized methodology for a visual mismatch negativity (vMMN) is a serious preclusion to its applicability.

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Visual mismatch negativity and representational momentum: Electrophysiological and behavioral manifestations of the same automatic prediction

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To successfully interact with dynamically-changing objects in real time (e.g., catching a flying ball), the brain is thought to automatically form a prediction about the next state of the object based on its preceding change pattern. A behavioral phenomenon known as representational momentum (RM: forward displacement of the remembered final state of an object along its preceding change pattern) and an electrophysiological phenomenon known as visual mismatch negativity (VMMN: an ERP component that is elicited when an object suddenly deviates from its preceding change pattern) have each indicated the existence of such automatic predictive processes. The automatic predictive processes underlying RM and VMMN appear to be considerably similar. However, there has been no direct investigation of whether or not these phenomena are involved in the same predictive processes. To address this issue, the present study examined the correlation between the magnitudes of RM and VMMN by using a hybrid paradigm in which both phenomena can be measured for the rotation of a bar. Thirty-five participants were required to observe a rotating bar and compare the orientations of the final (i.e., tenth) bar and a subsequent probe (Figure 1); the orientation of the probe was either the same as or slightly different than that of the final bar (-8° , -6° , -4° , -2° , 0° , $+2^\circ$, $+4^\circ$, $+6^\circ$, or $+8^\circ$). In the regular trial, the bar was rotated regularly ("inducing" stimulus). In the irregular trial, the bar was rotated regularly, but the direction of rotation was suddenly reversed at the seventh, eighth, or ninth position ("braking" stimulus). The magnitude of RM was measured as the mean position of a probe judged as "same" in the regular trials. The magnitude of VMMN was measured as the mean amplitude of difference waves (within 200-300 ms time window at the P8 electrode site) which were obtained by subtracting ERPs elicited by the inducing stimuli at the seventh, eighth, and ninth positions in the regular trials from those elicited by the braking stimuli at the seventh, eighth, and ninth positions in the irregular trials. The results showed that the magnitudes of RM and VMMN were positively correlated ($r = .41$; $p < .01$); participants who exhibited greater RM tended to show greater VMMN. This result provides empirical support for the hypothesis that RM and VMMN are involved in the same automatic predictive processes.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18001/add_1_437700_08ec39d4-4bef-433e-ab0d-387d8382969d.png

Caption 1: Schematic illustration of the regular and irregular trials.

Visual mismatch response and fMRI signal adaptation correlate in the occipital-temporal cortex

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Introduction:

Several electrophysiological studies found response differences to a given stimulus when it is repeated frequently as compared to when it occurs rarely in oddball sequences. Initially defined in acoustic perception, such difference also exists in the visual modality and is referred to as visual mismatch negativity (vMMN). However, the repetition of a stimulus also leads to the reduction of the blood oxygen-level dependent (BOLD) signal (fMRI adaptation, fMRIa) when compared to alternating stimuli in fMRI experiments. So far, no study compared the vMMN to fMRIa within the same paradigm and participants.

Methods:

Here we tested the possible connection between fMRIa and vMMN in a visual oddball paradigm. In two separate sessions electrophysiological and neuroimaging data from the same participants (N=18) was acquired for frequent and infrequent presentations of real and false Roman characters.

Results:

We found significant visual mismatch response (vMM) in ERPs as well as a significant fMRIa within the letter form area (LFA) and lateral occipital cortex (LO) for both real and false characters. Importantly, the later part of the electrophysiologically measured vMM and the fMRIa in the LFA showed a significant correlation for real characters, suggesting the existence of a congruent neuronal mechanism behind vMM and fMRIa measured within the same oddball paradigm.

Conclusions:

In conclusion, this study shows for the first time that the magnitude of vMM and fMRIa in the occipito-temporal cortex correlate with each other for stimuli of high familiarity (i.e. real Roman characters). This suggests that the two phenomena have similar neural mechanisms, presumably explained by predictive coding theories.

Fast Periodic Visual Stimulation: Developing an objective measure of short term memory for the early diagnosis of Alzheimer's disease

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Fast Periodic Visual Stimulation (FPVS) provides a new objective method for assessing an individual's ability to discriminate between different categories of visual stimuli. Using a combination of steady-state visual evoked potentials and oddball paradigms it has been demonstrated to be a powerful measure of visual discrimination in single subjects.

Importantly what defines the visual categories can range from low-level perceptual properties to abstract cognitive properties. We have adapted this approach to examine a range of cognitive processes and will demonstrate that the technique can be used to assess the integrity of semantic categorisation, short term memory, self-referential processing and visuo-spatial processing in single subjects in as little as 3 minutes EEG recording time. The implications for the objective assessment of cognition in dementia and the potential as an early diagnosis tool will be discussed.

We also present a free Matlab and Psychopy toolbox designed to easily run FPVS experiments and analyse the subsequent data. The Fastball toolbox is available now from:

<https://gsthart.github.io/Fastball/>

Vanishing stimuli: object, texture and spatial attention

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In a series of studies we investigated the automatic detection of infrequent offset of visual stimuli. Infrequent vanishing parts of objects, but not the re-appearance of these objects elicited visual mismatch negativity (vMMN). Vanishing parts of visual textures elicited similar vMMN, but vMMN appeared also to the re-appearance of the texture stimuli. Spatial attention has no effect on the offset-related vMMN. According to the results, in comparison to textures, objects established more specific representation in the memory system underlying vMMN. Earlier part of the offset-related vMMN was similar in older and younger participants, but the later part of this component was smaller in elderly. The new method of stimulation (disappearance - re-appearance of some parts of stimuli) is less susceptible to low-level adaptation, and it provides stimulation with decreased bottom-up saliency.

Symposium C: Olfactory Cognition: a bridge from olfactory perception to clinical practice - Part 1

(Invitto S. - Lecce, Italy, Sartucci F. – Pisa, Italy; Mazzatenta A. – Teramo, Italy)

Olfaction: from now to next

A Mazzatenta

University of Chieti -Pescara 'G.d'Annunzio', Chieti, Italy

Currently, the nose is included in the human fashion business, which often ignores the conceal the sense of smell, besides it represents a primeval physiological key system. Chemical senses, from the simplest unicellular to the multicellular form of life, are devoted to detecting vital chemicals for nutrition, housing, social and sexual relationship. The modern study of olfaction and related systems arose from the odorant receptor discovery in the 1990's. This seminal discovery accelerated our understanding of the mechanisms of volatile chemical sensing including an appreciation of the transduction mechanism, comprehension of neural pathways and receptor function. Further evidence of its evolutionarily crucial role are: i. the significant proportion of the genomes, up to 4%, devoted to encoding the whole machinery of smell; ii. the premature olfactory impairment as a distinctive marker of neurodegenerative disease; iii. the disease characterization by chemical cues, e.g. acetone in diabetes. Consequently, olfaction becomes an important system for biological modeling, electronic nose development, and disease studies. Recently the development of new sensor allowed to investigate the 'odorant' emitted by a body, termed Volabolome, and use it in the diagnostic process and to investigated neurodegenerative diseases

Assessing neonatal responses to odorants: breathing patterns

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Neonatal olfactory capacities have long been a matter of interest, and their physiological responses to odorous stimuli have been used as indicators of odor detection and also of more complex concepts such as odor valence. In a recent study, we recorded neonates' responses to highly diluted odorants from sweat and milk, these compounds being supposed to be salient for breast-fed newborns as they encounter them during breastfeeding. Since neonates have formerly been shown to change their breathing rate in response to odorous stimuli, and respiration directly being linked to odor perception, we hypothesized that neonates will show discriminative breathing patterns towards different concentrations of these odorants. To test this hypothesis, aqueous solutions of the odorants were presented to 3-day-old neonates (n = 16). The stimulus set additionally comprised water, vanillin, mother's milk, and sweat. Respiration was recorded during the experiment using a piezo-electric respiration transducer. Respiratory data were analysed considering different methods and time intervals. The results will be discussed with regard to both methodological aspects and concepts for the adoption of respiratory response measures in future studies.

There is anger in the air - Preferential processing of chemosensory anger signals in men and women

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Women but not men show pronounced evaluative processing of chemosensory anxiety signals. Gender effects in response to anger sweat have not been investigated yet. Using event-related potentials (ERP), the current study is the first to examine gender differences in the processing of chemosensory anger signals.

Axillary sweat was collected via cotton pads from 17 men and 17 women participating in a competitive, frustrating computer game (anger condition) and while playing a simple construction computer game (control condition). The donors reported a stronger increase of anger during frustration compared to the control condition ($p < .001$). Sweat samples were pooled with reference to donor gender and condition, and presented to 23 men and 25 women for 0.4 seconds (ISI: 18.5-22.5 s) with constant flow (100 ml/s). Ongoing EEG was recorded from 61 scalp locations, and chemosensory ERP (N1, P3-1) were analyzed.

In general, women showed larger N1 ($p = .043$) and P3-1 ($p = .019$) amplitudes in response to male compared to female sweat. Moreover, they responded with larger P3-1 amplitudes to male compared to female anger sweat ($p = .017$). Overall, P3-1 amplitudes were larger in response to male anger compared to control sweat ($p = .009$), and in response to male compared to female anger sweat ($p = .009$).

Women seem to be especially sensitive to male chemosensory signals, showing pronounced early, preattentive (N1) as well as pronounced late, evaluative processing (P3-1) of male sweat. However, both men and women show an enlarged P3-1 in response to male anger sweat, suggesting that it contains an important alarm signal. Thus, in contrast to chemosensory anxiety signals, male anger sweat might carry a signal of potential threat of relevance to both genders. Moreover, women demonstrate a specific sensitivity to chemosensory signals per se, in line with the notion of a female superiority in the perception of weak socio-emotional cues.

A cerebral bridge from olfactory cognition to spatial navigation

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An evolutionary paradox is the variability of the olfactory bulb size, in contrast to the other brain regions, which are sized proportionally to the peripheral function. This variability seems to be the result of selection for the olfactory function. This disagreement may derive from considering smell as a sense linked to odorous discrimination. In many vertebrates and in terrestrial and marine mammals, the sense of smell has evolved into functions related to the eco-localization. So, if the olfactory function involves spatial perception and navigation, this, could explain the proportional discrepancy between the olfactory bulb and olfactory cortex. Humans are able to discriminate a spatial position as a function of olfactory cues. Vice versa, in neurodegenerative syndromes the orientation capacity and olfactory perception are impaired. This leads us to think that could be a common cross-modal processing, of phylogenetic origin, which links olfactory perception and spatial orientation. Starting from these theoretical assumptions, we conducted a basic research, on 100 healthy subjects, investigating, through both behavioral and electroencephalographic data, the connection between spatial memory span and olfactory spatial memory span. Subjects were assessed through a three-condition task: normal Corsi Block Test (CBT), 'Olfactory' Block Test (OBT) and a 'Semantic-Olfactory' Block Test (SOBT). CBT consisted in a test on spatial memory span; OBT consisted in a presentation a spatial sequences of 9 different odorants (i.e., Eucalyptol, Carvone, Eugenol, Isoamyl Acetate, Geraniol, Phenethyl Alcohol, Acetophenone, Cinnamon, Hexanal) instilled on paper square not recognizable by any sign, positioned on a CBT, and showed in a spatial navigation way, and SOBT consisted of a semantic labelled of olfactory spatial navigation. A GLM repeated measure highlighted significant differences during the three conditions. Subjects had different SPANs due to different conditions. The Semantic olfactory memory SPAN was inferior respect Olfactory span and Spatial Span. Furthermore was found a significant positive correlation between the three condition. The 5 subjects with higher SPAN scores, 5 with medium scores and the 5 subjects with lower SPAN scores were recruited to investigate ERP components elicited during the cross-modal task. Subjects had to perform, during a high-density EEG recording, an olfactory task (administered through the device US2017127971 (A1) "□ 2017-05-11), an EEG Posner spatial cueing task and a go/no-go olfactory semantic categorization task. The results of this study will be discussed in light of a theoretical connection between these three aspects of cortical functions that seem strongly interconnected.

Symposium D: EEG and individual differences

(De Blasio F. – Wollongong, Australia ; Barry R. Wollongong, Australia)

The review of the probable individually determined alpha EEG predictors of major depressive disorder

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Over the last decade, a prevailing theory has emerged that alpha oscillations reflect as an essential top-down mechanism of neuronal inhibition and thus may play a prominent role in the prediction of the destroyed sensorimotor integration and impairment of emotions perception in patients with a major depressive disorder (MDD). Meanwhile, results from the list of studies used non-individualized analysis of alpha-activity in the standard alpha range are contradictory. According to some authors, MDD associated with an increase, and other researchers demonstrate equal or decrease in alpha-activity compared with healthy control (HC). Among the possible causes of these contrasting results, could be the use of different methodological approaches to EEG alpha-activity assessment. Often, in particular, measuring does not address the Berger effect; disregards to the EMG contaminations in the low frequency; ignores the neurohumoral conditions in women etc. All of them may lead to misinterpretation of the results of the alpha EEG measurements

With the aim to highlight the probable individually determined alpha EEG predictors of MDD this review covers potential biomarkers from individualised EEG alpha activity indices within the EEG personally identified alpha frequency bands. Among them could be the frequency of the low and upper alpha band limits, individual alpha peak frequency, magnitude and duration of alpha suppression that might help to identify favourable treatment outcome. Further, the various markers are discussed in the context of their potential MDD predictive power. Individualized analysis of EEG alpha activity during resting-or task-related state conditions have not only been used to discriminate patients from healthy subjects, but also for the prediction of treatment outcome in MDD, yielding information about tailored therapy approaches for an individual.

Changes of spontaneous EEG-band oscillations to tonic cold pain and the Behavioural Inhibition and Fight-Flight-Freeze Systems

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The association between electroencephalography (EEG) changes and human pain has never been definitely resolved. Little effort has been devoted to test personality traits as neurobiological factors that could potentially play an important role in clinical pain and its effects on behaviour.

Using EEG delta, theta, alpha, beta, and gamma band power measures our objectives were: (1) to find cortical

correlates of subjective perception of cold pain (CP); (2) to evaluate the relation of pain and distress ratings with the behavioural inhibition system (BIS), fight-flight-freeze system (FFFS), and behavioural approach system (BAS) personality traits and to identify EEG bands associated with these traits. EEG was recorded in 55 healthy right-handed women under: (i) no-pain during white-noise change detection condition (Baseline); (ii) enduring CP induced by the cold cup test. Delta, theta, beta and gamma spectral powers during CP were significantly higher than those during Baseline. Beta and gamma powers were significantly smaller in high pain scorers compared to low pain scorers. Midline frontal alpha, left-frontal beta, and right-parietal gamma power changes to CP from Baseline were all predictors of subjective pain ratings. During CP, higher BIS scores were associated with smaller left-parietal delta and right-parietal theta power scores, whereas higher FFFS scores with greater right-temporal and smaller left-parietal delta power scores. Results suggest a functional role of EEG alpha, beta and gamma activities in the subjective experience of tonic pain. Theta and delta activities underpin two "pain avoidance" systems, respectively, inhibition behaviour and escape control.

The effects of caffeine on threat-selective attention moderated by EEG theta/beta ratio

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It has been reported that spontaneous EEG theta/beta ratio (TBR) marks prefrontal cortical (PFC) executive control and its regulation of attentional threat-bias. Caffeine at moderate doses likely strengthens PFC-mediated executive control through increased PFC catecholamine action. However, basal catecholamine levels and PFC functioning interact with dose to produce nonlinear dose-response effects of catecholamines, and likely caffeine, manipulation. A moderate dose of caffeine might support executive functioning in anxious individuals through normalization of PFC-controlled attentional threat bias, but as a function of basal PFC functioning. We therefore investigated if caffeine affects attentional threat bias and if baseline frontal EEG TBR (as a marker of basal PFC function) moderates this effect. Forty female participants, preselected for consuming a maximum of 100 mg caffeine per day visited the lab three times. This included EEG TBR and attentional bias measurements during a first baseline session and two more sessions during which participants were orally administered 200mg caffeine or placebo, in counterbalanced order. A Pictorial Emotional Stroop Task was used to measure attentional bias as interference from highly arousing threatening or positive pictures. At baseline, a direct effect of TBR was observed on interference, also interacting with trait anxiety, for negative pictures only. The same was observed after placebo administration. Caffeine administration had opposite effects on threat bias for people with low and high TBR (high and low PFC function), effectively cancelling out individual differences and caffeine's simple effect. These results support the notion that TBR reflects PFC-mediated attentional control that helps to maintain adaptive attention to threat. They also confirm theoretical predictions that studies into effects of caffeine on executive function should control for basal PFC functioning. This furthers understanding of what TBR reflects and how caffeine affects executive control as a function of individual differences of basal PFC function.

EEG and compulsive behaviours

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Centre for Mental Health

Swinburne University of Technology

Introduction:

The underlying neurophysiology of compulsive buying has been investigated previously but with far less enthusiasm than those studies investigating associated behaviours. Compulsive buying has been associated with addiction (or sensitivity to reward), obsessive-compulsive disorder and hoarding. In this preliminary study, we investigate underlying neural responses associated with the need to purchase in a cohort of female participants.

Methods:

We investigated the electrophysiology of compulsive buying during executive processing and cue reactivity using a block design with multiple EEG techniques; EEG coherence and sLORETA (Pascual-Marqui 2011). Twenty-four female participants were assessed with the Compulsive Acquisition Scale (CAS) which predominately focuses on scoring buying acquisition behaviour. EEG was recorded using a 32 channel electrode cap via a Neuroscan system using acquisition software SCAN 4.3. Further off-line analyses included artifact and EOG correction. Alpha coherence and sLORETA were calculated for the encoding phase of a memory task, which consisted of over 60 images including some luxury images/items. Participants were asked to respond to preferred and non-preferred images and rate their urge to buy.

Results:

EEG coherence data suggests that decision making was associated with brain networks involving frontotemporal parietal regions. sLORETA data suggest regions BA9, BA24 and limbic regions were involved for compulsive buying decisions. Data suggest that during the preferred item processing, participants were more aware of the luxury stimuli.

Conclusion:

This study investigated the EEG of compulsive buying associated with executive processing and cue reactivity. Data suggest differences in neural responses in both EEG Coherence and sLORETA data. Findings suggests that compulsive buying may involve regions associated with awareness and reward satisfaction. This interpretation is supported by models of addiction (Goltstein et al 2011). Interestingly, "Sensitivity to reward" has been reported to be

the most important predictor of compulsive buying severity.

Group differences in EEG and their association with binge drinking in young adults

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Binge drinking is particularly prevalent in young adulthood, a neurodevelopmental period of specific sensitivity to the neurotoxic effects of excessive alcohol consumption. This drinking pattern has been associated with behavioural and cortical abnormalities which could reflect attentional and/or impulse control impairment. It remains unclear whether these abnormalities precede, or are consequential to binge drinking onset. The present investigation thus sought to identify possible antecedent EEG biomarkers of binge drinking onset in young adults.

Twenty-six undergraduate university students ($M_{age} = 20.0$; $SD = 2.1$ years) completed two testing sessions approximately four months apart. The Barrett Impulsivity Scale (BIS-11) was administered at session 1, and each session included self-reported alcohol use and the recording of EEG data during 2 minute blocks of eyes-closed (EC) and eyes-open (EO) resting. The alcohol use measures classified all participants as non-binge drinkers (NB) at session 1; 12 participants retained their NB classification at session 2, and 14 were reclassified as binge-drinkers (BD). Artifact free 2 s non-overlapping EEG epochs were subjected to FFT, and the mean spectral power in the traditional delta, theta, alpha, and beta bands were computed for each resting condition. Spectral topography and condition effects were assessed between groups; to control for pre-existing group differences, session 1 data served as a covariate for each corresponding session 2 analysis. Associations between the BIS-11 scores and resting EEG band power at session 1 were investigated via correlation.

At session 1, the NB and BD groups showed significant topographical differences in their theta and alpha band power across the resting conditions (both, $F \geq 4.28$, $p \leq .049$), and in the EC > EO condition effect (theta, $F = 5.82$, $p = .024$; both alpha, $F \geq 5.01$, $p \leq .035$). The groups showed further topographic discrepancies at session 2, although significant effects were limited to alpha power across the conditions. The BIS-11 scores and resting EEG band power showed a complex pattern of correlations. In the NB group the correlations were inverse, topographically focal, and occurred in the delta, alpha, and beta bands in EC, and in the theta, alpha and beta bands in EO. In the BD group the correlations were positive, somewhat less topographically localised, and were restricted to delta in each resting condition.

The present findings provide evidence of antecedent resting EEG biomarkers of binge drinking onset in young adults, and suggest links between these and aspects of impulsivity.

Symposium E : In search of neurophysiological basis of insight

(Shemyakina N. – Saint Petersburg, Russia; Leikin M. – Haifa, Israel ; Bhattacharaya J. - Lonond, UK)

Neurophysiological markers of insight and original remote associations

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Introduction. An insight is the most intriguing stage of creative thinking that is not investigated enough. “Aha” effect is the time of suddenly coming and fitting the task correct decisions (Keller,1930; Wagner et al.,2004). The series of studies aimed consideration of similarities/differences in event-related synchronization/desynchronization (ERS/ERD) markers of remote and trivial associations finding and those that were named as insight by subjects.

Methods. Three EEG/ERP studies using two RAT alike tasks (Mednick, 1968) for remote associative search (with two and three words) and a task for overcoming long-term memory stereotype were carried out, exploring ERS/ERD in 22, 13, 20 right-handed healthy adults correspondingly (mean age of all participants 23.6 ± 3.1 [SD]) In the 1st test condition subjects were to operate two nouns from different semantic fields and produce combining adjectives (“Definitions”); in the 2nd - to operate three words and suggest one more, that can be used with each of them (classical “RAT”); in the 3rd - to suggest own ending of the well-known saying (“Proverbs”). In all studies, subjects had to decide if their answers appeared through insight. EEG/ERPs were registered with 31AgCl electrodes in 0.3-30Hz range with 500Hz sample rate (Mitsar Ltd., Russia). ERS/ERD was analyzed on artifact-free (ICA corrected) trials for each subject using Morlet wavelets applied for 4 s (2 s before and after a marker of the decision). Statistics were performed with RM ANOVA and T-tests.

Results. All tasks demonstrated the special role of frontal cortex. Creative decisions in “Proverbs” were characterized by higher ERS at 7Hz in the left frontal area (F3) at 800-400ms prior the answers in comparison with memorizing. Nontrivial “Definitions” demonstrated an increase of ERS in low theta frequencies at F7(4Hz), Fz(3Hz), T3(3.5Hz) sites with starting differences 1500 ms before the answer and in the alpha2 band in comparison with trivial findings. Insightful decisions in classical RAT compared to those, that were not marked as insight demonstrated an increase of 4-6Hz power 1000-800 ms before the answers in frontotemporal areas bilaterally ($F_{StateZone}(30,360)=2.2$, $e(H-F)=0.26$, $p<0.05$). The data corresponds with RAT performance (Razumnikova et al.,2007) and insight solutions in math (Wu et al.,2014)

Conclusions. Obtained data demonstrated an influence of conditions on correlates of creative and insightful

decisions. Stressed the role of low frequencies synchronization prior the answers in the frontal cortex in the tasks connected with associative search and creative or insight decisions. Was carried out within the assignments of FASO of RF

THE EEG CORRELATES OF CREATING HUMOROUS AND ORIGINAL IDEAS BY INSIGHT: SIMILARITIES AND DIFFERENCES

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Even though the similarities of the psychological mechanisms of insight and humour perception are proven right, the cerebral mechanisms of humour generation still await their studies.

Methods. The objective of this study was to explore spatial EEG correlates of insight in creating original and humorous phrases by 78 right-handed specialists in art (the average age being 23 years) in tasks based on "doodle" pictures.

EEG registration was performed by 64 derivations. The subjects were to find non-standard, original answers in the first test and humorous answers in the second one.

They had to decide whether his/her decision was insight-based or not as well.

To analyse each functional test, five-second artefact-less EEG segments were chosen; in each of them the coefficient of coherence values of each subject were averaged in theta, alpha, beta and gamma frequency bands. Statistical processing of data was performed by using the post hoc comparative analysis with the help of the PC software bundle "STATISTICA 12.0".

Results. In the theta band, in creating the humorous responses, the coherent connections in the posterior cortex areas of each brain hemisphere were more significant in the non-insight-based way of solving the problem other than in the insight-based one ($p < 0.05$).

In the alpha band, in finding the answer using the insight-based way, all the significant coherent connections were more powerful in case of original answer as opposed to the humorous one, excluding the connections in the right occipital cortex ($p < 0.05$) that were most involved in the process of finding the humorous answer.

In the beta band, in comparing the insight-based solution, the coherent connections were stronger in the posterior cortex area of the left hemisphere when finding an original answer, and in the posterior cortex area of the right hemisphere when finding a humorous one.

In the gamma band the stronger coherent connections in the pre-frontal cortex area of the right hemisphere were reliable in differentiating the non-inside-based way of finding a humorous answer from the insight-based one ($p < 0.05$).

Conclusions. In the insight-based answers, in the low-frequency bands the EEG coherent connections in the prefrontal cortex area of the right hemisphere and the interhemispheric connections in the occipital cortex area were important, as are coherence in the posterior cortex area of both hemispheres in all explored EEG frequency bands. The occipital cortex areas of the right hemisphere turned out to be specific to the insight-based humour creation.

Expertise, giftedness and insight in mathematics

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In this research report we will discuss links between expertise in school mathematics, general giftedness and mathematical insight. Expertise is acquired by means of deliberate practice that leads to the ability to make fluent and flexible use of strategy-based processes as and when required. Mathematical insight is associated with production of original work, invention and illumination, which is an experience of suddenly realizing "how to solve a problem". Several distinctions were introduced in the study: First, based on theories of gifted education (e.g., Milgram and Hong 2009), a distinction was made between levels of intelligence ("general giftedness," G, determined by IQ scores higher than 130) and levels of expertise ("excellence in mathematics," EM, determined by high scores in secondary school mathematics). This was applied in the sampling procedure, whereby four research groups were designed by a varying combination of EM and G characteristics. Second, based on the theories of mathematics education, a distinction was made between the translations of different representations of mathematical objects required by the task (Kaput 1998) and different areas of mathematics (i.e., algebra and geometry), together with a third distinction between learning-based and insight-based tasks; these distinctions were implemented in the design of the research tools. The task design was determined by Pólya's (1973) theory of problem-solving strategies. Comparison between behavioral and ERP measures associated with solving learning-based and insight-based mathematical problems will be presented. The study design led to some exciting discoveries: The distinction between general giftedness and expertise in mathematics proved to be powerful in understanding that these two characteristics, even though interrelated, are different in nature. It was also obvious that using behavioral measures only is insufficient and sometimes misleading. We will argue that effects associated with solving insight-based tasks are linked to general giftedness. In contrast, effects associated with solving learning-based tasks are linked to expertise in mathematics. The insight-based component associated with mathematical expertise when solving learning-based tasks will be analyzed.

Late Afternoon Session: 5.00 – 06.30 p.m.

Symposium A : Using Magnetoencephalography to study dynamics of brain activity and functional connectivity: method developments and applications

(Betti V. – Rome, Italy)

A MEG source reconstruction workflow

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Nowadays, performing all the data processing steps that are required for a complete MEG/EEG analysis pipeline often needstouse a multitude of software packages and in-house or custom tools (e.g. MRI segmentation, pre-processing, source reconstruction, graph theoretical analysis, statistics). This is not only cumbersome, but may also increase sources of errors and leads to a not easy reproducibility of the experiment results. Here we describe NeuroPycon, an open-source, multi-modal brain data analysis kit which provides Python-based pipelines for advanced multi-thread processing of fMRI, MEG, and EEG data, with a focus on connectivity and graph analyses [1].

NeuroPycon is based on NiPype framework [2] which facilitates data analyses by wrapping many commonly-used neuroimaging software into a common python framework. The several pipelines provided by NeuroPycon represent the different steps of data analyses(preprocessing, source reconstruction, connectivity analysis, ...) and can be usedin a stand-alone mode orcan be combined within building blocks to form a larger workflow.

NeuroPycon provides a common and fast framework to develop workflows for advanced neuroimaging data analyses. Several workflows have already been developed to analyze different datasets coming from either MEG and EEG studies, such as MEG sleep data, MEG resting state measurements performedduringdifferent meditation sessions and MEG recordingson Schizophrenia patients.

References:

1. Bullmore, Sporns (2009)
2. Gorgolewski et al. (2011)

Across-time MEG decoding reveals the temporal organization of action representations

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Introduction

Successful interactions within our environment require representations of our actions in time. During movement execution, the brain keeps track of the actions we are performing, updating the representations of these actions during their unfolding. At the same time, the brain also needs to represent our planned action as an intended outcome, as we need to match what we planned to achieve with what we are actually executing. Exactly how the human brain represents these different types of action representations – namely, of the on-going movement and of the intended outcome - is still unknown. The aim of this study is to characterise the temporal organization of these representations in the human brain.

Methods

To this aim, participants were requested to perform a non-visually guided motor task, where they were cued to reach one of two possible targets with their hand. The performance of the movement was triggered by a go cue presented 1.5 seconds after the first cue, which allows dissociating the execution from the planning phase of the movement. We adopted multivariate pattern analysis (MVPA) of MEG data and the temporal generalization method. This method consists in decoding between two different conditions (reaching right vs. left target) at specific moments in time. Training and testing of the classifier is done both at the same time point and across time (i.e., training the classifier at one time point and testing it in another time point). Our rationale for adopting this method was to investigate if action-related information is maintained in time (representation of on-going movement) or if the same information is represented at different time points, i.e. during planning and execution (representation of planned action as an intended outcome). We focused our decoding analysis on the beta band, as it has been previously proposed to play a pivotal role in sensorimotor processing.

Results

Our results showed significant decoding for the beta band at specific time-points both during planning and execution. Furthermore, we obtained significant across-time decoding between planning and execution in the beta band, which we interpreted as a possible matching mechanism between what we intend to do (planned action) and what we are performing (outcome).

Conclusions

We characterized the temporal dynamics of action encoding through MEG decoding. Our results started to reveal the temporal organization of action representations within the human brain, suggesting the crucial role of the beta

band in representing action-related information across different time periods.

Topology of functional connectivity and hub dynamics in the beta band as temporal prior for natural vision in the human brain

V Betti

Sapienza University of Rome, Rome, Italy

Brain hubs act as important points of convergence for the integration of distributed processing across multiple brain regions and systems. Behavior unfolds not only in space, but also in time, yet the temporal dynamics of integration among hub regions remain elusive. Specifically, it is not known whether hub centrality and its dynamics at rest resemble those generated during natural vision. We used Magnetoencephalography (MEG) to measure static and transient regional and network-level interaction in α and β -band limited power (BLP) in three conditions: visual fixation (rest), viewing of movie clips (natural vision), and time-scrambled versions of the same clips (scrambled vision). As compared to rest, we observed in both movie conditions a robust decrement of α -, but not β -BLP connectivity strength with a relative preservation of within-network topology. Graph analyses showed that the number of connections, especially between-networks, decreased in the α -band, but did not change in the β -band during natural vision. A core network of hub regions remained stable during rest and movie conditions, especially in the β -band. At short time scales, these highly central nodes behave as temporally overlapping transient hubs that alternate periods of strong and weak centrality. While these joint hub activity fluctuations were altered in the α -band between rest and natural vision, they remained highly similar in the β -band. We conclude that the temporal and spatial configurations of cortical hubs in the β -band are highly similar between rest and natural stimulation, possibly reflecting temporal priors of the slow-varying temporal structure of the natural environment.

Symposium B - Object recognition in the psychophysiological detection of memory: New methods, new insights

(Ambach W. – Freiburg, Germany)

Psychophysiology of recognition in a misinformation study: Effects of a post-encoding interview

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Recognition of known, meaningful objects is mainly driving the psychophysiological responses used in the Concealed Information Test (CIT) to detect hidden knowledge in examinees. Yet, detection of erroneous or altered memory has barely been investigated. The idea of this project, based on the CIT in principle, is to investigate psychophysiological responding related to the three types of memory induced in the misinformation paradigm: true recognition, false recognition, and absent recognition.

In the first term, fifty participants underwent an encoding phase (mock-crime video) and - in this particular follow-up study - then filled in an interview (derived from the self-administered interview, Gabbert et al., 2008) either referring to the video or to a self-chosen film scene. After a one-week retention phase, misleading information about four out of eight video details was introduced in a set of suggestive questions. The following interrogation with psychophysiological measurement was CIT-like, but without information concealment. Finally, levels of confidence and visual as well as auditory detail recollection were self-assessed for each item.

To meet the deadline for this abstract, a preliminary analysis was performed. Memory performance was clearly compromised when misleading information was given. The post-encoding interview, if referring to the video, markedly increased memory accuracy and weakened the influence of misleading information on explicit memory. Differential physiological responding to recognized vs. non-recognized items, corresponding to a CIT effect, was found for electrodermal activity in the condition without misleading information but not after misleading information was presented. No such effects were observed for the respiratory and cardiovascular measures. A response difference between true and false recognition was not confirmed.

The study replicates the finding that misleading information may compromise the CIT. It further replicates the observation that, without information concealment, only the electrodermal measure is valid for memory detection. Possible further implications concern the theoretical foundations as well as the forensic application of the CIT, but also extend to estimating the validity of eyewitness memories.

'Memory Detection with eye-movement measures: The Role of Task-Demands'

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Abstract

In a previous study (Lancry-Dayana et al., 2018) we introduced a modified CIT paradigm, that included a parallel presentation of several items, followed by a presentation of a single item. This paradigm, coupled with a working

memory task (examinees were requested to indicate whether the single item appeared in the previous display), resulted in a very impressive detection efficiency of familiar faces, based on eye-movement measures, even when examinees were instructed to use countermeasures that were specifically adapted to the gaze behavior. This detection efficiency was largely driven by an initial attraction towards the familiar face, followed by a tendency to spend more direct fixation time on the unfamiliar faces. This later avoidance of the familiar faces can be accounted for by the working memory task. In this study we examine whether the observed detection efficiency is limited to the working memory task. The results of the previous study are compared with the results observed under similar conditions, but with a visual search task (i.e., indicating whether a dot appeared to the left or the right side of the presented pictures), which does not require memorizing the items and encourages examinees to view all faces equally. Although gaze behavior changed drastically, detection of the familiar faces was still high. Under this paradigm the detection of the familiar faces was driven by a strong tendency to focus on the familiar face throughout the display period. These two studies provide a proof of concept for a highly accurate and easy to implement method for detecting concealed information.

Frontal slow wave asymmetry and the concealment of crime-related recognition

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A frontal negative slow wave (500–1000 ms) component of the event-related potential (ERP) has been observed in the concealed information test (CIT) only when participants are required to conceal the recognition of a crime-relevant item. The cortical source of this slow wave has been estimated in the right prefrontal cortex. However, it remains unclear whether the right prefrontal activation reflects a process that is specific to concealment, or a more general cognitive control process related to attention and working memory. To clarify this issue, we examined frontal negative slow wave asymmetry when manipulating the presence or absence of memory and the intention to conceal.

Twenty-four participants underwent the CIT under the following four conditions. In the Conceal condition, participants were asked to conceal the memorized crime-relevant item. In the Reveal condition, participants were asked to inform the experimenter of which item they had stolen without any overt action. In the Exposed condition, they were asked to disclose the crime-relevant item before performing the CIT, removing the intention to conceal. In the Innocent condition, they did not know which item was crime-relevant. An electroencephalogram was recorded from 128 scalp sites during the CIT. Frontal negative slow wave asymmetry was examined by comparing the mean voltages of the 500–1000 ms time window between the right and left frontal sites. Its cortical source was estimated using standardized low-resolution brain electromagnetic tomography.

In the Conceal condition, the crime-relevant item elicited a greater right than left frontal negative slow wave, and its source was estimated in the right prefrontal cortex. In the Reveal condition, the crime-relevant item also elicited a greater frontal negative slow wave than did the irrelevant items. However, its amplitude was greater over the left frontal sites than over the right frontal sites, and its source was estimated in the left prefrontal cortex. In the Exposed and Innocent conditions, no amplitude difference was found between the crime-relevant and irrelevant items.

The hemispheric asymmetry of the frontal negative slow wave during the CIT depended on the type of instruction. The results suggested that the intention to conceal recognition recruited the right prefrontal cortex. This greater-right-than-left frontal slow wave may be related to a concealment-specific process, because it did not occur in a task requiring a general cognitive control process but not concealment.

Examining the steps towards Recognition: Functional Microstates in the Misleading Information Paradigm

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Functional microstates are brief periods of quasi-stable scalp-topographies depicted in the EEG (Lehmann, 1987). As a change in scalp topography is assumed to be due to changes in neurological activations, microstates are proposed to correspond to different blocks of human information processing. To identify and time the chain of mental processes involved in recognition, we analyzed functional microstates during the formation of memories in a misleading information paradigm. A Concealed Information Test with truthful answering was used to examine the memory of specific crime-relevant information. Functional microstates during correct remembering of crime-relevant information, false remembering of misleading information, and correct rejection of irrelevant information were compared. In doing so, it was assessed whether equal or different processes associated with the different kinds of recognition. If processes were found to be equal, it was analyzed whether they differed in duration and intensity. 40 participants watched a video showing a mock crime that included eight randomized details (e.g., the color of an envelope). After a retention interval of one week, four out of eight details were replaced by misleading details in a narrative text. Afterwards, EEG was recorded during a Concealed Information Test with truthful answering. Event-related potentials were averaged per condition. Functional microstates were segmented at group average level using a k-means approach. Finally, clusters were fitted on group-level EEG data and compared using randomization statistics (Koenig et al., 2011). Preliminary results indicate that correct memory of crime-relevant information and false memory of misleading information were associated with the same processes, which do not differ in intensity or duration. However, the comparison between correct memory of crime-relevant information and correct rejection of irrelevant information revealed differences in one microstate preceding the subject's answer. Both intensity and

duration of this microstate were enhanced when participants reacted to crime-relevant compared to irrelevant items. Concluding, we found first evidence that the chain of mental processes differs between the recognition of crime-relevant information and the correct rejection of irrelevant information. In future studies, processes associated with the concealment of knowledge can be examined: Is information concealment reflected in specific functional EEG microstates?

Effects of practice on Lukacs' (2016) countermeasures (CMs) to the P300-based Complex Trial Protocol (CTP) for detection of concealed information.

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Introduction: The CTP (Rosenfeld et al., 2008) has proven a robust CIT in forensic analogs, with good accuracy and resistance to the CMs typically applied in CITs, which involve subject-generated secret responses to irrelevant stimuli. Meixner & Rosenfeld (2011) also reported the utility of the CTP in anti-terrorist situations in which planned but undone crime specifics are unknown. In this situation, investigators compare the largest with the next largest P300 response, (the "blind I-max test") assuming the former to represent response to the (crime-relevant) probe item, and the latter to represent the response to the most salient irrelevant, the "I-max." Lukacs et al. (2016), while replicating the major findings of the CTP in forensic situations in which the probe is known, developed a CM technique which foiled the I-max test in anti-terror scenarios. This technique appeared to our lab as challenging for the subject and requiring considerable practice, as reported by Lukacs et al.

Methods: Thus in the present study we compared 2 groups, a practice (P) group in which we tried to approximate the practice CM training as in Lukacs et al (2016) vs. a non-practice (NP) group. The concealed information was semantic/autobiographical: the subject's birth date.

Results & Conclusions:At the time of this abstract submission, 13 P and 11 NP subjects have been run. Using the bootstrap method (Rosenfeld et al., 2013) to determine stimulus knowledge, 7 of 13 (54%) P and 11 of 11 (100%) NP subjects were detected as recognizing birth dates. In a Fisher exact test, these proportions are different, $p < .02$. The mean number of significant bootstrap iterations (with probe > irrelevant) in 100 was 96.1 in P subjects with 77.7 in NP subjects, $p < .04$. The mean probe-minus-irrelevant p-p P300 amplitude was 9.8 microvolts in NP subjects, versus 4.8 microvolts in P subjects; $p < .03$.

Symposium C - Olfactory Cognition: a bridge from olfactory perception to clinical practice - Part 2

(Invitto S. – Lecce, Italy; Sartucci F. - Pisa, Italy; Mazzatenta A. – Teramo, Italy)

The smell of wood and its impact on physiological responses

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The smell of wood and its impact on physiological responses

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Introduction

Humans experience woody smells every day, and not only while walking in the forest. Since wood is an important raw material it is commonly used in furniture, building material or products of daily use. Wood odor is generally perceived as natural, pleasant and harmonizing and often associated with a positive impact on health. Moreover, essential oil of various pinaceae trees has been demonstrated to exert relaxing effects indicated by the panelists' electroencephalogram and electrocardiogram signals during the performance of visual exercises. In previous studies we identified the main substances responsible for the odor of cedar and pine wood by using odorant analysis methods. In the current study, we investigated the effects of those wood smells on humans' physiological responses.

Methods

Thymoquinone (pencil-like odor) and α -pinene (woody, resinous odor), as well as the essential oils from cedar and pine were presented to the panelists using a constant airflow olfactometer. The physiological responses were continuously recorded, including skin conductance, heart rate, respiratory parameters and skin temperature. The subjects were further asked to rate perceptual characteristics of the odor stimuli.

Results

Subjective evaluations of pleasantness, intensity, and physiological impact of the odor stimuli were compared to the respective individual physiological responses to them. Furthermore, different methods of evaluating and interpreting physiological responses to wood odors were analyzed. The results will be presented at the conference. Furthermore, the strengths and limitations of the different methodologies will be discussed as well as practical implications of subjective evaluations and physiological responses to wood odors and wood-related odorous volatiles will be given.

Conclusions

The current study advances our understanding of the impact of wood smell and its constituents on humans'

physiological responses. Moreover, it shows the need of a consistent method to evaluate physiological responses to olfactory stimuli.

How to assess clinically olfactory dysfunctions.

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Introduction: Olfactory dysfunction has attracted much attention among researchers in the field of brain aging and is a well-known marker of several age-related neurodegenerative diseases. Consequently a complete and appropriate evaluation of patients plays a role in any diagnostic workup in neurodegenerative disorders. To appreciate types of changes in pathology the olfactory system has to be evaluated in its principal components: threshold, discrimination, identification, associative and short-term memory. Both psychophysiological and instrumental test are now available and many other are developing. Presentation will be focused on how the system is involved in main neurological diseases. The aim is to clarify the meaning of sense of smell alterations and discuss their role; furthermore the most recent acquisition and knowledge in the field.

Methods: In our study, the olfactory function impairment in patients with Idiopathic Parkinson's disease (IPD) and Alzheimer Disease (AD) was assessed by using psychophysical tests. We investigated a sample of IPD patients (n = 11, age range 67-80 y.o.), divided in early stages EPD and advanced APD and a small group of Mild Cognitively Impaired subjects (MCI, n = 9, age range 63-83 y.o.). A complete olfactory function was done by testing its principal components: threshold; discrimination, identification, associative and short-term memory.

Results: We found that olfactory threshold was significantly higher in either IPD and AD subjects respect to healthy population in the same cluster of age; olfactory discrimination was significantly impaired and both associative and short-term olfactory memory were severely compromised in both groups.

Conclusions: Our preliminary results suggest dramatic and specific olfactory impairments in both these diseases. Furthermore, olfactory impairment might represent an early sign of neurodegeneration that could be useful in association with other biomarkers to identify people at risk of developing neurodegenerative disease. We will increase the number of patients involved in the study and follow up them in order to confirm such results.

A meta-analysis on olfactory compensation in blindness

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Some studies suggest that blind people can develop enhanced olfactory sensitivity as a result of sensory compensation. However, despite many hypotheses on the etiology of increased olfactory abilities of the blind people, the behavioral studies provide a mixed pattern of findings. Inconsistent observations are reported for both sensory-driven olfactory tasks (e.g., odor threshold) and higher-order olfactory functions (e.g., odor identification). To address this issue, we conducted a meta-analysis of available studies targeting olfactory function in blind and sighted individuals. We provide a comprehensive examination of studies assessing odor threshold (19 studies), odor discrimination (14 studies), cued odor identification (14 studies), and free odor identification (9 studies) in blind people as compared with sighted controls. Further, we investigated the potentially moderating roles of age and onset of blindness upon the observed differences between blind and sighted controls. We found that compensatory effects in smell function are not straightforward – in comparison to sighted people, pooled samples of blind individuals rather did not exhibit increased olfactory performance. Only a marginal effect was found for odor threshold, and cued identification was higher in sighted than in the blind. However, in the moderator analysis, we observed that early blind individuals performed better than sighted in odor discrimination and free identification, and that the sighted superiority in cued odor identification was observed only in comparison to pooled samples of late-blind, mixed or unspecified groups of visually impaired individuals. The observed pattern of findings suggests that the effect of blindness on olfactory functions depends also on factors other than visual impairment itself. However, the restricted number of studies that control for such factors makes future investigations highly warranted.

Symposium D : Cognitive neuroscience approaches to autism spectrum disorder

(Wiersema JR. - Ghent, Belgium)

Brain activity for spontaneous and explicit mentalizing in adults with autism spectrum disorder: an fMRI study

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Introduction

The socio-communicative difficulties of individuals with autism spectrum disorder (ASD) are hypothesized to be caused by a specific deficit in the ability to represent one's own and others' mental states, referred to as Theory of Mind or mentalizing. However, many individuals with ASD show successful performance on explicit measures of mentalizing, and for this reason, the deficit is thought to be better captured by measures of spontaneous mentalizing. While there is initial behavioural support for this hypothesis, spontaneous mentalizing in ASD has not yet been studied at the neural level. Recent findings indicate involvement of the right temporoparietal junction (rTPJ) in both explicit and spontaneous mentalizing. In the current study, we investigated brain activation during explicit and spontaneous mentalizing in adults with ASD by means of fMRI. Based on our hypothesis of a core mentalizing deficit in ASD, decreased rTPJ activity was expected for both forms of mentalizing.

Methods

A group of 24 adults with ASD and 21 neurotypical controls carried out a spontaneous and an explicit version of the same mentalizing task. They watched videos in which both they themselves and another agent formed a belief about the location of an object (belief formation phase). Only in the explicit task version participants were instructed to report the agent's belief on some trials.

Results

At the behavioural level, no group differences were revealed in either of the task versions. A planned region-of-interest analysis of the rTPJ showed that this region was more active for false- than for true-belief formation, independent of task version, especially when the agent's belief had a positive content (when the agent was expecting the object). This effect of belief was absent in adults with ASD. A whole-brain analysis revealed reduced activation in the anterior middle temporal pole in ASD for false - versus true-belief trials, independent of task version.

Conclusions

Our findings suggest neural differences between adults with ASD and neurotypical controls both during spontaneous and explicit mentalizing, and indicate the rTPJ to be crucially involved in ASD. Moreover, the possible role of the anterior middle temporal pole in disturbed mentalizing in ASD deserves further attention. The finding that these neural differences do not necessarily lead to differential performance warrants further research.

What's in a name? Neural response to hearing one's own and other names in children with and without autism spectrum disorder

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One's own name has a preferential status. It attracts one's attention (e.g., cocktail party effect), is essential in social interaction, is a core element of one's social identity, and is uniquely related to the self and thus to self-other distinction. Lack of response to hearing one's own name is one of the strongest and earliest predictors for developing autism spectrum disorder (ASD). Surprisingly, there is only one study so far that investigated the neural correlates of hearing the own name in persons diagnosed with ASD (Nijhof et al., 2018). This event-related potential (ERP) study showed an enhancement of a parietal positivity for the own name (compared to the name of a close other and an unknown name) in neurotypical adults, and this effect seems to be completely absent in adults with ASD. The lack of preference for the own name could be linked to decreased activation in the right temporo-parietal junction (rTPJ), a brain region that plays a key role in self-other distinction and mentalizing and has been strongly implicated in ASD in earlier research. The aim of the current study was to apply a similar approach in children with ASD. We therefore investigated the neural responses, by means of ERPs, to hearing the own name in children with a formal diagnosis of ASD and neurotypical children between 7 and 13 years old. Atypical processing of the own name in ASD in both childhood and adulthood would suggest that this is related to a fundamental deficit. Preliminary results show indeed a similar pattern as in adults. They indicate reduced neural responses to hearing the own name in individuals with ASD. Further research is warranted to evaluate the ERP response to the own name as a putative neurocognitive biomarker of ASD across the lifespan. The full results will be presented and discussed during the conference.

Nijhof, A., Dhar, M., Goris, J., Brass, M., & Wiersema, R. (2018). Atypical neural responding to hearing one's own name in adults with Autism Spectrum Disorder. *JOURNAL OF ABNORMAL PSYCHOLOGY*, 127(1), 129-138.

The impact of personal relevance on emotional face perception in adults with autism spectrum conditions - a simultaneous EEG-fMRI study

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The ability to recognize emotional facial expressions is an essential component of social communication, and deficits in this area are among the defining symptoms of autism spectrum conditions (ASC). The project investigates the role of personal relevance (faces of relevant others) on the neural processing of emotional faces in ASC and controls. We hypothesize that a) personal relevance boosts activation in the face processing network, b) emotion effects are enhanced for relevant faces, c) in ASC, emotion effects are limited to relevant faces but reduced or absent for strangers. In a first study, we established the paradigm with neurotypical controls and are currently collecting data from an ASC sample, which will also be presented at the conference. In the first study, 22 neurotypical participants viewed photographs of their boyfriend, a male friend, and a stranger displaying fearful, happy, and neutral

expressions while simultaneous EEG-fMRI and pupillometry data was collected. In neurotypical individuals, hemodynamic activity was significantly increased for relevant vs. stranger's faces in the face processing network, including fusiform gyrus, precuneus, and ACC. Relevant faces also elicited enhanced event-related potentials and pupil activations. In a preliminary sample of ASC participants (n=8), we replicated increased activation in ACC and fusiform gyrus for relevant vs. stranger's faces. Our preliminary data show comparable effects of personal relevance in neurotypical and ASC individuals, suggesting that emotional face perception deficits might be attributable to reduced attention to stranger's faces, rather than to dysfunctional emotional face perception per se.

Interaction between pre-stimulus and post-stimulus oscillations differentiates ADHD and ASD

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Oscillatory activity in the brain has been shown to be a key factor in regulating attention. Neural oscillations measured using EEG can index attentional processes both before and after a stimulus appears. Accumulating evidence suggests that activity occurring during the pre-stimulus period is a reliable index of attentional engagement and plays a significant role in modulating post-stimulus behavioural and neurophysiological responses. Attentional impairments have been proposed as a common mechanism for the development of autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD). In this talk, I will introduce concepts underlying pre-stimulus oscillatory activity in relation to attentional processes and present findings that demonstrate differential associations between pre-stimulus alpha, task performance and post-stimulus oscillatory activity and event-related potentials, in a cross-disorder study of children with ASD and ADHD. Alpha (9-12 Hz) power and phase at stimulus onset were measured in the pre-stimulus period, and compared to behavioural responses, amplitude of early event-related potentials (ERPs; P1, N2) and post-stimulus theta (5-8 Hz), derived from EEG sources separated using independent component analysis (ICA). Children with ASD showed increased attentional engagement, or preparation for the upcoming stimulus (greater alpha desynchronisation) compared to children with ADHD. Children with ADHD showed impaired attention and cognitive control (N2 and P3) compared to ASD and TDC. A clear distinction between the disorders was found in the relationship between desynchronisation of pre-stimulus alpha and early ERP components and post-stimulus theta. Alpha desynchronisation was positively correlated with both P1 amplitude and theta synchronisation in ADHD and TDC, but negatively correlated in ASD. That is, in ASD, greater preparation for the upcoming stimulus unexpectedly resulted in poorer attentional processing post-stimulus. These findings may explain inconsistent attention deficits reported in previous studies in ASD and demonstrate the importance of objective brain measures in distinguishing pathophysiological mechanisms between ADHD and ASD.

Altered neural sensitivity to faces and dynamic gaze in 8-month-old infants with later autism spectrum disorder

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Introduction: Accumulating evidence from studies of infant siblings of children diagnosed with autism spectrum disorder (ASD) suggest core cognitive and neural characteristics of emerging ASD that are apparent early in development. Investigating the consistency of these findings is critical in order to test their clinical and scientific utility. This study aimed to reproduce previously reported atypical cortical responses to face and gaze processing in a large cohort of infant siblings.

Methods: In a prospective longitudinal design, we measured event-related potentials (ERPs) to visual noise and faces with static gaze and dynamic gaze shifts in 8-month-old infants with (n=166) and without (n=75) familial risk for ASD, and investigated the association with ASD outcome at 36 months.

Results: Longitudinal analyses indicated that infant siblings with later ASD at 36 months showed (i) greater P400 amplitude and longer P1 and P400 latency to gaze shifting towards versus away from the infant and (ii) longer N290 latency to visual noise versus faces. Increased P400 amplitude and longer P400 latency to gaze shifting towards versus away were associated with increased autism symptom scores across the whole sample.

Conclusions: These findings extend previous work to suggest robust neurophysiological differences early in development that define later ASD outcomes. Identification of sensitive and objective brain-based predictors may help to target more specific therapeutic strategies to infants at high-risk for ASD.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18001/add_1_437307_dbf69781-4942-47ed-b4f2-4e9e7172176e.png

Friday, September 7th, 2018

Early Morning Session: 08.30 – 10.00 a.m.

Symposium A : Cutting Edges of Basar's Work on Oscillatory Dynamics

(Karakas S. – Istanbul, Turkey; Basar-Eroglu C. – Bremen, Germany)

UNDERSTANDING BASAR'S THEORY ON BRAIN-BODY-MIND OSCILLATIONS

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Erol Başar was one of the pioneers of EEG-Brain Dynamics theory, and he proposed his theory in 1980 in a book named "EEG-Brain Dynamics" which is known as a milestone in EEG research. Başar's work on Event Related Oscillations included the studies performed in the cat brain and the human brain; he had even studies performed in the Helix Pomatia ganglion. However, before his longstanding research on EEG-Brain Dynamics, he also performed studies on the dynamics of vasculature and circulation. Between 2006-2011 his research focused on the understanding of oscillations in body and mind. Therefore he published articles and as well as a book named "Brain-Body-Mind in the Nebulous Cartesian System: A Holistic Approach by Oscillations." He proposed that a fundamental analytical approach to brain-body-mind problem require more than the prerequisite of conventional psychophysiology and neuroscience. Furthermore, Başar proposed that in the analysis of Brain-Body-Mind construct, it is important to understand the uncertain causalities and consequently "multiple uncertain causalities". These multiple causalities are originated from (1) Nonlinear properties of the vegetative system (irregularities in biochemical transmitters, cardiac output, turbulence in the vascular system, respiratory apnea, nonlinear oscillatory interactions in peristalsis); (2) Nonlinear behavior of the neuronal electricity (for example chaotic behavior of EEG), (3) Genetically modulations and (4) Additional to these physiological entities, one should also consider the nonlinear proprieties of physical processes in the body.

According to these facts, Başar confronted a hyper- probabilistic approach or to <i>Hyper- probabilistic</i> <i>Cartesian System</i> to describe and analyze the processes in the brain-body system. In this symposium talk Başar's view on the understanding of Brain-Body –Mind oscillations will be presented with new data in the literature supporting his theory

Key Words: EEG, Brain Oscillations, Body Oscillations, Brain Models and Theories

An Alternative Solution to Functional Neuroanatomy: The CLAIR Atlas.

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At the beginning of the 20th century, Brodmann introduced a system of functional brain mapping. This system is currently used not only in applied sciences but also basic research. The system is based on static structures that are delineated according to their cytoarchitectural properties. The Brodmann areas (BA) are responsible from cognitive-affective functions, but the effect of associated areas are overlooked. E. Başar criticized the Brodmann system on several grounds: (1) The structural conceptualization in BA is against the contemporary consensus according to which cognitive-affective functions are produced within a selectively distributed parallel processing (SDPP) system. (2) The specified functional correlates are merely cognitive-affective in nature. The BA system does not account for the neural operations that are responsible from these behavioral functions. Based on pioneering work and decades of systematic study, Başar had concluded that the real responses of the brain are the oscillations, where the neural codes are the frequencies (pass letters), and the associations between these frequencies (pass words). Sensory-cognitive processing is represented by unique oscillatory patterns that vary in oscillation-related parameters such as amplitude, latency, and duration. (3) However, SDPP should work within a mesh of connectivities, the complexity of which increase with increasing cognitive load. According to Başar, SDPP, which forms the basis of his concept of "whole brain work", dictates that the connectivities and coherences are among the most important parameters in oscillatory behavior, and should be the basis of models on brain mapping. (4) In his last 2-3 years, Başar had been working on a new approach to brain mapping: The CLAIR (an acronym from connectivities, linkage, association, integration, response). CLAIR would be maps of (a) temporal coherences that emanate from the superposition of oscillations, and (b) spatial coherences that occur between distant areas. CLAIR Atlas would thus include maps of temporospatial coherences which represent cognitive-affective processes. The test of CLAIR on Alzheimer's disease and bipolar disorder showed that coherences and connectivities have a strong potential for serving as biomarkers. Başar had outlined future studies on the CLAIR model as; the coherency mapping of cognitive-affective processing using multi-electrode recordings, adding phase-locking to the time scale, designing the illustrations according to geographical maps and to 3D, and developing the model to include not only modules of different sizes and extensions but also dynamically changing scenes. Several years were predicted by Başar for attaining a fully functioning CLAIR Atlas.

Clinical Applications in Alzheimer's Disease

G Yener

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Alzheimer's disease (AD) is the most common cause of dementia. Amnesic mild cognitive impairment (MCI) is considered as pre-dementia state in AD in majority of cases. With the increasing rates of aging population, prevention and recognition of AD/MCI are gaining importance. Our group has studied the use of EEG-brain

oscillatory responses as a candidate electrophysiological biomarker of AD/MCI. It was found that delta responses show a continuum across the groups of age-matched healthy controls (HC), MCI and AD with decreasing values toward dementia. Beta responses is decreased in MCI while gamma responses increase in AD with a late appearance. The coherence values indicate decreased connectivity in AD in alpha, theta and delta responses. On the other hand, simple visual sensory responses indicate increased excitability or decreased inhibition over occipital regions in AD patients. Frontal delta responses are related to frontal volume in MCI. The recovery of theta phase-locking is observed with cholinergic drugs. These findings indicate that EEG brain oscillatory responses are important to investigate the brain dynamics in AD/MCI, and they may be helpful in diagnosis and follow-up in future studies.

Brain oscillatory activity in bipolar disorder across different illness states

AO OZERDEM

DOKUZ EYLUL UNIVERSITY, IZMIR, Turkey

Bipolar disorder is a chronic, severe and often debilitating brain illness which is associated with significant cognitive deficits in a number of domains including executive functions, processing speed, attention, memory and social cognition as well as neuroanatomical abnormalities containing neural circuits that regulate cognitive processing. The course of illness is characterized by episodes of mania and depression and well being states (euthymia) between the episodes. Biomarkers for early diagnosis as well as for predicting treatment response are crucial for improving quality of life and longevity in patients suffering from bipolar disorder.

Our group focused on oscillatory brain dynamics in bipolar disorder both in euthymic and manic states of illness, with and without medication. Spontaneous, and event related oscillatory activity in the theta, alpha, beta, and gamma frequency ranges as well as long distance coherence in the gamma frequency range were assessed in patients in comparison to healthy controls. In drug free patients, during both mania and euthymia, spontaneous and event related alpha activity, event related theta activity and long distance gamma coherence were significantly reduced as opposed to beta range activity which was significantly increased both in mania and euthymia before treatment. Treatment with mood stabilizers seem to cause alterations in oscillatory responses compared to unmedicated state.

The findings will be discussed with regard to the corresponding cognitive functioning for the assessed oscillatory activity in different frequency ranges as well as location of the alterations in the oscillatory activity. A proposal for a constellation of oscillatory biomarkers for bipolar disorder will be brought to the attention of the audience.

Symposium B: How physiological measures inform us about psychiatric and neurological symptoms

(Ottaviani C. – Rome, Italy; Lombardo C. Rome, Italy)

Heart rate variability as a mediator of the longitudinal association between rumination and depressive symptoms

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Over the past two decades, the role of ruminative thought processes in the development, persistence and recurrence of depressed mood has clearly emerged. At a physiological level, a series of studies have associated rumination with a reduced variability in the periods between consecutive heart beats (heart rate variability; HRV), a measure of the dynamic interplay between parasympathetic (vagal) and sympathetic influences on sinoatrial node activity. The objective of this longitudinal study was to evaluate the interplay between rumination (scores on the Ruminative Response Scale), depressive symptoms (scores on the Center for Epidemiological Studies Depression Scale), and HRV in twenty-two women and twenty men at three assessment points (Time 0, 1 and 2). Vagally-mediated HRV was assessed in a laboratory session (Time 0) and in two ambulatory sessions at Time 1 and Time 2 (~ 13 and 34 months after Time 0, respectively). Resting HRV was negatively correlated with both rumination and depressive symptoms. Notably, HRV at Time 1 mediated the relationship between rumination at Time 0 and depressive symptoms at Time 2. Results suggest that autonomic dysfunction, specifically low vagal tone, may be prospectively implicated in the generation of depressive symptoms in a non-clinical setting. Hence, improvement of vagal modulation might potentially have important future application for the prevention and treatment of depression.

Eye-gaze disengagement from emotional faces predicts depressive symptoms via ruminative brooding: A five-month longitudinal study with two eye-tracking assessments

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Background: Ruminative brooding is a maladaptive form of emotion regulation linking adverse events to increases in depressive symptom. Current cognitive frameworks highlight attentional disengagement processes as a main mechanism involved in the emergence and maintenance of this maladaptive ruminative response. Yet, longitudinal research testing prospective associations between attentional disengagement processes, brooding, and depressive symptoms is lacking.

Methods: The present study tested these prospective predictions, relying on eye-tracking to assess and monitor processes of attentional disengagement from emotional faces (i.e., time to move gaze away from either positive or negative faces when prompted to fixate in a different face). A sample of undergraduates (n=89) completed measures of depression, ruminative brooding as well as the attention disengagement eye-tracking task at baseline assessment (beginning of the semester) and five months later (immediately after a stressful period: examination period).

Results: Our analyses supported a moderated mediation model where longer gaze disengagement from positive faces at baseline (predictor) was predictive of brooding decreases in the follow-up (mediator), indirectly predicting depression decreases (outcome) via changes in brooding, for individuals encountering more adverse events (moderator): moderated mediation effect= -0.86 (SE= 0.67), 95%-CI: [-2.9169, -0.0002]. Furthermore, analyses also supported a moderation model where higher habitual brooding at baseline (predictor) was predictive of increases in gaze disengagement from negative faces at follow-up (outcome) for individuals encountering more adverse events (moderator): $\Delta R^2 = 16.7\%$, $\Delta F = 12.87$, $p = 0.002$.

Conclusions: Our findings support bidirectional influences between attentional disengagement and brooding and highlight protective attention patterns with implications for the development of efficient strategies of depression prevention.

Keywords: Visual-spatial attention; emotion processing; rumination; depression; longitudinal research; eye-tracking

Heart rate variability predicts therapy outcome in anxiety disorders

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Psychotherapy has been shown to be useful for the treatment of a wide range of disorders. However, there are individual differences in the extent to which these interventions are effective in reducing symptoms and maintaining those reductions. The factors associated with successful therapy outcomes are an important topic of investigation as these factors might influence the nature of the interventions as well as enhance our understanding of the process associated with the disorder and its treatment. In the present study we sought to investigate the effect of pre-treatment heart rate variability (HRV) on return of fear following exposure therapy in social phobics. Forty adult participants (60% female) diagnosed with Social Anxiety Disorder were assigned to a single massed exposure therapy session. Self-report, behavioral and physiological responses were recorded pre-treatment, immediately following treatment, and at one month follow-up. Pre-treatment HRV was positively associated with less return of fear as indexed by lower subjective distress and heart rate at one month follow-up (all p 's < 0.05). We have previously shown that heart rate variability (HRV) before treatment is associated with treatment drop out and residual symptoms after treatment such that higher HRV at baseline is associated with better treatment outcomes (Wendt et al 2018). Taken together these results support models of exposure therapy that emphasize the importance of inhibitory learning in extinction and are consistent with research linking HRV to inhibition.

Exploiting HRV measures for clinical evaluation of depressive symptomatology

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, Italy

We will present a possible use of HRV metrics to evaluate depressive symptoms in two clinical frameworks. In the first study 31 patients admitted to cardiac rehabilitation were recruited. We used HRV features in time, frequency, and nonlinear domains extracted from 5-min-ECG recordings at rest as predictors of "least absolute shrinkage and selection" (LASSO) operator regression model to estimate patients' CES-D score and to predict depressive state. The model significantly predicted the CES-D score with an explained variance of 89.93%. Using a score of 16 at CES-D as a cut off to differentiate depressed and non-depressed patients the algorithm discriminated the groups with 86.75% accuracy.

In a second experiment we used a similar approach on dysphoric individuals as compared to non-dysphoric. As widely accepted in literature we considered dysphoric individuals who scored at least 12 on the Beck Depression Inventory (BDI-II) and had two to four depressive symptoms for at least two weeks. We recruited 24 dysphoric individuals and 36 controls and measure their HRV from a 5-min-ECG recorded at rest.

A supported vector machine was used to automatically discerning dysphoria patients from controls on the bases of HRV metrics. The algorithms achieved an accuracy of 79.17.

Interestingly, the most informative metrics were non-linear HRV-metrics, with dysphoric patients having, unexpectedly higher values than controls. In line with some pieces of literature we hypothesized that this type of condition is a autonomous psychopathological entity and not just a blunted form of depression.

To summarize these studies suggest a possible exploitation of the use of ECG and HRV measurements in clinical practice as a screening tool for psychopathology in general and in at risk populations.

Autonomic modulation and epileptic seizures: Biofeedback therapy for epilepsy

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Nagai and her colleagues introduced method of biofeedback to modulate sympathetic activity (Galvanic Skin Response: GSR) reduces epileptic seizures in patients with drug resistant epilepsy. This method was established based on a series of neuroscientific studies characterizing an inverse relationship between electroencephalographic (EEG) indices of cortical neural excitability (slow cortical potentials) and peripheral sympathetic arousal (indexed by GSR activity). An increase in sympathetic activity reduces cortical excitation. The first randomized controlled trial demonstrated a robust positive effect that 60% of patients in the active biofeedback therapy group experienced seizure reduction of more than 50%. The group also identified that ventromedial prefrontal cortex (VMPFC) activity is inversely correlated to the tonic level of GSR suggesting that this part of the brain is an important hub for modulation of sympathetic activity.

In the current study, we conducted a wider clinical trial with 40 patients with drug resistant temporal lobe epilepsy (N= 20 Therapy group, N = 20 Control). Neuroimaging (fMRI) was conducted to explore neural network changes before and after GSR biofeedback intervention. There was a significant difference in reduction of seizure frequency between the therapy and control groups ($p < 0.001$). A month of biofeedback training, elicited a significant reduction in the patients' seizure frequency ($p < 0.001$), with average seizure reduction of 43% and response rate of 45%. Neuroimaging analysis revealed that post-therapy seizure reduction was linearly correlated with enhanced functional connectivity between amygdala and the orbitofrontal cortex (OFC).

Our combined clinical trial and neuroimaging study demonstrates the potential of biofeedback therapy (termed as Autonomic Cognitive Rehabilitation Training:ACRT) as an effective technology-driven therapy that can be widely offered for patients with drug resistant epilepsy in the near future.

Symposium C: Psychophysiological contributions for synergy-based and biologically-inspired rehabilitation and prostheses

(Leo A. – Lucca, Italy)

Decoding imagined upper limb movements using spectral features from high-density EEG

G. Valenza

University of Pisa, Italy, Italy

This talk will present recent findings on brain dynamics during motor imagery tasks of upper limb involving different kinds of interaction with an object. Specifically, spectral correlates of high-density electroencephalographic (EEG) oscillations are exploited to discern between transitive (actions involving an object), intransitive (meaningful gestures that do not include the use of objects), and tool-mediated (actions using an object to interact with another one). Findings related to EEG complexity changes throughout these categories will be presented as well. We show the significance of EEG gamma (30-45Hz) oscillations over the fronto-occipital and ipsilateral-parietal areas in discerning between transitive-intransitive imaginary upper limb movements, allowing a recognition accuracy at a group-wise level of 70.97% (from nonlinear support vector machine algorithms endowed with a recursive feature elimination procedure). We also show how EEG complexity level during motor imagery tasks of the upper limb are strongly biased by the presence of an object, as minor topographical changes between EEG complexity metrics are associated with transitive and tool-mediated tasks, whereas major significant differences are between the intransitive actions vs. the others.

Prosthetic Hands for the real World: Soft Robotics Technologies to Enable Robustness and Interaction

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, Italy

In this talk, we will discuss how the technologies of soft robotics, i.e. the artificial implementation of the principles of impedance adaptation in natural motion control and its role in embodying intelligent manipulation and grasping behaviors, can be used to translate lessons from neuroscience and human motor control into a practically viable hand prosthesis. Today, most prostheses in real use are either merely aesthetic, or extremely simple, while robotics-enabled prostheses are still too costly, fragile, and unintuitive to be widely used. To try to increase users' acceptance, in this talk we report on the modeling and technological implementation that led to the SoftHand Pro, an anthropomorphic soft hand prosthesis endowed with one degree of actuation and inspired by the neuroscientific model of soft-synergies for grasping. Thanks to hand adaptability, the users can perform most of activities of daily-living still maintaining an extreme control simplicity. Moreover, the intrinsic softness and robustness embedded in the design of the hand, allow for a natural deformation of the fingers, enabling effective interactions with the world surrounding, people and the user own body. In the talk we will report data and results related to the real use of the device, together with results coming from clinical evaluations, collected during ongoing clinical trials, performed in collaboration with several clinical partners. Finally we will also show preliminary results about novel solutions on the sensing, actuation and haptic feedback delivery that are capable to enrich the behaviour of the SoftHand Pro, still

maintaining its intrinsic mechanical simplicity and easiness of use. Perspectives and future directions will be finally discussed.

The Robotic Sixth Finger: design of an EMG-controlled device for hemiparetic upper limbs

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The talk will present design, analysis and experimental and clinical evaluation of a prototype of robotic extra finger that can be used as grasp compensatory devices for hemiparetic upper limb. The device's design is the result of experimental sessions with chronic stroke patients and consultations with clinical experts. The principle of work of the robotic extra finger consists in opposing to the paretic hand/wrist so to restrain the motion of an object. It can be used by chronic stroke patients to compensate for grasping in several Activities of Daily Living (ADL) with a particular focus on bimanual tasks. The robotic extra finger is designed to be extremely portable and wearable. It can be wrapped as bracelets when not being used, to further reduce the encumbrance. The device is intrinsically-compliant and driven by a single motor through a tendon system. The motion of the robotic device can be controlled using an Electromyography (EMG) based interface embedded in a cap. The interface allows the user to control the device motion by contracting the frontalis muscle. The performance characteristics of the devices have been measured through experimental set up and the shape adaptability has been confirmed by grasping various objects with different shapes. We tested the devices through qualitative experiments based on ADL involving five chronic stroke patients. The prototypes successfully enabled the patients to complete various bi-manual tasks. Results show that the proposed robotic devices improve the autonomy of patients in ADL and allow them to complete tasks which were previously impossible to perform.

Symposium D - Psychophysiology of posture control: part 1) the neurophysiological underpinnings of individual differences in the ability to maintain balance

(Bazanova O. – Novosibirsk, Russia)

Postural control ability and autonomic and central nervous system parameters in healthy volunteers

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²V.I. Vernadsky Crimean Federal University, Simferopol, Russian Federation

The aim of the study was to reveal associations between postural control characteristics and some physiological parameters in trained and untrained adults. 36 young healthy adults 18-25 years old with different balance training experience participated in our study. The 1st group – 13 untrained students, 2nd group – 12 moderately trained young actors, 3rd group – 11 well trained amateur athletes. Stabilometric measurements (Romberg test) were performed on stabilometric platform and calculated with STPL software (Biomer, Russia). In addition to the traditional stabilometric parameters (surface area (S), velocity (V) and length (L) of center of pressure fluctuations), we used an index of mechanical energy (A), which is quantified as energy, spent by patient's center of pressure in the plane of stabilometric platform, dependent on the mass and stated in Joules (Grohovskiy S.S., Kubryak O.V., 2011). Autonomic characteristics (breathing frequency and amplitude, and heart rate variability, HRV) and EEG were recorded at rest conditions. Nonparametric statistics were applied for data analysis.

For the whole sample significant nonlinear correlations were found between index of mechanical energy (A) and alpha-band width (+0.39 in eyes open and +0.37 in eyes closed), breathing amplitude (+0.61 in eyes open and +0.48 in eyes closed). Surface area and velocity are closely connected to the heart rate variability: bad balance control assumes high VLF, low HF-component of HRV spectral power and high LF/HF ratio. Associations with HRV parameters mean high sympathetic activation and stress. In the 1st (students) group only one negative significant correlation was found between surface area in eyes closed condition with heart rate (-0.63). In the 2nd (actors) group significant correlations of stabilometric parameters were revealed with arousal reaction (alpha power depression in response to opening the eyes): the more activation amplitude the better balance control (lower A index). It was also found some significant correlations with autonomic parameters (HRV characteristics and abdominal amplitude). In the 3rd (athletes) group we found only one significant correlation coefficient of stabilometric parameters with alpha-band characteristics: low surface area in eyes closed conditions (good balance control) had those athletes, who had high individual alpha peak frequency (IAPF). The other significant correlations were with HRV parameters, almost the same as for the whole sample.

These results allow us to suggest that different level of fitness and education specialization can lead to the fact that the same task (postural or balance control) involve different brain and body systems in organism.

Relationships between postural control mechanism during dynamic balance test with and without cognitive supplementary tasks among young boys and athletes.

P.R. Pozzo

Introduction The ability of the nervous system to detect joint positions, movement directions and force applications is mainly processed by sensory afferents. Thus human posture and motion are controlled by a complex interaction of centrally and peripherally neuronal networks. Proprioception is a basic information source for the control of body movements basically in the context of balance regulation. Both components, balance control and joint stabilization, already interact in simple tasks like the upright stance. During balance test under dynamic condition, i.e. tilting support surface, anticipatory or reactive strategies could be influenced by the simultaneous cognitive task to be completed.

.The aim of this study was to analyse the level of postural control in dynamic balance tests, under normal visual conditions with and without a supplementary cognitive task consisting in counting a list of numbers.

MethodsThe reference population comprised 125 healthy boys aged 15 to 19 years, as well 8 high level ski-jumpers. The conditions to be included in the experimental population were: BMI less than 22 kg/m², no back pain, no specific sport specific training adaptations. A tilting computerized plate for upright dynamic balance analysis (Delos) was used. Subjects had to maintain the horizontal level of the plate as long as possible for 20s. Referring to the absolute horizontal position of the supporting plane average error and tilting velocity of the rotation axis were calculated.

Different task conditions were tested: open and closed eyes (OE, CE), bipedal and single leg standing position (BP, MP) in the sagittal and frontal planes (SAG, FRO). In the FRO testing subjects were required to perform the equilibrium task once under normal condition (OE) and subsequently to repeat the performance while counting loud the numbers from 20 to 1 (CON), thus having a supplementary task to be realised. Video sequences were collected for qualitative and kinematic late analysis.

ResultsFor all the young subjects we observed a polynomial relationship between the tilting velocity with and without the supplementary counting task .The supplementary CON task seems to have different influence in the ability to maintain the equilibrium according to aging groups for the young subjects. In the groups aged between 15-16 years greater tilting velocity was observed during the CON tasks compared to the test without CON. Other behaviour was observed in the group of ski-jumpers.

Posture influences on the musical performance fluency

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Background

Recently we had shown that success in music performance is associated with enhancement of alpha brain power and simultaneous decreasing redundant muscle tension. Moreover, it was established that self-regulation strategy "to put support on the forefeet" increases the efficiency of alpha-EEG/EMG neurofeedback training directed to improving musical performance. In the present study, we want to specifically focus on the benefits that posture control might exert on musical performance

Methods

Fluency in timed motor finger task performance and self-rating of musical performance in sitting and standing positions were assessed in twelve non-musicians, twenty-two musical students, and in nine expert musicians. Simultaneous monitoring of the EEG and forehead EMG was provided in three experimental tasks: (1) rest (R), (2) motor task (MT) and (3) imagined motor task (IT) performance in eyes closed (EC) and eyes open (EO). The neurophysiological efficiency of the motor and ideomotor performance was calculated as a change (ln%) of the upper alpha EEG /EMG power ratio in comparison with rest condition.

Results

The MANOVA with factors of GROUP (3) × POSTURE (2) × TASK (2) revealed significant groups difference in fluency of MT and IT performance. Fluency of MT and Self-esteems of music performance in sitting was lower than in standing position in all participants. Fluency of IT was lower than of the MT in non-musicians and students groups ($p \leq 0.02$), but higher in expert musicians ($p \leq 0.001$). The neurophysiological efficiency of MT and IT performance enhanced when participants went stand up.

Conclusion.

These findings are particularly interesting as they might indicate that quality in musical performance can potentially be improved by posture-related continuous engagement in complex motor activity as is required for instrumental practice in musicians

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18001/add_1_435072_d5d5394a-0998-44b2-9f0f-528e61fc304b.png

Caption 1: Motor task (MT) and imaginary motor task (IT) fluency scores (Mean, SE) of non-musicians, musical students, and expert musicians groups.

Early Afternoon Session: 1.30 – 3.30 p.m.

Symposium A: Behaviorally-committed representation of the world in the primate brain: objects agents and space

(Cattaneo L. – Verona, Italy)

Pragmatic and social processing of objects in the monkey parieto-frontal motor system.

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Introduction. Brain processing of objects around us involves visual areas as well as the parieto-frontal motor system, which extracts from the object's sensory description the various motor possibilities that an observer has to interact with it. However, in everyday life, the same sensory description of an object may be provided to the observer in a multiplicity of contextual situations: for example, the object may be targeted by one's own or another's action, it may be presented near or far from the observer, or it can be unreachable because of an interposed physical barrier. Here we asked how these factors affect object processing in areas AIP, F6 and F5.

Methods. We recorded single neuron activity with chronically implanted multielectrode probe from AIP, F6 and F5 of three monkeys during the presentation of different types of graspable objects, within a go/no-go task in which either the monkey or another agent had to grasp or refrain from grasping the object, depending on a contextual auditory cue. Furthermore, we also used a transparent physical barrier to make the object unreachable despite the same sensory information available during go trials.

Results We found that all these nodes play a key role in the pragmatic encoding of object features, switching from dynamic representations in AIP and F6 (which encode object-related visual and preparatory signals, respectively) to more static, goal-based representations of potential grasping acts in F5. We also found that the presence of another agent who is expected to act on the object can modulate the observer's motor representation of the object as if the object was a target for his/her own action, but only when it is in a shared peripersonal space allowing for potential social interaction.

Conclusions These findings highlight the relevance of contextual and social information, which integrates in a dynamic and complex manner along parieto-premotor nodes of the extended grasping network allowing the emergence of agent-based representations of self and others' action.

Mapping spatial and effector-representations in the human premotor cortex.

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Introduction. Behaviorally-committed representation of space is a poorly understood neural function. Three distinct dimensions are reciprocally entangled in situations of daily life: 1) the sensory representation of the target, 2) the spatial endpoint of the movement, 3) the side of the active effector and 4) the effector type. The aim of the present work is to map systematically the role of the entire premotor cortex in producing components 1), 3) and 4) of spatially-oriented behavior, using transcranial magnetic stimulation (TMS).

Methods. I used event-related TMS applied to single spots of a dense grid over the whole left premotor cortex. Participants were engaged in a sensorimotor task similar to the well-known Simon task. A color cue presented on the right or left side prompted right or left responses performed with either the upper or the lower limbs.

Results. We showed that the hand and foot effectors had spatially separate representations. Contralateral stimulus and effector representations were independent but spatially overlapping in a region in the mid-anterior portion of the dorsal premotor cortex. Congruent or incongruent integration of the sides of stimulus and effector had a fragmented representation depended on the actual side of the stimulus and effector.

Conclusions. The premotor cortex is somatotopically organized. Contralateral sensory and motor information are represented in neural systems that have a well-separated cortical topography from ipsilateral sensory and motor information.

Motor processes in a multi-agent environment.

A. D'Ausilio, P. Cardellicchio, E. Dolfini, P. Hilt
University of Ferrara, Ferrara, Italy

Joint action (JA) requires fast behavioral adaptations and online movement corrections. Others' errors must be monitored to allow effective behavioral coordination. We propose that the action observation brain network (AON) may support the detection of other's errors to online update movement planning and/or to implement an effective corrective action. Although different studies suggest that inappropriate actions may rapidly be inhibited during execution, little is known about the modulation of the AON when an action misstep is shown. Recent data from our group suggest that motor cortical inhibition may be the neurophysiological marker of other's error detection as well as the mechanism by which action execution is modulated by the contextual cues provided by other's action. Elucidating the neural mechanism responsible for other's error encoding and use in JA may provide a better understanding of how smooth behavioral coordination is achieved and how these errors may be exploited in observational learning.

Symposium B: Event-Related Frontal Brain Activation Imaging and Evoked Potentials

(Collura T. - Bedford, OH, USA)

Physiology and methodology for event-related frontal gamma brain activation imaging

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Electroencephalographic (EEG) electromagnetic tomographic analysis (ETA) imaging techniques provide a mechanism for exploring decisions, while the individual is directly engaged in choice making, thus exposing precognitive emotional responses to identified beliefs, thoughts, feelings, and actions. This presentation discusses frontal EEG gamma band activity research, at the precognitive level and its use for describing approach-avoidance decision making. Gamma is the primary focus of measurements as it provides an immediate emotional response to a stimulus, even before a conscious thought has formed. Our approach process provides the intensity of a person's emotional response to a stimulus by measuring voxel activation and also provides emotional directionality by differentiating approach/withdrawal responses within the prefrontal cortex. While agreement between the self-report and the scanned gamma activation can form confirmation, additional insights are revealed when the two data basis do not agree. By examining precognitive gamma asymmetry, we can expose the thought process, especially the role of emotions. While most of the time our initial brain activity aligns with our written response, internal conflict can be exposed when our stated response and the brain imaging do not align. In addition, emotional triggers are very personal and differ in directionality and intensity from person to person.

Gamma Activation Asymmetry in Emotions and Decision-making

RJB Bonnstetter

Target Training International, Scottsdale, United States of America

This presentation offers insights into how humans respond to stimuli, with a focus on personal emotional triggers; thus, exposing underlying precognitive beliefs and related emotions that ultimately influence behaviors and decisions. We will describe the protocols used to generate these modified-event-related-potentials, with a focus on gamma asymmetry in both the temporal and frontal lobes. Administering these protocols in real world contexts, such as during coaching sessions, job interviews, and even in psychotherapeutic milieus (given proper ethical constraints), are promising areas for additional study and promise to impact and potentially expose hidden decision-making mechanisms of the preconscious mind. Special attention will be given to triangulation of data related to the validation of personal attribute surveys instruments and the role of precognitive avoidance asymmetry in decision-making.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18001/add_453876_6ebbf38-d672-4aca-943f-e3e413253f05.png

Picture 2: https://www.eventure-online.com/parthen-uploads/175/18001/add_1_453876_6ebbf38-d672-4aca-943f-e3e413253f05.png

Event Related Brain Activation in Experiments, Analysis and Neurofeedback

T. Feiner

BCIA BCN Direktor of the Institute for EEG-Neurofeedback, Italy

It is well known that pathologies show certain brain regions with either increased or decreased activity. For example, typical depression has an increased activation in the insula according to fMRI studies. If we show negative pictures to a person, there are specific locations in the brain that are activated as a consequence of those stimuli (Canli et al., 2002). The same concept works with standardized low-resolution brain electromagnetic tomography (sLORETA) which incorporates a mathematical inverse solution of surface EEG data to provide cortical source localization, and generating three-dimensional images, similar to those produced by fMRI data (Thatcher, 2013). It is a The negative brain activation to a stimulus often causes problems for example with patients suffering from depression and anxiety. Based on those findings we have created first sLORETA Neurofeedback-Protocol that works with the negative stimulus itself by using precisely time locked operant feedback and neurotherapy which is directly related to the given stimulus and the brain response.

Symposium C: Multidisciplinary studies of reading in adults and children from normal and clinical population

(Kornev A. – Saint Petersburg, Russia; Grigorenko E. – TX, USA; Shemyakina N. – Saint Petersburg, Russia)

ERP data on reading words and sentences in typically developing children of different ages (9-10 and 12-13 years old)

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There are many evidences that the brain base for the reading text processing has multilevel organization. It seems reasonable to expect that functional brain networks for the word decoding and for the sentence processing have

different time of development. In the ERP studies the role of the N400 and P600 components relevant to the sentence processing and the word decoding is still argued. The higher N400 amplitude reported in complicated signals detecting (metaphor compared to trivial words, Van Petten, Luka, 2012; incongruent end of sentence compared to congruent, Kutas, M., Federmeier, K., 2000), the formation of lexicality effect on N400 (https://www.ncbi.nlm.nih.gov/pubmed/?term=Tzeng%20YL%5BAuthor%5D&cauthor=true&cauthor_uid=28424638 et al., 2017), is discussed. The aim of the study was to evaluate the age-related features of the ERP's in a word reading and a sentence processing activity. Eighteen young (9-10 years old) and twelve elder adolescents (12-13 years old) were EEG registered in two categorization task paradigms 1) reading and categorizing the meaningful/nonsense sentences, presented in two steps – first, the contextual part of a sentence and second, the last, key word; 2) the reading and memorizing sequentially presented two different words followed by the same/different word. The comparison of the ERPs related to the last word reading in meaningful and nonsense sentences in elder group revealed the significant difference of P600 waves (respectively 620-670 ms and 672-708 ms) in frontal area and no significant distinctions in younger group. The between-group comparison has shown the largest N400 wave latency with the lowest amplitude in the old age group both in the word reading and in the sentence reading tasks. In the meaningful sentences processing the between- group difference was significant in the frontal areas (Fp2, F3, F4, Fz). In the words pairs reading task the age related distinction was significant in the case of the second identical word reading in T4 and in the case of second different word reading in F3, C3, P3, Pz, T6, O1. Our results should be discussed from the perspective of the words and sentences reading proficiency growing in the age range of 9-14 years. The less N400 amplitude in the elder participants could be related to the fewer resources consuming of the sentences and words processing. It could be explained by the development of the more specialized reading-related brain networks enable the parallel mode of the text processing.

The project was supported by RFBR grant No18-013-01082, <https://kias.rfbr.ru/index.php>, FASO AAAA-A18-118012290373-7.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18001/add_1_444473_e535dc2e-fa0e-4e17-b704-7ae5c3047728.gif

Caption 1: The ERPs difference between 9-10 and 12-13 years old children during single word reading.

The strategic reading brain development: An eye-tracking study of the text reading in typically-developing and dyslexic children

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Introduction

In a vast number of dyslexia studies, a decoding incapability related to the phonological weakness has been discussed as the core deficit in dyslexia. At the same time, we still lack a knowledge about a development of the text processing strategies in dyslexics. Both typically-developing (TD) and dyslexic children (DY) must develop some strategies for text processing. Some of DYs struggle both in a word decoding and in a processing of a sentence and a whole text. Thus, the aim of the current study was to evaluate the written text processing strategies in the DYs and the TD peers by means of the eye-tracking method.

Methodology

The subjects of the study were 9-11- and 12-14-years age (Grade 3 and 6, respectively) TD and DY children with normal nonverbal intelligence (in the DYs, the mean reading score was ≥ 1.5 SD below the age-related standards). During the offline experiment, the speed of the printed text reading was measured; additionally, a comprehension score was estimated according to results of answering the comprehension questions. During the online experiment, two scientific-expository were presented to the subjects for a self-paced reading from a PC screen, and the eye gaze movements were registered by the eye tracker SMI RED500. Measures analyzed in the eye-tracking experiment included: the mean duration of fixations, the mean number of fixations per word, the mean number of progressive and regressive saccades per word, and the mean amplitude of progressive and regressive saccades. All the data was submitted for the ANOVA analysis.

Results

A comparative analysis between the groups in the offline settings evidenced, as it was expected, the significantly slower reading in the DYs both in Grade 3 and 6; however, a difference in the text comprehension was significant only in the Grade 3.

The online experiment highlighted significant distinctions between the groups in all the measures both in Grade 3 and 6. Also, a correlational analysis between the mean duration of fixations and the mean amplitude of progressive saccades significantly differentiated the TDs and DY; namely, $r = -0.72$ ($P < 0.000$) in the TDs and $r = 0.71$ ($P < 0.000$) in the DYs. The regression curves illustrate the qualitative distinctions between the groups rather convincingly (see Fig.1.A, B).

Conclusions

Our data evidenced that the DYs tend to employ less mature, qualitatively distinct and less effective strategies for text processing in comparison to the TD peers. But the comprehension distinction was significant only in the Grade 3.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18001/add_1_443378_63afdd6b-5831-4af1-9d59-a0893b6b85f1.png

Caption 1: Figure 1. Quadratic regression between the duration of fixations and the amplitude of progressive

saccades in the TD children (A) and the DYs (B)

Developmental changes of the text processing functional brain organization from an adolescent to an adulthood: an fMRI study

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Introduction. It was supposed that the reading skills develop in consequence with the so called “neuronal recycling” (Dehaene, Cohen,2007). Thus the reading experience should influence the brain mechanisms of text processing. The study aimed comparison of reading mechanisms in young adults and adolescents.

Methods. The fMRI investigation was carried out with group of typically developing adolescents (12 subjects, 11-14 years old, (ADOL)) and 2 subgroups of young adults (mean age 19.5±0.8[SD]), that were composed according to the Scientific written text comprehension test assessment results (Balčiūnienė et al.,2015; Shemyakina et al.,2018). Fourteen adult subjects scored≥85 percentile composed the “good comprehenders” subgroup (GComp), while 13 subjects scored≤15 percentile composed the “poor comprehenders” subgroup (PComp). The whole brain BOLD signal analysis, comparing performance of word reading (WR), non-word reading (NWR), sentences reading (SR) tasks (in block paradigm) in ADOLs versus adults was applied, using separate two sample T-tests with p<0.001, FWE corrected. Images were acquired using 1.5T Philips Ingenia scanner.

Results. Behavioral data analysis of in-scanner tasks fulfillment revealed slower response times (RTs) in ADOLs: in WR the mean RTs were 965±249ms in the ADOLs, 693±139 ms in the PComp (p<0.01), 624±94ms in the GComp (p<0.01); in SR mean RTs were 2123±534ms in the ADOLs, 1463±194ms in the PComp (p<0.01), 1237±167ms in the GComp (p<0.01); in NWR the mean RTs were 1055±393ms in the ADOLs, 763±171ms in the PComp, 637±109 in the GComp (p<0.05) (see Fig.). There were no between group (ADOLs vs adults subgroups) significant differences in error rates.

fMRI results “GComp” subgroup demonstrated higher BOLD levels in MTG(BA37/21) and MTG/AG(BA39) of the right hemisphere correspondingly: while sentence and words reading; and in the left occipital cortex while words’ reading in comparison with ADOLs. Group of “PComp” demonstrated an increase in BOLD level in MTG and occipital areas bilaterally while words reading and more activated areas of the right temporal cortex during NWR in comparison with ADOLs.

Conclusions. According to the data obtained in current study it should be reasonable to suppose that the brain networks functionally related to the sentence and the words reading comprehension in adolescents less mature then in adults and neural mechanisms of reading are influenced by both age and reading competence.

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Picture 1: https://www.eventure-online.com/parthen-uploads/175/18001/add_1_445511_431f3a75-6341-491e-9f66-6e5a28fe98e1.1.png

Caption 1: The response times in tasks performance

Left-lateralized N170 effects in reading of words with high and low frequency in adults with a history of institutionalization

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Children and adolescents raised in institutional care settings are at an increased risk for general cognitive deficits academic difficulties, and poor language performance. Less is known about 1) the neural correlates of language and literacy skills in this population and 2) the extent to which these deficits persist into adolescence and adulthood.

Thus, the current study aimed to investigate neural indices of orthographic processing in adolescents and young adults with a history of institutionalization using event-related EEG data.

A total of 52 Russian-speaking individuals in the age range from 16 to 37 years participated in the study: 24 individuals (M = 22.1, SD = 6.57; 17 men) were raised in institutional care settings (IC) and 28 individuals (M = 22.3, SD = 4.99; 14 men) were raised in biological families (BF). Groups did not significantly differ on gender, age, and socioeconomic status. The participants were shown orthographic strings to elicit N170 component that is particularly sensitive to print tuning and orthographic processing specialization. The stimuli were presented for 1000 ms on the screen, and then the subject performed lexical decision task. The data reported here based on the analysis of the two experimental conditions: high frequency (HF) words (Q3, based on the National Corpus of the Russian Language) and low frequency (LF) words (Q1) of the same length and structure.

In IC (post-hoc Tuckey test, p = .049) and BF groups (p < .001) average N170 amplitude was more negative in left parietal cluster of electrodes (L-P) in comparison with right-sided parietal cluster (R-P) but were no differences between the groups. There were no significant differences in neither peak amplitude nor latency in L-P clusters

between IC and BF, however average amplitude of the difference waveform (LF minus HF) in L-P (200-250 ms time window) was significantly larger in IC ($F(1, 49) = 8.18, p = .006$).

Although it has been previously shown that N170 effect reflects differences in processing of high and low frequency words (e.g., Hauk&Pulvermuller, 2004), we received no reliable N170 effect between those conditions in both groups. Our study suggests that the difference between low and high-frequency words is larger in IC than in BF group, suggesting increased neural effort in the processing of LF words in post-institutionalized adults.

This research was supported by the Government of the Russian Federation (grant □'-14.Z50.31.0027; E.L.G., Principal Investigator).

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18001/add_1_444944_7c53a985-70ef-4099-be47-cd3dcdbd343b4.png

Caption 1: The figure shows event related potentials for high-frequency and low-frequency words in the left parietal cluster of electrodes.

Are the distinct syntactic structures of the text processed differently? An eye-tracking study of the natural reading in good and poor comprehenders

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Introduction

There is a multiple evidence that the written texts comprehension skills vary within a population with a great extent. Following the simple model of reading, the distinction between so-called good and poor comprehenders is a consequence of the different efficiency in word comprehension and semantic integration. From the other point of view, syntactic structures processing strategies may also have an impact on the text comprehension. Hence, the current study aimed at the evaluation of an impact of different syntactic structures on the text processing in good and poor comprehenders.

Methods

First, 136 young adults were assessed by the <i>Scientific printed text comprehension test</i>. 18 subjects scored ≥ 85 percentile composed a group of good comprehenders (GC), while 16 subjects scored ≤ 15 percentile were treated as poor comprehenders (PC). Then, both the groups participated in an eye-tracking experiment. During individual sessions, two scientific expository texts were presented for a self-paced reading and answering comprehension questions (CQs). The experiment included two modes of task presentation: (1) the CQs appeared twice, i.e. before and after the text reading (B-A-mode); and (2) the CQs appeared only after the text reading (A-mode); the order of modes was balanced. For the area-of-interest (Aoi) analysis, the texts were annotated according to boundaries between the basic syntactic structures marked by punctuation signs (commas, dots, dashes): periods (full stops), coordinating clauses marks, subordinating clauses marks, and items' listing/ description within a clause. The measures of the eye-tracking included: the first fixation duration, the number of the first skip, the first pass duration, and the second pas duration towards the given AiOs.

Results

The ANOVA analysis proved the hypothesis that the punctuation signs marking different syntactic structures selectively influence the text processing and the relevant gaze movements. The task presentation mode had the significantly different impact on the text processing strategies between the GCs and PCs (Fig. 1, 2). The PCs demonstrated higher duration of the first fixation (in all Aois) in the A-mode than in the B-A-mode, while in the GCs, a difference between the paradigms was insignificant. Similarly, the B-A-mode lead to a higher second pass gaze duration within some Aois in the PCs, while it almost did not change the same measure in the GCs.

Conclusions

The oculomotor behavior analysis evidenced significant distinctions between the groups in the different syntactic structures processing while reading. The PCs' strategy was less selective and more effortful, especially in the A-mode.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18001/add_1_443144_361c8886-dd20-4a0a-a3d2-68794a6459df.PNG

Caption 1: Figure 1. The mean of the first fixation duration within the Aois

Picture 2: https://www.eventure-online.com/parthen-uploads/175/18001/add_443144_361c8886-dd20-4a0a-a3d2-68794a6459df.PNG

Caption 2: Figure 2. The mean of the second pass gaze duration within the Aois

Symposium D: Psychophysiology of posture control: part 2 -the psychophysiological peculiarities of posture control impairment

(Bazanova O. – Novosibirsk, Russia)

Postural control in adults with mood disorders: a relevant mobility assessment as a diagnostic and prognostic tool?

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, France

This presentation will review the evidence linking characteristics of postural control including center-of-pressure (COP) position- and velocity-based variables, with global cognitive ability, executive function, verbal fluency and psychomotor retardation in patients with major depressive disorder (MDD). Studies done on MDD patients consistently demonstrate an impaired balance performance in comparison to healthy controls. Stronger associations have been detected for postural performance and psychomotor retardation, which is a core symptom of depression. Emerging evidence shows positive changes in postural control in MDD after exercise program or repetitive transcranial magnetic stimulation (rTMS) treatment. Interestingly the initial postural instability, as assessed under cognitively demanding conditions (i.e. dual-task) is likely a sound moderator of positive outcomes in depressed patients after a rTMS intervention.

Posture-motor and posture-ideomotor dual-tasks costs as a putative marker of depressive rumination in patients with major depressive disorder

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Background

Recent studies have demonstrated that the assessment of postural performance may be a potentially reliable and objective marker of the major depressive disorder (MDD) symptoms. We aimed at investigating whether patients with (MDD) can allocate cognitive resources in dual-tasking performance, involving a timed fine actual or imagined finger movement task and a seemingly automatic in nature task of posture control. For this purpose, we investigated the interplay between the severity of depression, cognitive slowing due to compelling depressive rumination and energy demands for the center of pressure deviations (CoPD) under the dual-tasking condition.

Method:

Assessment of the energy demands for CoPD of 26 patients with MDD was compared with 24 age- and body mass index-matched (age range between the range of 20 and 52) healthy controls (HC). All participants performed posture control under three experimental tasks: (1) single referent task (a quiet stance), (2) actual posture-motor dual-task (AMT); (3) mental (i.e., imaginary) posture-motor dual-task (MMT). All the tasks were performed in the eyes open (EO) and the eyes closed (EC) conditions. This approach allowed us to separate sensorimotor and cognitive components of the same motor task.

Result:

The signs of psychomotor retardation (PMR) in the MDD group were objectively indexed by deficient posture control in the eyes closed condition along with overall slowness of fine motor and ideomotor activity. Another critical and probably more challenging feature of the findings was that the posture deficit manifested in the single task condition was substantially and significantly attenuated by the MMT and AMT dual-tasking activity (figure 1). A multiple linear regression analysis evidenced further that the dual-tasks costs significantly predicted clinical scores of severity of depression and depressive rumination

Conclusion:

The findings from the dual-task costs assessment allow suggesting that execution of concurrent timed fine motor (actual or imaginary) finger movement task with closed visual input deallocates attentional resources from compelling maladaptive depressive rumination thereby improving the depression-related PMR, as a putative marker of psychomotor retardation and depressive rumination in patients with the major depressive disorder

Keywords: major depressive disorder, depressive rumination, psychomotor retardation, posture, posture-motor dual-tasking, posture-ideomotor dual-tasking

Research was supported by Russian Science Foundation grant #16-15-00128

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18001/add_1_434949_794d491a-c1a7-406e-b0de-aa44c343d1c4.png

Caption 1: Figure 1. Energy demands for center of pressure deviation (E) scores during single (ST), dual-motor (AMT) and dual-mental/ideomotor (MMT) tasks in eye

Postural Control in Parkinson Disease: The Influence of Depression and Dysautonomia Paula Viana Wackermann¹, Andreas Hetzel² ¹Assistent Physician, Schwarzwaldklinik, Dept. of Neurology, Bad Krozingen, Germany ² Medical Director, Schwarzwaldklinik, Dept. of Neurology, Bad Krozingen, Germany

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Postural instability is a well-known incapacitating manifestation of Parkinson Disease (PD), mainly in its akinetic-rigid form. A growing body of evidence has shown a 25–50% prevalence of depression and a 30–40% prevalence of dysautonomia, especially orthostatic hypotension—often associated with supine hypertension—in PD patients. Depressive symptoms are not only prevalent, but also independently associated with cardiovascular dysautonomia as well as with Hoehn and Yahr Parkinson Stage (HYPS). Furthermore, depression is not dependent from duration and severity of Parkinson disease; nevertheless, it is related with posture and walking disorders.

The aim of the reported ongoing study is to investigate the relevance of depression and dysautonomia on postural control, as negative outcome markers in Parkinson patients.

36 consecutive PD patients attended in 2017 in Schwarzwald Klinik Bad Krozingen, were examined: 18 patients with (PDD) and 18 without (PD) depression. Patients underwent a full neurological evaluation, including HYPSS and Schwab and England daily life activities (SEDLA). Depression was assessed by Beck's Depression Inventory. All patients underwent routine blood pressure (BP) measures. Hypertension was defined as BP >140/90 mmHg. The groups did not differ significantly in terms of the patients' age (PD: mean 68.8 ± SD 19.7 years, PDD: mean 65.9 ± SD 17.9), age at symptoms beginning (PD: mean 61.6 ± SD 19.7, PDD: mean 57.9 ± SD 18.4) or disease duration (PD: mean 7.2 ± SD 8.2, PDD: mean 7.9 ± SD 8.5). Most of the patients in both groups had an akinetic-rigid form, followed by the equivalent form. No differences between groups regarding sex, fatigue, hyposmia, on-off fluctuations, affected side, sleep disorders, pain, constipation, bladder disorders, dizziness, tobacco or alcohol consumption, HYPSS distribution and SEDLA were observed.

Four out of 18 patients with PD without depression had orthostatic hypotension. Our preliminary results did not show the repercussion of depression or dysautonomia in the postural control. There was, however, a trend towards higher frequency of arterial hypertension in the PDD group ($\chi^2 = 2.786$, $df = 1$, $p = 0.095$). Although arterial hypertension is associated with reduced risk of PD, the PD protective mechanism from some anti-hypertensive drugs must be considered. Furthermore, a high supine systolic blood pressure coupled with orthostatic hypotension is often seen in PD patients. The association between depression and arterial hypertension in our patients could be explained by a functional disorder in the insular cortex, which is the locus of autonomic and limbic integration.

DISORDERS OF DUAL-TASK (POSTURAL AND COGNITIVE) PROCESSING IN PATIENTS AT DIFFERENT TERMS AFTER BRAIN TRAUMA

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Healthy persons are able to perform dual-tasks that consist of concurrent motor and cognitive components, while patients with traumatic brain injury (TBI) demonstrate deficits in multiple spheres and show poor performance in these tasks. The aim of the present study was to understand neurophysiological mechanisms that ensure success or fail in dual-tasks at different terms after TBI.

Twenty one TBI patients (28±5.3) and 32 healthy persons (27,6±0,07) participated in studies. Complex EEG, stabilographic, clinical and psychological studies (memory, attention and etc.) were examined. Participants performed three cognitive (calculation of tones, verbal-logical, visual-spatial) and two postural (static and dynamic) tasks on force platform isolated and simultaneously. Studies in TBI patients were performed at the early (three months after TBI) or late period (over twelve months) and these data were compared healthy subjects investigations.

In healthy subjects successfulness of dual-tasks performance correlated with higher level of individual cognitive resources – volume of memory and speed of attention switch etc. EEG data showed that performance of all cognitive tasks demonstrated EEG coherence increase for slow (delta and theta) spectral bands at distant pairs while tasks were performed isolated or simultaneously. Postural task performance was accompanied by the functional coupling increase for fast spectral bands (alpha and beta) also predominantly at distant pairs. The EEG and stabilographic changes were the most pronounced during dual-task performance in comparison single task performance.

TBI patients demonstrated EEG coupling decrease at distant pairs and increase of EEG functional connectivity at short networks (especially for beta and gamma bands) while dual-tasking at the early terms after TBI. These impairments of EEG data correlated to poor dual-tasking at TBI patients compared to healthy subjects. At the late period after TBI reduced quality of dual-tasking was correlated with EEG coupling decrease for slow spectral bands predominantly at the frontal areas.

Thus, EEG study showed that successfulness of dual-task performance by healthy subjects is provided by frequency-spatial diversity and recruitment of distant connections between brain areas. At the early period after TBI an increase of EEG coupling for fast spectral bands at short networks can reflect the inclusion of compensator mechanisms. At the late period after TBI EEG coupling increase for slow spectral bands especially at the frontal areas can reflect the weakening of compensatory resources. Dual-tasking may be used as important approach to prognosis TBI patient's quality of life and to select goals of patient's rehabilitation. Supported by RBRF □'- 17-06-01012

EEG-based monitoring of the focused attention related to athletic performance in shooters

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, Singapore

Electroencephalogram (EEG) signal patterns, differ with level of expertise in rifle shooting due to the level of focused attention and posture control exhibited by variously skilled shooters. The aim of this study is to correlate EEG-based data including the posture control related ones with shooting performance to propose an assistive system for shooters

training. 9 rifle shooters including 6 elite shooters participated in the experiment. 2 assessment sessions were carried out at shooting range. Each participant underwent the field-based test of 40 shots at a 10m air rifle range. During the field-based tests, participants' real-time brain activity was recorded via the 14 electrodes of Emotiv EEG device. The pre-shot 4 seconds EEG data of each of the 40 shots was processed and analysed against the shooting performance. To find out the correlation between EEG data and shooting performance, we extracted different types of EEG-based indexes including poster control related ones and recognized the shooters emotion and mental workload levels right before they pulled the trigger. These indexes and emotion/workload levels were correlated with the shooting scores to understand what are the optimal brain states for "good" shots. The following results were reported after the data analyses. According to the results, we confirmed that EEG-based indexes could be used to reflect the shooting performance of the shooters. Mental workload level of shooters (amount of the mental effort to perform the task) has a negative correlation with the shooting score, which means the lower mental workload before the shot release the better shooting performance. Alpha power has a positive correlation with the shooting score that complies with the literature review that alpha power increases before the best shots compared with the worst shots. The difference of beta power between left and right hemisphere has a positive correlation with the shooting performance for the majority of the participants. The results of the experiment would be used to develop the EEG-based assistive system to improve athletic performance in shooters.

Symposium E : Orthographic processing and language transparency

(Gonzalez-Garrido A.A. – Guadalajara, Mexico)

Statistical Learning and Orthographic Preferences among Kindergarten and First Native Arab Graders

H Taha

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Abstract

Aim

Statistical learning is defined as a cognitive process where the individual learns about the frequencies of the occurrence and re-occurrence of events. Such learning is considered as an implicit process while there is no necessary for further explicit understanding why the event is expected to occur in certain circumstances. Recent research findings reported about the role of statistical learning in reading and spelling acquisition among children. The current study investigated the effect of the orthographic features of the Arabic orthography and their frequency on the orthographic preferences among preschoolers and first grade readers measured by an orthographic choice task.

Method

40 first grade and 40 kindergarten native Arab children were tested. Each participant was tested with an orthographic choice task. Two sets of written patterns were developed for the purposes of the current study: 90 real words patterns and 90 pseudo-orthographic patterns (the non-words which were composed from non-alpha symbols and real letters). The real words group itself consisted from three types of written words: a) 30 Full connected words <ب'□'□ك > b) 30 partially connected words < سور > and, c) 30 Non-connected words <رأس>

Results

The results of the current study revealed that for the first grade group, high accuracy levels for acceptance real words and rejection pseudo-orthographic patterns were found. In addition, the first grade group showed significant preferences for accepting the connected patterns among the non-connected patterns as real words. For the kindergarten group, the participants showed a high tendency to accept the connected pseudo-orthographic patterns as real words than the non-connected patterns.

Conclusions

These findings were explained in light of the fact that in Arabic orthography there are high proportions of full-connected than non-connected patterns and this might affect the orthographic preferences of first grade and pre-school children.

The orthographic effects (word spelling) on the perception, production, and learning of spoken words in a second language.

B Bassetti

University of Warwick, UK, Coventry, United Kingdom

The presentation will report findings from a series of studies on the effects of the orthographic form (spelling) of second language sounds and words on second language (L2) speech perception and production. In particular, the paper will report the effects of number of letters (single letter or letter digraph) in the spelling of a consonant on the perception, production and learning of L2 English words in L2 speakers of English who are native readers of a transparent orthography (Italian). It will be argued that native users of transparent orthographies rely on L2 orthographic forms when learning L2 phonological forms, even when the L2 orthography is phonologically opaque as in English.

Implicit recognition of orthographic violations in Spanish. Eye-tracking and fMRI evidence.

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Recently, our group reported that in a transparent language as Spanish, individuals with higher orthographic abilities have developed a more efficient arrangement of reading-driven brain functional activation. In this presentation, additional evidence using eye-tracking and fMRI techniques is shown; demonstrating that individuals with high orthographic knowledge automatically run orthographic recognition processes disregarding task requirements and behavioral costs, while this does not occur in participants with lower orthographic processing abilities. The theoretical implications of the present findings are discussed.

A systematic revision of brain connectivity in fMRI data in linguistic task paradigms.

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The development of neuroimaging techniques has enabled the study of the neurofunctional substrates underlying reading-writing acquisition processes. However, further efforts have to be made in order to fully understand the complex patterns of brain connectivity involved in these processes, along with the differential effect of crucial variables such as language transparency, orthographic knowledge, word exposure, etc. This presentation aims to discuss the usefulness of several methods developed to approach these issues, as well as their competence to deal with the interpretation of linguistic tasks' performance.

Late Afternoon Session: 5.00 – 6.30 p.m.

Symposium A: Brain stimulation

(Hermann C. – Oldenburg, Germany ; Miniussi C. – Trento, Italy)

TACS and motor cortex stimulation: individual variability and task dependency

A Antal

University Medical Center, Göttingen, Germany

The modulation of cortical excitability and resultant activity; a central mechanism of 'induced neuroplasticity', has been investigated using several external stimulation methods such as transcranial direct current (tDCS), alternating current (tACS) and random noise (tRNS) stimulation. By using tACS, alternating current is assumed to entrain endogenous neural oscillations possibly by modulating the power of oscillations or the phase-locking index between the driving and endogenous oscillations. TACS has recently been extensively used to examine whether neural activities can selectively be increased or decreased with manipulations of the frequency, intensity and phase of the current and/or the duration of stimulation. Although early studies, mainly targeting the primary motor cortex (M1) and studying motor evoked potential (MEP) changes, reported clear frequency and intensity dependent activity changes, recently, the field has reevaluated the traditional MEP-increase/decrease assumptions, due to the growing number of contradictory and/or mixed findings. These outcomes imply that tACS effects are highly inter-individual, tasks and brain-states dependent. These factors together with the physical differences of stimulation parameters used in different protocols, are likely the key contributors to the wide range of inconsistent tACS effects that were recently published.

TACS is state-dependent and requires adaptation to individual parameters

C.S. Herrmann

Oldenburg University, Oldenburg, Germany

It has been shown that tACS is able to up-regulate human EEG alpha activity if tACS is applied at or near the frequency of subjects individual alpha frequency. In line with the theory of entrainment, effects of enhancing alpha amplitude are larger if the frequency of tACS is tuned to the individual alpha frequency of the participants. In addition, the state of subjects before the stimulation determines the outcome of stimulation. If subjects have low alpha amplitudes before stimulation (eyes open), the alpha amplitude will be significantly enhanced after stimulation. If, however, the alpha amplitude is already high (eyes closed), no further enhancement of alpha amplitude can be achieved by tACS. We will explain the theory of entrainment, demonstrate network simulations of tACS and results

of multiple experiments which support the idea that tACS entrains human EEG oscillations.

Calculating and measuring the current flow to improve spatial targeting during TACS

Axel Thielscher

Technical University Denmark & Danish Research Center for Magnetic Resonance, Kgs. Lyngby, Denmark

Spatial targeting is often only loosely controlled in TACS studies, which can weaken the conclusions drawn about the brain areas that underlie the physiological and behavioral stimulation effects. Targeting control can be improved using electric field calculations based on Finite-Element Methods (FEM) and anatomically realistic head models. The talk will summarize some key findings from simulation studies that employed accurate field calculations to characterize the field distributions generated by established single- and dual-site TACS montages. In addition, it will give an overview of how much systematic optimizations of multi-electrode montages can help to improve focality and targeting accuracy.

The accuracy of the field simulations is mainly limited by uncertainties about the ohmic tissue conductivities, highlighting the need for validation studies. The second half of the talk will therefore focus on recent results of in-vivo measurements of the TACS current flow in the human brain based on Magnetic Resonance Current Density Imaging (MRCDI). Relating them to the results of invasive recordings of the TACS-induced electric fields in patients performed by other groups, the aim is to give an overview of the status of validation work of individualized field calculations for TACS.

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Saturnino GB, Madsen KH, Siebner HR, <i>Thielscher A</i> (2017). How to target inter-regional phase synchronization with dual-site Transcranial Alternating Current Stimulation. *Neuroimage* 163:68-80

Symposium B: Toward a Psychophysiological Understanding of Personality: Theory and Research

(De Pascalis V. – Rome, Italy)

A Neuroscience of Approach, Avoidance and Conflict Personality Traits.

P.J. Corr

City University London, London, United Kingdom

Research strands from different areas of psychology (theoretical and applied) converge on the general idea that, at a fundamental level, there exist a few major dimensions of motivated behaviour and emotion: approach, avoidance, and their conflict. The most prominent theory to explain the neuropsychology of these systems is the reinforcement sensitivity theory (RST) of personality, which has been in continual development over the past 50 years. This talk will outline RST's three major systems: Fight-Flight-Freeze System (FFFS; related to active avoidance/escape), Behavioural Approach System (BAS; related to exploration and reward sensitivity), and Behavioural Inhibition System (BIS; related to conflict detection/processing and passive avoidance). It shows how they can be used to throw light on a range of psychological phenomena, and how they have made an important contribution to the neuroscience of personality. Challenges for the future will be outlined.

Agreeableness and reactive social behavior.

G.G. Knyazev

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Human behavior in social situations has two distinct components – reactive and nonreactive. Reactive behavior is largely driven by the perceived behavioral manifestation of the opponent, whereas nonreactive behavior depends on a host of factors including actor's goals and intentions, his or her personality, attentional capacity and so on.

Appropriate reactive behavior is indispensable for successful social interactions, but it needs ability and willingness to pay attention and correctly interpret verbal and nonverbal signs from the opponent, as well as to tune his or her own behavior accordingly. Agreeableness is the personality trait, which uniquely predicts inter-individual dispositional variation and is associated with better performance in Theory of Mind and emotional attribution tasks. It is not clear, however, how agreeableness manifests itself in dynamic social interactions and how this is implemented in the brain activity. In this study, we used virtual social interactions as an experimental model of social behavior. Participants were presented with three kinds of emotional facial stimuli (happy, neutral, and angry faces) and were asked to choose one out of three variants of behavioral response (friendship, avoidance, or aggression). EEG was recorded throughout the experiment and afterwards participants completed the IPIP Big Five Factor Markers. EEG data were projected into the source space using sLORETA and were submitted for the multilevel mediation analysis, where stimulus characteristics (happy vs. neutral vs. angry) were used as predictor, response type (friendship vs.

avoidance vs. aggression) as outcome, and brain activity as mediator. Significant mediation effect was revealed in the theta frequency band in the right temporo-parietal junction, which is involved in processing goals, intentions, and beliefs of others. Agreeableness, but not other personality dimensions, was moderately positively associated with the strength of mediation, indicating that brain mechanism underlying reactive social behavior is particularly active in agreeable people.

Does Emotional Intelligence Impact on Face Processing?

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Does Emotional Intelligence Impact on Face Processing?

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Introduction: Research has suggested strong support for the neural processes associated with the temporal analysis of face structure and emotion. Previous research suggests that many significant brain regions are associated with recognition of emotion with faces. However, there are inconsistencies in the literature about how fast humans can process this information. Research associated with emotions suggest that the level of emotional intelligence may explain some of these inconsistencies. Few studies have reported whether emotion regulation modulate early face processing evoked potentials, particularly the N170 response.

Methods: The present study aims to build on a previous studies with MSCEIT faces which demonstrated correlations with individual EI scores. This current study also aimed to explore the impact of EI on the timing and extent of a standard emotional face processing task using Event-Related Potentials (ERPs) methodologies. Standardised photographs of neutral and emotional facial expressions were presented to 24 participants whilst recording EEGs.

Results: The results demonstrated that emotional valence modulated the face-specific N170 potential, highlighted by larger amplitudes and shorter latencies for fearful facial expressions compared to happy faces across all individuals. The expectation that this effect would be more pronounced in individuals with greater EI was also partially supported. Individuals with high EI had larger amplitudes and shorter latencies for neutral and happy faces, compared to those with low EI.

Conclusion: Although methodological concerns are raised, this study provides promising preliminary evidence of altered neural processing of facial expressions across emotional valences and EI scores.

High empathy traits measured with either a questionnaire or a physiological measure are associated with different emotional responses

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Starting from current methods and literature on psychophysiology of emotions, two experiments are presented. In the first study, a sample of female students was divided into high vs low empathy levels by means of the IRI (Interpersonal Reactivity Index, Davis, 1983) questionnaire and watched a sample of emotional slides while startle reflex and evoked potentials were recorded. Results evidenced greater emotional reactivity in high vs low empathic women in the subjective measures (emotional valence and arousal), but not in the psychophysiological indexes. In the second study, the paradigm was reversed and participants were selected through a psychophysiological index of emotional reactivity rather than a cognitive measure of empathy. Starting from a large sample of female students two groups were selected according to startle baseline reflex. The high vs low startle groups were compared in an emotional picture presentation task while subjective responses (valence and arousal), empathy levels (IRI), startle reflex modulation and evoked potentials were recorded. Results showed greater emotional responses and empathy levels in the high vs low startle group. Results are discussed in relation to the index used for measuring empathy in psychophysiological and metacognitive domains.

Resting Frontal Asymmetry and Revised Reinforcement Sensitivity Theory Motivational Traits

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The revised reinforcement sensitivity theory (rRST) of personality has conceptualized three main systems: the fight-flight-freeze system (FFFS), the behavioral inhibition system (BIS), and the behavioral approach system (BAS). Previous models of frontal activity link greater relative left frontal activity with approach-related tendencies and impulsivity and greater relative right frontal activity with "withdrawal" motivation that included both BIS and FFFS. Although the newer classes of rRST measures have addressed the separation between FFFS and BIS, much of the personality neuroscience research does not indicate which system is related to right frontal activity. We used the Reinforcement Sensitivity Theory of Personality Questionnaire (RST-PQ; Corr and Cooper, 2016) to measure: BAS and its facets (goal drive persistence, reward interest, reward reactivity, and impulsivity), withdrawal FFFS, and BIS. We examined the association of RST-PQ traits with resting electroencephalogram (EEG) alpha-asymmetry in female participants (N = 162) by considering the influence of experimenter's gender. In the total group, that included

two subgroups with experimenters of different gender, BAS-impulsivity was related to greater left- than rightfrontal activity, and FFFS, but not BIS, was related to greater relative right-frontocentral activity. These associations remained significant for the subgroup with a young same-sex experimenter, but not with opposite-sex experimenter.

Symposium C: CLINICAL APPLICATION OF QEEG AND ERPs IN NEUROPSYCHIATRIC DISORDERS

(Markovska -Simoska, S. – Skopje, R. Macedonia)

EXG oscillations - an electrophysiological parameter of learning in patients with schizophrenia

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The aim of the study was to evaluate the parameters of a learning process that occurred during the electroexpectogram (EXG) paradigm in patients with different neuropsychiatric disorders such as schizophrenia, anxiety disorders and epilepsy and to compare them between groups and with healthy subjects. The investigation was undertaken on thirty patients with chronic schizophrenia aged 25-40 years, thirty patients with anxiety disorder aged 20-40 years, thirty patients with temporal epilepsy aged 15-40 years and fifty healthy subjects aged 15-40 years. The EXG paradigm is an electrophysiological method, which employs an experimental brain-computer interface design. It is a modified and an expanded auditory CNV paradigm. Based on a biofeedback design, the occurrence of S2 tone in the EXG paradigm depends on the amplitude of the CNV potential recorded from Cz. If CNV reaches a predefined threshold level, the S2 tone turns off, which causes an extinction of the CNV potential after several consecutive trials. The computer recognizes this change and the S2 tone turns on again causing a consecutive increment in the CNV amplitude. As a result, an electrophysiological oscillatory process occurs in the subject's mind, and is graphically presented by a curve named electroexpectogram. The dynamics of expectancy and attention, represented by CNV amplitude, as parameters of associative learning taking place during the S1-S2-MR sequence of the EXG paradigm, can be observed in this manner. We performed one experiment with the EXG paradigm in which the threshold value of the CNV amplitude was 10 mV. Successful learning of biofeedback was accompanied by reduced oscillations of CNV amplitude, shortened duration of the oscillatory EXG cycles and faster motor reaction in healthy subjects, while this effect was diminished in patients with chronic schizophrenia. The Post Imperative Negative Variation (PINV) occurred in 80% of patients with chronic schizophrenia. Patients with anxiety disorders and patients with epilepsy showed results similar to those of patients with chronic schizophrenia, although worst results were obtained in patients with chronic schizophrenia. The results of the study suggest that patients with different neuropsychiatric disorders show both disturbance in adjustment of their attention and a poor learning process during demanding cognitive tasks.

The role of electroencephalography in psychiatry - clinical aspects and correlation of psychopathology in schizophrenia and bipolar disorder

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Since the very beginning electroencephalography was supposed to give explanation of psychiatric disorders. But the only approved clinical application of EEG was for diagnosis of epilepsy and this diagnostic procedure is rarely used in psychiatric settings mainly to rule out some organic changes that could be of interest for the diagnosis. We will present some interesting cases that point to the usefulness of EEG in the diagnostic evaluation of patients with atypical clinical presentation.

In the last few decades the development of the digital acquisition of EEG and the possibility for quantified analysis of the EEG signals gave us opportunity for precise measurement of frequencies, amplitudes and localization and comparison between groups of interest and therefore a window of opportunities opens for clinical application in the field of psychiatry.

Although much work is done there is still not enough evidence for recognizable patterns of disturbed background activity of the EEG in patients with schizophrenia and bipolar disorder. So, the aim of this presentation is to present current actual knowledge and our own results of the differences in QEEG power spectrum in patients with these disorders.

Standardization of the methodology in the future would allow wider application in the field of clinical psychiatry.

Quantitative EEG and ERPs in children and adults with Attention Deficit Hyperactivity Disorder

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Introduction: In recent decades, resting state electroencephalographic (EEG) measures have been widely used to document underlying neurophysiological dysfunction in attention deficit hyperactivity disorder (ADHD).

Although most EEG studies focus on children, there is a growing interest in adults with ADHD too. The aim of this study is to objectively assess and compare the absolute and relative EEG power as well as the theta/beta ratio, coherence and ICA ERPs components in children and adults with ADHD.

Methods: Studied sample included ADHD children and adults as well as control group. The resting EEG activity in eyes open and eyes closed condition for the four EEG spectral bands (delta, theta, alpha and beta) was evaluated in examined groups. The Visual and Emotional Continuous Performance Tests as modifications of GO/NOGO paradigm were applied in order to obtain cognitive ERPs as indexes of executive functions. Beside behavioral parameters of test performance, amplitude and latency of several cognitive ERPs reflecting different stages of information processing were explored.

Results: The findings obtained for ADHD children are increased absolute power of slow waves (theta and delta), whereas adults exhibited no differences compared with normal subjects. For the relative power spectra there were no differences between the ADHD and control groups. Across groups, the children showed greater relative power than the adults in the delta and theta bands, but for the higher frequency bands (alpha and beta) the adults showed more relative power than children. Classification analysis showed that ADHD children could be differentiated from the control group by the absolute theta values and theta/beta ratio at Cz, but this was not the case with ADHD adults. The ERPs results point out that there is disturbance in executive functioning in investigated ADHD group obtained by the significantly lower amplitude and longer latency for the engagement, motor inhibition and monitoring components.

Conclusions: Nowadays, QEEG parameters and independent components of ERPs have been applied in order to objectively discriminate ADHD population from norms. Their application is very important for choosing the right medication and type of psychotherapy or choosing the right location for neurofeedback treatment and localizing the area for TMS or tDCS. Thus, EEG and ERPs measures used as a diagnostic add-on in ADHD may be of interest in guiding a personalized medicine approach in particular regarding treatment outcomes.

Keywords: ADHD, QEEG, ICA ERPs, treatment modalities.

Psycho-social and Psycho-physiological Characteristics of Juvenile Offenders

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Introduction: Psychosocial factors are known to play a significant role in the aetiology and course of delinquent behavior, but also in the last decades many studies have tried to establish the neurobiological correlates of delinquency.

Objective: The aim of the study is to analyze juvenile offenders (JO) in the Juvenile Detention Center, their forensic, psychological and neurobiological characteristics considering antisocial behavior, conduct disorder and violence.

Method: We have interviewed all JO (24) in the Juvenile Detention Center in Ohrid, and performed a psychological, neuropsychological and neurophysiological assessment. A Structured Interview, Questionnaire for aggression, and a Scale for assessment of ADHD symptoms, neuropsychological testing and QEEG were performed.

Results: All JO come from low level socio-economic families, and majority of them lived in single parent families, being exposed to all kinds of adverse childhood experiences – having members of the family convicted for crimes, death in the family, domestic violence. One third has dropped out from school in the first three years. Nearly all of them had a history of early onset conduct disorder, and a history of substance abuse. Their scores on Aggression Scale are higher than controls, and on Anger Scale significantly higher. In nearly half of the JO there are symptoms of ADHD, 20% show symptoms of attention deficit, and 32% of hyperactivity and impulsivity, deficit in inhibition and affect regulation. The neuropsychological tests showed impairment of the executive functions, impulsive response due to reduced motor inhibition. QEEG showed a widespread presence of slow wave brain activity, decrease of beta frontal activity and of alpha power.

Conclusion: JO residing in the Juvenile Detention Center in Ohrid is a group of youngsters with severe psychopathology, neurobiological deficit in cognitive and executive functions, and with a high risk for recidivism, in need of support from families and society.

Brain function in anorectic patients using QEEG assessment

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Background: Anorexia is an emotional disorder characterized by an obsessive desire to lose weight by refusing to eat. Persons with anorexia can also develop a distorted view of their body. Abnormalities in brain functioning in anorectic patients are mostly persistent. Among psychological and behavioral signs depression and obsessive-compulsive behavior are the most important. The goal of our study was to evaluate EEG spectra power and the spectrum weighted frequency - brain rate. Special goal of the study was to evaluate frontal alpha asymmetry which has been studied as a state related to affective response.

OUR HYPOTHESIS is that frontal asymmetry in anorectic young people may be marker of emotion imbalance.

Methodology: The diagnosis of examinees was made according two statistic manuals (DMS-IV-R and ICD-10). Medical history, neuropsychological state and biochemical analysis were also assessed. In examined patients

we made QEEG recording and analyze the results for EEG spectra power, brain rate, alpha spectra power and log of alpha spectra power for four conditions (eyes closed, eyes open, VCPT and ACPT).

Results Beta waves have absolute spectra power significantly lower in anorectic group vs control group in frontal region which explains their poor cognitive flexibility. Results for alpha power showed higher cortical activity in right hemisphere. Greater right brain activity especially for frontal regions is associated with negative emotions. Factorial ANOVA for brain rate results showed strong statistical significance between groups of healthy subjects vs. anorectic group. The analysis of the results for log of alpha power from separate points – Fp1-Fp2; F3-F4 and F7-F8 followed. According to literature the primary sites of interest are the midfrontal (F3/F4). Higher right cortical activity in all conditions except VCPT was found.

Conclusions It is known that people with anorexia often manifest comorbid depression. There are some experience that depression is not a separate illness but result of the physical and biological changes that anorexia produces on the brain and body. During analysis of the power of alpha band - right frontal asymmetries in all tested participants were found. But when we tested log of the power of alpha band, right frontal asymmetry was found only in mid-frontal regions. This correlates with the research published by other authors, where only alpha-band asymmetry in the mid-frontal region is significantly discriminative between depressed and non-depressed participants, with the depressed participants showing negative asymmetries and the non-depressed participants showing positive asymmetries.

Symposium D: The executive functions in ontogenesis

(Nikolaeva E. – Saint Petersburg, Russia; Shemayakina N. – Saint Petersburg, Russia)

ERP study of executive functions development in children living in northern regions of Russia

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Introduction. An adolescence is a period when the high cognitive functions (attention, working memory, abstract thinking) are still developing. The study aimed to compare cognitive ERPs in adolescents living in Northern regions of Russia during arithmetical tasks (addition/subtraction) performance. The visual EEG/ERP task (200 trials) was carried out as the model of testing executive functions and connected with exploring cognitive, attention processes and inhibitory control in school children.

Methods. Forty-two adolescents (12-16 years old) living in Subpolar and the Polar regions of Russia took part in the investigation. All children had normal IQ rates. They were presented arithmetical tasks (for 400 ms) and given 1000 ms to find solutions and then compare them with the presented answers (for 200 ms) while monopolar EEG/ERP registration (31AgCl electrodes, 10-10% system, range 0.3-30Hz, NF50Hz, sampling rate 500Hz, Ltd. Mitsar, St.Petersburg). In case of correct answers, subjects were to press the mouse button. According to behavioral data, there were no correlations of age and number of mistakes (Subpolar region $-12\% \pm 10[SD]$, Polar region group $-1-10\% \pm 10[SD]$, $-2-17\% \pm 11[SD]$) or response times for correct answers in children. RM ANOVA was used for ERP data.

Results and Conclusions. There were ERPs differences within each group – higher negativity on 220-310ms; the higher amplitude of the descending wave of the ERPs positive component (360-480ms) in frontal sites and parieto-occipital areas in response to incorrect answers (comparing with correct). In the first case, observed distinctions were presumably connected with a mental mismatch of expected and shown answers - “arithmetic mismatch negativity” (Hsu, Szücs, 2011). In the second case, two topographically distributed ERP subcomponents – with a higher amplitude peak in frontal areas, and with a smaller amplitude and latency of peak – in parieto-occipital areas were revealed that might correspond to “late positive component”. At perception of the correct answers, the maximum amplitudes of the peak with latency about 300ms were distributed in parietal cortex.

Between-group ERP distinctions were observed on 480-550ms after the first stimuli (problems) presentation in teenagers living in the Subpolar and the Polar regions versus Saami teenagers (from the Polar region). The ERPs amplitudes in the central, parietal-occipital regions in the latter were higher. It might be correlated with the different strategy of the solutions, load of spatial thinking. There were also observed earlier differences in ERP between groups that can clarify some ontogenetic specificity in northern regions. Carried out within the assignments of FASO of RF (reg. \square -AAAA-A18-118012290142-9).

Personality as moderator of aging effects on inhibition functions and brain activity

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Introduction. Personality may be a potential moderator of aging effects on both inhibitory processes and brain activity. This hypothesis is based on a wide range of individual variability in the processes of information selection and the structural and functional organization of brain activity in aging.

Methods. To test this hypothesis, a comparative analysis of the functions of attention systems and frequency-spatial organization of the brain activity at rest due to factors of the Eysenck's personality, sex and age (22±3 and 63±6 years) was performed. EEG data were recorded using a 60-channel Neuroscan 4.4 system from 170 subjects.

Results. It was found that the personality-related variability of both brain activity and selective processes is most pronounced in elderly men. Neuroticism was the common for elderly predictor of the alpha3 power at rest: its increase was accompanied by significant left hemispheric synchronization of the oscillations in the temporo-parieto-occipital region in men and a tendency to the right hemispheric effect in women. Psychoticism was a predictor of the variability of high-frequency alpha and beta oscillations in women, and this effect increased with age.

The executive control of information selection was related to extraversion in young men and psychoticism in senior women. Also extraversion and psychoticism were predictors of vigilance system functions in older men.

Conclusion. The frequency and regional specificity of changes in the resting-state EEG in men and women relating personality traits reflects the variability of age-related changes in hemispheric activity and potential resources for cognitive functions in old age. The findings prompt an assumption that dynamic interactionist models would be necessary to capture the multiple interactions between personality, brain activity, and behavioral inhibition/activation.

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Crossed laterality and cognitive disturbances

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Introduction. Among biological factors of cognitive underdevelopment or disturbances, the prenatal and perinatal complications as well as brain damages are mostly mentioned. Lateral preferences (profile of functional sensorimotor asymmetry) are underestimated. The new data prove a high correlation of crossed or mixed laterality with learning disability and cognitive problems.

Methods. We distinguished 2 types of crossed laterality: intramodal (only in motor functions) and intermodal (between motor and sensory functions). They were determined by special tests included in the integrated Lurian neuropsychological battery with qualitative and quantitative analysis of results. We assessed 18 Parkinson's disease (PD) patients, 32 stuttering patients and 32 learning disable children suffering from ADHD. All subjects considered themselves right handed

Results. Crossed laterality decreases the brain activation both in motor and intellectual activities. Crossed laterality, especially intermodal one, has negative effect on verbal functions and memory. Intermodal crossed laterality had a negative effect on disease progress (stage of PD and severity of verbal and emotional disturbances in stuttering). Crossed laterality significantly decreases everyday activity. The highest correlation with learning disability and severity of cognitive disturbances is revealed in cases of different lateral preference for hand and eye. The physiological reason for it is a delayed interaction of the cerebral hemispheres. Social help - an early stimulation of interhemispheric interaction by neuropsychological remediation techniques in the preschool age decreases the crossed laterality, and provides better learning. It is also important to adopt the learning process for students with left profile.

Conclusions. Crossed laterality is a significant pathological factor. A comprehensive Lurian neuropsychological assessment with qualitative analysis of disturbances reveals the structure of cognitive disturbances in different nosological groups of patients and its specific relations with the profile of laterality. Children and adults with crossed laterality need neuropsychological and social supervision to stimulate formation of the interhemispheric interaction. By this, a biological and social interaction permits to surmount the learning disability in children and to reduce speech problems in stutters.

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The ratio of working memory and parameters of sensorimotor integration in the 'go-go' paradigm in children 7-8 years old

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Executive functions are a collection of downward mental processes required to concentrate attention when automatic, instinctive, intuitive behavior becomes ineffective or impossible (Burgess, Simons, 2005; Bari, Robbins, 2013.) School admission requires a significant change in a child's behavior, the actualization of executive functions under conditions where the physiological basis of their prefrontal cortex is not yet ripe and is actively changing (Luna et al., 2015.) The main components of executive functions are: inhibitory control, working memory and cognitive flexibilities. The aim of the study was to correlate working memory efficiency with the parameters of sensorimotor integration requiring inhibitory control. Sensorimotor integration is a convergence of sensory and motor flows on the prefrontal cortex's neurons and, therefore, requires the usage of extra resources in first grade children. At the same time, data on the relationship between working memory parameters and inhibitory control is insufficient.

The survey examined 60 7-8 year old children. Working memory level was estimated with a technique using three series of the same subjects (familiar to the child) which were presented on a monitor in a different order. The child had to click on an object they had not yet pressed in the series. The number of correct reactions in three presentations and interference were estimated. In the process of reflexometry, the child first trained in the training series to press the "space" key when circles of different colors appeared, before acting in accordance with the 'go-

go' paradigm in the experimental series. The reaction time for presentation of stimuli and the number of errors were estimated. In the training series, the stimuli were presented at the same interval, whereas in the experimental series, the intervals had a fractal basis.

Regression analysis showed that the lower the interference in working memory, the more errors the child makes in the training series of reflexometry and the fewer stimuli they recall in the first series, the more stimuli they remember in the last series of tasks. The higher the recall level of stimuli in the first presentation, the fewer mistakes the child makes in the training series of reflexometry. The higher the memory span during the second presentation, the fewer mistakes the child makes in the experimental series of reflexometry.

None of the parameters of working memory are related to the reaction rate in reflexometry.

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Comparative analysis of inhibitory processes of healthy preschool children and children with the autistic spectrum disorder

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The concept of executive functions is now widely used by researchers (Buttelmann, Karbach, 2017; de Cock et al., 2017; Kaunhoven, Dorjee et al., 2017; O'toole, Monks, 2016; Luna et al., 2015). From a theoretical point of view this concept allows describing the peculiarities of plastic reconstructions in the brain, from a practical standpoint it is possible to improve Self-regulation in early childhood. Executive functions include inhibitory control, working memory and cognitive control. There are no any correct data about inhibitory controls of children with autistic spectrum diseases (ASD). The purpose of the research was to compare the inhibitory controls of children with ASD (30 persons) and healthy children (30 persons). Groups were equalizing to level of intelligence. Methods were used: nonverbal intelligence assessing with Raven Colored Progressive Matrices, the Theory of mind assessing test Sully-Ann, inhibitory processes assessing the mushroom test by W. Mishel and reflexometry- assessing with the paradigm of "Go/Go", handedness using the sets of tests. 28 children with ASD were left-handed and two children were ambidextrous ones. Just 4 children from healthy group were left-handed and other 26 were right-handed. In the group of children with ASD just 6 children passed the mushroom test (9 children from group of healthy children had passed this test). In healthy children the levels of intelligence positively correlated with inhibitory controls and its negatively correlated with the number of mistakes in reflexometry. Just 1 child from the group with ASD had the formed Theory of mind. In the course of individual work, the Theory of mind was formed in 4 children. Both the Theory of mind and inhibitory processes correlate with the intelligence levels of healthy children. The reaction times of children with ASD were longer than of those healthy children and children with ASD had more mistakes during reflexometry.

The study is founded by Russian Foundation of Fundamental Research, project #18-013-00323A, and project #18-013-00721

Saturday, September 8th, 2018

Morning Session: 08.45 – 10.30 a.m.

Symposium A: Technical/methodological aspects of EEG and its applications

(Berry R. – Wollongong, Australia; De Blasio – Wollongong, Australia)

Natural frequency components in the resting (eyes-open and -closed) EEG and their links to arousal

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Some years ago we established that EEG alpha band activity in the eyes-closed (EC) resting condition was negatively correlated with skin conductance level (SCL), a long-established measure of arousal. We also reported that the change from resting EC to eyes-open (EO) conditions reduced alpha (known from the pioneering work by Berger) and increased SCL. These links were shown in adults and in children, and supported our view that the major change from EC to EO represented an increase in arousal. Rather than the traditional broad-band (8-13 Hz) alpha definition used previously, here we sought natural alpha frequency components, using a frequency Principal Components Analysis (f-PCA) decomposition of the resting EEG spectra.

Twenty-nine right-handed undergraduate students aged 18–27 years participated in three 2 min blocks of resting EEG collection: EO, EC, EO, ordered to obviate EC/EO arousal differences due to resting time in the recording booth. SCL was simultaneously collected. EEG data were corrected for ocular artefact, then 2 s epochs with any deflections exceeding $\pm 100 \mu\text{V}$ were deleted. Participants had between 88–120 EO epochs, and 39-60 EC epochs. Each EEG epoch was submitted to FFT analysis, and mean EC and EO amplitude spectra were obtained for each participant, along with mean EC and EO SCLs. The EC and EO spectra were submitted to separate f-PCAs, and

explored with both Promax and Varimax rotations.

From EC to EO, mean SCL increased significantly, and mean alpha amplitude in the 8–13 Hz range decreased significantly. Across EC and EO, both grand mean (GM) alpha (across all sites), and mean alpha in the parietal region, showed a significant negative correlation with SCL. These data confirm the traditional arousal relationships. In line with our previous work with f-PCA, Promax gave better solutions than Varimax. The EC solution contained three parietal alpha components (at 9.0, 9.5, and 10.5 Hz), while the EO solution had two components (at 9.5 and 11.5 Hz). Despite the shift in frequency, the low-and high alphas showed good congruence and topographic similarity between EC and EO, suggesting that they were corresponding components. Across EC and EO, the GM low alpha component, and its mean in the parietal region, showed a significant negative correlation with SCL; the high alpha component did not.

These data suggest that only one natural alpha component (low alpha) is associated with arousal. This f-PCA approach shows merit and should help illuminate alpha functionality in future research.

Power versus amplitude measures in young and older adults' resting EEG

F. M. De Blasio, R. J. Barry

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Electroencephalographic (EEG) data has long served as a core psychophysiological measure providing valuable insight into both healthy and atypical function. Several quantification techniques are commonly employed, but there remains little consensus as to their comparability of outcomes. The present study compared three common spectral measures (absolute amplitude, absolute power, \log_{10} power), with the aim of identifying which is optimal.

Continuous EEG was recorded from 20 young ($M_{age} = 20.4$, $SD = 1.6$ years) and 20 gender-matched older ($M_{age} = 68.2$, $SD = 4.5$ years) adults during 3 minute blocks of eyes-closed (EC) and eyes-open (EO) resting. Non-overlapping artefact-free 2 s epochs were subjected to Discrete Fourier Transform (DFT) yielding spectra of 0.5 Hz frequency resolution. Total (DC–45 Hz) absolute amplitude and absolute power were computed from the single-sided spectra, and then averaged across epochs for each participant and resting state; \log_{10} transformation was applied to the mean absolute power to derive the third spectral measure. Each measure was assessed for its characteristics (skew, kurtosis, normality), and for the effects of resting state (EC, EO), group (young, older adult), and topography. Data in each measure were also correlated against age (across groups); this was done separately for EC and EO data, and for the EO-EC difference, an index of spectral reactivity with the opening of the eyes.

The absolute total power data were more skewed and kurtotic, and less normally distributed than both the absolute amplitude and \log_{10} power; the latter measures had comparable characteristics across the groups, although they differed between groups. More favourable characteristics were seen in the young adult absolute amplitude data, and in the older adult \log_{10} power. Although each measure showed generally comparable topography statistically, the absolute measures (amplitude and power) were more sensitive to the effects of resting state, group, and their interaction. Across the groups, inverse correlations between age and total spectral magnitude were identified in more channels for the absolute amplitude than \log_{10} power data. Somewhat similarly, spectral reactivity magnitude directly correlated with age at more locations for the absolute amplitude data.

The present results indicate that \log_{10} power provided no characteristic advantage compared to the absolute amplitude measure in this dataset, and absolute amplitude proved to be a more sensitive measure to the effects of interest. This study highlights the importance of measure selection when undertaking spectral analysis, and supports the adoption of absolute amplitude in favour of power measures.

Measuring the mirror-neuron system using mu suppression

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Introduction: Mirror neurons (MNs) are a type of visuomotor neuron that fires both when an individual performs an action and when they observe another perform the same action. In humans, activation of MNs may be measured using the mu rhythm of the EEG, which is suppressed during observation and imitation of motor actions.

However, findings regarding the exact range and topography, as well as how suppression is calculated, vary greatly.

Methods: 23 participants (9 male; age $M = 20.26$, $SD = 3.68$) were presented with videos of grasping movements made with left and right hands while EEG was recorded. All participants were instructed to either sit quietly and watch (observe) or to perform the grasping movement (imitate). Two rest conditions, one with a scrambled image and another with a white fixation cross on a black screen, were also presented. Continuous EEG were epoched for each condition, baselined using a DC correction and Fast Fourier Transformed. Absolute power for narrow bands between 8 to 13 Hz were computed. Mu suppression was calculated by subtracting power in each band during the baseline (fixation cross, scrambled image, prestimulus video) from the power in the corresponding band during the condition of interest (imitate, observe) for the left and right hands separately.

Results: Mu suppression was found to be maximal within 9 to 11 Hz, so suppression was averaged across this range for each condition for further analysis. For the fixation cross and scrambled image baselines, mu suppression was maximal across the posterior regions, and larger for the observe relative to the imitate condition. The prestimulus video baseline also revealed more suppression at posterior regions for the observe condition, however suppression was largest at central regions for the imitate condition.

Conclusion: As suppression was found to be maximal within 9 to 11 Hz range, a narrower band limit than the 8 to 13 Hz range typically used may better reflect mu suppression. Further, calculating mu suppression using a

resting baseline may reflect broader attentional processes rather than motor processes specifically. Finally, the posterior increase for the observe condition relative to a prestimulus video baseline may reflect similar modulations of attention as well as inhibition of movement, while increases in the central region for the imitate condition reflects actual movement.

Effects of tDCS Electrode Placement on Alpha Power and Working Memory Performance

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Transcranial direct current stimulation (tDCS) effects on working memory (WM) have been widely investigated, with generally inconsistent effects reported. Such variability has been attributed to inconsistencies in stimulation parameters including stimulation location, intensity and duration, and outcome measure/s. Moreover, the cognitive enhancement effects of tDCS may occur (at least partially) via the modulation of changes in arousal, and this is yet to be well investigated. The current study thus assessed the effects of tDCS on electrode placement, arousal and behavioural performance during a WM task.

Seventy-two healthy young adults completed a two-part study employing a counterbalanced cross-over design in which they received both an active and sham stimulation session one week apart. Equal numbers of participants were randomly assigned to the focal frontal (FF), broad frontal (BF), or broad parietal (BP) montage groups. The 1- and 2-back variants of the n-back task were completed during active/sham tDCS administration. Pre- and post-task arousal was assessed via EEG alpha power and skin conductance level (SCL) recorded during six minute eyes-closed (EC1)/eyes-open (EO)/eyes-closed (EC2) resting baseline conditions.

For active relative to sham tDCS, improvements in non-target ($F = 5.50$, $p = .028$) and total ($F = 6.38$, $p = .019$) accuracy were found in the FF group, and these approached significance in the BP group (non-target, $F = 3.93$, $p = .059$; total, $F = 3.12$, $p = .091$); no main effect of stimulation was found in the behavioural measures for the BF group. The post (cf. pre) tDCS increase in parietal alpha power was greater for active compared to sham stimulation in the BP group; this effect was significant in EC2 ($F = 6.55$, $p = .018$), and near significant in EO resting ($F = 4.19$, $p = .052$). Moreover, the inverse relationship typically found between SCL and alpha power was reversed for active but not sham tDCS during EO resting in the BP group; smaller post-pre tDCS change in SCL and alpha power were each associated with improved RT performance, and in alpha this was also linked to poorer non-target accuracy.

In summary FF stimulation improved WM accuracy, BF stimulation had no effect, and BP stimulation appeared to weakly mimic the FF stimulation effects. Associations with EO arousal change in the BP group was associated with a tendency toward impulsive responsivity. The selection of tDCS montage has significant consequences for both arousal effects and behavioural outcomes in the n-back WM task.

Symposium B : QEEG in clinical practice with a focus on neurology

(Collura T. – Bedford, OH USA)

QEEG in clinical practice with a focus on neurology

Harry Kerasidis
Clinical Director
Chesapeake Neurology Associates

Introduction - This talk will focus on QEEG results obtained from patients with brain injury, particularly concussion.

Aim – the aim of this work is to present clinical cases that illustrate the value of QEEG in clinical management of neurological cases. Methods - Approximately 8-12 cases will be presented, with quantitative EEG maps and statistical summaries shown to produce useful assessment data, and to show the progress of treatment and recovery. Results – When informed by QEEG data, clinical implications for patient assessment, treatment planning, and outcome evaluation are found, and will be discussed with case examples. Discussion – this talk illustrates the value of QEEG in the management of a neurological practice that works with clients with brain injury, concussion, and related issues.

What can a systematic analysis of the scientific literature tell us about the clinical relevance of different EEG measures?

A.W. Keizer
QEEG-Pro, The Hague, Netherlands

QEEG-guided neurofeedback is based on interpreting abnormalities in the resting-state EEG in relationship with psychopathology. Setting up effective neurofeedback treatment protocols relies on the correct interpretation of individual QEEG profiles in relationship with the symptoms of the patient. Scientific studies have demonstrated associations between certain deviations in resting-state EEG and specific psychological disorders. The most well-known association is that of excess theta/beta ratio in relation with ADHD (e.g. Arns et al., 2012). Recent approval of the FDA for an ADHD diagnostic test based on excess theta/beta ratio illustrates that this 'EEG biomarker' is both meaningful and reliable. Other markers for psychopathology include 'alpha asymmetry' for depression (Thibodeau et al., 2006) and excess beta power for anxiety and insomnia (Pavlenko et al., 2001; Perlis et al., 2001). However, a

modern QEEG report will contain many different and detailed analyses of an individual EEG. Moreover, the number of analyses that can be performed on EEG data has been increasing rapidly. Interpreting the relevance of these analyses for the treatment of an individual patient depends on scientific studies demonstrating associations between these measures and the symptoms of the patient. In this presentation, an attempt will be made to assess the relevance of different QEEG analyses for clinical purposes using a systematic analysis of the scientific literature. One of the approaches is to analyze trends in the scientific literature in order to make predictions on the future clinical relevance of different EEG analyses. Also, comparisons with scientific literature in different fields may provide useful analogies. For example, the interpretation of an individual blood test for cancer relies on scientific research on the association between certain biomarkers (e.g. certain proteins) and the presence of a tumor. How did scientific research on these 'tumor markers' evolve and eventually lead up to the use of tumor markers in clinical testing today, and what can this tell us about the current state-of-the-art and future clinical relevance of different EEG analyses?

The quantified EEG characteristics of children with Attention Deficit Hyperactive Disorders with long-term treatment with Atomoxetine

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International Center learning, attention and hyperactivity disorders (CIDAAI), Milan, Italy

Objective: The aim of this study is to examine quantitative Electroencephalogram (QEEG) differences between ADHD patients that are Responders and Non-Responders to long-term treatment with Atomoxetine at baseline and after 6 and 12 months of treatment. Patients with Attention Deficit Hyperactivity Disorder (ADHD) received atomoxetine titrated, over 7 days, from 0.5 to 1.2 mg/kg/day. QEEG and Swanson, Nolan, and Pelham-IV Questionnaire (SNAP-IV) scores were recorded before treatment and after therapy.

Methods: Twenty minutes of eyes closed resting EEG was recorded from 19 electrodes referenced to linked earlobes. Full frequency and narrow band spectra of two minutes of artifact-free EEG were computed as well as source localization using Variable Resolution Electrical Tomography (VARETA). Abnormalities were identified using Z-spectra relative to normative values.

Results: Patients were classified as responders, non-responders and partial responders based upon the SNAP-IV findings. At baseline, the responders showed increased absolute power in alpha and delta in frontal and temporal regions, whereas, non-responders showed increased absolute power in all frequency bands that was widely distributed. With treatment responders' absolute power values moved toward normal values, whereas, non-responders remained at baseline values.

Conclusions: Patients with increased power in the alpha band with no evidence of alterations in the beta or theta range, might be responders to treatment with atomoxetine. Increased power in the beta band coupled with increased alpha seems to be related to non-responders and one should consider atomoxetine withdrawal, especially if there is persistence of increased alpha and beta accompanied by an increase of theta.

Symposium C - Disorders of consciousness: New insights on clinical evaluation and neural correlates

(Cecchetti L. – Lucca, Italy)

Disorders of Consciousness: New insights on clinical evaluation and neural correlates

L. Cecchetti

IMT School for Advanced Studies Lucca, Lucca, Italy, Lucca, Italy

Disorders of consciousness (DOC) are clinical conditions characterized by a complete (i.e., coma and unresponsive wakefulness syndrome) or partial (i.e., minimally conscious state) loss of awareness following severe brain injury. To date, the diagnosis of DOC mainly relies on behavioral assessment carried out at patients bedside and, despite standardized methods have been proposed (e.g., revised version of the Coma Recovery Scale), misdiagnosis rates reach worrisome levels. Since early '90s, the idea that level of consciousness and behavioral capabilities are completely dissociated in some of these individuals arose, fostering the use of functional neuroimaging techniques to capture signs of awareness in patients' neural activity and improve diagnostic accuracy. Since then, several attempts have been made to demonstrate the clinical utility of positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) in the assessment of residual level of consciousness, with simpler resting state and passive stimulation paradigms being gradually replaced by more sophisticated and active tasks. Interestingly, though, both these approaches have pearls and pitfalls: on the one hand, metabolic activity, resting state and passive tasks demonstrate high sensitivity in measuring the similarity of brain responses between DOC patients and conscious healthy controls, yet these measures do not represent markers of consciousness per se; on the other hand, active tasks require willful modulation of brain activity and thus represent a clear proof of patients awareness, yet some of them, showing minimal signs of conscious behavior, may not be able to perform such effortful tasks.

In the present talk, (1) I will provide an overview of argumentations supporting these two seemingly opposite views, emphasizing how these approaches are however complementary and should be used conjointly in the assessment

of DOC patients. In addition, (2) I will show that other than focusing on the paradigm, we should rather consider as crucial the longitudinal evaluation of DOC patients and integrate neuroimaging findings with behavioral assessment in the diagnostic decision making process. Lastly, (3) I will reason that the use of hierarchical and naturalistic paradigms, as well as the adoption of novel analysis methods based on network theory could provide valuable tools to further explore consciousness and related disorders.

Toward latent brain networks markers in disorders of consciousness

A. Cacciola
, Italy

The human connectome is a comprehensive description of neural elements and connections reflecting the complex organization of the brain. Such complexity arises from several, integrated and segregated distributed networks around critical and participating cortical epicentres embedded in their physical space. Modern network neuroscience has led to a paradigmatic improvement in understanding the brain-network organization and has challenged the traditional framework that many neurological disorders involves exclusively focal alterations.

Consciousness is the product of multiple brain structures and depends on the brain's ability to integrate different complex patterns of internal communication. Although several studies demonstrated that the fronto-parietal and default mode networks play a key role in in conscious processes, it is still not clear whether the brain network organization is altered at the global level in patients with disorders of consciousness (DOC). Indeed, only a few evidences suggest that the global network topology is substantially altered between patients in different states of consciousness. The topology of a network is often intricately related to the physical distances between elements in the network: brain regions that are spatially close have a relatively high probability of being interconnected, while longer white matter projections are more expensive in terms of their material and energy costs. This same concept is also the basic hypothesis on which is founded network geometry, a very active field of network science assuming that the network nodes reside in an underlying hidden metric space (latent geometry), which plays a role in shaping the observed network topology. In this regard, we have recently developed a class of topological-based unsupervised nonlinear dimension reduction methods, namely coalescent embedding, able to efficiently map structural and functional brain networks in the 2D or 3D latent hyperbolic space.

We will discuss the network studies suggesting that the brain of patients in different states of consciousness is altered at the network-level and we will introduce novel potential latent network geometry markers for the characterization of DOC. Indeed, we will show how simple geometric measures allow to identify latent network geometry changes and to distinguish between patients in minimally conscious state and unresponsive wakefulness syndrome, starting from the mere functional connectivity derived from resting state EEG recording. We hope that this scenario has the potential to improve diagnosis, prognosis and therapeutic treatment evaluation of DOC patients.

A non-invasive perturbation approach to disorders of consciousness

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Measuring complexity of electroencephalographic responses to transcranial magnetic stimulation (TMS-EEG) has been recently proposed to gauge a substrate of consciousness in a way that is independent of sensory input and motor output (Perturbational Complexity Index - PCI; Casali et al., Sci Transl Med 2013). Here, we validate PCI in a large benchmark population (n=150) and we test its performance in patients (n=81) with disorders of consciousness (DOC).

The benchmark population included (1) healthy subjects and conscious brain-injured patients who were awake and able to communicate; (2) unresponsive subjects who reported no conscious experience upon awakening from non-rapid eye movement (NREM) sleep or midazolam, xenon, or propofol anesthesia; and (3) subjects who were disconnected and unresponsive during rapid eye movement (REM) sleep and ketamine anesthesia but retrospectively reported having had vivid conscious experiences upon awakening. The DOC population included 38 minimally conscious state (MCS) and 43 unresponsive wakefulness syndrome (UWS) patients diagnosed with the Coma Recovery Scale Revised (CRS-R). Several TMS-EEG sessions were collected in each participant by stimulating different cortical sites and PCI was computed for each session. For each participant, the maximum PCI value (PCI_{max}) across sessions was used for classification purposes. Receiver operating characteristic curve analysis was performed to define an optimal PCI cutoff for discriminating between the conscious and unconscious conditions in the benchmark population. This cutoff was then applied to a cohort of non-communicative DOC patients.

In the benchmark population, PCI_{max} was always higher in conscious compared to unconscious subjects: therefore, we derived an empirical cutoff (PCI*) that discriminated with 100% sensitivity and specificity between these conditions. This cutoff applied to DOC patients was able to detect MCS patients with 97.4% sensitivity (only 2 out of 38 MCS patients resulted in PCI_{max}<PCI*). Concerning UWS patients, they were stratified into three subgroups according to their PCI_{max} value: a 'no-response' subgroup with PCI_{max}=0 (n=13), a 'low-complexity' subgroup with PCI_{max}<PCI* (n=21) and a 'high-complexity' subgroup with PCI_{max}>PCI* (n=9).

The validation of PCI in a benchmark population represents a novel approach to break the circularity of evaluating a

measure of consciousness to brain-injured patients who might be conscious but disconnected and unresponsive. PCI showed an unprecedented sensitivity to detect minimal signs of consciousness. This result suggests that UWS patients within the high-complexity subgroup may retain a capacity for consciousness that is not expressed in behavior.

Diffusion tensor imaging in patients with disorders of consciousness

C. Cavaliere
, Italy

Progress in neuroimaging has yielded new powerful tools which, potentially, can be applied to clinical populations, improve the diagnosis of neurological disorders and predict outcome. At present, the diagnosis of consciousness disorders is mainly limited to subjective assessment and objective measurements of behavior, with an emerging role for neuroimaging techniques. Moreover, the need to explain clinical and behavioral abnormalities in the absence of focal brain lesions detectable with conventional imaging techniques has boosted the use of 'non-conventional' magnetic resonance imaging (MRI) techniques to investigate apparently normal brain tissue. Diffusion tensor imaging (DTI) is a non-invasive imaging technique implemented in MRI, which can detect WM alterations that are not visible using conventional imaging techniques such as computed tomography (CT) and MRI. DTI has been used in both research and clinical settings and has provided valuable biomarkers for tissue injury severity and outcome predictors. Although its scientific spread, technical challenges affect DTI application, mainly, in patients with disorders of consciousness (DOC) due to cerebral anoxic/ischemic or traumatic injury. Moreover, despite significant variation in sample characteristics, experimental setup, technical aspects of imaging and analysis approaches, a valuable contribution of DTI to brain pathologies, including the large spectrum of DOC, is now recognized. Whilst progress has been made describing DOC from a clinical perspective, few studies have described white matter alterations measured using DTI techniques in DOC patients and examined the main issues related to DTI analyses. New insights from DTI study of white matter alterations could improve our understanding of DOC, the diagnosis of these conditions and possibly prognosis and treatment.

Symposium D - Genetic and environmental determinants of visual perception

(Ermakov P. – Rostov on Don, Russia; Vorobyeva E. Rostov on Don, Russia)

The impact of the BDNF, HTR2A and COMT genes' polymorphisms on the estimation of emotional valence of objects

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Introduction. It is known that genetic factors have an impact on cognitive functions (Nettiksimmons J. et al., 2016; Contestabile A. et al., 2016; Thomas M. S. C. et al., 2016). Emotional reaction to events is an important element of communication. It might be suggested that genes regulating the neurochemical metabolism (Meyer-Lindenberg A. et al., 2005; Fink K. B. et al., 2007; Park H. et al., 2013), could exert some influence on those processes. The aim of the study is to define the impact of the BDNF, HTR2A and COMT polymorphisms on the reactions induced by the objects with different emotional valence (EV).

Methods. 435 photos were neutral, positive and negative objects (145 in each group). The stimuli were presented in a random order for 500 ms each. An observer had to define their EV. EEG was registered with 128 electrodes. Artefactless fragments of the EEG were averaged based on the observer's estimation of EV. We had 3 VEPs in each lead - for objects appraised as neutral, positive and negative. The participants were 50 women with normal vision aged between 18 and 22.

Results. We found that groups with the BDNF and HTR2A genes polymorphisms did not have any different. On the contrary, the group with the COMT Met-Met genotype differed from the Val-Met and Val-Val genotype groups. The subjects with the Met-Met genotype had significantly larger P300 amplitude (Figure 1). These differences in VEPs are seen in many leads (Figure 2).

sLORETA shows that the focus of activity during P300 in the subjects with the Val-Val and Val-Met genotypes is localized in the field 19, while in the carriers of the Met-Met genotype it is shifted forward - into the parietal cortex. It turned out that the observers with Met-Met genotype who have a decreased speed of the monoamine decomposition in the synapses (Egan M.F., et al., 2003), perform the task of differentiating the objects based on their EV worse than the other subjects and estimate the objects as neutral more frequently than the representatives from other groups.

Conclusions. The carriers of COMT Met-Met genotype experience difficulties with differentiating objects based on their EV. Involving additional processing resources during decision-making process leads to increasing of P300 amplitude.

Supported by MESRF project 3336.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18001/add_1_435900_2f3b4bbf-a544-4c48-8034-364ff165fa4c.png

Caption 1: Figure 1. The comparing of the averaged VEPs on the objects inducing positive emotions in the subjects with Met-Met genotype (solid line) and Val-Met

Picture 2: https://www.eventure-online.com/parthen-uploads/175/18001/add_435900_2f3b4bbf-a544-4c48-8034-364ff165fa4c.png

Caption 2: Figure. 2. The statistically significant differences in P300 amplitude between the observers with COMT Met-Met and Val-Met genotypes

Peculiarities of the evoked brain activity of carriers of different genotypes on polymorphic loci Val66Met of the BDNF gene

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Introduction. The BDNF gene is associated with the structural and functional peculiarities of the brain neurotrophic factor - protein, synthesized in many areas of the brain. BDNF plays an important role in the processes of synaptic plasticity and in realization of cognitive functions. This makes it possible to assume that different genotypes of BDNF can be associated with different ways of the visual perception processes.

Methods. 55 right-handed women ages 19 to 22 took part in the experiment (Val/Val – 40, Val/Met – 15; “AmpliPrime DNK-sorb-AM” was used for DNA extraction, “Tertsik” was used for PCR (DNK-Tekhnologiya, Russia). EEG-VEPs was registered in unipolar assignment with 128 electrodes and 2 referents (“NVX-136”, “MCS”, Russia); with resistance – no more than 40 kOhm. The sampling frequency: 1000 Hz.

Experimental task was to estimate the emotional valence of images and attribute pictures to one of the three groups: “positive”, “negative”, “neutral”.

Statistical processing: Student’s T-test, $p \leq 0.01$.

Results. In assessing of positive images by carriers of the Val / Val genotype of the BDNF gene, in comparison with neutral ones, a small number of significant differences was observed in the parameters of the evoked brain activity, characterized by more intensive activation in the right fronto-central brain area (Figure 1). The evoked brain activity during the assessment of the negative images is characterized by the symmetrical involvement of frontal and central-parietal areas of both hemispheres.

The evoked brain activity of the carriers of the Val/Met genotype is characterized by greater activation of the fronto-central and fronto-temporal areas of the right hemisphere in assessing “positive” stimuli, compared with “neutral” ones. The main differences were manifested in the increasing of positive peaks of late cognitive components of VEP (Figure 2). When this group evaluated negative images, there was an increase in amplitude and a decrease in latency of the late components of VEPs in the central areas of the brain, from the frontal to the parietal-occipital areas, and also in the symmetric areas of the right hemisphere.

Conclusion. Thus, we can conclude that the carriers of Val / Val and Val / Met genotypes of the BDNF gene have different trajectories of brain processing of emotionally charged visual information.

Supported by MESRF project 3336.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18001/add_1_435855_39e5eb33-0f17-4e73-a07f-8ef0cb648cfc.png

Caption 1: Figure 1. VEP in frontal and parietal brain regions of people with genotype Val/Val in polymorphic loci Val66Met of the BDNF gene.

Picture 2: https://www.eventure-online.com/parthen-uploads/175/18001/add_435855_39e5eb33-0f17-4e73-a07f-8ef0cb648cfc.png

Caption 2: Figure 2. VEP in fronto-central brain regions in response to the images of people with genotype Val/ Met in polymorphic loci Val66Met of the BDNF gene

Molecular-genetic correlates of hostile behavior in teenagers and young adults

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Studying the problem of hostile behavior of people representing different age, ethnic, and cultural groups is becoming increasingly relevant, especially in complex and conflicted societies. To date, this field of research suffers from substantial shortage of studies that explore the relationships between hereditary factors and such psychological characteristic as “hostility.”

Of a particular interest is the issue of the connection between the polymorphism of the MAOA gene (often associated with the development of such hereditary complications as mental disorders, dependencies, depression, and asocial traits) and the psychological characteristics of hostile strategies in behavior.

The purpose of the study: To analyze the associations of the polymorphism of the MAOA gene with hostile behavior among adolescents and young adults.

Participants, materials and method: 285 male adolescents and young adults (aged 12-19) composed the study sample. The Buss-Durkee Hostility inventory scales (in adaptation of A.K Osnitsky, 1998) were used as a measure

of hostility. As a gene-candidate, the genotypes and alleles of the gene determining the work of the monoamine oxidase (MAOA) enzyme were considered. Isolating genomic DNA from buccal epithelium cells was used as a method for determining polymorphic variants of MAOA gene. Further statistical analysis and data processing were carried out using the PSPP program 0.8.5 and the program STATISTICA 6.1.478.

Study results: a low-active variant of the MAOA gene is found in 18% of the participants, high-activity variant in 63%. In 98% of young adults who have allele 3 (low enzyme activity), a high level of hostility is detected (according to the Buss-Durkee technique).

The results of the single-factor analysis of variance, where the genetic parameters acted as an independent variable, and the dependent variables were different forms of manifestation of hostility, indicate the presence of robust relationships ($F = 24.30$, $p < 0.05$) between propensity to hostile behavior with a low-active variant of the monoamine oxidase enzyme gene MAOA-A (LPR).

Among the genetic polymorphisms of the MAOA gene that determine the risk of aggressive and hostile behavior, the low-active variant of the monoamine oxidase gene MAOA-A (LPR) plays the most important role in adolescents and young adults.

This investigation has been carried out with financial support from Russian Science Foundation (project No. 213.01-03/2016-4, agreement No. 16-18-10222)

The success of recognition of the emotional valence of visual stimuli by the carriers of Val / Val and Val / Met genotypes of the COMT gene

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Introduction. Nowadays there is no single-valued opinion about the role of genotypes of polymorphic loci Val158Met of the COMT gene in process of differentiation of emotional valence of perceived stimuli. In this regard, the purpose of this study is to research the spatio-temporal and amplitude characteristics of elicited brain activity (EBA) of carriers of Val/Val and Val/Met gene COMT genotypes.

Methods. Participants – 55 right-handed people (Val/Val - 20, Val/Met – 35), aged 19-22 years.

Equipment: digital EEG amplifier “NVX-136” with 128 electrodes (“MCS”, Russia); programmed thermostat “Tertsik” (DNK-Tekhnologiya, Russia) for PCR;

Program for EEG data processing: EEGLab for Matlab package;

The analysis epoch of Visual evoked potentials (VEP): [-100; 500 ms].

Statistical processing criteria: Student's T-test, $p \leq 0.01$.

Experimental task: differentiation of 445 stimuli (complex visual scenes) to groups “negative”, “neutral”, “positive”.

Results. The VEP map of carriers of the Val/Met genotype in response to “negative” stimuli is characterized by a symmetrical distribution of the VEP with the active involvement of the frontal and temporal areas in the analysis of incoming visual information (Fig.1). The differences in EBA in assessing “negative” and “neutral” stimuli are expressed in higher exponents of the amplitude of the late VEP components in frontal (from P300), central and parietal leads (from P350), which indicates increased intensity of the cognitive processing processes, namely - the comparison with the templates available in memory and categorization of incoming visual information.

There are few differences in the components of VEP in response to the presentation of “positive” stimuli, compared to “neutral”. Differences were revealed in the fronto-central and fronto-temporal areas with the right sight asymmetry. In this case, the latency of the peak is lower, compared with the evaluation of “negative” stimuli, which indicates a faster categorization of this group of stimuli (Fig.1).

In general, the carriers of Val/Val genotype have fewer differences in the spatio-temporal and amplitude characteristics of the EBA in response to the presentation of emotionally charged stimuli compared to “neutral” images (Fig.2).

Conclusions. Based on the data obtained, we can conclude that the presence of the Met allele associated with a higher level of dopamine in the prefrontal regions of the cerebral cortex is associated with a more careful distinction of the emotional valences of the stimuli presented.

Supported by MESRF project 3336.

Picture 1: https://www.eventure-online.com/parthen-uploads/175/18001/add_1_435870_5004d318-7e41-49e5-bf52-e930fd18e05d.png

Caption 1: Fig.1. VEP of carriers of the Val/Met genotype in response to emotionally charged and neutral stimuli

Picture 2: https://www.eventure-online.com/parthen-uploads/175/18001/add_435870_5004d318-7e41-49e5-bf52-e930fd18e05d.png

Caption 2: Fig. 2. VEP of carriers of the Val/Val genotype in response to emotionally charged and neutral stimuli

History of research of visual perception: problem of child's ability in colour separation according to William Preyer's concept of a psychogenesis

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The problem of determination of age limits in the context of taking into account different factors of development of an organism has acquired relevance in the 19th century. In the concept of a psychogenesis of the German physiologist William Thierry Preyer (1841-1897) much attention has been paid to a problem of development of sense organs, thinking, motility and emotions. The originality of methodological approach of the researcher consisting of availability only one subject of observations, careful selection of the stimulating materials and daily record of observations' results with the subsequent analytical comparison of these data with other scientists has allowed to carry out measurements of duration and emotional coloring of reactions of the child to color incentives. The problem of perception by the person of various colours of an iridescent range and impact of color on the person in the context of feeling him temperatures of rooms has been investigated earlier by W.T. Preyer in work "Color and feeling of temperature" / "Farben und Temperratsinn" (1881).

The experimental study of features for distinction of colours by the child described in work of "The soul of the child" has begun from the first day of his life and had duration for 3 years. It has been directed to clarification of maturing of functions of the visual analyzer of the child, development of operations of thinking and motility. The experiment has allowed to establish readiness of the visual device of the child for distinction of the shown color incentives within a week. The sequence of maturing of readiness of distinction by the child of colours of dark and light ranges, shades and tones at various intensity of illumination of household objects and the stimulating materials has been established (the researcher used the standard "Plates for perception of color/Tafel zur Erziehung des Farbensinnes" introduced for scientific use in 1879 by Dr. H. Magnus). The data obtained by stimulation of the child to recognition and the name of colours of a short-wave and long-wave part of a range have been repeatedly rechecked in the course of testing. Restrictions have been defined for using of the mixed colours in the first didactic toys (rattles) which aren't perceived by the child owing to backwardness of the visual analyzer; it is offered to enter the elements into their structure providing sounding at their intensive "shaking" by the child.
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