(30–70 Hz). In a first task induced gamma activity was investigated in regard to source and in relation to an ERP component peaking at 230 msec. P1 component was often associated with spatial attention. In a second task we wanted to outline the influence of nonspatial processing on P1 amplitude and evoked alpha oscillations. We also investigated evoked oscillations in a priming paradigm in the time-window of the P2 component. P2 was often associated with working memory so we expected to find effects in the theta frequency (4–7 Hz), usually related to working memory processes.

Method

In a first experiment, participants were shown picture stimuli that they had to judge as real or scrambled objects. The same stimulus material was used for a second experiment, but now participants had to indicate whether objects represent living or nonliving things. For the first experiment ERP and frequency analyses were performed; in addition, LORETA and BESA source analyses methods were used to unravel possible generators of a component peaking at around 230 msec. In the third experiment the impact of semantic priming on ERP components and frequency characteristics were investigated.

Results

We found that in the visual discrimination task a pronounced ERP component at around 230 msec is apparent. In this time window, increased induced gamma oscillations are observable. Localization of the C230 component showed enhanced activity in the anterior cingulate gyrus. Visual discrimination was also associated with a pronounced P1 component that was further investigated in a second experiment. In the time window of the P1, enhanced evoked alpha oscillations were found. In the priming experiment it was found that a priming-related P2 component could be associated with theta phase-locking stronger for new as opposed to primed items.

Conclusions

In the series of experiments we show the significance of EEG oscillations on cognitive functioning. Enhanced induced gamma was found to be strongest in a frontal region, which can be interpreted as a mechanism involving the establishing of visual object representations. P1 amplitude analyses showed that within the time window of the P1 an early categorization of object stimuli might take place. Evoked theta as shown in a priming task is probably related to encoding of new stimuli which is also characterized in enhanced P2 amplitudes.

Discrete Biochemical Reactions Dynamics of the Neural Networks and Brain Creativity Mathematical Modeling

V. Gontar, PhD
Ben-Gurion University of the Negev
galita@bgu.ac.il

Human brain thinking abilities and brain creativity in particular are specific properties of the living matter, which is still not fully scientifically understood as it happens with components of nonliving matter where the main theories and dynamical laws of nature have been formulated and supported by corresponding mathematical models. Here we are proposing novel theoretical approach for mathematical modeling of living and thinking systems based on biochemical reactions discrete chaotic dynamics (CRDCD). CRDCD is the theory based on expanded first physico-chemical principles by including into consideration specific for living and thinking systems properties such as an information processing and exchange, reproduction, memorizing. Basic equations derived from CRDCD have a form of systems of nonlinear difference equations and describing multicomponent systems evolution in discrete time and space.

According to this theory, interaction between living and thinking system's constituents formally include into basic equations "information exchange." Physical meaning of information exchange between neurons, discrete time, and space found its explanation within the proposed theory. CRDCD and its basic equations being applied to a neural networks dynamics simulation starts with an initial hypothesis about mechanisms of biochemical reactions that are taking place within individual neurons and a scheme of "information exchange" between neurons. We speculate that specific time–space chemical distributions (patterns) within the brain's neurons networks initiate and are intrinsically responsible for its creativity. For example, before artist starting to paint, the image should appear in a specific part of the brain in a form of the neuron's distributed chemicals. If our theory is correct it should have an ability to generate a variety of creative patterns correlated with natural human brains activity such as artistic patterns in a form of ornaments, music, poems, and all other types of natural brain creative activity. Our basic equations are easily expandable to 3D and to nD neural networks and to any complex schemes of biochemical reactions within the neural networks, which will enable us to simulate extremely complex patterning. This approach for neural networks mathematical modeling should lead to the creation of computerized artificial brain systems with the abilities to simulate basic brain functions with tremendous facilities.

Based on our results, we can expect that the CRDCD theory and resulting mathematical models could be effectively used for simulation of neural networks dynamics and brain creativity in a form of emerged artistic patterns in particular. This proposed approach could contribute to better understanding of brain functioning and explain basic features of living and thinking systems' dynamics, which is quite different from nonliving matter dynamics. Possible applications of CRDCD: new generation of artificial neural networks and "artificial brain" systems, biofeedback systems with the visual stimuli in a form of mandalas, electroencephalography simulation and analysis, mathematical imaging, and signals generators.

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Integrating Neuromarkers for the Era of Brain-Related "Personalized Medicine"

Evian Gordon, PhD
The Brain Resource Company
evian.gordon@brainresource.com

The talk outlines key drivers (including the Food and Drug Administration [FDA] and the *Diagnostic and Statistical Manual of Mental Disorders* [5th ed.]) for a "Personalized Medicine." Personalized Medicine has been driven by the FDA as finding the best markers of treatment prediction (of which individuals will respond to what drugs). The proof of concept successes in Personalized Medicine and exemplars of neuromarkers were presented in attention deficit hyperactivity disorder, depression, MCI/Alzheimer's dementia, schizophrenia and posttraumatic stress disorder. This context will serve as a frame of reference as to how a Personalized Medicine approach may be effectively implemented in neurofeedback training. Success of this endeavor is contingent on a deeper understanding of mechanisms underpinning electroencephalography and how this insight translates into more valid and personalized protocol selection in neurofeedback training.

EEG-Related Colored Symmetrical Images as Visual Stimuli for Neurofeedback

Olga Grechko, MSc and Vladimir Gontar, PhD
Ben-Gurion University of Negev
grachko@bgu.ac.il

Introduction

In this work we propose a new methodology for neurofeedback based on a visual