

## **Somatosensory Functional Connectivity Differences between Term and Preterm Infants Demonstrated using Coherence EEG Analysis**

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This is the first study demonstrating resting state and tactile functional connectivity in hospitalized term and preterm infants using EEG coherence analysis. We have recorded EEG with 128 channel dense array system, during delivery of calibrated air puffs to the palm of the hand in 54 term and 61 preterm infants. We performed coherence analysis on the 200ms time window prior to stimulus (resting state) and the 171-240ms time window (onset of somatosensory response as defined previously). We focused on children Alpha (8-14Hz) as well as infants alpha oscillations (3-5Hz), associated with tactile processing. Each electrode served as a node in the connectivity matrix. A bootstrap significance test ( $p=0.01$ ) was applied on the top 2% coherence values to search for the most significant connections. We calculated each infant's network Characteristic Path Length (CPL), Global efficiency (GE) and Average clustering coefficient (ACC). Both term and preterm infants' resting state connectivity was characterized by a dense cluster between central and centro-parietal locations. However, the tactile network in term infants displayed lateralization to the centro-parietal locations overlaying the somatosensory cortex, while preterm tactile network was dense between frontal and central locations. Overall, the tactile network CPL decreased, while GE and ACC increased with higher gestational age at birth, indicating increased efficiency. The increasing ACC of tactile networks across all infants was associated with increased behavioral reactivity to tactile stimuli at 1 year and improved fine motor function at 2 years. These measures may be useful as biomarkers of tactile-dependent functional outcomes in early childhood.

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## **Using the HCP-Derived Parcellation to Examine Relationships Between Gray Matter Volume and MMN in the First-Episode Schizophrenia Spectrum**

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Our laboratory showed correlations between gray matter (GM) volume in manually traced Heschl's gyrus (HG) and pitch and duration mismatch negativity (pMMN/dMMN) in first-episode schizophrenia (FESz). Here, we used the human connectome project (HCP) atlas to automatically yet precisely parcellate auditory and dorsolateral prefrontal cortex (dlPFC) and investigate relationships between GM and MMN in FESz. pMMN and dMMN were measured at Fz from 29 FESz and 27 matched healthy controls, and T1-weighted MRI scans were acquired. Using the HCP workbench, the HCP parcellation was applied to individuals. The parcellated A1 resided within the manually traced HG, validating the resampled parcellation. In FESz only, impaired pMMN correlated with reduced GM volume in left A1 ( $r=-.43$ ), medial belt ( $r=-.49$ ), and A4 ( $r=-.41$ ). Impaired dMMN correlated with reduced left A1 ( $r=-.37$ ), lateral belt ( $r=-.50$ ), parabelt ( $r=-$

.41), and medial belt ( $r = -.53$ ). In FESz dlPFC, impaired dMMN was associated with reduced GM in left area 46 ( $r = -.40$ ), left area p9-46v ( $r = -.41$ ), right posterior inferior frontal sulcus ( $r = -.40$ ), and right anterior inferior frontal sulcus ( $r = -.40$ ). The HCP parcellation showed similar correlations with pMMN and dMMN in FESz as manually traced HG. However, more extensive parcellation revealed overlapping and distinct associations for pMMN and dMMN. pMMN was associated with GM volume of left hemisphere A1 and anterior auditory areas, while dMMN correlated with GM in left A1, surrounding auditory areas, and prefrontal areas. This provides a more precise understanding of the spatial extent of gray matter reduction associated with impaired MMN in FESz.

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### **fMRI examination of the efficacy of group therapy in patients with anxiety disorder and functional dizziness**

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Autism spectrum disorder (ASD) is characterized by impairments in social communication and behavior. Current treatments in ASD include medications to treat behavioral problems, behavioral therapy and sensory integration therapies. Transcranial magnetic stimulation (TMS) has been used in a number of psychiatric disorders. It offers the advantage of stimulating cortical activity non-invasively. In this open-label study we aimed to test the effect of low frequency stimulation of bilateral dorsolateral prefrontal cortices in children with ASD. Eight children with ASD (age 7-18) were recruited and TMS was applied over 20 sessions. ABC autism checklist were completed before and after TMS treatment by parents. In addition resting EEG was obtained at baseline and after treatment. The results show that, after TMS the children improved in sensory, relating, body and object use, language, and social and self-help skills subscale scores. EEG findings are not yet analyzed but will be presented in the conference. None of the children stopped the treatment due to adverse effects. Although preliminary, our findings indicate that bilateral frontal low frequency stimulation could be used as a safe and effective treatment in Autism Spectrum Disorder.

### **Proactive, but not reactive, inhibitory control is disrupted in hazardous drinkers: Evidences from ERPs in a Continuous Performance Task**

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Inhibitory control is thought to be altered in subjects with alcohol use disorders. However, inhibitory control is not a unitary construct, and the exact mechanisms involved in this deficiency remain poorly understood, with a lack of coherence in the results reported in the literature. In the last decade, the Dual Mechanisms of Control theory has increasingly received scientific attention. This theoretical framework divides cognitive control into two different strategies: proactive control (based on the active maintenance of contextual information in working memory in anticipation of the inhibition that has to come) and reactive control (based on the transient activation of inhibitory mechanisms due to an external stimulus). The impact of alcohol on proactive vs. reactive

inhibitory control abuse has not been studied to date. To specifically study this impact, 30 light and 30 heavy drinkers underwent an AX version of the Continuous Performance Task concomitant with an EEG recording. ERP analysis revealed a specific reduction in the amplitude of the Contingent Negative Variation (CNV) in a context of uncertainty (i.e., when the next action could either be a “Go” or a “Nogo” task) in the group of heavy drinkers compared to the control group, while the CNV amplitudes in a context of certainty (i.e., when the next action is always a “Go” task) were equivalent between the two groups. These results suggest a specific impairment in the activation of a default proactive control mode in the context of uncertainty.

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### **EEG Signature of Amygdala Activity during Real-Time fMRI Neurofeedback Training for Depression**

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Real-time fMRI neurofeedback (rtfMRI-nf) training to upregulate amygdala hemodynamic activity during positive autobiographical memory recall decreases depressive symptoms. The current analysis characterized the EEG signal correlated to the fMRI amygdala signal during rtfMRI-nf training in order to translate amygdala rtfMRI-nf into a more easily implemented EEG-only intervention. 33 depressed patients recalled positive memories while upregulating hemodynamic activity in an amygdala (n=18) or parietal (n=15) region during rtfMRI-nf training. 32-channel EEG recordings were collected simultaneously with fMRI. After removing MRI and cardioballistic artifacts, a continuous wavelet transform was applied to obtain EEG signal power for each channel in four frequency bands at each electrode, which were convolved to a canonical hemodynamic response function. The average positive memory related amygdala signal and EEG frequency band data was calculated for each participant. A Principle Component Analysis (PCA) was performed on the EEG data, and the top 7 factors were included in a linear regression analysis to predict the amygdala signal across participants. Using the 7 factors identified by the PCA, we were able to explain 56% of the variance in amygdala activity ( $p=0.04$ ). The alpha band, particularly in the posterior regions, was driving the model significance and was negatively related to amygdala activity. Using concurrent EEG measured during amygdala rtfMRI-nf training, we identified EEG correlates of amygdala hemodynamic activity during positive memory recall. The alpha band was a particularly important predictor. As alpha suppression is associated with processing high-arousal positive stimuli, reducing alpha activity during positive memory recall may be an effective intervention for depression.

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### **Effect of acupuncture for frontal lobe $\alpha$ band asymmetry evoked by anger**

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According to motivational direction, previous studies have shown that anger induces frontal lobe  $\alpha$  (8–13Hz) band asymmetry (FAA) in electroencephalogram (EEG). This study aimed to explore the effects of acupuncture on declining the FAA caused by evoked anger statement. In the study, right-handed 34 subjects with lots of anger, over the criteria score of 75 points in Novaco Anger Scale were included. For the baseline, EEG signals were recorded by 32 channel cap, under comfortable condition for eight minutes. Emotions of anger was induced by Articulated Thoughts in Simulated Situations (ATSS) task sequence, for nine minutes. After that, participants received acupuncture at GB20, GB21 for 10 minutes. The fast fourier transform was done for frequency analysis. The results showed that in the emotion of anger, participants displayed higher FAA at FP1, FP2, F3, F4, F7, F8 especially in left hemisphere than right one, compared to the baseline. Interestingly, with acupuncture stimulation, greater left sided FAA declined and even altered to the opposite as the stimulation continues. After the removal of acupuncture, FAA returned to the value between the baseline and the evoked anger stage. In conclusion, this study confirmed that anger stimulation increase left sided FAA and acupuncture affects toward opposite direction. It suggests the potential of acupuncture treatment on reducing FAA induced by anger stimulation. Therefore, the study confirms the clinical possibility that acupuncture can immediately recover the brain change caused by anger.

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